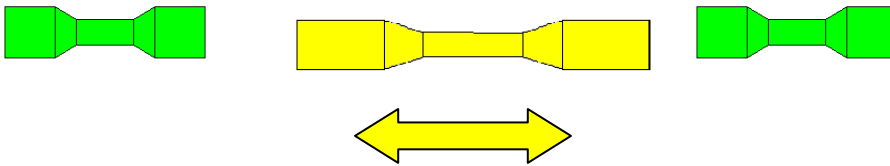

The Nuts and Bolts of Nuts and Bolts *by*

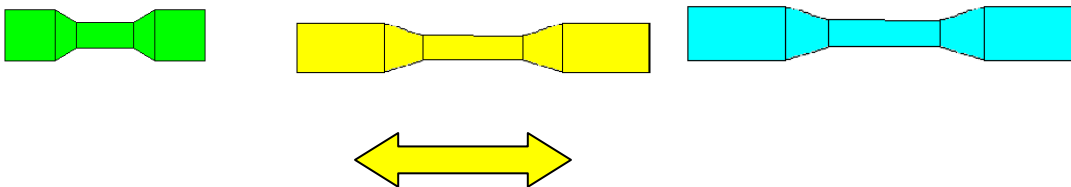
Patrick Ofenloch

Could you imagine how difficult our life would be with out the threaded fastener? Fasteners allow us to assemble a variety of components together with reliability, safety and ease. Many of us tighten nuts, bolts and screws everyday. Most items of our cars are assembled using threaded fasteners. Fasteners can be fascinating in how they actually work. Sometimes we don't think about what is actually happening.

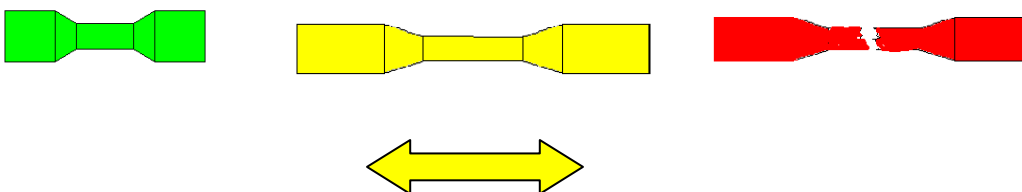
Let's first look at a few of a few basic mechanical properties of steel. Steel actually reacts in many ways like a rubber band or a spring. Steel stretches and has an elastic property. The steel can be stretched and will return to it original shape for many cycles. This is known as the elastic limit. Sometimes this is also called plasticity or ductility.



If we continue to exert more force on the steel it no longer returns to it original shape. This is known as the plastic deformation of steel.



If we continue to exert even more force the metal fractures. The term actually is called the tensile strength which is the maximum load in tension a material with withstand before fracturing.



Now that we have some of the basic mechanical properties let's continue.

Continued on Page 2

The Nuts and Bolts of Nuts and Bolts (Con't)

by Patrick Ofenloch

Continued from Page 1

Bolts are pretensioned by turning them until they are snug, then using a twisting force (torque) from a specialized torque wrench or adjustable impact hammer to further turn the bolt. Since the head of the bolt is snug against the washer or surface, turning the bolt actually elongates or stretches it. We are taking the material to a yield point where plastic deformation is now taking place. The elongated bolt acts as a stretched spring, pulling the two materials together. This is also called the pretension force.

If we over tighten the bolt beyond this yield point the bolts ability to be reused will be limited. Like the example above if we continue to over tighten the bolt we have two pieces. One piece of the bolt in the component and the head of the bolt in our hand. This is not a good thing. In the event this does happen there are a few ways to restore a thread.

Torquing bolts

As a rule, when a bolt is installed, the nut (over a washer) should be turned and not the bolt's head. Unless a torque wrench is used the tendency is to under tighten large bolts and over tighten small ones. Suggested torques are given below.

Approximate Torque Settings for Cadmium-Plated Bolts

Not specially lubricated, in foot-pounds

Bolt diameter in inches

Bolt Grade	¼	5/16	3/8	7/16	½	9/16	5/8	¾	7/8	1
SAE 2	4.6	9	15	24	36	50	69	117	184	273
SAE 3	6.9	14	24	38	57	82	113	198	317	477
SAE 5	7.5	15	25	40	59	83	114	196	309	459
SAE 6/7	9.7	19	34	55	83	120	166	291	469	710
SAE 8	10.5	21	37	60	90	130	180	316	509	769
Socket Head Cap Screws	12.7	25	45	72	109	157	217	381	615	929

Continued on Page 2

The Nuts and Bolts of Nuts and Bolts (Con't)

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Continued from Page 2

These suggestions do not apply if the bolt or nut has been specially lubricated.

Bolt definitions

Did you ever wonder what was being said you hear the car parts counter person yell out, “where are the 3/8-16 coarse threaded bolts”.

Here are the definitions.

3/8”- 16 UNC – 2A

3/8 inch (.375 “) Major diameter

16 threads per inch. 1.000” /16 threads per inch. Each revolution moves the bolt .0625 of an inch forward.

UNF Unified fine thread these types of threads have a greater tensile strength. These are used when the resistance to stripping is greater. Length of thread engagement is shorter. Most used in automotive and Aerospace applications.

UNC Unified Coarse thread. Generally used in lower tensile strength materials such as cast iron.

UNEF Extra fine thread series. Used mostly in thin wall material.

Bolt Classification

A is for an external thread

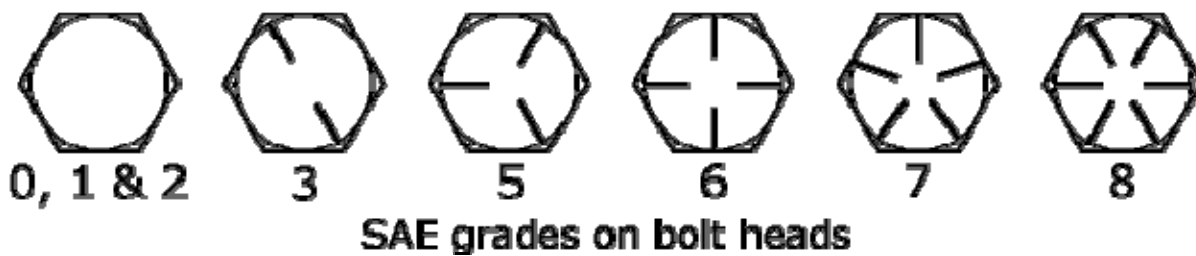
B is used to specify an internal thread

1 for special applications

2 are normal production tolerance

3 minimum tolerances.

Bolt Grades.



Continued on Page 4

The Nuts and Bolts of Nuts and Bolts (Con't)

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Continued from Page 3

The SAE (society of Automobile Engineers) has established a sequence of grades from 0 to 8 for steel bolts, on the basis of the metal from which the bolt is made and the manner of how it is manufactured. Available grades run from 2 to 8, with 8 the strongest. Higher grade numbers almost always mean increased strength (an exception is that some grade 6 bolts are stronger than grade 7). The heads of steel bolts are marked to identify their grade.

It isn't always a good idea to replace a bolt with a stronger one. Some bolts are deliberately chosen so that they are weak enough to fail before the stress or strain damages some more expensive or critical part of the equipment. For the same reason, in making furniture cabinetmakers use glues that are weaker than wood. That way, if the furniture is overloaded, the joints break. It is much easier to reglue a broken joint than to replace a piece of broken wood.

Interesting facts:

When using a bolt actually the first thread takes a third of the load, the first three threads take three-quarters of the load, and the first six threads take essentially the whole load. Beyond the first six threads, the remaining threads are under basically under no load at all. This is because of the stress properties the bolt undergoes while being stretched.

Once tightened, what makes a bolt loosen? Vibration is often thought to be as the chief culprit, but several studies indicate the main reason is insufficient preload, allowing side-to-side slippage of the bolt relative to the bolted joint members. For that reason, preload, or residual tension, in a tightened bolt actually is more important to assembly strength than the strength of the fastener itself. In a joint, a bolt torqued to its proper load level can resist a maximum amount of external load without loosening. In fact, an installed bolt is tightest when stressed as closely as possible to its elastic limit.

Hopefully now we have a new respect and understanding for threaded fasteners. We can all have a bad day sometimes. Our friends the threaded fasteners are threaded , stretched, graded, strained, and under stress all the time.