

## SCREW FASTENER SELECTION FOR LIGHT GAUGE STEEL FRAME CONSTRUCTION

**Summary:** Specifying the proper fastener is necessary to assure the proper performance of the connections used in light gauge (cold formed) steel construction. Connections in traditional wood construction rely on the embedment of nails to provide shear and tensile strength. Since cold formed steel connections primarily are made with externally threaded fasteners, there is no embedment to consider. Instead, the design of the fastener along with the thickness of the steel govern the value of the connection. This Tech Note is the first in a series on fasteners, and is designed to provide the basic information used in determining the appropriate screw type for various applications. Other issues in this series will discuss specific applications.

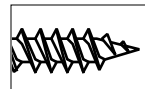
**Definitions:** Tapping screws are externally threaded fasteners with the ability to “tap” their own internal mating threads when driven into metallic and non-metallic materials. Cold formed steel construction utilizes two specific types of tapping screws:

1. **Self-Drilling Screws** are externally threaded fasteners with the ability to drill their own hole and form, or “tap”, their own internal threads without deforming their own thread and without breaking during assembly. These screws are high-strength, one-piece installation fasteners and are used if the connection



is multiple thicknesses of 33 mils (20 gauge) steel or thicker.

2. **Self-Piercing Screws** are externally threaded fasteners with the ability to self-pierce metallic material, form a sleeve by extruding metallic material and “tap” their own mating threads when driven. Self-piercing screws are high-strength, one-piece one-side installation fasteners with sharp point angles of 20 to 26 degrees and are used to attach rigid materials to 33 mils (20 gauge), (one thickness) or thinner.



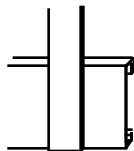
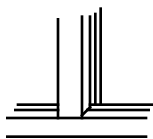
### SECTION I: Procedure for Selection

The first step in choosing the proper fastener for cold formed steel construction is to define the connection to be made. Two fundamental questions must be answered:

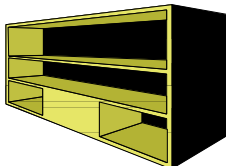
#### 1. What materials are being joined?

Possible alternatives include:

Steel to Steel, such as stud to track, x-bracing, and gusset plates



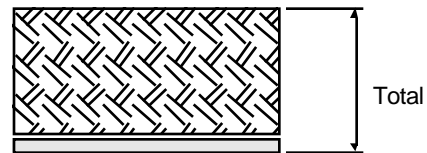
Rigid Material to Steel, including plywood or gypsum board to steel, cabinets, and exterior fiber cement board.



#### 2. What is the total thickness of the material in the connection? For example:



- 43 mils (18 gauge) steel + 33 mils (20 gauge) steel = Total thickness:



- 3/4" plywood + 54 mils (16 gauge) steel = Total thickness:
- 1/2" OSB + 54 mils (16 gauge) steel = Total thickness:

When attaching sheathing to steel at the corner of the wall or panel, be aware there will be multiple thicknesses of steel (i.e., the stud and the track) to drill through.

## SECTION II: Fastener Selection

When the application has been defined, it is then possible to choose fasteners with the appropriate point design, body diameter, length, head style, drive, thread type and plating requirements.

### POINT TYPES

Point types include self-piercing or self-drilling. Although many other types of tapping screws are available, including thread cutting, thread rolling and thread forming, it is unlikely they would be considered for a construction application since they require a pre-drilled hole.

The point type also will determine the total thickness the screw is designed to drill through. The larger the point type number, the thicker the material it is designed to penetrate. If the manufacturer conforms to SAEJ78 specifications the screws will provide the capacities noted in Table 1. While point types 1, 4, and 5 are available, the most common are point types 2 and 3. If point types 1, 4, or 5 are chosen, or if the point is a proprietary design, care should be taken to assure that the proper drill capacity (appropriate rpm) is specified.

### SELF-DRILLING SCREW SELECTION CHART

*Table 1*

Screw Type	Point Style	Nominal Screw Size	P
			Recommended Total Panel Thickness - Steel to Steel - (inch)
BSD and CSD*	2	4	0.080 Max.
		6	0.090 Max.
		8	0.100 Max.
		10	0.110 Max.
		12	0.140 Max.
	3	1/4"	0.175 Max.
		6	0.090-0.110
		8	0.100-0.140
		10	0.110-0.175
		12	0.110-0.210
	1/4"	0.110-0.210	

\* Basic Screw Diameter and Coarse Screw Diameter

### BODY DIAMETER

The body diameter is specified by the nominal screw size. Table 2 gives the correlation between common screw size and the nominal diameter of the screw. Normally, connections will be made with a minimum of No. 8 fastener, except for attaching gypsum wall board which generally uses No. 6. All body diameters should meet ANSI / ASME B18 6.4

### BODY DIAMETER *Table 2*

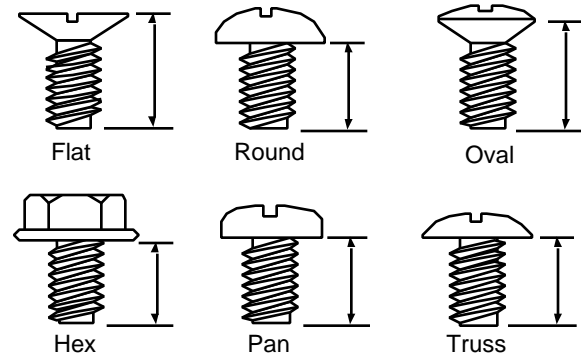
Number Designation	Nominal Diameter, d, in. *
0	0.0600
1	0.0730
2	0.0860
3	0.0990
4	0.1120
5	0.1250
6	0.1380
7	0.1510
8	0.1640
10	0.1900
12	0.2160
1/4 "	0.2500



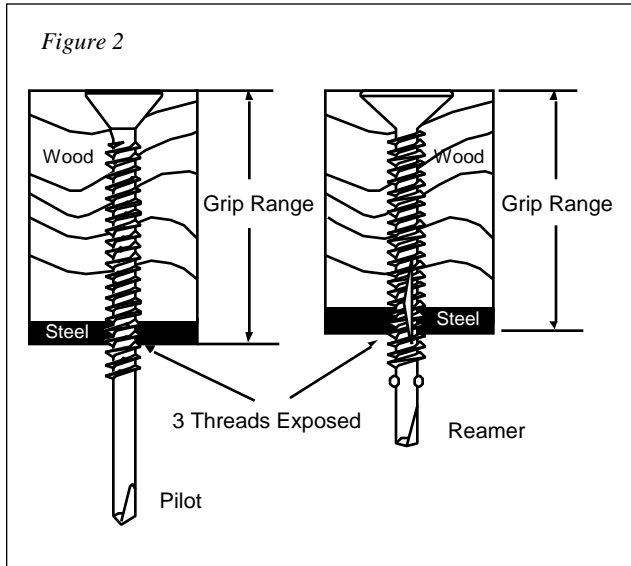
### LENGTH

The length of the fastener is measured from the bearing surface of the fastener to the end of the point. For example, the length of a flat or countersunk head is measured from the top of the head to the end of the point. A pan head screw length is measured from under the head (bearing surface) to the end of the point. See Figure 1.

### SCREW LENGTH MEASUREMENT *Figure 1*



The length of self-drilling screws may require special consideration since some designs have an unthreaded pilot section or reamer wings between the threads and the drill point. These features may be necessary for the application and are considered in the overall length of the fastener, however the grip range of the drill screw will be different. Steel connections will require three threads to be exposed for a good connection. See Figure 2.

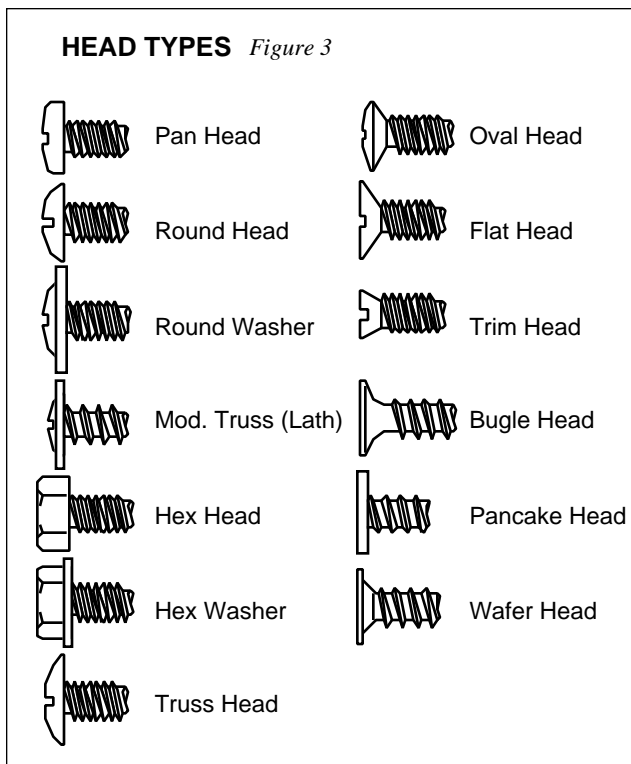


### HEAD STYLES

Common head styles include flat, oval, wafer, truss, modified truss, hex washer head, pan, round washer and pancake. See Figure 3. Which style is specified may be determined by the application, preference and availability.

Typical examples of head style selections are:

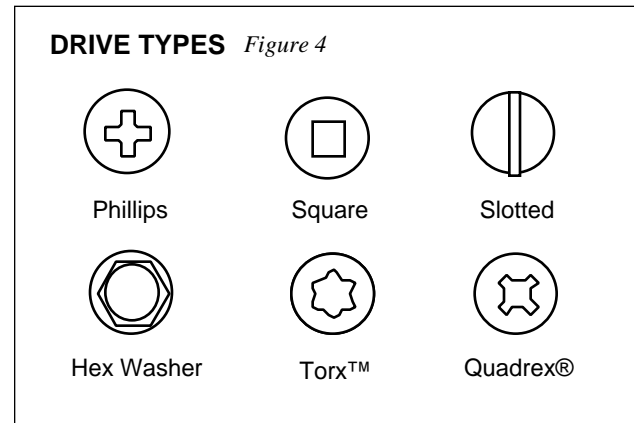
a. Plywood to Steel - Normally requires a fastener that would be flush with the plywood, such as a flat or wafer head style.



b. Steel to Steel - Requires a head with some bearing surface on the top of the material being connected, such as a hex washer head, pancake head, modified truss or pan head styles. It should be noted that when sheathing is to be applied over the steel, a low profile head style (i.e., modified truss or pancake head) is required.

### DRIVE TYPES

Drive types are usually determined by availability and preference. Common drive types are shown by Figure 4.



### THREAD

Self-piercing and self-drilling screws intended for cold formed steel applications generally have a coarse thread. (e.g., 10-16 x 5/8 HWH SD, would indicate a 10 diameter, 16 threads per inch, 5/8" length, hex washer head self-drilling screw). There also are many drill screws that have fine threads for drilling thicker steel.

Product specifications should be supplied by the manufacturer of each screw specified. The accepted tolerances for coarse and fine self-drilling screws is contained in SAEJ78.

### PLATING

Common platings include zinc (mechanical galvanizing), phosphate and oil, and zinc with a yellow dichromate finish (appearing gold in color). In addition, many specialty platings are given trade names by the manufacturer.

Although self-drilling screws are typically zinc plated and comply with 96-hour salt spray testing, the manufacturer should verify corrosion resistance.

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## CODE APPROVALS AND QUALITY ASSURANCE

The manufacturer must comply with all codes and performance criteria to assure that the fastener that is supplied will meet the required shear and tensile values. An acceptance criteria, that covers dimensional, torsional, performance and traceability requirements, has been approved and is in place with ICBO ES under AC118.

It is more certain that a manufacturer's fastener will provide consistent performance if the supplier has an on-going, in-house, quality assurance program in place. Head marking of structural products and independent testing are other key factors that should be required before a screw is specified.

## INSTALLATION

Proper installation tools are required to achieve a sound connection. For steel-to-steel connections using a Number 10 screw or smaller, a maximum of 2500 rpm tool should be used. For No. 12 and 1/4" drill screws, the tool should have a maximum rpm of 1800. An adjustable torque and clutch is recommended for all steel to steel connections to help prevent stripping of the connection. All connections requiring the fastener to countersink must use a depth sensitive nosepiece.

## References

1. Compass International, Inc., © 1996, Selecting the Correct Fastener.
2. Industrial Fastener Institute, 6th Edition Section H, Fastener Standards
3. ICBO ES AC118 Acceptance Criteria for Tapping Screw Fasteners, July 1996
4. SAEJ78, 1979 Standard Specification for Self-Drill Tapping Screws
5. ANSI B 18.6.4 1981, ASME Standard Specifications for Tapping Screws.

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