NFPA® 13D

Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

2010 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA® DOCUMENTS
NOTICE AND DISCLAIMER OF LIABILITY CONCERNING THE USE OF NFPA DOCUMENTS

NFPA® codes, standards, recommended practices, and guides ("NFPA Documents"), of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in NFPA Documents.

The NFPA disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on NFPA Documents. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making NFPA Documents available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of NFPA Documents. Nor does the NFPA list, certify, test, or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.

IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA DOCUMENTS

ADDITIONAL NOTICES AND DISCLAIMERS

Updating of NFPA Documents

Users of NFPA codes, standards, recommended practices, and guides ("NFPA Documents") should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of Tentative Interim Amendments. An official NFPA Document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments and any Errata then in effect. In order to determine whether a given document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments or corrected through the issuance of Errata, consult appropriate NFPA publications such as the National Fire Codes® Subscription Service, visit the NFPA website at www.nfpa.org, or contact the NFPA at the address listed below.

Interpretations of NFPA Documents

A statement, written or oral, that is not processed in accordance with Section 6 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Patents

The NFPA does not take any position with respect to the validity of any patent rights referenced in, related to, or asserted in connection with an NFPA Document. The users of NFPA Documents bear the sole responsibility for determining the validity of any such patent rights, as well as the risk of infringement of such rights, and the NFPA disclaims liability for the infringement of any patent resulting from the use of or reliance on NFPA Documents.

NFPA adheres to the policy of the American National Standards Institute (ANSI) regarding the inclusion of patents in American National Standards ("the ANSI Patent Policy"), and hereby gives the following notice pursuant to that policy:

NOTICE: The user's attention is called to the possibility that compliance with an NFPA Document may require use of an invention covered by patent rights. NFPA takes no position as to the validity of any such patent rights or as to whether such patent rights constitute or include essential patent claims under the ANSI Patent Policy. If, in connection with the ANSI Patent Policy, a patent holder has filed a statement of willingness to grant licenses under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license, copies of such filed statements can be obtained, on request, from NFPA. For further information, contact the NFPA at the address listed below.

Law and Regulations

Users of NFPA Documents should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of its codes, standards, recommended practices, and guides, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

NFPA Documents are copyrighted by the NFPA. They are made available for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of safe practices and methods. By making these documents available for use and adoption by public authorities and private users, the NFPA does not waive any rights in copyright to these documents.

Use of NFPA Documents for regulatory purposes should be accomplished through adoption by reference. The term "adoption by reference" means the citing of title, edition, and publishing information only. Any deletions, additions, and changes desired by the adopting authority should be noted separately in the adopting instrument. In order to assist NFPA in following the uses made of its documents, adopting authorities are requested to notify the NFPA (Attention: Secretary, Standards Council) in writing of such use. For technical assistance and questions concerning adoption of NFPA Documents, contact NFPA at the address below.

For Further Information

All questions or other communications relating to NFPA Documents and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA documents during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, NFPA, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101; email: stds_admin@nfpa.org

For more information about NFPA, visit the NFPA website at www.nfpa.org.

NFPA® 13D

Standard for the

Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

2010 Edition

This edition of NFPA 13D, *Standard for Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, was prepared by the Technical Committee on Residential Sprinkler Systems and released by the Technical Correlating Committee on Automatic Sprinkler Systems, and acted on by NFPA at its June Association Technical Meeting held June 8-11, 2009, in Chicago, IL. It was issued by the Standards Council on August 6, 2009, with an effective date of August 26, 2009, and supersedes all previous editions.

This edition of NFPA 13D was approved as an American National Standard on August 26, 2009.

Origin and Development of NFPA 13D

Recognizing the need to reduce the annual life loss from fire in residential occupancies (about 50 percent of total loss of life by fire), the Committee on Automatic Sprinklers appointed a subcommittee in May 1973 to prepare the *Standard on the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes*. The subcommittee was composed of members of the Committee on Automatic Sprinklers and other technically competent experts. The standard was submitted and adopted at the NFPA Annual Meeting in Chicago, Illinois, on May 12–16, 1975.

The 1980 edition was a complete rewrite of the 1975 edition, including SI units where appropriate. The 1980 edition incorporated the results of the residential sprinkler test program administered by the National Fire Protection Association and funded by a research grant from the United States Fire Administration. Factory Mutual Research Corporation and the Los Angeles City Fire Department conducted the dwelling tests. Factory Mutual Research Corporation, McNeary Insurance Consulting Services, and the Charlotte, North Carolina, Fire Department conducted the mobile home tests.

After gaining practical experience using the 1980 edition, modifications to the standard, including removal of design parameters for dry pipe systems, were made in the 1984 edition.

The 1989 and 1991 editions established criteria for the use of antifreeze systems as well as some of the installation criteria associated with specially listed piping materials.

The 1994 edition provided expanded information on nonmetallic pipe and introduced a new design option that reduced water storage requirements for limited area dwellings.

The 1996 edition of the standard included expanded information on the use and placement of residential sprinklers near heat sources. For the first time since 1941, the use of ½ in. (12.7 mm) piping material was permitted again for sprinkler systems under specific conditions. A number of appendix figures were also added to address methods for protecting pipe from freezing in unheated attics.

The 1999 edition revised criteria for certain types of multipurpose piping systems and added requirements to mitigate the effect of water softeners and filters on system performance. Information on the application of solvent cement for nonmetallic piping systems was provided, and the exception for omitting sprinkler coverage in attics and crawl spaces was modified.

The 2002 edition incorporated revisions to update the standard to comply with the 2000 edition of the *Manual of Style for NFPA Technical Committee Documents*. These revisions included editorially rewording any exceptions as requirements. The 2002 edition also included changes that established a minimum design discharge density. The requirements for multipurpose systems were changed to require a bypass valve for installations with water softeners or water filtration equipment installed and to update the requirements for network systems. The chapter specifically addressing limited area dwelling systems was no longer included in the standard.

The 2007 edition included new spacing and obstruction rules addressing sloped ceilings, ceiling pockets, ceiling fans, and kitchen cabinets. Also new to this edition were installation, design, and acceptance requirements for pumps. The acceptability of insulation as a method of freeze protection and the acceptability of wells as a water source were clarified for this edition. New requirements for listed dry pipe/preaction residential sprinkler systems, as well as clarified requirements for multipurpose combined and networked sprinkler systems, were incorporated. Finally, specific obstruction rules were added for residential sprinklers.

In the 2010 edition new requirements have been added for a prescriptive pipe sizing method as an alternative to the hydraulic calculation method. The standard added the term *townhouses* to the definition of *dwelling* in order to clarify that townhouses that meet the definition of *dwelling* can be protected by an NFPA 13D system. Finally, there is annex material added to provide clear guidance for the owner on how to properly inspect, test, and maintain the system.

Technical Correlating Committee on Automatic Sprinkler Systems (AUT-AAC)

Edward K. Budnick, *Chair*
Hughes Associates, Inc., MD [SE]

James D. Lake, *Administrative Secretary*
National Fire Protection Association, MA

Jose R. Baz, JRB Associates Group Inc., FL [M]
Rep. NFPA Latin American Section
Kerry M. Bell, Underwriters Laboratories Inc., IL [RT]
Russell P. Fleming, National Fire Sprinkler Association, Inc., NY [M]
Scott T. Franson, The Viking Corporation, MI [M]
Michael J. Friedman, Friedman Consulting, Inc., MD [SE]
Raymond A. Grill, Arup Fire, DC [SE]
Luke Hilton, Liberty Mutual Property, NC [I]
Alex Hoffman, Viking Fire Protection Inc., Canada [IM]
Rep. Canadian Automatic Sprinkler Association
Roland J. Huggins, American Fire Sprinkler Association, Inc., TX [IM]
Sultan M. Javeri, SC Engineering, France [IM]
Charles W. Ketner, National Automatic Sprinkler Fitters LU 669, MD [L]
Rep. United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry
Andrew Kim, National Research Council of Canada, Canada [RT]
Russell B. Leavitt, TVA Fire and Life Safety, Inc., AZ [U]
Rep. Trinity Health
John G. O'Neill, The Protection Engineering Group, PC, VA [SE]
Chester W. Schirmer, Schirmer Engineering Corporation, NC [I]
J. William Sheppard, General Motors Corporation, MI [U]
Robert D. Spaulding, FM Global, MA [I]
Douglas Paul Stultz, U.S. Department of the Navy, VA [E]
Lynn K. Underwood, Axis U.S. Property, IL [I]

Alternates

Donald D. Becker, RJC & Associates, Inc., MO [IM]
(Alt. to R. J. Huggins)
Thomas C. Brown, The RJA Group, Inc., MD [SE]
(Alt. to R. A. Grill)
David B. Fuller, FM Global, MA [I]
(Alt. to R. D. Spaulding)
Kenneth E. Isman, National Fire Sprinkler Association, Inc., NY [M]
(Alt. to R. P. Fleming)
George E. Laverick, Underwriters Laboratories Inc., IL [RT]
(Alt. to K. M. Bell)
Ernest (Russ) Mower, TVA Fire and Life Safety, Inc., TX [U]
(Alt. to R. B. Leavitt)
Garner A. Palenske, Schirmer Engineering Corporation, CA [I]
(Alt. to C. W. Schirmer)
Donato A. Pirro, Electro Sistemas De Panama, S.A., Panama [M]
(Alt. to J. R. Baz)
J. Michael Thompson, The Protection Engineering Group, PC, VA [SE]
(Alt. to J. G. O'Neill)

Nonvoting

James B. Biggins, Marsh Risk Consulting, IL [I]
Rep. TC on Private Water Supply Piping Systems
Antonio C. M. Braga, FM Global, CA [I]
Rep. TC on Hanging & Bracing of Water-Based Systems
Robert M. Gagnon, Gagnon Engineering, MD [SE]
Rep. TC on Foam-Water Sprinklers
William E. Koffel, Koffel Associates, Inc., MD [SE]
Rep. Safety to Life Correlating Committee
Kenneth W. Linder, Swiss Re, CT [I]
Rep. TC on Sprinkler System Discharge Criteria
Joe W. Noble, Noble Consulting Services, LLC, NV [E]
Rep. TC on Sprinkler System Installation Criteria
Maurice M. Pilette, Mechanical Designs Ltd., MA [SE]
Rep. TC on Residential Sprinkler Systems
John J. Walsh, UA Joint Apprenticeship Committee, MD [SE]
(Member Emeritus)

James D. Lake, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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

Committee Scope: This Committee shall have overall responsibility for documents that pertain to the criteria for the design and installation of automatic, open and foam-water sprinkler systems including the character and adequacy of water supplies, and the selection of sprinklers, piping, valves, and all materials and accessories. This Committee does not cover the installation of tanks and towers, nor the installation, maintenance, and use of central station, proprietary, auxiliary, and local signaling systems for watchmen, fire alarm, supervisory service, nor the design of fire department hose connections.

Technical Committee on Residential Sprinkler Systems (AUT-RSS)

Maurice M. Pilette, *Chair*
Mechanical Designs Ltd., MA [SE]

James D. Lake, *Administrative Secretary*
National Fire Protection Association, MA

George W. Baker, Mashpee Fire & Rescue Department, MA [E]
Rep. International Association of Fire Chiefs
Kerry M. Bell, Underwriters Laboratories Inc., IL [RT]
Fred Benn, Advanced Automatic Sprinkler, Inc., CA [IM]
Jonathan C. Bittenbender, REHAU Inc., VA [M]
Frederick C. Bradley, FCB Engineering, GA [SE]
Phillip A. Brown, American Fire Sprinkler Association, Inc., TX [IM]
Thomas G. Deegan, The Viking Group, Inc., MI [M]
Rep. National Fire Sprinkler Association
Dana R. Haagensen, Massachusetts Office of the State Fire Marshal, MA [E]
Mark Hopkins, Hughes Associates, Inc., MD [SE]
Kenneth E. Isman, National Fire Sprinkler Association, Inc., NY [M]
Gary L. Johnson, Lubrizol, VA [M]
Rep. Committee for Firesafe Dwellings
Charles W. Ketner, National Automatic Sprinkler Fitters LU 669, MD [L]
Rep. United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry
David Killey, Fire Busters Incorporated, Canada [IM]
Rep. Canadian Automatic Sprinkler Association
Ronald G. Nickson, National Multi Housing Council, DC [U]
Steven Orlowski, National Association of Home Builders, DC [U]
Steven R. Rians, Standard Automatic Fire Enterprises, Inc., TX [IM]
Rep. American Fire Sprinkler Association
Chester W. Schirmer, Schirmer Engineering Corporation, NC [I]
Harry Shaw, Fail Safe Safety Systems Inc., MD [M]
Sandra Stanek, Fire Code Consultants, CA [E]
Rep. California Fire Chiefs Association
George W. Stanley, Wiginton Fire Systems, FL [IM]
Rep. National Fire Sprinkler Association
Randolph W. Tucker, The RJA Group, Inc., TX [SE]
Ed Van Walraven, Aspen Fire Protection District, CO [E]
Terry L. Victor, Tyco/SimplexGrinnell, MD [M]
Hong-Zeng Yu, FM Global, MA [I]

Alternates

David W. Ash, Lubrizol Advanced Materials, Inc., OH [M]
(Alt. to G. L. Johnson)
Lawrence Brown, National Association of Home Builders, DC [U]
(Alt. to S. Orlowski)
Edward K. Budnick, Hughes Associates, Inc., MD [SE]
(Alt. to M. Hopkins)
Michael F. Cabral, REHAU Inc., VA [M]
(Alt. to J. C. Bittenbender)
James K. Clancy, The RJA Group, Inc., CA [SE]
(Alt. to R. W. Tucker)
Mark E. Fessenden, Tyco Fire Suppression and Building Products, RI [M]
(Alt. to T. L. Victor)
David B. Fuller, FM Global, MA [I]
(Alt. to H.-Z. Yu)
Timothy C. Higgins, Aegis Fire Systems, Inc., CA [IM]
(Alt. to P. A. Brown)
George E. Laverick, Underwriters Laboratories Inc., IL [RT]
(Alt. to K. M. Bell)
Stephen M. Leyton, Protection Design and Consulting, CA [IM]
(Alt. to S. R. Rians)
Thomas L. Multer, Reliable Automatic Sprinkler Company, Inc., SC [M]
(Alt. to T. G. Deegan)
Matthew Osburn, Canadian Automatic Sprinkler Association, Canada [IM]
(Alt. to D. Killey)
Peter T. Schwab, Wayne Automatic Fire Sprinklers, Inc., FL [IM]
(Alt. to G. W. Stanley)
Ronald N. Webb, S.A. Comunale Company, Inc., OH [M]
(Alt. to K. E. Isman)
James V. C. Yates, West Windsor Emergency Services, NJ [E]
(Alt. to G. W. Baker)

Nonvoting

Rohit Khanna, U.S. Consumer Product Safety Commission, MD [C]
M. Larry Maruskin, U.S. Department of Homeland Security, MD [C]
Lawrence A. McKenna, Jr., U.S. Department of Homeland Security, MD [C]
(Alt. to Nonvoting Member M.L. Maruskin)

James D. Lake, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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

Committee Scope: This Committee shall have primary responsibility for documents on the design and installation of automatic sprinkler systems in dwellings and residential occupancies up to and including four stories in height, including the character and adequacy of water supplies, and the selection of sprinklers, piping, valves, and all materials and accessories.

Contents

NFPA 13D

Standard for the

Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

2010 Edition

IMPORTANT NOTE: This NFPA document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading "Important Notices and Disclaimers Concerning NFPA Documents." They can also be obtained on request from NFPA or viewed at www.nfpa.org/disclaimers.

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

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

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 B. 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 shall be sent to the technical committee responsible for the source document.

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

Chapter 1 Administration

1.1* Scope.

1.1.1 This standard shall cover the design, installation, and maintenance of automatic sprinkler systems for protection against the fire hazards in one- and two-family dwellings and manufactured homes.

1.1.2 This standard assumes that the sprinkler system is designed to protect against a fire originating from a single ignition location.

1.2* Purpose.

1.2.1 The purpose of this standard shall be to provide a sprinkler system that aids in the detection and control of residential fires and thus provides improved protection against injury and life loss.

1.2.2 A sprinkler system designed and installed in accordance with this standard shall be expected to prevent flashover (total involvement) in the room of fire origin, where sprinklered, and to improve the chance for occupants to escape or be evacuated.

1.3 Retroactivity. The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time the standard was issued.

1.3.1 Unless otherwise specified, the provisions of this standard shall not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the standard. Where specified, the provisions of this standard shall be retroactive.

1.3.2 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.3.3 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided.

1.4 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.5 Units.

1.5.1* Metric units of measurement in this standard shall be in accordance with the modernized metric system known as the International System of Units (SI).

1.5.2 The liter and bar units shall be permitted to be used in this standard.

1.5.3 The conversion factors for liter, pascal, and bar shall be in accordance with Table 1.5.3.

Table 1.5.3 Metric Conversions

Name of Unit	Unit Symbol	Conversion Factor
liter	L	1 gal = 3.785 L
pascal	Pa	1 psi = 6894.757 Pa
bar	bar	1 psi = 0.0689 bar
bar	bar	1 bar = 10^5 Pa

1.5.4* Where a value for measurement as specified in this standard is followed by an equivalent value in other units, the first stated value shall be regarded as the requirement.

1.5.5 The equivalent value for a measurement in SI shall be converted by multiplying the value by the conversion factor and then rounding the result to the appropriate number of significant digits.

1.6 New Technology.

1.6.1 Nothing in this standard shall be intended to restrict new technologies or alternate arrangements, provided the level of safety prescribed by this standard is not lowered.

1.6.2 Materials or devices not specifically designated by this standard shall be utilized in complete accord with all conditions, requirements, and limitations of their listings.

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 13, *Standard for the Installation of Sprinkler Systems*, 2010 edition.

NFPA 72®, National Fire Alarm and Signaling Code, 2010 edition.

NFPA 220, *Standard on Types of Building Construction*, 2009 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI B36.10M, *Welded and Seamless Wrought Steel Pipe*, 2004.

2.3.2 ASME Publications. American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

ASME B16.1, *Cast Iron Pipe Flanges and Flanged Fittings*, 1998.

ASME B16.3, *Malleable Iron Threaded Fittings*, 2006.

ASME B16.4, *Gray Iron Threaded Fittings*, 1998.

ASME B16.5, *Pipe Flanges and Flanged Fittings*, 2003.

ASME B16.9, *Factory-Made Wrought Steel Buttwelding Fittings*, 2007.

ASME B16.11, *Forged Fittings, Socket-Welding and Threaded*, 2001.

ASME B16.18, *Cast Copper Alloy Solder Joint Pressure Fittings*, 2001.

ASME B16.22, *Wrought Copper and Copper Alloy Solder Joint Pressure Fittings*, 2001.

ASME B16.25, *Buttwelding Ends*, 1997.

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

ASTM A 53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, 2007.

ASTM A 135, *Standard Specification for Electric-Resistance-Welded Steel Pipe*, 2006.

ASTM A 234, *Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperatures*, 2007.

ASTM A 795, *Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use*, 2008.

ASTM B 32, *Standard Specification for Solder Metal*, 2008.

ASTM B 75, *Standard Specification for Seamless Copper Tube*, 2002.

ASTM B 88, *Standard Specification for Seamless Copper Water Tube*, 2003.

ASTM B 251, *Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube*, 2002.

ASTM B 813, *Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper-Alloy Tube*, 2009.

ASTM B 828, *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings*, 2002.

ASTM F 437, *Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*, 2006.

ASTM F 438, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40*, 2004.

ASTM F 439, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*, 2006.

ASTM F 442, *Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)*, 2005.

2.3.4 AWS Publications. American Welding Society, 550 NW LeJeune Road, Miami, FL 33126.

AWS A5.8, *Specification for Filler Metals for Brazing and Braze Welding*, 2004.

2.3.5 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2010 edition.

NFPA 5000®, Building Construction and Safety Code®, 2009 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.

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 Shall. Indicates a mandatory requirement.

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

3.2.7 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. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Compartment. A space completely enclosed by walls and a ceiling. Each wall in the compartment is permitted to have openings to an adjoining space if the openings have a minimum lintel depth of 8 in. (203 mm) from the ceiling and the total width of the openings in a single wall does not exceed 8 ft (2.44 m) in width. A single opening of 36 in. (914 mm) or less in width without a lintel is permitted when there are no other openings to adjoining spaces.

3.3.2 Design Discharge. The rate of water discharged by an automatic sprinkler expressed in gpm (mm/min).

3.3.3 Dwelling. Any detached building, or any part of a townhouse structure that is separated from the remainder of the townhouse structure with fire resistance rated assemblies in accordance with local building code, that contains no more than two dwelling units intended to be used, rented, leased, let, or hired out to be occupied or that are occupied for habitation purposes.

3.3.4 Dwelling Unit. One or more rooms, arranged for the use of one or more individuals living together, as in a single housekeeping unit, that normally have cooking, living, sanitary, and sleeping facilities.

3.3.5* Manufactured Home. A structure, transportable in one or more sections, which, in the traveling mode, is 8 body-ft (2.4 m) or more in width or 40 body-ft (12.2 m) or more in length or, when erected on site, is 320 ft^2 (29.7 m^2) or more and which is built on a permanent chassis and designed to be used as a dwelling, with or without a permanent foundation, when connected to the required utilities, and includes plumbing, heating, air-conditioning, and electrical systems contained therein; except that such terms include any structure that meets all the requirements of this paragraph except the size requirements and with respect to which the manufacturer voluntarily files a certification required by the regulatory agency. Calculations used to determine the number of square feet in a structure are based on the structure's exterior dimensions, measured at the largest horizontal projections when erected on site. These dimensions include all expandable rooms, cabinets, and other projections containing interior space, but do not include bay windows.

3.3.6 Pressure.

3.3.6.1 ***Supply Pressure.*** The pressure within the supply (e.g., city or private supply water source).

3.3.6.2 ***System Pressure.*** The pressure within the system (e.g., above the control valve).

3.3.6.3 ***System Working Pressure.*** The maximum anticipated static (nonflowing) or flowing pressure applied to sprinkler system components exclusive of surge pressures.

3.3.7 Pump. A mechanical device that transfers or raises, or transfers and raises, the pressure of a fluid (water).

3.3.8 Sprinkler.

3.3.8.1 ***Automatic Sprinkler.*** A fire suppression or control device that operates automatically when its heat-actuated element is heated to its thermal rating or above, allowing water to discharge over a specific area.

3.3.8.2 ***Residential Sprinkler.*** A type of fast-response sprinkler having a thermal element with an RTI of 50 $(meters\text{-}seconds)^{1/2}$ or less, that has been specifically investigated for its ability to enhance survivability in the room of fire origin, and that is listed for use in the protection of dwelling units.

3.3.9 Systems.

3.3.9.1 ***Antifreeze Sprinkler System.*** A wet pipe sprinkler system employing automatic sprinklers that are attached to a system that contains an antifreeze solution and that are connected to a water supply. The antifreeze solution, followed by water, discharges immediately from sprinklers opened by a fire.

3.3.9.2 ***Dry Pipe Sprinkler System.*** A sprinkler system employing automatic sprinklers that are attached to a piping system containing air or nitrogen under pressure, the release of which (as from the opening of a sprinkler) permits the water pressure to open a valve known as a dry pipe valve, and the water then flows into the piping system and out the opened sprinkler.

3.3.9.3* *Multipurpose Piping System.* A piping system intended to serve both domestic and fire protection needs.

3.3.9.4* *Network System.* A type of multipurpose system utilizing a common piping system supplying domestic fixtures and fire sprinklers where each sprinkler is supplied by a minimum of three separate paths.

3.3.9.5 ***Preaction Sprinkler System.*** A sprinkler system employing automatic sprinklers that are attached to a piping system that contains air that might or might not be under pressure, with a supplemental detection system installed in the same areas as the sprinklers.

3.3.9.6 ***Preengineered System.*** A packaged sprinkler system including all components connected to the water supply and designed to be installed according to pretested limitations.

3.3.9.7 ***Sprinkler System.*** For fire protection purposes, an integrated system of underground and overhead piping designed in accordance with fire protection engineering standards. The installation includes one or more automatic water supplies. The portion of the sprinkler system aboveground is a network of specially sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to which sprinklers are attached in a systematic pattern. The system is usually activated by heat from a fire and discharges water over the fire area.

3.3.9.8 ***Wet Pipe Sprinkler System.*** A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire.

3.3.10 Townhouse. A one-family dwelling constructed in attached groups of three or more units in which each unit extends from the foundation to the roof and has open space on at least two sides. [**5000**, 2009]

3.3.11 Valve.

3.3.11.1 ***Check Valve.*** A valve that allows flow in one direction only.

3.3.11.2* ***Control Valve.*** An indicating valve employed to control (shut) a supply of water to a sprinkler system.

3.3.12 Waterflow Alarm. A sounding device activated by a waterflow detector or alarm check valve.

3.3.13 Waterflow Detector. An electric signaling indicator or alarm check valve actuated by waterflow in one direction only.

Chapter 4 General Requirements

4.1 Maintenance.

4.1.1* The installer shall provide to the owner/occupant instructions on inspecting, testing, and maintaining the system.

4.1.2 Operated or damaged sprinklers shall be replaced with sprinklers having the same performance characteristics as the original equipment.

4.1.3 Any sprinklers that have been painted outside of the factory shall be replaced with a new listed sprinkler.

4.1.4* Antifreeze Systems. Before freezing weather each year, the following procedure shall be performed:

(1) Empty solution in the entire antifreeze system into convenient containers
(2) Bring solution to the proper specific gravity by adding concentrated liquid as needed, or prepare a new solution, in accordance with 8.3.3
(3) Refill system with the new or remixed solution

4.2* Hydrostatic Tests.

4.2.1 Where a fire department pumper connection is not provided, the system shall be hydrostatically tested for leakage at normal system operating pressure.

4.2.2 Where a fire department pumper connection is provided, the system shall pass a hydrostatic pressure test performed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems.*

4.3 Sprinkler Temperature Ratings.

4.3.1 Sprinklers having a temperature rating of 135°F to 170°F (57°C to 77°C) shall be classified as ordinary temperature–rated sprinklers.

4.3.2 Sprinklers having a temperature rating of 175°F to 225°F (79°C to 107°C) shall be classified as intermediate temperature–rated sprinklers.

4.4 Tube. Wherever the word *pipe* is used in this standard, it shall also mean *tube.*

4.5 Listed or Labeled. Listed or labeled devices and materials shall be installed and used in accordance with the listing limitations and the manufacturers' instructions unless permitted by other sections of this document.

4.6 Smoke Alarms. Smoke alarms shall be provided in accordance with *NFPA 72, National Fire Alarm and Signaling Code.*

4.7* Documentation. Documentation shall be available upon request to ensure adequate water supply, listed devices, and adequate sprinkler coverage have been addressed.

4.8 Qualifications. The layout, calculation, and installation of sprinkler systems installed in accordance with this standard shall only be performed by people knowledgeable and trained in such systems.

Chapter 5 System Components

5.1 General.

5.1.1* Only new sprinklers shall be installed in sprinkler systems.

5.1.2 Devices and materials used in sprinkler systems shall be listed unless permitted not to be by 5.1.3.

5.1.3 Tanks, expansion tanks, pumps, hangers, waterflow detection devices, and waterflow valves shall not be required to be listed.

5.2 Aboveground Pipe and Equipment.

5.2.1* Pipe or tube used in sprinkler systems shall be of the materials specified in Table 5.2.1.1 or shall be in accordance with 5.2.2.

5.2.1.1 The chemical properties, physical properties, and dimensions of pipe materials shall be at least equivalent to the standards cited in Table 5.2.1.1.

5.2.1.2 Pipe used in sprinkler systems other than those addressed in 5.2.1.3 shall be designed to withstand a working pressure of not less than 175 psi (12.1 bar).

5.2.1.3 Nonmetallic pipe used in multipurpose piping systems not equipped with a fire department connection shall be designed to withstand a working pressure of not less than 130 psi (8.9 bar) at 120°F (49°C).

5.2.2 Types of pipe other than those specified in Table 5.2.1.1 shall be permitted to be used where listed for sprinkler system use.

5.2.2.1 Pipe differing from those specified in Table 5.2.1.1 shall be installed in accordance with their listings and the manufacturers' installation instructions.

5.2.2.2* Chlorinated polyvinyl chloride (CPVC) pipe shall comply with the portions of the American Society for Testing and Materials (ASTM) standards specified in Table 5.2.2.2 that apply to fire protection service.

5.2.3 Schedule 10 steel pipe shall be permitted to be joined with mechanical groove couplings approved for service.

5.2.4* Where mechanical groove couplings are used to join pipe, grooves shall be rolled on the pipe by an approved groove-rolling machine.

5.2.5 Fittings used in sprinkler systems shall be of the materials listed in Table 5.2.5 or shall be in accordance with 5.2.9.

Table 5.2.1.1 Pipe or Tube Materials and Dimensions

Materials and Dimensions	Standard
Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use	ASTM A 795
Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless	ASTM A 53
Welded and Seamless Wrought Steel Pipe	ANSI B36.10M
Standard Specification for Electric-Resistance-Welded Steel Pipe	ASTM A 135
Standard Specification for Seamless Copper Tube [Copper Tube (Drawn, Seamless)]	ASTM B 75
Standard Specification for Seamless Copper Water Tube	ASTM B 88
Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	ASTM B 251
Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper-Alloy Tube	ASTM B 813
Specification for Filler Metals for Brazing and Braze Welding (BCuP, copper-phosphorus, or copper-phosphorus-silver brazing filler metal)	AWS A5.8
Standard Specification for Solder Metal [alloy grades containing less than 0.2 percent lead as identified in ASTM B 32, Table 5, Section 1, and having a solidus temperature that exceeds 400°F (204°C)]	ASTM B 32

Table 5.2.2.2 Specially Listed Pipe or Tube Materials and Dimensions

Materials and Dimensions	Standard
Nonmetallic Piping:	
Standard Specification for Chlorinated Poly (Vinyl) Chloride (CPVC) Pipe	ASTM F 442

5.2.5.1 The chemical properties, physical properties, and dimensions of fitting materials shall be at least equivalent to the standards cited in Table 5.2.5.

5.2.5.2 Fittings used in sprinkler systems other than those addressed in 5.2.5.3 shall be designed to withstand a working pressure of not less than 175 psi (12.1 bar).

5.2.5.3 Nonmetallic fittings used in multipurpose piping systems not equipped with a fire department connection shall be designed to withstand a working pressure of not less than 130 psi (8.9 bar) at 120°F (49°C).

5.2.6 Joints for the connection of copper tube shall be brazed on dry pipe and preaction systems.

Table 5.2.5 Fitting Materials and Dimensions

Materials and Dimensions	Standard
Cast Iron:	
Gray Iron Threaded Fittings	ASME B16.4
Cast Iron Pipe Flanges and Flanged Fittings	ASME B16.1
Malleable Iron:	
Malleable Iron Threaded Fittings	ASME B16.3
Steel:	
Factory-Made Wrought Steel Buttwelding Fittings	ASME B16.9
Buttwelding Ends	ASME B16.25
Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperatures	ASTM A 234
Pipe Flanges and Flanged Fittings	ASME B16.5
Forged Fittings, Socket-Welding and Threaded	ASME B16.11
Copper:	
Wrought Copper and Copper Alloy Solder Joint Pressure Fittings	ASME B16.22
Cast Copper Alloy Solder Joint Pressure Fittings	ASME B16.18

5.2.7 Joints for the connection of copper tube for wet pipe systems and antifreeze systems shall be solder joints or be brazed.

5.2.8 Solder joints, where permitted, shall be fabricated in accordance with the methods and procedures listed in ASTM B 828, *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.*

5.2.9 Types of fittings other than those specified in Table 5.2.5 shall be permitted to be used where listed for sprinkler system use.

5.2.9.1 Fittings differing from those specified in Table 5.2.5 shall be installed in accordance with their listings and the manufacturers' installation instructions.

5.2.9.2* Chlorinated polyvinyl chloride (CPVC) fittings shall comply with the portions of the American Society for Testing and Materials (ASTM) standards specified in Table 5.2.9.2 that apply to fire protection service.

Table 5.2.9.2 Specially Listed Fittings Materials and Dimensions

Materials and Dimensions	Standard
Standard Specification for Schedule 80 CPVC Threaded Fittings	ASTM F 437
Standard Specification for Schedule 40 CPVC Socket-Type Fittings	ASTM F 438
Standard Specification for Schedule 80 CPVC Socket-Type Fittings	ASTM F 439

5.2.10 Other joining methods investigated for suitability in automatic sprinkler installations and listed for this service shall be permitted.

5.3* Underground Pipe. Any type of pipe or tube acceptable under the applicable plumbing code for underground supply pipe shall be acceptable as underground supply for fire sprinkler system when installed between the point of connection and the system riser.

5.4 Pre-engineered Systems. Where listed pre-engineered systems are installed, they shall be installed within the limitations that have been established by the testing laboratories.

Chapter 6 Water Supply

6.1 General Provisions.

6.1.1 Every automatic sprinkler system shall have at least one automatic water supply.

6.1.2 Where stored water is used as the sole source of supply, the minimum quantity shall equal the water demand rate times 10 minutes unless permitted otherwise by 6.1.3.

6.1.3 Where stored water is used as the sole source of supply, the minimum quantity shall be permitted to equal the two sprinkler water demand rate times 7 minutes where dwelling units meet the following criteria:

(1) One story in height
(2) Less than 2000 ft^2 (186 m^2) in area

6.1.4 The stored water requirement of 6.1.2 or 6.1.3 shall be permitted to be a combination of the water in the well (including the refill rate) plus the water in the holding tank if such tank can supply the sprinkler system.

6.2* Water Supply Sources. The following water supply sources shall be considered to be acceptable by this standard:

(1) A connection to a reliable waterworks system with or without an automatically operated pump
(2) An elevated tank
(3) A pressure tank designed to American Society of Mechanical Engineers (ASME) standards for a pressure vessel with a reliable pressure source
(4) A stored water source with an automatically operated pump
(5) A well with a pump of sufficient capacity and pressure to meet the sprinkler system demand

6.2.1* Prior to system acceptance, a system utilizing a pump shall be tested by opening the drain/test connection.

6.2.1.1 The pump shall sense the flow, turn on, and flow water for the required duration of 6.1.2 or 6.1.3 without interruption.

6.2.2 Where a pump and tank is the source of supply for a fire sprinkler system but is not a portion of the domestic water system, the following shall be met:

(1) A test connection shall be provided downstream of the pump that creates a flow of water equal to the smallest sprinkler on the system. The connection shall return water to the tank.
(2) Pump motors using ac power shall be connected to a 240 V normal circuit.
(3) Any disconnecting means for the pump shall be approved.
(4) A method for refilling the tank shall be piped to the tank.
(5) A method of seeing the water level in the tank shall be provided without having to open the tank.
(6) The pump shall not be permitted to sit directly on the floor.

6.2.3* Where more than one dwelling unit is served by the same water supply pipe, each dwelling unit shall have an individual control valve that serves the fire sprinkler system in that dwelling unit and the owner shall have access to the valve that controls the sprinkler system in their unit.

6.2.3.1 The control valve shall be permitted to serve the domestic water supply.

6.2.3.2 In the situation addressed by 6.2.3, no valve controlling the sprinkler system in a unit shall be located in another unit.

6.3* Multipurpose Piping System.

6.3.1 A multipurpose piping system shall be installed in accordance with 6.3.2 through 6.5.4.

6.3.2 Multipurpose piping systems shall be approved by the local plumbing or health authority.

6.3.3 All piping in the system supplying sprinklers shall be listed and conform to the piping specifications of this standard.

6.3.3.1 Piping connected to the system that supplies only plumbing fixtures shall comply with local plumbing and health authority requirements but is not required to be listed.

6.4 Manufactured Home Water Supply. For sprinklered buildings manufactured off-site, the minimum pressure needed to satisfy the system design criteria on the system side of the meter shall be specified on a data plate by the manufacturer.

6.5 Common Supply Pipes.

6.5.1 Where common supply pipes serve both fire sprinkler and domestic use, they shall comply with 6.5.2 through 6.5.4.

6.5.2 In common water supply connections serving more than one dwelling unit, 5 gpm (19 L/min) shall be added to the sprinkler system demand to determine the size of common piping and the size of the total water supply requirements where no provision is made to prevent flow into the domestic water system upon operation of a sprinkler.

6.5.3 A warning sign, with minimum ¼ in. letters, shall be affixed adjacent to the main shutoff valve and shall state the following;

> **WARNING:** The water system for this home supplies fire sprinklers that require certain flows and pressures to fight a fire. Devices that restrict the flow or decrease the pressure or automatically shut off the water to the fire sprinkler system, such as water softeners, filtration systems, and automatic shutoff valves, shall not be added to this system without a review of the fire sprinkler system by a fire protection specialist. Do not remove this sign.

6.5.4 Where water treatment and filtration are installed, one of the following conditions shall be met:

(1) The flow restriction and pressure loss through the water treatment equipment shall be taken into account in the hydraulic calculations.
(2) An automatic bypass shall be installed around the water treatment equipment that directs all water directly to the system.

Chapter 7 Installation

7.1 Valves.

7.1.1 A single control valve arranged to shut off both the domestic system and the sprinkler system shall be installed unless a separate shutoff valve for the sprinkler system is installed in accordance with 7.1.2.

7.1.2 The sprinkler system piping shall not have a separate control valve installed unless supervised by one of the following methods:

(1) Central station, proprietary, or remote station alarm service
(2) Local alarm service that causes the sounding of an audible signal at a constantly attended location
(3) Valves that are locked open

7.1.3 A separate shutoff valve shall be installed for the domestic water supply in installations other than those complying with Section 6.3.

7.2 Drains and Test Connections.

7.2.1 Each sprinkler system shall have a drain on the system side of the control valve.

7.2.2 A valve shall be installed in the drain piping.

7.2.3 A drain shall be installed for each trapped portion of a dry system that is subject to freezing temperatures.

7.2.4* Where waterflow alarms are provided, inspector's test connections shall be installed at locations that allow flow testing of water supplies, connections, and alarm mechanisms.

7.2.5 The inspector's test connections shall contain an orifice equal to or smaller than the smallest sprinkler installed in the system.

7.3 Pressure Gauges.

7.3.1 Where a dry system is installed, a pressure gauge shall be installed to indicate system air pressure.

7.3.2 Where a pressure tank is used for the water supply, a pressure gauge shall be installed to indicate tank pressure.

7.4 Piping Support.

7.4.1 Listed pipe shall be supported in accordance with any listing limitations.

7.4.2 Pipe that is not listed, and listed pipe with listing limitations that do not include piping support requirements, shall be supported from structural members using support methods comparable to those required by applicable local plumbing codes.

7.4.3 Piping laid on open joists or rafters shall be supported in a manner that prevents lateral movement.

7.4.4* Sprinkler piping shall be supported in a manner that prevents the movement of piping upon sprinkler operation.

7.5 Sprinklers.

7.5.1 Listed residential sprinklers shall be used unless another type is permitted by 7.5.3 or 7.5.4.

7.5.2 Residential sprinklers shall not be used on systems other than wet pipe systems unless specifically listed for use on that particular type of system.

7.5.3 Listed standard dry-pendent or dry-sidewall sprinklers shall be permitted to be extended into unheated areas not intended for living purposes.

7.5.4 Quick-response sprinklers shall be permitted to be used in mechanical closets.

7.5.5 Temperature Ratings.

7.5.5.1 Sprinklers installed where maximum ambient ceiling temperatures do not exceed 100°F (38°C) shall be ordinary temperature–rated sprinklers unless modified by the requirements of 7.5.5.3.

7.5.5.2 Sprinklers installed where maximum ambient ceiling temperatures are between 101°F and 150°F (39°C and 66°C) shall be intermediate temperature–rated sprinklers unless modified by 7.5.5.3.

7.5.5.3* The following practices shall be observed when installing residential sprinklers unless higher expected ambient temperatures require a higher temperature rating:

(1) Sprinklers under glass or plastic skylights exposed to direct rays of the sun shall be of intermediate temperature classification.
(2) Sprinklers in an unventilated concealed space under an uninsulated roof or in an unventilated attic shall be of intermediate temperature classification.
(3) Sprinklers installed near specific heat sources that are identified in Table 7.5.5.3 shall be of the temperature rating indicated in Table 7.5.5.3 unless sprinklers are listed for positioning closer to the heat source.

Table 7.5.5.3 Minimum Distances for Ordinary and Intermediate Temperature Residential Sprinklers

	Minimum Distance from Edge of Source to Ordinary Temperature Sprinkler		Minimum Distance from Edge of Source to Intermediate Temperature Sprinkler	
Heat Source	in.	mm	in.	mm
Side of open or recessed fireplace	36	914	12	305
Front of recessed fireplace	60	1524	36	914
Coal- or wood-burning stove	42	1067	12	305
Kitchen range	18	457	9	229
Wall oven	18	457	9	229
Hot air flues	18	457	9	229
Uninsulated heat ducts	18	457	9	229
Uninsulated hot water pipes	12	305	6	152
Side of ceiling- or wall-mounted hot air diffusers	24	610	12	305
Front of wall-mounted hot air diffusers	36	914	18	457
Hot water heater or furnace	6	152	3	76
Light fixture				
0 W–250 W	6	152	3	76
250 W–499 W	12	305	6	152

7.5.6* Painting and Ornamental Finishes. Sprinklers shall not be painted or enameled unless applied by the manufacturer and the sprinkler has been listed with such finishes.

7.5.7 Escutcheon Plates. Where nonmetallic sprinkler ceiling plates (escutcheons) or recessed escutcheons (metallic or nonmetallic) are used, they shall be listed based on testing of the assembly as a residential sprinkler.

7.5.8 Solvent Cement. Where solvent cement is used as the pipe and fittings bonding agent, sprinklers shall not be installed in the fittings prior to the fittings being cemented in place.

7.6* Alarms. Local waterflow alarms shall be provided on all sprinkler systems in homes not equipped with smoke alarms or smoke detectors in accordance with *NFPA 72, National Fire Alarm and Signaling Code*.

7.7 Attics. When nonmetallic piping is installed in attics, adequate insulation shall be provided on the attic side of the piping to avoid exposure of the piping to temperatures in excess of the pipe's rated temperature.

Chapter 8 System Design

8.1 Design Criteria.

8.1.1 Design Discharge.

8.1.1.1 Sprinklers That Are Not Listed with Specific Discharge Criteria.

8.1.1.1.1 The system shall provide a discharge of not less than 13 gpm (49 L/min) per sprinkler simultaneously to all of the design sprinklers.

8.1.1.1.2 The system shall provide a discharge of not less than 18 gpm (68 L/min) to any sprinkler in the system.

8.1.1.2* Sprinklers That Are Listed with Specific Discharge Criteria.

8.1.1.2.1 The system shall provide at least the flow required for the multiple and single sprinkler operating criteria specified by the sprinkler listing.

8.1.1.2.2* The system shall provide at least the flow required to produce a minimum discharge density of 0.05 gpm/ft^2 (2.04 mm/min) to the design sprinklers.

8.1.2* Number of Design Sprinklers. The number of design sprinklers under flat, smooth, horizontal ceilings shall include all sprinklers within a compartment, up to a maximum of two sprinklers, that require the greatest hydraulic demand.

8.1.3 Sprinkler Coverage.

8.1.3.1 Residential Sprinklers.

8.1.3.1.1 Sprinklers shall be installed in accordance with their listing where the type of ceiling configuration is referenced in the listing.

8.1.3.1.2* Where construction features or other special conditions exist that are outside the scope of sprinkler listings, listed sprinklers shall be permitted to be installed beyond their listing limitations.

8.1.3.1.3 Sloped Ceilings.

8.1.3.1.3.1 Where the ceiling is sloped, the maximum *S* dimension shall be measured along the slope of the ceiling to the next sprinkler, as shown in Figure 8.1.3.1.3.1.

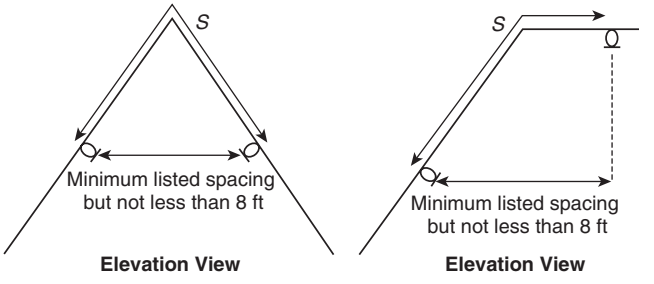


FIGURE 8.1.3.1.3.1 Measuring *S* Dimension.

8.1.3.1.3.2 The sprinklers shall maintain the minimum listed spacing, but no less than 8 ft (2.44 m), measured in the plan view from one sprinkler to another, as shown in Figure 8.1.3.1.3.1.

8.1.3.2 Nonresidential Sprinklers. Sprinklers other than residential sprinklers shall be installed in accordance with the coverage criteria specified by NFPA 13, *Standard for the Installation of Sprinkler Systems*.

8.1.4 Operating Pressure. The minimum operating pressure of any sprinkler shall be the higher of the minimum operating pressure specified by the listing or 7 psi (0.5 bar).

8.2 Position of Sprinklers.

8.2.1 Residential Pendent and Upright Sprinklers.

8.2.1.1 Pendent and upright sprinklers that have not been listed with specific positioning criteria shall be positioned so that the deflectors are within 1 in. to 4 in. (25.4 mm to 102 mm) from the ceiling unless otherwise permitted by 8.2.1.3.

8.2.1.2 Pendent and upright sprinklers that have been listed with specific positioning criteria shall be positioned in accordance with their listing unless permitted otherwise by 8.2.1.3.

8.2.1.3 Pendent and upright sprinklers in closets shall be permitted to be installed within 12 in. (305 mm) of the ceiling in order to avoid obstructions near the ceiling.

8.2.2 Residential Sidewall Sprinklers.

8.2.2.1 Sidewall sprinklers that have not been listed with specific positioning criteria shall be positioned so that the deflectors are within 4 in. to 6 in. (102 mm to 152 mm) from the ceiling.

8.2.2.2 Sidewall sprinklers that have been listed with specific positioning criteria shall be installed in accordance with their listing.

8.2.3 Nonresidential Sprinklers. Sprinklers other than residential sprinklers shall be positioned in accordance with the positioning criteria specified by NFPA 13, *Standard for the Installation of Sprinkler Systems*.

8.2.4 In basements where ceilings are not required for the protection of piping or where metallic pipe is installed, residential sprinklers shall be permitted to be positioned in a manner that anticipates future installation of a finished ceiling.

8.2.5* Obstructions to Residential Sprinklers.

8.2.5.1 Closets. In all closets, including those closets housing mechanical equipment, that are not larger than 400 ft^3 (11.3 m^3) in size, a single sprinkler at the highest ceiling space in the closet shall be sufficient without regard to obstructions.

8.2.5.2 Pendent Sprinklers.

8.2.5.2.1 Pendent sprinklers shall be located at least 3 ft (914 mm) away from obstructions such as ceiling fans and light fixtures unless the requirements of 8.2.5.4 are met.

8.2.5.2.2 The distance shall be measured from the center of the sprinkler to the center of the obstruction.

8.2.5.2.3 Where the sprinkler cannot be located 3 ft (914 mm) away from the obstruction (as measured from the center of the obstruction), an additional sprinkler shall be located on the other side of the obstruction.

8.2.5.2.4 Where the area of the fan blades encompass more than 50 percent of the area of the plan view, the sprinkler shall be installed in accordance with 8.2.5.4.

8.2.5.3 Sidewall Sprinklers.

8.2.5.3.1 Sidewall sprinklers shall be located at least 5 ft (1.52 m) away from obstructions such as ceiling fans and light fixtures unless the requirements of 8.2.5.5 are met.

8.2.5.3.2 The distance shall be measured from the center of the sprinkler to the center of the obstruction.

8.2.5.3.3 Where the sprinkler cannot be located 5 ft (1.52 m) away from the obstruction (as measured to the center of the obstruction), an additional sprinkler shall be installed on the other side of the obstruction.

8.2.5.3.4 Where the area of the fan blades encompasses more than 50 percent of the area of the plan view, the sprinkler shall be installed in accordance with 8.2.5.5.

8.2.5.4 Continuous Obstructions to Pendent Sprinklers.

8.2.5.4.1 Sprinklers shall be positioned with respect to continuous obstructions in accordance with 8.2.5.4.2, 8.2.5.4.3, or 8.2.5.4.4.

8.2.5.4.2 Sprinklers shall be positioned with respect to continuous obstructions in accordance with Table 8.2.5.4.2 and Figure 8.2.5.4.2.

Table 8.2.5.4.2 Position of Sprinklers to Avoid Obstructions to Discharge (Residential Upright and Pendent Spray Sprinklers)

Distance from Sprinklers to Side of Obstruction (*A*)	Maximum Allowable Distance of Deflector Above Bottom of Obstruction (in.) (*B*)
Less than 1 ft	0
1 ft to less than 1 ft 6 in.	0
1 ft 6 in. to less than 2 ft	1
2 ft to less than 2 ft 6 in.	1
2 ft 6 in. to less than 3 ft	1
3 ft to less than 3 ft 6 in.	3
3 ft 6 in. to less than 4 ft	3
4 ft to less than 4 ft 6 in.	5
4 ft 6 in. to less than 5 ft	7
5 ft to less than 5 ft 6 in.	7
5 ft 6 in. to less than 6 ft	7
6 ft to less than 6 ft 6 in.	9
6 ft 6 in. to less than 7 ft	11
7 ft and greater	14

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.
Note: For *A* and *B*, refer to Figure 8.2.5.4.2.

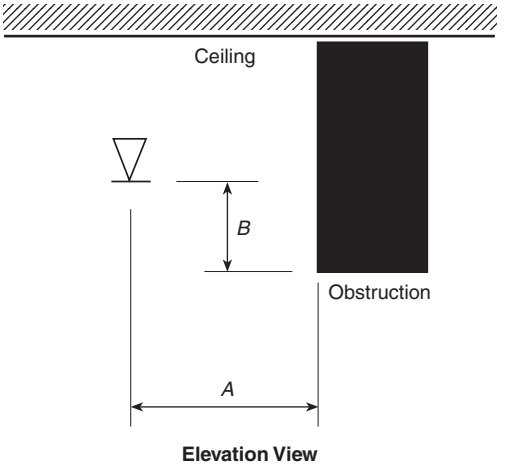


FIGURE 8.2.5.4.2 Position of Sprinkler to Avoid Obstructions to Discharge (Residential Upright and Pendent Spray Sprinklers).

8.2.5.4.3 Sprinklers shall be positioned with respect to an obstruction against a wall in accordance with Figure 8.2.5.4.3.

8.2.5.4.4 A sprinkler shall be installed on the other side of the obstruction.

8.2.5.5 Continuous Obstructions to Sidewall Sprinklers.

8.2.5.5.1 Sprinklers shall be positioned with respect to continuous obstructions in accordance with 8.2.5.5.2 or 8.2.5.5.3.

8.2.5.5.2 Sprinklers shall be positioned with respect to continuous obstructions in accordance with Table 8.2.5.5.2(a), Figure 8.2.5.5.2(a), Table 8.2.5.5.2(b), and Figure 8.2.5.5.2(b).

8.2.5.5.3 A sprinkler shall be installed on the other side of the obstruction.

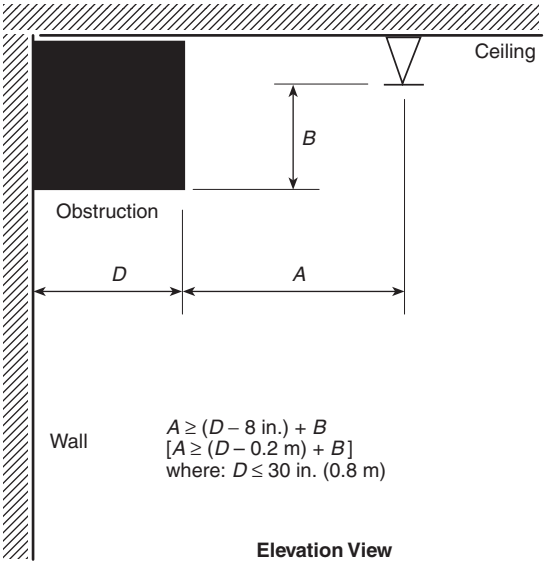


FIGURE 8.2.5.4.3 Obstructions Against Walls (Residential Upright and Pendent Spray Sprinklers).

Table 8.2.5.5.2(a) Positioning of Sprinklers to Avoid Obstructions (Residential Sidewall Sprinklers)

Distance from Sidewall Sprinkler to Side of Obstruction (*A*)	Maximum Allowable Distance of Deflector Above Bottom of Obstruction (in.) (*B*)
Less than 8 ft	Not allowed
8 ft to less than 10 ft	1
10 ft to less than 11 ft	2
11 ft to less than 12 ft	3
12 ft to less than 13 ft	4
13 ft to less than 14 ft	6
14 ft to less than 15 ft	7
15 ft to less than 16 ft	9
16 ft to less than 17 ft	11
17 ft or greater	14

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.
Note: For *A* and *B*, refer to Figure 8.2.5.5.2(a).

Table 8.2.5.5.2(b) Positioning of Sprinklers to Avoid Obstructions Along the Wall (Residential Sidewall Sprinklers)

Distance from Sidewall Sprinkler to Side of Obstruction (*A*)	Maximum Allowable Distance of Deflector Above Bottom of Obstruction (in.) (*B*)
Less than 1 ft 6 in.	0
1 ft 6 in. to less than 3 ft	1
3 ft to less than 4 ft	3
4 ft to less than 4 ft 6 in.	5
4 ft 6 in. to less than 6 ft	7
6 ft to less than 6 ft 6 in.	9
6 ft 6 in. to less than 7 ft	11
7 ft to less than 7 ft 6 in.	14

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.
Note: For *A* and *B*, refer to Figure 8.2.5.5.2(b).

8.2.5.6 Soffits and Cabinets. Where soffits are used for the installation of sidewall sprinklers, the sprinklers and soffits shall be installed in accordance with 8.2.5.6.1, 8.2.5.6.2, or 8.2.5.6.3.

8.2.5.6.1 Where soffits exceed more than 8 in. (203 mm) in width or projection from the wall, sprinklers shall be installed under the soffit.

8.2.5.6.2 Sidewall sprinklers shall be permitted to be installed in the face of a soffit located directly over cabinets, without requiring additional sprinklers below the soffit or cabinets, where the soffit does not project horizontally more than 12 in. (305 mm) from the wall.

8.2.5.6.3 Where sidewall sprinklers are more than 3 ft (0.91 m) above the top of cabinets, the sprinkler shall be permitted to be installed on the wall above the cabinets where the cabinets are no greater than 12 in. (305 mm) from the wall.

8.3 System Types. Systems shall be permitted to be wet pipe, dry pipe, or preaction.

8.3.1* Wet Pipe Systems. A wet pipe system shall be permitted to be used where all piping is installed in areas maintained above 40°F (4°C), including areas properly insulated to maintain 40°F (4°C).

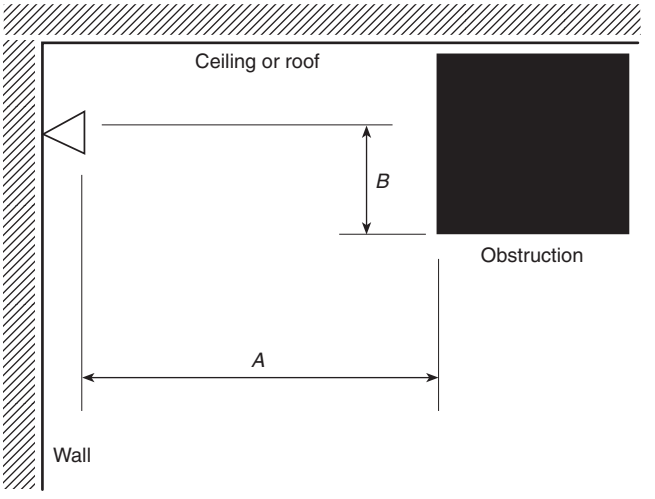


FIGURE 8.2.5.5.2(a) Positioning of Sprinklers to Avoid Obstructions (Residential Sidewall Sprinklers).

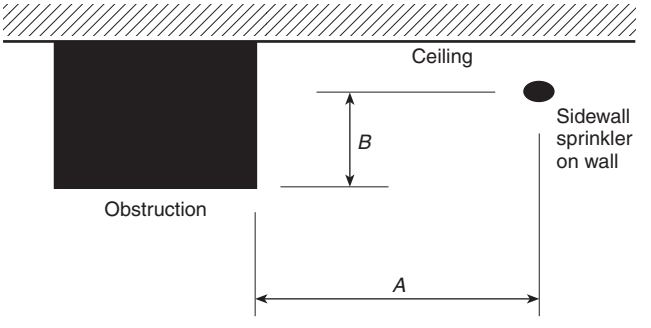


FIGURE 8.2.5.5.2(b) Positioning of Sprinklers to Avoid Obstructions Along the Wall (Residential Sidewall Sprinklers).

8.3.2 Where system piping is located in areas not maintained above 40°F (4°C), the pipe shall be protected against freezing by use of one of the following methods:

(1) Dry pipe system and preaction systems in accordance with 8.3.4
(2) Antifreeze system in accordance with 8.3.3
(3) Listed standard dry-pendent or dry-sidewall sprinklers extended from pipe in heated areas into unheated areas not intended for living purposes

8.3.3 Antifreeze Systems.

8.3.3.1* Conformity with Health Regulations. The use of antifreeze solutions shall be in conformity with any state or local health regulations.

8.3.3.2* Antifreeze Solutions.

8.3.3.2.1 For the purposes of this standard, pure glycerine shall mean chemically pure or United States Pharmacopeia 96.5 percent grade.

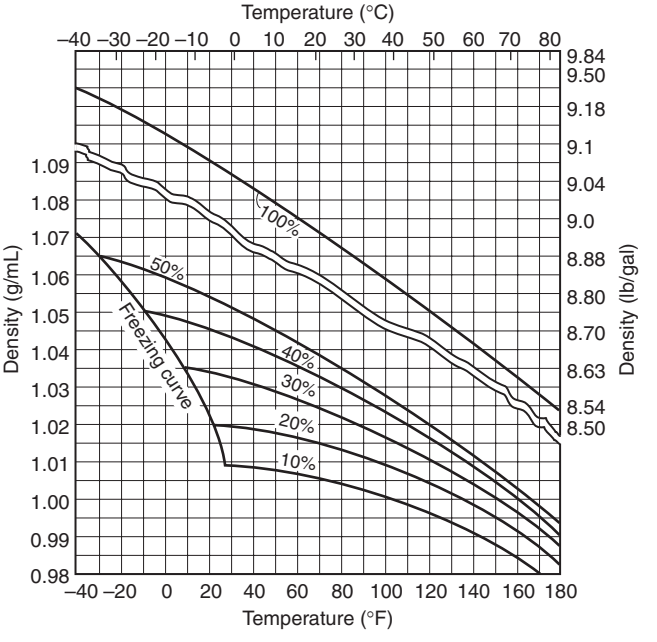
8.3.3.2.2 Where sprinkler systems are supplied by public water connections, the use of antifreeze solutions other than water solutions of pure glycerine or propylene glycol shall not be permitted.

8.3.3.2.3* Percent solution by volume of glycerine–water and propylene glycol–water mixtures shall be in accordance with Table 8.3.3.2.3, Figure 8.3.3.2.3(a), and Figure 8.3.3.2.3(b).

Table 8.3.3.2.3 Antifreeze Solutions to Be Used If Potable Water Is Connected to Sprinklers

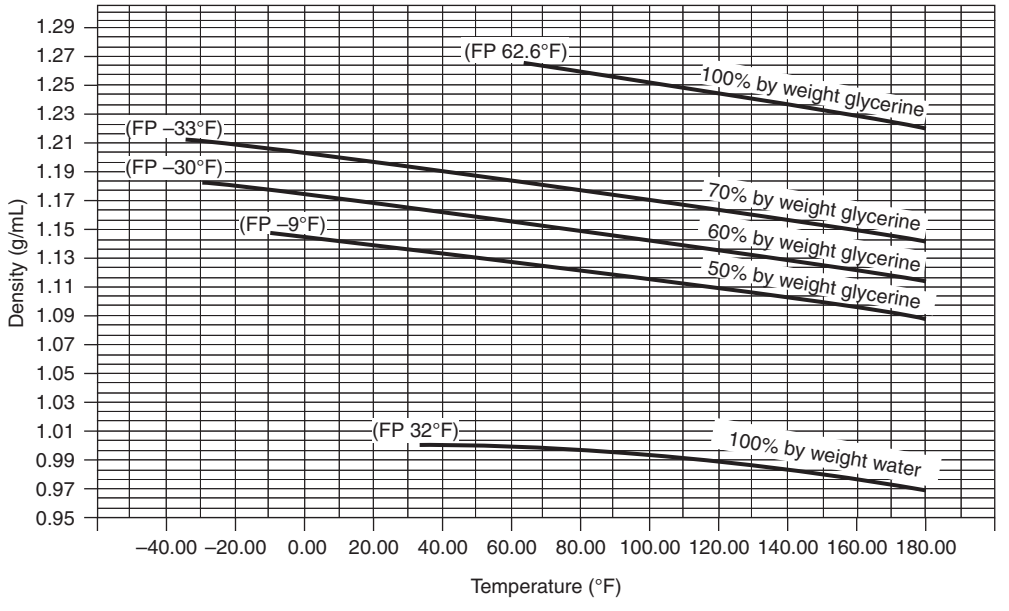
Material	Solution (by volume)	Specific Gravity at 60°F (15.6°C)	Freezing Point °F	Freezing Point °C
Glycerine	50% water	1.145	–20.9	–29.4
C.P. or U.S.P. grade*	40% water	1.171	–47.3	–44.1
	30% water	1.197	–22.2	–30.1
Hydrometer scale 1.000 to 1.200				
Propylene glycol	60% water	1.034	–6	–21.1
	50% water	1.041	–26	–32.2
	40% water	1.045	–60	–51.1
Hydrometer scale 1.000 to 1.200 (subdivisions 0.002)				

*C.P.: Chemically pure. U.S.P.: United States Pharmacopoeia 96.5%. [**13**: Table 7.6.2.2]



Note: The 100 percent concentration curves are provided for information only so that densities are known for calculating solutions.

FIGURE 8.3.3.2.3(a) Densities of Aqueous Propylene Glycol Solutions (Percent by Weight). [13: Figure 7.6.2.5(b)]



Note: The 100 percent concentration curves are provided for information only so that densities are known for calculating solutions.

FP=Freezing Point

FIGURE 8.3.3.2.3(b) Densities of Aqueous Glycerine Solutions (Percent by Weight). [13: Figure 7.6.2.5(c)]

8.3.3.2.3.1 The concentration of antifreeze solutions shall be limited to the minimum necessary for the anticipated minimum temperature.

8.3.3.2.4 Where public water is not connected to sprinklers, water solutions of glycerine, diethylene glycol, ethylene glycol, and propylene glycol shall be permitted to be used in antifreeze solutions.

8.3.3.2.5 Percent solution by volume of diethylene glycol–water and ethylene glycol–water shall be in accordance with Table 8.3.3.2.5.

Table 8.3.3.2.5 Antifreeze Solution to Be Used If Nonpotable Water Is Connected to Sprinklers

Material	Solution (by volume)	Specific Gravity at 60°F (15.6°C)	Freezing Point °F	Freezing Point °C
Glycerine	See Table 7.6.2.2.			
Diethylene glycol	50% water	1.078	–13	–25.0
	45% water	1.081	–27	–32.8
	40% water	1.086	–42	–41.1
Hydrometer scale 1.000 to 1.120 (subdivisions 0.002)				
Ethylene glycol	61% water	1.056	–10	–23.3
	56% water	1.063	–20	–28.9
	51% water	1.069	–30	–34.4
	47% water	1.073	–40	–40.0
Hydrometer scale 1.000 to 1.120 (subdivisions 0.002)				
Propylene glycol	See Table 8.3.3.2.3.			

[**13**: Table 7.6.2.3]

8.3.3.2.6* An antifreeze solution with a freezing point below the expected minimum temperature for the locality shall be installed.

8.3.3.2.7 The specific gravity of the antifreeze solution shall be checked by a hydrometer with a scale having 0.002 subdivisions.

8.3.3.3* Arrangement of Supply Piping and Valves.

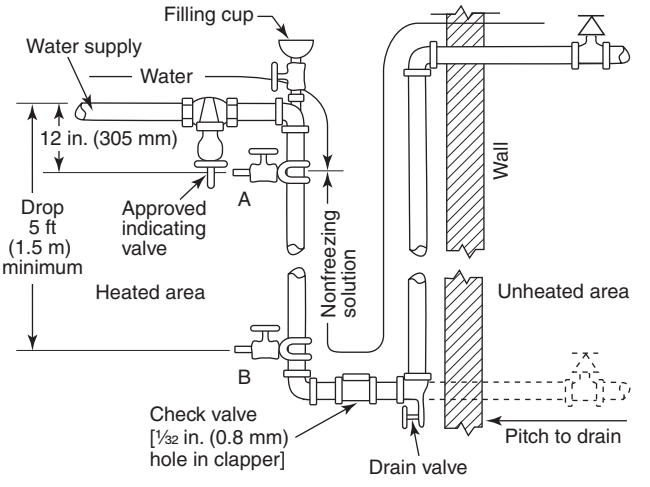
8.3.3.3.1 Connections Between Antifreeze System and Wet Pipe System with No Backflow Prevention Device.

8.3.3.3.1.1 A 5 ft (1.5 m) drop pipe, or U-loop, shall be installed in the connection between the antifreeze system and the wet pipe system as illustrated in Figure 8.3.3.3.1.1.

8.3.3.3.1.2 If sprinklers are above the level of the water supply to the antifreeze system, a check valve with a 1⁄32 in. (0.8 mm) hole in the clapper shall be provided in the U-loop.

8.3.3.3.1.3 Valves shall be provided as illustrated in Figure 8.3.3.3.1.1.

8.3.3.3.1.4 Arrangement of supply piping when the water supply comes from a storage tank or the water supply feeds through a check valve that does not have a 1⁄32 in. (0.8 mm) hole drilled in the clapper shall meet the requirements of 8.3.3.3.2.2.



Notes:
1. Check valve shall be permitted to be omitted where sprinklers are below the level of valve A.
2. The 1⁄32 in. (0.8 mm) hole in the check valve clapper is needed to allow for expansion of the solution during a temperature rise, thus preventing damage to sprinklers.

FIGURE 8.3.3.3.1.1 Arrangement of Supply Piping and Valves.

8.3.3.3.2* Connections Between Antifreeze System and Wet Pipe System with Backflow Prevention Device Installed.

8.3.3.3.2.1 Valves shall be provided as illustrated in Figure 8.3.3.3.2.1.

8.3.3.3.2.2 An expansion chamber shall be provided as illustrated in Figure 8.3.3.3.2.1.

8.3.3.3.2.3 The expansion chamber shall be sized based on the minimum and maximum volume of the antifreeze solution over the life of the system.

8.3.3.4 Where pendent sprinklers are utilized, and where a hydrostatic test shall be performed, the hydrostatic test shall be performed with water and then the water shall be completely drained before antifreeze solution is placed in the system, or the hydrostatic test shall be performed with antifreeze solution at the proper concentration for the system.

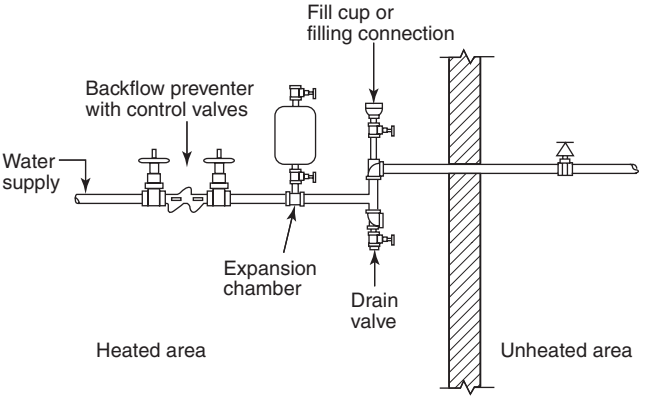


FIGURE 8.3.3.3.2.1 Arrangement of Supply Piping with Backflow Device.

8.3.3.5 A placard shall be placed on the antifreeze system main valve that indicates the manufacturer type and brand of antifreeze solution, the concentration of antifreeze solution used, and the volume of the antifreeze solution used in the system.

8.3.4 Dry Pipe and Preaction Systems.

8.3.4.1 Sprinklers.

8.3.4.1.1 Sprinklers shall be specifically listed for use on dry pipe and double interlock preaction systems.

8.3.4.1.2 The following types of sprinklers and arrangements shall be permitted for dry pipe and preaction systems:

(1) Residential upright sprinklers
(2) Residential dry sprinklers
(3) Residential pendent and sidewall sprinklers installed on return bends, where the sprinklers, return bends, and branch line piping are in an area maintained at or above 40°F (4°C)
(4) Residential horizontal sidewall sprinklers, installed so that water is not trapped

8.3.4.1.3 Return bends required per 8.3.4.1.2(3) shall be permitted to be omitted when using potable water supplies combined with corrosion-resistant pipe.

8.3.4.1.4 Sprinklers with nominal K-factors greater than 4.0 and less than 5.6 shall be permitted to be installed on dry pipe systems where piping is corrosion resistant or internally galvanized.

8.3.4.1.5 Sprinklers with nominal K-factors of 5.6 or greater shall be permitted to be installed on pipe complying with the requirements of Section 5.2.

8.3.4.2 Preaction Systems. Preaction systems shall be one of the following types:

(1) A single interlock system, which admits water to sprinkler piping upon operation of detection devices
(2) A non-interlock system, which admits water to sprinkler piping upon operation of detection devices or automatic sprinklers
(3) A double interlock system, which admits water to sprinkler piping upon operation of both detection devices and automatic sprinklers

8.3.4.3 Dry Pipe and Double Interlock Preaction System Water Delivery.

8.3.4.3.1 Water delivery shall be based on the hazard shown in Table 8.3.4.3.1.

Table 8.3.4.3.1 Water Delivery Time for Dry Pipe and Double Interlock Preaction Systems

Hazard	Number of Most Remote Sprinklers Initially Open	Maximum Time of Water Delivery
Residential	1	15 seconds

8.3.4.3.2 Water delivery shall be based on one of the following:

(1) Calculation program and method that shall be listed by a nationally recognized laboratory
(2) An inspector's test connection providing a flow equivalent to the smallest orifice sprinkler utilized, wherein the test orifice is located on the end of the most distant sprinkler pipe

8.3.4.4 Location and Protection of Dry Pipe and Preaction Valves. The dry pipe valve, preaction valve, and supply pipe shall be protected against freezing and mechanical injury.

8.3.4.5* Detection Devices.

8.3.4.5.1 The detection system shall be designed to operate sooner than the first sprinkler.

8.3.4.5.2 Detectors shall be installed in all areas/compartments where sprinklers are installed.

8.3.4.6 System Configuration. Dry pipe systems and preaction systems of the type described in 8.3.4.2(3) shall not be gridded.

8.3.4.7 Drainage. Piping shall be pitched a minimum of ¼ in. per 10 ft (6.4 mm per 3.05 m) to facilitate draining.

8.3.4.8 Auxiliary Drains.

8.3.4.8.1 Auxiliary drains shall be provided where a change in piping direction prevents drainage of system piping through the drain valve on the system side of the control valve.

8.3.4.8.2 At a minimum, auxiliary drains shall be a nipple and cap or plug not less than ½ in. (12.7 mm).

8.3.4.9 Air Supply. The system air pressure shall be maintained by approved equipment.

8.4 Pipe Sizing.

8.4.1 The pipe sizes shall be verified for each of the single sprinkler and multiple sprinkler design discharge.

8.4.2 For specially listed piping products, friction loss for pipe and fittings shall be permitted to be calculated based on the manufacturer's data.

8.4.3 Minimum Pipe Size.

8.4.3.1 The minimum size of steel pipe shall be 1 in. (25.4 mm).

8.4.3.2 The minimum size of pipe other than steel pipe shall be ¾ in. (19 mm) unless smaller sizes are permitted by 8.4.3.3.

8.4.3.3* Along with listed special fittings, ½ in. (12.7 mm) nonmetallic pipe and ½ in. (12.7 mm) copper pipe shall be permitted to be used only in network systems under the following conditions:

(1)*Each sprinkler shall be supplied through a minimum of three separate paths from the supply manifold.
(2) Calculations shall clearly indicate the pipes that create the paths to each sprinkler.
(3) A water distribution pipe that supplies a sprinkler shall not terminate in a dead end.
(4) Hydraulic calculations shall be prepared for each sprinkler flowing individually within the system and for each pair of sprinklers within the same compartment.
(5) The location of the most demanding single sprinkler and pair of sprinklers, including their pressure and flow requirements, shall be indicated on the plan review documents.
(6) The system shall be hydraulically calculated in accordance with the provisions of NFPA 13, *Standard for the Installation of Sprinkler Systems*, except that the friction loss straight through a fitting shall be included.
(7) The method of joining the pipe to fittings or to other pipe shall be in accordance with the applicable plumbing code.

(8) A maximum of one insert tee shall be permitted in each pipe section between sprinklers to serve only domestic fixtures.
(9) When insert fittings are installed, each sprinkler shall have four separate paths from the water supply.
(10) The piping supplying only plumbing fixtures shall be in accordance with the applicable plumbing code.

8.4.4* Unless the pipe size is in accordance with the prescriptive pipe sizing method of 8.4.10, pipe shall be sized by hydraulic calculations in accordance with the methods described in NFPA 13, *Standard for the Installation of Sprinkler Systems*, in accordance with 8.4.5, or in accordance with the following general method for straight-run systems connected to a city water main of at least 4 in. (102 mm) in diameter:

(1) The system flow rate shall be established in accordance with Section 8.1, and it shall be determined that the flow allowed by the water meter meets or exceeds the system demand and that the total demand flow does not exceed the maximum flow allowed by the piping system components.
(2) The water pressure in the street shall be determined.
(3) Pipe sizes shall be selected.
(4) Pressure loss for a water meter, if any, shall be determined and deducted using one of the following:
   (a) Table 8.4.4(g) shall be used.
   (b) Higher pressure losses specified by the manufacturer shall be used in place of those specified in Table 8.4.4(g).
   (c) Lower pressure losses shall be permitted to be used where supporting data are provided by the meter manufacturer.
(5) Pressure loss for elevation shall be deducted as follows:
   (a) Building height above street (in ft) × 0.434 = pressure loss (in psi)
   (b) Building height above street (in m) × 0.098 = pressure loss (in bar)
(6)*Pressure losses from the city main to the inside control valve shall be deducted by multiplying the factor from Table 8.4.4(a) or Table 8.4.4(b) by the total length(s) of pipe in feet (meters).
(7) Pressure loss for piping within the building shall be deducted by multiplying the factor from Table 8.4.4(a) or Table 8.4.4(b) by the total length in feet (meters) of

Table 8.4.4(a) Pressure Losses in psi/ft for Schedule 40 Steel Pipe ($C = 120$)

Pipe Size (in.)	Flow Rate (gpm)											
	10	12	14	16	18	20	25	30	35	40	45	50
1	0.04	0.05	0.07	0.09	0.11	0.13	0.20	0.28	0.37	0.47	0.58	0.71
1¼	0.01	0.01	0.02	0.02	0.03	0.03	0.05	0.07	0.10	0.12	0.15	0.19
1½	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.05	0.06	0.07	0.09
2	—	—	—	—	—	0.01	0.01	0.01	0.01	0.02	0.02	0.03

For SI units, 1 gal = 3.785 L; 1 psi = 0.0689 bar; 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Table 8.4.4(b) Pressure Losses in psi/ft for Copper Tubing — Types K, L, and M ($C = 150$)

Tubing Size (in.)	Type	Flow Rate (gpm)											
		10	12	14	16	18	20	25	30	35	40	45	50
¾	M	0.08	0.12	0.16	0.20	0.25	0.30	0.46	0.64	0.85	—	—	—
	L	0.10	0.14	0.18	0.23	0.29	0.35	0.53	0.75	1.00	—	—	—
	K	0.13	0.18	0.24	0.30	0.38	0.46	0.69	0.97	1.28	—	—	—
1	M	0.02	0.03	0.04	0.06	0.07	0.08	0.13	0.18	0.24	0.30	0.38	0.46
	L	0.03	0.04	0.05	0.06	0.08	0.10	0.15	0.20	0.27	0.35	0.43	0.53
	K	0.03	0.04	0.06	0.07	0.09	0.11	0.17	0.24	0.31	0.40	0.50	0.61
1¼	M	0.01	0.01	0.02	0.02	0.03	0.03	0.05	0.07	0.09	0.11	0.15	0.17
	L	0.01	0.01	0.02	0.02	0.03	0.03	0.05	0.07	0.10	0.12	0.16	0.19
	K	0.01	0.01	0.02	0.02	0.03	0.04	0.06	0.08	0.11	0.13	0.17	0.20
1½	M	—	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08
	L	—	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.07	0.08
	K	—	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.05	0.06	0.07	0.09
2	M	—	—	—	—	—	—	0.01	0.01	0.01	0.01	0.02	0.02
	L	—	—	—	—	—	—	0.01	0.01	0.01	0.01	0.02	0.02
	K	—	—	—	—	—	—	0.01	0.01	0.01	0.01	0.02	0.02

For SI units, 1 gal = 3.785 L; 1 psi = 0.0689 bar; 1 in. = 25.4 mm; 1 ft = 0.3048 m.

each size of pipe between the control valve and the farthest sprinkler.

(8) Pressure loss for valves and fittings shall be deducted as follows:
   (a) The valves and fittings from the control valve to the farthest sprinkler shall be counted.
   (b) The equivalent length for each valve and fitting as shown in Table 8.4.4(c), Table 8.4.4(d), Table 8.4.4(e), or Table 8.4.4(f) shall be determined and the values added to obtain the total equivalent length for each pipe size.
   (c) The equivalent length for each size shall be multiplied by the factor from Table 8.4.4(a) or Table 8.4.4(b) and the values totaled.

(9) In multilevel buildings, the steps in 8.4.4(1) through 8.4.4(8) shall be repeated to size piping for each floor.

(10) If the remaining pressure is less than the operating pressure established by the testing laboratory for the sprinkler being used, the sprinkler system shall be redesigned.

(11) If the remaining pressure is higher than required, smaller piping shall be permitted to be used where justified by calculations.

(12) The remaining piping shall be sized the same as the piping up to and including the farthest sprinkler unless smaller pipe sizes are justified by calculations.

8.4.5 Smaller pipe sizes than those determined by 8.4.4 shall be permitted where justified by calculations for systems connected to city water mains of at least 4 in. (102 mm) in diameter.

8.4.6 To size piping for systems with an elevated tank, pump, or pump–tank combination, the pressure at the water supply

Table 8.4.4(c) Equivalent Length in Feet of Fittings and Valves for Schedule 40 Steel Pipe

Diameter (in.)	45 Degree Elbow	90 Degree Elbow	Long-Radius Elbow	Tee or Cross (flow turned 90 degrees)	Tee Run	Gate Valve	Angle Valve	Globe Valve	Globe "Y" Pattern Valve	Cock Valve	Check Valve
1	1	2	2	5	2	0	12	28	15	4	5
1¼	1	3	2	6	2	0	15	35	18	5	7
1½	2	4	2	8	3	0	18	43	22	6	9
2	2	5	3	10	3	1	24	57	28	7	11

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Table 8.4.4(d) Equivalent Length in Feet of Fittings and Valves for Type K Copper Tube

Diameter (in.)	45 Degree Elbow	90 Degree Elbow	Long-Radius Elbow	Tee or Cross (flow turned 90 degrees)	Tee Run	Gate Valve	Angle Valve	Globe Valve	Globe "Y" Pattern Valve	Cock Valve	Check Valve
¾	0	1	0	3	1	0	7	14	7	2	0
1	1	2	2	6	2	0	14	33	18	5	6
1¼	1	3	2	5	2	0	14	32	16	5	6
1½	2	4	2	8	3	0	18	43	22	6	9
2	2	6	3	12	4	1	28	66	33	8	13

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Table 8.4.4(e) Equivalent Length in Feet of Fittings and Valves for Type L Copper Tube

Diameter (in.)	45 Degree Elbow	90 Degree Elbow	Long-Radius Elbow	Tee or Cross (flow turned 90 degrees)	Tee Run	Gate Valve	Angle Valve	Globe Valve	Globe "Y" Pattern Valve	Cock Valve	Check Valve
¾	0	2	0	4	1	0	8	18	10	3	0
1	1	3	3	7	2	0	16	38	20	5	7
1¼	1	3	2	6	2	0	15	35	18	5	7
1½	2	4	2	9	3	0	20	47	24	7	10
2	2	6	4	12	4	1	30	71	35	9	14

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Table 8.4.4(f) Equivalent Length in Feet of Fittings and Valves for Type M Copper Tube

Diameter (in.)	45 Degree Elbow	90 Degree Elbow	Long-Radius Elbow	Tee or Cross (flow turned 90 degrees)	Tee Run	Gate Valve	Angle Valve	Globe Valve	Globe "Y" Pattern Valve	Cock Valve	Check Valve
¾	0	2	0	4	1	0	10	21	11	3	0
1	2	3	3	8	3	0	19	43	23	6	8
1¼	1	3	2	7	2	0	16	38	20	5	8
1½	2	5	2	9	3	0	21	50	26	7	11
2	3	7	4	13	5	1	32	75	37	9	14

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Table 8.4.4(g) Pressure Losses in psi in Water Meters

Meter Size (in.)	Flow (gpm)					
	18	23	26	31	39	52
⅝	9	14	18	26	*	*
¾	4	8	9	13	*	*
1	2	3	3	4	6	10
1½	†	1	2	2	4	7
2	†	†	†	1	2	3

For SI units, 1 gpm = 3.785 L/min; 1 in. = 25.4 mm; 1 psi = 0.0689 bar.
*Above maximum rated flow of commonly available meters.
†Less than 1 psi (0.0689 bar).

outlet shall be determined and the steps in 8.4.4(3), (4), (7), (8), (9), (10), and (11) shall be followed.

8.4.7 Hydraulic calculation procedures in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, shall be used for grid-type systems.

8.4.8 Hydraulic calculation procedures in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, shall be used for looped-type systems.

8.4.9 Hydraulic calculation procedures in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, shall be used for systems connected to city water mains of less than 4 in. (100 mm) in diameter.

8.4.10 Prescriptive Pipe Sizing Method. Pipe shall be sized by determining the available pressure to offset friction loss in piping and identifying a piping material, diameter, and length using the equation in 8.4.10.1 and the procedure in 8.4.10.2.

8.4.10.1 Available Pressure Equation. The pressure available to offset friction loss in the interior piping system (P_t) shall be determined in accordance with the following formula:

$$P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp}$$

where:

P_t = pressure used in applying Table 8.4.10.1(a) through Table 8.4.10.1(i)
P_{sup} = pressure available from the water supply source
PL_{svc} = pressure loss in the water service pipe
PL_m = pressure loss in the water meter
PL_d = pressure loss from devices other than the water meter
PL_e = pressure loss associated with changes in elevation
P_{sp} = maximum pressure required by a sprinkler

8.4.10.2 Calculation Procedure. Determination of the required size for water distribution piping shall be in accordance with the following procedure:

(1) *Step 1 — Determine P_{sup}.* Obtain the static supply pressure that will be available from 1. The water main from the water purveyor, or 2. For a private source, such as a tank system, a private well system, or a combination of these, the available water supply pressure shall be based on the minimum pressure control setting for the pump.
(2) *Step 2 — Determine PL_{svc}.* Use Table 8.4.10.2(a) to determine the pressure loss in the water service pipe based on the selected size of the water service.
(3) *Step 3 — Determine PL_m.* Use Table 8.4.10.2(b) to determine the pressure loss from the water meter based on the selected water meter size.
(4) *Step 4 — Determine PL_d.* Determine the pressure loss from devices, other than the water meter, installed in the piping system supplying sprinklers, such as pressure-reducing valves, backflow preventers, water softeners, or water filters.
   (a) Device pressure losses shall be based on the device manufacturer's specifications.
   (b) The flow rate used to determine pressure loss shall be the rate from 8.1.1 and 8.1.2, except that 5 gpm shall be added where the device is installed in a water service pipe that supplies more than one dwelling.
   (c) As alternative to deducting pressure loss for a device, an automatic bypass valve shall be installed to divert flow around the device when a sprinkler activates.

Table 8.4.10.2(a) Water Service Pressure Loss (PL_{svc})

Flow Rate* (gpm)	¾ in. Water Service Pressure Loss (psi)				1 in. Water Service Pressure Loss (psi)				1¼ in. Water Service Pressure Loss (psi)			
	40 ft or less	41 ft to 75 ft	76 ft to 100 ft	101 ft to 150 ft	40 ft or less	41 ft to 75 ft	76 ft to 100 ft	101 ft to 150 ft	40 ft or less	41 ft to 75 ft	76 ft to 100 ft	101 ft to 150 ft
8	5.1	8.7	11.8	17.4	1.5	2.5	3.4	5.1	0.6	1.0	1.3	1.9
10	7.7	13.1	17.8	26.3	2.3	3.8	5.2	7.7	0.8	1.4	2.0	2.9
12	10.8	18.4	24.9	NP	3.2	5.4	7.3	10.7	1.2	2.0	2.7	4.0
14	14.4	24.5	NP	NP	4.2	7.1	9.6	14.3	1.6	2.7	3.6	5.4
16	18.4	NP	NP	NP	5.4	9.1	12.4	18.3	2.0	3.4	4.7	6.9
18	22.9	NP	NP	NP	6.7	11.4	15.4	22.7	2.5	4.3	5.8	8.6
20	27.8	NP	NP	NP	8.1	13.8	18.7	27.6	3.1	5.2	7.0	10.4
22	NP	NP	NP	NP	9.7	16.5	22.3	NP	3.7	6.2	8.4	12.4
24	NP	NP	NP	NP	11.4	19.3	26.2	NP	4.3	7.3	9.9	14.6
26	NP	NP	NP	NP	13.2	22.4	NP	NP	5.0	8.5	11.4	16.9
28	NP	NP	NP	NP	15.1	25.7	NP	NP	5.7	9.7	13.1	19.4
30	NP	NP	NP	NP	17.2	NP	NP	NP	6.5	11.0	14.9	22.0
32	NP	NP	NP	NP	19.4	NP	NP	NP	7.3	12.4	16.8	24.8
34	NP	NP	NP	NP	21.7	NP	NP	NP	8.2	13.9	18.8	NP
36	NP	NP	NP	NP	24.1	NP	NP	NP	9.1	15.4	20.9	NP

NP: Not permitted. Pressure loss exceeds reasonable limits.

Notes:

(1) Values are applicable for underground piping materials permitted by the local plumbing code and are based on an SDR of 11 and a Hazen-Williams *C* factor of 150.

(2) Values include the following length allowances for fittings: 25 percent length increase for actual lengths up to 100 ft and 15 percent length increase for actual lengths over 100 ft.

*Flow rate from 8.1.1 and 8.1.2. Add 5 gpm to the flow rate required by 8.4.10.2, Step 4, where the water service pipe supplies more than one dwelling.

Table 8.4.10.2(b) Minimum Water Meter Pressure Loss (PL_m)

Flow Rate (gpm)*	⅝ in. Meter Pressure Loss (psi)	¾ in. Meter Pressure Loss (psi)	1 in. Meter Pressure Loss (psi)
8	2	1	1
10	3	1	1
12	4	1	1
14	5	2	1
16	7	3	1
18	9	4	1
20	11	4	2
22	NP	5	2
24	NP	5	2
26	NP	6	2
28	NP	6	2
30	NP	7	2
32	NP	7	3
34	NP	8	3
36	NP	8	3

NP: Not permitted unless the actual water meter pressure loss is known.

Note: Table 8.4.10.2(b) establishes conservative values for water meter pressure loss for installations where the water meter loss is unknown. Where the actual water meter pressure loss is known, P_m shall be the actual loss.

* Flow rate from 8.1.1. Add 5 gpm to the flow required by 8.4.10.2, Step 4, where the water service pipe supplies more than one dwelling.

(5) *Step 5 — Determine PL_e.* Use Table 8.4.10.2(c) to determine the pressure loss associated with changes in elevation. The elevation used in applying the table shall be the difference between the elevation where the water source pressure was measured and the elevation of the highest sprinkler.

(6) *Step 6 — Determine PL_{sp}.* Determine the maximum pressure required by any individual sprinkler based on the following:

(a) The area of coverage
(b) The ceiling configuration
(c) The temperature rating
(d) Any additional conditions specified by the sprinkler manufacturer

The required pressure is provided in the sprinkler manufacturer's published data for the specific sprinkler model based on the selected flow rate.

Table 8.4.10.2(c) Elevation Loss (PL_e)

Elevation (ft)	Pressure Loss (psi)
5	2.2
10	4.4
15	6.5
20	8.7
25	10.9
30	13.0
35	15.2
40	17.4

(7) *Step 7 — Calculate* PL_t. Using the equation in 8.4.10.1, calculate the pressure available to offset friction loss in water-distribution piping between the service valve and the sprinklers.

(8) *Step 8 — Determine the maximum allowable pipe length.* Use Table 8.4.10.2(d) through Table 8.4.10.2(i) to select a material and size for water distribution piping. The piping material and size shall be acceptable if the developed length of pipe between the service valve and the most remote sprinkler does not exceed the maximum allowable length specified by the applicable table. Interpolation of P_t between the tabular values shall be permitted.

8.4.10.3 The maximum allowable length of piping in Table 8.4.10.2(d) through Table 8.4.10.2(i) incorporates an adjustment for pipe fittings, and no additional consideration of friction losses associated with pipe fittings shall be required.

8.5 Piping Configurations.

8.5.1 The piping configuration shall be permitted to be looped.

8.5.2 The piping configuration shall be permitted to be gridded.

8.5.3 The piping configuration shall be permitted to be straight run.

8.5.4 The piping configuration shall be permitted to be a combination of the configurations permitted in 8.5.1 through 8.5.3.

8.6 Location of Sprinklers.

8.6.1 Sprinklers shall be installed in all areas except where omission is permitted by 8.6.2 through 8.6.7.

8.6.2 Sprinklers shall not be required in bathrooms of 55 ft^2 (5.1 m^2) and less.

Table 8.4.10.2(d) Allowable Pipe Length for ¾ in. Type M Copper Water Tubing

Sprinkler Flow Rate* (gpm)	Water Distribution Size (in.)	Available Pressure, P_t (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable Length of Pipe from Service Valve to Farthest Sprinkler (ft)									
8	¾	217	289	361	434	506	578	650	723	795	867
9	¾	174	232	291	349	407	465	523	581	639	697
10	¾	143	191	239	287	335	383	430	478	526	574
11	¾	120	160	200	241	281	321	361	401	441	481
12	¾	102	137	171	205	239	273	307	341	375	410
13	¾	88	118	147	177	206	235	265	294	324	353
14	¾	77	103	128	154	180	205	231	257	282	308
15	¾	68	90	113	136	158	181	203	226	248	271
16	¾	60	80	100	120	140	160	180	200	220	241
17	¾	54	72	90	108	125	143	161	179	197	215
18	¾	48	64	81	97	113	129	145	161	177	193
19	¾	44	58	73	88	102	117	131	146	160	175
20	¾	40	53	66	80	93	106	119	133	146	159
21	¾	36	48	61	73	85	97	109	121	133	145
22	¾	33	44	56	67	78	89	100	111	122	133
23	¾	31	41	51	61	72	82	92	102	113	123
24	¾	28	38	47	57	66	76	85	95	104	114
25	¾	26	35	44	53	61	70	79	88	97	105
26	¾	24	33	41	49	57	65	73	82	90	98
27	¾	23	30	38	46	53	61	69	76	84	91
28	¾	21	28	36	43	50	57	64	71	78	85
29	¾	20	27	33	40	47	53	60	67	73	80
30	¾	19	25	31	38	44	50	56	63	69	75
31	¾	18	24	29	35	41	47	53	59	65	71
32	¾	17	22	28	33	39	44	50	56	61	67
33	¾	16	21	26	32	37	42	47	53	58	63
34	¾	NP	20	25	30	35	40	45	50	55	60
35	¾	NP	19	24	28	33	38	42	47	52	57
36	¾	NP	18	22	27	31	36	40	45	49	54
37	¾	NP	17	21	26	30	34	38	43	47	51
38	¾	NP	16	20	24	28	32	36	40	45	49
39	¾	NP	15	19	23	27	31	35	39	42	46
40	¾	NP	NP	18	22	26	29	33	37	40	44

NP: Not permitted.

*Flow rate from 8.1.1 and 8.1.2.

Table 8.4.10.2(e) Allowable Pipe Length for 1 in. Type M Copper Water Tubing

Sprinkler Flow Rate* (gpm)	Water Distribution Size (in.)	Available Pressure, P_t (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable Length of Pipe from Service Valve to Farthest Sprinkler (ft)									
8	1	806	1075	1343	1612	1881	2149	2418	2687	2955	3224
9	1	648	864	1080	1296	1512	1728	1945	2161	2377	2593
10	1	533	711	889	1067	1245	1422	1600	1778	1956	2134
11	1	447	596	745	894	1043	1192	1341	1491	1640	1789
12	1	381	508	634	761	888	1015	1142	1269	1396	1523
13	1	328	438	547	657	766	875	985	1094	1204	1313
14	1	286	382	477	572	668	763	859	954	1049	1145
15	1	252	336	420	504	588	672	756	840	924	1008
16	1	224	298	373	447	522	596	671	745	820	894
17	1	200	266	333	400	466	533	600	666	733	799
18	1	180	240	300	360	420	479	539	599	659	719
19	1	163	217	271	325	380	434	488	542	597	651
20	1	148	197	247	296	345	395	444	493	543	592
21	1	135	180	225	270	315	360	406	451	496	541
22	1	124	165	207	248	289	331	372	413	455	496
23	1	114	152	190	228	267	305	343	381	419	457
24	1	106	141	176	211	246	282	317	352	387	422
25	1	98	131	163	196	228	261	294	326	359	392
26	1	91	121	152	182	212	243	273	304	334	364
27	1	85	113	142	170	198	226	255	283	311	340
28	1	79	106	132	159	185	212	238	265	291	318
29	1	74	99	124	149	174	198	223	248	273	298
30	1	70	93	116	140	163	186	210	233	256	280
31	1	66	88	110	132	153	175	197	219	241	263
32	1	62	83	103	124	145	165	186	207	227	248
33	1	59	78	98	117	137	156	176	195	215	234
34	1	55	74	92	111	129	148	166	185	203	222
35	1	53	70	88	105	123	140	158	175	193	210
36	1	50	66	83	100	116	133	150	166	183	199
37	1	47	63	79	95	111	126	142	158	174	190
38	1	45	60	75	90	105	120	135	150	165	181
39	1	43	57	72	86	100	115	129	143	158	172
40	1	41	55	68	82	96	109	123	137	150	164

*Flow rate from 8.1.1 and 8.1.2.

8.6.3 Sprinklers shall not be required in clothes closets, linen closets, and pantries that meet all of the following conditions:

(1) The area of the space does not exceed 24 ft^2 (2.2 m^2).
(2) The least dimension does not exceed 3 ft (0.9 m).
(3) The walls and ceilings are surfaced with noncombustible or limited-combustible materials as defined in NFPA 220, *Standard on Types of Building Construction.*

8.6.4* Sprinklers shall not be required in garages, open attached porches, carports, and similar structures.

8.6.5 Sprinklers shall not be required in attics, penthouse equipment rooms, elevator machine rooms, concealed spaces dedicated exclusively to and containing only dwelling unit ventilation equipment, floor/ceiling spaces, elevator shafts, crawl spaces, and other concealed spaces that are not used or intended for living purposes and do not contain fuel-fired equipment.

8.6.5.1 When fuel-fired equipment is present, at least one quick-response intermediate temperature sprinkler shall be installed above the equipment.

8.6.6 Sprinklers shall not be required in covered unheated projections of the building at entrances/exits as long as the dwelling unit has another means of egress.

8.6.7 Sprinklers shall not be required for ceiling pockets that meet the following conditions:

(1) The total volume of unprotected ceiling pocket does not exceed 100 ft^3 (2.83 m^3).
(2) The entire floor under the unprotected ceiling pocket is protected by the sprinklers at the lower ceiling elevation.
(3) Each unprotected ceiling pocket is separated from any adjacent unprotected ceiling pocket by a minimum 10 ft (3.05 m) horizontal distance.
(4) The interior finish of the unprotected ceiling pocket is noncombustible or limited-combustible material.
(5) Skylights not exceeding 32 ft^2 (2.97 m^2) shall be permitted to have a plastic cover.

Table 8.4.10.2(f) Allowable Pipe Length for ¾ in. CPVC Pipe

Sprinkler Flow Rate* (gpm)	Water Distribution Size (in.)	Available Pressure, P_t (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable Length of Pipe from Service Valve to Farthest Sprinkler (ft)									
8	¾	348	465	581	697	813	929	1045	1161	1278	1394
9	¾	280	374	467	560	654	747	841	934	1027	1121
10	¾	231	307	384	461	538	615	692	769	845	922
11	¾	193	258	322	387	451	515	580	644	709	773
12	¾	165	219	274	329	384	439	494	549	603	658
13	¾	142	189	237	284	331	378	426	473	520	568
14	¾	124	165	206	247	289	330	371	412	454	495
15	¾	109	145	182	218	254	290	327	363	399	436
16	¾	97	129	161	193	226	258	290	322	354	387
17	¾	86	115	144	173	202	230	259	288	317	346
18	¾	78	104	130	155	181	207	233	259	285	311
19	¾	70	94	117	141	164	188	211	234	258	281
20	¾	64	85	107	128	149	171	192	213	235	256
21	¾	58	78	97	117	136	156	175	195	214	234
22	¾	54	71	89	107	125	143	161	179	197	214
23	¾	49	66	82	99	115	132	148	165	181	198
24	¾	46	61	76	91	107	122	137	152	167	183
25	¾	42	56	71	85	99	113	127	141	155	169
26	¾	39	52	66	79	92	105	118	131	144	157
27	¾	37	49	61	73	86	98	110	122	135	147
28	¾	34	46	57	69	80	92	103	114	126	137
29	¾	32	43	54	64	75	86	96	107	118	129
30	¾	30	40	50	60	70	81	91	101	111	121
31	¾	28	38	47	57	66	76	85	95	104	114
32	¾	27	36	45	54	63	71	80	89	98	107
33	¾	25	34	42	51	59	68	76	84	93	101
34	¾	24	32	40	48	56	64	72	80	88	96
35	¾	23	30	38	45	53	61	68	76	83	91
36	¾	22	29	36	43	50	57	65	72	79	86
37	¾	20	27	34	41	48	55	61	68	75	82
38	¾	20	26	33	39	46	52	59	65	72	78
39	¾	19	25	31	37	43	50	56	62	68	74
40	¾	18	24	30	35	41	47	53	59	65	71

*Flow rate from 8.1.1 and 8.1.2.

Table 8.4.10.2(g) Allowable Pipe Length for 1 in. CPVC Pipe

Sprinkler Flow Rate* (gpm)	Water Distribution Size (in.)	Available Pressure, P_t (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable Length of Pipe from Service Valve to Farthest Sprinkler (ft)									
8	1	1049	1398	1748	2098	2447	2797	3146	3496	3845	4195
9	1	843	1125	1406	1687	1968	2249	2530	2811	3093	3374
10	1	694	925	1157	1388	1619	1851	2082	2314	2545	2776
11	1	582	776	970	1164	1358	1552	1746	1940	2133	2327
12	1	495	660	826	991	1156	1321	1486	1651	1816	1981
13	1	427	570	712	854	997	1139	1281	1424	1566	1709
14	1	372	497	621	745	869	993	1117	1241	1366	1490
15	1	328	437	546	656	765	874	983	1093	1202	1311
16	1	291	388	485	582	679	776	873	970	1067	1164
17	1	260	347	433	520	607	693	780	867	954	1040
18	1	234	312	390	468	546	624	702	780	858	936
19	1	212	282	353	423	494	565	635	706	776	847
20	1	193	257	321	385	449	513	578	642	706	770
21	1	176	235	293	352	410	469	528	586	645	704
22	1	161	215	269	323	377	430	484	538	592	646
23	1	149	198	248	297	347	396	446	496	545	595
24	1	137	183	229	275	321	366	412	458	504	550
25	1	127	170	212	255	297	340	382	425	467	510
26	1	118	158	197	237	276	316	355	395	434	474
27	1	111	147	184	221	258	295	332	368	405	442
28	1	103	138	172	207	241	275	310	344	379	413
29	1	97	129	161	194	226	258	290	323	355	387
30	1	91	121	152	182	212	242	273	303	333	364
31	1	86	114	143	171	200	228	257	285	314	342
32	1	81	108	134	161	188	215	242	269	296	323
33	1	76	102	127	152	178	203	229	254	280	305
34	1	72	96	120	144	168	192	216	240	265	289
35	1	68	91	114	137	160	182	205	228	251	273
36	1	65	87	108	130	151	173	195	216	238	260
37	1	62	82	103	123	144	165	185	206	226	247
38	1	59	78	98	117	137	157	176	196	215	235
39	1	56	75	93	112	131	149	168	187	205	224
40	1	53	71	89	107	125	142	160	178	196	214

*Flow rate from 8.1.1 and 8.1.2.

Table 8.4.10.2(h) Allowable Pipe Length for ¾ in. PEX Tubing

Sprinkler Flow Rate* (gpm)	Water Distribution Size (in.)	Available Pressure, P_t (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable Length of Pipe from Service Valve to Farthest Sprinkler (ft)									
8	¾	93	123	154	185	216	247	278	309	339	370
9	¾	74	99	124	149	174	199	223	248	273	298
10	¾	61	82	102	123	143	163	184	204	225	245
11	¾	51	68	86	103	120	137	154	171	188	205
12	¾	44	58	73	87	102	117	131	146	160	175
13	¾	38	50	63	75	88	101	113	126	138	151
14	¾	33	44	55	66	77	88	99	110	121	132
15	¾	29	39	48	58	68	77	87	96	106	116
16	¾	26	34	43	51	60	68	77	86	94	103
17	¾	23	31	38	46	54	61	69	77	84	92
18	¾	21	28	34	41	48	55	62	69	76	83
19	¾	19	25	31	37	44	50	56	62	69	75
20	¾	17	23	28	34	40	45	51	57	62	68
21	¾	16	21	26	31	36	41	47	52	57	62
22	¾	NP	19	24	28	33	38	43	47	52	57
23	¾	NP	17	22	26	31	35	39	44	48	52
24	¾	NP	16	20	24	28	32	36	40	44	49
25	¾	NP	NP	19	22	26	30	34	37	41	45
26	¾	NP	NP	17	21	24	28	31	35	38	42
27	¾	NP	NP	16	20	23	26	29	33	36	39
28	¾	NP	NP	15	18	21	24	27	30	33	36
29	¾	NP	NP	NP	17	20	23	26	28	31	34
30	¾	NP	NP	NP	16	19	21	24	27	29	32
31	¾	NP	NP	NP	15	18	20	23	25	28	30
32	¾	NP	NP	NP	NP	17	19	21	24	26	28
33	¾	NP	NP	NP	NP	16	18	20	22	25	27
34	¾	NP	NP	NP	NP	NP	17	19	21	23	25
35	¾	NP	NP	NP	NP	NP	16	18	20	22	24
36	¾	NP	NP	NP	NP	NP	15	17	19	21	23
37	¾	NP	NP	NP	NP	NP	NP	16	18	20	22
38	¾	NP	NP	NP	NP	NP	NP	16	17	19	21
39	¾	NP	NP	NP	NP	NP	NP	NP	16	18	20
40	¾	NP	NP	NP	NP	NP	NP	NP	16	17	19

NP: Not permitted.

*Flow rate from 8.1.1 and 8.1.2.

Table 8.4.10.2(i) Allowable Pipe Length for 1 in. PEX Tubing

Sprinkler Flow Rate* (gpm)	Water Distribution Size (in.)	Available Pressure, P_t (psi)									
		15	20	25	30	35	40	45	50	55	60
		Allowable Length of Pipe from Service Valve to Farthest Sprinkler (ft)									
8	1	314	418	523	628	732	837	941	1046	1151	1255
9	1	252	336	421	505	589	673	757	841	925	1009
10	1	208	277	346	415	485	554	623	692	761	831
11	1	174	232	290	348	406	464	522	580	638	696
12	1	148	198	247	296	346	395	445	494	543	593
13	1	128	170	213	256	298	341	383	426	469	511
14	1	111	149	186	223	260	297	334	371	409	446
15	1	98	131	163	196	229	262	294	327	360	392
16	1	87	116	145	174	203	232	261	290	319	348
17	1	78	104	130	156	182	208	233	259	285	311
18	1	70	93	117	140	163	187	210	233	257	280
19	1	63	84	106	127	148	169	190	211	232	253
20	1	58	77	96	115	134	154	173	192	211	230
21	1	53	70	88	105	123	140	158	175	193	211
22	1	48	64	80	97	113	129	145	161	177	193
23	1	44	59	74	89	104	119	133	148	163	178
24	1	41	55	69	82	96	110	123	137	151	164
25	1	38	51	64	76	89	102	114	127	140	152
26	1	35	47	59	71	83	95	106	118	130	142
27	1	33	44	55	66	77	88	99	110	121	132
28	1	31	41	52	62	72	82	93	103	113	124
29	1	29	39	48	58	68	77	87	97	106	116
30	1	27	36	45	54	63	73	82	91	100	109
31	1	26	34	43	51	60	68	77	85	94	102
32	1	24	32	40	48	56	64	72	80	89	97
33	1	23	30	38	46	53	61	68	76	84	91
34	1	22	29	36	43	50	58	65	72	79	86
35	1	20	27	34	41	48	55	61	68	75	82
36	1	19	26	32	39	45	52	58	65	71	78
37	1	18	25	31	37	43	49	55	62	68	74
38	1	18	23	29	35	41	47	53	59	64	70
39	1	17	22	28	33	39	45	50	56	61	67
40	1	16	21	27	32	37	43	48	53	59	64

*Flow rate from 8.1.1 and 8.1.2.

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 NFPA 13D is appropriate for protection against fire hazards only in one- and two-family dwellings and manufactured homes. Residential portions of any other type of building or occupancy should be protected with residential sprinklers in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, or in accordance with NFPA 13R, *Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height*. Other portions of such buildings should be protected in accordance with NFPA 13 or NFPA 13R as appropriate for areas outside the dwelling unit.

The criteria in this standard are based on full-scale fire tests of rooms containing typical furnishings found in residential living rooms, kitchens, and bedrooms. The furnishings were arranged as typically found in dwelling units in a manner similar to that shown in Figure A.1.1(a), Figure A.1.1(b), and Figure A.1.1(c). Sixty full-scale fire tests were conducted in a two-story dwelling in Los Angeles, California, and 16 tests were conducted in a 14 ft (4.3 m) wide mobile home in Charlotte, North Carolina.

Sprinkler systems designed and installed according to this standard are expected to prevent flashover within the compartment of origin where sprinklers are installed in the compartment. A sprinkler system designed and installed according to this standard cannot, however, be expected to completely control a fire involving fuel loads that are significantly higher than average for dwelling units [10 lb/ft^2 (49 kg/m^2)] and where the interior finish has an unusually high flame spread index (greater than 225) when tested in accordance with ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or ANSI/UL 723, *Standard for Test for Surface Burning Characteristics of Building Materials*.

(For protection of multifamily dwellings, see NFPA 13 or NFPA 13R.)

A.1.2 While the purpose of this standard is to provide improved protection against injury and loss of life, the use of these systems has demonstrated an ability to provide improved protection against property damage. Various levels of fire safety are available to dwelling occupants to provide life safety and property protection.

This standard recommends, but does not require, sprinklering of all areas in a dwelling; it permits sprinklers to be omitted in certain areas. These areas have been proved by NFPA statistics *[see Table A.1.2(a) and Table A.1.2(b)]* to be those where the incidence of life loss from fires in dwellings is low. Such an approach provides a reasonable degree of fire safety. Greater protection to both life and property is achieved by sprinklering all areas.

Guidance for the installation of smoke detectors and fire detection systems is found in *NFPA 72, National Fire Alarm and Signaling Code*.

A.1.5.1 For additional conversions and information, see IEEE/ASTM SI 10, *Standard for Use of the International System of Units (SI): The Modern Metric System*.

A.1.5.4 A given equivalent value is considered to be approximate.

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

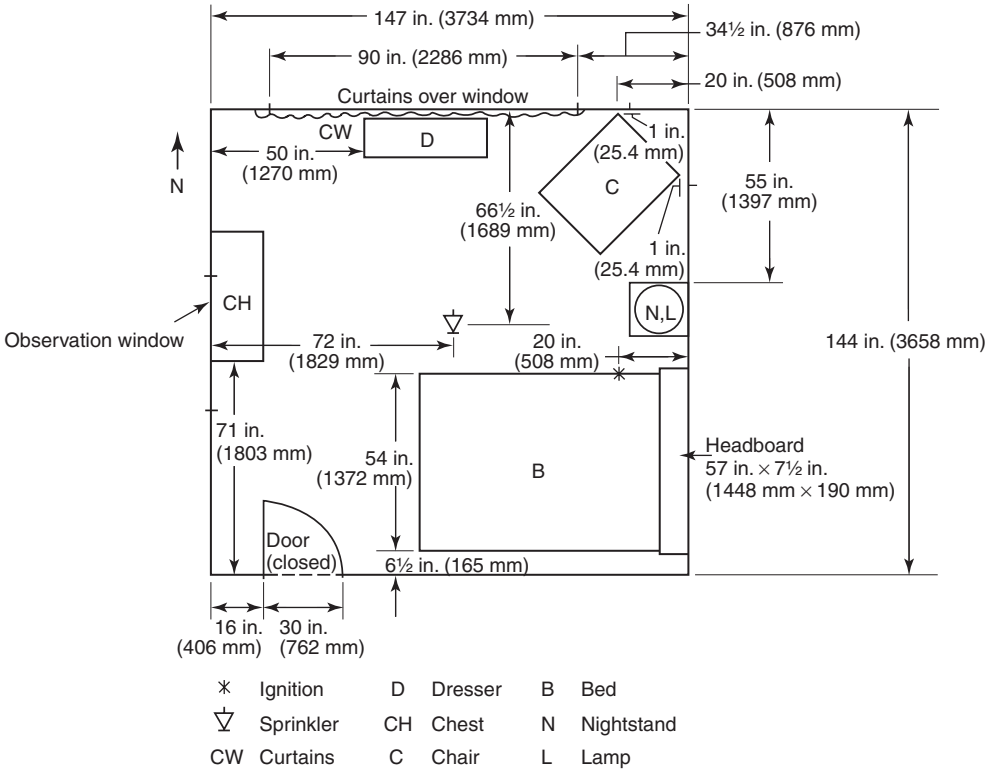


FIGURE A.1.1(a) Bedroom.

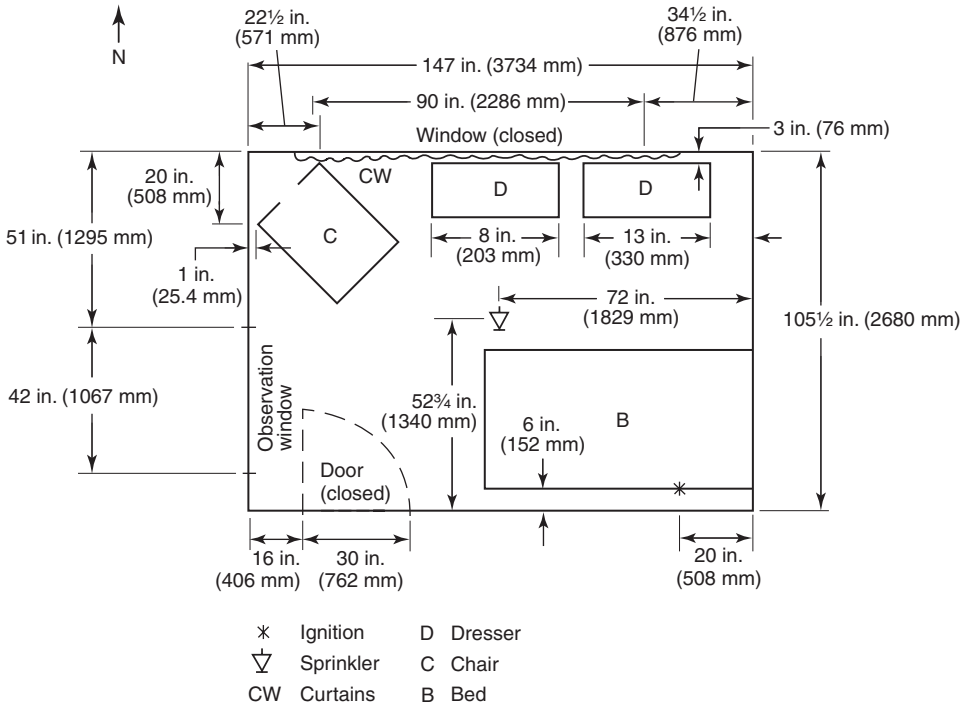


FIGURE A.1.1(b) Manufactured Home Bedroom.

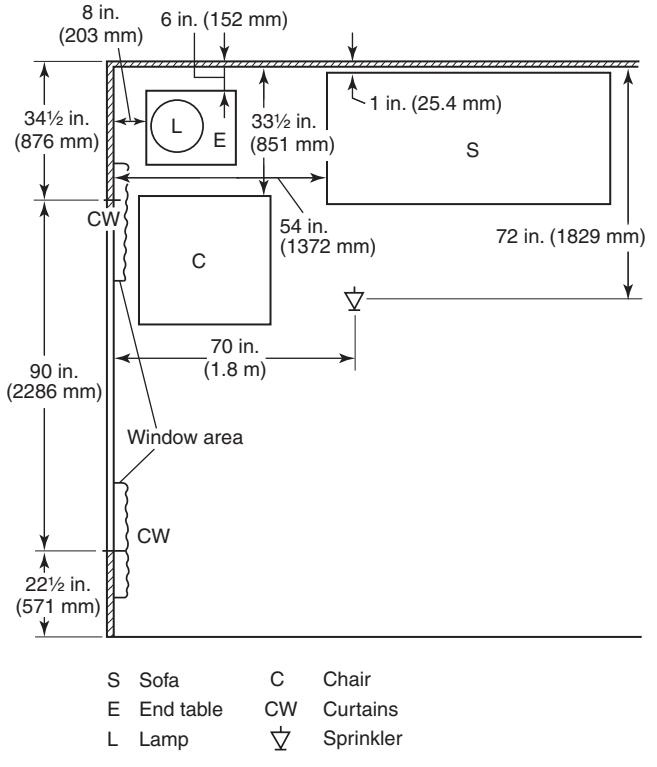


FIGURE A.1.1(c) Living Room.

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

Table A.1.2(a) Causal Factors in One- and Two-Family Dwelling Fires That Caused One or More Deaths

Area of Origin	Percent Occurrence[1]
Living room	41
Bedroom	27
Kitchen	15
Storage area	4
Heating equipment room	3
Structural area	2
Other areas	8
Form of Materials Ignited	**Percent Occurrence[2]**
Furniture	27
Bedding	18
Combustible liquid or gas	13
Interior finish	9
Structural member	9
Waste, rubbish	4
Clothing (on a person)	3
Cooking materials	3
Electrical insulation	2
Curtains, draperies	2
Other	10
Form of Heat of Ignition	**Percent Occurrence[3]**
Smoking materials	36
Heat from fuel-fire or powered object	25
Heat from miscellaneous open flame (including match)	15
Heat from electrical equipment arcing or overload	14
Hot objects, including properly operating electrical equipment	7
Other	3

Note: Total number of incidents reported: 10,194.
[1] Based on 6066 incidents where area of origin was reported.
[2] Based on 5080 incidents where form of material ignited was reported.
[3] Based on 5016 incidents where form of heat of ignition was reported.
Source: FIDO Database 1973 to 1982, NFPA Fire Analysis Department.

the system employed by the listing organization to identify a listed product.

A.3.3.5 Manufactured Home. Manufactured homes were formerly referred to as "mobile homes" or "trailer coaches."

A.3.3.9.3 Multipurpose Piping System. Examples of multipurpose piping systems are shown in Figure A.3.3.9.3(a), Figure A.3.3.9.3(b), and Figure A.3.3.9.3(c).

A.3.3.9.4 Network System. A network system is a type of multipurpose system that often uses ½ in. piping to serve both domestic and fire protection needs, providing an equivalent level of suppression capability as larger piping systems. To accomplish this protection, each sprinkler is supplied by water flowing to it from at least three separate paths. An example of a network system is shown in Figure A.3.3.9.4.

A.3.3.11.2 Control Valve. System control valves should be of the indicating type, such as plug valves, ball valves, butterfly valves, or OS&Y gate valves.

A.4.1.1 The occupants of a home with a sprinkler system should understand that maintaining a sprinkler system is mostly about common sense. Keeping the control valve open, not hanging items from the sprinklers, and making sure that the sprinklers do not get painted or obstructed are the most important items. It is also important to know where the control valve is located so that the water can be shut down after sprinkler activation to minimize water damage.

The building owner or manager should understand the sprinkler system operation and should conduct periodic inspections and tests to make sure that the system is in good working condition. A recommended inspection and testing program includes the following:

(1) Monthly inspection of all valves to ensure that they are open.
(2) Monthly inspection of tanks, if present, to confirm they are full.
(3) Monthly testing of pumps, if present, to make sure they operate properly and do not trip circuit breakers when starting.
(4) Testing of all waterflow devices, when provided, every 6 months including monitoring service (note that notification of the monitoring service is essential to make sure that the fire department is not called due to testing).
(5) Ongoing visual inspection of all sprinklers to make sure they are not obstructed and decorations are not attached or hung from them.
(6) Whenever painting or home improvements are made in the dwelling unit, special attention should be paid to ensure that sprinklers are not painted or obstructed either at the time of installation or during subsequent redecoration. When painting is occurring in the vicinity of sprinklers, the sprinklers should be protected by covering them with a bag, which should be removed immediately after painting is finished.

A.4.1.4 Tests should be made by drawing a sample of the solution from valve B, as shown in Figure 8.3.3.3.1.1, two or three times during the freezing season, especially if it has been necessary to drain the building sprinkler system for reasons such as repairs or changes. A small hydrometer should be used so that a small sample is sufficient. Where water appears at valve B or where the test sample indicates that the solution has become weakened, the entire system should be emptied and then recharged as previously described.

A.4.2 Testing of a system can be accomplished by filling the system with water and checking visually for leakage at each joint or coupling.

Fire department connections are not required for systems covered by this standard but can be installed at the discretion of the owner. In these cases, hydrostatic tests in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, are necessary.

Dry systems also should be tested by placing the system under air pressure. Any leak that results in a drop in system pressure greater than 2 psi (0.14 bar) in 24 hours should be corrected. Leaks should be identified using soapy water brushed on each joint or coupling. The presence of bubbles indicates a leak. This test should be made prior to concealing the piping.

A.4.7 A scaled drawing where required should show the following:

(1) Address (if known)
(2) Size and type of domestic line, including length to city connection
(3) Water meter size
(4) Current static water pressure

Table A.1.2(b) Fires and Associated Deaths and Injuries in Dwellings, Duplexes, and Manufactured Homes by Area of Origin: Annual Average of 1986–1990 Structure Fires Reported to U.S. Fire Departments

Area of Origin	Civilian Deaths	Civilian Percent	Fires	Percent	Injuries	Percent
Living room, family room, or den	1,330	37.1	42,600	10.5	2,546	18.6
Bedroom	919	25.6	50,200	12.4	3,250	23.7
Kitchen	541	15.1	92,670	22.9	3,987	29.1
Dining room	83	2.3	3,780	0.9	189	1.4
Heating equipment room or area	62	1.7	15,130	3.7	374	2.7
Hallway or corridor	48	1.3	3,690	0.9	155	1.1
Laundry room or area	47	1.3	15,370	3.8	363	2.7
Garage or carport*	45	1.2	14,580	3.6	524	3.8
Bathroom	44	1.2	8,040	2.0	271	2.0
Unclassified structural area	43	1.2	4,530	1.1	104	0.8
Crawl space or substructure space	41	1.2	11,200	2.8	317	2.3
Multiple areas	41	1.1	3,350	0.8	96	0.7
Ceiling/floor assembly or concealed space	32	0.9	3,470	0.9	64	0.5
Wall assembly or concealed space	27	0.8	7,090	1.8	93	0.7
Closet	23	0.6	5,020	1.2	186	1.4
Exterior balcony or open porch	22	0.6	5,570	1.4	121	0.9
Exterior wall surface	22	0.6	14,620	3.6	118	0.9
Unclassified area	21	0.6	2,590	0.6	87	0.6
Attic or ceiling/roof assembly or concealed space	21	0.6	10,740	2.7	98	0.7
Tool room or other supply storage room or area	20	0.5	4,160	1.0	133	1.0
Lobby or entrance way	17	0.5	1,410	0.3	44	0.3
Interior stairway	17	0.5	1,100	0.3	41	0.3
Chimney	17	0.5	60,530	14.9	75	0.5
Unclassified function area	17	0.5	1,090	0.3	43	0.3
Unclassified storage area	14	0.4	2,460	0.6	80	0.6
Area not applicable	11	0.3	1,180	0.3	22	0.2
Exterior stairway	8	0.2	1,090	0.3	25	0.2
Lawn or field	7	0.2	1,670	0.4	24	0.2
Trash room or area	5	0.1	1,140	0.3	14	0.1
Product storage area	5	0.1	780	0.2	23	0.2
Unclassified means of egress	5	0.1	610	0.2	15	0.1
Unclassified service or equipment area	4	0.1	380	0.1	12	0.1
Library	3	0.1	180	0.0	11	0.0
Other known area	26	0.7	12,880	3.2	195	1.4
Total	3,589	100.0	404,900	100.0	13,691	100.0

Note: Fires are estimated to the nearest 10; civilian deaths and injuries are estimated to the nearest 1.
*Does not include dwelling garages coded as a separate property, which averaged 19 deaths, 259 injuries, and 21,170 fires per year.
Source: 1986–1990 NFIRS and NFPA survey.

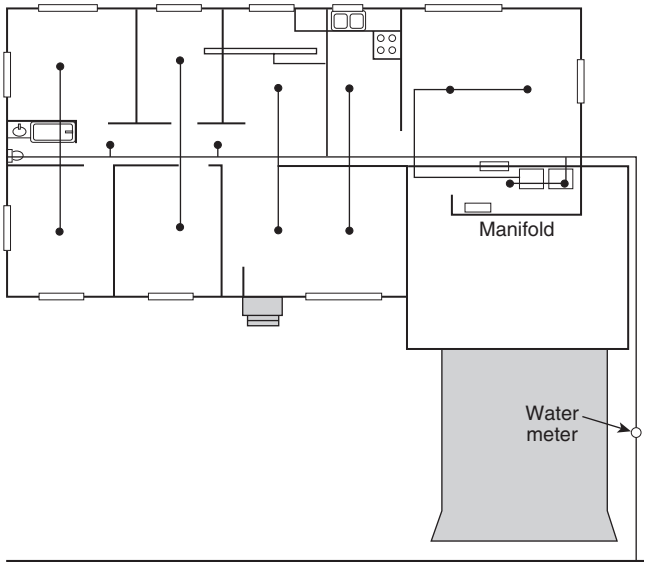


FIGURE A.3.3.9.3(a) Multipurpose Piping System — Example 1.

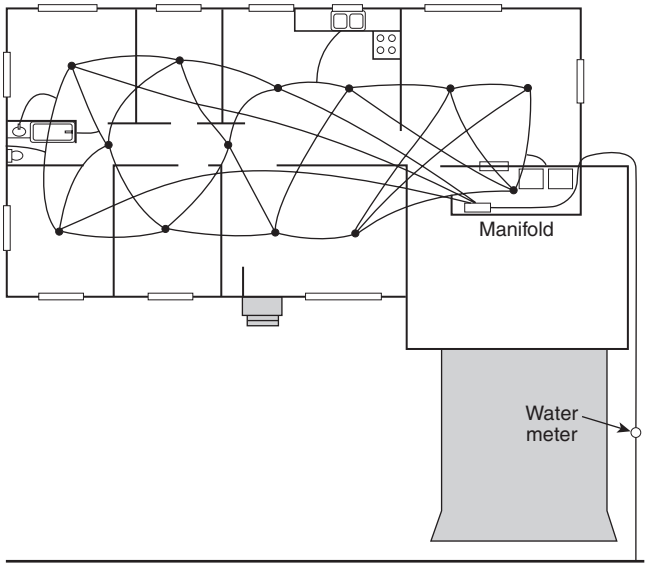


FIGURE A.3.3.9.3(c) Multipurpose Piping System — Example 3 (Network System).

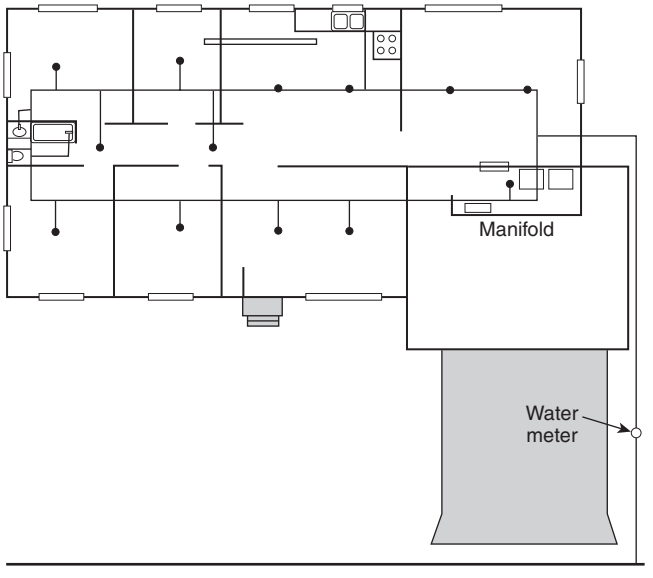


FIGURE A.3.3.9.3(b) Multipurpose Piping System — Example 2.

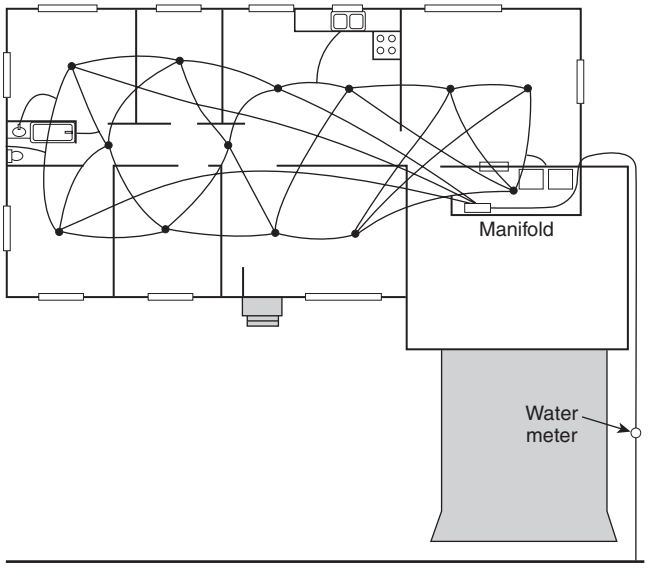


FIGURE A.3.3.9.4 Network System.

(5) Interior walls
(6) Model, manufacturer, temperature, orifice size, and spacing requirements of sprinklers
(7) Type of pipe
(8) Hanger spacing requirement per the pipe manufacturer
(9) Riser detail
(10) Installing contractor information
(11) Preliminary hydraulic calculations

A.5.1.1 Where fused sprinklers are replaced by the owner, fire department, or others, care should be taken to ensure that the replacement sprinkler has the same operating characteristics.

A.5.2.1 For reference the information in Table A.5.2.1(a) through Table A.5.2.1(d) is provided to assist in the determination of acceptable water availability.

A.5.2.2.2 Not all pipe or tube made to ASTM F 442, *Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)*, as described in 5.2.2.2 is listed for fire sprinkler service. Listed pipe is identified by the logo of the listing agency.

All nonmetallic pipe and fitting materials can be damaged by contact with chemicals found in some construction products, such as thread sealants, leak detectors, firestops, insulation, spray foams, cutting oils, termiticides, insecticides, antifreeze, coupling lubes, communication cables, wires, flux,

Table A.5.2.1(a) SDR 13.5 IPS Pipe (CPVC)

Nominal Pipe Size (in.)	Average Outside Diameter (in.)	Average Inside Diameter (in.)
¾	1.05	0.87
1	1.32	1.10
1¼	1.66	1.39
1½	1.90	1.60
2	2.38	2.00
2½	2.88	2.42
3	3.50	2.95

Table A.5.2.1(b) SDR 9 CTS Pipe (PEX)

Nominal Diameter (in.)	Outside Diameter		Wall		Inside Diameter	
	in.*	mm	in.†	mm	in.	mm
⅜	0.50	12.7	0.07	1.8	0.36	9.1
½	0.63	15.9	0.07	1.8	0.49	12.3
¾	0.88	22.2	0.10	2.5	0.68	17.2
1	1.30	28.6	0.13	3.2	0.88	22.2
1¼	1.38	34.9	0.15	3.9	1.07	27.2
1½	1.63	41.2	0.18	4.6	1.26	32.1
2	2.13	54.0	0.24	6.0	1.65	42.0

* Average dimensions from ASTM F 876.
† Minimum wall thickness from ASTM F 876.

solder, mastic, PVC coated floor clamps, pipe tapes, grease and cooking oils, rubber and plasticizers, antimicrobial coatings, and so forth. The chemical compatibility of such products with the particular pipe or fitting material must be verified prior to use. Otherwise, contact between the construction product and the pipe or fitting must be avoided.

A.5.2.4 Compatible thread sealant or Teflon tape can be used in a CPVC sprinkler head adapter. The combination of the two cannot be used together. The manufacturer of the sprinkler head adapter installation instructions must be followed for each sprinkler head adapter used.

A.5.2.9.2 Not all fittings made to ASTM F 437, *Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*; ASTM F 438, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40*; and ASTM F 439, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*, as described in 5.2.9.2 are listed for fire sprinkler service. Listed fittings are identified by the logo of the listing agency.

A.5.3 It is not the intent of NFPA 13D to require the use of NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, for any supply piping.

A.6.2 The connection to city mains for fire protection is often subject to local regulation of metering and backflow prevention requirements. Preferred and acceptable water supply arrangements are shown in Figure A.6.2(a), Figure A.6.2(b), and Figure A.6.2(c). Where it is necessary to use a meter between the city water main and the sprinkler system supply, an acceptable arrangement as shown in Figure A.6.2(c) can be used. Under these circumstances, the flow characteristics of the meter are to be included in the hydraulic calculation of the system [*see Table 8.4.4(g)*]. Where a tank is used for both domestic and fire protection purposes, a low water alarm that actuates when the water level falls below 110 percent of the minimum quantity specified in 6.1.2 should be provided.

The effect of pressure-reducing valves on the system should be considered in the hydraulic calculation procedures.

Table A.5.2.1(c) Steel Pipe Dimensions

Nominal Pipe Size		Outside Diameter		Schedule 5				Schedule 10[a]				Schedule 30				Schedule 40			
				Inside Diameter		Wall Thickness		Inside Diameter		Wall Thickness		Inside Diameter		Wall Thickness		Inside Diameter		Wall Thickness	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
½[b]	15	0.84	21.3	—	—	—	—	0.67	17.0	0.08	2.1	—	—	—	—	0.62	15.8	0.11	2.8
¾[b]	20	1.05	26.7	—	—	—	—	0.88	22.4	0.08	2.1	—	—	—	—	0.82	21.0	0.11	2.9
1	25	1.32	33.4	1.19	30.1	0.07	1.7	1.10	27.9	0.11	2.8	—	—	—	—	1.05	26.6	0.13	3.4
1¼	32	1.66	42.2	1.53	38.9	0.07	1.7	1.44	36.6	0.11	2.8	—	—	—	—	1.38	35.1	0.14	3.6
1½	40	1.90	48.3	1.77	45.0	0.07	1.7	1.68	42.7	0.11	2.8	—	—	—	—	1.61	40.9	0.15	3.7
2	50	2.38	60.3	2.25	57.0	0.07	1.7	2.16	54.8	0.11	2.8	—	—	—	—	2.07	52.5	0.15	3.9
2½	65	2.88	73.0	2.71	68.8	0.08	2.1	2.64	66.9	0.12	3.0	—	—	—	—	2.47	62.7	0.20	5.2
3	80	3.50	88.9	3.33	84.7	0.08	2.1	3.26	82.8	0.12	3.0	—	—	—	—	3.07	77.9	0.22	5.5

[a] Schedule 10 defined to 5 in. (127 mm) nominal pipe size by ASTM A 135, *Standard Specifications for Electric-Resistance-Welded Steel Pipe.*
[b] These values applicable when used in conjunction with 8.15.19.3 and 8.15.19.4 of NFPA 13.
[**13:** Table A.6.3.2]

Table A.5.2.1(d) Copper Tube Dimensions

Nominal Tube Size		Outside Diameter		Type K				Type L				Type M			
				Inside Diameter		Wall Thickness		Inside Diameter		Wall Thickness		Inside Diameter		Wall Thickness	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
¾	20	0.88	22.2	0.75	18.9	0.07	1.7	0.79	19.9	0.05	1.1	0.81	20.6	0.03	0.8
1	25	1.13	28.6	1.00	25.3	0.07	1.7	1.03	26.0	0.05	1.3	1.06	26.8	0.04	0.9
1¼	32	1.38	34.9	1.25	31.6	0.07	1.7	1.27	32.1	0.06	1.4	1.29	32.8	0.04	1.1
1½	40	1.63	41.3	1.48	37.6	0.07	1.8	1.51	38.2	0.06	1.5	1.53	38.8	0.05	1.2
2	50	2.13	54.0	1.96	49.8	0.08	2.1	1.99	50.4	0.07	1.8	2.01	51.0	0.06	1.5
2½	65	2.63	66.7	2.44	61.8	0.10	2.4	2.47	62.6	0.08	2.0	2.50	63.4	0.07	1.7
3	80	3.13	79.4	2.91	73.8	0.11	2.8	2.95	74.8	0.09	2.3	2.98	75.7	0.07	1.8

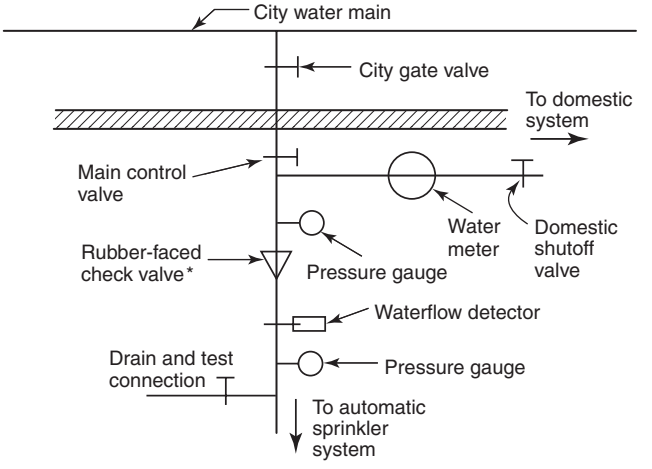
[**13**: Table: A.6.3.5]

Figure A.6.2(a) is the preferred method for getting the water supply into the unit for a stand-alone sprinkler system (one that does not also provide direct connections to the cold water fixtures) because the common supply pipe for the domestic system and the sprinkler system between the water supply and the dwelling unit has a single control valve that shuts the sprinkler system, which helps to ensure that people who have running water to their domestic fixtures also have fire protection. This serves as a form of supervision for the control valve and can be used to make sure that the valve stays open in place of other, more expensive options such as tamper switches with a monitoring service.

Some water utilities insist on separate taps and supply pipes from the water supply to the dwelling unit for fire sprinkler systems as shown in Figure A.6.2(b), due to concerns about shutting off the water supply for nonpayment of bills and the desire not to shut off fire protection if this ever occurs. While this type of arrangement is acceptable, it is not cost efficient and should be discouraged due to the extra cost burden this places on the building owner. The concern over shutting off the water for nonpayment of bills is a nonissue for a number of reasons. First, the water utilities rarely actually shut off water for nonpayment. Second, if they do shut off water for nonpayment, they are creating violations of all sorts of health and safety codes, allowing people to live in a home without running water. Concern over the fire protection for those individuals when they are violating all kinds of other health codes is disingenuous. More likely, the water utility will not shut off the water and will follow other legal avenues to collect on unpaid bills such as liens on property. Millions of people should not have to pay hundreds of millions of dollars to install separate water taps and lines for the few services that might get shut off.

A.6.2.1 The flow of water is necessary to make sure that the pump does not get damaged during testing. Use of a timer to keep the pump running is not recommended because the timer will allow the pump to run when no water is flowing. The pump needs to run for the entire duration without interruption, including not tripping the circuit breaker.

A.6.2.3 The best method for getting the water supply into the unit for a stand-alone sprinkler system (one that does not also provide direct connections to the cold water fixtures) is to have a common pipe for the domestic system and the sprinkler system between the water supply and the dwelling unit.

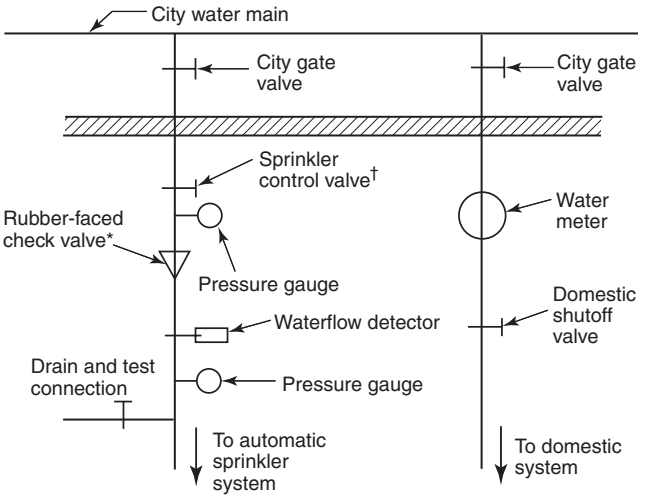


* Rubber face optional.

FIGURE A.6.2(a) Preferable Arrangement for Stand-Alone Piping Systems.

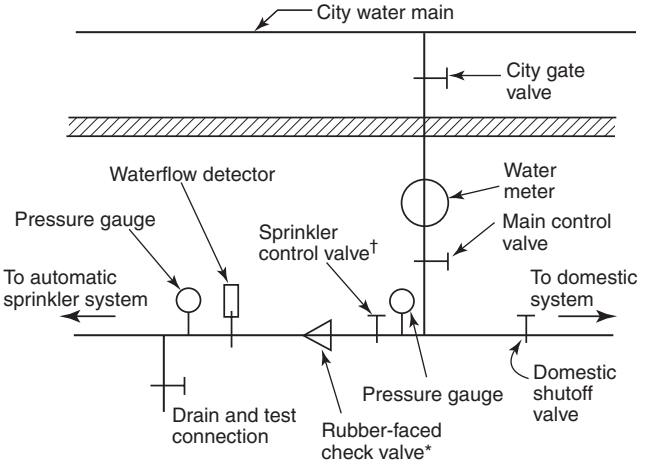
Once inside the dwelling unit, the pipes can be split to provide the individual domestic and sprinkler systems. In this arrangement, a single control valve on the combined pipe (prior to the split) as shown in Figure A.6.2(a) being the only control valve that shuts the sprinkler system is preferred because it ensures that people who have running water to their domestic fixtures also have fire protection. This serves as a form of supervision for the control valve and can be used to make sure that the valve stays open in place of other, more expensive options such as tamper switches with monitoring service.

Some water utilities insist on separate taps and supply pipes from the water supply to the dwelling unit for fire sprinkler systems due to concerns about shutting off the water supply for nonpayment of bills and the desire not to shut off fire protection if this ever occurs. While this type of arrangement is acceptable [see Figure A.6.2(b)], it is not cost efficient and should be discouraged due to the extra burden this places on the building owner. The concern over shutting off the water for nonpayment of bills is a nonissue for a number of reasons. First the water utilities rarely actually shut off water for nonpayment. Second, if they do shut off water for nonpayment, they are creating violations of all sorts of health and safety



* Rubber face optional.
† Optional valve: See 7.1.2.

FIGURE A.6.2(b) Acceptable Arrangement for Stand-Alone Piping Systems with Valve Supervision — Option 1.



* Rubber face optional.
† Optional valve: See 7.1.2.

FIGURE A.6.2(c) Acceptable Arrangement for Stand-Alone Piping Systems with Valve Supervision — Option 2.

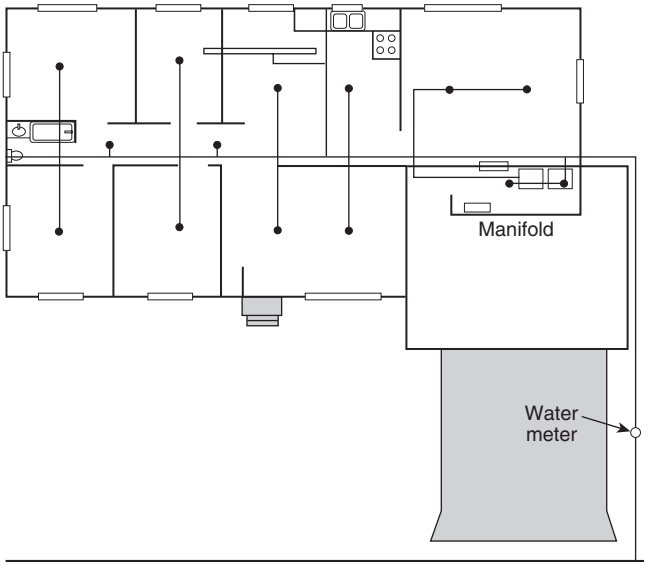


FIGURE A.6.3(a) Multipurpose Piping System — Example 1.

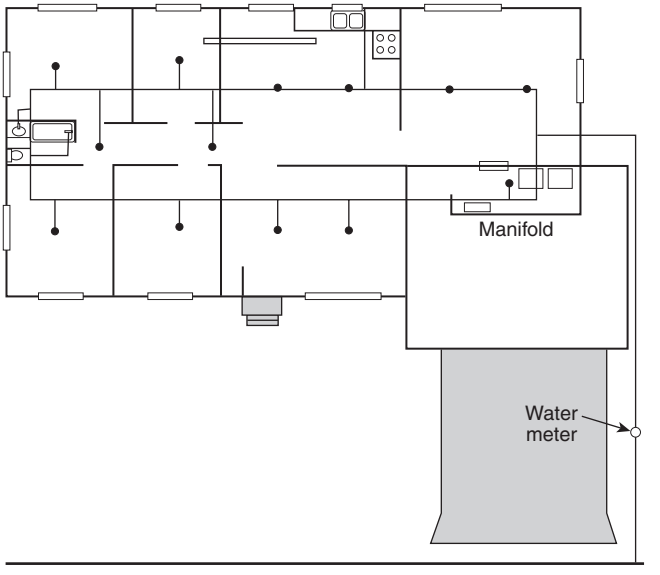


FIGURE A.6.3(b) Multipurpose Piping System — Example 2.

codes, allowing people to live in a home without running water. Concern over the fire protection for those individuals when they are violating all kinds of other health codes is disingenuous. More likely, the water utility will not shut off the water and will follow other legal avenues to collect on unpaid bills such as liens on property. Millions of people should not have to pay hundreds of millions of dollars to install separate water taps and lines for the few services that might get shut off.

A.6.3 Multipurpose piping systems consist of a single piping system within a residential occupancy that is intended to serve both domestic and fire protection needs. Basic forms of this system are shown in Figure A.6.3(a), Figure A.6.3(b), Figure A.6.3(c), and Figure A.6.3(d). A network system, as defined in 3.3.9.4, is a type of multipurpose system that utilizes a common piping system supplying domestic fixtures and fire sprinklers where each sprinkler is supplied by a minimum of three separate paths. In dwellings where long-term use of lawn sprinklers is common, provision should be made for such usage.

A.7.2.4 These connections should be installed so that the valve can be opened fully and for a sufficient time period to ensure a proper test without causing water damage. The test connection should be designed and sized to verify the sufficiency of the water supply and alarm mechanisms.

A.7.4.4 The reaction forces caused by the flow of water through the sprinkler could result in displacement of the sprinkler, thereby adversely affecting sprinkler discharge.

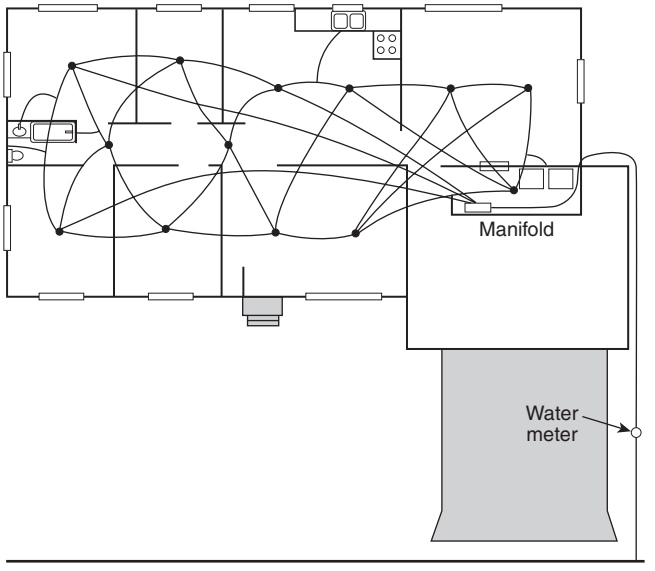


FIGURE A.6.3(c) Multipurpose Piping System — Example 3 (Network System).

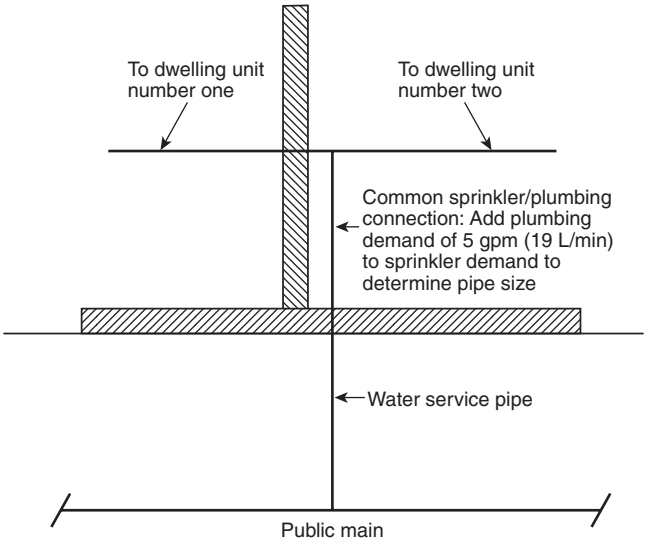


FIGURE A.6.3(d) Common Water Supply Connection Serving More Than One Dwelling Unit.

A.7.5.5.3 Care should be taken in positioning sprinklers in bathrooms near exhaust fan units. Some exhaust fan units have heaters built in to warm up the bathroom, and these units have the potential to activate sprinklers. Combination exhaust fan and heater units should be treated as wall-mounted diffusers for the purposes of using Table 7.5.5.3.

A.7.5.6 Decorative painting of a residential sprinkler is not to be confused with the temperature identification colors as specified in 6.2.5 of NFPA 13, *Standard for the Installation of Sprinkler Systems.*

A.7.6 The local waterflow alarm is intended to be a single alarm audible from the outside of the building. It can be mounted on the outside of the home or within the building close to the outside. This should not limit its use to prevent interior or remote notification. Interconnection with a smoke alarm or remote monitoring might improve notification, but is considered too costly to mandate for every system installed in accordance with this standard. It is not the intent of this standard to require central station monitoring or a fire alarm system.

An exterior alarm can be of benefit in areas where a neighbor could alert the fire department or to enhance the ability for an assisted rescue by a passerby.

A waterflow test is normally conducted using the system drain. Figure A.6.2(a), Figure A.6.2(b), and Figure A.6.2(c) show examples of this arrangement.

A.8.1.1.2 The minimum pressure and flow requirements need to be satisfied while also meeting the requirements of the formula $q = K(p)^{0.5}$. If a sprinkler with a K-factor of 4.3 is listed to cover an area of 18 ft × 18 ft (5.5 m × 5.5 m) at 16.2 gpm (61.3 L/min), the minimum pressure is required to be 14.2 psi (0.98 bar) so that the flow is achieved. Likewise, if a sprinkler with a K-factor of 5.6 is covering an area 12 ft × 12 ft (3.66 m × 3.66 m), the minimum flow is required to be 14.8 gpm (56 L/min) [the flow at 7 psi (0.48 bar)] even though a flow of 7.2 gpm (27.3 L/min) will satisfy the density criteria.

A.8.1.1.2.2 Sprinklers need to be used in accordance with their listed areas and density. *(See Figure A.8.1.1.2.2.)*

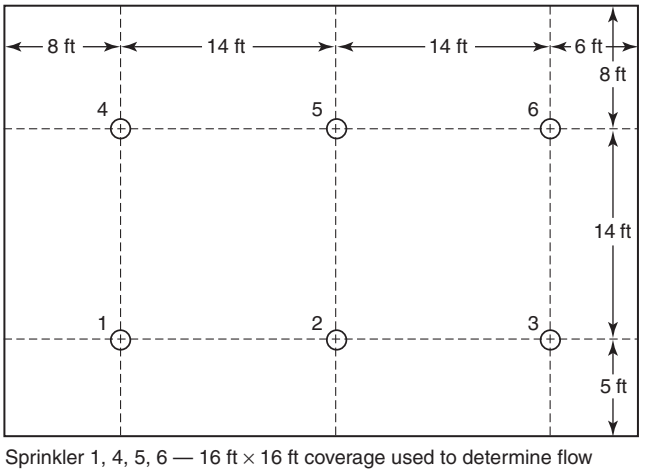


FIGURE A.8.1.1.2.2 Determining Required Flow.

A.8.1.2 All residential sprinklers have been investigated and are currently listed for use under flat, smooth, horizontal ceilings. Some residential sprinklers have been investigated and listed for use under specific smooth sloped or horizontal beamed ceilings. Where ceilings have configurations outside the scope of current listings, special sprinkler system design features such as larger flows, a design of three or more sprinklers to operate in a compartment, or both can be required. Figure A.8.1.2(a) and Figure A.8.1.2(b) show examples of design configurations.

Questions are frequently asked regarding the minimum two sprinkler design when certain sprinkler performance statistics have indicated that in a majority of the cases (with residential sprinklers) the fire is controlled or suppressed with a single sprinkler. While these statistics may or may not be correct, the water

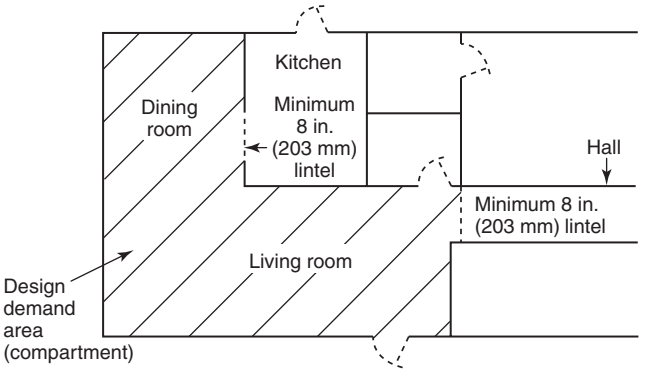


FIGURE A.8.1.2(a) Sprinkler Design Areas for Typical Residential Occupancy — Without Lintel.

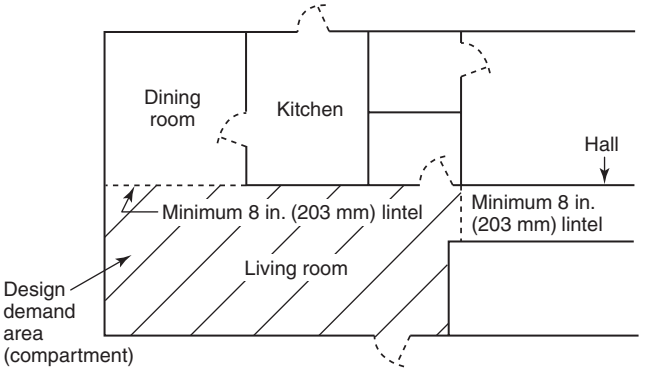


FIGURE A.8.1.2(b) Sprinkler Design Areas for Typical Residential Occupancy — With Lintel.

supplies for the fire sprinkler systems under which these statistics were generated were designed for two or more sprinklers in the first place. When the fires occurred, the first sprinkler operated in excess of its individual design flow and pressure because the sprinkler system's water supply was strong enough to handle multiple sprinklers and only a single sprinkler opened. At these higher flows and pressures, the discharge from a single sprinkler was sufficient to limit or suppress the heat generated from the fire. This concept is called "hydraulic increase." Hydraulic increase can also occur when a water supply's capabilities during the fire event exceeded that required by the minimum design requirements of the standard. Since none of the data used to generate the previously mentioned statistics captured the capabilities of the water supply in relation to the design requirements, the impact of the hydraulic increase on the number of single sprinkler activations cannot be determined.

But if the minimum water supply requirement of the standard is reduced to only be capable of handling a single sprinkler, then there could be no hydraulic increase safety factor. When the first sprinkler opens, it will only get the flow and pressure that were originally designed for it, and the potential is significant for that to be insufficient to control the fire given any obstructions and the layout of the space where the fire starts.

The National Institute for Standards and Technology (NIST), under a grant from the United States Fire Administration, studied this concept several years ago in the hopes of being able to propose a single sprinkler flow for the 2007 edition of NFPA 13D (see NIST Report NIST GCR 05-875 prepared by Underwriters Laboratories with a publication date of February 2004). Unfortunately, the research did not support the design of a sprinkler system with only the flow for a single sprinkler, even under conditions of small rooms with flat, smooth ceilings. Without the hydraulic increase associated with the two sprinkler design, the fire scenarios were too many where the first sprinkler to open would have insufficient flow to control the fire and then multiple sprinklers would open, causing the room to reach untenable conditions and the water supply to be overrun. These same fire scenarios were easily controlled by a sprinkler system designed for a two sprinkler water supply from the start.

In addition to the NIST tests, the National Fire Sprinkler Association conducted a series of full-scale fire tests in simulated bedrooms that were 14 ft × 14 ft with an adjoining hallway, each with flat, smooth, 8 ft high ceilings. The tests were performed to determine better rules for keeping sprinklers clear of obstructions like ceiling fans, but baseline tests were also performed without any obstructions at the ceiling. In nine out of the twelve tests, including the two baseline tests without obstructions at the ceiling, a sprinkler in the hall outside the room of fire origin opened first, followed by the sprinkler in the room of origin. Even though the room of origin met all of the rules of NFPA 13D as a compartment, a sprinkler outside of this room was opening first. All of these fires were controlled by the sprinklers, but if the water supply had only been sufficient for a single sprinkler, the sprinklers would never have been able to provide fire control.

A.8.1.3.1.2 Construction features such as large horizontal beamed ceilings, sloped ceilings having beams, and steeply sloped ceilings are outside of the current listings. In these situations, sprinklers can be installed in a manner acceptable to the authority having jurisdiction to achieve the results specified in this standard. In making these determinations, consideration should be given to factors influencing sprinkler system performance, such as sprinkler response characteristics, impact of obstructions on sprinkler discharge, and number of sprinklers anticipated to operate in the event of a fire.

A.8.2.5 The objective is to position sprinklers so that the response time and discharge are not unduly affected by obstructions such as ceiling slope, beams, light fixtures, or ceiling fans. The rules in this section, while different from the obstruction rules of NFPA 13, *Standard for the Installation of Sprinkler Systems*, provide a reasonable level of life safety while maintaining the philosophy of keeping NFPA 13D relatively simple to apply and enforce.

Fire testing has indicated the need to wet walls in the area protected by residential sprinklers at a level closer to the ceiling than that accomplished by standard sprinkler distribution. Where beams, light fixtures, sloped ceilings, and other obstructions occur, additional residential sprinklers are necessary to achieve proper response and distribution. In addition, for sloped ceilings, higher flow rates could be needed. Guidance should be obtained from the manufacturer.

A series of 33 full-scale tests were conducted in a test room with a floor area of 12 ft × 24 ft (3.6 m × 7.2 m) to determine the effect of cathedral (sloped) and beamed ceiling construction, and combinations of both, on fast-response residential sprinkler performance. The testing was performed using one pendent-type residential sprinkler model, two ceiling slopes (0 degrees and 14 degrees), and two beam configurations on a single enclosure size. In order to judge the effectiveness of sprinklers in controlling fires, two baseline tests, in which the

ceiling was smooth and horizontal, were conducted with the pendent sprinklers installed and with a total water supply of 26 gpm (98 L/min) as required by this standard. The results of the baseline tests were compared with tests in which the ceiling was beamed or sloped, or both, and two pendent sprinklers were installed with the same water supply. Under the limited conditions used for testing, the comparison indicates that sloped or beamed ceilings, or a combination of both, represent a serious challenge to the fire protection afforded by fast-response residential sprinklers. However, further tests with beamed ceilings indicated that fire control equivalent to that obtained in the baseline tests can be obtained where one sprinkler is centered in each bay formed by the beams and a total water supply of 36 gpm (136 L/min) is available. Fire control equivalent to that obtained in the baseline tests was obtained for the smooth, sloped ceiling tests where three sprinklers were installed with a total water supply of 54 gpm (200 L/min). In a single smoldering-started fire test, the fire was suppressed.

Small areas created by architectural features such as planter box windows, bay windows, and similar features can be evaluated as follows:

(1) Where no additional floor area is created by the architectural feature, no additional sprinkler protection is required.
(2) Where additional floor area is created by an architectural feature, no additional sprinkler protection is required, provided all of the following conditions are met:
    (a) The floor area does not exceed 18 ft^2 (1.7 m^2).
    (b) The floor area is not greater than 2 ft (0.65 m) in depth at the deepest point of the architectural feature to the plane of the primary wall where measured along the finished floor.
    (c) The floor area is not greater than 9 ft (2.9 m) in length where measured along the plane of the primary wall.

Measurement from the deepest point of the architectural feature to the sprinkler should not exceed the maximum listed spacing of the sprinkler. The hydraulic design is not required to consider the area created by the architectural feature.

Where the obstruction criteria established by this standard are followed, sprinkler spray patterns will not necessarily get water to every square foot of space within a room. As such, a sprinkler in a room with acceptable obstructions as outlined in this standard might not be capable of passing the fire test (specified by ANSI/UL 1626, *Residential Sprinklers for Fire-Protection Service*, and other similar laboratory standards) if the fire is started in one of these dry areas. This occurrence is not to be interpreted as a failure of the sprinkler. The laboratory fire tests are sufficiently challenging to the sprinkler without additional obstructions as a safety factor to account for the variables that actually occur in dwellings, including acceptable obstructions to spray patterns.

The rules on 8.2.5.2 and 8.2.5.3 were developed from a testing series conducted by the National Fire Sprinkler Association and The Viking Corporation that included fire modeling, sprinkler response tests, sprinkler distribution tests, and full-scale fire tests (Valentine and Isman, *Interaction of Residential Sprinklers, Ceiling Fans and Similar Obstructions*, National Fire Sprinkler Association, November 2005). This test series, along with additional industry experience, shows that a difference exists between obstructions that are tight to the ceiling and obstructions that hang down from the ceiling, allowing spray over the top. Residential sprinklers require high wall wetting, which means that they tend to spray over obstructions that hang down from the ceiling. The test series showed that the fan blades were not significant obstructions and that as long as the sprinkler was far enough from the fan motor housing (measured from the center of the housing), the sprinkler could control a fire on the other side of the fan in a small room. In larger rooms, the sprinkler will need to be augmented by additional sprinklers on the other side of the fan. The test series showed that the fan on low or medium speed did not make a significant difference in sprinkler performance. On high speed (pushing air down), the fan did impact sprinkler performance, but fire control was still achieved in small rooms. In larger rooms, it is expected that additional sprinklers would be installed. The test series also showed that the fan blowing down was more significant than the fan pulling air up.

The rules in 8.2.5.6 were developed from years of experience with obstruction rules and an additional test series conducted by the National Fire Sprinkler Association with the help of Tyco International (Valentine and Isman, *Kitchen Cabinets and Residential Sprinklers*, National Fire Sprinkler Association, November 2005), which included fire modeling, distribution tests, and full-scale fire tests. The test series showed that pendent sprinklers definitely provide protection for kitchens, even for fires that start under the cabinets. The information in the series was less than definitive for sidewall sprinklers, but distribution data show that sprinklers in the positions in this standard provide adequate water distribution in front of the cabinets and that sidewall sprinklers should be able to control a fire that starts under the cabinets. When protecting kitchens or similar rooms with cabinets, the pendent sprinkler should be the first option. If pendent sprinklers cannot be installed, the next best option is a sidewall sprinkler on the opposite wall from the cabinets, spraying in the direction of the cabinets. The third best option is the sidewall sprinkler on the same wall as the cabinets on a soffit flush with the face of the cabinet. The last option should be putting sprinklers on the wall back behind the face of the cabinet because this location is subject to being blocked by items placed on top of the cabinets. It is not the intent of the committee to require sprinklers to be installed under kitchen cabinets.

A.8.3.1 In areas subject to freezing, care should be taken in unheated attic spaces to cover sprinkler piping completely with insulation. Installation should follow the guidelines of the insulation manufacturer. Figure A.8.3.1(a) through Figure A.8.3.1(e) show several methods that can be considered.

A.8.3.3.1 Antifreeze solutions can be used for maintaining automatic sprinkler protection in small, unheated areas. Antifreeze solutions are recommended only for systems not exceeding 40 gal (151 L).

Because of the cost of refilling the system or replenishing small leaks, small, dry valves should be used where more than 40 gal (151 L) are to be supplied.

Propylene glycol or other suitable material can be used as a substitute for priming water to prevent evaporation of the priming fluid and thus reduce ice formation within the system.

A.8.3.3.2 Listed CPVC sprinkler pipe and fittings should be protected from freezing with glycerine only. The use of diethylene glycol, ethylene glycol, or propylene glycol is specifically prohibited. Laboratory testing shows that glycol-based antifreeze solutions present a chemical environment detrimental to CPVC. Listed PB sprinkler pipe and fittings can be protected with glycerine, diethylene glycol, ethylene glycol, or propylene glycol.

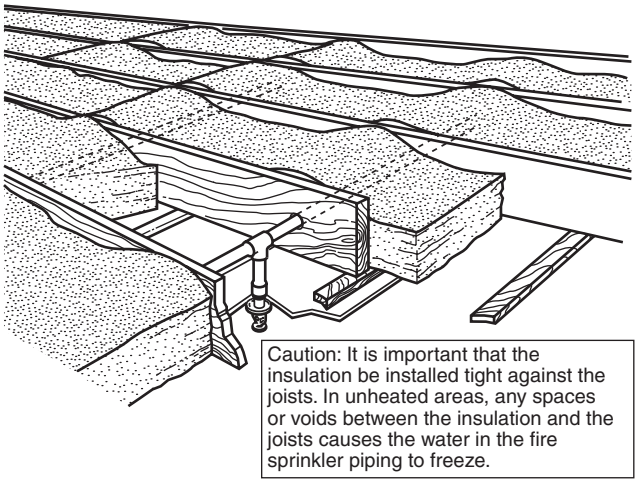


FIGURE A.8.3.1(a) Insulation Recommendations — Arrangement 1.

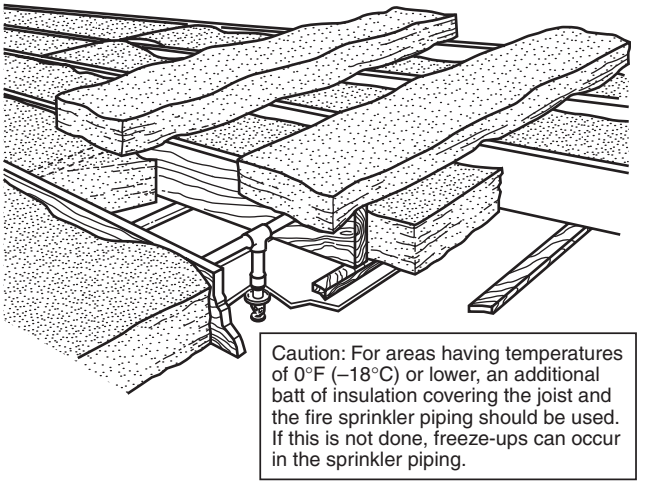


FIGURE A.8.3.1(b) Insulation Recommendations — Arrangement 2.

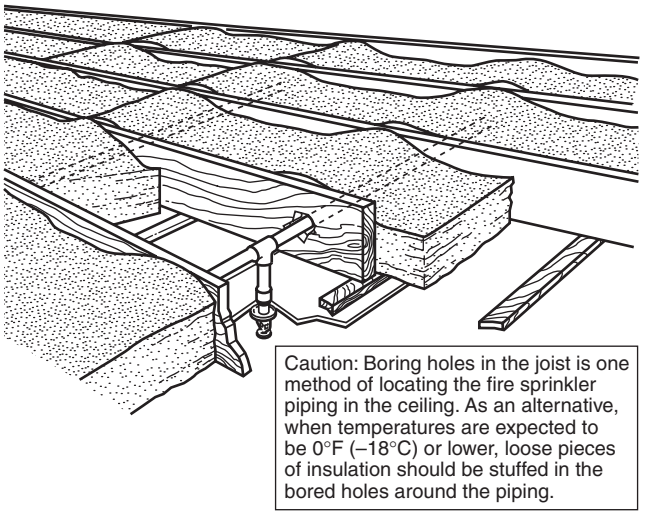


FIGURE A.8.3.1(c) Insulation Recommendations — Arrangement 3.

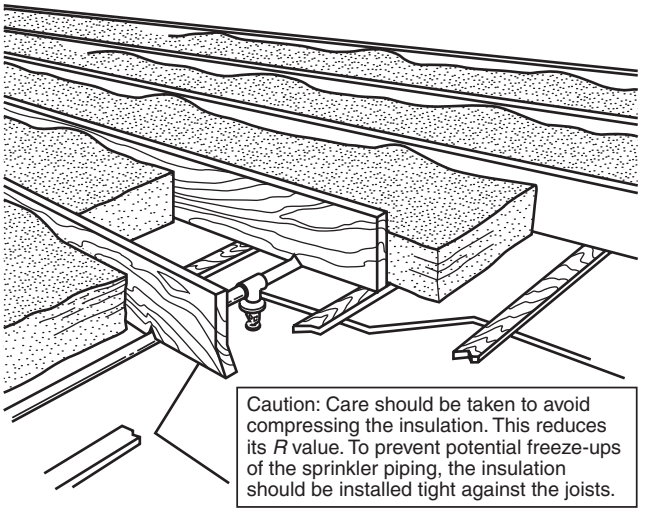


FIGURE A.8.3.1(d) Insulation Recommendations — Arrangement 4.

A.8.3.3.2.3 The following are data sources for Figure 7.6.2.5(c) of NFPA 13:

(1) Density data for 100 percent water was taken from Lange's *Handbook of Chemistry*, Revised Tenth Edition, page 1199. Temperatures have been converted from Celsius to Fahrenheit units, and data points at 10 degree Fahrenheit multiples have been determined by linear interpolation. Conversion from relative to absolute density was achieved by multiplying by 0.999973.

(2) Densities of glycerine–water solutions at 0°C and above were taken from Table III (p. 6) in *Glycerol* by Anthony Armin Newman, C.R.C. Press, 1968, Densities for temperatures below 0°C were taken from Table IV. Temperatures have been converted from Celsius to Fahrenheit units, and data points at 10 degree Fahrenheit multiples have been determined by linear interpolation.

(3) Density data for pure glycerine was taken from Table II (p. 6) in *Glycerol* by Anthony Armin Newman, C.R.C. Press, 1968, and derived from the thermal expansion data in Table 7–9 in *Glycerol* by Carl S. Miner and N. N. Dalton, Reinhold Publishing Corp., 1953 (American Chemical Society Monograph Series #117) using the density for 0°C as a base point. Temperatures have been converted from Celsius to Fahrenheit units, and data points 10 degree Fahrenheit multiples have been determined by linear interpolation.

(4) Freezing points were taken from the article, "Freezing Points of Glycerol and its Aqueous Solution" by Leonard B. Lane in *Industrial and Engineering Chemistry*, volume 17 (1925), number 9, page 924. Temperatures have been converted from Celsius to Fahrenheit units. [**13:** A.7.6.2.5]

A.8.3.3.2.6 Beyond certain limits, an increased proportion of antifreeze does not lower the freezing point of the solution (*see Figure A.8.3.3.2.6*). Glycerine, diethylene glycol, ethylene

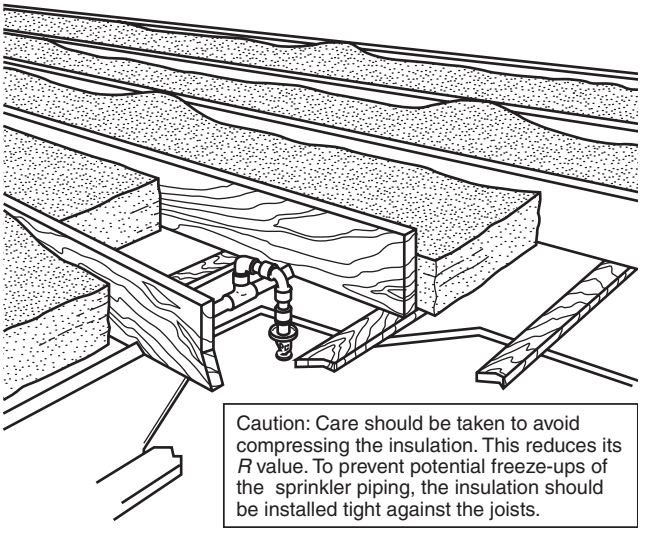


FIGURE A.8.3.1(e) Insulation Recommendations — Arrangement 5.

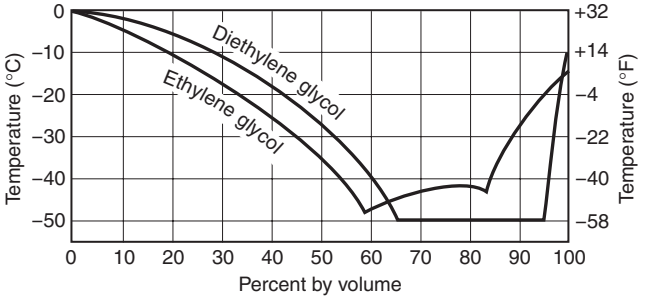


FIGURE A.8.3.3.2.6 Freezing Points of Water Solutions of Ethylene Glycol and Diethylene Glycol.

glycol, and propylene glycol never should be used without mixing with water in the proper proportions, because these materials tend to thicken near 32°F (0°C).

A.8.3.3.3 All permitted antifreeze solutions are heavier than water. At the point of contact (interface), provisions are required by 8.3.3.3 to prevent the diffusion of water into unheated areas.

To avoid leakage, the quality of materials and workmanship should be superior, the threads should be clean and sharp, and the joints should be tight. Only metal-faced valves should be used.

A.8.3.3.3.2 One formula for sizing the chamber is as follows, although other methods also exist:

$$\Delta L = S_V\left(\frac{D_L}{D_H} - 1\right)$$

where:

ΔL = change in antifreeze solution volume (gal) due to thermal expansion

S_V = volume (gal) of antifreeze system, not including the expansion chamber

D_L = density (gm/ml) of antifreeze solution at lowest expected temperature

D_H = density (gm/ml) of antifreeze solution at highest expected temperature

This method is based on the following information:

$$\frac{P_0 \cdot V_0}{T_0} = \frac{P_1 \cdot V_1}{T_1} = \frac{P_2 \cdot V_2}{T_2}$$

where:

V_{EC} = minimum required volume (gal) of expansion chamber

V_0 = air volume (gal) in expansion chamber at precharge (before installation)

V_1 = air volume (gal) in expansion chamber at normal static pressure

V_2 = air volume (gal) in expansion chamber at post-expansion pressure (antifreeze at high temperature)

P_0 = absolute precharge pressure (psia) on expansion chamber before installation

P_1 = absolute static pressure (psi) on water (supply) side of backflow preventer

P_2 = absolute maximum allowable working pressure (psi) for antifreeze system

T_0 = temperature (°R) of air in expansion chamber at precharge

T_1 = temperature (°R) of air in expansion chamber when antifreeze system piping is at lowest expected temperature

T_2 = temperature (°R) of air in expansion chamber when antifreeze system piping is at highest expected temperature

This equation is one formulation of the ideal gas law from basic chemistry. The amount of air in the expansion chamber will not change over time. The pressure, temperature, and volume of the air at different times will be related in accordance with this formula:

$$V_2 = V_1 - \Delta L$$

The antifreeze in the system is essentially incompressible, so the air volume in the expansion chamber will decrease by an amount equal to the expansion of the antifreeze.

It is assumed that air is not trapped in the system piping, so the only air in the system is in the expansion chamber. This assumption is conservative, since more air is better. In reality, there will be at least some trapped air. However, only the air in the expansion chamber can be relied upon to be available when needed:

$$V_{EC} = V_0$$

At precharge, the chamber will be completely full of air:

$$V_{EC} = \frac{P_1 \cdot T_0 \cdot P_2 \cdot \Delta L \cdot T_1}{P_0 \cdot T_1 \left(P_2 \cdot T_1 - P_1 \cdot T_2\right)}$$

In cases where the normal static pressure on the sprinkler system is close to the maximum working pressure, antifreeze systems are not advisable if the connection to the wet pipe system will incorporate a backflow device. In these cases, expansion of the antifreeze solution during warm weather will cause the antifreeze system to exceed the maximum working pressure, regardless of the size of the expansion chamber. The

normal static pressure is too close to the maximum working pressure if the preceding formula for V_{EC} yields a negative result. If this occurs, use a dry pipe system instead or install a pressure-reducing valve before the backflow preventer.

A.8.3.4.5 With regard to preaction systems, it is assumed that the release system will activate before the sprinklers. It is generally accepted that smoke detectors and rate-of-rise detectors are more sensitive than sprinklers and that fixed-temperature-release devices with RTIs lower than that of sprinklers will react faster than sprinklers at similar spacings and locations.

A.8.4.3.3 Any special listing of products covered in 8.4.3.3 should include certification by the manufacturer of personnel involved in the layout, calculation, and installation of their product.

A.8.4.3.3(1) Where a four-port fitting is used, and one of the ports is not being used to satisfy this requirement or to feed a domestic fixture, the extra port should be connected to another open port at a sprinkler or should be connected to the water supply pipe (manifold). *[See Figure A.8.4.3.3(1).]*

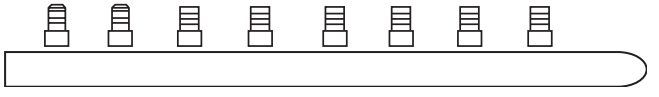


FIGURE A.8.4.3.3(1) Water Supply Manifold.

A.8.4.4 The determination of public water supply pressure should take into account the probable minimum pressure conditions prevailing during such periods as during the night or during the summer months when heavy usage can occur; the possibility of interruption by floods or ice conditions in winter also should be considered. *[See Figure A.8.4.4(a) and Figure A.8.4.4(b).]*

A.8.4.4(6) The total length includes equivalent length of fittings as determined by applying Table 8.4.4(c), Table 8.4.4(d), Table 8.4.4(e), or Table 8.4.4(f).

A.8.6.4 Although NFPA 13D does not require garages to be sprinklered, some authorities having jurisdiction take it upon themselves to add this requirement locally. In such circumstances, residential or quick-response sprinklers with a two sprinkler design in the garage with the same piping used in the rest of the dwelling can be used. It is recognized that residential sprinklers have not been tested specifically for fires in garages, but field experience has shown that the sprinklers help to alert occupants to the fact that there is a fire, to reduce the possibility of flashover, and to improve the chances for occupants to escape.

		Individual Loss	**Net Total**
(1) Water pressure in street	_____	_____	_____
(2) Arbitrarily select pipe size	_____		
(3) Deduct meter loss (size)	_____	_____	_____
(4) Deduct head loss for elevation			
(_____ ft × 0.434)	_____		
(5) Deduct pressure loss from city main to sprinkler system control valve*	_____		
____ Pipe _____ ft		_____	_____
____ Valves _____ ft		_____	_____
____ Elbows _____ ft		_____	_____
____ Tee _____ ft		_____	_____
____ Total _____ ft × _____		_____	_____
(6) Deduct pressure loss for piping-control valve to farthest sprinkler*			

Size	**Quantity**	**Description**	**Total Equivalent (ft)**
_____	_____	90 degree elbow	_____
_____	_____	45 degree elbow	_____
_____	_____	Tee	_____
_____	_____	Check valve	_____
_____	_____	Valve (_____)	_____
_____	_____	Total	____ ft × ____ = ____

Size	**Quantity**	**Description**	**Total Equivalent (ft)**
_____	_____	90 degree elbow	_____
_____	_____	45 degree elbow	_____
_____	_____	Tee	_____
_____	_____	Check valve	_____
_____	_____	Valve (_____)	_____
_____	_____	Total	____ ft × ____ = ____

Remaining pressure for sprinkler operation _____

For SI units, 1 ft = 0.3048 m; 1 psi = 0.0689 bar.

* Factors from Table 8.4.4(a) through Table 8.4.4(e).

FIGURE A.8.4.4(a) Calculation Sheet.

	Individual Loss	Net Total
Water pressure at supply outlet		
(1) Deduct head loss for elevation	_____	_____
(_____ ft × 0.434)	_____	_____
(2) Deduct pressure loss from piping within building*	_____	_____
Remaining pressure for sprinkler operation	_____	_____

For SI units, 1 ft = 0.3048 m; 1 psi = 0.0689 bar.

* Factors from Table 8.4.4(a) through Table 8.4.4(g).

FIGURE A.8.4.4(b) Calculation Sheet — Elevated Tank, Booster Pump, Pump Tank Supply.

Annex B Informational References

B.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.

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

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2010 edition.

NFPA 13R, *Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height*, 2010 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2010 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*, 2010 edition.

B.1.2 Other Publications.

B.1.2.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM A 135, *Standard Specification for Electric-Resistance-Welded Steel Pipe*, 2006.

ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2009.

ASTM F 437, *Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*, 1996.

ASTM F 438, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40*, 1997.

ASTM F 439, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*, 1997.

ASTM F 442, *Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)*, 1997.

ASTM F 876, *Standard Specification for Crosslinked Polyethylene (PEX) Tubing*, 2008.

IEEE/ASTM SI 10, *Standard for Use of the International System of Units (SI): The Modern Metric System*, 1997.

B.1.2.2 NFSA Publications. National Fire Sprinkler Association, P.O. Box 1000, Patterson, NY 12563.

Valentine and Isman, *Kitchen Cabinets and Residential Sprinklers*, November 2005.

Valentine and Isman, *Interaction of Residential Sprinklers, Ceiling Fans and Similar Obstructions*, November 2005.

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

ANSI/UL 723, *Standard for Test for Surface Burning Characteristics of Building Materials*, 2008.

ANSI/UL 1626, *Residential Sprinklers for Fire-Protection Service*, 2008.

NIST GCR 05-875, *Research Investigation for Determination of Residential Sprinkler Performance*, February 2004.

B.2 Informational References. (Reserved)

B.3 References for Extracts in Informational Sections.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2010 edition.

Index

Formal Interpretation

NFPA 13D

Sprinkler Systems — One- and Two-Family Dwellings

2010 Edition

Reference: 1.1
F.I. 80-1

Question: Is NFPA 13D appropriate for use in multiple (three or more) attached dwellings under any condition?

Answer: No. NFPA 13D is appropriate for use only in one- and two-family dwellings and mobile homes. Buildings which contain more than two dwelling units shall be protected in accordance with either NFPA 13R or NFPA 13 as appropriate. Paragraph 8.4.5 of NFPA 13 permits residential sprinklers to be used in residential portions of other buildings provided all other requirements of NFPA 13, including water supplies, are satisfied.

Note: Building codes may contain requirements such as 2-hour fire separations which would permit adjacent dwellings to be considered unattached. This FI has been editorially updated to include NFPA 13R since NFPA 13R was not available when the Technical Committee was balloted.

Issue Edition: 1980
Reference: 1-1
Date: June 1983

Tentative Interim Amendment

NFPA 13D

Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

2010 Edition

Reference: 3.3.9.1, 4.1.4, 5.2.7, 8.3.3, and A.8.3.3.1
TIA 10-1
(SC 10-8-18/TIA Log #994)

Pursuant to Section 5 of the NFPA Regulations Governing Committee Projects, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes,* 2010 edition. The TIA was processed by the Technical Committee on Residential Sprinkler Systems and the Technical Correlating Committee on Automatic Sprinkler Systems, and was issued by the Standards Council on August 5, 2010, with an effective date of August 25, 2010.

A Tentative Interim Amendment is tentative because it has not been processed through the entire standards-making procedures. It is interim because it is effective only between editions of the standard. A TIA automatically becomes a proposal of the proponent for the next edition of the standard; as such, it then is subject to all of the procedures of the standards-making process.

1. Delete 3.3.9.1 and renumber remainder of subsection 3.3.9.

2. Delete entire subsection 4.1.4, Antifreeze Systems.

3. Revise 5.2.7 to read as follows:
"Joints for the connection of copper tube for wet type systems shall be soldered joints or be brazed." (delete the words "and antifreeze systems").

4. Delete Item (2) of subsection 8.3.2 and renumber (3) as (2).

5. Revise section 8.3.3.1 to read:
8.3.3.1 Antifreeze shall not be permitted in sprinkler systems.

6. Delete A.8.3.3.1.

7. Delete all subsections and accompanying Annex A paragraphs commencing with 8.3.3.2 and ending with 8.3.3.5.

Issue Date: August 5, 2010

Effective Date: August 25, 2010

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/codelist**)**

Tentative Interim Amendment

NFPA 13D

Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

2010 Edition

Reference: 3.3.9.1 Premixed Antifreeze Solution (New), 4.1.4, 5.2.7, 8.3.2, 8.3.3, and A.4.1.4
TIA 10-2
(SC 11-3-4/TIA Log #1012)

Pursuant to Section 5 of the NFPA Regulations Governing Committee Projects, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes,* 2010 edition. The TIA was processed by the Technical Committee on Residential Sprinkler Systems and the Technical Correlating Committee on Automatic Sprinkler Systems, and was issued by the Standards Council on March 1, 2011, with an effective date of March 21, 2011.

A Tentative Interim Amendment is tentative because it has not been processed through the entire standards-making procedures. It is interim because it is effective only between editions of the standard. A TIA automatically becomes a proposal of the proponent for the next edition of the standard; as such, it then is subject to all of the procedures of the standards-making process.

1. Undo all of the changes made by TIA No. 10-1 (Log #994) to sections 3.3.9.1, 4.1.4, 5.2.7, 8.3.2 and 8.3.3 returning NFPA 13D to the text of the published 2010 edition with the following changes:

2. Add a new definition as 3.3.9.1.1 and related annex note to read as follows:

3.3.9.1.1* Premixed Antifreeze Solution. A mixture of an antifreeze material with water that is prepared and factory-mixed by the manufacturer with a quality control procedure in place that ensures that the antifreeze solution remains homogeneous.

A.3.3.9.1.1 Where a tank is used as the water supply for the sprinkler system, the tank is not permitted to be filled with antifreeze.

3. Revise 4.1.4 and related annex note to read as follows:

4.1.4* Antifreeze Systems.

A.4.1.4 Sampling from the top and bottom of the system helps to determine if the solution has settled. Antifreeze solutions are heavier than water. If the antifreeze compound is separating from the water due to poor mixing, it will exhibit a higher concentration in the lower portion of the system than in the upper portions of the system. If the concentration is acceptable near the top, but too low near the water connection, it may mean that the system is becoming diluted near the water supply. If the concentration is either too high or too low in both the samples, it may mean that the wrong concentration was added to the system.

On an annual basis, test samples should be drawn from test valve B as shown in Figure 8.3.3.2.1(1), especially if the water portion of the system has been drained for maintenance or repairs. A small hydrometer can be used so that a small sample is sufficient. Where water appears at valve B, or where the sample indicates that the solution has become weakened, the entire system should be emptied and refilled with acceptable solution as previously described.

Where systems are drained in order to be refilled, it is not typically necessary to drain drops that are less than 36 inches in length. Most systems with drops have insufficient volume to cause a problem, even if slightly higher concentration solutions collect in the drops. For long drops with significant volume, consideration should be given to draining drops if there is evidence that unacceptably high concentrations of antifreeze have collected in these long drops.

When emptying and refilling antifreeze solutions, every attempt should be made to recycle the old solution with the antifreeze manufacturer rather than discarding it.

4.1.4.1 Annual Antifreeze Solution Test and Replacement Procedure.

4.1.4.1.1 Samples of antifreeze solution shall be collected by qualified individuals in accordance with 4.1.4.1.1.1 or 4.1.4.1.1.2 on an annual basis.

4.1.4.1.1.1 The system shall be drained to verify that (a) the solution is in compliance with 8.3.3, and (b) the solution provides the necessary freeze protection. Solution samples shall be taken near the beginning and near the end of the draining process.

4.1.4.1.1.2* Solution samples shall be taken at the highest practical elevation and the lowest practical elevation of the system.

A.4.1.4.1.1.2 If not already present, test connections (valves) for collection of solution samples should be installed at the highest and lowest practical locations of the system or portion of the system containing antifreeze solution.

4.1.4.1.2 The two samples collected in accordance with the procedures specified in 4.1.4.1.1.1 or 4.1.4.1.1.2 shall be tested to verify that the specific gravity of both samples is similar and that the solution is in compliance with 8.3.3. The specific gravity of each solution shall be checked using a hydrometer with a suitable scale or a refractometer having a scale calibrated for the antifreeze solution.

4.1.4.1.3* If concentrations of the two samples collected in accordance with the procedures above are similar and in compliance with 8.3.3, then (a) the solution drained in accordance with 4.1.4.1.1.1 can be used to refill the system, or (b) the existing undrained solution tested in accordance with 4.1.4.1.1.2 shall be permitted to continue to be used. If the two samples are not similar and not in compliance with 8.3.3, then a solution in compliance with 8.3.3 shall be used to refill the system.

A.4.1.4.1.3 In the past, for some existing systems subject to extremely low temperatures, antifreeze solutions with concentrations greater than what is now permitted by NFPA 13D were used. Such high concentrations of antifreeze are no longer permitted. In situations where extremely low temperatures are anticipated, refilling the fire sprinkler system with a concentration of antifreeze solution currently permitted by the standard might not provide sufficient freeze protection without additional measures. Such measures might include converting the antifreeze system to another type of sprinkler system.

4.1.4.1.4 A tag shall be attached to the riser indicating the date the antifreeze solution was tested. The tag shall also indicate the type and concentration of antifreeze solution (by volume) with which the system is filled, the date the antifreeze was replaced (if applicable), the name of the contractor that tested and/or replaced the antifreeze solution, the contractor's license number, a statement indicating if the entire system was drained and replaced with antifreeze, and a warning to test the concentration of the antifreeze solutions at yearly intervals per NFPA 13D.

4. Add an asterisk to 8.3.3 and add a new A.8.3.3 to read as follows:

8.3.3* Antifreeze Systems.

A.8.3.3 Where protection of pipes from freezing is a concern, options other than antifreeze are available. Such alternatives include running the piping in warm spaces, tenting insulation over pipe, dry-pipe systems, and preaction systems.

5. Revise 8.3.3.2.1 to read as follows:

8.3.3.2.1* Unless permitted by 8.3.3.2.1.1, antifreeze solutions shall be limited to premixed antifreeze solutions of glycerine (chemically pure or United States Pharmacopoeia 96.5%) at a maximum concentration of 48% by volume, propylene glycol at a maximum concentration of 38% by volume, or other solutions listed specifically for use in fire protection systems.

6. Add a new 8.3.3.2.1.1 to read as follows:

8.3.3.2.1.1. For existing systems, antifreeze solutions shall be limited to premixed antifreeze solutions of glycerine (chemically pure or United States Pharmacopoeia 96.5%) at a maximum concentration of 50% by volume, propylene glycol at a maximum concentration of 40% by volume, or other solutions listed specifically for use in fire protection systems.

7. Delete 8.3.3.2.2 and 8.3.3.2.3 and related Annex material A.8.3.3.2.3.

8. Move Table 8.3.3.2.3 to the annex and renumber as Table A.8.3.3.2.1 while deleting the rows in the table dealing with glycerine and 40% water, glycerine and 30% water, propylene glycol and 50% water and propylene glycol and 40% water. Add an annex note so that the annex and Table would appear as follows:

A.8.3.3.2.1 See Table A.8.3.3.2.1.

Table A.8.3.3.2.1 Properties of Glycerine and Propylene Glycol

Material	Solution (by volume)	Specific Gravity at 60ºF (15.6ºC)	Freezing Point	
			ºF	ºC
Glycerine (C.P. or U.S.P. grade)	50% water	1.145	-20.9	-29.4
Hydrometer scale 1.000 to 1.200				
Propylene glycol	60% water	1.034	-6	-21.1
Hydrometer scale 1.000 to 1.200 (subdivisions 0.002)				

C.P.: Chemically Pure; U.S.P.: United States Pharmacopoeia 96.5%.

9. Renumber 8.3.3.2.3.1 to 8.3.3.2.2.

8.3.3.2.2 The concentration of antifreeze solutions shall be limited to the minimum necessary for the anticipated minimum temperature.

10. Delete 8.3.3.2.4, 8.3.3.2.5 and Table 8.3.3.2.5.

11. Renumber 8.3.3.2.6 as 8.3.3.2.3 and renumber A.8.3.3.2.6 as A.8.3.3.2.3. Also renumber Figure A.8.3.3.2.6 as Figure A.8.3.3.2.3.

8.3.3.2.3* An antifreeze solution with a freezing point below the expected minimum temperature for the locality shall be installed.

A.8.3.3.2.3 Beyond certain limits, an increased proportion of antifreeze does not lower the freezing point of the solution (*see Figure A.8.3.3.2.3*). Glycerine, diethylene glycol, ethylene glycol, and propylene glycol never should be used without mixing with water in the proper proportions, because these materials tend to thicken near 32°F (0°C).

12. Renumber 8.3.3.2.7 as 8.3.3.2.4 and revise to read as follows:

8.3.3.2.4 The specific gravity of the antifreeze shall be checked by a hydrometer with a scale having 0.002 subdivisions in accordance with Figure 8.3.3.2.4(a) and 8.3.3.2.4(b).

13. Renumber Figure 8.3.3.2.3(a) as Figure 8.3.3.2.4(a) and delete the 50% curve.

14. Renumber Figure 8.3.3.2.3(b) as Figure 8.3.3.2.4(b) and delete the 60% and 70% curves.

Issue Date: March 1, 2011

Effective Date: March 21, 2011

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/codelist**)**

Tentative Interim Amendment

NFPA 13D

Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

2010 Edition

Reference: 6.5.3
TIA 10-4
(SC 12-3-3/TIA Log #1041)

Pursuant to Section 5 of the NFPA Regulations Governing Committee Projects, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes,* 2010 edition. The TIA was processed by the Technical Committee on Residential Sprinkler Systems and the Technical Correlating Committee on Automatic Sprinkler Systems, and was issued by the Standards Council on March 6, 2012, with an effective date of March 26, 2012.

A Tentative Interim Amendment is tentative because it has not been processed through the entire standards-making procedures. It is interim because it is effective only between editions of the standard. A TIA automatically becomes a proposal of the proponent for the next edition of the standard; as such, it then is subject to all of the procedures of the standards-making process.

1. Move 6.5.3 to 6.3.4 as follows:

6.3.4 A warning sign, with minimum 1⁄4 in. letters, shall be affixed adjacent to the main shutoff valve and shall state the following:

> **WARNING:** The water system for this home supplies fire sprinklers that require certain flows and pressures to fight a fire. Devices that restrict the flow or decrease the pressure or automatically shut off the water to the fire sprinkler system, such as water softeners, filtration systems, and automatic shutoff valves, shall not be added to this system without a review of the fire sprinkler system by a fire protection specialist. Do not remove this sign.

Issue Date: March 6, 2012

Effective Date: March 26, 2012

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/codelist**)**

Tentative Interim Amendment

NFPA® 13D

Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

2010 Edition

Reference: 8.1.2, 8.1.3, A.8.1.2, and A.8.1.3
TIA 10-3
(SC 11-8-19/TIA Log #1028R)

Pursuant to Section 5 of the NFPA Regulations Governing Committee Projects, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes,* 2010 edition. The TIA was processed by the Technical Committee on Residential Sprinkler Systems and the Technical Correlating Committee on Automatic Sprinkler Systems, and was issued by the Standards Council on August 11, 2011, with an effective date of August 31, 2011.

A Tentative Interim Amendment is tentative because it has not been processed through the entire standards-making procedures. It is interim because it is effective only between editions of the standard. A TIA automatically becomes a proposal of the proponent for the next edition of the standard; as such, it then is subject to all of the procedures of the standards-making process.

1. Revise 8.1.2 and A.8.1.2 to read as follows:

8.1.2* Number of Design Sprinklers.

A.8.1.2 All residential sprinklers have been investigated under a flat, smooth, 8 ft (2.4 m) high horizontal ceiling. Some residential sprinklers have been investigated and listed for use under specific ceiling configurations such as a horizontal beamed ceiling. The performance of residential sprinklers under flat, smooth, horizontal ceilings has been well documented throughout the life of NFPA 13D. Prior to 2010, several manufacturers of residential sprinklers had performed testing and received listings for residential sprinklers under certain slopes and in certain beam conditions. In 2010, the Fire Protection Research Foundation (FPRF) conducted a research project consisting of 76 FDS simulations and 12 full-scale fire tests. The results have been used to develop system design criteria in a generic manner in order to simplify the use of residential sprinklers. Some residential sprinkler listings still exist for situations beyond the scope of the generic design. See the FPRF report, Analysis of the Performance of Residential Sprinkler Systems with Sloped or Sloped and Beamed Ceilings, dated July 2010, for more information. Questions are frequently asked regarding the minimum two-sprinkler design when certain sprinkler performance statistics have indicated that in a majority of the cases (with residential sprinklers) the fire is controlled or suppressed with a single sprinkler. While these statistics may or may not be accurate, the water supplies for the fire sprinkler systems under which these statistics were generated were designed for two or more sprinklers in the first place. When the fires occurred, the first sprinkler operated in excess of its individual design flow and pressure because the sprinkler system's water supply was strong enough to handle multiple sprinklers and only a single sprinkler opened. At these higher flows and pressures, the discharge from a single sprinkler was sufficient to limit or suppress the heat generated from the fire. This concept is called "hydraulic increase." Hydraulic increase can also occur when a water supply's capabilities during the fire event exceeded that required by the minimum design requirements of the standard. Since none of the data used to generate the previously mentioned statistics captured the capabilities of the water supply in relation to the design requirements, the impact of the hydraulic increase on the number of single sprinkler activations cannot be determined. But if the minimum water supply requirement of the standard is reduced to only be capable of handling a single sprinkler, then there could be no hydraulic increase safety factor. When the first sprinkler opens, it will only get the flow and pressure that were originally designed for it, and the potential is significant for that to be insufficient to control the fire given any obstructions and the layout of the space where the fire starts. The National Institute for Standards and Technology (NIST), under a grant from the United States Fire Administration, studied this concept several years ago in the hopes of being able to propose a single sprinkler flow for the 2007 edition of NFPA 13D (see NIST Report NIST GCR 05-875 prepared by Underwriters Laboratories with a publication date of February 2004). Unfortunately, the research did not support the

design of a sprinkler system with only the flow for a single sprinkler, even under conditions of small rooms with flat, smooth ceilings. Without the hydraulic increase associated with the two-sprinkler design, the fire scenarios were too many where the first sprinkler to open would have insufficient flow to control the fire and then multiple sprinklers would open, causing the room to reach untenable conditions and the water supply to be overrun. These same fire scenarios were easily controlled by a sprinkler system designed for a two-sprinkler water supply from the start. In addition to the NIST tests, the National Fire Sprinkler Association conducted a series of full-scale fire tests in simulated bedrooms that were 14 ft × 14 ft (4.3 m × 4.3 m) with an adjoining hallway, each with flat, smooth, 8-ft (24-m) high ceilings. The tests were performed to determine better rules for keeping sprinklers clear of obstructions like ceiling fans, but baseline tests were also performed without any obstructions at the ceiling. In nine out of the twelve tests, including the two baseline tests without obstructions at the ceiling, a sprinkler in the hall outside the room of fire origin opened first, followed by the sprinkler in the room of origin. Even though the room of origin met all of the rules of NFPA 13D as a compartment, a sprinkler outside of this room was opening first. All of these fires were controlled by the sprinklers, but if the water supply had only been sufficient for a single sprinkler, the sprinklers would never have been able to provide fire control. For examples of selecting a compartment for consideration, see Figure A.8.1.2(a) and Figure A.8.1.2(b), which show examples of design configurations for compartments based on the presence of lintels to stop the flow of heat.

2. Add 8.1.2.1, 8.1.2.2, 8.1.2.3, and A.8.1.2.3 to read as follows:

8.1.2.1 For each of the following situations, the number of sprinklers in the design area shall be all of the sprinklers within a compartment, up to a maximum of two sprinklers, that require the greatest hydraulic demand:

(1) A flat, smooth, horizontal ceiling with no beams up to a maximum of 24 ft (7.3 m) above the floor.
(2) A smooth, flat, sloped ceiling with no beams up to a maximum slope of 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor. The highest sprinkler in the sloped portion of the ceiling shall be above all openings from the compartment containing the sloped ceiling into any communicating spaces.
(3) A sloped ceiling with beams up to 14 in. (4.3 m) deep with pendent sprinklers under the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft^2 (56 m^2) in area. The slope of the ceiling shall be between 2 in 12 and 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor. The highest sprinkler in the sloped portion of the ceiling shall be above all openings from the compartment containing the sloped ceiling into any communicating spaces.
(4) A sloped ceiling with beams of any depth with sidewall or pendent sprinklers in each pocket formed by the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft^2 (56 m^2) in area. The slope of the ceiling shall be between 2 in 12 and 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor.

8.1.2.2 For situations not meeting one of the conditions in 8.1.2.1, residential sprinklers listed for use in specific ceiling configurations shall be permitted to be used in accordance with their listing.

8.1.2.3* For situations not meeting one of the conditions in 8.1.2.1 and 8.1.2.2, the number of sprinklers in the design area shall be determined in consultation with the authority having jurisdiction as appropriate for the conditions. Sprinklers shall be installed in accordance with their listing where a type of ceiling configuration is referenced in the listing.

A.8.1.2.3 A number of variables exist that would influence the number of sprinklers that might open during a fire. In many of the fire tests that led to the development of the residential sprinkler, and in many of the subsequent tests including the testing conducted as a part of the previously referenced FPRF sloped ceiling research project, more than two sprinklers have opened during certain fire tests, but the water supply, sized for only two sprinklers, was still capable of controlling the fire for ten minutes and meeting the goals of NFPA 13D. While there is no guarantee that this would always happen, it is believed that the two sprinkler design criteria is appropriate for ceiling constructions and room configurations that are within the limitations referenced 8.1.2.1 and 8.1.2.2. For the ceiling constructions and room configurations that are beyond the scope of the two-sprinkler discharge criteria referenced in 8.1.2.1 and 8.1.2.2, a greater number of design sprinklers and/or higher discharge flows should be considered in the system design. As of this date, there is limited fire test data available to include specific design criteria in this standard. In these situations, sprinklers can be installed in a manner acceptable to the authority having jurisdiction to achieve the results specified in this standard. In making these determinations, consideration should be given to factors influencing sprinkler system performance, such as sprinkler response characteristics, impact of obstructions on sprinkler discharge, and number of sprinklers anticipated to operate in the event of a fire. For the situation of flat, smooth, horizontal ceilings with beams at the ceiling, there are a number of variables that could cause many sprinklers to open during a fire. Residential sprinklers used in accordance with all of the restrictions of their listing can be used to protect this circumstance.

3. Revise 8.1.3 to read as follows:

8.1.3 Sprinkler Coverage.

8.1.3.1 Residential Sprinklers.

8.1.3.1.1 Sprinklers shall be installed in accordance with their listing where a type of ceiling configuration is referenced in the listing.

8.1.3.1.2* Where construction features or other special conditions exist that are outside the scope of sprinkler listings, listed sprinklers shall be permitted to be installed beyond their listing limitations.

A.8.1.3.1.2 See A.8.1.2 and A.8.1.2.3.

Issue Date: August 11, 2011

Effective Date: August 31, 2011

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/codelist**)**

Sequence of Events Leading to Issuance of an NFPA Committee Document

Step 1: Call for Proposals

- Proposed new Document or new edition of an existing Document is entered into one of two yearly revision cycles, and a Call for Proposals is published.

Step 2: Report on Proposals (ROP)

- Committee meets to act on Proposals, to develop its own Proposals, and to prepare its Report.
- Committee votes by written ballot on Proposals. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.
- Report on Proposals (ROP) is published for public review and comment.

Step 3: Report on Comments (ROC)

- Committee meets to act on Public Comments to develop its own Comments, and to prepare its report.
- Committee votes by written ballot on Comments. If two-thirds approve, Report goes forward. Lacking two-thirds approval, Report returns to Committee.
- Report on Comments (ROC) is published for public review.

Step 4: Technical Report Session

- "*Notices of intent to make a motion*" are filed, are reviewed, and valid motions are certified for presentation at the Technical Report Session. ("Consent Documents" that have no certified motions bypass the Technical Report Session and proceed to the Standards Council for issuance.)
- NFPA membership meets each June at the Annual Meeting Technical Report Session and acts on Technical Committee Reports (ROP and ROC) for Documents with "certified amending motions."
- Committee(s) vote on any amendments to Report approved at NFPA Annual Membership Meeting.

Step 5: Standards Council Issuance

- Notification of intent to file an appeal to the Standards Council on Association action must be filed within 20 days of the NFPA Annual Membership Meeting.
- Standards Council decides, based on all evidence, whether or not to issue Document or to take other action, including hearing any appeals.

Committee Membership Classifications

The following classifications apply to Technical Committee members and represent their principal interest in the activity of the committee.

M *Manufacturer:* A representative of a maker or marketer of a product, assembly, or system, or portion thereof, that is affected by the standard.

U *User:* A representative of an entity that is subject to the provisions of the standard or that voluntarily uses the standard.

I/M *Installer/Maintainer:* A representative of an entity that is in the business of installing or maintaining a product, assembly, or system affected by the standard.

L *Labor:* A labor representative or employee concerned with safety in the workplace.

R/T *Applied Research/Testing Laboratory:* A representative of an independent testing laboratory or independent applied research organization that promulgates and/or enforces standards.

E *Enforcing Authority:* A representative of an agency or an organization that promulgates and/or enforces standards.

I *Insurance:* A representative of an insurance company, broker, agent, bureau, or inspection agency.

C *Consumer:* A person who is, or represents, the ultimate purchaser of a product, system, or service affected by the standard, but who is not included in the *User* classification.

SE *Special Expert:* A person not representing any of the previous classifications, but who has a special expertise in the scope of the standard or portion thereof.

NOTES;
1. "Standard" connotes code, standard, recommended practice, or guide.
2. A representative includes an employee.
3. While these classifications will be used by the Standards Council to achieve a balance for Technical Committees, the Standards Council may determine that new classifications of members or unique interests need representation in order to foster the best possible committee deliberations on any project. In this connection, the Standards Council may make appointments as it deems appropriate in the public interest, such as the classification of "Utilities" in the National Electrical Code Committee.
4. Representatives of subsidiaries of any group are generally considered to have the same classification as the parent organization.

NFPA Document Proposal Form

NOTE: All Proposals must be received by 5:00 pm EST/EDST on the published Proposal Closing Date.

For further information on the standards-making process, please contact the Codes and Standards Administration at 617-984-7249 or visit www.nfpa.org/codes.

For technical assistance, please call NFPA at 1-800-344-3555.

FOR OFFICE USE ONLY

Log #: _____

Date Rec'd: _____

Please indicate in which format you wish to receive your ROP/ROC ☐ **electronic** ☐ **paper** ☒ **download**
(Note: If choosing the download option, you must view the ROP/ROC from our website; no copy will be sent to you.)

Date April 1, 200X **Name** John J. Doe **Tel. No.** 716-555-1234

Company Air Canada Pilot's Association **Email**

Street Address 123 Summer Street Lane **City** Lewiston **State** NY **Zip** 14092

******If you wish to receive a hard copy, a street address MUST be provided. Deliveries cannot be made to PO boxes.***

Please indicate organization represented (if any)

1. (a) NFPA Document Title National Fuel Gas Code **NFPA No. & Year** 54, 200X Edition

(b) Section/Paragraph 3.3

2. Proposal Recommends (check one): ☐ new text ☒ revised text ☐ deleted text

3. Proposal (include proposed new or revised wording, or identification of wording to be deleted): [Note: Proposed text should be in legislative format; i.e., use underscore to denote wording to be inserted (inserted wording) and strike-through to denote wording to be deleted (~~deleted wording~~).]

Revise definition of effective ground-fault current path to read:

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.

4. Statement of Problem and Substantiation for Proposal: (Note: State the problem that would be resolved by your recommendation; give the specific reason for your Proposal, including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

Change uses proper electrical terms.

5. Copyright Assignment

(a) ☐ **I am the author of the text or other material (such as illustrations, graphs) proposed in the Proposal.**

(b) ☒ **Some or all of the text or other material proposed in this Proposal was not authored by me. Its source is as follows:** (please identify which material and provide complete information on its source)

ABC Co.

I hereby grant and assign to the NFPA all and full rights in copyright in this Proposal and understand that I acquire no rights in any publication of NFPA in which this Proposal in this or another similar or analogous form is used. Except to the extent that I do not have authority to make an assignment in materials that I have identified in (b) above, I hereby warrant that I am the author of this Proposal and that I have full power and authority to enter into this assignment.

Signature (Required) _____

PLEASE USE SEPARATE FORM FOR EACH PROPOSAL

Mail to: Secretary, Standards Council · National Fire Protection Association
1 Batterymarch Park · Quincy, MA 02169-7471 OR
Fax to: (617) 770-3500 OR Email to: proposals_comments@nfpa.org

6/11/2009

NFPA Document Proposal Form

NOTE: All Proposals must be received by 5:00 pm EST/EDST on the published Proposal Closing Date.

For further information on the standards-making process, please contact the Codes and Standards Administration at 617-984-7249 or visit www.nfpa.org/codes.

For technical assistance, please call NFPA at 1-800-344-3555.

FOR OFFICE USE ONLY

Log #: _____

Date Rec'd: _____

Please indicate in which format you wish to receive your ROP/ROC ☐ electronic ☐ paper ☐ download
(Note: If choosing the download option, you must view the ROP/ROC from our website; no copy will be sent to you.)

Date _____ **Name** _____ **Tel. No.** _____

Company _____ **Email** _____

Street Address _____ **City** _____ **State** _____ **Zip** _____

******If you wish to receive a hard copy, a street address MUST be provided. Deliveries cannot be made to PO boxes.***

Please indicate organization represented (if any) _____

1. (a) NFPA Document Title _____ **NFPA No. & Year** _____

(b) Section/Paragraph _____

2. Proposal Recommends (check one): ☐ new text ☐ revised text ☐ deleted text

3. Proposal (include proposed new or revised wording, or identification of wording to be deleted): [Note: Proposed text should be in legislative format; i.e., use underscore to denote wording to be inserted (inserted wording) and strike-through to denote wording to be deleted (~~deleted wording~~).]

4. Statement of Problem and Substantiation for Proposal: (Note: State the problem that would be resolved by your recommendation; give the specific reason for your Proposal, including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

5. Copyright Assignment

(a) ☐ I am the author of the text or other material (such as illustrations, graphs) proposed in the Proposal.

(b) ☐ Some or all of the text or other material proposed in this Proposal was not authored by me. Its source is as follows: (please identify which material and provide complete information on its source)

_____

I hereby grant and assign to the NFPA all and full rights in copyright in this Proposal and understand that I acquire no rights in any publication of NFPA in which this Proposal in this or another similar or analogous form is used. Except to the extent that I do not have authority to make an assignment in materials that I have identified in (b) above, I hereby warrant that I am the author of this Proposal and that I have full power and authority to enter into this assignment.

Signature (Required) _____

PLEASE USE SEPARATE FORM FOR EACH PROPOSAL

Mail to: Secretary, Standards Council · National Fire Protection Association
1 Batterymarch Park · Quincy, MA 02169-7471 OR
Fax to: (617) 770-3500 OR Email to: proposals_comments@nfpa.org

6/11/2009