

# NFPA 295

## Standard for Wildfire Control

### 1998 Edition



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An International Codes and Standards Organization

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## **NFPA 295**

### **Standard for**

## **Wildfire Control**

### **1998 Edition**

This edition of NFPA 295, *Standard for Wildfire Control*, was prepared by the Technical Committee on Forest and Rural Fire Protection and acted on by the National Fire Protection Association, Inc., at its Annual Meeting held May 18–21, 1998, in Cincinnati, OH. It was issued by the Standards Council on July 16, 1998, with an effective date of August 5, 1998, and supersedes all previous editions.

This edition of NFPA 295 was approved as an American National Standard on August 6, 1998.

### **Origin and Development of NFPA 295**

This complete rewrite of NFPA 295 was prepared by the Technical Committee on Forest and Rural Fire Protection. This edition emphasizes the incident command structure for wildfire control and reduces the amount of information on air operations. The Technical Committee recommends that personnel required to work around air operations for wildfire control receive special training and more information than could be reasonably included in this standard.

This edition replaces the previous edition (1991) and succeeds the 1985 and 1978 editions as well as other editions that bore the titles *Wildfire Control and Environmental Improvement* (1972); *Forest, Grass and Brush Fire Control* (1965); *Community Organization and Equipment for Fighting Forest, Grass and Brush Fires* (1956); and the original NFPA 295, *Community Forest Fire Equipment*, adopted by NFPA in 1934.

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

**Committee Scope:** This Committee shall have primary responsibility for documents on fire protection for rural, suburban, forest, grass, brush, and tundra areas. This Committee shall also have primary responsibility for documents on Class A foam and its utilization for all wildland and structural fire fighting. This excludes fixed fire protection systems.

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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 Appendix A.

Information on referenced publications can be found in Chapter 9 and Appendix C.

**Chapter 1 Introduction**

**1-1 Scope.** This standard presents fundamental information to fire protection organizations on the control of wildfire.

**1-2\* Purpose.** The purpose of this standard is to specify management practices and policies necessary for a fire protection organization to develop an effective wildfire control program.

**1-3 Definitions.** For the purposes of this standard, terms have the following meanings.

**Agency.** A division of government with a specific function or a nongovernmental organization (e.g., private business) that offers a particular kind of assistance.

**Apparatus.** A motor-driven vehicle or group of vehicles designed and constructed for the purpose of fighting fires. Examples include fire engines, water tenders, and ladder trucks.

**Approved.\*** Acceptable to the authority having jurisdiction.

**Authority Having Jurisdiction.\*** The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

**Brush.** A collective term that refers to a stand of vegetation dominated by shrubby, woody plants or by low-growing trees, usually of a type undesirable for livestock or timber management.

**Command.** The act of directing and/or controlling resources by virtue of explicit legal, agency, or delegated authority.

**Company.** An organized group of fire fighters under the leadership of a company officer or other designated official. Companies are often assigned to specific apparatus or stations. (*Also see Crew.*)

**Company Officer.** The officer or any other position of comparable responsibility in the department in charge of a fire department company or station.

**Control a Fire.** To complete a control line around a fire, any spot fire therefrom, or any interior island to be saved; to burn out any unburned area adjacent to the fire side of the control line and to cool down all hot spots that are an immediate threat to the control line.

**Crew.** An organized group of fire fighters under the leadership of a crew leader or other designated official. (*Also see Company.*)

**Crew Boss (Leader).** A person who is in supervisory charge of usually 10–20 fire fighters and who is responsible for their performance, safety, and welfare.

**Finance.** The incident management section responsible for all incident costs and financial considerations.

**Forest Fire.** An uncontrolled fire on lands covered wholly or in part by timber, brush, grass, grow, or other flammable vegetation.

**Grass Fire.** See Forest Fire.

**Incident.** An occurrence, either human-caused or a natural phenomenon, that requires action or support by emergency services personnel to prevent or minimize loss of life or damage to property and/or natural resources.

**Incident Commander (IC).** The individual responsible for the management of all incident operations at the incident site.

**Incident Management System.\*** A system that provides structure and coordination to the management of emergency incident operation in order to provide for the safety and health of fire department members and other persons involved in those activities.

**Labeled.** Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

**Liaison.** The coordination of activities with assisting agencies.

**Listed.\*** Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

**Logistics.** The incident management section responsible for providing facilities, services, and materials for the incident.

**Operations.** The incident management section responsible for all tactical operations at the incident.

**Planning.** The incident management section responsible for the collection, evaluation, and dissemination of tactical information related to the incident and for preparation and documentation of incident management plans.

**Prevention.** Activities — including public education, law enforcement, personal contact, and reduction of fuel hazards — directed at reducing the incidence of fires.

**Rural.** Any area wherein residences and other developments are scattered and intermingled with forest, range, or farmland and native vegetation or cultivated crops.

**Shall.** Indicates a mandatory requirement.

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

**Unified Command.** A team effort that allows all agencies with jurisdictional responsibility, either geographical or functional, to manage an incident by establishing a common set of objectives and strategies. This shall be accomplished without

loss of or abdication of authority, responsibility, or accountability.

**Wildfire.** An unplanned and unwanted fire requiring suppressive action; an uncontrolled fire, usually spreading through vegetative fuels and often threatening structures.

**Wildland/Urban Interface.** The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.

## Chapter 2 General Policy

### 2-1 Wildfire Control Policies.

**2-1.1** Where wildfire could constitute a threat to the jurisdiction, the fire protection organization shall be organized to perform fire prevention and control activities in order to protect life and property from wildfire. The fire organization's goal shall be to minimize wildfire loss through the establishment of effective policies, planning, fire prevention, personnel, infrastructure, training, communications, operational systems, safety, and coordination.

**2-1.2** The authority having jurisdiction (AHJ) shall develop a policy for managing the organization in all aspects of wildfire control. As a minimum, the policy shall establish — in accordance with legal mandates — department priorities, planning procedures, incident management, personnel safety and training, and cooperative agreements. Additional policy items shall be included as determined necessary by the AHJ.

## Chapter 3 Organization

**3-1\* Organizational Structure.** The AHJ shall structure an organization in a manner to provide for effective wildfire control. Each of the following functions shall be addressed regardless of the size and complexity of the incident. On a small incident, one person shall handle all of these functions.

- (a) Command
- (b) Operations
- (c) Planning
- (d) Logistics
- (e) Finance

## Chapter 4 Command

**4-1\* Incident Command.** In the management of wildfire incidents, the AHJ shall utilize an incident management system as specified in NFPA 1561, *Standard on Fire Department Incident Management System*.

**4-2 Unified Command.** When wildfire control efforts involve a multiagency or multijurisdictional incident, the AHJ shall utilize a unified command approach to incident management.

**4-3 Strategic Considerations.** The command function shall develop strategic goals for the control of wildfire incidents.

**4-4 Command Staff.** The incident commander (IC) shall provide for public information, safety, and liaison functions. Each function shall be filled as needed depending on the size and complexity of the incident.

**4-4.1 Public Information Function.** The AHJ shall prepare a written public information plan to guide the department and the public information officer in executing the organization's

responsibilities to inform the public of the danger of wildfire. The plan shall consider the following.

**4-4.1.1 Pre-Incident Public Information.** The plan shall include the following:

- (a) Familiarization of local press and media representatives with the wildfire danger problem
- (b) Dissemination of fire prevention materials, including the development and use of public service announcements
- (c) Appointment of a public information officer (PIO) whose duties shall include executing the public information plan (The PIO shall be provided with appropriate training in public information and public/media relations.)

**4-4.1.2 Incident Public Information.** The plan shall include the following:

- (a) A media alert system to inform media of wildfire events in a timely manner
- (b) A method of safely allowing media representatives to approach the fire scene to take photographs, to record video, and/or to conduct interviews

**4-4.1.3 Post-Incident Public Information.** The plan shall include the following:

- (a) Follow-up contacts with public and press/media to ensure an unimpeded flow of information to the public
- (b) A process for allowing the public and residents to return to evacuated areas

### 4-4.2 Safety Function.

**4-4.2.1\* Pre-Incident Safety Requirements.** The AHJ shall develop pre-incident safety requirements that include the following:

(a) The AHJ shall develop a safety program that includes all aspects of wildfire incident operation, personnel welfare, and the use of personal protective clothing and equipment. The program shall be established in accordance with jurisdictional policies and procedures and reflect the established guidance provided by NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*.

(b) The safety officer's function shall be to carry out duties in accordance with established wildfire incident procedures and to carry out criteria as outlined in NFPA 1521, *Standard for Fire Department Safety Officer*.

(c) Protective safeguards shall be developed for appropriate apparatus and equipment used during wildfire incidents. Equipment operators shall be properly trained as outlined in NFPA 1002, *Standard for Fire Department Vehicle Driver/Operator Professional Qualifications*.

(d) The AHJ shall follow the medical examination standards established in NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*.

**4-4.2.2 Incident Safety Requirements.** The AHJ shall develop incident safety requirements that include the following:

(a)\*During wildfire suppression activities protective clothing shall, as a minimum, include approved head protection, gloves, protective footwear, and flame-resistant clothing as defined in NFPA 1977, *Standard on Protective Clothing and Equipment for Wildland Fire Fighting*.

(b) Protective safeguards shall be developed for apparatus and equipment used during wildfire incidents. Equipment operators shall be properly trained in accordance with NFPA 1002, *Standard for Fire Department Vehicle Driver/Operator Professional Qualifications*.



(c)\*All fireline actions shall be in compliance with the Ten Standard Fire-Fighting Orders and the 18 "Watch Out!" Situations.

**4-4.2.3 Post-Incident Safety Critique.** The AHJ shall conduct a review and critique of the safety actions following each incident.

**4-4.3 Liaison Function.** The incident commander of a wildfire incident shall provide the liaison with any and all assisting or cooperating agencies.

## Chapter 5 Operations

**5-1 Operations.** The operations function shall be responsible to the command function for carrying out the strategic and tactical plans of the incident. The operations function shall include incident and post-incident planning and actions. (*See also Section 6-1.*)

**5-2 Resource Evaluation.** When a wildfire incident occurs, the incident commander shall evaluate available resources.

**5-2.1 Personnel Resources.** The incident commander shall evaluate the number of qualified and properly equipped people available, their physical condition, their experience and skill levels, and the daytime and evening hours they are available.

**5-2.2\* Equipment.** The IC shall evaluate the types and amount of equipment and apparatus normally available within an acceptable response time, where the resources are located, how quickly and easily they can be transported to the incident, and the suitability of such equipment for use in wildfire control considering terrain and other local conditions. All members of the fire protection organization shall be acquainted with the standards set by the AHJ for the safe operation of equipment.

**5-2.3\* Aviation/Air Operations.** At a minimum, all members of the fire protection organization shall be acquainted with basic air operations including safety considerations.

**5-3 Size-Up.** Upon arrival at a fire incident, the IC shall determine the extent of the fire and its potential for becoming a major event. The IC shall immediately report the fire size-up to the communications center and request additional resources, as necessary. The following conditions shall be addressed:

- (a) Special or unusual hazards or potential hazards
- (b) Type and amount of fuel
- (c) Terrain
- (d) Present and predicted weather conditions
- (e) Fire intensity and behavior
- (f) Available resources
- (g) The need for specialized personnel and equipment to address special or unusual hazards

### 5-4 Fire Attack and Control.

**5-4.1\*** The IC shall deploy personnel and equipment to the incident according to strategic and tactical plans, within the priorities established for the incident, and with consideration for the safety of civilians and fire-fighting personnel.

**5-4.2\*** Once the threat to life and property is minimized, the IC shall plan for and execute tasks necessary for the containment, control, and mop-up of the remainder of the fire. The plan of containment and control shall address the following:

- (a) Available resources
- (b) Fireline location
- (c) Method of fireline construction
- (d) Application of water and chemicals from the air and on the ground

### 5-5 Mop-Up and Demobilization

**5-5.1** Once the fire is controlled, the IC shall develop plans for the thorough mop-up of the fire scene and for demobilization of personnel and equipment. The plan shall assure that the fire is completely out.

**5-5.2** During mop-up activities, the IC shall begin an orderly demobilization of resources used on the fire.

**5-5.3** The IC shall complete all necessary and appropriate documentation for financial and fire reporting purposes. The completed reports shall be properly submitted to the AHJ.

### 5-6 Post-Incident Review.

**5-6.1** The AHJ shall conduct a review of actions taken on the incident as soon as reasonably possible after the completion of the incident.

**5-6.2** Appropriate personnel from all operational areas of the fire shall be in attendance to provide for a thorough review of the operation.

**5-6.3** The AHJ shall review all activities related to the fire incident, including safety practices and provisions; strategy and tactics; the deployment of personnel, equipment, and apparatus; and the overall management of the fire.

**5-6.4** The AHJ shall take corrective actions in all areas where deficiencies exist or problems occurred.

## Chapter 6 Planning

**6-1 General.** The planning function is responsible to the IC for the preparation of all plans necessary to safely, efficiently, and effectively carry out the purpose and goals of the fire control organization.

**6-2\* Pre-Incident Planning.** The AHJ shall develop a written pre-incident plan(s) for wildfire control consistent with fire fighter and public safety. The plan shall be based on life safety, followed by resource/property values to be protected, as well as the political, social, economic, environmental, and other concerns of the local jurisdictions. This plan shall be reviewed annually and, as a minimum, include the following:

- (a) An identification of specific wildfire hazards and risks and hazard areas within the jurisdiction and other hazards that can negatively affect wildfire control efforts
- (b) An identification of fire protection features such as lakes, rivers, water points, natural fire breaks, and other areas or features that can be beneficial to wildfire control efforts
- (c) A listing of resources including personnel, apparatus, and equipment
- (d) A listing of all cooperating agencies and other mutual aid resources and the procedures for requesting assistance from these agencies and resources
- (e) A reference to any and all existing mutual aid agreements, contracts, and other protection agreements applicable to wildfire control efforts
- (f) A list of specific objectives relating to training, safety, response times, and staffing levels

- (g) A list of other resources that can provide an analysis of fire cause, identification of special fire hazards and risks, an assessment of wildland/urban interface and intermix fire protection problems, and proposed measures to reduce fire occurrence

**6-2.1 Coordination and Cooperation.** The AHJ shall cooperate with other entities involved in wildfire control and protection and coordinate with those entities for the purpose of expanding their capability to protect the public from wildfire.

**6-2.2 Cooperative Agreement Planning.** The AHJ shall prepare a written coordination and cooperative agreement plan that includes entities affected by or involved in wildfire protection and related cooperative procedures, such as the following:

- (a) Neighboring fire organizations
- (b) Police organizations
- (c) Public works agencies
- (d) Service/support organizations
- (e) Public utilities
- (f) Medical/health facilities
- (g) Media and the general public
- (h) Dispatch/communications centers and procedures
- (i) Command procedures
- (j) Reimbursement procedures
- (k) Liability issues
- (l) Operating procedures

**6-2.3 Cooperative Agreements.** Each cooperative agreement shall include provisions to enhance safety, effectiveness, and efficiency in wildfire control. The AHJ shall use the following as the basis for establishing new and reviewing existing cooperative agreements:

- (a) Cooperation in prevention, pre-incident, and suppression operations
- (b) Coordination in development and implementation of wildfire control plans, protection standards, strategies, tactics, and procedures
- (c) Identification of parties responsible for implementing various aspects of the agreement
- (d) A command structure (In order to facilitate a cooperative effort on a wildfire incident, a system to manage the incident shall be used, as outlined in NFPA 1561, *Standard on Fire Department Incident Management System*. If the incident involves multiple jurisdictions, a unified command shall be implemented. Command of the incident can also be delegated from the agency with jurisdiction to the cooperating agency by mutual agreement, as necessary.)
- (e) Communications (Command radio frequencies shall be designated and limited to command purposes.)
- (f) Minimum qualification requirements (Fire suppression personnel shall meet the minimum requirements as outlined in NFPA 1051, *Standard for Wildland Fire Fighter Professional Qualifications*.)
- (g) An annual operating plan, used to define and update specific operating procedures prior to each fire season

**6-2.4\* Fire Danger Rating.** The AHJ shall obtain weather observations and determine the wildfire danger rating or shall obtain the information daily from the state forester or federal or provincial wildfire control agency.

**6-2.5\* Training and Qualifications.** Each organization having wildfire control responsibility shall develop and conduct a training and qualification program that ensures the safety and

effectiveness of all personnel, as outlined in NFPA 1051, *Standard for Wildland Fire Fighter Professional Qualifications*.

**6-3 Incident Planning.** The IC shall establish objectives for the overall incident management strategy, specific tactical actions, and supporting information for the operational period. The plan, written or oral, shall include incident objectives, organization, current and predicted fire weather and behavior, resource assignments, communications, safety, transportation, logistics, incident map, and air operations.

#### 6-4 Post-Incident Activities.

**6-4.1\* Fire Reporting.** The AHJ shall complete and properly file an appropriate fire report for every incident. Where applicable, suitable wildland fire reports shall be completed in addition to standard incident/casualty reports. Such reports, whether hard copy or electronic, shall be filed in a timely manner with appropriate state, provincial, or federal agencies.

**6-4.2 Reviews and Evaluations.** All reviews and evaluations shall be conducted as constructive critiques to determine the facts related to a specific incident. As a minimum, evaluations shall cover the following:

- (a) Examine the progress of an ongoing incident and confirm effective decisions or correct deficiencies.
- (b) Identify new or improved procedures, techniques, or tactics.
- (c) Examine incidents in order to determine cause(s) and contributing factors, and, where applicable, recommend corrective actions.

## Chapter 7 Logistics

**7-1\* Logistics Function.** The logistics function shall be responsible to the IC for providing support resources that meet the goals and purposes of the wildfire control effort. Each logistics chief shall assess and determine its need for facilities, communications, support services, and supplies and equipment.

**7-2\* Facilities.** The logistics function shall determine the need for and locate appropriate facilities required for the use of the fire control organization.

The logistics function shall evaluate the physical facilities and usable space required to meet pre-incident planning objectives. Where relevant, such plans shall identify locations for apparatus storage, equipment and personnel staging, base camp operations, lodging of personnel, and support services sites.

#### 7-3\* Communications.

**7-3.1** The AHJ shall establish a communications function to determine communication needs and required resources, including various radio networks (fixed and portable); landline and cellular telephones; pagers, scanners, and other audible alert equipment; and computers, data, and fax capabilities.

**7-3.2** The communications function shall also determine radio system needs, including frequency allocation, availability and compatibility of equipment between responding agencies, transmission and security priorities and procedures, and equipment assignment and accountability.

**7-4\* Support Services.** The logistics pre-incident plan shall identify necessary support services that facilitate continual operations throughout the incident.

**7-4.1** The logistics function shall determine the required level of emergency medical support and identify available resources. During incidents, appropriate emergency medical support — including transportation capabilities — shall be made available near the incident locations.

**7-4.2\*** The logistics function shall determine the required level of food services support and identify available resources. Applicable health standards must be reviewed and placed in perspective with the size and complexity of anticipated incident activity. The pre-incident plans must include identification of providers and probable location sites including available utilities, tentative operation schedules, and contract prices.

**7-4.3\*** The logistics function shall determine the required level of sanitation services — including resources for ample toilets — with cleaning, inspection, and maintenance schedules; trash and garbage collection and removal to approved sites; and ample replacement of consumable supplies.

**7-4.4\*** The logistics function shall determine the requirements for potable water and identify sources and a system of water distribution.

**7-4.5\*** The logistics function shall determine the requirements for ground support for personnel, equipment, and supplies.

**7-4.6** The logistics function shall determine and provide for adequate security for personnel and equipment.

**7-5 Supplies and Equipment.** The logistics function shall provide supplies and equipment as requested to support the incident.

**7-6 Demobilization.** The logistics function shall plan for and carry out demobilization activities in support of and in cooperation with command, operations, planning, and finance.

## Chapter 8 Finance

**8-1 General.** The finance function is responsible to the IC for all aspects of financial management in support of the fire protection organization.

**8-2 Pre-Incident.** The financial element of the operational plan shall include, as a minimum, the contractual agreements to provide for the following services:

- (a) Fuel, oil, and lubricants
- (b) Medical services, including injury reports
- (c) Catering, food, and drinking water
- (d) Personnel hiring and hourly pay
- (e) Outside services, including lodging and communications
- (f) Equipment maintenance
- (g) Specialized fire-fighting equipment
- (h) Purchasing agreements and systems
- (i) Incident support
- (j) Insurance notification systems

**8-3 Incident.** Pre-incident plans shall be followed to accurately account for all expenditures during the incident. A methodology for the timely and accurate disbursement of funds shall be followed.

**8-4 Post-Incident.** The AHJ shall prepare and distribute, as required, a summary report that will assure that all accounts are paid and reimbursable costs are billed.

## Chapter 9 Referenced Publications

**9-1** The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix C.

**9-1.1 NFPA Publications.** National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 1002, *Standard for Fire Department Vehicle Driver/Operator Professional Qualifications*, 1998 edition.

NFPA 1051, *Standard for Wildland Fire Fighter Professional Qualifications*, 1995 edition.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 1997 edition.

NFPA 1521, *Standard for Fire Department Safety Officer*, 1997 edition.

NFPA 1561, *Standard on Fire Department Incident Management System*, 1995 edition.

NFPA 1977, *Standard on Protective Clothing and Equipment for Wildland Fire Fighting*, 1998 edition.

## Appendix A Explanatory Material

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

**A-1-2** The current text is designed to help the thousands of small community organizations existing in the rural and forested areas of North America. Many of these communities are exposed to the dangers of a large fire involving many acres of natural fuels, such as forest, grass, or brush. To prepare effectively for such emergencies, the responsive fire protection organizations and individuals must be informed of the most recent and useful wildland fire control techniques, equipment, training, and operations.

Additional information on large equipment, heavy power tools, specialized wildfire-fighting equipment, and techniques is available in other publications. This standard includes a list of mandatory requirements that must be met if fire fighters are to be safe and effective in the prevention and suppression of wildfires.

It is suggested that fire organizations consider the adoption of this standard through a vote by the fire department members or by citizens of the protected area. Legal counsel should be consulted to explain how the adoption of this standard affects the department and its members.

In many rural and wildland areas, forest, grass, crop, and brush fires are a continual problem. These fires, if not controlled, can endanger human life and cause serious damage to property, natural resources, and the environment. Careful evaluation of wildfires in the United States and Canada for many years has shown that fire damage can be prevented or minimized if such fires are aggressively attacked by trained fire fighters in the early stages of fire development.

**A-1-3 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-1-3 Authority Having Jurisdiction.** The phrase “authority having jurisdiction” 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-1-3 Incident Management System.** See NFPA 1561, *Standard on Fire Department Incident Management System*.

**A-1-3 Listed.** The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

**A-3-1** In order to provide fire prevention and control and to protect life and property from wildfire, a community should establish the following:

(a) An officially designated formal organization headed by a fire chief or fire warden charged with the responsibility of prevention and suppression of wildland fires. The chief is in charge of the entire departmental operation. The chief should be appointed by the governing body, if one exists, or elected by the membership on the basis of merit and ability. The chief can be a paid professional, a part-time paid employee, or a volunteer.

(b) A well-organized, equipped, and trained fire company or crew who will operate under the authority of the chief, fire warden, or subordinate officer. Most small wildfires can be handled by a well-trained squad or company of two to five fighters if attacked quickly. Large or rapidly spreading fires require more fire fighters, more equipment, expert supervision, and extensive radio and telephone communications.

(c) Three or four small companies or squads of five or six fire fighters, with leaders, can be grouped together under the command of a crew leader or company officer. This leader can be one of several crew leaders commanding similar groups, and all personnel under his command, and others concerned, will know who the crew leader is and the scope of the leader's authority. The crews or companies can be assigned to action only on a designated portion of the main fire. This designated portion of the fire is commonly called a sector or division.

**A-4-1** The first responsible authority ranger, warden, company officer, crew leader, or other officer who arrives at the emergency is the incident commander until someone with higher authority

specifically assumes command. Whenever a new incident commander assumes command, all officers, crew leaders, and others on the incident should be notified immediately. The incident commander is responsible for planning and directing the fire control efforts; assembling crews of fire companies and telling them where and how to work; making the best use of personnel; arranging for communications, rest periods, and relief crews; making the best use of equipment and tools; obtaining supplies; and ensuring that the fire is completely extinguished before the last crews are released from the scene. In other words, the incident commander is responsible for all activities and operations at an emergency incident. The incident commander delegates more and more responsibility to assistants as the needed organizational effort grows, but the incident commander is always the final authority and bears total responsibility.

**A-4-4.2.1** Fire fighting requires fast action, sustained effort, and greater energy than most other work. Fire fighting is always potentially hazardous. In the United States, fire fighting has one of the highest accident rates of any occupation. Wildfire control can be particularly hazardous unless the necessary safety procedures and principles are constantly practiced and obeyed. Most accidents can be prevented by careful procedures and training before emergencies. The safety and welfare of the entire fire-fighting organization are the responsibility of the incident commander. All persons in authority are likewise responsible for the safety of the personnel under their direction.

**A-4-4.2.2(a)** A safety hard hat with chin strap must be worn on the fireline. A standard fire fighter's helmet shall be permitted to be worn as an alternative. Hard hats greatly reduce the number of serious injuries. Lightweight “bump” hats are unacceptable because they do not provide adequate protection in wildfire control.

Footwear should be leather lace-up boots. It is recommended that boots be without steel toes except for those used by chain saw operators. The boots should have slip-resistant soles, such as a hard rubber lug-type or tractor tread. This feature allows for maximum traction and prevents melting when exposed to normal fireline conditions. Soles should not be made of composition rubber or plastic, which have low melting points. This does not preclude the use of boots with smooth, hard rubber soles or those with a well-defined tread. However, the disadvantage of these soles is their tendency to slip on smooth rock, logs, dry grass, and pine needle surfaces, which are often encountered on wildfires. The height of boot tops should be a minimum of 6 in. (15.2 cm), with at least 8 in. (20.3 cm) or greater preferred. Low-quarter boots or shoes should not be worn because they do not provide ankle support or keep out sparks and dirt. Pull-on type boots, such as structural fire-fighting rubber boots, cowboy boots, or engineering boots, are not recommended because they do not provide adequate ankle support, do not keep out sparks and dirt, and are loose-fitting and can cause blisters.

If available, flame-resistant clothing specially designed for wildfire fighting should be worn. If flame-resistant clothing is not available, fire fighters should wear loose, cuffless trousers and shirts made of cotton or wool. Loose-fitting clothing reduces chafing and affords more protection. Collars and cuffs should be buttoned to protect the arms and neck from heat, burns, scratches, and insects.

Fire shelters, if available, should be worn by all fire fighters engaged in suppression activities.

Gloves should be worn to protect hands and make hand work easier. Fire fighters should wear goggles for eye protection when encountering excessively smoky or dusty environments.

**A-4-4.2.2(c)** The Ten Standard Fire-Fighting Orders and 18 “Watch Out!” Situations are used as the basic safety instructions for wildland fire suppression activities and should be included in all wildland fire suppression training.

#### **Ten Standard Fire-Fighting Orders**

1. Fight fire aggressively but provide for safety first.
2. Initiate all actions based on the current and expected fire behavior.
3. Recognize current weather conditions and obtain forecasts.
4. Ensure instructions are given and understood.
5. Obtain current information on fire status.
6. Remain in communication with crew members, your supervisor, and adjoining forces.
7. Determine safety zones and escape routes.
8. Establish lookouts in potentially hazardous situations.
9. Retain control at all times.
10. Stay alert, keep calm, think clearly, act decisively.

#### **18 “Watch Out!” Situations**

1. The fire is not scouted and sized up.
2. You’re in country not seen in daylight.
3. Your safety zones and escape routes aren’t identified.
4. You’re unfamiliar with weather and local factors influencing fire behavior.
5. You’re uninformed on strategy, tactics, and hazards.
6. Instructions and assignments are not clear.
7. You have no communication link with crew members and supervisors.
8. You’re constructing a line without a safe anchor point.
9. You’re building a fireline downhill with fire below.
10. You’re attempting a frontal assault on the fire.
11. There is unburned fuel between you and the fire.
12. You cannot see the main fire, and you’re not in contact with anyone who can.
13. You’re on a hillside where rolling material can ignite fuel below.
14. The weather is getting hotter and drier.
15. Wind increases and/or changes direction.
16. You’re getting frequent spot fires across the fireline.
17. Terrain and fuels make escape to safety zones difficult.
18. You feel like taking a nap near the fireline.

**A-5-2.2 Hand tools.** Tools needed will vary by sections of the country due to differences in fuels, soil, and topography. All equipment selected for fire control work should be dependable, properly maintained, and used for the type of work for which it was designed. Many national standards and specifications are available to help fire department organizations purchase the proper equipment. Assistance in selecting appropriate tools can be obtained from federal, state, or provincial wildfire-fighting agencies.

**Power saws.** It is not necessary that fire suppression organizations own power saws; they are frequently available from woods operators, the same operators that communities often rely on for additional fire-fighting manpower.

Information on power saws can be secured from the manufacturers as well as from operators who have used the various makes and types. Because fire suppression can require carrying saws long distances over rough terrain, an important consideration is weight.

Saws must be equipped with adequate spark arresters to minimize the possibility of igniting nearby fuels by hot exhaust particles. References for information on approved spark arresters for power saws can be found in Appendix D.

**Tractor plows and dozers.** Dozers and tractor plows are valuable tools for wildfire suppression. (See Figures A-5-2.2[a] and [b].) Most fire departments will not find it economical to own tractors or bulldozers but should make a careful evaluation to determine use possibilities under existing conditions of terrain, fuels, and rates of fire spread. Heavy tractor equipment is frequently available from construction and logging operators, whose names and telephone numbers should be included in the fire plan. Recommendations for safe operation of tractor plows and dozers can be found in the National Wildfire Coordinating Group (NWCG) *Fireline Handbook* (PMS 410-1).



**Figure A-5-2.2(a)** Dozers are a valuable tool for wildfire suppression. This one is properly equipped with protective canopy, lights, brush guards, and a winch.

Any tractors or bulldozers used for wildfire suppression should be equipped with protective canopies, winches, and adequate lights for operating at night. Unless turbocharged, bulldozers or tractors should also be equipped with approved and effective spark arresters. References for information on approved spark arresters for tractor plows and dozers can be found in Appendix D.



**Figure A-5-2.2(b)** Tractor plows are often used in suitable terrain to build firelines along the flank and rear of a wildfire.

**A-5-2.3 Aircraft safety-fixed wing aircraft.** The use of fire retardants dropped from aircraft is a modern, sophisticated attack tool in wildfire control. (See Figure A-5-2.3[a].) It is likely that members of fire departments will become involved in the use of airtankers; therefore, they must be cognizant of the safety rules regarding airtanker operations.

Ground forces should be warned when drops will be made in their area. Often the airtanker pilot will make a dry run or high pass over the portion of the fire where the drop will be made. This usually indicates the drop will be made within 1 to 3 minutes. If drops have already been made in the area, there usually will be no dry runs.

If unable to retreat to a safe place when an airdrop is imminent, follow these safety procedures:

(a) Lie face down with head toward oncoming aircraft and hard hat in place. If possible, grab something solid and get behind it to prevent being carried or rolled about by the drop. Spread feet apart for better body stability and to assist digging in.



**Figure A-5-2.3(a)** An airtanker makes a drop of fire retardant on a wildfire.

(b) Hold tools firmly out to the side and away from the body. Flying tools or equipment can cause injury.

(c) Do not run unless escape is assured. Never stand up in the path of an airdrop.

(d) Stay away from large old trees and snags. Tops, limbs, or entire trees could break and fall, causing injury.

After the retardant drop has been made, there is a follow-up advantage on the fire. However, these factors must be considered after the drop:

(a) Most retardants are slippery; therefore, be careful of footing and wipe off all hand tools, especially the handles.

(b) Heavy application of retardant on surfaced roads can be hazardous and should be washed down as soon as possible.

(c) Retardant should be washed from equipment and structures as soon as possible to prevent damage to finishes.

(d) Retardant could also damage agricultural or ornamental vegetation; actions should be taken to minimize such damage.

**Rotary wing aircraft (helicopters).** The use of helicopters has become a key part of wildfire protection (see Figure A-5-2.3[b]); however, as with any other piece of fire-fighting equipment, definitive safety rules should be followed when using or operating near a helicopter. The following safety procedures apply to helicopter operations:



**Figure A-5-2.3(b)** The use of helicopters has become a common occurrence in wildfire suppression. This helicopter is being used to make water drops on a wildfire.

(a) *Approach and departure.*

1. Get the pilot's attention and permission before approaching the helicopter.
2. Always approach in full view of the pilot. Never approach from the rear of the helicopter.
3. Always approach or depart in a crouched position. Gusts of wind can cause the rotor blades to drop dangerously low to the ground.
4. Safety helmets must be held securely to prevent their being blown away or blown up into the rotors by the rotor blast.
5. Never approach or depart a helicopter from ground that is upslope from the main rotor. Rotors are almost invisible when turning at high speed or under poor lighting conditions.
6. Keep clear of the main and tail rotors at all times. Do not walk to the rear of the helicopter when entering or exiting.
7. Carry all long-handled tools in such a manner that the handles will not be inadvertently raised into the rotor path.

(b) *Working around heliports.*

1. Stay at least 100 ft (30 m) from helicopters at all times unless you have a specific job that requires otherwise. Your presence can cause confusion and disrupt the pilot's concentration.
2. Do not face a landing helicopter unless wearing goggles.
3. Do not remain in an area that is consistently under the flight path of any helicopter.
4. Do not smoke within 50 ft (15 m) of any helicopter or fueling area.

(c) *In-flight safety.*

1. Do not smoke in the helicopter.
2. Use the seat belt and keep it secured until the pilot instructs you to leave the helicopter.
3. Ensure that all loose gear and helmets, maps, papers, and so forth, are securely held to prevent their being blown about the helicopter or out the windows.
4. Do not let any gear get in the way of the pilot or the pilot's controls.
5. Never throw anything out of a helicopter.
6. Do not talk to the pilot unless necessary, particularly during takeoff and landing.

7. Be alert for hazards such as other aircraft and especially telephone and power lines.
8. Never slam the doors of a helicopter. The doors do not have spring-loaded locks, so the handles must be physically turned to secure the door.

**A-5-4.1** The threat to the lives of fire fighters and citizens is always the highest priority, and the IC's fire attack decision should consider the following methods of attack:

- (a) For low-intensity fires, consideration should be given to direct attack.
- (b) For high-intensity fires with unpredictable fire behavior or difficult terrain, consideration should be given to indirect attack.

**A-5-4.2** In wildland fire suppression and fire management including prescribed burning, fire retardants fall into one of two categories:

(a) *Long-term retardants*. Long-term retardants contain fire-retarding salts, ammonium sulfate, ammonium phosphate, or a combination of each that alters the combustion process. Since the chemical additives alter the combustion process, they are effective for a long period of time.

These long-term retardants are used for direct attacks that might not be in coordination with fire crews; short-term protection of items such as improvements, log decks, and forest fuels adjacent to a fireline; prescribed burning and backfiring; and mop-up. Chemical retardants can be applied to a fire by fixed-wing airtankers, helicopters with buckets or fixed tanks, fire engines, portable pumps, or back pumps.

(b) *Suppressants*. Suppressants are water with additives such as polymers or foam concentrate. They depend on the water and moisture retention for effectiveness; when the water dries out, the effectiveness disappears. Therefore, they are usually effective from just a few minutes to 1 hour or so under optimum conditions.

Suppressants are used in direct attack: in support of on-the-line fire crews; short-term protection of items such as improvements, log decks, and forest fuels adjacent to a fireline; prescribed burning and backfiring; and mop-up. The methods of application include fixed-wing airtankers, helicopters with buckets or fixed tanks, fire engines, and back pumps.

Class A foams are familiar suppressants used in wildfire attack and control. Class A foams are chemically derived surfactant-agent foams. As such, they have the ability to form an insulating blanket on the surface of fuels, as well as to increase the efficiency of water by increased penetration into fuels and to reduce the amount of water that runs off onto the ground.

The foam solution is a homogeneous mixture of water and foam concentrate. An aerated solution is created by forcing or entraining air into a foam solution by means of suitably designed equipment or by cascading it through the air at a high velocity. Very small amounts of Class A foam concentrate are needed, usually between 0.1 percent and 1.0 percent by volume of water.

The consistency of foam is a function of the inputs of air, water, and concentrate, and the generation method. Changes in any of these variables will change the foam. Aerial and ground foam delivery systems are designed to allow changing inputs in order to create the most effective foam for the situation.

The viscosity and density, or consistency, of foam is described by drain time and expansion ratio. A wet foam has a rapid drain time and a low expansion ratio. A dry foam is characterized by long drain times and high expansion ratios. A dripping foam has properties of both wet and dry foams. Wet and dripping foams are excellent for suppression, mop-up, and as a wetting treat-

ment under a dry foam that creates a fire barrier. Dry foam is most effective as a barrier for short-term protection of structures, improvements, and forest fuels. The thickest, driest foams are made by using compressed air foam systems (CAFS).

For mop-up, regular fire hose nozzles and aspirating nozzles with low water/air expansion rates are the most effective. Aspirating nozzles with water/air expansion rates of  $\pm 10$  to  $\pm 100$  are available.

**A-6-2** Written fire suppression mobilization plans are important even if prepared only in outline form. As shown below, they should list all preplanned decisions and attack plans and outline other information needed for planned action. Such fire control plans allow a subordinate to take emergency action in the absence of the fire chief or other key individuals. Copies of the plans with necessary maps should be distributed to key fire officers. Plans must be updated at least annually and at any other time when required by changing conditions.

- (a) Fire department organizational chart
  1. Line of succession: Names — how to contact
  2. Personnel roster: Names — how to contact
- (b) Cooperating agencies: Names — how to contact
- (c) Resources
  1. Reserve personnel: how to contact
  2. List of available equipment: type, locations, how to contact and procure
  3. List of available supplies and suppliers: types, locations, how to contact and procure
  4. List of other available facilities: types, locations, who to contact
- (d) Map of protected area that should include items such as the following:
  1. Boundary of protected area and adjacent jurisdictions
  2. Roads and other means of access such as heliports and airports
  3. Locations of manpower, equipment, and facilities' resources
  4. Water sources
  5. Areas of concern
    - a. Hazardous fuels
    - b. High-risk ignition sources such as dumps, sawmills, logging operations, recreation areas, and so forth
- (e) Fire weather information
  1. Source of information
  2. Methods of notifying the public
- (f) Pre-attack plans
- (g) Fire prevention

Fire prevention is often said to be the most important function of a fire protection organization. A major responsibility of every fire protection organization is to keep the community informed of the methods and need for sound fire prevention. Prevention of wildfire is a continual job. Fire is an ever-present danger, and, to be effective, fire prevention must be constantly practiced. A fire prevention program must include plans for the entire year. The program should analyze the common causes of fire, identify significant fire hazards and risks existing in the protection area, and propose measures to reduce the occurrence of fire and fire damages. The following is an example of a systematic wildland fire prevention planning process.

(h) **Wildfire prevention planning**

In order to implement a wildfire prevention program as an integrated element of the fire management program, wildfire prevention must be focused. Efforts should focus on ignitions

that pose the greatest potential for unacceptable damage or losses. Utilizing wildfire prevention as a selected strategy based on the threat of the ignition integrates it into the fire management program. Other strategies within the fire management program that may be employed include suppression, fuel management, prescribed fire, and so forth.

In order to focus wildfire prevention programs, it is important to identify problems or potential problems accurately. Any wildfire prevention planning process that does not accurately assess or identify wildfire prevention problems is doomed to fail. Identification of priority wildfire prevention programs must look at a number of variables, including the following:

(a) *Risks.* Risks are defined as those uses or human activities that have the potential to result in wildfire ignition. When assessing the risk of a given area, only the *risk* should be examined. The potential for a fire to spread or burn will be looked at separately; these two items should not be confused. Wherever there are concentrations of people or activity, the potential for a human-caused ignition exists. After assessing the risks within an area, it can be helpful to look at historical fires to validate the risk assessment. Historical fires alone, however, are not an accurate reflection of the risks within a given area. The objective of this effort is to determine the degree of risk within given areas of an administrative unit.

(b) *Hazards.* Hazards are defined as the fuels and topography of an area. The objective in examining risks is to determine the potential of a large fire resulting from an ignition. In other words, the objective is to determine the degree of difficulty in suppressing a fire once it is ignited. Again, it is important to examine hazards without regard to anything else.

(c) *Values.* Values are defined as natural or developed areas whose loss or destruction by wildfire would be considered unacceptable. The objective of this process is to rate values based on the need to protect these from wildfire.

Once risks, hazards, and values have been evaluated, it will be possible to determine when, where, and how to implement effective fire prevention programs. By comparing an area's potential to have an ignition (risks) with its potential to burn after ignition (hazards) and the values threatened by a wildfire, an effective fire prevention plan can be written. This plan can focus on the highest-priority wildfire prevention problems within an administrative unit. It is not necessary to have an extensive fire prevention effort in an area where there are a number of risks but the hazard is minimal and there are no real values threatened. In contrast, it will be important to have a comprehensive effort in an area where there are substantial risks, a high hazard, and a threat to high values.

The wildfire prevention plan should address what needs to be done in each area based on the type of activities and uses. It should clearly define what actions will take place and when and who is responsible. Wildfire prevention activities generally fall within one of three broad categories. These categories include the following:

(a) *Education.* Education is aimed at changing people's behavior by informing them. People can be informed through printed materials, mass media (radio, television, etc.), one-on-one contacts, or group presentations. Information can also be delivered through signs, displays, fairs, parades, and so forth.

(b) *Engineering.* Engineering is an activity designed to shield an ignition source (e.g., spark arrester) or remove the fuel that would ignite from a spark (e.g., clearance around a home).

(c) *Enforcement.* Enforcement is used to gain compliance with fire codes and ordinances.

The wildfire prevention plan should select the most cost effective mix of activities to mitigate potential fire problems

within each priority area. The wildfire prevention plan should be evaluated annually. If ignitions are occurring in an area where an active fire prevention program is implemented, perhaps the fire prevention activities should be reviewed. This review could result in a change of activities within the area. If the plan is working, there will be no need to make any changes.

**A-6-2.4** The probability of a wildfire starting is largely dependent on an ignition source, fuel conditions, and weather. Accurate determination of fire danger can be made only through specific weather-related measurements such as temperature, humidity, wind speed, and fuel moisture. These observations are used by systems such as the United States Fire Danger Rating System and the Canadian Forest Fire Danger Rating System.

**A-6-2.5** All personnel should receive frequent training in first aid, fireline safety, fire behavior, and techniques and methods of wildfire suppression. Periodic hands-on training with hand tools and equipment, as well as crew and fireline organization, should be included. Crew leaders and company officers need specialized training in fire control tactics to assure their competence when directing fire suppression operations. It is recommended that cooperative training with other wildfire control organizations be conducted. Federal, state, and provincial forest fire officers have technical training materials and are usually available to assist.

Many states and provinces have established programs through which fire fighters can receive training in structural fire fighting. Special training in wildfire tactics and techniques can be obtained from state, provincial, or federal wildfire protection agencies, which frequently conduct special fire schools, seminars, and other forms of instruction. A number of publications dealing with wildfire control are available from state forester's offices or the National Wildfire Coordinating Group's Publication Management System. (See *Appendix D*.)

**A-6-4.1** *Fire reporting.* The reporting of fires is an important function of the fire department. Fire reports provide a realistic and factual basis for fire prevention planning, support for funding requests, and aid in organizational development. They could also be significant documents during investigations and/or in insurance claim adjustment cases. A report must be completed on every fire or false alarm responded to by the fire department. It is important to compile information when it is fresh in the mind of the reporting officer.

The U.S. Fire Administration (USFA), in conjunction with the National Fire Information Council (NFIC), has developed the National Fire Incident Reporting System (NFIRS) with Version 5.0, including several modules that provide information specific to wildland fire incidents. At the state level, NFIRS provides for the collection of written reports on incidents to which local communities responded. At the national level, NFIRS provides databases from individual states to form the national database. The USFA analyzes this database and publishes the analysis.

The basic NFIRS-1 report [Figure A-6-4.1(a)] captures data relevant to fire location (B), incident type (C), dates and times (E1), actions taken (F), resources (G1), estimated dollar losses and values (G2), and completed modules like Wildland Fire.

NFIRS Module-8 [Figure A-6-4.1(b)] specifically focuses on wildland fire and provides in-depth information relevant to wildland fire cause (D1), human factors contributing to ignition (D2), weather information (H), national fire danger rating system (NFDRS), fuel model and origin (K), among other information.

Although field forms can assist on information gathering, the NFIRS Version 5.0 system is a computer-based program developed to reduce record-keeping time and improve output report capability.



<b>A</b> FDID ☆ State ☆ Department Name Station Incident Number ☆ Exposure ☆		<input type="checkbox"/> Delete <input type="checkbox"/> Change <input type="checkbox"/> No Activity	<b>NFIRS - 1</b> <b>Basic</b>
<b>B Location</b> ☆ <input type="checkbox"/> Check this box to indicate that the address for this incident is provided on the Wildland Fire Module in <b>Section B</b> "Alternative Location Specification." Census Tract (Local option) _____			
<div style="display: flex; justify-content: space-between;"> <div style="width: 20%;"> <input type="checkbox"/> Intersection  <input type="checkbox"/> Block address  <input type="checkbox"/> In front of  <input type="checkbox"/> Rear of  <input type="checkbox"/> Adjacent to  <input type="checkbox"/> Directions         </div> <div style="width: 80%;">           Number/Milepost Prefix Street or Highway Street Type Suffix            Apt./Suite/Room City State Zip Code            Cross street or directions, as applicable         </div> </div>			
<b>C Incident Type</b> ☆ Incident Type _____	<b>E<sub>1</sub> Dates &amp; Times</b> Midnight is 0000 Month Day Year Hour Min Check boxes if dates are the same as Alarm Date. Alarm ☆ _____ Arrival _____ Controlled _____ Last Unit Cleared _____		<b>E<sub>2</sub> Shifts &amp; Alarms</b> Local Option Shift or platoon _____ Alarms _____ District _____ <b>E<sub>3</sub> Special Studies</b> Local Option Special Study (1) _____ Special Study (2) _____
<b>D Aid Given or Received</b> 1 <input type="checkbox"/> Mutual aid received 2 <input type="checkbox"/> Automatic aid recv. _____ 3 <input type="checkbox"/> Mutual aid given 4 <input type="checkbox"/> Automatic aid given 5 <input type="checkbox"/> Other aid given N <input type="checkbox"/> None Their FDID Their State Their incident number			
<b>F Actions Taken</b> Primary Action Taken (1) _____ Additional Action Taken (2) _____ Additional Action Taken (3) _____	<b>G<sub>1</sub> Resources</b> ☆ <input type="checkbox"/> Check this box and skip this section if Apparatus or Personnel forms are used. Apparatus Personnel Suppression _____ EMS _____ Other _____ <input type="checkbox"/> Check box if resource counts include mutual aid resources.		<b>G<sub>2</sub> Estimated Dollar Losses &amp; Values</b> LOSSES: Required for all fires. Otherwise optional. None Property \$ _____ Contents \$ _____ PRE-INCIDENT VALUE: Optional Property \$ _____ Contents \$ _____
<b>Completed Modules</b> <input type="checkbox"/> Fire-2 <input type="checkbox"/> Structure-3 <input type="checkbox"/> Civilian Fire Cas.-4 <input type="checkbox"/> Fire Serv. Casualty-5 <input type="checkbox"/> EMS-6 <input type="checkbox"/> Hazmat-7 <input type="checkbox"/> Wildland Fire-8 <input type="checkbox"/> Apparatus-9 <input type="checkbox"/> Personnel-10	<b>H<sub>1</sub> Casualties</b> <input type="checkbox"/> None Fire Deaths Injuries Service _____ Civilian _____ <b>H<sub>2</sub> Detector</b> Required for confined fires <input type="checkbox"/> Check box if detector alerted occupants		<b>H<sub>3</sub> Hazardous Materials Release</b> N <input type="checkbox"/> None 1 <input type="checkbox"/> Natural gas: Slow leak, no evacuation or hazmat actions 2 <input type="checkbox"/> Propane gas: <21 lb. tank (as in home BBQ grill) 3 <input type="checkbox"/> Gasoline: vehicle fuel tank or portable container 4 <input type="checkbox"/> Kerosene: fuel burning equipment or portable storage 5 <input type="checkbox"/> Diesel fuel/fuel oil: vehicle fuel tank or portable storage 6 <input type="checkbox"/> Household solvents: home/office spill, cleanup only 7 <input type="checkbox"/> Motor oil: from engine or portable container 8 <input type="checkbox"/> Paint: from paint cans totaling <55 gallons 0 <input type="checkbox"/> Other: Special hazmat actions required or spill >55 gal., Please complete the Hazmat form
<b>I Mixed Use Property</b> NN <input type="checkbox"/> Not mixed 10 <input type="checkbox"/> Assembly use 20 <input type="checkbox"/> Education use 33 <input type="checkbox"/> Medical use 40 <input type="checkbox"/> Residential use 51 <input type="checkbox"/> Row of stores 53 <input type="checkbox"/> Enclosed mall 58 <input type="checkbox"/> Business & residential 59 <input type="checkbox"/> Office use 60 <input type="checkbox"/> Industrial use 63 <input type="checkbox"/> Military use 65 <input type="checkbox"/> Farm use 00 <input type="checkbox"/> Other mixed use			
<b>J Property Use</b> ☆ <b>Structures</b> 131 <input type="checkbox"/> Church, place of worship 161 <input type="checkbox"/> Restaurant or cafeteria 162 <input type="checkbox"/> Bar/tavern or nightclub 213 <input type="checkbox"/> Elementary school or kindergart. 215 <input type="checkbox"/> High school or junior high 241 <input type="checkbox"/> College, adult ed. 311 <input type="checkbox"/> Care facility for the aged 331 <input type="checkbox"/> Hospital 341 <input type="checkbox"/> Clinic, clinic type infirmary 342 <input type="checkbox"/> Doctor/dentist office 361 <input type="checkbox"/> Prison or jail, not juvenile 419 <input type="checkbox"/> 1- or 2-family dwelling 429 <input type="checkbox"/> Multifamily dwelling 439 <input type="checkbox"/> Rooming/boarding house 449 <input type="checkbox"/> Commercial hotel or motel 459 <input type="checkbox"/> Residential, board and care 464 <input type="checkbox"/> Dormitory/barracks 519 <input type="checkbox"/> Food and beverage sales 539 <input type="checkbox"/> Household goods, sales, repairs 579 <input type="checkbox"/> Motor vehicle/boat sales/repairs 571 <input type="checkbox"/> Gas or service station 599 <input type="checkbox"/> Business office 615 <input type="checkbox"/> Electric generating plant 629 <input type="checkbox"/> Laboratory/science lab 700 <input type="checkbox"/> Manufacturing plant 819 <input type="checkbox"/> Livestock/poultry storage (barn) 882 <input type="checkbox"/> Nonresidential parking garage 891 <input type="checkbox"/> Warehouse <b>Outside</b> 124 <input type="checkbox"/> Playground or park 655 <input type="checkbox"/> Crops or orchard 669 <input type="checkbox"/> Forest (timberland) 807 <input type="checkbox"/> Outdoor storage area 919 <input type="checkbox"/> Dump or sanitary landfill 931 <input type="checkbox"/> Open land or field 936 <input type="checkbox"/> Vacant lot 938 <input type="checkbox"/> Graded/cared for plot of land 946 <input type="checkbox"/> Lake, river, stream 951 <input type="checkbox"/> Railroad right of way 960 <input type="checkbox"/> Other street 961 <input type="checkbox"/> Highway/divided highway 962 <input type="checkbox"/> Residential street/driveway			
Look up and enter a Property Use code only if you have NOT checked a Property Use box: <span style="float: right;">Property Use _____</span>			

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Figure A-6-4.1(a) Sample basic NFIRS-1 fire reporting form.

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<b>A</b> FDID      Department Name      Station      Incident Number      Exposure <input type="checkbox"/> Delete <input type="checkbox"/> Change <b>NFIRS - 8 Wildland Fire</b>		
<b>B</b> <b>Alternate Location Specification</b> Enter latitude/longitude OR Section/Township/Range/Subsection/Meridian if <b>Section B</b> on the Basic Module is not completed <div style="display: flex; justify-content: space-around;"> <div>           Latitude      Longitude  <input type="text"/> • <input type="text"/>      <input type="text"/> • <input type="text"/> </div> <div> <b>OR</b> </div> <div>           Township      Range      Meridian  <input type="text"/> • <input type="text"/>      <input type="text"/> • <input type="text"/> </div> </div> <div style="display: flex; justify-content: space-around;"> <div> <input type="checkbox"/> North      <input type="checkbox"/> East  <input type="checkbox"/> South      <input type="checkbox"/> West         </div> </div> <div style="display: flex; justify-content: space-around;"> <div>           Section      Subsection      Meridian  <input type="text"/>      <input type="text"/>      <input type="text"/> </div> </div>	<b>D1</b> <b>Wildland Fire Cause</b> ☆ 1 <input type="checkbox"/> Natural source      8 <input type="checkbox"/> Misuse of fire 2 <input type="checkbox"/> Equipment      0 <input type="checkbox"/> Other 3 <input type="checkbox"/> Smoking      U <input type="checkbox"/> Undetermined 4 <input type="checkbox"/> Open/outdoor fire 5 <input type="checkbox"/> Debris/vegetation burn 6 <input type="checkbox"/> Structure (exposure) 7 <input type="checkbox"/> Incendiary  <b>D2</b> <b>Human Factors Contributing To Ignition</b> <input type="checkbox"/> None Check as many boxes as are applicable. <input type="checkbox"/> Asleep <input type="checkbox"/> Possible alcohol or drug impairment <input type="checkbox"/> Unattended person <input type="checkbox"/> Possibly mentally disabled <input type="checkbox"/> Physically disabled <input type="checkbox"/> Multiple persons involved <input type="checkbox"/> Age was a factor	<b>D3</b> <b>Factors Contributing to Ignition</b> #1 <input type="text"/> #2 <input type="text"/>  <b>D4</b> <b>Fire Suppression Factors</b> Enter up to three factors #1 <input type="text"/> #2 <input type="text"/> #3 <input type="text"/>  <b>E</b> <b>Heat Source</b> <input type="text"/> <b>F</b> <b>Mobile Property Type</b> <input type="text"/> <b>G</b> <b>Equipment Involved in Ignition</b> <input type="text"/>
<b>C</b> <b>Area Type</b> ☆ 1 <input type="checkbox"/> Rural, farms >50 acres 2 <input type="checkbox"/> Urban (heavily populated) 3 <input type="checkbox"/> Rural/urban 4 <input type="checkbox"/> Urban-wildland interface area	<b>H</b> <b>Weather Information</b> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">         Note: If Weather Station ID is entered, the rest of Section H is optional.       </div> NFDRS Weather Station ID <input type="text"/> <div style="display: flex; justify-content: space-between;"> <div>           Weather Type      Wind Direction  <input type="text"/>      <input type="text"/> </div> <div>           Wind speed MPH      Air Temperature F°      <input type="checkbox"/> Check if negative  <input type="text"/>      <input type="text"/> </div> </div> <div style="display: flex; justify-content: space-between;"> <div>           Relative Humidity      Fuel Moisture      Fire Danger Rating  <input type="text"/> %      <input type="text"/> %      <input type="text"/> </div> </div>	
<b>I1</b> <b>Number of Buildings Involved</b> <input type="checkbox"/> None <input type="text"/> Number of buildings that were involved in Wildland fire  <b>I2</b> <b>Number of Buildings Threatened</b> <input type="checkbox"/> None <input type="text"/> Number of buildings that were threatened by Wildland fire but were not involved  <b>I3</b> <b>Total Acres Burned</b> <input type="text"/> , <input type="text"/> , <input type="text"/> • <input type="text"/>		<b>I4</b> <b>Primary Crops Burned</b> Identify up to 3 crops if any crops were burned Crop 1 <input type="text"/> Crop 2 <input type="text"/> Crop 3 <input type="text"/>
<b>J</b> <b>Property Management</b> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">         Indicate the percent of the total acres burned for each ownership type, then check the appropriate box to identify the property ownership at the origin of the fire. If the ownership at origin is Federal, enter the Federal Agency Code.       </div> <div style="display: flex; justify-content: space-between;"> <div>           Ownership            ↓            U <input type="checkbox"/> Undetermined         </div> <div>           % Total Acres Burned            ↓  <input type="text"/> %         </div> </div> <div> <b>Private</b>          1 <input type="checkbox"/> Tax-paying      <input type="text"/> %          2 <input type="checkbox"/> Non-tax-paying      <input type="text"/> %       </div> <div> <b>Public</b>          3 <input type="checkbox"/> City, town, village, local      <input type="text"/> %          4 <input type="checkbox"/> County or parish      <input type="text"/> %          5 <input type="checkbox"/> State or province      <input type="text"/> %          6 <input type="checkbox"/> Federal      <input type="text"/> %              Federal Agency Code      <input type="text"/>           7 <input type="checkbox"/> Foreign      <input type="text"/> %          8 <input type="checkbox"/> Military      <input type="text"/> %          0 <input type="checkbox"/> Other      <input type="text"/> %       </div>	<b>K</b> <b>NFDRS Fuel Model at Origin</b> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">         Enter the code and the descriptor corresponding to the NFDRS Fuel Model at Origin       </div> <input type="text"/> <b>L1</b> <b>Person Responsible For Fire</b> 1 <input type="checkbox"/> Identified person caused fire 2 <input type="checkbox"/> Unknown person caused fire 3 <input type="checkbox"/> Fire not caused by person If person identified, complete the rest of Section L <b>L2</b> <b>Gender of Person Involved</b> 1 <input type="checkbox"/> Male 2 <input type="checkbox"/> Female <b>L3</b> <b>Age or Date of Birth</b> Age in Years      Date of Birth <input type="text"/> OR <input type="text"/> / <input type="text"/> / <input type="text"/> Month      Day      Year <b>L4</b> <b>Activity of Person</b> <input type="text"/> Activity of Person Involved	<b>M</b> <b>Right of Way</b> Required if less than 100 feet <input type="text"/> Feet <input type="text"/> <input type="text"/> Horizontal distance      Type of right of way from right of way  <b>N</b> <b>Fire Behavior</b> <div style="border: 1px solid black; padding: 2px; margin-bottom: 5px;">         These optional descriptors refer to observations made at the point of initial attack       </div> <div style="display: flex; justify-content: space-between;"> <div> <input type="text"/> Feet            Elevation  <input type="text"/> </div> <div> <input type="text"/>             Relative position on slope  <input type="text"/> </div> </div> <div style="display: flex; justify-content: space-between;"> <div> <input type="text"/> Feet            Flame Length         </div> <div> <input type="text"/> Chains per Hour            Rate of spread         </div> </div>

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Figure A-6-4.1(b) Sample basic NFIRS-8 wildland fire reporting form.



**A-7-4.2 Food service checklist:**

- (a) Sanitation requirements (i.e., state, local, and OSHA) should be met.
- (b) Food service sanitation requirements should be met.
- (c) Food handlers should keep hands clean and should avoid handling food without wearing proper clothing and gloves.
- (d) Food handlers should be free of communicable disease.
- (e) Perishable foods should be stored under refrigeration at 40°F (4°C) or lower until served.
- (f) Hot foods should be kept at 150°F (66°C) or more until served.
- (g) Reusable food utensils should be cleaned thoroughly and immersed for 2 minutes in at least 170°F (77°C) water.
- (h) First aid material and first aid treatment should not be in kitchen or serving areas.
- (i) Recycling should be considered.

**A-7-4.3 Sanitation checklist:**

- (a) Provide adequate toilet facilities and establish a regular inspection and maintenance schedule to keep them clean.
- (b) Provide trash and garbage collection points and daily removal.
- (c) Do not locate garbage or trash collection points upwind of sleeping or eating areas.

**A-7-4.4 Water supply checklist:**

- (a) Use a safe local water supply, or haul it from a domestic water supply in trucks approved for potable water only.
- (b) Have the water tested, and protect it from contamination.

**A-7-4.5 Transportation checklist:**

- (a) Provide direction signs on roads to facilities and drop points.
- (b) Place signs at incident facilities and drop points.
- (c) Plan adequate rest for drivers.
- (d) Isolate and place signs at fuel storage area.
- (e) Develop and enforce vehicle control plan.
- (f) Plan for transportation for both personnel and equipment to and from incident camp to actual incident.
- (g) Provide maintenance and fueling according to schedule.
- (h) Inspect equipment condition.
- (i) Maintain all equipment records.
- (j) Provide transportation and support vehicles.

## Appendix B Air Operations for Forest, Brush, and Grass Fires

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

**B-1 Introduction.**

**B-1.1 Scope.** This guide presents fundamental information for agencies desiring to use aircraft for any and all aspects of wildland fire prevention, detection, and suppression. It presents necessary and useful information on procedures, practices, organization, and management, as well as suggested policy.

**B-1.2 Purpose.** The primary purpose of this guide is to present the information necessary to plan, organize, and manage safe, cost-effective aircraft operations. The guide focuses

on aircraft under the control of agencies responsible for wildland fire prevention, detection, and suppression.

**B-1.3 General.** Many agencies in different countries use aircraft for reconnaissance, fire detection, fire suppression, fuel management, and coordination of ground control forces.

**B-1.4 Definitions of Aeronautical and Air Operations Terminology.**

**Abort.** An order to terminate a preplanned aircraft maneuver (e.g., abort takeoff, abort retardant drop run).

**AGL.** Above ground level.

**Air Attack.** An operation involving the use of aircraft as part of the fire suppression action.

**Air Tactical Group Supervisor (ATGS).** The officer, normally airborne, in tactical command of all aircraft operating at an incident.

**Air Traffic.** Aircraft operating in the air or on an airport surface, exclusive of loading ramps and parking areas. (*See Federal Aviation Regulations, Part 1*)

**Aircraft Footprint.** That area on the surface of the earth, runway, or ramp that is covered by the tread of the aircraft tires while the aircraft is in a motionless condition.

**Airport Traffic Control Tower (Tower).** A facility providing airport traffic control service.

**Airspeed.** The speed of an aircraft relative to its surrounding air mass. The unqualified term *airspeed* means one of the following:

*Indicated airspeed.* The speed shown on the aircraft airspeed indicator. This is the speed used in pilot/controller communications under the general term *airspeed*. (*See U.S. Federal Aviation Regulations, Part 1.*)

*True airspeed.* The airspeed of an aircraft relative to undisturbed air; used primarily in flight planning and en route portion of flight. When used in pilot/controller communications, it is referred to as *true airspeed*, not shortened to *airspeed*.

**Airtanker.** A fixed-wing aircraft equipped to drop fire retardants or fire suppressants.

**Airtanker Coordinator/ Bird dog Pilot/Lead Plane Pilot.** The pilot of the control aircraft, working under supervision of the air tactical group supervisor (ATGS), who designates targets of retardant drops and coordinates the movement of airtankers.

**Approved.** Acceptable to the authority having jurisdiction.

NOTE: 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.

**Armed.** A term used in connection with the safety device that prevents accidental opening of retardant tank doors. When the door actuating system is "armed," the controls are operative.

**Artificial Horizon Attitude Indicator.** An instrument that indicates attitude with respect to the true horizon. A substitute for the natural horizon.

**Authority Having Jurisdiction.** The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

NOTE: The phrase “authority having jurisdiction” 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.

**Autorotation.** A nonpowered flight condition, with the rotor system maintaining the required flight rpm at a given forward airspeed. It is due to the relative wind upward through the rotors, caused by the weight, forward speed, and descent of the helicopter.

**Base/Rear/Heel.** The side of the fire having the slowest rate of speed.

**Bird dog/Air Attack (Aircraft).** The aircraft carrying the officer or individual in charge of air attack operations over a fire.

**Bomb Away/ or “Now.”** The voice command that signals the moment for actuating the controls that open the retardant doors.

**Break/Left or Right.** To turn left or right. Applies to aircraft in flight, usually on a retardant drop run, and when given as a command to the pilot, implies a prompt compliance.

**Bull’s-eye.** Term indicating that a load was placed exactly where requested.

**Called Shot.** The drop technique wherein the control aircraft triggers the load by voice signal to the pilot. (*See Countdown.*)

**Candling/Torching.** The burning of the foliage of a single tree, or a small group of trees, from the bottom up.

**Canopy.** The uppermost layer of tree foliage.

**Countdown.** A reverse count, from ten down to one, on a called shot starting approximately  $1\frac{1}{2}$  mile (0.8 km) from the target. (*See Called Shot.*)

**Crosswind Component.** The wind component measured in knots at 90 degrees to the longitudinal axis of the flight path.

**Crown Fire.** Fire traveling in the upper foliage of standing timber.

**Cruising Altitude.** A flight level determined by the vertical measurement from mean sea level (MSL).

**Density Altitude.** Pressure altitude for ambient temperature. In standard (ICAO) atmosphere, density and pressure altitude are equal. For a given pressure altitude, the higher the temperature, the higher the density altitude.

**Direct Attack.** A drop with the main portion of retardant or suppressant falling on the flame front.

**Discrete Frequency.** A frequency assigned to a particular function.

**DME.** Distance measuring equipment.

**Down Loading.** The reduction in aircraft gross weight made to compensate for loss of performance due to increase in density altitude.

**Dozer Line.** A physical fire break made by dozers or tractor plows.

**Drift.** The effect of wind on smoke or on retardant/suppressant drop.

**Drop Accuracy.** The assessment of a drop (i.e., where a load lands in relation to target) made by the air tactical group supervisor or a fireline supervisor.

**Drop Sequence.** The order and method in which the tanks are released.

**Dummy Run/Dry Run.** A simulated retardant or suppressant run made on a target by the bird dog, lead plane, or airtanker. Used to indicate approach and target to airtanker and to check for flight hazards.

**DZ.** Drop zone (i.e., target area).

**Early/Short.** Landing before the target. Retardant/suppressant dropped before reaching target.

**Elevation.** The elevation of the lead plane or bird dog when over the target on a dry run.

**Emergency Locator Transmitter (ELT).** A radio transmitter attached to the aircraft structure, which operates from its own power source on 121.5 MHz and 243 MHz, transmitting a distinctive downward swept audio tone for homing purposes; it is designed to function without human action after an accident.

**End of Load.** The last portion of retardant/suppressant to be released from an airtanker.

**ETA.** Estimated time of arrival.

**ETD.** Estimated time of departure.

**ETE.** Estimated time en route.

**FAA.** Federal Aviation Administration.

**FAR.** Federal Aviation Regulations.

**Final.** That portion of the flight path that is aligned with the retardant/suppressant drop line.

**Fire Fighter’s Certificate.** A method of carding fire fighters so overhead can determine their qualifications prior to assigning them to a position.

**Flank.** Side of a fire joining base or rear to head.

**Front/Start of Load.** The early end of the load.

**Gallons per Hour Concept.** An initial and supporting attack on a fire based on a continuous delivery of retardant/suppressants by airtankers or helicopters until complete control of the fire is achieved by ground personnel.

**Ground Effect.** Reaction of the wing or rotor downwash against ground surface forming a “ground cushion” that increases lifting capability of that section of air.

**Ground Fire.** Fire in duff, ground debris, or low-growing vegetation.

**Ground Speed.** The speed with which an aircraft transverses the ground over which it flies.

**Head.** The side of the fire having the fastest rate of spread.

**Heading.** The compass direction in which the longitudinal axis of an aircraft points.

**Helibase.** Location for parking, fueling, and maintenance of helicopters within the general area of an incident.

**Helibase Manager.** The officer responsible for managing resources/supplies at a helibase, heliport, or helispot.

**Helibucket.** A specially designed bucket carried by the helicopter like a sling load and used to drop retardants or suppressants.

**Helicopter Coordinator.** With instructions from the air tactical group supervisor (ATGS), the person responsible for coordinating tactical or logistical mission(s) by helicopters assigned to an incident.

**Heliport.** A designated landing area that is accessible by road and large enough to accommodate, at a minimum, two helicopters. It should have fueling facilities, a wind indicator, fire extinguishers, surfaced pads, tie-downs, parking areas, a water source, telephone and radio communications, officers for base personnel, pilots' rest areas, and lights.

**Helipumper.** A portable pump unit developed for transport by helicopter.

**Helispot.** Location where a helicopter can land and take off.

**Helitack.** The initial attack phase of fire suppression using helicopters and trained airborne teams to achieve immediate control of wildfire in a safe and economical manner.

**Helitack Crew Member.** A fire fighter trained in the use of helicopter accessories and in techniques to attack and suppress wildfire.

**Helitack Manager.** The person directly in charge of a helitack crew.

**Helitank.** A tank that is attached to a helicopter and is used to carry liquids such as suppressants or retardants.

**HF.** High frequency.

**High Drop.** A drop well above the canopy to give a soft falling, well-dispersed pattern. Used mainly to give a light retardant or suppressant coating that will reduce fire intensity.

**Hold/"Do not drop."** An order to hold a load and go around; should be followed by an explanation and new directions from the air attack supervisor. It is usually due to a change in attack plan or to a ground crew being in the way.

**Hole.** Weak or missed area in retardant or suppressant drop.

**Hot Spot.** A particularly active part of a fire within or along the fire boundary.

**Incident Command System (ICS).** Qualifying and organizing personnel to manage wildfires or other incidents.

**Incident Commander (IC).** The chief of an incident management team under the ICS.

**Identification Run.** A pass over the target area by the airtanker coordinator, bird dog, or lead aircraft to indicate the flight path and target while the airtanker pilot is observing.

**IFR.** Instrument flight rules.

**In-Ground Effect (IGE).** Use of the high-density ground cushion to hover the helicopter.

**Initial Attack.** The first action taken to suppress a fire, whether it be ground or air attack.

**Inspection Run.** A flight over target area to check for wind and smoke conditions and other hazards.

**Knot.** Nautical mile per hour.

**Late Drop.** Retardant or suppressant landing beyond the target.

**Lay-Up.** Connecting a drop to the rearward part of a previous drop.

**Lead In.** Lead plane/bird dog flies the target run in front of the tanker on final approach to target.

**Line.** A stretch of retardant or suppressant laid by aircraft to support constructed line or to retard fire spread.

**Line Length.** The distance actually covered on the ground by a single retardant or suppressant drop at a given coverage level.

**Listed.** Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

**Long-Term Retardant.** Solution having a chemical retardant action on fire even after water content has evaporated.

**Low Drop.** A drop lower than recommended minimum drop height.

**Magnetic Bearing.** Angle to an object measured from magnetic north in a clockwise direction.

**Magnetic Course.** The angle that the longitudinal axis of the aircraft makes with magnetic north.

**Magnetic Variation.** The angle between true north and magnetic north, measured east or west.

**Maneuvering Speed.** The greatest safe speed for abrupt maneuvers or for very rough air. Upon encountering severe gusts, the pilot should reduce airspeed to maneuvering speed. For airplanes in which the maneuvering speed is not specified, it can be safely computed as 70 percent greater than normal stalling speed. (Stalling speed  $\times 1.7$  = maneuvering speed.)

**Mean Sea Level (MSL).** The base commonly used in measuring altitudes.

**MOT.** Canadian Ministry of Transport.

**Night.** The time between the end of the evening civil twilight and the beginning of morning civil twilight, as published in the *American Air Almanac*.

**OAT.** Outside air temperature.

**One Strike/One Shot Concept.** An initial attack on a fire based on enough long-term retardant or suppressant arriving to finish the action and control the fire without the airtanker's having to make a second trip.

**Orbit.** The circular holding pattern an aircraft makes over one specific spot or area.

**Parallel Attack.** An outside (indirect) attack parallel to and removed from the fire's edge. It is usually effective only with long-term retardants in an air attack operation.

**Pass.** A run by the target without making a retardant drop.

**Pilotage.** Navigation by visual reference to landmarks.

**Pilot-in-Command.** The pilot responsible for the operation and safety of an aircraft during flight time.

**Pull-Up.** The act of executing a sharp maneuver to indicate the target area.

**Restricted Area.** Special use airspace of defined dimensions identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions.

**Retardant.** A chemical having a retarding action on fire.

**Retardant Support Base.** A base set up to support the operations of retardant/suppressant aircraft.

**“Return and Hold.”** An order to a pilot, denoting mission completed and further loads not required, to return to base and wait for further instructions.

**Rheologic Properties.** Cohesiveness, or the ability of a material to hold together during a drop.

**Rising Ground.** Terrain of increasing elevation ahead or on either side.

**Salvo.** The dropping of the entire retardant or suppressant load at one time.

**Short Takeoff and Landing (STOL) Aircraft.** An aircraft that has the capability of operating from a STOL runway, in accordance with applicable airworthiness and operating regulations.

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

**Slurry Base.** The same as retardant support base.

**Snag/Chicot.** Any dead or living tree rising above the forest canopy.

**Special Use Airspace.** Defined airspace within which flight is prohibited or restricted, or in which special hazards to flight exist.

**Split Load.** A drop sequence wherein the load is dropped in increments.

**Spot Fire.** A fire outside or ahead of the main fire boundary.

**Suppressants.** Agents (i.e., water or foam) used to extinguish the flaming and glowing phases of combustion by direct application to burning fuels.

**Tag-On.** Connecting a drop to the forward part of a previous drop.

**Temporary Flight Restriction (TFR).** Special use airspace obtained under *U.S. Federal Aviation Regulations*, Part 91.137, for the use of air attack or other incident aircraft.

**Touchdown Area (Pad).** That part of the landing and take-off area from which the helicopter alights.

**Track.** The flight path of an aircraft over the surface of the earth.

**Traffic Pattern.** The traffic flow that is prescribed for aircraft landing at, taxiing on, and taking off from an airport. The usual components of a traffic pattern are upwind leg, crosswind leg, base leg, and final approach.

**Trail Drop.** To drop retardant from separate compartments in rapid succession in order to give an extended pattern on the ground.

**True Bearing.** A bearing by true north rather than magnetic north.

**Turn-the-Corner.** Connecting a drop to a previous drop at an angle toward the head of the fire.

**Uncontrolled Airport.** An airport not having an operating control tower.

**Unicom.** Frequencies authorized for aeronautical advisory services to private aircraft.

**Vector.** A heading issued to an aircraft to provide navigational guidance by radar.

**Vertical Takeoff and Landing (VTOL) Aircraft.** An aircraft that has the capability of vertical takeoff and landing. These aircraft include, but are not limited to, helicopters.

**VFR Conditions.** Basic weather conditions prescribed for flight under visual flight rules.

**VHF.** Very high frequency.

**Viscosity.** The thickness of a solution or suspension. A measure of the relative ability of a fluid to resist flow. Heavy syrup has a high viscosity; gasoline has a low viscosity. Viscosity is usually measured in centipoise.

**Weather Advisory.** In aviation forecast practice, an expression of hazardous weather conditions not predicted in the area forecast, as they affect the operation of air traffic and as prepared by the National Weather Service.

**Wetting Agent.** Chemical added to water to reduce surface tension.

**Wing Span.** The distance in feet (meters) and inches (centimeters) from wing tip to wing tip of an airplane.

## B-2 Aircraft and Equipment Suitability and Selection.

### B-2.1 Aircraft — Fixed Wing.

**B-2.1.1 Detection, Reconnaissance, and Survey.** Small airplanes (single- and multi-engine) are used for detection, reconnaissance, and surveys. Airplanes for fire reconnaissance are used in combination with ground detection systems in areas of high fire occurrence. The use of aircraft for checking areas not visible from ground detection units is an accepted practice. Reconnaissance flights are usually scheduled following lightning storms. Flights to check “going” fires and controlled fires from previous days provide the latest information on conditions and progress.

Recently, heat sensing systems, known as forward looking infrared (FLIR) systems, have been developed for use with small aircraft. These systems are economically feasible, and simplicity of operation warrants their consideration for detection and reconnaissance activities. With further development, the detection could be computerized. (*See Table B-2.1.1.*)

**Table B-2.1.1 Thermal (IR) Indicator Correspondence to Scan Angle**

Altitude ft (m)	Swath Width ft (m)	Speed mph (knots)
500 (152.4 m)	1730 (527.9 m)	100 (88 knots)
1000 (304.8 m)	3460 (1054.6 m)	200 (176 knots)
1500 (457.2 m)	5200 (1585 m)	300 (264 knots)
2000 (609.6 m)	6920 (2109.2 m)	400 (352 knots)



Surveys of an area before and after a burn can provide a detailed review and study of an area that might otherwise be expensive and time-consuming. Many times the measurement of burn areas can be accomplished with a minimal amount of flying time.

Small airplanes can be made available for other jobs in connection with wildland fire protection. It is standard practice for agencies that do not own their own aircraft to contract with a local fixed base operator (FBO) to provide the aircraft and pilot.

**B-2.1.2 Paracargo and Freight.** Numerous types of small, medium, and large airplanes are used for transporting freight and dropping paracargo to fire camps or isolated crews. Not all airplanes are suitable for freight activities, and relatively few can be modified into good paracargo aircraft. Most civilian airplanes now being used were designed and built for carrying passengers and require special modifications for adaptation for freight or paracargo work.

Desirable features for airfreight and paracargo airplanes are as follows: sufficient capacity; smooth floors; inherent stability; moderate or low stalling and landing speeds; suitable paracargo discharge aperture; ample reserve power at near gross weight (multiengine); easy control under marginal flying conditions; good visibility; stripped utility interior; cargo tie-down facilities; and approved seats, seat belts, and shoulder harness.

**B-2.1.3 Special Equipment.** Cargo tie-down facilities are necessary in all airplanes used to transport airfreight or cargo. Special equipment must be installed to prevent any malfunctions. Most special equipment must have FAA approval before use.

**B-2.1.4 Amphibious Operations.** Amphibious aircraft or float-equipped aircraft can be more versatile and serve more functions than land-based aircraft. In Alaska and some parts of Canada and the contiguous United States where suitable lakes and rivers are numerous, and in the coastal area, this type of aircraft is used extensively.

As long as adequate water depth and an unobstructed water surface area are maintained, little or no preparation other than suitable docking or ramp facilities is required for a water-based operation. If no safe natural docking or beaching site is available, temporary docks can be constructed to facilitate loading and unloading and to avoid damage to the aircraft.

Many amphibious aircraft are equipped to drop suppressants such as foam.

**B-2.1.5 Detection, Reconnaissance, and Survey Aircraft.** Airplanes that are available and suitable for detection, reconnaissance, and surveys can be divided into three basic types:

- (a) Light high-wing, single-engine airplanes
- (b) Light low-wing, single-engine airplanes
- (c) Light twin-engine airplanes (See Figure B-2.1.5.)

The light high-wing, single-engine type of airplane is usually the most suitable.

Light airplanes are usually more economical and efficient than helicopters for detection, reconnaissance, and survey flights; however, because of its versatility, the helicopter is especially useful for intensive-type missions that require landing for ground inspections and low-level, slow flight.

Factors to consider in selecting aircraft for these assignments include the following:

- (a) Number of persons necessary to carry out the assignment
- (b) Performance characteristics of the airplane; landings and takeoffs from airfields at high elevations, with short unsurfaced runways; adequate cruising range; visibility (maximum forward and lateral visibility is essential); cabin space; aircraft instruments, and properly installed radio equipment
- (c) Suitability for infrared scanning and mapping



Figure B-2.1.5 Detection, reconnaissance, and survey aircraft.

**B-2.1.6 Airtankers.** Aircraft selection for wildfire suppression and related uses involves certain problems. The performance characteristics must be such that safe and efficient operations can be conducted over typical terrain and at necessary elevations. The aircraft integrity should be such that atmospheric conditions will not present a structural problem. (See Figure B-2.1.6.)

Tank capacity, drop speed, cruise speed, and other characteristics of the various makes and models of airtankers are listed in Table B-2.1.6.

Light airtankers can be operated efficiently and economically as initial attack aircraft on wildfires where the fires are within 30 miles (48.3 km) of the air attack base. These aircraft are also capable of support action and accurate low-volume drops in confined areas.

Medium and larger airtankers with 2000-gal plus (7600-L plus) capacities are more efficient on a cost-per-gallon mile basis for high-volume cascading on fires and retardant fireline construction. This should not preclude the use of large airtankers at short range, because many times fires are contained or controlled by several high-volume cascading actions.



Figure B-2.1.6 Lockheed C-130 (MAFFS) airtanker.



**Table B-2.1.6 Fixed-Wing Airtankers Specifications Chart**

Airtanker	Min. Runway Required ft (m)	No. of Engines	No. of Crews	A/C Loaded		No. of Doors	Minimum Releasable		Total Capacity	
				Speed Drop	Knots Cruise		U.S.	IMP	U.S.	IMP
LIGHT — up to and including 800 gal (3028 L)										
Aero Commander Snow	2000 (610)	1	1	61	96	1	300	200	300	250
DeHavilland Otter	2500 (762)	1	1	70	100	2	108	90	276	230
DeHavilland DHC-6 Twin Otter	2500 (762)	2	1	59	150	2	276	230	480	400
Grumman AG-Cat N3N Stearman	2000 (610)	1	1	61	87	1–2	300	250	300	250
Grumman S2F Tracker	3500 (1067)	2	1	104	161	2	200	167	800	666
FLZ M18 Dromader	1000 (305)	1	1	78	118	1	660	550	660	550
MEDIUM — 800 gal (3028 L) up to 2000 gal (7570 L)										
Douglas B-26 STOL	4000 (1220)	2	1	122	190	4	250	208	1200	1000
Consolidated PBY5A Canso	5000 (1525)	2	2	87	104	2	400	333	960	800
Consolidated Super PBY 5	4200 (1281)	2	2	87	148	2	624	520	1500	1249
Canadair CL-215	4000 (1220)	2	2	96	152	2	588	490	1412	1176
Lockheed PV2	4000 (1220)	2	2	113	180	2	437	364	1050	874
Douglas DC-4	4000 (1220)	4	2	126	170	4–8	207	172	2000	1666
SP2H	4000 (1220)	2	2	120	216	2	500	416	2000	1666
HEAVY — 2000 gal plus (7570 L plus)										
Convair Super PB4Y-2	4000 (1220)	4	2	113	190	8	275	2200	2200	1832
Douglas Super DC-4	3600 (1098)	4	2	126	190	8	275	2200	2200	1832
Douglas DC-6	5000 (1525)	4	2	126	216	8	250	208	3000	2499
Douglas DC-7	4500 (1373)	4	2	130	230	8	250	208	3000	2499
Lockheed P2V	4000 (1220)	4	2	126	216	8	408	340	2450	2040
Lockheed P-3A	4000 (1220)	4	2	130	300	8	250	208	3000	2499
Lockheed C-130A	4000 (1220)	4	3	130	256	8	375	312	3000	2499
Lockheed C-130 (MAFFS)	4500 (1373)	4	5	130	256	8	3000	2499	3000	2499

Note: Individual airplanes on this list are sometimes modified for local needs.

**B-2.1.6.1 Suitability Factors for Airtankers.** To select suitable airtankers, consider the tank capacities, performance capabilities, and general flight characteristics listed in Table B-2.1.6, in relation to the following factors:

(a) *Airport.* Airtankers using an airport at high elevations, above standard temperatures or with a gradient of 1 percent or above, will require more runway length for safe efficient operation than they would at sea-level airports.

To help evaluate airport capability versus airtanker performance for safety during maximum load takeoff purposes, the 80 percent takeoff concept (four-engine) or the accelerated stop concept (two-engine) should be used. If either of these two concepts fails to meet the runway length, the cleared area concept can be used.

(b) *Airtanker loading.* It could be necessary to reduce the load to obtain safe performance in response to certain variables such as density altitude, runway lengths, gradient, runway surface, and obstructions.

(c) *Cruising speed.* Generally, high cruising speed is desired, especially for initial attack operation.

(d) *Drop speed.* Finally, the speed at which the aircraft flies during retardant/suppressant drops (slower than cruising speed) must be considered.

**B-2.1.6.2 Application Variation.** For maximum flexibility and efficiency, the retardant/suppressant application rate should be variable to fit the fire situation. This can be done by sequencing various combinations of multiple doors or using a variable flow-rate system.

**B-2.1.7 Smoke-Jumping Aircraft.** Civil aircraft are not designed specifically for smoke-jumping use, so certain approved installations and modifications must be made to the properly selected aircraft. These modifications will include a static line anchor cable (installation will vary with the aircraft), door safety strap, safety handrails, doorstep, cargo parachute static line anchor, cargo-dropping harness anchor cable, and cargo tie-down facilities. All sharp corners and projections near the door and step, along the fuselage, and under the belly that could snag parachutes or cargo must be removed or shielded. (Smoke-jumper aircraft equipment drawings and specifications can be obtained from the U.S. Forest Service.)

**B-2.2 Aircraft — Rotary Wing.** The helicopter has become a familiar multiuse fire-fighting aircraft in wildland fire suppression. This aircraft has become as necessary in today's fire suppression as hand tools, crews, tractors, smoke jumpers, engines, and airtankers (*see Table B-2.2*).

**B-2.2.1 Retardant and Suppressant Dropping.** The versatility and maneuvering capabilities of the helicopter make this aircraft an important initial attack tool. Helicopters with capacities for dropping 80–3000 gal (303–11,400 L) of suppressants or retardants are principal weapons in the helitack phase of wildland fire suppression. Helicopters generally utilize two methods of dropping (*see Table B-2.2.1*):

- (a) A bucket slung underneath the helicopter
- (b) A fixed external tank

**B-2.2.2 Initial Attack Transport.** Helitack functions are designed to transport trained personnel to a fire as quickly as possible. Small crews, trained and properly equipped, can

gain control of most incipient wildland fire situations if they can make fast initial attack. This can be accomplished by landing or rappelling near the fire.

**B-2.2.3 Reconnaissance and Scouting.** Performance characteristics of the helicopter make it an excellent reconnaissance and scouting aircraft. Slow speed and ability to operate in areas that could not be observed from fixed-wing aircraft, plus its usefulness in providing terrain and fire intelligence that otherwise could not be obtainable, are obvious benefits. The helicopters provide an ideal platform for using heat sensing and mapping systems. The systems range from handheld units to permanently mounted units.

**B-2.2.4 Shuttling Equipment and Personnel.** Equipment can be moved to other fire areas, by heliport to heliport or by paracargo or sling load methods, where landings cannot be safely accomplished. Personnel (fire crews, helitack personnel, and others) can be airlifted as conditions warrant. Food and water can be delivered to line crews, and spike camps can be supported in this manner.

**B-2.2.5 Rescue.** Helicopters are an essential part of many rescue operations. The following are some uses:

- (a) Airlifting medical aid crew personnel to care for and move injured persons to medical aid sites or hospitals
- (b) Scouting and directing rescue crews
- (c) Servicing isolated parties until rescue can be accomplished

Weather and performance limitations of the aircraft can, at times, prevent their use in rescue operations.

**B-2.2.6 Other Uses.** Helicopters can also be used for the following:

- (a) Aerial ignition operations such as helitorch, ping-pong dispenser, and other similar devices
- (b) Rappelling of trained crews
- (c) Retrieving of smoke jumpers
- (d) Detection and prevention activities

**B-2.2.7 Criteria for Selecting Landing Sites.** Consideration should be given to the following issues in selecting a site for a helibase or helispot.

**B-2.2.7.1** The following factors regarding proximity to fire should be considered:

- (a) Close enough to minimize flight time
- (b) Out of the path of the fire

**B-2.2.7.2** The topography of the site involves the following considerations:

- (a) Recommended size of takeoff and landing area (i.e., safety circle)
  1. Light helicopters — 75 ft (23 m) in diameter
  2. Medium helicopters — 90 ft (27 m) in diameter
  3. Large helicopters — 100 ft (33 m) in diameter

NOTE: No obstacles greater than 2-ft (0.6-m) high brush should be allowed in the safety circle. All other vegetation and obstacles (e.g., trees, large rocks) should be removed.

- (b) Slope of landing/parking area — 6 degrees maximum recommended

**Table B-2.2 Helicopter Model Specifications**

Helicopter Make/ Model	Diam. in ft (m)	Type Landing Gear	Fuel Type	U.S./ IMP Fuel Capacity	Wkg. Hours	Cruise Speed Knots	Hover IGE in ft (m)	Pass. Seats	Int. Pay- load in lb (kg)	Ext. Pay- load in lb (kg)	Remarks
LIGHT											
Bell 47B3B-1	37' 2" (11.3)	Skid	100 Octavgas	57/46	2	70	15,000 (4575)	2	600 (272.4)	650 (295.1)	Used extensively in forest work, good altitude performance
Bell 47G38-2	37' 2" (11.3)	Skid	100 Octavgas	57/46	2	70	15,000 (4575)	2	600 (272.4)	650 (295.1)	Same as B-1 with improved turbo and lower instrument panel
Soloy Bell 47G	37' 2" (11.3)	Skid	Jet fuel	57/46	2	83	16,500 (5032.5)	2	1100 (499.4)	1100 (499.4)	Good altitude performance
Bell 206BII	33' 4" (10)	Skid	Jet fuel	76/43	3	109	10,000 (3050)	4	973 (441.7)	1200 (544.8)	Same as above only with better altitude performance
Bell 206BIII	33' 4" (10)	Skid	Jet fuel	76/63	2	109	10,500 (3202.5)	4	973 (441.7)	1200 (441.7)	Same as above only with better altitude performance
Bell 206 L1 or L3	35' 5" (10.82)	Skid	100 Octavgas	46/39	2	61	8500 (2592.5)	2	580 (263.3)	700 (319.8)	Good work horse below 6000 ft
Bell 407	37' (11.27)	Skid	Jet A	128/103	3	130	15,000 (4572)	6	2000 (907)	2500 (1134)	
Hiller 12E	35' 5" (10.82)	Skid	100 Octavgas	46/39	2	61	8500 (2592.5)	2	580 (263.3)	700 (319.8)	Good work horse below 6000 ft
Hiller 12-53/5	35' 5" (10.82)	Skid	Jet fuel	46/39	1 <sup>3</sup> / <sub>4</sub>	78	13,500 (4117.5)	3	1100 (499.4)	1100 (499.4)	Good altitude performance, short working time
McDonald Douglas 500 C	26' 4" (8.05)	Skid	Jet fuel	64/54	2 <sup>1</sup> / <sub>2</sub>	100	11,000 (3355)	4	582 (309.6)	782 (355)	Same as above only with increased hp giving increased altitude performance
Aerospatiale	33' 6" (10.24)	Skid	Jet fuel	149/124	4	78	5200 (1586)	4	600 (272.4)	900 (408.6)	Light turbine aircraft, good performance up to 8000 ft
Aerospatiale Alouette Lama	36' 2" (11.03)	Skid	Jet fuel	149/124	2 <sup>1</sup> / <sub>2</sub>	96	20,000 (6100)	4	980 (444.9)	1442 (6544.7)	Excellent for high-altitude and external load work; internal load only limited by non-jettisonable
Aerospatiale Alouette SA-341	34' 6" (11.33)	Skid	Jet fuel	120/110	3 <sup>1</sup> / <sub>2</sub>	130	10,500 (3202.5)	2	833 (378)	1600 (454)	Light turbine helicopter, very good cruise speed
Aerospatiale Aster AS-350	35' 0" (10.67)	Skid	Jet fuel	140/116	3	121	9000 (2775)	5	900 (408.6)	1600 (454)	Good medium altitude lifter, good speed
Aerospatiale Twinstar AS-350	35' 0" (10.67)	Skid	Jet fuel	140/116	3	121	9000 (2775)	5	840 (381.4)	1540 (699.2)	Same as above except twin engine
MEDIUM											
Aerospatiale SA-365N	38' 4" (11.7)	Wheel	Jet fuel	210/180	2 <sup>1</sup> / <sub>2</sub>	148	6700 (2043.5)	13	2800 (1271.2)	2300 (1044.2)	Excellent speed
Bell 204B	49' 0" (14.64)	Skid	Jet fuel	165/137	2	100	9000 (2745)	9	3575 (1623.1)	3000 (1362)	Excellent speed, payload, and altitude performance

**Table B-2.2 Helicopter Model Specifications** *(continued)*

Helicopter Make/ Model	Diam. in ft (m)	Type Landing Gear	Fuel Type	U.S./ IMP Fuel Capacity	Wkg. Hours	Cruise Speed Knots	Hover IGE in ft (m)	Pass. Seats	Int. Pay- load in lb (kg)	Ext. Pay- load in lb (kg)	Remarks
K-Max	51.5'	Wheel	Jet A	228	2 <sup>1</sup> / <sub>2</sub>	80	15,000	0	0	6000	
Bell 205A-1	48' 0" (14.63)	Skid	Jet fuel	220/183	2 <sup>1</sup> / <sub>2</sub>	104	11,000 (3355)	14	2593 (1177.2)	3100 (1407.4)	Excellent speed, pay- load, and altitude performance
Bell 212	48' 0" (14.63)	Skid	Jet fuel	225/187	2	113	11,200 (3416)	14	2295 (1041.9)	3000 (1362)	Like 2055A-1, except has two engines
Bell 412	46' 0" (14.02)	Skid	Jet fuel	214/180	2	121	11,600(35 38)	14	2700 (1225.8)	3400 (1543.6)	
Vought	36' 2" (11.03)	Wheel	Jet fuel	148/124	2 <sup>1</sup> / <sub>2</sub>	95	10,000 (3050)	6	1000 (454)	1200 (544.8)	Excellent altitude, payload, and altitude capability
Sikorsky S55T	53' 0" (16.15)	Wheel	Jet fuel	186/153	3	78	10,000 (3050)	10	1520 (690.1)	1650 (749.1)	Turbine version of S55, good altitude performance
Sikorsky S58	56' 0" (17.06)	Wheel	100	158/133	2	87	5000 (1525)	15	3500 (1589)	4,000 (1916)	Good performance at lower altitudes
Sikorsky S58T	56' 0" (17.06)	Wheel	Jet fuel	274/228	2 <sup>1</sup> / <sub>2</sub>	87	8000 (2440)	15	3717 (1679.8)	4,500 (2065.7)	Twin turbine pow- ered version of S58, good altitude perfor- mance
Bell 214	50' 0" (15.2)	Skid	Jet fuel	204/176	1 <sup>1</sup> / <sub>2</sub>	139	17,800 (5429)	14	3300 (1498.2)	6,000 (2860.2)	Excellent external load aircraft
Bell 214SAT	52' 0" (15.8)	Skid	Jet fuel	412/342	2	121	12,500 (3812.5)	19	4500 (2043)	6,000 (2724)	Same as above except twin engines
HEAVY											
Aerospatiale SA330 Puma	49' 5" (15.1)	Wheel	Jet fuel	408/330	3	130	11,500 (3507.5)	18	5200 (2360.8)	7,500 (3405)	Excellent high-alti- tude performance
Aerospatiale AS332C	51' 5" (14.7)	Wheel	Jet fuel	408/339	2 <sup>1</sup> / <sub>2</sub>	148	14,800 (4514)	18	6200 (2814.8)	9,500 (4313)	Excellent high-alti- tude performance
Aerospatiale AS332L	51' 2" (15.6)	Wheel	Jet fuel	536/429	3 <sup>1</sup> / <sub>2</sub>	148	14,800 (4514)	22	6200 (2724)	9,500 (4313)	Excellent high-alti- tude performance
Sikorsky S61	62' 0" (18.9)	Wheel	Jet fuel	410/341	2	104	6700 (2043.5)	26	4000 (1816)	6,000 (2724)	Twin turbine, good payload and altitude performance
Sikorsky Sky Crane S-64	72' 0" (21.9)	Wheel	Jet fuel	1700/1396	3	87	6000 (1830)			10,526 (4778.8)	Largest heavy lift crane-type
Boeing-Vertol BV- 107	50' 0" (15.2)	Wheel	Jet fuel	350/292	1 <sup>1</sup> / <sub>2</sub>	113	7300 (2226.5)	26	4795 (2176.9)	5,700 (2587.8)	Large twin engine with good payload and altitude perfor- mance
Boeing-Vertol 114 (CH47A)	60' 0" (18.3)	Wheel	Jet fuel	630/515	1 <sup>1</sup> / <sub>2</sub>	113	13,000 (3965)	34	6500 (2951)	6,500 (2951)	Large twin-engine helicopter, good per- formance
Boeing-Vertol 234	60' 0" (18.3)	Wheel	Jet fuel	2090/1700	3 <sup>1</sup> / <sub>2</sub>	139	14,500 (4422.5)	44	24000 (10896)	28,000 (12712)	Commercial version of military CH-47

**Table B-2.2.1 Helicopter Fire-Fighting Bucket Specification**

Make and Model No. <sup>+</sup>	Collapsible Diam. × H (in.)	H <sub>2</sub> O Level Adjustment (gal) Pop-Out Plug	Injection Pump	Flotation Ring	Overall Dimensions		Unit Complete Weight (lb)		Door Operation		
					Diam. × H (in.)	Cubic Vol. (ft)	Empty	Full/H <sub>2</sub> O 8.5 lb	No.	Type	Hookup
Chadwick C-140	No	50-70-90 110-140	Yes	Yes	45 × 39	35.8	90	1280	1	Valve	Electric
Chadwick C-450	No	170-230-300 380-450	Yes	Yes	45 × 51	46.9	300	4125	3	Valve	Electric
Hawkins & Powers 200 <sup>1</sup>	42 × 4 <sup>1</sup> / <sub>2</sub>	70-100 Zipper	No	No	42 × 24	19.2	101	1036	2	Butter	Pneumatic
Hawkins & Powers 200 <sup>2</sup>	48 × 4 <sup>1</sup> / <sub>2</sub>	125-200 Zipper	No	No	48 × 24	25.1	104	1804	2	Butter	Pneumatic
Hawkins & Powers 300 <sup>2</sup>	48 × 4 <sup>1</sup> / <sub>2</sub>	200-300 Zipper	No	No	48 × 38	39.7	108	2658	2	Butter	Pneumatic
Hawkins & Powers 400 <sup>2</sup>	48 × 4 <sup>1</sup> / <sub>2</sub>	300-400 Zipper	No	No	48 × 50	52.3	111	3511	2	Butter	Pneumatic
Sims PTF-50 <sup>1</sup>	No	50	Yes	Yes	32 × 22 <sup>1</sup> / <sub>2</sub>	11.8	50	475	1	Valve	Electric
Sims PTF-100	No	50-70-100	Yes	Yes	46 × 33	31.7	81	931	1	Valve	Electric
Sims PTF-150	No	50-70-90 110-140-150	Yes	Yes	47 × 39	39.1	86	1361	1	Valve	Electric
Sims PTF-300 <sup>2</sup>	58 × 21	None	Yes	Yes	59 × 36 <sup>1</sup> / <sub>2</sub>	71.1	300	2850	2	Butter	Electric
Sims PT-450	No	200-250-300 350-450	Yes	Yes	64 × 57 <sup>1</sup> / <sub>2</sub>	106.9	252	4077	2	Butter	Electric
Sims PT-1000	No	500-600-700 800-1000	Yes	Yes	84 × 74	237.2	625	9125	2	Butter	Electric
Griffith 140 <sup>1</sup>	34 × 24	Variable adjustment	No	Yes	34 × 43 <sup>1</sup> / <sub>2</sub>	22.8	84	1357	1	Valve	Electric
Griffith 140 <sup>2</sup>	50 × 30	Variable adjustment	No	Yes	51 × 55	64.9	225	3625	1	Valve	Electric or hydraulic
Bambi	Variable		Available	No	Variable	Variable	1	Dump valve	Electric		
Griffith 2000	80 × 34	Variable adjustment	No	Yes	96 × 82	474.4	900	17,900	1	Valve	Electric or hydraulic
Sims PT-250	45 × 25	None	Yes	Yes	45 × 45	41.4	180	2305	1	Valve	Electric
Sims SF-2000	No	1500 1700	Yes	No	98 × 79	344.8	700	17,000	1	Butter	Electric
Griffith 50	24 × 20	+35	No	Yes	24 × 30	7.9	94	470	1	Valve	Electric
Griffith 100	30 × 18	+70	No	Yes	31 <sup>1</sup> / <sub>2</sub> × 38 <sup>1</sup> / <sub>2</sub>	17.4	106	956	1	Valve	Electric
Griffith 250	45 × 26	+193	No	Yes	42 × 44	35.3	198	2323	1	Valve	Electric
Griffith 600	50 × 30	+400	No	Yes	58 × 58	88.7	350	3325	1	Valve	Electric or hydraulic
Griffith 1000	50 × 35	+400	No	Yes	65 × 84	161.3	575	9075	1	Valve	Electric or hydraulic

Note: All above buckets are sling mounted to helicopter with open top.

Material: Hawkins and Powers, canvas/steel frame; Griffith, polyurethane; the rest are fiberglass.

<sup>1</sup>Can be carried on small helicopter cargo rack.

<sup>2</sup>Will fit in cabin or passenger compartment of a 205.

<sup>+</sup>All Griffith Buckets can be ordered with adjustment plugs.

For SI Units: 1 in. = 2.54 cm; 1 gal = 3.78 L

#### Guide to Drop Patterns:

Size Bucket (gal)	Pattern	Coverage gal/per 100 ft <sup>2</sup>	Height Dropped	Air Speed (mph)
150	20–25 × 200–250	1.4–2.0	50–70	25
200–450	35 × 330	3.7		36
500–1000	50 × 850	2.2		48

- (c) Touchdown, taxiway, and parking surfaces
  1. Maximum brush height of 2 ft (0.6 m) (Caution: Dry grass can be a fire hazard around helicopters.)
  2. Sufficiently free of large rocks so as to ensure a stable landing
  3. Minimum foreign object damage potential
    - a. All proximate loose objects such as twigs, branches, and trash secured or eliminated.
    - b. Employment of dust abatement, to avoid severe damage to a helicopter's rotating components, especially the engine. Dust abatement will also minimize the rotor-wash-generated dust cloud that could dangerously restrict a pilot's visibility.
  4. Compacted enough to support the following weights:
    - a. Light helicopters — 7000 lb (3178 kg)
    - b. Medium helicopters — 15,000 lb (6810 kg)
    - c. Large helicopters — 60,000 lb (27,240 kg)
  5. Touchdown/parking pad (on which the landing gear will physically sit) — should be a minimum of the following:
    - a. Light helicopters — 15 ft × 15 ft (4.6 m × 4.6 m)
    - b. Medium helicopters — 20 ft × 20 ft (6.1 m × 6.1 m)
    - c. Large helicopters — 30 ft × 30 ft (9.1 m × 9.1 m)
  6. Soft surfaces, such as tundra or bogs — could require a log pad
  7. Recommended minimum obstacle clearance for touchdown, taxiway, and parking areas — 10 ft (3 m) from the tip of the main and tail rotor. If, during planning, the turning radius of the helicopter is not known, the radius of the appropriate safety circle outlined in B-2.2.7.2(a)2 should be utilized to determine the minimum distance that an obstacle (including other helicopters) should be from the touchdown, parking pad, or centerline of the taxiway.
- (d) Approach and departure capability in several directions if possible. This will allow the pilots to utilize the wind to their best advantage.
- (e) Bare, open pinnacles, ridgelines, and meadows— make the best helispots and helibases. Due to the potential volume of traffic at a helibase, a more level, open, and preferably improved area should be sought, along with stricter adherence to the guidelines.
- (f) Although helicopters are capable of operating out of areas in which the safety circle is surrounded by tall trees (hover hole), it is not necessarily safe to do so. Every effort should be made to allow the helicopter to make shallow approaches and departures.

If operating from a hover hole is the only alternative, ensure that the approach and departure paths to the hover hole meet the minimum criteria outlined in B-2.2.7.3.

**B-2.2.7.3** The following are criteria recommended for approach and departure paths:

- (a) Preferably, the approach and departure paths should not be the same. In fact, several approach and departure paths should be developed if possible. This will allow pilots to adjust to changing meteorological conditions.
- (b) The minimum width of approach and departure paths should be the same as the diameter of the corresponding safety circle. Safety would be enhanced if the paths could be

widened by 10 degrees on either side of the centerline as they leave the circle (20-degree spread).

(c) Curving paths are permissible in order to avoid major obstacles.

(d) The paths should have a minimum 8:1 slope, measured from the edge of the safety circle.

(e) No obstacle should penetrate that slope during the 20-degree spread for the following:

1. 150 ft (48 m) of the approach path
2. 300 ft (96 m) of the departure path

(f) Areas suitable for landing the helicopter in the event of an emergency would be desirable along the paths.

(g) The paths can generally be aligned with the prevailing wind but not always. Pilots will utilize such variables as velocity of the wind, turbulence, updrafts, and downdrafts in deciding the direction of their approach and departure; hence the importance of having several approach and departure paths available.

**B-2.2.7.4** Flight routes should be established in order to ensure the following:

- (a) Separation between helicopters
- (b) Separation between other aircraft on the fire
- (c) Flight following check points
- (d) Aircraft performance. (Try not to have a heavily loaded helicopter climb steep terrain.)

**B-2.2.7.5 Advice of the Pilots.** This is the most important factor to consider when establishing these sites. This test offers only general guidelines for selecting helibases and helispots. The pilots will make the final decision on all proposed site selections.

### B-3 Ground Facilities.

**B-3.1 Ground Support Facilities.** Permanent or auxiliary bases for aircraft engaged in wildfire or related operational activities should be arranged so that aircraft ground traffic, parking, and public movement will not delay or hinder the efficient and safe operation. Taxiways and loading areas must afford adequate width and clearance for safe ground maneuvering of the aircraft. Ramps or heliport pads should be designed to support the gross weights of the aircraft and other necessary equipment.

The National Wildfire Coordinating Group's Fire Equipment Working Team has developed an *Airtanker Base Planning Guide* that identifies planning criteria for developing or upgrading airtanker base facilities.

**B-3.1.1 Aircraft Rescue and Fire Fighting.** In most cases, rescue and fire-fighting operations in response to accidents at an airport will be performed by regular airport fire-fighting personnel. However, it could be necessary at times to furnish this service where such facilities are not provided by the airport management. The National Fire Protection Association has published a number of useful standards, manuals, and guides on this subject, listed in Appendix D.

NOTE: At no time should air attack operations be conducted without approved fire-extinguishing equipment and trained personnel on "fire guard."

### B-3.2 Airports, Heliports, Helibases, and Helispots.

**B-3.2.1 Runways.** Suitable runway lengths for aircraft employed in air operations could vary from a sod runway of 2000 ft (610 m) — being used by single-engine detection,

reconnaissance, and scouting aircraft — to the 4000–10,000 ft (1220–048 m) of hard surfaced runway capable of supporting, and of adequate length to assure safe operations of, the largest airtankers. Runway length requirements given for specific aircraft usually apply only at sea level altitude with standard day temperatures 59°F (15°C) and where the runway gradient is 1 percent or less. For other conditions, the runway length must be increased.

(a) *Altitude.* Increase the basic runway length by 7 percent for each 1000 ft (305 m) above sea level.

(b) *Temperature.* Increase the runway length that has been fixed by altitude by 0.5 percent for each degree (F) that the mean temperature of the hottest day exceeds 59°F (15°C).

With normally aspirated engines (nonsupercharged), approximately one-half of the rated horsepower is lost at 10,000 ft (3.050 m).

The FAA Flight Standards Service Operations Division has developed the Denalt Performance Computer, which is intended to supplement the aircraft manufacturer's published performance data for computing takeoff performance. Two types are available: one for fixed-pitch and one for variable-pitch propeller aircraft.

Runways for airtanker use must be of sufficient length to assure safe takeoffs and landings. Repaired runways, taxiways, and ramps should be of such structural design that the gross weight of airtanker operations will not cause damage to the surface.

Runway orientation should be such that the crosswind factor can be held to a minimum. If possible, it is desirable to have unobstructed departure and approach lanes for the runways.

**B-3.2.2 Air Traffic.** Ideally, air traffic should be minimal. If air traffic becomes heavy, employ an approved air traffic controller to expedite departures and arrivals.

Rural-located bases — such as heliports, helibases, or helispots — are rarely confronted with competing activities that slow down or hinder air operations as opposed to an airport-located base. One exception in some areas is military training routes (MTRs).

**B-3.2.3 Operations Buildings.** The operations building for a permanent or auxiliary base should be of adequate design and size to accommodate present and foreseeable future operations office activities. It should include the necessary communications facilities essential for efficient and safe operations, office space, pilot lounge, and so forth, in a permanent base operations building.

## **B-4 General Operating Procedures.**

**B-4.1 Air Operations Plan.** Considerable evaluation and study will be necessary for those who plan air operations. First-hand experiences and sound information from others who are using aircraft will be extremely helpful.

Some of the factors involved for consideration will include the overall objectives and needs for the operations; cost evaluation; availability of suitable aircraft to fulfill the objectives and needs; operational base locations; ground support facilities; communications; and the personnel necessary to operate the aircraft, the bases, and the ground support facilities and to operate the overall supervision of the air operations.

**B-4.2 Retardant and Suppressant Drops.** The proper use of air attack is important to resource protection.

The decision to use airtankers should be based on careful consideration of the following:

- (a) Fire potential and its likelihood of doing extensive damage or requiring costly suppression efforts
- (b) Threat to life safety
- (c) Opportunity to obtain more economic control
- (d) Availability of an airtanker organization sufficiently trained, equipped, and organized to perform the mission
- (e) Accomplishing the mission during daylight hours so that terrain, visibility, and wind conditions permit safe and effective dropping

The airtanker is a highly specialized and costly fire-fighting tool. It is the responsibility of the incident commander to suspend the use of an airtanker when it is no longer effective or essential.

Specialists with airtanker experience should be consulted and assisted in the planning of the airtanker program. An airport facility guide and map showing the airports suitable for primary and auxiliary airtanker operations, within or adjacent to protection areas, should be made.

Airports selected for either primary or auxiliary airtanker operations should be rated on the number of airtankers that can be handled simultaneously. That capacity will depend on the size of the airport and area set aside for loading facilities, the mixing and loading facilities, the amount of fire-retardant chemical, and the available ground personnel.

The primary objective should be to have airports within 30-minute transit time from the areas to be protected by initial attack aircraft. The distance will depend on the performance of the aircraft (*see Table B-2.1.6*).

Pre-wildfire season planning should include preparing the base for airtanker operations by addressing the following:

- (a) An operational check of mixing equipment
- (b) Determination of the dry and wet chemical supply, water supply, and storage facilities
- (c) Training of the ground crews that are to support the operation and the logistics necessary to keep the air attack aircraft operational

**B-4.3 Detection, Reconnaissance, and Scouting.** The essential components for a successful airborne detection, reconnaissance, and scouting operation are as follows.

**B-4.3.1 Preliminary Planning.** Maps, charts, seen-area composites, spot maps, weather information, fire statistics, and any other information that could help in accomplishing the operation should be utilized.

**B-4.3.2 Aircraft Selection Suitable for the Operation.** The aircraft should satisfy all functions of the mission. Aircraft size, performance characteristics, visibility, and safety are of prime importance.

**B-4.3.3 Pilot Qualifications.** A properly qualified pilot capable of accomplishing the mission safely under any conditions that might be encountered should be selected. Qualifications should include the skill and knowledge necessary to determine when the mission can no longer be considered safe and should be terminated. A properly qualified pilot is usually an excellent observer.

**B-4.3.4 Aerial Observers.** Aerial observers should have the proper training and have gained through actual experience the capabilities of distinguishing and interpreting their observations in relation to the mission's objectives. In wildfire and related missions, the observer should be experienced in fire behavior, fuels, weather measurements, and fire suppression.

**B-4.3.5 Preflight Briefing.** Pilot and observer should completely understand their individual responsibilities, along with other combined efforts necessary in conducting a successful and safe mission.

**B-4.3.6 Reconnaissance.** The aircraft should be flown to provide the observer with the best possible visibility. The objective should be on the observer's side and as free as possible from visibility restrictions. Approaches should be planned to provide the necessary light and background.

Frequently, the pilot can offer assistance to verify questionable observations and, at times, assist by providing data from aircraft instruments, maps, and aircraft radio use.

Flying should be as smooth as possible to relieve the observer of unnecessary strain. The pilot should anticipate the observer's needs and maneuver the aircraft so that the observer does not have to shift position constantly.

**B-4.3.7 Detection.** Flight routes should be planned and timed to give the observer every possible advantage for the best observations. The selection routes should be prepared on charts for each foreseeable condition that could occur and to preclude overlapping of jurisdictions. Systematic profiling of critical areas along the proposed route is essential, as this permits easier determination of alternate flight routes. It could be necessary to fly the flight routes several times before establishing the selected route. The observers then can continue to refine and make adjustments.

It could be necessary to adjust flight altitudes and place areas with backgrounds that limit visibility on proper profile for flight line adjustments in improving the efficiency of the detection flights.

**B-4.3.8 Direction of Flight in Relation to Drainage.** Normally, in mountainous areas, the flight routes should be planned to parallel the major drainages. This allows the observer to look up or down the secondary drainages. Flights across major drainages restrict the observation behind secondary and minor ridges.

**B-4.3.9 Correct Flight Line Altitude.** Correct flight altitudes are determined by the following:

- (a) Intensity of search and frequency of observations
- (b) Visibility restriction (e.g., smokey haze) and its elevation
- (c) Width of observation strip
- (d) Topographic type
- (e) Amount of cloud and topographical shadows
- (f) Sun angle and direction
- (g) Background and minimum altitude required for safe flight

One method of determining flight altitude is to profile and calculate coverage at 500-ft (152-m) intervals and altitudes.

There is very little advantage to flying at high altitudes, even in clear weather, when the observation strip is limited by topography. The best observation altitudes can vary according to terrain. Varying atmospheric conditions can require adjustment of flight altitude.

**B-4.3.10 Observation Distance.** The observer should not waste any effort searching the distant horizon. Observations should be confined principally to the assigned strip. The search area ahead should be limited to 15 miles (24 km) or less. For intensive search, such as lightning coverage or during extreme or emergency fire danger, this distance should be reduced. About half the time is used in forward observation.

The rest of the time is spent searching those areas that later will be hidden from view.

**B-4.3.11 Flying Speed.** The slow cruise speed of the aircraft is a good observation speed. Under certain conditions, slower speeds could be necessary to observe specific areas. The experience and training of the pilot and observer have an important bearing on the flying speed. High and low speeds have certain advantages, depending on conditions and observation objectives.

**B-4.3.12 Number and Frequency of Flights.** The number and frequency of flights will depend on the desired objectives, available personnel and aircraft, and atmospheric conditions.

**B-4.3.13 Estimating.** Rapid and accurate estimating is essential to a successful mission. The following are some of the common methods of estimating from aircraft:

(a) Distance

1. Compare the lineal measurements of objects, either visually or from maps and air photos. Lakes, runways, and similar landmarks are suitable for this purpose.
2. Measure the approximate distance by using flight time and airspeed.

(b) Slope

1. Aircraft instruments, such as the artificial horizon and altimeter, can be used to estimate slopes. Slopes can also be estimated from topographic maps.

**B-4.4 Communications.** Satisfactory communications equipment should be installed in the aircraft either permanently or on a temporary basis.

**B-4.4.1 Radio.** Suitable transceivers, either permanent or for temporary installation, should be provided for each aircraft. The use of Federal Aviation Administration (FAA) VOR navigational equipment or LORAN can be used to locate ground positions accurately.

**B-4.4.2 Message Dropper.** Message droppers should be carried in all aircraft for use when other means of communications are not possible or available.

**B-4.4.3 Air-Ground Signals.** A copy of the air-ground signals should be carried in the aircraft and by all crew members.

**B-4.5 Flight Plans.** Planned periodic aircraft position reports should be made (frequency should depend on the mission). These position reports should be followed up promptly if not received within a specified time limit.

Any deviation or change from a planned route should be reported immediately and a new flight plan filed with notification of check points and destination.

A definite procedure should be established designating personnel responsible for follow-up if aircraft is unreported at its destination. This is especially important for flights terminating during hours the dispatching office is not manned.

Following flight procedures and requirements should be mandatory for each flight. Radio contact and a location report should be made at least at 15-minute intervals. A flight search should be initiated if contact cannot be established within 30 minutes.

**B-4.6 Records and Reports.** Adequate records and reports are necessary for proper management of air operations. The reports help determine whether the operation is being conducted safely and economically and is accomplishing the objectives of the plan. Once it is determined that both are being met, reports can be reduced to a minimum.



## Appendix C Referenced Publications

**C-1** The following documents or portions thereof are referenced within this standard for informational purposes only and are thus not considered part of the requirements of this standard unless also listed in Chapter 9. The edition indicated here for each reference is the current edition as of the date of the NFPA issuance of this standard.

**C-1.1 NFPA Publication.** National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 1561, *Standard on Fire Department Incident Management System*, 1995 edition.

**C-1.2 National Interagency Fire Center Publications.** National Interagency Fire Center Publications, Great Basin Cache Supply Office, 3833 So. Development Avenue, Boise, ID 83705.

National Wildfire Coordinating Group, NFES 1259, *Airtanker Base Planning Guide*, 1995.

National Wildfire Coordinating Group, NFES No. 0065, *Fireline Handbook*, 1989.

**C-1.3 U.S. Government Publications.** U.S. Government Printing Office, Washington, DC 20402.

*U.S. Federal Aviation Regulations, Part 1*, U.S. Government Printing Office, Washington, DC 20402.

## Appendix D Bibliography

**D-1** The following documents or portions thereof are recommended within this standard for informational purposes only. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

**D-1.1 NFPA Publications.** National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 18, *Standard on Wetting Agents*, 1995 edition.

NFPA 298, *Standard on Fire Fighting Foam Chemicals for Class A Fuels in Rural, Suburban, and Vegetated Areas*, 1994 edition.

NFPA 402, *Guide for Aircraft Rescue and Fire Fighting Operations*, 1996 edition.

NFPA 403, *Standard for Aircraft Rescue and Fire-Fighting Services at Airports*, 1998 edition.

NFPA 407, *Standard for Aircraft Fuel Servicing*, 1996 edition.

NFPA 408, *Standard for Aircraft Hand Portable Fire Extinguishers*, 1994 edition.

NFPA 409, *Standard on Aircraft Hangars*, 1995 edition.

NFPA 410, *Standard on Aircraft Maintenance*, 1994 edition.

NFPA 412, *Standard for Evaluating Aircraft Rescue and Fire-Fighting Foam Equipment*, 1998 edition.

NFPA 414, *Standard for Aircraft Rescue and Fire Fighting Vehicles*, 1995 edition.

NFPA 1001, *Standard for Fire Fighter Professional Qualifications*, 1997 edition.

NFPA 1051, *Standard for Wildland Fire Fighter Professional Qualifications*, 1995 edition.

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NFPA 1221, *Standard for the Installation, Maintenance, and Use of Public Fire Service Communication Systems*, 1994 edition.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 1997 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 1996 edition.

NFPA 1906, *Standard for Wildland Fire Apparatus*, 1995 edition.

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**D-1.2 National Interagency Fire Center Publications.** National Interagency Fire Center Publications, Great Basin Cache Supply Office, 3033 So. Development Avenue, Boise, ID 83705.

NWCG-NFES No. 0065, *Fireline Handbook*, 1989.

NWCG-NFES No. 1256, *Wildland Fire Suppression Tactics*, Reference Guide, 1996.

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**D-1.4 Far Publications.** *U.S. Federal Aviation Regulations.* The following publications are available from the U.S. Government Printing Office, Washington, DC 20402.

*Vol. I:*

Part 1, Definitions and Abbreviations

*Vol. II:*

Part 11, General Rule-Making Procedures

Part 13, Enforcement Procedures

Part 15, Nondiscrimination of Federally Assisted Programs for the FAA

Part 21, Certification Procedures for Products and Parts

Part 37, Technical Standard Order Authorization

Part 39, Airworthiness Directives

Part 45, Identification and Registration Marking

Part 47, Aircraft Registration

Part 49, Recording of Aircraft Titles and Security Documents

Part 183, Representatives of the Administrator

Part 187, Fees

Part 189, Use of Federal Aviation Administration Communication Systems

## Index

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