NFPA®

# 402

## Guide for Aircraft Rescue and Fire-Fighting Operations

2019

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**NFPA® 402**

**Guide for**

# Aircraft Rescue and Fire-Fighting Operations

**2019 Edition**

This edition of NFPA 402, *Guide for Aircraft Rescue and Fire-Fighting Operations*, was prepared by the Technical Committee on Aircraft Rescue and Fire Fighting. It was issued by the Standards Council on November 5, 2018, with an effective date of November 25, 2018, and supersedes all previous editions.

This edition of NFPA 402 was approved as an American National Standard on November 25, 2018.

## Origin and Development of NFPA 402

These standard operating procedures were first developed by the sponsoring NFPA committee in 1947 and were first adopted by the Association in 1949. They were amended in 1951, 1969, 1973, and 1978. In 1984, the committee combined the text of NFPA 406M, *Manual on Aircraft Rescue and Fire Fighting Techniques for Fire Departments Using Structural Fire Apparatus and Equipment*, with the text of NFPA 402, *Recommended Practice for Aircraft Rescue and Fire Fighting Operational Procedures for Airport Fire Departments*, and re-identified the document as NFPA 402M. The entire texts of both NFPA 402 and NFPA 406M were revised to create NFPA 402M. The 1989 edition of NFPA 402M was a complete revision of the manual. This guide was revised again in 1991.

The aircraft figures were deleted for the 1996 edition. A comprehensive collection of figures is now available in a publication titled *NFPA Aircraft Familiarization Charts Manual*.

The 2002 edition was a partial revision.

The 2008 edition was a partial revision.

For the 2013 edition, the Committee on Aircraft Rescue and Fire Fighting updated several photos of aircraft and appliances that were no longer in use or just out of date and brought the document up to date with the *Manual of Style for NFPA Technical Committee Documents*. The committee also updated the use and application of foam and foam types due to potential environmental impacts regarding the use of certain foams.

For the 2019 edition, the committee updated and deleted photos that were either out of date or no longer relevant to the document. The committee updated several definitions in the document so that they were in line with accepted industry practices relative to aircraft rescue and fire fighting. The committee added language to address the fact that passenger evacuation might have already begun prior to the arrival of aircraft rescue and fire-fighting crews. Also included was language on the increased presence of lithium ion batteries, both in aircraft as well as in what passengers bring on the aircraft. There was also the recognition of the importance of conducting a risk assessment prior to the start of rescue operations by the inclusion of new language for factors the AHJ should take into account when conducting the risk assessment. There has been new language added that discusses the increased use of aircraft interior access vehicles at airports and how they can be used to assist in rescue operations.

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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 aircraft rescue and fire-fighting (ARFF) documents used by organizations providing ARFF services for operational procedures; training; foam testing and application; specialized equipment; and planning for aircraft emergencies.

## Contents

**NFPA 402**

**Guide for**

# Aircraft Rescue and Fire-Fighting Operations

**2019 Edition**

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in advisory sections of this document are given in Chapter 2 and those for extracts in the informational sections are given in Annex E. 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 should be sent to the technical committee responsible for the source document.

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

## Chapter 1 Administration

### 1.1 Scope.

**1.1.1** This guide provides information relative to aircraft rescue and fire-fighting operations and procedures for airport and structural fire departments.

**1.1.2** Statistics indicate that approximately 80 percent of all major commercial aircraft accidents occur in the critical rescue and fire-fighting access area. This is the primary response area for airport-based ARFF services. Approximately 15 percent of the accidents occur in the approach areas. In such instances the community/mutual services could be the prime responders.

**1.1.3** Some airport fire departments have the total fire prevention and fire protection responsibility for the entire airport, including structural fire-fighting responsibilities in terminal buildings, aircraft hangars, airport hotels, cargo buildings, and other facilities. Procedures for these fire prevention and protection operations are not covered in this guide.

### 1.2 Purpose.

**1.2.1** This guide has been prepared for the use and guidance of those charged with the responsibility of providing and maintaining aircraft rescue and fire-fighting (ARFF) services on airports.

**1.2.2** This guide's content is also intended for the use of structural fire departments to assist them in developing methods to effectively handle aircraft incidents that might occur within their jurisdiction. It also provides for a basis of understanding, relative to emergencies on airports, that would enhance structural fire departments' effectiveness when called to assist airport fire departments.

### 1.3 General.

**1.3.1** Providing protection for the occupants of an aircraft takes precedence over all other operations. Fire control is frequently an essential condition to ensure such survival. The objectives of the airport fire department should be to respond to any aircraft emergency as expeditiously and safely as possible and to employ rescue and fire-fighting techniques effectively. These objectives can be accomplished when properly trained personnel work together as a team and apply the operational procedures presented in this guide.

**1.3.2** Governmental and organizational publications frequently referenced in this guide can be found in Annex E.

### 1.4 Units and Formulas.

**1.4.1** If a value for measurement as given in this guide is followed by an equivalent value in other units, the first stated is to be regarded as the requirement. A given equivalent value might be approximate.

**1.4.2** Metric units of measurement in this guide are in accordance with the modernized metric systems known as the International System of Units (SI). One unit (liter), outside of, but recognized by SI, is commonly used in international fire protection.

## Chapter 2 Referenced Publications

**2.1 General.** The documents or portions thereof listed in this chapter are referenced within this guide and should be considered part of the recommendations of this document.

**2.2 NFPA Publications.** National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 403, *Standard for Aircraft Rescue and Fire-Fighting Services at Airports,* 2018 edition.

NFPA 405, *Standard for the Recurring Proficiency of Airport Fire Fighters,* 2015 edition.

NFPA 407, *Standard for Aircraft Fuel Servicing,* 2017 edition.

NFPA 414, *Standard for Aircraft Rescue and Fire-Fighting Vehicles,* 2017 edition.

NFPA 424, *Guide for Airport/Community Emergency Planning,* 2018 edition.

NFPA 1003, *Standard for Airport Fire Fighter Professional Qualifications,* 2019 edition.

**2.3 Other Publications.**

**2.3.1 FAA Publications.** Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591.

FAA AC 150/5210-7D, *Aircraft Rescue and Firefighting Communications*, 2008.

**2.3.2 ICAO Publications.** International standards and recommended practices are promulgated by the International Civil Aviation Organization, 999 Robert-Bourassa Boulevard, Montréal, Quebec H3C 5H7, Canada.

*Airport Services Manual, Part 7:* "Airport Emergency Planning," second edition, 1991.

• *N* **2.3.3 PHMSA Publications.** Pipeline and Hazard Materials Safety Administration, Office of Pipeline Safety, East Building, 2nd Floor, 1200 New Jersey Avenue SE, Mail Stop: E24-455, Washington, DC 20590.

*Emergency Response Guidebook*, U.S. Department of Transportation, 2012.

**2.3.4 Other Publications.**

*Merriam-Webster's Collegiate Dictionary*, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

**2.4 References for Extracts in Advisory Sections.**

NFPA 10, *Standard for Portable Fire Extinguishers,* 2018 edition.
NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam,* 2016 edition.
NFPA 17, *Standard for Dry Chemical Extinguishing Systems,* 2017 edition.
NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft,* 2015 edition.
NFPA 403, *Standard for Aircraft Rescue and Fire-Fighting Services at Airports,* 2018 edition.
NFPA 408, *Standard for Aircraft Hand Portable Fire Extinguishers,* 2017 edition.
NFPA 424, *Guide for Airport/Community Emergency Planning,* 2018 edition.
NFPA 472, *Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents,* 2018 edition.
NFPA 600, *Standard on Facility Fire Brigades,* 2015 edition.
NFPA 921, *Guide for Fire and Explosion Investigations,* 2017 edition.
NFPA 1051, *Standard for Wildland Firefighting Personnel Professional Qualifications,* 2016 edition.
NFPA 1145, *Guide for the Use of Class A Foams in Fire Fighting,* 2017 edition.
NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents,* 2017 edition.
NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services,* 2019 edition.

## Chapter 3 Definitions

**3.1 General.** The definitions contained in this chapter apply to the terms used in this guide. Where terms are not defined in this chapter or within another chapter, they should be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, is 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 Guide.** A document that is advisory or informative in nature and that contains only nonmandatory provisions. A guide may contain mandatory statements such as when a guide can be used, but the document as a whole is not suitable for adoption into law.

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

**3.3 General Definitions.**

**3.3.1 Air Accident Investigations Branch (AAIB).** A UK agency that is responsible for investigating and determining the probable cause of all British aircraft accidents.

**3.3.2 Air Traffic Control (ATC).** A service established to provide air and ground traffic control for airports.

**3.3.3 Aircraft.**

**3.3.3.1** ***Pressurized Aircraft.*** Sealed, modern-type aircraft within which the internal atmospheric pressure can be regulated.

**3.3.3.2** ***Turboprop Aircraft.*** An aircraft powered by one or more turbine engines each of which drives a propeller.

**3.3.4 Aircraft Accident.** An occurrence associated with the operation of an aircraft that takes place between the time any person boards the aircraft with the intention of flight and until all such persons have disembarked and in which any person suffers death or serious injury or in which the aircraft receives substantial damage. [**403,** 2018]

**3.3.5* Aircraft Accident Pre-Incident Planning.** The process of forecasting all factors that could possibly exist involving an aircraft accident that could bear upon the existing emergency resources.

**3.3.6 Aircraft Defueling.** See 3.3.50, Fuel Servicing.

**3.3.7 Aircraft Familiarization.** Refers to the knowledge of vital information that rescue and fire-fighting personnel should learn and retain with regard to the specific types of aircraft that normally use the airport and other aircraft that might use the airport due to weather conditions at scheduled destinations.

**3.3.8* Aircraft Fire Fighting.** The control or extinguishment of fire adjacent to or involving an aircraft following ground accidents/incidents.

**3.3.9* Aircraft Incident.** An occurrence, other than an accident associated with the operation of an aircraft, that affects or could affect continued safe operation if not corrected.

**3.3.10* Aircraft Rescue and Fire Fighting (ARFF).** The fire-fighting action taken to prevent, control, or extinguish fire involved or adjacent to an aircraft for the purpose of maintaining maximum escape routes for occupants using normal and emergency routes for egress.

**3.3.11 Aircraft Rescue and Fire-Fighting Vehicle.** A vehicle intended to carry rescue and fire-fighting equipment for rescuing occupants and combating fires in aircraft at or in the vicinity of airports.

**3.3.12 Aircraft Skin.** The outer covering of an aircraft fuselage, wings, and empennage.

**3.3.13 Air-Cushioned Vehicle (ACV).** A vehicle that can travel on land and water.

**3.3.14 Airport (Aerodrome).** An area on land or water that is used or intended to be used for the landing and takeoff of aircraft and includes buildings and facilities.

**3.3.15 Airport Familiarization.** Refers to the knowledge that rescue and fire-fighting personnel must maintain relative to locations, routes, and conditions that will enable them to respond quickly and efficiently to emergencies on the airport and those areas surrounding the airport.

**3.3.16 Aluminum.** A lightweight metal used extensively in the construction of aircraft airframes and aircraft skin sections.

**3.3.17 Area.**

**3.3.17.1 *Critical Rescue and Fire-Fighting Access Area.*** The rectangular area surrounding any runway within which most aircraft accidents can be expected to occur on airports. Its width extends 150 m (500 ft) from each side of the runway centerline, and its length is 1000 m (3300 ft) beyond each runway threshold.

**3.3.17.2 *Practical Critical Fire Area (PCA).*** This area is two-thirds of the theoretical critical fire area (TCA). *[See also 3.3.17.3, Theoretical Critical Fire Area (TCA).]*

**3.3.17.3 *Theoretical Critical Fire Area (TCA).*** The theoretical critical fire area (TCA) is a rectangular area, the longitudinal dimension of which is the overall length of the aircraft and the width includes the fuselage and extends beyond it by a predetermined set distance that is dependent on the overall width. Therefore, the aircraft length multiplied by the calculated width equals the size of the TCA.

**3.3.18 Auxiliary Power Unit (APU).** A self-contained power source, provided as a component of an aircraft, that is used to energize aircraft systems when power plants are not operating or when external power is not available.

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**3.3.19 Cockpit Voice Recorder (CVR).** A device that monitors flight deck crew communications through a pickup on the flight deck connected to a recorder that is usually mounted in the tail area of the aircraft and that is designed to withstand certain impact forces and a degree of fire.

**3.3.20 COMBI.** An aircraft designed to transport both passengers and cargo on the same level within the fuselage.

**3.3.21 Command Post (CP).** The location at the scene of an emergency where the incident commander is located and where command, coordination, control, and communications are centralized.

**3.3.22* Composite Materials.** Lightweight materials having great structural strength. They are made of fine fibers embedded in carbon/epoxy materials. The fibers are usually boron, fiberglass, aramid, or carbon in the form of graphite.

**3.3.23 Dangerous Goods.** This term is synonymous with the terms *hazardous materials* and *restricted articles*. The term is used internationally in the transportation industry and includes explosives and any other article defined as combustible liquids, corrosive materials, infectious substances, flammable compressed gases, oxidizing materials, poisonous articles, radioactive materials, and other restrictive articles.

**3.3.24 Deck Gun (Deluge Set).** See 3.3.96, Turret.

**3.3.25 Departure.** An aircraft taking off from an airport.

**3.3.26 Dry Chemical.** A powder composed of very small particles, usually sodium bicarbonate–, potassium bicarbonate–, or ammonium phosphate–based with added particulate material supplemented by special treatment to provide resistance to packing, resistance to moisture absorption (caking), and the proper flow capabilities. [**17,** 2017]

**3.3.27 Dry Powder.** Solid materials in powder or granular form designed to extinguish Class D combustible metal fires by crusting, smothering, or heat-transferring means. [**10,** 2018]

**3.3.28 Empennage.** The tail assembly of an aircraft, which includes the horizontal and vertical stabilizers.

**3.3.29 Evacuee.** An aircraft occupant who has exited the aircraft following an accident/incident.

**3.3.30 Exposure.** Any person or property that could be endangered by fire, smoke, gases, runoff, or other hazardous conditions.

**3.3.31 Extinguishing Agent.**

**3.3.31.1 *Complementary Extinguishing Agent.*** An agent that provides unique extinguishing capability beyond the primary chosen agent.

**3.3.31.2 *Primary Extinguishing Agent.*** Agents that have the capability of suppressing and preventing the reignition of fires in liquid hydrocarbon fuels.

**3.3.32 Extinguishing Agent Compatibility.** Related to the requirement that the chemical composition of each agent be such that one will not adversely affect the performance of other agents that might be used on a common fire.

**3.3.33 Extrication.** The removal of trapped victims from a vehicle or machinery. [**1670,** 2017]

**3.3.34 Federal Aviation Administration (FAA).** An agency of the United States federal government charged with the primary responsibility of regulating aviation activities.

**3.3.35 Fire Classifications.**

**3.3.35.1 *Class A.*** A fire in ordinary combustible materials such as wood, cloth, paper, rubber, and many plastics.

**3.3.35.2 *Class B.*** A fire in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases.

**3.3.35.3 *Class C.*** A fire that involves energized equipment where the electrical resistivity of the extinguishing media is of importance.

**3.3.35.4 *Class D.*** Combustible metals.

**3.3.36 Fire Wall.** A bulkhead designed to stop the lateral spread of fire in a fuselage or engine nacelle.

**3.3.37 Flashback.** The tendency of flammable liquid fires to reignite from any source of ignition after the fire has once been extinguished.

**3.3.38 Flashover.** A transition phase in the development of a compartment fire in which surfaces exposed to thermal radiation reach ignition temperature more or less simultaneously and fire spreads rapidly throughout the space, resulting in full room involvement or total involvement of the compartment or enclosed space. [**921,** 2017]

**3.3.39 Flight Attendants.** Those members of the flight deck crew whose responsibility includes the management of activities within the passenger cabin.

**3.3.40* Flight Data Recorder (FDR).** An instrument that monitors performance characteristics of an aircraft in flight.

**3.3.41 Flight Deck Crew.** Those members of the crew whose responsibility includes the management of the aircraft's flight control and ground movements.

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**3.3.42 Foam.**

Δ **3.3.42.1*** ***Aqueous Film Forming Foam (AFFF) Concentrate.*** A concentrate based on fluorinated surfactants plus foam stabilizers to produce a fluid aqueous film for suppressing hydrocarbon fuel vapors and usually diluted with water to a 1 percent, 3 percent, or 6 percent solution. [**11,** 2016]

**3.3.42.2** ***Film-Forming Fluoroprotein Foam Concentrate (FFFP).*** A protein-foam concentrate that uses fluorinated surfactants to produce a fluid aqueous film for suppressing hydrocarbon fuel vapors. [**11,** 2016]

**3.3.42.3*** ***Fluoroprotein Foam Concentrate.*** A concentrate very similar to protein-based foam concentrate but with a synthetic fluorinated surfactant additive. [**11,** 2016].

Δ **3.3.42.4** ***Protein Foam Concentrate.*** A concentrate consisting primarily of products from a protein hydrolysate, plus stabilizing additives and inhibitors to protect against freezing, to prevent corrosion of equipment and containers, to resist bacterial decomposition, to control viscosity, and to otherwise ensure readiness for use under emergency conditions. [**11,** 2016]

**3.3.43 Foam Application Rate.** The amount of foam solution in liters or gallons per minute expressed as a relationship with a unit of area, usually square meter or square foot.

**3.3.44 Foam Blanket.** A covering of foam over a surface to insulate, prevent ignition, or extinguish the fire. [**1145,** 2017]

**3.3.45 Foam Burnback Resistance.** The ability of a foam blanket to retain aerated moisture and resist destruction by heat and flame.

Δ **3.3.46 Foam Drain Time.** The 25 percent drainage time (or ¼ drainage time) required for 25 percent of the original foam solution (foam concentrate plus water) to drain out of the foam.

**3.3.47 Forcible Entry.** Techniques used by fire personnel to gain entry into buildings, vehicles, aircraft, or other areas of confinement when normal means of entry are locked or blocked.

**3.3.48 Forward Looking Infrared (FLIR).** The detection of heat energy radiated by objects to produce a "thermal image." This thermal image is converted by electronics and signal processing into a visual image that can be viewed by the operator.

**3.3.49 Frangible Gate/Fence.** Gates or fence sections designed to open, break away, or collapse when struck with the bumper of an ARFF vehicle responding to an emergency.

**3.3.50 Fuel Servicing.** Fueling and defueling of aircraft fuel tanks, not including aircraft fuel transfer operations and design of aircraft fuel systems during aircraft maintenance or manufacturing operations.

**3.3.51 Fuselage.** The main body of an aircraft.

**3.3.52 Gear.**

**3.3.52.1** ***Main Gear.*** Refers to the two or more larger landing gear structures of an aircraft, as opposed to wing, nose, or tail gear assemblies.

**3.3.52.2** ***Nose Gear.*** That mechanical part of a landing gear system mounted under the nose of an aircraft. It can be designed either as a stationary component or one that retracts into the fuselage.

Δ **3.3.53 Grid Map.** A plan view of an area superimposed with a system of numbered and lettered squares that provide a fixed reference to any point in the area. [**424,** 2018]

**3.3.54 Halogenated Agents.** Liquefied gas extinguishing agents that extinguish fire by chemically interrupting the combustion reaction between fuel and oxygen. Halogenated agents leave no residue.

**3.3.55 Halon 1211.** A halogenated agent whose chemical name is bromochlorodifluoromethane ($CF_2BrCl$). [**408,** 2017]

Δ **3.3.56 Halon 1301.** A halogenated agent whose chemical name is bromotrifluoromethane ($CBrF_3$). [**408,** 2017]

Δ **3.3.57 Hazardous Materials.** Substances (solid, liquid, or gas) that when released are capable of creating harm to people, the environment, and property.

**3.3.58 Hot Brakes.** A condition in which the aircraft's brake and wheel components have become overheated, usually due to excessive braking during landing.

**3.3.59* Ignition Temperature.** Minimum temperature a substance should attain in order to ignite under specific test conditions. [**921,** 2017]

**3.3.60 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. [**472,** 2018]

**3.3.61 International Air Transport Association (IATA).** An international group composed of the major airlines of the world that reviews aviation policy, including safety items.

**3.3.62 International Civil Aviation Organization (ICAO).** An international body charged with matters dealing with the development, coordination, and preservation of international civil aviation.

**3.3.63 Jet Blast.** The thrust-producing exhaust from a jet engine.

**3.3.64 Joint Aviation Authority (JAA).** An agency in Europe charged with the responsibility of regulating safety in civil aviation.

**3.3.65 Knockdown.** The reduction of flame and heat to a point where further extension of a fire has been abated and the overhaul stage can begin.

**3.3.66 Magnesium.** Refers to either pure metal or alloys having the generally recognized properties of magnesium marketed under different trade names and designations.

**3.3.67 Master Stream.** A portable or fixed fire-fighting appliance supplied by either hose lines or fixed piping and that has the capability of flowing in excess of 1140 L/min (300 gpm) of water or water-based extinguishing agent. [**600,** 2015]

**3.3.68 Mutual Aid.** Reciprocal assistance by emergency services under a prearranged plan.

**3.3.69 National Transportation and Safety Board (NTSB).** A U.S. federal agency that is responsible for investigating and determining the probable cause of aircraft accidents.

*N* **3.3.70 Ordnance.** Explosives, chemicals, pyrotechnics, and similar stores (e.g., bombs, guns, ammunition, flares, smoke, or napalm).

**3.3.71 Overhaul.** The final stages of fire extinguishment, following knockdown of the main body of fire, during which pockets of fire are sought out to complete extinguishment.

**3.3.72 Penetrating Nozzle.** An appliance designed to penetrate the skin of an aircraft and inject extinguishing agent.

**3.3.73 Post Aircraft Accident.** The specific time when all fires have been extinguished, persons have been accounted for, survivors have been removed, and the hazards have been identified.

**3.3.74 Preservation of Evidence.** After an aircraft accident/incident, it is imperative that investigative evidence be preserved after life safety and rescue operations have been concluded.

**3.3.75* Protective Clothing.** Equipment designed to protect the wearer from thermal hazards, hazardous materials, or from the hazardous component of a weapon of mass destruction contacting the skin or eyes. [**472,** 2018]

**3.3.76 Rescue.** Those activities directed at locating endangered persons at an emergency incident, removing those persons from danger, treating the injured, and providing for transport to an appropriate health care facility.

**3.3.77 Rescue Path.** A fire-free path from an aircraft accident site to a safe area. This path, normally selected by evacuees, must be maintained by fire fighters during the evacuation process.

**3.3.78 Resources.** All personnel and major items of equipment that are available, or potentially available, for assignment to incidents. [**1051,** 2016]

**3.3.79 Response Time.** See 3.3.92.2, Response Time.

**3.3.80 Restricted Articles.** See 3.3.23, Dangerous Goods.

**3.3.81 Runoff.** Liquids that flow by gravity away from an aircraft accident and might include aviation fuel (ignited or not), water/foam from fire-fighting streams, liquid cargo, or a combination of these liquids.

**3.3.82 Runway.** A defined rectangular area on a land airport prepared for the landing and taking off of aircraft along its length. Runways are normally numbered relative to their magnetic direction.

**3.3.83 Salvage.** A fire-fighting procedure for protecting property from further loss following an aircraft accident or fire.

**3.3.84* Self-Contained Breathing Apparatus (SCBA).** An atmosphere-supplying respirator that supplies a respirable air atmosphere to the user from a breathing air source that is independent of the ambient environment and designed to be carried by the user. [**1981,** 2019]

**3.3.85 Size-Up (Risk Assessment).** A mental process of evaluating the influencing factors at an incident prior to committing resources to a course of action. [**1670,** 2017]

**3.3.86 Smoke Ejector.** A mechanical device, similar to a large fan, that can be used to force heat, smoke, and gases from a post-fire environment and draw in fresh air.

**3.3.87 Stabilizer.**

**3.3.87.1** ***Horizontal Stabilizer.*** That portion of an aircraft's structure that contains the elevators.

**3.3.87.2** ***Vertical Stabilizer.*** That portion of the aircraft's empennage that contains the rudder.

**3.3.88 Surface Movement Guidance and Control System (SMGCS).** A process or plan used by airports conducting operations in visibility conditions less than 366 m (1200 ft) runway visual range (RVR).

**3.3.89 Tabletop Training.** A workshop style of training involving a realistic emergency scenario and requiring problem-solving participation by personnel responsible for management and support at emergencies.

**3.3.90 Threshold.** The beginning of that portion of the runway usable for landing.

**3.3.91 Time.**

**3.3.91.1** ***Evacuation Time.*** The elapsed time between an aircraft accident/incident and the removal of all surviving occupants.

Δ **3.3.91.2** ***Response Time.*** The total period of time measured from the time of an alarm until the first ARFF vehicle arrives at the scene of an aircraft accident/incident and is in position to apply agent.

**3.3.92 Titanium.** Refers to either pure metal or alloys having the generally recognized properties of titanium metal, including the fire or explosion characteristics of titanium in its various forms.

**3.3.93 Triage.** The sorting of casualties at an emergency according to the nature and severity of their injuries.

**3.3.94 Triage Tag.** A tag used in the classification of casualties according to the nature and severity of their injuries.

**3.3.95 Turret.** A vehicle-mounted master stream appliance.

**3.3.96 Undercarriage.** All components of an aircraft landing gear assembly.

**3.3.97 United Kingdom Civil Aviation Authority (CAA).** A UK agency charged with the responsibility of regulating safety in civil aviation.

*N* **3.3.98 U.S. National Grid.** A standard area and point grid reference system that quickly enables multidiscipline and multijurisdictional emergency service agencies to precisely locate incidents and universally communicate locations using paper maps and/or electronic applications.

**3.3.99* Ventilation.** The changing of air within a compartment by natural or powered means. [**302,** 2015]

**3.3.99.1** ***Mechanical Ventilation.*** A process of removing heat, smoke, and gases from a fire area by using exhaust fans, blowers, air-conditioning systems, or smoke ejectors.

## Chapter 4 Pre-Incident Planning for Aircraft Emergencies

### 4.1 General.

**4.1.1** Many accidents within the critical rescue and fire-fighting access area involve undershoots, overshoots, and rejected takeoffs, and are generally survivable. Accidents occurring outside of the critical rescue and fire-fighting access area could involve impact with adverse terrain, with resultant rupture of the aircraft structure. Rapid response to these areas is crucial for the purpose of saving lives.

**4.1.2** In addition to routine training programs, airport ARFF services and all structural fire departments and community emergency services with jurisdictions adjacent to an airport or its traffic patterns are encouraged to frequently schedule and participate in multi-agency training sessions based on the material in this guide. The objective of these sessions should be to focus on achieving maximum unity, compatibility, and effectiveness at aircraft emergencies, should they be on or off the airport. *(See Section 4.5.)*

Δ **4.1.3** All ARFF personnel should participate in regular exercises involving simulated aircraft accidents throughout the year. Frequent command-level training for those persons assigned to major roles in the airport/community emergency plan is also essential. Command training can be presented in the form of workshop or tabletop exercises designed to develop effective emergency management techniques. Guidance for emergency plan exercises is provided in NFPA 424.

**4.1.4** Command authority at any accident site should be predetermined according to the jurisdictional responsibilities of the agencies involved and as designated in their airport/community mutual aid agreement.

### 4.2 Emergency Response Preplanning.

Δ **4.2.1** All ARFF vehicles in use at the airport should be able to meet the provisions of NFPA 414 upon acceptance from the manufacturer and should be maintained in a manner to ensure such levels of performance. Special training should be provided to enhance the skills of all vehicle operators, as their performance is critical to successful vehicle utilization, particularly under unfavorable conditions. ARFF drivers should actually drive all service roads and be familiar with any gates.

**4.2.2*** Operators assigned to each ARFF vehicle should make trial runs to all areas of the airport in all weather conditions during which flight operations take place. Particular emphasis should be placed on the ability to respond to the critical rescue and fire-fighting access area as this is where most accidents occur. These runs will demonstrate each vehicle's operational capability and the time required to reach each site. Because many aircraft accidents occur in the overrun areas of the runways, it is important to provide suitable routes for use by the vehicles to enable them to reach these areas. Bridges spanning gullies, streams, ditches, cattle grids, or other ground surface appurtenances should be capable of supporting at least 120 percent of the weight of the heaviest emergency vehicle.

**4.2.2.1** Some airports have installed Engineered Material Arresting Systems (EMAS) at runway ends. These passive systems are designed to bring overrunning aircraft to a safe stop.

**4.2.2.2** ARFF equipment can safely traverse these installations, but ARFF crews should be advised regarding specific maneuverability precautions and evacuation issues. *(See 9.4.3.1.)*

**4.2.3** Where construction work of any kind is likely to affect the response capability or operational performance of the ARFF service, prior notification of the work should be provided so that amendments can be made to operational procedures to overcome or minimize their effect. This is particularly important where work on airport water mains is likely to close down one or more fire hydrants.

**4.2.4** In order to provide multivehicle access to the accident site, service roads should be constructed so that one vehicle cannot block ingress or egress for other emergency vehicles. This can be accomplished by providing roads of sufficient width or suitable passing and turnaround areas. An access for service roads should also be strategically placed and maintained near the ends of runways, or key taxiways that will allow ARFF crews all-weather access. Where gates are secured using locks, all airport gates should be capable of being opened using the same key. Where remotely controlled, the operation should be provided from each ARFF vehicle.

**4.2.5** Gates should be located at strategic locations to allow rapid access by ARFF vehicles to areas outside the airport boundary. Keys to gate locks should be carried on each authorized emergency vehicle, and by airport security personnel and designated local emergency services.

**4.2.6** Grid maps should be provided for each airport and its environs. They should be ruled with numbered and lettered grids, as shown in Figure 4.2.6, to permit rapid identification of any response area. The area covered by a grid map should be a distance of 8 km (5 mi) from the center of the airport. This distance can vary depending upon the type of terrain or location of the airport in relation to other emergency facilities. Map nomenclature should be compatible with that used by off-airport public safety authorities. Two or more maps might be required where the area exceeds an 8 km (5 mi) radius. One map should display medical facilities, heliports, and other features according to the airport/community emergency plan. Where more than one grid map is used, grid identifications should differ by color and scale to assist in their identification. Prominent local features, access routes, staging areas, and compass headings should be shown to facilitate locating accident and medical facility sites. Copies of grid maps should be prominently displayed at ATC, the airport operations office, each airport and community fire station, and all mutual aid services, and should be carried on all appropriate emergency vehicles.

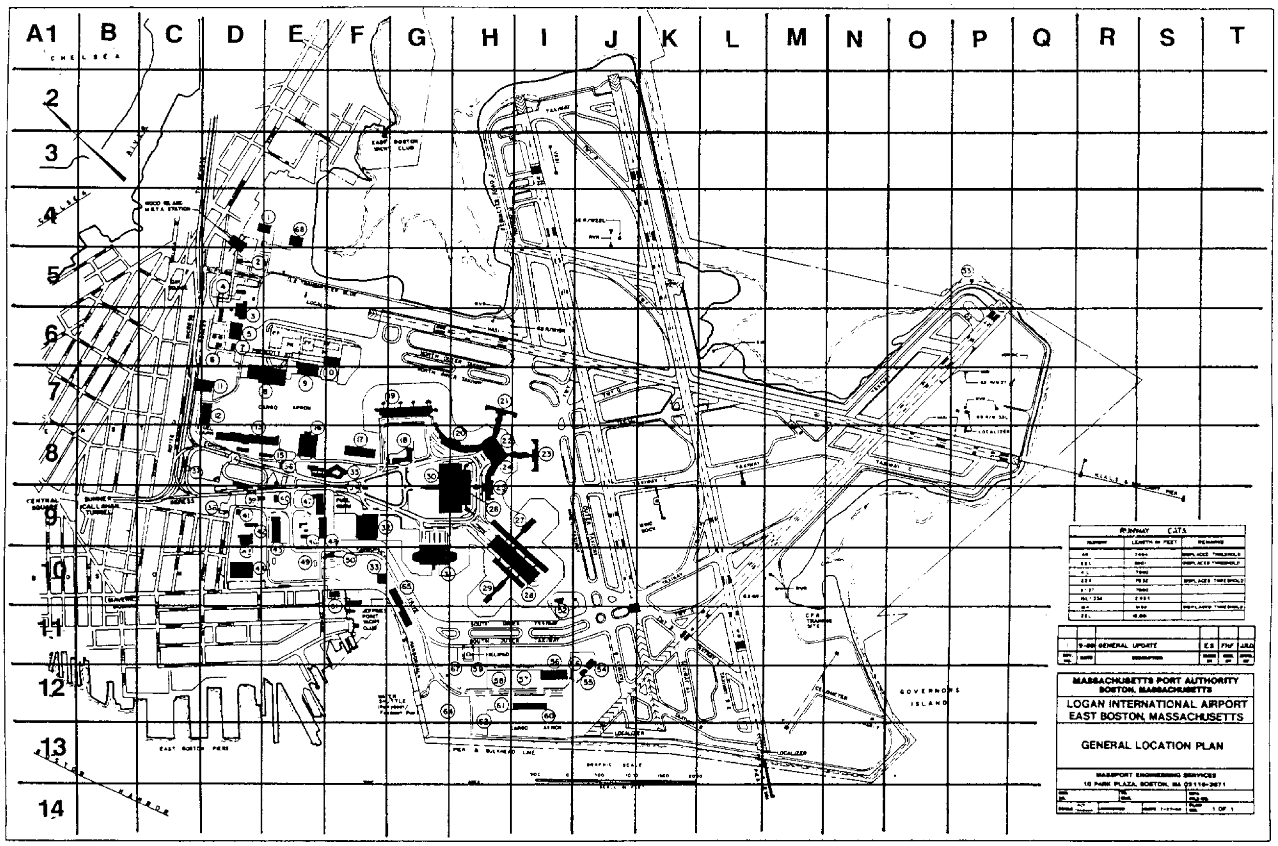



**FIGURE 4.2.6 Typical Airport Grid Map.**

**4.2.7** Backup systems should be provided in airport fire stations to allow for the rapid operation of vehicle bay doors, for the efficient reception/transmission of vital communications, and for the provision of emergency lighting.

**4.2.8** A communication system from the airport to community or regional emergency services should be provided. The reliability of the system should be tested daily.

**4.2.9** Any off-airport emergency services authorized to respond to an on-airport incident should pre-incident plan access to the various areas of the airport, particularly the designated staging areas. Personnel should also be trained in the special procedures to be followed once at the airport.

Δ **4.2.10** Sufficient ARFF vehicles, personnel, and equipment should be provided to meet the required level of protection as specified in NFPA 403 for the airport during flight operations. When this protection level is reduced for any reason (e.g., off-airport response, mechanical breakdown, lack of qualified personnel), all incoming and departing aircraft carriers should be notified of the change in ARFF capability.

**4.2.11** It is important that pre-incident planning includes response of additional pumping vehicles, ladder trucks, elevated platform vehicles, portable lighting equipment, hoisting and lifting equipment, medical supplies, and any other available specialized equipment or vehicle for which a requirement is anticipated. It is extremely important that the pre-incident plan also ensures the immediate availability of the special vehicles and equipment, provision for qualified driver/operators, and especially the availability of an approving authority on an around-the-clock basis.

**4.3 Airport Fire Fighter Basic Knowledge.**

Δ **4.3.1** To assure that airport fire fighters have a suitable degree of skill, basic training should be provided in accordance with NFPA 1003.

Δ **4.3.2** Comprehensive, continuous in-service training in accordance with NFPA 405 should be provided to maintain each fire fighter's proficiency. For further information on training subjects, see the references listed in Chapter 2 and Annex E.

**4.3.3** The complexity of modern aircraft and the variety of types in service make it difficult to train ARFF personnel in all the important design features of each model. However, personnel should become as familiar as possible with each type of aircraft that normally uses the airport. Particular emphasis should be placed on all of the following:

(1) Location and operation of normal and emergency exits, cargo doors, equipment, and galley access doors
(2) Seating configurations
(3) Type of fuel and location of fuel tanks
(4) Location of ejection seats and armament (military aircraft)

(5) Locations of batteries, hydraulics, and oxygen systems
(6) Positions of break-in points on the aircraft
(7) Location of rapidly activated standby generators or turbines
(8) Fire access panels
(9) Location of aircraft construction materials (carbon fibers, composite materials, etc.) that are subject to releasing hazardous/toxic substances while burning
(10) Hazard areas (e.g., collapse zones)

**4.3.4** Airports are large commercial complexes that contain many potential life and fire hazards. These hazards vary relative to aircraft operations, time of day, weather conditions, construction, or a combination of these factors. It is, therefore, vital that ARFF personnel become extensively knowledgeable about the airport and any changes that could adversely affect immediate response or the efficient performance of their rescue and fire-fighting responsibilities. Minimum requirements should include knowledge of all of the following:

(1) Water supply locations (hydrants)
(2) Runway identifications and locations
(3) Taxiway identifications and locations
(4) Airport lighting systems
(5) Most effective response routes and alternatives
(6) Fuel handling and storage areas
(7) Key airport locations
(8) Airport service roads
(9) Gates and fences
(10) Airport drainage systems

**4.4 Communications.**

**4.4.1** All airport emergency vehicles should be provided with multi-channel two-way radios operating on the airport's assigned ground control frequency and other airport emergency frequencies.

Δ **4.4.2** It is desirable that airport ARFF vehicles be able to monitor or be in direct voice communications with an aircraft during an emergency situation. This procedure is especially important when airport control towers are not in operation. A discrete emergency frequency (DEF), where available, should be used for communications between the aircraft crew and the ARFF incident commander.

**4.4.3** At an aircraft accident site, power megaphones can be valuable tools to coordinate flight deck crew/ARFF activities, direct evacuating aircraft occupants to safe locations, and so forth.

**4.4.4** Portable radios can be utilized at an accident site to communicate with the command post, airport emergency dispatcher, airport management, arriving back-up units, and so forth. Where personnel and vehicles from more than one agency will operate in mutual support, common radio frequencies or other interoperable solutions should be available. If common frequencies or other interoperable solutions are not used, pre-incident planning procedures should be established so that portable radios can be exchanged, the use of messengers employed, or methods of relaying messages through the command post utilized. When portable radios are exchanged, consideration should be given to avoiding channel saturation and the maintenance of communication discipline.

**4.4.5** Experience from recent accidents has shown that the use of automated voice notification systems greatly facilitates emergency response/mutual aid notification.

**4.4.6** The use of cellular telephones in ambulances, in supervisory vehicles, and in command post vehicles can provide significant benefits in command and control functions.

**4.5 Mutual Aid Considerations.**

**4.5.1** It is essential to have mutual fire-fighting assistance agreements with community and regional off-airport fire departments. Successful rescue operations and handling of aircraft accident fires both on and off the airport depend on pre-incident planning the effective use of mutual aid *(see also Annex D)*. The following considerations are significant:

(1) Special attention should be given to ensuring compatibility in equipment designs (e.g., fire hose threads, communications equipment) and to fire control operational techniques.
(2) It is important to familiarize structural fire department personnel with the special problems relating to aircraft rescue and fire fighting, including methods of access to aircraft operating areas and how to operate vehicles while at the airport.

**4.5.2** Airport orientation visits should be arranged by fire departments bordering airports for consultations with the airport fire department, airlines, the military services, and others as appropriate. Their training in airport/aircraft familiarization should include those items listed in 4.3.3 and 4.3.4, and grid maps of the airport and surrounding area.

**4.5.3** Structural fire-fighting vehicles normally carry small amounts of water compared to the amounts usually carried on major airport ARFF vehicles. However, they can be useful in relaying water from hydrants, reservoirs, or other sources to maintain ARFF vehicle supplies.

**4.5.4** Structural fire fighters can be utilized to provide assistance to airport ARFF personnel by handling hose lines, operating tools and equipment, assisting in rescue operations, and protecting exposures.

## Chapter 5 Flight Deck Crew and ARFF Personnel Responsibilities

**5.1 Areas of Responsibility.**

**5.1.1** The flight deck crew, flight attendants, and ARFF personnel should have the skills to deal with aircraft emergencies and should be familiar with each others' responsibilities to ensure that all their efforts are clearly directed toward the common goals of life and fire safety.

Δ **5.1.2** The prime mission of all concerned is the safety of all persons aboard the aircraft and any others involved in the emergency. Duties and responsibilities can generally be defined as follows:

(1) Flight deck crews and flight attendants are responsible for the aircraft and for the safety of its occupants. The final decision to evacuate an aircraft, and how to do so, is made by the flight deck crew.

(2) It is the duty of responding ARFF personnel to create conditions in which survival is possible and evacuation or rescue can be conducted. As visibility from within an aircraft is limited, any external features or situations likely to be of significance in the evacuation process should be communicated to the aircraft's crew. Should it become apparent that crew incapacitation precludes their initiation of evacuation, the incident commander of the ARFF personnel should take the initiative to do so.

(3) In some cases, evacuation and passenger-assisted rescues might have already commenced prior to the arrival of ARFF crews.

**5.1.3** To prevent injury when an emergency aircraft evacuation takes place, consideration should be given to assisting occupants in using the aircraft slides.

**5.2 Communications.**

**5.2.1** Effective communications between flight deck crew and ARFF personnel is very important during emergencies. Contact should be established at the earliest possible time between persons in charge of each group. Exchange of pertinent information can assist in developing better decisions and plans of action. Several methods of direct communication are generally available, such as aircraft interphone, tower relay, direct radio communication via approved DEF, or visual signals.

**5.2.2** Where aircraft engines are operating, radio communications near the aircraft can be very difficult. Most aircraft are equipped with intercom systems and provided with plug-in jacks normally located under the forward portion of the aircraft near the nose gear. ARFF personnel should be aware of this means of communication and carry the necessary headset and microphone to plug into these facilities. Even with the engines operating, direct communications with the flight deck crew can be established by use of this system as long as the power is on.

**5.2.3** Where a more direct means of communication cannot be established, a designated ARFF individual should go to the left side of the aircraft nose and establish direct eye contact and voice communications with the captain of the flight deck crew. If engine noise is a problem and a power megaphone is not available, it might be necessary to resort to hand signals to communicate. Figure 5.2.3 depicts standard international ground-to-aircraft hand signals that should be used by ARFF personnel to communicate with the captain during emergencies. These hand signals are established for emergency communication between the ARFF incident commander and/or ARFF fire fighters and the cockpit and/or cabin crews of the incident aircraft. ARFF emergency hand signals should be given from the left front side of the aircraft for the cockpit crew. (Note: In order to communicate more effectively with the cabin crew, emergency hand signals may be given by ARFF fire fighters from other positions.)

Δ **5.2.4** If aircraft engines are operating, ARFF personnel should use extreme caution when approaching an aircraft for communications purposes as described in 5.2.2 and 5.2.3. The aircraft should be approached only from the front and well ahead of the nose and, if possible, in full view of the captain. Vehicle and hand-held lights should be used in periods of darkness and poor visibility. See Table 5.2.4 for light-gun signals.

**Recommend Evacuation** — Evacuation recommended based on ARFF incident commander's assessment of external situation.

Arm extended from body and held horizontal with hand upraised at eye level. Execute beckoning arm motion angled backward. Nonbeckoning arm held against body.

Night — same with wands.

**Recommend Stop** — Recommend evacuation in progress be halted. Stop aircraft movement or other activity in progress.

Arms in front of head, crossed at wrists.

Night — same with wands.

**Emergency Contained** — No outside evidence of dangerous condition or "all clear."

Arms extended outward and down at a 45-degree angle. Arms moved inward below waistline simultaneously until wrists crossed, then extended outward to starting position (umpire's "safe" signal).

Night — same with wands.

Δ **FIGURE 5.2.3 Standard International Ground-to-Aircraft Signals.** ***(Photos courtesy of the Air Line Pilots Association.)***

**Δ Table 5.2.4 Standard Air Traffic Control Tower Light-Gun Signals**

| Color and Type of Signal | Meaning: Movement of Vehicles, Equipment, and Personnel | Meaning: Aircraft on the Ground | Meaning: Aircraft in Flight |
|---|---|---|---|
| Steady green | Cleared to cross, proceed, or go | Cleared for takeoff | Cleared to land |
| Flashing green | Not applicable | Cleared for taxi | Return for landing (to be followed by steady green at the proper time) |
| Steady red | STOP | STOP | Give way to other aircraft and continue circling |
| Flashing red | Clear the taxiway/runway | Taxi clear of runway in use | Airport unsafe do not land |
| Flashing white | Return to starting point on airport | Return to starting point on airport | Not applicable |
| Alternating red and green | Exercise extreme caution | Exercise extreme caution | Exercise extreme caution |

## Chapter 6 Emergency Response

### 6.1 General.

**6.1.1** The survivable atmosphere inside an aircraft fuselage involved in an exterior fuel fire is limited to approximately 3 minutes if the integrity of the airframe is maintained during the impact. This time could be substantially reduced if the fuselage is fractured. When the aluminum aircraft skin is directly exposed to flame, burnthrough will occur within 60 seconds or less, while the windows and insulation may withstand penetration for up to 3 minutes. Because of this serious life hazard to occupants, rapid fire control is critical. Therefore, whenever flight operations are in progress, ARFF vehicles and personnel should be located so that optimum response and fire control can be achieved within this time frame.

**6.1.2** At many airports portions of the critical rescue and fire-fighting access areas, as shown in Figure 6.1.2, might be outside the airport boundaries. There also can be obstructions created by natural features, highways, or railroad right-of-ways that would delay or preclude access by ARFF vehicles. In these instances, consideration should be given to providing specialized vehicles where conventional vehicles can be restricted due to unusual terrain characteristics. Any delay in response time is critical, and mutual assistance agreements with off-airport agencies should be established to provide optimum response in problem areas.

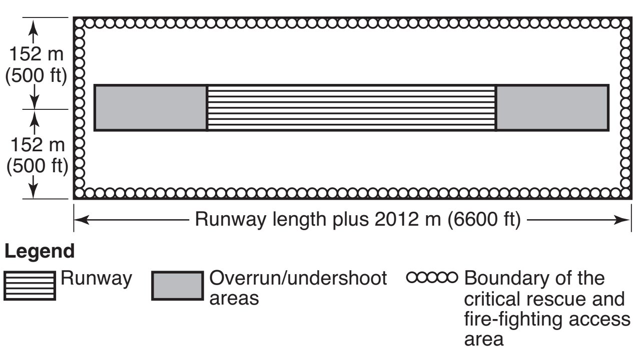



**FIGURE 6.1.2 Critical Rescue and Fire-Fighting Access Area.**

**6.1.3** To obtain the desired response, pre-incident planning should include a wide range of factors such as adequate alarm systems, fire station locations (or prepositioning of resources), vehicle operator training, airport familiarization, and staging areas for outside assistance.

**6.1.4** Fire stations should be located to allow rapid direct access to the operational runway(s) so that maximum acceleration rate and top speed of the vehicles can be utilized to enable them to reach any point on the runway(s). The access road to the runway(s) should be as direct as possible.

**6.1.5** All-weather access routes to the critical rescue and fire-fighting access area suitable for ARFF vehicles should be designated and should be maintained in usable condition while flight operations are in progress.

**6.1.6** To minimize response times, operational procedures should exist through which ATC would stop or divert all aircraft and nonessential traffic that would conflict with responding emergency vehicles.

**6.1.7** Airports updating their master plan for airport development should consider the location of obstructions in the critical rescue and fire-fighting access area, such as ditches, mounds, vegetation, or nonfrangible structures that could cause extensive damage to any overrunning aircraft or obstruct the positioning of emergency vehicles.

### 6.2 Low-Visibility Operations.

**6.2.1** New and improved techniques for instrument takeoff and landing permit flight operations to continue under adverse weather conditions. Low-visibility operations criteria vary from one airport to another depending upon the type of instrument landing system available, the level of natural and manmade obstructions in the surrounding terrain, the type of runway lighting, and the capability of the onboard instrument systems of the aircraft using the airport. Such operational minimums can vary from 5 km (3 mi) visibility to 100 m (300 ft) for landings, with similar restrictions for takeoff. ARFF personnel should ascertain operational restriction levels from the local ATC agency or airfield operations, or both, in order to establish response capability under low-visibility conditions.

**6.2.2*** Although aircraft operational navigational weather minimums might not be in effect, fully staffed Local Standby Alert procedures should be initiated when flight operations are in progress and surface visibility and conditions are less than 800 m (½ mi). Whenever operational or environmental conditions exist that have the potential to impede a timely ARFF response, an assessment should be made regarding ARFF personnel and equipment or repositioning of resources or both. *(See also Section 10.2.)*

**6.2.3** Standbys during low-visibility operations and adverse weather conditions should have at least one major ARFF vehicle located at a distance no closer than the taxiway hold line adjacent to the midpoint of the active runway, unless the fire station(s) location(s), as shown in Figure 6.2.3, permits effective response times. When on standby, vehicle operators should keep engines running and such lights operating as needed to effectively mark the position of the vehicle. If the vehicle is equipped with a Forward Looking Infrared (FLIR) system, it should be fully operational with an in-cab display.

**6.2.4** ARFF personnel assigned to any standby should monitor all applicable radio frequencies.

**6.2.5** ATC should be made aware of the exact location of the ARFF vehicles assigned to standby duty. Where available, surface navigational aids, such as ground radar (ASDE), should be fully utilized through coordination between ARFF personnel and the control tower.

**6.2.6** ARFF vehicles can be equipped with an infrared vision system to help the crew of the vehicles locate and respond to emergencies in low-visibility conditions.

**6.2.7** Positioning equipment such as the driver's enhanced vision system (DEVS) can be installed on ARFF vehicles so drivers know their position on the airport at all times.

**6.3 Considerations for Airports Adjacent to Water.**

**6.3.1** Where airports are situated adjacent to large bodies of water such as rivers or lakes, or where they are located on coastlines, provisions should be made for the availability of specialized water rescue vessels or helicopters, or both, and equipment should be in place.

**6.3.2** Inclined ramps or docking facilities should be considered by airports located adjacent to large bodies of water to allow rapid response to aircraft accidents. Launch ramps should be located adjacent to the overrun areas of the critical rescue and fire-fighting areas. Where appropriate, ARFF crews should have navigational maps available.

**6.3.3** For rescue purposes, the vessel(s) should be equipped with flotation platforms, rafts and/or personal flotation devices, or a combination of these for the maximum number of occupants carried on the largest aircraft regularly scheduled into the airport.

**6.3.4** Rescue vessels should be capable of rapid response to the accident site.

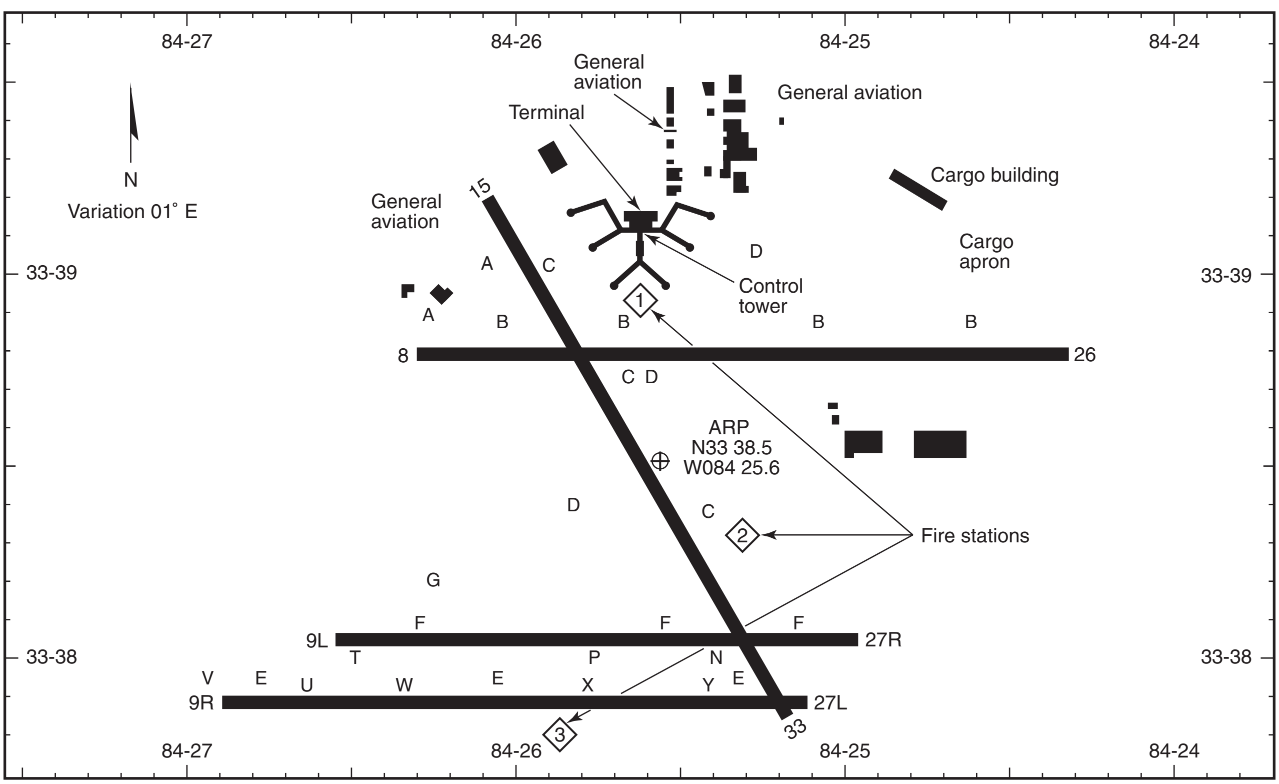



**FIGURE 6.2.3 Example of Airport Fire Station Locations.**

## Chapter 7 Factors Common to Airport Emergencies

### 7.1 General.

**7.1.1** The primary hazard associated with aircraft accidents is that liquid fuels are likely to be released and ignited during the accident sequence. A secondary hazard is that fuels released but not ignited could subsequently be ignited prior to or during the egress of occupants. In addition, fires can occur involving combustible materials such as interior furnishings, stored goods, and aircraft system components. Further complications could result if the aircraft comes to rest in such an attitude that forcible fuselage entry or shoring for stabilization might be required.

**7.1.2** During all aircraft emergencies, all persons not directly involved in the ARFF phase of the incident, including the news media, should be required to stay well clear of the site until evacuation, occupant care, full fire control, and site safety security are completed. Responsibility for site security should be preassigned to the law enforcement agency of primary jurisdiction and could be augmented by other law enforcement agencies, guards, military personnel, and volunteers as needed.

**7.1.3** The various emergencies that can be anticipated include emergencies involving aircraft in flight *(see Section 7.2)*, as well as emergencies that occur on the ground. The emergency declarations associated with pre-flight and post-flight aircraft operations, maintenance, and servicing are generally referred to as aircraft ground emergencies. Information on aircraft ground emergencies can be found in Sections 12.1 through 12.10 of this document.

### 7.2 Types of Alerts.

Δ **7.2.1** The terms used to describe categories of emergency alerts are not standardized. *Local standby alert, full emergency alert,* and *aircraft accident alert* and the International Civil Aviation Organization (ICAO) terms *local standby, full emergency*, and *aircraft accident* are equivalent. Individual airports might have adopted their own nomenclature for the terms *local standby alert, full emergency alert,* or *aircraft accident alert*. This must be coordinated with the appropriate authority.

**7.2.2 Local Standby Alert (Local Standby).** When an aircraft has or is suspected to have an operational defect, the incident should be considered a Local Standby Alert. The defect should not normally cause serious difficulty for the aircraft to achieve a safe landing.

**7.2.2.1** Under Local Standby Alert conditions, at least one ARFF vehicle should be staffed and positioned to permit immediate use in the event of an accident.

**7.2.2.1.1** If time and conditions permit, ARFF personnel should be advised of the following:

(1) Aircraft type
(2) Number of passengers and crew
(3) Amount of fuel remaining
(4) Nature of the emergency
(5) Type, amount, and location of dangerous goods aboard
(6) Number and location of nonambulatory passengers on board, if any

**7.2.2.1.2** All other in-service ARFF vehicles should remain available for immediate response.

•

**7.2.2.2** Whenever operational or environmental conditions exist that have the potential to impede a timely ARFF response, an assessment should be made regarding ARFF personnel and equipment or repositioning of resources or both.

**7.2.2.3** Operational policies should be in effect for aircraft movements not normally encountered by the airport.

**7.2.2.4*** A Local Standby Alert should also be initiated when an aircraft is involved in an operation that could present an additional life hazard risk.

**7.2.3 Full Emergency Alert (Full Emergency).** When an aircraft has or is suspected to have an operational defect that affects normal flight operations to the extent that there is danger of an accident, the incident should be considered to be a Full Emergency Alert, or a Full Emergency.

**7.2.3.1** When a Full Emergency Alert emergency is declared, ARFF personnel should be provided with detailed information that allows preparation for likely contingencies. A full response should be made with the ARFF vehicles staffed and in position with engines running and all emergency lights operating so that the fastest response to the accident/incident site can be accomplished.

**7.2.3.2** It is important that appropriate radio frequencies be continuously monitored by ARFF personnel. One or more major ARFF vehicles should be able to initiate fire suppression within the briefest period of time after the aircraft comes to rest. Standby positions for ARFF vehicles should be established for the type of emergency and aircraft involved.

**7.2.3.3** ARFF personnel should be informed of any changes in a distressed aircraft's emergency situation.

**7.2.4 Aircraft Accident Alert (Aircraft Accident).** This alert denotes that an aircraft accident has occurred on or in the vicinity of the airport.

**7.2.4.1** Regardless of the source of an Aircraft Accident Alert alarm, full ARFF response should be put into effect. When possible, all known pertinent information should be relayed via radio by ATC to responding units and include, as accurately as possible, the accident location using landmarks and grid map coordinates.

Δ **7.2.4.2** When an accurate accident location is not available, ARFF personnel should anticipate the worst situation and stand by until signs of an accident are evident or better information is received. Mutual aid assistance should be initiated in accordance with the airport/community emergency plan. *(See also NFPA 424 and ICAO Airport Services Manual, Part 7.)* During all Aircraft Accident Alerts, ARFF crews should always assume there are survivors.

### 7.3 Vehicle Response to Aircraft Accidents.

**7.3.1** ARFF vehicles should approach any aircraft accident by the route that provides the most expeditious and safest possible response. This might not necessarily be the shortest distance to the scene. Traversing unimproved areas can take longer than traveling a greater distance on paved surfaces such as taxiways, ramps, and roads. Total response time is vital. Preferred routes, especially those within the critical rescue and fire-fighting access area, should be preselected. Practice response runs should be made under both ideal and inclement weather conditions.

**7.3.2** In some cases, runways and taxiways are blocked by aircraft awaiting taxi clearance or takeoff. Vehicle operators should be aware of alternate routes that can be used so as not to delay response.

**7.3.3** The load-bearing characteristics of the airport soil structure under various weather conditions should be known, and vehicle operators should be trained to deal with off-road driving conditions.

**7.3.3.1** When responding in rough terrain conditions, ARFF responders should consider alternate routes.

**7.3.3.2** For those airports that have Engineered Material Arresting Systems (EMAS) installed at runway ends, ARFF personnel should be mindful of the following:

(1) While vehicles may depress the material, the material should not cause the vehicles to become bogged down.
(2) While material is inherently noncombustible, it could absorb fuel.

**7.3.4** When nearing the accident scene, vehicle operators should be alert to avoid all persons in the area, especially those who might be injured, unconscious, or wandering about in a dazed condition. In darkness, periods of low visibility, or when operating in areas of tall vegetation, extra caution and effective use of lighting equipment, audible warnings, FLIR systems, or a combination of these might be needed.

**7.4 Positioning of ARFF Vehicles.**

**7.4.1** Information from the flight deck crew relative to the nature of the emergency will assist the ARFF personnel to better determine the most advantageous positioning of the vehicles upon arrival at the scene of an aircraft emergency.

**7.4.2** Piston-type engine aircraft provide different options for initial positioning of ARFF vehicles than do turbojet aircraft that have swept-back wings and produce a jet blast hazard. ARFF personnel should therefore consider an approach from the nose of jet aircraft. However, this should not become a standard procedure as wind conditions, terrain, type of aircraft, location of engines, cabin configurations, and other factors can dictate the optimum approach in a given circumstance.

**7.4.3** Vehicle position should never obstruct aircraft evacuation or interfere with the deployment of evacuation slides. *(See also Chapter 9.)*

**7.4.4** Propellers turning on turboprop or piston-type engine aircraft present a hazard to evacuees and ARFF personnel.

**7.4.4.1** Turbojet engines present different problems, as the areas directly ahead of and for a considerable distance behind the engines should be avoided because of the intake and jet blast hazards.

**7.4.4.2** Turbojet engines will rotate for a considerable time after they have been shut down, as shown in Figure 7.5.6.

**7.4.5** When combination cargo/passenger (COMBI) aircraft have declared an emergency, ARFF personnel should be informed of cabin configurations prior to the landing. Because some cargo areas extend over the wings, the overwing exits could be unavailable for use as emergency exits.

**7.4.6** The mission of the first-arriving ARFF vehicle and crew is to assist in evacuation of occupants, prevent the outbreak or spread of fire, and perform any rescue operations required. The vehicle should be positioned to protect the principal evacuation route being used by the occupants. Caution must be exercised to avoid placing evacuees, ARFF personnel, or vehicles in locations that could become hazardous in the event of a sudden extension of fire.

**7.5 Hazards to ARFF Personnel.**

**7.5.1** ARFF personnel should always remain alert to the presence of flammable vapors. Elimination of ignition sources and the maintenance of a foam blanket are the best procedures for preventing ignition.

**7.5.2** All ARFF personnel should be provided with and be required to wear proper protective clothing and equipment (PPE). Personnel should be fully trained in the use limitations and value of such protective clothing and equipment by utilizing them in frequent fire-fighting drills.

**7.5.3** Aircraft structures damaged by fire or impact forces are often very unstable and subject to collapse or rollover. If these conditions are suspected to exist, precautions in the form of blocking or shoring should take place as soon as practicable to ensure the safety of ARFF personnel working in the area.

**7.5.4** If dangerous goods are believed to be involved in an emergency, procedures should be carried out as prescribed in the U.S. Department of Transportation *Emergency Response Guidebook*. This also includes incidents involving agricultural spraying aircraft and the associated pesticides.

**7.5.5** An undercarriage fire creates a potential for aircraft collapse or explosive disintegration of affected components from wheel assemblies. Personnel should not cross the possible fragmentation area, which covers a 45-degree angle from the side of the wheel assemblies to a distance of at least 90 m (289 ft), as shown in Figure 7.5.5.

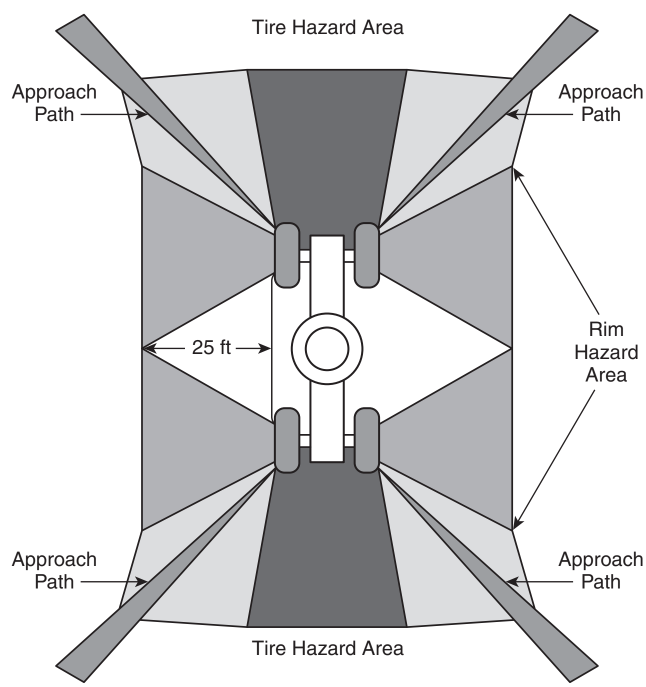



**FIGURE 7.5.5 Wheel Fragmentation Area.**

**7.5.6** ARFF personnel should stay well clear of an operating jet engine to avoid intake and exhaust hazards. The danger zones at idle power are shown in Figure 7.5.6. Before ARFF personnel approach an aircraft, the incident commander should request that the captain shut down appropriate engine(s) to ensure that there is a safe area of work.

**7.5.7** The propellers of piston-type engine aircraft should never be moved when at rest as any movement could, under certain conditions, restart the engine. ARFF crews should be aware of the various prop arcs of aircraft and make it standard operating procedure to never pass under or through a prop arc.

**7.5.8** Some modern jet aircraft are equipped with Ram Air Turbines (RAT) or Air Driven Generators (ADG), as shown in Figure 7.5.8, designed to provide back-up electrical and hydraulic power in the event of in-flight failures of primary systems. These devices are often designed to deploy from flush fuselage or engine-mounted storages, and some can deploy with considerable force. ARFF personnel should be aware of aircraft employing these systems and their locations. Serious injury could result should the RAT accidentally deploy and strike a person during emergency operations.

**7.5.9** On some aircraft if the ground spoilers are deployed and an overwing exit is opened, the ground spoilers will rapidly retract down. This is done so that exiting passengers will not be hampered in evacuation. The slide also deploys from the side of the fuselage.

**7.5.10** When approaching a helicopter while the pilot is conscious, approach in full view and follow the pilot's instruction (pilot normally sits in the right-hand seat); avoid blind areas where the pilot cannot be seen. Figure 7.5.10(a) shows the danger areas around a helicopter. Under crash conditions where the pilot is incapacitated and the rotors are still operating, it may be advisable to approach in a crouching position from the side opposite the tail stabilizing rotor at a position slightly to the rear of the main rotor head, remaining as close to the fuselage as possible, because the main rotors are designed to rise clear above the tail [remember that main rotors tend to lower at the front of the helicopter, as shown in Figure 7.5.10(b)].

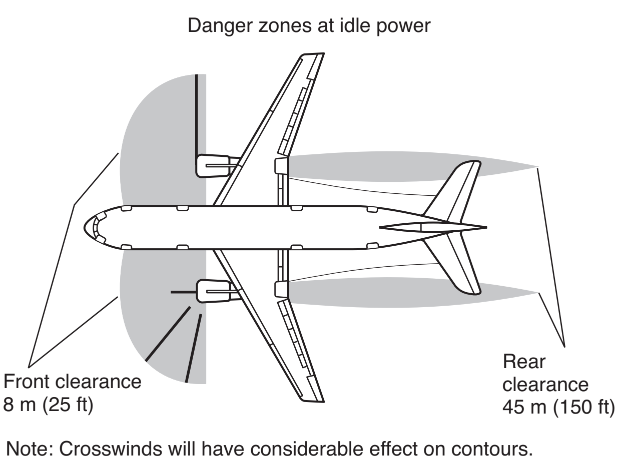



**FIGURE 7.5.6 Engine Run Danger Areas.**

**FIGURE 7.5.8 Ram Air Turbine.**

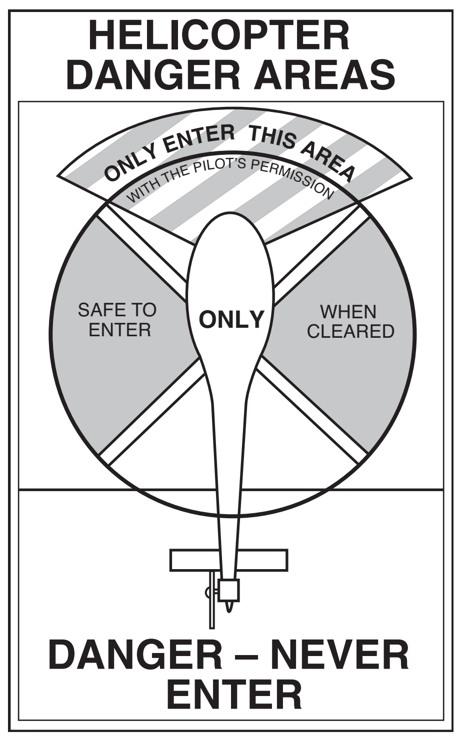



**FIGURE 7.5.10(a) Helicopter Danger Areas.**

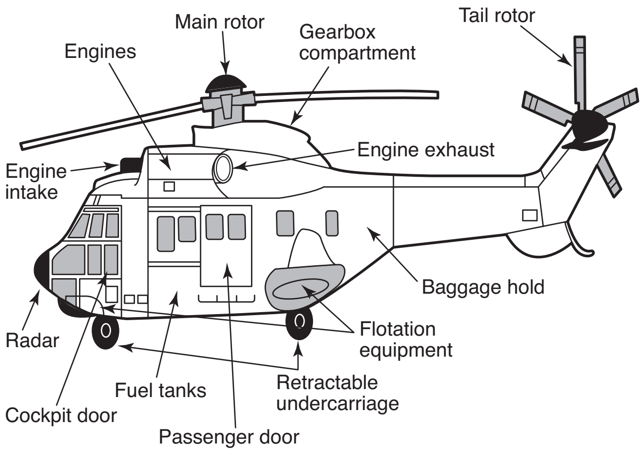



**FIGURE 7.5.10(b) Helicopter Showing Main Rotor Lower in Front.**

**7.5.11** The use of composite materials in aircraft construction necessitates the use of appropriate PPE and respiratory protection. The problem areas are as follows:

(1) Emission of toxic gases from the decomposition of resins and bonding agents.
(2) Airborne sharp particles of composite materials that can be ingested into the respiratory system and cause skin injuries and traumatic dermatitis.
(3) In post-fire conditions composite materials are capable of absorbing all of the products of a post-crash fire, potentially acting as a carrier if fibers enter the body by skin injection or inhalation.
(4) Composite materials exhibit different characteristics for fire fighting and extrication.

Δ **7.5.11.1** A size-up (risk assessment) of whether or not composite materials are involved with the accident/incident should be undertaken, and the appropriate level of personnel protection for site management should be established. Factors to be considered should include the following:

(1) Whether composite materials, carbon, aramid, boron, fiberglass, or other synthetics are involved
(2) The scale of involvement
(3) Whether the composite material components in the internal airframe structure (e.g., flooring, seating) (internal containment if fuselage is intact) or external airframe structure (e.g., skin panel control surfaces, rotor blades) are free to atmosphere
(4) The prevailing wind and weather conditions
(5) Whether there is a fire or immediate risk of fire

*N* **7.5.11.2** ARFF vehicles should be positioned on the upwind side whenever possible.

**7.5.11.3** In post-fire conditions when composite materials such as carbon, aramid, boron, fiberglass, and other synthetics are involved, the fibers may initially be suppressed within the accident site by the application of aspirated foam or fine water spray, or by covering the immediate wreckage with salvage sheets, which will assist in the control of airborne fibers materials. When resources are available, the above can be achieved by the application of water-based suppressants or mixtures similar to a domestic-based floor wax.

**7.5.11.4** Control of access and egress from the scene is essential for successful decontamination. ARFF personnel should undergo formal decontamination based on likely hazards and levels of exposure.

**7.5.11.5 Ballistic Parachute Recovery System.**

**7.5.11.5.1** An increasing number of certified general aviation, amateur built, light sport, and ultralight aircraft are now being fitted with a ballistic parachute recovery system (BPRS). In the event of an aircraft structural failure or loss of flight control, the pilot can activate the BPRS. The BPRS is designed to recover control and lower the aircraft and occupants to the ground at a survivable rate. A typical BPRS consists of a parachute, attachment cables, and a propellant system for deployment.

**7.5.11.5.2** The components of the propellant system will contain detonators, small explosive charges, and solid-fuel rocket motors, which cannot be rendered safe by emergency response personnel.

**7.5.11.5.3** Inadvertent operation of a BPRS may result in serious injury or death. When approaching a general aviation accident, an early assessment should be made to determine if a BPRS is installed. A robust emergency plan should be developed for dealing with a BPRS that safeguards emergency responding personnel and the aircraft occupants against inadvertent operation during extrication activities and wreckage movement. Further information can be found on the FAA web site (www.faa.gov) under ARFF and first responder training. Also see Certification Alert 13-04 under ARFF related CertAlerts on the FAA web site.

*N* **7.5.11.6 Lithium-Ion Main Battery Events.**

*N* **7.5.11.6.1** Some airplanes, both commercial and military, are being equipped with lithium-ion batteries. These batteries store energy that can generate intense heat in the event of a short circuit or other failures. Lithium-ion batteries can short circuit if they are improperly packaged, dropped, damaged, or have manufacturing defects.

*N* **7.5.11.6.2** Each lithium-ion cell contains a flammable electrolyte. If the cell has a short circuit or is exposed to high temperatures, it can swell and the electrolyte may begin to vaporize, creating internal pressure resulting in a thermal runaway.

*N* **7.5.11.6.3** For example, on the Boeing 787 the lithium-ion batteries are secured inside a reinforced stainless steel enclosure that is capable of containing a lithium-ion battery event. Venting of vapor during a battery failure event may be visible from an exterior vent on the bottom of the airplane under the forward or aft electrical and electronic (E&E) bay. During active venting, there is no reason to make access to the E&E bay.

## Chapter 8 Aircraft Construction and Materials

### 8.1 Aircraft Construction.

**8.1.1** It is fundamental that ARFF personnel have a working knowledge of named parts and construction of an aircraft to ensure commonality in terms used and recognition of potential difficulties and hazards when gaining access or extricating casualties. Aircraft are manufactured in many sizes. However, the terms used in respect to identification of structural features are common to most sizes of aircraft. These are identified in Figure 8.1.1.

**8.1.2** The structure of the fuselage consists of the following components, as shown in Figure 8.1.2:

(1) The tapering shape of the fuselage is formed by a series of vertical frames (formers) placed transversely from nose to tail.
(2) Metal struts (stringers) run horizontally along the length of the fuselage, positioned around the circumference of the formers.
(3) The cabin floor is supported by horizontal weight-bearing struts (longerons).
(4) The rigidity of the airframe is achieved by an aircraft skin (stressed aircraft skin), which is riveted or bonded to the formers and stringers.

**8.1.3** The structure of the wings (main plane), as shown in Figure 8.1.3, consists of tapering spars (main and secondary spars), which can run either from the center section of the fuselage or from wing tip to wing tip. The number of spars depends on the wing design. Struts (ribs) are placed at right angles to the spars to form a profile of the wing design. Struts (stringers) run across the ribs, on which a stressed aircraft skin is riveted or bonded.

**8.1.4** The undercarriage normally consists of a nose wheel and two groups of wheels (or more) situated behind the center of

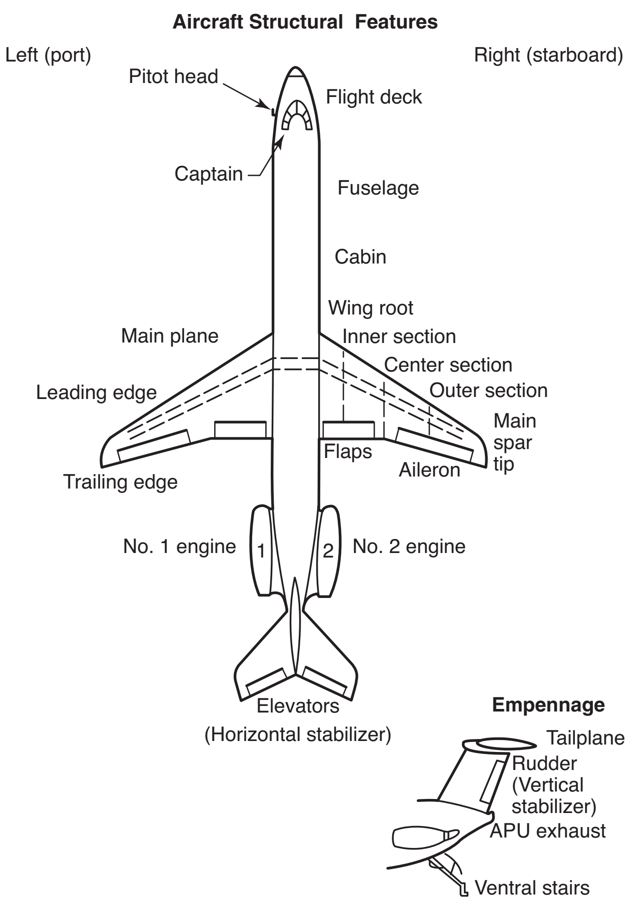
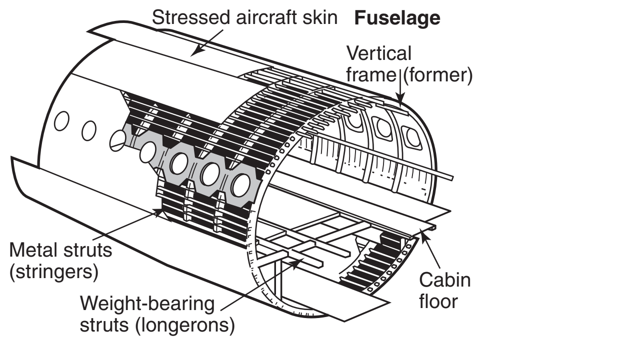
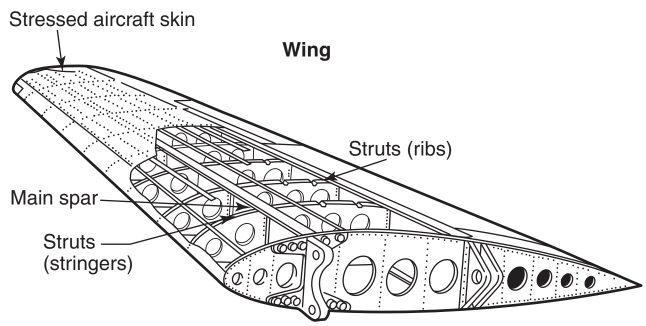



**FIGURE 8.1.1 Nomenclature for Aircraft Structural Features.**




**Δ FIGURE 8.1.2 Fuselage Components.**




**Δ FIGURE 8.1.3 Wing Components.**

gravity beneath the aircraft. The landing gear incorporates a mechanism to raise and lower the undercarriage. A shock-absorbing unit (oleo leg), wheels, and braking units are attached to the base of the oleo leg and supporting hydraulic pipe work. It is normal practice for wheels to incorporate a fusible plug that deflates the tire when excessive tire pressures develop. Hazards associated with the undercarriage are burst tires, hot brakes, ruptured hydraulic piping, and seals contained in the oleo leg rupturing and causing the oleo to drop. Braking units are not normally situated on the nose wheel.

**8.1.5** The construction of the airframe of a helicopter is similar to the fuselage of a fixed-wing aircraft. However, a helicopter is not stressed to carry a main plane. The cabin is not pressurized for high altitude. Undercarriage assemblies are comparatively small and in some cases not retractable, which means that structural components are smaller and lighter.

**8.2 Aircraft Materials.**

**8.2.1** ARFF personnel should be familiar with aircraft construction materials. Most of these materials have a low resistance to flame exposure, and their behavior under fire conditions should be understood. They have high resistance to cutting or other forcible entry methods, which can make access difficult and time consuming and can virtually impede successful rescue and fire-fighting operations.

**8.2.2** Much of a modern aircraft structure is aluminum alloy. It is approximately 50 percent lighter than steel, and its normal appearance is light gray or a silvery surface when polished. It is used as sheets for aircraft skin surfaces, as channels for framework, and as plates and castings for bulkheads and fittings. This metal will not contribute to a fire to any significant degree.

However, it will melt under the high-temperature conditions found in aircraft fires. As a rule, aluminum will buckle and distort at 400°C (778°F) and decompose, depending on thickness, at 600°C (1138°F).

**8.2.3** On some aircraft, magnesium alloys are used for wheels, engine mounts, brackets, crankcase sections, cover plates, and other engine parts. The appearance of this metal is silvery-white or grayish, and it is about two-thirds the weight of aluminum. It is not easily ignited; however, when it is, it burns at 900°C (1678°F) to 1000°C (1858°F) violently and cannot be easily extinguished. It thus presents a serious reignition source. Sparks developed when the metal comes in contact with paved surfaces, as might occur in a wheels-up landing, have the capability of igniting flammable vapors.

**8.2.3.1** Where special extinguishing agents are not available for magnesium fires, water in coarse, heavy streams might provide a suitable alternative fire control method.

**8.2.3.2** At first, such streams will result in localized intensification of flame and considerable sparking and showering of burning magnesium. Isolated burning pieces of magnesium should be removed from flammable vapor areas.

**8.2.4** Steel in various forms, including stainless steel, is used in aircraft engine parts, around engine nacelles, engine fire walls, flap gear, and tubing. This metal presents no fire hazard, nor does it contribute to a fire except that it can create friction sparks when in contact with hard surfaces during a wheels-up landing. The sparks have sufficient energy to ignite flammable vapors. In most forms used in aircraft, steel can be cut with metal cutting saws, but because of the sparks produced, this is a potentially hazardous operation in the presence of flammable vapors.

**8.2.5** Titanium is used primarily in engine parts, nacelles, and for engine fire walls. It is a combustible metal, but in the forms used in aircraft, it has a high degree of heat and fire resistance. Although not easily ignited, it will burn between 1300°C (2372°F) and 1450°C (2642°F). Once ignited, titanium is difficult to extinguish. Water is ineffective. Turbine engine fires involving titanium cannot normally be extinguished by external fire-fighting techniques within the time period necessary to complete rescue operations. Titanium metals have a friction spark hazard similar to steel and magnesium. Surfaces of titanium are very difficult to penetrate, even with power equipment.

**8.2.6** To improve the payload/vehicle-weight ratio of aircraft without compromising structural strength, increasing use is being made of composite materials. They are made of small, fine fibers embedded in carbon/epoxy materials. The fibers are usually boron, fiberglass, aramid, or carbon in the form of graphite. Composite fiber plus plastic materials have replaced metal in many aircraft components, such as engine nacelles, flaps, floor panels, struts, undercarriage doors, wing structure, tail plane, and horizontal and vertical stabilizers. Temperature-resistant composites can also be found in engine, tire, and brake components. These materials do not present any unusual fire extinguishment problems. However, when cutting composite materials fire fighters should have full body protection, including positive-pressure SCBA or a suitable full-face respirator, to prevent injections from fibers into the skin or ingestion into the respiratory system.

**8.2.6.1** The composite materials are bonded together in layers, forming a matrix. The types of matrices in use include diglycidyl ether of bisphenol A, and polyurethane and urea or phenol/formaldehyde. If composite materials are directly involved in a fire with a temperature of 400°C to 500°C (778°F to 958°F), the resins and bonding agents used decompose, emitting highly toxic fumes in the immediate area. Burn-through of these materials has demonstrated a greater fire resistance than conventional duraluminum aircraft construction.

**8.2.6.2** The hazards associated with an aircraft incident/accident that does not involve a fire are limited to composite material being liberated through abrasion and breakage. With a combination of fire and impact, the risk is higher. Subsequent handling and disturbance of damaged components made from composite materials will liberate additional fibers into the atmosphere.

**8.2.7** Many aircraft cabin materials in current and continuing use, as well as newer fire-resistive materials, can produce high concentrations of toxic gases when heated even though no open flaming is visible. Some examples of toxic gases given off by cabin materials are hydrogen cyanide (HCN), ammonia ($NH_3$), benzene, and sulfur dioxide ($SO_2$). (It is imperative that positive-pressure SCBA be worn by all fire fighters engaged in rescue, fire-fighting, and overhauling operations.)

**8.2.8** Modern aircraft use a new material in its fuselage construction called GLARE, which stands for glass-reinforced fiber metal laminate. It is more fire resistive than common aircraft duraluminum construction. Burn-through of this material has demonstrated a greater fire resistance than conventional duraluminum aircraft construction.

**8.3 Aircraft Fuel Tanks.**

**8.3.1** In some aircraft, where the wing joins the fuselage there is no substantial separation to provide a desired fire wall. As all aircraft have wing tanks, many without separate metal or synthetic bladders within the wing cavity, vapors are seriously exposed under fire conditions. Fuel is carried in storage tanks that are structurally separate but interconnected, incorporating vent systems to ensure equalization of pressure and prevent collapse of the tank. Aircraft with a high rate of climb have fuel tanks that are pressurized to prevent the fuel from boiling off or with vapor locks.

Δ **8.3.1.1** Types of fuel tanks in use are as follows:

(1) *Rigid Tanks.* These are usually made of aluminum or Duralumin with internal baffles to brace the tank and reduce surging of fuel. These tanks are normally covered in fabric, fitted with cradles, and held by metal straps.
(2) *Integral Tanks.* These are shaped by compartments formed by the airframe structure, and are made fueltight. The advantage to this type of tank is that it does not add weight to the structure.
(3) *Flexible/Semi-flexible Tanks.* These are bags made from plastic or other man-made material that are held in place by rubber-buttoned area press studs. The advantage to this type of tank is that it is not ruptured by shock; however, they are susceptible to rupture by piercing.
(4) *Auxiliary Tanks.* These are normally constructed of metal or fiberglass and found in the form of pods, which can be fitted under wing, wing tips, or within the fuselage. The fuel in auxiliary tanks is usually used in flight first, and in

some circumstances, these tanks may be jettisoned in an emergency.

**8.3.2** Some aircraft carry fuel in the center wing section, which in effect places fuel storage within the fuselage. It is thus possible, under some conditions, for fuel or vapors from tanks damaged due to an aircraft accident to enter the fuselage.

Δ **8.3.3** Wide-body aircraft have provisions for additional fuel storage within both the horizontal and vertical stabilizers. Damage to these tanks in the event of an aircraft accident poses a number of problems, including those where fuel or vapors might enter occupied sections of the aircraft and become ignited. These additional fuel storage locations can complicate the fire-fighting operations and will require additional agent. *(See also NFPA 403.)*

**8.3.4** Wing tanks on some aircraft are located directly above or to the side of landing gear mounts. These tanks have been ruptured during hard landings or other ground accidents.

**8.3.5*** Aviation fuels that are in use for civil and military aircraft include the following (Table 8.3.5 provides a summary of aviation fuel designations and their significant fire hazard characteristics):

(1) Fuels for piston-driven aircraft are aviation gasoline (AVGAS) or motor gasoline (MOGAS).
(2) Fuels in use in turbine engines are Jet A and Jet A1 (AVTUR) kerosene, Jet B (AVTAG) 60 percent gasoline 40 percent kerosene, and JP-5 (AVCAT) for naval carrier–borne aircraft.

**8.4 Aircraft Exits and Doors.**

**8.4.1** Aircraft exits on transport category aircraft include doors, hatches, and windows of various sizes. These exits will vary with the age, size, and type of the aircraft. ARFF personnel should be familiar with the operation of the various exit types on all makes of aircraft normally using the airport.

**8.4.2** Doors on most older, unpressurized aircraft open outward and can be opened from both outside and inside the aircraft.

**8.4.3** The doors on the majority of U.S.-built modern pressurized aircraft are called “plug-type” doors. When these doors open, they push in slightly and then pull out or retract upward into the ceiling. These doors are not operable as long as the cabin remains pressurized [as little as 103 Pa (0.015 psi)].

**8.4.4** Aircraft having a door sill higher than 1.5 m (5 ft), with landing gear deployed, are normally equipped with inflatable evacuation slides mounted at the emergency exits. When the system is armed and the emergency exit is opened, the slide can inflate and extend outward in less than 5 seconds with considerable force. ARFF personnel, therefore, should consult aircraft manufacturer crash charts to be knowledgeable of the areas where those inflatable slides deploy.

**8.4.5** If the cabin crew fails to open the aircraft doors, ARFF personnel can gain access by using the emergency door release mechanism situated on or adjacent to the external face of the door. ARFF personnel must be aware of the different external door operations in use. On some aircraft, doors are designed so that on operating the external door opening mechanism, the girt bar will be released automatically, preventing the evacuation slide from deploying. On aircraft where girt bars are manually housed by the cabin crew, if the girt bar is not removed, evacuation slides will deploy when the door is opened externally. However, doors should be approached and opened with caution, ensuring that the girt bar is disengaged, as the slide may deploy either by design or malfunction. ARFF personnel must be aware of emergency exits where, on operating the internal or external opening mechanism, the door will eject outward with an explosive force to deploy an inflatable slide. An example of an aircraft with this design is the B757.

**8.4.6** When positioning ladders, elevated platforms, aircraft interior access vehicles (AIAV), or mobile stairways prior to opening cabin doors from the outside, care should be taken as all aircraft doors do not open in the same direction or by the same mode of operation.

**8.4.7** Opening the doors of most modern-type aircraft from the exterior can be accomplished more readily and safely using an aerial platform, a mobile stairway, or an AIAV. If these units are not available, a ground ladder can be raised to a position adjacent to the door control mechanism and, if possible, on the side away from the direction the door is to be opened. Once the door is opened the ladder can then be moved into the door opening and secured at the top to prevent movement.

**8.4.8** Overwing exits are part of the emergency evacuation system on several types of aircraft. They might also be useful as

Δ **Table 8.3.5 Aviation Fuel Designations and Characteristics**

| Fuel Type | Civil Aviation Designation | UK Designation | Military Designation | Minimum Flash Point | Auto-Ignition Temp | Explosive Range (Volume %) |
|---|---|---|---|---|---|---|
| Kerosene | Jet A<br>Jet A1 | AVTUR | JP-8 | 37.8°C<br>(100°F) | 246.1°C<br>(475°F) | 0.7–5.3 |
| Kerosene (high flash) | JP-5 | AVCAT | JP-5 | 60°C<br>(140°F) | 246.1°C<br>(475°F) | 0.7–5.3 |
| Kerosene and gasoline mixture | Jet B | AVTAG | JP-4 | –23.3°C<br>(–10°F) | 248.9°C<br>(480°F) | 1.2–7.6 |
| Aviation gasoline | AVGAS | AVGAS | AVGAS | –45.6°C<br>(–50°F) | 448.9°C<br>(840°F) | 1.4–7.6 |
| Motor gasoline | MOGAS | MOGAS | MOGAS | –45.6°C<br>(–50°F) | 448.9°C<br>(840°F) | 1.4–7.6 |

Note: Bio fuels are currently being developed for use in commercial aviation and are generally blended with other fuels. Limited information was available during time of publication.

entry points for rescue teams and for facilitating ventilation of the cabin. Some overwing exits are equipped with slides that are similar to door exit slides when deployed. Some aircraft overwing hatches are spring loaded. Caution should be used when opening these exits to prevent injury.

**8.4.9** Some aircraft have doors that incorporate stairs on the side of the fuselage or in the tail section to facilitate passenger boarding and deplaning. Although in some circumstances these stairs might be used as such, they are not considered emergency exits. ARFF personnel should know which aircraft using the airport have these types of doors and should exercise proper caution when the need arises to open them.

**8.4.10** Fires can occur within a cargo hold either from onboard electrically operated equipment or from the cargo carried. Doors to cargo holds have external operating devices that are manually or electrically operated. Upon failure of electrical power, doors normally have a secondary means of operation. ARFF personnel should be trained in opening the cargo doors on aircraft using their airport. This should be incorporated into recurrent training programs *(see NFPA 405)*.

*N* **8.4.11 Reinforced Flight Deck Doors.** Commercial aircraft flight deck doors are secured, and in the event that the aircraft is unoccupied or occupants are incapacitated, forcible entry will be required for access in the event emergency.

## Chapter 9 Evacuation and Rescue

*N* **9.1 Risk Assessment.** It is imperative that before commencing rescue operations, a scene survey and risk assessment are carried out. They should consider at least the following:

(1) Stability of the aircraft and/or its wreckage
(2) Training and competence of crews
(3) Availability and suitability of equipment
(4) Hazards arising from the accident site
(5) Prevailing weather conditions
(6) Hazards that may emerge during rescue operations

**9.2 Aircraft Evacuation.**

**9.2.1** Evacuation of occupants involved in aircraft accidents and assistance to those who cannot remove themselves should proceed with the greatest possible speed. While care is necessary in the movement of injured occupants so that their injuries are not aggravated, removal from the fire-threatened area is the primary objective.

**9.2.2** Flight deck crews receive extensive training in aircraft emergency evacuation procedures. They are in the best position to make optimum decisions relative to evacuation procedures in most emergency situations. They also have immediate contact with those aboard the aircraft and therefore can direct the operations.

**9.2.3** Prior to any planned emergency landing, flight deck crews normally will consider passenger relocation within the cabin. This procedure is used to expedite use of potential emergency exits. The practice of placing a crew member or a person knowledgeable in evacuation procedures at each exit to assist flight attendants in the direction and movement of occupants is common practice where time and circumstances permit. Under certain circumstances, flight attendants might have the necessary time prior to impact to more fully instruct passengers on how to survive impact and evacuate the aircraft. Training and checklists provide, among other things, for selection of able-bodied helper passengers to receive instructions pertaining to operation of exits and slides. These persons would then be more capable of assisting the flight attendants. Additionally, ARFF personnel should realize that the first passengers to leave the plane might have received instructions to remain at the bottom of a slide, wing, airstair, and so forth. ARFF personnel should direct survivors away from the aircraft and prevent survivors from obstructing the evacuation path.

**9.2.4** The tendency toward forward exiting is natural; most passengers boarded the aircraft at terminals through forward doors and so will instinctively attempt to exit in the same manner. Other exit facilities are apt to be bypassed, especially if passengers are under mental strain or feel panic. Overwing and other emergency exits requiring physical agility probably will be passed up by those doubting their ability to use them effectively. Access to overwing and some other emergency exits is usually restricted by seating arrangements. Overwing exits are often smaller than door exits, and have caused passengers to become entangled just inside the exit. If visibility in the cabin is impaired due to darkness or dense smoke, orderly evacuation can be further complicated.

**9.2.5** Limited evacuation options might be available to the flight deck crew due to circumstances aboard the aircraft. One or more emergency exits could be inoperable as the result of distortion caused by impact. Doors might be blocked by loose galley equipment. Aisles might be difficult to travel due to injured passengers, collapse of overhead panels and partitions, dislodged seats, and carry-on items. Although normal evacuation procedures provide for the use of all available exits, flight deck crews are trained to remain flexible and are prepared to select the best means of exit as circumstances and conditions permit.

**9.2.6** Many variations of aircraft accidents are possible, and the flight deck crew can be faced with many decisions in the seconds before or after they occur. ARFF personnel, therefore, cannot expect that standard procedures will be used in all instances and should remain flexible to provide whatever protection and support evacuees require. In the event that the flight deck crew becomes incapacitated and evacuation does not begin immediately, ARFF personnel should initiate evacuation procedures.

**9.2.7** If fire conditions or fuel spills initially prohibit the use of certain emergency exits, ARFF personnel are usually in a better position to make this observation. The ARFF incident commander should not hesitate to communicate this information to the flight deck crew.

**9.3 Evacuation Slides.**

**9.3.1** Evacuation slides are provided to expedite occupant egress from aircraft that have normal door sill heights above 1.5 m (5 ft). Because passengers are not trained in proper evacuation slide use, as shown in Figure 9.3.1, there is a degree of personal injury risk (approximately 6 percent) when slides are used. ARFF personnel should expect the occurrence of sprains, bruises, friction burns, and other minor injuries whenever evacuation slides are used.

Δ **9.3.2** If the nose gear fails during landing, the aircraft might come to rest in a tail-high attitude. The failure of one or more landing gears can result in a nose-high or listing attitude. In these instances, evacuation slides become somewhat ineffective


**FIGURE 9.3.1 Deployed Evacuation Slide.**

because they do not deploy at the proper angle to the ground. A high percentage of injuries can be expected when evacuation slides are used under these circumstances. ARFF personnel should be able to reduce the amount and severity of injuries and expedite evacuation by manipulating the slides and assisting evacuees.

**9.3.3** Aircraft evacuation slides are coated with gray aluminized paint to protect them from nearby fires for up to 90 seconds; however, they remain susceptible to heat and fire exposure. They are combustible, and when exposed to radiant heat they may melt, and deflate, rendering them unusable. ARFF personnel should protect evacuation slides from heat and flame to the best of their abilities but should be extremely careful not to apply foam to the operational area of the slide. Foam on the slide makes it very slippery and increases the descent speed of evacuees, potentially causing severe injuries.

**9.3.4** If time and conditions permit, aircraft interior access vehicles (AIAVs) should be used as an alternative to deploying evacuation slides. This method of evacuation, when there is no immediate danger to aircraft occupants, would prevent many injuries. Response of available nonemergency AIAVs should be prearranged between ARFF personnel and one or more of the following:

(1) Airlines
(2) Airport maintenance facilities
(3) Airport operations

*N* **9.3.4.1** AIAVs are now being used at large airports, particularly where multideck aircraft operate.

**9.4 Evacuation Assistance by ARFF Personnel.**

**9.4.1** The need to assist in aircraft occupant evacuation depends on a variety of factors. When occupants are self-evacuating, ARFF personnel should support the operation and expedite it where possible. In other instances, actions would depend on the degree of occupant survivability, the fire situation, the condition of exits, and the status of evacuation facilities. In any event, rescue efforts should begin with fire prevention/control and should maintain a safe path from egress points. Evacuees should be directed to an upwind location.

**9.4.2** Fire prevention/control during evacuation should require strategic positioning of ARFF vehicles and applying foam from turrets to establish a blanket covering the practical critical fire area (PCA). During this operation, emphasis should be placed on maintaining safe egress paths and eliminating the threat of fire extension into the fuselage. Foam handlines, which are more maneuverable than turret streams, should then be employed to protect evacuees and ARFF personnel, extinguish spot fires, and maintain the integrity of the foam blanket. *(See also Chapter 7.)*

**9.4.3** If time and conditions permit, ARFF personnel should assist in the off-loading of evacuees at the base of the evacuation slides to minimize injuries. When high winds or unusual aircraft attitudes cause slides to invert or deploy in a faulty position, an attempt should be made to align them manually.

**9.4.3.1** For those airports that have EMAS installed at runway ends, ARFF crews should be aware that passengers with heeled shoes can penetrate the initial layer of EMAS, which can cause difficulty in walking.

**9.4.3.2** Unnecessary damage to EMAS material should be avoided.

**9.4.4** Ground ladders might be needed to assist occupants who have exited onto wing surfaces and those attempting to exit from openings where evacuation slides are unusable. It is important that assistance be given to evacuees using ladders to ensure that they safely complete their exit and that any one ladder does not become overloaded.

**9.5 Aircraft Forcible Entry.**

**9.5.1** Aircraft involved in accidents can come to rest in almost any attitude. Any abnormal landing force can jam emergency exits. The fuselage might be broken open by the impact forces, and doors, windows, and hatches dislodged. It is difficult to anticipate the various possible accident conditions, and each incident presents unique problems that must be dealt with. ARFF personnel should be thoroughly trained in forcible entry procedures and be provided with a wide variety of tools and equipment necessary to accomplish successful entry and extrication of trapped aircraft occupants. Aircraft rescue and fire-fighting personnel training programs should include a discussion of methods to be used for a situation that involves an aircraft in an inverted position. Such training should include crash charts that depict, in plain view, the entire underside of the various aircraft using the airport.

**9.5.2** In some instances, entry into an aircraft fuselage can only be gained by cutting through the aircraft skin. Knowledge of the aircraft is required to avoid contact with wires, cables, tubing, and heavy structural members. An area of the aircraft normally clear of these features is located in the upper fuselage area above the windows, and any necessary cutting should be attempted in this area. Caution should be exercised to ensure that cutting operations do not endanger trapped occupants.

Δ **9.5.3** Turbine-powered aircraft have heavier aircraft skins and structures than the older piston aircraft. Due to this heavy construction, the only practical method of entry, other than using normal or emergency exits, is through the use of portable power tools. Power saws can be used to cut through aircraft skin and structural materials. CAUTION SHOULD BE EXERCISED WHEN USING SPARK-PRODUCING POWER TOOLS WHERE FLAMMABLE VAPORS EXIST. Claw and pry tools can be used for forcing doors and hatches that are jammed, to pull down panels and partitions, to dislodge aircraft seats, and so forth. The air chisel can be used to cut aluminum and other light metals found on aircraft. Hydraulic rescue tools are used to assist with forcible entry during aircraft accident operations . These tools take the form of electric-, pneumatic-, hydraulic-, or gasoline-powered cutting, spreading, or shifting equipment. At best, this type of entry into a modern jet aircraft fuselage is very difficult and time consuming. Areas safe to cut or pry into should be depicted on aircraft emergency diagrams.

**9.5.4** Military combat aircraft present additional hazards due to armament, jettison equipment, and ejection seats.

**9.5.4.1** This type of aircraft should always be assumed to be armed.

**9.5.4.2** Caution should be exercised around this type of aircraft, especially forward and aft, because it can carry ordnance.

**9.5.4.3** Unlaunched rockets, when exposed to fire, are dangerous from both the front and rear.

**9.5.4.4** As with any ammunition, personnel should keep the rockets cool with foam or water.

**9.5.4.5** ARFF personnel should remain at a safe distance, as determined by the AHJ, from the aircraft during the ammunition cooling operation.

**9.5.4.6** Further unclassified information should be obtained from the commanding officer of the nearest military installation.

**9.6 Extrication and Rescue.**

**9.6.1** Immediately following the self-evacuation phase of an aircraft accident, a search of the fuselage interior and physical rescue of surviving occupants is crucial. Search and rescue teams should wear full protective clothing and positive-pressure SCBA. They should also be equipped with charged hose lines for their protection and the extinguishment of any fire that might have entered the fuselage. A THOROUGH SEARCH OF THE FUSELAGE INTERIOR AT THIS TIME IS EXTREMELY IMPORTANT. PERSONS, PARTICULARLY INFANTS, CAN BE EASILY OVERLOOKED OR HIDDEN BY DEBRIS.

**9.6.2** Rescue operations should be carried out using normal aircraft openings wherever possible. Occasionally, openings caused by airframe separations can be utilized when it is more convenient and safe to do so.

**9.6.3** ARFF personnel should have a general knowledge of the occupant capacity of the various types of aircraft that use the airport. Initial rescue plans should be based on the assumption that occupant load is at maximum.

**9.6.4** The location of occupants in military aircraft can generally be determined by the aircraft type and sometimes by exterior design features such as canopies, gun positions, and so forth.

**9.6.5** Even in survivable aircraft accidents, disruption of the fuselage can be severe, necessitating the improvisation of rescue efforts. ARFF personnel should be skilled in the use of appropriate extrication tools and equipment and possess the basic knowledge and skills to properly stabilize an injured occupant prior to removal from the wreckage.

**9.6.6** ARFF personnel rescue and extrication knowledge should include accepted post–aircraft accident procedures, particularly those matters dealing with fatalities and preservation of evidence as described in Chapter 13. If it is necessary to move portions of a damaged aircraft, either in rescue operations or fire control, caution should be taken to avoid changes in the aircraft's stability. Undue strain on the airframe can release fuel from damaged tanks, cause collapse or rollover of the fuselage, or cause greater injuries to trapped occupants.

**9.6.7** Aircraft accidents can occur during temperature extremes. These conditions can seriously aggravate the condition of persons trapped within an aircraft wreckage for an extended period. During this time it is extremely important to maintain the critical body temperature and vital functions of trapped victims. Tarps, blankets, portable lights, fans, oxygen units, and portable temperature control units (heating and cooling) should be immediately available at an accident site. Portable heating and cooling units should be designed or located so as not to be an ignition hazard.

## Chapter 10 Fire Control and Extinguishment

**10.1 General.**

**10.1.1** The risk of fire at an aircraft accident is due to the close proximity of the systems that contain and distribute the fuel and ignition sources such as heated components in engines and undercarriages, damaged electrical circuits, and friction caused by ground slide.

**10.1.2** Any post-accident fire can seriously affect the ability of the aircraft occupants to evacuate safely and will reduce the time available to mount a successful fire-fighting operation prior to rescue.

**10.1.3** Upon impact, or after impact, a post-accident fire can develop to severe intensity very quickly and can enter the fuselage through opened exits and openings created by the impact.

Δ **10.1.4** Aircraft designers are continually studying design factors and construction material changes that will increase "crashworthiness" and limit the development of fire situations that can impede evacuation. Additional modifications intended to increase the impact survivability of occupants are being developed, such as passenger restraints, reduced combustibility of cabin interiors, better marking of exit routes, upgraded emergency exits, and greater emphasis on the training of flight deck crews. Prompt and effective intervention by trained ARFF personnel becomes even more important because a greater number of aircraft accident survivors needing assistance can be expected. ARFF personnel should become familiar with all aircraft types using the airport and should preincident plan the optimum rescue and fire-fighting effort that the fire department can produce with the resources at its disposal. Careful consideration of the recommendations in this guide can facilitate the development of practical operational plans.

**10.2 Extinguishing Agents for Aircraft Fires.**

**10.2.1** Foam approved by the AHJ is the primary extinguishing agent preferred for aircraft rescue and fire fighting.

*N* **10.2.2** It is important that complementary and principal agents are carefully selected to ensure they do not adversely affect each other's fire-fighting or vapor suppression capabilities.

**10.2.3** Complementary extinguishing agents consist of approved dry chemicals, halogenated agents, and carbon dioxide agents. These are generally best for use on three-dimensional flammable liquid fires or on fires in concealed spaces, such as those occurring behind wall panels, engine nacelles, or wheel wells.

**10.2.4** Experience has shown that dry chemicals tend to be more effective than halogenated agents when used in the open air to extinguish three-dimensional fires, while halogenated agents are the preferred agents for electrical fires and fires in concealed areas.

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**10.2.5** Different types of foam concentrates should not be mixed. The ARFF vehicle manufacturer should be consulted to ensure that the agent system design is compatible with the agent to be used.

**10.2.6** AFFF and FFFP are compatible with protein and fluoroprotein foams in the applied form and can be applied simultaneously on the same fire area.

**10.2.7** AFFF and FFFP agents are compatible with dry chemicals. These agents can be applied simultaneously to improve flame knockdown and control fire spread.

**10.2.8** Protein foams should be applied only with compatible dry chemicals.

**10.2.9** Fluoroprotein foams have demonstrated an improved compatibility with dry chemicals; however, the user should determine that the agent is adequate to meet operational requirements. If any problems arise, the agent manufacturer should be consulted.

**10.2.10** If foam is being used and the fire is not completely extinguished before the supply is depleted, it might be necessary to complete extinguishment with water streams. When this occurs, avoid applying water or walking in any area that has been secured with foam, as water can break down the established vapor seal that the foam blanket provides.

Δ **10.2.11** If the fire has not been completely extinguished by foam, the secured area will "burn back" at a rate that is dependent on the stability of the foam being used.

**10.3 Water and Agent Resupply and Conservation.** Additional water supplies should be available whenever there is any indication of possible need, especially when the aircraft accident site is known to be beyond water relay capability. Prearrangements should be made to ensure that additional supplies of extinguishing agents are brought to the scene. Prudent utilization of agents under these circumstances is particularly important, and application methods should be carefully selected to ensure their most effective use.

**10.3.1** It is considered impractical to require airport authorities to provide quantities of extinguishing agents to deal with the worst situation that could arise using only the equipment located on the airport. Therefore, it is necessary for airport emergency plans to contain instructions for requesting support from externally based fire services following an emergency. It is not easy to specify an operational requirement that makes adequate provision in all circumstances. It is clear that a need for additional water could arise in as little as 5 minutes, although in this time the initial fire situation should be greatly reduced. If total extinguishment has not been achieved, the fire can quickly extend and the equipment must be replenished.

**10.3.2** Airports should consider providing additional water as a support facility. There might be exceptions where airports have adequate piped, stored, or natural water supplies, provided that these are available at an accident in sufficient quantity and in time to meet the operational requirement.

**10.3.3** In each case, the AHJ should consult closely with the chief fire officer of the Mutual Aid Fire Service regarding response and supply of additional agent/media supplies. The airport authority will need to assess the suitability of the agent/media resources that can be mobilized to support the airport fire service when a serious and prolonged post-accident fire occurs. The speed of mobilization and the rate at which the agent/media can be delivered to the accident site, and its compatibility, are important factors.

**10.4 Rescue Operations.**

**10.4.1** The primary objective of ARFF personnel at the scene of any aircraft accident is to control and extinguish the fire to enable safe evacuation of the aircraft.

**10.4.2** Occupant survival is generally limited to aircraft accidents that are of low impact in nature, where the fuselage is not severely broken up and a fuel fire has not developed. In more severe accidents, even those where fire does develop, ARFF personnel should assume that there is always the possibility of survivors and take actions to control the fire, initiate evacuation, and rescue those unable to self-evacuate.

**10.4.2.1** Local procedures should be in place for ARFF/pilot communications during a declared emergency situation.

**10.4.2.2** These procedures should limit the frequency specifically for emergency responders and pilot usage. Guidelines for this topic can be found in local state publications such as FAA Advisory Circular 150/5210-7D, *Aircraft Rescue and Firefighting Communications.*

**10.4.3** Rescue operations should begin as soon as conditions permit and often are a simultaneous function during the firefighting phase that requires considerable coordination. The rescue team's mission includes assisting evacuees, accomplishing forcible entry if necessary, completing interior extinguishment, extricating trapped survivors, and removing the injured to safety.

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**10.5 Size-Up (Risk Assessment).**

**10.5.1** The size-up (risk assessment) process is initiated by first responding ARFF personnel and is carried on throughout the duration of the incident in varying degrees of depth and scope.

**10.5.2** The size-up (risk assessment) process is initiated by the first-responding ARFF personnel and is carried on throughout the duration of the incident in varying degrees of depth and scope by later-arriving superior officers.

**10.5.3** When an aircraft accident occurs, some size-up (risk assessment) information in the form of established facts should be immediately known as the result of training, pre-incident planning, knowledge of available resources, and interpretation of alarm information. Additional facts become known through observation during response and upon arrival at the scene.

**10.5.4** Vital operational decisions based upon initial size-up (risk assessment) information should be made without delay. Realistic objectives are critical, and consideration should be given to the capabilities of resources that are immediately available.

**10.5.5** Initial assignments of tasks based on the size-up (risk assessment) are generally not fixed and tend to be modified as the incident develops. The size-up (risk assessment) process should continue throughout the duration of the incident, and any changes in strategy or objective that develop should be communicated to key personnel involved in the operation.

**10.6 Aircraft Accident — Fire Involvement.**

**10.6.1** In an aircraft accident, occupants are confined within the fuselage and are surrounded by very large amounts of fuel that, when ignited, can release heat at about five times the rate that develops in the typical structure fire. An aircraft fuselage has a very low resistance to fire, except for engine areas, cargo compartments, and galleys, because fire and smoke barriers are nonexistent.

**10.6.2** Priority should be given to aircraft occupant survival. Those who have survived the impact forces then face exposure to fire and toxic products of combustion. Total extinguishment of the fire is an acceptable initial approach if it is determined to be the most effective method of successfully accomplishing rescue. A resource-conserving alternative would be selective control of fire in areas where occupants are successfully evacuating and maintaining these escape routes until it has been determined that evacuation is complete. A decision as to the precise method of initial fire attack should be made by the ARFF incident commander immediately upon arrival at the scene. All members of the ARFF team should realize that initial plans are always subject to change and should remain alert for orders that alter operations as conditions dictate.

**10.6.3** If upon arrival at an aircraft accident the operator of the first-arriving ARFF vehicle encounters a small fire, the best tactic would be to extinguish it rapidly and then begin to blanket any fuel spill with foam. Later-arriving vehicles should assist in the foam application if needed or perform other tasks as directed by the incident commander.

**10.6.4** If a large fire is in progress upon arrival of the ARFF personnel, foam should be applied using the vehicle turrets. Since initial foam supplies can be exhausted in 2 minutes, turret operators should understand that foam application by this method must be effective and that streams should be shut down on occasion to assess progress and conserve foam. Once a fire has been controlled and any fuel spill blanketed with foam, consideration should be given to employing foam handlines that are more maneuverable and therefore more effective for maintaining a foam blanket and extinguishing small fires.

**10.6.5** If foam becomes contaminated by fuel splashing into it, then at some time the foam will become flammable. The degree to which this is a problem depends on the type of foam and the amount of contamination. As solution drains from the foam, the water drains at a faster rate than the fuel, resulting in a fuel-rich foam matrix that can ignite if exposed to a source of ignition. This problem is more evident in AFFF than in other foams because it has a much faster drainage rate and becomes flammable at a lower level of contamination.

**10.6.6** Foaming agents should form a blanket over the surface of a flammable liquid fire in order to extinguish it. The foam should be applied using a dispersed pattern over the surface of the burning fuel to completely cover the spill area. It needs to be applied in such a manner that it does not break up any previously established blanket. If isolated openings in the foam blanket occur, foam should be reapplied and the foam blanket maintained for the duration of an existing hazard.

**10.7 Extinguishment Techniques.**

**10.7.1** Vehicle approach to a burning aircraft should be such that turret streams can be applied along the length of the fuselage with efforts concentrated on driving the fire outward while keeping the fuselage cool, protecting occupants as they evacuate, and assisting with the entry of rescue teams.

Δ **10.7.2** The location of survivors, if known, and the area of fire will determine where the first streams should be applied. If the fire has penetrated the fuselage, a direct interior attack should be initiated as soon as possible.

**10.7.3** Where it is compatible with the evacuation process, it is best to approach an aircraft fire from the windward side. Agents should be applied from the windward side to provide better reach and greater ability to monitor extinguishing effectiveness, as the heat and smoke will be moving in the opposite direction. When vehicle turrets are in operation on opposite sides of a fuselage, care should be taken that the fire is not driven underneath from one side to the other.

**10.7.4** When an aircraft comes to rest on sloping terrain or adjacent to a gully or wash, circumstances permitting, the fire should be approached from high ground and the burning fuel driven away from the fuselage.

**10.7.5** Aircraft accidents do not occur under the best conditions or permit the ideal conditions for combating a fire. It will not always be possible to approach the fire from high ground or the windward side. What is important is that an aggressive attack is used to isolate the fuselage from the fire, and efficient fireground coordination is in place to achieve a successful evacuation of occupants and complete fire extinguishment.

**10.7.6** The initial attack on an aircraft fuel fire should normally be by judicious application of foam, or alternatively by the combined use of foam and a complementary agent. A three-dimensional or flowing fire should be extinguished by using an approved dry-chemical or halogenated agents, followed by an application of foam. Even where foam alone is used, a suitable complementary agent should be available to deal with fire inaccessible to direct foam application.

**10.7.7** If a fire threatens exposed aircraft, structures, or other combustibles, the exposure should be protected by foam or water spray. Water streams or runoff should not be permitted to destroy any foam blanket in the critical fire area.

**10.7.8** If a large fuel spill occurs without igniting, it is important to eliminate as many ignition sources as possible while the spill is being stabilized with a foam blanket. There can be enough residual heat present in jet engines to ignite fuel vapors 30 minutes after shutdown.

**10.7.9** Extinguishing agents should be applied in a manner to avoid spot cooling of components that can cause stress failure and disintegration. If possible, streams should be employed so that even surface cooling can result. Approved dry chemicals and halogenated agents can extinguish fires involving hydraulic fluids or lubricants, but they lack the cooling ability necessary to prevent reignition.

**10.7.10** Fire-fighting foam can be applied with turret nozzles or handlines. Either spray or straight streams can be used as the situation dictates. It is best to approach the fire area as closely as possible and apply the foam in a wide spray pattern initially, changing to a narrower pattern after the heat has been reduced. The stream should be applied gently to avoid unnecessary plunging of the stream into the burning fuel. The foam should be applied to the near edge of the fire with a rapid side-to-side sweeping motion to distribute the foam rapidly and thinly over the burning fuel. Fire fighters should advance as the fire is controlled, always applying the foam to the nearest burning fuel surface, and should advance only after a continuous, unbroken foam cover is established. The entire foam blanket integrity should be maintained to compensate for voids created by movements of ARFF personnel, evacuees, and equipment, as well as the normal drain down of the foam.

**10.8 Turret Operations.**

**10.8.1** ARFF vehicles should be positioned to make the most effective use of all extinguishing agent systems. The most efficient use can require movement of the vehicle during turret or even handline operations. It is vitally important not to waste available agent. TURRETS SHOULD BE USED ONLY AS LONG AS THEY ARE BEING EFFECTIVE. After initial knockdown of the heat and flame, use of handlines to maintain control of evacuation areas can be the key to a successful rescue operation.

Δ **10.8.2** When selecting vehicle positions for applying extinguishing agents from a turret, remember that wind has a considerable influence upon the quality of the pattern and the rate of fire and heat travel. Utilize the wind whenever possible to achieve more effective fire control.

**10.8.3** Turret application should never be directed so as to drive fuel or fire toward the fuselage. The main objective is to maintain an escape route for occupants until complete evacuation is achieved.

**10.8.4** Usually water supplies are a key factor, and turret operators should concentrate their extinguishing efforts on the escape route from the aircraft.

**10.8.5** The "pump and roll" concept, a method of applying agent from a turret while the vehicle is in motion, can be a very effective fire control technique when used correctly.

**10.9 Turret Application.**

**10.9.1** The basic principle of this type of foam application is to distribute a visible foam blanket over the burning fuel to act as a blanket for vapor suppression. The original blanket should not be relied on to be permanent and should be maintained as necessary until the fuel vapor hazard no longer exists.

**10.9.2** Both aspirating and nonaspirating nozzles can be used for foam application. A nonaspirated nozzle typically provides longer reach and quicker control and extinguishment. However, expansion rates and foam drainage times are generally less when foam is applied with nonaspirating nozzles, and it should be understood that the foam blanket might be less stable and have a lower resistance to burnback than that formed using aspirating nozzles. Manufacturers should be consulted for guidance on nozzle performance. Extreme caution should be taken when using the straight stream method, as this can cause an increase in the liquid pool surface or cause an opening in the foam blanket, releasing flammable vapors.

**10.10 Foam Application.**

**10.10.1** Foaming agents should be applied to burning fuel so that they gently form a uniform and cohesive blanket with the least possible turbulence to the fuel surface.

**10.10.2** Aspirating nozzles should be used for applying protein and fluoroprotein foams in either the straight stream or dispersed patterns to distribute the foam over a wide area. When using the straight stream method of application, the foam should be applied indirectly using deflection techniques, and special care should be exercised to avoid disturbing the established foam blanket.

**10.11 Handline Foam Application.**

**10.11.1** As soon as the fire has been knocked down by turrets, the turrets should be shut down, perhaps repositioned, and held in a state of readiness to resume operation should the need occur. During this phase of rescue and fire fighting, handlines are more effective than turrets in controlling the fire, maintaining rescue paths for occupants, mopping up spot fires, maintaining the foam blanket, and conserving vital agent supply.

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**10.11.2** Foam application principles are the same for handlines as they are for turrets.

**10.12 Aircraft Accident — No Fire Involvement.** At an aircraft accident without fire, appropriate fire prevention measures should be initiated immediately.

**10.12.1** All spilled fuel should be cleaned up or covered with foam.

**10.12.2** The washing of spilled fuel from around the aircraft requires caution; any fuel and/or vapors should be directed away from sources of ignition.

**10.12.3** Every effort should be made to prevent sparks whenever there is the possibility of exposed fuel or fuel vapors in the area. Particular care should be taken to prevent sparks due to arcing before the aircraft electrical system can be de-energized.

**10.12.4** ARFF personnel need to exercise extreme care when cutting tools are used at an accident site where fuel liquid and vapor is present. A support fire fighter should be on standby with a fully charged hoseline to deal with any incipient fire that might develop.

**10.13 Exposure Protection.**

**10.13.1** After rescue of occupants, protection of exposed property should be the next consideration at the scene of an aircraft accident, whether fire exists or not. In addition to protecting airport structures and other aircraft, plans should include preventing contamination and fire spread into drains, sewers, waterways, and any belowground facilities. Authorities should be immediately notified of any exposure to fire or contamination involving property under their control.

**10.13.2** Early and effective fire extinguishment ensures the least amount of property loss, and that includes exposed properties whether involved in fire or not. Where resources are limited, conditions will dictate which exposures receive first priority for protection.

## Chapter 11 Interior Aircraft Fires

### 11.1 General.

**11.1.1** The recommendations contained in this chapter are provided for the guidance of ARFF personnel encountering interior aircraft fires occurring in both parked, unoccupied aircraft and aircraft with passengers and crew aboard.

*N* **11.1.1.1** Examples of circumstances that could lead to an aircraft internal fire are the following:

(1) An external fire (normally burning aviation fuel) penetrates the fuselage skin and combustible materials inside are ignited.
(2) Combustible materials inside the aircraft cabin are for some reason ignited. In this situation the fire may be discovered early and may be dealt with by trained aircraft crew, or the fire may have developed and the crew can merely strive to contain or minimize the effects of the fire until the aircraft can effect an emergency landing at a suitable airport.
(3) Smoke or fumes may be present in the aircraft cabin, but the source may not be obvious and may be difficult to locate.
(4) A fire involving aircraft engines, auxiliary power units, or undercarriages may spread to areas inside the fuselage.
(5) Cargo or baggage carried on the aircraft may for some reason cause a fire that may develop and spread to occupied areas of the aircraft.

*N* **11.1.1.2** However an internal fire comes about, if there is or there is suspected to be life involvement, a prompt response following the correct tactics is vital.

**11.1.2** The occurrence of interior aircraft fires where passengers and crew are onboard presents a major problem for ARFF personnel. An acute life safety hazard exists in these instances, and the ability to enter the aircraft and extinguish the fire might have to be delayed until evacuation has been completed. Because forcible entry and rescue are discussed in detail elsewhere in this guide, they will not be covered here. Instead, emphasis will be on the procedures and techniques of attacking and extinguishing interior aircraft fires.

**11.1.3** Aircraft passenger cabin fires normally involve ordinary combustibles such as upholstery, paneling, carpeting, refuse, electrical insulation, and carry-on materials. Generally, a direct attack on the fire with water streams, using structural firefighting techniques, is effective.

**11.1.4** ARFF personnel should understand the structural characteristics of an aircraft fuselage. The absence of fire stops at the floor, behind wall panels, and above ceiling areas permits fires to spread undetected and unchecked through combustible materials once fire has entered those areas. ARFF personnel should always assume, until it is proven otherwise, that fire has moved away from its origin via these concealed spaces. Sections of flooring, wall panels, and ceilings should be removed where fire travel is suspected so that complete extinguishment can be accomplished.

Δ **11.1.5** Because the burning of aircraft interior materials creates a toxic atmosphere, ARFF personnel should wear positive-pressure SCBA whenever working inside the fuselage both during the fire-fighting stage and later, while overhauling. Additionally, the entire fuselage should be ventilated as quickly as possible by whatever means available. Ventilation fans can expedite horizontal ventilation and are usually the only method to choose as an aircraft has no designed vertical openings.

**11.1.6** Interior aircraft fire situations can differ widely; therefore, explicit guidance regarding extinguishment techniques is not possible. Points of entry and methods of attack should be dependent upon an evaluation of conditions and assessment of resource capability by the ARFF incident commander.

**11.1.7** An interior aircraft fire location and its intensity can, to some degree, be determined by observation through cabin windows, smoke characteristics, aircraft skin that shows buckling or paint blisters, or by use of a handheld or vehicle-mounted thermal imaging camera.

**11.1.8** In the event that an interior aircraft fire cannot be immediately extinguished, the application of foam or water spray should be considered for cooling and protecting external risks.

*N* **11.1.9** ARFF personnel should consider the development and behavior of fire in interior aircraft fires and adopt fire-fighting techniques that minimize the risk of sudden conflagration.

### 11.2 Aircraft Interior Fires Occurring in Flight.

**11.2.1** A major hazard of commercial aviation is the in-flight fire that cannot be controlled by onboard portable extinguishers or fixed extinguishing systems.

**11.2.2** Aircraft emergency landings or accidents can be the result of uncontrolled fires occurring in flight. The most common types of in-flight fires involve the following:

(1) Engines
(2) Cabin areas
(3) Lavatories
(4) Heaters
(5) Cargo areas
(6) Electrical compartments

**11.2.3** Portable fire extinguishers are required to be mounted at specific locations in the cabin of passenger aircraft, and flight deck crews receive periodic training in their use. The extinguishers are designed to handle incipient fires in accessible areas. However, fires can and do originate in locations not readily accessible from the cabin while the aircraft is in flight. If the area involved in fire is isolated and is not equipped with a fixed extinguishing system, a serious fire can develop and spread rapidly.

Δ **11.2.4** When the aircraft is on the ground, heat, smoke, and gases will build up, creating a toxic atmosphere and setting the stage for a flashover.

**11.2.5** After the aircraft has landed and the flight deck crew has initiated emergency evacuation, it should be assumed that some of the occupants might not have the ability to self-evacuate. ARFF personnel should allow normal procedures to be carried out to their full potential without compromising the evacuation process. However, ARFF personnel and vehicles should be placed in strategic positions to effect entry into the fuselage to confirm complete evacuation and achieve fire control.

**11.2.6** If there is no evidence of occupant evacuation, immediate steps should be taken to make entry for control of the fire and rescue of occupants. Entry will permit an inrush of fresh air into a possibly overheated or unstable atmosphere that could rapidly accelerate the fire. Toxic gases will be present, so ventilation and a thorough search for survivors should take place immediately and simultaneously with the fire-fighting effort. In darkness or heavy smoke conditions these efforts will be much more difficult.

*N* **11.2.6.1** Consideration should be given to details such as the following:

(1) Options for gaining access
(2) Methodical search patterns
(3) Communications
(4) Hose management

**11.3 Interior Fires in Unoccupied Aircraft.**

**11.3.1** Fires occurring in unoccupied aircraft often result in delayed detection. An unattended aircraft with its doors closed can contain a smoldering fire that can burn unnoticed for an extended period of time. Under these conditions, a build-up of extremely hot fire gases can develop as the fire consumes all the available oxygen. Opening up an aircraft under such circumstances can be very hazardous because when oxygen is introduced into such an atmosphere the entire interior can become immediately ignited, possibly with explosive force. Handlines that are fully charged need to be in place prior to entry into the fuselage.

**11.3.2** When arriving at a closed, unoccupied aircraft that is suspected of having an interior fire, the internal atmosphere should be assessed before entry is attempted. If flame cannot be seen, and the windows are hot to the touch and obscured by heavy smoke, it can be expected that a hot, smoldering fire exists and entry of outside air at this time would ignite the entire interior.

**11.3.3** If an interior fire in an unoccupied aircraft has not reached the smoldering stage, there is sufficient oxygen present and a free-burning fire can be maintained. Under these circumstances, entry should be made and the fire extinguished with water or foam in the conventional manner.

**11.3.4** Extinguishment of a hot, smoldering, internal aircraft fire can be very difficult. Where this type of fire exists, one method is worth consideration. It can be referred to as an indirect attack that is made from small fuselage openings such as slightly opened exits or openings made in cabin windows. A coordinated multiple-point attack is more effective than a single-point attack and is necessary when applying the method to fires in wide-body or multideck aircraft with large-volume interiors. It must be remembered that this method is not suitable if there is any possibility of occupants being onboard the aircraft.

**11.3.4.1** The extinguishment principle of this indirect method is based on the conversion of water spray into steam as it contacts the superheated atmosphere within an enclosure. The rapid expansion of water spray droplets into minute stream droplets increases the surface area of the water, permitting it to absorb more heat, thus making it more efficient as a cooling agent. Water in this form and under pressure has the ability to penetrate dense burning materials and enter areas behind panels and coverings. When properly applied, the method lowers the temperature of the entire fire area to a point where combustion ceases.

Δ **11.3.4.2** Should a smoldering, interior aircraft fire occur in compartments below the passenger and flight deck levels, the indirect attack method can also be applied and adapted to the particular circumstances involved. However, it can be more difficult to achieve convenient openings in these compartments.

**11.4 Penetrating Nozzles.**

**11.4.1** The use of penetrating nozzles is another way of combating aircraft cabin and compartment fires. Most penetrating nozzles are designed so that any agent currently used by ARFF providers can be utilized.

**11.4.2** To extinguish an aircraft cabin or compartment fire using penetrating nozzles, the total fire area requiring agent application needs to be considered. For example, to extinguish a large fire in the cabin of a wide-body aircraft, penetrating nozzles injecting agent simultaneously from dispersed, multiple injection points would be required to provide a sufficient amount of agent to effect extinguishment in a timely manner.

**11.4.3** Currently, there are a number of hand-held penetrating nozzles in use. The manner of application can be slow, awkward, and occasionally dangerous when applied to aircraft fire fighting and should be done with great care. When using this type of penetrating nozzle, ARFF personnel should make certain that they have proper footing and sufficient operating area, and have an understanding of aircraft design and construction and emergency access points of entry.

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**11.4.4* Boom-Mounted Turrets and Piercing Nozzles.**

*N* **11.4.4.1** Boom-mounted turrets and piercing nozzles can be used to discharge extinguishing agents inside the aircraft.

*N* **11.4.4.2** Boom-mounted piercing nozzles can usually push cabin and fuselage windows inward, allowing access for interior agent application. Because of the forward-facing cockpit window construction, boom-mounted piercing nozzles should not be used to penetrate these windows.

*N* **11.4.4.3** Boom-mounted piercing nozzles are effective at penetrating the fuselage below the cabin floor level and baggage compartments to extinguish fire in concealed spaces.

Δ **11.5 Interior Aircraft Fire Overhaul.** During the overhaul phase of an interior aircraft fire, hose lines should remain charged and available to extinguish any deep-seated fire, hidden uncovered fire, or reignition. Carpeting, wall panels, partitions, and ceiling covering should be removed when necessary to ensure that all fire is extinguished and that there is no threat of reignition. The use of portable lighting units and ventilation fans will help to make the aircraft interior safer and more tenable for ARFF personnel. Any person entering the aircraft during the overhaul phase should use positive-pressure SCBA.

## Chapter 12 Miscellaneous Aircraft Incidents

**12.1 General.**

**12.1.1** Each year ARFF personnel respond to numerous on-airport incidents that are considered “minor.” These seemingly routine activities do not make headlines, but the absence of intervention could often result in catastrophic loss of life, serious injuries, and extensive property loss.

**12.1.2** Guidance presented in this chapter is intended to inform ARFF personnel of a variety of aircraft incident types and how to deal with them so that the hazards relative to on-airport aircraft operations can be safely abated.

**12.2 Engine Fires.**

Δ **12.2.1** It is reasonable for ARFF personnel responding to aircraft engine fires to expect that all of the following actions have probably been accomplished by the flight deck crew, where appropriate:

(1) Engine shut down
(2) Engine fire extinguishing system (if any) activated
(3) Electrical power to the affected engine(s) de-energized
(4) Fuel supply to the affected engine(s) shut down

**12.2.1.1** These actions should be verified as conditions permit. It should be emphasized that turbine engines, following shutoff of power and fuel, can remain a potential hazard during "wind down," with high heat retention continuing for as long as 30 minutes. This heat constitutes a potential ignition source for flammable vapors.

**12.2.1.2** On propeller-driven or rotary-wing aircraft, contact with propellers or entry into their path of rotation should be avoided during all stages of the emergency.

**12.2.2** When jet engines are started or shut down in certain wind conditions, hot starts or tail pipe fires can occur. These fires can usually be controlled by the flight deck crew. In some cases, however, fire department intervention might be necessary.

**12.2.3** When reciprocating engine fires are confined within the nacelle but cannot be controlled by the aircraft extinguishing system, dry chemical or a halogenated agent should be applied first, as these agents are more effective than water or foam for fires inside an enclosure. Foam or water spray should be used to cool the outside of the nacelle.

**12.2.4** Fires confined to the hot section of jet engines can be best controlled by keeping the engine rotating. Such action should be considered in the context of necessary aircraft evacuation and other safety considerations. Fires outside the combustion chambers but confined within the nacelle are best controlled with the engine's fixed extinguishing system. If the fire continues after the system has been discharged, or if reignition occurs, an extinguishing agent should be applied through the maintenance openings. In order to carry out post-fire inspections, ARFF personnel should be aware of the methods of opening the engine nacelle and the subsequent danger of pooled hot fuel contained within the nacelle. The aircraft operator should be advised of the type of extinguishing agent used so that appropriate maintenance action can be taken.

**12.2.5** Foam or water should not be applied to either the intake or exhaust of a jet engine unless control cannot be secured or confined to the engine nacelle using a halogenated agent or dry chemical. If foam or water is applied to either the intake or exhaust, ARFF personnel should stand clear to avoid being struck by disintegrating engine parts.

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**12.2.6** On fires contained within tail pipes, ARFF personnel should carry out an internal post-fire inspection of the surrounding area to ensure that the fire has been contained within the engine or APU and the heat has not been transmitted by conduction. When tail pipe fire occurs in the elevated center engine of three-engine wide-body aircraft or a B-747 APU, special elevating equipment might be required to effectively discharge agent onto the fire. *(See also Annex C.)*

**12.3 Aircraft Fuel Servicing Incidents.**

**12.3.1** A number of aircraft fires have occurred during fuel servicing. Ignition has been caused by static developed in flowing fuel, surface-generated static within an aircraft fuel tank or refueling vehicle, defective fuel pumps, an external source of ignition, and other improper fueling procedures. Defueling and fuel transfer operations are also serious fire potentials. Standards relative to aircraft fueling procedures and proper equipment maintenance should be diligently enforced by the AHJ on the airport.

Δ **12.3.2** Fuel spills exterior to the aircraft should be handled in the manner described in NFPA 407 when fire does not occur. If fire does occur, it should be handled similarly to any other aircraft accident, with primary emphasis on life safety. The practice of fueling occupied transport category aircraft necessitates that, in the event of a fuel spill fire, an immediate check of the interior for occupants is imperative.

**12.3.3** Many transport category aircraft have ganged fuel tank vents near wing tips. Vented JET A–type fuel (kerosene grades) vapors normally present very little hazard. If tanks are overfilled, the fuel will discharge through the vents, causing a fuel spill. There is a greater potential for a flammable vapor-air mixture being present in the immediate vicinity of wing tip vents when JET B fuel is used. Regardless of which fuel is used, it is good practice not to position or operate vehicles within an 8 m (25 ft) radius of aircraft fuel system vent openings.

**12.4 Hot Brakes.**

**12.4.1** Hot brakes can contribute to the overheating of wheels and tire assemblies. The heating of aircraft tires causes overpressure and presents a potential explosion hazard. Good judgment should be exercised in determining the severity of the situation, and this information should be conveyed to the flight deck crew. The flight deck crew in turn can assist the rescue and fire-fighting effort by performing necessary procedures.

**12.4.2** In order to avoid endangering ARFF personnel and aircraft occupants and causing unnecessary damage to the aircraft, it is important not to mistake hot brakes for brake fires (where flames are visible). Hot brakes normally cool by themselves and do not require an extinguishing agent; however, overheating can create circumstances that necessitate additional actions.

**12.4.3** When a hot brake condition occurs on a propeller-driven aircraft, it is usually beneficial to keep the propeller that is directly forward of the wheel with hot brakes operating until the brakes have cooled. Larger, modern aircraft have fusible plugs mounted in the wheels that fail at high temperatures, allowing the tires to deflate before dangerous pressure can develop.

**12.4.4** ARFF personnel should remain clear of the sides of aircraft wheel assemblies on all landing gear emergencies and approach only at a 45 degree angle from the fore and aft directions. Because heat is transferred from the brake to the wheel, extinguishing agent should be available.

**12.4.5** Acceptable cooling procedures should include, but not be limited to, the following:

(1) Advise the flight crew to continue taxiing the aircraft when appropriate.
(2) Stand by and monitor gear conditions without intervention.

(3) Apply water to gear using a narrow fog pattern.
(4) Apply forced-air ventilation.

**12.5 Wheel Fires.**

**12.5.1** ARFF personnel should extinguish any wheel fire with any extinguishing agent available. Effective cooling is a primary consideration.

**12.5.2** Dry-chemical and halogenated agents might extinguish fires involving hydraulic fluids and lubricants, but reignition can occur since these agents lack sufficient cooling effect. Halogenated agents are particularly effective in extinguishing undercarriage fires. However, where magnesium wheel components are burning, halogenated agents should not be used.

**12.5.3** Effectiveness of any gaseous extinguishing agent can be severely reduced if wind conditions are such that sufficient concentration cannot be maintained to extinguish the fire.

**12.5.4** Fires involving magnesium wheels have been successfully extinguished by applying large amounts of water from a distance. This method rapidly reduces the heat to a point below the ignition temperature of the magnesium, and the fire is extinguished. ARFF personnel should exercise extreme caution when this method of extinguishment is used, as explosive failure of the wheel components is likely.

**12.6 Combustible Metal Fires.** Burning magnesium or titanium parts should be isolated, if possible, and extinguished by applying a Class D agent. Large quantities of water could be effective when a Class D agent is not available.

**12.7 Broken Flammable Liquid Lines.** Broken fuel, hydraulic, alcohol, and lubricating oil lines should be plugged or crimped when possible to reduce the amount of spill potential.

**12.8 Heater Fires.** Heaters located in wings, fuselage, and tail sections of aircraft can be protected with a fixed fire extinguishing system. In the event of an airborne heater compartment fire, it can be assumed that the system would have been activated. After the aircraft has landed, a thorough check of the heater compartment and surrounding area should be made to ensure that there has been no reignition or spread of fire.

**12.9 Bomb Threats/Security.**

**12.9.1** Incidents of unlawful acts, including terrorism, have forced airports to implement ever-increasing security measures, often impacting the operation of emergency services.

**12.9.2** Preplanning and response protocols must be in effect for mutual aid responders to access staging areas and the accident site. Protocols must ensure that only authorized persons are granted access to the operating interior of the airport.

Δ **12.9.3** When a bomb threat involving an aircraft is declared an emergency, the aircraft should be evacuated without delay. The situation might dictate the use of the emergency evacuation slides or built-in stairs. Use of portable stairways might be the safest and most practical alternative.

**12.9.4*** Immediately after evacuation has been completed, the aircraft involved will normally be moved to a remote location designated by the AHJ.

**12.9.5** Airport pre-incident plans should incorporate assignment of initial responsibility in any bomb threat emergency for initiating protective measures, conducting and controlling any search activities, transferring their responsibility, and declaring the termination of the emergency.

**12.9.6** The role of the ARFF personnel in bomb threat emergencies should be limited to the following:

(1) Assisting occupants evacuate the aircraft
(2) Assuming a standby status and remaining in readiness after evacuation is complete and the aircraft has been moved to a safe location
(3) In the event of a bomb detonation, assuming command and control of any rescue operation or fire incident that results

**12.9.7** The airline is responsible for the safety and well-being of its passengers and resources, and should cooperatively assist local authorities in any search of the aircraft or its contents.

**12.10 Incidents Where Aircraft Fire Warnings Occur.**

Δ **12.10.1** It is often difficult for the flight deck crew to accurately evaluate conditions following actuation of an aircraft fire warning indicator. Therefore, the aircraft should be brought to a stop before approaching the terminal. ARFF personnel should inspect the affected area by checking for external evidence of smoke or heat. If no evidence exists, the aircraft should continue on to the terminal, where a more thorough inspection can be made.

**12.10.2** If there is evidence of fire, immediate access should be made and the fire extinguished. If this occurs, the aircraft should be shut down and the decision made as to whether an evacuation of occupants should take place. Airline maintenance personnel and equipment should be requested to respond and assist ARFF personnel in gaining access and operating ground power units, and to assist with portable stairways if needed for evacuation.

**12.11 Emergency Landings.**

**12.11.1** Often, a landing gear stuck in the retracted position is the result of broken hydraulic lines or loss of electrical power. Spilled hydraulic fluid can ignite in the wheel wells due to the presence of electrical shorts, friction sparks due to a wheels-up landing, or other heat sources. Should ignition occur, the fire has a tendency to travel up into the fuselage and can rapidly become a major interior fire. ARFF personnel should take immediate steps to ensure the stabilization of this problem even if appearances from the exterior do not immediately indicate the presence of fire.

Δ **12.11.2** Hydraulic problems on landing aircraft can involve the brake systems, flaps, spoilers, and so forth. This has a tendency to lengthen the rollout after touchdown and can also affect the aircraft's directional control. As soon as the aircraft touches down and passes each ARFF vehicle that is standing by, that vehicle should immediately follow the aircraft and be ready to perform any necessary operation when it comes to a stop.

**12.11.3** At emergencies involving landing gear malfunctions, tire problems, or flight control and hydraulic problems, there is always a possibility of the aircraft veering off the runway after landing and hitting standby ARFF vehicles. It is difficult to predict the touchdown point. Therefore, if there are two or more ARFF vehicles available, they should stand by on opposite sides of the runway, a suitable distance from the edge.

**12.12 Aircraft Accidents in the Water.**

**12.12.1** Many aircraft accidents in the water have occurred in the critical response area off the end of the runway. Where runways terminate adjacent to a significant body of water, special provisions should be made to ensure the rapid response of ARFF services. For any aircraft overrunning or landing short of the runways into water, response times should be as close as possible to those of land emergencies.

**12.12.2** Many transport category aircraft not engaged in intercontinental overwater flights are equipped only with flotation-type seat cushions as emergency flotation devices. Survivability of passengers using this equipment is limited. Survivors are susceptible to hypothermia in water below 21°C (70°F) and ingestion of vapors from floating fuel. Rapid response is extremely important.

**12.12.3** In water landing accidents, the possibility of fire is normally reduced because of the cooling of the heated surfaces by the water. In situations where fire occurs, chances of its control and extinguishment are minimal unless the accident occurs within close proximity to shore and extinguishing operations can take place at close range.

**12.12.3.1** Airport runways located within 800 m (½ mile) of large bodies of water should ensure immediate access is available, that is, wide service roads able to handle ARFF vehicles and boat ramps capable of rapidly deploying rescue boats.

**12.12.3.2** Blow-up tents or other types of emergency shelters should be available for emergency workers and survivors in areas where there may be inclement weather conditions.

**12.12.4** Where the distance offshore is within range, fire hose can sometimes be floated into position by scuba divers or boats and used to supplement other means of fire attack.

**12.12.5** The impact of an aircraft into water can rupture fuel tanks and lines. It is reasonable to assume that fuel is floating on the water surface. Watercraft having exhausts at or above the waterline can present an ignition hazard and should not enter the area. Advantage should be taken of wind and water currents when dealing with floating fuel. Every effort should be made to keep floating fuel from moving into areas where it would be hazardous to rescue operations. As soon as possible, pockets of fuel should either be broken up, moved away with large velocity nozzles, covered with foam, or disposed of by commercial reclaiming enterprises. The local water pollution control agency can be of assistance during this operation.

**12.12.6** If fuel on the water has ignited, approach should be made from the direction where wind direction and velocity, water current, and site accessibility create an advantage. Fire can be moved away from an area by using a sweeping technique with hose streams. Foam and other extinguishing agents can be used where practical and necessary.

**12.12.7** Scuba diving units should be dispatched to the scene of an aircraft accident in the water. Helicopters can be used to expedite the transportation of divers to the actual area of the accident. All divers who might be called for this type of service should be qualified in both scuba diving and underwater search and recovery techniques.

**12.12.8** In all operations where divers are in the water, standard diver's flags should be flown and all watercraft restricted from the diving area.

**12.12.9** Victims in the water are more apt to be found downwind or downstream. Where only the approximate location of the impact site is known upon arrival, divers should use standard underwater search patterns, marking the locations of major parts of the aircraft with marker buoys. If sufficient divers are not available, dragging operations should be conducted from surface craft. In no instance should dragging and diving operations be conducted simultaneously.

**12.12.10** Life-sustaining air can remain in large, submerged, occupied sections of the aircraft. As soon as practicable, entry by divers should be made carefully at the deepest point possible.

**12.12.11** Where occupied sections of the aircraft are found floating, great care should be exercised not to disturb their buoyancy, and supplemental floating devices should be attached. Removal of any occupants should be accomplished as smoothly and quickly as possible. Any shift in weight or lapse in time can result in the section sinking. Rescuers should use caution so that they are not injured or trapped should the section capsize or sink.

Δ **12.12.12** A command post should be established on an adjacent shore to facilitate implementation of the airport/community emergency plan. *(See NFPA 424.)*

## Chapter 13 Post-Aircraft Accident Procedures

**13.1 General.**

**13.1.1** Many local statutes stipulate that it is the duty of the fire department to protect life and property from fire and to extinguish all destructive fires. They further state that no person has the right to interfere or hinder the fire department in the performance of this responsibility. It is vital that the area of an accident site be identified and sealed off as soon as possible; only persons required for the rescue and fire fighting should be allowed access to the wreckage, thus protecting vital evidence from being destroyed by well-intentioned persons. The investigating authority will require detailed information from ARFF personnel where, in the execution of their duty, wreckage, switches, or other parts of the aircraft were moved for rescue purposes *(see 7.1.2)*.

**13.1.2** During post-aircraft accident operations, a reassessment of the potential risks to personnel and the environment should be undertaken, and subsequent control measures put into operation to ensure the safety of all agencies working on site.

**13.1.3** It is essential that personnel are aware of the possibility of the ignition of fuels. Any source of ignition should be prohibited at the accident site (smoking, etc.). It is of paramount importance that adequate control measures are put into place before using equipment that may produce a source of ignition. Procedures should be implemented to ensure that PPE is worn, with full-body and respiratory protection, and that a "no drinking, no eating" rule is enforced within the immediate accident site.

**13.1.4*** ARFF personnel should familiarize themselves with all applicable regulations relating to movement of aircraft wreckage and disposition of accident fatalities. *(See also Annex D.)*

**13.2 Preservation of Evidence.**

**13.2.1** Following extrication of occupants from an aircraft, preservation of evidence at the site is of vital importance in determining the probable cause of the accident/incident. ARFF personnel should be aware of this requirement, and it should be stressed in training exercises.

**13.2.2** ARFF personnel should take notice of and record the condition and position of the aircraft structure prior to beginning any significant cutting and shifting of any portions of the wreckage. If time permits, photographs should be taken of initial conditions for later study.

**13.2.3*** The preservation of evidence also includes debris that may be scattered across the accident site, for example, on runways or taxiways. This evidence can include parts of the aircraft and effects belonging to passengers and crew. A large number of documents and papers may be carried on aircraft, recovery and preservation of which is vital. (If the flight deck is intact, then these documents should not be removed unless there is risk of loss or damage.) In addition, the observations of ARFF personnel can be useful in assisting the investigating authorities.

**13.3 Fatalities.**

Δ **13.3.1** The location of all fatalities in and about the aircraft wreckage should be clearly identified by the use of flags, stakes, or other suitable markings, numbered to coincide with a number securely attached to the body, and photographed, if possible. Triage/medical tags can be used for this purpose. *(See also NFPA 424.)*

**13.3.2** Premature removal of remains can interfere with identification and destroy pathological evidence; however, if removal of remains is absolutely necessary, the original location of the remains should be properly documented. Movement of fatalities remaining in or around an aircraft wreckage can be done to minimize further hazards and preserve evidence. Consideration should be given to tactics involved in extinguishment, rescue operations, preservation of evidence, and showing proper respect towards the deceased prior to moving a confirmed fatality.

**13.4 Preservation of Mail, Baggage, and Cargo.**

**13.4.1** The original location of mail sacks, baggage, and cargo should be observed and this information passed on to investigators. These items should be protected from further damage and, if necessary, removed to a safe location such as the command post.

**13.4.2** Postal officials normally extend blanket authority to fire departments to remove mail from aircraft involved in an accident, for the purpose of saving as much of it as possible. After the responding postal official has been properly identified, the ARFF officer can transfer the custody of the mail.

**13.4.3** If it is necessary to remove baggage from an aircraft involved in an accident, it should be placed in the custody of airline officials. Under certain circumstances, customs officials would be granted initial custody. Responsibility for final disposition of baggage belongs to the airline involved.

**13.4.4** Cargo manifests should be reviewed for the presence of dangerous goods. If present, they should be examined for leakage or damage to packaging. If damage has been sustained, containment and decontamination procedures should be initiated immediately by qualified personnel. If cargo is removed from the aircraft, it should be held by the responsible agency.

**13.4.5** When personal property, such as jewelry, purses, watches, and so forth, is found in the vicinity of an aircraft accident, ARFF personnel should not move it but record the location and notify their incident commander, who should advise security personnel of the information. These items and their locations can be of great value to the AHJ in making positive body identifications.

**13.5 Flight Data and Cockpit Voice Recorders.** Flight data and cockpit voice recorders, as shown in Figure 13.5(a), are usually located in the aft fuselage area of most commercial aircraft, as shown in Figure 13.5(b), and are designed to be resistant to crash forces and fire. The outer surface is normally painted "International Orange." ARFF personnel should be able to recognize these recorders so that they can be protected from loss or damage until accident investigators assume responsibility. Although no attempt should be made to remove these recorders from the aircraft, as they could be damaged by such efforts, if failure to remove them will result in their total loss, recovery should be made.

**13.6 Defueling Accident Aircraft.**

**13.6.1*** Defueling operations should be done under the direct supervision of a qualified aircraft fuel systems specialist. The defueling itself should be performed by qualified technicians using approved methods. Provision should be made for an ARFF vehicle to stand by on-site while defueling takes place.

**13.6.2** Defueling of aircraft should not take place until there has been full consultation between the airport fire service, police, airline, and accident investigation authority. Aircraft should not be defueled during rescue operations. If there is fuel leakage, it should be dealt with in the same manner as any other fuel leak, regardless of the aircraft's attitude.


**FIGURE 13.5(a) Flight Data Recorder and Cockpit Voice Recorder.**

**13.6.3** Defueling an inverted aircraft has potentially very serious implications. A number of reasons why an inverted aircraft should not or cannot be defueled during the rescue operation are as follows:

(1) Ignition can be caused by surface-generated static as the fuel flows between the aircraft fuel tank and the fueling vehicle.
(2) Due to the accident, fuel pump access doors and the fuel pumps themselves could have been damaged.
(3) The wing attitude could make it difficult to determine in which tank the fuel is located, in what position, and in what quantity, with the result that while attempting to defuel, the fuel could be accidentally discharged onto the accident site.
(4) Fueling normally involves delivery by pressure, and defueling utilizes gravity flow from underwing orifices when the aircraft is on its wheels. Inverted aircraft or those on their bellies do not offer the benefits of gravity flow. This technical problem is compounded by the fact that most fueling vehicles cannot "lift" fuel by suction in the same way that fire vehicles "lift" water from a ground level reservoir up into their water tanks.

**13.6.4*** During defueling operations, an ignition-free area with a radius of at least 15 m (50 ft) from the outer edge of the operating area should be maintained. Persons within the controlled area should be only those necessary for the work being done. Open flames, floodlights, ground power units, and radio transmitters should be prohibited in the operating area.

**FIGURE 13.5(b) Location of Flight Data Recorder and Cockpit Voice Recorder.**

ARFF personnel should also be aware that their vehicles and equipment can be a source of ignition and should take necessary precautions.

**13.6.5** Concurrent operations such as jacking, shifting, and removing panels should not be conducted during defueling operations. Transfer of fuel during defueling operations can cause changes in weight distribution, balance, and stability of the aircraft. Cribbing, blocking, use of air bags, and other stabilizing methods and equipment should be in place, ready for use if needed. Safe access for fueling vehicles, empty or full, should be provided.

**13.7 Post-Accident Fuel Leaks.**

**13.7.1** To control fuel system leaks prior to completion of aircraft defueling, fuel cell sealant, clay, or other material can be used to make mini-dams on smooth surfaces to direct the flow of fuel into containers. Crimping, pegs, and plugs should also be used where appropriate. It might also be possible to dig trenches to direct the fuel to collecting spots where it can be protected from ignition sources.

**13.7.2** Prior to moving the wreckage, the interior of the aircraft should be well ventilated to ensure a fire-safe environment.

*N* **13.7.3** After removal of the aircraft, hard ground surfaces should be thoroughly cleaned to remove any flammable liquids or debris before permitting normal traffic to resume. Soft ground surfaces may be contaminated. Advice should be sought from an environmental agency as to whether removal of contaminated ground surfaces may be required.

**13.8 Aircraft Systems Hazards.** ARFF personnel should seek the advice of aircraft systems specialists concerning items that might present problems during overhaul and salvage operations. Advice can include information regarding liquid or pressurized systems that need to be bled off prior to any cutting, bending, or prying around components.

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## Annex A Explanatory Material

*Annex A is not a part of the recommendations 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.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, 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 documents in a broad manner, since 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.3.3.5 Aircraft Accident Pre-Incident Planning.** A pre-incident plan should define the emergency organizational authority and the responsibilities of all those involved.

**A.3.3.8 Aircraft Fire Fighting.** Aircraft fire fighting does not include the control or extinguishment of airborne fires in aircraft.

**A.3.3.9 Aircraft Incident.** An incident does not result in serious injury to persons or substantial damage to aircraft.

**A.3.3.10 Aircraft Rescue and Fire Fighting (ARFF).** Additionally, ARFF personnel will enter the aircraft to provide assistance to the extent possible in the evacuation of the occupants. Although life safety is primary to ARFF personnel, responsibilities such as fuselage integrity and salvage should be maintained to the extent possible.

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**A.3.3.22 Composite Materials.** Composite materials do not present unusual fire-fighting problems, but products of their combustion arising from an aircraft fire should be considered a potential respiratory hazard to fire fighters.

**A.3.3.40 Flight Data Recorder (FDR).** It is usually mounted in the tail area of an aircraft and is designed to withstand certain impact forces and a degree of fire. Its purpose is to provide investigators with flight performance data that might be relevant in determining the cause of an accident/incident.

Δ **A.3.3.42.1 Aqueous Film Forming Foam (AFFF) Concentrate.** The foam formed acts as a barrier both to exclude air or oxygen and to develop an aqueous film on the fuel surface that is capable of suppressing the evolution of fuel vapors. The foam produced with AFFF concentrate is dry chemical compatible and thus is suitable for combined use with dry chemicals. [**11,** 2016]

**A.3.3.42.3 Fluoroprotein Foam Concentrate.** This has the effect of giving the foam a measurable degree of compatibility with dry-chemical extinguishing agents and an increase in tolerance to contamination by fuel.

**A.3.3.59 Ignition Temperature.** Reported values are obtained under specific test conditions and might not reflect a measurement at the substance's surface. Ignition by application of a pilot flame above the heated surface is referred to as pilot ignition temperature. Ignition without a pilot energy source has been referred to as autoignition temperature, self-ignition temperature, or spontaneous ignition temperature. The ignition temperature determined in a standard test is normally lower than the ignition temperature in an actual fire scenario. [**921,** 2017]

**A.3.3.75 Protective Clothing.** Protective clothing is divided into three types:

(1) Structural fire-fighting protective clothing
(2) High temperature–protective clothing
(3) Chemical-protective clothing
    (a) Liquid splash–protective clothing
    (b) Vapor-protective clothing

[**472,** 2018]

Δ **A.3.3.84 Self-Contained Breathing Apparatus (SCBA).** For the purposes of this guide, where this term is used without any qualifier, it indicates only open-circuit self-contained breathing apparatus or combination SCBA/SARs. For the purposes of this guide, combination SCBA/SARs are encompassed by the terms *self-contained breathing apparatus* or *SCBA*.

**A.3.3.99 Ventilation.** Ventilation can be achieved by introduction of fresh air to dilute contaminated air or by local exhaust of contaminated air. [**302,** 2015]

**A.4.2.2** When creating the response roadways from the firehouse to the incident area(s), the airport designer should consider the information in Table A.4.2.2(a) and Table A.4.2.2(b) when sizing the radius of curves. ARFF vehicles accelerate much faster than over-the-road vehicles and are capable of obtaining higher speeds in a short distance.

**A.6.2.2** Previous editions of this document used the following alerts:

(1) Local Standby Alert was Alert I
(2) Full Emergency Alert was Alert II
(3) Aircraft Accident Alert was Alert III

Δ **Table A.4.2.2(a) Vehicle Speed over Distance from a Standing Start**

| Distance Traveled from a Standing Start of the Vehicle | | Speed of Vehicle at the Given Distance | | | | | |
|---|---|---|---|---|---|---|---|
| | | Vehicle Water Tank Capacity ≥378.5 to ≤1892.5 L (≥100 to ≤500 gal) | | Vehicle Water Tank Capacity 1892.5 to ≤6000 L (>500 to ≤1585 gal) | | Vehicle Water Tank Capacity >6000 L (>1585 gal) | |
| m | ft | kph | mph | kph | mph | kph | mph |
| 30.5 | 100 | 29.0 | 18 | 32.2 | 20 | 29.0 | 18 |
| 76.2 | 250 | 40.2 | 25 | 48.3 | 30 | 40.2 | 25 |
| 152.4 | 500 | 48.3 | 30 | 64.4 | 40 | 48.3 | 30 |
| 228.6 | 750 | 64.4 | 40 | 72.4 | 45 | 64.4 | 40 |
| 304.8 | 1000 | 72.4 | 45 | 80.5 | 50 | 72.4 | 45 |

Δ **Table A.4.2.2(b) Minimum Radius of a Curve Based on Speed**

| Speed | | Minimum Radius of a Curve with a 0.04 Supervention (Almost Flat)* | |
|---|---|---|---|
| kph | mph | m | ft |
| 32.2 | 20 | 39.6 | 130 |
| 48.3 | 30 | 92.0 | 302 |
| 64.4 | 40 | 174.6 | 573 |
| 80.5 | 50 | 291.1 | 955 |
| 88.5 | 55 | 436.5 | 1432 |
| 96.6 | 60 | 498.9 | 1637 |

*Values were extracted from *A Policy on Geometric Design of Highways and Streets,* 2011 edition.

**A.7.2.2.4** Examples of this type of non-emergency ARFF response would include, but not be limited to, aeromedical evacuation operations with patient(s) on board, commercial passenger aircraft that are refueling without airstairs adjacent to opened doors, and aircraft defueling operations.

Δ **A.8.3.5** For more information on the physical properties of aviation fuels, see Annex B of NFPA 407.

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**A.11.4.4** Figure A.11.4.4 shows an example of a boom-mounted penetrating nozzle.

**A.12.9.4** Proximity to runway approach and departure corridors will require vertical clearance as well. Temporarily restricting runway thresholds may be required.

**A.13.1.4** See ICAO Annex 13, *Aircraft Accident and Incident Investigation,* and ICAO Document 6920, *Manual of Aircraft Accident Investigation.*

**A.13.2.3** These documents can include Certificate of Airworthiness, Certificate of Registration, Certificate of Maintenance, Technical Log, Load and Balance Sheets, Passenger and Flight Manifests, Crew Licenses, Navigational Log Sheets, Aircraft and Operations Manuals, Maps, and Notes. Eyewitnesses' and passengers' statements will be fundamental in assisting the investigating authorities in determining the probable cause, for example, indicating the final flight path.

**FIGURE A.11.4.4 Boom-Mounted Penetrating Nozzle.**

Δ **A.13.6.1** See NFPA 407, NFPA 410, and ICAO *Airport Service Manual,* Part 5, Removal of Disabled Aircraft.

**A.13.6.4** ARFF personnel should be made aware that defueling an inverted aircraft has very serious potential for fire. The common conclusion of experts in this field is, "If there is no leakage, leave it alone until the rescue operation is completed." The issue here is defueling an inverted aircraft, not fuel leakage. If there is fuel leakage, it should be dealt with in the same manner as any other fuel leak, regardless of the aircraft's attitude.

## Annex B Air Transport of Dangerous Goods (Hazardous Materials and Restricted Articles) and Nuclear Weapons

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

**B.1 Commercial Air Transport of Dangerous Goods.**

**B.1.1** The carriage of dangerous goods in commercial transport aircraft is an accepted practice and is closely controlled by national and international regulations.

**B.1.2 Definition of Dangerous Goods.** Dangerous goods include the following:

(1) Explosives and any other article defined as a combustible liquid, corrosive material, infectious substance, flammable compressed gas, flammable liquid, flammable solid, magnetized material, nonflammable compressed gas, oxidizing material, poisonous article, radioactive material, or other restricted article.
(2) Some unlikely items can come under the heading of dangerous goods. For example, wheelchairs could contain wet-cell batteries, and breathing apparatus might have compressed air cylinders. Personnel should be aware of hazards that might not be immediately apparent.

**B.2 Radioactive Material.** Radioactive materials constitute a particular hazard. They emit certain rays that can be a health hazard and that cannot be detected except by instruments. Radioactive materials transported by air fall into the following three categories:

(1) *Category I.* Material emits minimal radiation.
(2) *Category II.* Material emits more radiation and is assigned a transport index up to 1.
(3) *Category III.* Material could have a transport index of 1.1, up to a maximum of 10.

**B.3 Transport Index.**

**B.3.1** The transport index for a package of radioactive material is a simplified expression of the maximum amount of radiation emitted, in millirem per hour, measured one meter from the surface of the package. This number should appear on the notification, and such notification should be received by the pilot-in-command. The sum of the transport indexes is the primary concern, along with the stowage of the packages, to ensure that no living beings are exposed to hazardous radiation.

NOTE 1: In the United States, dangerous goods are transported by air under authority of 49 CFR 175, "Transportation."

NOTE 2: The International Air Transport Association has issued the IATA *Restricted Articles Regulations.* Also, the International Civil Aviation Organization has developed technical instructions (Document 9284-AN/905) for the safe transportation of dangerous goods by air.

**B.3.2** Dangerous goods are regularly being carried on commercial transport aircraft. This includes passenger aircraft, passenger cargo aircraft (COMBI), and cargo aircraft. While the packaging requirements used to transport these materials are designed for proper containment, the possibility of breakage cannot be overlooked. This introduces the hazards of leaking flammable liquids and poisons, or radioactive contamination at an accident site. By knowing and recognizing dangerous goods labels, fire fighters can be alerted to these hazards.

**B.4 Dangerous Goods Warning Labels.**

**B.4.1** The dangerous goods warning labels are authorized by the U.S. Department of Transportation (DOT) based on the United Nations labeling system and are authorized for domestic and foreign shipments. Shippers must furnish and attach the appropriate label(s) to each package of dangerous goods being offered for shipment by air. Refer to the AHJ references for descriptions, labels, and information regarding dangerous goods.

**B.4.2** The pilot-in-command of an aircraft should be provided with all relevant information regarding dangerous goods onboard the aircraft, and, in the event of an incident, this information should be obtained by airport emergency services either directly from the pilot or through the operations office.

**B.4.3** The NFPA publication *Fire Protection Guide on Hazardous Materials* provides essential information for those confronted with emergencies such as fire, accidental spills, and aircraft accidents. With the urgency of prompt identification in mind, this guide has been arranged so that the user can access the information with a minimum of delay.

**B.5 Incidents or Accidents Involving Radioactive Materials.**

**B.5.1** Radioactive materials carried in commercial transport aircraft are packed in rugged containers of varying sizes, such as steel drums, wooden containers, heavy corrugated cardboard, or lead boxes. In the event of an aircraft accident, the possibility of these containers breaking should always be considered.

**B.5.2** This introduces the hazard of radioactive contamination of an accident site. The following procedures should then be followed in the United States (similar procedures are followed in other countries):

(1) Notify the nearest Department of Energy office or military base (if military aircraft is involved) of the accident immediately. They in turn will respond with a radiological team to the accident scene.
(2) Restrict the public to as far away from the scene as possible. Souvenir collectors should be forbidden at all accident scenes.
(3) Segregate fire fighters who have had possible contact with radioactive material until they have been examined further by competent authorities.
(4) Remove injured from the area of the accident with as little physical contact as possible and hold them at a transfer point. Take any measure necessary to save lives, but carry out minimal (no more than necessary) first aid and surgical procedures until help is obtained from the radiological team physicians or other physicians familiar with radiation medicine. Whenever recommended by a doctor, an injured individual should be removed to a hospital or office for treatment, but the doctor or hospital should be informed when there is reason to suspect that the injured individual's body or clothing has been contaminated with radiation.
(5) In accidents involving fire, fight fires upwind as far as possible, keeping out of any smoke, fumes, or dust arising from the accident. Handle this as a fire involving toxic chemicals (using positive-pressure SCBA and full-protective clothing). Do not handle suspected material until it has been monitored and released by monitoring personnel. Segregate all clothing and tools used at the fire until they can be checked by the radiological emergency team.
(6) Do not eat, drink, or smoke in the area. Do not use food or drinking water that might have been in contact with material from the accident.
(7) Measure the level of radioactivity. The use of instruments such as Geiger counters, ionization chambers, dosimeters, and so forth, is the only accurate means of determining if radioactive contamination is being given off.
(8) Control runoff. To the extent possible, runoff water and other agents used in fire fighting and cleaning should be channeled, collected, and dammed to prevent entry into watercourses and the possible spread of contamination.

**B.6 Military Aircraft Carrying Weapons.**

**B.6.1** While most military aircraft will attempt to return to a military airbase in case of emergency, this is sometimes impossible, and landings are frequently made at nonmilitary airports. There are also many cases where "joint-use" airports serve both the military and civil aircraft operations. For these reasons, it is advisable for aircraft rescue and fire-fighting crews to be familiar with the various types of military aircraft operating in the area. For this purpose, training visits to promote knowledge of the special features of military aircraft at nearby military installations are of value. Such liaisons are encouraged by the military.

**B.6.2** Any person receiving information of a military aircraft accident should immediately notify the base operations office at the nearest military establishment, giving all relevant information. Telephone numbers of such military installations should be kept on hand at civil airports, at nearby municipal fire stations, and in airport control towers.

**B.6.3** Care should be exercised by the rescue and fire-fighting crews when approaching any military aircraft involved in fire. Armament, ejection seats, or hazardous or other dangerous cargoes can present severe hazards during such operation.

**B.6.4** The possibility of an atomic explosion from the detonation of a nuclear weapon or warhead due to a fire, inadvertent release, or impact accident is so small it is practically nonexistent. Safety features and devices have been carefully designed and incorporated in nuclear weapons and warheads to make this assurance possible. The danger of a nuclear weapon is from the high explosives (HE) used, plus radiation from the components.

**B.6.5** The presence of nuclear weapons in aircraft generally creates no greater hazard than does the presence of conventional high explosives. Most weapons contain a high explosive that could detonate upon moderate to severe impact or when subject to fire. In fact, exposure to heat can make the high explosive more sensitive. In nuclear weapons, the amount of high explosive is considerably less than that found in conventional high explosive bombs. Chemical or radiological hazards might exist during and after an accident or in a fire where a nuclear weapon is involved.

**B.6.6** Basically, the same techniques are used for fighting aircraft fires involving nuclear weapons as are those in which conventional high explosive bombs are involved; special extinguishing agents are not required to control and extinguish such fires. The brief amount of time available to control or extinguish the fire before an explosion might be expected is the only special factor to be considered.

**B.7 Description.** In general, nuclear weapons resemble conventional bombs in that they are enclosed in a shell or casing that is generally cylindrical in shape with tail fins. The weapon or warhead casings are of various thicknesses and might break up upon impact. Most weapons contain a conventional type of high explosive that can detonate upon moderate to severe impact or when subject to fire. The quantity of high explosives involved in a detonation can vary from a small amount to several hundred pounds and constitutes the major hazard in such an accident. If the casing breaks upon impact, the exposed and unconfined pieces of high explosive can ignite and burn, or might explode if stepped on or run over. Regardless of the type of weapon, some minor radiological hazards might exist if the weapon burns or if detonation of a high explosive occurs.

**B.8 Time Factors.** The length of time available to safely fight a fire involving nuclear weapons depends largely upon the physical characteristics of the weapon or warhead case, the intensity of the fire, and the proximity of the fire. Since weapon and warhead cases vary in thickness, fire-fighting time factors range from 3 minutes to an indefinite period if the fire impact incident does not detonate the high explosive immediately. The time element for each type of nuclear weapon or component is an important factor in fighting these fires. As soon as fire envelops the weapon area these time factors become effective. For weapons or warheads within a fire impact incident area, and subject to extreme heat but not enveloped in flames, a time factor of 15 minutes will apply; if the fire-fighting time factor is unknown to the fire fighters, the minimum time factor of 3 minutes should be observed. Military flight communications procedures normally provide for notification to control towers of pertinent information regarding such time factors. When a weapon or warhead has been involved in a fire and its time factor has expired, even though the fire has been extinguished or burned out, safe evacuation distances should be observed until the arrival of authorized explosive ordinance disposal personnel.

**B.9 High-Explosive Blast and Fragmentation.** The radius of a high-explosive blast from a weapon varies, depending on the amount of high explosive that actually detonates. High-explosive blast fragmentation distances for these weapons range from a minimum radius of 122 m (400 ft) to a maximum of 305 m (1000 ft). Personnel within these areas can be seriously injured from blast or fragmentation upon detonation of the high explosive. These areas and distances should be considered during the initial fire department approach to an accident where weapons have been enveloped in flames for a period approximating or exceeding the weapon time factor limitations. All except experienced fire-fighting personnel should immediately evacuate to a minimum distance of 450 m (1500 ft) for protection against blast or fragmentation.

**B.10 Precautionary Measures.** Under no circumstances should any high-explosive material from ruptured weapons that have been exposed to fire (or any components that have been scattered) be handled, stepped on, driven over, or disturbed in any manner. High-explosive material is extremely sensitive to minor detonations from shock or impact and can cause serious injury. Protective clothing and positive-pressure SCBA should be worn during fire-fighting operations to provide the fire fighter maximum protection from any chemical or minor radiological hazards that are present. Additional protection is afforded by fighting any fire from an upwind position. All exposed clothing, apparatus, and equipment used during a fire or impact incident where nuclear weapons or components have been involved should be monitored for possible radiological contamination by specialized recovery personnel equipped for this purpose.

**B.11 Associated Hazards.** Some possible hazards are as follows:

(1) *Radiological.* In the event of a high-explosive detonation or burning of a radioactive weapon, one has to be concerned principally with alpha-emitting contamination, which is serious only when ingested. Other types of radiation, which are harmless at the low levels produced in a weapon, can be detected with the use of sensitive detection instruments. (The effect of this radiation can be likened to the effects of radiation emanating from a luminous dial wristwatch.) Since alpha-emitting particles are so fine that they can be carried as smoke or dust from the burning or high-explosive detonation of a nuclear weapon, some alpha-emitting contamination should be expected in the immediate accident area and downwind. Although this material can present a minor radiation problem, danger from these particles exists only when they are inhaled in significant amounts. Protection against the highest alpha levels that could be expected from such burning or high-explosive detonation incidents is afforded fire-fighting personnel by the prescribed protective clothing and SCBA.

(2) *Fire.* Hazards associated with the burning of nuclear weapons and components are generally the same as those presented by conventional high explosives.

(3) *Impact.* Weapons or warheads can break up, and the high explosive can detonate from impact. Detonation and breakup are contingent to a large degree upon the characteristics of the weapon or warhead case, the impact velocity, and the location of aircraft suspension devices.

(4) *Sympathetic Detonation.* Detonation of a weapon or warhead, by fire or by impact, is also likely to induce detonation (nonnuclear) of any other weapon or warhead in the open within a 15 m to 90 m (50 ft to 300 ft) radius of the incident area.

(5) *High-Explosive Burning Characteristics.* Flame and smoke characteristics of burning high explosives vary and provide no specific pattern upon which to determine when the high explosive is about to detonate. Burning high explosives produce flames of various colors; they can be bright red, yellow, greenish-white, or combinations thereof with no predominant color. Some give off a white smoke, while others burn with no trace of smoke.

## Annex C Specialized Vehicles and Equipment

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

**C.1 Hovercraft.** The hovercraft in Figure C.1 is typical of many designs available. They are easily operated and maintained with minimum training and can traverse a variety of surfaces such as water, tidal flats, snow, and ice. Payloads of 908 kg (2000 lb) permit up to 20 life rafts to be carried on this model. Piston engine operation offers a unique rescue vehicle at a fraction of the cost of a helicopter.

Δ **C.2 Aircraft Interior Access Vehicle (AIAV).** An AIAV can provide valuable assistance for expeditious ingress/egress firefighting operations *(see Figure C.2)*.

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Δ **FIGURE C.1 Hovercraft.**


*N* **FIGURE C.2 Aircraft Interior Access Vehicle.**

## Annex D Sample Format for Agreement for Mutual Aid in Fire Protection and Hazardous Materials Incident Response (U.S.)

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

**D.1 Source.** The material in Section D.2 was provided by the United States Air Force.

Δ **D.2 Sample Agreement.** This agreement, entered into this XX day of XXX 20XX, between the Secretary of the (insert name of DoD Component) acting pursuant to the authority of 42 U.S.C. 1856a and (insert name of fire organization) is securing to each the benefits of mutual aid in fire prevention and hazardous materials incident response, in the protection of life and property from fire, hazardous materials incident and in firefighting. It is agreed that:

a. On request to a representative of the (insert name of installation) fire department by a representative of the (insert name of fire organization), firefighting equipment and personnel of the (insert name of installation) fire department will be dispatched to any point within the area for which the (insert name of fire organization) normally provides fire protection or hazardous materials incident response as designated by the representatives of the (insert name of fire organization).

b. On request to a representative of the (insert name of fire organization) by a representative of the (insert name of installation) fire department, firefighting equipment or hazardous materials incident response and personnel of the (insert name of fire organization) will be dispatched to any point within the firefighting or hazardous materials incident response jurisdiction of the (insert name of installation) fire department as designated by the representative of the (insert name of installation) fire department.

c. Any dispatch of equipment and personnel pursuant to this agreement is subject to the following conditions:

(1) Any request for aid hereunder shall include a statement of the amount and type of equipment and personnel requested and shall specify the location to which the equipment and personnel are to be dispatched, but the amount and type of equipment and the number of personnel to be furnished shall be determined by a representative of the responding organization.
(2) The responding organization shall report to the officer in charge of the requesting organization at the location to which the equipment is dispatched, and shall be subject to the orders of that official.
(3) A responding organization shall be released by the requesting organization when the services of the responding organization are no longer required or when the responding organization is needed within the area for which it normally provides fire protection.
(4) In the event of a crash of an aircraft owned or operated by the United States or military aircraft of any foreign nation within the area for which the (insert name of fire organization) normally provides fire protection, the chief of the (insert name of installation) fire department or his or her representative may assume full command on arrival at the scene of the crash.

(5) Where local agencies do not assign an incident safety officer, an Air Force representative will be assigned to act the incident safety officer to observe operations when responding to mutual aid emergencies.

d. (Insert name of fire service) may claim reimbursement for the direct expenses and losses that are additional firefighting or hazardous materials incident costs above the normal operating costs incurred while fighting a fire or hazardous materials incident response under this agreement as provided in 44 CFR Part 151, "Reimbursement for Costs of Firefighting on Federal Property."

e. Both parties agree to implement the National Incident Management System during all emergency responses on and off installations in accordance with NFPA 1561.

f. Each party waives all claims against every other party for compensation for any loss, damage, personal injury, or death occurring as a consequence of the performance of this agreement. This provision does not waive any right of reimbursement pursuant to paragraph d above.

g. All equipment used by (insert name of fire organization) in carrying out this agreement will, at the time of action hereunder, be owned by it; and all personnel acting for (insert name of fire organization) under this agreement will, at the time of such action, be an employee or volunteer member of (insert name of fire organization).

For (insert name of fire organization); For the Secretary of the (insert name of DoD Component)

____________________ ____________________

(TITLE) (COMMANDER)

## Annex E Informational References

**E.1 Referenced Publications.** The documents or portions thereof listed in this annex are referenced within the informational sections of this guide and are not advisory in nature unless also listed in Chapter 2 for other reasons.

**E.1.1 NFPA Publications.** National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 407, *Standard for Aircraft Fuel Servicing*, 2017 edition.

NFPA 410, *Standard on Aircraft Maintenance*, 2015 edition.

NFPA 1561, *Standard on Emergency Services Incident Management System*, 2014 edition.

*Fire Protection Guide on Hazardous Materials*, 13th edition, 2010.

**E.1.2 Other Publications.**

**E.1.2.1 IATA Publications.** International Air Transport Association Headquarters, IATA Building, 2000 Peel Street, Montreal, Canada H3A 2R4.

*Restricted Articles Regulations*, 2015.

**E.1.2.2 ICAO Publications.** International Civil Aviation Organization, 999 Robert-Bourassa Boulevard, Montréal, Quebec H3C 5H7, Canada.

*Aircraft Accident and Incident Investigation* (Annex 13), 10th edition, July 2010.

*Airport Service Manual*, Part 5, Removal of Disabled Aircraft, 4th edition, 2009.

Document 6920, *Manual of Aircraft Accident Investigation.*

Document 9284, *Technical Instructions for the Safe Transport of Dangerous Goods by Air*, 2015–2016.

**E.1.2.3 U.S. Government Publications.** U.S. Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

*A Policy on Geometric Design of Highways and Streets,* American Association of State Highway and Transportation Officials, 6th edition, 2011.

Title 44, Code of Federal Regulations, Part 151, "Reimbursement for Costs of Firefighting on Federal Property."

Title 49, Code of Federal Regulations, Part 175, "Transportation."

**E.2 Informational References.** The following documents or portions thereof are listed here as informational resources only. They are not directly referenced in this guide.

**E.2.1 ICAO Publications.** International standards and recommended practices are promulgated by the International Civil Aviation Organization, 999 Robert-Bourassa Boulevard, Montréal, Quebec H3C 5H7, Canada.

*Aerodromes* (Annex 14), 6th edition, July 2013.

*Airport Services Manual, Part 1*: "Rescue and Fire Fighting," 3rd edition, 1990, reprinted 2004.

*Emergency Response Guidance for Aircraft Incidents Involving Dangerous Goods*, 2015–2016.

*Technical Instructions for the Transport of Dangerous Goods by Air,* Document 9284-AN/905, 2015–2016.

**E.2.2 U.S. Government Publications.** U.S. Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Δ **E.2.2.1 Department of Transportation Publications.** Available from Department of Transportation, Distribution Unit, M-494.3, Washington, DC 20590.

*Advisory Circulars.* This listing is limited to those free advisory circulars relating to aircraft rescue and fire-fighting services. Advisory Circulars are available for free download at www.faa.gov.

FAA AC 150/5200-12C, *First Responders' Responsibility for Protecting Evidence at the Scene of an Aircraft Accident/Incident,* 2009 (AAS-100). Furnishes general guidance for airport employees, airport management, and other personnel responsible for fire-fighting and rescue operations, at the scene of an aircraft accident, on the proper presentation of evidence.

FAA AC 150/5200-18C, *Airport Safety Self-Inspection,* 2004 (AAS-310). Suggests functional responsibility, procedures, a checklist, and schedule for an airport safety self-inspection.

FAA AC 150/5210-6D, *Aircraft Fire Extinguishing Agents,* 2004 (AAS-100). Outlines scales of protection considered as the recommended level — compared with the minimum level in Federal Aviation Regulation Part 139.49 — and tells how these levels were established from test and experience data.

FAA AC 150/5210-13C, *Airport Water Rescue Plans and Equipment,* 2010 (AAS-300). Suggests planning procedures, facilities, and equipment to effectively perform rescue operations when an aircraft lands in a body of water, swamp, or tidal area where normal aircraft fire-fighting and rescue service vehicles are unable to reach the accident scene.

FAA AC 150/5210-14B, *Airport Rescue Fire Fighting Equipment, Tools, and Clothing,* 2008 (AAS-100). Developed to assist airport management in the development of local procurement specifications for an acceptable, cost-effective proximity suit for use in aircraft rescue and fire-fighting operations.

FAA AC 150/5210-15A, *Airport Rescue and Fire Fighting Station Building Design,* 2008 (AAS-100). Provides standards and guidance for planning, designing, and constructing an airport rescue and fire-fighting station.

FAA AC 150/5210-5D, *Painting, Marking, and Lighting of Vehicles Used on an Airport,* 2010 (AAA-120). Provides guidance, specifications, and standards — in the interest of airport personnel safety and operational efficiency — for painting, marking, and lighting of vehicles operating in the airport air operations areas.

FAA AC 150/5210-7D, *Aircraft Rescue and Fire Fighting Communications,* 2008 (AAS-120). Provides guidance and information for planning and implementing an airport communications system for airport fire and rescue service.

(Cancelled 9-19-2011) FAA AC 150/5220-4, *Water Supply Systems for Aircraft Fire and Rescue Protection* (AAS-120). Provides guidance for the water source selection and standards for a water distribution system designed to support aircraft rescue and fire-fighting (ARFF) service operations on airports.

FAA AC 150/5220-9A, *Aircraft Arresting Systems,* 2006 (AAS-300). Updates existing policy, and describes and illustrates the various types of military aircraft emergency arresting systems that are now installed at various joint civil/military airports. It also informs users of criteria concerning installations of such systems at joint civil/military airports.

FAA AC 150/5220-10E, *Guide Specification for Aircraft Rescue and Fire Fighting Vehicles,* 2011 (AAS-100). Assists airport management in the development of local procurement specifications.

FAA AC 150/5230-4B, *Aircraft Fuel Storage, Handling, and Dispensing on Airports,* 2011 (AAS-300). Provides information on aviation fuel deliveries to airport storage and the handling, cleaning, and dispensing of fuel into aircraft.

FAA AC 150/5340-1L, *Standards for Airport Markings,* 2013 (AAS-200). Describes standards for marking paved runways, taxiways, closed and/or hazardous areas on airports.

FAA AC 150/5340-18F, *Standards for Airport Sign Systems,* 2010 (AAS-200). Contains the Federal Aviation Administration standards for use of sign systems on airports.

FAA AC 150/5370-2F, *Operational Safety on Airports During Construction,* 2011 (AAS-300). Concerns operational safety on airports — with special emphasis on safety during periods of construction activity — to assist airport operators in complying with *Part 139*.

FAA AC 150/5210-24, *Airport Foreign Object Debris (FOD) Management,* 2010. (Supersedes FAA AC 150/5380-5B) (AAS-300). Discusses problems of debris at airports, gives information on foreign objects, and tells how to eliminate such objects from operational areas.

**E.2.2.2 U.S. Military Publications.**

Air Force: Technical Manual 00-105E-9, *Aircraft Emergency (Fire Protection Information)*, available from HQ WR-ALC (MMEOTD), Robbins AFB, GA 31093.

Navy and Marine: NAVAIR 00-80R-14, *Aircraft Fire Fighting and Rescue Manual for US Naval and Marine Air Stations and Facilities*, available from Naval Air Technical Services Facility, 700 Robins Avenue, Philadelphia, PA 19111.

Army: *Technical Manual 5-315*, available from Superintendent of Public Documents, Public Documents Department, U.S. Government Publishing Office, Washington, DC 20402.

**E.2.2.3 Other Publications.**

*Advanced Techniques in Impact Protection and Emergency Egress from Air Transport Aircraft*, R.G. Snyder Report, HEARD-AG 221, National Transportation Safety Board Accident Reports.

*Federal Aviation Register Part 139*.

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**E.3 References for Extracts in Informational Sections.**

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2016 edition.

NFPA 302, *Fire Protection Standard for Pleasure and Commercial Motor Craft*, 2015 edition.

NFPA 472, *Standard for Competence of Responders to Hazardous Materials/Weapons of Mass Destruction Incidents*, 2018 edition.

NFPA 921, *Guide for Fire and Explosion Investigations*, 2017 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*, 2019 edition.

# Index

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## *Sequence of Events for the Standards Development Process*

*Once the current edition is published, a Standard is opened for Public Input.*

**Step 1 – Input Stage**

- Input accepted from the public or other committees for consideration to develop the First Draft
- Technical Committee holds First Draft Meeting to revise Standard (23 weeks); Technical Committee(s) with Correlating Committee (10 weeks)
- Technical Committee ballots on First Draft (12 weeks); Technical Committee(s) with Correlating Committee (11 weeks)
- Correlating Committee First Draft Meeting (9 weeks)
- Correlating Committee ballots on First Draft (5 weeks)
- First Draft Report posted on the document information page

**Step 2 – Comment Stage**

- Public Comments accepted on First Draft (10 weeks) following posting of First Draft Report
- If Standard does not receive Public Comments and the Technical Committee chooses not to hold a Second Draft meeting, the Standard becomes a Consent Standard and is sent directly to the Standards Council for issuance (see Step 4) or
- Technical Committee holds Second Draft Meeting (21 weeks); Technical Committee(s) with Correlating Committee (7 weeks)
- Technical Committee ballots on Second Draft (11 weeks); Technical Committee(s) with Correlating Committee (10 weeks)
- Correlating Committee Second Draft Meeting (9 weeks)
- Correlating Committee ballots on Second Draft (8 weeks)
- Second Draft Report posted on the document information page

**Step 3 – NFPA Technical Meeting**

- Notice of Intent to Make a Motion (NITMAM) accepted (5 weeks) following the posting of Second Draft Report
- NITMAMs are reviewed and valid motions are certified by the Motions Committee for presentation at the NFPA Technical Meeting
- NFPA membership meets each June at the NFPA Technical Meeting to act on Standards with “Certified Amending Motions” (certified NITMAMs)
- Committee(s) vote on any successful amendments to the Technical Committee Reports made by the NFPA membership at the NFPA Technical Meeting

**Step 4 – Council Appeals and Issuance of Standard**

- Notification of intent to file an appeal to the Standards Council on Technical Meeting action must be filed within 20 days of the NFPA Technical Meeting
- Standards Council decides, based on all evidence, whether to issue the standard or to take other action

**Notes:**

1. Time periods are approximate; refer to published schedules for actual dates.
2. Annual revision cycle documents with certified amending motions take approximately 101 weeks to complete.
3. Fall revision cycle documents receiving certified amending motions take approximately 141 weeks to complete.

## *Committee Membership Classifications*[1,2,3,4]

The following classifications apply to Committee members and represent their principal interest in the activity of the Committee.

1. M *Manufacturer:* A representative of a maker or marketer of a product, assembly, or system, or portion thereof, that is affected by the standard.
2. U *User:* A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.
3. IM *Installer/Maintainer:* A representative of an entity that is in the business of installing or maintaining a product, assembly, or system affected by the standard.
4. L *Labor:* A labor representative or employee concerned with safety in the workplace.
5. RT *Applied Research/Testing Laboratory:* A representative of an independent testing laboratory or independent applied research organization that promulgates and/or enforces standards.
6. E *Enforcing Authority:* A representative of an agency or an organization that promulgates and/or enforces standards.
7. I *Insurance:* A representative of an insurance company, broker, agent, bureau, or inspection agency.
8. C *Consumer:* A person who is or represents the ultimate purchaser of a product, system, or service affected by the standard, but who is not included in (2).
9. SE *Special Expert:* A person not representing (1) through (8) and who has special expertise in the scope of the standard or portion thereof.

NOTE 1: “Standard” connotes code, standard, recommended practice, or guide.

NOTE 2: A representative includes an employee.

NOTE 3: While these classifications will be used by the Standards Council to achieve a balance for Technical Committees, the Standards Council may determine that new classifications of member or unique interests need representation in order to foster the best possible Committee deliberations on any project. In this connection, the Standards Council may make such appointments as it deems appropriate in the public interest, such as the classification of “Utilities” in the National Electrical Code Committee.

NOTE 4: Representatives of subsidiaries of any group are generally considered to have the same classification as the parent organization.

## Submitting Public Input / Public Comment Through the Online Submission System

Soon after the current edition is published, a Standard is open for Public Input.

Before accessing the Online Submission System, you must first sign in at www.nfpa.org. *Note: You will be asked to sign-in or create a free online account with NFPA before using this system:*

a. Click on Sign In at the upper right side of the page.
b. Under the Codes and Standards heading, click on the "List of NFPA Codes & Standards," and then select your document from the list or use one of the search features.

*OR*

a. Go directly to your specific document information page by typing the convenient shortcut link of www.nfpa.org/document# (Example: NFPA 921 would be www.nfpa.org/921). Sign in at the upper right side of the page.

To begin your Public Input, select the link "The next edition of this standard is now open for Public Input" located on the About tab, Current & Prior Editions tab, and the Next Edition tab. Alternatively, the Next Edition tab includes a link to Submit Public Input online.

At this point, the NFPA Standards Development Site will open showing details for the document you have selected. This "Document Home" page site includes an explanatory introduction, information on the current document phase and closing date, a left-hand navigation panel that includes useful links, a document Table of Contents, and icons at the top you can click for Help when using the site. The Help icons and navigation panel will be visible except when you are actually in the process of creating a Public Input.

Once the First Draft Report becomes available there is a Public Comment period during which anyone may submit a Public Comment on the First Draft. Any objections or further related changes to the content of the First Draft must be submitted at the Comment stage.

To submit a Public Comment you may access the online submission system utilizing the same steps as previously explained for the submission of Public Input.

For further information on submitting public input and public comments, go to: http://www.nfpa.org/publicinput.

## Other Resources Available on the Document Information Pages

**About tab:** View general document and subject-related information.

**Current & Prior Editions tab:** Research current and previous edition information on a Standard.

**Next Edition tab:** Follow the committee's progress in the processing of a Standard in its next revision cycle.

**Technical Committee tab:** View current committee member rosters or apply to a committee.

**Technical Questions tab:** For members and Public Sector Officials/AHJs to submit questions about codes and standards to NFPA staff. Our Technical Questions Service provides a convenient way to receive timely and consistent technical assistance when you need to know more about NFPA codes and standards relevant to your work. Responses are provided by NFPA staff on an informal basis.

**Products & Training tab:** List of NFPA's publications and training available for purchase.

## Information on the NFPA Standards Development Process

**I. Applicable Regulations.** The primary rules governing the processing of NFPA standards (codes, standards, recommended practices, and guides) are the NFPA *Regulations Governing the Development of NFPA Standards (Regs)*. Other applicable rules include NFPA *Bylaws*, NFPA *Technical Meeting Convention Rules*, NFPA *Guide for the Conduct of Participants in the NFPA Standards Development Process*, and the NFPA *Regulations Governing Petitions to the Board of Directors from Decisions of the Standards Council*. Most of these rules and regulations are contained in the *NFPA Standards Directory*. For copies of the *Directory*, contact Codes and Standards Administration at NFPA Headquarters; all these documents are also available on the NFPA website at "www.nfpa.org."

The following is general information on the NFPA process. All participants, however, should refer to the actual rules and regulations for a full understanding of this process and for the criteria that govern participation.

**II. Technical Committee Report.** The Technical Committee Report is defined as "the Report of the responsible Committee(s), in accordance with the Regulations, in preparation of a new or revised NFPA Standard." The Technical Committee Report is in two parts and consists of the First Draft Report and the Second Draft Report. (See *Regs* at Section 1.4.)

**III. Step 1: First Draft Report.** The First Draft Report is defined as "Part one of the Technical Committee Report, which documents the Input Stage." The First Draft Report consists of the First Draft, Public Input, Committee Input, Committee and Correlating Committee Statements, Correlating Notes, and Ballot Statements. (See *Regs* at 4.2.5.2 and Section 4.3.) Any objection to an action in the First Draft Report must be raised through the filing of an appropriate Comment for consideration in the Second Draft Report or the objection will be considered resolved. [See *Regs* at 4.3.1(b).]

**IV. Step 2: Second Draft Report.** The Second Draft Report is defined as "Part two of the Technical Committee Report, which documents the Comment Stage." The Second Draft Report consists of the Second Draft, Public Comments with corresponding Committee Actions and Committee Statements, Correlating Notes and their respective Committee Statements, Committee Comments, Correlating Revisions, and Ballot Statements. (See *Regs* at 4.2.5.2 and Section 4.4.) The First Draft Report and the Second Draft Report together constitute the Technical Committee Report. Any outstanding objection following the Second Draft Report must be raised through an appropriate Amending Motion at the NFPA Technical Meeting or the objection will be considered resolved. [See *Regs* at 4.4.1(b).]

**V. Step 3a: Action at NFPA Technical Meeting.** Following the publication of the Second Draft Report, there is a period during which those wishing to make proper Amending Motions on the Technical Committee Reports must signal their intention by submitting a Notice of Intent to Make a Motion (NITMAM). (See *Regs* at 4.5.2.) Standards that receive notice of proper Amending Motions (Certified Amending Motions) will be presented for action at the annual June NFPA Technical Meeting. At the meeting, the NFPA membership can consider and act on these Certified Amending Motions as well as Follow-up Amending Motions, that is, motions that become necessary as a result of a previous successful Amending Motion. (See 4.5.3.2 through 4.5.3.6 and Table 1, Columns 1-3 of *Regs* for a summary of the available Amending Motions and who may make them.) Any outstanding objection following action at an NFPA Technical Meeting (and any further Technical Committee consideration following successful Amending Motions, see *Regs* at 4.5.3.7 through 4.6.5.3) must be raised through an appeal to the Standards Council or it will be considered to be resolved.

**VI. Step 3b: Documents Forwarded Directly to the Council.** Where no NITMAM is received and certified in accordance with the Technical Meeting Convention Rules, the standard is forwarded directly to the Standards Council for action on issuance. Objections are deemed to be resolved for these documents. (See *Regs* at 4.5.2.5.)

**VII. Step 4a: Council Appeals.** Anyone can appeal to the Standards Council concerning procedural or substantive matters related to the development, content, or issuance of any document of the NFPA or on matters within the purview of the authority of the Council, as established by the Bylaws and as determined by the Board of Directors. Such appeals must be in written form and filed with the Secretary of the Standards Council (see *Regs* at Section 1.6). Time constraints for filing an appeal must be in accordance with 1.6.2 of the *Regs*. Objections are deemed to be resolved if not pursued at this level.

**VIII. Step 4b: Document Issuance.** The Standards Council is the issuer of all documents (see Article 8 of *Bylaws*). The Council acts on the issuance of a document presented for action at an NFPA Technical Meeting within 75 days from the date of the recommendation from the NFPA Technical Meeting, unless this period is extended by the Council (see *Regs* at 4.7.2). For documents forwarded directly to the Standards Council, the Council acts on the issuance of the document at its next scheduled meeting, or at such other meeting as the Council may determine (see *Regs* at 4.5.2.5 and 4.7.4).

**IX. Petitions to the Board of Directors.** The Standards Council has been delegated the responsibility for the administration of the codes and standards development process and the issuance of documents. However, where extraordinary circumstances requiring the intervention of the Board of Directors exist, the Board of Directors may take any action necessary to fulfill its obligations to preserve the integrity of the codes and standards development process and to protect the interests of the NFPA. The rules for petitioning the Board of Directors can be found in the *Regulations Governing Petitions to the Board of Directors from Decisions of the Standards Council* and in Section 1.7 of the *Regs*.

**X. For More Information.** The program for the NFPA Technical Meeting (as well as the NFPA website as information becomes available) should be consulted for the date on which each report scheduled for consideration at the meeting will be presented. To view the First Draft Report and Second Draft Report as well as information on NFPA rules and for up-to-date information on schedules and deadlines for processing NFPA documents, check the NFPA website (www.nfpa.org/docinfo) or contact NFPA Codes & Standards Administration at (617) 984-7246.

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