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 2024 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). Do not increase for load duration.
- Withdrawal design values in pounds per inch of thread penetration determined based on specific gravity (G) of 0.50:
  - Lag screws: 2024 NDS® Table 12.2A or Equation 12.2-1.
  - Wood screws: 2024 NDS® Table 12.2B or Equation 12.2-2.
- Spacing of fasteners shall be taken as:
  - Lag screws: 2024 NDS® Table 12.5.1E.
  - Wood screws: 2024 NDS® Table C12.1.5.7 (or sufficient to prevent splitting of the flange).

TABLE 1: RESIDENTAIL TJI® JOIST FLANGE SIZES

TJI® 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: WITHDRAWAL CAPACITIES OF SCREWS

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] Reference withdrawal design value from 2024 NDS® Tables 12.2A and 12.2B based on the fastener diameter and G = 0.50. Capacity shown is pounds per inch of thread penetration into the main member, excluding the tapered tip of the fastener.
[2] Maximum withdrawal capacity 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 2024 NDS® 12.1.4 for clearance hole definition.

Design Example

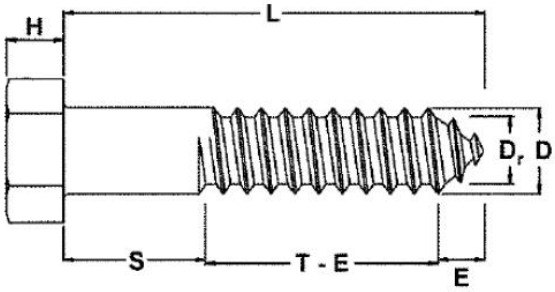
Given

- 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 2024 NDS® Table L2, the dimensions for a ¼″ x 1½″ lag screw are as follows:
  - Diameter, D = ¼ in.
  - Root diameter, D_r = 0.173 in.
  - Length of tapered tip, E = $^5/_{32}$ in.
  - Height of head, H = $^{11}/_{64}$ in.
  - Lag screw length, L = 1½ in.
  - Unthreaded body length, S = ¼ in.
  - Minimum thread length, T = 1¼ in.
  - T – E = $1^3/_{32}$ in.
- From **Table 2**, the reference withdrawal design value is 225 lb/in. of thread penetration.
- From **Table 1**, the flange thickness of a TJI® 230 is 1.25 in.
- Determine the length of thread engaged in the main member (flange):
  - Determine whether the unthreaded body length, S, penetrates the flange. In this example, S is the same as the thickness of the metal side member, therefore the shank does not penetrate the flange.
  - Determine the length of thread in the main member. The shank does not penetrate the flange, so the length of thread engaged 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 = $1^3/_{32}$ in.
  - In this example, the flange thickness is greater than T – E . Had the flange thickness been less than T – E, the flange thickness would be used as the length of thread engaged in the flange.
- Lag screw withdrawal capacity = (T – E) x W = ($1^3/_{32}$ in.) x (225 lb/in.) = 245 lb
- Check end, edge, and spacing requirements per 2024 NDS®:

  Minimum end distance = 4D = 1 in.

  Minimum edge distance = 1.5D = ⅜ in.

  Minimum spacing = 4D = 1 in.

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