NFPA® 13E

Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems

2015 Edition

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NFPA® 13E

Recommended Practice for

Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems

2015 Edition

This edition of NFPA 13E, *Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems,* was prepared by the Technical Committee on Fire Service Training. It was issued by the Standards Council on November 11, 2014, with an effective date of December 1, 2014, and supersedes all previous editions.

This edition of NFPA 13E was approved as an American National Standard on December 1, 2014.

Origin and Development of NFPA 13E

In 1933, NFPA adopted an informative brochure that was prepared by the Committee on Field Practice and entitled "Use of Automatic Sprinklers by Fire Departments." It was published as a separate pamphlet and reprinted in 1936. The work formerly carried on by the Committee on Field Practice was distributed to a number of new committees in 1953, and at that time the Committee on Standpipes and Outside Protection was given responsibility for the brochure. A subcommittee of the Committees on Standpipes and Outside Protection, Automatic Sprinklers, Fire Department Equipment, and Fire Service Training prepared a revision, "Fire Department Operations in Protected Properties," which, on recommendation of the four committees, was adopted as an informative report at the NFPA Annual Meeting in 1961. The informative report was published and circulated as a separate pamphlet, No. SPI-1961, but was not included in the annual volumes of the *National Fire Codes.*

Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems, NFPA 13E, was adopted with minor revisions by NFPA at its 1966 Annual Meeting on recommendation of the Committee on Standpipes and Outside Protection. It was amended and updated in 1973, 1978, 1983, 1989, 1995, and 2000. The changes made by the Technical Committee on Fire Service Training in the 2000 edition of this document aligned its text with changes made to NFPA 13, *Standard for the Installation of Sprinkler Systems.* In addition, several chapters presenting new pre-incident planning and fireground operational considerations for fire personnel were added.

In the revision process for the 2005 edition, the previous numbering of chapters and paragraphs changed to reflect requirements in the 2004 edition of the *Manual of Style for NFPA Technical Committee Documents.*

The 2010 edition included some clarifying language regarding the use of alternative water supplies for fire department support of sprinkler and standpipe systems. In addition, this edition included additional illustrations of primary sprinkler/standpipe system valves and an improved illustration of a typical sprinkler system layout, using symbols from NFPA 170, *Standard for Fire Safety and Emergency Symbols,* 2009 edition.

In the 2014 edition, the committee updated the standpipe system sections to bring them up to current practices.

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

Committee Scope: This Committee shall have primary responsibility for all fire service training techniques, operations, and procedures to develop maximum efficiency and proper utilization of available personnel. Such activities can include training guides for fire prevention, fire suppression, and other missions for which the fire service has responsibility.

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Recommended Practice for

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

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in the recommendations sections of this document are given in Chapter 2 and those for extracts in the informational sections are given in Annex C. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text should be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1 Scope. This recommended practice provides basic procedures and information for use in fire department operations concerning properties equipped with certain fixed fire protection systems. The fixed systems covered in this recommended practice are interior automatic sprinkler systems, exterior sprinkler systems, and standpipe systems.

1.2 Purpose.

1.2.1 The purpose of this recommended practice is to assist fire departments in developing training programs and planning effective operations for supporting certain fixed fire protection systems in buildings in which fire can occur. Recommended practices are given for the adequate support and use of sprinkler and standpipe systems.

1.2.2 Nothing herein is intended to restrict any jurisdiction from exceeding these minimum suggestions.

Chapter 2 Referenced Publications

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

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

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems,* 2014 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations,* 2013 edition.

2.3 Other Publications.

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

2.4 References for Extracts in Recommendations Sections.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems,* 2013 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances,* 2013 edition.

Chapter 3 Definitions

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

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

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

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

3.2.4* 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.

3.2.5 Recommended Practice. A document that is similar in content and structure to a code or standard but that contains only nonmandatory provisions using the word "should" to indicate recommendations in the body of the text.

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

3.3 General Definitions.

3.3.1 Pressure-Regulating Device. A device designed for the purpose of reducing, regulating, controlling, or restricting water pressure. [**24,** 2013]

3.3.2 Standpipe System. An arrangement of piping, valves, hose connections, and allied equipment installed in a building or structure, with the hose connections located in such a manner that water can be discharged in streams or spray patterns through attached hose and nozzles, for the purpose of extinguishing a fire, thereby protecting a building or structure and its contents in addition to protecting the occupants. [**14,** 2013]

3.3.3 Yard Hydrant. A hydrant that is not designed to supply a fire department pumper.

Chapter 4 Properties Protected by Automatic Sprinkler Systems

4.1* General. Fire department administrations should use the record of effectiveness of automatic sprinkler systems and current data to promote these systems and should focus on actively supporting the operations of these systems.

4.1.1 Fire department personnel should be knowledgeable of and prepared to deal with the following three principal causes of unsatisfactory sprinkler performance:

(1) A closed valve in the water supply line
(2) The delivery of an inadequate water supply to the sprinkler system
(3) Occupancy changes that render the installed system unsuitable

4.1.2 The fire department should correct these situations by implementing effective departmental pre-incident planning, inspections, and other appropriate actions. The use of sprinkler systems initially designed for a low-heat-release product or intended only to accommodate low storage when a change has been made to a high-heat commodity, a significantly increased storage height, or new storage configurations can result in unsuccessful sprinkler performance, so the fire department or authority having jurisdiction should take steps to correct such problems.

4.1.3 Whenever automatic sprinklers are installed within the jurisdiction, the fire department training program should include a course on the fundamentals of automatic sprinkler systems. The fire department should recognize the following:

(1) When properly designed, installed, maintained, and supported by the fire department, a sprinkler system can apply water directly to the fire in a more effective manner than can the fire department using manual fire suppression methods.
(2) Not all sprinkler systems are equally effective in their performance. Systems might not have been properly maintained or might not be effective for the current occupancy.
(3) Changing conditions, including the following, might have reduced the required water supply calculated for sprinklers by the system designer:
    (a) Installation of a backflow preventor
    (b) Increased demand in area
    (c) Partially closed valves
    (d) Use of hose streams in larger volumes than anticipated
    (e) Deterioration of the water supply
    (f) Degradation of the sprinkler pipe caused by corrosion
(4) Changes in occupancies and commodity storage packaging and configuration methods might necessitate increased fire department support for the sprinkler system. Knowledge of sprinklered buildings within the response area will enable fire companies to be alert for the types of changes described in 4.1.3(3), which should be referred to the authority having jurisdiction so it can determine the need for sprinkler system modification.
(5) Sprinkler systems are installed in single-family and multiple-family dwellings as well as other types of residential occupancies. Some of these systems might not have the traditional fire department connection and other traditional exterior building fittings or dedicated separate water supplies.

4.2* Inspection and Pre-Incident Planning.

4.2.1 Fire personnel should thoroughly understand the following about properties protected by automatic sprinklers:

(1) The construction, contents, and layout of the buildings, the nature of the occupancies protected by automatic sprinklers, the extent of this protection, and the type of sprinkler systems
(2) The water supply to the sprinklers, including the source and type of supply, the flow and pressure normally available, and the anticipated duration of the available supply
(3)*The location of all sprinkler control valves, the area controlled by each valve, and the consequence of shutting off each valve
(4) The location of fire department connections to sprinkler systems, the specific area each connection serves, and the water supply, hose, and pumper layout that will be used to feed the sprinkler connections *(See Figure 4.2.1.)*
(5) The location of water supplies for handlines that can be used without jeopardizing the water supply to the operating sprinklers
(6) An alternative means for supplying water to the system in case of damage to the fire department connection
(7) The location of spare or replacement sprinklers
(8) The location of water flow indicators and annunciator panels associated with the systems
(9) Keyholder information for contact in case of emergency

FIGURE 4.2.1 Fire Department Connection to Automatic Sprinkler Systems.

4.2.2 The company that is assigned primary responsibility for charging the sprinkler connection during pre-incident plan-

ning or annual inspections should hook up to the fire department connection to verify hose thread compatibility.

4.2.3 During periodic inspections, fire personnel should ascertain the location and accessibility of fire department connections and connections to the water source, as well as the availability of an adequate water supply. In addition, fire personnel should verify fire department connection inlet caps or plugs and inlet swivel(s) are operational and the fire department connection inlets are free of debris.

4.2.4 Arrangements should be made with the property owners for entering the building as quickly as possible following activation of sprinkler systems when the building is unattended in order to avoid using forcible entry equipment and the resulting damage.

4.3 Fireground Operations in Sprinklered Properties.

4.3.1 Each fire department responding to properties protected by automatic sprinkler systems should implement standard operating procedures for handling fires in sprinklered buildings. The incident commander should ensure that these procedures are carried out as promptly and efficiently as possible. *(See Annex B.)*

4.3.2 Fire fighters operating in properties protected by automatic sprinkler systems should base operations on a thorough knowledge of the property gained from prior inspection and pre-incident planning.

4.3.3 A sprinkler system should not be shut down to improve visibility.

4.3.4* When arriving at a property protected by an automatic sprinkler system, fire companies should take prompt action to supply the system. *[See Figure 4.3.4(a) and Figure 4.3.4(b).]* A minimum of one sprinkler supply line should be connected to the fire department connection and should be supplemented according to fire conditions. The supply line should be pumped and the line charged to a pressure of 150 psi (10.3 bar) unless the system is posted for a different pressure. Additional hose lines should be stretched to the fire area as directed by the incident commander in charge. *[See Figure 4.3.4(c).]*

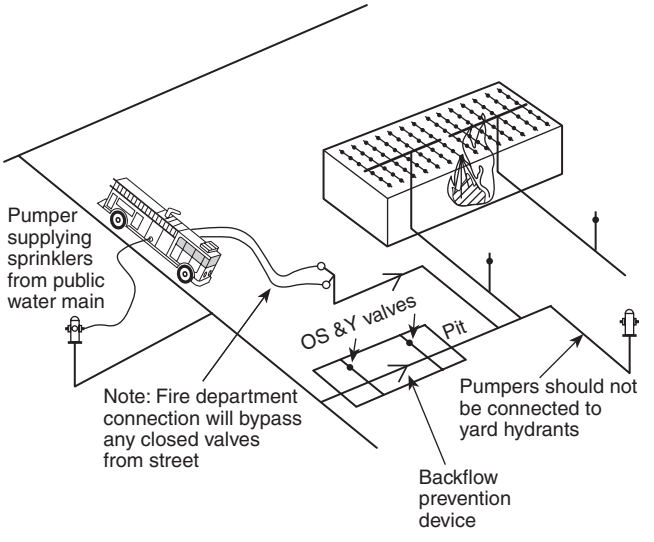

FIGURE 4.3.4(a) Public Water Supply to the Sprinkler System.

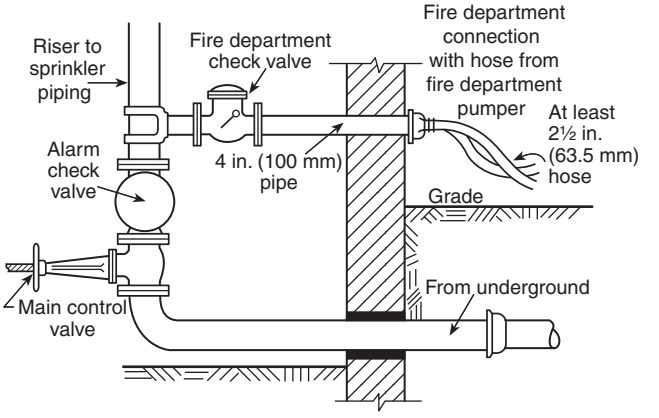

FIGURE 4.3.4(b) Water Supply to the Fire Department Connection.

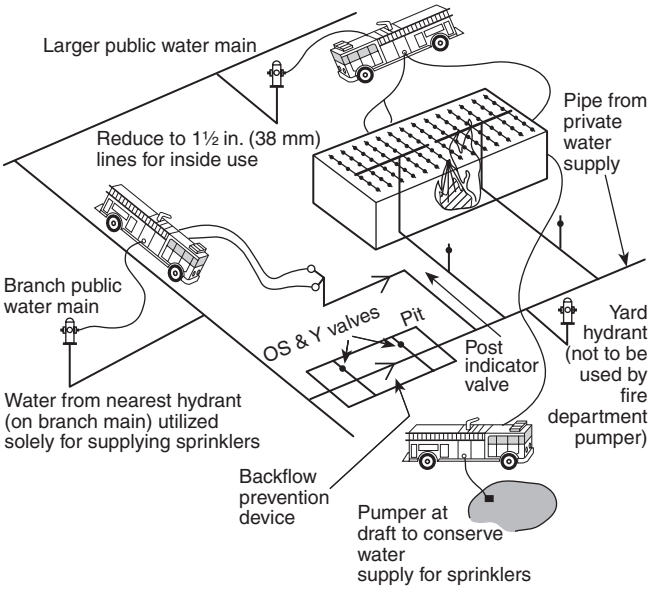

FIGURE 4.3.4(c) Pumper Supply Options That Should Be Considered.

4.3.5 Where hose streams will be used, water should be taken from sources that do not reduce the sprinklered protection. Pumpers should be supplied by one of the following methods:

(1) Connecting pumpers to large mains from which flow tests have indicated adequate flows to supply both sprinklers and the required hose streams
(2) Connecting pumpers to water mains not needed for sprinkler supply
(3) Drafting pumpers from static sources

4.3.6 Immediately after all water supply connections have been completed and the fire department connection has been charged, the incident commander should verify that water is flowing into the sprinkler system. If water is not flowing, the incident commander should take action to verify that all accessible control valves are open. If a valve is found to be closed, the incident commander should be notified promptly and the

valve should be opened fully unless it is tagged "Closed for Repairs." Valves found closed should be reported to the fire investigator after the incident. If the system is supplied or augmented by a fire pump, a fire fighter should also be assigned to verify that the pump is in operation.

4.3.7 When possible, fire departments should avoid drafting from open water sources into sprinkler systems and standpipe systems where such systems are connected to potable water supplies unless appropriate backflow protection equipment is installed.

4.3.8 Personnel performing ladder company functions should provide ventilation as needed to avoid delay in advancing hose lines to complete extinguishment. *(See Section 4.6 for other considerations regarding ventilation procedures.)*

4.3.9 Salvage covers should be used to protect those items or areas likely to be affected by operating sprinklers, hose lines, or both. Special attention should be given to those areas on floor levels below the area of sprinkler operation.

4.3.10 Fire personnel should be aware that not all residential sprinkler piping is tested to the same level as commercial sprinkler piping. Therefore, a residential sprinkler system should not be pressurized to more than water main pressure if this system has a fire department connection.

4.3.11 Appropriate plans for water removal should be undertaken.

4.4 Post-Fire Operations.

4.4.1 Automatic sprinklers should not be shut off until the fire has been extinguished. If there is a sectional or floor fire control valve, this valve should be closed in lieu of the main valve. A fire fighter with a means of communication should be assigned to remain at the valve until overhaul is completed. Orders should also be given to the pump operator to shut down the lines connected to the fire department connection, because these lines can bypass the main sprinkler valve and, in the absence of a floor valve, water will flow until the pump discharge gates are closed. Where a combined sprinkler–standpipe system is installed, the hose lines should be charged and maintained charged until fire overhaul is completed. Where only a few sprinklers are operating, sprinkler tongs, tapered wooden wedges, or dowels should be used to immediately stop the flow from the opened sprinklers without shutting off the entire system. *(See Figure 4.4.1.)*

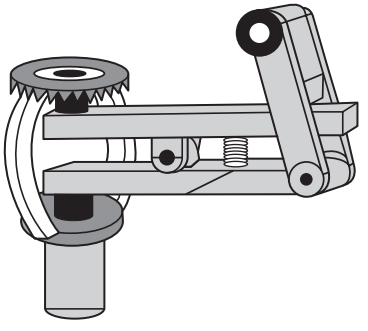

FIGURE 4.4.1 Sprinkler with Sprinkler Wedge Installed.

4.4.2 Routine overhaul should be provided and a cause and origin investigation should be initiated.

4.4.3 When the fire is extinguished and overhaul is completed, the lines from the pumper to the sprinkler system fire department connection should be ordered disconnected.

4.4.4* Where appropriate, the fire department should assist in restoring the sprinkler system. Because actions to restore a sprinkler system can present potential consequences for improper or negligent actions, each fire department should review its policy on this matter. Where fire departments are tasked with restoring sprinkler systems post-fire or after accidental sprinkler activations, departments should consider using ½ in. (13 mm) or ¾ in. (19 mm) pipe nipples with caps if spare sprinklers are not available. This provides complete sprinkler protection, which facilitates reoccupation of areas not affected by fire, smoke, or water damage. Sprinklers that were exposed to high heat conditions during a fire should be examined by a qualified sprinkler installer and replaced as needed.

4.4.5 Code enforcement and fire prevention authorities should be notified of any event that involves activation of an automatic sprinkler system.

4.4.5.1 If the sprinkler system cannot be restored to operating condition by the time the fire department leaves the premises, the code enforcement and/or fire prevention authorities and the building owner/representative should be promptly notified of the structure's noncompliant status. Depending on post-fire conditions, the fire department or code enforcement authority should consider requiring a fire watch.

4.5 Reports.

4.5.1* The officer in charge should include data regarding the operation of the sprinkler system in the incident report.

4.5.2 Past incident analysis of fire department operations and the performance of the automatic sprinkler system should be reported to improve future operations at sprinklered properties. The following information should be gathered to use in the analysis process:

(1) Location of operating sprinklers
(2) Number of sprinklers operating
(3) Result of sprinkler operation
(4) Reason for any unsatisfactory operation
(5) Employee assigned to check control valve
(6) Whether the fire department connected to the sprinkler system and, if not, the reason
(7) Company and engine number that connected to the sprinkler system
(8) Number of hose lines used
(9)*Size of hose lines used
(10) Whether water was pumped into the system; if so, for how long and at what pressure; and any issues with the backflow device or pressure-reducing devices
(11) Whether the valve was closed after the fire, and which employee ordered that the valve be closed
(12) Number of sprinklers replaced by the fire department
(13) Type of sprinklers installed
(14) Whether sprinkler protection was fully restored and by whom
(15) Actions taken to restore service
(16) Whether the private water supply to sprinklers operated satisfactorily
(17) Whether the fire prevention bureau was notified
(18) Whether the representative of management was notified as well as the names of the employee making notification and of those notified

4.6 Ventilation in Storage Occupancies.

4.6.1 Fire department personnel should study occupancies with a wide variety of configurations and a wide range of storage commodities to determine whether there is a need for special procedures, particularly where storage heights are in excess of 12 ft (3.66 m). This study should be done because, in some cases, routine ventilation procedures in the early stages of a fire can hinder effective sprinkler operation. The fire department should discuss its pre-incident plan for these types of occupancies with the occupant, sprinkler system designer, and insurance carrier to determine whether a modification in procedures is appropriate.

4.6.2* Where search and rescue operations have been completed prior to the fire department's performance of ventilation work, the incident commander should allow the automatic sprinklers to continue to operate without further ventilation.

Chapter 5 Properties Protected by Exterior Sprinklers for Protection Against Exposure Fires

5.1 General.

5.1.1* Fire department personnel should be aware that many buildings or properties that have a severe exposure problem might be equipped with exterior sprinkler systems designed to provide a water curtain capable of shielding the property from fires in other buildings or in storage areas.

5.1.2 Fire department training and operational protocols should be in place so that, when used properly, sprinklers for exterior protection (specially designed for a water curtain effect) and sprinkler systems will prevent an exposure fire from entering the building.

5.2 Pre-Incident Planning. In properties having exterior sprinkler protection, fire personnel and officers assigned to the first-due companies should thoroughly understand the following:

(1) The construction and layout of the building, the nature of the occupancies protected by exterior sprinklers, the extent of this protection, and the type and operation (automatic or manual) of sprinkler systems
(2) The water supply to the sprinklers, including the source and type of supply, the flow and pressure normally available, and the anticipated duration of the available supply
(3) The location of all sprinkler control valves, the area controlled by each valve, and the consequence of shutting off each valve
(4) The location of fire department connections to sprinkler systems, the specific area each connection serves, and the water supply, hose, and pumper layout that will be used to feed the sprinkler connections
(5) The specific company assignment having the primary responsibility for charging the sprinkler connection
(6) The location of water supplies for handlines that can be used without jeopardizing the water supply to the operating sprinklers
(7) An alternative means for supplying water to the system in case of damage to the fire department connection
(8) The location of spare or replacement sprinklers
(9) Keyholder information for contact in case of emergency

5.3 Water Supply for Fire Fighting.

5.3.1* A sketch should be prepared showing the location of the control valves, the fire department supply connections, and the hydrants to be used for pumping into the system. Where exposure fire is a problem, an assumption should be made that a major fire could happen that will also require a number of hose streams for manual fire fighting. An assumption should also be made that standard automatic sprinkler systems might be in the fire area that must be supplied with lines from pumpers as their water supplies.

5.3.2 When possible, fire departments should avoid drafting from open water sources into sprinkler systems and standpipe systems where such systems are connected to potable water supplies unless appropriate backflow protection equipment is installed.

5.4 Fireground Operations Involving Exterior Sprinklers.

5.4.1* The incident commander in charge should ensure that exterior systems are used to fulfill their intended purpose and should be aware of the existence of the system and the means of water supply.

5.4.2 The incident commander should determine as quickly as possible whether exterior sprinklers are operating. If the system is manually operated, a fire department member with a portable radio should immediately be sent to open the valve in case the exterior sprinklers are needed later. In some cases, several valves control different exposed parts of a protected building, so the correct valve must be opened. Care should be taken to conserve the water supply and minimize potential water damage by shutting off the exterior sprinklers when they are no longer required.

5.4.3 Where a fire department connection is provided, an engine company should pump into the connection.

5.4.4 The incident commander in charge should be responsible for the following:

(1) Ordering fire personnel into the exposed buildings to ascertain that all windows are closed and fire has not extended into the buildings concerned
(2) Setting up fire department lines in the exposed buildings if the exposure is severe; standpipe facilities can be used if available.
(3) Sending fire personnel to the roof to make certain that no part of the roof structure has ignited
(4) Ordering salvage operations in exposed buildings
(5) Ordering exterior sprinklers to be shut off and drained when no longer needed
(6) Ordering the system to be restored *(see 4.4.4)*

Chapter 6 Properties Protected by Standpipe Systems

6.1 Inspection and Pre-Incident Planning.

6.1.1 Personnel responsible for inspection and pre-incident planning should be aware that many properties have standpipe systems serving fire hose outlets in various parts of one or more buildings and that standpipe systems can be used by the fire personnel to place streams in service quickly in areas that cannot be reached conveniently with hose lines that are directly connected to pumpers or hydrants outside of buildings.

6.1.2 Standpipe hose threads should be checked for compatibility with fire department threads.

6.1.3* Fire personnel should determine the source and reliability of the water supply and follow the piping, while noting the location of control valves.

6.1.4 Where the fire department is required to supply hose outlets several hundred feet (meters) from the fire department connection, plans should be made in advance to provide the required pressure and fire flow based on the size of hose, the length of pipe, the maximum height of standpipe outlets, and the number of streams to be supplied.

6.1.5 Pre-incident planning should include identification of pressure-regulation devices installed within the system. For those standpipe systems with devices that regulate the pressure available to the hose lines attached to the system, fire personnel should be aware of the devices and their placement on standpipe systems and know how to adjust them so that they work properly with the hose lines and nozzles that can be attached to them. Pressure-regulation device settings should be compatible with the hose and nozzles used by the local fire department.

6.1.6* Standpipe hose outlets should be checked annually by opening and closing the valves.

6.2 Water Supply for Fire Fighting.

6.2.1* Fire personnel should be familiar with the variety of supply sources for water used in fire fighting, including standpipe systems with water supplied by public or private water mains, as well as fire pumps, gravity tanks, pressure tanks, fire department connections, or combinations of these, in order to provide water at adequate pressure and quantity at the outlets.

6.2.2 Fire personnel should determine the needed pressure and quantity of water at the highest outlets, and they should develop procedures to provide appropriate amounts of water for fire fighting when using the system.

6.2.3 Alternative means of supplying water to the fire area should be identified in case the system is unusable or needs to be supplemented at the time of a fire.

6.2.4 When possible, fire departments should avoid drafting from open water sources into sprinkler systems and standpipe systems where such systems are connected to potable water supplies unless appropriate backflow protection equipment is installed.

6.3 Fireground Operations Involving Properties Protected by Manual Dry or Manual Wet Standpipe Systems.

6.3.1* Fire department personnel should carefully plan operations in properties protected by standpipe systems designed to supply fire department hose streams. These procedures should be similar to operations in buildings protected by automatic sprinklers.

6.3.2 Standpipes should be utilized when fires occur on floors above the reach of ground or aerial ladders and when valuable time will be lost in stretching lines up stairways. Careful pre-incident and on-scene fireground planning should be performed to ensure successful operations.

6.3.3* Where standpipe systems provide fire department connections, lines from a pumper supplied by a water main should be connected and charged to the pressure required to give the desired working pressure on the standpipe outlets being used. Where several independent standpipes are available for fire department use in the fire area, each standpipe should be charged. *(See Figure 6.3.3.)*

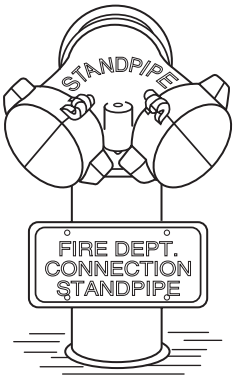

FIGURE 6.3.3 Standpipe Connection.

6.3.4* Fire Department Standpipe Connections and Pump Discharge Pressures for Manual Dry or Manual Wet Standpipes.

6.3.4.1 When pumping to a fire department standpipe connection, the pump operator should consider the following factors in calculating pump discharge pressure:

(1) Friction loss in the hose line between the pump and the standpipe connection
(2) Friction loss in the standpipe system
(3) Pressure loss due to elevation of the nozzle(s)
(4) Number, length, and size of attack lines operating from the standpipe
(5) Pressure desired at the nozzle(s)

6.3.4.2 Pump discharge pressure in excess of 200 psi (13.8 bar) should not be used unless the standpipe system has been designed to withstand higher pressures. Fire suppression personnel should be familiar with options and acceptable practices available to them in response to varying configurations and locations of standpipe outlets.

6.3.5 Hose or "house lines" attached to standpipe outlets should not be used except in the case of extreme emergency. Fire personnel should provide hose and nozzles of appropriate size and length along with proper accessory equipment for the anticipated fire conditions.

6.3.6 Limitations of communication devices, as well as the essential ability to maintain effective portable radio communications between the incident command post and officers on the upper floors, should be identified and resolved during pre-incident planning.

6.3.7 Where private water supplies serve the standpipe system, fire personnel should make certain that supply valves are open and private fire pumps, if any, are operating.

6.3.8 Before proceeding upstairs, fire personnel should ensure that all hose outlet valves on lower floors are closed.

6.3.9 Fire departments should operate hose lines from standpipe hose valves on the intermediate stair landing or floor below the fire floor in multi-story buildings and in areas remote from the emergency in other standpipe-equipped struc-

tures. Where possible to do so, fire fighters should connect and deploy hose lines from standpipe hose valves outside any immediately dangerous to life and health (IDLH) environment to ensure the safety and operational effectiveness of all fire department personnel.

6.3.10 Fire departments operating in standpipe-equipped buildings should utilize appropriately sized hose lines based on their required pre-incident planning for those structures. Fire fighters should base this decision upon necessary fire flows for the hazard of the building, conditions at the time of the incident, and operational capabilities of the system. Fire departments should be cognizant of the possibility of low operating pressures that can warrant the choosing of larger hose lines of 2½ in. (63.5 mm) and nozzles that require lower operating pressures for initial fire department operations from a standpipe system. The authority having jurisdiction should have the ultimate decision in regard to the fire department hose line selection for use when operating from standpipes.

6.4 Fireground Operations Involving Properties Protected by Automatic Standpipe Systems with Fire Pumps.

6.4.1* Fire department personnel should carefully plan operations in properties protected by automatic standpipe systems that are designed to supply fire department hose streams and combined sprinkler systems. These procedures should be specific to automatic standpipes with fire pumps.

6.4.2 Fire suppression operations can be limited to the pressure and flow design of the standpipe. Fire departments should limit interior fire suppression operations to be within the pressure and flow parameters specific to each automatic standpipe system.

6.5 Automatic Standpipe Water Supply Considerations.

6.5.1* Fire departments should plan water supply operations to support the automatic standpipe systems in their jurisdictions.

6.5.2* The fire department's initial water supply action should be to support the automatic standpipe as a secondary water supply.

6.5.3* Fire department pumpers should pump the system demand pressure and flow into the fire department connection when taking over any automatic standpipe or standpipe zone.

6.6* Pressure-Regulating Devices Used in Automatic Standpipe Systems. Fire department personnel should be thoroughly familiar with the design and function of the various types of pressure-regulating devices used in automatic standpipe systems in their jurisdictions.

Chapter 7 Impairments

7.1* Impairment Procedures. When a sprinkler system or standpipe system is found to be impaired, fire department procedures should be followed as covered in Chapter 11 of NFPA 25. Each building owner should appoint an impairment coordinator for the purpose of authorizing planned impairments and dealing with emergency impairments.

7.1.1 When an impairment occurs, the following procedure should be performed by the impairment coordinator:

(1) Determine the extent and expected duration of the impairment
(2) Determine the increased risk in the areas of the building affected
(3) Submit recommendations to the owner or manager of the building for dealing with the risk
(4) Notify the fire department and the dispatch center for emergency services
(5) Notify the insurance carrier, the alarm company, the building owner or manager, and other involved authorities having jurisdiction
(6) Notify the supervisors in the area being affected
(7) Install an impairment tag on the affected control valve and fire department connection
(8) Assemble the necessary tools and materials to make the repair as quickly as possible
(9) Prohibit all welding, cutting, and other forms of hot work
(10) Consider establishing a fire watch

7.1.2 Once the impairment has been repaired and the system has been restored to service, the following steps should be taken:

(1) Conduct necessary inspections and tests to verify that the system is restored to operational condition
(2) Advise supervisors that the system has been restored
(3) Advise the fire department and dispatch center that protection has been restored
(4) Notify the insurance carrier, the building owner or manager, the alarm company, and any other authorities having jurisdiction or concerned parties that the system has been restored
(5) Remove the impairment tags

Chapter 8 Reliability of Systems

8.1 System Status. Fire department personnel should be thoroughly knowledgeable of the reliability of the system(s). If the condition of the system(s) is questionable, a change in preplans, procedures, or tactics should be required. A greater commitment of resources to the initial fire attack should be considered.

Chapter 9 Buildings Under Construction

9.1 Site Visits. Fire department personnel should provide continual preplan visits to high-rise buildings under construction to evaluate special needs in accordance with the provisions of Chapter 5 of NFPA 241.

Chapter 10 Inspection and Testing Requirements

10.1 Inspection, Testing, and Maintenance for Sprinkler and Standpipe Systems. Sprinkler and standpipe systems should be evaluated in accordance with NFPA 25.

Annex A Explanatory Material

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

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

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

A.3.2.4 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.4.1 Records of the National Fire Protection Association and other fire protection associations around the world clearly indicate the highly effective performance of automatic sprinkler systems.

A.4.2 Figure A.4.2 shows a typical layout of water supply and sprinkler system features serving a building.

A.4.2.1(3) The diagram in Figure A.4.2 indicates two types of valves that fire department personnel need to understand the function of and be able to recognize and locate in emergencies. These are the outside screw and yoke valves that control the flow of water for the entire system from various points and the post indicator valves that control the flow of water to specific mains and sections of the system. These two types of valves are shown in Figure A.4.2.1(3).

A.4.3.4 It might be necessary to alter the pressure of 150 psi (10.3 bar) to properly supply foam-water sprinkler systems, hydraulically calculated sprinkler systems, or high rise systems. Performance of certain systems, such as foam-water sprinkler systems or hydraulically calculated sprinkler systems, can be adversely affected by increased pressures beyond the design limits of the system.

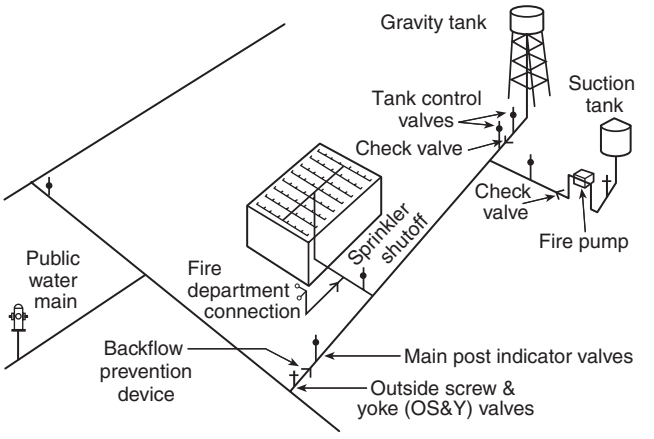

FIGURE A.4.2 A Typical Layout of a Water Supply System for Automatic Sprinkler Systems.

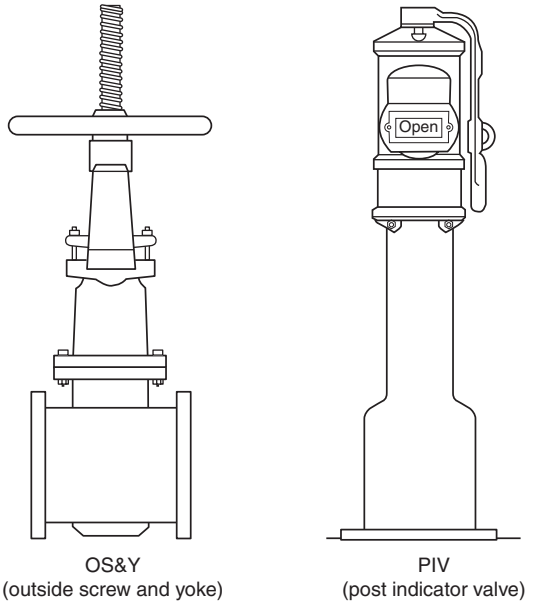

FIGURE A.4.2.1(3) Two Types of Control Valves That Fire Department Personnel Should Readily Recognize and Understand the Purposes of.

A.4.4.4 Adding ½ in. (13 mm) and ¾ in. (19 mm) pipe nipples 6 in. (152 mm) in length with pipe caps installed on one end to the standard engine company inventory allows sprinkler systems a prompt return to service if no spare sprinklers are on site. In addition, a brightly painted and identified pipe nipple installed can assist fire inspectors and code enforcement officials with identifying areas of activation, while the absence of pipe nipples signifies the sprinkler system was restored to service.

A.4.5.1 Reports on emergencies are essential to providing an accurate record of a department's activities, including sprinkler performance in structure alarms and fires.

Reports also serve as a basis for determining local, state, and national fire trends and for establishing the needs of a fire department. NFPA 901 should be used as the basis for classify-

ing data on emergency incidents. The National Fire Incident Reporting System (NFIRS) of the Federal Emergency Management Agency should form the basis of an incident reporting system.

A.4.5.2(9) Some departments now use large diameter hose (LDH) lines to supply fire department connections.

A.4.6.2 Continued operation enables the sprinklers to achieve full control of the fire, which, in some cases, can take 20 minutes or more.

A.5.1.1 These systems can be designed for automatic thermostatically operated or manual open-sprinkler operation. Some are specially designed sprinklers on pipes extending from a wet- or dry-pipe sprinkler system inside the building and placed to protect window openings.

A.5.3.1 Alternative sources of water meeting the requirements of NFPA 1142 can be used to supplement fire department water sources for supplying standpipe and sprinkler systems.

A.5.4.1 The purpose of exterior sprinkler systems is to prevent the extension of fires to exposed properties.

A.6.1.3 The procedure for fire department pre-incident planning for properties protected by standpipe systems is in many ways similar to that for automatic sprinkler systems.

A.6.1.6 Hose outlets on manual standpipes should be tested annually by opening and closing the valve and checking for proper operation and good working condition. Note that pressure-restricting devices (PRD) and pressure-reducing valves (PRV) are generally used only on automatic standpipe systems and are typically not installed on manual standpipe outlets.

A.6.2.1 Manual wet-pipe systems supplied only by fire department connections are also used.

A.6.3.1 Many buildings could have sprinkler systems, standpipe systems, or a combination of these systems. Alternative sources of water meeting the requirements of NFPA 1142 can be used to supplement fire department water sources for supplying standpipe and sprinkler systems.

A.6.3.3 Standpipes can be combined with automatic sprinkler systems when the residual pressure from the municipal water mains provides adequate pressure and flow to the sprinkler systems. Fire departments will still need to charge the standpipe to the pressure required to give the desired working pressure at the standpipe outlets being used for hose line operations.

A.6.3.4 Fire department standpipe outlets are required by NFPA 14 to be located in the stair towers, adjacent to the horizontal exits, and near entrances to exit access corridors. In some cases, however, the standpipe might be located on the exterior of the building, frequently adjacent to outside stairs or a fire escape. Accepted practice in standpipe operations is to connect the fire department hose to an outlet located at the intermediate stair landing or one floor below the fire and to advance the line up the flight of stairs. The purpose of this practice is to prevent an intense fire on the fire floor from driving fire fighters away from the standpipe connection. Where additional lines are needed, connections can be made to lower outlets.

A.6.4.1 Automatic standpipes with fire pumps are very different from manual standpipes in many ways. NFPA 14 requires automatic standpipe systems to contain water at all times and be attached to a water supply capable of supplying the system demand at all times and requiring no action other than opening a hose valve to provide water at hose connections. This means automatic standpipe systems are designed to supply water, on-demand, without any assistance from the department pumpers.

A.6.5.1 NFPA 14 requires a minimum residual pressure of 100 psi (6.9 bar) at any 2½ in. (63.5 mm) standpipe outlet and also requires that pressure-reducing valves be used anytime an outlet pressure to a hose connection is greater than 175 psi (12.1 bar). Normal expected outlet pressure ranges on these systems could be from 100 psi (6.9 bar) to 175 psi (12.1 bar). Connecting an in-line pressure gauge between the hose line and the standpipe outlet on the floor below the fire floor allows a fire fighter stationed at the standpipe to accurately set and maintain the correct pressure to a flowing hose line by gating down a higher outlet pressure. A 100 psi (6.9 bar) residual outlet pressure would support approximately 500 ft (152 m) of 2½ in. (63.5 mm) hose line with a 50 psi (3.4 bar) nozzle flowing 250 gpm (946 L/m). This would place a maximum of 475 ft (145 m) of working hose line on the fire floor when connected to the standpipe outlet one floor below the fire floor.

Prior to 1993, NFPA 14 required a minimum residual pressure of 65 psi (4.5 bar) at 2½ in. (63.5 mm) standpipe outlets and required pressure-reducing valves when standpipe outlet pressures at hose connections were greater than 100 psi (6.9 bar). Normal expected outlet pressures on systems built to pre-1993 standards could be from 65 psi (4.5 bar) to 100 psi (6.9 bar). A 65 psi (4.5 bar) residual outlet pressure would support 150 ft (45 m) of 2½ in. (63.5 mm) hose line with a 50 psi (3.4 bar) nozzle flowing 250 gpm (946 L/m). When connected to the standpipe outlet one floor below the fire floor, this places a maximum of 125 ft (38 m) of hose line on the fire floor. Connecting additional lengths of 2½ in. (63.5 mm) hose line can increase the friction loss of the hose line and reduce the flow and reach of the nozzle.

A 65 psi (4.5 bar) residual outlet pressure would not support traditional hotel bundles or high rise bundles utilizing 1¾ in. (44.4 mm) hose line and 75 psi (5.2 bar) or 100 psi (6.9 bar) nozzles. A 100 psi (6.9 bar) residual outlet pressure would be able to support only 100 ft (30 m) of 1¾ in. (44.4 mm) hose line with a 75 psi (5.2 bar) nozzle flowing 150 gpm (568 L/m). This would place a maximum of 75 ft (23 m) of working hose line on the fire floor. A 100 psi (6.9 bar) residual outlet pressure would not support the use of 100 psi (6.9 bar) nozzles.

Automatic or constant-pressure nozzles are not recommended for use on automatic standpipes. Potential low system pressures insufficient to supply the required nozzle pressure can cause the nozzle orifice to constrict, which greatly reduces the flow and reach of the hose line.

Combination nozzles with adjustable patterns are easily fouled by standpipe debris, which can result in a partial or complete blockage. Smooth-bore nozzles are less prone to blockage from standpipe debris and generally function in a predictable manner when under-pressurized.

Attaching a 2½ in. (63.5 mm) by 2½ in. (63.5 mm) gated wye to a standpipe outlet to allow the connection of two 2½ in. (63.5 mm), or large diameter hose lines is not always a recommended practice because 2½ in. (63.5 mm) standpipe outlets are only required to flow 250 gpm (946 L/m) and might not support flowing two handlines simultaneously. Pressure-reducing valves (PRV) connected to 2½ in. (63.5 mm) stand-

pipe outlets are generally sized for 250 gpm (946 L/m) to 400 gpm (1514 L/m) and should generally not provide adequate flow for two large diameter hose lines. Initial actions should be to connect a single large diameter hose line to each standpipe hose connection. Additional hose lines can be connected to standpipe hose connections on lower floors.

A.6.5.2 NFPA 14 requires signage at the fire department connection to indicate the pressure required to be pumped into the fire department connection to supply the automatic standpipe system demand. Signage is also required to identify the type of standpipe, whether it is part of a combined sprinkler system, and the location of the standpipe services.

Fire departments should have knowledge of all system demand pressures required to support all of the automatic standpipe systems in their jurisdictions. Hose lines used to connect a hydrant to the intake of a pumper should have a working pressure rating equal to or greater than the available hydrant pressure. Hose lines used to connect the discharge of a pumper to the fire department connection on an automatic standpipe should have a working pressure rating equal to or greater than the system demand pressure of the automatic standpipe system.

NFPA 14 limits automatic standpipe pressures to no more than 350 psi (24.1 bar). Fire department pumpers should be configured to provide the highest system demand pressure for automatic standpipes in their jurisdictions. An accepted rule of thumb is one pumper per 150 psi (10.3 bar) of system demand pressure required. The configuration of pumpers should also provide the required flow into the fire department connection.

A fire department pumper with a two-stage pump in volume mode connected to a hydrant with 50 psi (3.4 bar) residual pressure can deliver 200 psi (13.8 bar) into an automatic standpipe while maximizing the pump's flow capacity. [150 psi + 50 psi = 200 psi (10.3 bar + 3.4 bar = 13.8 bar)]. At a net discharge pressure of 150 psi (10.3 bar), the pump impeller can deliver its maximum flow capacity plus additional flow from the incoming hydrant pressure. Using a single pumper to supply pressure into systems requiring pressures greater than 200 psi (13.8 bar) can reduce the flow capacity of the pump when the pump's net discharge pressure exceeds 150 psi (10.3 bar). Operating a two-stage pump in pressure mode allows the pump to generate higher discharge pressures at lower engine speeds but limits the pump to half its rated flow capacity.

Configuring two pumpers in series on a hydrant with 50 psi (3.4 bar) residual pressure will allow the pumpers to split the work load and deliver 350 psi (24.1 bar) into the standpipe [150 psi + 150 psi + 50 psi = 350 psi (10.3 bar + 10.3 bar + 3.4 bar = 24.1 bar)]. In a series configuration, both pumps can remain in volume mode and operate at the optimum net discharge pressure to maximize the flow capacity of both engines into the standpipe. Standpipes that are part of a combined system are required to be at least 6 in. (152.4 mm) in size. When supplying water at the system demand pressure into the fire department connection, fire department pumpers with a higher flow capacity than the standpipe fire pump can potentially increase the flow capacity of the standpipe.

A.6.5.3 The fire pump motor is paired with an impeller that is sized to provide the standpipe system's required water flow capacity. Fire department connections are required to be sized to provide one 2½ in. (63.5 mm) inlet for every 250 gpm (946 L/m) of standpipe capacity. An automatic standpipe designed to flow 750 gpm (2839 L/m) would be supplied by a 750 gpm (2839 L/m) fire pump and would have three 2½ in. (63.5 mm) inlets at the fire department connection.

Fire departments should pump into automatic standpipes at the system demand pressure regardless of the fire location.

A standpipe supplied at one system pressure should have incrementally higher pressures at each floor below the highest standpipe sprinkler connection by virtue of diminishing head pressure.

Pressure-reducing valves connected to the standpipe utilize water pressure inside the valve body to manipulate an internal piston that opens and closes to deliver the intended discharge pressure and flow. Pressure-reducing valves are designed to operate from the specific standpipe pressure that is present at each floor while the standpipe is being supplied at the system demand pressure.

When an automatic standpipe fire pump is not working and the fire department has taken over supplying water into the standpipe, pumping to the fire floor would not provide the system demand inlet pressure required for the pressure-reducing valves to function. This would produce significantly low discharge pressures and reduced flow from the pressure-reducing valve.

Automatic standpipes that are combined systems should have sprinkler connections to the standpipe at each floor. The standpipe pressure at each floor could require a pressure-reducing valve to be installed at the sprinkler connection to the standpipe, reducing the standpipe pressure down to the required sprinkler system operating pressure.

In an automatic standpipe system design where pressure-reducing valves are not installed on the standpipe outlets for hose connections, any sprinkler connection that utilizes a pressure-reducing valve could still require the standpipe to be supplied at system demand for the pressure-reducing valve to operate correctly.

It is possible for the fire department to pump to the fire floor when standpipe outlets for hose connections do not have pressure-reducing valves installed. However, the calculated pump discharge pressure just to the fire floor or highest operating hose line would not be sufficient to allow the sprinkler system pressure-reducing valves to operate correctly. Unless the fire location was at the top of the standpipe and the calculated discharge pressure was equal to the system demand, pumping to the fire floor could effectively disable all of the sprinklers connected to the standpipe on or above the fire floor. It is recommended practice to keep the sprinklers functioning on and above the fire floor as well as throughout the rest of the building whenever possible.

The system demand pressure should always be pumped when taking over automatic standpipe systems to allow all of the pressure-regulating and distribution components to operate correctly. This provides the designed working pressure and flow to any outlet or sprinkler head in the system.

A.6.6 NFPA 20 might require pressure-relief devices to be installed in the standpipe to protect the standpipe from over pressurization.

When pressure-relief devices are required, they should be located on the discharge side of the fire pump and before the check valve. A pressure-relief device should not limit the standpipe pressure when the system demand is supplied through the fire department connection. The intent is to allow the fire department to pump additional pressure above system demand into the fire department connection if necessary. It is

recommended to pump no more than 50 psi (3.4 bar) above system demand to avoid over-pressurizing the standpipe beyond its required test pressure and design limitations.

NFPA 14 requires the use of pressure-reducing valves to limit residual and static pressure at the outlet of the hose connection to no more than 175 psi (12.1 bar). Prior to 1993, pressure-reducing valves were required to limit residual and static pressure at the outlet of the hose connection to no more than 100 psi (6.9 bar).

Pressure-restricting devices (PRD) limit pressure only when water is flowing. Pressure-restricting devices attached to the discharge threads of existing standpipe outlet valves can be removed to increase pressure and flow when necessary. Standpipe outlet valves can have removable clips or stops that limit how far the valve can be opened. Removing the clips or stops should allow the valves to be fully opened and no longer restricting pressure and flow.

Pressure-reducing valves regulate pressure under both flowing and static conditions. Pressure-reducing valves reduce a higher inlet pressure to a lower outlet pressure, which is a ratio of the inlet to outlet pressure. A valve with an inlet pressure of 300 psi (20.7 bar) with an outlet pressure of 100 psi (6.9 bar) would have a pressure-reducing ratio of 3:1. Pumping an additional 50 psi (3.4 bar) above system demand into the fire department connection would result in 350 psi (24.1 bar) to the inlet side of the pressure-reducing valve with approximately 117 psi (8.1 bar) on the discharge side.

Pressure-reducing valves are installed on automatic standpipe outlets and sprinkler connections on combined systems. Pressure-reducing valves should not be removed from the standpipe while the system is under pressure. If a pressure-reducing valve was removed, the pipe threads at the standpipe connection would not be compatible with fire hose threads.

A.7.1 An impairment is generally defined as a shutdown of a system or portion thereof. The two types of impairments are emergency and planned. An emergency impairment results from an unexpected occurrence. A planned impairment is scheduled for the purposes of repair or revisions.

Annex B Recommendations for Fighting Rubber Tire Fires in Sprinklered Buildings

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

B.1 Introduction. It is essential that the steps necessary for fighting rubber tire fires be understood by both the building occupant and the fire service to prevent unnecessary injury or loss of life and to prevent loss of fire control during overhaul. This activity necessitates emergency pre-planning with the local fire department, building occupant, and others as deemed necessary.

Fire tests of rubber tire storage have indicated that smoke can quickly obstruct the visibility within a building and obscure the burning materials. Plans for the attack and extinguishment of the fire should be prepared in advance.

Because the products of combustion are harmful, all personnel assigned to interior functions should use breathing apparatus even before obscuration occurs.

Ventilation efforts should be carefully controlled. Drafts from open doors and windows allow fresh air to reach the fire and make control of the fire difficult. Doors and windows should be closed as soon as possible to limit the air supply to the fire and to allow control by automatic systems to be established.

Fire brigades should be trained and equipped with the necessary tools and equipment to respond to a fire emergency and, if possible, attack the fire prior to the arrival of the fire department.

Review of building and fire protection system plans should be part of the ongoing training of both the on-site personnel and fire departments.

A tire fire can progress quickly through the phases described in the following paragraphs, and each phase presents different conditions to responding emergency personnel. Items for consideration in the emergency pre-planning program are provided for inclusion in such plans.

Observations at tire fire tests and accounts of actual fires have indicated that, while automatic sprinklers with adequate densities in approved configurations can control a fire, extinguishment by sprinklers alone normally does not occur. The four tests used also indicate that sprinkler protection can be overcome by the following:

(1) Storage exceeding the heights indicated in NFPA 13
(2) Storage configurations that inhibit the movement of heat to the roof, slowing sprinkler operation, and inhibit the waterflow to the seat of the fire, reducing sprinkler effectiveness

B.1.1 Incipient Stage. This stage occurs within 2 to 5 minutes of ignition.

Important: Drafts from open doors increase the intensity of the fire and make control difficult. Doors should be closed as quickly as possible to isolate the fire area.

Important: Fire tests indicate that smoke obscuration occurs within 6 to 9 minutes of ignition, even when the fire is sprinkler controlled. Breathing apparatus could be needed even before obscuration occurs.

If caught in the incipient stage, control can be achieved using interior hand hose and portable extinguishers. Quick reaction is essential, as this window of opportunity no longer exists within 2 to 5 minutes of actual ignition, since the generation of heat and smoke make the area untenable. Dry chemical extinguishers have been found to be most effective but should be backed up with small hose, as the knock-down is only temporary.

Tires in the affected area should be removed from storage. Tires removed from storage should be taken out of doors, thoroughly soaked, and left where they cannot expose other combustibles. The area where the fire occurred should be closely watched for several hours for rekindling.

While the first sprinkler can be expected to operate within the first 2 to 5 minutes of ignition, the updraft from the fire can disrupt the sprinkler pattern to such an extent that the water might not get to the seat of the fire. After the first 4 minutes, the fire has generally progressed beyond the stage where portable extinguishers are effective and, within minutes, the smoke and carbon monoxide make the area untenable. Vision is obscured, and any personnel without breathing apparatus is at risk.

B.1.2 Active Stage. The active stage of the fire follows the initial stage and is generally defined as that period where the sprinkler system is establishing control over the fire.

Important: Even though the fire is sprinkler controlled, roof temperatures resulting from the tire fires can reach temperatures high enough to cause steel joists to deflect and possibly fail. In recent fire tests, gas temperatures at roof level ranged between 1110°F and 1450°F (593°C and 788°C) for 10 minutes. Roof steel exposed to this high gas temperature could deflect or fail if subjected to additional loading. Do not place personnel on roof to attempt ventilation.

Important: Local fire departments attempting to draft from the sprinkler supply system will decrease the sprinkler effectiveness. If possible, separate municipal hydrants should be identified for fire department use.

Important: As the sprinklers gain control of the fire, the smoke will turn from black to gray. A return to black smoke is an indication that the sprinklers are not controlling the fire. Pump and system pressure also should be monitored. Loss of system pressure is an indication of more sprinklers operating, pump failure, or loss of control.

Responding local fire departments should be arriving by this time. Building personnel should advise arriving fire personnel of the location of all occupants of the building. At this point, there is little for the fire department to do except to connect to the municipal water supply and prepare to supplement the fire protection system through the fire department connection.

Fire department personnel or maintenance personnel, or both, should respond to the fire pump room and work to maintain operation of the fire pump. System discharge pressure should be observed to determine if the pressure is stable. Unstable or decreasing discharge pressure indicates changes in the operating conditions of the fire protection system.

During this stage, the building is untenable, and obscured vision makes the use of hose streams questionable. It should be noted that, in buildings with smoke vents, longer use of fire hose could be possible, but at some risk to personnel. It is best to allow the sprinklers to take control of the fire. Most of the sprinklers will begin to operate within 15 to 20 minutes of ignition, if sprinkler control is effected. Sprinklers should be allowed to operate at least 60 to 90 minutes to gain control. Successful fire tests indicate that waterflow stabilizes within the first 20 minutes of the fire.

The building is best left unventilated at this time. As control is gained, the smoke will change from black to gray and will diminish in intensity. During this period, at least six charged 1½ in. (38 mm) hose lines should be laid out preparatory to entering the building. Portable flood lights should be secured as well as turn-out gear, breathing apparatus, and forklifts for the overhaul crew.

B.1.3 Critical Stage. The critical stage occurs between the final extinguishment and the ventilation of the building.

Important: Ventilation should be done slowly, and the sprinklers should be left in operation. A return to black smoke is an indication that control is being lost. If this happens, ventilation should cease, the building should be closed, and the sprinkler system should be allowed to regain control. It should be understood that, during the attempt to ventilate the building, the fire intensity can increase due to the addition of outside air. Additional sprinklers can be expected to operate during the ventilation effort. If control has been gained, extra sprinklers might make no difference in overall performance. If control has not been gained or is marginal, this increase in the number of operating sprinklers could make regaining control more difficult due to the overall increase in sprinkler demand. Unless there is a system failure, the sprinklers should regain control. If there is any doubt that control of the fire has been gained, the sprinkler system should be allowed to soak the fire for longer than 90 minutes.

Important: The officer in charge should have a contingency plan if control is lost due to a system failure. In the event that control of the fire is lost, as evidenced by such indicators as increasing smoke generation, loss of pressure at the fire pump discharge (indicating massive sprinkler operation), or collapsing roof, efforts should be directed toward preventing the spread of the fire beyond the area bounded by the fire walls. At this point, consideration should be given to shutting off the sprinklers in the fire area to provide water for protecting the exposures.

After 60 to 90 minutes and when the smoke intensity has diminished, the building should be ventilated around the periphery of the fire area. If control has been gained, the roof temperature will usually have cooled sufficiently to allow roof vents to be opened manually if they have not already opened automatically.

B.1.4 Overhaul. Although visible fire is no longer present, overhaul of the area of the fire should be conducted to be certain of complete extinguishment.

Important: Care should be taken that the hose streams do not lower the pressure or water supply to the sprinkler system. Sprinkler operation should cease only when the fire chief is certain that hoses can control the fire.

Important: Caution should be used, since the tire piles will be unstable.

As soon as the smoke clears to the extent that the building can be entered, entry should be made using small hose streams that should be directed into the burning tires. Sprinklers should be kept in operation during this period.

Forklifts and other means should be used to remove the tires from the fire area to outside the building. It usually is necessary to keep the sprinklers in operation during this procedure at least until there is no evidence of flame. Patrols should be made of the affected area for at least 24 hours following the fire.

Following fire extinguishment, all fire protection systems should be restored to service as quickly as possible. These systems include but are not limited to the following:

(1) Sprinkler systems
(2) Alarm systems
(3) Pumps
(4) Water supplies

B.2 Use of High-Expansion Foam. If a high-expansion foam system is used in connection with automatic sprinklers, sprinklers can be shut off 1 hour after ignition, and foam can soak the fire for an additional hour before the building is opened and overhaul is begun. Limited tests with high-expansion foam indicate that fire extinguishment is largely complete after a period of soaking in foam. As a precautionary measure, charged hose streams should be available when foam is drained away.

After the initial fill, foam generators should be operated periodically during the soaking period to maintain the foam level. This procedure is necessary since sprinklers and products of combustion will cause partial foam breakdown.

Annex C Informational References

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

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

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2013 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2013 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2013 edition.

NFPA 901, *Standard Classifications for Incident Reporting and Fire Protection Data*, 2011 edition.

NFPA 1142, *Standard on Water Supplies for Suburban and Rural Fire Fighting*, 2012 edition.

C.1.2 Other Publications. (Reserved)

C.2 Informational References. (Reserved)

C.3 References for Extracts in Informational Sections. (Reserved)

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