

Attaching Fire Sprinkler Components to Trus Joist® TJI® Joists

NFPA 13, *Standard for the Installation of Sprinkler Systems*, may be confusing to those who are not familiar with fire sprinklers and their support systems. This technical bulletin explains options available for designing sprinkler system supports, whether using the prescriptive tables provided in NFPA 13 or an engineered solution and explains the design assumptions for attaching sprinkler components to Trus Joist® TJI® joists. For additional information about connections into the bottom flange of the TJI® joists, refer to *Bottom Flange Trus Joist® TJI® Joist Attachment Connections* ([TB-808](#)). For additional information regarding residential and commercial sprinkler system attachment details, refer to *Fire-Rated Assemblies and Sprinkler Systems* ([TJ-1500](#)).

NFPA 13 2019 Edition provides two solution paths for fire sprinkler support systems. One way is to use the prescriptive guidelines and tables in Chapter 17; Hanging, Bracing, and Restraint of System Piping, and does not require engineering analysis. The alternative option is to design the support system using engineering principles as allowed by Section 17.1.2, which states:

17.1.2 Hangers certified by a registered professional engineer to include all the following shall be an acceptable alternative to the requirements of Section 17.1:

1. *Hangers shall be designed to support five times the weight of the water-filled pipe plus 250 lbs. (115 kg) at each point of piping support.*
2. *These points of support shall be adequate to support the system.*
3. *The spacing between hangers shall not exceed the value given for the type of pipe as indicated in Table 17.4.2.1(a) or table 17.4.2.1(b).*
4. *Hanger components shall be ferrous.*
5. *Detailed calculations shall be submitted, when require by the reviewing authority, showing stresses developed in hangers, piping, and fittings, and safety factors allowed.*

Weyerhaeuser has chosen to follow the engineered approach permitted by Section 17.1.2 for sprinkler support system details. A discussion of Weyerhaeuser's interpretation of the five components, based on discussions with NFPA's technical staff, is provided below:

1. The metal hanger itself or metal connectors, not the supporting structure (e.g. TJI® joists), must be designed to withstand five times the weight of the water filled pipe plus 250 lbs. The additional 250 lb. requirement is to represent a sprinkler installer or construction worker possibly losing balance and hanging from a pipe. The extra load on the system is treated as a temporary load, whereas the weight of the water filled pipe is treated as a permanent load. For the permanent load, the duration of load (DOL) factor of 0.9 is applied to the fastener(s) in the system. For the temporary load, the DOL of 1.45 is used. The factor of 1.45 was taken from NDS® Appendix D Table B1 assuming the loading will be applied for approximately 30 minutes. It is assumed that the adequacy of the metal components is the responsibility of the Engineer of Record and/or the metal hardware supplier.
2. The 2018 NDS® is used for connection design with the appropriate equivalent specific gravity for the Trus Joist® product. In the case of connections to the bottom flange of TJI® joists, the equivalent specific gravity is 0.50 and connections are capped at a maximum of 500 lbs. at 5' o.c. along the length of the joist. If two (2) fasteners are required, the hanger shall be positioned to allow for the fasteners to be offset. Connections into the side of TJI® joist flanges are not recommended.
3. This requirement is based on the span capacity of the piping and this the maximum hanger spacing in NFPA 13 must be followed.
4. Hanger components must be metal. Plastic or other materials are not acceptable.
5. The local building official has the authority to request calculations justifying the support system design. In many cases, supplying the UL listing for the metal fire sprinkler system component and Weyerhaeuser's sprinkler systems guide are adequate to satisfy this request.

Design Example: Ceiling Flange Design

Given:

2-screw ceiling flange hanger with thickness of $\frac{1}{8}$ ", spaced 15 feet on-center (rotated to offset fasteners), and fastened with two (2) $\frac{5}{16}$ " x 2" lag screws.

Find:

For a TJI® 230, what is the maximum pipe diameter allowed.

Solution:

- From 2018 NDS® Table L2, the dimensions for a $\frac{5}{16}$ " x 2" lag screw are as follows:
 - $D_r = 0.227$ "
 - $E = \frac{3}{16}$ "
 - $H = \frac{7}{32}$ "
 - $L = 2$ "
 - $D = \frac{5}{16}$ "
 - $S = \frac{1}{2}$ "
 - $T - E = 1 \frac{5}{16}$ "
- From 2018 NDS® Table 12.2A, the withdrawal capacity is 266 lbs/in. of thread penetration for a specific gravity of 0.50.
- From Table 1, the flange thickness of a TJI® 230 is 1.25 in.
- Determine the length of thread engages in the flange:
 - Determine if the screw shank dimensions, S, penetrates in the flange. In this example, the screw dimension "S" is greater than the ceiling flange thickness, so the shank penetrates the member by $\frac{3}{8}$ in.
 - Determine length of the thread in the main member. Since T-E is greater than the flange thickness, it is the flange thickness minus the length of the shank in the flange: $[1.25" - 0.375" = 0.875"]$.
- Allowable lag screw withdrawal capacity = $0.875 \times 266 \text{ lbs/in.} = (232.7 \text{ lbs/lag screw}) \times 2 \text{ lag screws} = 465.5 \text{ lbs.}$
- Allowable lag screw capacities with DOL factors applied:
 - Permanent load, $465.5 \text{ lbs} \times 0.9 = 419 \text{ lbs.}$
 - Temporary load, $465.5 \text{ lbs} \times 1.45 = 675 \text{ lbs.}$
- Determine the maximum allowable pipe diameter.
 - Try a 4 in. diameter pipe: From NFPA 13 Table A.18.5.9, a schedule 40, water filled, 4 in. diameter pipe, weighs 16.4 lbs/ft at 15 ft o.c. between supports, the total weight is $16.4 \text{ lbs/ft} \times 15 \text{ ft} = 246 \text{ lbs.}$
 - Permanent pipe weight = 246 lbs.
 - Temporary pipe weight = $246 \text{ lbs} + 250 \text{ lbs} = 496 \text{ lbs.}$
- Check that the pipe weights are less than the flange pull-off and lag screw withdrawal capacities.
 - Permanent load check: $246 \text{ lbs} < [500 \text{ lbs (flange pull-off) and } 419 \text{ lbs (lag screw withdrawal)}]$
 - Temporary load check: $496 \text{ lbs} < [500 \text{ lbs (flange pull-off) and } 675 \text{ lbs (lag screw withdrawal)}]$
- Temporary load check controls the design, and the maximum diameter pipe that can be supported by the bottom flange of a TJI® 230 using a ceiling flange hanger with two (2) $\frac{5}{16}$ " x 2" lag screws is 4 in.

In the above example, the maximum allowable diameter of pipe is greater than the 2" pipe diameter shown in Detail S21 of the [TJ-1500](#) because the details are limited by NFPA 13's prescriptive rules.

It is important to note that some jurisdictions have only adopted NFPA 13's prescriptive solutions and have excluded Section 17.1.2 and the alternative option of engineering a fire sprinkler support system. Therefore, it is important to contact your local building official to confirm that this approach is permitted for your structure.

If you have any questions, please contact your Weyerhaeuser representative.

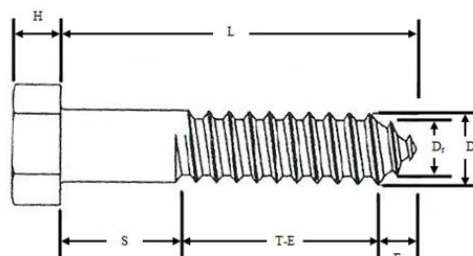


FIGURE 1: $\frac{1}{4}$ " X $1 \frac{1}{2}$ " LAG SCREW

TABLE 1: RESIDENTIAL TJI® FLANGE SIZES

Joist Series	Flange Thickness (in.)	Flange Depth (in.)
TJI® 110	1.75	1.25
TJI® 210	2.06	1.25
TJI® 230	2.31	1.25
TJI® 360	2.31	1.38
TJI® 560	3.50	1.38