Code Compliance Research Report
CCRR-0387

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DIVISION: 05 00 00 - Metals
Section: 05 05 23 – Metal Fastening

REPORT HOLDER:
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REPORT SUBJECT:
SFS Bi-Met 300® Self-Drilling Fasteners

1.0 SCOPE OF EVALUATION

1.1 This Research Report addresses compliance with the following Codes:

- 2021 and 2018 *International Building Code®* (IBC)
- 2021 and 2018 *International Residential Code®* (IRC)
- 2020 *Florida Building Code* (see Section 9.0)

NOTE: This report references 2018 Code sections with [2015] Code sections shown in brackets where they differ.

1.2 SFS Bi-Met 300® Self-Drilling Fasteners have been evaluated for the following properties:

- Screw Hardness
- Screw Yield and Tensile Strength
- Screw Ductility
- Corrosion Resistance
- Pull Out Strength
- Pull Over Strength
- Lap-Joint Shear

1.3 SFS Bi-Met 300® Self-Drilling Fasteners have been evaluated for the following uses:

- Engineered connections of cold-formed steel members to cold-formed steel members
- Engineered connections of cold-formed steel members to hot-rolled steel members
- Engineered connections of cold-formed steel members to aluminum members
- Engineered connections of aluminum members to aluminum members
- Engineered connections of aluminum members to hot-rolled steel members
- Engineered connections of hot-rolled steel members to hot-rolled steel members
- Engineered screw connections in accordance with IRC Section R301.1.3

2.0 STATEMENT OF COMPLIANCE

SFS Bi-Met 300® Self-Drilling Fasteners comply with the Codes listed in Section 1.1, for the properties stated in Section 1.2, and uses stated in Section 1.3, when installed as described in this report, including the Conditions of Use stated in Section 6.0.

3.0 DESCRIPTION

3.1 SFS Bi-Met 300® fasteners are self-drilling and self-tapping bi-metal fasteners that are manufactured from 300-series stainless steel welded to a hardened carbon steel tip. The carbon steel portion of the fasteners have the drilling performance of fasteners conforming to ASTM C1513. All fasteners are available with stainless steel bonded washers. SFS Bi-Met 300® fasteners come in three different types (as covered by this report). See Table 1 for more information.

- 1/4-14 SD2
- 1/4-20 SD4
- 1/4-20 SD5

3.2 SFS Bi-Met 300 ® fasteners were tested in and for use in the following metals:

- ASTM A653, 33 ksi steel thickness of 20 gauge, 18 gauge
- ASTM A653, 50 ksi steel thickness of 16 gauge, 14 gauge, 12 gauge and 1/8 inch
- ASTM A36, 36 ksi hot rolled steel thickness of 3/16 inch, 1/4 inch, 5/16 inch and 3/8 inch
- 6063-T5 Aluminum thickness of 1/8 inch, 1/4 inch, and 3/8 inch

4.0 PERFORMANCE CHARACTERISTICS

4.1 Characteristic of screw hardness, screw shear strength, screw tensile strength, screw ductility and screw corrosion resistance were tested and evaluated in accordance with AC491 and AC118 and comply with minimum requirements.

4.2 SFS Bi-Met 300® screws are recognized for use in Prescriptive Design under the IRC where ASTM C1513 screws are specified and under IBC Section 2211 within the referenced AISI Standards.

4.3 SFS Bi-Met 300® screws are recognized for use in engineered steel-to-steel connections. Allowable Strength Design (ASD) connections must comply with section J4 for AISI S100-16 [section E4 for AISI S100-12]. ASD connections shall use the allowable fastener tension and shear strength for the screws shown in Table 2, and the allowable connection strengths for pull-out, pull-over, and shear (bearing) capacity for common sheet steel thickness provided in Table 3, Table 4, and Table 5. Load Resistance Factor Design (LRFD) are either provided in the tables on instructions for calculation of connection design strengths are found in the foot notes.

4.4 Fastener shear strength, tension strength, tensile pull-out capacity of the screw connections, tensile pull-over capacity of screw connections, and shear bearing capacity of screw connections are found in Table 2, Table 3, Table 4, and Table 5.

5.0 INSTALLATION

5.1 General: SFS Bi-Met 300 ® must be installed in accordance with the manufacturer's published installation instructions, the applicable Code, and this Research Report. A copy of the manufacturer's instructions must be available on the jobsite during installation.

5.2 Application: Screws must be installed perpendicular to the material being connected. Screws must be installed using a variable speed screw gun set not to exceed 2,000 RPM. The variable speed screw gun shall have an adjustable nose piece or a depth-sensitive nose piece.

When installing a SD4 or SD5 point screw in materials that are 1/4 inch (6.4 mm) thick or greater, speeds recommended by the manufacture are 1,500 to 1,800 RPM. Use of impact guns are not recommended.

The installed screws must penetrate through supporting base metal enough to comply with the length of the load bearing area. When fully installed, the total assembly thickness, including substrate, must not exceed the length of the load bearing area given in Table 1.

6.0 CONDITIONS OF USE

6.1 Installation must comply with this Research Report, the manufacturer's published installation instructions, and the applicable Code. In the event of a conflict, this report governs.

6.2 The connecting metal must comply with ASTM specification listed in Section A3.1.1 of AISI S100-16 [A2.1.1 of AISI S100-12] for cold-formed steel members, Section A3 of AISC 360 for hot-rolled steel members and Part IV of the Aluminum Design Manual.

6.3 No increase can be taken on the allowable strength values specified on table at the end of this report when the screws are in use to resist wind or seismic forces.

6.4 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.

6.5 Minimum spacing between screws and the minimum edge distance shall be three (3) times the nominal diameter of the screw. This is for screws to be fully effective for screws used in framing connections. Exceptions are when the edge of the material is parallel to the direction for the applied force in the connection. In this instance the minimum edge distance mut be 1.5 times the nominal screw diameter. A reduction of twenty percent (see section D1.4 of AISI S220-15 [section D1.52 of AISI S200-12]) must be used when spacing between screw is 2 times fastener diameter.

Minimum spacing between the fasteners must be three (3) times the nominal screw diameter and the minim edge and end distance must be 1.5 times the nominal screw diameter when screws are installed other than in framing connections.

Limitations on spacing and edge distance based on Section J4.1 and J4.2 for AISI S100-16 [E4.1 and E4.2 of AISI S100-12].

6.6 Consideration for aluminum connected members of the maximum spacing of fasteners in accordance with Section J.1.3 of AA ADM1 shall be made. Limitations on spacing and edge distance based on Section J5.2 and J5.3 of ADM1.

6.7 Shear strengths of the connections are when the connected steel and/or aluminum elements are in direct contact with one another.

6.8 Drawings and calculations prepared by a Registered Design Professional in the jurisdiction of the project shall be submitted verifying compliance with this CCRR and applicable local Code. The Registered Design Professional is also responsible for determining the applicable limit states for the connection that must be considered.

6.9 Combined shear and tension connection loading are outside the scope of the fasteners in this CCRR.

6.10 Rupture must be checked for connection in accordance with section J6 of AISI S100-16 [E6 of AISI S100-12 and section J.7.3 of AA ADM1 as applicable.

6.11 Resistance to corrosion due to environmental conditions or galvanic action between steel and aluminum is outside the scope of this evaluation. A Registered Design Professional is responsible for determining the required corrosion resistance that must be considered for self-drilling tapping screw used with dissimilar metals.

6.12 SFS Bi-Met 300 ® fasteners are manufactured under a quality control program with inspections by Intertek Testing Services NA, Inc.

7.0 SUPPORTING EVIDENCE

7.1 Reports of tests in accordance with ICC-ES AC491 dated June 2017 and ICC-ES AC118 dated January 2018.

8.0 IDENTIFICATION

See Figures 1, 2, and 3 for the SFS Bi-Met 300® that are identified with "SFS" on the fastener head. The manufacturers name (SFS), address and telephone number, the product name Bi-Met 300®, the Intertek Mark as show below, and the Code Compliance Research Report number (CCRR-0387) are on the package of self-drilling tapping screws.

Intertek

9.0 FLORIDA BUILDING CODE

9.1 Scope of Evaluation: The SFS Bi-Met 300® fasteners were evaluated for compliance with the 2020 *Florida Building Code – Building, Florida Building Code – Residential.*

9.2 Conclusion: The SFS Bi-Met 300® fasteners described in Sections 2.0 through 7.0 of this Research Report, comply with the 2020 *Florida Building Code – Building, Florida Building Code – Residential*, subject to the following conditions:

- Use of the SFS Bi-Met 300® fasteners for compliance with the High-Velocity Hurricane Zone provisions of the 2020 *Florida Building Code – Building* and the *Florida Building Code – Residential* has not been evaluated and is outside the scope of this Research Report
- See Section 6.0 Conditions of Use for limitations
- Intertek is a quality assurance entity approved by the Florida Building Commission

10.0 CODE COMPLIANCE RESEARCH REPORT USE

10.1 Approval of building products and/or materials can only be granted by a building official having legal authority in the specific jurisdiction where approval is sought.

10.2 Code Compliance Research Reports shall not be used in any manner that implies an endorsement of the product by Intertek.

10.3 Reference to the https://bpdirectory.intertek.com is recommended to ascertain the current version and status of this report.

TABLE 1 – SFS FOR BI-MET 300® SELF-DRILLING TAPPING SCREW DIMENSIONAL CHARACTERISTICS

Diameter Size	Nominal Major Diameter (inch)	TPI	Point Type	Head Type[1]	Nominal Head Diameter (inch)	Corrosion Resistance	Nominal Shank Length (inch)	Drill Capacity[2] (inch)		Length of Load Bearing Area[3] (inch)
								Min.	Max.	
1/4-14 SD2	0.246	14	SD2	HWH	0.500	300-series Stainless Steel	1.00	0.0312	0.1017	0.472
							1.50			0.965
							2.00			1.457
1/4-20 SD4	0.252	20	SD4	HWH	0.500	300-series Stainless Steel	1.161	0.056	0.3125	0.375
							1.50			0.709
							2.00			1.20
1/4-20 SD5	0.252	20	SD5	HWH	0.500	300-series Stainless Steel	2.00	0.0966	0.5	0.945
							4.00			2.97

For SI: 1 inch = 25.4 mm

1 Head styles: Hex Washer Head (HWH)

2 The drilling capacity of a fastener refers to the minimum and maximum substrate thickness that the fastener is designed to drill through.

3 The length of the load bearing area for Bi-Met 300® fasteners is the minimum stainless steel length of the screw.

TABLE 2 – FASTENER TENSION AND SHEAR STRENGTH FOR BI-MET 300®[1, 2, 3]

Fastener Type	Nominal Strength		Allowable Strength (ASD)		Design Strength (LRFD)	
	Tensile, P_{ts} (lbf)	Shear, P_{ss} (lbf)	Tensile, P_{ts}/Ω (lbf)	Shear, P_{ss}/Ω (lbf)	Tensile, P_{ts}* Φ (lbf)	Shear, P_{ss}* Φ (lbf)
1/4-14 SD2	3623	2620	1208	873	1812	1362
1/4-20 SD4	4134	2380	1387	793	2067	1261
1/4-20 SD5	4089	2732	1363	911	2045	1448

For SI: 1 inch = 25.4 mm

1 Available strength listed herein are based on laboratory testing.

2 for tensile connections, the lowest of the allowable fastener ensile strength, pull-out strength and pull-over strength values must be sued for design.

3 For shear connections, the lesser for the allowable fastener shear strength and allowable shear (bearing) strength must be used for design.

TABLE 3A – ALLOWABLE TENSILE PULL-OUT CAPACITY OF SCREW CONNECTIONS (lbf)[1, 2, 3, 4, 5, 6, 7]

Fastener	Nominal Diameter (inch)	Nominal Thickness of Member not in Contact with the Fastener Head (inch)												
		Cold-Formed Steel 33 ksi		Cold-Formed Steel 50 ksi				Hot-Rolled Steel 36 ksi				Aluminum 6063-T5		
		20 ga.	18 ga.	16 ga.	14 ga.	12 ga.	1/8”	3/16”	1/4"	5/16”	3/8”	1/8”	1/4"	3/8”
		0.035	0.045	0.057	0.071	0.102	0.125	0.188	0.25	0.313	0.375	0.125	0.25	0.375
1/4-14 SD2	0.246	119	155	258	355	471	-	-	-	-	-	194	-	-
1/4-20 SD4	0.252	-	-	228	369	594	749	1230	1703	-	-	205	557	-
1/4-20 SD5	0.252	-	-	-	-	-	-	-	1653	1506	1506	-	567	854

TABLE 3B – DESIGN STRENGTH TENSILE PULL-OUT CAPACITY OF SCREW CONNECTIONS (lbf)[1, 2, 3, 4, 5, 6, 7]

Fastener	Nominal Diameter (inch)	Nominal Thickness of Member not in Contact with the Fastener Head (inch)												
		Cold-Formed Steel 33 ksi		Cold-Formed Steel 50 ksi				Hot-Rolled Steel 36 ksi				Aluminum 6063-T5		
		20 ga.	18 ga.	16 ga.	14 ga.	12 ga.	1/8”	3/16”	1/4"	5/16”	3/8”	1/8”	1/4"	3/8”
		0.035	0.045	0.057	0.071	0.102	0.125	0.188	0.25	0.313	0.375	0.125	0.25	0.375
1/4-14 SD2	0.246	190	248	412	568	753	-	-	-	-	-	290	-	-
1/4-20 SD4	0.252	-	-	365	590	951	1197	1967	2724	-	-	307	836	-
1/4-20 SD5	0.252	-	-	-	-	-	-	-	2643	2408	2408	-	851	1280

Notes for Table 3A and 3B

For SI: 1 inch = 25.4 mm

1 Available strength listed herein are based on laboratory testing.

2 Values for Cold-Formed Steel 33 ksi are based on members with a minimum yield strength of F_y = 33 ksi and a minimum tensile strength of F_u = 45 ksi.

3 Values for Cold-Formed Steel 50 ksi are based on members with a minimum yield strength of F_y = 50 ksi and a minimum tensile strength of F_u = 65 ksi.

4 Values for Hot-Rolled Steel 36 ksi are based on members with a minimum yield strength of F_y = 36 ksi and a minimum tensile strength of F_u = 58 ksi.

5 Values for Aluminum 6063-T5 are based on members with a minimum yield strength of F_y = 16 ksi and a minimum tensile strength of F_u = 22 ksi.

6 (-) Indicates the given steel or aluminum member was not tested.

7 Shading indicates that the value exceeds the allowable fastener tensile strength from Table 2 and will not govern the design of the connection.

TABLE 4A – ALLOWABLE TENSILE PULL-OVER CAPACITY OF SCREW CONNECTIONS (lbf)[1, 2, 3, 4, 5, 6, 7, 8, 9]

Fastener	Nominal Diameter (inch)	Nominal Thickness of Member not in Contact with the Fastener Head (inch)												
		Cold-Formed Steel 33 ksi		Cold-Formed Steel 50 ksi				Hot-Rolled Steel 36 ksi				Aluminum 6063-T5		
		20 ga.	18 ga.	16 ga.	14 ga.	12 ga.	1/8”	3/16”	1/4"	5/16”	3/8”	1/8”	1/4"	3/8”
		0.035	0.045	0.057	0.071	0.102	0.125	0.188	0.25	0.313	0.375	0.125	0.25	0.375
1/4-14 SD2	0.246	587	756	992	1333	1428	-	-	-	-	-	641	-	-
1/4-20 SD4	0.252	-	-	976	1376	1664	1664	1664	1664	-	-	633	908	-
1/4-20 SD5	0.252	-	-	-	-	-	-	-	1649	1649	1649	-	892	892

TABLE 4B – DESIGN STRENGTH TENSILE PULL-OVER CAPACITY OF SCREW CONNECTIONS (lbf)[1, 2, 3, 4, 5, 6, 7, 8, 9]

Fastener	Nominal Diameter (inch)	Nominal Thickness of Member not in Contact with the Fastener Head (inch)												
		Cold-Formed Steel 33 ksi		Cold-Formed Steel 50 ksi				Hot-Rolled Steel 36 ksi				Aluminum 6063-T5		
		20 ga.	18 ga.	16 ga.	14 ga.	12 ga.	1/8”	3/16”	1/4"	5/16”	3/8”	1/8”	1/4"	3/8”
		0.035	0.045	0.057	0.071	0.102	0.125	0.188	0.25	0.313	0.375	0.125	0.25	0.375
1/4-14 SD2	0.246	939	1210	1586	2132	2284	-	-	-	-	-	961	-	-
1/4-20 SD4	0.252	-	-	1561	2199	2660	2660	2660	2660	-	-	949	1361	-
1/4-20 SD5	0.252	-	-	-	-	-	-	-	2636	2636	2636	-	1338	1338

Notes for Table 4A and 4B

For SI: 1 inch = 25.4 mm

1 Available strength listed herein are based on laboratory testing.

2 Head type for all screws in table is HWH: Hex Washer Head

3 Nominal Effective Pull-Over Diameter for all screws in table is 0.520 inches

4 Values for Cold-Formed Steel 33 ksi are based on members with a minimum yield strength of F_y = 33 ksi and a minimum tensile strength of F_u = 45 ksi.

5 Values for Cold-Formed Steel 50 ksi are based on members with a minimum yield strength of F_y = 50 ksi and a minimum tensile strength of F_u = 65 ksi.

6 Values for Hot-Rolled Steel 36 ksi are based on members with a minimum yield strength of F_y = 36 ksi and a minimum tensile strength of F_u = 58 ksi.

7 Values for Aluminum 6063-T5 are based on members with a minimum yield strength of F_y = 16 ksi and a minimum tensile strength of F_u = 22 ksi.

8 (-) Indicates the given steel or aluminum member was not tested.

9 Shading indicates that the value exceeds the allowable fastener tensile strength from Table 2 and will not govern the design of the connection.

TABLE 5 – ALLOWABLE AND DESIGN STRENGTH SHEAR (BEARING) CAPACITY OF SCREW CONNECTIONS (lbf)[1, 2, 3, 4, 5, 6, 7]

Fastener	Nominal Outside Diameter (inch)	Side Member	Main Member	Allowable Shear ASD (Bearing) (lbf)	Design Shear LRFD (Bearing) (lbf)
1/4-14 SD2	0.246	1/8” Aluminum (0.125”)	1/8” Aluminum (0.125”)	555	833
		1/8” Aluminum (0.125”)	20 gauge steel (0.035”)	208	312
		1/8” Aluminum (0.125”)	12 gauge steel (0.102”)	695	1043
		20 gauge steel (0.035”)	1/8” Aluminum (0.125”)	350	525
		12 gauge steel (0.102”)	1/8” Aluminum (0.125”)	508	762
		20 gauge steel (0.035”)	12 gauge steel (0.102”)	470	752
		12 gauge steel (0.102”)	20 gauge steel (0.035”)	315	503
1/4-20 SD4	0.252	1/8” Aluminum (0.125”)	1/8” Aluminum (0.125”)	510	765
		1/8” Aluminum (0.125”)	16 gauge steel (0.057”)	467	700
		1/4” Aluminum (0.25”)	1/4” steel (0.25”)	516	774
		1/4” Aluminum (0.25”)	16 gauge steel (0.057”)	462	694
		16 gauge steel (0.057”)	1/8” Aluminum (0.125”)	492	738
		1/4” steel (0.25”)	1/4” Aluminum (0.25”)	520	780
		1/4” steel (0.25”)	1/8” Aluminum (0.125”)	513	769
		20 gauge steel (0.035”)	1/8” steel (0.125”)	475	760
		1/8” steel (0.125”)	20 gauge steel (0.035”)	308	492
1/4-20 SD5	0.252	1/4” Aluminum (0.25”)	1/4” Aluminum (0.25”)	577	866
		3/8” Aluminum (0.375”)	1/4” Aluminum (0.25”)	589	884
		1/4” Aluminum (0.25”)	1/4” steel (0.25”)	569	853
		3/8” Aluminum (0.375”)	3/8” steel (0.375”)	556	833
		3/8” Aluminum (0.375”)	1/4” steel (0.25”)	585	877
		1/4” steel (0.25”)	1/4” Aluminum (0.25”)	585	877
		3/8” steel (0.375”)	3/8” Aluminum (0.375”)	576	863
		3/8” steel (0.375”)	1/4” Aluminum (0.25”)	573	859
		1/4” steel (0.25”)	3/8” steel (0.375”)	943	1508
		3/8” steel (0.375”)	1/4” steel (0.25”)	959	1531

For SI: 1 inch = 25.4 mm

1 Values for Cold-Formed Steel 33 ksi thickness 20 gauge and 18 gauge are based on members with a minimum yield strength of F_y = 33 ksi ans a minimum tensile strength of F_u = 45 ksi.

2 Values for Cold-Formed Steel 50 ksi thickness 16 gauge, 14 gauge, 12 gauge and 1/8 inch are based on members with a minimum yield strength of F_y = 50 ksi ans a minimum tensile strength of F_u = 65 ksi.

3 Values for Hot-Rolled Steel 36 ksi thickness 3/16 inch, 1/4 inch, 5/16 inch and 3/8 inch are based on members with a minimum yield strength of F_y = 36 ksi ans a minimum tensile strength of F_u = 58 ksi

4 Values for Aluminum 6063-T5 thickness 1/8 inch, 1/4 and 3/8 inch are based on members with a minimum yield strength of F_y = 16 ksi ans a minimum tensile strength of F_u = 22 ksi.

5 For shear connections, the lesser of the allowable fastener shear strength and the allowable shear (bearing) strength must be used in design.

6 For shear connections, the lesser of the design fastener shear strength and the design shear (bearing) strength must be used in design.

7 Screw head rests against side member.

8 Shading indicates that the value exceeds the allowable fastener shear strength from Table 2 and will not govern the design of the connection.

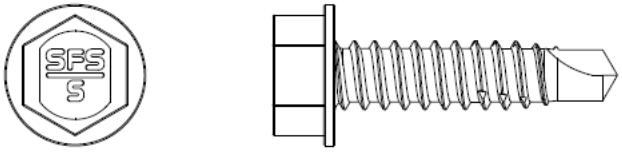

FIGURE 1 – 1/4-14 SD2 BI-MET 300® SCREW

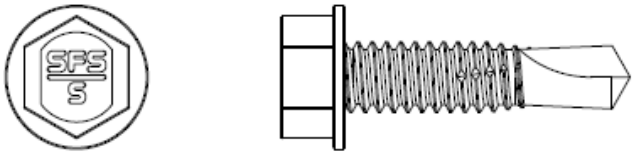

FIGURE 2 – 1/4-20 SD4 BI-MET 300® SCREW

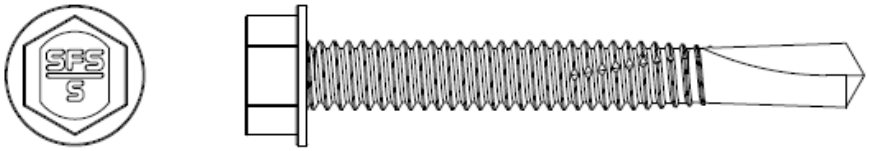

FIGURE 3 – 1/4-20 SD5 BI-MET 300® SCREW