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HEX FLANGE SCREWS

IFI-111 2002

Note: IFI-111 is a standard developed through the procedures of Industrial Fasteners Institute. IFI-111 was first published in 1970, revised in 1986, and revised again and reissued in 2002.

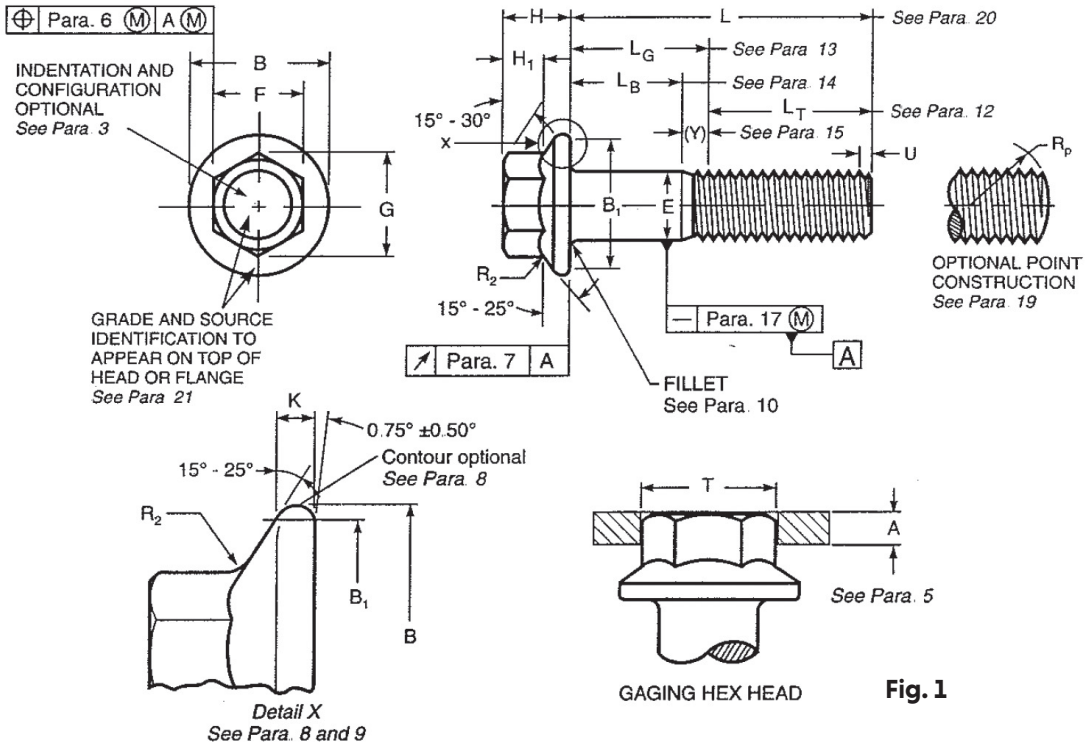

Fig. 1

Table 1: Dimensions of Hex Flange Screws

Nominal Size or Basic Major Diameter of Thread		E		F			G		B	K	H	H_1	R_2	A	
		Body Diameter		Width Across Flats			Width Across Corners		Flange Dia	Flange Thick-ness	Head Height	Hex Height	Flange Top Radius	Gaging Ring Thickness	
		Max	Min	Basic	Max	Min	Max	Min	Max	Min	Max	Min	Max	Max	Min
1/4"	0.2500	0.2500	0.2450	3/8"	0.3750	0.367	0.433	0.409	0.56	0.04	0.28	0.17	0.015	0.0514	0.0511
5/16"	0.3125	0.3125	0.3065	1/2"	0.5000	0.489	0.577	0.548	0.68	0.05	0.32	0.21	0.019	0.0643	0.0640
3/8"	0.3750	0.3750	0.3690	9/16"	0.5625	0.551	0.650	0.618	0.81	0.06	0.39	0.25	0.022	0.0771	0.0768
7/16"	0.4375	0.4375	0.4305	5/8"	0.6250	0.612	0.722	0.685	0.93	0.07	0.46	0.30	0.026	0.0900	0.0897
1/2"	0.5000	0.5000	0.4930	3/4"	0.7500	0.736	0.866	0.825	1.07	0.08	0.51	0.34	0.030	0.1029	0.1026
9/16	0.5625	0.5625	0.5545	13/16"	0.8125	0.798	0.938	0.895	1.19	0.09	0.57	0.38	0.034	0.1157	0.1154
5/8"	0.6250	0.6250	0.6170	15/16"	0.9375	0.922	1.083	1.034	1.33	0.10	0.62	0.42	0.038	0.1286	0.1283
3/4"	0.7500	0.7500	0.7410	1-1/8"	1.1250	1.100	1.299	1.234	1.59	0.11	0.73	0.51	0.045	0.1543	0.1540
See Para. 23		18					5		8		4		8	5	

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Table 1: Dimensions of Hex Flange Screws (continued)

Nominal Size or Basic Major Diameter of Thread		T		B_1	Runout of Bearing Surface FIM		L_1		Y	
		Gaging Ring Diameter		Bearing Diameter			Thread Length		Transition Thread Length	
							For Screws with L < 6 in.	For Screws with L > 6 in.	For Screws with L < 6 in.	For Screws with L > 6 in.
		Max	Min	Min	Max	Min	Basic		Max	Min
1/4"	0.2500	0.4093	0.4090	0.48	0.010		0.750	1.000	0.400	0.650
5/16"	0.3125	0.5483	0.5480	0.60	0.011		0.875	1.125	0.417	0.667
3/8"	0.3750	0.6183	0.6180	0.73	0.012		1.000	1.250	0.438	0.688
7/16"	0.4375	0.6853	0.6850	0.85	0.013		1.125	1.375	0.464	0.714
1/2"	0.5000	0.8253	0.8250	0.98	0.014		1.250	1.500	0.481	0.731
9/16	0.5625	0.8953	0.8950	1.10	0.015		1.375	1.625	0.750	0.750
5/8"	0.6250	1.0343	1.0340	1.23	0.017		1.500	1.750	0.773	0.773
3/4"	0.7500	1.2343	1.2343	1.47	0.020		1.750	2.000	0.800	0.800
See Para. 23		5		9	7		12		15	

1.0 Scope

This standard establishes the requirements for hex flange and indented hex flange screws in sizes 1/4 inch thru 3/4 inches. Provisions include three styles of standard fillets.

2.0 Dimensions

All dimensions are in inches and apply before plating or coating, unless otherwise specified

3.0 Top of Head

Top of head may be full form or indented at option of the manufacturer. If full form, the top of head shall be chamfered or rounded. The diameter of the chamfer circle or the start of rounding shall be equal to the maximum width across flats, F max, within a tolerance of minus 15 percent.

4.0 Head Height

The head height, H, is the distance, parallel to the axis of the screw, from the plane of the bearing surface to the top of the head, not including any raised markings. **See Para 21.**

5.0 Corner Fill

The rounding due to lack of fill on all six corners of the head shall be reasonably uniform and the width across corners of the head shall be such that when a sharp ring having an inside diameter equal to the specified T dimension is placed on the top of the head and normal to the screw axis, the screw head may enter, but not protrude through the gage.

6.0 True Position of Head

The axis of the head shall be located at true position with respect to the axis of the body determined over a distance under the head equal to one diameter within a tolerance zone whose diameter is equivalent to 6 percent of the maximum width across flats, regardless of feature size.

7.0 Bearing Surface

Runout of the bearing surface with respect to the axis of the body shall be within the FIM limits specified. Measurement of FIM shall be made as close to the periphery of the bearing surface as possible while the screw is held in a collet or other gripping device at a distance of one screw diameter from the underside of the head.

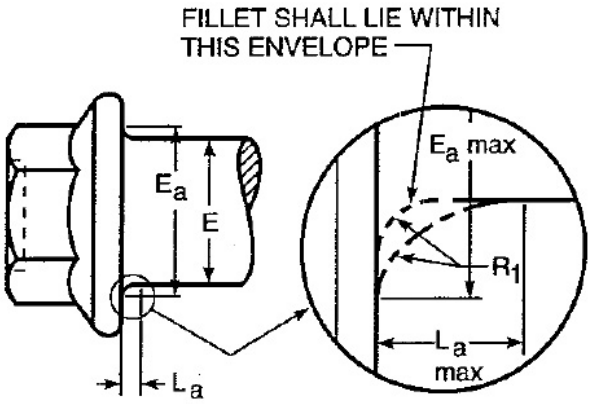

Fig. 2 Underhead Fillet for Long Screws

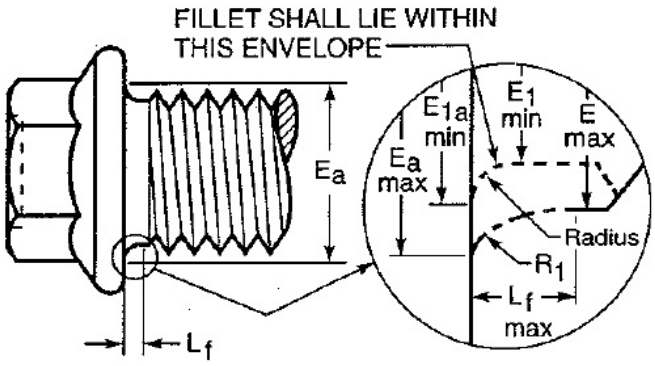

Fig. 3 Underhead Fillet for Short Screws Threaded Full Length

8.0 Flange

No mechanical properties like hardness, proof load, tensile strength are specified for lag screws. They are required to meet only the chemical requirements of the following standards

9.0 Bearing Diameter

The top surface of the flange shall be conical or slightly rounded (convex). Radius, R_2, applies both at the corners and at the flats of the hexagon.. The contour of edge at flange periphery, between the maximum flange diameter, B max, and the minimum bearing circle diameter, B_1 min, shall be optional provided that the minimum flange edge thickness, K min, is maintained at the minimum bearing circle diameter, B_1 min.

9.1 Fillet Style 1 & 2

The bearing diameter B_1 is determined from the bearing area necessary to support 75 percent of the specified proof load of a fine thread SAE Grade 5 screw with a max bearing stress of 20,500 psi based on using the clearance hole specified in ASME B18.2 8-1999. This same bearing area/clearance hole will support 100 percent of the specified proof load of a fine thread SAE Grade 8 screw with a max bearing stress of 38,650 psi.

9.2 Fillet Style 3

The bearing diameter is the same as for Fillet Style 1 and 2. The undercut reduces the bearing area, thereby increasing the bearing stress. The bearing stress increases to a max of 25,100 psi at 75 percent of the specified proof load of a fine thread SAE Grade 5 screw and to 47,200 psi for 100 percent the specified proof load of a fine thread SAE Grade 8 screw.

10.0 Fillet

Three styles of fillet are available as Style 1, Style 2 and Style 3 and the style shall be that furnished by the manufacturer unless otherwise specified by the purchaser at the time of inquiry and order.

10.1 Style 1 for Long Screws

A fillet at the junction of the head and shank which shall have a smooth concave curve within an envelope of R, min and a smooth multi-radius curve tanget to the underside of the head at a point no greater than one-half of E. max from the axis of the screw tangent to the shank at a distance from the underside of the head within the limits specified for L. **See Fig. 2 and Table 2** No radius shall be less than R1 min.

Table 2: Dimensions of Underhead Style 1 and Style 2 Fillets

Nominal Size or Basic Product Diameter		Long Screws (Fig. 2)		Long and Short Screws			Short Screw (Fig. 3)		
		E_a		L_a	R_1		E_a	E_{1a}	L_f
		Fillet Transition Diameter		Fillet Length	Radius of Fillet		Fillet Transition Diameter		Fillet Length
		Max	Min	Max	Max	Min	Max	Min	Max
1/4"	0.2500	0.300	0.280	0.087	0.025	0.015	0.300	0.236	0.043
5/16"	0.3125	0.362	0.342	0.087	0.025	0.015	0.362	0.300	0.045
3/8"	0.3750	0.425	0.405	0.087	0.025	0.015	0.425	0.357	0.048
7/16"	0.4375	0.488	0.468	0.087	0.025	0.015	0.488	0.416	0.052
1/2"	0.5000	0.550	0.530	0.087	0.025	0.015	0.550	0.477	0.053
9/16	0.5625	0.652	0.602	0.157	0.045	0.020	0.652	0.527	0.075
5/8"	0.6250	0.715	0.665	0.157	0.045	0.020	0.715	0.587	0.078
3/4"	0.7500	0.840	0.790	0.157	0.045	0.020	0.840	0.709	0.081

Note: Short screws are screws which are threaded full length.

Table 3: L_G Maximum and L_B Minimum Limitations for Short Screws Threaded Full Length

Nominal Size or Basic Product Diameter	For Nominal Product Lengths	L_G Max	For Nominal Product Lengths		L_G Max	L_B Min
	Less Than or Equal To	All Thread Series	Greater Than	Less Than or Equal To	All Thread Series	All Thread Series
1/4"	0.500	0.075	0.500	1.250	0.162	0.087
5/16"	0.625	0.83	0.625	1.375	0.170	0.087
3/8"	0.750	0.94	0.750	1.500	0.181	0.087
7/16"	0.875	0.107	0.875	1.750	0.194	0.087
1/2"	1.000	0.115	1.000	1.875	0.202	0.087
9/16	1.125	0.125	1.125	2.250	0.282	0.157
5/8"	1.250	0.136	1.250	2.500	0.293	0.157
3/4"	1.500	0.150	1.500	2.750	0.307	0.157
See Notes	1	2	4		3	5

Notes:

1. Tabulated values are equal to 2 times the basic product diameter.

2. Tabulated values are equal to 1. 5. times the coarse thread (UNC) pitch.

3. L_g max equals fillet length, L_a max, as given in Table 2 + 1 .5 times the coarse thread (UNC) pitch.

4. Nominal product length, max, equals 2.5 times the coarse thread (UNC) pitch + Y + L_T rounded down to the next 0.250 or 0.125 length increment.

5. L_B min in Table 3 equals L_a max in Table 2.

Table 4: Dimensions of Type 3 Underhead Fillet

Nominal Size or Basic Product Diameter		E_a	E_v	L_f	R_3	V	
		Undercut Diameter	Fillet Diameter	Fillet Length	Undercut Radius	Undercut Depth	
		Max	Max	Max	Min	Max	Min
1/4"	0.2500	0.325	0.275	0.058	0.010	0.010	0.004
5/16"	0.3125	0.406	0.344	0.072	0.013	0.013	0.004
3/8"	0.3750	0.488	0.413	0.086	0.015	0.015	0.005
7/16"	0.4375	0.569	0.481	0.101	0.018	0.018	0.006
1/2"	0.5000	0.650	0.550	0.115	0.020	0.020	0.007
9/16	0.5625	0.731	0.619	0.129	0.023	0.023	0.008
5/8"	0.6250	0.813	0.688	0.144	0.025	0.025	0.009
3/4"	0.7500	0.975	0.825	0.173	0.030	0.030	0.011

10.2 Style 2 for Short Screws Threaded Full Length

The fillet may have a smooth multi-radius curve tangent to the underside of the head at a point no greater than one-half of E_a max nor less than one-half of E_{1a} min from the axis of the screw, and tanget to the shank at a distance from the underside of the head within the limits specified for L_f max. See Fig. 3 and Tables 2 and 3. No radius shall be less than R_1 min.

10.3 Style 3

An undercut fillet design as shown in Fig. 4 and specified in Table 4. The fillet shall be a smooth and continuous curve fairing smoothly into the bearing surface and the shank within the limits specified in Table 4.

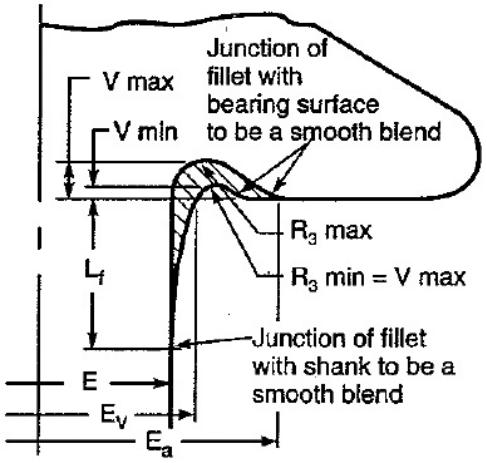

Fig. 4 Style 3 Underhead Fillet

11.0 Threads

Threads, when rolled, shall be Unified coarse or fine thread series UNRC or UNRF, Class 2A, in accordance with ASME B1.1, page A-33 Threads produced by other methods shall preferably be UNRC or UNRF, Class 2A but at manufacturer's option may be Unified coarse or fine thread series UNC or UNF, Class 2A Acceptability of screw threads shall be determined based on System 21, ASME B1 .3M, Screw Thread Gaging Systems for Dimensional Acceptability, page A-63.

12.0 Thread Length, L_T

Basic thread length is the distance from the extreme end of the screw to the last full form threads. Variations in thread length are controlled by L_B min and L_G max.

13.0 Grip Gaging Length, L_G

13.1 Grip Gaging Length

Grip gaging length is the distance, as measured parallel to the axis of the screw, from the underside of the head to the face of a noncounterbored or noncountersunk standard GO thread ring gage which has been assembled by hand on the screw as far as the thread will permit.

13.2 Long Screws

The maximum grip gaging length for long screws equals nominal screw length minus the basic thread length (L_G max = L nom – L_T) See Table 5.

13.3 Short Screws Over Two Times Nominal Diameter Fully Threaded

Screws shall have an unthreaded length L_B min equal to or greater than L_a max. The max grip gaging length L_G max shall be equal to L_a max plus a length of 1-1/2 threads. See Table 3.

13.4 Maximum Grip Length

Short screws two times nominal diameter and less shall have a maximum grip length, L_G, equal to 1-1/2 times the pitch of coarse threads for all thread series. See Table 3.

14.0 Body Length, L_B

Body length is the distance, as measured parallel to the axis of the screw, from the underside of head to the last scratch of thread or top of the extrusion angle. Min body length equals max grip gaging length minus the max transition thread length (L_B min = L_G max — Y max).

15.0 Transition Thread Length, Y

Transition thread length is the distance, as measured parallel to the axis of the screw, from the last full form thread to the last scratch of thread or top of extrusion angle. The transition thread length includes the incomplete threads and tolerances for grip gaging and body lengths.

16.0 Incomplete Thread

The major diameter of incomplete thread shall not exceed the actual major diameter of the full form thread.

17.0 Thread Runout and Screw Straightness

The runout of the thread in relation to screw body and the shank straightness shall be such that the screw will meet the requirements given in ASME B18.2.1, page C-28.

18.0 Body Diameter

On screws threaded full length, E_1 min, diameter of the body under the head shall not be less than the specified minimum pitch diameter of the thread. See Fig. 3.

19.0 Points

The end of the screw shall be chamfered or rounded from a diameter equal to or slightly less than the thread root diameter. The length of the point to the first full formed thread at major diameter, as determined by the distance the point enters into a cylindrical NOT GO major diameter ring gage, shall not exceed U max, specified in Table 6. The end of the screw shall be reasonably square with the axis of the screw, but the slight rim or cup resulting from roll-threading shall be permissible. At the manufacturer's option, the end of the screw may have a rounded point of radius R_p specified in Table 6.

20.0 Length Tolerances

Screw length tolerances are given in ASME B18.2.1, page C-26. Tolerances for pointed products shall apply.

21.0 Identification Symbols

Identification marking symbols on the tops of screw heads or flanges shall be legible to the unaided eye with the exception of corrective lenses. When indented, the depth of the marking shall not reduce the load carrying capability of the screw. Recessed markings optional with the manufacturer, unless otherwise specified.

Table 5: Maximum Grip Gaging Lengths, L_G, and Minimum Body Lengths, L_B

Nominal Diameter	1/4		5/16		3/8		7/16		1/2		9/16		5/8		3/4	
Nominal Lengths	L_B Min	L_G Max	L_B Min	L_G Max	L_B Min	L_G Max	L_B Min	L_G Max	L_B Min	L_G Max	L_B Min	L_G Max	L_B Min	L_G Max	L_B Min	L_G Max
1-1/4"																
1-3/8"	0.225	0.625														
1-1/2"	0.350	0.750	0.208	0.625												
1-5/8"	0.475	0.875	0.333	0.750	0.187	0.625										
1-3/4"	0.600	1.000	0.458	0.875	0.312	0.750										
1-7/8	0.725	1.125	0.583	1.000	0.437	0.875	0.286	0.750								
2"	0.850	1.250	0.708	1.125	0.562	1.000	0.411	0.875	0.269	0.750						
2-1/8"	0.975	1.375	0.833	1.250	0.687	1.125	0.536	1.000	0.394	0.875						
2-1/4"	1.100	1.500	0.958	1.375	0.812	1.250	0.661	1.125	0.519	1.000						
2-3/8"	1.225	1.625	1.083	1.500	0.937	1.375	0.786	1.250	0.644	1.125	0.250	1.000				
2-1/2"	1.350	1.750	1.208	1.625	1.062	1.500	0.911	1.375	0.769	1.250	0.375	1.125				
2-5/8"	1.475	1.875	1.333	1.750	1.187	1.625	1.036	1.500	0.894	1.375	0.500	1.250	0.352	1.125		
2-3/4"	1.600	2.000	1.458	1.875	1.312	1.750	1.161	1.625	1.019	1.500	0.625	1.375	0.477	1.250		
2-7/8"	1.725	2.125	1.583	2.000	1.437	1.875	1.286	1.750	1.144	1.625	0.750	1.500	0.602	1.375	0.325	1.125
3"	1.850	2.250	1.708	2.125	1.562	2.000	1.411	1.875	1.269	1.750	0.875	1.625	0.727	1.500	0.450	1.250
3-1/4"	2.100	2.500	1.958	2.375	1.812	2.250	1.661	2.125	1.519	2.000	1.125	1.875	0.977	1.750	0.700	1.500
3-1/2"	2.350	2.750	2.208	2.625	2.062	2.500	1.911	2.375	1.769	2.250	1.375	2.125	1.227	2.000	0.950	1.750
3-3/4"	2.600	3.000	2.458	2.875	2.312	2.750	2.161	2.625	2.019	2.500	1.625	2.375	1.477	2.250	1.200	2.000
4"	2.850	3.250	2.708	3.125	2.562	3.000	2.411	2.875	2.269	2.750	1.875	2.625	1.727	2.500	1.450	2.250
4-1/4"	3.100	3.500	2.958	3.375	2.812	3.250	2.661	3.125	2.519	3.000	2.125	2.875	1.977	2.750	1.700	2.500
4-1/2"	3.350	3.750	3.208	3.625	3.062	3.500	2.911	3.375	2.769	3.250	2.375	3.125	2.227	3.000	1.950	2.750
3-3/4"	3.600	4.000	3.458	3.875	3.312	3.750	3.161	3.625	3.019	3.500	2.625	3.375	2.477	3.250	2.200	3.000
5"	3.850	4.250	3.708	4.125	3.562	4.000	3.411	3.875	3.269	3.750	2.875	3.625	2.727	3.500	2.450	3.250
5-1/4"	4.100	4.500	3.958	4.375	3.812	4.250	3.661	4.125	3.519	4.000	3.125	3.875	2.977	3.750	2.700	3.500
5-1/2"	4.350	4.750	4.208	4.625	4.062	4.500	3.911	4.375	3.769	4.250	3.375	4.125	3.227	4.000	2.950	3.750
5-3/4"	4.600	5.000	4.458	4.875	4.312	4.750	4.161	4.625	4.019	4.500	3.625	4.375	3.477	4.250	3.200	4.000
6"	4.850	5.250	4.708	5.125	4.562	5.000	4.411	4.875	4.269	4.750	3.875	4.625	3.727	4.500	3.450	4.250
6-1/4"	4.600	5.250	4.458	5.125	4.312	5.000	4.161	4.875	4.019	4.750	3.875	4.625	3.727	4.500	3.450	4.250
6-1/2"	4.850	5.500	4.708	5.375	4.562	5.250	4.411	5.125	4.269	5.000	4.125	4.875	3.977	4.750	3.700	4.500
6-3/4"	5.100	5.750	4.958	5.625	4.812	5.500	4.661	5.375	4.519	5.250	4.375	5.125	4.227	5.000	3.950	4.750

General Note: Screw lengths above thick black line are fully threaded. See Para 13.

Table 6: Dimensions of Points

Nominal Size or Basic Product Diameter		R_P	U
		Point Radius	Point Length
		Approx	Max
1/4"	0.2500	0.35	0.08
5/16"	0.3125	0.44	0.10
3/8"	0.3750	0.52	0.11
7/16"	0.4375	0.60	0.13
1/2"	0.5000	0.70	0.15
9/16	0.5625	0.79	0.16
5/8"	0.6250	0.88	0.16
3/4"	0.7500	1.05	0.19

22.0 Material

Chemical and mechanical properties of I steel screws normally conform to Grades 2, 5 or 8 of SAE J429, page B-79, ASTM A307, page B-90, ASTM A449, page B-97 or ASTM A354, page B-139.

Properties of several grades of nonferrous materials are covered in ASTM F468, page B-158, and of several stainless steels in ASTM F593, page B-148.

23.0 Nominal Size

Where specifying nominal size in decimals, zeros preceding the decimal point and in the fourth decimal place shall be omitted.

24.0 Quality Assurance

Screws shall be furnished to ASME B18.18.1, page M-5, unless otherwise specified.

25.0 Hex Bolt Length Tolerance

Nominal Length	Diameter					
	1/4" - 3/8"	7/16" - 1/2"	9/16" - 3/4"	7/8" - 1"	1-1/8" - 1-1/2"	Over 1-1/2"
Up to 1"	+0.02 -0.03	+0.02 -0.03	+0.02 -0.03	–	–	–
Over 1" to 2-1/2"	+0.02 -0.04	+0.04 -0.06	+0.06 -0.08	+0.08 -0.10	+0.12 -0.12	+0.18 -0.18
Over 2-1/2" to 4"	+0.04 -0.06	+0.06 -0.08	+0.08 -0.10	+0.10 -0.14	+0.16 -0.16	+0.20 -0.20
Over 4" to 6"	+0.06 -0.10	+0.08 -0.10	+0.10 -0.10	+0.12 -0.16	+0.18 -0.18	+0.22 -0.22
Longer than 6"	+0.10 -0.18	+0.12 -0.18	+0.12 -0.18	+0.16 -0.22	+0.22 -0.22	+0.24 -0.24