

**Maintenance Schedule.** The items shown in Table A-10-1.1 should be checked on a routine basis.

Table A-10-1.1 Maintenance Schedule

Parts	Activity	Frequency
Flushing piping	Test	5 years
Fire department connections	Inspection	Monthly
Control valves	Inspection	Weekly—sealed
	Inspection	Monthly—locked
	Inspection	Monthly—tamper switch
Main drain	Maintenance	Yearly
Open sprinklers	Flow test	Quarterly
Pressure gauge	Test	Annual
Sprinklers	Calibration test	
Sprinklers—high temp	Test	50 years
Sprinklers—residential	Test	5 years
Waterflow alarms	Test	20 years
Preaction/deluge detection system	Test	Quarterly
Preaction/deluge systems	Test	Semiannually
Antifreeze solution	Test	Annually
Cold weather valves	Open and close valves	Annually
Dry/preaction/deluge systems	Test	Fall, close; spring, open
Air pressure and water pressure	Inspection	Weekly
Enclosure	Inspection	Daily—cold weather
Priming water level	Inspection	Quarterly
Low-point drains	Test	Fall
Dry pipe valves	Trip test	Annual—spring
Dry pipe valves	Full flow trip	3 years—spring
Quick-opening devices	Test	Semiannually

## Appendix B Miscellaneous Topics

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

**B-1** Figure B-1 shows acceptable methods for interconnection of the fire protection and domestic water supply.

### B-2 Sprinkler System Performance Criteria.

**B-2.1** Sprinkler system performance criteria have been based on test data. The factors of safety are generally small and are not definitive, and can depend on expected (but not guaranteed) inherent characteristics of the sprinkler systems involved. These inherent factors of safety consist of the following:

(a) The flow-declining pressure characteristic of sprinkler systems whereby the initial operating sprinklers discharge at a higher flow than with all sprinklers operating within the designated area.

(b) The flow-declining pressure characteristic of water supplies. This is particularly steep where fire pumps are the water source. This characteristic similarly produces higher than design discharge at the initially operating sprinklers.

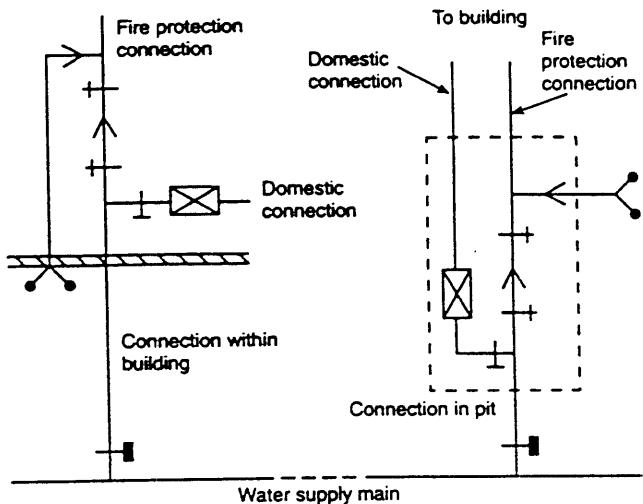


Figure B-1 Permitted arrangements between the fire protection water supply and the domestic water supply.

The user of these standards may elect an additional factor of safety if the inherent factors are not considered adequate.

**B-2.1.1** Performance-specified sprinkler systems as opposed to scheduled systems can be designed to take advantage of multiple loops or gridded configurations. This results in minimum line losses at expanded sprinkler spacing, in contrast to the older tree-type configurations, where advantage cannot be taken of multiple path flows.

Where the water supply characteristics are relatively flat with pressures being only slightly above the required sprinkler pressure at the spacing selected, gridded systems with piping designed for minimal economic line losses can all but eliminate the inherent flow-declining pressure characteristic generally assumed to exist in sprinkler systems. In contrast, the economic design of a tree-type system would likely favor a system design with closer sprinkler spacing and greater line losses, demonstrating the inherent flow-declining pressure characteristic of the piping system.

Elements that enter into the design of sprinkler systems include:

- (a) Selection of density and area of application.
- (b) Geometry of the area of application (remote area).
- (c) Permitted pressure range at sprinklers.
- (d) Determination of the water supply available.
- (e) Ability to predict expected performance from calculated performance.
- (f) Future upgrading of system performance.
- (g) Size of sprinkler systems.

In developing sprinkler specifications, each of these elements needs to be considered individually. The most conservative design will be based on the application of the most stringent conditions for each of the elements.

**B-2.1.2 Selection of Density and Area of Application.** Specifications for density and area of application are developed from NFPA and other standards. It is desirable to specify densities rounded upward to the nearest 0.005 gpm/sq ft (0.20 Lpm/m<sup>2</sup>).

Prudent design should consider reasonable-to-expect variations in occupancy. This would include not only variations in type of occupancy, but also, in the case of warehousing, the anticipated future range of materials to be stored, clearances, types of arrays, packaging, pile height, and pile stability, as well as other factors.

Design also considers some degree of adversity at the time of a fire. To take this into account, the density and/or area of application may be increased. Another way is to use a dual-performance specification where, in addition to the normal primary specifications, a secondary density and area of application is specified. The objective of such a selection is to control the declining pressure-flow characteristic of the sprinkler system beyond the primary design flow.

A case can be made for designing feed and cross mains to lower velocities than branch lines to achieve the same result as specifying a second density and area of application.

**B-2.1.3 Geometry of the Area of Application (Remote Area).** It is expected that, over any portion of the sprinkler system equivalent in size to the area of application, the system will achieve the minimum specified density for each sprinkler within that area.

Where a system is computer-designed, ideally the program should verify the entire system by shifting the area of application the equivalent of one sprinkler at a time so as to cover all portions of the system. Such a complete computer verification of performance of the system is most desirable, but unfortunately not all available computer verification programs currently do this.

This selection of the proper Hazen-Williams coefficient is important. New unlined steel pipe has a Hazen-Williams coefficient close to 140. However, it quickly deteriorates to 130 and, after a few years of use, to 120. Hence, the basis for normal design is a Hazen-Williams coefficient of 120 for steel-piped wet systems. A Hazen-Williams coefficient of 100 is generally used for dry pipe systems because of the increased tendency for deposits and corrosion in these systems. However, it should be realized that a new system will have fewer line losses than calculated, and the distribution pattern will be affected accordingly.

Conservatism can also be built into systems by intentionally designing to a lower Hazen-Williams coefficient than that indicated.

**B-2.1.4 Ability to Predict Expected Performance from Calculated Performance.** Ability to accurately predict the performance of a complex array of sprinklers on piping is basically a function of the pipe line velocity. The greater the velocity, the greater is the impact on difficult-to-assess pressure losses. These pressure losses are presently determined by empirical means that lose validity as velocities increase. This is especially true for fittings with unequal and more than two flowing ports.

The inclusion of velocity pressures in hydraulic calculations improves the predictability of the actual sprinkler system performance. Calculations should come as close as practicable to predicting actual performance. Conservatism in design should be arrived at intentionally by known and deliberate means. It should not be left to chance.

**B-2.1.5 Future Upgrading of System Performance.** It may be desirable in some cases to build into the system the capability to achieve a higher level of sprinkler performance than needed at present. If this is to be a consideration in

conservatism, consideration needs to be given to maintaining sprinkler operating pressures on the lower side of the optimum operating range, and/or designing for low pipe line velocities, particularly on feed and cross mains, to facilitate future reinforcement.

## Appendix C Referenced Publications

**C-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.

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

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 1996 edition.

NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*, 1996 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 1996 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 1995 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 1995 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 1996 edition.

NFPA 30B, *Code for the Manufacture and Storage of Aerosol Products*, 1994 edition.

NFPA 40, *Standard for the Storage and Handling of Cellulose Nitrate Motion Picture Film*, 1994 edition.

NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*, 1995 edition.

NFPA 72, *National Fire Alarm Code*, 1996 edition.

NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*, 1996 edition.

NFPA 96, *Standard on Ventilation Control and Fire Protection of Commercial Cooking Operations*, 1994 edition.

NFPA 220, *Standard on Types of Building Construction*, 1995 edition.

NFPA 231, *Standard for General Storage*, 1995 edition.

NFPA 231C, *Standard for Rack Storage of Materials*, 1995 edition.

NFPA 231D, *Standard for Storage of Rubber Tires*, 1994 edition.

NFPA 231F, *Standard for the Storage of Roll Paper*, 1996 edition.

NFPA 291, *Recommended Practice for Fire Flow Testing and Marking of Hydrants*, 1995 edition.

NFPA 409, *Standard on Aircraft Hangars*, 1995 edition.

NFPA 703, *Standard for Fire Retardant Impregnated Wood and Fire Retardant Coatings for Building Materials*, 1995 edition.

**C-1.2 Other Publications.**

**C-1.2.1 ANSI Publication.** American National Standards Institute, Inc., 1450 Broadway, New York, NY 10018.

ANSI/ASME B1.20.1-1983, *Pipe Threads, General Purpose (Inch)*.

**C-1.2.2 ASME Publication.** American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.

ASME A17.1-1993, *Safety Code for Elevators and Escalators*.

**C-1.2.3 ASTM Publications** American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19105.

ASTM A 135-1993, *Standard Specification for Electric-Resistance-Welded Steel Pipe*.

ASTM E 119-Rev. A-95, *Standard Test Methods for Fire Tests of Building Construction and Materials*.

**C-1.2.4 IMO Publications.** International Maritime Organization, 4 Albert Embankment, London, SE1 7SR, United Kingdom.

*International Convention for the Safety of Life at Sea, 1974 (SOLAS 74), as amended, regulations II-2/3 and II-2/26.*

International Maritime Organization Maritime Safety Committee Circular 580, *Guidelines for the Application of Plastic Pipes on Ships*.

**C-1.2.5 SNAME Publication.** Society of Naval Architects and Marine Engineers, 601 Pavonia Ave., Ste. 400, Jersey City, NJ 07306.

Technical Research Bulletin 2-21, "Aluminum Fire Protection Guidelines."

**C-1.2.6 UL Publication.** Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

"Fact Finding Report on Automatic Sprinkler Protection for Fur Storage Vaults," November 25, 1947.

**C-2** The following NFPA documents contain specific sprinkler design criteria on various subjects.

NFPA 16A, *Standard for the Installation of Closed-Head Foam-Water Sprinkler Systems*, 1994 edition.

NFPA 231E, *Recommended Practice for the Storage of Baled Cotton*, 1996 edition.

## Index

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