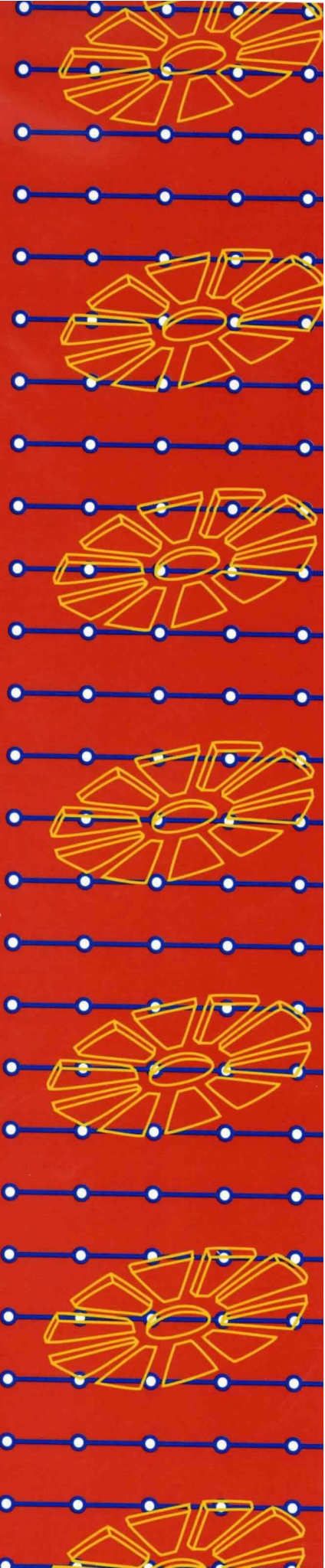
SPRINKLER SYSTEMS

in One- and Two-Family Dwellings and Manufactured Homes

NFPA

13D

1994 Edition



National Fire Protection Association
1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101

ANSI/NFPA 13D An American National Standard February 11, 1994

NOTICE

All questions or other communications relating to this document should be sent only to NFPA headquarters, addressed to the attention of the Committee responsible for the document.

For information on the procedures for requesting Technical Committees to issue Formal Interpretations, proposing Tentative Interim Amendments, proposing amendments for Committee consideration, and appeals on matters relating to the content of the document, write to the Secretary, Standards Council, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

A statement, written or oral, that is not processed in accordance with Section 16 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.

Users of this document should consult applicable federal, state and local laws and regulations. NFPA does not, by the publication of this document, intend to urge action that is not in compliance with applicable laws, and this document may not be construed as doing so.

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

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

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

---

1. Adoption by Reference—Public authorities and others are urged to reference this document in laws, ordinances, regulations, administrative orders, or similar instruments. Any deletions, additions, and changes desired by the adopting authority must be noted separately. Those using this method are requested to notify the NFPA (Attention: Secretary, Standards Council) in writing of such use. The term "adoption by reference" means the citing of title and publishing information only.

2. Adoption by Transcription—A. Public authorities with lawmaking or rule-making powers only upon written notice to the NFPA (Attention: Secretary, Standards Council), will be granted a royalty-free license to print and republish this document in whole or in part, with changes and additions, if any, noted separately, in laws, ordinances, regulations, administrative orders, or similar instruments having the force of law, provided that: (I) due notice of NFPA's copyright is contained in each law and in each copy thereof; and (2) that such printing and republication is limited to numbers sufficient to satisfy the jurisdiction's lawmaking or rule-making process. **B.** Once this NFPA Code or Standard has been adopted into law, all printings of this document by public authorities with lawmaking or rule-making powers or any other persons desiring to reproduce this document or its contents as adopted by the jurisdiction in whole or in part, in any form, upon written request to NFPA (Attention: Secretary, Standards Council), will be granted a nonexclusive license to print, republish, and vend this document in whole or in part, with changes and additions, if any, noted separately, provided that due notice of NFPA's copyright is contained in each copy. Such license shall be granted only upon agreement to pay NFPA a royalty. This royalty is required to provide funds for the research and development necessary to continue the work of NFPA and its volunteers in continually updating and revising NFPA standards. Under certain circumstances, public authorities with lawmaking or rule-making powers may apply for and may receive a special royalty where the public interest will be served thereby.

3. Scope of License Grant—The terms and conditions set forth above do not extend to the index to this document.

(For further explanation, see the Policy Concerning the Adoption, Printing, and Publication of NFPA Documents, which is available upon request from the NFPA.)

Statement on NFPA Procedures

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

NFPA has no power or authority to police or enforce compliance with the contents of this document, and any certification of products stating compliance with requirements of this document is made at the peril of the certifier.

Errata

NFPA 13D

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

1994 Edition

Reference: Table 3-3.1

The Committee on Automatic Sprinklers notes the following errors in the 1994 edition of NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes:*

1. Revise the last entry in Table 3-3.1 as follows:

Specification for Solder Metal (alloy grades containing less than 0.2% lead as identified in ASTM B32, Table 5, Section 1 and having a solidus temperature that exceeds 400°F)	ASTM B32

Issue Date: August 24, 1994

NFPA 13D

Standard for the

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

1994 Edition

This edition of NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, was prepared by the Technical Committee on Automatic Sprinklers and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 15-18, 1993, in Phoenix, AZ. It was issued by the Standards Council on January 14, 1994, with an effective date of February 11, 1994, and supersedes all previous editions.

The 1994 edition of this document has been approved by the American National Standards Institute.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

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 a *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 Annual Meeting in Chicago, IL 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 with 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 anti-freeze systems as well as some of the installation criteria associated with specially listed piping materials.

The 1994 edition contains expanded information on nonmetallic pipe. A new design option has been included in a new chapter for limited area dwellings. This design approach will result in smaller water storage capacities.

Technical Committee on Automatic Sprinklers

Chester W. Schirmer, *Chair*
Schirmer Engineering Corp., NC

Stephen R. Hoover, *Nonvoting Secretary*
Kemper Nat'l. Insurance Companies, IL

Charles B. Barnett, ASCOA Fire Systems, OH
Rep. National Fire Sprinkler Association
Kerry M. Bell, Underwriters Laboratories Inc., IL
Edward K. Budnick, Hughes Assoc. Inc., MD
Albert M. Comly, Vitetta Group, PA
Rep. American Institute of Architects
Thomas G. Daly, Hilton Hotels Corp., CA
Rep. American Hotel & Motel Assn.
James R. Dowling, Nat'l Assn. of Home Builders, DC
(Vote Limited to 13D, 13R)
Robert E. Duke, Fire Control Inc., IL
Russell P. Fleming, Nat'l Fire Sprinkler Assn., NY
Christopher M. Goddard, ICI Americas Inc., DE
Rep. NFPA Industrial Fire Protection Section
Robert J. Gray, Fire Spec Inc., MA
Rep. American Fire Sprinkler Assn., Inc.
Richard E. Hughey, ISO Commercial Risk Services, NJ
Rolf H. Jensen, Rolf Jensen & Associates Inc., IL
Kenneth W. Linder, Industrial Risk Insurers, CT
B. J. Lukes, Grinnell Fire Protection System Co. Ltd., BC
Rep. Canadian Automatic Sprinkler Assn.
Daniel Madrzykowski, Nat'l Inst. of Standards and Technology, MD
Wayne M. Martin, Los Angeles City Fire Dept., CA
M. L. "Larry" Maruskin, U.S. Fire Administration, MD
(Vote Limited to 13D, 13R)
J. R. Mawhinney, Nat'l Research Council of Canada, ON
Joseph G. Novak, S. Pasadena Fire Dept., FL
Rep. Fire Marshals Association of North America
John G. O'Neill, Gage-Babcock & Assoc. Inc., VA
E. J. Schiffhauer, Eastman Kodak Co., NY
Thomas L. Siegfried, Altamonte Springs Fire Dept., FL
Rep. International Association of Fire Chiefs
William P. Stackpole, Liberty Mutual, NH
Rep. The Alliance of American Insurers
Willie R. Templin, American Automatic Sprinkler, Inc., TX
Rep. American Fire Sprinkler Association, Inc.
William L. Testa, Grinnell Fire Protection Systems Co. Inc., RI
Rep. National Fire Sprinkler Association
John J. Walsh, United Assn. of Jrnymen & Apprentices of the Plumbing & Pipe Fitting Ind of US & Can, MD
William E. Wilcox, Factory Mutual Research Corp., MA
R. J. Wright, Underwriters Laboratories of Canada, ON

Alternates

James R. Bell, Marriott Corp., DC
(Alt. to T. G. Daly)
Antonio C. M. Braga, Factory Mutual Research Corp., MA
(Alt. to W. E. Wilcox)
Graham Clarke, Gage-Babcock & Associates, CA
(Alt. to J. G. O'Neill)
Don R. Dean, Dow Chemical Co., TX
(Alt. to C. M. Goddard)
David D. Evans, Ctr for Fire Research, MD
(Alt. to D. Madrzykowski)
John Galt, Canadian Automatic Sprinkler Assn., ON
(Alt. to B. J. Lukes)
Kenneth E. Isman, Nat'l Fire Sprinkler Assn., NY
(Alt. to R. P. Fleming)
George E. Laverick, Underwriters Laboratories Inc., IL
(Alt. to K. M. Bell)
Edward R. Lising, Underwriters Laboratories of Canada, ON
(Alt. to R. J. Wright)
Francis J. Miklоucich, Eastman Kodak Co., NY
(Alt. to E. J. Schiffhauer)
Robert J. Pearce, Industrial Risk Insurers, CA
(Alt. to K. W. Linder)
James Retzloff, The Viking Corp., MI
(Alt. to C. Barnett)
J. K. Richardson, Nat'l Research Council of Canada
(Alt. to J. R. Mawhinney)
Paul E. Rousseau, HFP Sprinkler Inc., MA
(Alt. to W. R. Templin)
Gerald R. Schultz, Schirmer Engineering Corp., IL
(Alt. to C. W. Schirmer)
Harry Shaw, Harry Shaw & Associates Inc., MD
(Alt. to T. L. Siegfried)
Neil P. Stong, Joseph Stong Inc., PA
(Alt. to R. J. Gray)
Jack Thacker, Allan Automatic Sprinkler Corp. of S. CA, CA
(Alt. to W. L. Testa)
Lynn K. Underwood, Wausau Insurance Cos., WI
(Alt. to W. P. Stackpole)
James B. Visger, Road Sprinkler Fitters Union, MD
(Alt. to J. J. Walsh)
William A. Webb, Rolf Jensen & Assoc. Inc., IL
(Alt. to R. H. Jensen)

Nonvoting

William E. Koffel, Koffel Associates Inc., MD
(Rep. Committee on Safety to Life)
Barry M. Lee, Wormald Australia Pty Limited, Australia

John Nigel Stephens, Loss Prevention Council, England
Richard G. Walker, Bassett Consulting Engineers, Australia

Robert E. Solomon, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

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

Committee Scope: This Committee shall have primary responsibility for documents on the design, installation, inspection, and maintenance of automatic and of open sprinkler systems, including the character and adequacy of water supplies, and the selection of sprinklers, piping, valves, and all materials and accessories; but not including the installation of fire pumps, nor the construction and installation of gravity and pressure tanks and towers, nor the installation, maintenance, and use of central station, proprietary, auxiliary, and local signaling systems for watchmen, fire alarm, and supervisory service, nor the supervision and care of valves controlling water supplies, nor the design of fire department hose connections, nor the installation of private fire service mains and their appurtenances.

Contents

Chapter 1 General Information **13D–** 5
1-1 Scope **13D–** 5
1-2 Purpose **13D–** 5
1-3 Definitions. **13D–** 5
1-4 Maintenance **13D–** 6
1-5 Devices, Materials, Design, and Installation **13D–** 6
1-6 Units **13D–** 6

Chapter 2 Water Supply **13D–** 6
2-1 General Provisions **13D–** 6
2-2 Water Supply Sources **13D–** 6
2-3 Multipurpose Piping System **13D–** 7
2-4 Manufactured Home Water Supply . . . **13D–** 7

Chapter 3 System Components **13D–** 7
3-1 Valves and Drains **13D–** 7
3-2 Pressure Gauges **13D–** 7
3-3 Piping **13D–** 7
3-4 Piping Support **13D–** 8
3-5 Sprinklers **13D–** 8
3-6 Alarms **13D–** 8

Chapter 4 System Design **13D–** 8
4-1 Design Criteria **13D–** 8
4-2 Position of Sprinklers **13D–** 9
4-3 System Types **13D–** 9
4-4 Pipe Sizing **13D–**10
4-5 Piping Configurations **13D–**12
4-6 Location of Sprinklers **13D–**12

Chapter 5 Limited Area Dwellings **13D–**12
5-1 General **13D–**12
5-2 Water Supply **13D–**12
5-3 Components **13D–**12
5-4 System Design **13D–**12
5-5 Location of Sprinklers **13D–**12

Chapter 6 Referenced Publications **13D–**13

Appendix A Explanatory Material **13D–**13

Appendix B Referenced Publications **13D–**19

Index **13D–**20

NFPA 13D

Standard for the

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

1994 Edition

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

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

Preface

It is intended that this standard provide a method for those individuals wishing to install a sprinkler system for additional life safety and property protection. It is not the purpose of this standard to require the installation of an automatic sprinkler system. This standard assumes that one or more smoke detectors will be installed in accordance with NFPA 72, *National Fire Alarm Code*.

Chapter 1 General Information

1-1* Scope. This standard deals with the design and installation of automatic sprinkler systems for protection against the fire hazards in one- and two-family dwellings and manufactured homes.

1-2* Purpose. The purpose of this standard is to provide a sprinkler system that will aid in the detection and control of residential fires and thus provide improved protection against injury, life loss, and property damage. A sprinkler system installed in accordance with this standard is 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.

Guidelines are established for the design and installation of sprinkler systems for one- and two-family dwellings and manufactured homes. Nothing in this standard is intended to restrict new technologies or alternate arrangements, provided that the level of safety prescribed by the standard is not lowered.

1-3 Definitions.

Approved. Acceptable to the authority having jurisdiction.

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

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

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, 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.

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

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

Design Discharge. Rate of water discharged by an automatic sprinkler expressed in gallons per minute (L/min).

Dry System. A system employing automatic sprinklers attached to a piping system containing air under atmospheric or higher pressures. Loss of pressure from the opening of a sprinkler or detection of a fire condition causes the release of water into the piping system and out the opened sprinkler.

Dwelling. Any building that contains not more than one or two "dwelling units" intended to be used, rented, leased, let, or hired out to be occupied or that are occupied for habitation purposes.

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

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.

Listed. Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

Manufactured Home. A structure, transportable in one or more sections, that in the traveling mode is 8 body ft (2.4 m) or more in width and 40 body ft (12 m) or more in length or, where erected on site, is 320 or more sq ft (28 m^2), and that is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation where connected to the required utilities, and includes the plumbing, heating, air conditioning, and electrical systems contained therein.

NOTE: Manufactured homes were formally referred to as "mobile homes" or "trailer coaches."

Multipurpose Piping Systems. Piping systems within dwellings and manufactured homes intended to serve both domestic and fire protection needs.

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

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

Residential Sprinkler. An automatic sprinkler that has been specifically listed for use in residential occupancies.

Shall. Indicates a mandatory requirement.

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

Sprinkler—Automatic. A fire suppression 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.

Sprinkler System. An integrated system of piping connected to a water supply, with listed sprinklers that will automatically initiate water discharge over a fire area. Where required, the sprinkler system also includes a control valve and a device for actuating an alarm when the system operates.

Standard. A document that contains only mandatory provisions using the word "shall" to indicate requirements. Explanatory material may be included only in the form of fine-print notes, in footnotes, or in an appendix.

Supply Pressure. Pressure within the supply (i.e., city or private supply water source).

System Pressure. Pressure within the system (i.e., above the control valve).

Waterflow Alarm. A sounding device activated by a waterflow detector or alarm check valve and arranged to sound an alarm that will be audible in all living areas over background noise levels with all intervening doors closed.

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

Wet System. A 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 a fire.

1-4* Maintenance. The owner is responsible for the condition of a sprinkler system and shall keep the system in normal operating condition.

1-5 Devices, Materials, Design, and Installation.

1-5.1* Only new residential sprinklers shall be employed in the installation of sprinkler systems.

1-5.2 Only listed and approved devices and approved materials shall be used in sprinkler systems.

Exception: Listing may be waived for tanks, pumps, hangers, waterflow detection devices, and waterflow valves.

1-5.3 Preengineered systems shall be installed within the limitations that have been established by the testing laboratories where listed.

1-5.4* All systems shall be tested for leakage at normal system operating water pressure.

Exception: Where a fire department pumper connection is provided, hydrostatic pressure tests shall be provided in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems.

1-6 Units. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection. These units are listed in Table 1-6 with conversion factors.

Table 1-6 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 = 105 Pa

For additional conversions and information see ASTM E380, *Standard for Use of the International System of Units (SI) (the Modernized Metric System).*

1-6.1 If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated shall be regarded as the requirement. A given equivalent value may be approximate.

1-6.2 The conversion procedure for the SI units has been to multiply the quantity by the conversion factor and then round the result to the appropriate number of significant digits.

Chapter 2 Water Supply

2-1 General Provisions. Every automatic sprinkler system shall have at least one automatic water supply. Where stored water is used as the sole source of supply, the minimum quantity shall equal the water demand rate times 10 min. (*See 4-1.3.*)

Exception: For dwelling units that are one story and less than 2,000 sq ft (186 m^2) in area, the water supply shall be at least 7 min for the 2-sprinkler demand.

2-2* Water Supply Sources. The following water supply sources are acceptable:

(a) A connection to a reliable waterworks system.

(b) An elevated tank.

(c) A pressure tank designed to ASME standards for a pressure vessel with a reliable pressure source.

(d) A stored water source with an automatically operated pump.

2-3* Multipurpose Piping System. A piping system serving both sprinkler and domestic needs shall be acceptable where:

(a)* In common water supply connections serving more than one dwelling unit, 5 gpm (19 L/min) is added to the sprinkler system demand to determine the size of common piping and the size of the total water supply requirements.

(b) Smoke detectors are provided in accordance with NFPA 72, *National Fire Alarm Code*.

(c) All piping in the system conforms to the piping specifications of this standard.

(d) Permitted by the local plumbing or health authority.

2-4 Manufactured Home Water Supply. A water supply for a sprinklered dwelling manufactured off-site shall not be less than that specified on the manufacturer's nameplate. [*See 4-4.3(k) Exception.*] (*See Chapter 5 for an alternative design approach for manufactured homes.*)

Chapter 3 System Components

3-1 Valves and Drains.

3-1.1 Each system shall have a single control valve arranged to shut off both the domestic and sprinkler systems and a separate shutoff valve for the domestic system only.

Exception No. 1: The sprinkler system piping may have a separate control valve where supervised by one of the following methods:

(a) Central station, proprietary, or remote station alarm service,

(b) Local alarm service that will cause the sounding of an audible signal at a constantly attended point, or

(c) Locking the valves open.

Exception No. 2: A separate shutoff valve is not required for the domestic water supply in multipurpose piping systems.

3-1.2 Each sprinkler system shall have a 1/2-in. (13-mm) or larger drain and test connection with valve on the system side of the control valve.

3-1.3 Additional drains shall be installed for each trapped portion of a dry system that is subject to freezing temperatures.

3-1.4* Where waterflow alarms are provided, waterflow test connections shall be installed at locations that will permit flow testing of water supplies, connections, and alarm mechanisms.

3-2 Pressure Gauges. A pressure gauge shall be installed to indicate air pressure on dry systems and on water supply pressure tanks.

3-3 Piping.

3-3.1* Pipe or tube used in sprinkler systems shall be of the materials in Table 3-3.1 on the following page or in accordance with 3-3.2 through 3-3.5. The chemical properties, physical properties, and dimensions of the materials listed in Table 3-3.1 shall be at least equivalent to the standards cited in the table and designed to withstand a working pressure of not less than 175 psi (12.1 bars).

Table 3-3.1 Pipe or tube Materials and Dimensions

Materials and Dimensions	Standard
Specification for Welded and Seamless Steel Pipe	ASTM A53
Wrought-Steel Pipe	ANSI B36.10M
Specifications for Electric-Resistance Welded Steel Pipe	ASTM A135
Copper Tube (Drawn, Seamless) Specification for Seamless Copper Tube	ASTM B75
Specification for Seamless Copper Water Tube	ASTM B88
Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	ASTM B251
Fluxes for Soldering Applications of Copper and Copper Alloy Tube	ASTM B813
Brazing Filler Metal (BCuP, Copper-Phosphorus or Copper-Phosphorus-silver Brazing Fller Metal)	AWS A5.8
Specification for Solder Metal, 95-5 (Tin-Antimony-Grade 95TA)	ASTM B32

3-3.2* Other types of pipe or tube shall be permitted to be used, but only those investigated and listed for this service by a testing and inspection agency laboratory. Listed piping materials, including but not limited to chlorinated polyvinyl chloride (CPVC), polybutylene, and steel differing from that provided in Table 3-3.1, shall be installed in accordance with their listing and the manufacturers' installation instructions. Nonmetallic pipe shall comply with the portions of the ASTM standards specified in Table 3-3.2 that apply to fire protection service in addition to the provisions of this paragraph.

Table 3-3.2 Specially Listed Nonmetallic Pipe or Tube Materials and Dimensions

Materials and Dimensions	Standard
Nonmetallic Piping	
Specification for Special Listed Chlorinated Polyvinyl Chloride (CPVC) Pipe	ASTM F442
Specification for Special Listed Polybutylene (PB) Pipe	ASTM D3309

In addition to satisfying these minimum standards, specially listed pipe is required to comply with the provisions of 3-3.2.

3-3.3 Wherever the word pipe is used in this standard, it shall be understood to also mean tube.

3-3.4 Schedule 10 steel pipe shall be permitted to be joined with mechanical groove couplings approved for service with grooves rolled on the pipe by an approved groove-rolling machine.

3-3.5 Fittings used in sprinkler systems shall be of the materials listed in Table 3-3.5 or in accordance with 3-3.7. The chemical properties, physical properties, and dimensions of the materials listed in Table 3-3.5 shall be at least equivalent to the standards cited in the table. Fittings used in sprinkler systems shall be designed to withstand the working pressures involved, but not less than 175 psi (12.1 bars) cold water pressure.

3-3.6 Joints for the connection of copper tube shall be brazed.

Exception: Soldered joints shall be permitted to be used for wet pipe copper tube systems.

Table 3-3.5 Fitting Materials and Dimensions

Materials and Dimensions	Standard
Cast Iron	
Cast Iron Threaded Fittings, Class 125 and 250	ANSI B16.4
Cast Iron Pipe Flanges and Flanged Fittings	ANSI B16.1
Malleable Iron	
Malleable Iron Threaded Fittings, Class 150 and 300	ANSI B16.3
Steel	
Factory-made Wrought Steel Buttweld Fittings	ANSI B16.9
Buttwelding Ends for Pipe, Valves, Flanges and Fittings	ANSI B16.25
Spec. for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures	ASTM A234
Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys	ANSI B16.5
Forged Steel Fittings, Socket Welded and Threaded	ANSI B16.11
Copper	
Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings	ANSI B16.22
Cast Copper Alloy Solder-Joint Pressure Fittings	ANSI B16.18

3-3.7* Other types of fittings shall be permitted to be used, but only those investigated and listed for this service by a testing and inspection agency laboratory. Listed fittings, including but not limited to chlorinated polyvinyl chloride (CPVC), polybutylene, and steel differing from that provided in Table 3-3.5, shall be installed in accordance with their listing and the manufacturers' installation instructions. Nonmetallic pipe fittings shall comply with the portions of the ASTM standards specified in Table 3-3.7 that apply to fire protection service in addition to the provisions of this paragraph.

3-4 Piping Support.

3-4.1 Piping shall be supported from structural members using support methods comparable to those required by local plumbing codes.

Exception: Listed piping shall be supported in accordance with any listing limitations.

3-4.2 Piping laid on open joists or rafters shall be secured to prevent lateral movement.

3-4.3* Sprinkler piping shall be adequately secured to restrict the movement of piping upon sprinkler operation.

Table 3-3.7 Specially Listed Fittings and Dimensions

Materials and Dimensions	Standard
Specification for Schedule 80 CPVC Threaded Fittings	ASTM F437
Specification for Schedule 40 CPVC Socket-type Fittings	ASTM F438
Specification for Schedule 80 CPVC Socket-type Fittings	ASTM F439

In addition to satisfying these minimum standards, specially listed pipe fittings are required to comply with the provisions of 3-3.7.

3-5 Sprinklers.

3-5.1 Listed residential sprinklers shall be used. The basis of such a listing shall be tests to establish the ability of the sprinklers to control residential fires under standardized fire test conditions. The standardized room fires shall be based on a residential array of furnishings and finishes.

Exception No. 1: Residential sprinklers shall not be used in dry systems unless specifically listed for that purpose.

Exception No. 2: Listed dry sprinklers shall be permitted for use in accordance with 4-3.2.

3-5.2 Ordinary-temperature-rated residential sprinklers [135 to 170°F (57 to 77°C)] shall be installed where maximum ambient ceiling temperatures do not exceed 100°F (38°C).

3-5.3 Intermediate-temperature-rated residential sprinklers [175 to 225°F (79 to 107°C)] shall be installed where maximum ambient ceiling temperatures are between 101 and 150°F (39 and 66°C).

3-5.4 The following practices shall be observed when installing residential sprinklers, unless maximum expected ambient temperatures are otherwise determined.

(a) Sprinklers under glass or plastic skylights exposed to direct rays of the sun shall be of intermediate temperature classification.

(b) Sprinklers in an unventilated concealed space under uninsulated roof, or in an unventilated attic, shall be of intermediate temperature classification.

3-5.5 Operated or damaged sprinklers shall be replaced with sprinklers having the same performance characteristics as the original equipment.

3-5.6 Painting and Ornamental Finishes.

3-5.6.1* Sprinkler frames are permitted to be factory painted or enameled as ornamental finish in accordance with 3-5.6.2; otherwise, sprinklers shall not be painted and any sprinklers that have been painted, except for factory-applied coatings, shall be replaced with new listed sprinklers.

3-5.6.2 Ornamental finishes shall not be applied to sprinklers by anyone other than the sprinkler manufacturer, and only sprinklers listed with such finishes shall be used.

3-5.7 Where nonmetallic sprinkler ceiling plates (escutcheons) or recessed escutcheons (metallic or nonmetallic) are used, they shall be listed based on tests of the assembly as a residential sprinkler.

3-6* Alarms. Local waterflow alarms with facilities for flow testing such as alarm devices shall be provided on all sprinkler systems.

Exception: Dwellings or manufactured homes having smoke detectors in accordance with NFPA 72, National Fire Alarm Code.

Chapter 4 System Design

4-1 Design Criteria.

4-1.1 Design Discharge. The system shall provide a discharge of not less than 18 gpm (68 L/min) to any single operating sprinkler and not less than 13 gpm (49 L/min)

per sprinkler to the number of design sprinklers but not less than the listing of the sprinkler.

4-1.2* Number of Design Sprinklers. The number of design sprinklers shall include all sprinklers within a compartment to a maximum of 2 sprinklers, under a flat, smooth, horizontal ceiling. For compartments containing 2 or more sprinklers, calculations shall be provided to verify the single operating sprinkler criteria and the multiple (2) operating sprinkler criteria.

4-1.2.1 The definition of compartment for use in 4-1.2 to determine the number of design sprinklers is a space that is completely enclosed by walls and a ceiling. The compartment enclosure may have openings to an adjoining space if the openings have a minimum lintel depth of 8 in. (203 mm) from the ceiling.

4-1.3 Water Demand. The water demand for the system shall be determined by multiplying the design discharge of 4-1.1 by the number of design sprinklers of 4-1.2.

4-1.4 Sprinkler Coverage.

4-1.4.1 Residential sprinklers shall be spaced so that the maximum area protected by a single sprinkler does not exceed 144 sq ft (13.4 m^2).

4-1.4.2 The maximum distance between sprinklers shall not exceed 12 ft (3.7 m) on or between pipelines, and the maximum distance to a wall or partition shall not exceed 6 ft (1.8 m). The minimum distance between sprinklers within a compartment shall be 8 ft (2.4 m).

4-1.5 The minimum operating pressure of any sprinkler shall be in accordance with the listing information of the sprinkler and shall provide the minimum flow rates specified in 4-1.1.

4-1.6 Application rates, design areas, areas of coverage, and minimum design pressures other than those specified in 4-1.1, 4-1.2, 4-1.4, and 4-1.5 are permitted with special sprinklers that have been listed for such specific residential installation conditions.

4-2 Position of Sprinklers.

4-2.1 Pendent and upright sprinklers shall be positioned so that the deflectors are within 1 to 4 in. (25.4 to 102 mm) from the ceiling.

Exception: Special residential sprinklers shall be installed in accordance with the listing limitations.

4-2.2 Sidewall sprinklers shall be positioned so that the deflectors are within 4 to 6 in. (102 to 152 mm) of the ceiling.

Exception: Special residential sprinklers shall be installed in accordance with the listing limitations.

4-2.3* Sprinklers shall be positioned so that the response time and discharge are not unduly affected by obstructions such as ceiling slope, beams, or light fixtures.

4-2.4 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 anticipating future installation of a finished ceiling.

4-3 System Types.

4-3.1 Wet Pipe Systems. A wet pipe system shall be used where all piping is installed in areas not subject to freezing.

4-3.2 Dry Pipe Systems. Where system piping is located in unheated areas subject to freezing, a dry pipe or antifreeze system shall be used.

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

4-3.3 Antifreeze Systems.

4-3.3.1 Definition. An antifreeze system is one employing automatic sprinklers attached to a piping system containing an antifreeze solution and connected to a water supply. The antifreeze solution, followed by water, discharges immediately from sprinklers opened by a fire.

4-3.3.2* The use of antifreeze solutions shall be in conformity with any state or local health regulations.

4-3.3.3 Antifreeze Solutions.

4-3.3.3.1 Where sprinkler systems are supplied by public water connections, the use of antifreeze solutions other than water solutions of pure glycerine (C.P. or U.S.P. 96.5 percent grade) or propylene glycol shall not be permitted. Suitable glycerine-water and propylene glycol-water mixtures are shown in Table 4-3.3.3.1.

Table 4-3.3.3.1 Antifreeze Solutions to Be Used if Public 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	1.133	−15	−26.1
C.P. or U.S.P. Grade*	40% Water	1.151	−22	−30.0
	30% Water	1.165	−40	−40.0
Hydrometer Scale	1,000 to 1,200			
Propylene Glycol	70% Water	1.027	+9	−12.8
	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%.

4-3.3.3.2 If public water is not connected to sprinklers, the commercially available materials indicated in Table 4-3.3.3.2 are suitable for use in antifreeze solutions.

4-3.3.3.3* An antifreeze solution shall be prepared with a freezing point below the expected minimum temperature for the locality. The specific gravity of the prepared solution shall be checked by a hydrometer with a suitable scale.

4-3.3.4* Arrangement of Supply Piping and Valves. All permitted antifreeze solutions are heavier than water. At the point of contact (interface), the heavier liquid will be below the lighter liquid in order to prevent diffusion of water into the unheated areas. In most cases, this necessitates the use of a 5-ft (1.5-m) drop pipe or U-loop as illustrated in Figure 4-3.3.4. The preferred arrangement is to

Table 4-3.3.3.2 *Antifreeze Solutions to Be Used if Public Water Is Not Connected to Sprinklers*

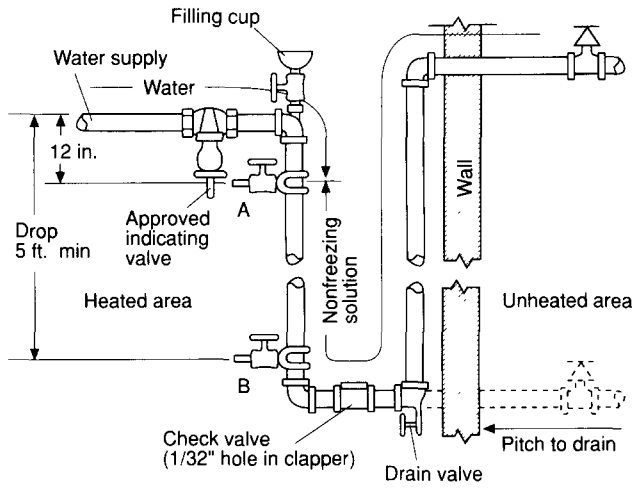
Material	Solution (by Volume)	Specific Gravity at 60°F (15.6°C)	Freezing Point °F	°C
Glycerine	If glycerine is used, see Table 4-3.3.3.1			
Diethylene Glycol	50% Water	1.078	−13	−25.0
	45% Water	1.081	−27	−32.8
	40% Water	1.086	−42	−41.1
Hydrometer Scale	1.000 to 1.120 (Subdivisions 0.002)			
Ethylene 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	If propylene glycol is used, see Table 4-3.3.3.1			
Calcium Chloride 80% "Flake"	lb $CaCl_2$ per gal of Water			
*Fire Protection Grade**	2.83	1.183	0	−17.8
Add corrosion inhibitor of sodium bichromate 1/4 oz per gal water	3.38	1.212	−10	−23.3
	3.89	1.237	−20	−28.9
	4.37	1.258	−30	−34.4
	4.73	1.274	−40	−40.0
	4.93	1.283	−50	−45.6

*Free from magnesium chloride and other impurities.

have the sprinklers below the interface between the water and the antifreeze solution.

If sprinklers are above the interface, a check valve with a 1/32-in. (0.8-mm) hole in the clapper shall be provided in the U-loop. A water control valve and two small solution test valves shall be provided as illustrated in Figure 4-3.3.4. An acceptable arrangement of a filling cup is also shown.

4-3.3.5* Testing. Before freezing weather each year, the solution in the entire system shall be emptied into convenient containers and brought to the proper specific gravity by adding concentrated liquid as needed. The resulting solution is permitted to be used to refill the system.



NOTE 1: Check valve may be omitted where sprinklers are below level of valve A.
NOTE 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 and thus prevent damage to sprinklers.
For SI Units: 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Figure 4-3.3.4 Arrangement of supply piping and valves.

4-4 Pipe Sizing.

4-4.1 Piping shall be sized in accordance with 4-4.3 and 4-4.4. If more than one design discharge is required (*see 4-1.1*), the pipe sizing procedure shall be repeated for each design discharge.

Exception No. 1: Where piping is sized hydraulically, calculations shall be made in accordance with the methods described in NFPA 13, Standard for the Installation of Sprinkler Systems.

Exception No. 2: For specially listed piping products, friction loss for pipe and fittings is permitted to be calculated based on manufacturer's data, where available.

4-4.2 Minimum Pipe Size. Minimum pipe size, including copper, listed chlorinated polyvinyl chloride (CPVC), and polybutylene (PB) piping, shall be 3/4 in. (19 mm).

Exception: Minimum size of steel pipe shall be 1 in. (25.4 mm).

4-4.3* To size piping for systems connected to a city water supply, the following approximate method is acceptable.

(a) Establish system flow rate in accordance with Section 4-1.

(b) Determine water pressure in the street.

(c) Select pipe sizes.

(d) Deduct meter pressure losses if any. [*See Table 4-4.3(e).*]

(e) Deduct pressure loss for elevation. (Building height above street in ft × 0.434 = psi.) (Building height above street in meters × 0.098 = bars.)

(f) Deduct pressure losses from the city main to the inside control valve by multiplying the factor from Table 4-4.3(a) or (b) by the total length(s) of pipe in ft (m). [Total length includes equivalent length of fittings as determined by applying Table 4-4.3(c) or (d).]

(g) Deduct pressure losses for piping within building by multiplying factor from Table 4-4.3(a) or (b) by the total length in ft (m) of each size of pipe between the control valve and the farthest sprinkler.

(h) Deduct valve and fitting pressure losses. Count the valves and fittings from the control valve to the farthest sprinkler. Determine the equivalent length for each valve and fitting as shown in Table 4-4.3(c) or (d) and add these values to obtain the total equivalent length for each pipe size. Multiply the equivalent length for each size by the factor from Table 4-4.3(a) or (b) and total these values.

(i) In multilevel buildings, steps (a) through (h) shall be repeated to size piping for each floor.

(j) If the remaining pressure is less than the operating pressure established by the testing laboratory for the sprinkler being used, a redesign is necessary. If this pressure is higher than required, smaller piping may be used where justified by calculations.

(k) The remaining piping shall be sized the same as the piping to the farthest sprinkler unless smaller sizes are justified by calculations.

Exception: For sprinklered dwellings 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. (See Section 2-3.)

Table 4-4.3(a) Pressure Losses (psi/ft) 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 ft = 0.3048 m.

Table 4-4.3(b) Pressure Losses (psi/ft) Copper Tubing — Types K, L, & 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 ft = 0.3048 m.

Table 4-4.3(c) Equivalent Length of Pipe in Feet for Steel Fittings and Valves

Fitting/Valve Diameter (in.)	Elbows			Tees		Valves					
	45 Degrees	90 Degrees	Long Radius	Flow Thru Branch	Flow Thru Run	Gate	Angle	Globe	Globe "Y" Pattern	Cock	Check
1	1	3	2	5	2	1	12	28	15	4	4
1¼	2	3	2	6	2	2	15	35	18	5	5
1½	2	4	3	8	3	2	18	43	22	6	6
2	3	5	3	10	3	2	24	57	28	7	8

Based on Crane Technical Paper No. 410.
For SI Units: 1 ft = 0.3048 m.

Table 4-4.3(d) Equivalent Length of Pipe in Feet for Copper Fittings and Valves

Fitting/Valve Diameter (in.)	Elbows			Tees		Valves					
	45 Degrees	90 Degrees	Long Radius	Flow Thru Branch	Flow Thru Run	Gate	Angle	Globe	Globe "Y" Pattern	Cock	Check
¾	1.5	3	1.5	4.5	1.5	1.5	15	32	17	4.5	4.5
1	1.5	3	3	7.5	3	1.5	18	42	23	6.0	7.5
1¼	1.5	4.5	3	9	3	1.5	23	53	27	7.5	11
1½	3	6	3	12	4.5	1.5	27	65	33	9	14
2	3	7	4.5	15	4.5	1.5	36	86	42	11	17

For SI Units: 1 ft = 0.3048 m.

Table 4-4.3(e) Pressure Losses in Water Meters

Meter (in.)	Pressure Loss (psi) Flow (gpm) 18	23	26	31	39	52
5/8	9	14	18	26	*	*
3/4	4	8	9	13	*	*
1	2	3	3	4	6	10
1 1/2	**	1	2	2	4	7
2	**	**	**	1	2	3

NOTE: Higher pressure losses specified by the manufacturer should be used in place of those specified in the table. Lower pressure losses may be used where supporting data is provided by the meter manufacturer.
* Above maximum rated flow of commonly available meters.
**Less than 1 psi.
For SI Units: 1 gpm = 3.785 L/min; 1 in. = 25.4 mm; 1 psi = 0.0689 bar.

4-4.4 To size piping for systems with an elevated tank, pump, or pump-tank combination, determine the pressure at the water supply outlet and proceed through steps (c), (e), (g), (h), (i), (j), and (k) of 4-4.3.

4-4.5 Hydraulic calculation procedures in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, shall be used for grid-type systems, looped-type systems and systems connected to city water mains of less than 4 in. (100 mm) in diameter.

4-5 Piping Configurations. Piping configurations are permitted to be looped, gridded, straight run, or combinations thereof.

4-6 Location of Sprinklers. Sprinklers shall be installed in all areas.

Exception No. 1: Sprinklers are not required in bathrooms 55 sq ft (5.1 m^2) and less.

Exception No. 2: Sprinklers are not required in clothes closets, linen closets, and pantries where the area of the space does not exceed 24 sq ft (2.2 m^2) and the least dimension does not exceed 3 ft (0.9 m) and the walls and ceilings are surfaced with noncombustible or limited combustible materials as defined in NFPA 220, Standard on Types of Building Construction.

Exception No. 3: Sprinklers are not required in garages, open attached porches, carports, and similar structures.

Exception No. 4: Sprinklers are not required in attics, crawl spaces, and other concealed spaces that are not used or intended for living purposes or storage.

Exception No. 5: Sprinklers are not required in entrance foyers that are not the only means of egress.

Chapter 5 Limited Area Dwellings

5-1* General. This chapter is only applicable as an alternative for one- and two-family dwellings, including manufactured homes, that do not exceed 2000 sq ft (186 m^2) in area and that are 1 story in height with smooth ceilings with a slope not exceeding 10 degrees and a height not exceeding 8 ft (2.4 m) for horizontal ceilings and 9 ft (2.7 m) for sloped ceilings. All other requirements of this standard apply except as modified by this chapter.

5-2 Water Supply. The water supply for this type of system shall be capable of supporting the system demand for 10 min for 1 sprinkler operating as determined by 5-4.1 and 7 min for 2 sprinklers operating as determined by 5-4.2.

5-2.1 A listed strainer shall be provided in risers or feed mains that supply sprinklers with orifices less than 3/8 in. (9.5 mm) nominal diameter.

5-3 Components.

5-3.1* Sprinklers. Sprinklers for use in this type of system shall be specifically listed for use in the conditions described in Section 5-1. All sprinklers installed in a compartment shall have the same thermal response characteristics.

5-3.2* Alarms. Local waterflow alarms and facilities for flow testing such alarm devices shall be provided on such sprinkler systems.

5-4 System Design.

5-4.1 The water demand for this system shall be not less than 10 gpm (37.8 L/min) at a flowing pressure of 25 psi (1.72 bars) at the sprinkler where only 1 sprinkler is installed in a compartment.

5-4.2 The water demand for this system shall be not less than 6.5 gpm (24.6 L/min) to each of 2 sprinklers at a flowing pressure of 11 psi (0.76 bar) at the sprinkler where 2 or more sprinklers are installed in a compartment. The single sprinkler demand point as described in 5-4.1 shall also be verified.

5-4.3* The area of coverage for sprinklers used in this system shall not exceed 64 sq ft (5.9 m^2) per sprinkler.

Exception: For compartments not exceeding 100 sq ft (9.3 m^2) and having no dimension exceeding 10 ft (3.1 m), a single sprinkler shall be permitted to cover this area.

5-4.4 The maximum perpendicular distance to a wall or partition shall not exceed 5 ft (1.5 m) and the minimum distance between sprinklers shall not be less than 6 ft (1.8 m).

5-4.5 The definition of compartment as used in 5-4.1, 5-4.2, and 5-4.3 is a space that is enclosed by walls and a ceiling.

The compartment enclosure can have openings to an adjoining space if the openings have a minimum lintel depth of 2 in. (51 mm) from the ceiling and where the openings do not exceed 20 sq ft (1.86 m^2) from each compartment.

5-5* Location of Sprinklers. Sprinklers shall be installed in all areas.

Exception No. 1: Sprinklers are not required in clothes closets, linen closets, and pantries where the area of space does not exceed 24 sq ft (2.2 m^2) and the least dimension does not exceed 3 ft (0.9 m) and the walls and ceilings are surfaced with noncombustible or limited combustible materials as defined by NFPA 220, Standard on Types of Building Construction.

Exception No. 2: Sprinklers are not required in garages, open attached porches, carports, and similar structures.

Exception No. 3: Sprinklers are not required in attics, crawl spaces, and other concealed spaces that are not used or intended for living purposes or storage.

Chapter 6 Referenced Publications

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

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

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1994 edition.

NFPA 72, *National Fire Alarm Code*, 1993 edition.

NFPA 220, *Standard on Types of Building Construction*, 1992 edition.

6-1.2 Other Publications.

6-1.2.1 ANSI Publications. American National Standards Institute, Inc., 1450 Broadway, New York, NY 10018.

ANSI B16.1-1989, *Cast Iron Pipe Flanges and Flanged Fittings.*

ANSI B16.3-1992, *Malleable Iron Threaded Fittings.*

ANSI B16.4-1992, *Cast Iron Threaded Fittings.*

ANSI B16.5-1988, *Pipe Flanges and Flanged Fittings.*

ANSI B16.9-1993, *Factory-Made Wrought Steel Buttwelding Fittings.*

ANSI B16.11-1991, *Forged Steel Fittings, Socket-Welding and Threaded.*

ANSI B16.18-1984, *Cast Copper Alloy Solder Joint Pressure Fittings.*

ANSI B16.22-1989, *Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.*

ANSI B16.25-1992, *Buttwelding Ends.*

ANSI B36.10M-1985, *Welded and Seamless Wrought Steel Pipe.*

6-1.2.2 ASTM Publications. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19105.

ASTM A53-1992, *Standard Specification for Pipe, Steel, Black, and Hot-Dipped, Zinc-Coated Welded and Seamless Steel Pipe.*

ASTM A135-1992, *Standard Specification for Electric-Resistance-Welded Steel Pipe.*

ASTM A234-1992, *Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.*

ASTM B32-1993, *Standard Specification for Solder Metal.*

ASTM B75-1992, *Standard Specification for Seamless Copper Tube.*

ASTM B88-1993, *Standard Specification for Seamless Copper Water Tube.*

ASTM B251-1993, *Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.*

ASTM B813-1991, *Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper-Alloy Tube.*

ASTM D3309-1992, *Standard Specification for Polybutylene (PB) Plastic Hot and Cold Water Distribution Systems.*

ASTM E380-1989, *Standard for Use of the International System of Units (SI) (the Modernized Metric System).*

ASTM F437-1989, *Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 (SDR-PR).*

ASTM F438-1990, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.*

ASTM F439-1990, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.*

ASTM F442-1989, *Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).*

Appendix A Explanatory Material

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

A-1-1 NFPA 13D is appropriate for the protection against fire hazards only in one- and two-family dwellings and manufactured homes. Residential portions of any other building may be protected with residential sprinklers in accordance with 4-3.6 of NFPA 13, *Standard for the Installation of Sprinkler Systems*. Other portions of such buildings should be protected in accordance with NFPA 13.

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 Figures A-1-1(a), (b), and (c). Sixty full-scale fire tests were conducted in a 2-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 if sprinklers are installed in the compartment. A sprinkler system designed and installed according to this standard cannot, however, be completely expected to control a fire involving unusually higher average fuel loads than typical for dwelling units [10 lb/sq ft (49 kg/m^2)] and where the interior finish has an unusually high flame spread rating (greater than 225).

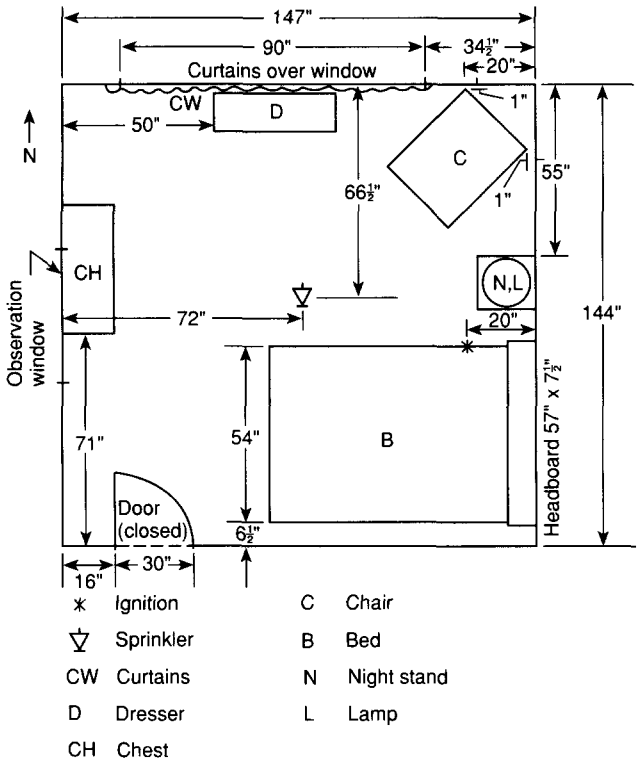
For protection of multifamily dwellings, refer to NFPA 13, *Standard for the Installation of Sprinkler Systems*, or NFPA 13R, *Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height.*

A-1-2 Levels of Protection. 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 are the ones shown by NFPA statistics [*see Table A-1-2(a)*] to be the ones where the incidence of life loss from fires in dwellings is low. Such an approach produces a reasonable degree of fire safety. Greater protection to both life and property will be achieved by sprinklering all areas.

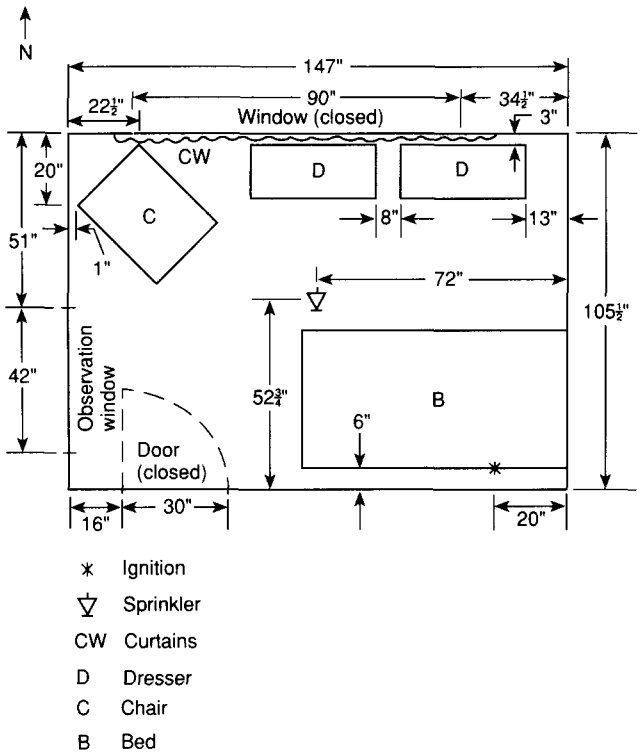
Guidance for installation of smoke detectors and fire detection systems may be found in NFPA 72, *National Fire Alarm Code*.

A-1-3 Control Valve. System control valves should be of the indicating type, such as plug valves, ball valves, butterfly valves, or O. S. & Y. gate valves.



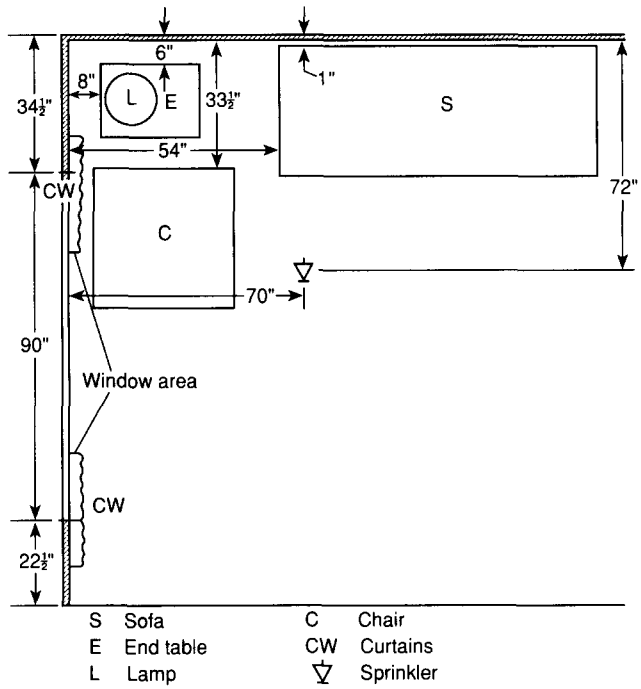
SI Units: 1 in. = 25.4 mm.

Figure A-1-1(a) Bedroom.



For SI Units: 1 in. = 25.4 mm.

Figure A-1-1(b) Manufactured home bedroom.



For SI Units: 1 in. = 25.4 mm.

Figure A-1-1(c) Living room.

A-1-4 The responsibility for properly maintaining a sprinkler system is the obligation of the owner or manager, who should understand the sprinkler system operation. A minimum monthly maintenance program should include the following:

(a) Visual inspection of all sprinklers to ensure against obstruction of spray.

(b) Inspection of all valves to assure that they are open.

(c) Testing of all waterflow devices.

(d) Testing of the alarm system, if installed.

NOTE: Where it appears likely that the test will result in a response of the fire department, notification to the fire department should be made prior to the test.

(e) Operation of pumps, where employed. See NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps.*

(f) Checking of the pressure of air used with dry systems.

(g) Checking of water level in tanks.

(h) Care should be taken to see that sprinklers are not painted either at the time of installation or during subsequent redecoration. When sprinkler piping or areas next to sprinklers are being painted, the sprinklers may be protected by being covered with a bag, which should be removed immediately after painting is finished.

For further information see NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*

A-1-5.1 At least 3 spare sprinklers of each type, temperature rating, and orifice size used in the system should be kept on the premises. When fused sprinklers are replaced by the owner, fire department, or others, care should be taken to assure that the replacement sprinkler has the same operating characteristics.

Table A-1-2(a) Casual Factors in One- and Two-Family Dwelling Fires that Caused One or More Deaths

Area of Origin			Form of Heat of Ignition		
Living Room	41%		Smoking Materials	36%	
Bedroom	27%		Heat from Fuel — Fire or Powered Object	25%	
Kitchen	15%		Heat from Miscellaneous Open Flame (Including Match)	15%	Based on 5016 incidents where form of heat of ignition was reported
Storage Area	4%	Based on 6066 incidents where area of origin was reported	Heat from Electrical Equipment Arcing or Overload	14%	
Heating Equipment Room	3%		Hot Objects Including Properly Operating Electrical Equipment	7%	
Structural Area	2%		Other	3%	
Other Areas	8%				Total number of incidents reported 10,194
Form of Materials Ignited					
Furniture	27%				
Bedding	18%				
Combustible Liquid or Gas	13%				
Interior Finish	9%	Based on 5080 incidents where form of material ignited was reported			
Structural Member	9%				
Waste, Rubbish	4%				
Clothing, on a Person	3%				
Cooking Materials	3%				
Electrical Insulation	2%				
Curtains, Drapery	2%				
Other	10%				

Source: FIDO Data Base 1973 to 1982, NFPA Fire Analysis Department.

Table A-1-2(b) Fires and Associated Deaths and Injuries in Dwellings, Duplexes, and Manufactured Homes, by Area of Origin — Annual Average of 1986-90 Structure Fires Reported to U.S. Fire Departments

Area of Origin	Civilian Deaths	Civilian Pct	Fires	Pct	Injuries	Pct
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%

*Does not include dwelling garages coded as a separate property, which averaged 19 deaths, 259 injuries, and 21,170 fires per year.
NOTE: Fires are estimated to the nearest ten; civilian deaths and injuries, to the nearest one.
SOURCE: 1986-1990 NFIRS and NFPA Survey.

A-1-5.4 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 may 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 should also 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. Check for leaks using soapy water brushed on each joint or coupling. Leaks will be shown by the presence of bubbles. This test should be made prior to concealing of piping.

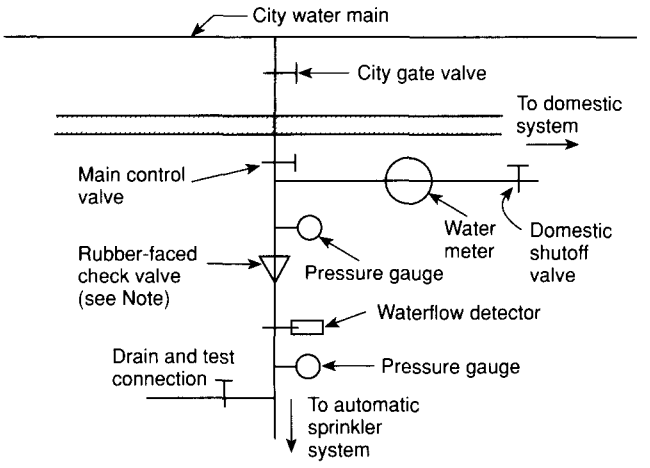
A-2-2 Connection for fire protection to city mains is often subject to local regulation concerning metering and backflow prevention requirements. Preferred and acceptable water supply arrangements are shown in Figures A-2-2(a), (b), and (c). When a meter must be used between the city water main and the sprinkler system supply, an acceptable arrangement is shown in Figure A-2-2(c). Under these circumstances, the flow characteristics of the meter must be included in the hydraulic calculation of the system. [*See Table 4-4.3(e).*] When a tank is used for both domestic and fire protection purposes, a low water alarm actuated when the water level falls below 110 percent of the minimum quantity specified in Section 2-1 should be provided.

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

A-2-3 See Figures A-2-3(a), (b), and (c).

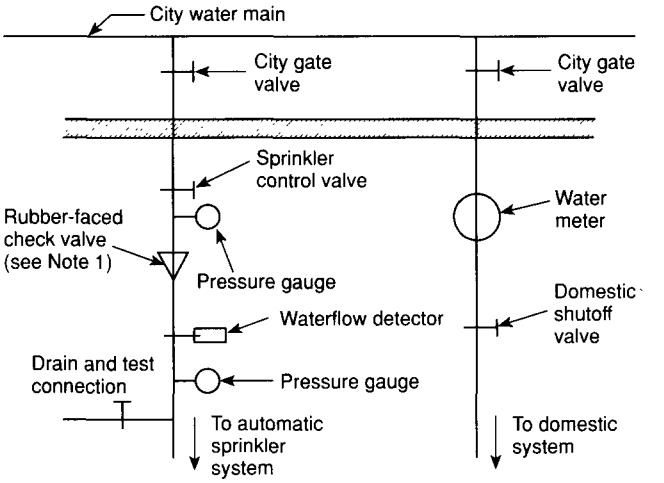
A-2-3(a) In dwellings where long-term use of lawn sprinklers is common, provision should be made for such usage.

A-3-1.4 These connections should be installed so that the valve may be opened fully and for a sufficient time period to assure a proper test without causing water damage. The test connection should be designed and sized to verify sufficiency of the water supply and alarm mechanisms.



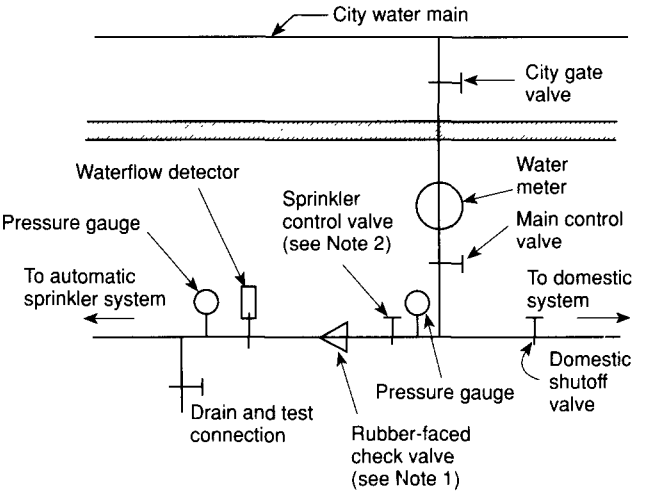
NOTE: Rubber-faced check valves optional.

Figure A-2-2(a) Preferable arrangement.



NOTE 1: Rubber-faced check valves optional.
NOTE 2: Option: Reference 3-1.1, Exception No. 1.

Figure A-2-2(b) Acceptable arrangement.



NOTE 1: Rubber-faced check valves optional.
NOTE 2: Option: Reference 3-1.1, Exception No. 1.

Figure A-2-2(c) Acceptable arrangement.

A-3-3.1 This standard anticipates the water supply for the system to be in compliance with the governing plumbing code for the jurisdiction. It is intended that any pipe material or diameter acceptable for one- or two-family dwellings in the plumbing code and that will satisfy the hydraulic criteria of NFPA 13D are considered to be acceptable.

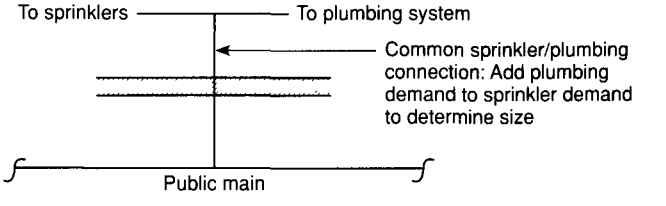


Figure A-2-3(a) Multipurpose pipe system with separate supply.

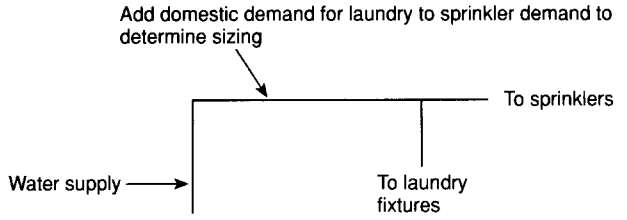


Figure A-2-3(b) Multipurpose pipe system calculation procedure.

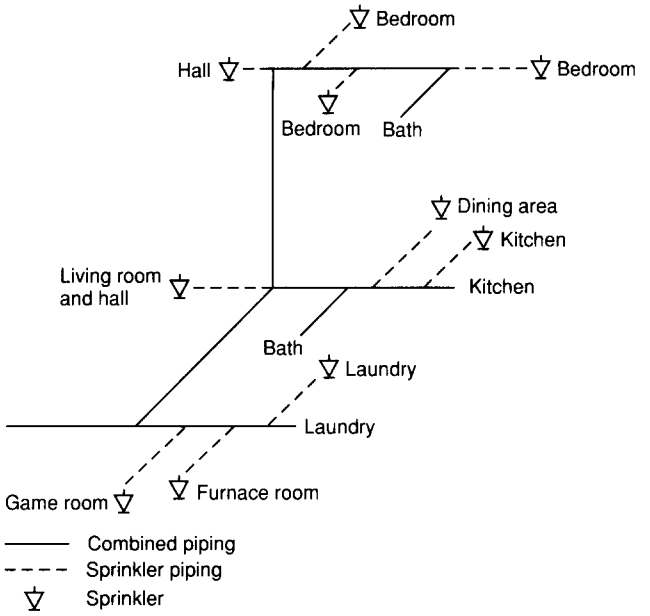


Figure A-2-3(c) Multipurpose pipe system arrangement.

A-3-3.2 Not all pipe or tube made to ASTM F442 and D3309 as described in 5-1.2.2 is listed for fire sprinkler service. Listed pipe is identified by the logo of the listing agency.

A-3-3.7 Not all fittings made to ASTM F437, F438, and F439 as described in 5-1.2.2 are listed for fire sprinkler service. Listed fittings are identified by the logo of the listing agency.

A-3-4.3 The reaction forces caused by the flow of water through the sprinkler could result in displacement of the sprinkler, thereby adversely affecting sprinkler discharge.

A-3-5.6.1 Decorative painting of a residential sprinkler is not to be confused with the temperature identification colors as referenced in 2-2.3 of NFPA 13, *Standard for the Installation of Sprinkler Systems*.

A-3-6 Alarms should be of sufficient intensity to be clearly audible in all bedrooms over background noise levels with all intervening doors closed. The tests of audibility level should be conducted with all household equipment that may be in operation at night in full operation. Examples of such equipment are window air conditioners and room humidifiers. Where off-premises alarms are provided, at least water flow and control valve position should be monitored.

An exterior alarm may 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. Figures A-2-2(a), (b), and (c) show examples of this arrangement.

A-4-1.2 Residential sprinklers are currently listed for use under flat, smooth, horizontal ceilings only. Sloped, beamed, and pitched ceilings may require special design approaches such as larger flow, design for 3 or more sprinklers to operate in the compartment, or both.

A-4-2.3 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 will be necessary to achieve proper response and distribution. In addition, for sloped ceilings, higher flow rates may be needed. Guidance may be obtained from the manufacturer.

A series of 33 full-scale tests were conducted in a test room of 12 ft × 24 ft (3.6 m × 7.2 m) floor area to determine the effect of cathedral (sloped) and/or beamed ceiling construction on fast-response residential sprinkler performance. The testing was limited to 1 pendent-type residential sprinkler model, 2 ceiling slopes (0 and 14 degrees), and 2 beam configurations on the single enclosure size. In order to judge the effectiveness of sprinklers in controlling fires, 2 baseline tests, in which the ceiling was smooth and

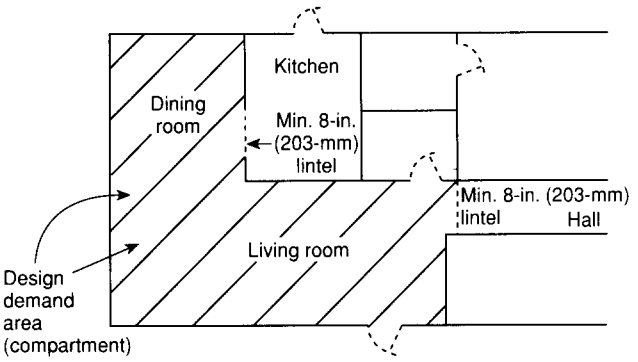


Figure A-4-1.2(a) Sprinkler design areas for typical residential occupancy.

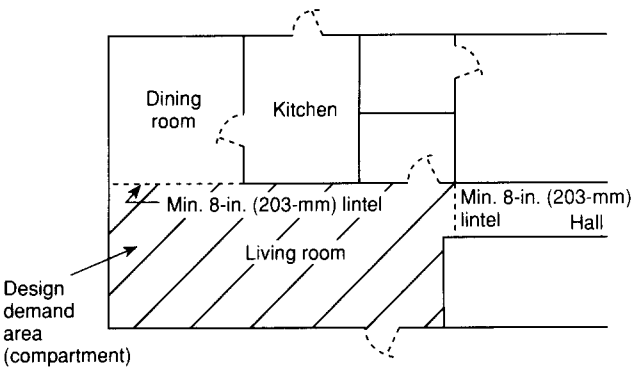


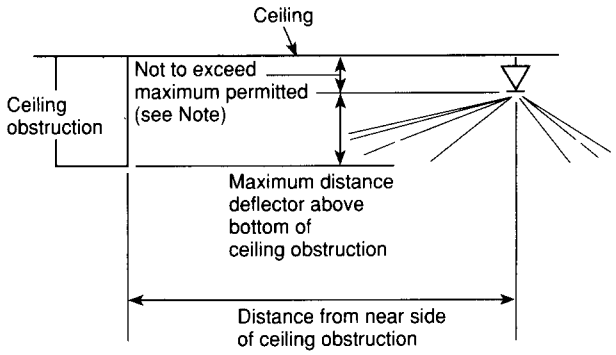
Figure A-4-1.2(b) Sprinkler design areas for typical residential occupancy.

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 and/or sloped and 2 pendent sprinklers were installed with the same water supply. Under the limited conditions tested, the comparison indicates that sloped and/or beamed ceilings 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 may be obtained if 1 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 3 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.[1]

Table A-4-2.3 Maximum Distance from Sprinkler Deflector to Bottom of Ceiling Obstruction

Distance from Sprinkler to Side of Ceiling Obstruction	Maximum Distance from Sprinkler Deflector to Bottom of Ceiling Obstruction
Less than 6 in.	Not permitted
6 in. to less than 1 ft	0 in.
1 ft to less than 2 ft	1 in.
2 ft to less than 2 ft 6 in.	2 in.
2 ft 6 in. to less than 3 ft	3 in.
3 ft to less than 3 ft 6 in.	4 in.
3 ft 6 in. to less than 4 ft	6 in.
4 ft to less than 4 ft 6 in.	7 in.
4 ft 6 in. to less than 5 ft	9 in.
5 ft to less than 5 ft 6 in.	11 in.
5 ft 6 in. to less than 6 ft	14 in.

For SI Units: 1 in. = 25.4 mm; 1 ft = 0.3048 m.



NOTE: See 4-2.1 and 4-2.2.

Figure A-4-2.3 Position of deflector, upright or pendent, when located above bottom of ceiling obstruction.

[1] Effects of Cathedral and Beamed Ceiling Construction on Residential Sprinkler Performance, FMRC J.I. M3N5.RA(3), by Bill Jr., R. G.; Kung, N-C; Brown, W. R.; and Hill, E., prepared for U.S. Fire Administration (Feb. 1988).

A-4-3.3.2 Antifreeze solutions may 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, it is advisable to use small dry valves where more than 40 gal (151 L) are to be supplied.

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

A-4-3.3.3.3 Beyond certain limits, increased proportion of antifreeze does not lower the freezing point of solution. (*See Figure A-4-3.3.3.3.*) Glycerine, diethylene glycol, ethylene glycol, and propylene glycol should never be used without mixing with water in proper proportions, because these materials tend to thicken near 32°F (0°C).

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

A-4-3.3.4 To avoid leakage, the materials and workmanship should be excellent, the threads clean and sharp, and the joints tight. Use only metal-faced valves.

A-4-3.3.5 Tests should be made by drawing a sample of the solution from valve B two or three times during the freezing season, especially if it has been necessary to drain the building sprinkler system for repairs, changes, etc. A small hydrometer should be used so that a small sample will be sufficient. When water appears at valve B or when the test sample indicates that the solution has become weakened, empty the entire system and recharge as previously described.

A-4-4.3 Determination of public water supply pressure should take into account probable minimum pressure conditions prevailing during such periods as at night, or during summer months when heavy usage may occur; also, the possibility of interruption by floods, or ice conditions in winter.

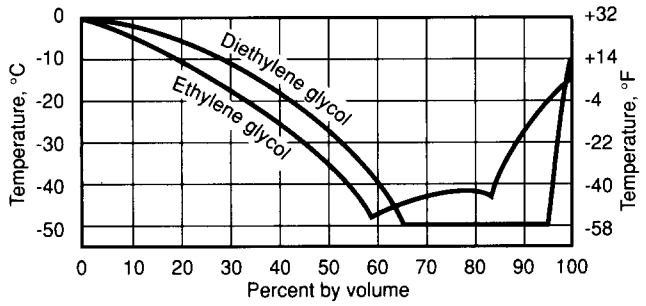


Figure A-4-3.3.3.3 Freezing points of water solutions of ethylene glycol and diethylene glycol.

		Individual Loss	Net Total
a.	Water Pressure in Street _____	_____	_____
b.	Arbitrarily Select Pipe Size _____		
c.	Deduct Meter Loss (_____ Size) _____	_____	_____
d.	Deduct Head Loss for Elevation System Control Valve* (_____ ft × 0.434)_____		
e.	Deduct Pressure Loss from City Main to Sprinkler _____	_____	_____
	___ Pipe – _____ ft		
	_____ Valves – _____ ft		
	_____ Elbows – _____ ft		
	_____ Tee – _____ ft		
	_____ Total – _____ ft × _____	_____	_____
f.	Deduct Pressure Loss for Piping— Control Valve to Farthest Sprinkler*		

Size	Quan.	Description	Total Equiv. (ft)	
	___	90° Elbow	___	
	___	45° Elbow	___	
	___	Tee	___	
	___	Check Valve	___	
	___	Valve (___)	___	
	___	Total		ft × ___ = ___ ___

Size	Quan.	Description	Total Equiv. (ft)	
	___	90° Elbow	___	
	___	45° Elbow	___	
	___	Tee	___	
	___	Check Valve	___	
	___	Valve (___)	___	
	___	Total		ft × ___ = ___ ___

Remaining Pressure for Sprinkler Operation _____

*Factors from Tables 4-4.3(a), (b), (c), (d), and (e).
For SI Units: 1 ft = 0.3048 m, 1 psi = 0.0689 bar.

Figure A-4-4.3(1) Calculation sheet.

	Individual Loss	Net Total
Water Pressure at Supply Outlet		
a. Deduct Head Loss for Elevation (_____ ft × 0.434)	_____	_____
b. Deduct Pressure Loss from Piping within Building*	_____	_____
Remaining Pressure for Sprinkler Operation	_____	_____

*Factors from Tables 4-4.3(a), (b), (c), (d), and (e).
For SI Units: 1 ft = 0.3048 m; 1 psi = 0.0689 bar.

Figure A-4-4.3(2) Calculation sheet — elevated tank, booster pump, pump tank supply.

A-5-1 The concept of this sprinkler system is the result of testing conducted by the United States Fire Administration. One of the goals of these tests was to determine if a smaller quantity of water could be used to protect smaller dwellings. The purpose of the system is to enhance life safety and make installation economically feasible for smaller dwellings.

Design items in this chapter assume that egress times from smaller dwellings are minimal since the units are single-story at grade level and occupants would be made aware of a fire in the unit almost immediately. This approach is considered in allowing the reduction of the water supply in some instances to 7 min.

A-5-3.1 The criteria used to list a sprinkler for this use should include but not be limited to:

(a) Temperature rating, 155°F - 165°F (68°C - 74°C)
(b) RTI: nominal 60 $(FT\text{-}S)^{1/2}$
(c) Droplet size
(d) Distribution patterns
(e) Areas of coverage
(f) Flow rates
(g) Operating pressures
(h) K Factor = nominal 2.0
(i) Ceiling slope.

All sprinklers within a compartment as defined in 5-4.5 should be within 10°F (5.5°C) in temperature rating.

A-5-3.2 These alarms should be located within the dwelling and should be of sufficient intensity to be clearly audible in all bedrooms over background noise levels with all intervening doors closed.

A-5-4.3 Sample areas of coverage for a sprinkler when listed for this design approach include the following:

Compartment Size (ft)	Number of Sprinklers
10 × 10 (3 m × 3 m)	1
10 × 12 (3 m × 3.6 m)	2
12 × 12 (3.6 m × 3.6 m)	4
16 × 16 (4.8 m × 4.8 m)	4
16 × 20 (4.8 m × 6 m)	6

A-5-5 Unlike Section 4-6, this chapter allows sprinklers to be omitted from only 3 areas. Foyers must be sprinklered since these areas are usually at the only entrance/exit for these smaller homes. Fires at this point could block the only available exit and could operate sprinklers in the adjoining spaces, thereby taxing the available water supply.

Bathrooms are required to be sprinklered since they are typically in the path of exit travel from bedrooms as well as from other living spaces. Fires originating in the bathroom and that would not be controlled if sprinklers were omitted would likely operate sprinklers in the adjoining compartments, resulting in the operation of more than the number of design sprinklers and depletion of the water supply.

Appendix B Referenced Publications

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

B-1 The following documents or portions thereof are referenced within this standard for informational purposes only and thus are not considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

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

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1994 edition.

NFPA 13R, *Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height*, 1994 edition.

NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*, 1993 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 1992 edition.

NFPA 72, *National Fire Alarm Code*, 1993 edition.

B-1.2 Other Publications.

B-1.2.1 ASTM Publications. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D3309-1992, *Standard Specification for Polybutylene (PB) Plastic Hot and Cold Water Distribution Systems.*

ASTM F437-1989, *Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 (SDR-PR).*

ASTM F438-1990, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.*

ASTM F439-1990, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.*

ASTM F442-1989, *Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).*

B-1.2.2 U.S. Fire Administration Publication. U.S. Fire Administration, 16825 S. Seton Ave., Emmitsburg, MD 21727.

Effects of Cathedral and Beamed Ceiling Construction on Residential Sprinkler Performance, FMRC J.I. M3N5.RA(3), by Bill Jr., R. G.; Kung, N-C; Brown, W. R.; and Hill, E., prepared for U.S. Fire Administration (Feb. 1988).

Index

-A-

Alarms ..... *see* Waterflow alarms
Antifreeze systems
Definition 4-3.3.1
General 4-3.3
Piping and valves 4-3.3.4, A-4-3.3.4
Solutions 4-3.3.3, 4-3.3.3.3, A-4-3.3.3.3
Testing 4-3.3.5, A-4-3.3.5
Use of 4-3.3.2, A-4-3.3.2
Approved (definition) 1-3
Authority having jurisdiction (definition) 1-3
Automatic sprinklers (definition) 1-3

-B-

Bedrooms ..... Fig. A-1-1(a), Fig. A-1-1(b)
Booster pump, pipe sizing ..... 4-4.4, Fig. A-4-4.3(2)
Brazing joints 3-3.6

-C-

Check valves (definition) 1-3
Chlorinated polyvinyl chloride (CPVC) piping
Antifreeze systems A-4-3.3.3.3
Fittings 3-3.7
Sizing 4-4.2
Use of 3-3.2
Control valves
Definition 1-3
Types A-1-3
Copper piping, sizing 4-4.2
CPVC piping ..... *see* Chlorinated polyvinyl chloride (CPVC) piping

-D-

Decorative painting ..... *see* Painting and ornamental finishes
Definitions 1-3
Diethylene glycol ..... A-4-3.3.3.3, Fig. A-4-3.3.3.3
Drains 3-1
Dry pipe systems
Definition 1-3
Installation 4-3.2
Dwelling unit (definition) 1-3
Dwellings
Definition 1-3
Limited area ..... Chap. 5

-E-

Elevated tank, pipe sizing ..... 4-4.4, Fig. A-4-4.3(2)
Ethylene glycol ..... A-4-3.3.3.3, Fig. A-4-3.3.3.3

-F-

Fires/death/injury statistics, in dwellings by area of origin, 1986-90 ..... Table A-1-2(b)
Fittings
Materials and dimensions ..... 3-3.5, Table 3-3.7
Types 3-3.7, A-3-3.7
Freezing points, water solutions of ethylene glycol and diethylene glycol ..... Fig. A-4-3.3.3.3

-G-

Gauges, pressure 3-2
Glycerine (C.P. or U.S.P) 4-3.3.3.1, A-4-3.3.3.1

-I-

International System of Units (SI) 1-6

-J-

Joints, brazing 3-3.6

-L-

Labeled (definition) 1-3
Levels of protection A-1-2
Limited area dwellings ..... Chap. 5
Alarms 5-3.2, A-5-3.2
Area of coverage 5-4.3, A-5-4.3
General 5-1, A-5-1
Sprinkler location 5-5
Sprinkler system design 5-4
Sprinklers 5-3.1, A-5-3.1
Water supply 5-2

Listed (definition) 1-3
Living rooms ..... Fig. A-1-1(c)

-M-

Maintenance, responsibility for 1-4, A-1-4
Manufactured homes
Bedroom ..... Fig. A-1-1(b)
Definition 1-3
Sprinkler systems 5-1
Water supply 2-4
Metric units of measurement 1-6
Minimum pipe size 4-4.2
Multipurpose piping systems ..... Fig. A-2-3(a) to Fig. A-2-3(c)
Definition 1-3
General 2-3

-P-

Painting and ornamental finishes 3-5.6, A-3-5.6.1
Pendent sprinklers, positioning 4-2.1
Piping .... *see also* Chlorinated polyvinyl chloride (CPVC) piping; Multipurpose piping systems; Polybutylene piping; Steel piping
Antifreeze systems 4-3.3.4, A-4-3.3.4
Configurations 4-5
Materials and dimensions ..... 3-3 to 3-3.7, Table 3-3.2, A-3-3.1, A-3-3.2
Sizing 4-4
Sizing, city water supply ..... 4-4.3 to 4-4.5, A-4-4.3
Support ..... 3-4 to 3-4.3, A-3-4.3
Polybutylene piping
Fittings 3-3.7
Sizing 4-4.2
Use of 3-3.2
Preengineered systems
Definition 1-3
Installation 1-5.3
Preferred/acceptable arrangements, water supply ..... Fig. A-2-2(a) to Fig. A-2-2(c)
Pressure gauges 3-2
Propylene glycol 4-3.3.3.1, A-4-3.3.2, A-4-3.3.3.3
Pump (definition) 1-3
Pump tank supply, pipe sizing ..... 4-4.4, Fig. A-4-4.3(2)
Purpose of the standard 1-2, A-1-2

-R-

Referenced publications ..... Chap. 6, B-1
Residential sprinklers
Definition 1-3
Positioning ..... Fig. A-4-1.2(a), Fig. A-4-1.2(b)
Use of A-4-1.2

-S-

Scope of the standard 1-1, A-1-1
Shall (definition) 1-3
Should (definition) 1-3
Sidewall sprinklers, positioning 4-2.2
Sprinkler coverage 4-1.4, 5-4.3, A-5-4.3
Sprinkler design areas ..... 4-1.2, A-4-1.2, Fig. A-4-1.2(a), Fig. A-4-1.2(b)
Sprinkler system components ..... Chap. 3
Fittings ..... 3-3.5, 3-3.7, Table 3-3.7, A-3-3.7
Limited area dwellings 5-3
Painting and ornamental finishes 3-5.6, A-3-5.6.1
Piping ..... 3-3 to 3-3.7, Table 3-3.2, A-3-3.1, A-3-3.2
Piping support ..... 3-4 to 3-4.3, A-3-4.3
Pressure gauges 3-2
Valves and drains 3-1
Waterflow alarms 3-6, A-3-6
Sprinkler system design ..... Chap. 4
Coverage 4-1.4, 5-4.3, A-5-4.3
Criteria ..... 4-1 to 4-1.2.1, A-4-1.2
Discharge 1-3, 4-1.1
Limited area dwellings 5-4
Location 4-6, 5-5, A-5-5
Pipe sizing 4-4
Pipe sizing, city water supply ..... 4-4.3 to 4-4.5, A-4-4.3
Piping configurations 4-5
Position of sprinklers ..... 4-2 to 4-2.4, A-4-2.3, Fig. A-4-2.3
Types ..... 4-3 to 4-3.3.5
Water demand 4-1.3
Sprinkler system installation
General 1-5
Limited area dwellings 5-5, A-5-5
Location of sprinklers 4-6
Replacements A-1-5.1
Sprinkler system pressure (definition) 1-3
Sprinkler systems .. *see also* Antifreeze systems; Dry pipe systems; Preengineered systems; Wet pipe systems
Definition 1-3
Devices, materials, design and installation ... 1-5, A-1-5.1, A-1-5.4
Pressure (definition) 1-3
Sprinklers ..... 3-5 to 3-5.7; *see also* Limited area dwellings; Residential sprinklers
Automatic (definition) 1-3
Location 4-6, 5-5, A-5-5
Positioning 4-2
Standard (definition) 1-3
Steel piping
Fittings 3-3.7
Sizing 4-4.2
Use of 3-3.2

-T-

Testing
Antifreeze systems 4-3.3.5, A-4-3.3.5
Sprinkler position A-4-2.3
System leakage 1-5.4, A-1-5.4

-U-

Units of measurement 1-6
Upright sprinklers, positioning 4-2.1

-V-

Valves
Antifreeze systems 4-3.3.4, A-4-3.3.4
Definition 1-3
Drains and 3-1
Types A-1-3

-W-

Water demand, determination 4-1.3, 5-4.1, 5-4.2
Water supply ..... Chap. 2
City, pipe sizing for ..... 4-4.3 to 4-4.5
General provisions 2-1
Limited area dwellings 5-2
Multipurpose piping system .... 2-3, Fig. A-2-3(a) to Fig. A-2-3(c)
Preferred/acceptable arrangements ..... Fig. A-2-2(a) to Fig. A-2-2(c)
Pressure calculation A-4-4.3
Pressure (definition) 1-3
Sources 2-2, A-2-2
Waterflow alarms
Definition 1-3
Design provisions 3-6, A-3-6
Limited area dwellings 5-3.2, A-5-3.2
Waterflow detector (definition) 1-3
Waterflow test connections, installation 3-1.4, A-3-1.4
Wet pipe systems
Definition 1-3
Installation 4-3.1