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ICC-ES Evaluation Report

ESR-4374

Reissued March 2023

This report is subject to renewal March 2024.

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

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

BI-FLEX®, DRIL-FLEX® AND ALUMI-FLEX® SELF-DRILLING STRUCTURAL SCREWS USED WITH ALUMINUM (DEWALT)

ADDITIONAL LISTEES:

ELCO CONSTRUCTION PRODUCTS

HILTI

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018, 2015 and 2012 *International Building Code®* (IBC)
- 2021, 2018, 2015 and 2012 *International Residential Code®* (IRC)

For evaluation for compliance with codes adopted by Los Angeles Department of Building and Safety (LADBS), see ESR-4374 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

The screws described in this report are used in engineered aluminum-to-aluminum and aluminum-to-steel connections, and to attach miscellaneous building materials to aluminum. The screws may be used in structures regulated under the IRC when an engineered design is submitted in accordance with IRC Section R301.1.3.

3.0 DESCRIPTION

3.1 General:

The evaluated screws are self-drilling, self-tapping screws with various head styles. See Table 1 for detailed product descriptions including screw size, nominal diameter, head style, head diameter, point number, drilling capacities in aluminum and steel, as applicable, and minimum required protrusion length. See Figure 1 for depictions of the screws. Product names for the report holder and the additional listees are presented in the following table:

Company Name	Product Name		
DEWALT	Dril-Flex®	Bi-Flex®	Alumi-Flex®
Elco Construction Products	Dril-Flex®	Bi-Flex®	Alumi-Flex®
Hilti	Kwik-Flex	Bi-Metal Kwik-Flex	–

3.1.1 Bi-Flex® Screws: The Bi-Flex® screws have a head and shank which are formed from 300 series stainless steel and a drill point and tapping threads which are formed from carbon steel which is hardened. The carbon steel and stainless steel parts are fused together, prior to being coated with a proprietary corrosion-resistant coating identified as Stalgard® GB, which is silver in color.

3.1.2 Dril-Flex® Screws: The Dril-Flex® screws are manufactured from alloy steel wire complying with the manufacturer's specifications. The drill point and lead threads of the screws are heat-treated to a relatively high hardness to facilitate drilling and thread forming. The balance of the screw is treated to a lower hardness complying with the hardness limits for SAE J429 Grade 5 screws and the hardness limits for ASTM A449 Type 1 screws. Hex washer head parts are coated with a corrosion-resistant coating identified as Stalgard® SUB, which is silver in color. All other head styles are coated with a corrosion-resistant coating identified as Stalgard®, which is silver in color.

3.1.3 Alumi-Flex® Screws: The Alumi-Flex® screws are manufactured from 300 series stainless steel. The screws also have a corrosion resistant coating designated as Stalgard® GB.

3.2 Connected Materials:

3.2.1 Aluminum: The design values in this report apply to screw connections of flat pieces of 6063-T5, 6061-T6 or 6063-T6 aluminum. The minimum yield and tensile strengths of these materials are shown in the tables in this report and correspond to ASTM standards shown in Table A.4.3 of the Aluminum Design Manual (ADM). The aluminum thicknesses must be as indicated in the applicable tables.

3.2.2 Steel: The applicable minimum yield and tensile strengths of steel materials are shown in the tables in this report. The steel thickness must be as indicated in the applicable tables.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 General: The screws described in this report have been evaluated for use in engineered connections. Determination of the suitability of a particular screw described in this report for the specific application is the responsibility of the registered design professional and is outside the scope of this report. The registered design professional is also responsible for determining the applicable limit states for the connection that must be considered. Design provisions are based on the ADM and AISI S100, as applicable.

Screw length must equal or exceed the sum of the thickness of the fastened materials, including interstitial material, when applicable, and the minimum required protrusion length shown in Table 1.

4.1.2 Available Strengths: Available strengths for the evaluated screws are tabulated as follows:

LIMIT STATE		TABLE	PAGE
Fastener Strength		2	4
Aluminum Pull-over Strength	ASD	3A	5
	LRFD	3B	
Aluminum Pull-out Strength	ASD	4A	6
	LRFD	4B	
Aluminum-to-Aluminum Shear Strength	ASD	5A	7
	LRFD	5B	
Steel Pull-out Strength	ASD	6A	8
	LRFD	6B	
Aluminum-to-Steel Shear Strength	ASD	7A	9
	LRFD	7B	

For aluminum-to-aluminum connections, shear (bearing) strengths are applicable to connections where the two connected pieces of aluminum are in direct contact with one another. For aluminum-to-steel connections, shear (bearing) strengths are applicable to connections where the spacing between the aluminum and steel pieces does not exceed the thickness of the spacer used in testing, which is addressed in Tables 7A and 7B.

Design provisions for self-drilling tapping screw connections subjected to combined shear and tension loading are outside the scope of the report.

4.1.3 Rupture: Connected members must be checked for rupture in accordance with Section J6 of AISI S100 (Section E6 of AISI S100 for the 2015 IBC, Section E5 of AISI S100 for the 2012 IBC) and/or Section J.7.3 of the ADM, as applicable.

4.1.4 Geometric Parameters: The minimum edge and end distances for the screws must be 1.5 times the nominal diameter of the screw, in accordance with Section J.5.3 of the ADM and Section J4.2 of AISI S100 (Section E4.2 for the 2015 and 2012 IBC). For screws installed into aluminum, screw spacing must be a minimum of 2.5 times the nominal diameter of the screw, in accordance with Section J.5.2 of the ADM. For screws installed into steel, the minimum spacing must be 3 times the nominal diameter of the screw. The maximum spacing of screws in aluminum must comply with Section J.1.3 of the ADM. See Table 8 for required spacing, edge and distance dimensions based on these requirements.

4.1.5 Corrosion Resistance: Screws formed partially or entirely from carbon steel have been tested for corrosion resistance in accordance with ASTM B117, and exhibit no white corrosion after three hours and no red rust after twelve hours. Resistance to corrosion due to environmental conditions and/or galvanic action between aluminum and steel base material and/or fastener material is outside the scope of this evaluation. The registered design professional is responsible for determining the required corrosion resistance.

4.2 Installation:

Installation of screws must be in accordance with the published installation instructions from the report holder or applicable listee and this report. The 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 screw gun incorporating a depth-sensitive or torque-limiting nose piece with a maximum speed of 1800 rpm for all $^1/_4$-inch screws and for #12 screws with a #4 or #5 point type; and a maximum speed of 2500 rpm for all other screws.

5.0 CONDITIONS OF USE

The 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 The screws must be installed in accordance with this report and the applicable published installation instructions. In the case of a conflict between the published installation instructions and this report, the more restrictive requirements govern.

5.2 Design loads for the screws must not exceed the available strengths described in Section 4.1.

5.3 Construction documents and calculations demonstrating that the design loads do not exceed the available strengths must be submitted to the code official. The calculations must be prepared by a registered design professional when required by statutes of the jurisdiction in which the project is to be constructed.

5.4 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 Self-drilling Tapping Screws Used with Aluminum (AC491) dated June 2017 (editorially revised February 2021).

7.0 IDENTIFICATION

7.1 The screw heads are marked as shown in Figure 1. Packages of the screws are labeled with one of the applicable company names (DEWALT, Elco, or Hilti), the product name, the fastener size, length, point number and coating and the evaluation report number (ESR-4374).

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

DEWALT
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.DEWALT.com
anchors@DEWALT.com

7.3 The Additional Listees' contact information is the following:

ELCO CONSTRUCTION PRODUCTS
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.elcoconstruction.com

HILTI, INC.
7250 DALLAS PARKWAY, SUITE 1000
PLANO, TEXAS 75024
(800) 879-8000
www.us.hilti.com

TABLE 1—SCREW DESCRIPTIONS[1]

SCREW TYPE	DESCRIPTION (nominal size and tpi)	NOMINAL DIAMETER (inch)	HEAD STYLE[2]	DRIVE SIZE (inch) / PHILLIPS SIZE (No.)	NOMINAL HEAD DIAMETER (inch)	POINT TYPE	MAXIMUM DRILLING CAPACITY (inch)		MINIMUM REQUIRED PROTRUSION LENGTH (inch)
							In Aluminum	In Steel	
Bi-Flex® Screws									
1	#8-18	0.164	HWH	1/4	0.335	#2	0.125	0.110	0.594
2	#8-18	0.164	PPH	2	0.315	#2	0.125	0.110	0.594
3	#10-16	0.190	HWH	5/16	0.400	#2	0.125	0.110	0.500
4	#10-16	0.190	Pancake	2	0.435	#2	0.125	0.110	0.500
5	#10-16	0.190	PPH	2	0.365	#2	0.125	0.110	0.500
6	#12-14	0.216	HWH	5/16	0.415	#2	0.125	0.110	0.594
7	#12-14	0.216	PUFH	3	0.415	#2	0.125	0.110	0.594
8	#12-14	0.216	HWH	5/16	0.415	#3	0.250	0.230	0.594
9	#12-14	0.216	Pancake	2	0.435	#3	0.250	0.230	0.594
10	#12-24	0.216	HWH	5/16	0.415	#5	0.500	0.500	1.000
11	1/4-14	0.250	HWH	3/8	0.500	#2	0.125	0.110	0.594
12[3]	1/4-20	0.250	PUFH	3	0.480	#3	0.250	0.230	0.594
13	1/4-20	0.250	HWH	3/8	0.500	#3	0.250	0.230	0.594
14[3]	1/4-20	0.250	HWH	3/8	0.500	#3	0.250	0.230	0.594
15	1/4-20	0.250	HWH	3/8	0.500	#5	0.500	0.500	1.000
16[3]	1/4-20	0.250	HWH	3/8	0.500	#5	0.500	0.500	1.000
Dril-Flex® Screws									
17	#10-16	0.190	PPH	2	0.365	#2	0.125	0.110	0.406
18A	#10-16	0.190	HWH	5/16	0.400	#3	0.175	0.150	0.500
18B	#10-16	0.190	HWH	5/16	0.415	#3	0.175	0.150	0.500
19	#10-24	0.190	PWH	2	0.470	#3	0.175	0.150	0.468
20	#12-14	0.216	HWH	5/16	0.500	#2	0.125	0.110	0.625
21	#12-14	0.216	HWH	5/16	0.415	#3	0.210	0.188	0.500
22	#12-14	0.216	PUFH	3	0.415	#3	0.210	0.188	0.500
23	#12-24	0.216	HWH	5/16	0.415	#5	0.500	0.500	1.000
24	1/4-14	0.250	HWH	3/8	0.500	#3	0.210	0.210	0.563
25	1/4-20	0.250	HWH	3/8	0.500	#4	0.313	0.313	0.813
26[3]	1/4-20	0.250	HWH	3/8	0.500	#4	0.313	0.313	0.813
27[3]	1/4-20	0.250	PUFH	3	0.460	#4	0.313	0.313	0.813
28	1/4-20	0.250	HWH	3/8	0.500	#5	0.500	0.500	1.000
Alumi-Flex® Screws									
29	#10-16	0.190	HWH	5/16	0.400	#3	0.175	–	0.438
30	#10-16	0.190	PUFH	2	0.350	#3	0.175	–	0.438
31	#12-14	0.216	HWH	5/16	0.415	#3	0.210	–	0.500
32	1/4-14	0.250	HWH	3/8	0.500	#3	0.250	–	0.563
33	1/4-14	0.250	PUFH	3	0.480	#3	0.250	–	0.563
34	1/4-20	0.250	HWH	5/16	0.500	#4	0.313	–	0.625

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

[1]Screws are fully threaded unless noted otherwise.
[2]Head style abbreviations denote the following: HWH = Hex Washer Head, PPH = Phillips Pan Head, PUFH = Phillips Undercut Flat Head, PWH = Phillips Wafer Head and Pancake = Phillips Pancake Head.
[3]This screw is partially threaded.

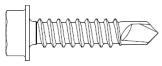
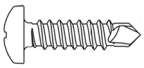
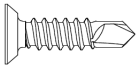
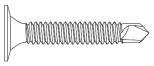
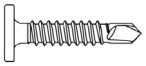
Hex Washer Head (HWH)			Phillips Pan Head (PPH)		Phillips Undercut Flat Head (PUFH)			Phillips Wafer Head (PWH)	Phillips Pancake Head
									
Bi-Flex®	**Dril-Flex®**	**Alumi-Flex®**	**Bi-Flex®**	**Dril-Flex®**	**Bi-Flex®**	**Dril-Flex®**	**Alumi-Flex®**	**Dril-Flex®**	**Bi-Flex®**
									

FIGURE 1—SCREW SHAPES AND HEAD MARKINGS

TABLE 2—FASTENER SHEAR AND TENSION STRENGTHS[1,2,3]

SCREW TYPE	SCREW SIZE	NOMINAL DIAMETER (inch)	HEAD STYLE[4]	NOMINAL STRENGTH (lbf)		ALLOWABLE STRENGTH (ASD) Ω=3 (lbf)		DESIGN STRENGTH (LRFD) Φ=0.5 (lbf)	
				Shear, P_{ss}	Tension, P_{ts}	Shear, P_{ss}/Ω	Tension, P_{ts}/Ω	Shear, ΦP_{ss}	Tension, ΦP_{ts}
	Bi-Flex® Screws								
1	#8-18	0.164	HWH	1,195	1,508	398	503	598	754
2	#8-18	0.164	PPH	1,066	1,437	355	479	533	719
3	#10-16	0.190	HWH	1,506	2,038	502	679	753	1,019
4	#10-16	0.190	Pancake	1,251	1,713	417	571	626	857
5	#10-16	0.190	PPH	1,274	1,758	425	586	637	879
6	#12-14	0.216	HWH	2,084	2,850	695	950	1,042	1,425
7	#12-14	0.216	PUFH	1,616	2,409	539	803	808	1,205
8	#12-14	0.216	HWH	2,148	2,788	716	929	1,074	1,394
9	#12-14	0.216	Pancake	1,668	2,331	556	777	834	1,166
10	#12-24	0.216	HWH	2,147	2,939	716	980	1,074	1,470
11	1/4-14	0.250	HWH	2,601	3,582	867	1,194	1,301	1,791
12	1/4-20	0.250	PUFH	2,356	3,042	785	1,014	1,178	1,521
13, 14	1/4-20	0.250	HWH	3,043	4,006	1,014	1,335	1,522	2,003
15 16	1/4-20	0.250	HWH	3,289	3,834	1,096	1,278	1,645	1,917
	Dril-Flex® Screws								
17,	#10-16	0.190	PPH	1,526	2,273	509	758	763	1,136
18A, 18B	#10-16	0.190	HWH	1,463	2,276	488	759	732	1,138
19	#10-24	0.190	PWH	1,080	2,613	360	871	540	1,307
20, 21	#12-14	0.216	HWH	1,992	3,216	664	1,072	996	1,608
22	#12-14	0.216	PUFH	1,980	2,149	660	716	990	1,075
23	#12-24	0.216	HWH	1,933	3,254	644	1,085	967	1,627
24	1/4-14	0.250	HWH	2,692	4,363	897	1,454	1,346	2,182
25, 28	1/4-20	0.250	HWH	2,617	4,359	872	1,453	1,308	2,179
26	1/4-20	0.250	HWH	2,659	4,729	886	1,576	1,330	2,364
27	1/4-20	0.250	PUFH	2,865	4,592	955	1,531	1,433	2,296
	Alumi-Flex® Screws								
29	#10-16	0.190	HWH	1,169	1,525	390	508	585	762
30	#10-16	0.190	PUFH	1,140	1,728	380	576	570	864
31	#12-14	0.216	HWH	1,544	2,110	515	703	772	1,055
32	1/4-14	0.250	HWH	2,054	2,966	685	989	1,027	1,483
33	1/4-14	0.250	PUFH	2,062	3,202	687	1,067	1,031	1,601
34	1/4-20	0.250	HWH	2,177	3,404	726	1,135	1,089	1,702

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Strengths are based on laboratory tests.
[2]For tension connections, the lowest of the available pull-out, pull-over, and screw tension strength must be used for design.
[3]For shear connections, the lower of the available screw shear strength and the available shear (bearing) must be used for design.
[4]Head style abbreviations denote the following: HWH = Hex Washer Head, PPH = Phillips Pan Head, PUFH = Phillips Undercut Flat Head, PWH = Phillips Wafer Head, and Pancake = Phillips Pancake Head.

TABLE 3A—ALLOWABLE (ASD) PULL-OVER STRENGTH OF ALUMINUM IN SCREW CONNECTIONS (lbf)[1,2,3,4]

SCREW TYPE	SCREW SIZE	NOMINAL DIAMETER (in.)	HEAD STYLE[5]	THICKNESS OF ALUMINUM MEMBER IN CONTACT WITH SCREW HEAD (inch)											
				6063-T5 (F_y = 16 ksi, F_u = 22 ksi)				6063-T6 (F_y = 25 ksi, F_u = 30 ksi)				6061-T6 (F_y = 35 ksi, F_u = 38 ksi)			
				1/32	1/16	1/8	3/16	1/32	1/16	1/8	3/16	1/32	1/16	1/8	3/16
Bi-Flex® Screws															
1	#8-18	0.164	HWH	36	72	145	217	49	99	198	296	63	125	250	375
2	#8-18	0.164	PPH	31	63	126	188	43	86	171	257	54	108	217	325
3	#10-16	0.190	HWH	45	168	408	718	62	263	637	1,121	78	368	892	1,570
4	#10-16	0.190	Pancake	54	181	433	756	74	283	677	1,181	93	396	947	1,653
5	#10-16	0.190	PPH	38	75	150	226	51	103	205	308	65	130	260	390
6, 8	#12-14	0.216	HWH	43	174	555	734	58	271	659	1,146	74	380	915	1,605
7	#12-14	0.216	PUFH	–	280	595	–	–	437	706	–	–	463	706	–
9	#12-14	0.216	Pancake	48	181	433	756	65	283	677	1,181	83	396	947	1,653
10	#12-24	0.216	HWH	43	174	555	734	58	271	659	1,146	74	380	915	1,605
11	1/4-14	0.250	HWH	54	202	595	819	73	316	742	1,279	93	442	1,039	1,791
13, 15	1/4-20	0.250	HWH	54	202	595	967	73	316	742	1,279	93	442	1,039	1,791
Dril-Flex® Screws															
17	#10-16	0.190	PPH	38	75	150	226	51	103	205	308	65	130	260	390
18A, 18B	#10-16	0.190	HWH	45	168	408	718	62	263	637	1,121	78	368	892	1,570
19	#10-24	0.190	PWH	–	277	510	–	–	432	605	–	–	458	605	–
20	#12-14	0.216	HWH	62	202	534	819	85	316	742	1,279	108	442	1,039	1,791
21	#12-14	0.216	HWH	43	174	534	734	58	271	654	1,146	74	380	915	1,605
22	#12-14	0.216	PUFH	–	249	515	515	–	390	612	612	–	413	612	612
23	#12-24	0.216	HWH	43	174	534	734	58	271	654	1,146	74	380	915	1,605
24	1/4-14	0.250	HWH	54	202	738	819	73	316	876	1,279	93	442	1,039	1,791
25, 28	1/4-20	0.250	HWH	54	202	738	988	73	316	876	1,279	93	442	1,039	1,791
Alumi-Flex® Screws															
29	#10-16	0.190	HWH	45	168	408	718	62	263	637	1,121	78	368	892	1,570
30	#10-16	0.190	PUFH	–	200	456	–	–	313	542	–	–	332	542	–
31	#12-14	0.216	HWH	43	174	418	734	58	271	654	1,146	74	380	915	1,605
32	1/4-14	0.250	HWH	54	202	673	819	73	316	799	1,279	93	442	1,039	1,791
33	1/4-14	0.250	PUFH	–	245	534	534	–	383	635	635	–	406	635	635
34	1/4-20	0.250	HWH	54	202	673	868	73	316	799	1,279	93	442	1,039	1,791

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N. **See notes below Table 3B.**

TABLE 3B—DESIGN (LRFD) PULL-OVER STRENGTH OF ALUMINUM IN SCREW CONNECTIONS (lbf)[1,2,3,4]

SCREW TYPE	SCREW SIZE	NOMINAL DIAMETER (in.)	HEAD STYLE[5]	THICKNESS OF ALUMINUM MEMBER IN CONTACT WITH SCREW HEAD (inch)											
				6063-T5 (F_y = 16 ksi, F_u = 22 ksi)				6063-T6 (F_y = 25 ksi, F_u = 30 ksi)				6061-T6 (F_y = 35 ksi, F_u = 38 ksi)			
				1/32	1/16	1/8	3/16	1/32	1/16	1/8	3/16	1/32	1/16	1/8	3/16
Bi-Flex® Screws															
1	#8-18	0.164	HWH	54	109	217	326	74	148	296	444	94	188	375	563
2	#8-18	0.164	PPH	47	94	188	283	64	128	257	385	81	163	325	488
3	#10-16	0.190	HWH	68	253	612	1,077	93	395	955	1,682	118	553	1,338	2,355
4	#10-16	0.190	Pancake	81	272	650	1,134	111	424	1,015	1,771	140	594	1,421	2,480
5	#10-16	0.190	PPH	56	113	226	338	77	154	308	461	97	195	390	584
6,8	#12-14	0.216	HWH	64	261	832	1,101	88	407	988	1,720	111	570	1,373	2,408
7	#12-14	0.216	PUFH	–	420	892	–	–	656	1,059	–	–	656	1,059	–
9	#12-14	0.216	Pancake	72	272	650	1,134	98	424	1,015	1,771	124	594	1,421	2,480
10	#12-24	0.216	HWH	64	261	832	1,101	88	407	988	1,720	111	570	1,373	2,408
11	1/4-14	0.250	HWH	80	303	893	1,228	110	474	1,113	1,919	139	663	1,559	2,687
13, 15	1/4-20	0.250	HWH	80	303	893	1,451	110	474	1,113	1,919	139	663	1,559	2,687
Dril-Flex® Screws															
17	#10-16	0.190	PPH	56	113	226	338	77	154	308	461	97	195	390	584
18A, 18B	#10-16	0.190	HWH	68	253	612	1,077	93	395	955	1,682	118	553	1,338	2,355
19	#10-24	0.190	PWH	–	415	765	–	–	649	908	–	–	688	908	–
20	#12-14	0.216	HWH	94	303	801	1,228	128	474	1,113	1,919	162	663	1,559	2,687
21	#12-14	0.216	HWH	64	261	801	1,101	88	407	980	1,720	111	570	1,373	2,408
22	#12-14	0.216	PUFH	–	374	773	773	–	585	918	918	–	620	918	918
23	#12-24	0.216	HWH	64	261	801	1,101	88	407	980	1,720	111	570	1,373	2,408
24	1/4-14	0.250	HWH	80	303	1,107	1,228	110	474	1,314	1,919	139	663	1,559	2,687
25, 28	1/4-20	0.250	HWH	80	303	1,107	1,482	110	474	1,314	1,919	139	663	1,559	2,687
Alumi-Flex® Screws															
29	#10-16	0.190	HWH	68	253	612	1,077	93	395	955	1,682	118	553	1,338	2,355
30	#10-16	0.190	PUFH	–	300	685	–	–	469	813	–	–	497	813	–
31	#12-14	0.216	HWH	64	261	628	1,101	88	407	980	1,720	111	570	1,373	2,408
32	1/4-14	0.250	HWH	80	303	1,009	1,228	110	474	1,199	1,919	139	663	1,559	2,687
33	1/4-14	0.250	PUFH	–	368	802	802	–	575	952	952	–	610	952	952
34	1/4-20	0.250	HWH	80	303	1,009	1,302	110	474	1,199	1,919	139	663	1,559	2,687

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Available strengths in shaded cells are based on laboratory tests, which exceed available strengths calculated in accordance with the ADM. Safety factors and resistance factors have been determined in accordance with the ADM. These values only apply to screws which are self-drilled.

[2]Available strengths in unshaded cells are based on calculations in accordance with the ADM. These values are applicable to screws which are self-drilled and to screws which are installed in existing holes in the aluminum which have the following dimensions: 0.177 inch for #8 screws; 0.201 inch for #10 screws; 0.228 inch for #12 screws; 0.266 inch for 1/4-inch screws.

[3]Available strengths for member thicknesses which are not addressed in the table may be determined by calculation in accordance with the ADM.

[4]For tension connections, the lowest of the available pull-out, pull-over, and screw tension strength must be used for design.

[5]Head style abbreviations denote the following: HWH = Hex Washer Head, PPH = Phillips Pan Head, PUFH = Phillips Undercut Flat Head, PWH = Phillips Wafer Head, and Pancake = Phillips Pancake Head.

TABLE 4A—ALLOWABLE (ASD) PULL-OUT STRENGTH OF SCREWS INSTALLED IN ALUMINUM (lbf)[1,2]

SCREW TYPE	SCREW SIZE	NOMINAL DIAMETER (in.)	POINT TYPE	THICKNESS OF ALUMINUM MEMBER NOT IN CONTACT WITH SCREW HEAD (inch)														
				6063-T5 (F_y = 16 ksi, F_u = 22 ksi)					6063-T6 (F_y = 25 ksi, F_u = 30 ksi)					6061-T6 (F_y = 35 ksi, F_u = 38 ksi)				
				1/16	1/8	3/16	1/4	5/16	1/16	1/8	3/16	1/4	5/16	1/16	1/8	3/16	1/4	5/16
Bi-Flex® Screws																		
1, 2	#8-18	0.164	#2	69	175	–	–	–	101	252	–	–	–	123	320	–	–	–
3, 4, 5	#10-16	0.190	#2	72	190	–	–	–	100	280	–	–	–	128	360	–	–	–
6, 7	#12-14	0.216	#2	70	206	–	–	–	106	308	–	–	–	134	406	–	–	–
8, 9	#12-14	0.216	#3	55	164	353	504	–	85	270	496	646	–	110	348	590	696	–
10	#12-24	0.216	#5	–	145	309	387	436	–	214	421	518	606	–	275	467	595	704
11	1/4-14	0.250	#2	84	237	–	–	–	133	357	–	–	–	180	473	–	–	–
12, 13, 14	1/4-20	0.250	#3	60	171	330	488	–	95	257	477	656	–	122	342	594	758	–
15, 16	1/4-20	0.250	#5	–	120	259	355	395	–	190	340	508	565	–	273	357	660	706
Dril-Flex® Screws																		
17	#10-16	0.190	#2	78	200	–	–	–	119	298	–	–	–	153	391	–	–	–
18A, 18B	#10-16	0.190	#3	76	180	–	–	–	100	277	–	–	–	132	381	–	–	–
19	#10-24	0.190	#3	82	193	–	–	–	100	283	–	–	–	109	361	–	–	–
20	#12-14	0.216	#2	103	226	–	–	–	114	329	–	–	–	146	415	–	–	–
21, 22	#12-14	0.216	#3	103	216	420	–	–	114	317	592	–	–	145	403	704	–	–
23	#12-24	0.216	#5	–	183	358	410	449	–	262	487	664	664	–	322	542	812	812
24	1/4-14	0.250	#3	85	241	437	–	–	123	346	644	–	–	144	428	832	–	–
25, 26, 27	1/4-20	0.250	#4	–	233	447	589	641	–	336	617	847	977	–	416	708	1,113	1,195
28	1/4-20	0.250	#5	–	224	437	596	600	–	333	621	842	882	–	434	752	1,075	1,134
Alumi-Flex® Screws																		
29, 30	#10-16	0.190	#3	71	190	–	–	–	109	286	–	–	–	143	379	–	–	–
31	#12-14	0.216	#3	66	189	391	–	–	114	286	556	–	–	132	382	556	–	–
32, 33	1/4-14	0.250	#3	72	199	422	826	–	107	313	589	826	–	130	401	688	826	–
34	1/4-20	0.250	#4	–	195	376	580	580	–	291	547	782	782	–	382	719	880	880

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Allowable strengths are based on laboratory tests. Safety factors have been determined in accordance with the ADM. These values only apply to screws which are self-drilled.
[2]For tension connections, the lowest of the allowable pull-out, pull-over, and screw tension strength must be used for design.

TABLE 4B—DESIGN (LRFD) PULL-OUT STRENGTH OF SCREWS INSTALLED IN ALUMINUM (lbf)[1,2]

SCREW TYPE	SCREW SIZE	NOMINAL DIAMETER (in.)	POINT TYPE	THICKNESS OF ALUMINUM MEMBER NOT IN CONTACT WITH SCREW HEAD (inch)														
				6063-T5 (F_y = 16 ksi, F_u = 22 ksi)					6063-T6 (F_y = 25 ksi, F_u = 30 ksi)					6061-T6 (F_y = 35 ksi, F_u = 38 ksi)				
				1/16	1/8	3/16	1/4	5/16	1/16	1/8	3/16	1/4	5/16	1/16	1/8	3/16	1/4	5/16
Bi-Flex® Screws																		
1, 2	#8-18	0.164	#2	103	262	–	–	–	152	377	–	–	–	185	480	–	–	–
3, 4, 5	#10-16	0.190	#2	109	285	–	–	–	150	420	–	–	–	193	541	–	–	–
6, 7	#12-14	0.216	#2	105	309	–	–	–	159	462	–	–	–	201	610	–	–	–
8, 9	#12-14	0.216	#3	82	246	529	756	–	127	405	744	968	–	166	523	885	1,044	–
10	#12-24	0.216	#5	–	218	464	581	655	–	321	631	778	909	–	413	701	892	1,056
11	1/4-14	0.250	#2	127	356	–	–	–	200	535	–	–	–	270	710	–	–	–
12, 13, 14	1/4-20	0.250	#3	91	257	496	733	–	143	386	715	984	–	184	513	892	1,137	–
15, 16	1/4-20	0.250	#5	–	180	389	532	592	–	286	510	762	848	–	410	536	990	1,059
Dril-Flex® Screws																		
17	#10-16	0.190	#2	118	300	–	–	–	179	447	–	–	–	230	586	–	–	–
18A, 18B	#10-16	0.190	#3	114	270	–	–	–	150	416	–	–	–	198	572	–	–	–
19	#10-24	0.190	#3	124	290	–	–	–	150	425	–	–	–	164	542	–	–	–
20	#12-14	0.216	#2	154	339	–	–	–	170	493	–	–	–	219	622	–	–	–
21, 22	#12-14	0.216	#3	155	325	630	–	–	170	475	887	–	–	218	605	1,057	–	–
23	#12-24	0.216	#5	–	275	537	615	674	–	393	730	996	996	–	483	813	1,219	1,219
24	1/4-14	0.250	#3	128	361	655	–	–	185	519	966	–	–	216	642	1,249	–	–
25, 26, 27	1/4-20	0.250	#4	–	350	671	884	962	–	503	926	1,271	1,465	–	625	1,063	1,670	1,793
28	1/4-20	0.250	#5	–	336	656	894	900	–	499	931	1,262	1,323	–	651	1,128	1,613	1,701
Alumi-Flex® Screws																		
29, 30	#10-16	0.190	#3	107	285	–	–	–	164	428	–	–	–	215	569	–	–	–
31	#12-14	0.216	#3	100	284	586	–	–	170	429	834	–	–	198	574	834	–	–
32, 33	1/4-14	0.250	#3	109	299	633	1,239	–	160	469	883	1,239	–	195	602	1,032	1,239	–
34	1/4-20	0.250	#4	–	293	565	870	870	–	437	821	1,172	1,172	–	574	1,078	1,321	1,321

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Design strengths are based on laboratory tests. Resistance factors have been determined in accordance with the ADM. These values only apply to screws which are self-drilled.
[2]For tension connections, the lowest of the design pull-out, pull-over, and screw tension strength must be used for design.

TABLE 5A—ALLOWABLE (ASD) SHEAR (BEARING) CAPACITY OF ALUMINUM-TO-ALUMINUM SCREW CONNECTIONS (lbf)[1,2,3,4]

SCREW TYPE	SCREW SIZE	NOMINAL DIAMETER (in.)	POINT TYPE	HEAD STYLE[5]	THICKNESS OF ALUMINUM (IN CONTACT – NOT IN CONTACT) WITH SCREW HEAD (inch)											
					6063-T5 (F_y = 16 ksi, F_u = 22 ksi)				6063-T6 (F_y = 25 ksi, F_u = 30 ksi)				6061-T6 (F_y = 35 ksi, F_u = 38 ksi)			
					0.0625 – 0.0625	0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250	0.0625 – 0.0625	0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250	0.0625 – 0.0625	0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250
Bi-Flex® Screws																
1	#8-18	0.164	#2	HWH	113	113	226	–	154	154	308	–	195	195	380	–
2	#8-18	0.164	#2	PPH	113	113	226	–	154	154	308	–	195	195	380	–
3	#10-16	0.190	#2	HWH	131	131	261	–	178	178	356	–	226	226	451	–
4	#10-16	0.190	#2	Pancake	131	131	261	–	178	178	356	–	226	226	451	–
5	#10-16	0.190	#2	PPH	131	131	261	–	178	178	356	–	226	226	451	–
6	#12-14	0.216	#2	HWH	149	149	297	–	203	203	405	–	257	257	513	–
7	#12-14	0.216	#2	PUFH	163	–	–	–	207	–	–	–	207	–	–	–
8	#12-14	0.216	#3	HWH	149	333	416	–	203	424	541	–	257	424	561	–
9	#12-14	0.216	#3	Pancake	149	335	425	–	203	426	442	–	257	426	442	–
10	#12-24	0.216	#5	HWH	149	149	423	607	203	203	547	607	257	257	559	607
11	1/4-14	0.250	#2	HWH	172	172	344	–	234	234	469	–	297	297	594	–
13	1/4-20	0.250	#3	HWH	172	324	453	–	234	412	623	–	297	412	725	–
15	1/4-20	0.250	#5	HWH	172	172	406	749	234	234	570	871	297	297	691	871
Dril-Flex® Screws																
17	#10-16	0.190	#2	PPH	131	131	261	–	178	178	356	–	226	226	451	–
18A, 18B	#10-16	0.190	#3	HWH	131	131	261	–	178	178	356	–	226	226	451	–
19	#10-24	0.190	#3	PWH	160	–	–	–	204	–	–	–	204	–	–	–
20	#12-14	0.216	#2	HWH	149	149	297	–	203	203	405	–	257	257	513	–
21	#12-14	0.216	#3	HWH	149	149	297	–	203	203	405	–	257	257	513	–
22	#12-14	0.216	#3	PUFH	168	326	–	–	214	415	–	–	214	415	–	–
23	#12-24	0.216	#5	HWH	149	149	433	696	203	203	578	760	257	257	637	760
24	1/4-14	0.250	#3	HWH	172	172	344	–	234	234	469	–	297	297	594	–
25	1/4-20	0.250	#4	HWH	172	172	498	–	234	234	663	–	297	297	724	–
28	1/4-20	0.250	#5	HWH	172	172	500	761	234	234	655	761	297	297	687	761
Alumi-Flex® Screws																
29	#10-16	0.190	#3	HWH	131	131	261	–	178	178	356	–	226	226	451	–
30	#10-16	0.190	#3	PUFH	111	–	–	–	142	–	–	–	142	–	–	–
31	#12-14	0.216	#3	HWH	149	327	–	–	203	416	–	–	257	416	–	–
32	1/4-14	0.250	#3	HWH	172	388	521	–	234	493	535	–	297	493	535	–
33	1/4-14	0.250	#3	PUFH	152	288	441	–	194	367	546	–	194	367	546	–
34	1/4-20	0.250	#4	HWH	172	172	436	–	234	234	544	–	297	297	544	–

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N. **Notes for Tables 5A and 5B are on page 8.**

TABLE 5B—DESIGN (LRFD) SHEAR (BEARING) CAPACITY OF ALUMINUM-TO-ALUMINUM SCREW CONNECTIONS (lbf)[1,2,3,4]

SCREW TYPE	SCREW SIZE	NOMINAL DIAMETER (in.)	POINT TYPE	HEAD STYLE[5]	THICKNESS OF ALUMINUM (IN CONTACT – NOT IN CONTACT) WITH SCREW HEAD (inch)											
					6063-T5 (F_y = 16 ksi, F_u = 22 ksi)				6063-T6 (F_y = 25 ksi, F_u = 30 ksi)				6061-T6 (F_y = 35 ksi, F_u = 38 ksi)			
					0.0625 – 0.0625	0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250	0.0625 – 0.0625	0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250	0.0625 – 0.0625	0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250
Bi-Flex® Screws																
1	#8-18	0.164	#2	HWH	169	169	338	–	231	231	461	–	292	292	584	–
2	#8-18	0.164	#2	PPH	169	169	338	–	231	231	461	–	292	292	584	–
3	#10-16	0.190	#2	HWH	196	196	392	–	267	267	534	–	338	338	677	–
4	#10-16	0.190	#2	Pancake	196	196	392	–	267	267	534	–	338	338	677	–
5	#10-16	0.190	#2	PPH	196	196	392	–	267	267	534	–	338	338	677	–
6	#12-14	0.216	#2	HWH	223	223	446	–	304	304	608	–	385	385	770	–
7	#12-14	0.216	#2	PUFH	245	–	–	–	311	–	–	–	311	–	–	–
8	#12-14	0.216	#3	HWH	223	500	624	–	304	636	812	–	385	636	841	–
9	#12-14	0.216	#3	Pancake	223	503	637	–	304	639	664	–	385	639	664	–
10	#12-24	0.216	#5	HWH	223	223	635	910	304	304	821	910	385	385	838	910
11	1/4-14	0.250	#2	HWH	258	258	516	–	352	352	703	–	445	445	891	–
13	1/4-20	0.250	#3	HWH	258	486	680	–	352	618	934	–	445	618	1,088	–
15	1/4-20	0.250	#5	HWH	258	258	609	1,124	352	352	855	1,307	445	445	1,037	1,307
Dril-Flex® Screws																
17	#10-16	0.190	#2	PPH	196	196	392	–	267	267	534	–	338	338	677	–
18A, 18B	#10-16	0.190	#3	HWH	196	196	392	–	267	267	534	–	338	338	677	–
19	#10-24	0.190	#3	PWH	240	–	–	–	306	–	–	–	306	–	–	–
20	#12-14	0.216	#2	HWH	223	223	446	–	304	304	608	–	385	385	770	–
21	#12-14	0.216	#3	HWH	223	223	446	–	304	304	608	–	385	385	770	–
22	#12-14	0.216	#3	PUFH	252	489	–	–	321	623	–	–	321	623	–	–
23	#12-24	0.216	#5	HWH	223	223	649	1,045	304	304	868	1,140	385	385	955	1,140
24	1/4-14	0.250	#3	HWH	258	258	516	–	352	352	703	–	445	445	891	–
25	1/4-20	0.250	#4	HWH	258	258	747	–	352	352	995	–	445	445	1,086	–
28	1/4-20	0.250	#5	HWH	258	258	751	1,142	352	352	982	1,142	445	445	1,030	1,142
Alumi-Flex® Screws																
29	#10-16	0.190	#3	HWH	196	196	392	–	267	267	534	–	338	338	677	–
30	#10-16	0.190	#3	PUFH	167	–	–	–	213	–	–	–	213	–	–	–
31	#12-14	0.216	#3	HWH	223	491	–	–	304	624	–	–	385	624	–	–
32	1/4-14	0.250	#3	HWH	258	582	782	–	352	740	803	–	445	740	803	–
33	1/4-14	0.250	#3	PUFH	229	432	662	–	291	550	820	–	291	550	820	–
34	1/4-20	0.250	#4	HWH	258	258	655	–	352	352	816	–	445	445	816	–

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N. **Notes for Tables 5A and 5B are on page 8.**

Notes for Tables 5A and 5B:
[1]Available strengths in shaded cells are based on laboratory tests, and exceed available strengths calculated in accordance with the ADM. Safety factors and resistance factors have been determined in accordance with the ADM. These values only apply to screws which are self-drilled.
[2]Available strengths in unshaded cells are based on calculations in accordance with the ADM. These values are applicable to screws which are self-drilled and to screws which are installed in existing holes in the aluminum which have the following dimensions: 0.177 inch for #8 screws; 0.201 inch for #10 screws; 0.228 inch for #12 screws; 0.266 inch for 1/4-inch screws.
[3]Available strengths for member thicknesses which are not addressed in the tables may be determined by calculation in accordance with the ADM.
[4]For lateral connections, the lower of the available shear (bearing) strength and screw shear strength must be used for design.
[5]Head style abbreviations denote the following: HWH = Hex Washer Head, PPH = Phillips Pan Head, PUFH = Phillips Undercut Flat Head, PWH = Phillips Wafer Head, and Pancake = Phillips Pancake Head.

TABLE 6A—ALLOWABLE (ASD) PULL-OUT STRENGTH OF SCREWS INSTALLED IN STEEL (lbf)[1,2]

SCREW TYPE	SCREW SIZE	NOMINAL DIAMETER (in.)	POINT TYPE	DESIGN THICKNESS OF STEEL MEMBER NOT IN CONTACT WITH SCREW HEAD (INCH):											
				(F_y = 33 ksi, F_u = 45 ksi)				(F_y = 36 ksi, F_u = 58 ksi)				(F_y = 50 ksi, F_u = 65 ksi)			
				1/8	3/16	1/4	5/16	1/8	3/16	1/4	5/16	1/8	3/16	1/4	5/16
Bi-Flex® Screws															
8, 9	#12-14	0.216	#3	387	523	–	–	447	674	–	–	447	755	–	–
10	#12-24	0.216	#5	390	429	601	652	451	553	774	841	451	620	867	943
12, 13, 14	1/4-20	0.250	#3	533	620	–	–	616	799	–	–	616	895	–	–
15, 16	1/4-20	0.250	#5	453	582	666	912	524	750	859	1,176	524	841	963	1,318
Dril-Flex® Screws[3]															
17	#10-16	0.190	#2	297	–	–	–	383	–	–	–	428	–	–	–
18A, 18B	#10-16	0.190	#3	297	–	–	–	383	–	–	–	428	–	–	–
19	#10-24	0.216	#3	546	–	–	–	704	–	–	–	704	–	–	–
21, 22	#12-14	0.216	#3	510	665	–	–	658	858	–	–	734	958	–	–
23	#12-24	0.216	#5	507	891	1,020	1,020	654	1,149	1,316	1,316	654	1,149	1,469	1,469
24	1/4-14	0.250	#3	561	899	–	–	724	1,160	–	–	808	1,295	–	–
25, 26, 27	1/4-20	0.250	#4	524	914	1,044	1,206	677	1,179	1,347	1,556	677	1,179	1,503	1,736
28	1/4-20	0.250	#5	524	914	1,044	1,206	677	1,179	1,347	1,556	677	1,179	1,503	1,736

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Allowable strengths are based on laboratory tests. The safety factors have been determined in accordance with AISI S100. These values only apply to screws which are self-drilled.
[2]For tension connections, the lowest of the allowable pull-out, pull-over, and fastener tension strength must be used for design.
[3]Dril-Flex® fasteners have also been evaluated for use in steel-to-steel connections, as addressed in ESR-3332, which includes pull-out values for thinner steel members.

TABLE 6B—DESIGN (LRFD) PULL-OUT STRENGTH OF SCREWS INSTALLED IN STEEL (lbf)[1,2]

SCREW TYPE	SCREW SIZE	NOMINAL DIAMETER (in.)	POINT TYPE	DESIGN THICKNESS OF STEEL MEMBER NOT IN CONTACT WITH SCREW HEAD (INCH):											
				(F_y = 33 ksi, F_u = 45 ksi)				(F_y = 36 ksi, F_u = 58 ksi)				(F_y = 50 ksi, F_u = 65 ksi)			
				1/8	3/16	1/4	5/16	1/8	3/16	1/4	5/16	1/8	3/16	1/4	5/16
Bi-Flex® Screws															
8, 9	#12-14	0.216	#3	619	837	–	–	715	1,079	–	–	715	1,209	–	–
10	#12-24	0.216	#5	624	643	961	1,044	721	829	1,238	1,345	721	929	1,387	1,507
12, 13, 14	1/4-20	0.250	#3	852	930	–	–	985	1,199	–	–	985	1,344	–	–
15, 16	1/4-20	0.250	#5	726	931	1,066	1,460	839	1,200	1,374	1,882	839	1,345	1,540	2,109
Dril-Flex® Screws[3]															
17	#10-16	0.190	#2	476	–	–	–	614	–	–	–	685	–	–	–
18A, 18B	#10-16	0.190	#3	476	–	–	–	614	–	–	–	685	–	–	–
19	#10-24	0.216	#3	874	–	–	–	1,127	–	–	–	1,127	–	–	–
21, 22	#12-14	0.216	#3	816	1,064	–	–	1,053	1,373	–	–	1,175	1,532	–	–
23	#12-24	0.216	#5	811	1,426	1,632	1,632	1,046	1,840	2,105	2,105	1,046	1,840	2,350	2,350
24	1/4-14	0.250	#3	897	1,439	–	–	1,157	1,493	–	–	1,292	2,072	–	–
25, 26, 27	1/4-20	0.250	#4	838	1,462	1,670	1,930	1,081	1,886	2,154	2,490	1,081	1,886	2,405	2,779
28	1/4-20	0.250	#5	838	1,462	1,670	1,930	1,081	1,886	2,154	2,490	1,081	1,886	2,405	2,779

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Design strengths are based on laboratory tests. The resistance factors have been determined in accordance with AISI S100. These values only apply to screws which are self-drilled.
[2]For tension connections, the lowest of the design pull-out, pull-over, and fastener tension strength must be used for design.
[3]Dril-Flex® fasteners have also been evaluated for use in steel-to-steel connections, as addressed in ESR-3332, which includes pull-out values for thinner steel members.

TABLE 7A—ALLOWABLE (ASD) SHEAR (BEARING) CAPACITY OF ALUMINUM-TO-STEEL SCREW CONNECTIONS (lbf)[1,2,3,4,5]

SCREW TYPE	SCREW SIZE	NOMINAL DIAMETER (in.)	POINT TYPE	HEAD STYLE	6063-T5 (F_y = 16 ksi, F_u = 22 ksi)			6063-T6 (F_y = 25 ksi, F_u = 30 ksi)			6061-T6 (F_y = 35 ksi, F_u = 38 ksi)		
					Thickness of Aluminum – Thickness of Steel (inch)								
					0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250	0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250	0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250
Bi-Flex® Screws													
8	#12-14	0.216	#3	HWH	301[6]	–	–	470[6]	–	–	499[6]	–	–
9	#12-14	0.216	#3	Pancake	303[6]	–	–	473[6]	–	–	501[6]	–	–
10	#12-24	0.216	#5	HWH	293	708	619	458	841	735	486	841	735
13	1/4-20	0.250	#3	HWH	305[6]	–	–	477[6]	–	–	506[6]	–	–
15	1/4-20	0.250	#5	HWH	291	453	785	455	538	932	482	765	932
Dril-Flex® Screws[8]													
21	#12-14	0.216	#3	HWH	300[7]	–	–	468[7]	–	–	496[7]	–	–
22	#12-14	0.216	#3	PUFH	323[7]	–	–	505[7]	–	–	535[7]	–	–
23	#12-24	0.216	#5	HWH	301	706	591	470	839	702	498	839	702
24	1/4-14	0.250	#3	HWH	301[6]	–	–	471[6]	–	–	499[6]	–	–
25	1/4-20	0.250	#4	HWH	292	766	–	457	910	–	484	910	–
28	1/4-20	0.250	#5	HWH	301	755	611	471	896	726	499	896	726

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N. **See notes below Table 7B.**

TABLE 7B—DESIGN (LRFD) SHEAR (BEARING) CAPACITY OF ALUMINUM-TO-STEEL SCREW CONNECTIONS (lbf)[1,2,3,4,5]

SCREW TYPE	SCREW SIZE	NOMINAL DIAMETER (in.)	POINT TYPE	HEAD STYLE	6063-T5 (F_y = 16 ksi, F_u = 22 ksi)			6063-T6 (F_y = 25 ksi, F_u = 30 ksi)			6061-T6 (F_y = 35 ksi, F_u = 38 ksi)		
					Thickness of Aluminum – Thickness of Steel (inch)								
					0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250	0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250	0.0625 – 0.125	0.125 – 0.125	0.125 – 0.250
Bi-Flex® Screws													
8	#12-14	0.216	#3	HWH	452[6]	–	–	706[6]	–	–	748[6]	–	–
9	#12-14	0.216	#3	Pancake	454[6]	–	–	709[6]	–	–	752[6]	–	–
10	#12-24	0.216	#5	HWH	440	1,062	929	687	1,261	1,103	728	1,261	1,103
13	1/4-20	0.250	#3	HWH	458[6]	–	–	716[6]	–	–	759[6]	–	–
15	1/4-20	0.250	#5	HWH	437	680	1,178	682	808	1,398	723	1,148	1,398
Dril-Flex® Screws[8]													
21	#12-14	0.216	#3	HWH	450[7]	–	–	702[7]	–	–	744[7]	–	–
22	#12-14	0.216	#3	PUFH	485[7]	–	–	757[7]	–	–	803[7]	–	–
23	#12-24	0.216	#5	HWH	452	1,059	887	705	1,258	1,054	748	1,258	1,054
24	1/4-14	0.250	#3	HWH	452[6]	–	–	707[6]	–	–	749[6]	–	–
25	1/4-20	0.250	#4	HWH	439	1,149	–	685	1,365	–	685	1,365	–
28	1/4-20	0.250	#5	HWH	452	1,132	917	706	1,344	1,089	706	1,344	1,089

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Available strengths are based on laboratory test with safety factors and resistance factors determined in accordance with the ADM and AISI S100.
[2]For shear connections, the lower of the available shear (bearing) strength and screw shear strength must be used for design.
[3]Head style abbreviations denote the following: HWH = Hex Washer Head, PUFH = Phillips Undercut Flat Head and Pancake = Phillips Pancake Head.
[4]Minimum steel strengths: F_u= 58 ksi, F_y = 36 ksi
[5]Testing included use of a flexible spacer material between the aluminum and the steel to simulate the use of interstitial materials intended to prevent galvanic corrosion of the steel. Unless otherwise noted, the spacer thickness used in testing was 0.063 inch.
[6]Spacer thickness used in testing was 0.05 inch.
[7]Spacer thickness used in testing was 0.008 inch.
[8]Dril-Flex® fasteners have also been evaluated for steel-to-steel connections, which are addressed in ICC-ES ESR-3332.

TABLE 8—SCREW SPACING, EDGE AND END DISTANCE REQUIREMENTS (inch)[1]

BASIC SCREW DIAMETER (inch)	ALUMINUM		STEEL	
	MINIMUM SPACING (2.5d)	MINIMUM EDGE AND END DISTANCE (1.5d)	MINIMUM SPACING (3d)	MINIMUM EDGE AND END DISTANCE (1.5d)
0.164 (#8)	7/16	1/4	1/2	1/4
0.190 (#10)	1/2	5/16	9/16	5/16
0.216 (#12)	9/16	3/8	11/16	3/8
0.250 (1/4)	5/8	3/8	3/4	3/8

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

[1]Maximum screw spacing in aluminum must comply with Section J.1.3 of the ADM.

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

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

BI-FLEX®, DRIL-FLEX® AND ALUMI-FLEX® SELF-DRILLING STRUCTURAL SCREWS USED WITH ALUMINUM (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the screws described in ICC-ES evaluation report ESR-4374 have also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2020 *City of Los Angeles Building Code* (LABC)
- 2020 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The screws described in Sections 2.0 through 7.0 of the evaluation report ESR-4374, comply with the LABC Chapter 20, and the LARC, and are subjected to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The screws described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-4374.
- The design, installation, conditions of use and identification of the screws are in accordance with the 2018 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-4374.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.

This supplement expires concurrently with the evaluation report, reissued March 2023.

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

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

BI-FLEX®, DRIL-FLEX® AND ALUMI-FLEX® SELF-DRILLING STRUCTURAL SCREWS USED WITH ALUMINUM (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the screws used with aluminum, described in evaluation report ESR-4374, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2020 *Florida Building Code—Building*
- 2020 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The screws described in Sections 2.0 through 7.0 of the evaluation report, ESR-4374, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*. The design requirements must be determined in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential*, as applicable. The installation requirements noted in ICC-ES evaluation report ESR-4374 for the 2018 *International Building Code®* meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential*, as applicable.

Use of the screws has also been found to be in compliance with the High-velocity Hurricane Zone provisions on the *Florida Building Code—Building* and the *Florida Building Code—Residential*.

For products falling under Florida Rule 61G20-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued March 2023.