

## California Fire Code Section R313 Residential Automatic Fire Sprinkler System Requirements

**Townhouse automatic fire sprinkler systems.** An automatic residential fire sprinkler system shall be installed in *townhouses*. (R313.1)

**Exception:** *An automatic residential fire sprinkler system shall not be required when additions or alterations are made to existing townhouses that do not have an automatic residential fire sprinkler system installed.*

**Design and installation.** Automatic residential fire sprinkler systems for *townhouses* shall be designed and installed in accordance with Section *R313.3* or *NFPA 13D*. (R313.1.1)

### **One- and two-family dwellings automatic fire systems.**

An automatic residential fire sprinkler system shall be installed in one- and two- family *dwellings*. (R313.2)

**Exception:** *An automatic residential fire sprinkler system shall not be required for additions or alterations to existing buildings that are not already provided with an automatic residential sprinkler system.*

**Design and installation.** Automatic residential fire sprinkler systems shall be designed and installed in accordance with Section *R313.3* or *NFPA 13D*. (R313.2.1)

### **Dwelling unit fire sprinkler system (R313.3)**

**General.** Where installed, residential fire sprinkler systems, or portions thereof, shall be in accordance with *NFPA 13D* or Section *R313.3*, which shall be considered equivalent to *NFPA 13D*. Section *R313.3* shall apply to stand-alone and multipurpose wet-pipe sprinkler systems that do not include the use of antifreeze. A multipurpose fire sprinkler system shall supply domestic water to both fire sprinklers and plumbing fixtures. A stand-alone sprinkler system shall be separate and independent from the water distribution system. A backflow flow preventer shall not be required to separate a stand-alone sprinkler system from the water distribution system. (R313.3.1)

#### **Required sprinkler locations. (R313.3.1.1)**

Sprinklers shall be installed to protect all areas of a *dwelling unit*.

**Exceptions:**

1. *Attics, crawl spaces and normally unoccupied concealed spaces that do not contain fuel-fired appliances do not require sprinklers. In attics, crawl spaces and normally unoccupied concealed spaces*

that contain fuel-fired equipment, a sprinkler shall be installed above the equipment; however, sprinklers shall not be required in the remainder of the space.

2. Clothes closets, linen closets and pantries not exceeding 24 square feet (2.2 m<sup>2</sup>) in area, with the smallest dimension not greater than 3 feet (915 mm) and having wall and ceiling surfaces of gypsum board.

3. Bathrooms not more than 55 square feet (5.1m<sup>2</sup>) in area.

4. Detached garages; carports with no habitable space above; open attached porches; unheated entry areas, such as mud rooms, that are adjacent to an exterior door; and similar areas.

**Sprinklers.** Sprinklers shall be new listed residential sprinklers and shall be installed in accordance with the sprinkler manufacturer's installation instructions. **(R313.3.2)**

### **Temperature rating and separation from heat sources.**

Except as provided for in Section R313.3.2.2 , sprinklers shall have a temperature rating of not less than 135°F (57°C) and not more than 170°F (77°C). Sprinklers shall be separated from heat sources as required by the sprinkler manufacturer's installation instructions. **(R313.3.2.1)**

### **Intermediate temperature sprinklers. (R313.3.2.2)**

Sprinklers shall have an intermediate temperature rating not less than 175°F (79°C) and not more than 225°F (107°C) where installed in the following locations:

1. Directly under skylights, where the sprinkler is exposed to direct sunlight.
2. In *attics*.
3. In concealed spaces located directly beneath a roof.
4. Within the distance to a heat source.

Sprinklers shall not be located at distances less than the minimum table distance unless the sprinkler listing allows a lesser distance.

Distances shall be measured in a straight line from the nearest edge of the heat source to the nearest edge of the sprinkler.

**Freezing areas.** Piping shall be protected from freezing as required by *the California Plumbing Code*. Where sprinklers are required in areas that are subject to freezing, dry-sidewall or dry-pendent sprinklers extending from a nonfreezing area into a freezing area shall be installed. *Where fire sprinkler piping cannot be adequately protected against freezing, the system shall be designed & installed in accordance with NFPA 13D.* **(R313.3.2.3)**

**Sprinkler coverage.** Sprinkler coverage requirements and sprinkler obstruction requirements shall be in accordance with Sections R313.3.2.4.1 and R313.3.2.4.2 .

**Coverage area limit.** The area of coverage of a single sprinkler shall not exceed 400 square feet (37m<sup>2</sup>) and shall be based on the sprinkler listing and the sprinkler manufacturer's installation instructions. **(R313.3.2.4.1)**

**Obstructions to coverage.** Sprinkler discharge shall not be blocked by obstructions unless additional sprinklers are installed to protect the obstructed area. Sprinkler separation from obstructions shall comply with the minimum distances specified in the sprinkler manufacturer's instructions, *and/or the provisions of NFPA 13D.* **(R313.3.2.4.2)**

**Additional requirements for pendent sprinklers.** Pendent sprinklers within 3 feet (915 mm) of the center of a ceiling fan, surface-mounted ceiling luminaire or similar object shall be considered to be obstructed, and additional sprinklers shall be installed. **(R313.3.2.4.2.1)**

**Additional requirements for sidewall sprinklers.** Sidewall sprinklers within 5 feet (1524mm) of the center of a ceiling fan, surface-mounted ceiling luminaire or similar object shall be considered to be obstructed, and additional sprinklers shall be installed. **(R313.3.2.4.2.2)**

**Sprinkler installation on systems assembled with solvent cement.** The solvent cementing of threaded adapter fittings shall be completed and threaded adapters for sprinklers shall be verified as being clear of excess cement prior to the installation of sprinklers on systems assembled with solvent cement. **(R313.3.2.5)**

**Sprinkler modifications prohibited.** Painting, caulking or modifying of sprinklers shall be prohibited. Sprinklers that have been painted, caulked, modified or damaged shall be replaced with new sprinklers. **(R313.3.2.6)**

**Sprinkler piping system.** Sprinkler piping shall be supported in accordance with the requirements for cold water distribution piping. Sprinkler piping shall comply with all requirements for cold water distribution piping. For multipurpose piping systems, the sprinkler piping shall connect to and be a part of the cold water distribution piping system. **(R313.3.3)**

**Nonmetallic pipe and tubing.** Nonmetallic pipe and tubing, such as CPVC and PEX, shall be listed for use in residential fire sprinkler systems. **(R313.3.3.1)**

**Nonmetallic pipe protection.** Nonmetallic pipe and tubing systems shall be protected from exposure to the living space by a layer of not less than  $\frac{3}{8}$  inch (9.5 mm) thick gypsum wallboard,  $\frac{1}{2}$  inch thick plywood (13 mm), or other material having a 15 minute fire rating. **(R313.3.3.1.1)**

**Exceptions:**

- 1. Pipe protection shall not be required in areas that do not require protection with sprinklers as specified in Section R313.3.1.1 .*
- 2. Pipe protection shall not be required where exposed piping is permitted by the pipe listing.*

**Shutoff valves prohibited.** With the exception of shutoff valves for the entire water distribution system, valves shall not be installed in any location where the valve would isolate piping serving one or more sprinklers. **(R313.3.3.2)**

**Single dwelling limit.** Piping beyond the service valve located at the beginning of the water distribution system shall not serve more than one *dwelling*. **(R313.3.3.3)**

**Drain.** A means to drain the sprinkler system shall be provided on the system side of the water distribution shutoff valve. **(R313.3.3.4)**

**Determining system design flow.** The flow for sizing the sprinkler piping system shall be based on the flow rating of each sprinkler in accordance with Section R313.3.4.1 and the calculation in accordance with Section R313.3.4.2 . **(R313.3.4)**

**Determining required flow rate for each sprinkler.** The minimum required flow for each sprinkler shall be determined using the sprinkler manufacturer's published data for the specific sprinkler model based on all of the following:

- 1. The area of coverage.*
- 2. The ceiling configuration.*
- 3. The temperature rating.*
- 4. Any additional conditions specified by the sprinkler manufacturer.*

**System design flow rate.** The design flow rate for the system shall be based on the following:

1. The design flow rate for a room having only one sprinkler shall be the flow rate required for that sprinkler, as determined by Section *R313.3.4.1*.
2. The design flow rate for a room having two or more sprinklers shall be determined by identifying the sprinkler in that room with the highest required flow rate, based on Section *R313.3.4.1*, and multiplying that flow rate by 2.
3. Where the sprinkler manufacturer specifies different criteria for ceiling configurations that are not smooth, flat and horizontal, the required flow rate for that room shall comply with the sprinkler manufacturer's instructions.
4. The design flow rate for the sprinkler system shall be the flow required by the room with the largest flow rate, based on Items 1, 2 and 3.
5. For the purpose of this section, it shall be permissible to reduce the design flow rate for a room by subdividing the space into two or more rooms, where each room is evaluated separately with respect to the required design flow rate. Each room shall be bounded by walls and a ceiling. Openings in walls shall have a lintel not less than 8 inches (203 mm) in depth and each lintel shall form a solid barrier between the ceiling and the top of the opening.

**Water supply.** The water supply shall provide not less than the required design flow rate for sprinklers in accordance with Section *R313.3.4.2* at a pressure not less than that used to comply with Section *R313.3.6*.

*Where a water supply serves both domestic and fire sprinkler systems, 5 gpm (19 L/min) shall be added to the sprinkler system demand at the point where the systems are connected, to determine the size of common piping and the size of the total water supply requirements where no provision is made to prevent flow into the domestic water system upon operation of a sprinkler. (R313.3.5)*

**Water supply from individual sources.** Where a dwelling unit water supply is from a tank system, a private well system, a pump, or a combination of these, the available water supply shall be based on the minimum pressure control setting for the pump. **(R313.3.5.1)**

**Required capacity.** The water supply shall have the capacity to provide the required design flow rate for sprinklers for a period of time as follows:

1. *Seven (7) minutes for dwelling units one story in height and less than 2,000 square feet (186 m<sup>2</sup>) in area. For the purpose of determining the area of the dwelling unit, the area of attached garages and attached open carports, porches, balconies and patios shall not be included.*
2. *Ten (10) minutes for dwelling units two or more stories in height or equal to or greater than 2,000 square feet in area. For the purpose of determining the area of the dwelling unit, the area of attached garages and attached open carports, porches, balconies, and patios shall not be included. Where a well system, a water supply tank system, a pump, or a combination thereof, is used, the water supply shall serve both domestic and fire sprinkler systems. Any combination of well capacity and tank storage shall be permitted to meet the capacity requirement.*

**Pipe sizing.** The piping to sprinklers shall be sized for the flow required by Section *R313.3.4.2*. The flow required to supply the plumbing fixtures shall not be required to be added to the sprinkler design flow. **(R313.3.6)**

**Method of sizing pipe.** Piping supplying sprinklers shall be sized using the prescriptive method in Section *R313.3.6.2* or by hydraulic calculation in accordance with NFPA 13D. The minimum pipe size from the water

supply source to any sprinkler shall be 3/4inch (19 mm) nominal. Threaded adapter fittings at the point where sprinklers are attached to the piping shall be a minimum of 1/2inch (13 mm) nominal. **(R313.3.6.1)**

**Prescriptive pipe sizing method.** Pipe shall be sized by determining the available pressure to offset friction loss in piping and identifying a piping material, diameter and length using the equation in Section *R313.3.6.2.1* and the procedure in Section *R313.3.6.2.2* . **(R313.3.6.2.2)**

**Available pressure equation.**

The pressure available to offset friction loss in the interior piping system (*P*) shall be determined in accordance with the Equation 29-1. **(R313.3.6.2.1)**

$$P_t = P_{sup} - PL_{svc} - PL_m - PL_d - PL_e - P_{sp} \text{ (Equation 29-1)}$$

Where:

*P<sub>t</sub>* = Pressure used in applying Tables *R313.3.6.2(4)* through *R313.3.6.2(9)*.

*P<sub>sup</sub>* = Pressure available from the water supply source.

*PL<sub>svc</sub>* = Pressure loss in the water-service pipe.

*PL<sub>m</sub>* = Pressure loss in the water meter.

*PL<sub>d</sub>* = Pressure loss from devices other than the water meter.

*PL<sub>e</sub>* = Pressure loss associated with changes in elevation.

*P<sub>sp</sub>* = Maximum pressure required by a sprinkler.

**Calculation procedure.** Determination of the required size for water distribution piping shall be in accordance with the following procedure:

**Instructions and signs.** An owner's manual for the fire sprinkler system shall be provided to the owner. A sign or valve tag shall be installed at the main shutoff valve to the water distribution system stating the following: "Warning, the water system for this home supplies fire sprinklers that require certain flows and pressures to fight a fire. Devices that restrict the flow or decrease the pressure or automatically shut off the water to the fire sprinkler system, such as water softeners, filtration systems and automatic shutoff valves, shall not be added to this system without a review of the fire sprinkler system by a fire protection specialist. Do not remove this sign." **(R313.3.7)**

**Inspections.** The water distribution system shall be inspected in accordance with Sections *R313.3.8.1* and *R313.3.8.2*. **(R313.3.8)**

**Preconcealment inspection.** The following items shall be verified prior to the concealment of any sprinkler system piping:

Sprinklers are installed in all areas as required by Section *R313.3.1.1*.

Where sprinkler water spray patterns are obstructed by construction features, luminaires or ceiling fans, additional sprinklers are installed as required by Section *R313.3.2.4.2*.

Sprinklers are the correct temperature rating and are installed at or beyond the required separation distances from heat sources as required by Sections *R313.3.2.1* and *R313.3.2.2*.

The pipe size equals or exceeds the size used in applying Tables R313.3.6.2(4) through R313.3.6.2(9) or, if the piping system was hydraulically calculated in accordance with Section R313.3.6.1, the size used in the hydraulic calculation.

The pipe length does not exceed the length permitted by Tables R313.3.6.2(4) through R313.3.6.2(9) or, if the piping system was hydraulically calculated in accordance with Section R313.3.6.1, pipe lengths and fittings do not exceed those used in the hydraulic calculation.

Nonmetallic piping that conveys water to sprinklers is listed for use with fire sprinklers.

Piping is supported in accordance with the pipe manufacturer's and sprinkler manufacturer's installation instructions.

The piping system is tested in accordance with *the California Plumbing Code*.

**Final inspection. (R313.3.8.2)** The following items shall be verified upon completion of the system:

1. Sprinkler are not painted, damaged or otherwise hindered from operation.
2. Where a pump is required to provide water to the system, the pump starts automatically upon system water demand.
3. Pressure-reducing valves, water softeners, water filters or other impairments to water flow that were not part of the original design have not been installed.
4. The sign or valve tag required by Section R313.3.7 is installed and the owner's manual for the system is present.

Water Service Pressure Loss

| FLOW RATE <sup>c</sup> (gpm) | <sup>3</sup> / <sub>4</sub> INCH WATER SERVICE PRESSURE LOSS (psi) |          |           |            | 1 INCH WATER SERVICE PRESSURE LOSS (psi) |          |           |            | <sup>1</sup> / <sub>4</sub> INCH WATER SERVICE PRESSURE LOSS (psi) |          |           |            |
|------------------------------|--|----------|-----------|------------|--|----------|-----------|------------|--|----------|-----------|------------|
|                              | Length of water service pipe (feet)                                |          |           |            | Length of water service pipe (feet)      |          |           |            | Length of water service pipe (feet)                                |          |           |            |
|                              | 40 or less   | 41 to 75 | 76 to 100 | 101 to 150 | 40 or less                               | 41 to 75 | 76 to 100 | 101 to 150 | 40 or less   | 41 to 75 | 76 to 100 | 101 to 150 |
| 8                            | 5.1  | 8.7      | 11.8      | 17.4       | 1.5                                      | 2.5      | 3.4       | 5.1        | 0.6  | 1.0      | 1.3       | 1.9        |
| 10                           | 7.7  | 13.1     | 17.8      | 26.3       | 2.3                                      | 3.8      | 5.2       | 7.7        | 0.8  | 1.4      | 2.0       | 2.9        |
| 12                           | 10.8   | 18.4     | 24.9      | NP         | 3.2                                      | 5.4      | 7.3       | 10.7       | 1.2  | 2.0      | 2.7       | 4.0        |
| 14                           | 14.4   | 24.5     | NP        | NP         | 4.2                                      | 7.1      | 9.6       | 14.3       | 1.6  | 2.7      | 3.6       | 5.4        |
| 16                           | 18.4   | NP       | NP        | NP         | 5.4                                      | 9.1      | 12.4      | 18.3       | 2.0  | 3.4      | 4.7       | 6.9        |
| 18                           | 22.9   | NP       | NP        | NP         | 6.7                                      | 11.4     | 15.4      | 22.7       | 2.5  | 4.3      | 5.8       | 8.6        |
| 20                           | 27.8   | NP       | NP        | NP         | 8.1                                      | 13.8     | 18.7      | 27.6       | 3.1  | 5.2      | 7.0       | 10.4       |
| 22                           | NP   | NP       | NP        | NP         | 9.7                                      | 16.5     | 22.3      | NP         | 3.7  | 6.2      | 8.4       | 12.4       |
| 24                           | NP   | NP       | NP        | NP         | 11.4                                     | 19.3     | 26.2      | NP         | 4.3  | 7.3      | 9.9       | 14.6       |
| 26                           | NP   | NP       | NP        | NP         | 13.2                                     | 22.4     | NP        | NP         | 5.0  | 8.5      | 11.4      | 16.9       |
| 28                           | NP   | NP       | NP        | NP         | 15.1                                     | 25.7     | NP        | NP         | 5.7  | 9.7      | 13.1      | 19.4       |
| 30                           | NP   | NP       | NP        | NP         | 17.2                                     | NP       | NP        | NP         | 6.5  | 11.0     | 14.9      | 22.0       |
| 32                           | NP   | NP       | NP        | NP         | 19.4                                     | NP       | NP        | NP         | 7.3  | 12.4     | 16.8      | 24.8       |
| 34                           | NP   | NP       | NP        | NP         | 21.7                                     | NP       | NP        | NP         | 8.2  | 13.9     | 18.8      | NP         |
| 36                           | NP   | NP       | NP        | NP         | 24.1                                     | NP       | NP        | NP         | 9.1  | 15.4     | 20.9      | NP         |

### Minimum Water Meter Pressure Loss

| FLOW RATE (gallons per minute, gpm) <sup>b</sup> | <sup>5</sup> / <sub>8</sub> INCH METER PRESSURE LOSS (pounds per square inch, psi) | <sup>3</sup> / <sub>4</sub> INCH METER PRESSURE LOSS (pounds per square inch, psi) | 1 INCH METER PRESSURE LOSS (pounds per square inch, psi) |
|--|--|--|--|
| 8  | 2  | 1  | 1  |
| 10   | 3  | 1  | 1  |
| 12   | 4  | 1  | 1  |
| 14   | 5  | 2  | 1  |
| 16   | 7  | 3  | 1  |
| 18   | 9  | 4  | 1  |
| 20   | 11   | 4  | 2  |
| 22   | NP   | 5  | 2  |
| 24   | NP   | 5  | 2  |
| 26   | NP   | 6  | 2  |
| 28   | NP   | 6  | 2  |
| 30   | NP   | 7  | 2  |
| 32   | NP   | 7  | 3  |
| 34   | NP   | 8  | 3  |
| 36   | NP   | 8  | 3  |

### Elevation Loss

| ELEVATION (feet) | PRESSURE LOSS (psi) |
|------------------|---------------------|
| 5                | 2.2                 |
| 10               | 4.4                 |
| 15               | 6.5                 |
| 20               | 8.7                 |
| 25               | 10.9                |
| 30               | 13                  |
| ult35            | 15.2                |
| 40               | 17.4                |

### Allowable Pipe Length for 3/4 Inch Type M Copper Water Tubing

| SPRINKLER<br>FLOW<br>RATE <sup>a</sup><br>(gpm) | WATER<br>DISTRIBUTION<br>SIZE (inch) | AVAILABLE PRESSURE -P <sub>t</sub> (psi)                                    |     |     |     |     |     |     |     |     |     |
|---|--------------------------------------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|   |                                      | 15  | 20  | 25  | 30  | 35  | 40  | 45  | 50  | 55  | 60  |
|   |                                      | Allowable length of pipe from service valve to farthest sprinkler<br>(feet) |     |     |     |     |     |     |     |     |     |
| 8   | 3/4                                  | 217   | 289 | 361 | 434 | 506 | 578 | 650 | 723 | 795 | 867 |
| 9   | 3/4                                  | 174   | 232 | 291 | 349 | 407 | 465 | 523 | 581 | 639 | 697 |
| 10  | 3/4                                  | 143   | 191 | 239 | 287 | 335 | 383 | 430 | 478 | 526 | 574 |
| 11  | 3/4                                  | 120   | 160 | 200 | 241 | 281 | 321 | 361 | 401 | 441 | 481 |
| 12  | 3/4                                  | 102   | 137 | 171 | 205 | 239 | 273 | 307 | 341 | 375 | 410 |
| 13  | 3/4                                  | 88  | 118 | 147 | 177 | 206 | 235 | 265 | 294 | 324 | 353 |
| 14  | 3/4                                  | 77  | 103 | 128 | 154 | 180 | 205 | 231 | 257 | 282 | 308 |
| 15  | 3/4                                  | 68  | 90  | 113 | 136 | 158 | 181 | 203 | 226 | 248 | 271 |
| 16  | 3/4                                  | 60  | 80  | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 241 |
| 17  | 3/4                                  | 54  | 72  | 90  | 108 | 125 | 143 | 161 | 179 | 197 | 215 |
| 18  | 3/4                                  | 48  | 64  | 81  | 97  | 113 | 129 | 145 | 161 | 177 | 193 |
| 19  | 3/4                                  | 44  | 58  | 73  | 88  | 102 | 117 | 131 | 146 | 160 | 175 |
| 20  | 3/4                                  | 40  | 53  | 66  | 80  | 93  | 106 | 119 | 133 | 146 | 159 |
| 21  | 3/4                                  | 36  | 48  | 61  | 73  | 85  | 97  | 109 | 121 | 133 | 145 |
| 22  | 3/4                                  | 33  | 44  | 56  | 67  | 78  | 89  | 100 | 111 | 122 | 133 |
| 23  | 3/4                                  | 31  | 41  | 51  | 61  | 72  | 82  | 92  | 102 | 113 | 123 |
| 24  | 3/4                                  | 28  | 38  | 47  | 57  | 66  | 76  | 85  | 95  | 104 | 114 |
| 25  | 3/4                                  | 26  | 35  | 44  | 53  | 61  | 70  | 79  | 88  | 97  | 105 |
| 26  | 3/4                                  | 24  | 33  | 41  | 49  | 57  | 65  | 73  | 82  | 90  | 98  |
| 27  | 3/4                                  | 23  | 30  | 38  | 46  | 53  | 61  | 69  | 76  | 84  | 91  |
| 28  | 3/4                                  | 21  | 28  | 36  | 43  | 50  | 57  | 64  | 71  | 78  | 85  |
| 29  | 3/4                                  | 20  | 27  | 33  | 40  | 47  | 53  | 60  | 67  | 73  | 80  |
| 30  | 3/4                                  | 19  | 25  | 31  | 38  | 44  | 50  | 56  | 63  | 69  | 75  |
| 31  | 3/4                                  | 18  | 24  | 29  | 35  | 41  | 47  | 53  | 59  | 65  | 71  |
| 32  | 3/4                                  | 17  | 22  | 28  | 33  | 39  | 44  | 50  | 56  | 61  | 67  |
| 33  | 3/4                                  | 16  | 21  | 26  | 32  | 37  | 42  | 47  | 53  | 58  | 63  |
| 34  | 3/4                                  | NP  | 20  | 25  | 30  | 35  | 40  | 45  | 50  | 55  | 60  |
| 35  | 3/4                                  | NP  | 19  | 24  | 28  | 33  | 38  | 42  | 47  | 52  | 57  |
| 36  | 3/4                                  | NP  | 18  | 22  | 27  | 31  | 36  | 40  | 45  | 49  | 54  |
| 37  | 3/4                                  | NP  | 17  | 21  | 26  | 30  | 34  | 38  | 43  | 47  | 51  |
| 38  | 3/4                                  | NP  | 16  | 20  | 24  | 28  | 32  | 36  | 40  | 45  | 49  |
| 39  | 3/4                                  | NP  | 15  | 19  | 23  | 27  | 31  | 35  | 39  | 42  | 46  |
| 40  | 3/4                                  | NP  | NP  | 18  | 22  | 26  | 29  | 33  | 37  | 40  | 44  |



### Allowable Pipe Length for 1 Inch Type M Copper Water Tubing

| SPRINKLER<br>FLOW<br>RATE <sup>a</sup><br>(gpm)                             | WATER<br>DISTRIBUTION<br>SIZE (inch) | AVAILABLE PRESSURE - $P_L$ (psi) |      |      |      |      |      |      |      |      |      |
|---|--------------------------------------|----------------------------------|------|------|------|------|------|------|------|------|------|
|   |                                      | 15                               | 20   | 25   | 30   | 35   | 40   | 45   | 50   | 55   | 60   |
| Allowable length of pipe from service valve to farthest sprinkler<br>(feet) |                                      |                                  |      |      |      |      |      |      |      |      |      |
| 8   | 1                                    | 806                              | 1075 | 1343 | 1612 | 1881 | 2149 | 2418 | 2687 | 2955 | 3224 |
| 9   | 1                                    | 648                              | 864  | 1080 | 1296 | 1512 | 1728 | 1945 | 2161 | 2377 | 2593 |
| 10  | 1                                    | 533                              | 711  | 889  | 1067 | 1245 | 1422 | 1600 | 1778 | 1956 | 2134 |
| 11  | 1                                    | 447                              | 586  | 745  | 894  | 1043 | 1192 | 1341 | 1491 | 1640 | 1789 |
| 12  | 1                                    | 381                              | 508  | 634  | 761  | 888  | 1015 | 1142 | 1269 | 1396 | 1523 |
| 13  | 1                                    | 328                              | 438  | 547  | 657  | 766  | 875  | 985  | 1094 | 1204 | 1313 |
| 14  | 1                                    | 286                              | 382  | 477  | 572  | 668  | 763  | 859  | 954  | 1049 | 1145 |
| 15  | 1                                    | 252                              | 336  | 420  | 504  | 588  | 672  | 756  | 840  | 924  | 1008 |
| 16  | 1                                    | 224                              | 298  | 373  | 447  | 522  | 596  | 671  | 745  | 820  | 894  |
| 17  | 1                                    | 200                              | 266  | 333  | 400  | 466  | 533  | 600  | 666  | 733  | 799  |
| 18  | 1                                    | 180                              | 240  | 300  | 360  | 420  | 479  | 539  | 599  | 659  | 719  |
| 19  | 1                                    | 163                              | 217  | 271  | 325  | 380  | 434  | 488  | 542  | 597  | 651  |
| 20  | 1                                    | 148                              | 197  | 247  | 296  | 345  | 395  | 444  | 493  | 543  | 592  |
| 21  | 1                                    | 135                              | 180  | 225  | 270  | 315  | 360  | 406  | 451  | 496  | 541  |
| 22  | 1                                    | 124                              | 165  | 207  | 248  | 289  | 331  | 372  | 413  | 455  | 496  |
| 23  | 1                                    | 114                              | 152  | 190  | 228  | 267  | 305  | 343  | 381  | 419  | 457  |
| 24  | 1                                    | 106                              | 141  | 176  | 211  | 246  | 282  | 317  | 352  | 387  | 422  |
| 25  | 1                                    | 98                               | 131  | 163  | 196  | 228  | 261  | 294  | 326  | 359  | 392  |
| 26  | 1                                    | 91                               | 121  | 152  | 182  | 212  | 243  | 273  | 304  | 334  | 364  |
| 27  | 1                                    | 85                               | 113  | 142  | 170  | 198  | 226  | 255  | 283  | 311  | 340  |
| 28  | 1                                    | 79                               | 106  | 132  | 159  | 185  | 212  | 238  | 265  | 291  | 318  |
| 29  | 1                                    | 74                               | 99   | 124  | 149  | 174  | 198  | 223  | 248  | 273  | 298  |
| 30  | 1                                    | 70                               | 93   | 116  | 140  | 163  | 186  | 210  | 233  | 256  | 280  |
| 31  | 1                                    | 66                               | 88   | 110  | 132  | 153  | 175  | 197  | 219  | 241  | 263  |
| 32  | 1                                    | 62                               | 83   | 103  | 124  | 145  | 165  | 186  | 207  | 227  | 248  |
| 33  | 1                                    | 59                               | 78   | 98   | 117  | 137  | 156  | 176  | 195  | 215  | 234  |
| 34  | 1                                    | 55                               | 74   | 92   | 111  | 129  | 148  | 166  | 185  | 203  | 222  |
| 35  | 1                                    | 53                               | 70   | 88   | 105  | 123  | 140  | 158  | 175  | 193  | 210  |
| 36  | 1                                    | 50                               | 66   | 83   | 100  | 116  | 133  | 150  | 166  | 183  | 199  |
| 37  | 1                                    | 47                               | 63   | 79   | 95   | 111  | 126  | 142  | 158  | 174  | 190  |
| 38  | 1                                    | 45                               | 60   | 75   | 90   | 105  | 120  | 135  | 150  | 165  | 181  |
| 39  | 1                                    | 43                               | 57   | 72   | 86   | 100  | 115  | 129  | 143  | 158  | 172  |
| 40  | 1                                    | 41                               | 55   | 68   | 82   | 96   | 109  | 123  | 137  | 150  | 164  |

Allowable Pipe Length for 3/4 Inch CPVC Pipe

| SPRINKLER<br>FLOW<br>RATE <sup>a</sup><br>(gpm) | WATER<br>DISTRIBUTION<br>SIZE (inch) | AVAILABLE PRESSURE - P <sub>t</sub> (psi)                                |     |     |     |     |     |      |      |      |      |
|---|--------------------------------------|--|-----|-----|-----|-----|-----|------|------|------|------|
|   |                                      | 15   | 20  | 25  | 30  | 35  | 40  | 45   | 50   | 55   | 60   |
|   |                                      | Allowable length of pipe from service valve to farthest sprinkler (feet) |     |     |     |     |     |      |      |      |      |
| 8   | 3/4                                  | 348  | 465 | 581 | 697 | 813 | 929 | 1045 | 1161 | 1278 | 1394 |
| 9   | 3/4                                  | 280  | 374 | 467 | 560 | 654 | 747 | 841  | 934  | 1027 | 1121 |
| 10  | 3/4                                  | 231  | 307 | 384 | 461 | 538 | 615 | 692  | 769  | 845  | 922  |
| 11  | 3/4                                  | 193  | 258 | 322 | 387 | 451 | 515 | 580  | 644  | 709  | 773  |
| 12  | 3/4                                  | 165  | 219 | 274 | 329 | 384 | 439 | 494  | 549  | 603  | 658  |
| 13  | 3/4                                  | 142  | 189 | 237 | 284 | 331 | 378 | 426  | 473  | 520  | 568  |
| 14  | 3/4                                  | 124  | 165 | 206 | 247 | 289 | 330 | 371  | 412  | 454  | 495  |
| 15  | 3/4                                  | 109  | 145 | 182 | 218 | 254 | 290 | 327  | 363  | 399  | 436  |
| 16  | 3/4                                  | 97   | 129 | 161 | 193 | 226 | 258 | 290  | 322  | 354  | 387  |
| 17  | 3/4                                  | 86   | 115 | 144 | 173 | 202 | 230 | 259  | 288  | 317  | 346  |
| 18  | 3/4                                  | 78   | 104 | 130 | 155 | 181 | 207 | 233  | 259  | 285  | 311  |
| 19  | 3/4                                  | 70   | 94  | 117 | 141 | 164 | 188 | 211  | 234  | 258  | 281  |
| 20  | 3/4                                  | 64   | 85  | 107 | 128 | 149 | 171 | 192  | 213  | 235  | 256  |
| 21  | 3/4                                  | 58   | 78  | 97  | 117 | 136 | 156 | 175  | 195  | 214  | 234  |
| 22  | 3/4                                  | 54   | 71  | 89  | 107 | 125 | 143 | 161  | 179  | 197  | 214  |
| 23  | 3/4                                  | 49   | 66  | 82  | 99  | 115 | 132 | 148  | 165  | 181  | 198  |
| 24  | 3/4                                  | 46   | 61  | 76  | 91  | 107 | 122 | 137  | 152  | 167  | 183  |
| 25  | 3/4                                  | 42   | 56  | 71  | 85  | 99  | 113 | 127  | 141  | 155  | 169  |
| 26  | 3/4                                  | 39   | 52  | 66  | 79  | 92  | 105 | 118  | 131  | 144  | 157  |
| 27  | 3/4                                  | 37   | 49  | 61  | 73  | 86  | 98  | 110  | 122  | 135  | 147  |
| 28  | 3/4                                  | 34   | 46  | 57  | 69  | 80  | 92  | 103  | 114  | 126  | 137  |
| 29  | 3/4                                  | 32   | 43  | 54  | 64  | 75  | 86  | 96   | 107  | 118  | 129  |
| 30  | 3/4                                  | 30   | 40  | 50  | 60  | 70  | 81  | 91   | 101  | 111  | 121  |
| 31  | 3/4                                  | 28   | 38  | 47  | 57  | 66  | 76  | 85   | 95   | 104  | 114  |
| 32  | 3/4                                  | 26   | 36  | 45  | 54  | 63  | 72  | 81   | 90   | 99   | 108  |
| 33  | 3/4                                  | 24   | 34  | 43  | 52  | 61  | 70  | 79   | 88   | 97   | 106  |
| 34  | 3/4                                  | 22   | 32  | 41  | 50  | 59  | 68  | 77   | 86   | 95   | 104  |
| 35  | 3/4                                  | 20   | 30  | 39  | 48  | 57  | 66  | 75   | 84   | 93   | 102  |
| 36  | 3/4                                  | 18   | 28  | 37  | 46  | 55  | 64  | 73   | 82   | 91   | 100  |
| 37  | 3/4                                  | 16   | 26  | 35  | 44  | 53  | 62  | 71   | 80   | 89   | 98   |
| 38  | 3/4                                  | 14   | 24  | 33  | 42  | 51  | 60  | 69   | 78   | 87   | 96   |
| 39  | 3/4                                  | 12   | 22  | 31  | 40  | 49  | 58  | 67   | 76   | 85   | 94   |
| 40  | 3/4                                  | 10   | 20  | 29  | 38  | 47  | 56  | 65   | 74   | 83   | 92   |

### Allowable Pipe Length for 1 Inch CPVC Pipe

| SPRINKLER<br>FLOW<br>RATE <sup>a</sup><br>(gpm) | WATER<br>DISTRIBUTION<br>SIZE (inch) | AVAILABLE PRESSURE - $P_t$ (psi)  |      |      |      |      |      |      |      |      |      |
|---|--------------------------------------|---|------|------|------|------|------|------|------|------|------|
|   |                                      | 15  | 20   | 25   | 30   | 35   | 40   | 45   | 50   | 55   | 60   |
|   |                                      | Allowable length of pipe from service valve to farthest sprinkler<br>(feet) |      |      |      |      |      |      |      |      |      |
| 8   | 1                                    | 1049  | 1398 | 1748 | 2098 | 2447 | 2797 | 3146 | 3496 | 3845 | 4195 |
| 9   | 1                                    | 843   | 1125 | 1406 | 1687 | 1968 | 2249 | 2530 | 2811 | 3093 | 3374 |
| 10  | 1                                    | 694   | 925  | 1157 | 1388 | 1619 | 1851 | 2082 | 2314 | 2545 | 2776 |
| 11  | 1                                    | 582   | 776  | 970  | 1164 | 1358 | 1552 | 1746 | 1940 | 2133 | 2327 |
| 12  | 1                                    | 495   | 660  | 826  | 991  | 1156 | 1321 | 1486 | 1651 | 1816 | 1981 |
| 13  | 1                                    | 427   | 570  | 712  | 854  | 997  | 1139 | 1281 | 1424 | 1566 | 1709 |
| 14  | 1                                    | 372   | 497  | 621  | 745  | 869  | 993  | 1117 | 1241 | 1366 | 1490 |
| 15  | 1                                    | 328   | 437  | 546  | 656  | 765  | 874  | 983  | 1093 | 1202 | 1311 |
| 16  | 1                                    | 291   | 388  | 485  | 582  | 679  | 776  | 873  | 970  | 1067 | 1164 |
| 17  | 1                                    | 260   | 347  | 433  | 520  | 607  | 693  | 780  | 867  | 954  | 1040 |
| 18  | 1                                    | 234   | 312  | 390  | 468  | 546  | 624  | 702  | 780  | 858  | 936  |
| 19  | 1                                    | 212   | 282  | 353  | 423  | 494  | 565  | 635  | 706  | 776  | 847  |
| 20  | 1                                    | 193   | 257  | 321  | 385  | 449  | 513  | 578  | 642  | 706  | 770  |
| 21  | 1                                    | 176   | 235  | 293  | 352  | 410  | 469  | 528  | 586  | 645  | 704  |
| 22  | 1                                    | 161   | 215  | 269  | 323  | 377  | 430  | 484  | 538  | 592  | 646  |
| 23  | 1                                    | 149   | 198  | 248  | 297  | 347  | 396  | 446  | 496  | 545  | 595  |
| 24  | 1                                    | 137   | 183  | 229  | 275  | 321  | 366  | 412  | 458  | 504  | 550  |
| 25  | 1                                    | 127   | 170  | 212  | 255  | 297  | 340  | 382  | 425  | 467  | 510  |
| 26  | 1                                    | 118   | 158  | 197  | 237  | 276  | 316  | 355  | 395  | 434  | 474  |
| 27  | 1                                    | 111   | 147  | 184  | 221  | 258  | 295  | 332  | 368  | 405  | 442  |
| 28  | 1                                    | 103   | 138  | 172  | 207  | 241  | 275  | 310  | 344  | 379  | 413  |
| 29  | 1                                    | 97  | 129  | 161  | 194  | 226  | 258  | 290  | 323  | 355  | 387  |
| 30  | 1                                    | 91  | 121  | 152  | 182  | 212  | 242  | 273  | 303  | 333  | 364  |
| 31  | 1                                    | 86  | 114  | 143  | 171  | 200  | 228  | 257  | 285  | 314  | 342  |
| 32  | 1                                    | 81  | 108  | 134  | 161  | 188  | 215  | 242  | 269  | 296  | 323  |
| 33  | 1                                    | 76  | 102  | 127  | 152  | 178  | 203  | 229  | 254  | 280  | 305  |
| 34  | 1                                    | 72  | 96   | 120  | 144  | 168  | 192  | 216  | 240  | 265  | 289  |
| 35  | 1                                    | 68  | 91   | 114  | 137  | 160  | 182  | 205  | 228  | 251  | 273  |
| 36  | 1                                    | 65  | 87   | 108  | 130  | 151  | 173  | 195  | 216  | 238  | 260  |
| 37  | 1                                    | 62  | 82   | 103  | 123  | 144  | 165  | 185  | 206  | 226  | 247  |
| 38  | 1                                    | 59  | 78   | 98   | 117  | 137  | 157  | 176  | 196  | 215  | 235  |
| 39  | 1                                    | 56  | 75   | 93   | 112  | 131  | 149  | 168  | 187  | 205  | 224  |
| 40  | 1                                    | 53  | 71   | 89   | 107  | 125  | 142  | 160  | 178  | 196  | 214  |

Allowable

| SPRINKLER<br>FLOW<br>RATE <sup>a</sup><br>(gpm) | WATER<br>DISTRIBUTION<br>SIZE (inch) | AVAILABLE PRESSURE - $P_t$ (psi)  |     |     |     |     |     |     |     |     |     |
|---|--------------------------------------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|   |                                      | 15  | 20  | 25  | 30  | 35  | 40  | 45  | 50  | 55  | 60  |
|   |                                      | Allowable length of pipe from service valve to farthest<br>sprinkler (feet) |     |     |     |     |     |     |     |     |     |
| 8   | 3/4                                  | 93  | 123 | 154 | 185 | 216 | 247 | 278 | 309 | 339 | 370 |
| 9   | 3/4                                  | 74  | 99  | 124 | 149 | 174 | 199 | 223 | 248 | 273 | 298 |
| 10  | 3/4                                  | 61  | 82  | 102 | 123 | 143 | 163 | 184 | 204 | 225 | 245 |

Pipe Length for 3/4

## Inch Pex Tubing

|    |     |    |    |    |     |     |     |     |     |     |     |
|----|-----|----|----|----|-----|-----|-----|-----|-----|-----|-----|
| 11 | 3/4 | 51 | 68 | 86 | 103 | 120 | 137 | 154 | 171 | 188 | 205 |
| 12 | 3/4 | 44 | 58 | 73 | 87  | 102 | 117 | 131 | 146 | 160 | 175 |
| 13 | 3/4 | 38 | 50 | 63 | 75  | 88  | 101 | 113 | 126 | 138 | 151 |
| 14 | 3/4 | 33 | 44 | 55 | 66  | 77  | 88  | 99  | 110 | 121 | 132 |
| 15 | 3/4 | 29 | 39 | 48 | 58  | 68  | 77  | 87  | 96  | 106 | 116 |
| 16 | 3/4 | 26 | 34 | 43 | 51  | 60  | 68  | 77  | 86  | 94  | 103 |
| 17 | 3/4 | 23 | 31 | 38 | 46  | 54  | 61  | 69  | 77  | 84  | 92  |
| 18 | 3/4 | 21 | 28 | 34 | 41  | 48  | 55  | 62  | 69  | 76  | 83  |
| 19 | 3/4 | 19 | 25 | 31 | 37  | 44  | 50  | 56  | 62  | 69  | 75  |
| 20 | 3/4 | 17 | 23 | 28 | 34  | 40  | 45  | 51  | 57  | 62  | 68  |
| 21 | 3/4 | 16 | 21 | 26 | 31  | 36  | 41  | 47  | 52  | 57  | 62  |
| 22 | 3/4 | NP | 19 | 24 | 28  | 33  | 38  | 43  | 47  | 52  | 57  |
| 23 | 3/4 | NP | 17 | 22 | 26  | 31  | 35  | 39  | 44  | 48  | 52  |
| 24 | 3/4 | NP | 16 | 20 | 24  | 28  | 32  | 36  | 40  | 44  | 49  |
| 25 | 3/4 | NP | NP | 19 | 22  | 26  | 30  | 34  | 37  | 41  | 45  |
| 26 | 3/4 | NP | NP | 17 | 21  | 24  | 28  | 31  | 35  | 38  | 42  |
| 27 | 3/4 | NP | NP | 16 | 20  | 23  | 26  | 29  | 33  | 36  | 39  |
| 28 | 3/4 | NP | NP | 15 | 18  | 21  | 24  | 27  | 30  | 33  | 36  |
| 29 | 3/4 | NP | NP | NP | 17  | 20  | 23  | 26  | 28  | 31  | 34  |
| 30 | 3/4 | NP | NP | NP | 16  | 19  | 21  | 24  | 27  | 29  | 32  |
| 31 | 3/4 | NP | NP | NP | 15  | 18  | 20  | 23  | 25  | 28  | 30  |
| 32 | 3/4 | NP | NP | NP | NP  | 17  | 19  | 21  | 24  | 26  | 28  |
| 33 | 3/4 | NP | NP | NP | NP  | 16  | 18  | 20  | 22  | 25  | 27  |
| 34 | 3/4 | NP | NP | NP | NP  | NP  | 17  | 19  | 21  | 23  | 25  |
| 35 | 3/4 | NP | NP | NP | NP  | NP  | 16  | 18  | 20  | 22  | 24  |
| 36 | 3/4 | NP | NP | NP | NP  | NP  | 15  | 17  | 19  | 21  | 23  |
| 37 | 3/4 | NP | NP | NP | NP  | NP  | NP  | 16  | 18  | 20  | 22  |
| 38 | 3/4 | NP | NP | NP | NP  | NP  | NP  | 16  | 17  | 19  | 21  |
| 39 | 3/4 | NP | NP | NP | NP  | NP  | NP  | NP  | 16  | 18  | 20  |
| 40 | 3/4 | NP | NP | NP | NP  | NP  | NP  | NP  | 16  | 17  | 19  |

### Allowable Pipe Length for 1 Inch Pex Tubing

| SPRINKLER<br>FLOW RATE <sup>a</sup><br>(gpm) | WATER<br>DISTRIBUTION<br>SIZE (inch) | AVAILABLE PRESSURE - $P_t$ (psi)   |     |     |     |     |     |     |      |      |      |
|--|--------------------------------------|--|-----|-----|-----|-----|-----|-----|------|------|------|
|  |                                      | 15   | 20  | 25  | 30  | 35  | 40  | 45  | 50   | 55   | 60   |
|  |                                      | Allowable length of pipe from service valve to farthest sprinkler (feet) |     |     |     |     |     |     |      |      |      |
| 8  | 1                                    | 314  | 418 | 523 | 628 | 732 | 837 | 941 | 1046 | 1151 | 1255 |
| 9  | 1                                    | 252  | 336 | 421 | 505 | 589 | 673 | 757 | 841  | 925  | 1009 |
| 10   | 1                                    | 208  | 277 | 346 | 415 | 485 | 554 | 623 | 692  | 761  | 831  |
| 11   | 1                                    | 174  | 232 | 290 | 348 | 406 | 464 | 522 | 580  | 638  | 696  |
| 12   | 1                                    | 148  | 198 | 247 | 296 | 346 | 395 | 445 | 494  | 543  | 593  |
| 13   | 1                                    | 128  | 170 | 213 | 256 | 298 | 341 | 383 | 426  | 469  | 511  |
| 14   | 1                                    | 111  | 149 | 186 | 223 | 260 | 297 | 334 | 371  | 409  | 446  |
| 15   | 1                                    | 98   | 131 | 163 | 196 | 229 | 262 | 294 | 327  | 360  | 392  |
| 16   | 1                                    | 87   | 116 | 145 | 174 | 203 | 232 | 261 | 290  | 319  | 348  |
| 17   | 1                                    | 78   | 104 | 130 | 156 | 182 | 208 | 233 | 259  | 285  | 311  |
| 18   | 1                                    | 70   | 93  | 117 | 140 | 163 | 187 | 210 | 233  | 257  | 280  |
| 19   | 1                                    | 63   | 84  | 106 | 127 | 148 | 169 | 190 | 211  | 232  | 253  |
| 20   | 1                                    | 58   | 77  | 96  | 115 | 134 | 154 | 173 | 192  | 211  | 230  |
| 21   | 1                                    | 53   | 70  | 88  | 105 | 123 | 140 | 158 | 175  | 193  | 211  |
| 22   | 1                                    | 48   | 64  | 80  | 97  | 113 | 129 | 145 | 161  | 177  | 193  |
| 23   | 1                                    | 44   | 59  | 74  | 89  | 104 | 119 | 133 | 148  | 163  | 178  |
| 24   | 1                                    | 41   | 55  | 69  | 82  | 96  | 110 | 123 | 137  | 151  | 164  |
| 25   | 1                                    | 38   | 51  | 64  | 76  | 89  | 102 | 114 | 127  | 140  | 152  |
| 26   | 1                                    | 35   | 47  | 59  | 71  | 83  | 95  | 106 | 118  | 130  | 142  |
| 27   | 1                                    | 33   | 44  | 55  | 66  | 77  | 88  | 99  | 110  | 121  | 132  |
| 28   | 1                                    | 31   | 41  | 52  | 62  | 72  | 82  | 93  | 103  | 113  | 124  |
| 29   | 1                                    | 29   | 39  | 48  | 58  | 68  | 77  | 87  | 97   | 106  | 116  |
| 30   | 1                                    | 27   | 36  | 45  | 54  | 63  | 73  | 82  | 91   | 100  | 109  |
| 31   | 1                                    | 26   | 34  | 43  | 51  | 60  | 68  | 77  | 85   | 94   | 102  |
| 32   | 1                                    | 24   | 32  | 40  | 48  | 56  | 64  | 72  | 80   | 89   | 97   |
| 33   | 1                                    | 23   | 30  | 38  | 46  | 53  | 61  | 68  | 76   | 84   | 91   |
| 34   | 1                                    | 22   | 29  | 36  | 43  | 50  | 58  | 65  | 72   | 79   | 86   |
| 35   | 1                                    | 20   | 27  | 34  | 41  | 48  | 55  | 61  | 68   | 75   | 82   |
| 36   | 1                                    | 19   | 26  | 32  | 39  | 45  | 52  | 58  | 65   | 71   | 78   |
| 37   | 1                                    | 18   | 25  | 31  | 37  | 43  | 49  | 55  | 62   | 68   | 74   |
| 38   | 1                                    | 18   | 23  | 29  | 35  | 41  | 47  | 53  | 59   | 64   | 70   |
| 39   | 1                                    | 17   | 22  | 28  | 33  | 39  | 45  | 50  | 56   | 61   | 67   |
| 40   | 1                                    | 16   | 21  | 27  | 32  | 37  | 43  | 48  | 53   | 59   | 64   |