

**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
	Inspection	Yearly
Main drain	Maintenance	Yearly
Open sprinklers	Flow test	Quarterly
Pressure gauge	Test	Annual
Sprinklers	Calibration test	50 years
Sprinklers—high temp	Test	5 years
Sprinklers—residential	Test	20 years
Waterflow alarms	Test	Quarterly
Precision/deluge detection system	Test	Semiannually
Precision/deluge systems	Test	Annually
Antifreeze solution	Test	Annually
Cold weather valves	Open and close valves	Fall, close; spring, open
Dry/precision/deluge systems		
Air pressure and water pressure	Inspection	Weekly
Enclosure	Inspection	Daily—cold weather
	Inspection	Quarterly
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.

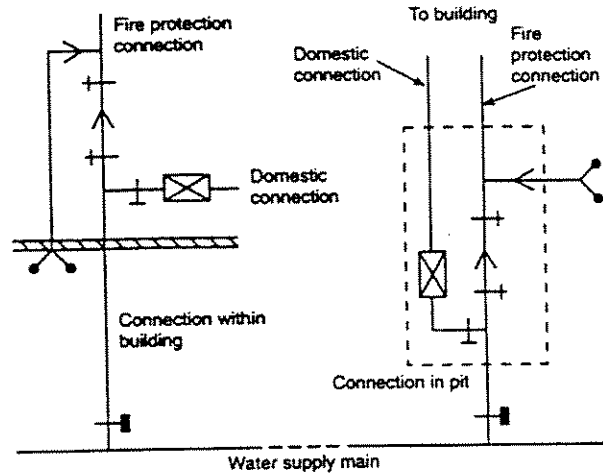


Figure B-1 Permitted arrangements between the fire protection water supply and the domestic water supply.

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:

- Selection of density and area of application.
- Geometry of the area of application (remote area).
- Permitted pressure range at sprinklers.
- Determination of the water supply available.
- Ability to predict expected performance from calculated performance.
- Future upgrading of system performance.
- 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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**-A-**

Abbreviations, hydraulic calculations .....	1-5
Acceptance, system .....	Chap. 8, A-8
Approval of system .....	8-1
Circulating closed loop systems .....	8-3, 8-6
Hydraulic design information sign .....	8-5, A-8-5
Instructions .....	8-4
Marine systems .....	9-8
Requirements .....	8-2, A-8-2
A-class boundary (definition) .....	9-1.1
Additives, water .....	see Water additives
Air exhaust valves .....	3-4.3, A-3-4.3
Air filling connections .....	3-2.6.3
Air pressure .....	
Leakage tests .....	8-2.3
Marine systems .....	9-4.12.1, A-9-4.12.1
Pressure tanks .....	7-2.3.3, A-7-2.3.3
Refrigerated spaces .....	3-8.2.2
System .....	3-2.6, A-3-2.6.2
Air supply .....	
Dry pipe system .....	3-2.6.2, 3-2.6.6, A-3-2.6.2
Marine systems .....	9-6.2.6, A-9-2.6.2.6
Refrigerated spaces .....	3-8.2.2, 3-8.2.4, 3-8.2.7 to 3-8.2.8, A-3-8.2.4, A-3-8.2.7
Shop .....	3-2.6.5
Alarms .....	see also Waterflow alarms/detection devices
Attachments .....	2-9.5, 2-9.6, 9-4.12.3, A-2-9.5
Low air pressure, refrigerated spaces .....	3-8.2.2
Marine systems .....	9-4.12, A-9-4.12.1
Sprinkler .....	4-15.1, A-14-15.1
Antiflooding devices .....	3-2.4.5
Antifreeze systems .....	3-5, A-3-5
Definition .....	1-4.3
Approved/approval .....	
Definition .....	1-4.1, A-1-4.1
System .....	8-1
Area, of protection .....	see System protection area

Area/density method .....	5-2.3.1.2, 5-2.3.2, 6-4.4.1(a), A-5-2.3.2.3, B-2.1.2
Attachments .....	
Alarms .....	2-9.5, 9-4.12.3, A-2-9.5
System .....	4-15, A-4-15
Attics .....	4-3.1.3.2(c), 5-3.2.3
Authority having jurisdiction (definition) .....	1-4.1, A-1-4.1
Automatic air compressor .....	3-2.6.6
Automatic drip, fire department connections .....	4-15.2.5
Automatic sprinkler systems .....	see Sprinkler systems
Auxiliary systems .....	3-1.3

**-B-**

Backflow prevention devices .....	3-5.3.1 to 3-5.3.2, 4-15.4.6, A-4-15.4.6.2
Operational tests .....	8-2.6
Baffles .....	4-6.3.4
Bar joist construction (definition) .....	A-1-4.6(b)(i)
Barriers, thermal .....	1-4.2
Basements .....	5-3.2.3
Bath modules, marine .....	9-4.6
Bathrooms .....	4-13.8.1
B-Class boundary (definition) .....	9-1.1
Beam and girder construction (definition) .....	A-1-4.6(a)(i)
Bends, return .....	4-13.17
Bracing .....	see Sway bracing
Branch lines .....	
Definition .....	1-4.4
Hangers, location .....	4-14.2.3, A-4-14.2.3
Large-drop sprinklers .....	5-3.4.6
Length for light hazard .....	6-5.2.1, 6-5.2.3, A-6-5.2.3.1
Length for ordinary hazard .....	6-5.3.1, 6-5.3.3
Protection area of coverage, determination of .....	4-5.2.1
Return bends connected to .....	4-13.17
Sway bracing .....	4-14.4.3.5.13, A-4-14.4.3.5.13
Brazed joints .....	2-5.4, A-2-5.4

Building service chutes ..... 4-13.4, 5-2.3.4.1, A-4-13.4  
 Buildings, high-rise ..... 4-15.1.1.6, A-4-15.1.1.6  
 Bushings ..... 2-4.5, 4-13.18.1, 4-13.18.5

## -C-

Calculations ..... Chap. 6, A-6  
 Canopies ..... 4-13.7, A-4-13.7  
 Ceiling flanges ..... 2-6.4.5  
 Ceilings ..... *see also* Drop-out ceilings; Open-grid ceilings  
 Deflector distance below ..... 4-5.4.1, 4-6.4.1, 4-7.4.1, 4-8.4.1,  
 4-9.4.1, 4-10.4.1, 4-11.4.1, A-4-6.4.1, A-4-8.4.1.3, A-4-10.4.1  
 Drop-out ..... 4-13.12, A-4-13.12  
 Marine systems ..... 9-4.7  
 Open-grid ..... 4-13.11, A-4-13.11  
 Peak, sprinklers at or near ..... 4-6.4.1.3, A-4-6.4.1.3  
 Sloped ..... 5-2.3.2.5  
 Smooth ceiling construction (definition) ..... A-1-4.6(b)(iii)  
 Sprinklers below, piping to ..... 4-13.18  
 Central safety station (definition) ..... 9-1.1  
 Check valves ..... 4-14.1.1.6 to 4-14.1.1.8, A-4-14.1.1.7 to A-4-14.1.1.8  
 Air compressor, automatic ..... 3-2.6.6  
 Air filling connection ..... 3-2.6.3  
 Alarm ..... 4-15.1.1.2  
 Antifreeze systems ..... 3-5.3.1  
 Combined systems ..... 3-4.2.3, 3-4.4  
 Dry pipe systems ..... 3-2.4.4  
 Fire department connections ..... 4-15.2.4.1  
 Hydrostatic tests ..... 8-2.2.3  
 Outside sprinklers ..... 3-7.4.2  
 Refrigerated spaces ..... 3-8.2.6  
 Chutes, building service ..... *see* Building service chutes  
 Circulating closed-loop systems ..... 3-6.1, 8-6, A-3-6.1.2  
 Acceptance ..... 8-3  
 Definition ..... 1-4.3  
 Marine systems ..... 9-3.4  
 Classification  
 Commodities ..... 1-4.7.4.2.1, 5-2.3.2.2  
 Occupancies ..... *see* Occupancy classifications  
 Clearance  
 Piping ..... 4-14.4.3.4, A-4-14.4.3.4  
 To storage ..... 4-5.6, 4-6.6, 4-7.6, 4-8.6, 4-10.6, 4-11.6, A-4-6.6  
 Closets ..... 4-13.8.2, A-4-13.8.2  
 Coatings, special ..... 2-2.5, A-2-2.5  
 Color coding of sprinklers ..... 2-2.4.1 to 2-2.4.2, A-2-2.4  
 Combined dry pipe-preaction systems ..... 3-4, A-3-4  
 Definition ..... 1-4.3  
 System riser, protection area of ..... 4-2  
 Commodity classification and storage ..... 1-4.7.4.2.1, 5-2.3.2.2  
 Compartments (definition) ..... 1-4.2  
 Composite wood joist construction (definition) ..... A-1-4.6(a)(ii)  
 Compressed air  
 Dry pipe systems ..... 3-2.6.2, 3-2.6.6, A-3-2.6.2  
 Pressure tanks (marine systems) ..... 9-6.2.3  
 Refrigerated spaces ..... 3-8.2.8, A-3-8.2.8  
 Concealed spaces  
 Sprinklers in ..... 4-3.1.3.2(e), 4-13.1, A-4-13.1.1  
 Marine systems ..... 9-4.4, A-9-4.4  
 Unsprinklered ..... 5-2.3.1.3(b), A-5-2.3.1.3(b)  
 Concealed sprinklers ..... 1-4.5.3, 4-14.4.3.5.14  
 Concrete, hangers in ..... 2-6.2  
 Connections ..... *see also* Fire department connections; Hose  
 connections; Test connections  
 Air filling ..... 3-2.6.3  
 City ..... 4-14.1.1.8, A-4-14.1.1.8  
 Domestic/fire protection water supply ..... B-1  
 Flexible ..... A-2-4.4  
 Construction ..... *see also* Obstructions to sprinklers  
 Definitions ..... 1-4.6, A-1-4.6  
 Obstructed (definition) ..... 1-4.6, A-1-4.6(a)  
 Unobstructed (definition) ..... 1-4.6, A-1-4.6(b)

Control valves ..... 4-15.1.1.4  
 In-rack sprinklers ..... 4-12.2  
 Marine systems ..... 9-2.6.1, 9-4.12.1, A-9-2.6.1, A-9-4.12.1  
 Outside sprinklers ..... 3-7.3  
 Preaction and deluge systems ..... 3-3.1.8  
 Refrigerated spaces ..... 3-8.2.5, A-3-8.2.5  
 Sprinkler system ..... 4-14.1.1, A-4-14.1.1  
 Conventional sprinklers (definition) ..... 1-4.5.2  
 Cooking equipment, commercial-type ..... 3-9, 4-3.1.3.2(g), A-3-9.2  
 Corridors  
 Design area ..... 5-2.3.4.2  
 Residential sprinklers in ..... 4-4.5.1, A-4-4.5.1  
 Corrosion protection, piping ..... 4-13.19, 4-14.4.2, A-2-3.5,  
 A-4-14.4.2.1  
 Corrosion-resistant sprinklers ..... 2-2.5.1 to 2-2.5.2, A-2-2.5.1,  
 A-2-2.5.1 to A-2-2.5.2  
 Definition ..... 1-4.5.4  
 Couplings ..... 2-4.4, 4-14.4.3.2, A-2-4.4, A-4-14.4.3.2  
 Cross mains  
 Definition ..... 1-4.4  
 Hangers, location on ..... 4-14.2.4  
 Cutting tables, sprinklers obstructed by ..... 4-5.5.3.1, 4-6.5.3.1,  
 4-7.5.3.1, 4-8.5.3.1, 4-9.5.3.1

## -D-

Decks, sprinklers obstructed by ..... 4-5.5.3.1, 4-6.5.3.1, 4-7.5.3.1,  
 4-8.5.3.1, 4-9.5.3.1  
 Decorative sprinklers ..... *see* Ornamental sprinklers  
 Definitions ..... 9-1.1  
 Construction ..... 1-4.6, A-1-4.6  
 General ..... 1-4.2, A-1-4.2  
 NFPA ..... 1-4.1, A-1-4.1  
 Occupancy classifications ..... 1-4.7, A-1-4.7  
 Sprinkler system components ..... 1-4.4, A-1-4.4  
 Sprinkler system types ..... 1-4.3, A-1-4.3  
 Sprinklers ..... 1-4.5, A-1-4.5  
 Deflectors  
 Clearance to storage ..... 4-5.6, 4-6.6, 4-7.6, 4-8.6, 4-10.6,  
 4-11.6, A-4-6.6  
 Obstructions below ..... 4-5.5.2.1, 4-6.5.2.1, 4-7.5.2.1, 4-8.5.2.1,  
 4-9.5.2.1, 4-10.5.2.1  
 Position ..... 4-5.4, 4-6.4, 4-7.4, 4-8.4, 4-9.4, 4-10.4, 4-11.4,  
 A-4-6.4, A-4-8.4.1.3, A-4-10.4.1  
 Deluge systems ..... 3-3, A-3-3  
 Definition ..... 1-4.3  
 Fire department connections ..... 4-15.2.1, 4-15.2.3.2(d), A-4-15.2.1  
 Hydraulic calculations ..... 6-5.5  
 Hydrostatic tests ..... 8-2.2.4  
 Open sprinklers ..... 4-4.4  
 Test connections ..... 4-15.4.5  
 Waterflow detecting devices ..... 2-9.2.3  
 Deluge valves ..... 4-15.1.1.3, 8-2.4.3  
 Design, sprinkler system ..... Chap. 5, A-5, B-2.1.1  
 Area-density method ..... 5-2.3.2, A-5-2.3.2.3  
 In-rack sprinklers ..... 5-4  
 Marine systems ..... 9-5, A-9-5  
 Occupancy hazard fire control ..... 5-2, A-5-2  
 Room design method ..... 5-2.3.3, A-5-2.3.3.1  
 Special methods ..... 5-2.3.4, 5-3, A-5-3  
 Water demand requirements  
 Hydraulic calculation methods ..... 5-2.3, A-5-2.3  
 Pipe schedule method ..... 5-2.2, A-5-2.2.3  
 Detection devices ..... *see also* Waterflow alarms/detection devices  
 Deluge systems ..... 3-3.1.6  
 Preaction systems ..... 3-3.1.6, 3-3.2.1, 3-3.2.3  
 Spare ..... 9-3.2  
 Dielectric fittings ..... 3-6.1.1.3  
 Diethylene glycol ..... A-3-5.2.3  
 Differential-type valves ..... 8-2.2.8  
 Discharge capacities, sprinklers ..... 2-2.2  
 Discharge tests ..... 8-6  
 Docks, exterior ..... 4-13.6

**Doors, automatic or self-closing** ..... 5-2.3.3.3  
**Double joist obstructions** ..... 4-6.4.1.4  
**Drain valves** ..... 2-7.2  
 Discharge of ..... 4-14.3.6, A-4-14.3.6.1  
 Marine systems ..... 9-2.6.2  
 Outside sprinklers ..... 3-7.4.1  
**Drains** ..... 4-14.3, A-4-14.3  
 Alarms ..... 2-9.6  
 Auxiliary ..... 4-14.3.5, A-4-14.3.5.2.3  
 Fire department connections ..... 4-15.2.5  
 Marine systems, discharge ..... 9-4.11  
 Pressure gauges at ..... 4-15.3  
 System/main drain/sectional drain connections ..... 4-14.3.4  
**Drop-out ceilings** ..... 1-4.2, 4-13.12, A-4-13.12  
**Dry pipe systems** ..... 3-2, 5-2.3.2.6, A-3-2; *see also* Combined dry pipe-preaction systems  
 Air pressure and supply ..... A-3-2.6.2  
 Air test ..... 8-2.3  
 Definition ..... 1-4.3  
 Drainage, auxiliary ..... 4-14.3.5.3  
 Early suppression fast-response sprinklers used in ..... 4-4.6.1  
 Fire department connections ..... 4-15.2.3.2(b)  
 Large-drop sprinklers used in ..... 4-4.7.1 to 4-4.7.2, 5-3.4.2.2, A-4-4.7.2  
 Quick-opening devices ..... 3-2.4, 3-4.2.4, 8-2.4.2  
 Residential sprinklers used in ..... 4-4.5.2  
 Test connections ..... 4-15.4.3, A-4-15.4.3  
 Underground pipe ..... 4-13.19  
 Volume limitations ..... A-3-2.3.1  
 Water demand requirements ..... 5-2.3.2.6  
 Waterflow detecting devices ..... 2-9.2.2  
**Dry pipe valves** ..... 3-2.4.1, 3-2.5, 3-4.2, 3-8.2.6, 4-15.1.1.3, A-3-2.5  
 Marine systems ..... 9-4.12.1, A-9-4.12.1  
 Operational tests ..... 8-2.4.2  
**Dry sprinklers** ..... 3-2.2, 3-4.1.4, A-3-2.2, A-3-4.1.4  
 Definition ..... 1-4.5.4, A-1-4.5.4  
**Ducts**  
 Sprinklers in ..... 3-9.2 to 3-9.7, A-3-9.2  
 Vertical shafts ..... 4-13.2.1, 9-4.5.1  
 Sprinklers obstructed by ..... 4-5.5.2.2, 4-5.5.3.1, 4-7.5.3.1, 4-8.5.3.1, 4-9.5.3.1, 4-10.5.3.1, 4-11.5.3.2  
**Dwelling units** ..... 1-4.2, 4-4.5.1, 4-13.8, A-4-4.5.1, A-4-13.8.2

**-E-**

**Early suppression fast-response (ESFR) sprinklers** ..... 4-4.6, 4-11, A-4-11.5.3  
 Clearance to storage ..... 4-11.6  
 Definition ..... 1-4.5.2, A-1-4.5.2  
 Deflector position ..... 4-11.4  
 Design approach ..... 5-3.5, A-5-3.5  
 Discharge characteristics ..... 2-2.2.2  
 Obstructions to discharge ..... 4-11.5, A-4-11.5.3  
 Protection areas ..... 4-11.2  
 Spacing ..... 4-11.3  
 Temperature rating ..... 4-4.6.4  
 Earthquake damage, pipe protection from ..... 4-14.4.3, A-4-14.4.3  
**EC** ..... *see* Extended coverage (EC) sprinklers  
**Egg crate ceilings** ..... *see* Open-grid ceilings  
**Electrical equipment** ..... 4-13.10  
**Elevator hoistways and machine rooms** ..... 4-13.5, A-4-13.5  
**Enclosures, dry pipe valves** ..... A-3-2.5  
**Escalators** ..... *see* Moving stairways  
**Escutcheons** ..... 2-2.6, 4-14.4.3.5.14, A-2-2.5.2, A-2-2.6.2  
**ESFR** ..... *see* Early suppression fast-response (ESFR) sprinklers  
**Ethylene glycol** ..... A-3-5.2.3  
**Exhaust systems** ..... 3-9.2 to 3-9.7, A-3-9.2  
**Exhaust valves, air** ..... 3-4.3, A-3-4.3  
**Expansion shields** ..... 2-6.2.2 to 2-6.2.6  
**Exposure protection systems** ..... 3-7, 5-3.6, A-3-7.2.1, A-5-3.6.1  
 Hydraulic calculations ..... 6-5.6, A-6-5.6  
 Operational tests ..... 8-2.7

**Extended coverage (EC) sprinklers** ..... 5-2.3.2.3  
 Clearance to storage ..... 4-8.6  
 Definition ..... 1-4.5.2  
 Deflector position ..... 4-8.4, 4-9.4, A-4-8.4.1.3  
 Obstructions to discharge ..... 4-8.5, 4-9.5, A-4-8.5.3, A-4-9.5.3  
 Permitted uses ..... 4-4.3  
 Protection areas ..... 4-8.2, 4-9.2, A-4-8.2.1, A-4-9.2.1  
 Sidewall spray ..... 4-9, A-4-9  
 Spacing ..... 4-8.3, 4-9.3  
 Upright and pendent ..... 4-8, A-4-8  
**Extra hazard occupancies** ..... 5-2.1.2  
 Definition ..... 1-4.7.3, A-1-4.7.3.1  
 Hydraulic calculations ..... 6-5.4, A-6-5.4  
 Openings, protection of ..... 5-2.3.3(b)  
 Sprinkler types used in ..... 4-4.1  
 High temperature sprinklers ..... 5-2.3.2.7  
 Large-drop sprinklers ..... 5-3.4.7  
 Quick-response sprinklers ..... 5-2.3.2.3  
 System protection area limitations ..... 4-2  
 Water demand requirements ..... 5-2.2.1, 5-2.3.2.1, 5-2.3.3(b)  
**Eye rods** ..... 2-6.4.3

**-F-**

**Fast response sprinklers** ..... *see* Early suppression fast-response (ESFR) sprinklers; Quick-response (QR) sprinklers  
**Fasteners** ..... 4-14.4.3.5.6, 4-14.4.3.5.16 to 4-14.4.3.5.18, A-4-14.4.3.4.6  
**Feed mains (definition)** ..... 1-4.4  
**Finish, ornamental** ..... 2-2.5.4; *see also* Ornamental sprinklers  
**Fire control (definition)** ..... 1-4.2  
**Fire department connections** ..... 4-13.21, 4-14.1.1.7, A-4-13.21  
 Exposure fire protection ..... 3-7.2.2  
 Hydrostatic tests ..... 8-2.2.3  
 Marine systems ..... 9-2.7, 9-4.9, 9-9.1.4, A-9-2.7  
 Specifications ..... 2-8, 4-15.2, A-4-15.2  
 Wet pipe systems ..... 5-2.3.1.3(c)  
**Fire pumps (marine systems)** ..... 9-6.3, 9-6.4.2, 9-6.4.4, 9-7.1, 9-9.1.2, A-9-6.3.6(a)  
**Fire suppression (definition)** ..... 1-4.2  
**Fittings** ..... 2-4, A-2-4  
 Circulating closed-loop systems ..... 3-6.1.1.2 to 3-6.1.1.3  
 Dielectric ..... 3-6.1.1.3  
 Equivalent pipe lengths ..... 6-4.3  
 Joining with pipe ..... 2-5, A-2-5  
 Materials and dimensions ..... Table 2-4.1, Table 2-4.2  
 Outside sprinklers ..... 3-7.5  
 Threaded ..... 2-5.1, A-2-5.1.2  
 Welded ..... 2-5.2, A-2-5.2  
**Flanges, ceiling** ..... 2-6.4.5  
**Flexible connections** ..... A-2.4.4  
**Flexible listed pipe coupling (definition)** ..... 1-4.4  
**Floor openings** ..... 4-13.3.4, 6-5.1.3, A-4-13.3.4  
**Floors, spaces under** ..... 4-13.6  
**Flow-declining pressure characteristics** ..... B-2.1  
**Flush sprinklers (definition)** ..... 1-4.5.3  
**Flushing systems, provision for** ..... 4-13.15, 8-2.1, 8-2.2.6, 9-9.1.8, A-8-2.1  
**Formulas, hydraulic** ..... 6-4.2  
**Foundation walls, piping through/under** ..... 7-1.2.3, A-7-1.2.3  
**Freezing, protection from** ..... 4-14.4.1; *see also* Antifreeze systems  
**Friction loss formula** ..... 6-4.2.1, 6-4.4.5  
**Fur storage vaults** ..... 4-13.13, A-4-13.13

**-G-**

**Gate valves** ..... 2-7.1.1  
**Gauges** ..... *see* Pressure gauges  
**Glycerine (C.P. or U.S.P.)** ..... 3-5.2.1, A-3-5.2

Graph sheets ..... 6-2.4, A-6-2.4  
 Gratings, sprinklers under ..... 4-5.5.3.2, 4-6.5.3.2, 4-8.5.3.2,  
 4-10.5.3.2, 4-11-5.3.3, A-2-2.7  
 Gravity tanks ..... 5-2.3.1.3(h), 7-2.4  
 Gridded systems  
 Definition ..... 1-4.3, A-1-4.3  
 Hydraulic calculation procedures ..... 6-4.4.2  
 Groove joining methods ..... 2-5.3  
 Ground floors, spaces under ..... 4-13.6  
 Guards, sprinkler ..... 2-2.7, A-2-2.7

**-H-**

Hangers ..... 2-6, A-2-6.1  
 Branch lines, location on ..... 4-14.2.3, A-4-14.2.3  
 Concrete ..... 2-6.2  
 Cross mains, location on ..... 4-14.2.4  
 Distance between, maximum ..... 4-14.2.2, A-4-14.2.2.1  
 Marine systems ..... 9-2.5.1, 9-2.5.3, A-9-2.5.1, A-9-2.5.3  
 Toggle ..... 4-14.2.1.1  
 Trapeze ..... 2-6.1.5, A-2-6.1.5  
 Hardware ..... Chap. 2, A-2, A-9-2  
 Hazen-Williams formula ..... 6-4.2.1, 6-4.3.2, 6-4.4.5, B-2.1.3  
 Heating system components, sprinklers near ..... 4-3.1.3.2(b)  
 Heat-responsive devices, preaction and deluge systems ..... 3-3.1.4  
 Heat-sensitive materials ..... 9-4.10, A-9-4.10  
 Definition ..... 9-1.1, A-9-1.1  
 Heel angle (definition) ..... 9-1.1  
 Heel (definition) ..... 9-1.1  
 Hexagonal bushings ..... 4-13.18.1  
 High challenge fire hazard (definition) ..... 1-4.2  
 High-piled storage  
 Definition ..... 1-4.2  
 High-rise buildings ..... 4-15.1.1.6, A-4-15.1.1.6  
 High-temperature sprinklers ..... 4-3.1.3.2, 5-2.3.2.7  
 Hoods  
 Electrical equipment protection ..... 4-13.10  
 Sprinklers in ..... 3-9.2, 3-9.4 to 3-9.7, A-3-9.2  
 Hose, outside ..... 5-2.3.1.3(f)  
 Hose connections  
 Fire department ..... *see* Fire department connections  
 Marine systems ..... 9-4.9, 9-9.1.4  
 One-and-one-half-inch ..... 4-13.20, A-4-13.20  
 Hose stations ..... 4-13.20, 5-2.3.1.3(d)  
 Hose stream  
 Allowance, marine systems ..... 9-5.3, A-9-5.3  
 Demand ..... 5-3.2.4, 5-3.4.7  
 Hose valves ..... 5-2.3.1.3(e)  
 Hydraulic calculations  
 Equivalent pipe lengths, valves and fittings ..... 6-4.3  
 Forms ..... 6-2, A-6-2  
 Formulas ..... 6-4.2  
 Graph sheets ..... 6-2.4, A-6-2.4  
 Methods ..... 5-2.3, A-5-2.3  
 Procedures ..... 6-4, A-6-4, B-2.1.3  
 Symbols and abbreviations ..... 1-5  
 Water supplies information ..... 6-3  
 Hydraulic junction points ..... 6-4.2.4  
 Hydraulic release systems ..... 3-3.1.5  
 Hydraulically designed systems  
 Circulating closed-loop systems ..... 3-6.1.2, A-3-6.1.2  
 Definition ..... 1-4.2  
 Deluge systems ..... 6-5.5  
 Exposure systems ..... 6-5.6, A-6-5.6  
 Extra hazard occupancies ..... 6-5.4, A-6-5.4  
 Information signs ..... 8-5, A-8-5  
 In-rack sprinklers ..... 6-6.1  
 Marine systems ..... 9-5.1  
 Hydrostatic tests ..... 8-2.2, A-8-2.2

**-I-**

Identification signs  
 Alarms ..... A-4-15.1.1  
 Fire department connections ..... 4-15.2.3.4 to 4-15.2.3.5  
 Hydraulically designed systems ..... 8-5, A-8-5  
 Pipe ..... 2-3.7  
 Sprinklers ..... 3-6.1.5  
 Valves ..... 2-7.3, 3-6.1.5, 9-2.6.3, A-2-7.3  
 Impairments ..... A-10-1.1  
 In-rack sprinklers ..... 4-12, 6-6  
 Flexible connections ..... A-2-4.4  
 Water demand requirements ..... 5-2.3.1.3(c), 5-4  
 Inserts ..... 2-6.2.1  
 Inspections ..... 10-1.1  
 Marine systems ..... 9-9.1  
 Installation ..... Chap. 4, A-4  
 Application of sprinkler types ..... 4-4, A-4-4  
 Baffles ..... 4-6.3.4  
 Basic requirements ..... 4-1, A-4-1  
 Location ..... 4-5 to 4-11, 4-12.4, A-4-5 to A-4-11  
 Piping ..... 4-14, A-4-14  
 Protection area per sprinkler ..... 4-5.2, 4-7.2, 4-8.2, 4-9.2,  
 4-10.2, 4-11.2, A-4-8.2.1, A-4-9.2.1, A-4-10.2  
 Spacing ..... 4-5.3, 4-6.3, 4-7.3, 4-8.3, 4-9.3, 4-10.3, 4-11.3,  
 A-4-6.3.2, A-4-10.3.1  
 Special situations ..... 4-13, A-4-13  
 System protection area limitations ..... 4-2  
 Use of sprinklers ..... 4-3, 4-5, A-4-3, A-4-5  
 Waterflow alarms ..... 2-9, A-2-9  
 Instructions, system ..... 8-4  
 Intermediate level sprinklers ..... 4-5.5.3.2, 4-6.5.3.2, 4-8.5.3.2,  
 4-10.5.3.2, 4-11-5.3.3  
 Definition ..... 1-4.5.4  
 Intermediate-temperature sprinklers ..... 4-3.1.3.2  
 Marine systems ..... 9-4.1  
 International shore connections ..... 9-2.7, 9-4.9, 9-9.1.4, A-9-2.7  
 Definition ..... 9-1.1, A-9-1.1

**-J-**

Joints ..... 2-5, A-2-5  
 Brazed and soldered ..... 2-5.4, A-2-5.4  
 End treatment ..... 2-5.6  
 Groove joining methods ..... 2-5.3  
 Welded ..... 2-5.2, A-2-5.2

**-L-**

Lag screw rods ..... 2-6.4.9 to 2-6.4.10  
 Large-drop sprinklers ..... 4-4.7, 4-10, 5-2.3.2.5, A-4-4.7.2, A-4-10  
 Clearance to storage ..... 4-10.6  
 Definition ..... 1-4.5.2  
 Deflector position ..... 4-10.4, A-4-10.4.1  
 Design approach ..... 5-3.4, A-5-3.4  
 Discharge characteristics ..... 2-2.2.2  
 Distance below ceilings ..... 4-10.4.1, A-4-10.4.1  
 Number of design ..... 5-3.4.2  
 Obstructions to discharge ..... 4-10.5, A-4-10.5  
 Protection areas ..... 4-10.2, A-4-10.2  
 Spacing ..... 4-10.3, A-4-10.3.1  
 Library stack rooms ..... 4-13.9  
 Light hazard occupancies ..... 5-2.1.2, 5-2.1.3  
 Definition ..... 1-4.7.1, A-1-4.7.1  
 Fire department connections ..... 4-13.21, A-4-13.21  
 Open-grid ceilings ..... 4-13.11, A-4-13.11  
 Openings, protection of ..... 5-2.3.3.3(a)  
 Pipe schedule ..... 6-5.2, A-6-5.2.3.1  
 Sprinkler types used in ..... 2-2.3.2, 4-4.2  
 Quick-response sprinklers ..... 5-2.3.2.4  
 Sidewall spray sprinklers ..... 5-2.3.2.3  
 System protection area limitations ..... 4-2  
 Water demand requirements ..... 5-2.2.1, 5-2.3.1.3, 5-2.3.2.1,  
 5-2.3.3.3(a), A-5-2.3.1.3(b)

- Limited area systems** ..... 1-6.2  
**Limited-combustible material (definition)** ..... 1-4.2  
**Lines, branch** ..... *see* Branch lines  
**Listed (definition)** ..... 1-4.1, A-1-4.1  
**Looped systems (definition)** ..... 1-4.3, A-1-4.3; *see also* Circulating closed-loop systems  
**Louver ceilings** ..... *see* Open-grid ceilings  
**Low-pressure blowoff valves** ..... 4-3.1.3.2(c)
- M-**
- Machine rooms, elevator** ..... 4-13.5.2, A-4-13.5.2  
**Main drain test connections** ..... 4-15.4.1  
**Main drain valve test** ..... 8-2.4.4  
**Mains** ..... *see also* Cross mains  
    **Feed (definition)** ..... 1-4.4  
**Maintenance, system** ..... Chap. 10, A-10  
    **Marine systems** ..... 9-9  
**Marine systems** ..... Chap. 9, A-9  
    **Acceptance** ..... 9-8  
    **Design approaches** ..... 9-5, A-9-5  
    **Fire department connections** ..... 9-2.7, A-9-2.7  
    **Installation requirements** ..... 9-4, A-9-4  
    **International shore connections** ..... 9-2.7, 9-9.1.4, A-9-2.7  
    **Maintenance** ..... 9-9  
    **Occupancy classifications** ..... 9-1.2, A-9-1.2  
    **Partial installation** ..... 9-1.3, A-9-1.3  
    **Piping** ..... 9-2.2, 9-2.4 to 9-2.5, 9-3.3, 9-4.10, 9-6.4.4, A-9-2.2, A-9-2.4.3(b), A-9-2.5, A-9-4.10  
    **Plans and calculations** ..... 9-7  
    **Requirements** ..... 9-3, A-9-3.1  
    **Spare sprinklers** ..... 9-2.3  
    **Sprinkler orifice size** ..... 9-2.1, A-9-2.1  
    **System components, hardware, and use** ..... 9-2, A-9-2  
    **Valves** ..... 9-2.6, 9-6.4.2  
    **Water supplies** ..... 9-6, A-9-6  
**Marine thermal barrier (definition)** ..... 9-1.1, A-9-1.1  
**Maximum horizontal load** ..... Table 4-14.4.3.5.5  
**Meters** ..... 7-1.3  
**Mezzanines** ..... 4-2, 6-5.1.3  
**Miscellaneous storage**  
    **Definition** ..... 1-4.2, A-1-4.2  
    **Early suppression fast-response (ESFR) sprinklers** ..... 5-3.5.1, A-5-3.5.1.2  
    **Large-drop sprinklers** ..... 5-3.4.1, 5-3.4.2.2  
    **Occupancy classification** ..... 1-4.7.4.2  
**Moving stairways** ..... 4-13.3.4, A-4-13.3.4
- N-**
- Nitrogen pressurized systems** ..... 3-2.6.8, 3-8.2.3, A-3-8.4  
**Noncombustible material (definition)** ..... 1-4.2  
**Nonfire protection connections to sprinkler systems** ..... 3-6, 8-6, A-3-6.1.2  
    **Working plans** ..... 6-1.1.3, A-6-1.1.3  
**Normal pressure formula** ..... 6-4.2.3  
**Nozzles (definition)** ..... 1-4.5.2
- O-**
- Obstructed construction (definition)** ..... 1-4.6, A-1-4.6(a); *see also* Obstructions to sprinklers  
**Obstructions to sprinklers** ..... 4-5.5, 4-7.5, 4-8.5, 4-9.5, 4-10.5, 4-11.5, A-4-5.5, A-4-10.5  
    **Circulating closed-loop systems** ..... 3-6.1.4  
    **Double joist** ..... 4-6.4.1.4  
    **Early suppression fast-response (ESFR) sprinklers** ..... 4-11.5, A-4-11.5.3  
    **Fixed** ..... 4-5.5.3.1, 4-6.5.3.1, 4-7.5.3.1, 4-8.5.3.1, 4-9.5.3.1  
    **Hazard, discharge prevented from reaching** ..... 4-5.5.3, 4-6.5.3, 4-7.5.3, 4-8.5.3, 4-9.5.3, A-4-5.5.3  
    **Large-drop sprinklers** ..... 4-10.5, A-4-10.5  
    **Pattern development** ..... 4-5.5.2, 4-6.5.2, 4-7.5.2, 4-8.5.2, 4-9.5.2, 4-10.5.2, 4-11.5.2, A-4-5.5.2  
    **Pendent and upright sprinklers** ..... 4-6.4.1.4, 4-6.5, 4-8.5, A-4-6.5, A-4-8.5.3  
    **Performance objectives** ..... 4-5.5.1, 4-6.5.1, 4-7.5.1, 4-8.5.1, 4-9.5.1, 4-10.5.1, 4-11.5.1  
    **Sidewall spray sprinklers** ..... 4-7.5  
    **Suspended or floor mounted vertical** ..... 4-6.5.4, 4-7.5.4, 4-8.5.4, 4-9.5.4, A-4-6.5.4  
**Occupancy classifications** ..... 1-4.7, 5-2.1, A-1-4.7, A-5-2.1.3; *see also* Extra hazard occupancies; Light hazard occupancies; Ordinary hazard occupancies; Special hazard occupancies  
    **Changes** ..... 4-3.1.3.3  
    **Marine** ..... 9-1.2, A-9-1.2  
    **Miscellaneous storage** ..... 1-4.7.4.2, Table 1-4.7.4.2  
    **Sprinkler types selected for use** ..... 4-4.1 to 4-4.4  
    **Water demand requirements** ..... 5-2.1, A-5-2.1.3  
    **Pipe schedule method** ..... 5-2.2, A-5-2.2.3  
**Occupancy hazard fire control design approach** ..... 5-2, A-5-2  
**Old-style sprinklers** ..... 1-4.5.2, 4-13.13, A-4-13.13  
**One-and-one-half-inch hose connections** ..... 4-13.20, A-4-13.20  
**Open sprinklers** ..... 1-4.5.2  
    **Permitted uses** ..... 4-4.4  
**Open-grid ceilings** ..... 4-13.11, A-1-4.6(b)(ii), A-4-13.11  
**Openings, protection of** ..... 5-2.3.3.3  
**Operational tests, system** ..... 8-2.4  
**Ordinary hazard occupancies** ..... 5-2.1.2  
    **Definitions** ..... 1-4.7.2, A-1-4.7.2  
    **Fire department connections** ..... 4-13.21, A-4-13.21  
    **Open-grid ceilings** ..... 4-13.11, A-4-13.11  
    **Openings, protection of** ..... 5-2.3.3.3(b)  
    **Pipe schedule** ..... 6-5.3, A-6-5.3.3.1  
    **Sprinkler types used in** ..... 4-4.2  
        **Early suppression fast-response (ESFR) sprinklers** ..... 5-3.5.1, A-5-3.5.1.2  
        **Large-drop sprinklers** ..... 5-3.4.1, 5-3.4.2.2  
        **Quick-response sprinklers** ..... 5-2.3.2.4  
        **Sidewall spray sprinklers** ..... 5-2.3.2.3  
    **System protection area limitations** ..... 4-2  
    **Water demand requirements** ..... 5-2.2.1, 5-2.3.1.3, 5-2.3.2.1, 5-2.3.3.3(b), A-5-2.3.1.3(b)  
**Orifice sizes, hydraulic calculation procedures** ..... 6-4.4.6 to 6-4.4.7, A-6-4.4.6 to A-6-4.4.7  
**Ornamental finishes** ..... 2-2.5.4  
**Ornamental sprinklers** ..... 1-4.5.4, 2-2.3.1, 2-2.5.4  
    **Definition** ..... 1-4.5.4  
**Outside hose** ..... 5-2.3.1.3(f)  
**Outside sprinklers** ..... 3-7, 6-5.6, A-3-7.2.1, A-6-5.6; *see also* Exposure protection systems  
**Overhead doors, sprinklers obstructed by** ..... 4-5.5.3.1, 4-6.5.3.1, 4-7.5.3.1, 4-8.5.3.1, 4-9.5.3.1
- P-**
- Paddle-type waterflow alarms** ..... 2-9.2.4, A-2-9.2.4  
**Painting, of sprinklers** ..... 2-2.5.3, A-2-2.5.3  
**Panel construction (definition)** ..... A-1-4.6(a)(iii)  
**Partial systems** ..... 5-2.3.1.3(e), 9-1.3, A-9-1.3  
**Pendent sprinklers** ..... 1-4.5.3, 4-6, 5-2.3.2.5, A-4-6  
    **Clearance to storage** ..... 4-6.6, 4-8.6, A-4-6.6  
    **Deflector position** ..... 4-6.4, 4-8.4, A-4-8.4.1.3  
    **Elevator hoistways** ..... 4-13.5.3, A-4-13.5.3  
    **Extended coverage** ..... 4-4.2, 4-8, A-4-8  
    **Obstructions to discharge** ..... 4-6.4.1.4, 4-6.5, 4-8.5, A-4-6.5, A-4-8.5.3  
    **Permitted uses** ..... 4-4.1  
    **Protection areas** ..... 4-6.2, 4-8.2, A-4-8.2.1  
    **Return bends** ..... 4-13.17, 9-4.8  
    **Spacing** ..... 4-6.3, 4-8.3  
**Pipe friction loss** ..... 6-4.2.1, 6-4.4.5

- Pipe schedule systems** ..... 6-5, A-6-5  
 Definition ..... 1-4.2  
 Exposure systems ..... 6-5.6, A-6-5.6  
 Light hazard occupancies ..... 6-5.2, A-6-5.2.3.1  
 Ordinary hazard occupancies ..... 6-5.3, A-6-5.3.3.1  
 Risers, size of ..... 6-5.1.2, A-6-5.1.2  
 Slatted floors/large floor openings/mezzanines/large platforms ..... 6-5.1.3  
 Stair towers ..... 6-5.1.4  
 Underground supply pipe ..... 7-1.2.1  
 Water demand requirements ..... 5-2.2, A-5-2.2.3
- Pipe support** ..... 4-14.2, A-4-14.2  
 Marine systems ..... 9-2.5, A-9-2.5
- Pipes and piping** ..... 2-3; *see also* Fittings; Valves  
 Above drop-out ceilings ..... 4-13.12.3, A-4-13.12.3  
 Antifreeze systems ..... 3-5.3, A-3-5.3  
 Bending ..... 2-3.6  
 Capacities ..... A-3-2.3  
 Circulating closed-loop systems ..... 3-6.1.1.2 to 3-6.1.1.3, 3-6.1.2, A-3-6.1.2  
 Clearance ..... 4-14.4.3.4, A-4-14.4.3.4  
 Couplings ..... 4-14.4.3.2, A-4-14.4.3.2  
 Drainage ..... 4-14.3, A-4-14.3  
 End treatment ..... 2-5.6  
 Equivalent lengths, valves and fittings ..... 6-4.3  
 Flushing of ..... 4-13.5, 8-2.1, 8-2.2.6, 9-9.1.8, A-8-2.1  
 Foundation walls, piping through/under ..... 7-1.2.3, A-7-1.2.3  
 Heat-sensitive materials ..... 9-4.10, A-9-4.10  
 Hydraulic calculations ..... 6-4.4.3, 6-4.4.5, A-6-4.4.3  
 Hydrostatic tests ..... 8-2.2.3  
 Identification ..... 2-3.7  
 Installation ..... 4-14, A-4-14  
 Joining ..... 2-5, A-2-5  
 Marine systems ..... 9-2.2, 9-2.4 to 9-2.5, 9-3.3, 9-4.10, 9-6.4.4, A-9-2.2, A-9-2.4.3(b), A-9-2.5, A-9-4.10  
 Materials and dimensions ..... 2-3.1 to 2-3.5, Table 2-3.1, Table 2-3.5, Table A-2-3.2, Table A-2-3.4, A-2-3.5  
 Maximum horizontal load ..... Table 4-14.4.3.5.5  
 Outside sprinklers ..... 3-7.5  
 Protection  
 Corrosion ..... *see* Corrosion protection, piping  
 Earthquake damage ..... 4-14.4.3, A-4-14.4.3  
 Freezing ..... 4-14.4.1; *see also* Antifreeze systems  
 Refrigerated spaces ..... 3-8.2, A-3-8.2  
 Size, fire department connections ..... 4-15.2.2  
 Sprinklers below ceilings ..... 4-13.18  
 Sprinklers obstructed by ... 4-5.5.2.2, 4-6.5.2.2, 4-7.5.2.2, 4-8.5.2.2  
 Steel ..... 4-4.7.2, A-4-4.7.2  
 Sway bracing ..... 4-14.4.3.5, A-4-14.4.3.5  
 System subdivision ..... 4-13.22, A-4-13.22  
 Test connections ..... 4-15.4, A-4-15.4  
 Threaded ..... 2-5.1, A-2-5.1.2  
 Underground ..... *see* Underground pipe  
 Welded ..... 2-5.2, A-2-5.2
- Plans and calculations** ..... Chap. 6, A-6  
 Marine systems ..... 9-7  
 Predicting expected performance from calculations ..... B-2.1.4
- Platforms**  
 Pipe schedules ..... 6-5.1.3  
 Spaces under ..... 4-13.6
- Plenums, sprinklers in** ..... 3-9.2, 3-9.5 to 3-9.7, A-3-9.2
- Powder-driven studs/fasteners** ..... 2-6.3, 4-14.4.3.5.18, A-2-6.3
- Preaction systems** ..... 3-3, A-3-3; *see also* Combined dry pipe-preaction systems  
 Definition ..... 1-4.3  
 Double interlock systems ..... 3-3.2.1(c), 5-2.3.2.6, 5-3.4.2.2  
 Air test ..... 8-2.3  
 Drainage, auxiliary ..... 4-14.3.5.2 to 4-14.3.5.3, A-4-14.3.5.2.3  
 Fire department connections ..... 4-15.2.3.2(c)  
 Large-drop sprinklers used in ..... 4-4.7.1 to 4-4.7.2, 5-3.4.2.2, A-4-4.7.2  
 Marine, supervision of ..... 9-3.3  
 Test connections ..... 4-15.4.4  
 Waterflow detecting devices ..... 2-9.2.3  
**Preaction valves** ..... 3-3.2.2, 3-8.2.6, 4-15.1.1.3  
 Operational tests ..... 8-2.4.3  
**Pressure, air** ..... *see* Air pressure  
**Pressure, working** ..... 2-1.2, 2-3.2 to 2-3.3  
**Pressure gauges** ..... 4-14.1.2.2, 4-15.3  
 Accessibility ..... 4-1.2, A-4-1.2  
 Circulating closed loop systems ..... 8-6  
 Deluge systems ..... 3-3.1.3  
 Dry pipe systems ..... 3-2.1  
 Outside sprinklers ..... 3-7.7  
 Preaction systems ..... 3-3.1.3  
 Wet pipe systems ..... 3-1.1  
**Pressure relief valves** ..... *see* Relief valves  
**Pressure tanks** ..... 5-2.3.1.3(h), 7-2.3, A-7-2.3.3  
 Marine systems ..... 9-6.2, 9-6.4.1, 9-6.4.4, 9-7.1, 9-9.1.3, A-9-6.2.6  
**Pressure-reducing valves** ..... 4-14.1.2, A-4-14.1.2.3  
 Operational tests ..... 8-2.5  
**Propylene glycol** ..... 3-5.2.1, A-3-5.2  
**Protection for system components**  
 Corrosion ..... *see* Corrosion protection, piping;  
 Corrosion-resistant sprinklers  
 Dry pipe valves ..... 3-2.5, A-3-2.5  
 Earthquake damage, pipe protection from ... 4-14.4.3, A-4-14.4.3  
 Exposure ..... *see* Exposure protection systems  
 Freezing ..... 4-14.4.1; *see also* Antifreeze systems  
 Preaction and deluge water control valves ..... 3-3.1.8  
**Protection provided by sprinkler system** ..... *see* System protection area
- Pumps**  
 Fire (marine systems) ..... 9-6.3, 9-6.4.1, 9-6.4.4, 9-7.1, 9-9.1.2, A-9-6.3.6(a)  
 Water supply ..... 5-2.3.1.3(h), 7-2.2, 7-2.2.1, A-7-2.2.1  
**Purpose of standard** ..... 1-2
- Q-
- QR** ..... *see* Quick-response (QR) sprinklers  
**QREC** ..... *see* Quick-response extended coverage (QREC) sprinklers  
**QRES** ..... *see* Quick-response early suppression (QRES) sprinklers  
**Quick-opening devices** ..... 3-2.4, 3-4.2.4, 8-2.4.2  
**Quick-response early suppression (QRES) sprinklers**  
 (definition) ..... 1-4.5.2, A-1-4.5.2  
**Quick-response extended coverage (QREC) sprinklers**  
 (definition) ..... 1-4.5.2  
**Quick-response (QR) sprinklers** ..... 4-4.5.3, 5-2.3.2.4  
 Definition ..... 1-4.5.2  
 Extra-hazard occupancies ..... 5-2.3.2.3  
 Light hazard occupancies ..... 5-2.1.3, A-5-2.1.3  
 Permitted uses ..... 4-4.1  
 Water demand requirements ..... 5-2.3.2.3 to 5-2.3.2.4
- R-
- Rack storage sprinklers** ..... 4-5.5.3.2, 4-6.5.3.2, 4-8.5.3.2, 4-10.5.3.2, 4-11-5.3.3  
 Definition ..... *see* Definition ..... 1-4.5.4  
**Recessed sprinklers (definition)** ..... 1-4.5.3  
**Records, pipe welding** ..... 2-5.2.9  
**Reducers** ..... 2-4.5  
**Referenced publications** ..... Chap. 11, App. C  
**Refrigerated spaces** ..... 3-8, A-3-8  
**Relief valves** ..... 3-1.2, 3-2.6.4  
 Marine systems ..... 9-3.1, A-9-3.1  
 Pressure tanks (marine systems) ..... 9-6.2.2  
**Remote area of application** ..... B-2.1.3  
**Residential sprinklers** ..... 2-2.3.1, 4-4.5, A-4-4.5.1  
 Definition ..... 1-4.5.2  
 Design approach ..... 5-3.2, A-5-3.2



- Light hazard occupancies ..... 5-2.1.3, A-5-2.1.3  
 Marine systems ..... 9-4.2, A-9-4.2  
 Residual pressure requirement ..... 5-2.2.3, A-5-2.2.3  
 Response Time Index (RTI) ..... 1-4.5.1(a), A-1-4.5.1  
 Retroactivity of standard ..... 1-3  
 Return bends ..... 4-13.17, 9-4.8  
**Risers**  
 Building service chutes ..... 5-2.3.4.1  
 Definition ..... 1-4.4  
 Outside refrigerated spaces ..... 3-8.2.5 to 3-8.2.6, A-3-8.2.5  
 Size ..... 6-5.1.2, A-6-5.1.2  
 Support of ..... 4-14.2.5  
 Sway bracing ..... 4-14.4.3.5.9, A-4-14.4.3.5.9  
 System ..... 3-8.2.6, 4-2  
 Definition ..... 1-4.4  
 System subdivision ..... 4-13.22, A-4-13.22  
**Rods** ..... 2-6.4.1  
 Eye ..... 2-6.4.3  
 Lag screw ..... 2-6.4.9 to 2-6.4.10  
**Roof**  
 Exterior ..... 4-13.7, A-4-13.7  
 Peak, sprinklers at or near ..... 4-6.4.1.3, A-4-6.4.1.3  
 Uninsulated, sprinklers under ..... 4-3.1.3.2(e)  
 Room design method ..... 5-2.3.1.2, 5-2.3.3, 6-4.4.1(b), A-5-2.3.3.1  
 Rooms, small ..... 1-4.2
- S-
- Scope of standard ..... 1-1, A-1-1  
**Screws** ..... 2-6.4.8  
 Bolt/lag ..... 2-6.4.6, 2-6.4.9 to 2-6.4.10  
 Ceiling flanges ..... 2-6.4.5  
 U-hook ..... 2-6.4.5  
 Wood ..... 2-6.4.7  
**Seismic separation assembly** ..... 4-14.4.3.3, A-4-14.4.3.3  
**Semi-mill construction (definition)** ..... A-1-4.6(a)(iv)  
**Shafts, vertical** ..... 4-13.2, A-4-13.2.2  
**Shall (definition)** ..... 1-4.1  
**Shields**  
 Electrical equipment protection ..... 4-13.10  
 Expansion ..... 2-6.2.2 to 2-6.2.6  
 Sprinkler ..... 2-2.7, A-2-2.7  
**Shop air supply** ..... 3-2.6.5  
**Shop welded**  
 Definition ..... 1-4.2  
 Piping ..... 2-5.2.2, A-2-5.2.2  
**Should (definition)** ..... 1-4.1  
**Show windows, sprinklers under** ..... 4-3.1.3.2(f)  
**Sidewall spray sprinklers** ..... 4-7, 5-2.3.2.5, A-4-7  
 Clearance to storage ..... 4-7.6  
 Definition ..... 1-4.5.3  
 Deflector position ..... 4-7.4, 4-9.4  
 Elevator hoistways ..... 4-13.5.1, A-4-13.5.1  
 Extended coverage ..... 4-9, A-4-9  
 Light hazard occupancies ..... 5-2.3.2.3  
 Obstructions to discharge ..... 4-7.5, 4-9.5, A-4-9.5.3  
 Ordinary hazard occupancies ..... 5-2.3.2.3  
 Protection areas ..... 4-7.2, 4-9.2, A-4-9.2.1  
 Spacing ..... 4-7.3, 4-9.3  
**Signs** ..... *see* Identification signs  
**Skylights, sprinklers under** ..... 4-3.1.3.2(d)  
**Slatted floors, pipe schedules** ..... 6-5.1.3  
**Small orifice sprinklers** ..... 2-2.3.2  
**Small rooms (definition)** ..... 1-4.2  
**Smooth ceiling construction (definition)** ..... A-1-4.6(b)(iii)  
**Soldered joints** ..... 2-5.4, A-2-5.4  
**Spaces** ..... *see* Concealed spaces  
**Spare detection devices, stock of** ..... 9-3.2  
**Spare sprinklers, stock of** ..... 2-2.8, 9-2.3  
**Special hazard occupancies** ..... 1-4.7.4, 4-4.4, 5-2.1.2, A-1-4.7.4.1  
**Special situations** ..... 4-13, A-4-13  
 Building service chutes ..... 4-13.4, A-4-13.4  
 Concealed spaces ..... 4-13, A-4-13.1.1  
 Drop-out ceilings ..... 4-13.12, A-4-13.12  
 Dry pipe underground ..... 4-13.19  
 Dwelling units ..... 4-13.8, A-4-13.8.2  
 Electrical equipment ..... 4-13.10  
 Elevator hoistways and machine rooms ..... 4-13.5, A-4-13.5  
 Exterior roofs/canopies ..... 4-13.7, A-4-13.7  
 Flushing systems, provision for ..... 4-13.15  
 Ground floors/exterior docks/platforms, spaces under ..... 4-13.6  
 Hose connections, fire department use ..... 4-13.21, A-4-13.21  
 Library stack rooms ..... 4-13.9  
 Old-style sprinklers ..... 4-13.13, A-4-13.13  
 Open-grid ceilings ..... 4-13.11, A-4-13.11  
 Piping to sprinklers below ceilings ..... 4-13.18  
 Return bends ..... 4-13.17  
 Stages ..... 4-13.14  
 Stair towers ..... 4-13.16  
 Stairways ..... 4-13.3, A-4-13.3  
 Vertical shafts ..... 4-13.2, A-4-13.2.2  
**Special sprinklers** ..... 1-4.5.2, 2-2.3.1, 4-4.9, A-4-4.9.1  
**Spray nozzles, cooking equipment protection** ..... 3-9, A-3-9.2  
**Spray sprinklers** ..... 5-2.3.2.3; *see also* Sidewall spray sprinklers  
 Definition ..... 1-4.5.2  
**Sprig-up**  
 Definition ..... 1-4.4  
 Sway bracing ..... 4-14.4.3.5.15, A-4-14.4.3.5.15  
**Sprinkler alarms** ..... 4-15.1, A-14-15.1; *see also* Waterflow alarms/detection devices  
**Sprinkler systems** ..... *see also* Antifreeze systems; Combined dry pipe-preaction systems; Deluge systems; Dry pipe systems; Hydraulically designed systems; Pipe schedule systems; Preaction systems; System protection area; Wet pipe systems  
 Acceptance ..... Chap. 8, A-8  
 Components and hardware ..... Chap. 2, 9-2, A-2, A-9-2  
 Definition ..... 1-4.2, A-1-4.2  
 Design ..... *see* Design, sprinkler system  
 Future upgrading of performance ..... B-2.1.5  
 Installation ..... Chap. 4, A-4  
 Limited area ..... 1-6.2  
 Maintenance ..... 9-9, Chap. 10, A-10  
 Marine systems ..... *see* Marine systems  
 Nonfire protection connections to ..... 3-6, 8-6, A-3-6.1.2  
 Working plans ..... 6-1.1.3, A-6-1.1.3  
 Partial systems ..... 5-2.3.1.3(e), 9-1.3, A-9-1.3  
 Performance criteria ..... B-2  
 Protection, level of ..... 1-6  
 Requirements ..... Chap. 3, A-3  
 Size of ..... 3-2.3, 3-3.2.2, 4-12.1, A-3-2.3  
 Subdivision ..... 4-13.22, A-4-13.22  
 Valves ..... *see* Valves  
 Working pressure ..... 2-1.2, 2-3.2 to 2-3.3  
**Sprinklers** ..... *see also* Dry sprinklers; Early suppression fast-response (ESFR) sprinklers; High-temperature sprinklers; In-rack sprinklers; Large-drop sprinklers; Old-style sprinklers; Outside sprinklers; Pendent sprinklers; Residential sprinklers; Sidewall spray sprinklers; Upright sprinklers  
 Application of types ..... 4-4, A-4-4  
 Clearance to storage ..... 4-5.6, 4-6.6, 4-7.6, 4-8.6, 4-10.6, 4-11.6, A-4-6.6  
 Corrosion-resistant ..... *see* Corrosion-resistant sprinklers  
 Definitions ..... 1-4.5, 1-4.5.3, A-1-4.5  
 Discharging capacities ..... 2-2.2, 2-2.3.2 to 2-2.3.3  
 Hydraulic calculations ..... 6-4.4.4, A-6-4.4.4  
 Limitations ..... 2-2.3  
 Location ..... 4-1.1, 4-5 to 4-11, A-4-1.1, A-4-5 to A-4-11  
 New sprinkler requirement ..... 2-2.1  
 Open ..... 4-4.4  
 Outside ..... 3-7, A-3-7.2.1  
 Painting ..... 2-2.5.3, A-2-2.5.3  
 Piping to, below ceilings ..... 4-13.18  
 Positioning ..... 4-1.1, 4-5 to 4-11, A-4-5 to A-4-11  
 Protection area per sprinkler ..... 4-5.2, 4-6.2, 4-7.2, 4-8.2, 4-9.2, 4-10.2, 4-11.2, A-4-8.2.1, A-4-9.2.1, A-4-10.2

Spacing ..... 4-1.1, 4-5.3, 4-6.3, 4-7.3, 4-8.3, 4-9.3, 4-10.3, 4-11.3, A-4-1.1, A-4-6.3.2, A-4-10.3.1

Spare, stock of ..... 2-2.8, 9-2.3

Temperature ratings ..... 4-3.1.3

Thermal sensitivity (definition) ..... 1-4.5.1(a), A-1-4.5.1; *see also* Temperature ratings of sprinklers

Use of ..... 4-3, 4-5, A-4-3, A-4-5

Stages ..... 4-13.14

Stairways ..... 4-13.3, A-4-13.3

Marine systems ..... 9-4.5.2

Stair towers ..... 4-13.16, 6-5.1.4

Type 1 (definition) ..... 9-1.1

Standard (definition) ..... 1-4.1

Standard mill construction (definition) ..... A-1-4.6(b)(iv)

Steel fittings ..... 2-5.1.2, A-2-5.1.2

Steel pipe ..... 4-4.7.2, A-4-4.7.2

Storage

Clearance to .... 4-5.6, 4-6.6, 4-7.6, 4-8.6, 4-10.6, 4-11.6, A-4-6.6

Design of system ..... 5-2.3.2.2

Early suppression fast-response (ESFR) sprinklers use .... 5-3.5.1, A-5-3.5.1.2

High-piled ..... 4-2

Definition ..... 1-4.2

Large-drop sprinklers ..... 5-3.4.1, 5-3.4.2.2

Miscellaneous ..... *see* Miscellaneous storage

Strainers ..... 2-2.3.2(c), 3-7.6, 3-9.10, 4-15.1.1.5

Structural members ..... A-4-1

Studs ..... 2-6.3, A-2-6.3

Summary sheet, hydraulic calculations ..... 6-2.2, A-6-2.2

Supervision

Definition ..... 9-1.1

Deluge systems ..... 3-3.3.1

Marine system piping ..... 9-3.3

Preaction systems ..... 3-3.2.3, 9-3.3

Supervisory devices ..... 4-14.1.1.3

Definition ..... 1-4.4

Survival angle (definition) ..... 9-1.1

Sway bracing ..... 4-14.4.3.5, A-4-14.4.3.5

System protection area ..... *see also* Area/density method

Geometry of area of application ..... B-2.1.3

Level of protection ..... 1-6

Limitations ..... 4-2

Maximum protection area of coverage ..... 4-5.2.2, 4-6.2.2, 4-8.2.2, 4-9.2.2, 4-10.2.2, 4-11.2.2

Protection area per sprinkler .... 4-5.2, 4-6.2, 4-7.2, 4-8.2, 4-9.2, 4-10.2, 4-11.2, A-4-8.2.1, A-4-9.2.1, A-4-10.2

Selection of area of application ..... B-2.1.2

-T-

Tanks

Gravity ..... 5-2.3.1.3(h), 7-2.4

Pressure ..... *see* Pressure tanks

Temperature characteristics ..... 2-2.4, A-2-2.4

Temperature ratings of sprinklers ..... 4-3.1.3

Early suppression fast-response (ESFR) sprinklers ..... 4-4.6.4

In-rack sprinklers ..... 4-12.3

Large-drop sprinklers ..... 4-4.7.3

Marine systems ..... 9-4.1

Special sprinklers ..... 4-4.9.2(b)

Test blanks ..... 8-2.2.7, A-8-2.2.7

Test connections ..... 3-4.6, 4-15.4, A-4-15.4

Deluge systems ..... 4-15.4.5

Dry pipe systems ..... 4-15.4.3, A-4-15.4.3

Main drain ..... 4-15.4.1

Marine systems ..... 9-4.13

Preaction systems ..... 4-15.4.4

Wet pipe systems ..... 4-15.4.2, A-4-15.4.2

Test valves ..... 2-7.2, 9-2.6.2, 9-6.3.5

Testing ..... 10-1.1

Apparatus/devices for ..... 3-3.1.7

Combined dry pipe-preaction systems ..... 3-4.6

Deluge systems ..... 3-3.1.7

Discharge ..... 8-6

Dry pipe and double-interlocked system air ..... 8-2.3

Hydrostatic ..... 8-2.2, A-8-2.2

Main drain valve ..... 8-2.4.4

Marine systems ..... 9-9.1

Preaction systems ..... 3-3.1.7

Special sprinklers ..... A-4-4.9.1

System operational ..... 8-2.4

Water disposal after ..... 8-2.2.6

Thermal barriers (definition) ..... 1-4.2

Thermal sensitivity (definition) ..... 1-4.5.1(a), A-1-4.5.1; *see also* Temperature ratings of sprinklers

Threaded pipe and fittings ..... 2-5.1, A-2-5.1.2

Time limitation, combined dry pipe-preaction systems ..... 3-4.5

Toggle hangers ..... 4-14.2.1.1

Trapeze hangers ..... 2-6.1.5, A-2-6.1.5

Tripping devices, combined systems ..... 3-4.2.2

Tube ..... *see* Pipes and piping

Type 1 stair (definition) ..... 9-1.1

## -U-

U-hooks ..... 2-6.4.2, 2-6.4.5, 4-14.4.3.5.10, 9-2.5.4, A-9-2.5.4

Underground pipe ..... 7-1.2.1 to 7-1.2.3, A-7-1.2.3

Dry pipe ..... 4-13.19

Hydrostatic tests ..... 8-2.2.5

Unions ..... 2-4.4, A-2-4.4

Unobstructed construction (definition) ..... 1-4.6, A-1-4.6(b)

Upright sprinklers

Clearance to storage ..... 4-6.6, 4-8.6, A-4-6.6

Definition ..... 1-4.5.3

Deflector position ..... 4-6.4, 4-8.4, A-4-8.4.1.3

Elevator hoistways ..... 4-13.5.3, A-4-13.5.3

Extended coverage ..... 4-4.2, 4-8, A-4-8

Installation ..... 3-2.2, 3-3.2.4, 3-4.1.4, 4-3.1.2, A-3-2.2, A-3-3.2.4, A-3-4.1.4, A-4-3.1.2

Obstructions to discharge ..... 4-6.4.1.4, 4-6.5, 4-8.5, A-4-6.5, A-4-8.5.3

Permitted uses ..... 4-4.1

Protection areas ..... 4-6.2, 4-8.2, A-4-8.2.1

Spacing ..... 4-6.3, 4-8.3

## -V-

Valve rooms ..... 3-2.5.2, 3-3.1.8.2, A-3-2.5

Valves ..... 2-7, A-2-7.3; *see also* Check valves; Control valves; Drain valves; Dry pipe valves; Preaction valves; Pressure-reducing valves

Accessibility ..... 4-1.2, A-4-1.2

Air exhaust ..... 3-4.3, A-3-4.3

Alarm ..... 4-15.1.1.2 to 4-15.1.1.3

Antifreeze systems ..... 3-5.3, A-3-5.3

Backflow prevention ..... 4-15.4.6.1

Combined systems ..... 3-4.2

Deluge ..... 4-15.1.1.3, 8-2.4.3

Differential-type ..... 8-2.2.8

Equivalent pipe lengths ..... 6-4.3

Fire department connections ..... 4-15.2.4

Gate ..... 2-7.1.1

Hose ..... 5-2.3.1.3(e)

Identification ..... 2-7.3, 3-6.1.5, 9-2.6.3, A-2-7.3

Low-pressure blowoff ..... 4-3.1.3.2(c)

Marine systems ..... 9-2.6, 9-6.4.2, 9-9.1.4

Outside sprinklers ..... 3-7.3, 3-7.4.1, 3-7.4.2

Supervision ..... 4-14.1.1.3

Test ..... 2-7.2, 9-2.6.2, 9-6.3.5

Types ..... 2-7.1

Wafer-type ..... 2-7.1.3

Velocity pressure formula ..... 6-4.2.2

Ventilation, cooking areas ..... 3-9, 4-3.1.3.2(g), A-3-9.2

Vertical obstructions to sprinklers .....	4-6.5.4, 4-7.5.4, 4-8.5.4, 4-9.5.4, A-4-6.5.4
Vertical shafts .....	4-13.2, A-4-13.2.2
Marine systems .....	9-4.5
-W-	
<b>Walls</b>	
Deflector distance from .....	4-7.4.1
Distance from sprinklers ...	4-5.3.2 to 4-5.3.3, 4-6.3.2 to 4-6.3.3, 4-7.3.2 to 4-7.3.3, 4-8.3.2 to 4-8.3.3, 4-9.3.2 to 4-9.3.3, 4-9.4.1, 4-10.3.2 to 4-10.3.3, 4-11.3.2 to 4-11.3.3, A-4-6.3.2
<b>Water additives</b> .....	8-2.2.2
Antifreeze solutions .....	3-5.1 to 3-5.2, A-3-5.1 to A-3-5.2
Circulating closed-loop systems .....	3-6.1.6
<b>Water curtains</b> .....	5-2.3.1.3(c), 5-3.7
<b>Water demand requirements</b> .....	5-1
Area/density method .....	5-2.3.2, A-5-2.3.2.3
Hydraulic calculation methods .....	5-2.3, A-5-2.3
In-rack sprinklers .....	5-2.3.1.3(c), 5-4, 6-6.2
Occupancy classifications .....	5-2.1, A-5-2.1.3
Pipe schedule method .....	5-2.2, A-5-2.2.3
Room design method .....	5-2.3.3, A-5-2.3.3.1
Special design approaches .....	5-3, A-5-3
<b>Water supplies</b> .....	Chap. 7, A-7
Arrangement .....	7-1.2
Capacity .....	7-1.1
Definition .....	9-1.1
Domestic/fire protection supply connections .....	B-1
Duration .....	5-3.2.4, 5-3.4.7, 5-3.5.5
Information .....	6-3
Marine systems .....	9-6, A-9-6
Meters .....	7-1.3
Outside sprinklers .....	3-7.2, A-3-7.2.1
Pendent sprinklers, return bend requirement .....	4-13.17
Types .....	7-2, A-7-2
Water temperature, closed-loop systems .....	3-6.1.3
Water works system, connections to .....	7-2.1, A-7-2.1

<b>Waterflow alarms/detection devices</b> .....	2-9, 4-15.1.1, 5-2.2.2, 5-2.3.1.3(g), 9-4.12.2, A-2-9, A-4-15.1.1
Attachments, electrically operated .....	2-9.5, A-2-9.5
Attachments, general .....	2-9.3, A-2-9.3
Circulating closed-loop systems .....	3-6.1.7, 8-6
Drains .....	2-9.6
Flow tests .....	8-2.4.1, 8-3(c), 8-6
High-rise buildings .....	4-15.1.1.6, A-4-15.1.1.6
Mechanically operated .....	4-15.1.1.5, A-4-15.1.1.5
<b>Water-motor-operated devices</b> .....	4-15.1.1.5, A-4-15.1.1.5
<b>Welded pipe</b> .....	2-5.2, A-2-5.2
Qualifications .....	2-5.2.8
Records .....	2-5.2.9.2
<b>Welding studs</b> .....	2-6.3, A-2-6.3, A-2-6.3.2
<b>Wet pipe systems</b> .....	3-1
Connections .....	4-14.1.1.7 to 4-14.1.1.8, A-4-14.1.1.7 to A-4-14.1.1.8
Definition .....	1-4.3
Drainage, auxiliary .....	4-14.3.5.2, A-4-14.3.5.2.3
Early suppression fast-response sprinklers used in .....	4-4.6.1
Fire department connections .....	4-15.2.3.2(a), 5-2.3.1.3(e)
Hose connections .....	4-13.20 to 4-13.21, A-4-13.20 to A-4-13.21
Large-drop sprinklers used in .....	4-4.7.1, 5-3.4.2.2
Marine systems .....	9-9.1.8
Pressure gauges .....	3-1.1
Quick-response sprinklers used in .....	5-2.3.2.4
Relief valves .....	3-1.2
Residential sprinklers used in .....	4-4.5.2
Return bends, marine systems .....	9-4.8
Test connections .....	4-15.4.2, A-4-15.4.2
Waterflow detecting devices .....	2-9.2.1, 2-9.2.4, A-2-9.2.4
<b>Window protection, marine system</b> .....	9-7.2
<b>Window protection, marine systems</b> .....	9-4.3, 9-5.2, A-9-5.2
<b>Wood joist construction (definition)</b> .....	A-1-4.6(a)(v)
<b>Wood truss construction (definition)</b> .....	A-1-4.6(b)(v)
<b>Work sheets, hydraulic calculations</b> .....	6-2.3, A-6-2.3
<b>Working plans</b> .....	6-1, A-6-1
<b>Working pressure</b> .....	2-1.2, 2-3.2 to 2-3.3
<b>Wrench, sprinkler</b> .....	2-2.8.2

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 10R Portable Fire Extinguishing Equipment in Dwellings  
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 11A Medium- and High-Expansion Foam Systems  
 11C Mobile Foam Apparatus  
 12 Carbon Dioxide Systems  
 12A Halon 1301 Systems  
 13 Sprinkler Systems  
 13D Sprinkler Sys., Dwellings  
 13E Sprinkler Prop., F.D. Operations in  
 13R Sprinkler Sys., Res. Occ. up to and including 4 Stories  
 14 Standpipes, Hose Systems  
 15 Water Spray Fixed Systems  
 16 Deluge Foam-Water Systems  
 16A Closed Head Foam-Water Sprinkler Systems  
 17 Dry Chem. Ext. Systems  
 17A Wet Chem. Ext. Systems  
 18 Wetting Agents  
 20 Centrifugal Fire Pumps  
 22 Water Tanks  
 24 Private Fire Service Mains  
 25 Water-Based Fire Prot. Systems  
 30 Flam. Liquids Code  
 30A Automotive and Marine Service Station Code  
 30B Aerosol Products  
 31 Oil-Burning Equipment  
 32 Drycleaning Plants  
 33 Spray Application  
 34 Dipping and Coating Processes  
 35 Organic Coatings  
 36 Solvent Extraction Plants  
 37 Combustion Engines and Gas Turbines  
 40 Motion Picture Film  
 40E Pyroxylin Plastic  
 43B Organic Peroxide Formulations  
 43D Pesticides, Storage  
 45 Laboratories Using Chemicals  
 46 Forest Products, Storage  
 49 Hazardous Chemicals Data  
 50 Bulk Oxygen Systems  
 50A Gaseous Hydrogen Systems  
 50B Liquefied Hydrogen Systems  
 51 Welding, Cutting and Allied Processes  
 51A Acetylene Charging Plants  
 51B Cutting and Welding Processes  
 52 CNG Vehicular Fuel Systems  
 53 Oxy. Atmospheres, Fires in  
 54 Nat'l Fuel Gas Code  
 55 Compressed and Liquefied Gases in Portable Cylinders  
 57 LNG Vehicular Fuel Systems  
 58 LP-Gas Storage  
 59 LP-Gas, Utility Plants  
 59A LN-Gas, Stg., Handling  
 61 Agricultural and Food Products Facilities  
 65 Aluminum Processing  
 68 Venting of Deflagrations  
 69 Explosion Prev. Systems  
 70 National Electrical Code  
 70B Elect. Equip. Maint.  
 70E Electrical Safety in Employee Work  
 72 National Fire Alarm Code  
 73 Residential Elect. Maint. for Dwellings  
 75 Electronic Computer Systems  
 77 Static Electricity  
 79 Elect. Std. for Ind. Machinery  
 80 Fire Doors and Fire Windows  
 80A Exterior Fire Exposure, Prof. from  
 82 Incinerators, Systems & Equip.  
 86 Ovens and Furnaces  
 86C Ind. Furn., Sp. Processing  
 86D Ind. Furnaces, Vacuum  
 88A Parking Structures  
 88B Repair Garages  
 90A Air Conditioning Systems  
 90B Warm Air Htg., Air Cond.  
 91 Exhaust Syst. for Air Conveying of Materials  
 92A Smoke-Control Systems  
 92B Smoke Mgmt. Syst. in Malls, Atria, Large Areas  
 96 Commercial Cooking Operations  
 97 Heating Terms, Glossary  
 99 Health Care Facilities  
 99B Hypobaric Facilities  
 101\* Life Safety Code  
 101A Alt. Approaches to Life Safety  
 102 Grandstands, Folding/Telescopic Seating, Tents, and Membrane Struct.  
 105 Smoke-Control Door Assemblies  
 110 Emer., Standby Power Systems  
 111 Stored Electrical Energy Emer. & Standby Power Systems  
 115 Laser Fire Protection  
 120 Coal Preparation Plants  
 121 Self-Propelled & Mobile Surface Mining Equip.  
 122 Underground Metal and Nonmetal Mines  
 123 Undergr. Bituminous Coal Mines  
 130 Fixed Guideway Transit Sys.  
 150 Racetrack Stables  
 170 Fire Safety Symbols  
 203 Roof Coverings/Roof Deck  
 204M Smoke, Heat Venting  
 211 Chimneys, Fireplaces, Vents  
 214 Water Cooling Towers  
 220 Types Bldg. Construction  
 231 General Storage  
 231C Rack Storage of Mat'ls.  
 231D Rubber Tires, Storage  
 231E Baled Cotton, Storage  
 231F Roll Paper, Storage  
 232 Records, Prot.  
 232A Archives and Records Centers  
 241 Construction, Operation, and Demolition Operations  
 251 Bldg. Constr. & Mat'ls., Fire Tests  
 252 Door Assem., Fire Tests of  
 253 Floor Covering Systems, Test for  
 255 Bldg. Mat'ls., Burning Character  
 256 Roof Coverings, Tests of  
 257 Window Assemblies, Tests of  
 258 Smoke Generation, Test of  
 259 Heat of Bldg. Mat'ls., Test for  
 260 Cig. Ignition Resistance—Components of Furniture, Tests for  
 261 Cig. Ignition Resistance—Uphol. Furn. Assem., Tests for  
 262 Wires and Cables, Test for Fire and Smoke Char. of  
 263 Heat & Smoke Release Rates, Test for  
 264 Heat-Release Rates Using Oxygen-Consumption Calorimeter, Test for  
 264A Heat Release Rates—Uphol. Furn. Comp. & Mattresses  
 265 Textile Wall Coverings—Room Fire Growth Contribution, Tests for  
 266 Uphol. Furn. Exp. to Flaming Ignition Sources, Test for  
 267 Mattress and Bedding Exp. to Flaming Ignition Source, Test for  
 268 Ignitibility of Exterior Wall Assemblies, Test for  
 269 Toxic Potency Data for Fire Hazard Modeling, Test for  
 291 Fire Hydrants  
 295 Wildfire Control  
 297 Communications Systems  
 298 Foam Chem. for Class A Fuels/Rural Suburban  
 299 Wildfire, Protection Life and Property from  
 302 Pleasure and Comm. Motor Craft  
 303 Marinas and Boatyards  
 306 Vessels, Gas Hazards on  
 307 Marine Terminals, Piers, Wharves  
 312 Vessels, Constr., Repair  
 318 Cleanrooms  
 325 Prop. of Flam. Liquids, Gases, Solids  
 326 Underground Storage Tanks, Safe Entry  
 327 Cleaning Small Tanks  
 328 Manholes, Sewers, Flam. Liquids and Gases in  
 329 Flam. and Com. Liquid, Underground Releases  
 385 Tank Vehicles  
 386 Portable Shipping Tanks  
 395 Farms, Storage Flam. Liquids  
 402 Aircraft Rescue, Fire Fighting  
 403 Aircraft Rescue Services  
 407 Aircraft Fuel Servicing  
 408 Aircraft Extinguishers  
 409 Aircraft Hangars  
 410 Aircraft Maintenance  
 412 Eval., Foam Equip. for Aircraft  
 414 Aircraft Rescue Vehicles  
 415 Aircraft Fueling Ramp Drainage  
 416 Airport Terminals  
 417 Aircraft Loading Walkways  
 418 Heliports  
 422 Aircraft Accident Response  
 423 Aircraft Engine Test Facilities  
 424 Airport/Community Emerg. Planning  
 430 Liquid/Solid Oxidizers  
 471 Responding to Haz. Mat. Incidents  
 472 Haz. Mat. Resp. Prof. Comp.  
 473 Competencies for EMS Personnel  
 480 Magnesium  
 481 Titanium  
 482 Zirconium  
 485 Lithium Metal  
 490 Ammonium Nitrate  
 491M Haz. Chem. Reactions  
 495 Explosive Materials  
 496 Purged Enclosures, Elec. Equip.  
 497A Class I Haz. Locations for Elec. Inst.  
 497B Class II Haz. Locations for Elec. Inst. in Chem. Process Areas  
 497M Gases, Vapors, Dusts for Elec. Equip. in Haz. Loc.  
 498 Explosives Motor Vehicle Term.  
 501A Manufactured Home Instal., Sites  
 501C Recreational Vehicles  
 501D Recreational Vehicle Parks  
 502 Highways, Turnets, Bridges  
 505 Powered Industrial Trucks  
 512 Truck Fire Protection  
 513 Motor Freight Terminals  
 550 Fire Safety Concepts Tree  
 555 Evaluating Potential for Room Flashover  
 560 Ethylene Oxide  
 560 Industrial Fire Brigades  
 601 Guard Service  
 650 Pneumatic Conveying Systems  
 651 Aluminum Powder  
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 703 Fire-Ret. Treat. of Bldg. Mat'ls.  
 704 Fire Hazards of Materials  
 705 Field Flame Test for Textiles and Films  
 750 Water Mist Fire Protection Systems  
 780 Lightning Protection Systems  
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 802 Nuclear Research Reactors  
 803 Light Water Nuclear Power Plants  
 804 Adv. Light Water Reactor Electric Generating Plants  
 820 Wastewater Facilities  
 850 Electric Generating Plants  
 851 Hydroelectric Generating Plants  
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 906 Fire Incident Field Notes  
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 914 Fire Prot. in Historic Struc.  
 921 Fire and Explosion Investigations  
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 1001 Fire Fighter Prof. Qual.  
 1002 F.D. Vehicle Driver Prof. Qual.  
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 1035 Public Fire Educator Prof. Qual.  
 1041 Fire Instructor Prof. Qual.  
 1051 Wildland Fire Fighter Prof. Qual.  
 1061 Public Safety Telecommunicator Prof. Qual.  
 1122 Model Rocketry  
 1123 Fireworks Display  
 1124 Fireworks, Mfg., Trans., Stge  
 1125 Model Rocket/High Power Rocket Motors, Mfg.  
 1126 Pyrotechnics Before Proximate Audience  
 1127 High Power Rocketry  
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 1221 Public Fire Serv. Comm. Sys.  
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 1401 Training Reports, Records  
 1402 Building Training Centers  
 1403 Live Fire Training Evolutions  
 1404 FD SCBA Program  
 1405 Land-Based Fire Fighters Who Respond to Manne Vessel Fires  
 1406 Outside Live Fire Training Evolutions  
 1410 Initial Fire Attack  
 1420 Warehouse Occupancies  
 1452 Dwelling Fire Safety Surveys  
 1470 Search and Rescue, Struct. Collapse  
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