ICC EVALUATION SERVICE®

# ICC-ES Evaluation Report

**ESR-3558**

*Reissued June 2021*

*This report is subject to renewal June 2023.*

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

**DIVISION: 05 00 00—METALS**
**Section: 05 05 23—Metal Fastenings**

**REPORT HOLDER:**

**KYOCERA SENCO INDUSTRIAL TOOLS, INC.**

**EVALUATION SUBJECT:**

**SENCO SELF-DRILLING AND SELF-PIERCING SCREWS**

## 1.0 EVALUATION SCOPE

**Compliance with the following codes:**

- 2021, 2018, 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2021, 2018, 2015, 2012 and 2009 *International Residential Code*® (IRC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)†

†The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

**Property evaluated:**

Structural

## 2.0 USES

The Senco self-drilling and self-piercing screws are used to connect cold-formed steel members together and to connect sheet steel to cold-formed steel. The screws are used in engineered connections of cold-formed steel and in connections prescribed by the code for cold-formed steel framing and for sheathing to steel connections.

## 3.0 DESCRIPTION

### 3.1 General:

The Senco self-drilling and self-piercing screws are tapping screws, case-hardened from carbon steel conforming to ASTM A510, Grade 1022. Table 1 provides screw designations, model numbers, descriptions including screw nominal size, threads per inch (tpi), length, screw diameter, drive recess, head style, head diameter, point style, drilling/piercing ranges, minimum required protrusion lengths and coatings. Screws are supplied in boxes or tubs of individual screws or in collated screw strips.

### 3.2 PMTH Self-piercing Screws:

The #8 PMTH self-piercing screws comply with ASTM C1513, with a coarse thread design. The screws have a Phillips modified truss head (PMTH) style, and have a clear zinc coating, as indicated in Table 1. See Figure 2.

### 3.3 PMTH, SPWH, PWH, SPFH and RPFH Self-drilling Screws:

The #8 PMTH, #8 SPWH, #10 PWH, #10 SPFH and #10 and #12 RPFH self-drilling screws comply with ASTM C1513. The screws have a type “BSD” thread design. The screws have a Phillips modified truss head (PMTH) style, square pan with washer head (SPWH) style, Phillips reduced wafer head (PWH) style, square pan framing head (SPFH) style, and Rex pan framing head (RPFH) style, respectively, and have a clear zinc coating, a yellow zinc coating or a proprietary exterior coating, as indicated in Table 1. See Figures 3, 4, 1, 5 and 6, for PMTH, SPWH, PWH, SPFH and RPFH screws, respectively.

### 3.4 Cold-formed Steel:

Cold-formed steel material must comply with one of the specifications listed in Section A3.1 of AISI S100 (Section A2.1 of AISI S100 for the 2015, 2012 and 2009 IBC) and must have the minimum base-metal thickness and tensile strength shown in the tables in this report.

## 4.0 DESIGN AND INSTALLATION

### 4.1 Design:

**4.1.1 General:** Selection of screw length must be based on the thickness of the fastened steel members plus the minimum required protrusion past the back of the supporting steel. Point selection must be based on the drilling/piercing capacity of the screw. See Table 1 for minimum required protrusion lengths and drilling/piercing capacities.

When tested for corrosion resistance in accordance with ASTM B117, the screws met the minimum requirement listed in ASTM F1941, as required by ASTM C1513, with no white corrosion after three hours and no red rust after 12 hours.

**4.1.2 Prescriptive Design:** The screws described in this report may be used where ASTM C1513 screws of the same size and head style/dimension are prescribed in the IRC and in the AISI standards referenced in IBC Section 2211 (2009 IBC Section 2210) for steel-to-steel connections.

**4.1.3 Engineered Design:** The screws described in this report may be used in engineered connections of cold-formed steel light-framed construction. Design of connections must comply with Section J4 of AISI S100 (Section E4 of AISI S100 for the 2015, 2012 and 2009 IBC), using the nominal and allowable screw tension and shear strengths for the screws shown in Table 5. Allowable connection strengths for use in Allowable Strength Design (ASD) for pull-out, pullover, and shear (bearing) capacity for common sheet steel thicknesses are provided in Tables 2, 3 and 4, respectively, based upon laboratory testing in accordance with AISI S905.

Instructions on how to calculate connection design strengths for use in Load and Resistance Factor Design (LRFD) are found in the footnotes of Tables 2, 3 and 4. For connections subject to tension, the least of the allowable pull-out, pullover, and screw tension strength of screws found in Tables 2, 3, and 5, respectively, must be used for design. For connections subject to shear, the lesser of the allowable shear (bearing) and screw shear strength found in Tables 4 and 5, respectively, must be used for design. Design provisions for tapping screw connections subjected to combined shear and tension loading are outside the scope of this report.

Under the 2021 IBC, for screws used in framing connections, in order for the screws to be considered fully effective, the minimum spacing between the screws must be 3 times the nominal diameter of the screws and the minimum edge distance must be 1.5 times the nominal screw diameter. Under the 2018, 2015, 2012 and 2009 IBC, for screws used in framing connections, in order for the screws to be considered fully effective, the minimum spacing between the screws and the minimum edge distance must be 3 times the nominal diameter of the screws, except when the edge is parallel to the direction of the applied force, the minimum edge distance must be 1.5 times the nominal screw diameter. When the spacing between screws is less than 3 times the nominal screw diameter, but at least 2 times the nominal screw diameter, the connection shear strength values in Table 4 must be reduced by 20 percent [Refer to Section B1.5.1.3 of AISI S240 (Section D1.5 of AISI S200 for the 2015, 2012 and 2009 IBC)].

For screws used in applications other than framing connections, the minimum spacing between the screws must be three times the nominal screw diameter and the minimum edge distance and minimum end distance must be 1.5 times the nominal screw diameter. Additionally, under the 2009 IBC, when the distance to the end of the connected part is parallel to the line of the applied force, the allowable connection shear strength determined in accordance with Section E4.3.2 of Appendix A of AISI S100-07 must be considered.

Connected members must be checked for rupture in accordance with Section J6 of AISI S100 (Section E6 of AISI S100 under the 2015 IBC, Section E5 of AISI S100 under the 2012 and 2009 IBC).

### 4.2 Installation:

Installation of the Senco self-drilling and self-piercing screws must be in accordance with the manufacturer's published installation instructions and this report. The manufacturer's published installation instructions must be available at the jobsite at all times during installation.

The screws must be installed perpendicular to the work surface using a variable speed screw driving tool set to not exceed 2,500 rpm. The screw must penetrate through the supporting steel with a minimum of three threads protruding past the back side of the supporting steel.

## 5.0 CONDITIONS OF USE

The Senco self-drilling and self-piercing screws described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

**5.1** Screws must be installed in accordance with the manufacturer's published installation instructions and this report. If there is a conflict between the manufacturer's published installation instructions and this report, this report governs.

**5.2** Connections made with the Senco screws must be designed and constructed in accordance with Section 4.0 of this evaluation report and the approved construction documents. In the case of a conflict between these documents, the more restrictive requirements govern.

**5.3** The allowable loads (ASD) specified in Section 4.1.3 are not to be increased when the screws are used to resist short-term loads, such as wind or seismic forces.

**5.4** Evaluation of screws subjected to cyclic or fatigue loading is outside the scope of this report. Applicable Seismic Design Categories shall be determined in accordance with the code for the entire assembly constructed with the screws.

**5.5** The utilization of the strength values contained in this evaluation report, for the design of diaphragm consisting of steel deck panels fastened to cold-formed steel framing, is outside the scope of this report. Diaphragms constructed using the Senco self-drilling or self-piercing screws must be addressed in a current ICC-ES evaluation report based upon the ICC-ES Acceptance Criteria for Steel Deck Roof and Floor Systems (AC43).

**5.6** Drawings and calculations verifying compliance with this report and the applicable code must be submitted to the code official for approval. The drawings and calculations are to be prepared by a registered design professional when required by the statutes of the jurisdiction in which the project is to be constructed.

**5.7** The screws are manufactured under a quality control program with inspections by ICC-ES.

## 6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Tapping Screw Fasteners Used in Steel-to-Steel Connections (AC118), dated January 2018 (editorially revised December 2020).

## 7.0 IDENTIFICATION

**7.1** Senco self-drilling and self-piercing screws are marked with a "D" on the top of the heads, as shown in Figures 1 through 6. Packages of Senco self-drilling and self-piercing screws are labeled with the report holder's name, the screw brand name (Senco) and model number, and the evaluation report number (ESR-3558).

**7.2** The report holder's contact information is the following:

**KYOCERA SENCO INDUSTRIAL TOOLS, INC.**
**8450 BROADWELL ROAD**
**CINCINNATI, OHIO 45244**
**(800) 543-4596**
**www.senco.com**

**TABLE 1—SENCO SELF-DRILLING AND SELF-PIERCING SCREWS (ASTM C1513) FOR ENGINEERED STEEL-TO-STEEL CONNECTIONS**

| DESIGNATION[1] (Nom. size – tpi x head type) (Head designation) | DESCRIPTION (Nom. size x length) | SENCO MODEL NUMBER[3] | DRIVE RECESS | HEAD DIAMETER (in.) | NOMINAL DIAMETER (in.) | DRILL POINT (Number) | DRILL CAPACITY (in.) | | MINIMUM REQUIERD PROTRUSION LENGTH (in.) | COATING[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Min. | Max. | | |
| #8-15 x Modified Truss (PMTH) | 8 x 1/2 | 08M050CTRFSP | Phillips | 0.350 | 0.164 | Self-piercing | 0.021 | 0.036 | 0.377 | Clear Zinc |
| #8-18 x Modified Truss (PMTH) | 8 x 1/2 | 08M050CTRFDP | Phillips | 0.350 | 0.164 | #2 | 0.035 | 0.100 | 0.356 | Clear Zinc |
| #8-18 x Pan with Washer (SPWH) | 8 x 2 | 08X200CKADDS | Square | 0.352 | 0.164 | #2 | 0.035 | 0.100 | 0.379 | Clear Zinc |
| | 8 x 1 1/4 | 08X125CKADDS | Square | 0.352 | 0.164 | #2 | 0.035 | 0.100 | 0.379 | Clear Zinc |
| #10-16 x Reduced Wafer (PWH) | 10 x 3/4 | 10M075CKNFDP | Phillips | 0.324 | 0.190 | #2 | 0.035 | 0.110 | 0.395 | Clear Zinc |
| #10-16 x Pan Framing (SPFH or RPFH) | 10 x 3/4 | 10M075CTMFDS | Square | 0.348 | 0.190 | #2 | 0.035 | 0.110 | 0.460 | Clear Zinc |
| | 10 x 1 | 10M100CKMFDS | Square | 0.348 | 0.190 | #2 | 0.035 | 0.110 | 0.460 | Clear Zinc |
| | 10 x 5/8 | 10M062CBFFDX | Rex | 0.348 | 0.190 | #2 | 0.035 | 0.110 | 0.460 | Clear Zinc |
| | 10 x 3/4 | 10M075YTFFDX | Rex | 0.348 | 0.190 | #2 | 0.035 | 0.110 | 0.460 | Yellow Zinc |
| #10-22 x Pan Framing (RPFH) | 10 x 3/4 | 10M075YLFT4X | Rex | 0.350 | 0.190 | #4 | 0.175 | 0.312 | 0.474 | Yellow Zinc |
| | 10 x 3/4 | 10M075YKFT4X | Rex | 0.350 | 0.190 | #4 | 0.175 | 0.312 | 0.474 | Yellow Zinc |
| | 10 x 3/4 | 10M075EBFT4X | Rex | 0.350 | 0.190 | #4 | 0.175 | 0.312 | 0.491 | E1000 |
| #10-22 x Modified Truss (PMTH) | 10 x 3/4 | 10M075CDK | Phillips | 0.350 | 0.190 | #2 | 0.039 | 0.158 | 0.372 | Clear Zinc |
| | 10 x 1 | 10M100CDK | Phillips | 0.350 | 0.190 | #2 | 0.039 | 0.158 | 0.372 | Clear Zinc |
| | 10 x 1 1/2 | 10M150CDK | Phillips | 0.350 | 0.190 | #2 | 0.039 | 0.158 | 0.372 | Clear Zinc |
| | 10 x 2 | 10M200CDK | Phillips | 0.350 | 0.190 | #2 | 0.039 | 0.158 | 0.372 | Clear Zinc |
| #12-18 x Pan Framing (RPFH) | 12 x 7/8 | 12M087YKFF4X | Rex | 0.348 | 0.216 | #4 | 0.175 | 0.312 | 0.563 | Yellow Zinc |
| #12-14 x Pan Framing (RPFH) | 12 x 1 | 12M100YKFF3X | Rex | 0.348 | 0.216 | #3 | 0.110 | 0.210 | 0.487 | Yellow Zinc |
| | 12 x 1 1/2 | 12M150CTFFDX | Rex | 0.348 | 0.216 | #2 | 0.035 | 0.110 | 0.487 | Clear Zinc |

For **SI**: 1 inch = 25.4 mm.

[1]Refer to Section 3.0 and Figures 1 through 6 for head configuration abbreviations.
[2]For coating abbreviations, Clear Zinc = Fe/Zn 3A per ASTM F1941; Yellow Zinc = Fe/Zn 3C per ASTM F1941; E1000 = Fe/Zn 8AS per ASTM F1941.
[3]The 7th digit denotes the coating: C = Clear Zinc, Y = Yellow Zinc, E = E1000. The 8th digit denotes the type of packaging: B = 4000 pcs box, K = 1000 pcs box, T = 1000 pcs tub, L = Loose; except for the #10-22 PMTH screw where the 7th digit denotes the coating and the 9th digit denotes the type of packaging.

**TABLE 2—ALLOWABLE TENSILE PULL-OUT LOADS ($P_{NOT}/\Omega$), pounds-force[1,2,3,4]**

| SCREW DESIGNATION | NOMINAL DIAMETER (in.) | STEEL $F_U$=45 Ksi | | STEEL $F_U$=55 Ksi | | STEEL $F_U$=65 Ksi | | |
|---|---|---|---|---|---|---|---|---|
| | | Design Thickness of Member Not in Contact with the Screw Head (in.) | | | | | | |
| | | 0.041 | 0.050 | 0.041 | 0.050 | 0.062 | 0.075 | 0.104 |
| #8-15 x Modified Truss (PMTH) | 0.164 | 126 | 167 | 130 | 167 | - | - | - |
| #8-18 x Modified Truss (PMTH) | 0.164 | 73 | 99 | 85 | 100 | - | - | - |
| #8-18 x Pan with Washer (SPWH) | 0.164 | 88 | 127 | 91 | 128 | 183 | 237 | 382 |
| #10-16 x Reduced Wafer (PWH) | 0.190 | 85 | 104 | 90 | 105 | 198 | 232 | 341 |
| #10-16 x Pan Framing (SPFH or RPFH) | 0.190 | 91 | 126 | 99 | 126 | 191 | 267 | 371 |
| #10-22 x Pan Framing (RPFH) | 0.190 | 88 | 100 | 94 | 100 | 201 | 250 | 372 |
| #10-22 x Modified Truss (PMTH) | 0.190 | 95 | 102 | 95 | 132 | 202 | 202 | 404 |
| #12-18 x Pan Framing (RPFH) | 0.216 | 93 | 124 | 96 | 125 | 195 | 240 | 368 |
| #12-14 x Pan Framing (RPFH) | 0.216 | 84 | 118 | 87 | 118 | 176 | 231 | 390 |

For **SI:** 1 inch = 25.4 mm, 1 pound-force = 4.4 N, 1 ksi = 6.89 MPa.

[1]For tension connections, the least of the allowable pull-out, pullover, and screw tension strength of screw found in Tables 2, 3, and 5, respectively must be used for design.
[2]Nominal load values are based upon laboratory testing in accordance with AISI S905.
[3]The allowable pull-out capacity for intermediate member thicknesses can be determined by interpolating within the values in the table for the applicable steel tensile strength.
[4]To calculate LRFD values, multiply values in table by the ASD safety factor of 3.0 and multiply again with the LRFD Φ factor of 0.5.

**TABLE 3—ALLOWABLE TENSILE PULL-OVER LOADS ($P_{NOV}/\Omega$), pounds-force[1,2,3,4]**

| SCREW DESIGNATION | NOMINAL DIAMETER (in.) | HEAD OR INTEGRAL WASHER DIAMETER (in.) | STEEL $F_U$=45 Ksi | | STEEL $F_U$=55 Ksi | | STEEL $F_U$=65 Ksi | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Design Thickness of Member in Contact with the Screw Head (in.) | | | | | | |
| | | | 0.041 | 0.050 | 0.041 | 0.050 | 0.062 | 0.075 | 0.104 |
| #8-15 x Modified Truss (PMTH) | 0.164 | 0.350 | 349 | 366 | 359 | 367 | - | - | - |
| #8-18 x Modified Truss (PMTH) | 0.164 | 0.350 | 370 | 385 | 381 | 385 | 387 | 387 | - |
| #8-18 x Pan with Washer (SPWH) | 0.164 | 0.352 | 463 | 488 | 477 | 488 | 488 | 547 | 557 |
| #10-16 x Reduced Wafer (PWH) | 0.190 | 0.324 | 435 | 451 | 448 | 451 | 490 | 518 | 638 |
| #10-16 x Pan Framing (SPFH or RPFH) | 0.190 | 0.348 | 493 | 501 | 502 | 502 | 788 | 881 | 881 |
| #10-22 x Pan Framing (RPFH) | 0.190 | 0.350 | 427 | 533 | 480 | 534 | 785 | 785 | 785 |
| #10-22 x Modified Truss (PMTH) | 0.190 | 0.350 | 368 | 368 | 420 | 466 | 507 | 531 | 619 |
| #12-18 x Pan Framing (RPFH) | 0.216 | 0.348 | 477 | 488 | 490 | 490 | 769 | 873 | 1011 |
| #12-14 x Pan Framing (RPFH) | 0.216 | 0.348 | 482 | 505 | 495 | 506 | 766 | 835 | 1030 |

For **SI:** 1 inch = 25.4 mm, 1 pound-force = 4.4 N, 1 ksi = 6.89 MPa.

[1]For tension connections, the least of the allowable pull-out, pullover, and screw tension strength of screw found in Tables 2, 3, and 5, respectively must be used for design.
[2]Nominal load values are based upon laboratory testing in accordance with AISI S905.
[3]The allowable pullover capacity for intermediate member thicknesses can be determined by interpolating within the values in the table for the applicable steel tensile strength.
[4]To calculate LRFD values, multiply values in table by the ASD safety factor of 3.0 and multiply again with the LRFD Φ factor of 0.5.

**TABLE 4—ALLOWABLE SHEAR (BEARING) CAPACITY ($P_{NS}/\Omega$) OF STEEL-TO-STEEL CONNECTIONS, pounds-force[1,2,3,4]**

| SCREW DESIGNATION | NOMINAL DIAMETER (in.) | STEEL $F_U$=45 Ksi | | STEEL $F_U$=55 Ksi | | STEEL $F_U$=65 Ksi | | |
|---|---|---|---|---|---|---|---|---|
| | | Design Thickness of Both Connected Members (in.) | | | | | | |
| | | 0.041 | 0.050 | 0.041 | 0.050 | 0.062 | 0.075 | 0.104 |
| #8-15 x Modified Truss (PMTH) | 0.164 | 286 | 334 | 294 | 334 | - | - | - |
| #8-18 x Modified Truss (PMTH) | 0.164 | 217 | 267 | 223 | 268 | 412 | 428 | - |
| #8-18 x Pan with Washer (SPWH) | 0.164 | 205 | 270 | 211 | 271 | 425 | 425 | 425 |
| #10-16 x Reduced Wafer (PWH) | 0.190 | 226 | 277 | 232 | 277 | 446 | 485 | 511 |
| #10-16 x Pan Framing (SPFH or RPFH) | 0.190 | 226 | 279 | 232 | 279 | 512 | 517 | 517 |
| #10-22 x Pan Framing (RPFH) | 0.190 | 233 | 262 | 240 | 263 | 470 | 550 | 550 |
| #10-22 x Modified Truss (PMTH) | 0.190 | 235 | 327 | 235 | 420 | 517 | 517 | 561 |
| #12-18 x Pan Framing (RPFH) | 0.216 | 238 | 292 | 245 | 292 | 573 | 573 | 573 |
| #12-14 x Pan Framing (RPFH) | 0.216 | 253 | 309 | 261 | 309 | 544 | 577 | 606 |

For **SI:** 1 inch = 25.4 mm, 1 pound-force = 4.4 N, 1 ksi = 6.89 MPa.

[1]The lower of the allowable shear (bearing) and the allowable screw shear strength found in Tables 4 and 5, respectively must be used for design.
[2]Nominal load values are based on laboratory testing in accordance with AISI S905.
[3]The allowable bearing capacity for other member thicknesses can be determined by interpolating within the values in the table for the applicable steel tensile strength.
[4]To calculate LRFD values, multiply values in table by the ASD safety factor of 3.0 and multiply again with the LRFD Φ factor of 0.5.

**TABLE 5—SCREW STRENGTH[1,2,3,4]**

| SCREW DESIGNATION | NOMINAL DIAMETER (in.) | NOMINAL SCREW STRENGTH DETERMINED BY TESTING | | ALLOWABLE SCREW STRENGTH | |
|---|---|---|---|---|---|
| | | Tension, $P_{ts}$ (lbf) | Shear, $P_{ss}$ (lbf) | Tension ($P_{ts}/\Omega$)[1] (lbf) | Shear ($P_{ss}/\Omega$)[1] (lbf) |
| #8-15 x Modified Truss (PMTH) | 0.164 | 1423 | 1132 | 475 | 377 |
| #8-18 x Modified Truss (PMTH) | 0.164 | 2280 | 1351 | 760 | 450 |
| #8-18 x Pan with Washer (SPWH) | 0.164 | 1927 | 1377 | 642 | 459 |
| #10-16 x Reduced Wafer (PWH) | 0.190 | 2426 | 1736 | 809 | 579 |
| #10-16 x Pan Framing (SPFH or RPFH) | 0.190 | 3175 | 1779 | 1058 | 593 |
| #10-22 x Pan Framing (RPFH) | 0.190 | 2318 | 1795 | 773 | 598 |
| #10-22 x Modified Truss (PMTH) | 0.190 | 1637 | 1576 | 545 | 525 |
| #12-18 x Pan Framing (RPFH) | 0.216 | 3585 | 2132 | 1195 | 711 |
| #12-14 x Pan Framing (RPFH) | 0.216 | 2826 | 2076 | 942 | 692 |

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.4 N, 1 ksi = 6.89 MPa.

[1]For tension connections, the least of the allowable pull-out, pullover, and screw tension strength of screw found in Tables 2, 3, and 5, respectively, must be used for design.
[2]For shear connections, the lower of the allowable shear (bearing) and the allowable screw shear strength found in Tables 4 and 5, respectively, must be used for design.
[3]See Section 4.1.3 for screw spacing and end distance requirements.
[4]To calculate LRFD values; multiply the nominal screw strengths by the LRFD Φ factor of 0.5.

**FIGURE 1—PHILLIPS REDUCED WAFER HEAD (PWH) SELF-DRILLING SCREW (SECTION 3.3)**

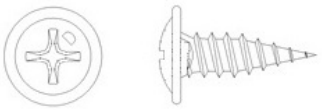

**FIGURE 2—PHILLIPS MODIFIED TRUSS HEAD (PMTH) SELF-PIERCING SCREW (SECTION 3.2)**

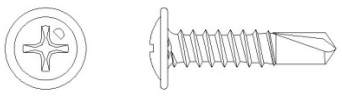

**FIGURE 3—PHILLIPS MODIFIED TRUSS HEAD (PMTH) SELF-DRILLING SCREW (SECTION 3.3)**

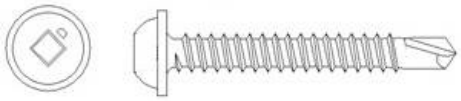

**FIGURE 4—SQUARE PAN WITH WASHER HEAD (SPWH) SELF-DRILLING SCREW (SECTION 3.3)**

**FIGURE 5—SQUARE PAN FRAMING HEAD (SPFH) SELF-DRILLING SCREW (SECTION 3.3)**

**FIGURE 6—REX PAN FRAMING HEAD (RPFH) SELF-DRILLING SCREW (SECTION 3.3)**