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TECHNICAL NOTE

On Cold-Formed Steel Construction

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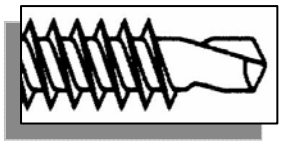
SCREW FASTENER SELECTION FOR COLD-FORMED STEEL FRAME CONSTRUCTION

This Technical Note updates and replaces LGSEA Technical Note 565c

Summary: Specifying the proper fastener is necessary to assure the proper performance of the connections used in 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 provides basic information for determining the appropriate screw type for various applications.

Definitions:

Tapping screws are externally threaded fasteners with the ability to form or "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 fracturing during assembly. These screws are high-strength, one-piece installation fasteners and are used if the connection is multiple thicknesses of 33 mils steel or thicker.

2. Self-Piercing Screws are externally threaded fasteners with the ability to self-pierce metallic material, form a sleeve by extruding steel sheet and form or "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 sheathing materials to 33 mils steel (one thickness) or thinner.

SECTION I: Procedure for Selection

When choosing the proper fastener for cold-formed steel construction 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 wood structural sheathing or gypsum board to steel, cabinets, and exterior fiber cement board.

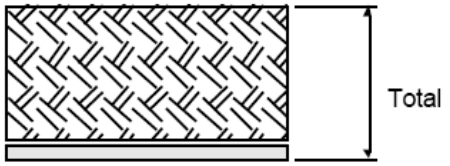
Steel-to-steel connection between stud and track being made using electric screw gun with nosepiece removed. Locking clamps help reduce gaps between fastened parts and prevent movement during screw installation. Consideration should be made for space needed for screw gun during installation.

Electric screw gun with automatic feed nosepiece using bugle-head screws for sheathing attachment to steel.

2. **What is the total thickness of the material in the connection?**

For example:

43 mil steel + 33 mil steel = Total thickness: 0.076”



3/4” plywood + 54 mils steel = Total thickness = 0.804”

1/2” OSB + 54 mils steel = Total thickness = 0.554”

When attaching sheathing to steel at the corner of the wall panel, consideration must be given to the fact that there may be multiple thicknesses of steel (i.e., the stud and the track) to drill through.

SECTION II: Fastener Selection

Based on the application a fastener with the appropriate point, body diameter, length, head style, drive, thread type and corrosion resistance must be chosen.

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 through which the screw is designed to drill. The larger the point type number, the thicker the material the screw is designed to penetrate. If the manufacturer conforms to ASTM C1513 specifications the screws will provide the capacities noted in Table 1. While point types 1, 4, or 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 take to assure that the proper drill capacity and appropriate screw gun speed (in revolutions per minute, or RPM) are used.

SELF-DRILLING SCREW SELECTION CHART

The following table represents a typical screw selection chart and may vary by manufacturer.

Table 1

Screw Type	Point Type	Nominal Screw Size	P = Recommended Total Panel Thickness -Steel to Steel- (inch)
Basic Screw Diameter & Coarse Screw Diameter	2	4 6 8	0.080 Max. 0.090 Max. 0.100 Max.
		10 12 1/4”	0.110 Max. 0.140 Max. 0.175 Max.
	3	6 8 10 12 1/4”	0.090-0.110 0.100-0.140 0.110-0.175 0.110-0.210 0.110-0.210

BODY DIAMETER

A body diameter is specified by a nominal screw size. Table 2 provides the correlation between the common screw size and the nominal body diameter of the screw. All body diameters should meet ANSI / ASME B18.6.4.

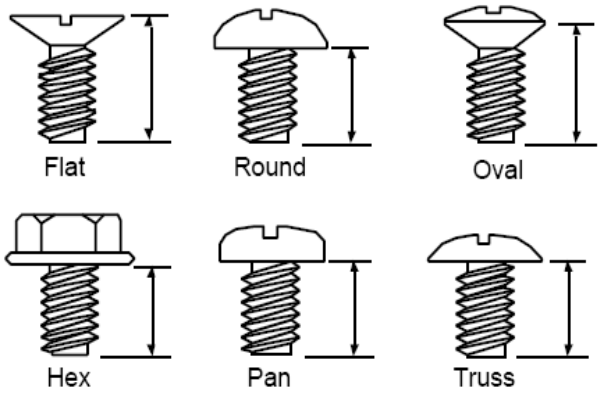
Screw Nominal Size	Nominal Screw Diameter, d	
	(inches)	(mm)
No. 6	0.138	3.51
No. 8	0.164	4.17
No. 10	0.190	4.83
No. 12	0.216	5.49
1/4"	0.250	6.35

Table 2

As illustrated by Figure 1, 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 measure from under the head (bearing surface) to the end of the point.

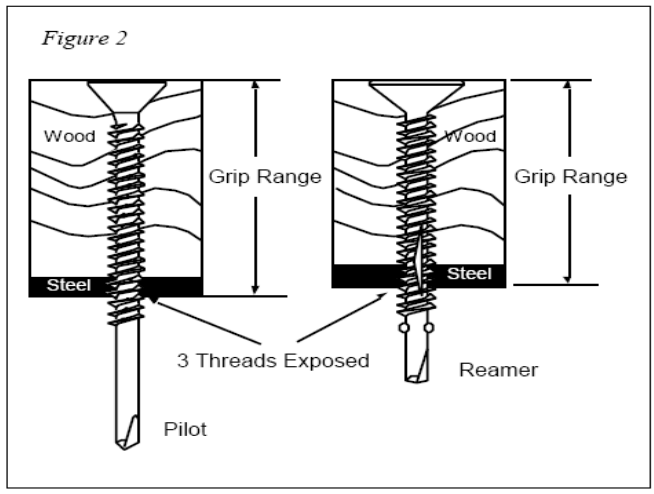
Some screws have "wings" or "tabs," designed to drill a larger pilot hole through wood or other sheathing to prevent "jacking." The tabs are designed to break off when they reach the steel framing.

SCREW LENGTH MEASUREMENT *Figure 1*



When specifying the length of a self-drilling screw, consideration must also be given to the required grip range. Some screws have an unthreaded pilot section or reamer wings between the threads and the drill point. These features may be necessary for an application and are considered in the overall length of the fastener. The grip range of the drill screw will be as illustrated by Figure 2. Even though the screw on the left is longer because of the unthreaded pilot section, both screws have the same grip range. Also, when specifying the screw length, steel connections will require three threads to be exposed for a good connection as stipulated by AISI S200.

Figure 2



Zinc plated hex washer head (HWH) self-drilling screws (SDS) are the most common type used for steel-to-steel connections when sheathing will not be applied over the fastener head. When sheathing will be applied, a low-profile head (such as pan-head or modified truss head) is more commonly used.

HEAD STYLES

Common head styles, as illustrated by Figure 3, include flat, oval, wafer, truss, modified truss, hex washer head, pan, round washer and pancake. The head style may be determined by the application, preference and availability. Typical examples of head style selections are:

A. Wood Structural Sheathing to Steel: Normally requires a fastener head to be flush with the plywood or oriented strand board (OSB), such as a flat or wafer head style.

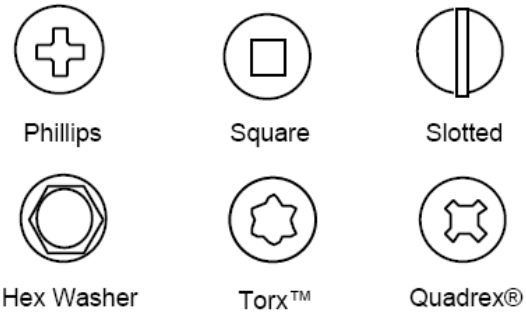
B. Steel-toSteel: Requires a fastener head with some bearing surface on the top of the material being connected, such as a hex or pan head.

It should be noted that when sheathing is to be applied over the steel, a low profile head style (e.g., modified truss or pancake head) is preferred.

DRIVE TYPES

Drive types are usually determined by availability and preference. Common drive types are shown by Figure 4. Hex washer head drive screws are often preferred by framers, because it provides stability of the screw in the nosepiece of the tool both before and during installation.

DRIVE TYPES *Figure 4*

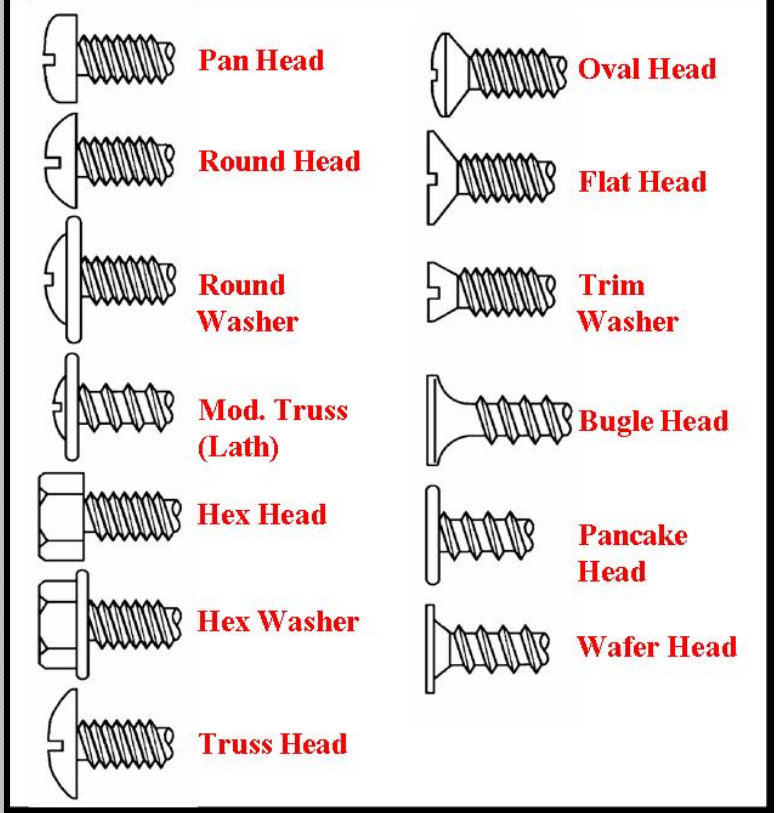


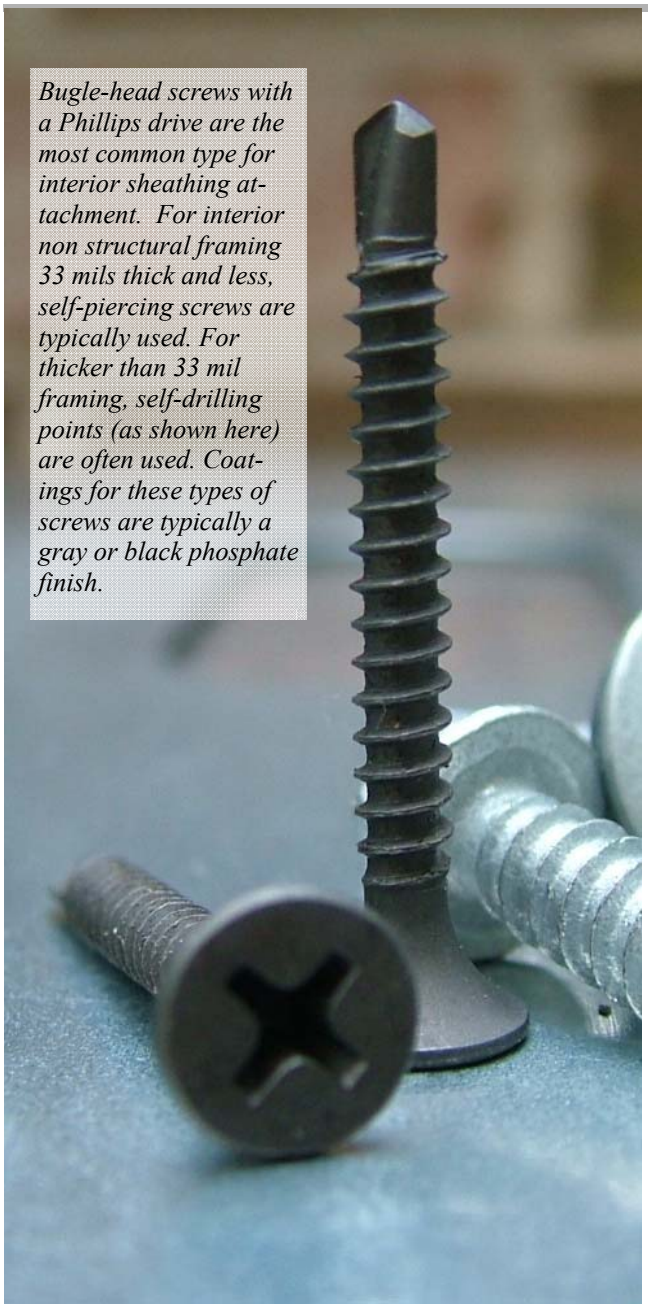
THREAD

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). Drill screws that have fine threads are used for drilling thicker steel and the screw may easily strip if used in thinner cold-formed steel applications.

Product specifications should be supplied by the manufacturer of each screw specified. The accepted tolerances for coarse and fine self-drilling screws are contained in ASTM C1513.

HEAD TYPES *Figure 3*





Bugle-head screws with a Phillips drive are the most common type for interior sheathing attachment. For interior non structural framing 33 mils thick and less, self-piercing screws are typically used. For thicker than 33 mil framing, self-drilling points (as shown here) are often used. Coatings for these types of screws are typically a gray or black phosphate finish.

CORROSION RESISTANCE

Common plating types for corrosion resistance include zinc (mechanical galvanizing), phosphate and oil, or zinc with a yellow dichromate finish (appearing gold in color). In addition, many specialty plating types 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.

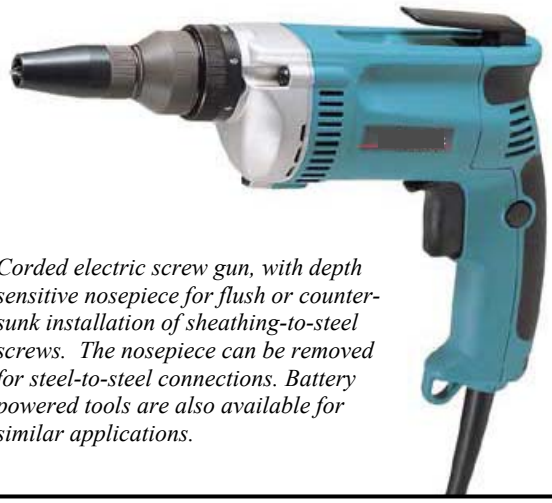
CODE APPROVALS AND QUALITY ASSURANCE

The screw 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. The *North American Standard for Cold-Formed Steel Framing—General Provisions* (AISI S200) stipulates that self-drilling tapping screws for steel-to-steel connections must be in compliance with ASTM C1513. This ASTM also covers test methods for determining performance requirements and physical properties. However, the tensile and shear strength of a screw must be determined in accordance with AISI S904. In addition, ASTM C1513 provides guidelines for developing a manufacturer's quality assurance program. Head marking of structural products and independent testing are also specified by ASTM C1513. International Code Council Evaluation Service (ICC-ES) acceptance criteria, AC 118 may also be considered, since it stipulates dimensional, torsional performance and traceability requirements.

INSTALLATION

The *North American Standard for Cold-Formed Steel Framing—General Provisions* (AISI S200) stipulates that a properly installed screw extends through the steel connection a minimum of three exposed threads and the screw shall penetrate the components without causing permanent separation between the components.

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 nose piece.



Corded electric screw gun, with depth sensitive nosepiece for flush or countersunk installation of sheathing-to-steel screws. The nosepiece can be removed for steel-to-steel connections. Battery powered tools are also available for similar applications.

References

1. AISI S200-07, *North American Standard for Cold-Formed Steel Framing—General Provisions,* American Iron and Steel Institute, Washington, D.C.
2. AISI S904-08, *Standard Test Methods for Determining the Tensile and Shear Strength of Screws,* American Iron and Steel Institute, Washington, D.C.
3. ANSI/ASME B18.6.4, *Standard Specifications for Thread Forming and Thread Cutting-Screws,* ASME International, New York, NY.
4. ASTM C1513-10, *Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections,* ASTM International, West Conshohocken, PA
5. International Code Council Evaluation Service (ICC-ES), Acceptance Criteria for Tapping Screw Fasteners, AC118, October 2010.

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