NFPA® 1144

Standard for Reducing Structure Ignition Hazards from Wildland Fire

2008 Edition



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NFPA® 1144

Standard for

Reducing Structure Ignition Hazards from Wildland Fire

2008 Edition

This edition of NFPA 1144, *Standard for Reducing Structure Ignition Hazards from Wildland Fire*, was prepared by the Technical Committee on Forest and Rural Fire Protection. It was issued by the Standards Council on June 4, 2007, with an effective date of June 24, 2007, and supersedes all previous editions.

This edition of NFPA 1144 was approved as an American National Standard on June 24, 2007.

Origin and Development of NFPA 1144

The basis for the 2008 edition of NFPA 1144, *Standard for Reducing Structure Ignition Hazards from Wildland Fire*, was NFPA 224, *Fire Protection and Prevention for Summer Homes in Forested Areas*, originally created in 1935. The document was developed by the Forest Committee of NFPA and was presented and adopted at the 1935 Annual Meeting of the Association. In 1952, the document was renumbered NFPA 224-T, and in 1953 was revised to *Fire Prevention Standards for Homes and Camps in Forested Areas*. The document was designated NFPA 224M, *Recommended Good Practice for Homes and Camps in Forest Areas*, when it was revised in the 1962, 1969, and 1972 editions.

In 1974, NFPA 224M was renamed *Standard for Homes and Camps in Forest Areas*, and was revised in progressively up-to-date editions in both 1979 and 1985. In 1988, the NFPA Forest Committee and the Correlating Committee on Suburban and Rural Fire Protection and Prevention were combined into the Technical Committee for Forest and Rural Fire Protection.

In 1991, NFPA 224, *Standard for Homes and Camps in Forest Areas*, was withdrawn, and the Forest and Rural Technical Committee incorporated parts of the document into the 1991 edition of NFPA 299, *Protecting Life and Property from Wildfire*. Following the tragic wildfires in the United States in 1985 that had resulted in the loss of 44 lives and 1400 homes, the 1991 edition was revised with a new approach to fire protection. More recent wildland/urban interface fires, such as the conflagrations in Oakland, CA (1991), Laguna Beach, CA (1993), and Malibu, CA (1996), had shown that fire fighters often are placed in dangerous situations due to inadequate planning and design of roadways, signs, water supplies, and other infrastructure considerations. These fires also demonstrated that the growing population of residential areas increasingly is encroaching into wildland areas. The fire season of 2000 resulted in renewed interest in seeking more creative alternative methods to reduce the historical trend of catastrophic fires.

In 2002, NFPA 299 was renumbered NFPA 1144 to bring it into sequence with other Forest and Rural Committee documents. NFPA 1144 was officially adopted by state and local governments and adapted for use by numerous jurisdictions involved in planning Firewise Communities. The 2002 edition clarified numerous requirements in the earlier editions and included a significant revision of the Wildland Fire Risk and Hazard Severity Assessment system in Annex B. The committee tested various assessment system versions in several Firewise Communities workshops, sponsored by the National Wildland/Urban Interface Fire Program, before arriving at the relative values and hazard levels given in the document. The committee increased the severity values for non-rated roofing, inadequate separation of vegetation from structures, and separation of structures from one another.

This 2008 edition, now entitled *Standard for Reducing Structure Ignition Hazards from Wildland Fire*, focuses on individual structure hazards and excludes subdivision requirements that were incorporated in the 2008 edition of 1141, *Standard for Fire Protection Infrastructure for Land Development in Suburban and Rural Areas*. The current edition also requires a new spatial approach to assessing and mitigating wildfire hazards around existing structures and includes improved ignition-resistant requirements for new construction.

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NFPA 1144 presents basic criteria for fire agencies, land use planners, architects, developers, and local government for planning development in areas that might be threatened by wildfire. This standard, when used as part of a cooperative approach among key disciplines, will provide guidance in the design and development of Firewise Communities in or near wildland fire–prone areas. It is hoped that the requirements set forth in this document will, first, help protect the lives of both residents and fire fighters when wildfires strike and, second, reduce property damage.

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

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Contents

Chapter 1 Administration **1144–** 5
1.1 Scope **1144–** 5
1.2 Purpose **1144–** 5
1.3 Application **1144–** 5
1.4 Equivalency **1144–** 5

Chapter 2 Referenced Publications **1144–** 5
2.1 General **1144–** 5
2.2 NFPA Publications **1144–** 5
2.3 Other Publications **1144–** 5
2.4 References for Extracts in Mandatory Sections **1144–** 5

Chapter 3 Definitions **1144–** 5
3.1 General **1144–** 5
3.2 NFPA Official Definitions **1144–** 5
3.3 General Definitions **1144–** 6

Chapter 4 Assessing Wildland Fire Hazards in the Structure Ignition Zone **1144–** 7
4.1 General **1144–** 7
4.2 Structure Assessment Elements and Conditions **1144–** 7
4.3 Development of Wildland Fire Hazard Mitigation Plan **1144–** 8
4.4 Mitigation Implementation and Enforcement **1144–** 8

Chapter 5 Building Design, Location, and Construction **1144–** 8
5.1 Construction in Wildland Areas **1144–** 8
5.2 Roof Design and Materials **1144–** 9
5.3 Overhanging Projections **1144–** 9
5.4 Overhanging Buildings **1144–** 9
5.5 Exterior Vertical Walls **1144–** 9
5.6 Exterior Openings **1144–** 9
5.7 Chimneys and Flues **1144–** 9
5.8 Accessory Structure(s) **1144–** 9
5.9 Mobile and Manufactured Homes **1144–** 9
5.10 Vehicle Parking Areas **1144–** 9
5.11 Exterior Exposure Hazards **1144–**10

Chapter 6 Fuel Modification Area **1144–**10
6.1 General **1144–**10
6.2 Fuels Modification and Treatment **1144–**10

Annex A Explanatory Material **1144–**10

Annex B Fuel Model Classifications **1144–**23

Annex C Type IV (2HH) Construction **1144–**25

Annex D Informational References **1144–**26

Index **1144–**28

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NFPA 1144

Standard for

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A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex D. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1* Scope. This standard provides a methodology for assessing wildland fire ignition hazards around existing structures, residential developments, and subdivisions and improved property or planned property improvement that will be located in a wildland/urban interface area, and provides minimum requirements for new construction to reduce the potential of structure ignition from wildland fires.

1.2 Purpose.

1.2.1* This standard shall be used to assess fuel sources in the structure ignition zone for their potential to ignite structures and to identify possible mitigation measures to reduce the possibility of structure ignition.

1.2.2 The standard provides minimum standards for design, construction, and landscaping for structures in the wildland/urban interface.

1.3 Application.

1.3.1 The standard shall apply to all existing structures, residential developments, and subdivisions and improved property or planned property improvement that will be located in a wildland/urban interface area, including commercial, ranch and farm structures, manufactured homes, and structures in recreational vehicle parks.

1.3.2 This standard shall not be construed as prohibiting any design, construction, or landscaping activity that will provide fire protection or hazard reduction at least equivalent to that required by this standard and that which has been set forth by the authority having jurisdiction (AHJ).

1.4 Equivalency.

1.4.1* This standard shall not be used to lessen or negate general fire protection requirements or procedures addressed in other standards.

1.4.2 The authority having jurisdiction shall use recognized fire protection standards and measures as necessary to meet local conditions.

1.4.3 Where extremely high hazard conditions exist, the authority having jurisdiction shall determine equivalent requirements that provide a level of protection no less than would be afforded by full compliance with this standard.

Chapter 2 Referenced Publications

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

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

NFPA 58, *Liquefied Petroleum Gas Code,* 2008 edition.

NFPA 256, *Standard Methods of Fire Tests of Roof Coverings,* 2003 edition.

NFPA 1141, *Standard for Fire Protection Infrastructure for Land Development in Suburban and Rural Areas,* 2008 edition.

NFPA 5000®, Building Construction and Safety Code®, 2006 edition.

2.3 Other Publications.

2.3.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E 108, *Standard Test Methods for Fire Tests of Roof Coverings*, 2005.

2.3.2 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 5000®, Building Construction and Safety Code®, 2006 edition.

Chapter 3 Definitions

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

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

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

3.2.3* 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 appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.4 Shall. Indicates a mandatory requirement.

3.2.5 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law.

3.3 General Definitions.

3.3.1 Accessory Structure. Any structure used incidentally to another structure.

3.3.2 Alternative. A system, condition, arrangement, material, or equipment submitted to the authority having jurisdiction as a substitute for a requirement in a standard.

3.3.3 Building. A structure, usually enclosed by walls and a roof, constructed to provide support or shelter for an intended occupancy.

3.3.4 Combustible. Any material that, in the form in which it is used and under the conditions anticipated, will ignite and burn or will add appreciable heat to an ambient fire.

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

3.3.6 Evacuation. The temporary movement of people and their possessions from locations threatened by wildland fire.

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

3.3.8 Fire Resistive. Construction designed to provide reasonable protection against fire.

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

3.3.10* Fuels. All combustible materials within the wildland/urban interface or intermix, including, but not limited to, vegetation and structures.

3.3.11 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.

3.3.12* Heavy Timber Construction. Type IV (2HH) construction as defined in *NFPA 5000, Building Construction and Safety Code*.

3.3.13* Ignition-Resistant Material. Any product designed for exterior exposure that, when tested in accordance with applicable standards, has a flame spread of not more than 25, shows no evidence of progressive combustion, and whose flame front does not progress more than 10½ ft (3.2 m) beyond the centerline of the burner at any time during the test.

3.3.14* Immediate Landscaped Area. The area of the structure ignition zone extending at least 30 ft (9 m) from the foundation of the structure, including the footprint on decks and all extensions, and the area in which the vegetation has been modified for reduced flammability or aesthetic purposes, such as lawns and gardens.

3.3.15 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.

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

3.3.17 Noncombustible. Any material that, in the form in which it is used and under the conditions anticipated, will not ignite and burn nor will add appreciable heat to an ambient fire.

3.3.18 Occupancy. The purpose for which a building or portion thereof is used or intended to be used.

3.3.19 Risk. The measure of the probability and severity of adverse effects that result from an exposure to a wildland fire (direct flames, radiant heat, or firebrands).

3.3.20 Road. Any access, not including a driveway, providing access to more than one parcel and primarily intended for vehicular access.

3.3.21* Slash. Debris resulting from natural events such as wind, fire, snow, or ice breakage; or from human activities such as building or road construction, logging, pruning, thinning, or brush cutting.

3.3.22* Slope. Upward or downward incline or slant, usually calculated as a percentage.

3.3.23 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.

3.3.24* Structure Assessment. An evaluation to determine the structure's potential to be ignited by an approaching wildland fire.

3.3.25* Structure Ignition Zone. The area around a specific structure and associated accessory structures, including all vegetation that contains potential ignition sources and fuels that can affect ignition potential during an intense wildland fire.

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

3.3.27 Wildland Fire. An unplanned and uncontrolled fire spreading through vegetative fuels, at times involving structures.

3.3.28* Wildland/Urban Interface. The presence of structures in locations in which the AHJ determines that topographical features, vegetation fuel types, local weather conditions, and prevailing winds result in the potential for ignition of the structures within the area from flames and firebrands of a wildland fire.

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

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Chapter 4 Assessing Wildland Fire Hazards in the Structure Ignition Zone

4.1 General.

4.1.1* In cases in which the AHJ 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 wildland fire hazard assessment of each structure ignition zone in the development to determine relative risk, the extent of wildland fire hazard, and applicable mitigation measures.

4.1.2* The structure assessment shall, as a minimum, include the following:

(1) Identification and documentation of the wildland fire hazards in the ignition zone(s) for each structure within wildland fire hazard areas, according to the elements and conditions in Section 4.2
(2) Determination of mitigation measures for vegetation, other combustibles, and the structure, including the periodic maintenance associated with such measures
(3) Establishment of priorities relative to mitigating the risks from wildland fire

4.1.3 The wildland fire hazard assessment shall be the basis for recommended mitigation measures relative to the vegetation, other combustibles, and structures on the site.

4.2* Structure Assessment Elements and Conditions. As a minimum, the structure assessment shall cover elements and conditions indicated in 4.2.1 through 4.2.5.

4.2.1 Overview of the Surrounding Environment. The structure assessment shall document the conditions of 4.2.1.1 through 4.2.1.5 in the assessment of the surrounding environment, as they will place the structure in the most risk from ignition by a wildland fire.

4.2.1.1* The structure assessment shall document the location of the structure in relation to predominant topographical features, such as flat open areas, ridges, saddles, steep slopes, natural chimneys like steep narrow draws, or small canyons, that will increase the ignition potential of the structure.

4.2.1.2* The structure assessment shall document local weather conditions, including wind, relative humidity, temperature, and fine fuel moisture content.

4.2.1.3* The structure assessment shall document nearby structures using the same criteria as the primary structure.

4.2.1.4* The structure assessment shall document any neighboring properties that could impact the ignition zone of the property being assessed.

4.2.1.5* The structure assessment shall document the structure's location on the slope relative to the structure's potential exposure to heat from a wildland fire.

4.2.2 From Chimney to Eaves. The structure assessment shall document the conditions of 4.2.2.1 through 4.2.2.6 to observe construction and vegetation as they place the structure in the most risk from ignition by a wildland fire.

4.2.2.1* The structure assessment shall document the type and construction of roofing materials.

4.2.2.2* The structure assessment shall document the condition of roofing materials and assemblies.

4.2.2.3* The structure assessment shall document all skylights in roof assemblies.

4.2.2.4* The structure assessment shall document the potential of roof gutters and areas where exterior walls meet roof or deck surfaces to collect litter on surfaces or in crevices.

4.2.2.5* The structure assessment shall document the construction materials of gutters, downspouts, and connectors.

4.2.2.6* The structure assessment shall document the materials and construction used in eaves of roof overhangs.

4.2.3 From Top of Exterior Wall to Foundation. The structure assessment shall document the conditions of 4.2.3.1 through 4.2.3.6 to observe construction and vegetation as they place the structure in the most risk from ignition by a wildland fire.

4.2.3.1* The structure assessment shall document the materials and construction used in exterior walls and exterior siding.

4.2.3.2 The structure assessment shall document the materials used for gutter downspouts and connectors on exterior walls.

4.2.3.3* The structure assessment shall document the materials used in windows and other openings in vertical surfaces.

4.2.3.4* The structure assessment shall document the location, size, and screening of ventilation openings.

4.2.3.5* The structure assessment shall document all attached accessory structures as part of the primary structure.

4.2.3.6* The structure assessment shall document areas next to or under a structure where combustible materials that present a source of flame exposure to the structure might collect.

4.2.4* From Foundation to the Immediate Landscaped Area. The structure assessment shall document the conditions of 4.2.4.1 through 4.2.4.5 to observe construction and vegetation, as they place the structure in the most risk from ignition by a wildland fire.

4.2.4.1* The structure assessment shall document all vegetative fuels and other combustible materials adjacent to and within 30 ft (9 m) of the structure for their potential to contribute to the intensity and spread of wildland fire.

4.2.4.2* The structure assessment shall document the presence and location of all heat and flame sources within 30 ft (9 m) of the primary structure.

4.2.4.3* The structure assessment shall document all projections attached to the primary structure.

4.2.4.4* The structure assessment shall document detached structures within 30 ft (9 m) of the primary structure that might be ignited by flames, radiant heat, or firebrands from wildland fires.

4.2.4.5* The structure assessment shall document vehicle parking areas within 30 ft (9 m) of any surface of the structure.

4.2.5 From the Immediate Landscaped Area to the Extent of the Structure Ignition Zone. The structure assessment shall document the conditions of 4.2.5.1 through 4.2.5.8 to observe construction and vegetation, as they place the structure in the most risk from ignition by a wildland fire.

4.2.5.1* The structure assessment shall document vegetation within the area between the outer edge of the immediate landscaped area and the extent of the structure ignition zone as potential fuel that can convey the fire to the structure.

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4.2.5.2* The structure assessment shall document the species and location of trees and the separation of tree crowns within the area between the outer edge of the immediate landscaped area and the extent of the structure ignition zone.

4.2.5.3* The structure assessment shall document the presence and location of all heat and flame sources within the area between the outer edge of the immediate landscaped area and the extent of the structure ignition zone.

4.2.5.4* The structure assessment shall document detached structures within the area between the outer edge of the immediate landscaped area and the extent of the structure ignition zone that might be ignited by flames, radiant heat, or firebrands from wildland fires.

4.2.5.5* The structure assessment shall document vehicle parking areas within the area between the outer edges of the immediate landscaped area and the extent of the structure ignition zone.

4.2.5.6* The structure assessment shall document all projections attached to the primary structure that extend beyond the immediate landscaped area.

4.2.5.7 The structure assessment shall document all other factors that can affect the risk of ignition or the spread of wildland fire on improved property within the structure ignition zone, including the risk of structure fires spreading to vegetation.

4.2.5.8 Any structure that fails to comply with the requirements of Chapter 5 shall be deemed to increase the risk of the spread of wildland fire to improved property and the risk of fires on improved property spreading to wildland fuels.

4.3 Development of Wildland Fire Hazard Mitigation Plan.

4.3.1 From the information gathered in each structure assessment, the AHJ shall require or cause to be developed a wildland fire hazard mitigation plan and schedule to address the wildland fire hazards identified in the specific structure ignition zone assessment.

4.3.2 The AHJ shall work with applicable agencies and organizations to resolve any conflicts between recommended wildland fire hazard mitigation measures and mitigation measures or objectives of other hazards.

4.3.3* This plan shall include, but not be limited to, the following:

(1) Specific mitigation recommendations based on the hazard assessment to reduce the ignition potential around and including the structure
(2) Construction modification or retrofit necessary to reduce the identified hazards as a minimum or to comply with the provisions of Chapter 5
(3) Fuel modification recommendations as specified in Chapter 6
(4) A hazard mitigation implementation and maintenance schedule approved by the AHJ

4.3.4* The history of wildland fire in the area under assessment shall be considered in determining required hazard mitigation plan.

4.3.5* The AHJ shall approve the mitigating measures relative to access, water supply, and construction based upon the structure assessment established in 4.1.2.

4.3.6 From the information gathered in each structure assessment, the AHJ shall require or cause to be developed a wildland fire hazard severity map of each residential development area addressed.

4.3.7 The map shall include, but not be limited to, the following data elements:

(1) Lot designations
(2) Structure locations on each lot
(3) Locations of wildland fire evacuation centers or safety zones
(4) Hazard severity for each lot
(5) Overlapping ignition zones

4.4 Mitigation Implementation and Enforcement.

4.4.1 The AHJ shall require the property owner to develop and comply with the approved wildland fire hazard mitigation plan and schedule according to 4.3.1.

4.4.2 No permit associated with construction shall be issued if the provisions of this standard are not addressed.

4.4.3 No permit associated with occupancy shall be issued until the provisions of this standard are satisfied.

Chapter 5 Building Design, Location, and Construction

5.1 Construction in Wildland Areas.

5.1.1 General.

5.1.1.1 All new construction in wildland/urban interface areas shall be designed, located, and constructed to comply with this standard; NFPA 1141, *Standard for Fire Protection Infrastructure for Land Development in Suburban and Rural Areas*; and the local building code.

5.1.1.2 In case of conflicts among this standard; NFPA 1141, *Standard for Fire Protection Infrastructure for Land Development in Suburban and Rural Areas*; and the local building code, the more stringent fire protection requirements shall be utilized to mitigate the ignition potential and combustibility of structures exposed to potential wildland fire.

5.1.2 Construction Documents. The AHJ shall be provided with plans and specifications for each project regulated by this standard.

5.1.2.1 Construction documents shall clearly indicate the methods, materials, and processes employed to meet the requirements of this standard and the location of each structure or feature drawn to scale.

5.1.2.2 Construction documents shall include a vicinity map that provides details regarding the vicinity within 300 ft (91 m) of property lines, including other structures, slope, vegetation, fuel breaks, water supply systems, and access roads.

5.1.3 Location.

5.1.3.1* Separation distances between primary and accessory structures on each lot and structures on adjacent lots shall not be less than 30 ft (9 m).

5.1.3.2* Buildings located closer than 30 ft (9 m) to a vegetated slope shall require special mitigation measures as determined by the AHJ.

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5.1.3.3* The AHJ shall be permitted to require a noncombustible wall or barrier where sufficient space is unavailable between the structure and undisturbed native vegetation or slopes.

5.1.3.4 Vegetation shall be modified to mitigate hazardous conditions within 30 ft (9 m) of the foundations prior to the start of construction.

5.1.3.5* All slash from vegetation modification and construction debris shall be treated or removed prior to or immediately upon completion of construction.

5.2* Roof Design and Materials.

5.2.1 The requirements for roof covering assemblies shall be as follows:

(1) Only listed roof covering, tested and rated in accordance with NFPA 256, *Standard Methods of Fire Tests of Roof Coverings*; ASTM E 108, *Standard Test Methods for Fire Tests of Roof Coverings*; or equivalent, shall be used.
(2) The specific class shall be consistent with the wildland fire hazard assessment as determined by the AHJ.

5.2.2 Vents shall be screened with a corrosion-resistant, noncombustible wire mesh with the mesh opening not to exceed nominal ¼ in. (6.3 mm) in size.

5.2.3 Eaves shall be boxed in with ⅝ in. (15.5 mm) nominal sheathing or noncombustible materials or meet the requirements of 5.5.2.

5.2.4 Where the roof profile allows space between the roof covering and the roof decking, the spaces shall be constructed to prevent the intrusion of flames and embers, be fire-stopped with approved materials, or have additional assembly components of noncombustible materials to prevent ignition.

5.2.5 Attic or foundation ventilation louvers or ventilation openings in vertical walls shall be covered with nominal ¼ in. (6.3 mm) mesh corrosion-resistant metal screen or other noncombustible and approved material that offers equivalent protection.

5.2.6 No attic ventilation openings or ventilation louvers shall be permitted in soffits, in eave overhangs, between rafters at eaves, or in other overhanging areas on those exposures facing hazardous vegetation, as determined by the AHJ.

5.2.7* Attic spaces shall be ventilated as approved for the building configuration, the climatological conditions of the site, and the moisture and temperature conditions associated with the occupancy and use of the building. [***5000:***38.8.1]

5.3 Overhanging Projections. All projections (exterior balconies, carports, decks, patio covers, unenclosed roofs and floors, and similar architectural appendages and projections) shall be of heavy timber construction; be constructed of noncombustible material, fire-retardant-treated wood, or other ignition-resistant materials; or be a 1-hour fire-rated assembly.

5.4 Overhanging Buildings. The underside of overhanging buildings and supporting structural elements shall be of heavy timber construction; be constructed of noncombustible material, fire-retardant-treated wood, or other ignition-resistant materials; or be a 1-hour fire-rated assembly.

5.5 Exterior Vertical Walls.

5.5.1 Exterior vertical walls shall meet the requirements for heavy timber construction, ignition-resistive material, fire-retardant-treated wood, or be a minimum 20-minute fire-rated assembly where walls are potentially exposed to a wildland fire, unless the AHJ determines that the wildland fire risk and structure assessment requires greater protection.

5.5.2 All exterior walls shall be protected with 2 in. (50 mm) nominal solid blocking between exposed rafters at all roof overhangs, under the exterior wall covering on all sides exposed to native vegetation, as determined by the AHJ.

5.5.3 When appendages and projections are attached to exterior fire-resistive walls, they shall be constructed to maintain the fire-resistive integrity of the wall.

5.5.4* Structural elements that result in or could result in the collection of combustible materials proximal to the structure shall be protected.

5.6 Exterior Openings.

5.6.1* Exterior windows, windows within exterior doors, and skylights shall be tempered glass, multilayered glazed panels, glass block, or have a fire-resistance rating of no less than 20 minutes.

5.6.2 Window screening shall be noncombustible mesh and installed to prevent the collection of firebrands and embers or their entry into open windows.

5.6.3 Exterior doors shall be solid-core wood no less than 1¾ in. (45 mm) thick, approved noncombustible construction, or have a fire protection rating of no less than 20 minutes.

5.6.4 Vents for attic and subfloor ventilation shall be screened with a corrosion-resistant wire mesh, with the mesh opening not exceeding nominal ¼ in. (6.3 mm) in size.

5.6.5* Attic and subfloor vents shall not be installed in a location that faces heavy vegetative fuels.

5.6.6* Vents shall not be installed in walls that face heavy vegetative fuels.

5.7 Chimneys and Flues.

5.7.1 Every fireplace and wood stove chimney and flue shall be provided with an approved spark arrester constructed of a minimum 12-gauge welded wire or woven wire mesh, with openings not exceeding ½ in. (12.7 mm).

5.7.2 Vegetation shall not be allowed within 10 ft (3 m) of a chimney outlet.

5.8* Accessory Structure(s). Accessory structures shall be constructed to meet the requirements of this chapter or shall be separated from the main structure by a minimum of 30 ft (9 m).

5.9 Mobile and Manufactured Homes.

5.9.1 Permanently located mobile and manufactured homes with an open space beneath shall have a skirt of noncombustible material or material that has a minimum fire-resistive rating of 20 minutes.

5.9.2 Any enclosed space beneath the mobile or manufactured home shall be vented according to 5.2.2.

5.10 Vehicle Parking Areas. Vehicle parking areas within the immediate landscaped zone shall be maintained free of dry grasses and fine fuels that could be ignited by hot exhaust systems or firebrands.

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5.11 Exterior Exposure Hazards.

5.11.1* Heat and flame sources that are unprotected or unsupervised shall not be permitted within 30 ft (9 m) of the primary structure.

5.11.2 Incinerators, outdoor fireplaces, permanent barbecues, and grills shall not be built, installed, or maintained in hazardous fire areas without prior approval of the AHJ.

5.11.3 Openings in incinerators, outdoor fireplaces, permanent barbecues, and grills shall be provided with an approved spark arrester, screen, or door.

5.11.4 Propane tanks and other flammable or combustible liquids storage shall conform to NFPA 58, *Liquefied Petroleum Gas Code*, and the wildland fire hazard mitigation plan required in Section 4.3.

5.11.5 Other combustible materials within 30 ft (9 m) of any structure shall be removed or stored in conformance with the wildland fire hazard mitigation plan as approved by the AHJ.

Chapter 6 Fuel Modification Area

6.1* General. Where the wildland fire hazard mitigation plan requires establishment of a fuel modification area, the modifications shall extend to the limits of the structure ignition zone.

6.2 Fuels Modification and Treatment.

6.2.1* Ground fuels, including native vegetation and plants used for landscaping within the defined landscaping zones, shall be treated or removed.

6.2.2 Live vegetation within the fuel modification area shall have dead material removed and shall be thinned and pruned in conformance with the wildland fire mitigation plan, as approved by the AHJ.

6.2.3 Dead and downed fuels within 30 ft (9 m) of all buildings shall be removed or treated to maintain the fuel modification area in conformance with the wildland fire mitigation plan, as approved by the AHJ.

6.2.4 Vegetation under trees within the fuel modification area shall be maintained at a height that will preclude ground fire from spreading in the tree crown.

6.2.5* Tree crowns within the structure ignition zone shall be spaced to prevent structure ignition from radiant heat.

6.2.6 The fuel modification plan shall include a maintenance element identifying and defining the responsibility for continued and periodic maintenance.

Annex A Explanatory Material

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

A.1.1 Residential developments and subdivisions are intended to include clubhouses, community meeting and activity centers, municipal buildings, offices, farm and ranch structures, and other structures within development boundaries.

A.1.2.1 In the case of extreme fire behavior, ignition of any structure can occur, but if mitigation measures are implemented and maintained, damage can be limited or avoided. Life safety is paramount in all fire situations, and residents and occupants are encouraged to plan for timely evacuation or shelter.

A.1.4.1 The optimal goal of this standard is to provide residential structures in wildland/urban interface areas with the ability to survive a wildland fire without the intervention of fire-fighting forces. Preventing ignition to these structures will reduce the exposure of fire fighters and residents to hazards that threaten life and injury and will reduce catastrophic home losses. Mitigating ignition hazards that reduce the threat to structures can optimize the deployment of personnel and apparatus during the fire. This approach will allow for a more effective and efficient commitment of resources for fire protection.

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

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

A.3.2.3 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.10 Fuels. Wildland fire fuels are described using two basic fuel model classifications: the National Forest Fire Laboratory (NFFL) Fire Behavior Fuel Models and the National Fire Danger Rating System (NFDRS).

A.3.3.12 Heavy Timber Construction. Annex C contains an excerpt from *NFPA 5000, Building Construction and Safety Code*, as additional information about heavy timber construction.

A.3.3.13 Ignition-Resistant Material. Applicable standards include UL 723, *Test for Surface Burning Characteristics of Building*

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Materials; ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*; and NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*. Certain jurisdictions might have testing requirements that are different.

A.3.3.14 Immediate Landscaped Area. This area, as defined by the AHJ, often referred to as the "defensible space" between an improved property and a potential wildland fire, is where combustible materials and vegetation have been removed or modified to reduce the potential for fire on improved property spreading to wildland fuels or to provide a safe working area for fire fighters protecting life and improved property from wildland fire.

A.3.3.21 Slash. Slash includes logs, chunks, bark, branches, stumps, and broken understory trees or brush.

A.3.3.22 Slope. Slope (or percent of slope) is calculated by dividing the vertical rise (or fall) of a surface for every 100 ft (30 m) of horizontal distance.

A.3.3.24 Structure Assessment. This assessment includes elements and condition of objects within the structure ignition zone (i.e., the fuels and vegetation in the yard and adjacent to the structure, roof environment, decking and siding materials, prevailing winds, topography, fire history, and related conditions) with the intent of mitigating hazards and risks from wildland fire.

A.3.3.25 Structure Ignition Zone. The "zone" includes the structures and their immediate surroundings 0–200 ft (0–60 m). Under some conditions, 100 ft (30 m) or less around structures might be enough distance to treat, while intense fire potential in heavier fuels might require the surroundings to extend to 200 ft (60 m) from the structure. The area and shape of the structure ignition zone is site-specific.

A.3.3.28 Wildland/Urban Interface. The term *wildland/urban interface* can distort the perception of the primary issue. It can direct attention to "where" structures are located (e.g., at the edge of communities near the wildland) rather than if they are highly ignitable. And if so, the focus on "where" can result in a concern about things that won't make a big difference in reducing structure loss (i.e., how fire fighters and equipment get there, what type of fire equipment is needed, and the location of fire hydrants and water sources). How wide the roads are and where the fire hydrants are located become of little value if there are more structures at risk than equipment to protect them, or if it's too dangerous to safely be there with fire-fighting forces.

The essence of this issue is not where structures and domestic landscapes adjoin wildland, but the location, density, and availability of ignitable structures. Which structures are at the greatest risk, ignition-resistant homes bordering the wildland or a dense subdivision with wood shingle roofs several miles away from wildland fuels? The wildland/urban interface is not geographic location, but rather a set of conditions that can exist in many communities.

A.4.1.1 Any person assigned to conduct structure assessments should meet the qualifications of Wildland/Urban Interface Coordinator in accordance with Chapter 10 of NFPA 1051, *Standard for Wildland Fire Fighter Professional Qualifications*. Information about the course is available at www.firewise.org.

A.4.1.2 Figure A.4.1.2 and Table A.4.1.2 are examples of two different approaches to hazard assessment.

Figure A.4.1.2 is an example of assessment guide with assessment information based on observation of the areas around the structure. This form, intended to be given to the resident, can be very useful by indicating the most serious hazards and the mitigation recommendation(s) that can be taken to reduce the ignition hazard. In this example, samples of the kind of information noted in an assessment are given as observations and suggestions for mitigation.

This example of an assessment guide is designed to help determine how vulnerable the structure will be during a wildland fire and to convey to the resident those items that should be corrected (mitigated) so that their home will have a better chance to survive a wildland fire. This form is offered as an example of the kind of tool that might be useful during a site visit as a guide for assessing the structure ignition zone. Remember, the following assessment items are for *prevention/mitigation* measures to be done *well in advance* of wildland fire season.

Figure A.4.1.2 is a form used to document observations, collect data, provide a hazard assessment, and give mitigation recommendations for the resident. From the mitigation recommendations, a mitigation plan and schedule is developed in accordance with Section 4.3. For more information on the use of this assessment form, refer to the course *Assessing Wildfire Hazards in the Home Ignition Zone*, available from the national Firewise Communities Program (www.firewise.org).

Table A.4.1.2 is a modified rating form based on the previous edition of NFPA 1144, *Standard for Reducing Structure Ignition Hazards from Wildland Fire*. Infrastructure elements of water supply, signage, and other fire suppression resources have been deleted, since the presence or absence of such resources does not modify the existing hazards of the structure. The table is presented only as an example of a rating system and should be modified to meet the environmental conditions of the area under consideration. For more information on a creating an assessment system, consult *Wildland/Urban Interface Fire Hazard Assessment Methodology Guide*, produced by the national Firewise Communities Program (www.firewise.org).

A numeric rating form that will yield a hazard rating number can have a variety of uses, for example, determining relative hazards among several properties and mapping overall hazard ratings on a map. However, residents and homeowners often accept the rating number as finite and undertake mitigation measures that will merely reduce the rating rather than actually reduce the ignition potential of the structure.

A.4.2 It is critical to keep in mind that the ignition of the structure might occur from one or more of the following sources:

(1) Big flames (crown fire or intense surface fire). One objective of observation of the conditions and elements and subsequent mitigation recommendations is to keep crown fire and high intensity surface fire at a distance of 100–200 ft (30–60 m) or more from home and other potential hazards (flammables, buildings, etc.).
(2) Small flames (surface fire). Another objective is to keep small flames at a distance of 30 ft (9 m) or more from home(s) and flammable attachments (decks).
(3) Firebrands (embers). A final and essential objective is to eliminate beds of fine fuel and entry points for firebrands on and near home(s).

A.4.2.1.1 Wildland fire dangers exist in flat land areas, as well as in mountainous terrain. In addition, property line limitations often preclude effective vegetation mitigation, and alternatives for mitigation are needed.

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STRUCTURE ASSESSMENT GUIDE

Date of assessment: *22 Nov* Property address: *70 Norris Rd.*

Resident: *John and Jane Doe* Property owner: *Same*

PRIMARY INFORMATION

Assessment Items	Mitigation Recommendations
1. OVERVIEW OF SURROUNDINGS	
How is the structure positioned in relationship to severe fire behavior? *The house is located near peak of a ridge at local map reference Q-4-12. The setbacks from the lot lines are approximately 15–20 ft. There is a slight sloping of the lot away from the house within 50 ft of the lot line on the north.*	*Since prevailing winds during fire season are most likely from the west-southwest, keep pine needles and leaf litter cleaned up on roadside berm.*
Type of construction: *Wood frame construction with brick façade on the front. Vinyl siding on back and two sides.*	
2. CHIMNEY TO EAVES	
Inspect the roof — noncombustible? shingles missing? shingles flat with no gaps? *Noncombustible roofing in good shape.*	*Inspect roof each spring for damage, especially after a hard winter or wind storm.*
Gutters — present? Noncombustible? *Aluminum gutters at all eaves. No overhanging limbs nearby. Pine needles and leaf litter not likely to collect in deep quantities.*	*Keep gutters free of pine needles and leaves. Check early spring and fall.*
Litter on roof, in gutters, and crevices? *Fairly clean. Not much of a concern. Easy to maintain.*	
3. TOP OF THE EXTERIOR WALL TO FOUNDATION	
Attic, eave, soffit vents, and crawl spaces: *Not much of a concern.*	
Inspect windows and screens — metal screens? Multi-paned windows? Picture windows facing vegetation? *Metal screens on all windows. Some windows on west side are double-paned. Some high vegetation near front windows. Low vegetation in rear.*	*Keep front bushes pruned and watered during fire season. Replace any missing or torn screens immediately, especially the front.*
Walls and attachments — noncombustible? Will they collect litter? *Not much of a concern.*	
Decks — combustible materials? *Wooden deck and privacy fence on south side. No skirting or screening beneath deck. Deck in good condition. Small vegetation around deck but overhanging tree limbs. Some collection of leaves and needles near deck and wooden stairs.*	*Prune trees closest to deck and privacy fence. Remove the pine needles and leaves. Store combustibles elsewhere — perhaps the shed in the backyard — especially during high fire danger periods. Put skirting or 1/4" wire mesh around deck openings.*

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FIGURE A.4.1.2 Structure Assessment Guide — Example with Notations.

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STRUCTURE ASSESSMENT GUIDE *(continued)*

Assessment Items	Mitigation Recommendations
3. TOP OF THE EXTERIOR WALL TO FOUNDATION *(continued)*	
Fences. *Wooden stockade fence joins house on north side. Wooden fencing also on south side. Chain link in rear along lot line. Neighbor's wooden fence is less than 2–3 ft from their wooden fence — will allow leaves and embers to accumulate.*	*Keep wooden fence perimeter clear of dry leaves and other combustible materials like chairs, wood, etc. If the chance presents itself to use noncombustible materials to separate fence from house, you should consider it.*
Flammable material next to or under the structure. *None observed.*	
Combustible materials near or on the structure where walls meet roof or decking surfaces. *Plastic outdoor furniture pads on deck might pose problem from ember shower.*	*Keep combustible chair pads put away except when in use.*
Crawl space, attic vents, soffits. *All appear to be in excellent condition and protected.*	
Nooks and crannies and other small spaces. *All appear to be in excellent condition and protected.*	
4. FOUNDATION TO IMMEDIATE LANDSCAPED AREA	
Landscaped (managed) vegetation — separation distances, maintenance, plant selection? Firewise Landscaping Zones? *Lawn well cared for. Leaf and needle accumulation along east side (rear of property) with small stand of trees. Front and south side have mix of pine and other vegetation.*	*Be sure to keep these areas well tended, pine needles cleared and limbs pruned. Lawn needs to be kept green and mowed. Plants irrigated, pruned and raked — especially during high fire danger periods.*
Propane tanks. *No large ones. Outdoor grill small tank.*	*Make sure this area is kept clear of any combustibles — especially when using the grill.*
Vehicle and RV use and parking, including lawn mowers, etc. *Parking in front. Mower storage in shed which is 40–50 ft from NE corner of house. Plastic children's play house etc. near wooden fence along north side but over 30 ft from house.*	
5. IMMEDIATE LANDSCAPED AREA TO EXTENT OF THE HOME IGNITION ZONE	
Inspect vegetation clearance and crown separation. *Lot is rather small and the neighboring properties' vegetation is more dense than this one. Trees in back should pose little concern as prevailing winds will not communicate fire towards house.*	*Work with neighbors to improve all three lots to reduce the hazards on this corner. The neighbors behind this address and those on either side might benefit from some clearance that might take place but the separation of those properties appears to be sufficient.*

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FIGURE A.4.1.2 ***Continued***

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Table A.4.1.2 Example of Structure Assessment Rating Form

Rating Values by Areas Assessed	Overview of Surrounding Environment (4.2.1)	From Chimney to Eaves (4.2.2)	From Top of the Exterior Wall to Foundation (4.2.3)	From Foundation to Immediate Landscaped Area (4.2.4)	From Immediate Landscaped Area to Extent of Structure Ignition Zone (4.2.5)
Topographical Features					
(1) Topographical features that adversely affect wildland fire behavior (4.2.1)	0–5				
(2) Areas with history of high fire occurrence (4.3.4)	0–5				
(3) Areas exposed to unusually severe fire weather and strong, dry winds (4.2.1.3)	0–5				
(4) Local weather conditions and prevailing winds (4.2.1.2)	0–5				
(5) Separation of structure on adjacent property that can contribute to fire spread/behavior (4.2.1.3)	0–5			0–5	0–5
Vegetation — Characteristics of predominant vegetation					
(1) Light (e.g., grasses, forbs, sawgrasses, and tundra) NFDRS Fuel Models A, C, L, N, S, and T	5			15	5
(2) Medium (e.g., light brush and small trees) NFDRS Fuel Models D, E, F, H, P, Q, and U	10			20	5
(3) Heavy (e.g., dense brush, timber, and hardwoods) NFDRS Fuel Models B, G, and O	15			25	15
(4) Slash (e.g., timber harvesting residue) NFDRS Fuel Models J, K, and L	15			30	20
Topography (4.2.1.1, 4.2.4, 4.2.5)					
(1) Slope 5–9%				1	1
(2) Slope 10–20%				4	2
(3) Slope 21–30%				7	3
(4) Slope 31–40%				10	6
(5) Slope >41%				15	10
Building Setback, relative to slopes of 30% or more (4.2.1.5, 5.1.3.2)					
(1) ≥30 ft (9.14 m) to slope	1				
(2) <30 ft (9.14 m) to slope	5				
Roofing Materials and Assembly, nonrated (4.2.2.1, 4.2.2.3)		50*			
Ventilation Soffits, without metal mesh or screening (4.2.3.4)		20			
Gutters, combustible (4.2.2.4, 4.2.2.5)		5			

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Table A.4.1.2 *Continued*

Rating Values by Areas Assessed	Overview of Surrounding Environment (4.2.1)	From Chimney to Eaves (4.2.2)	From Top of the Exterior Wall to Foundation (4.2.3)	From Foundation to Immediate Landscaped Area (4.2.4)	From Immediate Landscaped Area to Extent of Structure Ignition Zone (4.2.5)
Building Construction (predominant)† (4.2.4)					
(1) Noncombustible/fire-resistive/ignition-resistant siding and deck			Low		
(2) Noncombustible/fire-resistive/ignition-resistant siding and combustible deck			Medium		
(3) Combustible siding and deck			High		
Fences and Attachments, combustible (4.2.4.3)				15	
Placement of Gas and Electric Utilities					
(1) One underground, one aboveground	3				
(2) Both aboveground	5				
Fuel Modification within the structure ignition zone (4.2.4, 4.2.5)					
(1) 71–100 ft (21–30 m) of vegetation treatment from the structure(s)					5
(2) 30–70 ft (9–21 m) of vegetation treatment from the structure(s)				7	
(3) <30 ft (9 m) of vegetation treatment from the structure(s)				15	
No Fixed Fire Protection (NFPA 13, 13R, 13D sprinkler system)			5		
TOTALS (if numerical ranking is desired)					
Hazard Rating Scale (Compare with above totals)					
Slight Structure Ignition Hazards from Wildland Fire	0–14	0–14	0–14	0–14	0–14
Moderate Structure Ignition Hazards from Wildland Fire	15–29	15–29	15–29	15–29	15–29
Significant Structure Ignition Hazards from Wildland Fire	30–49	30–49	30–49	30–49	30–49
Severe Structure Ignition Hazards from Wildland Fire	50+	50+	50+	50+	50+

*Nonrated and combustible roof assemblies are predominantly structural exposures and severely increase the ignition hazard from wildland fire.

†The table provides both numerical and value rankings (low, medium, high). The user is urged to assign the value ranking of low, medium, or high based on the other ignition factors prevalent at the assessment site. For example, a deck made of combustible materials might rank low if it is small in size and the rest of the site is in a low fuel loading area that will not promote a large amount of firebrands. That same deck might rate high if it is in an area of high fuel loading that will promote numerous firebrands. Numeric values can be substituted as a local option.

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A.4.2.1.2 Local weather conditions or prevailing winds play a role in fire behavior (e.g., from which direction a fire is most likely to come, to the intensity and speed of fire travel, depending on the degree of slope), and the direction from which a wildland fire is most likely to approach the structure is an important exposure consideration. Sources of local weather records and fire weather history from the National Weather Service, National Oceanic and Atmospheric Administration (NOAA), local weather bureaus, or wildland fire agencies can be a valuable resource in assessing existing structures or in planning for new construction.

A.4.2.1.3 Adjacent ignitable structures (garages, carports, sheds, gazebos, utility cabinets) can contribute to heat intensity, flame contact, and fire spread from firebrands.

A.4.2.1.4 Overlapping zones could have a positive result in that the outermost extent of a structure ignition zone might be a neighboring parking lot or already treated vegetation area, such as a fuel modification. On the other hand, the overlap might include other private or public lands, which could make mitigation more difficult because it could involve state or federal agencies or absentee landowners who do little or no vegetation management or hazard mitigation.

A.4.2.1.5 Structure location on a slope increases the structure's exposure to heat (e.g., structure setback from the slope is sufficient to reduce its radiant heat exposure). Setback distances of the structure can be measured in accordance with A.5.1.3.2.

A.4.2.2.1 All common coverings (composition shingles, tile, and, in many cases, metal) typically have a fire-resistive roofing classification adequate for interface fire protection if the covering material is tightly assembled to resist firebrand intrusion.

Untreated wood roofing is easily ignited and a major hazard. The only wood roof coverings that can be considered acceptable are wood shakes or shingles that have been treated at the factory by a pressure-impregnation fire-retardant process, tested for fire resistance, and certified with a fire-resistant roofing classification of Class A, Class B, or Class C. Pressure-treated wood roofing looks very similar to the hazardous untreated wood roofing, and currently there is no permanent identification method. If in doubt, assume wood roofing is untreated unless documentation is provided.

A.4.2.2.2 Look for gaps in the roof covering that might allow small wind-blown firebrands to penetrate under the covering and ignite material below.

Some fire-resistive roof coverings are designed or installed with gaps that allow firebrand intrusion under the covering and have resulted in firebrand intrusion and ignition of the building under the roof covering. The worst example is roof coverings that allow combustible debris to blow under the covering or that allow rodents and birds to bring nesting material in under the roof covering. Clay (Spanish or straight barrel mission) tile roof covering can have this problem unless eave closures or "bird stops" are used to close the convex opening created by the shape of the tile at the eave. Metal tile roofing installed on top of old wood roofing left in place has been a problem. If you can see wood through gaps in metal tile roof covering, firebrands can penetrate and ignite the building.

A.4.2.2.3 Plastic skylights can melt from radiant heat or flaming embers or both. Deformation can result in large openings that can allow the entry of embers and other flaming materials. Skylights constructed of multilayered glazed panels or tempered glass provide increased protection from heat and embers.

A.4.2.2.4 The roof is the most vulnerable part of the structure and is subject to the collection of combustible vegetative litter (e.g., leaves, pine needles) or other debris and buildup that can be ignited by firebrands. Can litter build up and accumulate on surfaces next to combustible, perpendicular walls? Will combustible decking or roofing provide ember beds next to combustible, perpendicular walls?

Heat trapping under eaves does not occur until the wall supports flaming combustion as indicated by the portions of the wall that were protected (shaded) and did not char during experiments conducted by the USDA Forest Service Fire Sciences Lab in Missoula, MT.

A.4.2.2.5 Gutters and downspouts collect leaves and pine needles. Gutters and eave troughs made from combustible materials (e.g., wood, vinyl) are as vulnerable to firebrand collection as the roof and other parts of the structure. If leaf litter is allowed to gather in gutters, firebrands or embers can ignite the leaf litter, which in turn could ignite combustible eave materials or overhangs. If gutters are attached to combustible fascia boards, the fascia board should be considered as a possible fuel that can be ignited by fine fuels burning in the gutters.

Gutters that pose a fire threat from an approaching wildland fire are often pulled down by attending fire fighters. For the resident, an alternative might be to remove the gutters along the side(s) of the house most prone to the collection of leaves and needles and install a noncombustible drip line shown in Figure A.4.2.2.5. Removing gutters eliminates the collection of dry leaves and needles along the roof line and fascia board. Also reduced is the possibility of ice damage to the roof in the winter. The use of a gravel bed for drip lines along the leeward side(s) of the house provides reduced ignition potential and reduced wind hazard, since the gravel would be less likely to be blown by high winds on the leeward elevations. The windward sides of the house can be landscaped with mulch (less impact damage in case of wind events) if protected with low volume sprinklers to raise the fine fuel moisture levels in times of high fire danger.



FIGURE A.4.2.2.5 Mitigating Risk of Leaf- and Needle-Filled Gutters. *(Courtesy of Firewise Communities Program. Photo by G. Johnston.)*

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A.4.2.2.6 Eaves should be boxed to prevent flying embers from entering small spaces.

A.4.2.3.1 Identify the wall covering or siding (e.g., wood, vinyl, brick, stucco) and determine the possibility of litter buildup and accumulation on surfaces next to walls. Under low radiant heat levels, vinyl siding is damaged and falls off a wall, which can leave openings for firebrands exposing the interior of the home to ignition through eave vents and other possible openings. Vinyl is difficult to ignite by firebrands or radiant heat, but will sustain combustion when directly contacted by flames.

Hanging ½ in. (12.5 mm) or thicker drywall on the exterior wall studs prior to adding stucco, siding, and so forth can increase the fire rating.

A.4.2.3.3 Windows should be constructed of multi-paned or tempered glass that will resist fracture from intense heat in accordance with 5.6.1, and window screens made from a material that will not allow hot firebrands to enter the home's interior in accordance with 5.6.2.

A.4.2.3.4 Check attic, crawl space, eave, and soffit vents for appropriate protection (e.g., metal screening, noncombustible skirting) to prevent entry of firebrands. Roof turbine vents should be screened to prevent the entry of firebrands into attic spaces.

A.4.2.3.5 Examples of attached structures include decks, lean-to overhangs, patio covers, carports, balconies, fences, and similar structures that could be ignited by convection or firebrands.

A.4.2.3.6 Areas on, next to, or under a structure should be kept free of combustible fuel such as debris, vegetation, wooden furniture, brooms, welcome mats, furniture cushions, gasoline cans, firewood stacks, or piled construction materials. Look for combustible walkways, fencing, or decking attached to the structure, highly combustible fuels adjacent to the structure (e.g., junipers near decks and walkways), combustible materials (e.g., building materials, firewood) stored under decks or adjacent to the structure, animal nests among combustible structural fuels, and landscaping materials (e.g., bark mulch, ground cover plants) near the structure and surrounding plants that might support flaming combustion or that could easily be ignited by firebrands.

A.4.2.4 The structure ignition zone includes the spatially arranged traditional landscaping zones, but can exceed the extent of the property line. Figure A.4.2.4 illustrates the relationship of the structure and immediate landscaped area to the larger structure ignition zone. Within the immediate landscaped area [from the structure to approximately 30 ft (9 m)], often referred to as the defensible space, special consideration should be given that any combustible materials (e.g., plants, lawn furniture, litter, construction materials) should be removed or reduced to prevent their ignition, which in turn could ignite the structure. The total structure ignition zone includes any spatially arranged landscaping area and can exceed the extent of the property line. The level of risk of ignition within the total area of the ignition zone depends on the type of construction and is further influenced by slope, soils, and other site-specific conditions.

The AHJ should require the development of a landscape plan for the property. Such plans should address four zones around the property as follows:

(1) The most immediate landscaped area is the closest to the house and includes the area encircling the structure for at least 30 ft (9 m) on all sides. The landscaped vegetation within 30 ft (9 m) of structures should be irrigated as needed, cleared of dead vegetation, and/or planted with succulents and other plants (where appropriate) that are low in flammability potential. Plantings should be limited to carefully spaced, low-growing, low-flammability species, grasses, and lawns. Shrubs planted next to the structure should be of low flammability, no more than 18 in. (45 cm) in height, and not planted against the home. The planting bed should be noncombustible (e.g., stone, gravel, bare ground) or irrigated if combustible materials (e.g., bark mulch) are used.

All highly combustible plants, such as junipers and ornamental conifers, should be removed or trimmed and maintained to be ignition-resistant. Vegetation deposits (dry leaf and pine litter) that can support surface fire and flames should be removed regularly. Areas of vegetation (natural areas, undeveloped areas, landscaped areas, fields, etc.) that exist near the structure should be evaluated for the possibility of causing ignition of the structure.

(2) Progressing outward from the structure, the types and densities of vegetation should change to reduce the continuity of vegetation fuels. For example, plantings can be done in islands. Trees can be introduced into this zone with careful consideration of their flammability and continued maintenance to separate crowns and avoid ladder fuels. Tree placement should be planned so that the edge of the canopy of the tree when fully mature is no closer than 10 ft (3 m) to the edge of the structure.

(3) Progressing even farther from the structure, more medium-sized plants and well-spaced trees can be planted in well-spaced groupings to reduce exposure to wildland fire and help maintain privacy. The volume of vegetation (i.e., fuel) should be kept as low as possible or practical.

(4) The most distant area [100–200 ft (30–60 m)] from the structure determines the extent of the structure ignition zone. Plants in this furthermost area should be carefully pruned and thinned, and highly flammable vegetation removed. Particular attention should be paid to the types and densities of the vegetation in this area. For example, some vegetation and trees generate more firebrands than others and require additional thinning, removal, or replacement.

A.4.2.4.1 Vegetative fuels include live vegetation, mulch and landscaping materials, slash piles, composting piles, and firewood storage.

Flammable vegetation close enough to windows to provide intense radiant heat or flame contact should be pruned, moved, or substituted with smaller, lower flammability plants. Figure A.4.2.4.1(a) illustrates the use of low flammability plants separated by a gravel area next to the foundation.

Mulch is an alternative to noncombustible landscaping materials such as gravel and rock. The size and texture of mulching materials affects its ignition and fire spread potential. Larger organic materials are preferable to smaller materials.

Landscaping with mulch can be acceptable if the mulch is protected with low volume sprinklers to raise the fine fuel moisture levels and offset its combustibility in times of high fire danger. The installation of sprinklers for areas using mulch for landscaping is shown in Figure A.4.2.4.1(b).

Figure A.4.2.4.1(c) describes the physical similarities of the NFDRS fuel models with fire behavior fuel models. See Annex B for fuel model classifications.

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FIGURE A.4.2.4 The Structure Ignition Zone. *(Source: Firewise Communities Program.)*



FIGURE A.4.2.4.1(a) Foundation Planting and Landscaping. *(Courtesy of Firewise Communities Program. Photo by K. Clineff.)*



FIGURE A.4.2.4.1(b) Use of Low Volume Sprinklers in Organic Material. *(Courtesy of Firewise Communities Program. Photo by G. Johnston.)*

A.4.2.4.2 Typical heat and flame sources include, but are not limited to, propane heaters, barbecue cookers, and grills.

A.4.2.4.3 Attachments include, but are not limited to, permanent and temporary construction such as decks, fences, awnings, lean-to buildings; and flammable walkways, fencing, or decking attached to the home.

Figure A.4.2.4.3(a) shows a typical deck where combustible decking materials could result in the gathering of embers next to combustible walls and where the construction and design of decks, balconies, and porches with open spaces underneath could allow leaf and needle debris and embers to collect.

Figure A.4.2.4.3(b) illustrates one method of separating a combustible fence from the structure by the installation of a transitional section of noncombustible (iron) fencing. Similar use of masonry or stone can provide the same fire-resistant separation.

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Physical Description Similarity Chart of NFDRS and FBO Fuel Models

NFDRS Models Realigned to Fuels Controlling Spread Under Severe Burning Conditions

NFDRS Fuel Models	Fire Behavior Fuel Models													
	1	2	3	4	5	6	7	8	9	10	11	12	13	
A Western Annuals	X													Grass
L Western Perennial	X													
S Tundra	X					3rd			2nd					
C Open Pine with Grass		X							2nd					
T Sagebrush with Grass		X			3rd	2nd								
N Sawgrass			X											
B Mature Brush over 6 ft (1.8 m)				X										Shrub
O High Pocosin				X										
F Intermediate Brush					2nd	X								
Q Alaskan Black Spruce						X	2nd							
D Southern Rough						2nd	X							
H Short-Needle Closed (Normal Dead)								X						Timber
R Hardwood Litter (Summer)								X						
U Western Long-Needle Pine									X					
P Southern Long-Needle Pine									X					
E Hardwood Litter (Fall)									X					
G Short-Needle Closed (Heavy Dead)										X				
K Light Slash											X			Slash
J Medium Slash												X		
I Heavy Slash													X	
	Grass				Shrub			Timber			Slash			

FIGURE A.4.2.4.1(c) Sample of a Physical Description Similarity Chart of NFDRS and FBO Fuel Models.

A.4.2.4.4 Examples of such structures include, but are not limited to, hot tubs, utility sheds, outbuildings, detached garages and carports, gazebos, trellises, auxiliary structures, stables, barns and other structures within 30 ft (9 m) of the primary structure, outdoor furniture, and recreational structures (e.g., children's playhouses, swing sets). In some cases, separation distances from lot lines might require the inclusion of neighboring residential structures in the assessment.

A.4.2.4.5 Parking vehicles on areas of dry grasses and fine fuels could result in ignition by hot exhaust systems or firebrands. Also, a fire that originates from a parked vehicle could present an exposure hazard to the primary structure or nearby vegetation. Any dry vegetation beneath the vehicle could cause ignition of the vehicle, which in turn could cause structure ignition; conversely, the ignition of the structure could cause ignition of the vehicle, which could present additional dangers to responding fire fighters.

A.4.2.5.1 Evaluation of the vegetative fuels should include the following:

(1) Can vegetative fuels lead surface fire and flames to the structure?
(2) Have ladder fuels been eliminated within the structure ignition zone?
(3) Are tree crowns separated enough to prevent big flames from coming within 30 ft (9 m) of the structure?

A.4.2.5.2 The location (placement) of trees and the separation between them is important to prevent ignition of the structure from radiant heat and to reduce the concentration of leaf fall and needle drop near the structure. Adequate separation and control of ignition potential are factors that affect fire intensity and are dependent on the size, density, and species of trees and vegetation.

Consider using islands of trees that offer separation of trees from the structure and other combustibles. Figure A.4.2.5.2(a)

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FIGURE A.4.2.4.3(a) Leaf Litter and Needles Collect in Small Spaces. *(Courtesy of Firewise Communities Program.)*



FIGURE A.4.2.4.3(b) Transition Fence Separates Combustible Fence from Structure. *(Courtesy of Firewise Communities Program. Photo by G. Johnston.)*

llustrates the use of such planting islands that preserve key trees for aesthetics while providing shade and exposure separation from structures. Figure A.4.2.5.2(b) shows that small planting islands within an expanse of maintained lawn provides both separation and low flammability protection from ignition close the structure.

A.4.2.5.3 Typical heat and flame sources include, but are not limited to, propane- and charcoal-fired barbecue cookers, heaters, and grills.

A.4.2.5.4 Examples of such structures include, but are not limited to, hot tubs, utility sheds, outbuildings, detached garages and carports, gazebos, trellises, auxiliary structures,



FIGURE A.4.2.5.2(a) Planting Islands Offer Exposure Protection, Preserve Aesthetics. *(Courtesy of Firewise Communities Program. Photo by G. Johnston.)*



FIGURE A.4.2.5.2(b) Small Planting Islands Within an Expanse of Maintained Lawn. *(Courtesy of Firewise Communities Program. Photo by D. Frazier.)*

stables, barns and other structures between the immediate landscaped area and the extent of structure ignition zone, outdoor furniture, recreational structures (children's playhouses, swing sets). In some cases, separation distances from lot lines might require the inclusion of neighboring residential structures in the assessment.

A.4.2.5.5 See A.4.2.4.5.

A.4.2.5.6 Attachments include, but are not limited to, permanent and temporary construction such as decks, fences, awnings, and lean-to buildings.

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A.4.3.3 Access and evacuation concerns along with fire suppression capabilities (such as fire station location, water supply, road widths, and grades) are important to overall fire protection and safety. Likewise, vegetation clearance and maintenance along private roadways, driveways, and water supplies are important elements in fire suppression and emergency evacuation. Since these elements do not relate specifically to reducing the ignition potential of the structure, these are covered in NFPA 1141, *Standard for Fire Protection Infrastructure for Land Development in Suburban and Rural Areas*; NFPA 1142, *Standard on Water Supplies for Suburban and Rural Fire Fighting*; and 17.3.5.3 of NFPA 1, *Uniform Fire Code*.

A.4.3.4 The frequency of wildland fire occurrence will affect the priorities of the mitigation measures and the periodic maintenance schedule of the property being assessed.

A.4.3.5 NFPA 1141, *Standard for Fire Protection Infrastructure for Land Development in Suburban and Rural Areas*, provides guidance on planning and installing fire protection infrastructure.

A.5.1.3.1 The primary structure is that structure for which the property is being used, for example, a single family residence, multiple family residential units consisting of townhouses, apartment buildings, duplex units, commercial buildings, community and activity centers, municipal buildings, offices, farm and ranch structures, and other structures.

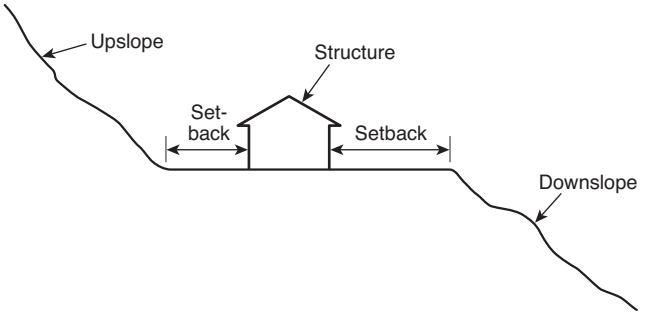

FIGURE A.5.1.3.2 Setback Measurement from the Structure to the Edge of the Predominant Slope.

A.5.1.3.2 Figure A.5.1.3.2 illustrates how setback is measured.

A.5.1.3.3 Noncombustible walls and barriers are effective for deflecting radiant heat and windblown embers from structures. These walls and barriers are usually constructed of noncombustible materials (concrete block, bricks, stone, stucco) or earth with emergency access openings built around a development where 30 ft (9 m) of defensible space is not available. These walls are usually 6 ft (1.8 m) tall, with openings provided every 200 ft (60 m) out into the undisturbed open space. Often there is some maintenance work required in the vegetation along the outside of the wall, so these openings also double as maintenance access points as well as emergency exits for fire fighters to escape through when they are working on wildland fires outside the walls in the open space zone. Figure A.5.1.3.3(a) and Figure A.5.1.3.3(b) illustrate the placement of these barriers on the upslope and the downslope near structures. Note that the area on the slope has had a fuel modification treatment that helps reduce the likelihood of fire, heat, and embers igniting the structure.



FIGURE A.5.1.3.3(a) Noncombustible Barrier on the Edge of a Downslope. *(Courtesy of Firewise Communities Program. Photo by J. Smalley.)*



FIGURE A.5.1.3.3(b) Noncombustible Barrier Behind a House on the Edge of the Upslope. *(Courtesy of Firewise Communities Program. Photo by J. Smalley.)*

Note that the drainage provisions shown in Figure A.5.1.3.3(b) prevent damage from storm water runoff and that storm drainage measures have been designed to direct runoff.

A.5.1.3.5 For more information, see NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*. Acceptable methods of fuel treatment include, but are not limited to, prescribed burning by qualified personnel, mowing, pruning, removing, substitution, mulching, converting to compost, and grazing.

A.5.2 Roof covering assemblies are tested for the following three levels of fire exposure:

(1) Severe (Class A)
(2) Moderate (Class B)
(3) Light (Class C)

The following descriptions of the expected performance of roofs meeting those classifications is based on NFPA 256, *Standard Methods of Fire Tests of Roof Coverings*:

(1) Class A tests are applicable to roof coverings that are effective against severe test exposure, that afford a high degree of fire protection to the roof deck, that do not slip from position, and that do not present a flying brand hazard.

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(2) Class B tests are applicable to roof coverings that are effective against moderate test exposure, that afford a moderate degree of fire protection to the roof deck, that do not slip from position, and that do not present a flying brand hazard.
(3) Class C tests are applicable to roof coverings that are effective against light test exposure, that afford a light degree of fire protection to the roof deck, that do not slip from position, and that do not present a flying brand hazard.

It is important to realize that the roofs are installed in a very specific manner for testing. For this reason, the class ratings should be thought of as roof covering assembly tests. In other words, in order to meet the standard at which it is rated, a roof covering material should be installed in the same manner as is described in its listing.

A.5.2.7 The design of ventilation of enclosed roof spaces can be found in the ASHRAE *Handbook of Fundamentals*. Traditional methods of ventilating the roofs of buildings include criteria for ventilated attics using the following:

(1) Cross-ventilation should be provided for each separate space by openings protected against the entrance of rain and snow. For roof decks with a minimum slope of 2:12, ventilation to the underside of the roof deck should be provided at both a low point (soffit) and high point (ridge or gable end) of the roof.
(2) The total net area of ventilation should be at least 1/150 of the roof area, projected on a horizontal plane. The minimum required net free ventilating area is permitted to be reduced to 1/300 of the roof area of the space ventilated, provided that a vapor retarder having a transmission rate not exceeding 1 perm in accordance with ASTM E 96M, *Standard Test Methods for Water Vapor Transmission of Materials*, is installed on the warm side of the attic insulation and provided that 50 percent of the required ventilating area is provided by ventilators located in the upper portion of the space to be ventilated at least 36 in. (915 mm) above eave or cornice vents, with the balance of the required ventilation provided by eave or cornice vents.
(3) A minimum of 1 in. (25 mm) of air space should be provided between insulation and roof sheathing where the insulation is located at the plane of the ceiling.
(4) Blocking and bridging should be arranged so as not to interfere with the movement of air.

A.5.5.4 Areas that encourage the collection of combustibles include window wells, inside corners of exterior walls and other nooks and crannies where dry leaves, pine needles, and other combustible litter can gather and whose ignition would present a source of flame exposure to the structure. Similar areas include storage areas for lumber, deck furniture, brooms, and such that are open to the outside.

A.5.6.1 Dual pane windows satisfy this requirement.

A.5.6.5 Vents can also pose a potential fire hazard when exposed to nearby steep slopes due to firebrand showers.

A.5.6.6 Vents also pose a potential fire hazard when exposed to nearby steep slopes due to firebrand showers.

A.5.8 Accessory structures include, but are not limited to, outbuildings, patio covers, gazebos, palapas, and similar outdoor structures.

A.5.11.1 Unprotected heat and flame sources include, but are not limited to, open burning without spark protection, barbecue pits, clay or stone fireplaces, and fire pits. Supervision of burning includes the presence of a source of water or other extinguishing equipment.

A.6.1 A minimum distance for fuel modification should be 30 ft (9 m) from structures. However, in those cases in which property boundaries limit the distance or involve overlapping ignition zones, collaborative efforts between property owners could be necessary to achieve the proper fuel modification.

A.6.2.1 Acceptable methods of fuel treatment include, but are not limited to, prescribed burning by qualified personnel, mowing, pruning, removing, substitution, mulching, converting to compost, and grazing.

Vegetation. Fire resistance in plants depends on many variables, including location, growing conditions, and maintenance. Plants should be chosen that are suitable for the geographic region and the location in the landscape, and plants with similar needs should be grouped to minimize care. Plant characteristics that reduce maintenance needs include the following:

(1) Drought-resistant
(2) Pest-resistant
(3) Native
(4) Noninvasive
(5) Slow-growing
(6) Wind-resistant
(7) Thriving without supplemental fertilizing

High Flammability (fire-prone, fire-tolerant) Plants. Some plants burn readily because they are adapted to survive in fire-dependent ecosystems and can contain volatile compounds that support fire. Fire-prone plants have traits (i.e., adaptations) that help them to survive fire, such as thick bark or extensive roots. They often contain resins, oils, or waxes that ignite easily and burn intensely. Fire-prone plants will flame, not smolder, when preheated and ignited with a match. They should be removed from Zone 1 of the landscape, as illustrated in Figure A.4.2.4, Figure A.4.2.5.2(a), and Figure A.4.2.5.2(b). Where it is not practical or desirable to remove a fire-prone plant, surrounding it with open space or fire-resistant plants can reduce the hazard. Typical characteristics of fire-prone plants include the following:

(1) Volatile resins, oils, or waxes, indicated by leaves that are aromatic when crushed
(2) Narrow leaves or needles (often evergreen)
(3) Waxy or fuzzy leaves
(4) Accumulation of fine, twiggy, dry, or dead material on the plant or on the ground under the plant
(5) Loose, papery, or thick bark

Low Flammability Plants. In place of fire-prone plants, landscapers and homeowners should use low flammability plants, often referred to as fire-resistant plants. Although all plants will burn at some point, wildland fire researchers have shown that some types of plants, including many native plants, resist burning more than others. Additionally, some ornamental plants, when properly irrigated and maintained, are more resistant to fire than others. Low flammability plants are typically low fuel volume, non-oily, nonresinous plants that are also drought-resistant, have small thick leathery leaves, and produce very little dead plant material. Typical characteristics of fire-resistant plants include the following:

(1) High moisture content in leaves

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(2) Low oil or resin content (not aromatic)
(3) Drought tolerance or drought resistance
(4) Minimal seasonal accumulation of dead vegetation, or accumulation of dead leaves that are somewhat resistant to fire because they hold moisture in the soil (large, flat leaves)
(5) Limited foliage and few dead branches
(6) Open or loose branching habit
(7) Easy maintenance and pruning

A.6.2.5 Studies of structural ignition from radiant heat indicate that ignitions are unlikely to occur from burning vegetation beyond 120 ft (36.6 m) from a structure. Therefore, clearing of vegetation and thinning of trees to a distance of 120 ft (36.6 m) from a dwelling — as in a zoned Firewise landscape — will prevent ignition of a structure from the radiant heat from a flame front in a high-risk ecosystem (Cohen and Butler, 1996).

A tree crown spacing of 18 ft (5.5 m) for trees within the Zone 1 defensible space [within 30 ft (9 m) of a structure] will reduce radiant heat to at or below the level where ignition of wood occurs, with closer spacing of trees allowed in the zones further from the structure, as described in Table A.6.2.5. These tree-spacing recommendations apply equally to thinning of mature trees or planting of new trees in high- or extreme-risk areas. Tree spacing is measured between the outer edges of the crowns of mature trees, so new trees must be planted with spacing equivalent to the estimated diameter of the mature crown.

Table A.6.2.5 Recommended Tree Crown Spacing to Prevent Structural Ignition from Wildland Fire Radiant Heat

Zone	Distance from Structure	Recommended Tree Crown Spacing
1	0–30 ft (0–9 m)	18 ft (5.5 m)
2	30–60 ft (9–18 m)	12 ft (3.7 m)
3	60–100 ft (18–30 m)	6 ft (1.8 m)
4	Beyond 100 ft (30 m)	No restrictions

Table A.6.2.5 illustrates general clearance distances for tree crowns. However, these distances can be adjusted by the AHJ in consideration of species of trees and understory vegetation, slope of the property, the proximity to other neighboring structures, overlapping ignition zones, and other site-specific factors.

Annex B Fuel Model Classifications

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

The following annex sections B.1 and B.2 are excerpts from PMS 932/NFES 2665, *Gaining an Understanding of the National Fire Danger Rating System (NFDRS),* July 2002, a publication of the National Wildfire Coordinating Group (NWCG).

B.1 General. The fuel model keys that follow are only general descriptions because they represent all wildland fire fuels from Florida to Alaska and from the East Coast to California.

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

b. The understory seldom burns: MODEL H.

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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 type.

A. The foliage is still attached; there has been little settling.

1. The loading is 25 tons/acre (56 metric tons/hectare) or greater: MODEL I.

2. The loading is less than 25 tons/acre (56 metric tons/hectare), but more than 15 tons/acre (33.6 metric tons/hectare): MODEL J.

3. The loading is less than 15 tons/acre (33.6 metric tons/hectare): 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 metric tons/hectare) or greater: MODEL J.

2. The loading is less than 25 tons/acre (56 metric tons/hectare): MODEL K.

B.2 Narrative Fuel Model Descriptions.

B.2.1 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 one-third of the area. Examples of types where Fuel Model A should be used are cheatgrass and medusahead. Open pinyon-juniper, sagebrush-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.

B.2.2 Fuel Model B. Mature, dense fields of brush 6 ft (1.8 m) or more in height is 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.

B.2.3 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. Types covered by Fuel Model C are open, longleaf, slash, ponderosa, Jeffery, and sugar pine stands. Some pinyon-juniper stands may qualify.

B.2.4 Fuel Model D. This fuel model is specifically for the palmetto-gallberry understory-pine 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 the high moisture of extinction associated with it.

B.2.5 Fuel Model E. Use this model after fall leaf fall for hardwood and mixed hardwood-conifer types where the hardwoods dominate. The fuel is primarily hardwood leaf litter. Fuel Model E best represents the oak-hickory types and is an acceptable choice for northern hardwoods and mixed forests of the Southeast. In high winds, the fire danger can be underrated because rolling and blowing leaves are not accounted for. In the summer after the trees have leafed out, Fuel Model R should replace Fuel Model E.

B.2.6 Fuel Model F. Fuel Model F represents mature closed chamise stands and oak brush 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 ground fuels are sparse.

B.2.7 Fuel Model G. Fuel Model G is used for dense conifer stands where there is a heavy accumulation of litter and down woody material. Such stands are typically overmature and can also be suffering insect, disease, and 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 to be represented by Fuel Model G are hemlock-Sitka spruce, coastal Douglas fir, and wind-thrown or bug-killed stands of lodgepole pine and spruce.

B.2.8 Fuel Model H. The short-needled 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 the H fuels are typically slow-spreading and are dangerous only in scattered areas where the downed woody material is concentrated.

B.2.9 Fuel Model I. Fuel Model I was designed for clear-cut conifer slash where the total loading of materials less than 6 in. (15 cm) in diameter exceeds 25 tons/acre (56 metric tons/hectare). 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.

B.2.10 Fuel Model J. This model complements Fuel Model I. It is for clear-cuts and heavily thinned conifer stands where the total loading of material less than 6 in. (15 cm) in diameter is less than 25 tons/acre (56 metric tons/hectare). Again, as the slash ages, the fire potential will be overrated.

B.2.11 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 overstory. This model applies to hardwood slash and to Southern pine clear-cuts where loading of all fuels is less than 15 tons/acre (33.6 metric tons/hectare).

B.2.12 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 in Model A fuels. Otherwise the situations are very similar; shrubs and trees occupy less than one-third of the area. The quantity of fuels in these areas is more stable from year to year. In sagebrush areas, Fuel Model T might be more appropriate.

B.2.12.1 There is no Fuel Model M.

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B.2.13 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 over standing water.

B.2.14 Fuel Model O. The O fuel model applies to dense, brush-like fuels of the Southeast. In contrast to B fuels, O fuels are almost entirely living except for a deep litter layer. The foliage burns readily except during the active growing season. The plants are typically over 6 ft (1.8 m) tall and are often found under open stands 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 (1.8 m) criteria in those areas, Fuel Model D should be used.

B.2.15 Fuel Model P. Closed, thrifty stands of long-needled Southern pines are characteristic of P fuels. A 2–4 in. (5–10 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. Model P has the high moisture of extinction characteristic of the Southeast. The corresponding model for other long-needled pines is H.

B.2.16 Fuel Model Q. Upland Alaska 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 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. Users should be alert to such events and note those levels of SC and BI when crowning occurs.

B.2.17 Fuel Model R. This fuel model represents hardwood areas after the canopies leaf out in the spring. It is provided as the off-season substitute for Fuel Model 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.

B.2.18 Fuel Model S. Alaskan and alpine tundra on relatively well-drained sites fit this 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.

B.2.19 Fuel Model T. The 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 of the Southeast.

B.2.20 Fuel Model U. This fuel model represents the closed stands of Western long-needled pines. The ground fuels are primarily litter and small branchwood. Grass and shrubs are precluded by the dense canopy but might occur in the occasional natural opening. Fuel Model U should be used for ponderosa, Jeffery, and sugar pine stands of the West and red pine stands of the Lake States. Fuel Model P is the corresponding model for Southern pine plantations.

Annex C Type IV (2HH) Construction

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

C.1 Type IV (2HH) Construction. [***5000:***7.2.5]

C.1.1 Type IV Construction. Type IV (2HH) construction shall be that type in which fire walls, exterior walls, and interior bearing walls and structural elements that are portions of such walls are of approved noncombustible or limited-combustible materials. Other interior structural elements, arches, floors, and roofs shall be of solid or laminated wood without concealed spaces and shall comply with the allowable dimensions of 7.2.5.5. [***5000:***7.2.5.1]

C.1.2 Exterior Wall Separation. Exterior walls greater than 30 ft (9100 mm) from the property line shall be permitted to be of heavy timber construction, provided that the 2-hour rating as required by Table 7.2.1.1 is maintained and such walls contain no combustible concealed spaces. [***5000:***7.2.5.2]

C.1.3 Interior Columns, Arches, Beams, Girders, and Trusses. Interior columns, arches, beams, girders, and trusses of approved materials other than wood shall be permitted, provided that they are protected to provide a fire resistance rating of not less than 1 hour. [***5000:***7.2.5.3]

C.1.4 Concealed Space. Certain concealed spaces shall be permitted in accordance with 7.2.5.5.3.4. [***5000:***7.2.5.4]

C.1.5 Type IV (2HH) Allowable Dimensions. All dimensions in 7.2.5.5 shall be considered nominal. [***5000:***7.2.5.5]

C.1.5.1 Columns. [***5000:***7.2.5.5.1]

C.1.5.1.1 Wood columns supporting floor loads shall be not less than 8 in. (200 mm) in any dimension. [***5000:***7.2.5.5.1.1]

C.1.5.1.2 Wood columns supporting only roof loads shall be not less than 6 in. (150 mm) in width and not less than 8 in. (200 mm) in depth. [***5000:***7.2.5.5.1.2]

C.1.5.2 Beams. [***5000:***7.2.5.5.2]

C.1.5.2.1 Wood beams and girders supporting floor loads shall be not less than 6 in. (150 mm) in width and not less than 10 in. (250 mm) in depth. [***5000:***7.2.5.5.2.1]

C.1.5.2.2 Wood beams and girders and other roof framing supporting roof loads only shall be not less than 4 in. (100 mm) in width and not less than 6 in. (150 mm) in depth. [***5000:***7.2.5.5.2.2]

C.1.5.3 Arches. [***5000:***7.2.5.5.3]

C.1.5.3.1 Framed or glued laminated arches that spring from grade or the floor line, and timber trusses that support floor loads, shall be not less than 8 in. (200 mm) in width or depth. [***5000:***7.2.5.5.3.1]

C.1.5.3.2 Framed or glued laminated arches for roof construction that spring from grade or the floor line and do not support floor loads shall have members not less than 6 in. (150 mm) in width and not less than 8 in. (200 mm) in depth for the lower half of the member height and not less than 6 in. (150 mm) in depth for the upper half of the member height. [***5000:***7.2.5.5.3.2]

C.1.5.3.3 Framed or glued laminated arches for roof construction that spring from the top of walls or wall abutments, and timber trusses that do not support floor loads, shall have

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members not less than 4 in. (100 mm) in width and not less than 6 in. (150 mm) in depth. [***5000:***7.2.5.5.3.3]

C.1.5.3.4 Spaced members shall be permitted to be composed of two or more pieces not less than 3 in. (75 mm) in thickness where blocked solidly throughout their intervening spaces or where such spaces are tightly closed by a continuous wood cover plate not less than 2 in. (50 mm) in thickness that is secured to the underside of the members. [***5000:***7.2.5.5.3.4]

C.1.5.4 Splice Plates. Splice plates shall be not less than 3 in. (75 mm) in thickness. [***5000:***7.2.5.5.4]

C.1.5.5 Floors. Floors shall be constructed of spline or tongue-and-groove plank not less than 3 in. (75 mm) in thickness that is covered with 1 in. (25 mm) tongue-and-groove flooring, laid crosswise or diagonally to the plank, or with ½ in. (13 mm) wood structural panel; or they shall be constructed of laminated planks not less than 4 in. (100 mm) in width, set close together on edge, spiked at intervals of 18 in. (460 mm), and covered with 1 in. (25 mm) tongue-and-groove flooring, laid crosswise or diagonally to the plank, or with ½ in. (13 mm) wood structural panel. [***5000:***7.2.5.5.5]

C.1.5.6 Roof Decks. Roof decks shall be constructed of spline or tongue-and-groove plank not less than 2 in. (50 mm) in thickness; or of laminated planks not less than 3 in. (75 mm) in width, set close together on edge, and laid as required for floors; or of 1⅛ in. (29 mm) thick interior wood structural panel (exterior glue); or of approved noncombustible or limited-combustible materials of equivalent fire durability. [***5000:***7.2.5.5.6]

C.1.6 Special Requirements — Type IV Construction. The special requirements in 7.2.5.6.1 through 7.2.5.6.8 shall apply to Type IV construction. [***5000:***7.2.5.6]

C.1.6.1 Structural Elements. Structural elements shall be of heavy timber members (sawn or glued-laminated) or of fire resistance rated construction as set forth in Table 7.2.1.1 when materials other than heavy timber are used. [***5000:***7.2.5.6.1]

C.1.6.2 Columns, Arches, Beams, and Roof Decking. Where horizontal separation of 20 ft (6100 mm) or more is provided, wood columns, arches, beams, and roof decking conforming to the requirements for heavy timber in 7.2.5.5 shall be permitted to be used on the exterior of the building. [***5000:***7.2.5.6.2]

C.1.6.3 Partitions. Permanent partitions shall be permitted to be of solid wood construction formed by not less than two layers of matched boards of 1 in. (25 mm) nominal thickness or of 1-hour fire resistance–rated construction as set forth in Table 7.2.1.1. [***5000:***7.2.5.6.3]

C.1.6.4 Floors. Floors shall be permitted to be of heavy timber, masonry, concrete, wood, or steel and shall be constructed as required in Chapter 8 of *NFPA 5000*. [***5000:***7.2.5.6.4]

C.1.6.5 Roofs. Roofs of 1-hour fire resistance–rated construction shall be permitted. [***5000:***7.2.5.6.5]

C.1.6.6 Stairways. [***5000:***7.2.5.6.6]

C.1.6.6.1 Stairways shall be permitted to be constructed with wood treads and risers of not less than 2 in. (50 mm) nominal thickness. [***5000:***7.2.5.6.6.1]

C.1.6.6.2 Where built-on, laminated, or plank inclines are required for floors, stairways shall be permitted to be 1 in. (25 mm) nominal thickness or shall be permitted to be constructed as required for buildings of Type I or Type II construction. [***5000:***7.2.5.6.6.2]

C.1.6.7 Exterior Walls. Approved fire-retardant-treated wood framing shall be permitted within the assembly of exterior walls having a required fire resistance rating of 2 hours or less and a horizontal separation of not less than 60 in. (1525 mm), provided that the fire resistance rating is maintained and the exposed outer and inner faces of such walls are constructed of limited-combustible or noncombustible materials. [***5000:***7.2.5.6.7]

C.1.6.8 Exterior Nonbearing Walls. Exterior nonbearing walls tested in accordance with, and meeting the conditions of acceptance of, NFPA 285, *Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components*, shall be permitted. [***5000:***7.2.5.6.8]

Annex D Informational References

D.1 Referenced Publications. The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

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

NFPA 1, *Uniform Fire Code*™, 2006 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2007 edition.

NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, 2007 edition.

NFPA 13R, *Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height*, 2007 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, 2004 edition.

NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, 2006 edition.

NFPA 256, *Standard Methods of Fire Tests of Roof Coverings*, 2003 edition.

NFPA 285, *Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components*, 2006 edition.

NFPA 1051, *Standard for Wildland Fire Fighter Professional Qualifications*, 2007 edition.

NFPA 1141, *Standard for Fire Protection Infrastructure for Land Development in Suburban and Rural Areas*, 2008 edition.

NFPA 1142, *Standard on Water Supplies for Suburban and Rural Fire Fighting*, 2007 edition.

NFPA 5000®, *Building Construction and Safety Code*®, 2006 edition.

Assessing Wildfire Hazards in the Home Ignition Zone, Student Workbook, Firewise Communities, National Wildland/Urban Interface Fire Program, 2006. www.firewise.org

D.1.2 Other Publications.

D.1.2.1 ASHRAE Publications. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 1791 Tullie Circle, NE, Atlanta, GA 30329–2305.

Handbook of Fundamentals.

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D.1.2.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2007.

ASTM E 96M, *Standard Test Methods for Water Vapor Transmission of Materials*, 2005.

D.1.2.3 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 723, *Test for Surface Burning Characteristics of Building Materials*, 2003.

D.1.2.4 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Anderson, H. E. 1982. "Aids to Determining Fuel Models for Estimating Fire Behavior." General Technical Report INT-122, U.S. Department of Agriculture, USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.

Cohen, J. D. and B. W. Butler. 1996. "Modeling Potential Structure Ignitions from Flame Radiation Exposure with Implications for Wildland/Urban Interface Fire Management." Intermountain Fire Sciences Laboratory, USDA Forest Service, Intermountain Research Station, Missoula, MT.

"National Fire Danger Rating System (NFDRS)." General Technical Report INT-39. USDA Forest Service, U.S. Department of Agriculture, revised edition 1988.

PMS 932/NFES 2665, *Gaining an Understanding of the National Fire Danger Rating System (NFDRS)*, National Wildfire Coordinating Group, July 2002.

D.2 Informational References. The following documents or portions thereof are listed here as informational resources only. They are not a part of the requirements of this document.

D.2.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

Fire Hazard Assessment in the Wildland/Urban Interface, Firewise Communities, National Wildland/Urban Interface Fire Program, 1997. www.firewise.org

Firewise Construction Checklist, Firewise Communities, National Wildland/Urban Interface Fire Program, 2003. www.firewise.org

Firewise Landscaping Checklist, Firewise Communities, National Wildland/Urban Interface Fire Program, 2003. www.firewise.org

Protecting Life and Property from Wildfire, Smalley, J., Ed., 2005.

D.2.2 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Cohen, J. D. and B. W. Butler. 1996. "Modeling Potential Structure Ignitions from Flame Radiation Exposure with Implications for Wildland/Urban Interface Fire Management." Missoula, MT: Intermountain Fire Sciences Laboratory, USDA Forest Service, Intermountain Research Station.

Cohen, J. P. 1991. "A Site-Specific Approach for Assessing the Fire Risk to Structures at the Wildland/Urban Interface." Missoula Fire Sciences Lab, Missoula, MT. www.firelab.org.

Cohen, J. P. "An Examination of the Summerhaven, Arizona Home Destruction Related to the Local Wildland Fire Behavior during the June 2003 Aspen Fire." Missoula Fire Sciences Lab, Missoula, MT. www.firelab.org.

Cohen, J. P. and J. Saveland. 1998. "Structure Ignition Assessment Can Help Reduce Fire Damages in the W-UI." USDA Forest Service, *Fire Management Notes*, 57(4) pp 19-23.

Moore, H. E. 1979. "Protecting Residences from Wildfires: A Guide for Homeowners, Lawmakers and Planners." General Technical Report PSW-50, U. S. Department of Agriculture, USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Albany, CA.

PMS 205, *Glossary of Wildland Fire Terminology*, National Wildfire Coordinating Group, October 2006.

PMS 410–1/NFES 0065, *Fireline Handbook*, National Interagency Fire Center, Boise, ID.

D.2.3 Other Publications.

Planning for Wildfires (PAS 529/530), American Planning Association, Chicago, IL, 2005.

Teie, W. C. *Firefighter's Handbook on Wildland Fire Fighting*, Deer Valley Press, Rescue, CA, 1994.

Teie, W. C. *Fire Officers Handbook on Wildland Fire Fighting*, Deer Valley Press, Rescue, CA, 1997.

D.2.4 Web Sites.

www.firewise.org: This web site is supported through the National Wildland/Urban Interface Fire Program, sponsored by a multi-agency, public–private partnership. It contains information on living more safely in the wildland/urban interface for fire officials and homeowners, presented through interactive guides, publications, and streaming video formats. The site features Firewise Communities activities (e.g., regional workshops, training materials, state-by-state lists of available materials, and resources for planning). Links to other related sites are also provided.

www.nwcg.gov: This web site supports the activities of the National Wildfire Coordinating Group. The purpose of NWCG is to provide an operational group designed to coordinate programs of the participating federal and state wildland fire management agencies, both to avoid wasteful duplication and to provide a means of constructively working together. Its goal is to provide more effective execution of each agency's fire management program. Information on the activities of the NWCG and its Working Teams is available.

www.firelab.org: This web site supports the Fire Sciences Lab (FiSL), an arm of the Rocky Mountain Research Station located in Missoula, MT, which is home to the Fire Behavior Project, the Fire Chemistry Project, the Fire Ecology/Fuels Project, and LANDFIRE. The staffs of these projects perform a variety of research on fire-related issues and topics. There is no central telephone number for the lab; each project's numbers are listed on its individual home page.

D.3 References for Extracts in Informational Sections.

NFPA 5000®, *Building Construction and Safety Code®*, 2006 edition.

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Access 4.3.5, A.4.3.3, A.4.3.5
Accessory structures
Construction 5.8, A.5.8
Definition 3.3.1
Separation distances 5.1.3.1, 5.8, A.5.1.3.1, A.5.8
Structure assessment, documentation in ... 4.2.1.3, 4.2.3.5, 4.2.4.4, 4.2.5.4, A.4.2.1.3, A.4.2.3.5, A.4.2.4.4, A.4.2.5.4
Alternative (definition) 3.3.2
Application of standard 1.3
Approved (definition) 3.2.1, A.3.2.1
Arches, Type IV (2HH) construction C.1.1, C.1.3, C.1.5.3, C.1.6.2
Attic ventilation ..... 5.2.5 to 5.2.7, 5.6.4, 5.6.5, A.4.2.3.4, A.5.2.7, A.5.6.5
Authority having jurisdiction (definition) 3.2.2, A.3.2.2

-B-

Barbecue cookers or pits 5.11.2, 5.11.3, A.4.2.4.2, A.4.2.5.3, A.5.11.1
Beams, Type IV (2HH) construction C.1.3, C.1.5.2, C.1.6.2
Big flames ..... A.4.2(1)
Building .....*see also* Structure
Definition 3.3.3
Overhanging 5.4
Building construction .....*see also* Building location; Heavy timber construction; Roofing design, materials, and construction; Vehicle parking areas
Accessory structures 5.8, A.5.8
Chimneys and flues 5.7
Debris, treatment or removal of 5.1.3.5, A.5.1.3.5
Documents 5.1.2
Exterior exposure hazards 5.11
Exterior openings 5.6, A.5.6.1, A.5.6.5
Exterior vertical walls 5.5, A.5.5.4
General 5.1.1
Mobile and manufactured homes 5.9
Overhanging buildings 5.4
Overhanging projections 5.3
Permits 4.4.2
Type IV (2HH) construction ..... Annex C
Building design ..... 5.1.1.1, 5.1.1.2; *see also* Building construction; Building location; Roofing design, materials, and construction
Building location ..... 5.1.1.1, 5.1.1.2, 5.1.3, A.5.1.3.1 to A.5.1.3.5
Burning, supervision of A.5.11.1

-C-

Charcoal-fired barbecues and grills 5.11.2, 5.11.3, A.4.2.4.2, A.4.2.5.3
Chimneys
Natural 4.2.1.1, A.4.2.1.1
Structure 5.7
Columns, Type IV (2HH) construction C.1.3, C.1.5.1, C.1.6.2
Combustible (materials)
Areas next to or under structure, assessment of 4.2.3.6, 5.5.4, A.4.2.3.6, A.5.5.4
Definition 3.3.4
Concealed spaces, Type IV (2HH) construction C.1.4
Connectors 4.2.2.5, 4.2.3.2, A.4.2.2.5
Construction .....*see* Building construction

-D-

Decks
Attached to home A.4.2.4.3, A.4.2.5.6
Roof decks 4.2.2.4, 5.2.4, A.4.2.2.4, C.1.5.6, C.1.6.2
Definitions ..... Chap. 3
Doors, exterior 5.6.3
Downspouts 4.2.2.5, 4.2.3.2, A.4.2.2.5
Dwelling (definition) 3.3.5

-E-

Eaves ..... 4.2.2, 5.2.3, 5.2.6, A.4.2.2.1 to A.4.2.2.6
Embers .....*see* Firebrands (embers)
Equivalency to standard 1.4, A.1.4.1
Evacuation ..... A.1.2.1, A.4.3.3; *see also* Structure assessment
Definition 3.3.6
Exterior exposure hazards 5.11
Exterior openings 5.6, A.5.6.1, A.5.6.5
Exterior walls and siding 5.5, A.5.5.4
Noncombustible 5.1.3.3, A.5.1.3.3
Structure assessment, documentation in ..... 4.2.3, A.4.2.3.1 to A.4.2.3.6
Type IV (2HH) construction C.1.2, C.1.6.7, C.1.6.8
Extinguishing equipment A.5.11.1

-F-

Fences A.4.2.4.3, A.4.2.5.6
Fire behavior fuel models A.4.2.4.1
Firebrands (embers) ..... A.4.2(3), A.4.2.1.3, A.5.1.3.3
Attachments, collection under or next to A.4.2.4.3
Exterior wall, entry through ..... A.4.2.3.1 to A.4.2.3.6
Roofs, intrusion into ..... A.4.2.2.1 to A.4.2.2.6
Vehicle parking, ignition by A.4.2.4.5
Vents subject to firebrand showers A.5.6.5
Fire extinguishing equipment A.5.11.1
Fire hazard .....*see also* Mitigation; Structure assessment
Definition 3.3.7
Wildland fire hazard severity map 4.3.6, 4.3.7
Fireplaces
Chimneys 5.7
Outdoor 5.11.2, 5.11.3, A.5.11.1
Fire protection infrastructure A.4.3.5
Fire-rated assembly
Exterior walls 5.5.1
Overhanging buildings 5.4
Overhanging projections 5.3
Fire resistive
Definition 3.3.8
Doors 5.6.3
Exterior walls 5.5.3
Mobile and manufactured homes, skirts for 5.9.1
Roofing A.4.2.2.1, A.4.2.2.2
Type IV (2HH) construction C.1.2, C.1.3
Windows 5.6.1, A.5.6.1
Fire-retardant-treated wood
Exterior walls 5.5.1
Overhanging buildings 5.4
Overhanging projections 5.3
Roofing materials A.4.2.2.1
Firestops 5.2.4
Floors
Subfloor ventilation 5.6.4, 5.6.5

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Type IV (2HH) construction C.1.5.1.1, C.1.5.3.1, C.1.5.4, C.1.6.4
Flues 5.7
Foundation planting 4.2.4.1, A.4.2.4.1
Foundation ventilation 5.2.5
Fuel model classifications ..... Annex B
Fuel modification (definition) 3.3.9
Fuel modification area ..... Chap. 6, A.5.1.3.3
Fuels (definition) ..... 3.3.10, A.3.3.10; *see also* Structure; Vegetation

-G-

Girders .....*See* Beams, Type IV (2HH) construction
Grills 5.11.2, 5.11.3, A.4.2.4.2, A.4.2.5.3
Ground fuels ..... 6.2.1, A.6.2.1, Annex B; *See also* Vegetation
Definition 3.3.11
Gutters 4.2.2.4, 4.2.2.5, 4.2.3.2, A.4.2.2.4, A.4.2.2.5

-H-

Heat and flame sources 4.2.4.2, 4.2.5.3, 5.11, A.4.2, A.4.2.5.3, A.5.11.1
Heaters A.4.2.4.2, A.4.2.5.3
Heavy timber construction C.1.6.1
Definition 3.3.14, A.3.3.14
Exterior walls C.1.2
Overhanging buildings 5.4
Overhanging projections 5.3
History of wildland fire in area, consideration of 4.3.4, A.4.3.4

-I-

Ignition-resistant material
Definition 3.3.12, A.3.3.12
Exterior walls 5.5.1
Overhanging buildings 5.4
Overhanging projections 5.3
Ignition sources .....*see* Heat and flame sources
Immediate landscaped area
Definition 3.3.13, A.3.3.13
Structural assessment of 4.2.4, A.4.2.4
Improved property
Definition 3.3.15
Structure ignition zones, wildland fire hazard assessment in 4.1.1, A.4.1.1
Incinerators 5.11.2, 5.11.3

-L-

Ladder fuels A.4.2.5.1
Landscaped area, immediate .....*see* Immediate landscaped area
Landscape plan A.4.2.4
Lawns A.4.2.5.2
Listed (definition) 3.2.3, A.3.2.3

-M-

Maintenance
In fuel modification plan 6.2.6
Plant characteristics reducing maintenance needs A.6.2.1
Of vegetation outside noncombustible wall A.5.1.3.3
Vehicle parking areas 5.10
Manufactured homes 5.9
Maps
Vicinity map 5.1.2.2
Wildland fire hazard severity map 4.3.6, 4.3.7
Mitigation
Definition 3.3.16
Implementation and enforcement 4.4
Plan
Compliance with 4.4.1
Development of ..... 4.3, A.4.3.3 to A.4.3.5
Exterior exposure hazards 5.11.4, 5.11.5
Fuel modification area, establishment of ..... Chap. 6
Schedule 4.3.1, 4.3.3, 4.4.1, A.4.3.3
Structural assessment to determine methods of ..... 4.1.1 to 4.1.3, A.4.1.1
Mobile homes 5.9
Mulch, landscaping with A.4.2.4.1, A.6.2.1

-N-

National Fire Danger Rating System (NFDRS) fuel models A.4.2.4.1
Neighboring properties
Collaborative fuel modification by A.6.1
Documentation of ... 4.2.1.4, A.4.2.1.4, A.4.2.4, A.4.2.4.4, A.4.2.5.4
Vegetation mitigation, limitations on A.4.2.1.1
Noncombustible (material)
Definition 3.3.17
Doors 5.6.3
Landscaping A.4.2.4.1
Mobile and manufactured homes, skirts for 5.9.1
Overhanging buildings 5.4
Overhanging projections 5.3
Type IV (2HH) construction C.1.1
Walls or barriers 5.1.3.3, A.5.1.3.3

-O-

Occupancy (definition) 3.3.18
Occupancy permits 4.4.3
Openings
Exterior 5.6, A.5.6.1, A.5.6.5
Ventilation 4.2.3.4, 5.2.5, 5.2.6, A.4.2.3.4
Outdoor fireplaces 5.11.2, 5.11.3, A.5.11.1
Overhanging projections ..... 5.2.6, 5.3, 5.5.2; *see also* Eaves

-P-

Partitions, Type IV (2HH) construction C.1.6.3
Permits
Construction 4.4.2
Occupancy 4.4.3
Prescribed burning A.6.2.1
Projections from structures ... 4.2.4.3, 4.2.5.6, A.4.2.4.3, A.4.2.5.6; *see also* Decks
From exterior walls 5.5.3
Overhanging projections ..... 5.2.6, 5.3, 5.5.2; *see also* Eaves
Propane
Heaters, barbecues, and grills ... 5.11.2, 5.11.3, A.4.2.4.2, A.4.2.5.3
Tanks, storage of 5.11.4
Property lines .....*See* Neighboring properties
Purpose of standard 1.2, A.1.2.1

-R-

References ..... Chap. 2, Annex D
Risk .....*see also* Mitigation
Definition 3.3.19
Wildland fire hazard assessment to determine relative risk 4.1.1, A.4.1.1
Roads A.4.3.3
Definition 3.3.20
Roof decks 4.2.2.4, A.4.2.2.4, C.1.5.6, C.1.6.2
Roofing design, materials, and construction 5.2, 5.5.2, A.5.2
Structure assessment, documentation in ..... 4.2.2, A.4.2.2.1 to A.4.2.2.6
Type IV (2HH) construction C.1.5.1.2, C.1.5.3.2, C.1.5.3.3, C.1.6.4
Roof vents 5.2.2, 5.6.6, A.4.2.3.4, A.5.6.6

-S-

Scope of standard 1.1, A.1.1

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Separation distances
Between structures 5.1.3.1, 5.8, A.5.1.3.1, A.5.8
Trees and tree crowns A.4.2.5.1, A.4.2.5.2
Shall (definition) 3.2.4
Skylights 4.2.2.3, 5.6.1, A.4.2.2.3, A.5.6.1
Slash ..... 5.1.3.5, A.4.2.4.1, A.5.1.3.5, Annex B
Definition 3.3.21, A.3.3.21
Slope 4.2.1.1, A.4.2.1.1, A.4.2.4
Buildings closer than 30 ft. from vegetated slope 5.1.3.2, 5.1.3.3, A.5.1.3.2, A.5.1.3.3
Definition 3.3.22, A.3.3.22
Location of structure on 4.2.1.5, A.4.2.1.5
Setback measurement from edge of A.5.1.3.2
Vents exposed to A.5.6.5
Small flames ..... A.4.2(2)
Spark arrestors 5.7.1, 5.11.3
Splice plates, Type IV (2HH) construction C.1.5.4
Sprinklers, low-volume A.4.2.4.1
Stairways, Type IV (2HH) construction C.1.6.6
Standard (definition) 3.2.5
Structure .....*see also* Accessory structures; Building; Separation distances
Definition 3.3.23
Primary structures, examples of A.5.1.3.1
Projections from .....*see* Projections from structures
Structure assessment ..... Chap. 4; *see also* Mitigation
Components 4.1.2, A.4.1.2
Definition 3.3.24, A.3.3.24
Elements and conditions 4.2, A.4.2
From chimney to eave ..... 4.2.2, A.4.2.2.1 to A.4.2.2.6
From foundation to immediate landscaped area 4.2.4, A.4.2.4
From immediate landscaped area to extent of structure ignition zone ..... 4.2.5, A.4.2.5.1 to A.4.2.5.6
Overview of surrounding environment ..... 4.2.1, A.4.2.1.1 to A.4.2.1.5
From top of exterior wall to foundation ..... 4.2.3, A.4.2.3.1 to A.4.2.3.6
General 4.1, A.4.1.1
Guide, example of A.4.1.2
Rating form, example of A.4.1.2
Structure ignition zone
Assessing wildland fire hazards in .....*see* Structure assessment
Definition 3.3.25, A.3.3.25
Trees, spacing of 4.2.5.2, 6.2.5, A.4.2.5.1, A.4.2.5.2, A.6.2.5
Subfloor ventilation 5.6.4, 5.6.5
Surface fires
Intense ..... A.4.2(1)
Small flames ..... A.4.2(2)
Vegetative fuels and A.4.2.5.1

-T-

Topographical features, structure in relationship to ..... 4.2.1.1, A.4.2.1.1; *see also* Slope
Trees and tree crowns ..... Annex B
Crown fires ..... A.4.2(1)
Planting islands A.4.2.4, A.4.2.5.2
Separation of 4.2.5.2, A.4.2.5.1, A.4.2.5.2
Spacing within structure ignition zone 4.2.5.2, 6.2.5, A.4.2.5.2, A.6.2.5
Species and location, documentation of 4.2.5.2, A.4.2.5.2
Trusses .....*See* Beams, Type IV (2HH) construction
Type IV (2HH) construction ..... Annex C

-V-

Vegetation .....*see also* Slash; Trees and tree crowns
Access routes, clearance from A.4.3.3
Areas next to or under structure, assessment of .. 4.2.3.6, A.4.2.3.6
Attic ventilation and 5.2.6
Chimney outlet, distance from 5.7.2
Documentation of vegetative fuel types 4.2.4.1, A.4.2.4.1
Evaluation of vegetative fuels A.4.2.5.1
Exterior walls exposed to 5.5.2
From foundation to immediate landscaped area ..... 4.2.4, 5.1.3.2 to 5.1.3.4, A.4.2.4, A.5.1.3.2, A.5.1.3.3
Fuel model classifications ..... Annex B
High-flammability and low-flammability A.6.2.1
From immediate landscaped area to extent of structure ignition zone ..... 4.2.5, A.4.2.5.1 to A.4.2.5.6
Lawns A.4.2.5.2
In parking areas A.4.2.4.5
Property line limitations on mitigation A.4.2.1.1
Selection of A.6.2.1
Treatment or removal of 6.2, A.4.2.4, A.6.2.1, A.6.2.5
Vehicle parking areas 5.10
Vehicle parking areas
Assessment of 4.2.4.5, 4.2.5.5, A.4.2.4.5
Maintenance of 5.10
Ventilation louvers 5.2.5
Ventilation openings 4.2.3.4, 5.2.5, 5.2.6, A.4.2.3.4
Vents A.4.2.3.4
Attic 5.6.4, 5.6.5, A.4.2.3.4
Mobile and manufactured homes, enclosed space beneath 5.9.2
Roof and wall 5.2.2, 5.6.6, A.4.2.3.4, A.5.6.6
Subfloor 5.6.4, 5.6.5

-W-

Walls .....*see* Exterior walls and siding
Water supply 4.3.5, A.4.3.3, A.4.3.5, A.5.11.1
Definition 3.3.26
Weather conditions, documentation of 4.2.1.2, A.4.2.1.2
Wildland fires 1.1
Definition 3.3.27
Wildland/urban interface 1.1, 1.2.2, 1.3.1, 4.1.1, A.1.4.1, A.4.1.1
Definition 3.3.28, A.3.3.28
Wildland/urban intermix 4.1.1, A.4.1.1
Definition 3.3.29
Windows ..... 4.2.3.3, 5.6.1, 5.6.2, A.4.2.3.3, A.5.6.1; *See also* Skylights
Woodstove chimneys 5.7

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3.3.78 Effective Ground-Fault Current Path. An intentionally constructed, permanent, low impedance electrically conductive path designed and intended to carry ~~underground~~ electric fault current ~~conditions~~ from the point of a ground fault on a wiring system to the electrical supply source.

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