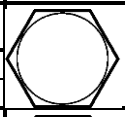
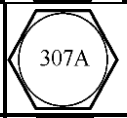
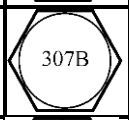
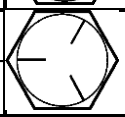
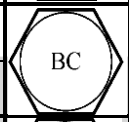
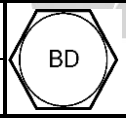
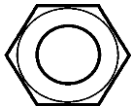
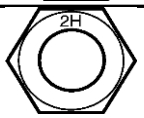
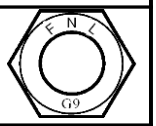
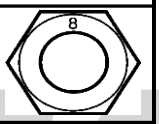
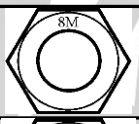
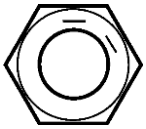
Mechanical Properties of Externally Threaded Fasteners

Specification	Typical Material	Size Range (in.)	Min. Proof Strength (psi)	Min. Tensile Strength (psi)	Core Hardness Rockwell Min.	Core Hardness Rockwell Max.	Min. Yield Strength (psi)	Grade Identification Marking	Compatible Nuts
SAE J429-Grade 1	Low or medium carbon steel	1/4 - 1 1/2		60,000	B70	B100	36,000		ASTM A563 Grade A Hex
SAE J429-Grade 2		1/4 - 3/4		74,000	B80	B100	57,000		
		7/8 - 1 1/2		60,000	B70	B100	36,000		
ASTM A307-Grade A	Low or medium carbon steel	1/4 - 4		60,000	B69	B100			ASTM A563 Grade A (Hex up to 1-1/2 & Heavy Hex 1-1/2 and over)
ASTM A307-Grade B	Low or medium carbon steel	1/4 - 4		60,000(min) 100,000(max)	B69	B95			ASTM A563 Grade A Heavy Hex
SAE J429-Grade 5	Medium carbon steel: quenched & tempered	1/4 - 1	85,000	120,000	C25	C34	92,000		SAE J995 Grade 5 Hex
		1 1/8 - 1 1/2	74,000	105,000	C19	C30	81,000		
ASTM F3125 - Grade A325 - Type 1	Medium carbon steel: quenched & tempered	1/2 - 1-1/2	85,000	120,000	C25	C34	92,000		ASTM A563 Grade C Heavy Hex, DH or A194/A194M 2H if Galv
ASTM A449-Type1	Medium carbon steel: quenched & tempered	1/4 - 1	85,000	120,000	C25	C34	92,000		SAE J995 Grade 5 up to 1-1/2, ASTM A563 Grade A Heavy Hex 1-1/2 & over, DH or 2H Heavy Hex if Galv
		1 1/8 - 1 1/2	74,000	105,000	C19	C30	81,000		
		1 3/4 - 3	55,000	90,000	B90	B99	58,000		
ASTM A354- Grade BC	Medium carbon alloy steel: quenched & tempered	1/4 - 2-1/2	105,000	125,000	C26	C36	109,000		ASTM A563 Grade C Heavy Hex, DH or 2H if Galv
		over 2-1/2	95,000	115,000	C22	C33	99,000		
SAE J429-Grade 8	Medium carbon alloy steel: quenched & tempered	1/4 - 1 1/2	120,000	150,000	C33	C39	130,000		SAE J995 Grade 8 Hex
ASTM A354 Grade BD	Medium carbon alloy steel: quenched & tempered	1/4 - 2-1/2	120,000	150,000	C33	C39	130,000		ASTM A563 Grade DH or A194/A194M 2H Heavy Hex
		Over 2-1/2	105,000	140,000	C31	C39	115,000		
ASTM F3125 - Grade A490-Type 1	Medium carbon alloy steel: quenched & tempered	1/2 - 1-1/2	120,000	150,000 (min) 173,000 (max)	C33	C38	130,000		ASTM A563 Grade DH or A194/A194M 2H Heavy Hex
SAE J429-Grade 8.2	Medium carbon boron steel: quenched & tempered	1/4 - 1	120,000	150,000	C33	C39	130,000		SAE J995 Grade 8 Hex
FNL Grade 9	Medium carbon alloy steel: quenched & tempered	1/4 - 1-1/4	140,650	180,000	C38	C42	159,500		FNL Grade 9 Thick Hex Nut
ASTM A574 Socket Head Cap Screw	Medium carbon alloy steel: quenched & tempered	#0 - 1/2	140,000	180,000	C39	C45			
		over 1/2 - 2	135,000	170,000	C37	C45	153,000		
ASTM F835 Socket Button & Flat Countersunk Head Cap Screw	Medium carbon alloy steel: quenched & tempered	#0 - 1/2		145,000	C39	C44			
		over 1/2		135,000	C37	C44			
Notes									1, 2, 3

1. Compatible denotes commercially available nut having suitable mechanical properties and dimensional configuration or style which will make it possible to obtain the desired bolt load. Higher strength nuts may be a suitable substitute provided bolt standard allows.
2. 2. Galvanized nuts are intended for use with externally threaded fasteners that are hot-dip or mechanically galvanized or have a coating of sufficient thickness to require over-tapping of the nut to provide assembly.

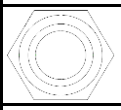
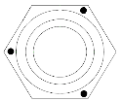
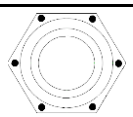
3. 3. ASTM A194 2H heavy hex nut may be used in lieu as a substitute for ASTM A563 DH heavy hex nut.

Mechanical Properties of Internally Threaded Fasteners

Specification	Typical Material	Nominal Size(in.)	Proof Load Stress (psi)		Hardness Rockwell		Grade Identification Marking
			Plain	Galvanize coating (1)	Min.	Max.	
ASTM A563-Grade A / SAE J995 Grade 2	Carbon Steel	1/4 - 1 1/2	90,000* 80,000**	68,000* 60,000**		C32	
ASTM A563-Grade A / SAE J995 Grade 2 Heavy Hex		1/4 - 4 (2)	100,000* 90,000**	75,000* 68,000**		C32	
ASTM A563-Grade C Heavy Hex	Carbon Steel, may be quenched and tempered	1/4 - 4	144,000		B78	C38	
ASTM A563-Grade DH Heavy Hex	Carbon Steel, quenched and tempered	1/4 - 4	175,000	150,000	C24	C38	
ASTM A194-Grade 2H Heavy Hex	Medium Carbon Steel quenched & tempered	1/4 – 1 1/2	175,000		C24	C35	
		Over 1 1/2			B95	C35	
FNL Grade 9 Thick Hex Nut	Carbon Steel quenched & tempered	1/4 – 5/8	180,000		C32	C38	
		3/4 – 1 1/2			C35	C40	
ASTM A194-Grade 8 Heavy Hex	304 Stainless Steel	1/4 – 1 1/2	80,000		B60	C32	
ASTM A194-Grade 8M Heavy Hex	316 Stainless Steel	1/4 – 1 1/2	80,000		B60	C32	
SAE J995 Grade 5 Hex Nut	Carbon steel	1/4 - 1	120,000* 109,000**			C32	
		Over 1 – 1 1/2	105,000* 94,000**			C32	
SAE J995 Grade 8 Hex Nut	Medium carbon or alloy steel, quenched & tempered	1/4 – 5/8	150,000		C24	C32	
		Over 5/8 – 1			C26	C34	
		Over 1 – 1 1/2			C26	C36	

(1): Galvanize coating refers to nuts that have been plated with a plating or coating of sufficient thickness to require overtapping of the nut to provide assembly: for example hot-dip or mechanical galvanizing. SAE J995 does not address proof strength reduction where overtapping is required.
(2): SAE J995 is only applicable up to 1-1/2-in diameter.
* UNC and 8 UN
** UNF, 12 UN & finer

Mechanical Properties of Inch Series Prevailing Torque Locknuts (ASME B18.16.6)

Nut Grade	Typical Material	Nominal Size(in.)	Approx. Proof Load Stress (psi) [1]	Hardness Rockwell		Grade Identification Marking Examples
				Min.	Max.	
N2, A	Carbon Steel	1/4 - 1 1/2	90,000		C28	 No Grade Marks
N5, B, F	Carbon Steel	1/4 - 1	120,000		C28	 Three Equally Spaced (120°) Marks - One mark may be MFG ID
		1 1/8 - 1 1/2	105,000			
N8, C, G	Medium Carbon Steel quenched & tempered	1/4 - 5/8	150,000	C24	C32	 Six Equally Spaced (60°) Marks - One mark may be MFG ID
		3/4 - 1		C26	C34	
		1 1/8 - 1 1/2		C24	C36	

1. Actual load per ASME B18.16.6 rounded to nearest pound.

Alloy Steel Bolting Materials for High & Low Temperature Service (ASTM A193/A193M & A320/A320M)

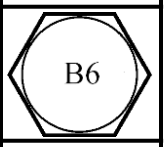
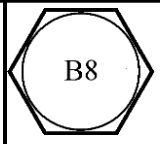
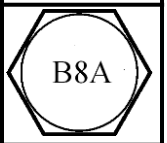
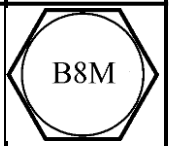
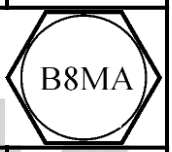
Specification & Grade	Size Range (in.)	Min. Tensile Strength (psi)	Min. Yield Strength (psi)	Core Hardness Rockwell (max)	Description	Grade Identification Marking	Compatible ASTM A194/A194M Heavy Hex Nut
ASTM A193/A193M B7	2 1/2 & under	125,000	105,000	C35	Chromium-Molybdenum alloy (typical-4140, 4142, 4145, 4140H, 4142H, 4145H) used for high-pressure, high-temperature applications.	B7	2H Grade 2H
	Over 2 1/2 - 4	115,000	95,000	C35			
	Over 4 – 7	100,000	75,000	C35			
ASTM A193/A193M B7M	4 & under	100,000	80,000	B99	Similar in chemistry to B7 except heat-treated to limit the maximum hardness. Considered in areas where stress embrittlement or hydrogen sulfide stress corrosion may be a factor.	B7M	2HM Grade 2HM
	Over 4 - 7	100,000	75,000	B99			
ASTM A193/A193M B16	2 1/2 & under	125,000	105,000	C35	A Chromium-Molybdenum-Vanadium alloy used for high-pressure, high-temperature service applications. Offers slightly higher temperature resistance than B7.	B16	7 7L Grade 7 or 7L
	Over 2 1/2 - 4	110,000	95,000	C35			
	Over 4 - 8	100,000	85,000	C35			
ASTM A320/A320M L7	2 1/2 & under	125,000	105,000	C35	Designed for low temperature applications. Similar chemical and mechanical properties as the A193 B7, however the material is also required to be impact tested at -150°F.	L7	7L Grade 7L
ASTM A320/A320M L7M	2 1/2 & under	100,000	80,000	B99	Designed for low temperature applications. Similar chemical and mechanical properties as the A193 B7M, however the material is also required to be impact tested at -100°F.	L7M	2HM 7M Grade 2HM or 7M
ASTM A320/A320M L43	4 & under	125,000	105,000	C35	Designed for low temperature applications. A 4340 alloy steel with similar mechanical properties as the L7, but with better cold-temperature impact properties particularly at larger diameters.	L43	7L Grade 7L

Compatible denotes commercially available nut having suitable mechanical properties and dimensional configuration or style which will make it possible to obtain the desired bolt load. Higher strength nuts or nuts of equal strength may be a suitable substitute provided bolt standard allows.

Mechanical Properties of Stainless Steel Fasteners Cold Worked Condition per ASTM F593

Stainless Alloy Group	Condition	Nominal Dia. (in.)	Tensile Strength (psi)	Core Hardness Rockwell		Min. Yield Strength (psi)	Grade Identification Marking
				Min.	Max.		
1 (304, 304L, 305, 384, 18-9LW, 302HQ)	CW	1/4 - 5/8	100,000 - 150000	B95	C32	65,000	F593C
		3/4 - 1 1/2	85,000 - 140000	B80	C32	45,000	F593D
2 (316, 316L)	CW	1/4 - 5/8	100,000 - 150000	B95	C32	65,000	F593G
		3/4 - 1 1/2	85,000 - 140000	B80	C32	45,000	F593H

Stainless Steel Bolting Materials for High & Low Temperature Service (ASTM A193/A193M)

ASTM A193/A193M Grade	Size Range (in.)	Min. Tensile Strength (psi)	Min. Yield Strength (psi)	Core Hardness Rockwell (max)	Description	Grade Identification Marking
ASTM A193/A193M B6	4-in and under	110,000	85,000		A martensitic 410 Stainless Steel heat treated to achieve mechanical properties	
ASTM A193/A193M B8 Class 1	3/4 & under	75,000	30,000	B100	A 304 Stainless Steel used for high temperature applications. This material has been carbide solution treated.	
	over 3/4			B96		
ASTM A193/A193M B8A Class 1A	All	75,000	30,000	B90	A 304 Stainless Steel used for high temperature applications. This material has been carbide solution treated in the finished condition.	
ASTM A193/A193M B8M Class 1	3/4 & under	75,000	30,000	B100	A 316 Stainless Steel used for high temperature applications. This material has been carbide solution treated.	
	over 3/4			B96		
ASTM A193A/193M B8MA Class 1A	All	75,000	30,000	B90	A 316 Stainless Steel used for high temperature applications. This material has been carbide solution treated.	
ASTM A193/A193M B8 Class 2	3/4 & under over 3/4 to 1 over 1 to 1-1/4 over 1-1/4 to 1-1/2	125,000 115,000 105,000 100,000	100,000 80,000 65,000 50,000	C35	A 304 Stainless Steel similar to the Class 1, but has been carbide solution treated and strain-hardened.	
ASTM A193/A193M B8M Class 2	3/4 & under over 3/4 to 1 over 1 to 1-1/4 over 1-1/4 to 1-1/2	110,000 100,000 95,000 90,000	95,000 80,000 65,000 50,000	C35	A 316 Stainless Steel similar to the Class 1, but has been carbide solution treated and strain-hardened.	

Mechanical Properties of ASTM F1554 – Anchor Bolts, Steel, 36, 55 & 105 KSI Yield Strength

ASTM F1554 Grade	Typical Material	Size Range (in.)	Min. Tensile Strength (psi)	Min. Yield Strength (psi)	Compatible Nuts	
					Plain Finish	Hot Dip Galv or other Finishes Required to be Overtapped
Grade 36	Low carbon steel	1/2 - 4-in	58,000(min) 80,000 (max)	36,000	ASTM A563 Grade A (hex up to 1-1/2 & Heavy Hex 1-1/2 and over)	
Grade 55	Modified low or medium carbon steel	1/2 - 4-in	75,000(min) 95,000 (max)	55,000	ASTM A563 Grade A (hex up to 1-1/2 & Heavy Hex 1-1/2 and over)	ASTM A563 Grade A Heavy Hex
Grade 105	Medium carbon alloy steel	1/2 - 3-in	125,000(min) 150,000 (max)	105,000	ASTM A563 Grade DH or ASTM A194/A194M Grade 2H	