How Tight is Tight?

By Rob Greene

Bolt torque is a subject that is often misunderstood or overlooked on basic repairs. An average technician will remove and reinstall thousands of fasteners during their career. Loose or incorrectly, torqued fasteners are amongst the most common reasons for a shop "comeback". Sometimes hours or days after the vehicle was placed back on the road, the technician may have after thoughts of the repair. Did I tighten that bolt enough, did I over tighten that bolt (maybe with an impact gun) or should those bolts have been replaced? The intention of this article is to point out some of the most commonly overlooked or misunderstood facts about fasteners and the torque of fasteners.

Common methods for bolt torque:

- Torque wrench

The "old standard", used to tighten bolts to a defined torque value. Applied torque is rated in foot-pounds (ft-lbs), inch pounds (in-lbs) and/or Newton meters (Nm) for metric applications. Multiple sizes and types are used for different applications. A ¼-inch drive 100 in-lbs beam type torque wrench would be appropriate for tightening a transmission valve body; where a ½- inch drive click type torque wench can be used on passenger car lug nuts and would not make a good choice for that valve body repair. Choosing the correct tool for the job is critical.

- Torque Angle

Torque angle gage is used in addition to a torque wrench when the bolt torque specification requires a torque value and additional tightening measured in degrees. Example: 35ft-lbs plus 90 degrees plus an additional 60 degrees making a three-step torque process. The torque angle gage is commonly used for torque to yield bolts.

- Bolt stretch

Measuring bolt stretch requires the use of a bolt-stretch gage (with a dial indicator). This application is for high performance connecting rod bolts and engines that are disassembled on a regular basis.
This allows the technician to achieve the highest tensile strength (yield point) of the bolt with a high level of consistency. The bolt manufacturer will specify the amount of stretch.

Dry vs. Wet torque

- When applying torque to a dry bolt more friction is created than applying torque to a wet bolt with oil or other automotive fluids on the threads. With less friction (wet threads), the bolt will stretch more before a torque wench will click. Because friction is such a big factor in bolt torque, it is important to know the difference between applying torque to a dry bolt and a wet bolt. Using oil, anti-seize or other types of thread lubricant is a common practice, but an understanding that wet threads require less torque than dry threads because of friction is very important. Since every type of lubricant has a different loss of friction coefficient, it is recommended that every technician own a chart showing how much to reduce the torque when using different bolts and lubricants. This type of chart can accompany a bolt torque table, a drill index chart for drilling and tapping, a conversion chart and a basic calculator. The "Pocket Ref" by Thomas J. Glover is a great all-in-one book with just about everything.

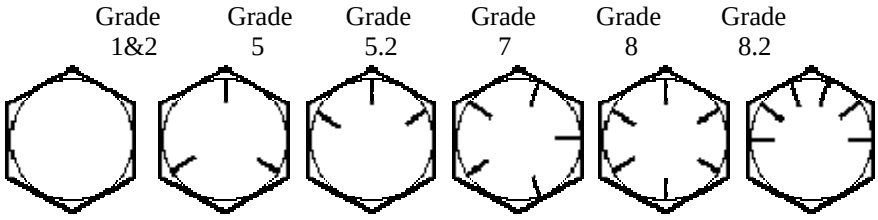
Sample: Dry bolt torque table (measured in ft-lbs).

Bolt size	Threads Pitch	SAE Grade 2	SAE Grade 3	SAE Grade 5	SAE Grade 6	SAE Grade 8
1/4	20	6	9	10	12	14
5/16	18	12	17	19	24	29
3/8	16	20	30	33	43	47
7/16	14	32	47	54	69	78
1/2	13	47	69	78	106	119
9/16	12	69	103	114	150	169
5/8	11	96	145	154	209	230
3/4	10	155	234	275	350	380

Torque to yield bolts

- Commonly used for head bolts, main bearing caps and other areas requiring a high clamping strength in automotive engines. These bolts are not reusable. Torque to yield bolts are stretched past the elastic stage (where the bolt can return to original shape) to a yield point (stretched to deformity) creating the highest clamping force. This is just before the bolt breaks in two (shear stage). Torque to yield bolts allow fewer bolts to apply more clamping load than conventional bolts used in greater numbers. Torque to yield bolts can be identified by having a more narrow shank than a conventional bolt of the same size.

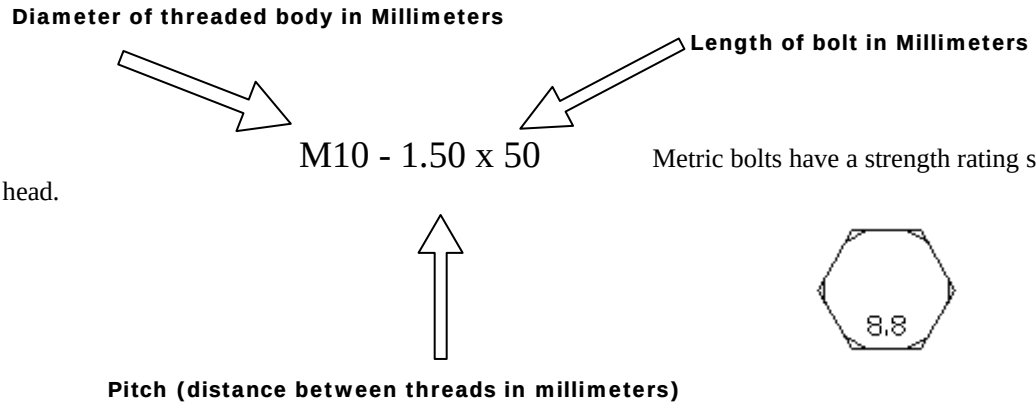
Society of Automotive Engineers (SAE) standard bolt markings.



Metric vs. SAE standard

- Metric and SAE standard fasteners not only have different sizes and thread pitches, but also different strength ratings. The SAE standard and Metric fasteners can be identified by markings on the bolt head. Grade 1 is the lightest duty and grade 8.2 is the highest strength SAE standard fastener. Metric Fasteners have a rating between 4 and 14 with 4 being the lightest duty and 14 having the highest strength.

Metric Bolt specifications



Metric bolts have a strength rating stamped on the bolt head.

Bolt replacement

- Bolts are replaced at the discretion of the technician. Anytime a critical bolt is in question, it is always best to replace it with new bolt of equal quality. Bolts tightened to an elastic stage can take multiple stretches, but once a bolt has passed the elastic stage to a point of yield and the bolt is no longer the original shape or size, it must be replaced! Careful inspection of bolts before reinstall will help weed out over stretched bolts and cut down on broken bolts. This simple practice can help prevent undesirable broken bolt extractions both during the repair and on the vehicles returning to the shop.