

## TechNotes Issue # 390 January 23, 2018

The following issue of TechNotes has been written by Robert (Bob) Upson, Manager of Engineering Services for the NFSA.

### When is Steel Pipe Smaller Than 1-Inch Acceptable in NFPA 13?

If you ask someone in the fire sprinkler business, they can probably tell you that steel pipe used in sprinkler systems must be at least 1-inch in diameter. They may even add that it can be as small as 3/4-inch for copper tubing or listed brass, stainless steel, or nonmetallic pipe. They may or may not be aware that there are two specific exceptions to that rule permitting steel pipe as small as 1/2-inch in diameter. This article will summarize when those exceptions can and cannot be applied.

First of all, where does the requirement for minimum pipe diameters actually come from? If you're like me and try looking for it in a logical place first, like Chapter 6 System Components and Hardware, you won't find it. This general requirement is located in the hydraulic calculation section of Chapter 23 Plans and Calculations:

#### 23.4 Hydraulic Calculation Procedures.

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**23.4.1.2** Pipe sizes shall be no less than 1 in. (25 mm) nominal for black or galvanized steel piping and 3/4 in. (20 mm) nominal for copper tubing or brass, stainless steel, or nonmetallic piping listed for fire sprinkler service unless permitted by 8.15.20.4 and 8.15.20.5.

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The only exceptions noted are for 8.15.20.4 Revamping of Pipe Schedule Systems and 8.15.20.5 Revamping of Hydraulic Design Systems. The wording in the two sections is slightly different but they both have the same net effect. When revamping an existing system, it is permissible to use a pipe nipple less than 1-inch in diameter but no more than 4 inches in length to attach to the existing 1/2- or 3/4-inch branch line fitting originally occupied by a sprinkler. This allowance makes sense as it can permit revamping existing systems without having to replace whole branch lines to relocate

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sprinkler outlets.

## Pipe Schedule Systems

When revamping a pipe schedule system, a single upright sprinkler may be replaced with a single pendent sprinkler by using a 4-inch pipe nipple to supply a 1-inch return bend to the new sprinkler as permitted by 8.15.20.4 and shown in Figure 8.15.20.4.2. Where a single sprinkler is to be replaced by two sprinklers, a 4-inch nipple may also be used as permitted by 8.15.20.5 and shown in Figure 8.15.20.4.3, but supporting hydraulic calculations are required.

### 8.15.20.4 Revamping of Pipe Schedule Systems.

**8.15.20.4.1** When pipe schedule systems are revamped, a nipple not exceeding 4 in. (100 mm) in length shall be permitted to be installed in the branch line fitting.

**8.15.20.4.2** All piping other than the nipple permitted in 8.15.20.4.1 and 8.15.20.4.3 shall be a minimum of 1 in. (25 mm) in diameter in accordance with Figure 8.15.20.4.2.

**8.15.20.4.3** When it is necessary to pipe two new ceiling sprinklers from an existing outlet in an overhead system, the use of a nipple not exceeding 4 in. (100 mm) in length and of the same pipe thread size as the existing outlet shall be permitted, provided that a hydraulic calculation verifies that the design flow rate will be achieved in accordance with Figure 8.15.20.4.3.

**8.15.20.4.4** Where an armover is attached to connect to a sprinkler, the use of pipe nipples less than 1 in. (25 mm) in diameter shall not be permitted where seismic design is required on the system.

Note that this section would technically permit adding 1/2-inch pipe nipples to existing 3/4-inch branch lines in very old pipe schedule systems. Even assuming that the system is in good condition and has been well maintained, if 3/4-inch branch lines are encountered, strong consideration should be given to replacing them with new 1-inch pipe and fittings.

## Hydraulically Calculated Systems

When revamping a hydraulically calculated system, any 1-inch hexagonal bushings provided as permitted by 8.15.20 must be removed. This permits the installation of 1-inch pipe and the exception provided by 8.15.20.5 is not needed.

### 8.15.20 Piping to Sprinklers Below Ceilings

**8.15.20.1\*** In new installations expected to supply sprinklers below a ceiling, minimum 1 in. (25 mm) outlets shall be provided.

**8.15.20.2\*** In new installations, it shall be permitted to provide minimum 1 in. (25 mm) outlets with hexagonal bushings to accommodate sprinklers attached directly to branch line fittings to allow for future system modifications.

**8.15.20.3** When systems are revamped to accommodate added ceilings, sprinkler outlets utilized for new armover or drop nipples shall have hexagonal bushings removed.

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If 1-inch bushings are not present, a single sprinkler may be replaced with one or two sprinklers by using a 4-inch pipe nipple as small as 1/2-inch in diameter to supply new 1-inch pipe to the new sprinkler(s) provided that hydraulic calculations demonstrate that the required demand flow can be achieved.

#### **8.15.20.5 Revamping of Hydraulic Design Systems.**

**8.15.20.5.1** When hydraulically designed systems are revamped, any existing bushing shall be removed and a nipple not exceeding 4 in. (100 mm) in length shall be permitted to be installed in the branch line fitting.

**8.15.20.5.2\*** Calculations shall be provided to verify that the system design flow rate will be achieved.

**8.15.20.5.3** When it is necessary to pipe two new ceiling sprinklers from an existing outlet in an overhead system, any bushings shall be removed and the use of a nipple not exceeding 4 in. (100 mm) in length and of the same pipe thread size as the existing outlet shall be permitted, provided that a hydraulic calculation verifies that the design flow rate will be achieved.

**8.15.20.5.4** Where an armover is attached to connect to a sprinkler, the use of pipe nipples less than 1 in. (25 mm) in diameter shall not be permitted where seismic design is required on the system.

Note that it is not the intent of 8.15.20.5.2 to require a complete hydraulic calculation of the system as indicated in the annex commentary.

**A.8.15.20.5.2** It is not the intent of this section to require a full hydraulic analysis of the existing piping system in addition to new sprinkler layout.

#### **Seismic Considerations**

The use of pipe nipples less than 1-inch in diameter is limited where seismic design is required in both pipe schedule and hydraulically calculated systems by 8.15.20.4.4 and 8.15.20.4.5 respectively. Both sections apply the same restriction to the exception for pipe nipples less than 1-inch in diameter: "Where an armover is attached to connect to a sprinkler, the use of pipe nipples less than 1 in. (25 mm) in diameter shall not be permitted where seismic design is required on the system."

The concern here is that the physical strength of small diameter nipples may not be sufficient for earthquake forces; particularly when supporting a load off to the side and placing the point of maximum stress on the small pipe nipple. Although not specifically named, this restriction should be applied to armovers, return bends, or any other configuration where the pipe supported by the pipe nipple has a horizontal component.

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