



# Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections<sup>1</sup>

This standard is issued under the fixed designation C 1513; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers steel self-drilling and self-piercing tapping screws for the connection of cold-formed steel members manufactured in accordance with Specifications C 645 and C 955. This specification also covers test methods for determining performance requirements and physical properties.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI equivalents of the inch-pound units are approximate.

1.3 The following safety hazards caveat pertains only to the test methods described in this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:

- A 370 Test Methods and Definitions for Mechanical Testing of Steel Products<sup>2</sup>
- A 510 Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel<sup>2</sup>
- B 117 Practice for Operating Salt Spray (Fog) Apparatus<sup>3</sup>
- C 11 Terminology Relating to Gypsum and Related Building Materials and Systems<sup>4</sup>
- C 645 Specification for Nonstructural Steel Framing Members<sup>4</sup>
- C 955 Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks) and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases<sup>4</sup>
- F 1941 Specification for Electrodeposited Coatings on

Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))<sup>5</sup>

### 2.2 ANSI/ASME Documents:

B18.18.1M Inspection and Quality Assurance for General Purpose Fasteners<sup>6</sup>

B18.6.4 Standard Specification for Thread Forming and Thread-Cutting Screws<sup>6</sup>

### 2.3 SAE Standards:

SAE J78-1998 Steel Self-Drilling Tapping Screws<sup>7</sup>

SAE J933 Mechanical and Quality Requirements for Tapping Screws<sup>7</sup>

## 3. Terminology

3.1 *Definitions*—For definitions relating to gypsum and related building materials and systems, use Terminology C 11.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *bearing surface (of the screw), n*—the supporting or locating surface of a fastener with respect to the part which it fastens (mates). The loading of the fastener is usually through the bearing surface, (that is, the bearing surface of the hex washer head style is under the head, the part that touches the top material being fastened).

3.2.2 *case depth (of the screw), n*—the thickness of the hardened surface of the screw.

3.2.3 *countersunk head style (for a screw), n*—all screw head designs that sink into the top material being fastened and that have the bearing surface (see 3.2.1), at the top of the head (that is, flat and bugle).

3.2.4 *crest (of the screw thread), n*—the highest point of the screw thread.

3.2.5 *drill capacity (of the self-drilling screw), n*—the total thickness of material the fastener is designed to drill through, including any space between the layers.

3.2.6 *head styles (of the screw), n*—refer to Fig. 1 drawings.

3.2.6.1 *bugle head, n*—bugle shape countersinking head typically used for fastening gypsum panel products to wood and steel.

3.2.6.2 *hex washer face, n*—see *hex washer head*.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee C11 on Gypsum and Related Building Materials and Systems and is the direct responsibility of Subcommittee C11.02 on Specifications and Test Methods for Accessories and Related Products.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 01.03.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 03.02.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 04.01.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 01.08.

<sup>6</sup> Available from ASME International Headquarters, Three Park Avenue, New York, NY 10016-5990.

<sup>7</sup> Available from Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

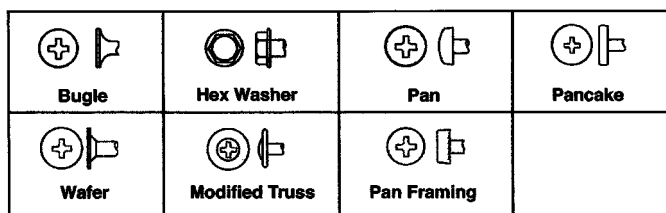


FIG. 1 Head Styles

3.2.6.3 *hex washer head, n*—has an indented top surface and six flat sides formed integrally with a flat washer which projects beyond the sides and provides a flat bearing surface.

3.2.6.4 *lath head, n*—see *modified truss*.

3.2.6.5 *modified truss, n*—low profile round washer head.

3.2.6.6 *pan framing head, n*—flat top surface rounding into cylindrical sides and a flat bearing surface.

3.2.6.7 *pan head, n*—a slightly rounded top surface rounding into cylindrical sides and a flat bearing surface.

3.2.6.8 *pancake head, n*—lower profile head style than the hex washer and pan head with a larger flat bearing surface.

3.2.6.9 *wafer head, n*—a countersinking head style with a large lip at the top of the countersinking contour that will “flush” with the substrate creating a greater bearing surface, therefore a greater pull-over/pull-through value.

3.2.7 *point style, n*—of the self-drilling tapping screw is designated by a number (that is, 1, 2, 3, 4, or 5). The higher the number, the higher the drill capacity (see 3.2.5) of the screw.

3.2.8 *root (of the screw thread), n*—the lowest point of the screw thread.

3.2.9 *self-drilling tapping screw, n*—externally threaded fasteners with the ability to drill their own hole and form or cut their own internal mating threads without breaking.

3.2.10 *self-piercing tapping screw, n*—externally threaded fasteners with the ability to pierce metallic material 33 mils (0.84 mm), or less, form a sleeve by extruding metallic material and “tap” their own mating threads when driven. Self-piercing screws have a sharp point with the point angle not more than 30 degrees.

3.2.11 *spin-out (for a screw), n*—for a screw, the continued rotation of a screw without further penetration into the substrate.

3.2.12 *tapping screw, n*—externally threaded fasteners with the ability to “tap” their own internal mating threads when installed.

#### 4. Classification

4.1 Steel tapping screws covered by this specification are two types:

- 4.1.1 Self-drilling.
- 4.1.2 Self-piercing.

#### 5. Materials

5.1 Steel wire, Specification A 510—minimum grade 1018.

#### 6. Physical Properties

6.1 *Dimensions:*

6.1.1 Self-drilling tapping screws shall be in accordance with SAE J78.

6.1.2 Self-piercing tapping screws shall be in accordance with head dimensions as shown in ANSI/ASME B18.6.4.

6.2 *Total Case Depth*—Screws shall have a total case depth conforming to the tabulation in Table 1.

6.2.1 Case depth shall be measured at the mid-point between crest and root on the thread shank.

#### 7. Packaging and Head Marking

7.1 Screws shall be marked with manufacturer’s/supplier’s head marking for traceability.

7.2 Screws shall be packaged in substantial commercial shipping containers, constructed so as to preserve the contents in good condition and to ensure acceptance and safe delivery by common or other carriers.

7.2.1 Individual packages shall be so constructed that the contents shall be able to be partially removed without destroying the container’s ability to serve as a receptacle for the remainder of the contents.

7.2.2 Individual packages and shipping containers shall be marked with the type, size, use, and quantity of the screws contained therein, the name brand headmarking example and trademark of the producer or supplier, the ASTM designation, and any or all appropriate evaluation reports. Boxes shall be marked with the drill capacity of the self-drilling tapping screws.

#### 8. Performance Requirements

8.1 *Hardness:*

8.1.1 The self-drilling tapping screws shall have a surface hardness of not less than Rockwell C 50 and core hardness of not less than Rockwell C 32 as tested in accordance with SAE J78.

8.1.2 The self-piercing screws shall have a surface hardness of not less than Rockwell C 45 and core hardness of not less than Rockwell C 28 as tested in accordance with SAE J933.

8.2 *Ductility:*

8.2.1 The self-drilling tapping screws shall have sufficient ductility to be able to withstand a 5° bend without visible signs of fracture as tested in accordance with SAE J78.

8.2.2 The self-piercing tapping screws shall have sufficient ductility to be able to withstand a 10° bend without visible signs of fracture as tested in accordance with SAE J933.

8.3 *Torsional Strength:*

8.3.1 Self-drilling tapping screws shall not fail the application of torque less than or equal to the torsional strength specified in Table 2, when tested in accordance with SAE J78.

8.3.2 Self-piercing tapping screws shall not fail with the application of torque less than the torsional strength specified in Table 3, as tested in accordance with ANSI/ASME B18.6.4, Section 2.9.1.2, for tapping screws.

8.4 *Drill Drive Performance Requirement:*

TABLE 1 Total Case Depth

Nominal Screw Size	Total Case Depth, Maximum, in. (mm)	Total Case Depth, Minimum, in. (mm)
8 through 12	0.009 (.2286 mm)	0.004 (.1016 mm)
¼ in.	0.011 (.2794 mm)	0.005 (.1270 mm)

**TABLE 2 Torsional Strength—Self-Drilling Tapping Screws**

Nominal Screw Size	Minimum lb-in. Type BSD <sup>A</sup>	Minimum lb-in. Type CSD <sup>B</sup>
6	24	24
8	42	48
10	61	65
12	92	100
1/4 in.	150	156

<sup>A</sup> Type BSD—spaced threads referred to as coarse thread.

<sup>B</sup> Type CSD—machine screw threads referred to as fine thread.

**TABLE 3 Torsional Strength—Self-Piercing Tapping Screws**

Nominal Screw Size	Minimum lb-in.
6	24
7	30
8	39
10	56

8.4.1 Self-drilling tapping screws shall not fail the drill-drive test requirements as noted in SAE J78 and shown in Table 4.

8.4.2 Self-drilling tapping screws shall be tested in accordance with SAE J78 as shown in Fig. 2.

**8.5 Self-Drilling Tapping Screw Drill Capacity:**

8.5.1 Screws shall be able to self-drill and thread into cold-formed steel thicknesses without breaking or stripping as specified by each specific manufacturer’s published recommendations. Manufacturers shall provide a min-max recommendation with the drill capacity of each self-drilling point style screw.

**9. Finish and Appearance**

9.1 The threads shall be clean, smooth, and neatly formed.

9.2 Each fastener shall have manufacturer’s/supplier’s head marking for traceability.

9.3 Screws shall have a corrosion-resistant treatment. The finish shall not inhibit adhesion to finishing materials nor bleed through field-applied decoration. The screws shall meet a

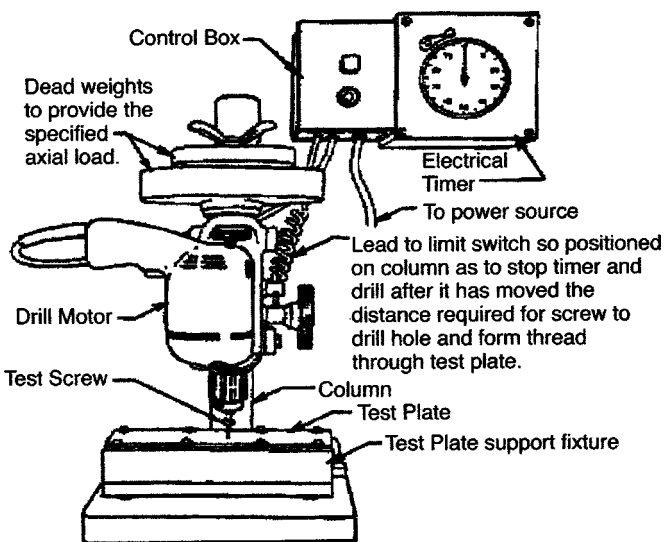
**TABLE 4 Drill-Drive Test Requirements**

Nominal Screw Size	Test Plate Thickness, <sup>A</sup> in., Max	Test Plate Thickness, <sup>A</sup> in., Min	Axial Loading, <sup>B</sup> lb, A, max	Axial Loading, <sup>B</sup> lb, B, Max	Axial Loading, <sup>B</sup> lb, C, Max	Time to Drill and Form Thread, <sup>C</sup> s, Max
4	0.068	0.062	25	30	40	2.0
6	0.068	0.062	30	35	45	2.5
8	0.068	0.062	30	35	45	3.0
10	0.068	0.062	35	40	50	3.5
12	0.068	0.062	45	50	60	4.0
1/4	0.068	0.062	45	50	60	5.0

<sup>A</sup> Test plates shall be low carbon, cold rolled steel having a hardness of Rockwell B 80-85.

<sup>B</sup> Axial loads are varied to offset the detrimental effects on drilling capability created by finishes applied to screws in accordance with the following: Column A—Axial loads tabulated shall apply to plain, oiled, and commercial phosphate coating and cadmium and zinc platings up to 0.0003 in. in thickness. Column B—Axial loads tabulated shall apply to special electroplated finishes exceeding 0.0003 in. in thickness and to special coatings, such as thread sealing hot melts, and so forth. Column C—Axial loads tabulated shall apply to chromium finish.

<sup>C</sup> Tool speed shall be 2500 rpm for screw sizes No. 4 through No. 10. Tool speed of 1800 rpm is recommended for screw sizes No. 12 and 1/4; however, 2500 rpm may be used provided care is exercised to minimize influence of high heat buildup due to surface speed.



**FIG. 2 Drill-Drive Test Apparatus**

minimum requirement as listed in Specification F 1941 as tested in accordance with Practice B 117.

**10. Sampling**

10.1 Obtain not less than one randomly selected specimen of each type of screw to be tested from each of five containers, with not less than five screws per 250 000 screws, to constitute a lot for testing.

**11. Test Methods**

11.1 Screws shall be tested per SAE J78 Table number 4, Section 8.4, to determine the ability of the screws to self-drill through cold-formed steel without spinout, thread deformation, or breaking.

**11.2 Significance and Use:**

11.2.1 The test methods provide procedures for evaluating the physical properties and performance requirements of steel drill screws.

**12. Test Materials**

**12.1 Materials:**

12.1.1 Screw fasteners used in the tests shall be of standard manufacturer and representative of the product for which recognition is sought. Where tested fasteners are prototype, the fasteners shall be representative of later production. Fasteners shall meet the minimum and quality requirements for tapping screws in accordance with ANSI/ASME B18.6.4 and ANSI/ASME B18.18.1M, 1987 or the pertinent standard, whichever is more restrictive. Compliance is determined by test reports submitted by a qualified testing laboratory.

12.1.2 Sheet Steel—Steel description, including material specification, yield strength, and minimum uncoated steel thickness noted.

12.2 Sharp point screws shall be tested using 33 mil (0.84 mm) steel.

12.3 Drill point screws shall be tested using 54 mil (1.37 mm) steel.

**13. Specimen Preparation**

13.1 Where the number of steel coupon specimens is not

noted in the specific standard, a minimum of three steel coupon specimens shall be tested to show compliance with the appropriate standard and to determine the minimum uncoated steel thickness and strengths. Steel tension test shall be performed in accordance with Test Methods and Definitions A 370.

13.2 *Screw Fasteners*—A minimum of three test specimens are to be tested for tension (pull-out) and for the lap shear connection. If the result from any one test is more than 15 % higher or lower than the other two, the lowest test value is used, unless an additional three tests are performed. Then use the average results of all six tests, regardless of the variation.

#### 14. Procedure

14.1 If any of the first lot on the drill-drive testing fails, test another lot. If two of that lot fail, the entire lot fails.

#### 15. Dimensional Measurement

15.1 *Self-Piercing Screws*—ANSI/ASME B18.6.4.

15.2 *Self-Drilling Tapping Screws*—SAE J78.

#### 16. Ductility Test

16.1 *Self-Piercing Screws*—ANSI/ASME B18.6.4.

16.2 *Self-Drilling Tapping Screws*—SAE J78.

#### 17. Torsional Strength

17.1 *Self-Piercing Screws*—ANSI/ASME B18.6.4.

17.2 *Self-Drilling Tapping Screws*—SAE J78.

#### 18. Inspection

18.1 Inspection of the steel screws shall be agreed upon between the purchaser and producer or supplier as part of the purchase agreement.

#### 19. Rejection and Rehearing

19.1 Rejection of steel screws that fail to conform to the requirements of the specification shall be reported to the producer or supplier promptly and in writing within 10 working days from receipt of shipment. Notice of rejection shall contain a specific statement as to the respects in which the screws have failed to conform to the requirements of the specification. In case of dissatisfaction with the test results, and at the request of the producer or supplier, such notice of rehearing shall be supported by results of a test conducted by a mutually agreeable independent laboratory.

#### 20. Certification

20.1 When specified in the purchase agreement, the producer or supplier shall furnish a report certifying that, at the time of shipment, the screws were in compliance with the requirements of this specification.

#### 21. Keywords

21.1 bugle head; crest; hex washer head; modified truss; pancake head; pan head; root; screws; self-drilling; self-piercing; spin-out; wafer head drill capacity

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