LOCKING FASTENERS

PREVAILING-TORQUE TYPE STEEL HEX AND HEX FLANGE NUTS

IFI 100/107 1987

IFI Notes:

1. *IFI-100/107 is a standard developed through the procedures of the Industrial Fasteners Institute. IFI-100/107 is under the jurisdiction of IFI Division V and is the direct responsibility of its Engineering Committee.*
2. *IFI-100/107 is a combination of 2 former IFI standards. Previously, IFI-100 covered 3 strength grades of prevailing-torque type steel hex nuts and IFI-107 covered 2 strength grades of prevailing-torque type steel hex flange nuts. IFI-100/107 retains all of the requirements of the 2 standards it supersedes.*
3. *IFI-100 was first published in 1967, and IFI-107 in 1969. Since first publication, both standards were periodically reviewed and updated. The combination of the 2 standards into IFI-100/107 was accomplished in 1987.*
4. *There are no American National Standards for inch series prevailing-torque type steel hex nuts or hex flange nuts, nor are any contemplated.*
5. *Reference to the discussion on locking fasteners, page F-1, may be of assistance in explaining the unique requirements of IFI-100/107 and help guide the proper selection and application of the products it covers.*

1.0 Scope.

1.1 Scope. This standard establishes the dimensional, mechanical and performance requirements for three grades of prevailing-torque type steel hex nuts, in sizes No. 4 thru 1½ in., and two grades of prevailing-torque type steel hex flange nuts, in sizes ¼ thru ¾ in.

1.2 Definition. A prevailing-torque type locknut is a nut which is frictionally resistant to rotation due to a self-contained prevailing-torque feature, and not because of a compressive load developed against the bearing surface of the locknut.

(Note: Locknut is a generic term used commercially for prevailing-torque type nuts. The term "locknut" is not intended to imply an indefinite permanency of fixity.

1.3 Torque-Tension Capability. In some engineering applications it may be desirable to use nuts which have the capability to develop a known tensile load in the mating externally threaded component when the nut is tightened with a specific torque. Under certain controlled conditions, prevailing-torque type steel hex nuts, in sizes ¼ thru 1 in., and all sizes of hex flange nuts have this capability. Torque-tension requirements for these nuts are covered in IFI-101, page F-16.

1.4 The inclusion of data in this standard is not intended to imply that all nut styles, sizes and grades in conjunction with the various options described herein are stock items. Purchasers are requested to consult with manufacturers concerning lists of stock production prevailing-torque hex and hex flange nuts.

2.0 Nut Designs.

2.1 There are three basic designs for prevailing-torque nuts:

(a) all-metal, one-piece construction nuts which derive their prevailing-torque characteristics from controlled distortion of the nut thread and/or body;

(b) metal nuts which derive their prevailing-torque characteristics from the addition or fusion of a nonmetallic insert, plug, or patch in their threads;

(c) top insert, two-piece construction nuts which derive their prevailing-torque

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characteristics from an insert, usually a full ring of nonmetallic material, located and retained in the nut at its top surface.

Note: "All metal" is a generic term encompassing nuts that are totally all metal and also those which have non-metallic (patches, pellets or plugs) located in their threads.

2.2 For hex nuts, the two nut designs defined in (a) and (b) of 2.1 have the same dimensional requirements and are designated "all-metal type" in Table 1; nut design (c) of 2.1 is designated "top insert type" in Table 1. For hex flange nuts, all three nut designs have the same dimensional requirements as detailed in Table 2.

2.3 The method of producing prevailing-torque characteristics, and the design of the prevailing-torque feature shall be in accordance with the practice of the manufacturer.

3.0 Nut Strength Grades.

3.1 There are three grades of prevailing-torque type steel hex nuts designated as Grades A, B and C, respectively. There are two grades of prevailing-torque type steel hex flange nuts designated respectively as Grades F and G.

Each grade of nut is suggested for use with externally threaded components having specified minimum tensile strengths within the following values:

Grade of Nut	Specified Min Ult Tensile Strength of Bolt, ksi
Grade A	not greater than 90
Grades B and F	not greater than 120
Grade C	not less than 105, nor greater than 150
Grade G	not less than 120, nor greater than 150

4.0 Requirements.

4.1 Materials and Processes.

4.1.1 *Material.* Nuts shall be made of steel of a grade adequate for the nut to meet the mechanical and performance requirements of this standard.

The prevailing-torque element of insert design nuts may be of a material other than steel.

4.1.2 *Heat Treatment.* Grade A nuts shall not be heat treated. Other nut grades may be heat treated as necessary to meet the mechanical and performance requirements of this standard, except that they shall not be case hardened. Heat treatment is defined as heating the nut to the austenitizing temperature of the material of which the nut is made, quenching in a proper medium to obtain a predominately martensitic microstructure, and tempering to or below the specified maximum hardness.

4.1.3 *Finish.* Nuts may be furnished plain (bare metal) or with a protective coating (electrodeposited plating and/or chemical conversion coating) as specified by the user. All nuts may be provided with an additional supplementary lubricant which shall be clean and dry to the touch. The performance of nuts which are furnished with a protective coating shall not deteriorate when nuts are stored indoors for a period of six months.

In cases where nuts are given a protective coating or are cleaned following delivery to the purchaser, the nut producer shall not be held responsible for failures of the nut to meet dimensional, mechanical, or performance requirements traceable to plating, coating, or cleaning practice.

4.1.4 *Hydrogen embrittlement.* Nuts shall not be embrittled. When heat treated nuts are electroplated or phosphate coated, appropriate plating or coating processes should be employed to avoid hydrogen embrittlement. If necessary, the product shall be suitably treated as soon as practicable after plating or coating to preclude detrimental hydrogen embrittlement.

4.2 Dimensions.

4.2.1 *Basic Dimensions.* Hex nuts shall conform to the dimensions given in Table 1 and hex flange nuts to the dimensions given in Table 2. The portion of the nut containing the prevailing-torque feature may have a special contour within the maximum permitted width across flats and thickness. The minimum width across flats shall

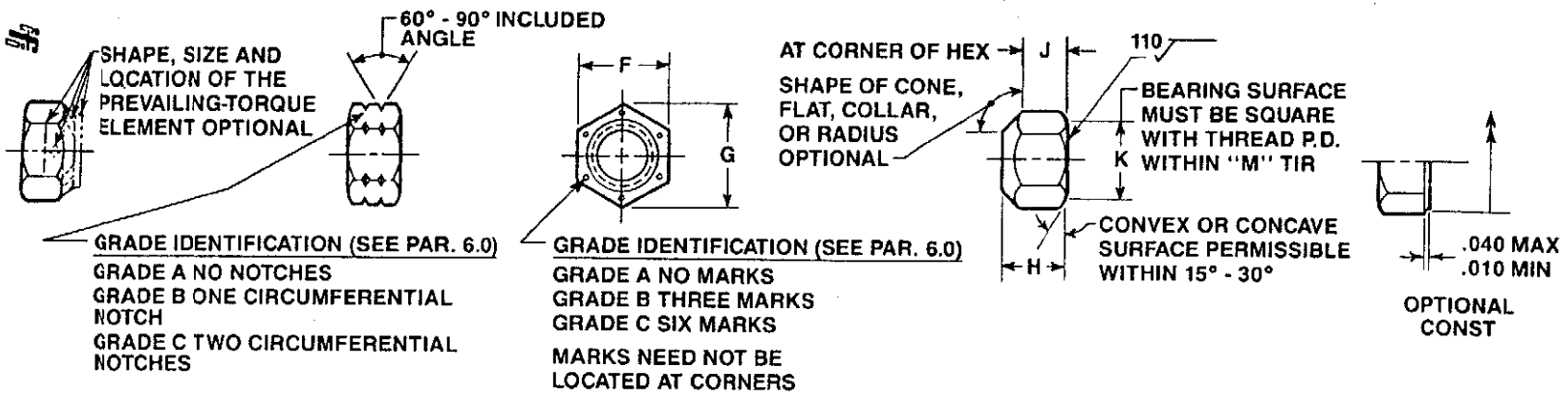

Table 1 Dimensions of Prevailing-Torque Type Hex Nuts

Nom Size or Basic Major Dia of Thread		Width Across Flats			Width Across Corners		Thickness			Height of Hex	Dia of Bearing Surface		Angularity of Bearing Surface FIM
		F			G		H	H	H	J	K		M
		Basic	Max	Min	Max	Min	Max	Max	Min	Min	Max	Min	Max
No. 4	0.1120	1/4	0.251	0.241	0.289	0.275	0.163	0.163	0.087	0.066	0.251	0.238	.008
6	0.1380	5/16	.313	.302	.361	.344	.188	.171	.102	.075	.313	.297	.008
8	0.1640	11/32	.345	.332	.397	.378	.239	.191	.117	.083	.345	.328	.009
10	0.1900	3/8	.376	.362	.433	.413	.249	.241	.117	.083	.376	.357	.009
12	0.2160	7/16	.438	.423	.505	.482	.328	.241	.148	.103	.438	.416	.010
1/4	0.2500	7/16	.4385	.428	.505	.488	.328	.288	.212	.145	.438	.416	.010
5/16	0.3125	1/2	.5020	.489	.577	.557	.359	.336	.258	.166	.502	.475	.011
3/8	0.3750	9/16	.5645	.551	.650	.628	.469	.415	.320	.198	.564	.534	.012
7/16	0.4375	11/16	.6895	.675	.794	.768	.524	.463	.365	.223	.689	.653	.013
1/2	0.5000	3/4	.7520	.736	.866	.840	.609	.573	.427	.262	.752	.712	.014
9/16	0.5625	7/8	.8770	.861	1.010	.982	.656	.621	.473	.286	.877	.830	.015
5/8	0.6250	15/16	.9395	.922	1.083	1.051	.765	.731	.535	.329	.939	.890	.016
3/4	0.7500	1-1/8	1.1270	1.088	1.299	1.240	.890	.827	.617	.382	1.127	1.069	.018
7/8	0.8750	1-5/16	1.3145	1.269	1.516	1.447	.999	.922	.724	.450	1.314	1.246	.020
1	1.0000	1-1/2	1.5020	1.450	1.732	1.653	1.124	1.018	.831	.513	1.502	1.425	.022
1-1/8	1.1250	1-11/16	1.6895	1.631	1.949	1.859	1.281	1.176	.939	.576	1.689	1.603	.025
1-1/4	1.2500	1-7/8	1.8770	1.812	2.165	2.066	1.422	1.272	1.030	.628	1.877	1.781	.028
1-3/8	1.3750	2-1/16	2.0645	1.994	2.382	2.273	1.609	1.399	1.138	.681	2.064	1.959	.031
1-1/2	1.5000	2-1/4	2.2520	2.175	2.598	2.480	1.671	1.526	1.245	.757	2.252	2.138	.034

NOTES:

1. All dimensions are in inches.
2. Except as noted dimensions apply to all grades of locknuts.
3. Tapped holes shall be countersunk on the bearing face. The maximum countersink diameter shall be the thread basic (nominal) major diameter plus .030 in. for 3/8 in. nuts or smaller, and 1.08 times the basic major diameter for nuts larger than 3/8 in. No part of the threaded portion shall project beyond the bearing surface.
4. Axis of tapped hole shall be concentric with axis of locknut body within a tolerance of 1.5 percent (3 percent FIM) of the maximum width across flats.
5. FIM signifies "Full Indicator Movement."

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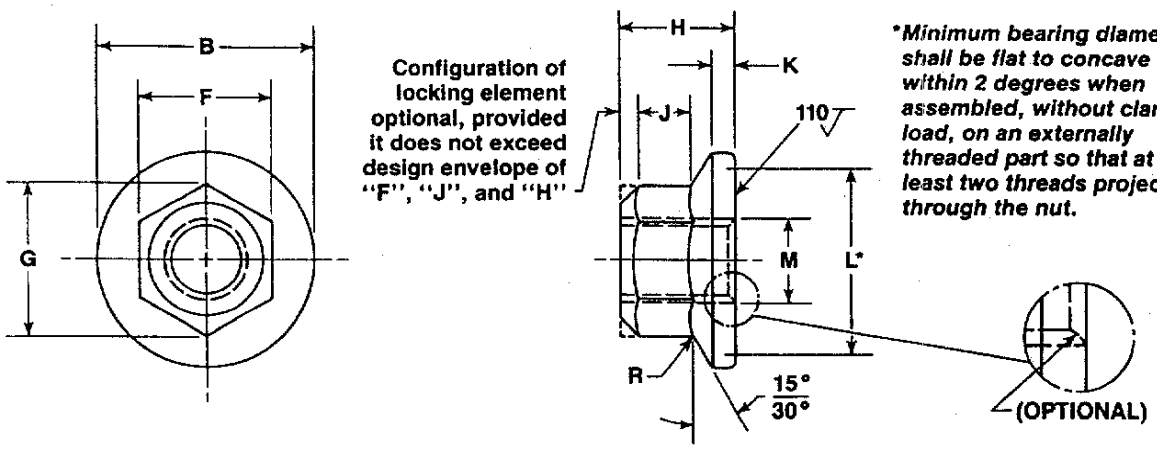

Table 2 Dimensions of Prevailing-Torque Type Hex Flange Nuts

Nom Size or Basic Major Dia of Thread		Width Across Flats			Width Across Corners		Height	Flange Dia	Bearing* Dia	Flange Thickness	Corner Wrenching Length	Countersink Dia	Angularity of Brg. Surf. with Thd P.D.	Flange Top Radius
		F			G		H	B	L	K	J	M	FIM	R
		Basic	Max	Min	Max	Min	Max	Max	Min	Min	Min	Max	Max	Max
1/4	0.2500	7/16	0.4385	0.428	0.505	0.488	0.300	0.560	0.484	0.04	0.14	0.295	0.011	0.01
5/16	0.3125	1/2	0.5020	0.489	0.577	0.557	0.365	0.680	0.602	0.05	0.17	0.357	0.013	0.01
3/8	0.3750	9/16	0.5645	0.551	0.650	0.628	0.425	0.810	0,730	0.06	0.20	0.420	0.015	0.02
7/16	0.4375	11/16	0.6895	0.675	0.794	0.768	0.495	0.930	0.846	0.07	0.23	0.482	0.016	0.02
1/2	0.5000	3/4	0.7520	0.736	0.866	0.840	0.555	1.070	0.982	0.08	0.26	0.560	0.018	0.02
9/16	0.5625	7/8	0.8770	0.861	1.010	0.982	0.625	1.190	1.101	0.09	0.29	0.622	0.019	0.03
5/8	0.6250	15/16	0.9395	0.922	1.083	1.051	0.690	1.330	1.230	0.10	0.32	0.685	0.021	0.03
3/4	0.7500	1-1/8	1.1270	1.088	1.299	1.240	0.825	1.585	1.472	0.11	0.38	0.810	0.023	0.03

NOTES:

1. All dimensions are in inches.
*2. The bearing diameter is determined from the bearing area necessary to support 75 percent of the specified proof load of an SAE Grade 5 UNF bolt with a bearing stress of 20,000 psi. This same bearing area will support 100 percent of the specified proof load of an SAE Grade 8 UNF bolt with a bearing stress of 37,800 psi.
3. Axis of tapped hole shall be concentric with axis of locknut body within a tolerance of 1.5 percent (3 percent FIM) of the maximum width across flats.

not apply at depressed portion of nut at prevailing-torque feature.

4.2.2 *Thread Form, Series and Tolerances.* Threads of nuts shall be Unified coarse or fine series, as specified in ANSI/ASME B1.1, page A-26, except that the portion of the threaded length containing the prevailing-torque element need not conform. Unless otherwise specified, nuts shall be tapped to Class 2B tolerances.

4.2.3 *Thread Start.* Hex nuts in sizes 3/8 in. and smaller shall assemble a minimum of one-half turn, and hex nuts 7/16 in. and larger and all sizes of hex flange nuts shall assemble a minimum of one full turn by hand on a basic GO thread plug gage. The plug gage shall be without a chip groove, and shall have a point with dimensions conforming to those for the point on hex cap screws as specified in ANSI/ASME B18.2.1, page C-10.

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Table 3 Mechanical Property Requirements

Grade	Locknut Size (Bolt Dia) in.	Proof Load Stress psi	Rockwell Hardness
A	No. 4 thru 1-1/2	90,000	C28 max
B	No. 4 thru 1	120,000	C28 max
	Over 1 thru 1-1/2	105,000	C28 max
C	No. 4 thru 5/8	150,000	C24/32
	Over 5/8 thru 1		C26/34
	Over 1 thru 1-1/2		C26/36
F	1/4 thru 3/4	120,000	C28 max
G	1/4 thru 5/8	150,000	C24/32
	3/4	150,000	C26/34

4.2.4 *Defects.* Nuts shall meet the surface discontinuity limits specified in ASTM F812, page B-141.

4.3 Mechanical Requirements.

4.3.1 *Proof Load.* Hex nuts shall withstand the proof load specified for the applicable grade and thread series in Table 4 when tested as specified in 5.1. Hex flange nuts shall withstand the proof load specified for the applicable grade and thread series in Table 5 when tested as specified in 5.1.

4.3.2 *Hardness.* Nuts shall have a hardness conforming to the limits specified for the applicable grade in Table 3 when tested as specified in 5.2. It is customary practice to waive the minimum hardness requirement for any nut which satisfactorily meets its specified proof load.

4.4 Performance Requirements.

4.4.1 *Prevailing-Torque.* The prevailing-torque developed by nuts during their first installation, or any subsequent installation or removal, shall not exceed the maximum first installation torque specified for the applicable grade in Table 4 for hex nuts and in Table 5 for hex flange nuts when tested as specified in 5.3. In addition, the maximum and minimum prevailing-torque developed by nuts during their first and fifth removals shall not be less than the respective "highest" and "lowest" readings removal torques specified for the applicable grade in Tables 4 and 5 when tested as specified in 5.3.

Note: The purpose of this requirement is to verify that the nut's resistance to removal is at least equal to or greater than a specified prevailing torque ("highest") in at least one location during a full 360 deg of rotation, and also, that at no location during that same 360 deg of rotation is the resistance to removal less than a specified prevailing torque ("lowest").

4.4.1.1 *Definition.* The prevailing-torque developed by a nut is the torque necessary to rotate the nut on its mating externally threaded component, with the torque being measured while the nut is in motion, and with no axial load in the mating component.

5.0 Test Methods.

5.1 Proof Load Test. The test sample nut shall be assembled on a test bolt (5.1.1) or on a hardened mandrel (5.1.2) with a minimum of three threads projecting through the nut. For referee test purposes, the hardened mandrel shall be used. The maximum prevailing-torque occurring during the assembly of the nut on the test bolt or mandrel shall be recorded.

A load equal to the specified proof load for the nut, as given in Tables 4 or 5, shall be applied in tension or compression through the test bolt or mandrel against the nut bearing surface in an axial direction. For referee purposes, the load shall be applied in tension. The nut shall resist this load without thread stripping or rupture. The prevailing-torque necessary to remove the nut from the test bolt or mandrel shall not exceed the maximum torque occurring during assembly.

5.1.1 *Test Bolt.* The bolt used for proof load testing a nut shall have threads conforming to Class 2A tolerances as specified in ANSI/ASME B1.1. The test bolt shall have a yield strength in excess of the specified proof load of the nut being tested.

5.1.2 *Hardened Mandrel.* The hardened mandrel used for proof load testing a nut shall have threads conforming to Class 3A tolerances as specified in ANSI/ASME B1.1, except that the major diameter shall be the minimum major diameter with a plus tolerance of 0.002 in. The mandrel shall be heat treated to a hardness of Rockwell C45 to 50.

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Table 4 Proof Loads, Clamp Loads, and Prevailing Torques for Hex Nuts

Nut Size and Threads Per Inch	Grade A Nuts							Grade B Nuts							Grade C Nuts						
			Prevailing Torque							Prevailing Torque							Prevailing Torque				
				First Removal		Fifth Removal					First Removal		Fifth Removal					First Removal		Fifth Removal	
	Proof Load lb	Clamp Load lb	First Install in. lb max	Highest Reading min in. lb	Lowest Reading min in. lb	Highest Reading min in. lb	Lowest Reading min in. lb	Proof Load lb	Clamp Load lb	First Install in. lb max	Highest Reading min in. lb	Lowest Reading min in. lb	Highest Reading min in. lb	Lowest Reading min in. lb	Proof Load lb	Clamp Load lb	First Install in. lb max	Highest Reading min In. lb	Lowest Reading min In. lb	Highest Reading min in. lb	Lowest Reading min in. lb.
Coarse Thread Series																					
No. 4-40	540	250	3.0	1.0	0.5	0.5	0.2	720	380	3.0	1.0	0.5	0.5	0.2	910	550	4.0	1.0	0.5	0.5	0.2
6-32	820	370	6.0	1.5	0.5	1.0	0.5	1,100	580	8.0	1.5	0.5	1.0	0.5	1,350	810	8.0	2.0	1.0	1.5	0.5
8-32	1,250	580	9.0	2.0	1.0	1.5	0.5	1,700	900	12.0	2.0	1.0	1.5	0.5	2,100	1,250	12	2.5	1.0	2.0	1.0
10-24	1,550	720	13	2.5	1.0	2.0	1.0	2,100	1,100	13	2.5	1.0	2.0	1.0	2,600	1,550	17	3.5	1.5	2.5	1.0
12-24	2,200	1,000	20	3.5	1.5	2.5	1.0	2,900	1,550	20	3.5	1.5	2.5	1.0	3,650	2,200	27	4.5	2	3.0	1.5
1/4 -20	2,900	1,300	30	5.0	2.5	3.5	1.5	3,800	2,000	30	5.0	2.5	3.5	1.5	4,750	2,850	40	6.0	3	4.5	2
5/16-18	4,700	2,150	60	8.0	4	5.5	2.5	6,300	3,350	60	8.0	4	5.5	2.5	7,850	4,700	80	10.5	5	7.5	3
3/8 -16	7,000	3,200	80	12	5	8.5	4	9,300	4,950	80	12	5	8.5	4	11,600	6,950	110	16	7.5	11.5	5
7/16-14	9,550	4,400	100	17	7.5	12	5	12,800	6,800	100	17	7.5	12	5	15,900	9,600	135	23	10	16	7.5
1/2 -13	12,800	5,850	150	22	10	15	7.5	17,000	9,050	150	22	10	15	7.5	21,300	12,800	17*	30	15	20	10
			*ft lb							*ft lb							*ft lb				
9/16-12	16,400	7,550	17*	30	15	21	10	21,800	11,600	17*	30	15	21	10	27,300	16,400	25*	40	20	28	12.5
5/8 -11	20,300	9,300	25*	39	17.5	27	12.5	27,200	14,500	25*	39	17.5	27	12.5	33,900	20,300	35*	52	25	36	15
3/4 -10	30,000	13,800	35*	58	25	41	20	40,100	21,300	35*	58	25	41	20	50,100	30,100	45*	78	35	54	25
7/8 - 9	41,600	11,400	50*	88	40	62	30	55,400	29,500	50*	88	40	62	30	69,300	41,600	70*	117	50	82	40
1 - 8	54,500	15,000	70*	120	60	84	40	72,700	38,700	70*	120	60	84	40	90,900	54,600	90*	160	80	112	50
1-1/8 - 7	68,700	18,900	75*	150	70	105	50	80,100	42,100	75*	150	70	105	50	115,000	69,000	100*	200	100	140	70
1-1/4 - 7	87,200	24,000	85*	188	90	132	60	101,700	53,500	85*	188	90	132	60	145,000	87,000	110*	250	120	176	80
1-3/8 - 6	104,000	28,700	100*	220	110	154	70	121,300	63,800	100*	220	110	154	70	173,000	104,000	135*	293	140	205	100
1-1/2 - 6	126,000	34,800	110*	260	130	182	90	147,500	77,600	110*	260	130	182	90	211,000	127,000	150*	346	170	242	120
Fine Thread Series																					
No. 4-48	600	270	3.0	1.0	0.5	0.5	0.2	790	420	3.0	1.0	0.5	0.5	0.2	990	600	4.0	1.0	0.5	0.5	0.2
6-40	900	420	6.0	1.5	0.5	1.0	0.5	1,200	640	8.0	1.5	0.5	1.0	0.5	1,500	900	8.0	2.0	1.0	1.0	0.5
8-36	1,350	610	9.0	2.0	1.0	1.5	0.5	1,750	930	12	2.0	1.0	1.5	0.5	2,200	1,300	12	2.5	1.0	2.0	1.0
10-32	1,800	840	13	2.5	1.0	2.0	1.0	2,400	1,300	13	2.5	1.5	2.0	1.0	3,000	1,800	17	3.5	1.5	2.5	1.0
12-28	2,300	1,050	20	3.5	1.5	2.5	1.0	3,100	1,650	20	3.5	1.5	2.5	1.0	3,900	2,350	27	4.5	2	3.0	1.5
1/4 -28	3,300	1,500	30	5	2.5	3.5	1.5	4,350	2,300	30	5.0	2.5	3.5	1.5	5,450	3,250	40	6.0	3	4.5	2
5/16-24	5,200	2,400	60	8	4	5.5	2.5	6,950	3,700	60	8.0	4	5.5	2.5	8,700	5,200	80	10.5	5	7.5	3
3/8 -24	7,900	3,600	80	12	5	8.5	4	10,500	5,600	80	12	5	8.5	4	13,200	7,900	110	16	7.5	11.5	5
7/16-20	10,700	4,900	100	17	7.5	12	5	14,200	7,550	100	17	7.5	12	5	17,800	10,700	135	23	10	16	7.5
1/2 -20	14,400	6,550	150	22	10	15	7.5	19,200	10,200	150	22	10	15	7.5	24,000	14,400	17*	30	15	20	10
			*ft lb							*ft lb							*ft lb				
9/16-18	18,300	8,350	17*	30	15	21	10	24,400	13,000	17*	30	15	21	10	30,400	18,300	25*	40	20	28	12.5
5/8 -18	22,900	10,500	25*	39	17.5	27	12.5	30,700	16,300	25*	39	17.5	27	12.5	38,400	23,000	35*	52	25	36	15
3/4 -16	33,600	15,400	35*	58	25	41	20	44,800	23,800	35*	58	25	41	20	56,000	33,600	45*	78	35	54	25
7/8 -14	45,800	12,600	50*	88	40	62	30	61,100	32,400	50*	88	40	62	30	76,400	45,800	70*	117	50	82	40
1 -14	61,100	16,800	70*	120	60	84	40	81,500	43,300	70*	120	60	84	40	101,900	61,100	90*	160	80	112	50
1 -12	59,700	16,400	70*	120	60	84	40	79,600	42,300	70*	120	60	84	40	99,500	59,700	90*	160	80	112	50
1-1/8 -12	76,900	21,200	75*	150	70	105	50	89,900	47,500	75*	150	70	105	50	128,000	76,800	100*	200	100	140	70
1-1/4 -12	96,600	26,600	85*	188	90	132	60	113,000	59,700	85*	188	90	132	60	161,000	96,600	110*	250	120	176	80
1-3/8 -12	118,000	32,500	100*	220	110	154	70	138,000	72,900	100*	220	110	154	70	197,000	118,000	135*	293	140	205	100
1-1/2 -12	142,000	39,100	110*	260	130	182	90	166,000	87,700	110*	260	130	182	90	237,000	142,000	150*	346	170	242	120

NOTE: Clamp loads for Grades A, B, and C locknuts respectively equal 75 percent of the proof loads specified for Grades 2, 5, and 8 bolts in SAE J429, page B-50. Clamp loads for Grades B and C locknuts also respectively equal 75 percent of the proof loads specified for ASTM A449, page B-63, and ASTM A354 Grade BD, page B-68, bolts.

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Table 5 Proof Loads, Clamp Loads, and Prevailing Torques for Hex Flange Nuts

Nut Size and Threads Per Inch	Grade F Nuts							Grade G Nuts						
			Prevailing Torque							Prevailing Torque				
				First Removal		Fifth Removal					First Removal		Fifth Removal	
	Proof Load lb	Clamp Load lb	First Install in. lb max	Highest Reading min in. lb	Lowest Reading min in. lb	Highest Reading min in. lb	Lowest Reading min in. lb	Proof Load lb	Clamp Load lb	First Install in. lb max	Highest Reading min in. lb	Lowest Reading min in. lb	Highest Reading min in. lb	Lowest Reading min in. lb.
Coarse Thread Series														
1/4 -20	3,800	2,000	30	5.0	2.5	3.5	1.5	4,750	2,850	40	6.0	3	4.5	2
5/16-18	6,300	3,350	60	8.0	4	5.5	2.5	7,850	4,700	80	10.5	5	7.5	3
3/8 -16	9,300	4,950	80	12	5	8.5	4	11,600	6,950	110	16	7.5	11.5	5
7/16-14	12,800	6,800	100	17	7.5	12	5	16,000	9,600	135	23	10	16	7.5
1/2 -13	17,000	9,050	150	22	10	15	7.5	21,300	12,800	17*	30	15	20	10
			*ft lb							*ft lb				
9/16-12	21,800	11,600	17*	30	15	21	10	27,300	16,400	25*	40	20	28	12.5
5/8 -11	27,200	14,500	25*	39	17.5	27	12.5	33,900	20,300	35*	52	25	36	15
3/4 -10	40,100	21,300	35*	58	25	41	20	50,100	30,100	45*	78	35	54	25
Fine Thread Series														
1/4 -28	4,350	2,300	30	5.0	2.5	3.5	1.5	5,450	3,250	40	6	3	4.5	2
5/16-24	6,950	3,700	60	8.0	4	5.5	2.5	8,700	5,200	80	10.5	5	7.5	3
3/8 -24	10,500	5,600	80	12	5	8.5	4	13,200	7,900	110	16	7.5	11.5	5
7/16-20	14,200	7,550	100	17	7.5	12	5	17,800	10,700	135	23	10	16	7.5
1/2 -20	19,200	10,200	150	22	10	15	7.5	24,000	14,400	17*	30	15	20	10
			*ft lb							*ft lb				
9/16-18	24,400	13,000	17*	30	15	21	10	30,500	18,300	25*	40	20	28	12.5
5/8 -18	30,700	16,300	25*	39	17.5	27	12.5	38,400	23,000	35*	52	25	36	15
3/4 -16	44,800	23,800	35*	58	25	41	20	56,000	33,600	45*	78	35	54	25

NOTE: Clamp loads for Grades F and G flange locknuts respectively equal 75 percent of the proof loads specified for Grades 5 and 8 bolts in SAE J429, page B-50, and are also respectively equal to 75 percent of the proof loads specified for ASTM A449, page B-63, and ASTM A354 Grade BD, page B-68, bolts. Proof loads for Grades F and G flange locknuts are based on 120,000 psi and 150,000 psi, respectively.

5.2 Hardness Test. The Rockwell hardness of a sample nut shall be determined on the top face of the nut. The top surface of the nut shall be prepared by grinding, removing sufficient material from the top to eliminate the effects of plating, coating or other surface conditions. Material removal shall also be such as to provide a flat area large enough to allow a hardness test to be made midway between the hex corner and the major diameter of the thread. The bearing surface of the nut shall be prepared parallel to the test surface with removal of plating or coating. Further preparation of the test specimen and the method of performing the test shall conform to ASTM E18.

For referee purposes, nut hardness shall be taken on a longitudinal section through the nut axis with readings taken as close as possible to the nominal major diameter of the nut thread.

5.3 Prevailing-Torque Test.

5.3.1 The prevailing-torque test shall be conducted at room temperature using a load measuring device (5.3.3). A test bolt (5.3.4) shall be inserted in the load measuring device, a hardened washer (5.3.5) placed on the bolt and the sample nut then assembled on the bolt. The nut shall be advanced on the bolt until a minimum of two full bolt threads protrude through the top of the nut. At that time, the maximum torque occurring while the nut is being advanced through the next 360 deg of nut rotation shall be recorded. This torque shall not exceed the first installation

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prevailing-torque value as specified for the applicable grade and thread series in Tables 4 and 5.

Tightening shall be continued until the nut is seated against the hardened washer. The length of the test bolt should be such that seating of the nut shall occur when a length equivalent to 6 to 9 thread pitches of the test bolt protrude through the top of the nut, measured from the end of the bolt. The nut shall then be tightened until a tensile load equal to the clamp load, as specified for the applicable grade and thread series in Tables 4 and 5, is developed in the bolt. The hardened washer shall be prevented from turning during nut tightening. The nut shall then be backed off by the application of reverse torque until the tensile load in the bolt has been reduced to zero. The maximum and minimum torques occurring while the nut is being backed off throughout the next 360 deg of rotation shall be recorded. The maximum torque shall not be less than the first removal "highest reading" prevailing-torque value as specified in Tables 4 and 5, and in addition, shall not be less than 40 percent of the actual prevailing torque occurring during first installation. The minimum torque shall not be less than the first removal "lowest reading" prevailing-torque value as specified in Tables 4 and 5. The nut shall then be backed off until the prevailing-torque element is disengaged from the bolt thread. The nut shall be reassembled and removed four more times. On each reassembly, the nut shall be assembled to the initial first off position but no clamp load shall be induced in the bolt.

This portion of the test need not be conducted in the load cell; however, regardless of method used, the test washer shall not be removed. At no time during these four additional installations and removals should the torque exceed the maximum first installation prevailing-torque value as specified for the applicable grade and thread series in Tables 4 and 5. During the fifth removal, the maximum and minimum torques occurring while the nut is being backed off throughout the first 360 deg of rotation shall be recorded. The maximum torque shall not be less than the fifth removal "highest reading" prevailing-torque value as specified in Tables 4 and 5 and the minimum torque shall not be less than the fifth removal "lowest reading" prevailing-torque value as specified in Tables 4 and 5. Sufficient time shall elapse between torquing cycles to prevent overheating of the test assembly.

The speed of installation and removal of the nut shall not exceed 30 rev/min and shall be continuous and uniform.

5.3.2 *Torque Measuring Device.* The torque measuring device (torque wrench or power device) shall be accurate within plus or minus 2 percent of the maximum of the specified torque range of the device. The measuring device shall be chosen so that all readings taken fall within the upper 50 percent of its torque range.

5.3.3 *Load Measuring Device.* The load measuring device used in the prevailing-torque test shall be an instrument capable of measuring the actual tension induced in the test bolt as the nut is tightened. The device shall be accurate within plus or minus 5 percent of test clamp load being used. The bolt clearance hole in the backing plate behind the washer shall have the same diameter and tolerance as the test washer.

5.3.4 *Test Bolt.* The test bolt used in the prevailing-torque test shall have a zinc phosphate and oil finish (dry to the touch) meeting a 72 hour salt spray life when tested in accordance with ASTM B 117.

The bolt shall have threads conforming to Class 2A tolerances as specified in ANSI/ASME B1.1. Threads on all bolts 1 in. diameter and smaller shall be produced by rolling. Inspection of test bolts shall be conducted using a basic size GO thread ring gage. Bolt length shall be such that a minimum length equivalent to 6 thread pitches as measured from the end of the bolt will protrude through the nut when the nut is seated against the test washer. Thread length shall be such that a minimum of two full threads are within the grip after the nut is seated. The bolt shall be pointed in accordance with the dimensional requirements for hex cap screws as given in ANSI/ASME B18.2.1. The thread surface shall be free of burrs or other contamination that might affect an accurate determination of the prevailing-torque developed by the nut.

The bolt shall have an ultimate tensile strength not less than the specified proof load of the nut to be tested. The threads of heat treated

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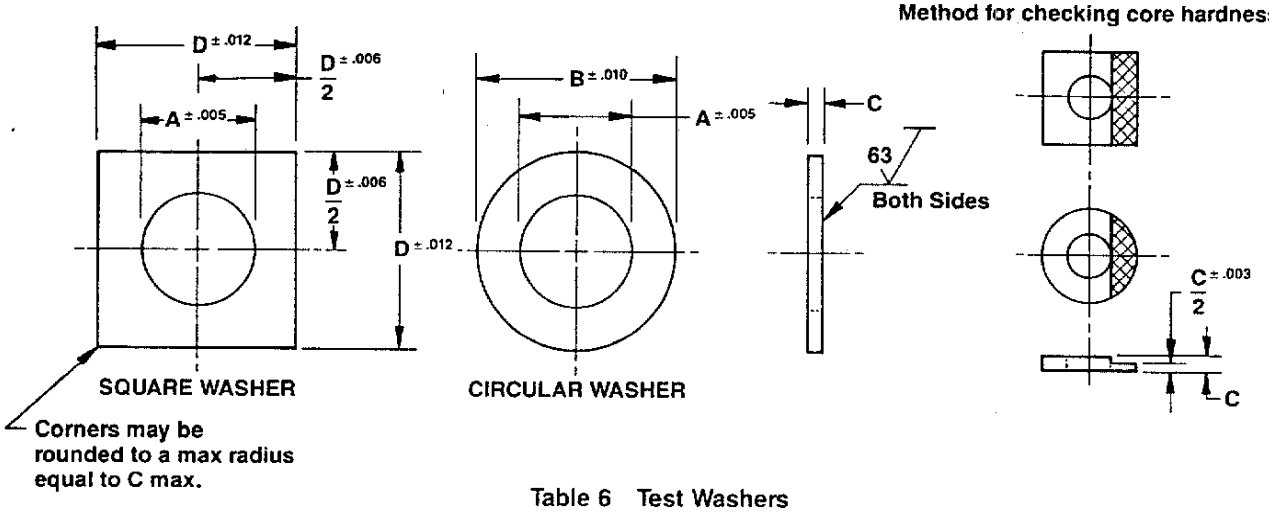

Table 6 Test Washers

Test Bolt Size in.	Inside Dia A	Outside Dia B	Width D	Thickness C	
				Max	Min
No. 4	0.125	0.250	0.403	0.028	0.021
6	.156	.312	.450	.048	.041
8	.187	.375	.499	.065	.058
10	.203	.468	.596	.065	.058
12	.234	.531	.601	.065	.058
1/4	.281	.750	.656	.080	.073
5/16	.344	.875	.776	.080	.073
3/8	.406	1.000	.892	.080	.073
7/16	.469	1.125	1.018	.080	.073
1/2	.531	1.312	1.152	.121	.114
9/16	.594	1.500	1.274	.121	.114
5/8	.656	1.625	1.422	.121	.114
3/4	.781	1.875	1.678	.160	.153
7/8	.906	1.750	1.916	.160	.153
1	1.031	2.000	2.184	.160	.153
1-1/8	1.187	2.500	2.318	.192	.185
1-1/4	1.312	2.750	2.562	.192	.185
1-3/8	1.437	3.000	2.804	.213	.206
1-1/2	1.562	3.250	3.046	.213	.206

NOTES:

1. All dimensions are in inches.
2. Square washers are preferred.
3. Material shall be carbon steel with a chemical composition of C .48 to .60 percent, Mn .60 to 1.50 percent, P .035 percent max, and S .045 percent max, quenched and tempered, with a surface hardness of Rockwell 15N 85 to 88, and a core hardness of Rockwell A73 to 78.
4. Washers shall be electro-deposited zinc plated to a coating thickness of 0.0002 to 0.0004 in. As soon as practicable following plating, washers shall be baked for 1 hour at 375°F plus or minus 25°F. Plating thickness shall be checked in accordance with ASTM B487 (Microscopic Test).
5. Washers shall be free from burrs and sharp edges.

IFI Note: These test washers are identical to those covered in SAE J174 "Torque-Tension Test Procedure for Steel Threaded Fasteners."

bolts shall have a metallurgical surface condition equal to Class B or Class C as specified in Federal Specification FF-S-85b.

A new bolt shall be used for testing each nut.

5.3.5 *Test Washer.* Washers shall conform to the dimensional, metallurgical, and mechanical requirements given in Table 6. Optionally, multihole plates or strips may be used providing they conform to the requirements for material, hardness, hole diameter, surface texture, and plating as given in Table 6.

A new washer shall be used for testing each nut.

6.0 Marking for Grade and Manufacturer Identification.

6.1 Grade A nuts are not required to be marked for grade or manufacturer identification.

6.2 Grades B and F nuts shall be marked with three equally spaced identical symbols (dot, line, letter, or other character), 120 deg apart on the chamfered surface of the top of nut, or on the top of flange.

Grades C and G nuts shall be marked with six symmetrically spaced identical symbols on the chamfered surface of the top of nut, or on the top of flange.

Alternatively, when Grades B and C nuts are machined from bar stock, Grade B nuts may be identified with one set of circumferential notches and Grade C nuts with two sets of circumferential notches cut into the corners of the nut.

Alternatively, at the option of the manufacturer, Grades F and G nuts may be marked respectively with the letters F and G located on one or more of the side flats of the nut.

6.3 Grades B, C, F, and G nuts shall be marked to identify the manufacturer. Such markings may be additional to the grade markings or an alteration of one or more of the three or six grade marking symbols.

Alternatively, at the manufacturer's option, the manufacturer's identification marking may be located on one or more of the side flats of the nut or on the top of the flange.

For top insert type nuts, the color of the insert is an acceptable manufacturer's identification.

6.4 Markings may be raised or depressed at the option of the manufacturer. However, markings located on the side flats of the nut shall be depressed, and raised markings shall not project beyond the specified height or width of the nut.

7.0 Inspection.

7.1 Inspection Procedure. Nuts shall be inspected to determine conformance with this standard. Inspection procedures may be specified by the purchaser on the inquiry, purchase order, or the engineering drawing or shall be as agreed upon between the purchaser and supplier prior to acceptance of the order. In the absence of a defined agreement, the requirements of B18.18.2M shall apply.