














Technical Information

ASTM AND SAE STANDARDS Specifications, Proof Loads, Tensile Strengths

Grade Marking	Specification	Material	Bolt and Screw Size (Inches)	Proof Load psi	Tensile Strength min. psi
	SAE-Grade 1	Low Carbon Steel	1/4 thru 1-1/2	33000	60000
	ASTM-A307		1/4 thru 1-1/2	33000	60000
		SAE-Grade 2	Low Carbon Steel	Over 1-1/2 thru 4	--
	SAE Grade 3	Med. Carbon Steel Cold Worked	1/4 thru 3/4	55000	74000
			Over 3/4 thru 1-1/2	33000	60000
	SAE Grade 5	Med. Carbon Steel Quenched and Tempered	1/4 thru 1/2	85000	110000
			Over 1/2 thru 5/8	80000	100000
	ASTM-A449	Med. Carbon Steel Quenched and Tempered	1/4 thru 1	85000	120000
				Over 1 thru 1-1/2	74000
	ASTM-A325	Med. Carbon Steel Quenched and Tempered	1/4 thru 1	85000	120000
				Over 1 thru 1-1/2	74000
	ASTM-A354 Grade BB	Low Alloy Steel Quenched and Tempered	1/2, 5/8, 3/4	85000	120000
				7/8, 1	78000
	ASTM-A354 Grade BC	Low Alloy Steel Quenched and Tempered	1-1/8 thru 1-1/2	74000	105000
				1/4 thru 2-1/2	80000
	SAE-Grade 5.1	Low or Med. Carbon Steel Quenched and Tempered with Assembled Lock Washer	Over 2-1/2 thru 4	75000	100000
				1/4 thru 2-1/2	105000
	SAE-Grade 7	Med. Carbon Alloy Steel Quenched and Tempered	Over 2-1/2 thru 4	75000	100000
				1/4 thru 2-1/2	105000
	SAE-Grade 8	Med. Carbon Alloy Steel, Quenched and Tempered	Up to 3/8 incl.	85000	120000
	ASTM-A354 Grade BD	Alloy Steel Quenched and Tempered	1/4 thru 1-1/2	105000	133000
	ASTM-A490	Alloy Steel, Quenched and Tempered	1/4 thru 1-1/2	120000	150000
				Over 1 thru 1-1/2	105000
			1/2 thru 2-1/2	120000	150000
			Over 2-1/2 thru 4	105000	140000

ASTM Specifications:

- A 307: Low Carbon Steel Externally and Internally Threaded Standard Fasteners
- A 325: High Strength Steel Bolts for Structural Steel Joints, including Suitable Nuts and Plain Hardened Washers
- A 449: Quenched and Tempered Steel Bolts and Studs
- A 354: Quenched and Tempered Alloy Steel Bolts and Studs with Suitable Nuts
- A 490: High Strength Alloy Steel Bolts for Structural Steel Joints, including Suitable Nuts and Plain Hardened Washers

SAE Specification:

- J 429c: Mechanical and Quality Requirements for Threaded Fasteners



Technical Information

THREAD LENGTHS

All Standard Bolts Except Lag Screws

Diameter of Bolt Inches	No. 10	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2	1-5/8	1-3/4	1-7/8	2
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THREAD LENGTH IN INCHES

6" and shorter	5/8	3/4	7/8	1	1-1/8	1-1/4	1-1/2	1-3/4	2	2-1/4	2-1/2	2-3/4	3	3-1/4	3-1/2	3-3/4	4	4-1/4
Longer than 6"	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2	1-3/4	2	2-1/4	2-1/2	2-3/4	3	3-1/4	3-1/2	3-3/4	4	4-1/4	4-1/2

Threaded Length Formula:

For bolts 6" and shorter—twice the diameter plus 1/4". (2D + 1/4"). Longer than 6"—twice the diameter plus 1/2" (2D + 1/2").

When bolts are short for formula thread length, thread will extend as close to head or shoulder as practical.

In actual production, thread lengths may be longer than the formula thread lengths.

BOLT THREADS

Number of Threads per Inch

Bolt Diameter (inches)	No. 10	No. 12	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2	1-3/4	2	2-1/4	2-1/2	2-3/4	3	
Coarse Thread Series	24	24	20	18	16	14	13	12	11	10	9	8	7	7	6	6	5	4-1/2	4-1/2	4	4	4	4
Fine Thread Series	32	38	28	24	24	20	20	18	18	16	14	14 12x	12	12	12	12							

X—Indicates number of threads per inch for Unified Fine

(1"—12 thread is U.N.F. standard). However 1"—14 threads is more popular and generally stocked.

Coarse Thread Series, Class 2A Fit.

FINISHED HEXAGON NUTS

Bolt Diameter Inches	Dimensions	
	Across Flats	Thickness
1/4	7/16	7/32
5/16	1/2	17/64
3/8	9/16	21/64
7/16	11/16	3/8
1/2	3/4	7/16
9/16	7/8	31/64
5/8	15/16	35/64
3/4	1 1/8	41/64
7/8	1-5/16	3/4
1	1-1/2	55/64
1-1/8	1-11/16	31/32
1-1/4	1-7/8	1-1/16
1-3/8	2-1/16	1-11/64
1-1/2	2-1/4	1-9/32
1-5/8	2-7/16	1-25/64
1-3/4	2-5/8	1-1/2
1-7/8	2-15/16	1-27/32
2	3	1-23/32
2-1/4	3-3/8	1-59/64
2-1/2	3-3/4	2-9/64
2-3/4	4-1/8	2-23/64
3	4-1/2	2-37/64
3-1/4		
3-1/2		
3-3/4		
4		

HEAVY SEMI-FINISHED HEXAGON NUTS

Bolt Diameter Inches	Dimensions	
	Across Flats	Thickness
1/4	1/2	15/64
5/16	9/16	19/64
3/8	11/16	23/64
7/16	3/4	27/64
1/2	7/8	31/64
9/16	15/16	35/64
5/8	1-1/16	39/64
3/4	1-1/4	47/64
7/8	1-7/16	55/64
1	1-5/8	63/64
1-1/8	1-13/16	1-7/64
1-1/4	2	1-7/32
1-3/8	2-3/16	1-11/32
1-1/2	2-3/8	1-15/32
1-5/8	2-9/16	1-19/32
1-3/4	2-3/4	1-23/32
1-7/8	2-15/16	1-27/32
2	3-1/8	1-31/32
2-1/4	3-1/2	2-13/64
2-1/2	3-7/8	2-29/64
2-3/4	4-1/4	2-45/64
3	4-5/8	2-61/64
3-1/4	5	3-3/16
3-1/2	5-3/8	3-7/16
3-3/4	5-3/4	3-11/16
4	6-1/8	3-15/16

FASTENER TECHNICAL INFORMATION



Dia. and thds per in.	SAE Grade 2 through 8" long						SAE Grade 5				
	Stress area sq. in.	Tensile strength min ksi.	Proof load lbs.	Clamp load lbs.	Torque		Tensile strength min. ksi.	Proof load lbs.	Clamp load lbs.	Torque	
					dry ft.lb.	lub ft.lb.				dry ft. lb.	lub. ft.lb.
1/4-20	.0318	74	1750	1310	5.5	4.2	120	2700	2020	8	6.3
28	.0364	74	2000	1500	6.3	4.7	120	3100	2320	10	7.2
5/16-18	.0524	74	2900	2160	11	8	120	4450	3340	17	13
24	.0580	74	3200	2400	12	9	120	4900	3700	19	14
3/8-16	.0775	74	4250	3200	20	15	120	6600	4950	30	23
24	.0878	74	4800	3620	23	17	120	7450	5600	35	25
7/16-14	.1063	74	5850	4380	32	24	120	9050	6780	50	35
20	.1187	74	6550	4900	36	27	120	10100	7570	55	40
1/2-13	.1419	74	7800	5850	50	35	120	12100	9050	75	55
20	.1599	74	8800	6600	55	40	120	13600	10200	85	65
9/18-12	.1820	74	10000	7500	70	55	120	15500	11600	110	80
18	.2030	74	11200	8400	80	60	120	17300	12950	120	90
5/8-11	.226	74	12400	9320	100	75	120	19200	14400	150	110
18	.256	74	14100	10560	110	85	120	21800	16350	170	130
3/4-10	.334	74	18400	13800	175	130	120	28400	21300	260	200
16	.373	74	20500	15390	200	140	120	31700	23780	300	220
7/8-9	.462	60	15200	11430	170	125	120	39300	29450	430	320
14	.509	60	16800	12600	180	140	120	43300	32450	470	350
1-8	.608	60	20000	15000	250	190	120	51500	38600	640	480
14	.679	60	20000	15000	250	190	120	57700	43300	720	540
1-1/8-7	.763	60	25200	18900	350	270	105	56500	42300	790	590
12	.856	60	28200	21200	400	300	105	63300	47500	890	670
1-1/4-7	.969	60	32000	24000	500	380	105	71700	53800	1120	840
12	1.073	60	35400	26550	550	420	105	79400	59600	1240	930
1-1/2-6	1.405	60	46400	34800	870	650	105	104000	78000	1950	1460
12	1.581	60	52200	39150	980	730	105	117000	87700	2200	1640

Notes:
These assembly torques are offered as a guide only. Tightening should be checked under actual field conditions due to the many variables possible.

Lamalloy L9 torque values are for nut and bolt assembly—not tapped holes. Lamalloy L9 torque values do not apply when L9 washers are omitted or if any of the L9 system components are substituted or if finish is supplied or altered in any way (including addition of lubricant). Torque-by-head values apply only when Lamalloy L9 nut and tension washers are used in the as-supplied condition. Actual results in individual applications may vary ± 15%. This variation is in accordance with accepted industry standards. When L9 Hex Screws with tension washers are used in tapped holes, above torque values may require adjustment to compensate for variables, such as joint material hardness, depth of thread engagement, internal thread condition, etc.

Dia. and thds per in.	SAE Grade 8						Lamalloy L9®				
	Stress area sq. in.	Tensile strength min ksi.	Proof load lbs.	Clamp load lbs.	Torque		Tensile strength min. ksi.	Proof load lbs.	Clamp load lbs.	Torque	
					dry ft.lb.	lub ft.lb.				dry ft. lb.	lub. ft.lb.
1/4-20	.0318	150	3800	2850	12	9	180	4610	3450	10	11
28	.0264	150	4350	3250	14	10	180	5270	3850	12	13
5/16-18	.0524	150	6300	4700	24	18	180	7590	5700	19	21
24	.0580	150	6950	5200	27	20	180	8410	6300	20	23
3/8-16	.0775	150	9300	6980	45	35	180	11230	8450	30	33
24	.0878	150	10500	7900	50	35	180	12730	9550	35	38
7/16-14	.1063	150	12800	9550	70	50	180	15410	11550	55	60
20	.1187	150	14200	10650	80	60	180	17210	12900	60	65
1/2-13	.1419	150	17000	12750	110	80	180	20570	15450	85	95
20	.1599	150	19200	14400	120	90	180	23180	17400	95	105
9/18-12	.1820	150	21800	16350	150	110	180	28390	19800	120	140
18	.2030	150	24400	18250	170	130	180	29430	22100	135	150
5/8-11	.226	150	27100	20350	210	160	180	32770	24550	170	185
18	.256	150	30700	2300	240	180	180	37120	27800	190	205
3/4-10	.334	150	40100	30100	380	280	180	48430	36350	265	290
16	.373	150	44800	33500	420	310	180	54080	40600	330	355
7/8-9	.462	150	55400	41600	600	450	180	66990	50300	475	505
14	.509	150	61100	45800	670	500	180	73800	55400	520	585
1-8	.608	150	72700	54500	910	680	180	87870	65900	550	775
14	.679	150	81500	61100	1020	760	180	98450	73800	700	900
1-1/8-7	.763	150	91600	68700	1290	970	180	110630	83000	1025	1150
12	.856	150	102700	77000	1440	1080	180	124120	93100	1150	1325
1-1/4-7	.969	150	116300	87200	1820	1360	180	140500	105400	1400	1600
12	1.073	150	128800	96600	2010	1510	180	15580	116700	1600	1750
1-1/2-6	1.405	150	168600	126500	3160	2370	180	203720	152800	2900	3250
12	1.581	150	189700	142200	3560	2670	180	245000	171900	3300	3650

	Grade 2	Grade 5	Grade 8	Lamalloy L9®
Proof Load—% of Tensile Strength	75% thru 3/4" diameter 55% over 3/4" diameter	70%	80%	80%
Clamp Load—% of Proof Load	75%	75%	75%	75%

Clamp Load, lbs. = Proof Load, lbs. x 75%
Grade 2 bolts longer than 6"—Tensile Strength = 60 M psi
Proof Load = 33 M psi

Lamalloy L9® torque values are nut and bolt assembly—not tapped holes.

Torque formula for Grades 2, 5 and 8
Torque in lbs = R X nominal diameter, in. X Clamp load, lbs.
R = .2 for dry conditions, .15 for lubricated conditions including plating. Values can vary between R = .05 and R = .35



Technical Information

PLATE WASHERS

Bolt Diameter	Outside Diameter	Hole Diameter	Dimensions		* Approx. Number in 100 lbs.	Approx. 1000 Pcs in lbs.
			Thickness Gauge	Inches		
1/8	7/16	3/16	18	3/64	55400	1.8
3/16	9/16	1/4	18	3/64	29400	3.4
1/4	3/4	5/16	16	1/16	16200	6.2
5/16	7/8	3/8	14	5/64	9600	10.4
3/8	1	7/16	14	5/64	7460	13.4
7/16	1-1/4	1/2	13	3/32	3800	26.2
1/2	1-3/8	9/16	12	7/64	2740	36.6
9/16	1-1/2	5/8	12	7/64	2300	43.3
5/8	1-3/4	11/16	10	9/64	1290	77.5
5/8	1-3/4	3/4	10	9/64	1340	74.8
3/4	2	13/16	10	9/64	1000	100.0
3/4	2	7/8	9	5/32	930	107.6
7/8	2-1/4	15/16	9	5/32	720	139.2
7/8	2-1/4	1	9	5/32	740	135.2
1 S	2-1/2	1-1/16	9	5/32	580	170.4
1 L	2-1/2	1-1/8	9	5/32	600	165.9
1-1/8 S	2-3/4	1-3/16	9	5/32	490	204.7
1-1/8 L	2-3/4	1-1/4	9	5/32	500	199.7
1-1/4 S	2-3/4	1-5/16	9	5/32	520	194.3
1-1/4 L	3	1-3/8	9	5/32	420	236.6
1-3/8	3-1/4	1-1/2	9	5/32	360	276.6
1-1/2 S	3-1/4	1-9/16	8	11/64	340	297.2
1-1/2 L	3-1/2	1-5/8	8	11/64	280	351.6
1-5/8	3-3/4	1-3/4	8	11/64	250	402.5
1-3/4 S	3-3/4	1-13/16	7	3/16	230	430.1
1-3/4 L	4	1-7/8	7	3/16	200	498.3
2 S	4-1/4	2-1/16	7	3/16	180	551.1
2 L	4-1/2	2-1/8	7	3/16	160	628.0

S.A.E. WASHERS

3/16	1/2	7/32	16	1/16	37000	2.7
1/4	5/8	9/32	16	1/16	24400	4.1
5/16	11/16	11/32	16	1/16	21200	4.7
3/8	13/16	13/32	16	1/16	15140	6.6
7/16	59/64	15/32	16	1/16	11360	8.8
1/2	1-1/16	17/32	13	3/32	5900	16.9
9/16	1-3/16	19/32	13	3/32	4740	21.1
5/8	1-5/16	21/32	13	3/32	3880	25.8
3/4	1-1/2	13/16	11	1/8	2360	42.3
7/8	1-3/4	15/16	11	1/8	1720	58.1
1	2	1-1/16	11	1/8	1310	76.4

PLATE WASHERS HOT GALVANIZED

1/4	3/4	5/16	16	1/16	15700	
5/16	7/8	3/8	14	5/64	9100	
3/8	1	7/16	14	5/64	6500	
7/16	1-1/4	1/2	13	3/32	3350	
1/2	1-3/8	9/16	12	7/64	2400	
9/16	1-1/2	5/8	12	7/64	2100	
5/8	1-3/4	11/16	10	9/64	1200	
3/4	2	13/16	10	9/64	950	
7/8	2-1/4	15/16	9	5/32	660	
1 S	2-1/2	1-1/16	9	5/32	530	
1-1/8 L	2-3/4	1-1/4	9	5/32	460	
1-1/4 S	2-3/4	1-5/16	9	5/32	480	

* Quantity per pound may vary ± 15% based on I.F.I. allowable thickness tolerances.