8

FASTENERS AND THREAD REPAIR

Figure 8-1 The dimensions of a typical bolt showing where sizes are measured. The major diameter is called the crest.

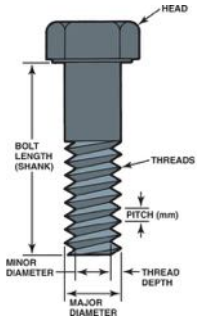


Figure 8-2 Thread pitch gauge used to measure the pitch of the thread. This bolt has 13 threads to the inch.

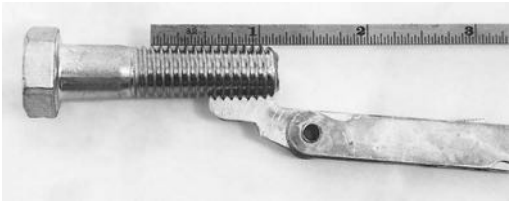


Figure 8-3 Bolts and screws have many different heads which determine what tool must be used.

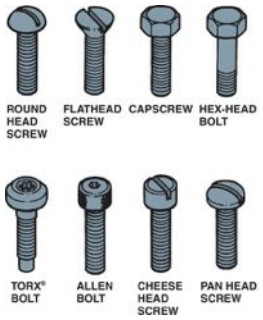
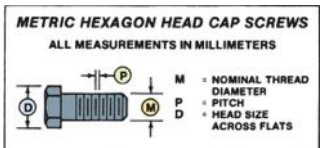


Chart 8-1 The American National System is one method of sizing fasteners.

SIZE	THREADS PER INCH NC UNC	THREADS PER INCH NF UNF	OUTSIDE DIAMETER INCHES
0	...	80	0.0600
1	64	...	0.0730
1	...	72	0.0730
2	56	...	0.0860
2	...	64	0.0860
3	48	...	0.0990
3	...	56	0.0990
4	40	...	0.1120
4	...	48	0.1120
5	40	...	0.1250
5	...	44	0.1250
6	32	...	0.1380
6	...	40	0.1380
8	32	...	0.1640
8	...	36	0.1640
10	24	...	0.1900
10	...	32	0.1900
12	24	...	0.2160
12	...	28	0.2160
1/4	20	...	0.2500
1/4	...	28	0.2500
5/16	18	...	0.3125
5/16	...	24	0.3125
3/8	16	...	0.3750
3/8	...	24	0.3750
7/16	14	...	0.4375
7/16	...	20	0.4375
1/2	13	...	0.5000
1/2	...	20	0.5000
9/16	12	...	0.5625
9/16	...	18	0.5625
5/8	11	...	0.6250
5/8	...	18	0.6250
3/4	10	...	0.7500
3/4	...	16	0.7500
7/8	9	...	0.8750
7/8	...	14	0.8750

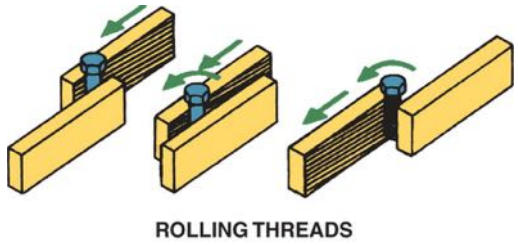
CHART 8-1

Figure 8-4 The metric system specifies fasteners by diameter, length, and pitch.



M	P	D	M	P	D	M	P	D
1.6	0.35	3.2	10	1.00	17	20	1.50	30
1.7	0.35	3.5	10	1.25	17	20	2.50	30
2	0.40	4	10	1.50	17	22	1.50	32
2.3	0.40	4.5	12	1.25	19	22	2.50	32
2.5	0.45	5	12	1.50	19	24	2.00	36
3	0.50	5.5	12	1.75	19	24	3.00	36
3.5	0.60	6	14	1.50	22	27	3.00	41
4	0.70	7	14	2.00	22	30	3.50	46
5	0.80	8	16	1.50	24	33	3.50	50
6	1.00	10	16	2.00	24	36	4.00	55
7	1.00	11	18	1.50	27	39	4.00	60
8	1.00	13	18	2.50	27	42	4.50	65
8	1.25	13				45	4.50	70

Figure 8-5 Stronger threads are created by cold-rolling a heattreated bolt blank instead of cutting the threads using a die.

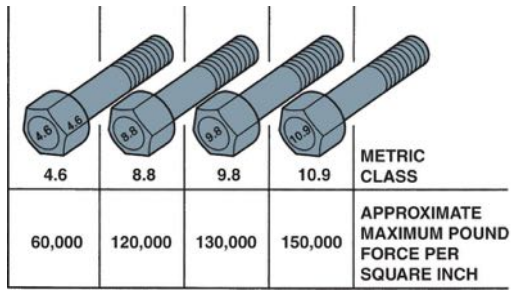


SAE Bolt Designations

SAE Grade No.	Size Range	Tensile Strength, PSI	Material	Head Marking
1	1/4 through 1-1/2	60,000	Low or medium carbon steel	
2	1/4 through 3/4 7/8 through 1-1/2	74,000 60,000		
5	1/4 through 1 1-1/8 through 1-1/2	120,000 105,000	Medium carbon steel, quenched & tempered	
5.2	1/4 through 1	120,000	Low carbon martensite steel*, quenched & tempered	
7	1/4 through 1-1/2	133,000	Medium carbon alloy steel, quenched & tempered	
8	1/4 through 1-1/2	150,000	Medium carbon alloy steel, quenched & tempered	
8.2	1/4 through 1	150,000	Low carbon Martensite steel*, quenched & tempered	

*Martensite steel is steel that has been cooled rapidly, thereby increasing its hardness. It is named after a German metallurgist, Adolf Martens.

Figure 8-6 Metric bolt (cap screw) grade markings and approximate tensile strength.



TECH TIP

A 1/2 In. Wrench Does Not Fit a 1/2 In. Bolt

A common mistake made by persons new to the automotive field is to think that the size of a bolt or nut is the size of the head. The size of the bolt or nut (outside diameter of the threads) is usually smaller than the size of the wrench or socket that fits the head of the bolt or nut. Examples are given in the following table.

Wrench Size	Thread Size
7/16 in.	1/4 in.
1/2 in.	5/16 in.
9/16 in.	3/8 in.
5/8 in.	7/16 in.
3/4 in.	1/2 in.
10 mm	6 mm
12 mm or 13 mm*	8 mm
14 mm or 17 mm*	10 mm

*European (Système International d'Unités-SI) metric.

HINT: An open-end wrench can be used to gauge bolt sizes. A 3/8 in. wrench will fit the threads of a 3/8 in. bolt.

Figure 8-7 Types of lock nuts. On the left, a nylon ring; in the center, a distorted shape; and on the right, a castle for use with a cotter key.

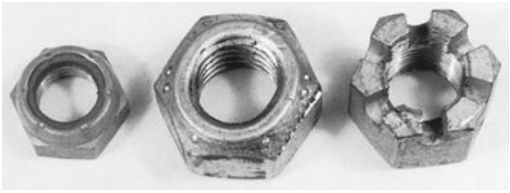


Figure 8-8 A typical bottoming tap used to create threads in holes that are not open, but stop in a casting, such as an engine block.

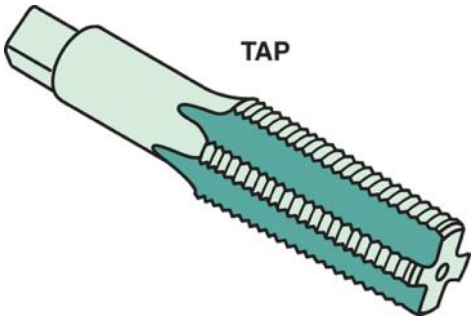


Figure 8-9 Many taps, especially larger ones, have the tap drill size printed on the top.

Figure 8-10 A die is used to cut threads on a metal rod.

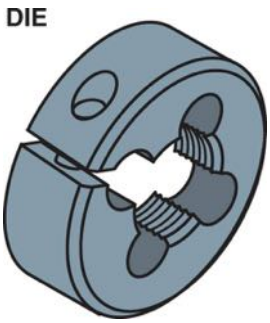


Figure 8-11 (a) A T-handle is used to hold and rotate small taps.

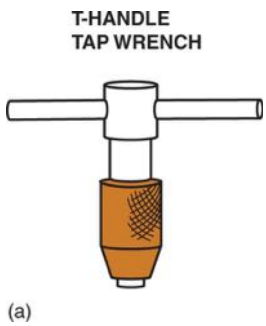
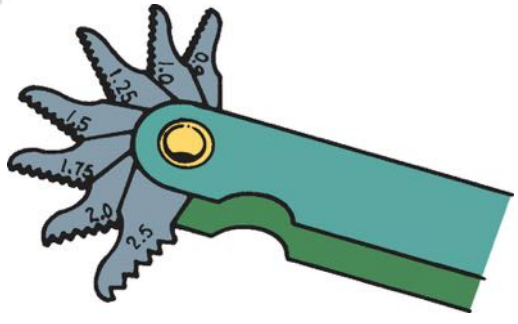


Figure 8-11 (b) A tap wrench is used to hold and drive larger taps.

Figure 8-12 A die handle used to rotate a die while cutting threads on a metal rod.

Figure 8-13 A typical metric thread pitch gauge.



FREQUENTLY ASKED QUESTION

What Is the Difference Between a Tap and a Thread Chaser?

A tap is a cutting tool and is designed to cut new threads. A thread chaser has more rounded threads and is designed to clean dirty threads without removing metal. Therefore, when cleaning threads, it is best to use a thread chaser rather than a tap to prevent the possibility of removing metal, which would affect the fit of the bolt being installed. ● **SEE FIGURE 8–14**

Figure 8-14 A thread chaser is shown at the top compared to a tap on the bottom. A thread chaser is used to clean threads without removing metal.

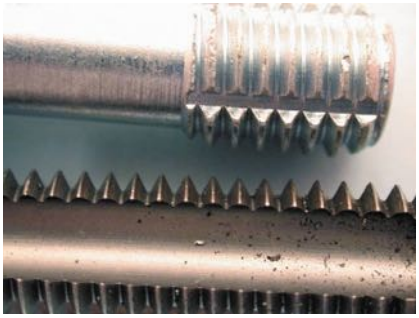
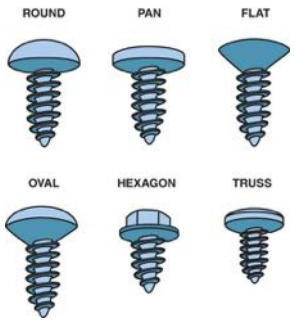
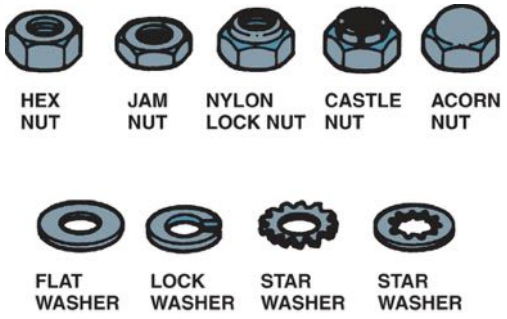


Figure 8-15 Sheet metal screws come with many head types.



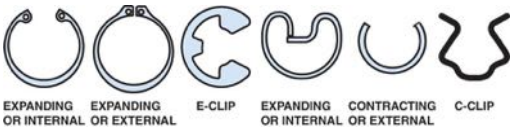
8 FASTENERS AND THREAD REPAIR

Figure 8-16 Various types of nuts (top) and washers (bottom) serve different purposes and all are used to secure bolts or cap screws.



8 FASTENERS AND THREAD REPAIR

Figure 8-17 Some different types of snap rings. An internal snap ring fits inside of a housing or bore, into a groove. An external snap ring fits into a groove on the outside of a shaft or axle. An E-clip fits into a groove in the outside of a shaft. A C-clip shown is used to retain a window regulator handle on its shaft.



8 FASTENERS AND THREAD REPAIR

Figure 8-18 A typical door panel retaining clip.

Figure 8-19 Plastic or metal trim tools are available to help the technician remove interior door panels and other trim without causing harm.

Figure 8-20 Pins come in various types.

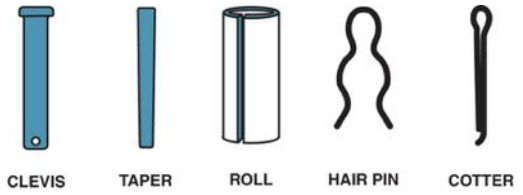


Figure 8-21 Various types of rivets.

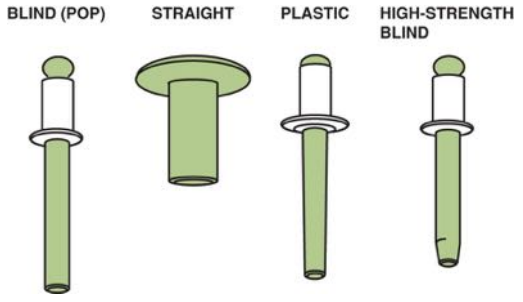


Figure 8-22 All of the nuts shown are used by themselves except for the pal nut, which is used to lock another nut to a threaded fastener so they will not be loosened by vibration.

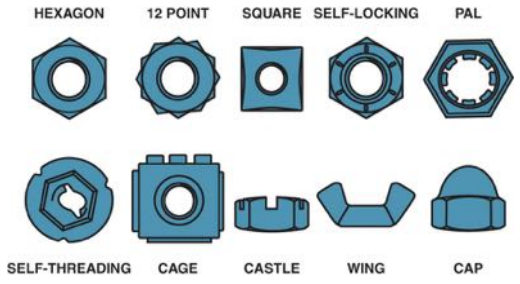


Figure 8-23 A castellated nut is locked in place with a cotter pin.

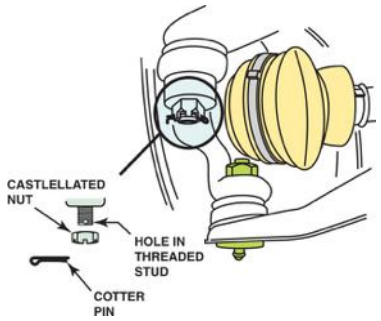


Figure 8-24 Helical inserts look like small, coiled springs. The outside is a thread to hold the coil in the hole, and the inside is threaded to fit the desired fastener.

Figure 8-25 The insert provides new, stock-size threads inside an oversize hole so that the original fastener can be used.

Figure 8-26 Heli-Coil® kits, available in a wide variety of sizes, contain everything needed to repair a damaged hole back to its original size.

Figure 8-27 This solid-bushing insert is threaded on the outside, to grip the workpiece. The inner threads match the desired bolt size.

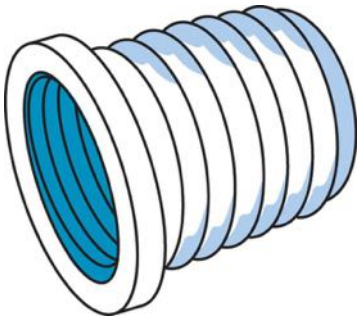


Figure 8-28 A Timesert® kit includes the drill (a), the recess cutter (b), a special tap (c), the installer (d), and the Timesert® threaded bushing (e).

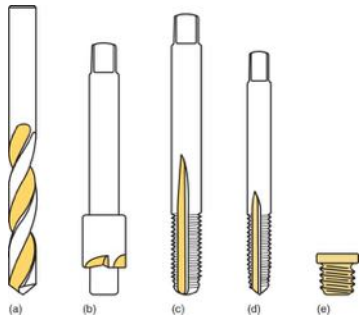


Figure 8-29 Drill out the damaged threads with the correct bit.

Figure 8-30 Use a special tap for the insert.

Figure 8-31 Put some thread-locking compound on the insert.

Figure 8-32 Use the driver to drive the keys down flush with the surface of the workpiece.

Figure 8-33 The insert and insert locks should be below the surface of the workpiece.