Bottom Flange Trus Joist® TJI® Joist Attachment Connections

This technical bulletin is intended to assist designers and engineers with specifying withdrawal connections into the bottom flange of residential Trus Joist® TJI® joists with wood screws or lag screws. Examples of items commonly attached to the bottom flange include furnaces, ductwork, bike racks, garage door motors/tracks, lights, etc. The design information presented is not appropriate for sprinkler attachments, which must comply with NFPA 13. For sprinkler details, please reference *Fire-Rated Assemblies and Sprinkler Systems* (TJ-1500).

Design Considerations for Bottom Flange Attachments

- Minimum edge and end distances shall follow 2018 NDS® guidelines.
- Penetration into the web is permitted.
- Lead holes are required as follows:
  - ¼″ lag screws: lead hole diameter = 1/8″ (50% of diameter).
  - Wood screws larger than No. 8: lead hole diameter = 70% of root diameter.
- **Loads applied to the bottom flange must be accounted for in the design of the joist.**
- Maximum allowable bottom flange concentrated load is 500 lb. every 5 ft. (250 lb. each side of flange).
- Withdrawal values shall be determined using a specific gravity (G) of 0.50 and taken as:
  - Lag screws: 2018 NDS® Table 12.2A or $W = 1800G^{(3/2)}D^{(3/4)}$ (lb/in. of thread penetration).
  - Wood Screws: 2018 NDS® Table 12.2B or $W = 2850G^{2}D$ (lb/in. of thread penetration).
- Spacing of fasteners shall be taken as:
  - Lag screws: 2018 NDS® Table 12.5.1E.
  - Wood Screws: 2018 NDS® Table C12.1.5.7 or sufficient to prevent splitting of the flange.

TABLE 1: RESIDENTAIL TJI® JOIST FLANGE SIZES

Joist Series	Minimum Flange Thickness [in]	Flange Width [in]
TJI® 110	1.25	1.75
TJI® 210	1.25	2.08
TJI® 230	1.25	2.30
TJI® 360	1.375	2.30
TJI® 560	1.375	3.50

For sprinkler attachments details, reference *Fire-Rated Assemblies and Sprinkler Systems* (TJ-1500).

TABLE 2: COMMON SCREW WITHDRAWAL CAPACITIES

Fastener	Lead Hole	W[1] [lb/in]	W_{max}[2] [lb]	
			TJI® 110/ 210 / 230	TJI® 360 / 560
No. 7 Wood Screw	3/32″	107	134	147
No. 8 Wood Screw	3/32″	117	146	161
No. 9 Wood Screw	7/64″	126	158	173
No. 10 Wood Screw	7/64″	135	169	186
No. 12 Wood Screw	1/8″	154	193	212
No. 14 Wood Screw	9/64″	172	215	237
¼″ Lag Screw[3]	1/8″	225	281	309

[1] Withdrawal capacity from 2018 NDS® Tables 12.2A and 12.2B based on the fastener diameter and specific gravity of 0.50. Capacity shown is in pounds per inch of thread penetration into the main member, excluding the tapered tip of the fastener.
[2] Maximum withdrawal capacity is based on the threaded portion of the fastener engaging the full thickness of the flange. This may not occur with many fastener lengths and connection configurations.
[3] Clearance holes may not penetrate the flange; see 2018 NDS® 12.1.4 for clearance hole definition.

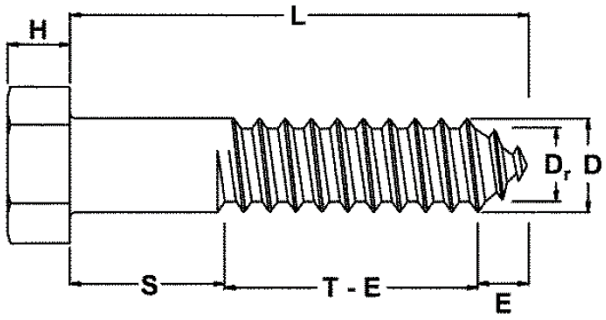
Design Example

Given

- Joist Series = TJI® 230
- ¼″ x 1½″ lag screw through ¼″ metal plate into bottom flange

Find

What is the maximum withdrawal capacity of the lag screw?



Solution

- From 2018 NDS® Table L2, the dimensions for a ¼″ x 1½″ lag screw are as follows:
  - Height of head (*H*) = $^{11}/_{64}$″
  - Lag screw length (*L*) = 1½″
  - Diameter (*D*) = ¼″
  - Root diameter (D_r) = 0.173″
  - Unthreaded body length (S) = ¼″
  - Minimum thread length (*T*) = 1¼″
  - Length of tapered tip (*E*) = $^{5}/_{32}$″
- From **Table 2**, the reference design withdrawal value is 225 lb/in of thread penetration.
- From **Table 1**, the flange thickness of a TJI® 230 is 1¼″.
- Determine the length of thread engaged in the flange:
  - Determine if the unthreaded body length (S) penetrates into the flange. In this example, the unthreaded body length is the same as the metal side member, so the shank does not penetrate the main member.
  - Determine the length of thread in the main member. Since the shank is not in the main member, the amount of thread in the main member is the minimum thread length (*T*) minus the length of tapered tip (*E*).
  - Length of thread engaged in the flange = $T - E = \left(1\frac{1}{4}\text{ in}\right) - \left(\frac{5}{32}\text{ in}\right) = 1\frac{3}{32}\text{ in}$
  - In this example, the flange thickness is greater than the *T* - *E* (1¼″ > $1^{3}/_{32}$″). Had the *T* - *E* been greater than the flange thickness, the flange thickness would be used as the length of thread engaged in the flange.
- Lag screw withdrawal capacity = $\left(1\frac{3}{32}\text{ in}\right) \times (225\text{ lb/in}) = 245\text{ lb}$
- Check end, edge, and spacing requirements per 2018 NDS®:
  - Minimum end distance = $4D = 1\text{ in}$
  - Minimum edge distance = $1.5D = \frac{3}{8}\text{ in}$
  - Minimum spacing = $4D = 1\text{ in}$

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