

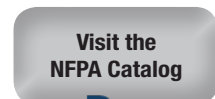
NFPA® 24

Standard for the Installation of Private Fire Service Mains and Their Appurtenances

2013 Edition



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NFPA® 24

Standard for the

Installation of Private Fire Service Mains and Their Appurtenances

2013 Edition

This edition of NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, was prepared by the Technical Committee on Private Water Supply Piping Systems and released by the Technical Correlating Committee Automatic Sprinkler Systems. It was issued by the Standards Council on May 29, 2012, with an effective date of June 18, 2012, and supersedes all previous editions.

This edition of NFPA 24 was approved as an American National Standard on June 18, 2012.

Origin and Development of NFPA 24

In 1903, the NFPA Committee on Hose and Hydrants first presented *Specifications for Mill Yard Hose Houses*, taken substantially from a standard published by the Eastern Factory Insurance Association. This text was revised and adopted in 1904. The NFPA Committee on Field Practice amended the Specifications in 1926, published as NFPA 25.

In 1925, the Committee on Field Practice prepared a *Standard on Outside Protection, Private Underground Piping Systems Supplying Water for Fire Extinguishment*, which was adopted by NFPA. It was largely taken from the 1920 edition of the NFPA *Automatic Sprinkler Standard*, Section M on Underground Pipes and Fittings. In September 1931, a revision was made, with the resulting standard designated as NFPA 24. In the 1981 edition the title was changed from *Standard for Outside Protection* to *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*.

In 1953, on recommendation of the Committee on Standpipes and Outside Protection, the two standards (NFPA 24 and NFPA 25) were completely revised and adopted as NFPA 24. Amendments were made leading to separate editions in 1955, 1959, 1962, 1963, 1965, 1966, 1968, 1969, 1970, 1973, 1977, 1981, 1983, and 1987.

The 1992 edition included amendments to further delineate the point at which the water supply stops and the fixed fire protection system begins. Minor changes were made concerning special topics such as thrust restraint and equipment provisions in valve pits.

The 1995 edition clarified requirements for aboveground and buried piping. Revisions were made to provide additional information regarding listing requirements, signage, valves, valve supervision, hydrant outlets, system attachments, piping materials, and thrust blocks. User friendliness of the document was also addressed.

The 2002 edition represented a complete revision of NFPA 24. Changes included reorganization and editorial modifications to comply with the *Manual of Style for NFPA Technical Committee Documents*. Additionally, all of the underground piping requirements were relocated into a new Chapter 10.

The 2007 edition was revised in five major areas: Chapter 10 was editorially updated and minor technical changes were made. In addition, newly established leakage test criteria, as well as updated requirements for thrust blocks and restrained joints were added to Chapter 10. Two annexes were new to this edition: Annex C, *Recommended Practice for Fire Flow Testing*, and Annex D, *Recommended Practice for Marking of Hydrants*. These two annexes were developed based on the 2002 edition of NFPA 291.

The 2010 edition was revised in three major areas: the provisions for location and identification of fire department connections, valves controlling water supply, and protection of fire service mains entering the building.

The 2013 edition of NFPA 24 includes clarifications on the requirements for running piping under buildings, including annex figures depicting clearances. The Contractors Material and Test Certificate for Underground Piping (*Figure 10.10.1*) was modified to include confirmation that the forward flow test of the backflow preventer has been conducted. A provision requiring the automatic drip valve to be located in an accessible location that permits inspections in accordance with NFPA 25 was also added.

Technical Correlating Committee on Automatic Sprinkler Systems

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

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, Telgian Corporation, AZ [U]
Rep. Trinity Health
John G. O'Neill, The Protection Engineering Group, PC,
VA [SE]
Garner A. Palenske, Aon/Schirmer Engineering
Corporation, CA [I]
J. William Sheppard, Sheppard & Associates, LLC, MI [SE]
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)

Scott T. Martorano, The Viking Corporation, MI [M]
(Alt. to S. T. Franson)
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, Global Risk Consultants Corporation,
IL [SE]
Rep. TC on Hanging and 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 Technical 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

Chester W. Schirmer, Aon/Schirmer Engineering
Corporation, NC [I]
(Member Emeritus)
Kenneth W. Wagoner, Parsley Consulting Engineers,
CA [SE]
Rep. TC on Private Water Supply Piping Systems
John J. Walsh, UA Joint Apprenticeship Committee,
MD [SE]
Rep. United Association of Journeymen and
Apprentices of the Plumbing and Pipe Fitting Industry
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Matthew J. Klaus, NFPA Staff Liaison

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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 Private Water Supply Piping Systems

Kenneth W. Wagoner, *Chair*
Parsley Consulting Engineers, CA [SE]

Richard W. Bonds, Ductile Iron Pipe Research Association, AL [M]
Phillip A. Brown, American Fire Sprinkler Association, Inc., TX [IM]
James A. Charrette, Allan Automatic Sprinkler Corporation of Southern California, CA [IM]
 Rep. National Fire Sprinkler Association
Flora F. Chen, City of Hayward, CA [E]
Stephen A. Clark, Jr., Allianz Risk Consultants, LLC, GA [I]
Jeffrey T. Dudley, National Aeronautics and Space Administration, FL [U]
Byron E. Ellis, Entergy Corporation, LA [U]
 Rep. Edison Electric Institute
Brandon W. Frakes, XL Global Asset Protection Services, NC [I]
David B. Fuller, FM Global, MA [I]
Robert M. Gagnon, Gagnon Engineering, MD [SE]
Tanya M. Glumac, Liberty Mutual Property, MA [I]
William J. Gotto, Global Risk Consultants Corporation, NJ [SE]
LaMar Hayward, 3-D Fire Protection, Inc., ID [IM]

Alan R. Laguna, Merit Sprinkler Company, Inc., LA [IM]
John Lake, City of Gainesville, FL [E]
Michael T. Larabel, Amway Inc., MI [U]
George E. Laverick, Underwriters Laboratories Inc., IL [RT]
James M. Maddry, James M. Maddry, P.E., GA [SE]
Kevin D. Maughan, Tyco Fire Protection Products, RI [M]
Bob D. Morgan, Fort Worth Fire Department, TX [E]
David S. Mowrer, Babcock & Wilcox Technical Services, LLC, TN [U]
Dale H. O'Dell, National Automatic Sprinkler Fitters LU 669, CA [L]
 Rep. United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry
Adam P. Olomon, Aon/RRS/Schirmer Engineering, TX [I]
Sam P. Salwan, Environmental Systems Design, Inc., IL [SE]
James R. Schifiliti, Fire Safety Consultants, Inc., IL [IM]
 Rep. Illinois Fire Prevention Association
Peter T. Schwab, Wayne Automatic Fire Sprinklers, Inc., FL [IM]
J. William Sheppard, Sheppard & Associates, LLC, MI [SE]
Scott M. Twele, The RJA Group, Inc., CA [SE]
Karl Wiegand, National Fire Sprinkler Association, NY [M]

Alternates

James B. Biggins, Global Risk Consultants Corporation, IL [SE]
 (Alt. to W. J. Gotto)
Mark A. Bowman, XL Global Asset Protection Services, OH [I]
 (Alt. to B. W. Frakes)
Joshua Davis, The RJA Group, Inc., GA [SE]
 (Alt. to S. M. Twele)
Steve L. Escue, TK Engineering Company, TN [M]
 (Alt. to K. Wiegand)
Cliff Hartford, Tyco Fire & Building Products, NY [M]
 (Alt. to K. D. Maughan)
Andrew C. Higgins, Allianz Risk Consultants, LLC, GA [I]
 (Alt. to S. A. Clark, Jr.)
Luke Hilton, Liberty Mutual Property, NC [I]
 (Alt. to T. M. Glumac)

Charles W. Ketner, National Automatic Sprinkler Fitters LU 669, MD [L]
 (Alt. to D. H. O'Dell)
Michael G. McCormick, Underwriters Laboratories Inc., IL [RT]
 (Alt. to G. E. Laverick)
Martin Ramos, Environmental Systems Design, Inc., IL [SE]
 (Alt. to S. P. Salwan)
Jeffrey J. Rovegno, Mr. Sprinkler Fire Protection, CA [IM]
 (Alt. to P. A. Brown)
Austin L. Smith, Babcock & Wilcox Y-12, LLC, TN [U]
 (Alt. to D. S. Mowrer)
Ronald N. Webb, S.A. Comunale Company, Inc., OH [IM]
 (Alt. to J. A. Charrette)

Matthew J. Klaus, NFPA Staff Liaison

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

Committee Scope: This Committee shall have the primary responsibility for documents on private piping systems supplying water for fire protection and for hydrants, hose houses, and valves. The Committee is also responsible for documents on fire flow testing and marking of hydrants.

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

Chapter 1 Administration

1.1 Scope.

1.1.1 This standard shall cover the minimum requirements for the installation of private fire service mains and their appurtenances supplying the following:

- (1) Automatic sprinkler systems
- (2) Open sprinkler systems
- (3) Water spray fixed systems
- (4) Foam systems
- (5) Private hydrants
- (6) Monitor nozzles or standpipe systems with reference to water supplies
- (7) Hose houses

1.1.2 This standard shall apply to combined service mains used to carry water for fire service and other uses.

1.1.3 This standard shall not apply to the following situations:

- (1) Mains under the control of a water utility
- (2) Mains providing fire protection and/or domestic water that are privately owned but are operated as a water utility

1.1.4 This standard shall not apply to underground mains serving sprinkler systems designed and installed in accordance with NFPA 13R that are under 4 in. (102 mm) in size.

1.1.5 This standard shall not apply to underground mains serving sprinkler systems designed and installed in accordance with NFPA 13D.

1.2 Purpose. The purpose of this standard shall be to provide a reasonable degree of protection for life and property from fire through installation requirements for private fire service main systems based on sound engineering principles, test data, and field experience.

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). Liter and bar units are not part of, but are recognized by, SI and are commonly used in international fire protection. These units are shown in Table 1.5.1 with conversion factors.

Table 1.5.1 Conversion Table for SI Units

Name of Unit	Unit Symbol	Conversion Factor
Liter	L	1 gal = 3.785 L
Liter per minute per square meter	(L/min)/m ²	1 gpm/ft ² = (40.746 L/min)/m ²
Cubic decimeter	dm ³	1 gal = 3.785 dm ³
Pascal	Pa	1 psi = 6894.757 Pa
Bar	bar	1 psi = 0.0689 bar
Bar	bar	1 bar = 10 ⁵ Pa

Note: For additional conversions and information, see IEEE/ASTM-SI-10.

1.5.2 If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated is to be regarded as the requirement. A given equivalent value might be approximate.

1.5.3 SI units have been converted by multiplying the quantity by the conversion factor and then rounding the result to the appropriate number of significant digits.

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*, 2013 edition.

NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, 2013 edition.

NFPA 13R, *Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies*, 2013 edition.

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

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 2008 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2011 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2011 edition.

NFPA 1961, *Standard on Fire Hose*, 2013 edition.

NFPA 1963, *Standard for Fire Hose Connections*, 2009 edition.

2.3 Other Publications.

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

ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*, 2001.

ASME B16.1, *Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, and 250*, 2005.

ASME B16.3, *Malleable Iron Threaded Fittings, Classes 150 and 300*, 2006.

ASME B16.4, *Gray Iron Threaded Fittings, Classes 125 and 250*, 2006.

ASME B16.5, *Pipe Flanges and Flanged Fittings NPS ½ through 24*, 2003.

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

ASME B16.11, *Forged Steel Fittings, Socket Welded and Threaded*, 2005.

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

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

ASME B16.25, *Butt Welding Ends*, 2007.

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

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

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

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

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

ASTM F 437, *Chlorinated Polyvinyl Chloride (CPVC) Specification for Schedule 80 CPVC Threaded Fittings*, 2006.

ASTM F 438, *Specification for Schedule 40 CPVC Socket-Type Fittings*, 2004.

ASTM F 439, *Specification for Schedule 80 CPVC Socket-Type Fittings*, 2006.

IEEE/ASTM-SI-10, *Standard for Use of the International System of Units (SI): The Modern Metric System*, 2002.

2.3.3 AWWA Publications. American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235.

AWWA C104, *Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water*, 2008.

AWWA C105, *Polyethylene Encasement for Ductile Iron Pipe Systems*, 2005.

AWWA C110, *Ductile Iron and Gray Iron Fittings*, 2008.

AWWA C111, *Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings*, 2000.

AWWA C115, *Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges*, 2005.

AWWA C116, *Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service*, 2003.

AWWA C150, *Thickness Design of Ductile Iron Pipe*, 2008.

AWWA C151, *Ductile Iron Pipe, Centrifugally Cast for Water*, 2002.

AWWA C153, *Ductile-Iron Compact Fittings for Water Service*, 2006.

AWWA C200, *Steel Water Pipe 6 in. and Larger*, 2005.

AWWA C203, *Coal-Tar Protective Coatings and Linings for Steel Water Pipelines Enamel and Tape — Hot Applied*, 2002.

AWWA C205, *Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4 in. and Larger — Shop Applied*, 2007.

AWWA C206, *Field Welding of Steel Water Pipe*, 2003.

AWWA C207, *Steel Pipe Flanges for Waterworks Service — Sizes 4 in. Through 144 in.*, 2007.

AWWA C208, *Dimensions for Fabricated Steel Water Pipe Fittings*, 2007.

AWWA C300, *Reinforced Concrete Pressure Pipe, Steel-Cylinder Type*, 2004.

AWWA C301, *Prestressed Concrete Pressure Pipe, Steel-Cylinder Type*, 2007.

AWWA C302, *Reinforced Concrete Pressure Pipe, Non-Cylinder Type*, 2004.

AWWA C303, *Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, Pretensioned*, 2002.

AWWA C400, *Standard for Asbestos-Cement Distribution Pipe, 4 in. Through 16 in. (100 mm through 400 mm), for Water Distribution Systems*, 2003.



AWWA C401, *Standard for the Selection of Asbestos-Cement Pressure Pipe 4 in. through 16 in. (100 mm through 400 mm)*, 2003.

AWWA C600, *Standard for the Installation of Ductile Iron Water Mains and Their Appurtenances*, 2005.

AWWA C602, *Cement-Mortar Lining of Water Pipe Lines 4 in. and Larger — in Place*, 2006.

AWWA C603, *Standard for the Installation of Asbestos-Cement Pressure Pipe*, 2005.

AWWA C900, *Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution*, 2007.

AWWA C905, *AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. Through 48 in. (350 mm Through 1,200 mm)*, 2010.

AWWA C906, *Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) Through 63 in. (1575 mm) for Water Distribution*, 2007.

AWWA M11, *A Guide for Steel Pipe Design and Installation*, 4th edition, 2004.

2.3.4 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2013 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 stan-

dards 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 are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the *Manual of Style for NFPA Technical Committee Documents*.

3.3 General Definitions.

3.3.1 Appurtenance. An accessory or attachment that enables the private fire service main to perform its intended function.

3.3.2 Corrosion-Resistant Piping. Piping that has the property of being able to withstand deterioration of its surface or its properties when exposed to its environment.

3.3.3 Corrosion-Retardant Material. A lining or coating material that when applied to piping or appurtenances has the property of reducing or slowing the deterioration of the object's surface or properties when exposed to its environment.

3.3.4 Fire Department Connection. A connection through which the fire department can pump supplemental water into the sprinkler system, standpipe, or other system, furnishing water for fire extinguishment to supplement existing water supplies.

3.3.5 Fire Pump. A pump that is a provider of liquid flow and pressure dedicated to fire protection. [20, 2010]

3.3.6 Hose House. An enclosure located over or adjacent to a hydrant or other water supply designed to contain the necessary hose nozzles, hose wrenches, gaskets, and spanners to be used in fire fighting in conjunction with and to provide aid to the local fire department.

3.3.7 Hydrant Butt. The hose connection outlet of a hydrant.

3.3.8 Hydraulically Calculated Water Demand Flow Rate. The waterflow rate for a system or hose stream that has been calculated using accepted engineering practices.

3.3.9 Pressure.

3.3.9.1 Residual Pressure. The pressure that exists in the distribution system, measured at the residual hydrant at the time the flow readings are taken at the flow hydrants.

3.3.9.2 Static Pressure. The pressure that exists at a given point under normal distribution system conditions measured at the residual hydrant with no hydrants flowing.

3.3.10* Pressure-Regulating Device. A device designed for the purpose of reducing, regulating, controlling, or restricting water pressure.

3.3.11* Private Fire Service Main. Private fire service main, as used in this standard, is that pipe and its appurtenances on private property (1) between a source of water and the base of the system riser for water-based fire protection systems, (2) between a source of water and inlets to foam-making systems, (3) between a source of water and the base elbow

of private hydrants or monitor nozzles, and (4) used as fire pump suction and discharge piping, (5) beginning at the inlet side of the check valve on a gravity or pressure tank.

3.3.12 Pumper Outlet. The hydrant outlet intended for use by fire departments for taking supply from the hydrant for pumps.

3.3.13 Rated Capacity. The flow available from a hydrant at the designated residual pressure (rated pressure) either measured or calculated.

3.3.14 Test.

3.3.14.1 Flow Test. A test performed by the flow and measurement of water from one hydrant and the static and residual pressures from an adjacent hydrant for the purpose of determining the available water supply at that location.

3.3.14.2 Flushing Test. A test of a piping system using high velocity flows to remove debris from the piping system prior to it being placed in service.

3.3.14.3 Hydrostatic Test. A test of a closed piping system and its attached appurtenances consisting of subjecting the piping to an increased internal pressure for a specified period of duration to verify system integrity and leak rates.

3.3.15 Valve.

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

3.3.15.2 Indicating Valve. A valve that has components that show if the valve is open or closed. Examples are outside screw and yoke (OS&Y) gate valves and underground gate valves with indicator posts.

3.4 Hydrant Definitions.

3.4.1 Hydrant. An exterior valved connection to a water supply system that provides hose connections.

3.4.1.1* Dry Barrel Hydrant. This is the most common type of hydrant; it has a control valve below the frost line between the footpiece and the barrel.

3.4.1.2 Flow Hydrant. The hydrant that is used for the flow and flow measurement of water during a flow test.

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

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

3.4.1.5 Residual Hydrant. The hydrant that is used for measuring static and residual pressures during a flow test.

3.4.1.6 Wet Barrel Hydrant. A type of hydrant that sometimes is used where there is no danger of freezing weather. Each outlet on a wet barrel hydrant is provided with a valved outlet threaded for fire hose.

Chapter 4 General Requirements

4.1* Plans.

4.1.1 Working plans shall be submitted for approval to the authority having jurisdiction before any equipment is installed or remodeled.

4.1.2 Deviation from approved plans shall require permission of the authority having jurisdiction.

4.1.3 Working plans shall be drawn to an indicated scale on sheets of uniform size, with a plan of each floor as applicable, and shall include the following items that pertain to the design of the system:

- (1) Name of owner
- (2) Location, including street address
- (3) Point of compass
- (4) A graphic representation of the scale used on all plans
- (5) Name and address of contractor
- (6) Size and location of all water supplies
- (7) Size and location of standpipe risers, hose outlets, hand hose, monitor nozzles, and related equipment
- (8) The following items that pertain to private fire service mains:
 - (a) Size
 - (b) Length
 - (c) Location
 - (d) Weight
 - (e) Material
 - (f) Point of connection to city main
 - (g) Sizes, types, and locations of valves, valve indicators, regulators, meters, and valve pits
 - (h) Depth at which the top of the pipe is laid below grade
 - (i) Method of restraint
- (9) The following items that pertain to hydrants:
 - (a) Size and location, including size and number of outlets and whether outlets are to be equipped with independent gate valves
 - (b) Thread size and coupling adapter specifications if different from NFPA 1963
 - (c) Whether hose houses and equipment are to be provided, and by whom
 - (d) Static and residual hydrants used in flow
 - (e) Method of restraint
- (10) Size, location, and piping arrangement of fire department connections

4.1.4 The working plan submittal shall include the manufacturer's installation instructions for any specially listed equipment, including descriptions, applications, and limitations for any devices, piping, or fittings.

4.2 Installation Work.

4.2.1 Installation work shall be performed by fully experienced and responsible persons.

4.2.2 The authority having jurisdiction shall always be consulted before the installation or remodeling of private fire service mains.

Chapter 5 Water Supplies

5.1* Connection to Waterworks Systems.

5.1.1 A connection to a reliable waterworks system shall be an acceptable water supply source.

5.1.2* The volume and pressure of a public water supply shall be determined from waterflow test data or other approved method.



5.2 Size of Fire Mains.

5.2.1 Private Fire Service Mains. Pipe smaller than 6 in. (152 mm) in diameter shall not be installed as a private service main supplying hydrants.

5.2.2 Mains Not Supplying Hydrants. For mains that do not supply hydrants, sizes smaller than 6 in. (152 mm) shall be permitted to be used subject to the following restrictions:

- (1) The main shall supply only the following types of systems:
 - (a) Automatic sprinkler systems
 - (b) Open sprinkler systems
 - (c) Water spray fixed systems
 - (d) Foam systems
 - (e) Standpipe systems
- (2) Hydraulic calculations shall show that the main is able to supply the total demand at the appropriate pressure.
- (3) Systems that are not hydraulically calculated shall have a main at least as large as the riser.

5.3 Pressure-Regulating Devices and Meters.

5.3.1 No pressure-regulating valve shall be used in the water supply, except by special permission of the authority having jurisdiction.

5.3.2 Where meters are required by other authorities, they shall be listed.

5.4* Connection from Waterworks Systems.

5.4.1 The requirements of the public health authority having jurisdiction shall be determined and followed.

5.4.2 Where equipment is installed to guard against possible contamination of the public water system, such equipment and devices shall be listed for fire protection service.

5.5 Connections to Public Water Systems. Connections to public water systems shall be arranged to be isolated by one of the methods permitted in 6.2.11.

5.6* Pumps. A single, automatically controlled fire pump installed in accordance with NFPA 20 shall be an acceptable water supply source.

5.7 Tanks. Tanks shall be installed in accordance with NFPA 22.

5.8 Penstocks, Flumes, Rivers, Lakes, or Reservoirs. Water supply connections from penstocks, flumes, rivers, lakes, or reservoirs shall be arranged to avoid mud and sediment and shall be provided with approved, double, removable screens or approved strainers installed in an approved manner.

5.9* Fire Department Connections.

5.9.1 General. Where the authority having jurisdiction requires a remote fire department connection, for systems requiring one by another standard, a fire department connection shall be provided as described in Section 5.9.

5.9.1.1 Fire department connections shall not be required where approved by the authority having jurisdiction.

5.9.1.2 Fire department connections shall be supported.

5.9.1.3 Fire department connections shall be of an approved type.

5.9.1.4 Fire department connections shall be equipped with listed plugs or caps that are secured and arranged for easy removal by fire departments.

5.9.1.5 Fire department connections shall be protected where subject to mechanical damage.

5.9.2 Couplings.

5.9.2.1 The fire department connection(s) shall use an NH internal threaded swivel fitting(s) with an NH standard thread(s).

5.9.2.2 At least one of the connections shall be the 2.5 to 7.5 NH standard thread specified in NFPA 1963.

5.9.2.3 Where local fire department connections do not conform to NFPA 1963, the authority having jurisdiction shall designate the connection to be used.

5.9.2.4 The use of threadless couplings shall be permitted where required by the authority having jurisdiction and where listed for such use.

5.9.3 Valves.

5.9.3.1 A listed check valve shall be installed in each fire department connection.

5.9.3.2 No shutoff valve shall be permitted in the piping from the fire department connection piping to the point that the fire department connection piping connects to the system piping.

5.9.4 Drainage.

5.9.4.1 The pipe between the check valve and the outside hose coupling shall be equipped with an approved automatic drip.

5.9.4.2 The automatic drip shall be installed in a location that permits inspection and testing as required by NFPA 25 and reduces the likelihood of freezing.

5.9.4.3 An automatic drip shall not be required in areas not subject to freezing.

5.9.5 Location and Signage.

5.9.5.1* Fire department connections shall be located at the nearest point of fire department apparatus accessibility or at a location approved by the authority having jurisdiction.

5.9.5.2* Fire department connections shall be located and arranged so that hose lines can be attached to the inlets without interference.

5.9.5.3* Each fire department connection shall be designated by a sign as follows:

- (1) The sign shall have raised or engraved letters at least 1 in. (25.4 mm) in height on a plate or fitting.
- (2)*The sign shall indicate the type of system for which the connection is intended.

5.9.5.4 Where the system demand pressure exceeds 150 psi (10.3 bar), the sign required by 5.9.5.3 shall indicate the required design pressure.

5.9.5.5 Where a fire department connection only supplies a portion(s) of the building, a sign shall be attached to indicate the portion(s) of the building supplied.

Chapter 6 Valves

6.1 Types of Valves.

6.1.1 All valves controlling connections to water supplies and to supply pipes to sprinklers shall be listed indicating valves.

6.1.2 Indicating valves shall not close in less than 5 seconds when operated at maximum possible speed from the fully open position.

6.1.3 A listed underground gate valve equipped with a listed indicator post shall be permitted.

6.1.4 A listed water control valve assembly with a reliable position indication connected to a remote supervisory station shall be permitted.

6.1.5* A nonindicating valve, such as an underground gate valve with approved roadway box, complete with T-wrench, and accepted by the authority having jurisdiction, shall be permitted.

6.2 Valves Controlling Water Supplies.

6.2.1 At least one valve shall be installed in each source of water supply.

6.2.2 No shutoff valve shall be permitted in the piping from the fire department connection to the point that the fire department connection piping connects to the system piping.

6.2.3 Where more than one source of water supply exists, a check valve shall be installed in each connection.

6.2.4 Where break tanks are used with automatic fire pumps, a check valve shall not be required in the break tank connection.

6.2.5* In a connection serving as one source of supply, listed indicating valves or post indicator valves shall be installed on both sides of all check valves required in 6.2.3.

6.2.6 In the discharge pipe from a pressure tank or a gravity tank of less than 15,000 gal (56.78 m³) capacity, a control valve shall not be required to be installed on the tank side of the check valve.

6.2.7* The following requirements shall apply where a gravity tank is located on a tower in the yard:

- (1) The control valve on the tank side of the check valve shall be an outside screw and yoke or a listed indicating valve.
- (2) The other control valve shall be either an outside screw and yoke, a listed indicating valve, or a listed valve having a post-type indicator.

6.2.8* The following requirements shall apply where a gravity tank is located on a building:

- (1) Both control valves shall be outside screw and yoke or listed indicating valves.
- (2) All fittings inside the building, except the drain tee and heater connections, shall be under the control of a listed valve.

6.2.9 One of the following requirements shall be met where a pump is located in a combustible pump house or exposed to danger from fire or falling walls, or where a tank discharges into a private fire service main fed by another supply:

- (1)*The check valve in the connection shall be located in a pit.
- (2) The control valve shall be of the post indicator type and located a safe distance outside buildings.

6.2.10* All control valves shall be located where accessible and free of obstructions.

6.2.11 All connections to private fire service mains for fire protection systems shall be arranged in accordance with one of the following so that they can be isolated:

- (1)*A post indicator valve installed not less than 40 ft (12 m) from the building
 - (a) For buildings less than 40 ft (12 m) in height, a post indicator valve shall be permitted to be installed closer than 40 ft (12 m) but at least as far from the building as the height of the wall facing the post indicator valve.
- (2) A wall post indicator valve
- (3) An indicating valve in a pit, installed in accordance with Section 6.4
- (4)*A backflow preventer with at least one indicating valve not less than 40 ft (12 m) from the building
 - (a) For buildings less than 40 ft (12 m) in height, a backflow preventer with at least one indicating valve shall be permitted to be installed closer than 40 ft (12 m) but at least as far from the building as the height of the wall facing the backflow preventer.
- (5)*A nonindicating valve, such as an underground gate valve with an approved roadway box, complete with T-wrench, located not less than 40 ft (12 m) from the building
 - (a) For buildings less than 40 ft (12 m) in height, a nonindicating valve, such as an underground gate valve with an approved roadway box, complete with T-wrench, shall be permitted to be installed closer than 40 ft (12 m) but at least as far from the building as the height of the wall facing the backflow preventer.
- (6) Control valves installed in a fire-rated room accessible from the exterior
- (7) Control valves in a fire-rated stair enclosure accessible from the exterior as permitted by the authority having jurisdiction

6.3 Post Indicator Valves.

6.3.1 Where post indicator valves are used, they shall be set so that the top of the post is 32 in. to 40 in. (0.8 m to 1.0 m) above the final grade.

6.3.2 Where post indicator valves are used, they shall be protected against mechanical damage where needed.

6.4 Valves in Pits.

6.4.1 Valve pits located at or near the base of the riser of an elevated tank shall be designed in accordance with Chapter 14 of NFPA 22.

6.4.2 Where used, valve pits shall be of adequate size and accessible for inspection, operation, testing, maintenance, and removal of equipment contained therein.

6.4.3 Valve pits shall be constructed and arranged to properly protect the installed equipment from movement of earth, freezing, and accumulation of water.

6.4.3.1 Depending on soil conditions and the size of the pit, valve pits shall be permitted to be constructed of any of the following materials:

- (1) Poured-in-place or precast concrete, with or without reinforcement
- (2) Brick
- (3) Other approved materials



6.4.3.2 Where the water table is low and the soil is porous, crushed stone or gravel shall be permitted to be used for the floor of the pit.

6.4.4 The location of the valve shall be marked, and the cover of the pit shall be kept free of obstructions.

6.5 Backflow Prevention Assemblies.

6.5.1 Where used in accordance with 6.2.11(4), backflow prevention assemblies shall be installed in accordance with their installation instructions.

6.5.2 Where backflow prevention assemblies are used, they shall be protected against mechanical damage where needed.

6.6 Sectional Valves.

6.6.1* Sectional valves shall be provided at appropriate points within piping sections such that the number of fire protection connections between sectional valves does not exceed six.

6.6.2 A sectional valve shall be provided at the following locations:

- (1) On each bank where a main crosses water
- (2) Outside the building foundation(s) where a main or a section of a main runs under a building

6.7 Identifying and Securing Valves.

6.7.1 Identification signs shall be provided at each valve to indicate its function and what it controls.

6.7.1.1 Identification signs in 6.7.1 shall not be required for underground gate valves with roadway boxes.

6.7.2* Control valves shall be supervised by one of the following methods:

- (1) Central station, proprietary, or remote station signaling service
- (2) Local signaling service that causes the sounding of an audible signal at a constantly attended location
- (3) An approved procedure to ensure that valves are locked in the correct position
- (4) An approved procedure to ensure that valves are located within fenced enclosures under the control of the owner, sealed in the open position, and inspected weekly

6.7.3 Supervision of underground gate valves with roadway boxes shall not be required.

6.8 Check Valves. Check valves shall be installed in a vertical or horizontal position in accordance with their listing.

7.1.1.2* The number, size, and arrangement of outlets; the size of the main valve opening; and the size of the barrel shall be suitable for the protection to be provided and shall be approved by the authority having jurisdiction.

7.1.1.3 Independent gate valves on 2½ in. (64 mm) outlets shall be permitted.

7.1.2 Hydrant outlet threads shall have NHS external threads for the size outlet(s) supplied as specified in NFPA 1963.

7.1.3 Where local fire department connections do not conform to NFPA 1963, the authority having jurisdiction shall designate the connection to be used.

7.2 Number and Location.

7.2.1* Hydrants shall be provided and spaced in accordance with the requirements of the authority having jurisdiction.

7.2.2 Public hydrants shall be permitted to be recognized as meeting all or part of the requirements of Section 7.2.

7.2.3* Hydrants shall be located not less than 40 ft (12 m) from the buildings to be protected.

7.2.4 Where hydrants cannot be located in accordance with 7.2.3, locations closer than 40 ft (12.2 m) from the building or wall hydrants shall be permitted to be used where approved by the authority having jurisdiction.

7.2.5 Hydrants shall not be installed at less than the equivalent depth of burial from retaining walls where there is danger of frost through the walls.

7.3 Installation.

7.3.1* Hydrants shall be set on flat stones or concrete slabs and shall be provided with small stones (or the equivalent) placed about the drain to ensure drainage.

7.3.2 Where soil is of such a nature that the hydrants will not drain properly with the arrangement specified in 7.3.1, or where groundwater stands at levels above that of the drain, the hydrant drain shall be plugged at the time of installation.

7.3.2.1 If the drain is plugged, hydrants in service in cold climates shall be pumped out after usage.

7.3.2.2 Such hydrants shall be marked to indicate the need for pumping out after usage.

7.3.3* The center of a hose outlet shall be not less than 18 in. (457 mm) above final grade or, where located in a hose house, 12 in. (305 mm) above the floor.

7.3.4 Hydrants shall be fastened to piping and anchored in accordance with the requirements of Chapter 10.

7.3.5 Hydrants shall be protected if subject to mechanical damage.

7.3.6 The means of hydrant protection shall be arranged in a manner that does not interfere with the connection to, or operation of, hydrants.

7.3.7 The following shall not be installed in the service stub between a fire hydrant and private water supply piping:

- (1) Check valves
- (2) Detector check valves
- (3) Backflow prevention valves
- (4) Other similar appurtenances

Chapter 7 Hydrants

7.1* General.

7.1.1 Hydrants shall be of an approved type and have not less than a 6 in. (152 mm) diameter connection with the mains.

7.1.1.1 A valve shall be installed in the hydrant connection.

7.1.1.1.1 Valves in the hydrant connection shall be installed within 20 ft (6.1 m) of the hydrant.

7.1.1.1.2 Where valves cannot be located in accordance with 7.1.1.1.1, valve locations shall be permitted where approved by the authority having jurisdiction.

Chapter 8 Hose Houses and Equipment

8.1 General.

8.1.1* A supply of hose and equipment shall be provided where hydrants are intended for use by plant personnel or a fire brigade.

8.1.1.1 The quantity and type of hose and equipment shall depend on the following:

- (1) Number and location of hydrants relative to the protected property
- (2) Extent of the hazard
- (3) Fire-fighting capabilities of potential users

8.1.1.2 The authority having jurisdiction shall be consulted regarding quantity and type of hose.

8.1.2 Hose shall be stored so it is accessible and is protected from the weather by storing in hose houses or by placing hose reels or hose carriers in weatherproof enclosures.

8.1.3* Hose shall conform to NFPA 1961.

8.1.4 Hose Connections.

8.1.4.1 Hose connections shall have external national hose standard (NHS) threads, for the valve size specified, in accordance with NFPA 1963.

8.1.4.2 Hose connections shall be equipped with caps to protect the hose threads.

8.1.4.3 Where local fire department hose threads do not conform to NFPA 1963, the authority having jurisdiction shall designate the hose threads to be used.

8.2 Location.

8.2.1 Where hose houses are utilized, they shall be located over, or immediately adjacent to, the hydrant.

8.2.2 Hydrants within hose houses shall be as close to the front of the house as possible and still allow sufficient room in back of the doors for the hose gates and the attached hose.

8.2.3 Where hose reels or hose carriers are utilized, they shall be located so that the hose can be brought into use at a hydrant.

8.3 Construction.

8.3.1 Hose houses shall be of substantial construction on foundations.

8.3.2 The construction shall protect the hose from weather and vermin and shall be designed so that hose lines can be brought into use.

8.3.3 Clearance shall be provided for operation of the hydrant wrench.

8.3.4 Ventilation shall be provided.

8.3.5 The exterior shall be painted or otherwise protected against deterioration.

8.4* Size and Arrangement. Hose houses shall be of a size and arrangement that provide shelves or racks for the hose and equipment.

8.5 Marking. Hose houses shall be plainly identified.

8.6 General Equipment.

8.6.1* Where hose houses are used in addition to the hose, each shall be equipped with the following:

- (1) Two approved adjustable spray-solid stream nozzles equipped with shutoffs for each size of hose provided
- (2) One hydrant wrench (in addition to wrench on hydrant)
- (3) Four coupling spanners for each size hose provided
- (4) Two hose coupling gaskets for each size hose

8.6.2 Where two sizes of hose and nozzles are provided, reducers or gated wyes shall be included in the hose house equipment.

8.7 Domestic Service Use Prohibited. The use of hydrants and hose for purposes other than fire-related services shall be prohibited.

Chapter 9 Master Streams

9.1* Master Streams. Master streams shall be delivered by monitor nozzles, hydrant-mounted monitor nozzles, and similar master stream equipment capable of delivering more than 250 gpm (946 L/min).

9.2 Application and Special Considerations. Master streams shall be provided as protection for the following:

- (1) Large amounts of combustible materials located in yards
- (2) Average amounts of combustible materials in inaccessible locations
- (3) Occupancies presenting special hazards, as required by the authority having jurisdiction

Chapter 10 Underground Piping

10.1* Piping Materials.

10.1.1* Listing. Piping shall be listed for fire protection service or shall comply with the standards in Table 10.1.1.

Table 10.1.1 Manufacturing Standards for Underground Pipe

Materials and Dimensions	Standard
Ductile Iron	
<i>Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water</i>	AWWA C104
<i>Polyethylene Encasement for Ductile Iron Pipe Systems</i>	AWWA C105
<i>Ductile Iron and Gray Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids</i>	AWWA C110
<i>Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings</i>	AWWA C111
<i>Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges</i>	AWWA C115
<i>Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service</i>	AWWA C116
<i>Thickness Design of Ductile Iron Pipe</i>	AWWA C150
<i>Ductile Iron Pipe, Centrifugally Cast for Water</i>	AWWA C151



Table 10.1.1 Continued

Materials and Dimensions	Standard
<i>Ductile-Iron Compact Fittings for Water Service</i>	AWWA C153
<i>Standard for the Installation of Ductile Iron Water Mains and Their Appurtenances</i>	AWWA C600
Steel	
<i>Steel Water Pipe 6 in. and Larger</i>	AWWA C200
<i>Coal-Tar Protective Coatings and Linings for Steel Water Pipelines Enamel and Tape — Hot Applied</i>	AWWA C203
<i>Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4 in. and Larger — Shop Applied</i>	AWWA C205
<i>Field Welding of Steel Water Pipe</i>	AWWA C206
<i>Steel Pipe Flanges for Waterworks Service — Sizes 4 in. Through 144 in.</i>	AWWA C207
<i>Dimensions for Fabricated Steel Water Pipe Fittings</i>	AWWA C208
<i>A Guide for Steel Pipe Design and Installation</i>	AWWA M11
Concrete	
<i>Reinforced Concrete Pressure Pipe, Steel-Cylinder Type</i>	AWWA C300
<i>Prestressed Concrete Pressure Pipe, Steel-Cylinder Type</i>	AWWA C301
<i>Reinforced Concrete Pressure Pipe, Non-Cylinder Type</i>	AWWA C302
<i>Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, Pretensioned</i>	AWWA C303
<i>Standard for Asbestos-Cement Distribution Pipe, 4 in. Through 16 in., for Water Distribution Systems</i>	AWWA C400
<i>Standard for the Selection of Asbestos-Cement Pressure Pipe</i>	AWWA C401
<i>Cement-Mortar Lining of Water Pipe Lines 4 in. and Larger — in Place</i>	AWWA C602
<i>Standard for the Installation of Asbestos-Cement Water Pipe</i>	AWWA C603
Plastic	
<i>Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution</i>	AWWA C900
<i>Polyvinyl Chloride (PVC) Pressure Pipe, 14 in. Through 48 in., for Water Distribution</i>	AWWA C905
<i>Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) Through 63 in. (1575 mm) for Water Distribution</i>	AWWA C906
Copper	
<i>Specification for Seamless Copper Tube</i>	ASTM B 75
<i>Specification for Seamless Copper Water Tube</i>	ASTM B 88
<i>Requirements for Wrought Seamless Copper and Copper-Alloy Tube</i>	ASTM B 251

10.1.2 Steel Pipe. Steel piping shall not be used for general underground service unless specifically listed for such service.

10.1.3 Steel Pipe Used with Fire Department Connections. Where externally coated and wrapped and internally galvanized, steel pipe shall be permitted to be used between the check valve and the outside hose coupling for the fire department connection.

10.1.4* Pipe Type and Class. The type and class of pipe for a particular underground installation shall be determined through consideration of the following factors:

- (1) Fire resistance of the pipe
- (2) Maximum system working pressure
- (3) Depth at which the pipe is to be installed
- (4) Soil conditions
- (5) Corrosion
- (6) Susceptibility of pipe to other external loads, including earth loads, installation beneath buildings, and traffic or vehicle loads

10.1.5* Working Pressure. Piping, fittings, and other system components shall be rated for the maximum system working pressure to which they are exposed but shall not be rated at less than 150 psi (10 bar).

10.1.6* Lining of Buried Pipe.

10.1.6.1 Unless the requirements of 10.1.6.2 are met, all ferrous metal pipe shall be lined in accordance with the applicable standards in Table 10.1.1.

10.1.6.2 Steel pipe utilized in fire department connections and protected in accordance with the requirements of 10.1.3 shall not be required to be internally lined.

10.2 Fittings.

10.2.1* Buried Fittings. Fittings shall be of an approved type with joints and pressure class ratings compatible with the pipe used.

10.2.2 Standard Fittings.

10.2.2.1 Fittings shall meet the standards in Table 10.2.2.1 or shall be in accordance with 10.2.3.

10.2.2.2 In addition to the standards in Table 10.2.2.2, CPVC fittings shall also be in accordance with 10.2.3 and with the portions of the ASTM standards specified in Table 10.2.2.2 that apply to fire protection service.

10.2.3 Special Listed Fittings. Other types of fittings investigated for suitability in automatic sprinkler installations and listed for this service, including, but not limited to, polybutylene, CPVC, and steel differing from that provided in Table 10.2.2.1, shall be permitted when installed in accordance with their listing limitations, including installation instructions.

10.2.4 Pressure Limits. Listed fittings shall be permitted for the system pressures as specified in their listings, but not less than 150 psi (10 bar).

10.3 Joining of Pipe and Fittings.

10.3.1* Buried Joints. Joints shall be approved.

10.3.2 Threaded Pipe and Fittings. All threaded steel pipe and fittings shall have threads cut in accordance with ASME B1.20.1.

10.3.3* Groove Joining Methods. Pipes joined with grooved fittings shall be joined by a listed combination of fittings, gaskets, and grooves.

10.3.4 Brazed and Pressure Fitting Methods. Joints for the connection of copper tube shall be brazed or joined using pressure fittings as specified in Table 10.2.2.1.

10.3.5 Other Joining Methods. Other joining methods listed for this service shall be permitted where installed in accordance with their listing limitations.

Table 10.2.2.1 Fittings Materials and Dimensions

Materials and Dimensions	Standard
Cast Iron	
<i>Gray Iron Threaded Fittings, Classes 125 and 250</i>	ASME B16.4
<i>Gray Iron Pipe Flanges and Flanged Fittings, Classes 12, 125, and 250</i>	ASME B16.1
Malleable Iron	
<i>Malleable Iron Threaded Fittings, Class 150 and 300</i>	ASME B16.3
Steel	
<i>Factory-Made Wrought Steel Butt Weld Fittings</i>	ASME B16.9
<i>Butt Welding Ends</i>	ASME B16.25
<i>Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures</i>	ASTM A 234
<i>Pipe Flanges and Flanged Fittings, NPS 1/2 Through 24</i>	ASME B16.5
<i>Forged Steel Fittings, Socket Welded and Threaded</i>	ASME B16.11
Copper	
<i>Wrought Copper and Bronze Solder Joint Pressure Fittings</i>	ASME B16.22
<i>Cast Bronze Solder Joint Pressure Fittings</i>	ASME B16.18

Table 10.2.2.2 Specially Listed Fittings Materials and Dimensions

Materials and Dimensions	Standard
<i>Chlorinated Polyvinyl Chloride (CPVC) Specification for Schedule 80 CPVC Threaded Fittings</i>	ASTM F 437
<i>Specification for Schedule 40 CPVC Socket-Type Fittings</i>	ASTM F 438
<i>Specification for Schedule 80 CPVC Socket-Type Fittings</i>	ASTM F 439

10.3.6 Pipe Joint Assembly.

10.3.6.1 Joints shall be assembled by persons familiar with the particular materials being used and in accordance with the manufacturer's instructions and specifications.

10.3.6.2* All bolted joint accessories shall be cleaned and thoroughly coated with asphalt or other corrosion-retarding material after installation.

10.4 Depth of Cover.

10.4.1* The depth of cover over water pipes shall be determined by the maximum depth of frost penetration in the locality where the pipe is laid.

10.4.2 The top of the pipe shall be buried not less than 1 ft (0.3 m) below the frost line for the locality.

10.4.3 In those locations where frost is not a factor, the depth of cover shall be not less than 2½ ft (0.8 m) to prevent mechanical damage.

10.4.4 Pipe under driveways shall be buried at a minimum depth of 3 ft (0.9 m).

10.4.5 Pipe under railroad tracks shall be buried at a minimum depth of 4 ft (1.2 m).

10.4.6 The depth of cover shall be measured from the top of the pipe to finished grade, and due consideration shall always be given to future or final grade and nature of soil.

10.5 Protection Against Freezing.

10.5.1* Where it is impracticable to bury pipe, pipe shall be permitted to be laid aboveground, provided that the pipe is protected against freezing and mechanical damage.

10.5.2 Pipe shall be buried below the frost line where entering streams and other bodies of water.

10.5.3 Where pipe is laid in water raceways or shallow streams, care shall be taken that there will be sufficient depth of running water between the pipe and the frost line during all seasons of frost; a safer method is to bury the pipe 1 ft (0.3 m) or more under the bed of the waterway.

10.5.4 Pipe shall be located at a distance from stream banks and embankment walls that prevents danger of freezing through the side of the bank.

10.6 Protection Against Damage.

10.6.1 Pipe shall not be run under the building except where permitted in 10.6.2 and 10.6.3.

10.6.2 Where approved, pipe shall be permitted to be run under buildings, and special precautions shall be taken, including the following:

- (1) Arching the foundation walls over the pipe
- (2) Running pipe in covered trenches
- (3) Providing valves to isolate sections of pipe under buildings

10.6.3 Fire service mains shall be permitted to enter the building adjacent to the foundation.

10.6.3.1* The requirements of 10.6.2(2) and 10.6.2(3) shall not apply where fire service mains enter under the building no more than 10 ft (3 m) as measured from the outside edge of the building to the center of the vertical pipe.

10.6.4* Pipe joints shall not be located under foundation footings.

10.6.5* Piping shall be run at least 1 ft (305 mm) below the bottom of foundations/footers.

10.6.5.1 The requirements of 10.6.6 shall not apply when piping is sleeved.

10.6.6 Mains shall be subjected to an evaluation of the following specific loading conditions and protected, if necessary:

- (1) Mains running under railroads carrying heavy cargo
- (2) Mains running under large piles of heavy commodities
- (3) Mains located in areas that subject the main to heavy shock and vibrations

10.6.7* Where it is necessary to join metal pipe with pipe of dissimilar metal, the joint shall be insulated against the passage of an electric current using an approved method.



10.6.8* In no case shall the underground piping be used as a grounding electrode for electrical systems.

10.6.8.1* The requirement of 10.6.8 shall not preclude the bonding of the underground piping to the lightning protection grounding system as required by NFPA 780 in those cases where lightning protection is provided for the structure.

10.7 Requirement for Laying Pipe.

10.7.1 Pipes, valves, hydrants, gaskets, and fittings shall be inspected for damage when received and shall be inspected prior to installation. (See Figure 10.10.1.)

10.7.2 The torquing of bolted joints shall be checked.

10.7.3 Pipe, valves, hydrants, and fittings shall be clean inside.

10.7.4 When work is stopped, the open ends of pipe, valves, hydrants, and fittings shall be plugged to prevent stones and foreign materials from entering.

10.7.5 All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench using appropriate equipment and carefully examined for cracks or other defects while suspended above the trench.

10.7.6 Plain ends shall be inspected for signs of damage prior to installation.

10.7.7 Under no circumstances shall water main materials be dropped or dumped.

10.7.8 Pipe shall not be rolled or skidded against other pipe materials.

10.7.9 Pipes shall bear throughout their full length and shall not be supported by the bell ends only or by blocks.

10.7.10 If the ground is soft or of a quicksand nature, special provisions shall be made for supporting pipe.

10.7.11 Valves and fittings used with nonmetallic pipe shall be supported and restrained in accordance with the manufacturer's specifications.

10.8 Joint Restraint.

10.8.1 General.

10.8.1.1* All tees, plugs, caps, bends, reducers, valves, and hydrant branches shall be restrained against movement by using thrust blocks in accordance with 10.8.2 or restrained joint systems in accordance with 10.8.3.

10.8.1.2* Piping with fused, threaded, grooved, or welded joints shall not require additional restraining, provided that such joints can pass the hydrostatic test of 10.10.2.2 without shifting of piping or leakage in excess of permitted amounts.

10.8.1.3 Steep Grades. On steep grades, mains shall be additionally restrained to prevent slipping.

10.8.1.3.1 Pipe shall be restrained at the bottom of a hill and at any turns (lateral or vertical).

10.8.1.3.2 The restraint specified in 10.8.1.3.1 shall be to natural rock or to suitable piers built on the downhill side of the bell.

10.8.1.3.3 Bell ends shall be installed facing uphill.

10.8.1.3.4 Straight runs on hills shall be restrained as determined by the design engineer.

10.8.2* Thrust Blocks.

10.8.2.1 Thrust blocks shall be considered satisfactory where soil is suitable for their use.

10.8.2.2 Thrust blocks shall be of a concrete mix not leaner than one part cement, two and one-half parts sand, and five parts stone.

10.8.2.3 Thrust blocks shall be placed between undisturbed earth and the fitting to be restrained and shall be capable of resisting the calculated thrust forces.

10.8.2.4 Wherever possible, thrust blocks shall be placed so that the joints are accessible for repair.

10.8.3* Restrained Joint Systems. Fire mains utilizing restrained joint systems shall include one or more of the following:

- (1) Locking mechanical or push-on joints
- (2) Mechanical joints utilizing setscrew retainer glands
- (3) Bolted flange joints
- (4) Heat-fused or welded joints
- (5) Pipe clamps and tie rods
- (6) Threaded or grooved joints
- (7) Other approved methods or devices

10.8.3.1 Sizing Clamps, Rods, Bolts, and Washers.

10.8.3.1.1 Clamps.

10.8.3.1.1.1 Clamps shall have the following dimensions:

- (1) ½ in. × 2 in. (12.7 mm × 50.8 mm) for 4 in. (102 mm) to 6 in. (152 mm) pipe
- (2) ⅝ in. × 2½ in. (15.9 mm × 63.5 mm) for 8 in. (204 mm) to 10 in. (254 mm) pipe
- (3) ⅝ in. × 3 in. (15.9 mm × 76.2 mm) for 12 in. (305 mm) pipe

10.8.3.1.1.2 The diameter of a bolt hole shall be ¼ in. (1.6 mm) larger than that of the corresponding bolt.

10.8.3.1.2 Rods.

10.8.3.1.2.1 Rods shall be not less than ⅝ in. (15.9 mm) in diameter.

10.8.3.1.2.2 Table 10.8.3.1.2.2 provides the numbers of various diameter rods that shall be used for a given pipe size.

Table 10.8.3.1.2.2 Rod Number — Diameter Combinations

Nominal Pipe Size (in.)	⅝ in. (15.9 mm)	¾ in. (19.1 mm)	⅞ in. (22.2 mm)	1 in. (25.4 mm)
4	2	—	—	—
6	2	—	—	—
8	3	2	—	—
10	4	3	2	—
12	6	4	3	2
14	8	5	4	3
16	10	7	5	4

Note: This table has been derived using pressure of 225 psi (15.5 bar) and design stress of 25,000 psi (172.4 MPa).