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NFPA 295
Wildfire Control
1991 Edition

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Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

Statement on NFPA Procedures

This material has been developed under the published procedures of the National Fire Protection Association, which are designed to assure the appointment of technically competent Committees having balanced representation. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

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NFPA 295

Standard for

Wildfire Control

1991 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 19–23, 1991 in Boston, MA. It was issued by the Standards Council on July 19, 1991, with an effective date of August 16, 1991, and supersedes all previous editions.

The 1991 edition of this document has been approved by the American National Standards Institute.

Origin and Development of NFPA 295

This complete rewrite of NFPA 295 was prepared by the Committee on Forest and Rural Fire Protection. This edition replaces the previous edition (1985) and succeeds the 1978 edition 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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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time changes in the membership may have occurred.

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.

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

Information on referenced publications can be found in Chapter 6 and Appendix C.

Chapter 1 Introduction

1-1 Scope. This standard presents fundamental information to fire departments on the control of wildfire burning in natural and other vegetative fuels. This standard recognizes that protection of structures in the wildland areas may require modification of strategy and tactics to allow for protection of those structures. It includes necessary and useful information on safe procedures and practices, as well as other topics that are essential for the safe and successful control of wildfires.

1-2* Purpose. The purpose of this standard is to identify organizational practices and management policies and to specify requirements on safe procedures, equipment, and apparatus to ensure the successful control of vegetation fires and exterior protection of structures and improvements. This standard does not apply to interior structural fire fighting operations.

1-3 Definitions. For the purposes of this standard the following terms have the meanings shown below:

Apparatus. Motor-driven vehicles specially designed or modified for fire fighting or other emergency service, or a collective group of such vehicles, such as pumpers or engines, tankers, ladder trucks, rescue squads, etc.

Brush. Shrubs and scrub vegetation or other growth heavier than grass but not full tree size.

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 in charge of a fire department company or station or any other position of comparable responsibility in the department.

Control. When an adequate line has been established completely around the perimeter of the fire and it no longer has a potential for additional destruction or for escaping under forseeable conditions. The fire has reached the phase in which mop-up and patrol are the only activities required to extinguish the fire. "Control" is also used as an inclusive term for any and all actions taken to halt, confine, and totally extinguish a fire, including detection, mobilization, size-up, attack, mop-up, and patrol.

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

Crew Leader. A supervisory person in charge of a group of fire fighters and responsible for their leadership, performance, safety, and welfare for the duration of their assignment; sometimes called a crew foreman, crew boss, or crew supervisor.

Forest Fire. Any uncontrolled, unwanted fire in a forested area.

Grass Fire. Any uncontrolled, unwanted fire involving dried grass.

Incident Commander. The person responsible for all suppression and service activities on a wildfire. Primary responsibilities are to develop control plans and organize and direct the fire suppression organization in such a manner that the fire is completely and efficiently controlled. The incident commander may carry out all responsibilities alone or assign prescribed line and staff duties to subordinates.

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. (*See NFPA 1561, Standard on Fire Department Incident Management System.*)

Prevention. That part of fire protection activities designed to prevent ignition of unwanted fires and to minimize loss if fire does occur. Such activities, including public education, personal contact, law enforcement, engineering, and reduction of fuel hazards, are directed at reducing or eliminating the number of fires that start.

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

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

Wildland/Urban Interface. An area where development and wildland fuels meet at a well-defined boundary.

Wildland/Urban Intermix. An area where development and wildland fuels meet with no clearly defined boundary.

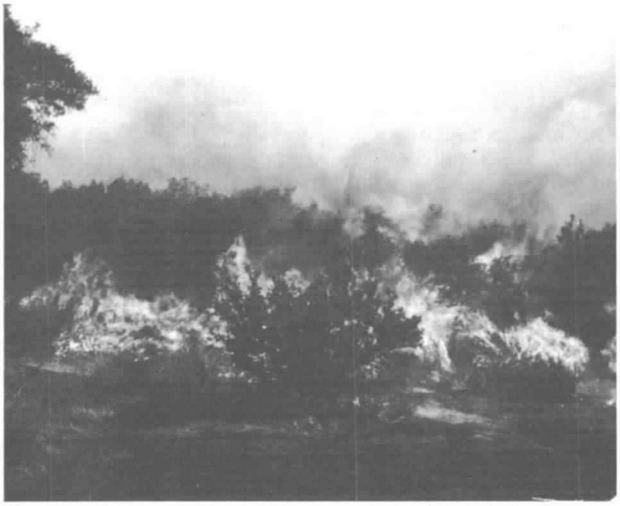

Figure 1-3 Wildfire.

Chapter 2 Organization and Management

2-1* Organization.

2-1.1* Purpose. The fire department shall be organized to perform fire prevention and control in order to protect life and property from fire. Other services demanded of the fire department, because the fire department force is available and has specialized training, shall be undertaken only to the extent that they do not interfere with the department's basic purpose and that they are activities justifiably related to it.

2-1.2 Goal. The fire department's goals shall be to protect life and property; to minimize fire losses through fire prevention; to take quick, aggressive initial action to prevent the small fire from becoming large; and to control the large fire as soon as possible with the minimum cost.

2-2* Command.

2-2.1 Fire Chief. The fire department shall have a fire chief who shall be in overall command of the department at all times.

2-2.2 Incident Commander. On every fire or emergency incident one individual or individuals (in a unified command structure) must be recognized as incident commander.

When the department responds to a fire or other emergency, the first officer to arrive shall assume command of the incident until specifically relieved by someone with higher authority.

2-2.3 Succession. A formal chain of command or succession shall be followed as described in NFPA 1561, *Standard on Fire Department Incident Management System*.

2-2.4 Company Officers. Each fire company or crew shall operate under the command of a designated officer, crew leader, or incident commander. Each company shall have enough officers to provide a leader to command the company at the time of any response.

2-3 Responsibilities.

2-3.1 Fire Chief. The fire chief shall be responsible for the administration, management, and operation of the fire department. Duties shall specifically include:

(a) Act as the principal spokesperson for and represent the fire department before the public and the governing legal authority.

(b) Establish the operational procedures of the department through the issuance of regulations and orders.

(c) Direct operations at a fire or emergency incident.

(d) Ensure that the department is adequately trained and staffed.

(e) Ensure that a training plan is developed and implemented and that all members are knowledgeable in the basic measures for attaining fast, safe, and effective fire suppression.

(f) Prepare a departmental budget.

(g) Be familiar with all laws and ordinances that apply to the operation of the fire department.

(h) Investigate all fires for cause, origin, and circumstances.

(i) Ensure compliance by the department with all sections of this standard and all applicable local laws and ordinances.

(j) Develop and implement a fire prevention program for the entire year.

(k) Be responsible for department equipment and the safety and welfare of all fire department members engaged in departmental operations.

2-3.2 Officers. Company officers or supervisors shall have the following duties and responsibilities:

(a) Ensure the safety and welfare of their company or crew members.

(b) Act as leader of a crew of individuals.

(c) Respond to alarms to which the unit is assigned and direct operations of the units.

(d) Have sufficient knowledge of fire strategy to be able, in the absence of a chief officer, to make a proper size-up or appraisal of the emergency and assume initial command until formally relieved.

(e) Be familiar with the area protected by the department.

(f) Ensure the care, maintenance, and fire readiness of assigned apparatus and equipment.

2-3.3 Members. All fire department members shall be responsible for the following:

(a) Be familiar with the rules and regulations governing the operation of the fire department.

(b) Keep themselves in good physical condition in accordance with the fire department's established fitness standards.

(c) Be familiar with and knowledgeable of the entire area protected by the department.

(d) Be knowledgeable in the methods of fire suppression, the safe use of tools and fire fighting equipment, and the procedures for safe and effective response to incidents.

(e) Be familiar with the fire laws and regulations of the local jurisdiction and state or province.

(f) Operate through established lines of responsibility and authority.

(g) Respond to incidents when notified.

(h) Protect themselves and others in the hazardous task of fire fighting through compliance with all safety standards, regulations, and procedures.

2-4 Emergency Response and Notification. Members shall be trained to achieve safe and effective response to incidents.

2-4.1 When an incident occurs, members of the fire department shall be immediately notified so they can respond with apparatus and equipment.

2-4.2 Provisions shall be made for immediate notification of fire department members. This may be accomplished through activation of a siren, use of radio pagers or alert monitors, or a telephone chain.

2-5* Pre-Incident Planning.

2-5.1 Plan Required. A written plan shall be prepared. A plan in outline form is acceptable. The plan shall be revised and updated annually or sooner if required by changing conditions.

2-5.2 Elements. The plan shall contain the following information as a minimum:

(a) Fire department organization and personnel roster with contact information.

(b) A listing of cooperating agencies and contacting procedures.

(c) Additional available resources of personnel, equipment, supplies, and facilities, and contracting or ordering procedures.

(d) Up-to-date map of protection area, including boundaries, roads and other means of access; heliports, airports, aviation hazards, water sources, special hazards; and dangerous fire risks.

(e) Mutual aid agreements, automatic response agreements, and other protection agreements.

2-6 Mutual Aid. Whenever possible, mutual aid, automatic response, and cooperative agreements for mutual assistance with adjacent fire departments or other agencies shall be negotiated and implemented. Such agreements shall include provisions to ensure clearly established command authorities and responsibilities.

2-7* Fire Prevention Program.

2-7.1* Plan Required. A fire prevention plan shall be developed and implemented each year.

2-7.2 Elements. The fire prevention plan shall contain an analysis of fire causes, special fire hazards and risks, an assessment of interface fire protection problems, and proposed measures to reduce fire occurrence and decrease fire damage. It shall also include provisions for cooperative efforts with all other neighboring fire protection agencies.

Chapter 3 Safety and Training

3-1 Safety.

3-1.1* Personnel. The safety and welfare of personnel shall be the first and foremost consideration in all incident operations and decisions.

3-1.2* Protective Clothing and Equipment. The officer in charge shall require that appropriate personal protective clothing and equipment be worn by all fire department personnel while engaged in any incident.

3-1.2.1 As a minimum, fire fighters engaged in wildfire suppression shall have and use a safety hard hat or fire helmet equipped with chin strap, leather boots at least 6 in. (15.24 cm) high, goggles, and gloves. Synthetic polyester clothing, tennis shoes, sneakers, or low-quarter shoes shall not be worn on the fireline. Fire department members shall wear cotton or wool clothing with cuffless trousers and long-sleeved shirts or lightweight flame resistant clothing, specially designed for wildfire fire fighting. Individual states or provinces may have more restrictive personnel protective clothing requirements. To ensure compliance with such regulations, the fire department shall check with its state or provincial occupational safety and health agency.

3-1.2.2 Structural fire fighting personal protection clothing and equipment (turnouts and rubber boots) are not appropriate for wildland fire suppression activities, and wildland fire suppression personal protective equipment shall not be utilized for interior attacks on structures.

3-1.3* Physical Examination. Prospective members of the fire department shall undergo and pass a physical examination before admission to the department as an active member. The medical examiner shall certify the applicant's physical ability to perform fire fighting duties.

3-1.4 First Aid.

3-1.4.1* Fire department members shall be trained and certified in first aid and cardiopulmonary resuscitation (CPR).

3-1.4.2 First Aid Kits. First aid kits for fireline use shall be readily available on all emergency responses.

3-1.5 Fire Apparatus.

3-1.5.1 All apparatus shall be equipped and operated as described in NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, and NFPA 1901, *Standard for Pumper Fire Apparatus*.

3-1.5.2 Vehicles on the fireline shall be parked so they face in the direction of the escape route.

3-1.5.3 Fire apparatus shall be driven and operated only by trained and qualified personnel. Apparatus shall be driven in a safe and sane manner. All applicable laws and departmental regulations regarding the response of emergency vehicles shall be obeyed.

3-1.6 Tractor Plows, Dozers, and Fire Plows

3-1.6.1 Fire fighters shall not work directly above or below tractor plows, dozers, or fire plows where they may slide beneath the machine or be struck by rolling material.

3-1.6.2 Fire fighters shall not approach a tractor plow, dozer, or fire plow until it has stopped and the operator has signaled it is safe to approach.

3-1.6.3 Fire fighters shall avoid being immediately in front of or in back of a tractor plow, dozer, or fire plow in operation.

3-1.6.4 Fire fighters shall not get on or off moving equipment.

3-1.6.5 Fire fighters shall not sit or bed down near a tractor plow, dozer, or fire plow.

3-1.6.6 Tractor plows, dozers, and fire plows shall be operated only by trained, experienced operators.

3-1.6.7 Fire fighers shall not ride on tractor plows, dozers, or fire plows.

3-1.7 Power Saws.

3-1.7.1 Power saws shall be operated only by trained, experienced personnel.

3-1.7.2 Power saw operators shall wear safety hard hats, protective chaps, ear and eye protection, and gloves.

3-1.7.3 The motor shall be stopped whenever a power saw is to be carried more than 10 ft (3.0 m) unless equipped with a chain break. The motor shall be stopped whenever the saw is to be carried more than 30 ft (9.0 m).

3-1.7.4 The motor shall be stopped for all cleaning, adjustments, and repairs.

3-1.7.5 The motor shall be stopped and the exhaust allowed to cool prior to refueling. Refueling shall be done on bare ground and spilled fuel wiped off the motor. The saw shall not be started within 10 ft (3.0 m) of the refueling area.

3-1.7.6 Whenever using a power saw, nearby there shall be either a portable fire extinguisher, or a backpack pump filled with water, or a shovel for extinguishing fires that may be started by the power saw.

3-1.8 Hand Tools.

3-1.8.1 All hand tools shall be maintained in good condition, with tight handles, properly sharpened, and all sharp edges guarded when not in use.

3-1.8.2 Hand tools shall not be carried on the shoulder. Hand tools shall be carried by the balance point on the downhill side with the cutting edge away from the body. A distance of at least 6 ft (2.0 m) shall be maintained between individuals when carrying hand tools. When using tools, a distance of at least 10 ft (3.0 m) shall be maintained between individuals. Except in an emergency, fire fighters shall not run while carrying hand tools.

Figure 3-1 A fire crew building a fireline. Note the safety helmets, canteens, and the spacing between crew members.

3-1.9* Aircraft. If the department has occasion to work with fire fighting aircraft, members shall be trained in safety procedures regarding fixed wing and rotary wing aircraft. An air operations safety briefing shall be conducted.

3-2* Training.

3-2.1 To ensure safety and effectiveness, every fire department member shall receive basic wildland fire training prior to responding to a wildland fire.

3-2.2 The content and length of the training program shall be determined by the fire chief. As a minimum, the content shall include courses in fireline safety, fire behavior, suppression methods, the 10 standard fire fighting orders, and the 18 situations that shout "Watch Out."

Chapter 4 Equipment and Apparatus

4-1 Equipment.

4-1.1* Hand Tools.

4-1.1.1 The organization shall have sufficient hand tools for wildland fire suppression.

4-1.1.2 All hand tools shall be for use in emergencies only and shall be distinctly labeled for emergency use.

4-1.2* Power Saws.

4-1.2.1 Power saws shall be carefully maintained and serviced in accordance with manufacturer's recommendations. Manufacturer's operating and safety instructions shall be followed.

4-1.2.2 Power saws shall be equipped with approved spark arresters.

4-1.3 Fire Hose. Fire hose shall be maintained in good condition and cared for properly. It shall not be used for other than fire fighting unless such use is approved by the fire chief. (*See NFPA 1962, Standard for the Care, Use, and Maintenance of Fire Hose Including Couplings and Nozzles*).

4-2* Tractor Plows and Dozers. All tractor plows and dozers shall have protective canopies, adequate lights for night operations, and if not turbocharged, shall be equipped with approved spark arresters.

Chapter 5 General

5-1* Retardants and Suppressants. These items shall not be used without a thorough knowledge of the particular precautions to be followed and the hazards associated with their use. Wildland fire foams shall meet NFPA 298 requirements. Wetting agents shall meet NFPA 18 requirements.

5-2 Communications.

5-2.1* Communications System. A wildland fire communications system plan shall be established by all fire departments and shall be incorporated into the fire department's/agency's everyday operational procedures.

As a minimum, a wildland fire communications system plan shall address the following:

(a) Communications between the public and the fire department/agency

(b) Communications procedures within the fire department/agency

(c) Communications between the fire department/agency and other public safety related agencies.

5-2.2 Emergency Telephone. An emergency telephone number shall be established for receiving reports of fires or other emergencies. This emergency telephone number shall be widely publicized in the response area and published in the local telephone directory.

Figures 3-1.5(a), (b), and (c) Apparatus used in wildfire suppression exist in a variety of configurations. The top photograph pictures a fire engine specifically designed for wildfire suppression. It includes an integral 300-gpm pump and a 500-gal water tank. The center photograph depicts a unit that was converted for wildfire suppression from a surplus military vehicle. The bottom photograph is a slip-on unit, including fire pump and water tank, designed to be placed on a 12,000-lb GVW truck whenever it is needed.

5-2.3 Alerting Systems. The fire department shall have an alerting system by which it can summon personnel at any time of the day or night.

5-2.4* Incident Radio Communications Plan. The fire department/agency shall have established procedures for determining incident radio system needs; methods for allocating frequencies and priorities; and support equipment assignment and accountability.

5-3 Fire Reporting and Investigation.

5-3.1* Fire Reporting. A fire report shall be completed and filed with the appropriate state or federal agency for every incident to which the fire department responds.

5-3.2* Fire Investigation. Every fire responded to by the fire department shall be investigated for fire cause, and an investigation report shall be completed. Significant wildland fires may require investigation by a specially trained wildland fire investigator.

The fire department shall contact its state forester, state fire marshal, or other equivalent officer to request assistance and determine required fire reporting and investigation procedures and report contents.

5-4 Air Operations Plan. All tactical air operations in support of wildland fire shall be conducted in accordance with an appropriate air operations plan and managed by a qualified air operations officer.

5-5 Wildland/Urban Interface Operations. Where jurisdiction or mutual aid and assistance agreements include wildland/urban interface areas, training shall be provided in basic wildland and structural fire, safety, and exposure protection.

Chapter 6 Referenced Publications

6-1 The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

6-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 18, *Standard on Wetting Agents*, 1990 edition

NFPA 298, *Foam Chemicals for Wildland Fire Control*, 1989 edition

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 1987 edition

NFPA 1561, *Standard on Fire Department Incident Management System*, 1990 edition

NFPA 1901, *Standard for Pumper Fire Apparatus*, 1991 edition

NFPA 1962, *Standard for the Care, Use, and Maintenance of Fire Hose Including Couplings and Nozzles*, 1988 edition

Appendix A

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

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 fire 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-2-1 Organization and Management. 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 may be a paid professional, part-time paid, or 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, may be grouped together under the command of a crew leader or company officer. This leader may be one of several crew leaders commanding similar groups, and all personnel under his command, and others concerned, should know who the crew leader is and the scope of the leader's authority. The crews or companies may 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-2-1.1 For more information see NFPA 1201, *Recommendations for Developing Fire Protection Services for the Public.*

A-2-2 Command. The first responsible authority ranger, warden, company officer or 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 organization needed grows, but the incident commander is always the final authority and bears total responsibility.

A-2-5 Pre-Incident Planning. Written fire suppression mobilization plans are important even if prepared only in outline form. 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. Include such items as:

1. Boundary of protected area and adjacent jurisdictions.
2. Roads and other means of access: heliports and airports.
3. Locations of manpower, equipment, and facilities' resources.
4. Water sources.
5. Areas of concern.
   (a) Hazards—mapped areas of hazardous fuels.
   (b) High risk ignition sources: dumps, sawmills, logging operations, recreation areas, etc.

E. Fire Weather Information
1. Source of information.
2. Methods of notifying the public.

F. Pre-Attack Plans

A-2-7 Fire Prevention. 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. Fire prevention is often said to be the most important function of a fire protection organization. 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.

A-2-7.1 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. Wildfire prevention efforts must focus upon ignitions that pose the greatest threat to cause 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, fuels management, prescribed fire, etc.

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. These variables include:

1. 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 may 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.

2. Hazards. Hazards are defined as the fuels and topography of an area. The objective in examining risks is to determine the potential for a large fire to result from an ignition. This could be more simply put as determining the degree of difficulty in suppressing a fire once it is ignited. Again, it is important to examine hazards without regard to anything else.

3. 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 upon the need to protect them 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 ignited (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 may not be necessary to have an extensive fire prevention effort in an area with a number of risks where the hazard is minimal and there are no real values at risk. In contrast, it will be important to have a comprehensive effort in an area where there are substantial risks, a high hazard, and high values threatened.

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

1. Education. Education is aimed at changing people's behavior by informing them. Informing people can be done 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, etc.

2. 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 (clearance around a home).

3. 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. Annually, the wildfire prevention plan should be evaluated. 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 may result in a change of activities within the area. If the plan is working, there will be no need to make any changes.

A-3-1.1 Personnel. 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-3-1.2 Protective Clothing. A safety hard hat with chin strap must be worn on the fireline. A standard fire fighter's helmet may be worn as an alternative. Hard hats greatly reduce the number of serious injuries. Lightweight "bump" hats are unacceptable as 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 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 that 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 as 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 may 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. Neck-buttoning collars should be worn to protect the arms and neck from heat, burns, scratches, and insects.

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

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

An NFPA standard on personal protective clothing and equipment for wildland fire fighters is currently being developed.

A-3-1.3 Physical Examination. Members of the fire department must be in good physical condition. Suppression operations often demand long hours of vigorous activity. Wildfires in particular require much climbing, carrying, and use of tools and equipment in uneven terrain, often for several days and nights. Persons unable to pass a rigid physical examination may be used within their abilities in nonfireline activities, such as dispatching, or other capacities.

Anyone selected as an active member of the fire department should undergo a physical examination by a physician. The fire department may establish standards for physical examinations and for physical fitness. These standards may be used for evaluation through testing procedures as well as guidance for physicians evaluating members. The U.S. federal wildfire control agencies and a number of states use a "step test" for evaluating the physical condition of new and experienced personnel. Information on the step test may be obtained from respective state forester's offices or the local federal wildlife management agency.

Medical files should be established to maintain a history of accidents or disabilities that the fire fighter receives in service. One of the first acts in the newly formed fire control organization should be to establish its membership requirements in accordance with the applicable provisions of state or provincial legislation. This would include provisions for workmen's compensation or other insurance for fire fighters. Requirements for professional fire fighters are included in NFPA 1001, *Fire Fighter Professional Qualifications*.

A-3-1.4.1 First Aid. All fire department members must be trained and certified in first aid and cardiopulmonary resuscitation (CPR). As a minimum, the training should consist of the American Red Cross's First Responder standard first aid course and the American Heart Association's First Responder cardiopulmonary resuscitation (CPR) course, or equivalent medically certified courses. It is highly recommended that fire department members be trained and certified beyond these courses to the more advanced First Responder First Aid training or Emergency Medical Technician (EMT) level.

A-3-1.9 Aircraft Safety—Fixed Wing Aircraft. The use of fire retardants dropped from aircraft is a modern, sophisticated attack tool in wildfire control. It is likely that members of fire departments may 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 min. 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-3-1.9(a) An airtanker makes a drop of fire retardant on a wildfire. If a drop is coming toward you, take cover and follow the safety procedures.

(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 air drop.

(d) Stay away from large old trees and snags. Tops, limbs, or entire trees may 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 may also damage agricultural or ornamental vegetation, and actions should be taken to minimize such damage.

Figure A-3-1.9(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.

Rotary Wing Aircraft (Helicopters). The use of helicopters has become a key part of wildfire protection; however, as with any other piece of fire fighting equipment, there are definite rules for safety when using or operating around a helicopter. The following safety procedures apply to helicopter operations.

Approach and Departure.

(a) Get the pilot's attention and permission before approaching the helicopter.

(b) Always approach in full view of the pilot. Never approach from the rear of the helicopter.

(c) Always approach or depart in a crouched position. Gusts of wind can cause the rotor blades to drop dangerously low to the ground.

(d) Safety helmets must be held securely to prevent their being blown away or blown up into the rotors by the rotor blast.

(e) 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.

(f) Keep clear of the main and tail rotors at all times. Do not walk to the rear of the helicopter when entering or exiting.

(g) Carry all long-handled tools in such a manner that the handles will not be inadvertently raised into the rotor path.

Working Around Heliports.

(a) Stay at least 100 ft (30 m) away 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.

(b) Do not face a landing helicopter unless wearing goggles.

(c) Do not remain in an area that is consistently under the flight path of any helicopter.

(d) Do not smoke within 50 ft (15 m) of any helicopter or fueling area.

In-flight Safety.

(a) Do not smoke in the helicopter.

(b) Use the seatbelt and keep it secured until the pilot instructs you to leave the helicopter.

(c) Ensure that all loose gear and helmets, maps, papers, etc., are securely held to prevent their being blown about the helicopter or out the windows.

(d) Do not let any gear get in the way of the pilot or the pilot's controls.

(e) Never throw anything out of a helicopter.

(f) Do not talk to the pilot unless necessary, particularly during takeoff and landing.

(g) Be alert for hazards such as other aircraft and especially telephone and power lines.

(h) 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-3-2 Training. All personnel should receive frequent training in first aid, fireline safety, fire behavior, and techniques and methods of wildfire suppression. This should include periodic hands-on training with hand tools and equipment, as well as crew and fireline organization. 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 C.*)

The 10 standard fire fighting orders and 18 situations that shout "Watch Out" 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 Situations That Shout Watch Out

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 fire line.
17. Terrain and fuels make escape to safety zones difficut.
18. You feel like taking a nap near the fireline.

A-4-1.1 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.

A-4-1.2 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 may 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 may 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 are found in Appendix C.

A-4-2 Tractor Plows and Dozers. Tractor plows and dozers are costly compared to hand tools or the majority of power tools used in line construction and mop-up work. 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. Any tractors or bulldozers used for wildfire suppression should be equipped with protective canopies, winches, and adequate lights for operating at night. Unless turbo-charged, 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 are found in Appendix C.

Figure A-4-2(a) Dozers are a valuable tool for wildfire suppression. This one is properly equipped with protective canopy, lights, brush guards, and a winch.

A-5-1 Retardants and Suppressant Applications.

In wildland fire suppression and fire management including prescribed burning, these items fall into two categories:

—Long-Term Retardant. (Depends upon chemicals that alter the combustion process—effective for long period of time.)

Figure A-4-2(b) Tractor plows are often used in suitable terrain to build firelines along the flanks and rear of a wildfire.

—Suppressants. (Depends upon availability to retain moisture—usually effective from just a few minutes to up to one hour or so under optimum conditions.)

Long-Term Retardants

1. Long-term retardants contain true fire-retarding salts, ammonium sulfate, ammonium phosphate, or a combination of each that alters the combustion process.

2. Used for:

Direct attacks: may or may not be used in support of fire crews.
Short-term protection of items such as improvements, log decks, and forest fuels adjacent to a fireline.
Prescribed burning and backfiring.
Mop-up.

3. Methods of application:

Fixed wing airtankers.
Helicopters with buckets or fixed tanks.
Fire engines.
Portable pumps.
Back pumps.

Suppressants

1. Suppressants are water with additives such as polymers or foam concentrate. They depend upon the water and moisture retention for effectiveness. When the water dries out, the effectiveness disappears.

2. Used for:

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.
Mop-up.

3. Methods of application:

Fixed wing airtankers.
Helicopters with buckets or fixed tanks.
Fire engines.
Back pumps.

4. Basic principles for the creation of foam for Class A fuels:

—Foam solution is a homogeneous mixture of water and foam concentrate. Foam is the aerated solution 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 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.

—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.

—WET and DRIPPING foams are excellent for suppression, mop-up, and as a wetting treatment under a DRY foam creating a fire barrier.

—DRY foam is most effective as a barrier for short-term protection of structures, improvements, and forest fuels.

—Aspirating nozzles with water/air expansion rates of ± 10 to ± 100 are available.

—For mop-up, regular fire hose nozzles and aspirating nozzles with low water/air expansion rates are the most effective.

—The thickest, driest foams are made by using compressed air foam systems (CAFS).

—Class A foams are chemically derived wetting agent foams. As such, they have the ability to form an insulating blanket on the surface of fuels, as well as increasing the efficiency of water by increased penetration into fuels and reducing the amount of water that runs off onto the ground.

References for information on retardants and suppressants are found in Appendix C.

A-5-2.1 Communication System. A communication system by which fires and emergencies may be reported to the fire organization is essential. There must be telephone communications to some central location that serves as a dispatch center. An emergency telephone number, widely publicized in the response area and published in the local telephone directory, must be established. It is essential that all persons in the community and surrounding area be notified of how and where to report a fire or other emergency. It is also essential that the fire department have an alerting system by which its personnel can be summoned at any time of the day or night. There are a number of ways to do this, including radio-activated pagers and monitors, sirens, and telephone chain systems.

Communications between officers, apparatus, and the dispatch center are also important. This is usually accomplished through the use of 2-way radios and cellular telephones.

Additional detailed information on fire department communications can be found in NFPA 1221, *Standard for the Installation, Maintenance, and Use of Public Fire Service Communication Systems*.

System Elements. There are four basic elements in the communications requirements of a fire protection agency:

(a) Communications between the public and the fire agency.

(b) Communications within the fire agency under both emergency and nonemergency conditions.

(c) Communications among fire agencies.

(d) Communications between the fire agency and other agencies.

Each plays an essential part, enabling the fire agency to meet its protection responsibility. The particular method used must provide for each in order to be effective.

Radio, telephone, and other electronic equipment, operating procedures, and personnel training must allow messages to be conveyed as quickly and reliably as the situation requires. Messages must be sent and received correctly with no delay. Time delay and the number of messages to be handled are strongly interrelated with service. Systems and equipment must be provided so that the public may notify the fire agency of fires or other emergencies. Attention must be given to message types, the number and length of messages, the equipment capabilities, radio frequencies, and system organization. Effective operating practices must be developed, and training must be provided to meet the needs of each agency. The measure of adequate service is the ability of the system to handle emergency situations as well as the normal daily activities of the agency. A major conflagration, or multiple fires, generate a much greater need for communications than do normal daily activities.

Communications Between the Public and the Fire Agency. Communications between citizens and the fire agency revolve around several areas:

(a) Calls from citizens for emergency assistance or for reporting fires.

(b) Calls from citizens giving information to, or requesting information from, the fire agency.

(c) Calls from the fire agency to citizens.

Calls from citizens, usually received through the telephone system, giving or requesting information, may be of an emergency nature. Whether or not such a call is an emergency is decided by the individual answering the telephone. Many fire agencies maintain different administrative and emergency telephone numbers to keep the two types of communications separate. Calls from the fire agency to citizens usually are of an administrative nature. Reporting using "911" (universal emergency telephone number) has become common. It is most easily accomplished in rural areas rather than urban areas.

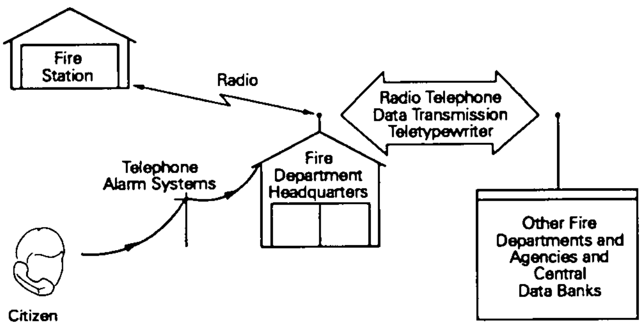

Figure A-5-2.1(a) Fire communications.

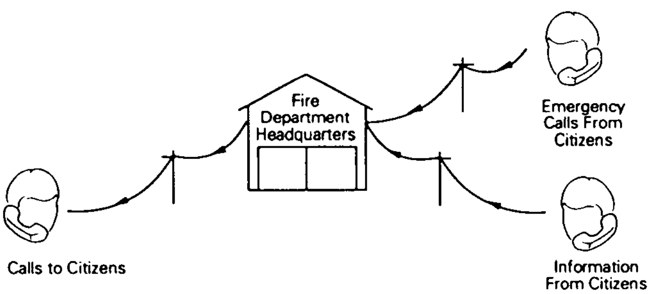

Figure A-5-2.1(b) Typical fire department communications with the public.

Communications with the Fire Agency. Communications between members of the fire agency include emergency and nonemergency messages. Most of these are accomplished by radio and may involve the dispatcher, radio-equipped vehicles (land, water, or air), personnel equipped with two-way radios, or personnel at outlying stations in a variety of emergency situations. Examples of such communications are:

(a) The radio dispatcher gives information to the fire stations and mobile equipment.

(b) Personnel report location and work status to the dispatcher for emergency assignment.

(c) The dispatcher gives coordination information and status to personnel and equipment responding to an emergency.

(d) Field commanders give instructions to ground or air mobile units and to fireline personnel under their command in a tactical situation.

(e) Communications between equipment units of personnel at a fire or other emergency.

(f) The field commander requests information or assistance, and the dispatcher advises status.

(g) Reports of fire are transmitted from lookouts or aircraft to dispatch centers.

(h) Information on status of personnel and equipment, fire danger rating, fire weather forecasts, and legal burning is transmitted between fixed stations, mobile units, and the radio dispatcher.

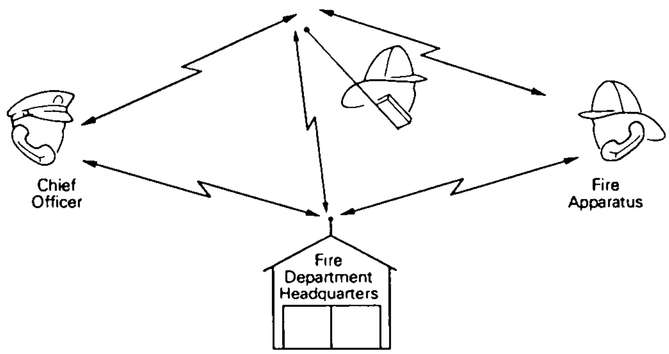

Figure A-5-2.1(c) Base-mobile radio communications.

Communications Among Fire Agencies. Many fire agencies supply their neighbors with requested information. Such communications are necessary because many small agencies depend on mutual aid agreements, and wildland fires are likely to cover more than the jurisdiction of a single agency. In addition, many fire agencies have common information needs.

Interchange may be divided into two kinds of communications—directed and incidental. Directed communication is the conveying of information from one agency to one or more specifically selected agencies. Incidental communication is the exchange of information among agencies that is a by-product of the primary purpose of the communications.

An example of directed communication is the exchange of information regarding burning permits or other smokes of interest to stations of other agencies, or the transmittal of a fire danger rating or fire weather information. It may also be advice regarding equipment in adjoining stations where first attack arrangements exist.

Incidental or nondirected communication among agencies occurs whenever one agency monitors the transmissions of another, although the information is not specifically intended for interagency distribution. Most of this kind of communication is by radio, especially among agencies that share a radio channel. (When agencies have a choice of channels on which to operate, they must weigh the advantages of mutual monitoring by all system users against the disadvantages of greater message traffic and the resulting problems of channel loading.) This kind of communication is no less important than directed communication, for it allows one agency to be aware of situations in another community or area that may "spill over" or involve it directly in a short time.

Monitoring of nearby fire departments' or fire agencies' transmissions helps the listener to anticipate the need for mutual aid and to be aware of the level of emergency activity in an area larger than the department's or agency's own boundaries. If two fire service agencies anticipate a need for mutual aid or cooperation, they frequently monitor each other's calls even when not on the same radio channel. Monitor-receivers at the dispatcher positions are generally used.

Special mutual aid radio frequencies or channels for mobile use only have been licensed so that fire agencies from adjacent jurisdictions can communicate directly with each other. Such a channel can assist normal day-to-day interagency communication needs and emergency communication during widespread disasters. The channels may serve as command channels for interagency communication. Although these are helpful, there are also problems with them. The frequencies may become overloaded very quickly. The multichannel synthesizer mobile radio allows all radio traffic to be conducted on the "Agency in Charge" radio system, starting with initial attack on through large fire operations.

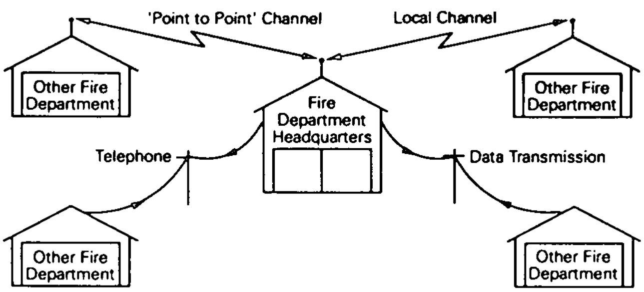

Figure A-5-2.1(d) Interdepartmental communications.

Communications Between the Fire Agency and Other Agencies. Another function of a communications system is to pass messages between the fire agency and public safety oriented agencies, such as public works, highway maintenance departments and utilities, hospitals and ambulance services, towing and wrecker services, law enforcement agencies, civil defense units, forest industries, and fire weather forecasters.

Fire agencies exchange a large variety of information with nonfire agencies or cooperators. Perhaps the information most widely exchanged in the rural and mountain areas is the local fire danger rating or fire weather information, reports of road conditions, flooding, fallen trees, and similar useful data. Reports of vehicle accidents are often made to the fire agency by police agencies where a fire department or rescue company response is required. Since many of these companies are radio equipped, they can be of assistance during large fires or other major incidents.

One of the greatest demands for communications with other agencies can occur during major emergencies. The ability to meet this problem requires planning for message volumes and possible language barriers. Telecommunications for a fire department or forest agency must include contingency plans for emergency situations. An emergency is no time to set up new communications links. The volume of messages that must be handled is likely to exceed mostestimates, so plans must include means for handling the volume of message traffic to prevent system breakdown due to overloading. Concerned citizens and news media can rapidly overload a telephone system. Nonfire agencies may not understand the standard language of fire radio. Therefore, liaison personnel familiar with the radio language of the fire service and the assisting organizations are needed to maintain effective communications. The National Interagency Incident Management System (NIIMS), which is being adopted by many fire agencies, includes two important communications concepts that should improve communications effectiveness during major emergencies. These are:

(a) Common Terminology—using "clear text" or "plain language" radio and established standard terms and phrases.

(b) Integrated Incident Communications—intends the best possible use of all participating agency radio systems including frequency sharing agreements.

The new synthesizer mobile radios can also be very useful here. Police, fire, and other public safety agencies can now converse with each other "at the scene" and not depend on time-consuming relays through dispatchers.

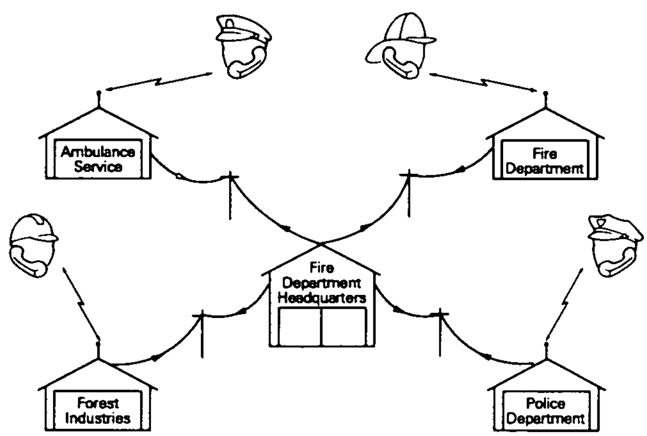

Figure A-5-2.1(e) Communications with other agencies.

A-5-2.4 Incident Radio Communications Plan. An incident radio communications plan should be prepared in direct support of the objectives and control operations established by the incident commander. This incident radio communications plan is usually a single-page form that outlines the general radio system needs and allocations, frequency assignments and priorities (ground to ground, ground to air, and air to air), communication equipment accountability, and specific remarks to meet the control and management objectives for the incident. Initially, incident radio communications planning is the responsibility of the incident commander until a logistics chief and communications unit leader is assigned to the more complex incidents.

Table A-5-2.4 Sample incident radio communications plan.

INCIDENT RADIO COMMUNICATIONS PLAN			**1. Incident Name** **Butte**	**2. Date/Time Prepared** **8-20-89** **2100 Hr**	**3. Operational Period Date/Time** **8-21-89** **0600–1800 Hr**
			4. Basic Radio Channel Utilization		
System/Cache	**Channel**	**Function**	**Frequency**	**Assignment**	**Remarks**
Fire Department "A"	1	Command Net	170.450	IC, Generic and Command Staff, Air Ops., Div Supv., and Group Supv.	1. Command and support net repeaters are located at DP-2 on Cleghorn Truck Trail 2. Command/Gen Staff, Air Ops, Helibase Mgr, Division Supervisors, & Group Leaders, all monitor the command net. When not using another net, keep radios on command net. 3. Communication Centers are to monitor the command support, tactical, support, and air to ground nets. 4. Turn in all radios at the end of each shift.
Fire Department "A"	2	Tactical Net	170.000	Division A	
Fire Department "A"	3	Tactical Net	170.250	Division B	
Fire Department "B"	1	Tactical Net Structure Protection	154.250	Engine Strike Teams: 1801 1802 1930	
Emergency Fire Cache (White)	1	Air to Ground	168.075	Air Ops, Helibase Manager, Helicopters, Airtankers, Division Sup.	
Emergency Fire Cache (White)	2	Logistics Net	168.250	Support Functions and in-camp communications tankers, Division Sup.	
205 ICS 8-78	5. Prepared By (Communications Unit)				

See Figure A-5-3.1 for a sample reporting form modified to include wildland fires.

A-5-3.1 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 may also be significant documents 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.

To maintain uniformity in fire reporting, the NFPA Technical Committee on Fire Reporting has developed NFPA 901, *Uniform Coding for Fire Protection*. This standard establishes basic definitions and terminology for use in fire reporting and a means of classifying data so that they can be aggregated either manually or automatically. NFPA 901 provides the common language used by nearly all large-scale (e.g., state, national) data bases in the United States and many others around the world.

The U.S. Fire Administration (USFA) has developed the National Fire Incident Reporting System (NFIRS), which is the automated system based on the work of the NFPA Fire Reporting Committee as published in NFPA 901. The system now has been installed in approximately 40 states, the District of Columbia, and a number of larger fire departments.

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 data bases from individual states to form the national data base. The USFA analyzes this data base and publishes the analysis.

The National Wildfire Coordinating Group (NWCG) has established a standard information content for wildfire reporting. This standardized content is now used by all U.S. Federal Wildfire Control Agencies and many states.

A-5-3.2 Fire Investigation. The effectiveness of future fire prevention efforts may depend on the thoroughness of fire investigation; therefore, every fire should be investigated for cause as soon as possible. Investigation can be performed simultaneously with the fire suppression operation. Crew members must be trained to protect the fire's area of origin and to protect any evidence at the fire scene. It is important that the fire's area of origin be as undisturbed as possible and that anything that might be evidence not be moved unless absolutely necessary to prevent it from being destroyed.

All fire fighters have responsibilities in fire investigation. When responding to a fire they should note anyone or anything that could relate to the starting of the fire; they should observe vehicles in the fire area and those moving away from it; they should record license numbers, vehicle descriptions, personal descriptions, number of people, and locations or directions of travel.

At the fire scene fire fighters should be alert for evidence on how the fire started and who started it. They should preserve and protect any evidence found, recording the time and place where each item was located. It may be necessary to assign one of the crew members to this task while the rest of the crew takes suppression action. All information obtained should be recorded, including the

Telephone Number Where You Can Be Contacted (____) ____________
Area Code

INCIDENT REPORT

NFIRS 1

1 ☐ DELETE
2 ☐ CHANGE

FILL IN THIS REPORT IN YOUR OWN WORDS ______________________ FIRE DEPARTMENT

10	A	FDID · INCIDENT NO. · EXP. NO · MO. · DAY · YEAR · DAY OF WEEK · ALARM TIME · ARRIVAL TIME · TIME IN SERVICE
	B	TYPE OF SITUATION FOUND · TYPE OF ACTION TAKEN · MUTUAL AID 1 ☐ REC'D 2 ☐ GIVEN
	C	FIXED PROPERTY USE · IGNITION FACTOR
	D	CORRECT ADDRESS · ZIP CODE · CENSUS TRACT
11	E	OCCUPANT NAME (LAST, FIRST, MI) · TELEPHONE · ROOM OR APT
12	F	OWNER NAME (LAST, FIRST, MI) · ADDRESS · TELEPHONE
13	G	METHOD OF ALARM FROM PUBLIC · DISTRICT · SHIFT · NO. ALARMS
	H	NUMBER FIRE SERVICE PERSONNEL RESPONDED · NUMBER ENGINES RESPONDED · NUMBER AERIAL APPARATUS RESPONDED · NUMBER OTHER VEHICLES RESPONDED
20	I	NUMBER OF INJURIES: FIRE SERVICE · OTHER · NUMBER OF FATALITIES: FIRE SERVICE · OTHER
	J	COMPLEX · MOBILE PROPERTY TYPE
	K	AREA OF FIRE ORIGIN · EQUIPMENT INVOLVED IN IGNITION
	L	FORM OF HEAT OF IGNITION · TYPE OF MATERIAL IGNITED · FORM OF MATERIAL IGNITED
	M	METHOD OF EXTINGUISHMENT · LEVEL OF FIRE ORIGIN · ESTIMATED LOSS (DOLLARS ONLY)
	N	NUMBER OF STORIES · CONSTRUCTION TYPE
	O	EXTENT OF FLAME DAMAGE · EXTENT OF SMOKE DAMAGE
	P	DETECTOR PERFORMANCE · SPRINKLER PERFORMANCE
	Q	IF SMOKE SPREAD BEYOND ROOM OF ORIGIN: TYPE OF MATERIAL GENERATING MOST SMOKE · AVENUE OF SMOKE TRAVEL
	R	FORM OF MATERIAL GENERATING MOST SMOKE
30	S	IF MOBILE PROPERTY · YEAR · MAKE · MODEL · SERIAL NO. · LICENSE NO.
10	T	IF EQUIPMENT INVOLVED IN IGNITION · YEAR · MAKE · MODEL · SERIAL NO.

COMPLETE FOR ALL INCIDENTS (rows A–H)
COMPLETE IF CASUALTY (row I)
COMPLETE FOR ALL FIRES (rows J–M)
COMPLETE IF STRUCTURE FIRE (rows N–R)

☐ CHECK IF COMMENTS ON REVERSE SIDE

U	OFFICER IN CHARGE (NAME, POSITION, ASSIGNMENT) · DATE
	MEMBER MAKING REPORT (IF DIFFERENT FROM ABOVE) · DATE

6	W	FIRE DANGER · SLOPE · ASPECT · RESISTANCE TO CONTROL · SPREAD RATE
	X	SIZE CLASS ACRES · TOTAL ACRES BURNED · ACRES GRASSLAND · ACRES FORESTLAND
	Y	FEDERAL ACRES BURNED · STATE ACRES BURNED · PRIVATE ACRES BURNED
	Z	SUPPRESSION COST · DAMAGE CLASS VALUE · VALUE CLASS

COMPLETE ON GRASS AND WILDLAND FIRES

1	Age of Building · Condition of Building · Equipment Used: Hose · Breathing · Water Used
2	Wind Direction · Velocity · Humidity · General Description
3	Exit Drill in the Home Practiced · Was it Used

Entries contained in this report are intended for the sole use of the State Fire Marshal. Estimations and evaluations made herein represent "most likely" and "most probable" cause and effect. Any representation as to the validity or accuracy of reported conditions outside the State Fire Marshal's office, is neither intended nor implied.

Figure A-5-3.1.

names of witnesses or anyone else contacted, and summaries of any conversations with them. If an official investigator arrives, that investigator should receive full cooperation from all fire fighters and all obtained information should be turned over to the investigator.

Additional detailed information on wildland fire investigation can be found in *Wildfire Cause and Determination Handbook*, National Wildfire Coordinating Group Handbook 1. (*See Appendix C.*)

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

This Appendix is not a part of the requirements of this document but is included for information 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, management, and even 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 run.

ADF. Automatic Direction Finder is a radio navigational receiver operating in the low frequency bands; found in many aircraft.

Advisory Service. Advice and information provided by a facility to assist pilots in the safe conduct of flight and aircraft movements.

AGL. Above Ground Level.

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

Air Attack Supervisor (AAS). 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. (FAR.1.1)

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 Advisory Area. The area within 10 miles (16.1 km) of an uncontrolled airport on which is located a flight service station.

Airport Advisory Service. A terminal service provided by a flight service station located at an airport where a control tower is not in operation.

Airport Information Desk. A local airport facility designed for pilot self-service, weather briefing, flight planning, and filing of flight plans.

Airport Traffic Area. Unless otherwise specifically designated in FAR Part 93, that airspace within a horizontal radius of 5 statute miles (8 km) from the geographical center of any airport at which a control tower is operating, extending from the surface up to, but not including, an altitude of 3,000 ft (914 m) above the elevation of an airport.

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

1. Indicated Airspeed—The speed shown on the aircraft airspeed indicator. This is the speed used in pilot/controller communications under the general term "airspeed." (Refer to FAR Part 1.)

2. 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" and not shortened to "airspeed."

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

Airtanker Coordinator, Birddog Pilot, Lead Plane Pilot. The pilot of the control aircraft, working under supervision of the Air Attack Supervisor (AAS), who designates targets of retardant drops and coordinates the movement of airtankers.

Airtanker Mandatory Requirements. Those requirements set forth by the Interagency Airtanker Board.

Alert Area. Airspace that may contain high volume pilot training activities or an unusual type of aerial activity.

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 or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations which is 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 "authority having jurisdiction" is 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, 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 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. This is a nonpowered flight condition with the rotor system maintaining the required flight rpm at a given forward airspeed, due to the relative wind upward through the rotors, caused by the weight, forward speed, and descent of the helicopter.

Avigation. Aerial navigation.

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

Birddog/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. Means 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.

Bullseye. 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 or 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.

Ceiling. The height, from the earth's surface, of the lowest layer of clouds or obscuring phenomena that is reported as "broken," "overcast," or "obstruction" and not classified as "thin" or partial.

Countdown. A ten down to one reverse count on a called shot starting approximately one-half mile (0.8 km) from the target. (*See "Called Shot."*)

Course. The intended direction of flight in the horizontal plane.

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 retardant/suppressant drop.

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

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 birddog/leadplane or airtanker. Used to indicate approach and target to airtanker and to check for flight hazards.

DZ. Drop Zone or target area.

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

Elevation. The elevation of the lead plane/birddog when over the target on a dry run.

ELT. Emergency Locator Transmitter. 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, and 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 Enroute.

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 a position.

Fix. A geographical position determined by visual reference to the surface, by reference to one or more radio navaids, by celestial plotting, or by any other navigational device.

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

Flight Path. The route an aircraft flies on any approach to and from a target.

Flight Plan. Specified information relating to the intended flight of an aircraft that is filed orally or in writing with an air traffic control facility.

Flight Time. The time from the moment the aircraft first moves under its own power for the purpose of flight until the moment it comes to rest at the next point of landing.

Flight Visibility. The average forward horizontal distance from the cockpit of an aircraft in flight at which prominent unlighted objects may be seen and identified by sight.

Front or Start of Load. The early end of the load.

FSS. Flight Service Station. A facility operated by the FAA to provide flight assistance service.

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.

Ground Visibility. Prevailing horizontal visibility near the earth's surface as reported by the U.S. National Weather Service or an accredited observer.

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

Helibase Manager. Manages resources/supplies at a helibase (heliport/helispot).

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

Helicopter Coordinator. Works for the air attack supervisor. With instructions from air attack supervisor, is primarily 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, wind indicator, fire extinguishers, surfaced pads, tie downs, parking areas, 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 use of helicopter accessories and techniques to attack and suppress wildfire.

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

Helitank. A tank attached to a helicopter 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. It should be followed by an explanation and new directions from the air attack supervisor, usually a change in attack plan or a ground crew 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.

ICS. The incident command system or qualifying and organizing personnel to manage wildfires or other incidents.

Incident Commander. The chief of an incident management team under the ICS.

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

IFR. Instrument Flight Rules.

IGE. In-Ground Effect. Using 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. Run over target area to check for wind and smoke conditions and other hazards.

Knot. Nautical mile per hour.

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization 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.

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/birddog flies the target run in front of the tanker on final approach to target.

LF. Low Frequency—in 30-300 KYz band.

Line. A stretch of retardant or suppressant laid by aircraft to support constructed line or suppressant 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 or materials included in a list published by an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which 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.

Lone-Wolf Action. Initial attack by a single airtanker operating without direction from an airtanker coordinator (lead plane pilot/birddog officer).

Long-Term Retardant. One having a chemical retarding 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 maneuvering speed is 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 × 1.7 = maneuvering speed.)

MOT. Canadian Ministry of Transport.

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

NAVAID. Air Navigation Facility. Any structure, equipment, or device used in air navigation or air traffic control and considered a part of the national airways system.

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

NOTAM. Notice to Airmen. A notice identified either as a Notam or Airmen Advisory, containing information concerning the establishment, condition, or change in any component of, or hazard in, the National Airspace System, the timely knowledge of which is essential to personnel concerned with flight operations.

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 airtankers having to make a second trip.

Orbit. 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. Usually only effective 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.

Radial. A magnetic bearing extending from a VOR, VORTAC, or TACAN.

Radio Fix. The determining of position by one or more radio navigational aids.

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. He returns to base and waits 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.

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 exist to flight.

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

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

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

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

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

Temporary Flight Restriction (TFR). Special use airspace obtained under FAR Part 91.137 for the use of air attack or other incident aircraft.

Touchdown Area (Pad). That part of the landing and takeoff area where the helicopter alights.

Tower. Airport traffic control tower. A facility providing airport traffic control service.

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 to give an extended pattern on the ground. Normally used to build a retardant line or barrier along the fireline.

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.

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

VFT (Special). Aircraft operating in accordance with clearances within control zones in weather conditions less than the basic VFR weather minima.

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.

VOR. VHF Omnidirectional Range. Provides pictorial guidance on any selected magnetic course to or from the radio facility. It is limited to line of sight reception. There is some "spillover," however, and reception at an altitude of 1,000 ft (305 m) is about 40 to 45 miles (64 km to 72 km). This distance increases with altitude.

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

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 multiengine) 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 (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.

Table B-2-1.1 Thermal (IR) Indicator Correspondence to Scan Angle

Altitude	Swath Width	Speed
500 ft	1730 ft	100 mph
1000 ft	3460 ft	200 mph
1500 ft	5200 ft	300 mph
2000 ft	6920 ft	400 mph

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 to adapt them for freight or paracargo work.

Desirable features for air-freight and paracargo airplanes are: 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 tiedown facilities, and approved seats, seatbelts, and shoulder harness.

B-2-1.3 Special Equipment. Cargo tiedown facilities are necessary in all airplanes used to transport air-freight 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 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-base operation. If no safe natural docking or beaching site is available, temporary docks can be constructed to facilitate loading and unloading, 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: (1) light high-wing, single engine airplanes, (2) light low-wing, single engine airplanes, and (3) light twin engine airplanes. The light high-wing single engine type of airplane is usually the most suitable.

Figure B-2-1.5 Detection, reconnaissance, and survey aircraft.

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

Some factors to consider in selecting aircraft for these assignments are:

(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.

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.

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 2,000 plus gal (7600 L) 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 use of large airtankers at short range because many times fires are contained or controlled by several high volume cascading actions.

With the development of the MAFFS concept (Modular Airborne Fire Fighting System), military and civil cargo aircraft can be converted for airtanker use provided the aircraft is equipped with a tail loading door and can carry the weight of the system.

Figure B-2-1.6 Lockheed C-130 (MAFFS) Airtanker.

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.

Table B-2-1.6 Fixed Wing Airtankers Specifications Chart

Airtanker	Min Runway Required Feet (Meters)	No. of Engines	No. of Crews	A/C Loaded Speed Drop	A/C Loaded Knots Cruise	No. of Doors	Minimum Releasable U.S.	Minimum Releasable IMP	Total Capacity U.S.	Total Capacity IMP
LIGHT—up to & including 800 gallons (3028 liters)										
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 gallons up to 2000 gallons (3028 liters) (7570 liters)										
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 gallons plus (7570 liters)										
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

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

To help evaluate airport capability versus airtanker performance for safety during maximum load takeoff purposes, the 80 percent takeoff concept (4-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 may be used.

(b) Airtanker Loading. It may 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. The speed at which the aircraft flies during retardant/suppressant drops (slower than cruising speed).

B-2-1.6.2 Special Appliances for Airtankers. Each airtanker should have the following equipment: FAA and agency approved installation of tanks, discharge gates, emergency dump mechanism, shoulder harness, parking brake, rotating beacon, emergency locator transmitter, warning sound device, strobe light, suitable radio equipment, camlock or quick connect fittings for loading tanks, and accurate tank gauge to control loading.

B-2-1.6.3 Tanks, Venting, Drop Gates. The criteria (requirements) for performance of these items are established in the Interagency Airtanker Board, Aircraft-Tank, and Gating Systems.

B-2-1.6.4 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-2-1.6.5 Quantity (Splitting the Load). A means of varying the quantity dropped should be provided on airtankers having capacities larger than 500 gal (1893 L). This may be accomplished by:

(a) Tank with separate compartments, each with its own door.

(b) One tank with controllable doors.

(c) A main tank with one door that can be filled from other tanks in the aircraft.

B-2-1.6.6 Discharge Rate. A means of varying the discharge rate is necessary for effective application. The amount of variation possible will depend on the aircraft and tank door arrangement. The maximum discharge rate should be as high as practicable, and the lowest rate should achieve minimum coverage levels. The discharge rate is measured with the airplane in level flight altitude, all doors open, dropping water in the amount equal to the chemical capacity.

B-2-1.6.7 Acquisition. Arrangements for obtaining airtankers must be based upon the most practical and economically feasible method—contract, lease, or outright ownership.

B-2-1.7 Smokejumping Aircraft. Civil aircraft are not designed specifically for smokejumping use, and 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 tiedown facilities. All sharp corners and projections near the door and step, along the fuselage, and under the belly that snag parachutes or cargo must be removed or shielded. (Smokejumper aircraft equipment drawings and specifications may 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, smokejumpers, 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 80-2000 gal (303-7600 L) of suppressant 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 the 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. The 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 may not be obtainable, are obvious benefits. The helicopters provide an ideal platform for using heat sensing and mapping systems. The systems range from hand-held units to permanently mounted units.

B-2-2.4 Shuttling Equipment and Personnel. Equipment can be moved to other fire areas, 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. Some uses are: airlifting medical aid crew personnel to care for and move the injured persons to medical aid sites or hospitals; scouting and directing rescue crews and servicing isolated parties until rescue can be accomplished.

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

Table B-2-2 Helicopter Model Specifications

Helicopter Make/Model	Diam. in ft (meters)	Type Landing Gear	Fuel Type	U.S./IMP Fuel Capacity	Wkg. Hrs	Cruise Speed Knots	Hover IGE in ft (meters)	Pass. Seats	Int. Payload in lb (kg)	Ext. Payload 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	37′0″ (11.28)	Skid	Jet Fuel	110/100	6	109	16,500 (5030)	5	1900 (870)	2000 (907)	Very good for forestry work and fire fighting.
Hiller 12E	35′5″ (10.82)	Skid	100 Octavgas	46/39	2	61	8,500 (2592.5)	2	580 (263.3)	700 (319.8)	Good work horse below 6,000 ft.
Hiller 12-53/5	35′5″ (10.82)	Skid	Jet Fuel	46/39	1¾	78	13,500 (4117.5)	3	1100 (499.4)	1100 (499.4)	Good altitude performance, short working time.
Hughes 500 C	26′4″ (8.05)	Skid	Jet Fuel	64/54	2½	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	5,200 (1586)	4	600 (272.4)	900 (408.6)	Light turbine aircraft, good performance up to 8,000 ft.
Aerospatiale Alouette Lama	36′2″ (11.03)	Skid	Jet Fuel	149/124	2½	96	20,000 (6100)	4	980 (444.9)	1442 (6544.7)	Excellent for high altitude and external load work. Int. load only limited by non-jettisonable.
Aerospatiale Alouettte SA-341	34′6″ (11.33)	Skid	Jet Fuel	120/110	3½	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	9,000 (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	9,000 (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	2½	148	6,700 (2043.5)	13	2800 (1271.2)	2300 (1044.2)	Excellent speed.
Bell 204B	49′0″ (14.64)	Skid	Jet Fuel	165/137	2	100	9,000 (2745)	9	3575 (1623.1)	3000 (1362)	Excellent speed, payload, and altitude performance.
Bell 205A-1	48′0″ (14.63)	Skid	Jet Fuel	220/183	2½	104	11,000 (3355)	14	2593 (1177.2)	3100 (1407.4)	Excellent speed, payload, 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 (3538)	14	2700 (1225.8)	3400 (1543.6)	
Vought	36′2″ (11.03)	Wheel	Jet Fuel	148/124	2½	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.

Table B-2-2 (continued)

Helicopter Make/Model	Diam. in ft (meters)	Type Landing Gear	Fuel Type	U.S./IMP Fuel Capacity	Wkg. Hrs	Cruise Speed Knots	Hover IGE in ft (meters)	Pass. Seats	Int. Pay-load in lb (kg)	Ext. Pay-load in lb (kg)	Remarks
MEDIUM (continued)											
Sikorsky S58	56′0″ (17.06)	Wheel	100	158/133	2	87	5,000 (1525)	15	3500 (1589)	4000 (1916)	Good performance at lower altitudes.
Sikorsky S58T	56′0″ (17.06)	Wheel	Jet Fuel	274/228	21/1	87	8,000 (2440)	15	3717 (1679.8)	4500 (2065.7)	Twin turbine powered version of S58, good altitude performance.
Bell 214	50′0″ (15.2)	Skid	Jet Fuel	204/176	11/2	139	17,800 (5429)	14	3300 (1498.2)	6000 (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)	6000 (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)	7500 (3405)	Excellent high altitude performance.
Aerospatiale AS332C	51′5″ (14.7)	Wheel	Jet Fuel	408/339	21/2	148	14,800 (4514)	18	6200 (2814.8)	9500 (4313)	Excellent high altitude performance.
Aerospatiale AS332L	51′2″ (15.6)	Wheel	Jet Fuel	536/429	31/2	148	14,800 (4514)	22	6200 (2724)	9500 (4313)	Excellent high altitude performance.
Sikorsky S61	62′0″ (18.9)	Wheel	Jet Fuel	410/341	2	104	6,700 (2043.5)	26	4000 (1816)	6000 (2724)	Twin turbine, good payload and altitude performance.
Sikorsky Sky Crane	72′0″ (21.9)	Wheel	Jet Fuel	1700/1396	3	87	6,000 (1830)			10526 (4778.8)	Largest heavy lift crane type.
Boeing-Vertol	50′0″ (15.2)	Wheel	Jet Fuel	350/292	11/2	113	7,300 (2226.5)	26	4795 (2176.9)	5700 (2587.8)	Large twin engine with good payload and altitude performance.
Boeing-Vertol 114 (CH47A)	60′0″ (18.3)	Wheel	Jet Fuel	630/515	11/2	113	13,000 (3965)	34	6500 (2951)	6500 (2951)	Large twin engine helicopter, good performance.
Boeing-Vertol 234	60′0″ (18.3)	Wheel	Jet Fuel	2090/1700	31/2	139	14,500 (4422.5)	44	24000 (10896)	28000 (12712)	Commercial version of military CH-47.

Table B-2-2.1 Helicopter Fire Fighting Bucket Specification

Make and Model No.	Collapsible Diam. × H Inches	H_2O Level Adjustment Gallons Pop-out Plug	Injection Pump	Flotation Ring	Overall Dimensions: Diam. × H Inches	Overall Dimensions: Cubic Vol. Ft	Unit Complete Weight lb: Empty	Unit Complete Weight lb: Full/H_2O 8.5 lb	Door Operation: No.	Door Operation: Type	Hookup
Chadwick C-140	No	50-70-90 110-140	Yes	Yes	45×39	35.8	90	1,280	1	Valve	Electric
Chadwick C-450	No	170-230-300 380-450	Yes	Yes	45×51	46.9	300	4,125	3	Valve	Electric
Hawkins & Powers 200[1]	42×4½	70-100 Zipper	No	No	42×24	19.2	101	1,036	2	Butter	Pneumatic
Hawkins & Powers 200[2]	48×4½	125-200 Zipper	No	No	48×24	25.1	104	1,804	2	Butter	Pneumatic
Hawkins & Powers 300[2]	48×4½	200-300 Zipper	No	No	48×38	39.7	108	2,658	2	Butter	Pneumatic
Hawkins & Powers 400[2]	48×4½	300-400 Zipper	No	No	48×50	52.3	111	3,511	2	Butter	Pneumatic
Sims PTF-50[1]	No	50	Yes	Yes	32×22½	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	1,361	1	Valve	Electric
Sims PTF-300[2]	58×21	None	Yes	Yes	59×36½	71.1	300	2,850	2	Butter	Electric
Sims PT-450	No	200-250-300 350-450	Yes	Yes	64×57½	106.9	252	4,077	2	Butter	Electric
Sims PT-1000	No	500-600-700 800-1000	Yes	Yes	84×74	237.2	625	9,125	2	Butter	Electric
Griffith 140[1]	34×24	Variable Adjustment	No	Yes	34×43½	22.8	84	1,357	1	Valve	Electric
Griffith 140[2]	50×30	Variable Adjustment	No	Yes	51×55	64.9	225	3,625	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	2,305	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	31½×38½	17.4	106	956	1	Valve	Electric
Griffith 250	45×26	+193	No	Yes	42×44	35.3	198	2,323	1	Valve	Electric
Griffith 600	50×30	+400	No	Yes	58×58	88.7	350	3,325	1	Valve	Electric or Hydraulic
Griffith 1000	50×35	+400	No	Yes	65×84	161.3	575	9,075	1	Valve	Electric or Hydraulic

All above buckets are sling mounted to helicopter with open top.
Material: Hawkins and Powers—Canvas/Steel Frame.
Griffith—Made of Polyurethane.
The rest are fiberglass.

[1]Can be carried on small helicopter cargo rack.
[2]Will fit in cabin or passenger compartment of a 205.
[+]All Griffith Buckets can be ordered with adjustment plugs.

For SI Units: 1 in. = 2.54 cm; 1 gallon—3.78 liters

Guide to Drop Patterns:

Size Bucket Gallon	Pattern	Coverage Gal/per 100 sq ft	Height Dropped	Air Speed mph
150	20-25 × 200-250	1.4-2	50-70	25
200-450	35×330	3.7		36
500-1000	50×850	2.2		48

B-2-2.6 Night Operations. Under tightly controlled conditions, night vision aids for piloting helicopters can extend the safe use of many daytime helicopter operations in the wildland environment into night.

Night operations have several tactical advantages: cooler temperatures, higher humidity, low density altitude, and more stable air are usually present after dark. Atmospheric conditions contribute to better flying conditions at times that suppression measures can be more effective.

Also, helicopter services will not be in competition with airspace requirements of airtankers, smokejumpers, and cargo planes.

B-2-2.7 Other Uses. Helicopters may also be used for aerial ignition operations such as helitorch, ping pong dispensor, and other similar devices; repelling of trained crews; retrieving smokejumpers; and for detection and prevention activities.

B-2-2.8 Criteria for Selecting Landing Sites. Consideration should be given to the following in selecting a site for a helibase or helispot.

(a) Proximity to Fire

1. Close enough to minimize flight time.
2. Out of the path of the fire.

(b) Topography of the Site

1. Recommended size of takeoff and landing area (safety circle).

a. Light helicopters—75 ft in diameter (23 m)
b. Medium helicopters—90 ft in diameter (27 m)
c. Large helicopters—100 ft in diameter (33 m)

NOTE: There should not be any obstacles other than 2-ft (.6-m) high brush maximum in the safety circle. All other vegetation and obstacles should be removed (trees, large rocks, etc.).

2. Slope of landing/parking area—6 degrees maximum recommended.

3. Touchdown, taxiway, and parking surfaces.

a. Maximum height of brush is 2 ft (.6 m). (Caution: Dry grass can be a fire hazard around helicopters.)

b. Sufficiently free of large rocks so as to ensure a stable landing.

c. Minimum foreign object damage potential.

(i) Secure or eliminate all loose objects in the vicinity, such as twigs, branches, and trash.

(ii) Dust abatement: Dust can do 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.

d. Compacted enough to support the following weights:

(i) Light helicopters—7,000 lb (3178 kg)
(ii) Medium helicopters—15,000 lb (6810 kg)
(iii) Large helicopters—60,000 lb (27,240 kg).

e. The touchdown/parking pad (on which the landing gear will physically sit) should be a minimum of the following:

(i) Light helicopters—15 ft × 15 ft (4.6 m × 4.6 m)
(ii) Medium helicopters—20 ft × 20 ft (6.1 m × 6.1 m)
(iii) Large helicopters—30 ft × 30 ft (9.1 m × 9.1 m).

f. Soft surfaces, such as tundra or boggs, may require a log pad.

g. Recommended minimum obstacle clearance for touchdown, taxiway, and parking areas is 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, utilize the radius of the appropriate safety circle outlined in 1.b above, to determine the minimum distance that an obstacle (including other helicopters) should be from the touchdown/parking pad or centerline of the taxiway.

4. Approach and departure capability in several directions if possible. This will allow the pilots to utilize the wind to their best advantage.

5. 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.

6. 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 (c) below.

(c) The recommended criteria for approach and departure paths:

1. 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.

2. 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).

3. Curving paths are permissable in order to avoid major obstacles.

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

5. No obstacle should penetrate that slope during the 20-degree spread for:

a. Approach path—150 ft (48 m)
b. Departure path—300 ft (96 m).

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

7. The paths may 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.

(d) Establish flight routes in order to ensure the following:

1. Separation between helicopters.
2. Separation between other aircraft on the fire.

3. Flight following check points.
4. Aircraft performance—try not to have a heavily loaded helicopter climb steep terrain.

(e) Pilots. The most important factor to consider when establishing these sites is the advice of the pilots flying in and out of them. This test offers only general guidelines for selecting helibases and helispots. The pilots will make the final decision on all proposed site selections.

B-2-2.9 Helicopter Accessories. The versatility of the helicopter permits utilization of a variety of helitack accessories. It is essential that helitack crews be able to use these accessories properly and that fire overhead personnel understand their tactical use.

(a) Cargo Hook. A cargo hook or cargo adapter assembly is required with helicopter accessories. The cargo hook or adapter assembly serves as a standard suspension hard point for attaching external helicopter accessories. With the cargo hook installed, the helicopter can take sling-type helitanks or any load suspended by a cable or cables.

(b) Swivels. Swivels are required for sling loads of supplies and for using drum lifters. A swivel permits sling loads to rotate freely and eliminates the possibility of lead line breakage due to oscillation.

(c) Lead Line. The cable that joins the cargo hook or swivel to the sling load. Regardless of the type of lead line material or length used, the following points should be considered:

1. Tensile strength
2. Condition of material
3. Length of line.

(d) Cargo Nets. Cargo nets are designed for transporting freight suspended beneath helicopters. A suspended load beneath the aircraft permits delivery of freight without landing and is considered the most efficient method for heliborne freight movement.

(e) Helicopter—Buckets and Tanks. These are used to drop retardants/suppressants on fires.

The key to effective use of the bucket is to have a water or chemical source as close as possible to the fire site. Hoverfilling (filling the bucket while the helicopter hovers) maximizes the turnaround and delivery capability since it is not necessary to land and load water or chemicals by pumping.

The helicopter buckets vary in capacity from 80 through 2000 gal (303-7600 L) and are designed for use with various makes and models of helicopters.

The helicopter fixed tank is made of metal (usually aluminum) and usually has a capacity of 200-360 gal (757-1363 L). These are filled by a hose from an engine, portable pump, or through an internal snorkel from a dip tanker or other water source.

(f) Cargo Racks. A variety of helicopter cargo carriers are in use—flat racks, basket-types (Stokes litter), etc. General requirements applicable to cargo racks must be observed. Litters can be mounted internally and externally.

(g) Loading Platforms. An elevated landing ramp or loading pit may be required for heavy or bulky loads that must be stacked as close to the sling release as possible.

(h) Firing Devices. At least two proven firing devices can be effectively used for "firing out" operations on wildland wildfires and for igniting prescribed burns.

The helitorch consists of a 35–200-gal (132–757-L) drum mounted on a sled platform, pump, discharge line, and an electronically activated glow plug. As the thickened fuel passes through the glow plug, the fuel ignites and free flows to the ground. The fuel consists of unleaded gasoline and a gelling agent. When properly mixed, the fuel thickens to a jello-like substance.

The Aerial Ignition Device System (AIDS) mounts within the helicopter's passenger doorway. "Ping pong balls," containing potassium permanganate, are fed through the device injecting each ball with ethylene glycol causing the ball to ignite within 20–40 sec after it exits the discharge tube.

(i) Forward Looking Infrared (FLIR). Units can be internally and externally mounted on helicopters for detection and reconnaissance. The images are recorded on videotape and can simultaneously be viewed on a screen within the helicopter. Hand-held infrared units can be operated effectively from within the helicopter. Tapes can then be cropped or delivered to fire camp where they can be used for tactical planning.

B-2-3 Effects of Increased Density Altitude on Aircraft Performance. With increased density altitude, lift and engine horsepower decrease; rotor blades and propellers lose efficiency; and ground speed increases for any given indicated airspeed. This increases takeoff distance and radius of turn, decreases rate of climb of fixed-wing aircraft, and reduces the performance of rotorcraft [*see Tables B-2-3(a) and B-2-3(b)*].

Table B-2-3(a) The ICAO Standard Atmosphere Table

	Altitude	Temperature		Speed of Sound	Pressure
	Meters (Ft)	**°C**	**°F**	**Knots**	**In. Hg**
Standard Atmosphere	**0**	**15**	**59.0**	**661.7**	**29.92**
	305 (1000)	13.019	55.4	659.5	28.86
	610 (2000)	11.037	51.9	547.2	27.82
	915 (3000)	9.056	48.3	654.9	26.82
	1220 (4000)	7.075	44.7	652.6	25.84
	1525 (5000)	5.094	41.2	650.3	34.90
	1830 (6000)	3.113	37.6	647.9	23.98
	2135 (7000)	1.132	34.0	645.6	23.09
	2440 (8000)	−.850	30.5	643.3	22.22
	2745 (9000)	−2.831	26.9	640.9	21.39
	3050 (10000)	−4.812	23.3	638.6	20.58
	3355 (11000)	−6.794	19.8	636.2	19.79
	3660 (12000)	−8.775	16.2	633.9	19.03
	3965 (13000)	−10.756	12.6	631.5	18.29
	4270 (14000)	−12.737	9.1	629.1	17.58
	4575 (15000)	−14.718	5.5	626.7	16.89

The four factors that affect density altitude are altitude, atmospheric pressure, temperature, and moisture content of the air.

Runway length requirements for specific aircraft are usually computed for sea level and standard atmospheric conditions of 59°F/29.92 Hf (15°C/101.32 kPa), with a runway gradient of one percent or less.

Table B-2-3(b) Density Altitude Table

Pressure Altitude	15°C 59°F	20°C 58°F	25°C 77°F	30°C 86°F	35°C 95°F	40°C 104°F	45°C 113°F	50°C 122°F
S.L.	0	550	1,100	1,650	2,200	2,750	3,300	3,850
1,000	1,200	1,750	2,300	2,850	3,400	3,950	4,500	5,050
1,500	1,850	2,400	2,960	3,500	4,050	4,600	5,150	5,700
2,000	2,450	3,000	3,550	4,100	4,650	5,200	5,750	6,300
2,500	3,050	3,600	4,150	4,700	5,250	5,800	6,350	6,900
3,000	3,650	4,200	4,750	5,300	5,850	6,400	6,400	7,500
3,500	4,250	4,800	5,350	5,900	6,450	7,000	7,550	8,100
4,000	4,900	5,450	6,000	6,550	7,100	7,650	8,200	8,750
4,500	5,500	6,050	6,600	7,700	7,700	8,250	8,800	9,350
5,000	6,100	6,650	7,200	7,750	8,300	8,850	9,400	9,950
5,500	6,700	7,250	7,800	8,350	8,900	9,450	10,000	10,550
6,000	7,300	7,850	8,400	8,950	9,500	10,050	10,600	11,150
6,500	7,950	8,500	9,050	9,600	10,150	10,700	11,250	11,800
7,000	8,550	9,100	9,650	10,200	10,750	11,300	11,850	12,400
7,500	9,150	9,700	10,250	10,800	11,350	11,900	12,450	13,000
8,000	9,750	10,300	10,850	11,400	11,950	12,500	13,050	13,600

1. Set altimeter at 29.92. Face of altimeter will now read Pressure Altitude.
2. Note the temperature on the outside air temperature gauge.
3. Find the Pressure Altitude in the Pressure Altitude column.
4. Read to the right of the Pressure Altitude figure until you come to the Temperature column corresponding to the temperature on the outside air temperature gauge. THIS IS THE DENSITY ALTITUDE FIGURE.

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 may be necessary at times to furnish this service and necessary equipment 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 C.

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 Airports. Suitable runway lengths for aircraft employed in air operations could vary from a sod runway of 2,000 ft (610 m), being used by single engine detection, reconnaissance, and scouting aircraft, to the 4,000 to 10,000 ft (1220 to 3048 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 one percent or less. For other conditions, the runway length must be increased.

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.

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 (MTR's).

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, etc., in a permanent base operations building.

(a) Altitude. Increase the basic runway length by 7 percent for each 1,000 ft (3-5 m) above sea level.

(b) Temperature. Increase the runway length that has been fixed by altitude by ½ of 1 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.

B-4 General Operating Procedures.

B-4-1 Air Operations Plan. Considerable evaluation and study will be necessary for those who plan air operations. Firsthand 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 need for the operations, cost evaluation, availability of suitable aircraft to fulfill the objectives and need, operational base locations, and ground support facilities, communications, personnel necessary to operate the aircraft, the bases, and ground support facilities, and for the overall supervision of the air operations.

B-4-2 Control of Aircraft During Incidents. The chain of command at a incident should be: Air Operations Director, Air Attack Supervisor (in the air or on the ground, job may be assumed by Incident Commander or Division Supervisor in early stages of fire), Airtanker Coordinator (lead airplane), smokejumper or cargo aircraft, and first initial attack pilot on the scene.

B-4-2.1 Control Procedures. Pilots should know before being dispatched who has aircraft control at the fire. They should check in with Aircraft Control at least 5 miles (8 km) from the fire area and should not takeoff, or enter, or remain in the fire area unless both primary and secondary radio frequencies are operating on transmit and receive.

Pilots, including the one arriving to assume control, who are unable to establish communication on the primary or secondary frequencies should remain clear of the fire area and attempt to relay through other stations to control. If no contact can be made, the pilot should return to the base.

Smokejumper or cargo drops, airtanker retardant drops, and helicopter operations should not be conducted simultaneously if one will interfere with the other. Aircraft control should designate which operation has priority when aircraft must accomplish more than one mission.

If an initial attack airtanker arrives when no control plane is in the area, the tanker pilot should attempt to establish ground contact for drop instructions. If contact cannot be established, and the pilot is positive it is not a radio malfunction, and the arrival of a control plane is not imminent, the pilot should circle the fire area at least once, evaluating it for water-chemical drop. The initial pass should be a dry run to check visibility, turbulence, and obstructions and to spot personnel in the anticipated drop area. If the pilot is satisfied that a safe effective drop can be made, the aircraft should proceed to accomplish the drop.

B-4-3 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) Threatened safety of lives.

(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, with terrain, visibility, and wind conditions permitting 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 as to the number of airtankers that can be handled simultaneously. This 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 min 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.

This will include:

1. An operational check of mixing equipment.
2. Determination of the dry and wet chemical supply, water supply, and storage facilities, and
3. Training of the ground crews that are to support the operation and the logistics necessary to keep the air attack aircraft operational.

B-4-4 Detection, Reconnaissance, and Scouting. The essential components for a successful airborne detection, reconnaissance, and scouting operation are as follows:

B-4-4.1 Preliminary Planning. Maps, charts, seen-area composites, spot maps, weather information, fire statistics, and any other information that may help in accomplishing the operation should be utilized.

B-4-4.2 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-4-4.3 Pilot Qualifications. The selection of a properly qualified pilot capable of accomplishing the mission safely under any conditions that might be encountered. This includes 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-4-4.4 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-4-4.5 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-4-4.5.1 Pilot responsibilities include:

(a) In-flight check points, established at 15-min intervals.

(b) Safety of airplane, cargo, and passengers during takeoff, in-flight, and landing.

(c) Monitor of Weather—turbulent air, altitude, and flight path direction changes, noting storms and cross wind components with regard to mission termination, flight plan revisions, and unscheduled landings.

(d) Check visibility per FAA requirements.

(e) Adjusting of flight route and termination of mission.

B-4-4.5.2 Selecting the proper class and type of mission is usually done with the assistance of the person responsible for dispatching the flight, but qualified observers are often delegated this duty. Observer responsibilities are as follows:

(a) Assemble current information and prepare information, maps, and notes. If on a wildfire mission, assemble current fire and weather information.

(b) Check to see if pilots have reached or will exceed their allowable number of safe flying hours per day or week.

NOTE: Pilots should not be allowed to exceed flight hour limitations.

(c) Be familiar with air safety rules.

(d) Check equipment and forms needed for the mission.

(e) Inform the pilots of mission route, and know deviations such as fire scouting, freight delivery, etc.

(f) Ground check of radio installation.

(g) Observer in-flight duties should include:

1. Recording flying time.
2. Radio communications, forest net radio, and applicable frequencies.
3. Pilot performance.
4. Other necessary activities.

(h) Schedule aircraft in advance when possible.

B-4-4.6 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 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-4-4.7 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 may 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 may be necessary to fly the flight routes several times before establishing the selected route. The observers then should continue to refine and make adjustments.

It may 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-4-4.8 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-4-4.9 Correct Flight Line Altitude. Correct flight altitudes are determined by:

1. Intensity of search and frequency of observations;
2. Visibility restriction, smokey haze, etc., and its elevation;
3. Width of observation strip;
4. Topographic type;
5. Amount of cloud and topographical shadows;
6. Sun angle and direction; and
7. Background and minimum altitude required for safe flight.

A 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 may vary according to terrain. Varying atmospheric conditions may require adjustment of flight altitude.

B-4-4.10 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 may be used in forward observation. The rest of the time is spent searching those areas that later will be hidden from view.

B-4-4.11 Flying Speed. The slow cruise speed of the aircraft is a good observation speed. Under certain conditions, slower speeds may 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-4-4.12 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-4-4.13 Estimating. Rapid and accurate estimating is essential to a successful mission. Some of the common methods of estimating from aircraft are:

(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 may also be estimated from topographic maps.

B-4-5 Communications. Satisfactory communications equipment must be installed in the aircraft either permanently or on a temporary basis.

B-4-5.1 Radio. Suitable transceivers, either permanent or for temporary installation, must be provided for each aircraft. The use of Federal Aviation Administration (FAA) VOR navigational equipment or LORAN may be used to locate ground positions accurately.

B-4-5.2 Message Dropper. Message droppers should be carried in all aircraft for use when other means of communications are not possible or available.

B-4-5.3 Air-Ground Signals. A copy of the air-ground signals should be carried in the aircraft and by all crew members.

B-4-6 Flight Plans. Planned periodic aircraft position reports should be made (frequency shall 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-min intervals. A flight search should be initiated if contact cannot be established within 30 min.

B-4-7 Records and Reports. Adequate records and reports are necessary for proper management of air operations. The reports help determine if the operation is:

1. Being conducted safely and economically, and
2. Accomplishing the objectives of the plan.

Once it is determined that both are being met, reports can be reduced to a minimum.

B-4-8 Lead Planes. The mission of the lead plane pilot is to serve as airtanker coordinator on the fire, assigned to the air attack supervisor. The primary purpose of the airtanker coordinator is to make certain that the airtankers place the retardant or water on the assigned targets safely and effectively.

NOTE: Lead planes are usually light twin engine aircraft.

At the present time, a number of lead plane techniques are used. The two most frequently used are:

(a) The lead plane orbits the fire at 1,000 ft (305 m) above ground level and directs the airtankers by radio. This high-level technique affords better visibility of both the ground and air operations, but radio conversation is often time consuming and time loss is costly.

(b) The lead plane acts in a low-level "show me" method, simulating the airtanker pass, and identifies the target by radio, by rocking its wings over the target, zooming, or by using other methods of identifying the target.

The lead plane pilot also determines if there are fire fighting personnel or others in the proposed drop area and if so notifies the air attack supervisor or incident commander so people on the ground can be warned of the impending drops.

B-4-9 Helitack. Helitack is designed to transport fire fighters, equipment, and helitack crew trained in the use of specialized accessories, such as cargo nets and helitank, to the fire without delay. The prime value is speed of attack with short turnaround in rugged terrain.

B-4-9.1 Rappelling. The development of a helicopter rappel deployment technique extends the present use of helicopters as a wildfire suppression tool. Successful rappelling from a helicopter to the ground in stands of tall timber [200 ft (61 m)] has proven that rappelling is possible, and a practical means of delivering specially trained wildfire suppression crews when other means are not possible.

B-4-9.2 Night Operations. Night vision goggles permit nighttime use of twin engine helicopters over forested areas where only natural light prevails. Special pilot training is needed to perform water and chemical dropping, personnel transportation, cargo hauling, reconnaissance, and medivac operations. Under carefully controlled conditions, the operations can be performed with one or more helicopters.

High intensity lights mounted in the helicopter have also proven to be an effective and safe means of conducting night operations. It is generally a less expensive program than night vision goggles. High intensity lights require no special pilot training and can be used adjacent to populated areas. Combinations of steerable large aircraft landing lights have proven most effective.

B-4-9.3 Coordinated Use. Airplanes and helicopters may be used in many ways on a single fire. Their use must be coordinated to provide the right action at the right time and to assure a safe air attack operation. This is done by the air attack supervisor.

B-4-10 Smokejumping. Airplanes can drop smokejumpers into remote, isolated areas for fast initial attack on wildfires or to build and prepare a helispot or landing area, so that ground crews and fire fighters can be landed by helicopters. Smokejumpers may be fire fighters with special training in parachute jumping. Smoke jumpers are used on any fire where their attack is faster than ground-crew attack. Normally, they are transported by airplane to the fire area, making parachute jumps as close to the fire area as possible and starting suppression work immediately. When the situation demands, smokejumpers are dropped near a fire and construct a helispot. Helicopters then shuttle fire fighters to the helispot and return jumpers to bases to be ready for another jump.

B-4-11 Air Traffic Pattern. The air traffic pattern in the fire area is determined in part by the terrain and wind conditions. Aircraft control should establish the most suitable patterns and coordinate aircraft separation.

Airtankers should orbit at least 1,000 ft (305 m) above the terrain in a left pattern while waiting to drop. The orbit generally will be made at a designated location away from the drop area. The aircraft speed and turning radius will determine size of the pattern. Airtanker aircraft should operate below the observation aircraft.

The aircraft of the air attack supervisor should maintain at least 2,000 ft (610 m) above the terrain, using the flight pattern most suitable to the mission. When descending below 3,000 ft (914 m), the pilot should fly a lefthand traffic pattern.

The lead plane should orbit to the left or wherever necessary to set up and observe the airtanker drops. The exact flight pattern and elevation above the terrain will depend on whether the high-level or low-level system of airtanker direction is used.

Smokejumper and cargo aircraft should advise aircraft control of the best pattern for their purpose. Aircraft control should then establish the aircraft separation required and notify the jumper or cargo aircraft when to proceed. All other aircraft should remain at a designated location well clear of the jumper or cargo drop area until receiving further instructions from aircraft control.

Aircraft control will instruct helicopters to stay clear of the area when any type of drops are being made. If priority use of a helicopter is desired, aircraft control should discontinue the drops until the helicopter has completed its assignment or is clear of the area.

B-4-12 Training Requirements. All people involved in aircraft operations on wildfires, such as the air operations director, air attack supervisor, lead plane pilot/airtanker coordinator, airtanker pilot, and helicopter pilot must be fully qualified to do their job. Special training is required for these positions.

B-4-13 General Aviation Hazards. Pilots should be briefed and familiarized with all possible air hazards approaching and returning to the base of operations and within the fire area. When practical, a hazard map should be prepared and the pilot should be given a familiarization flight over the area in which the flight operations will be conducted. Such flight hazards will include:

(a) Restricted areas (military activities, etc.).

(b) Obstructions less than 1,000 ft (305 m) above ground (observation towers, antennas, TV towers, etc.).

(c) Obstructions more than 1,000 ft (305 m) above the ground (radio and TV towers, microwave, and related communications towers).

(d) Valleys, rivers, and lakes with dangerous power lines, telephone lines, or towers.

(e) Power lines and towers, telephone lines, and poles in the immediate vicinity where air operations and low flying may be required.

(f) A single tree or snag that is taller than the other trees in the area, where low flying is to be conducted.

(g) Narrow canyons, valleys, and steep terrain that could cause extreme turbulence or alleys, and steep terrain that could cause extreme turbulence or down-drafts.

(h) Extreme air turbulence or high winds, generally over 30-40 mph (45-65 kmh), that could restrict or suspend low-level flying.

(i) Military flight training routes where low flying, high speed aircraft could present a hazard.

(j) Aircraft or related activities in the vicinity of the airport (parachute jumping).

(k) Obstructions on or near the air base that may affect takeoff or landing of the aircraft.

(l) Geographic features that could cause wind conditions that might be hazardous to flight operations.

(m) Domestic or wild animals on the air base that could cause a collision or damage the operational surface.

(n) Roads crossing air bases that could cause collisions or damage.

(o) Airborne sightseers, news media, etc.

(p) Where required, on-going wildfire operations with aircraft should be coordinated with FAA route structure controllers and military low-level high speed training route schedulers and coordinators.

B-4-14 Airtanker Base Operations. By the designation of a safety officer or person in charge, the following steps should be taken to assure the safe performance of all airtanker operations:

(a) Keep unauthorized persons out of the mixing and loading areas.

(b) Designate a parking area for needed vehicles, and keep all other vehicles elsewhere or away from the operations base.

(c) Use airport matting around mixing and loading areas to ensure footing of ground personnel. A water hose should be provided to flush retardant materials that cause hazardous conditions.

(d) Require all airtanker operations personnel to wear hard hats, goggles, and earmuffs, and to wear respirators during mixing operations.

(e) Enforce safety regulations for loading and refueling aircraft.

(f) Provide a fire guard with suitable fire extinguishers. Crash trucks should be arranged for or provided when practical.

(g) Require airtanker pilots to wear crash helmet, safety belt, safety harness, and fire resistant clothing.

(h) Prohibit all unnecessary low flying of airtankers over fire camps or other large concentrations of personnel off the fireline.

(i) Airtankers operating from water bases will exercise all water-related safety precautions.

(j) Designated personnel will make periodic inspections of crash and survival gear, replacing and renewing items as needed.

(k) Require all aircraft to be operated in conformance with the operations manuals prepared by the contracting or owning agencies.

(l) Prior to airtanker use, brief the tanker pilot as to the fire situation, general plan of action, and specific missions. The briefing will include hazards, topography, wind velocity, turbulence, anticipated operations at the target site, and whom to contact when about 3 min from the fire, or some other ground contact.

(m) Provide a taxi director for congested ground operations.

B-4-15 Airtanker Water Operations. Amphibious or float-equipped aircraft can pick up a load of water in a very few seconds. These amphibious aircraft or seaplanes may be equipped with external or internal tanks and range in capacity up to 1,500 U.S. gal (5678 L). The method of filling is generally the same for all aircraft, with fixed, adjustable, or retractable probes. The water is forced up the filling tubes by ram pressure developed by forward movement of the aircraft while planing or taxiing.

Air attack operating principles and procedures are essentially the same as land-based airtankers with the exception of the loading operation. Airtankers making water pickups from the same source can be confronted with water turbulence caused by the preceding aircraft during its filling operation. This can also hold true during the cascading operation if adequate spacing is not maintained. The amount of turbulence depends on the size of the aircraft and prevailing wind and conditions. This turbulence is dispersed more rapidly in high and cross winds. Under normal operating conditions, the minimum spacing of the aircraft making water pickups from the same source would be 1 min apart. With a fast turnaround time, there is a limit to the number of aircraft that can operate from the same source. If more than one loading source is established, it becomes essential that suitable control of loading at the sources and cascading operations at the fire site be conducted in a safe manner.

Amphibious airtankers are usually equipped with an onboard supply of wildland fire and foam and can inject it into the water on the way from the pickup spot to the fire.

To assure safety in flight between the loading source and the fire, adequate aircraft separation and altitudes must be maintained. This separation is usually maintained by a delay between aircraft during the cascading and altitude separation of aircraft attacking the fire, and the aircraft returning from the fire. Safety is always a prime factor when more than one aircraft is involved in the same operation:

(a) Amphibious and float-equipped attack aircraft have a definite advantage over land-based aircraft, provided a suitable water source for loading is available near the fire.

(b) No ground crew or equipment is required at the loading site.

Since loading time generally requires less than 30 sec, delivery time per load is the flying time from the water source to the fire and return. This normally results in more loads per hour than could be delivered and cascaded by land-based aircraft. In many cases, small aircraft operating from a water source close to the fire can equal or surpass the delivery rate in gallons per hour of much larger land-based aircraft. It must be remembered, however, that amphibious aircraft drop suppressants, not retardants; and while not necessarily less effective, they definitely require a different attack strategy than do retardants.

Amphibious and float-equipped aircraft are mobil and independent; they may be moved rapidly from fire to fire with concerns only for normal fuel, oil, and maintenance requirements.

B-4-16 Amphibious and Float-Equipped Support Aircraft. Amphibious and float-type aircraft are utilized in many support functions ranging from detection, reconnaissance, and survey flights, to the transporting of cargo and personnel. Aircraft that were designed, or could be configured, for water operations have for the past 50 or more years provided vital support to remote inland rivers, lakes, and coastal areas.

B-4-17 Helicopter Operations. Helicopter operations will comply with the applicable general rules for aerial operations and practices prescribed for specialized helicopter operations.

The pilot is responsible for the safety of the aircraft at all times.

With the exception of specially trained pilots equipped for nighttime operations, daytime operation of the helicopter will be conducted during the period of time defined as ½ hr before sunrise to ½ hr after sunset.

Helicopters must not be dispatched for mountain flying when average velocity over a 5-min period at exposed peaks is 30 mph (27 KNTS) or more.

The helicopter pilot must not be permitted to fly more than the maximum number of allowable hours in a day.

A person trained in helicopter use should be stationed at each helicopter landing area during flight operations to supervise loading operations and enforce safety regulations.

Nighttime helicopter operations can be conducted with a qualified pilot, using night vision goggles or high intensity lights when performed within closely controlled and defined limits.

Helicopter arm signals should be practiced by all personnel assigned to helitack operations.

Ground-to-air signals and FAA ground signals should be remembered and use by associated personnel.

B-4-17.1 Precautions on the Ground—Helicopters. All unauthorized personnel will be kept clear of the area of operation. Hard hats with chin straps will be worn at all times.

(a) Keep clear of helicopter rotors. Unless required to go near, stay 50 ft (15.2 m) from small helicopters, 100 ft (30 m) from large helicopters, at all times. When necessary, approach from front or side, in full view of pilot.

(b) Always approach and depart helicopters from downhill side, at a slight crouch, keeping visual contact with pilot at all times.

(c) Before takeoff, fasten and adjust safety belt and shoulder harness. Keep belt fastened until instructed by pilot, after landing, to leave aircraft.

(d) Do not face helicopters when they are landing, taking off, or hovering unless goggles are worn.

(e) Keep clear of main rotor and tail rotor at all times. Carry long-handled tools low and parallel to the ground, keeping clear of the main rotor or stabilizer bar.

(f) Do not overload helicopter; put cargo in racks and tie down securely.

(g) Obtain pilot's approval for all gear stowed in or on the helicopter.

(h) Always indicate wind direction by wind socks, streamers, flagging, or throwing dirt.

(i) Helibases, particularly refueling areas, should be dustproofed by wetting down, using polybinder, or other means, to prevent dust and other foreign objects from entering engine's fuel containers, damaging engine parts of the ship, or presenting danger to the eyes of personnel.

(j) Equip helibase, helispots, and heliport with a minimum of two fire extinguishers—separated to each side of the landing area.

(k) Keep field helispots clear of debris, equipment, and unauthorized personnel.

(l) When helicopter accessories such as sling loads and helitanks are being used, personnel should never be standing directly beneath any portion of the helicopter or equipment.

(m) Smoking regulations and other safety signs shall be posted at all field heliports.

The following regulations must be observed when refueling helicopters:

1. Helicopter engine must be stopped and master switch shut off unless a certified and functioning closed circuit refueling system is installed.
2. Helicopters and fuel containers will be grounded.
3. There will be no passengers aboard the aircraft.
4. A suitable fire extinguisher will be available for immediate use.
5. No smoking within 50 ft (15.2 m) of fueling area.
6. No unauthorized personnel within 100 ft (30.5 m) of fueling area.

B-4-17.2 Pretakeoff Briefing. Conducted by the pilot or helitack personnel. The type of operation will dictate the type of briefing necessary, and the following topics should be discussed:

(a) Overwater Flights. The location and use of flotation gear and other survival equipment aboard; how and when to abandon the helicopter should ditching be necessary.

(b) Flights Over Rough or Isolated Terrain. Occupants should be informed of access to maps and survival gear.

(c) Emergency Instructions. Each passenger should be aware of necessary actions and precautions in the event of an emergency, such as assuming correct body position for best spinal protection against a high vertical impact landing (erect, with back firmly against the seat back) and when and how to exit after landing.

B-4-17.3 Precautions for Passengers During Flight:

(a) No smoking.

(b) Keep clear of the controls.

(c) Hold maps, papers, etc., securely while in flight.

(d) Use chin strap when in flight. If chin strap is not available, hold hard hat securely under arm or in hand.

(e) Keep oriented—aware of bearing—at all times.

(f) Keep alert for hazards, particularly power and telephone lines. Inform pilot of their presence, and assist the pilot, when requested, in watching tail rotor clearance during landings at field landing area.

B-4-17.4 Prelanding Briefing. The nature of the landing area will determine the information given to passengers. A few items to consider:

(a) If on a hill, depart downhill. If this involves walking around the helicopter to avoid area of the lowest rotor clearance, always go around the front, NEVER THE REAR.

(b) Review of safety precautions for ground operations.

B-4-18 Ground Personnel—Hazards From Airtankers. All ground personnel should listen and watch for low flying aircraft making retardant or water drops. If no prior notification of the drop has been received, the first warning of the arrival of the aircraft may be the sound of the air to ground warning siren or "whooper," or the aircraft engine sounds during the dry run over the target area. The safest procedure in such a situation is:

(a) Do not run unless escape is assured.

(b) Discard hand tools to the side in as safe a manner as time permits. Do not leave tools where cascading retardants can dislodge them, causing injury to personnel in the area. If uncertain as to safety, retain tools in hand.

(c) Lie face down, head toward the oncoming aircraft, with hard hat in place and grab something firm to prevent being carried or rolled by the dropping liquid.

(d) When in timber, get away from large trees and snags if at all possible. Retardant and water drops can break off both dead and live branches. Do not remain in any area where there are loose rocks or other material that may be dislodged and thrown by the liquid drop.

B-4-19 Air Space Control. With the smoke, turbulence, and topography problems, the air operations and air attack flying on wildfires can, in themselves, be dangerous. With the added problems of the presence of sightseeing, commercial, and military aircraft in the fire area, the hazards increase greatly, and mid-air collisions become a possibility.

There are measures, however, that can be taken to reduce the nonessential air traffic in the fire area. U.S. Federal Aviation Regulation 91.137, Temporary Flight Restrictions, allow the affected agency to request FAA restriction of air traffic around disaster areas. When this flight restriction is requested, and when a Notice to Airmen has been issued under this section, no person may operate an aircraft within the designated area unless the aircraft is operated in compliance with this flight rule.

The airspace restriction should be requested and set up only when necessary to air operations being conducted in the fire area. When this request is made to the nearest FAA air traffic facility, the FAA files a NOTAM (Notice to Airmen) of existence and location of restriction that could include a request that nonparticipating aircraft avoid using the selected bases of operation to relieve airport traffic congestion. This restriction system is not foolproof, and continued vigilance for other aircraft is absolutely essential.

There are hazards created by military aircraft with their low altitude, high-speed training routes. These routes—Department of Defense Flip Low Altitude Training Routes—cover much of the United States with a constantly moving network of low-level, high-speed military aircraft.

This is a difficult problem without a ready solution. To minimize the problem, Flip Low Altitude Training Route Charts should be available, thus enabling the dispatcher to notify all persons involved that a fire is near a given route. Notification of the base designated responsible for the route does not assure that military training aircraft will always be diverted from this route.

Again, as previously stated, the best defense against this problem is coordination, communication, and constant vigilance.

B-5 An Interagency Airtanker Board Charter. The Interagency Airtanker Board was established to provide coordination between fire agencies in evaluation, testing, and use of airtankers to accomplish the fire suppression job.

A. Purpose of the Board:

1. Accept, review, and evaluate proposed new or modified airtankers. Recommend approval of acceptable airtankers to concerned agencies.

2. Act as advisor to the agencies and industry operators in the overall improvement of airtanker retardant delivery systems.

3. Provide the vehicle for cooperative effort among all participating agencies and industry operators in the development, evaluation, improvement, introduction, screening, selection, and approval of experimental and operational airtanker retardant delivery systems.

4. Promote, through any and all available means, the long-term improvement in the effectiveness and efficiency of airtanker retardant delivery systems.

B. Objectives of the Board:

1. Through an evaluation and testing process, determine acceptable types of airtanker aircraft, tanks, and gate design, and recommend them for interagency use.

2. Integrate advancement of retardant technology into aerial delivery systems.

3. Provide a central source of data and information regarding evaluation, testing, selection, and introduction of airtankers, tanks, gates, and all participating agencies and industry operators.

C. Function of the Board:

1. Accept and review applications for the development and introduction of airtanker aircraft and tank and gate design as part of the total retardant delivery system. Applications may include the proposal of a concept, design for development, or the completed hardware.

2. Evaluate the application and proposal in reference to:

(a) Mandatory requirements.
(b) Other than mandatory criteria.

3. Select the best flight test programs and qualified organization to conduct or perform flight testing and field evaluation on the drop characteristics of the retardant drop systems.

4. Review and recommend approval or rejection of the proposed airtanker, aircraft tank, and gating system based on the results of the flight test and retardant drop test program.

5. When the airtanker is drop tested, designate an individual, agency, or facility to supervise and report on the performance of drop tests, field evaluation, and pattern acceptability and effectiveness.

6. If the drop tests are acceptable and other requirements are satisfactorily completed, recommend approval of the airtanker, tank, and gating system and type of aircraft for interagency use. If not acceptable, recommend redesign, or reject the proposed airtanker, tank, and gating system.

7. Obtain an operational field evaluation from the participating agency or other concerned agencies after the first season of use and provide appropriate agencies with the results.

8. When a given type of aircraft is approved as an airtanker, the Board, as a matter of expediency, may recommend temporary approval of proposed additional airtankers that are to be modified in conformity to the same TC/STC approval, pending submission of the required conformity statement, weight and balance data, and revised flight manual.