**Chapter 7 Requirements for System Components and Hardware**

7.1 General

This chapter shall provide requirements for correct use of sprinkler system components and hardware.

7.1.1\* Listing

7.1.1.1

Materials or devices not specifically designated by this standard shall be used in accordance with all conditions, requirements, and limitations of their special listing.

7.1.1.1.1

All special listing requirements shall be included and identified in the product submittal literature and installation instructions.

7.1.1.2

Unless the requirements of 7.1.1.3, 7.1.1.4, or 7.1.1.5 are met, all materials and devices essential to successful system operation shall be listed.

7.1.1.2.1

Valve components (including valve trim, internal parts, gaskets, and the like) shall not be required to be individually listed.

7.1.1.3

Equipment as permitted in Table 7.3.1.1 and Table 7.4.1 shall not be required to be listed.

7.1.1.3.1

Nonmetallic pipe and fittings included in Table 7.3.1.1 and Table 7.4.1 shall be listed.

7.1.1.4

Materials meeting the requirements of 17.1.2, 17.1.6.2, 17.1.6.3, and 17.1.7.3 shall not be required to be listed.

7.1.1.5\*

Components that do not affect system performance shall not be required to be listed.

7.1.2 Rated Pressure

System components shall be rated for the maximum system working pressure to which they are exposed but shall not be rated at less than 175 psi (12 bar) for components installed above ground and 150 psi (10 bar) for components installed underground.

7.2 Sprinklers

7.2.1\* Sprinkler Identification

All sprinklers shall be permanently marked with one or two English uppercase alphabetic characters to identify the manufacturer, immediately followed by three or four numbers, to uniquely identify a sprinkler as to K-factor, deflector characteristic, pressure rating, and thermal sensitivity.

7.2.2 Sprinkler Discharge Characteristics

7.2.2.1\* General

Unless the requirements of 7.2.2.2, 7.2.2.3, or 7.2.2.4 are met, the K-factor, relative discharge, and marking identification for sprinklers having different K-factors shall be in accordance with Table 7.2.2.1.

Table 7.2.2.1 Sprinkler Discharge Characteristics Identification

Nominal

K-Factor

[gpm/(psi)1/2] Nominal

K-Factor

[L/min/(bar)1/2] K-Factor Range

[gpm/(psi)1/2] K-Factor Range

[L/min/(bar)1/2] Percent of Nominal K-5.6 Discharge Thread Type

1.4 20 1.3—1.5 19—22 25 1/2 in. (15 mm) NPT

1.9 27 1.8—2.0 26—29 33.3 1/2 in. (15 mm) NPT

2.8 40 2.6—2.9 38—42 50 1/2 in. (15 mm) NPT

4.2 60 4.0—4.4 57—63 75 1/2 in. (15 mm) NPT

5.6 80 5.3—5.8 76—84 100 1/2 in. (15 mm) NPT

8.0 115 7.4—8.2 107—118 140 3/4 in. (20 mm) NPT or 1/2 in. (15 mm) NPT

11.2 160 10.7—11.7 159—166 200 1/2 in. (15 mm) NPT or 3/4 in. (20 mm) NPT

14.0 200 13.5—14.5 195—209 250 3/4 in. (20 mm) NPT

16.8 240 16.0—17.6 231—254 300 3/4 in. (20 mm) NPT

19.6 280 18.6—20.6 272—301 350 1 in. (25 mm) NPT

22.4 320 21.3—23.5 311—343 400 1 in. (25 mm) NPT

25.2 360 23.9—26.5 349—387 450 1 in. (25 mm) NPT

28.0 400 26.6—29.4 389—430 500 1 in. (25 mm) NPT

Note: The nominal K-factor for dry-type sprinklers are used for sprinkler selection. See 27.2.4.10.3 for use of adjusted dry-type sprinkler K-factors for hydraulic calculation purposes.

7.2.2.2 Pipe Threads

Listed sprinklers having pipe threads different from those shown in Table 7.2.2.1 shall be permitted.

7.2.2.3 K-Factors Greater Than K-28 (400)

Sprinklers listed with nominal K-factors greater than K-28 (400) shall increase the flow by 100 percent increments when compared with a nominal K-5.6 (80) sprinkler.

7.2.2.4 Residential Sprinklers

Residential sprinklers shall be permitted with K-factors other than those specified in Table 7.2.2.1.

7.2.2.5 CMSA and ESFR K-Factors

Control mode specific application (CMSA) and early suppression fast-response (ESFR) sprinklers shall have a minimum nominal K-factor of K-11.2 (160).

7.2.2.6 ESFR K-Factor

ESFR sprinkler K-factor shall be selected as appropriate for the hazard. (See Chapter 20.)

7.2.3 Occupancy Limitations

Unless the requirements of 7.2.3.1 or 7.2.3.2 are met, sprinklers shall not be listed for protection of a portion of an occupancy classification.

7.2.3.1 Residential Sprinklers

Residential sprinklers shall be permitted to be listed for portions of residential occupancies as defined in 12.1.1.

7.2.3.2 Special Sprinklers

Special sprinklers shall be permitted to be listed for protection of a specific construction feature in a portion of an occupancy classification. (See Section 15.2.)

7.2.4\* Temperature Characteristics

7.2.4.1

Automatic sprinklers shall have their frame arms, deflector, coating material, or liquid bulb colored in accordance with the requirements of Table 7.2.4.1 or the requirements of 7.2.4.2, 7.2.4.3, 7.2.4.4, or 7.2.4.5.

Table 7.2.4.1 Temperature Ratings, Classifications, and Color Codings

Maximum Ceiling Temperature Temperature Rating Temperature Classification Color Code Glass Bulb Colors

°F °C °F °C

100 38 135—170 57—77

Ordinary

Uncolored or black

Orange or red

150 66 175—225 79—107

Intermediate

White

Yellow or green

225 107 250—300 121—149

High

Blue

Blue

300 149 325—375 163—191

Extra high

Red

Purple

375 191 400—475 204—246

Very extra high

Green

Black

475 246 500—575 260—302

Ultra high

Orange

Black

625 329 650 343

Ultra high

Orange

Black

7.2.4.2

A dot on the top of the deflector, the color of the coating material, or colored frame arms shall be permitted for color identification of corrosion-resistant sprinklers.

7.2.4.3

Color identification shall not be required for ornamental sprinklers such as factory-plated or factory-painted sprinklers or for recessed, flush, or concealed sprinklers.

7.2.4.4

The frame arms of bulb-type sprinklers shall not be required to be color coded.

7.2.4.5

The liquid in bulb-type sprinklers shall be color coded in accordance with Table 7.2.4.1.

7.2.5 Special Coatings

7.2.5.1\* Corrosion Resistant

7.2.5.2\* Painting

Sprinklers shall only be painted by the sprinkler manufacturer.

7.2.5.3 Ornamental Finishes

7.2.5.3.1

Ornamental finishes shall only be applied to sprinklers and, if applicable, their concealed cover plates, by the sprinkler manufacturer.

7.2.5.3.2

Sprinklers with ornamental finishes where utilized shall be specifically listed.

7.2.6 Escutcheons and Cover Plates

7.2.6.1

Plates, escutcheons, or other devices used to cover the annular space around a sprinkler shall be metallic or shall be listed for use around a sprinkler.

7.2.6.2\*

Escutcheons used with recessed, flush-type, or concealed sprinklers shall be part of a listed sprinkler assembly.

7.2.6.3

Cover plates used with concealed sprinklers shall be part of the listed sprinkler assembly.

7.3 Aboveground Pipe and Tube

7.3.1 General

7.3.1.1

Pipe or tube shall meet or exceed one of the standards in Table 7.3.1.1 or be in accordance with 7.3.3.

Table 7.3.1.1 Pipe or Tube Materials and Dimensions

Materials and Dimensions Standard

Ferrous Piping (Welded and Seamless)

Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use ASTM A795/A795M

Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless ASTM A53/A53M

Welded and Seamless Wrought Steel Pipe ASME B36.10M

Standard Specification for Electric-Resistance-Welded Steel Pipe ASTM A135/A135M

Copper Tube (Drawn, Seamless)

Standard Specification for Seamless Copper Tube ASTM B75/B75M

Standard Specification for Seamless Copper Water Tube ASTM B88

Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube ASTM B251

Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube ASTM B813

Specification for Filler Metals for Brazing and Braze Welding AWS A5.8M/A5.8

Standard Specification for Solder Metal, Section 1: Solder Alloys Containing Less Than 0.2% Lead and Having Solidus Temperatures Greater than 400°F ASTM B32

Alloy Materials ASTM B446

CPVC

Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR) ASTM F442/F442M

Brass Pipe

Standard Specification for Seamless Red Brass Pipe, Standard Sizes ASTM B43

Stainless Steel

Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes ASTM A312/A312M

7.3.2\* Nonmetallic Pipe and Tubing

7.3.2.1

Nonmetallic pipe in accordance with Table 7.3.1.1 shall be investigated for suitability in automatic sprinkler installations and listed for this service.

7.3.2.1.1

Other types of nonmetallic pipe or tube investigated for suitability in automatic sprinkler installations and listed for this service, including but not limited to CPVC, and differing from that provided in Table 7.3.1.1 shall be permitted where installed in accordance with their listing limitations.

7.3.2.1.2

Manufacturer's installation instructions shall include its listing limitations.

7.3.2.2

Nonmetallic pipe shall not be listed for portions of an occupancy classification.

7.3.3\* Listed Metallic Pipe and Tubing

7.3.3.1

Other types of pipe or tube investigated for suitability in automatic sprinkler installations and listed for this service, including steel, and differing from that provided in Table 7.3.1.1 shall be permitted where installed in accordance with their listing limitations, including installation instructions.

7.3.3.2

Pipe or tube shall not be listed for portions of an occupancy classification.

7.3.4 Pipe and Tube Identification

7.3.4.1\*

All pipe shall be marked along its length by the manufacturer in such a way as to properly identify the type of pipe.

7.3.4.2

The marking shall be visible on every piece of pipe over 2 ft (600 mm) long.

7.3.4.3

Pipe identification shall include the manufacturer's name, model designation, or schedule.

7.4 Fittings

7.4.1

Fittings used in sprinkler systems shall meet or exceed the standards in Table 7.4.1 or be in accordance with 7.4.2 or 7.4.4.

Table 7.4.1 Fittings Materials and Dimensions

Materials and Dimensions Standard

Cast Iron

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

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

Malleable Iron

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

Steel

Factory-Made WroughtButtwelding Fittings ASME B16.9

Buttwelding Ends ASME B16.25

Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service ASTM A234/A234M

Pipe Flanges and Flanged Fittings, NPS 1/2 through NPS 24 Metric/Inch Standard ASME B16.5

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

Copper

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

Cast Copper Alloy Solder Joint Pressure Fittings ASME B16.18

CPVC

Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 ASTM F437

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

Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 ASTM F439

Bronze Fittings

Cast Copper Alloy Threaded Fittings, Classes 125 and 250 ASME B16.15

Stainless Steel

Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings ASTM A403/A403M

7.4.2

In addition to the standards in Table 7.4.1, nonmetallic fittings shall also be in accordance with 7.4.4.

7.4.3 Nonmetallic Fittings

Nonmetallic fittings in accordance with Table 7.4.1 shall be investigated for suitability in automatic sprinkler installations and listed for this service. Listed nonmetallic fittings shall be installed in accordance with their listing limitations, including installation instructions.

7.4.4\*

Other types of fittings investigated for suitability in automatic sprinkler installations and listed for this service, including but not limited to CPVC and steel, and differing from that provided in Table 7.4.1 shall be permitted when installed in accordance with their listing limitations, including installation instructions.

7.5 Joining of Pipe and Fittings

7.5.1 Threaded Pipe and Fittings

7.5.1.1

All threaded pipe and fittings shall have threads cut to ASME B1.20.1, Pipe Threads, General Purpose (Inch).

7.5.1.2\*

Steel pipe with wall thicknesses less than Schedule 30 [in sizes 8 in. (200 mm) and larger] or Schedule 40 [in sizes less than 8 in. (200 mm)] shall only be permitted to be joined by threaded fittings where the threaded assembly is investigated for suitability in automatic sprinkler installations and listed for this service.

7.5.2 Welded Pipe and Fittings

7.5.2.1 General

7.5.2.1.1

Welding shall be permitted as a means of joining sprinkler piping in accordance with 7.5.2.2 through 7.5.2.6.

7.5.2.2\* Fabrication

7.5.2.2.1

When welding sprinkler pipe, the pipe shall be shop welded unless the requirements of 7.5.2.2 or 7.5.2.3 are met.

7.5.2.2.2

Where the design specifications require any part of the piping system to be welded in place, welding of sprinkler piping shall be permitted where the welding process is performed in accordance with NFPA 51B and the mechanical fittings required by 16.9.11.5 and Section 16.6 are provided.

7.5.2.2.3

Tabs for longitudinal earthquake bracing shall be permitted to be welded to in-place piping where the welding process is performed in accordance with NFPA 51B.

7.5.2.2.4

Welding shall not be performed where there is impingement of rain, snow, sleet, or high wind on the weld area of the pipe product.

7.5.2.2.5

Torch cutting and welding shall not be permitted as a means of modifying or repairing sprinkler systems.

7.5.2.3 Fittings

7.5.2.3.1\*

Welded fittings used to join pipe shall be listed fabricated fittings or manufactured in accordance with Table 7.4.1.

7.5.2.3.2

Fittings referenced in 7.5.2.3.1 shall be joined in conformance with a qualified welding procedure as set forth in this section and shall be an acceptable product under this standard, provided that materials and wall thickness are compatible with other sections of this standard.

7.5.2.3.3

Fittings shall not be required where pipe ends are buttwelded in accordance with the requirements of 7.5.2.4.3.

7.5.2.3.4

When the pipe size in a run of piping is reduced, a reducing fitting designed for that purpose shall be used in accordance with the requirements of 7.5.2.3.1.

7.5.2.4 Welding Requirements

7.5.2.4.1\*

Welds between pipe and welding outlet fittings shall be permitted to be attached by full penetration welds, partial penetration groove welds, or fillet welds.

7.5.2.4.2\*

The minimum throat thickness shall be not less than the thickness of the pipe, the thickness of the welding fitting, or 3/16 in. (5 mm), whichever is least.

7.5.2.4.3\*

Circumferential butt joints shall be cut, beveled, and fit so that full penetration is achievable.

7.5.2.4.4

Full penetration welding shall not be required.

7.5.2.4.5

Where slip-on flanges are welded to pipe with a single fillet weld, the weld shall be on the hub side of the flange and the minimum throat weld thickness shall not be less than 1.25 times the pipe wall thickness or the hub thickness, whichever is less.

7.5.2.4.6

Face welds on the internal face of the flange shall be permitted as a water seal in addition to the hub weld required in 7.5.2.4.5.

7.5.2.4.7

Tabs for longitudinal earthquake bracing shall have minimum throat weld thickness not less than 1.25 times the pipe wall thickness and welded on both sides of the longest dimension.

7.5.2.4.8

When welding is performed, the following shall apply:

Holes in piping for outlets shall be cut to the full inside diameter of fittings prior to welding in place of the fittings.

Discs shall be retrieved.

Openings cut into piping shall be smooth bore, and all internal slag and welding residue shall be removed.

Fittings shall not penetrate the internal diameter of the piping.

Steel plates shall not be welded to the ends of piping or fittings.

Fittings shall not be modified.

Nuts, clips, eye rods, angle brackets, or other fasteners shall not be welded to pipe or fittings, except as permitted in 7.5.2.2.3 and 7.5.2.4.7.

Completed welds shall be free from cracks, incomplete fusion, surface porosity greater than 1/16 in. (1.6 mm) diameter, and undercut deeper than 25 percent of the wall thickness or 1/32 in. (0.8 mm), whichever is less.

Completed circumferential butt weld reinforcement shall not exceed 3/32 in. (2 mm).

7.5.2.5 Qualifications

7.5.2.5.1

A welding procedure shall be prepared and qualified by the contractor or fabricator before any welding is done.

7.5.2.5.2

Qualification of the welding procedure to be used and the performance of all welders and welding operators shall be required and shall meet or exceed the requirements of AWS B2.1/B2.1M, Specification for Welding Procedure and Performance Qualification; ASME Boiler and Pressure Vessel Code, Section IX, "Welding, Brazing, and Fusing Qualifications"; or other applicable qualification standard as required by the authority having jurisdiction, except as permitted by 7.5.2.5.3.

7.5.2.5.3

Successful procedure qualification of complete joint penetration groove welds shall qualify partial joint penetration (groove/fillet) welds and fillet welds in accordance with the provisions of this standard.

7.5.2.5.4

Welding procedures qualified under standards recognized by previous editions of this standard shall be permitted to be continued in use.

7.5.2.5.5

Contractors or fabricators shall be responsible for all welding they produce.

7.5.2.5.6

Each contractor or fabricator shall have available to the authority having jurisdiction an established written quality assurance procedure ensuring compliance with the requirements of 7.5.2.4.

7.5.2.6 Records

7.5.2.6.1

Welders or welding machine operators shall, upon completion of each welded pipe, place their identifiable mark or label onto each piece adjacent to a weld.

7.5.2.6.2

Contractors or fabricators shall maintain certified records, which shall be available to the authority having jurisdiction, of the procedures used and the welders or welding machine operators employed by them, along with their welding identification.

7.5.2.6.3

Records shall show the date and the results of procedure and performance qualifications.

7.5.3 Groove Joining Methods

7.5.3.1\*

Pipe, fittings, valves, and devices to be joined with grooved couplings shall contain cut, rolled, or cast grooves that are dimensionally compatible with the couplings.

7.5.3.1.1\*

Pipe, fittings, valves, devices, and couplings that conform with or are listed in compliance with standardized groove specifications shall be considered compatible.

7.5.3.1.2

Other groove dimensions and grooving methods shall be acceptable in accordance with 7.5.5.1.

7.5.3.2

Grooved couplings, including gaskets used on dry pipe, preaction, and deluge systems, shall be listed for dry service.

7.5.4\* Brazed and Soldered Joints

7.5.4.1

Solder joints, where permitted, shall be fabricated in accordance with the methods and procedures listed in ASTM B828, Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

7.5.4.2

Unless the requirements of 7.5.4.3 or 7.5.4.4 are met, joints for the connection of copper tube shall be brazed.

7.5.4.3

Solder joints shall be permitted for exposed wet pipe systems in light hazard occupancies where the temperature classification of the installed sprinklers is of the ordinary- or intermediate-temperature classification.

7.5.4.4

Solder joints shall be permitted for wet pipe systems in light hazard and ordinary hazard (Group 1) occupancies where the piping is concealed, irrespective of sprinkler temperature ratings.

7.5.4.5\*

Soldering fluxes shall be in accordance with Table 7.3.1.1.

7.5.4.6

Brazing fluxes, if used, shall not be of a highly corrosive type.

7.5.5 Other Joining Methods

7.5.5.1

Other joining methods investigated for suitability in sprinkler installations and listed for this service shall be permitted where installed in accordance with their listing limitations, including installation instructions.

7.5.5.2 Outlet Fittings

Rubber-gasketed outlet fittings that are used on sprinkler systems shall meet the following requirements:

Be installed in accordance with the listing and manufacturer's installation instructions

Have all disks retrieved

Have smooth bores cut into the pipe, with all cutting residue removed

Not be modified

7.5.6 End Treatment

7.5.6.1

After cutting, pipe ends shall have burrs and fins removed.

7.5.6.2

Pipe used with listed fittings and its end treatment shall be in accordance with the fitting manufacturer's installation instructions and the fitting's listing.

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

7.7 Waterflow Alarm Devices

Waterflow alarm devices shall be listed for the service and so constructed and installed that any flow of water from a sprinkler system equal to or greater than that from a single automatic sprinkler of the smallest K-factor installed on the system will result in an audible alarm on the premises within 5 minutes after such flow begins and until such flow stops.

7.8 Additives and Coatings

7.8.1

Additives to the water supply intended for control of microbiological or other corrosion shall be listed for use within fire sprinkler systems.

7.8.2

Internal pipe coatings, excluding galvanizing, intended for control of microbiological or other corrosion shall be listed for use within fire sprinkler systems.