

NFPA 299

Standard for Protection of Life and Property from Wildfire

1997 Edition



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An International Codes and Standards Organization

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NFPA 299
Standard for
Protection of Life and Property from Wildfire
1997 Edition

This edition of NFPA 299, *Standard for Protection of Life and Property from Wildfire*, 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 19–22, 1997, in Los Angeles, CA. It was issued by the Standards Council on July 24, 1997, with an effective date of August 15, 1997, and supersedes all previous editions.

This edition of NFPA 299 was approved as an American National Standard on August 15, 1997.

Origin and Development of NFPA 299

NFPA 299, *Standard for Protection of Life and Property from Wildfire*, was first developed by the Forest and Rural Fire Protection Committee, following the tragic wildfires in 1985 that resulted in the loss of 44 lives and 1400 homes in the United States. Since its introduction, wildfires have continued to claim more lives and property each year. The most recent wildland/urban interface fire incidents in California, like the 1991 Oakland conflagration, the 1993 Laguna Beach fire, and the 1996 Calabasas (in Malibu) fire, have demonstrated that fire fighters are often placed in dangerous situations due to inadequate planning and design of roadways, signs, water supplies, and other infrastructure considerations, as well as the increasing population of residential areas encroaching into wildland areas.

This edition includes changes in the requirements for gate openings and the requirements allowing dead-end roads. These changes were made to improve fire department access to fire areas as well as provide for resident evacuation.

The purpose of this standard is to provide criteria for fire agencies, land use planners, architects, developers, and local government for fire-safe development in areas that may be threatened by wildfire. It is hoped that the requirements set forth in this document will, most importantly, help protect the lives of both residents and fire fighters when wildfires strike and also reduce property damage.

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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 membership may have occurred. A key to classifications is found at the back of this document.

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 that explanatory material on the paragraph can be found in Appendix A.

Information on referenced publications can be found in Chapter 11 and Appendix B.

Chapter 1 Introduction

1-1 Scope. This standard presents minimum planning, construction, maintenance, education, and management elements for the protection of life and property from wildfire. It includes information on safe procedures and practices in areas where life or improved property might be threatened by wildfire.

1-2 Purpose. This standard provides planning, construction, maintenance, education, and management elements to parties responsible for fire protection, land use planning, property development, property maintenance, wildfire safety training, public fire safety education, and others responsible for or interested in improving fire and life safety in areas where wildfire might threaten lives or improved property.

Chapter 2 Definitions

2-1 Definitions. Definitions in this standard are intended for use only with the sections of this standard. Definitions set forth in any document referenced by this standard shall be the acceptable definitions for use of that document but not necessarily for this document. Words not specifically defined in this standard or other referenced documents shall be interpreted as being ordinary usage of the word as set forth in *Webster's Third New International Dictionary of the English Language*.

Accessory Building or Structure. Any building or structure used incidentally to another building or structure.

Alternative. A system, condition, arrangement, material, or equipment submitted to the authority having jurisdiction (AHJ) as a substitute for a code requirement.

Approved.* Acceptable to the authority having jurisdiction.

Aspect. Compass direction toward which a slope faces.

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

Average Daily Traffic. The average daily volume of vehicles traveling on a given road.

Building. Any structure used or intended for supporting any occupancy.

Combustible. Any material that, in the form in which it is used and under the conditions anticipated, will ignite and burn (*see Noncombustible*).

Defensible Space. An area as defined by the AHJ [typically a width of 30 ft (9.14 m) or more], between an improved property and a potential wildfire where the combustibles have been removed or modified with the following intent:

- (a) To protect life and property from wildfire
- (b) To reduce the potential for fire on improved property spreading to wildland fuels
- (c) To provide a safe working area for fire fighters protecting life and improved property

Driveway. See Fire Service Access.

Dry Hydrant. An arrangement of pipe permanently connected to a water source other than a piped, pressurized water supply system that provides a ready means of water supply for fire-fighting purposes and that utilizes the drafting (suction) capability of fire department pumpers.

Dwelling. One or two living units, each providing complete and independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking, and sanitation.

Evacuation. The temporary movement of people and their possessions from locations threatened by wildfire.

Fire Hydrant. A valved connection on a piped water supply system having one or more outlets that is used to supply hose and fire department pumpers with water.

Fire Service Access (Driveway). Vehicular ingress and egress routes that serve no more than two buildings or structures, on one parcel of land, excluding accessory structures and containing no more than a total of three dwelling units.

Fuel Hazard Rating. A measure of the fire behavior and the difficulty of fire control in non-fire-resistive materials.

Fuel Loading. The volume of fuel in a given area generally expressed in tons per acre.

Fuel Modification. Any manipulation or removal of fuels to reduce the likelihood of ignition or the resistance to fire control.

Fuels. All combustible material within the wildland/urban interface or intermix, including vegetation and structures.

Greenbelt. An area with fire-resistive vegetation (planted or native), maintained to cause a reduction in fire intensity, and used for other than fire protection (golf course, cemetery, park, playground, orchard, etc.).

Ground Fuels. All combustible materials such as grass, duff, loose surface litter, tree or shrub roots, rotting wood, leaves, peat, or sawdust that typically support combustion.

Hammerhead-T. A roadway that provides a "T"-shaped, three-point turnaround for emergency equipment that is no narrower than the road that it serves. The top of the "T" shall be a minimum of 40 ft (12.19 m) long (*see Turnaround*).

Hazard. A fuel complex defined by kind, arrangement, volume, condition, and location, that determines the ease of ignition and/or of resistance to fire control.

Improved Property. A piece of land or real estate upon which a structure has been placed, a marketable crop is growing (including timber), or other property improvement has been made.

Ladder Fuels. Fuels that provide vertical continuity allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease.

Life Risk. Events, actions, or situations created by wildfire that have the potential to cause serious injury or death to people.

Life Safety. Actions taken to prevent the endangerment of people threatened by wildfire or by activities associated with the suppression of wildfire.

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

Mitigation. Action that moderates the severity of a fire hazard or risk.

Noncombustible.* A material that, in the form in which it is used and under the conditions anticipated, will not aid combustion or add appreciable heat to an ambient fire.

Occupancy. The purpose for which a building, or part thereof, is used or intended to be used.

Planned Building Groups. Multiple structures constructed on a parcel of land under the ownership, control, or development by an individual, corporation, partnership, or firm, excluding farms. Fire safety for planned building groups is addressed in NFPA 1141, *Standard for Fire Protection in Planned Building Groups*.

Public Street. A thoroughfare that has been dedicated for public use.

Rated Roof. A roof constructed with a "roof covering assembly" that is listed as meeting the requirements for Class A, B, or C "roof covering assembly materials."

Roadway. An open way for passage of vehicles giving access to more than one parcel.

Shall. Indicates a mandatory requirement.

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

Shoulder. Surface of a road adjacent to the traffic lane.

Slope. Upward or downward incline or slant, usually calculated as a percent of slope [rise or fall per 100 ft (30.45 m) of horizontal distance].

Street or Road Signs. Any sign containing words, numbers, directions, or symbols that provides information to emergency responders.

Structure. That which is built or constructed, an edifice or building of any kind, or any piece of work artificially built up or composed of parts joined together in some definite manner.

Traffic Lane. That portion of a roadway that provides a single lane of vehicle travel in one direction.

Turnaround. A portion of a roadway, unobstructed by parking, that allows for a safe reversal of direction for emergency equipment.

Turnouts. A widening in a travelway of sufficient length and width to allow vehicles to pass one another.

Water Supply. A source of water for fire-fighting activities.

Wildfire. An unplanned and uncontrolled fire spreading through vegetative fuels, at times involving structures.

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

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

Chapter 3 Wildfire Hazard Severity Analysis of Improved Property

3-1* General. When the AHJ (Authority Having Jurisdiction) determines that existing improved property is, or a planned property improvement will be, located in a wildland/urban interface or intermix area, the AHJ shall perform, or cause to be performed, a wildfire hazard severity analysis of the area to determine relative hazard ratings. The analysis shall, as a minimum, include the following:

- (a) Identification and documentation of wildfire hazard areas
- (b) Development and application of standards and regulations
- (c) Establishment of priorities relative to mitigating the dangers from wildfire
- (d) Determination of mitigation measures for vegetation, other combustibles, and construction criteria

3-2* Wildfire Hazard Severity Analysis.

3-2.1 System Selection. The AHJ shall select a hazard rating system to be used in assigning a level of risk from wildfire to life and improved property. These ratings shall be the basis for the implementation of mitigation measures relative to vegetation, other combustibles, and construction criteria. As a minimum, the rating system shall contain the components covered in 3-2.1.1 through 3-2.1.7.

3-2.1.1 Weather History. The history of local weather, including wind factors, relative humidity, temperatures, and fine fuel moistures shall be considered in the elements determining defensible space.

3-2.1.2* Fuels. All vegetative fuels and other combustible materials shall be evaluated for their potential to contribute to the intensity and spread of wildfire.

3-2.1.3 Structures. A structure that lacks external fire-resistant features (as outlined in Chapter 8) shall be deemed to increase the risk from the spread of wildfire to life and improved property, and the risk of fires on improved property spreading to wildland fuels.

3-2.1.4 Slope and Aspect. Slope and aspect shall be evaluated as to their potential to increase the threat of wildfire to life or improved property. On hillside properties, where deemed appropriate by the AHJ, the dimensions of defensible space shall be increased to mitigate convective and radiant heat transfer resulting from the slope and/or aspect of the property.

3-2.1.5 Fire History. The factors determining required defensible space shall include the history of wildfire behavior for the area.

3-2.1.6 Access and Evacuation. Fire-safe routes of access for emergency service apparatus and egress for vehicles shall be provided.

3-2.1.7 Additional Factors. Other factors that can affect the risk of ignition or the spread of wildfire on improved property, including the risk of structure fires spreading to vegetation, shall be part of the analysis. These additional factors can be positive (reducing risk) or negative (increasing risk) in the overall rating.

3-3 Review of Rating Assignments. The rating assignments and mitigation programs developed to meet the requirements of this chapter shall be periodically reviewed and updated by the AHJ. In no case shall the period between reviews exceed five years.

Chapter 4 Creation of Defensible Space

4-1 General. When the hazard analysis identifies a threat from wildfire, the AHJ shall approve plans for the establishment and maintenance of defensible space. The primary means of establishing defensible space shall be the management of vegetation and other fuels with the following intent:

- (a) To protect life and property
- (b) To reduce the potential for fire on improved property spreading to wildland fuels
- (c) To provide a safe working area for emergency responders

4-2 Fuel Load Reduction. The dimensions of the defensible space shall be based upon the components of the Wildland Hazard Severity Analysis (*see Section 3-2*).

4-2.1 Ground Fuel. Ground fuel within the defined defensible space, shall be treated (mowed, mulched, converted to compost, etc.) or removed annually or more frequently as directed by the AHJ.

4-2.2 Thinning and Pruning. Live vegetation within the defensible space shall have all dead material removed and shall be thinned and pruned to reduce fire intensity and rate of spread.

4-2.3 Dead Trees. Dead trees within the defensible space of buildings shall be removed.

4-2.4 Ladder Fuels. Vegetation under trees, within the defined defensible space, shall be maintained at a height that will preclude its functioning as a “ladder” for fire to travel from ground vegetation into the tree crown.

4-3 Landscaping. Where landscaping is desired, the proposed vegetation type and/or management practices shall be approved by the AHJ.

4-4 Greenbelts. If the AHJ determines it is necessary to reduce the threat of wildfires to life or improved property, fuel modification outside of the defensible space shall be required.

4-5 Defensible Space Maintenance. The defensible space plan shall include a maintenance element with the responsibility for maintenance defined.

4-6 Greenbelt Maintenance. The greenbelt plan shall include a maintenance element with the responsibility for maintenance defined.

Chapter 5 Means of Access and Evacuation

5-1 General. Access for emergency responders and evacuation shall be provided for all buildings. Routes shall provide ingress for fire department apparatus used in establishing a defensive perimeter around building(s) and shall be designed and constructed to allow simultaneous egress. The standard for access and evacuation routes to buildings shall be determined by the AHJ. Access routes shall be deemed fire service access (driveways) or roadways. Fire service access shall be provided when roadways are not required by the AHJ. When the AHJ is not a fire department, the chief fire official shall be consulted prior to the issuance of access and evacuation standards for roadways and fire service access.

5-2 Roadways.

5-2.1 Roadways Required. Roadways shall be required when routes of access serve three or more dwellings. Roadways shall be designed and constructed to allow evacuation simultaneously with fire department operations. See Section 5-4 for access to planned building groups.

5-2.2 Width and Vertical Clearance. Simultaneous access for emergency vehicles and the evacuation of residents shall be provided for by a traveled way of not less than 24 ft (7.32 m) horizontally and 14.5 ft (4.42 m) vertically. If two separate, one-way routes are provided, the width of each route shall not be less than 16 ft (4.88 m).

5-2.3 Maximum Grades. Grades on roadways shall be no greater than 10 percent, except that the AHJ shall be permitted to allow steeper grades where it can agree upon mitigation measures.

5-2.4 Minimum Drainage Grades. To prevent pooling of water in the traveled way, roadways shall have a minimum grade to their side of not less than 0.5 percent. Drainage shall be provided to protect a primary road where it intersects with a secondary road.

5-2.5 Curve Radius. No roadways shall be constructed with a curvature radius of less than 100 ft (30.48 m), measured at the center line.

5-2.6 Shoulders. Improved gravel shoulder width shall be a minimum of 4 ft (1.22 m) on each side of the roadway.

On roadways with an average daily traffic in excess of 1000 vehicles per day, shoulders shall be constructed to the same specifications as the traveled way.

Vegetation on the shoulder area of all roadways shall be maintained at a length of not more than 4 in.

5-2.7 Dead Ends. Every dead-end roadway more than 300 ft (91.5 m) in length shall be provided with a turnaround at the terminus having no less than 120 ft (36.58 m) outside diameter of traveled way. The AHJ shall be authorized to approve, as an alternative, a “hammerhead-T” turnaround to provide emergency vehicles with a three-point turnaround ability.

5-2.8 Parking. Where parking is allowed along the roadway, at least 9 ft (2.74 m) of additional improved width shall be provided.

5-2.9 Gate Openings. All gates shall be located a minimum of 30 ft (9.14 m) from the public right-of-way and shall not open outward. Gate openings shall provide a clear opening of not less than 2 ft (.6 m) wider than the traveled way.

5-2.10 Locking Devices. Fire department personnel shall have ready access to locking mechanisms on any gate restricting access to any roadway.

5-2.11 Roadway Construction. All roadways shall be constructed of a hard, all-weather surface adequately designed and constructed to support the fire apparatus likely to be operated on the roadway as designated by the AHJ.

5-2.12 Roadway Special Factors. Provision shall be made for factors that could impinge on the minimum width (e.g., drainage, snow removal, parking, and utilities).

5-2.13 Easements and Rights-of-Way. Vehicular easements and rights-of-way shall be of sufficient width to accommodate the traveled way, shoulder, parking spaces, vegetation modification, and other local requirements. Where necessary, easements shall be obtained by the property owner from adjacent property owners.

5-3 Fire Service Access.

5-3.1 Required Fire Service Access. As approved by the AHJ, fire service access or other means of emergency vehicle access shall be required when any point of the building is more than 150 ft (45.75 m) from a roadway.

5-3.2 Width and Vertical Clearance. Fire service access, including bridges, shall be a minimum of 12 ft (3.66 m) in width and have a vertical clearance of at least 14.5 ft (4.42 m) over its full width. The AHJ shall have the authority to require additional width and clearance.

5-3.3 Turns. Fire service access turns shall not restrict access of the largest emergency vehicle, as determined by the AHJ, likely to be operated on the fire service access.

5-3.4 Gate Openings. All gates shall be located a minimum of 30 ft (9.2 m) from the public right-of-way and shall not open outward. Gate openings shall provide a clear opening of not less than 2 ft (.6 m) wider than the traveled way.

5-3.5 Locking Devices. Fire department personnel shall have ready access to locking mechanisms on any gate restricting access.

5-3.6 Construction. All fire service access, including bridges, shall be designed and constructed with an all-weather surface adequate to support the heaviest piece of fire apparatus likely to be operated on the fire service access as designated by the AHJ.

5-3.7 Turnouts. Turnouts shall be spaced so that drivers can see from one turnout to the next. This requirement shall be permitted to be waived if the fire service access is 20 ft (6.1 m) or more in width.

5-3.8 Easements and Rights-of-Way. Vehicular easements and rights-of-way shall be of sufficient width to accommodate the traveled way, vegetation modification, and other local requirements. Where necessary, easements shall be obtained from adjacent property owners to operate emergency vehicles.

5-3.9 Maximum Grades. Grades shall be no greater than 15 percent, except as permitted by the AHJ.

5-3.10 Dead Ends. Every dead-end fire service access road more than 300 ft (91.44 m) in length shall be provided with a turnaround at the terminus having a minimum radius of 50 ft (15.24 m) to the center line. The AHJ shall be authorized to approve, as an alternative, a “hammerhead-T” turnaround to

provide emergency vehicles with a three-point turnaround ability.

5-4 Means of Access and Evacuation for Planned Building Groups. All fire apparatus access and vehicular evacuation routes serving planned building groups shall meet the provisions of NFPA 1141, *Standard for Fire Protection in Planned Building Groups*.

5-5 Bridges.

5-5.1 Existing. The AHJ shall assure that the load limit of all bridges be clearly posted at the approaches to each bridge.

5-5.2 Construction. All bridges shall be designed and constructed of a hard, all-weather surface capable of supporting the heaviest piece of fire apparatus likely to be operated on the bridge as determined by the AHJ.

Chapter 6 Signs

6-1 General. All means of fire service access and all buildings shall be uniquely designated on signs clearly visible and legible from the roadway on which it is addressed.

6-2 Size of Letters, Numbers, and Symbols for Signs. All letters, numbers, and symbols shall be a minimum of 4 in. (10.16 cm) in height, with a $\frac{1}{2}$ -in. (12.7-mm) stroke, and shall be reflectorized and contrasting with the background color of the sign.

6-3 Height of Signs. Signs shall be mounted 6 ft to 8 ft (1.83 m to 2 m) above the surface of the road, unless local conditions or existing standards prescribe otherwise.

6-4 Names and Numbers. Approved roadways, fire service access, dwellings, and commercial structures shall be identified by a consistent system that provides for sequenced or patterned numbering and nonduplicated naming within each jurisdiction. In cases where the AHJ is not a fire department, that fire department shall be consulted prior to the issuance of the name and/or number.

6-5 Special Conditions. Signs identifying pertinent information such as “dead-end road,” “bridge out,” and so forth, shall be appropriately placed as designated by the AHJ.

6-6 Water Supply. The location of a fire-fighting water source and each access to that source shall be identified and shall indicate whether it is a fire hydrant, a dry hydrant, or another type of water supply.

Chapter 7 Water Supplies for Fire Fighting

7-1 Minimum Water Supply Requirements. At a minimum, every building shall be provided a water supply for the purpose of fire fighting, meeting the requirements of NFPA 1231, *Standard on Water Supplies for Suburban and Rural Fire Fighting*.

Chapter 8 Structural Location, Design, and Construction

8-1 General. All buildings in the wildland/urban interface or intermix shall be designed, located, and constructed to comply with one of the model building codes and with this standard. In case of conflict between the local building code and

this standard, the more stringent fire protection requirements shall be utilized to mitigate the combustibility of structures exposed to potential wildfire.

8-2 Location. Buildings located closer than 30 ft (9.15 m) to a vegetated slope shall require special mitigation measures as determined by the AHJ.

8-3* Roofing. Only fire-retardant roof covering assemblies rated Class A, B, or C shall be used. The specific class shall be consistent with the wildfire threat as determined by the AHJ.

8-4 Attic and Sub-Floor Ventilation. Vents shall be screened with a corrosion-resistant, noncombustible wire mesh with the mesh opening not to exceed nominal $\frac{1}{4}$ in. (6.35 mm) in size.

8-5 Eaves. Eaves shall be boxed in with $\frac{1}{2}$ -in. (12.7-mm) nominal sheathing or noncombustible materials.

8-6 Overhanging Projections. Porches, decks, patios, balconies, and similar undersides of overhangs shall be constructed of heavy timber as defined by local building codes, 1-hr fire-resistive material, or noncombustible material.

8-7 Overhanging Buildings. The underside of overhanging buildings shall be constructed with material specified in Section 8-6.

8-8 Exterior Vertical Walls. Exterior vertical wall coverings shall be constructed of at least $\frac{1}{2}$ -in. (12.7-mm) nominal sheathing or equivalent material.

8-9 Chimneys and Flues.

8-9.1 Outlet Screen. Every fireplace and woodstove chimney and flue shall be provided with an approved spark arrestor constructed of a minimum 12-gauge welded wire or woven wire mesh, with the openings not to exceed $\frac{1}{2}$ in. (12.7 mm).

8-9.2 Clearance. Vegetation shall not be allowed within 10 ft (3.05 m) of a chimney outlet.

8-10 Accessory Structures. Outbuildings, patio covers, trellises, and other accessory structures shall be constructed to meet the requirements of this chapter.

8-11 Mobile and Manufactured Homes. Permanently located mobile and manufactured homes shall comply with all requirements of this standard and shall be skirted with noncombustible materials.

Chapter 9 Public Fire Safety Information and Education

9-1 General. The AHJ shall prepare and implement a fire safety public information/education program with emphasis on wildland/urban interface and intermix issues. The program, at a minimum, shall identify and analyze the following:

- (a) Wildfire hazards
- (b) Life and property risks
- (c) Fire causes
- (d) Prevention and safety programs
- (e) Target audiences
- (f) Activities

Chapter 10 Community Planning for Protection of Life and Property from Wildfire

10-1* General. The AHJ shall be responsible for the development and maintenance of a multi-agency operational plan for the protection of lives and property during wildfires.

10-2 Goals. The primary goal of the plan shall be to protect people in the fire area, including emergency personnel responding to the incident from injury or loss of life. A secondary objective is to minimize or eliminate property loss from wildfire.

10-3 Command Element. The plan shall contain a command element that clearly defines the responsibilities and authorities of all agencies and organizations that will be used in control of the incident. Supporting resources such as social service agencies, local media, amateur radio, law enforcement, and so forth, shall be included. An incident management system will be used in accordance with NFPA 1561, *Standard on Fire Department Incident Management System*.

10-4* Training Element. Training, qualifications, and equipment requirements shall be prepared to assure that all personnel and equipment assigned to a wildfire incident will be able carry out assignments in a predictable, safe, cooperative, and effective manner. Preparation shall be appropriate for national, state, provincial, or local certification where required.

10-5 Community Involvement Element. Public preparation shall include the following:

- (a) The establishment of a communication system to provide rapid and accurate information to the public regarding wildfire incidents that endanger their community, including detailed instructions for public notification of impending evacuations
- (b) Information regarding actions to be taken for self-protection
- (c) Information regarding appropriate assistance that can be rendered by the public to fire protection agencies in the control of wildfires
- (d) Security measures to protect evacuated area

10-6 Public Safety and Evacuation Element. A public safety and evacuation element shall provide for the safety of residents and area workers threatened by potential wildfire. This element shall include the following:

- (a) Incident personnel authorities and criteria for ordering evacuations
- (b) Incident personnel responsibilities in evacuations
- (c) Public notification of impending evacuations
- (d) Routes for evacuation
- (e) Shelter locations
- (f) Policy addressing the issue of persons who remain to protect their property
- (g) Procedures for allowing evacuees to return when the current fire threat has passed

10-7 Mutual Assistance Element. Mutual assistance (mutual aid) agreements shall be developed that detail those services and resources available to support the management of a wildfire incident. Agreements shall be reviewed annually. The agreements shall include the following:

- (a) Legal authorities, responsibilities, and liabilities

- (b) Command organization
- (c) Fiscal responsibilities
- (d) Operational and logistical responsibilities

Chapter 11 Referenced Publications

11-1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix B.

11-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 1141, *Standard for Fire Protection in Planned Building Groups*, 1996 edition.

NFPA 1231, *Standard on Water Supplies for Suburban and Rural Fire Fighting*, 1993 edition.

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

11-1.2 Other Publication.

Webster's Third New International Dictionary of the English Language, Unabridged, G. & C. Merriam Company, Springfield, MA, 1966.

Appendix A

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

A-2-1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A-2-1 Authority Having Jurisdiction. The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction;

at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A-2-1 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A-2-1 Noncombustible. Materials tested in accordance with ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C (1382°F)*, and conforming to the criteria contained in Section 8 of the referenced standard are generally accepted as noncombustible.

A-3-1 There are many excellent examples of what a wildfire hazard severity analysis should include around the various regions of the United States and Canada. It is a generally accepted fact that no one inclusive boilerplate-type analysis will work for all the many and diverse vegetative fuel types found in North America. The two examples listed in Wildfire Hazard Severity Analysis (*see Section A-3-2*) are examples for the AHJ to use as their basic format.

A-3-2 Wildfire Hazard Severity Analysis. Tables A-3-2(a) and A-3-2(b) depict two different approaches to conducting a wildfire hazard severity analysis. Table A-3-2(a) is a format adopted by the Colorado State Forest Service and modified by the NFPA Forest and Rural Fire Protection Technical Committee to incorporate elements and ratings previously listed in NFPA 299, *Standard for Protection of Life and Property from Wildfire*, 1991 edition. Table A-3-2(b) is a wildfire hazard severity analysis summary developed by the NFPA Forest and Rural Fire Protection Technical Committee based upon a combination of several fire hazard severity analyses. Table A-3-2(c) is a summation of typical desirable characteristics found in various wildfire hazard analyses.

Table A-3-2(a) Wildfire Hazard Severity Form Checklist
(Check off Most Appropriate Element in Each Category and Add the Point Totals)

Element	Points
A. Subdivision Design	
1. Ingress and egress	
Two or more, primary roads	1 __
One road, primary route	3 __
One way in/out	5 __
2. Primary road width	
Minimum of 20 ft (6.1 m)	1 __
Less than 20 ft (6.1 m)	3 __
3. Road accessibility	
Smooth road, grade < 5%	1 __
Rough road, grade > 5%	3 __
Other	5 __
4. Secondary road terminus	
Loop roads, cul-de-sacs	
Outside radius > 50 ft (15.2 m)	1 __
Outside radius < 50 ft (15.2 m)	3 __
Cul-de-sac turnaround	

Table A-3-2(a) Wildfire Hazard Severity Form Checklist
(Check off Most Appropriate Element in
Each Category and Add the Point Totals) (Continued)

Element	Points
Dead-end roads < 200 ft (61 m)	3 __
Dead-end roads > 200 ft (61 m)	5 __
5. Average lot size	
More than 10 acres (4.1 ha)	1 __
Between 1 and 10 acres (0.4–4.1 ha)	3 __
Less than 1 acre (0.4 ha)	5 __
6. Street signs	
Present [4 in. (10.2 cm) in size and reflectorized]	1 __
Not present	5 __
B. Vegetation (Fuel Models)	
1. NFDRS fuel models	
Light (grasses, forbs, sawgrasses, and tundra)	1 __
Fuel models A, C, L, N, S, and T	
Medium (light brush and small trees)	5 __
Fuel models D, E, F, H, P, Q, and U	
Heavy (dense brush, timber, and hardwoods)	10 __
Fuel models B, G, and O	
Slash (timber harvesting residue)	10 __
Fuel models J, K, and L	
2. Defensible space	
More than 100 ft (30.48 m) of treatment from buildings	1 __
30–70 ft (9.1–21.3 m) of treatment from buildings	5 __
No defensible space treatment	10 __
C. Topography	
1. Slope	
Less than 9%	1 __
Between 10 and 20%	4 __
Between 21 and 30%	7 __
Between 31 and 40%	8 __
Greater than 41%	10 __
D. Additional Rating Factors	
1. Rough topography that contains steep canyons	2 __
2. Areas with a history of higher fire occurrence than surrounding areas due to special situations such as heavy lightning, railroads, escaped debris burning, arson, etc.	3 __
3. Areas that are periodically exposed to unusually severe fire weather and strong dry winds	4 __
E. Roofing Material	
1. Construction material	
Class A roof	1 __
Class B roof	3 __
Class C roof	5 __
Nonrated	10 __
F. Existing Building Construction	
1. Materials (predominate)	
Noncombustible siding/deck	1 __
Noncombustible siding/wood deck	5 __
Combustible siding and deck	10 __

Table A-3-2(a) Wildfire Hazard Severity Form Checklist
(Check off Most Appropriate Element in
Each Category and Add the Point Totals) (Continued)

Element	Points
G. Available Fire Protection	
1. Water source availability (on site)	
500 gpm (1892.7 Lpm) hydrants < 1000 ft (304.8m) apart	1 __
Hydrants above or draft site	2 __
No hydrants or draft site available	3 __
2. Water source availability (off site)	
Sources within 20 min round-trip	1 __
Sources within 21-45 min round-trip	5 __
Sources > 46 min round-trip	10 __
H. Utilities (Gas and Electric)	
1. Placement	
All underground utilities	1 __
One underground, one aboveground	3 __
All aboveground	5 __
I. Totals for Subdivision (Tally up all check-point totals.)	
1. Low hazard: < 49 points	
2. Moderate hazard: 49-68 points	
3. High hazard: 69-83 points	
4. Extreme hazard: 84+ points	

Table A-3-2(b) Wildfire Hazard Severity Classification Analysis
by Fuel Type, Slope, and Building Material

NFDRS Fuel Models	FBO Fuel Models	Slope Percent			Building Material Combustibility*
		0-20%	21-40%	41+%	
H, R	8 Grass	L	L	M	L or M or H
U, P, E	9 Timber	L	L	M	L or M or H
K	11 Slash	L	M	H	L or M or H
A, L, S	1 Grass	L	M	H	L or M or H
D	7 Shrub	L	M	H	L or M or H
N	3 Grass	M	M	H	L or M or H
G	10 Timber	M	M	H	L or M or H
F	5 Shrub	M	M	H	L or M or H
C, T	2 Grass	M	M	H	L or M or H
F, Q	6 Shrub	M	H	H	L or M or H
J	12 Slash	M	H	H	L or M or H
I	13 Slash	M	H	H	L or M or H
B, O	4 Shrub	H	H	H	L or M or H

*L = Low (Class A roof, noncombustible siding and deck); M = Moderate (Class B roof, noncombustible siding and deck); H = High (Class C or nonrated roof, combustible siding and deck).

Wildfire hazard ratings are as follows: L = low; M = moderate; H = high. An overall wildfire hazard severity rating of "low" is to be given when two "L"s are assigned (slope rating and combustibility rating). A moderate wildfire hazard severity rating is to be given when either of the two ratings is "M" (i.e., L/M or M/M). A high rating is assigned when either rating is "H" (i.e., M/H or H/H).

Table A-3-2(c) Defensible Space Clearing and Structural Summary*

Low	Moderate	High
30 ft (9.14 m) clearance	30 ft (9.4 m) irrigated	30 ft (9.4 m) irrigated
Class C roof	Class B roof	Class A roof
No portion of trees or other vegetation within 10 ft (3.05 m) of chimney outlets	Noncombustible siding/wood decks	100 ft (30.48 m) fuel treatment
Trees within defensible space shall be pruned to minimize ladder fuels	Selected fire-resistant trees within 30 ft (9.14 m) of structures	Noncombustible siding/decks and boxed eaves
	Trees within defensible space shall be pruned to minimize ladder fuels	Selected fire-resistant trees within 30 ft (9.14 m) of structures
	No portion of trees or other vegetation within 10 ft of chimney outlets	Selected thinning of trees and shrubs
		Trees within defensible space shall be pruned to minimize ladder fuels
		No portion of trees or other vegetation within 10 ft (3.05 m) of chimney outlets

*This summary does not include all the requirements listed in this standard.

A-3-2.1.2 Fuel Model. Wildland fire fuels are described in two basic fuel model classifications, the National Forest Fire Laboratory (NFFL) or Fire Behavior Fuel Models and National Fire Danger Rating (NFDR) System. The following is an excerpt from the NFDR System, 1978, United States Department of Agriculture — Forest Service, General Technical Report INT-39, and is for information purposes and not intended for adoption. The fuel model keys that follow are only general descriptions because they represent all wildfire fuels from Florida to Alaska and from the East Coast to California.

FUEL MODEL KEY

I. Mosses, lichens, and low shrubs predominate ground fuels.

A. An overstory of conifers occupies more than one-third of the site: MODEL Q.

B. There is no overstory, or it occupies less than one-third of the site (tundra): MODEL S.

II. Marsh grasses and/or reeds predominate: MODEL N.

III. Grasses and/or forbs predominate.

A. There is an open overstory of conifer and/or hardwood trees: MODEL C.

B. There is no overstory.

1. Woody shrubs occupy more than one-third, but less than two-thirds of the site: MODEL T.

2. Woody shrubs occupy less than one-third of the site:

a. The grasses and forbs are primarily annuals: MODEL A.

b. The grasses and forbs are primarily perennials: MODEL L.

IV. Brush, shrubs, tree reproduction, or dwarf tree species predominate.

A. Average height of woody plants is 6 ft (1.8 m) or greater.

1. Woody plants occupy two-thirds or more of the site.

a. One-fourth or more of the woody foliage is dead.

(1) Mixed California chaparral: MODEL B.

(2) Other types of brush: MODEL F.

b. Up to one-fourth of the woody foliage is dead: MODEL Q.

c. Little dead foliage: MODEL O.

2. Woody plants occupy less than two-thirds of the site: MODEL F.

B. Average height if woody plants are less than 6 ft (1.8 m).

1. Woody plants occupy two-thirds or more of the site.

a. Western United States: MODEL F.

b. Eastern United States: MODEL O.

2. Woody plants occupy less than two-thirds but greater than one-third of the site.

a. Western United States: MODEL T.

b. Eastern United States: MODEL D.

3. Woody plants occupy less than one-third of the site.

a. The grasses and forbs are primarily annuals: MODEL A.

b. The grasses and forbs are primarily perennials: MODEL L.

V. Trees predominate.

A. Deciduous broadleaf species predominate.

1. The area has been thinned or partially cut, leaving slash as the major fuel component: MODEL K.

2. The area has not been thinned or partially cut.

a. The overstory is dormant; the leaves have fallen: MODEL E.

b. The overstory is in full leaf: MODEL R.

B. Conifer species predominate.

1. Lichens, mosses, and low shrubs dominate as understory fuels: MODEL Q.

2. Grasses and forbs are the primary ground fuels: MODEL C.

3. Woody shrubs and/or reproduction dominate as understory fuels.

a. The understory burns readily.

(1) Western United States: MODEL T.

(2) Eastern United States:

(a) The understory is more than 6 ft (1.8m) tall: MODEL O.

(b) The understory is less than 6 ft (1.8m) tall: MODEL D.

- b. The understory seldom burns: MODEL H.
- 4. Duff and litter, branchwood, and tree boles are the primary ground fuels.
 - a. The overstory is overmature and decadent; there is a heavy accumulation of dead tree debris: MODEL G.
 - b. The overstory is not decadent; there is only a nominal accumulation of debris.
 - (1) The needles are 2 in. (5.1 cm) or more in length (most pines).
 - (a) Eastern United States: MODEL P.
 - (b) Western United States: MODEL U.
 - (2) The needles are less than 2 in. (5.1 cm) long: MODEL H.
- VI. Slash is the predominant fuel.
- A. The foliage is still attached; there has been little settling.
 - 1. The loading is 25 tons/acre (56.1+/ha) or greater: MODEL I.
 - 2. The loading is less than 25 tons/acre (56.1 tons/ha) but more than 15 tons/acre (33.6+/ha): MODEL J.
 - 3. The loading is less than 15 tons/acre (33.6+/ha): MODEL K.
- B. Settling is evident; the foliage is falling off; grasses, forbs, and shrubs are invading the area.
 - 1. The loading is 25 tons/acre (56.1+/ha) or greater: MODEL J.
 - 2. The loading is less than 25 tons/acre (56.1+/ha): MODEL K.

FUEL MODEL A

This fuel model represents western grasslands vegetated by annual grasses and forbs. Brush or trees can be present but are very sparse, occupying less than a third of the area. Examples of types where Fuel Model A should be used are cheatgrass and medusahead. Open pinyon-juniper, sage-brush-grass, and desert shrub associations can appropriately be assigned this fuel model if the woody plants meet the density criteria. The quantity and continuity of the ground fuels vary greatly with rainfall from year to year.

FUEL MODEL B

Mature, dense fields of brush 6 ft (1.83 m) or more in height are represented by this fuel model. One-fourth or more of the aerial fuel in such stands is dead. Foliage burns readily. Model B fuels are potentially very dangerous, fostering intense, fast-spreading fires. This model is for California mixed chaparral generally 30 years or older. The F model is more appropriate for pure chamise stands. The B model can also be used for the New Jersey Pine barrens.

FUEL MODEL C

Open pine stands typify Model C fuels. Perennial grasses and forbs are the primary ground fuel, but there is enough needle litter and branchwood present to contribute significantly to the fuel loading. Some brush and shrubs can be present but they are of little consequence. Situations covered by Fuel Model C are open, longleaf, slash, ponderosa, Jeffrey, and sugar pine stands. Some pinyon-juniper stands might qualify.

FUEL MODEL D

This fuel model is specifically for the palmetto-gallberry understory-pine overstory association of the southeast coastal plains. It can also be used for the so-called "low pocosins" where Fuel Model O might be too severe. This model should only be used in the Southeast because of a moisture of extinction.

FUEL MODEL E

Use this model after leaf fall for hardwood and mixed hardwood-conifer types where the hardwoods dominate. The fuel is primarily hardwood leaf litter. The oak-hickory types are best represented by Fuel Model E, but E is an acceptable choice for northern hardwoods and mixed forests of the Southeast. In high winds, the fire danger might be underrated because rolling and blowing leaves are not accounted for. In the summer after the trees have leafed out, Fuel Model E should be replaced by Fuel Model R.

FUEL MODEL F

Fuel Model F is the only one of the 1972 NFDR System Fuel Models whose application has changed. Model F now represents mature closed chamise stands and oakbrush fields of Arizona, Utah, and Colorado. It also applies to young, closed stands and mature open stands of California mixed chaparral. Open stands of pinyon-juniper are represented; however, fire activity will be overrated at low wind speeds and where there is sparse ground fuels.

FUEL MODEL G

Fuel Model G is used for dense conifer stands where there is a heavy accumulation of litter and downed woody material. Such stands are typically overmature and might also be suffering insect, disease, wind, or ice damage — natural events that create a very heavy buildup of dead material on the forest floor. The duff and litter are deep and much of the woody material is more than 3 in. (7.6 cm) in diameter. The undergrowth is variable, but shrubs are usually restricted to openings. Types meant to be represented by Fuel Model G are hemlock-Sitka spruce, Coast Douglas-fir, and wind-thrown or bug-killed stands of lodgepole pine and spruce.

FUEL MODEL H

The short-needed conifers (white pines, spruces, larches, and firs) are represented by Fuel Model H. In contrast to Model G fuels, Fuel Model H describes a healthy stand with sparse undergrowth and a thin layer of ground fuels. Fires in H fuels are typically slow spreading and are dangerous only in scattered areas where the downed woody material is concentrated.

FUEL MODEL I

Fuel Model I was designed for clear-cut conifer slash where the total loading of materials less than 6 in. (15.2 cm) in diameter exceeds 25 tons/acre (56.1+/ha). After settling and the fines (needles and twigs) fall from the branches, Fuel Model I will overrate the fire potential. For lighter loadings of clear-cut conifer slash, use Fuel Model J, and for light thinnings and partial cuts where the slash is scattered under a residual overstory, use Fuel Model K.

FUEL MODEL J

This model is complementary to Fuel Model I. It is for clear-cuts and heavily thinned conifer stands where the total loading of materials less than 6 in. (15.2 cm) in diameter is less than 25 tons/acre (56.1+/ha). Again, as the slash ages, the fire potential will be overrated.

FUEL MODEL K

Slash fuels from light thinnings and partial cuts in conifer stands are represented by Fuel Model K. Typically, the slash is scattered about under an open understory. This model applies to hardwood slash and to southern pine clear-cuts where the loading of all fuels is less than 15 tons/acre (33.6+/ha).

FUEL MODEL L

This fuel model is meant to represent western grasslands vegetated by perennial grasses. The principal species are coarser and the loadings heavier than those of Model A fuels. Otherwise, the situations are very similar; shrubs and trees occupy less than one-third of the area. The quantity of fuel in these areas is more stable from year to year. In safebrush areas, Fuel Model T could be more appropriate.

FUEL MODEL N

This fuel model was constructed specifically for the sawgrass prairies of south Florida. It can be useful in other marsh situations where the fuel is coarse and reed-like. This model assumes that one-third of the aerial portion of the plants is dead. Fast-spreading, intense fires can occur even over standing water.

FUEL MODEL O

The O fuel model applies to dense, brush-like fuels of the Southeast. O fuels, except for a deep litter layer, are almost entirely living, in contrast to B fuels. The foliage burns readily, except during active growing season. The plants are typically over 6 ft (1.83 m) tall and are often found under an open stand of pine. The high pocosins of the Virginia, North Carolina, and South Carolina coasts are the ideal of Fuel Model O. If the plants do not meet the 6-ft (1.83-m) criteria in those areas, Fuel Model D should be used.

FUEL MODEL P

Closed, thrifty stands of long-needled southern pines are characteristic of P fuels, A 2- to 4-in. (5.06- to 10.12 cm) layer of lightly compacted needle litter is the primary fuel. Some small-diameter branchwood is present but the density of the canopy precludes more than a scattering of shrubs and grass. Fuel Model P has the high moisture of extinction characteristic of the Southeast. The corresponding model for other long-needled pines is U.

FUEL MODEL Q

Upland Alaskan black spruce is represented by Fuel Model Q. The stands are dense but have frequent openings filled with usually flammable shrub species. The forest floor is a deep layer of moss and lichens, but there is some needle litter and small-diameter branchwood. The branches are persistent on the trees, and ground fires easily reach into the tree crowns. This fuel model can be useful for jack pine stands in the Lake States. Ground fires are typically slow spreading, but a dangerous crowning potential exists.

FUEL MODEL R

This fuel model represents the hardwood areas after the canopies leaf out in the spring. It is provided as the off-season substitute for E. It should be used during the summer in all hardwood and mixed conifer-hardwood stands where more than half of the overstory is deciduous.

FUEL MODEL S

Alaskan or alpine tundra on relatively well-drained sites characterize the S fuel model. Grass and low shrubs are often present, but the principal fuel is a deep layer of lichens and moss. Fires in these fuels are not fast spreading or intense, but are difficult to extinguish.

FUEL MODEL T

The bothersome sagebrush-grass types of the Great Basin and the Intermountain West are characteristic of T fuels. The shrubs burn easily and are not dense enough to shade out grass and other herbaceous plants. The shrubs must occupy at least one-third of the site or the A or L fuel models should be used. Fuel Model T might be used for immature scrub oak and desert shrub associations in the West, and the scrub oak-wire grass type in the Southeast.

FUEL MODEL U

Closed stands of western long-needled pines are covered by this model. The ground fuels are primarily litter and small branchwood. Grass and shrubs are precluded by the dense canopy but occur in the occasional natural opening. Fuel Model U should be used for ponderosa, Jeffrey, sugar pine, and red pine stands of the lake states. Fuel Model P is the corresponding model for southern pine plantations.

A-8-3 Fire Rating of Roof Covering Assemblies. Roof covering assemblies are tested for three levels of fire exposure, severe (Class A), moderate (Class B), and light (Class C). The following descriptions of the expected performance of roofs meeting those class standards is based on Standard Specification 790, December 15, 1978, of the Underwriters Laboratories Inc.

(a) *Class A roof coverings.* Class A roof coverings are tested against *severe* fire exposures. Under such exposures, roof coverings of this class are fire-retardant, afford a fairly high degree of fire protection to the roof deck, do not slip from position, and pose no flying-brand hazard.

(b) *Class B roof coverings.* Class B roof coverings are tested against *moderate* fire exposures. Under such exposures, roof coverings of this class are fire-retardant, afford a moderate degree of fire protection to the roof deck, do not slip from position, and pose no flying-brand hazard.

(c) *Class C roof coverings.* Class C roof coverings are tested against *light* fire exposures. Under such exposures, roof coverings of this class are fire-retardant, afford a measurable