TORQUE

[fastidious fastener fastening]

Glen Zediker

In most applications where there is a specific torque requirement on a fastener, meaning those outside shooting, the function of setting a precise amount of tension on a nut or bolt is normally to prevent metal fatigue and damage to the parts. This function of setting torque does apply to rifle owners, but is relegated mostly to the armorer (for instance, several parts on an AR15 have specific torque requirements).

What we're using torque for, mostly, is to set a consistent amount of pressure against action screws and other "flexible tension" fasteners.

[I'm not an engineer, mechanic, gunsmith, or otherwise degreed in fastener technology; however, neither are most shooters. What this article will attempt to do is follow the education process I went through upon deciding that I needed to start torquing a few parts on my rifles. The information here came from the experience of others who told me what I needed to know.]

First things first: Torque is twisting force. In using a torque wrench, what we're concerned with is applying a specific amount of twisting force in tightening down a fastener. Setting torque is a way to quantify "snug," "tight," or "light" tension. Torque is measured in foot-pounds (ft.lbs.) and inch-pounds (in.lbs.) for most applications in this country, although metric equivalents -- such as newton/meters and the like -- can also describe a torque requirement.

Torque calculations are a matter of simple leverage. Force multiplied by distance equals torque. For instance: if one pound of force is applied to a wrench handle at a point that's one foot from the center of the nut or bolt, that's one ft.lb. of torque. Simple.

Second things second: why do you need to worry about torquing the fasteners on a rifle? For the most part, a torque wrench is used to set the action screws. In theory at least, if these screws are holding consistent tension, then your rifle will likewise shoot more consistently. You might also find that torquing the screws after a rifle disassembly will bring back zero faster.

Selection

You have a choice of three basic wrench types -- beam, dial, and micrometer (also called a "clicker"). All are named for the means each employs to indicate torque. A beam-type uses a pointer and a scale; apply pressure to the wrench handle until the pointer reaches the desired mark on the scale. A dial wrench works in essentially the same way except that you apply pressure to the handle until the pointer on the dial face indicates you've reached the desired torque. A clicker is a whole different deal. Set the torque by twisting the wrench handle until index marks on the handle and wrench body show the amount of torque you want. In use, when the force you're putting on the wrench handle equals the torque setting dialed into the wrench, the wrench head "releases" with a click.

Which is the most accurate? Depends on, literally, how you look at it. Rumor has it that the beam- and dial-types are the most accurate; however, while the precision may be in the tool design, the question is how accurately, and consistently, your eyes can determine when exactly X in.lbs. is reached. The clickers may not be as supremely accurate, but in the hands of most of us, the effect is that they'll work out that way. And

If your gun has a wood stock and is not pillar-bedded, don't go too high. 60 in.lbs. might be too much; try about 40 first. One point to pillar-bedding is to prevent the stock bushings and/or screws from imbedding. Those pillars are put in there primarily so that the action can be pulled down against them without the screws over-penetrating.

keep in mind the mission in torquing on a match rifle. Since we may be continually loosening and re-torquing the same fastener, consistency matters most. In an application where a fastener may require one torquing for the life of the part, such as in engine assembly, better pure accuracy might matter. "Accurate," by the way, is a pretty fine point here: most micrometer wrenches are capable of ± 2 to 4 percent, while this tolerance may drop to ± 1 to 2 percent on a dial or beam wrench.

On this subject -- accuracy -- you pretty much have to take the manufacturer's word for its product. A "test" that some folks like to do is torque down a fastener with wrench-A and then loosen it with wrench-B, which is set to the same torque. Won't work. It takes less force to loosen a fastener than to tighten it. You could test a wrench by making a mark on a fastener that's been torqued with one wrench and then seeing which setting on another wrench caused the fastener to move (but, remember, this only enables you to test one wrench against another, and you still won't know if either one is "good"). Reality is that we're not overhauling rocketships. The most important thing is not whether your rifle has exactly 60, 62, or 58 in.lbs. of torque on its action screws; it is, again, that the torque (whatever it may be) can be applied consistently from tightening to tightening.

Best torque wrench —
Bob Pease Accuracy
P.O. Box 310787
New Braunfels TX 78131
210-625-1342
(1:00-6:00 PM, Monday, Tuesday, Friday, Saturday)

The Search

Torque wrenches are pretty easy to find, but the trick is finding one that will, one, cover the torque range you might need, and, two, go with you to the range. I had some measure of difficulty in running one down. The ones at the tool stores were either way expensive or too bulky or not finely graduated enough, or all three. Also, most you'll find locally won't start at 0.0 on the scale. Finding a wrench that will read in the lower range is nice because then it can also be used on small-bores and non-bedded rifles (both these need low torque).

The Anschütz® torque wrench is a handy item. It's relatively tiny (about 6 inches long) and works just fine for action screws, but not much else. These wrenches are easy to find mail-order, but you may have to look a little harder to get an American-sized key (standard key is a 4mm; we usually need either 5/32 or 3/16 inch). You can get an Anschütz, including an American key, for about 80.00.

One of the nicest wrenches I found was a Proto® dial-type, but at nearly 150.00 with appropriate attachments, I passed. Go to your finest local tool emporium to check one out. Expect to pay even more for a Snap-On® product.

When you're torquing a fastener, pull the wrench slowly and smoothly -- and make sure you grasp it by the handle, never farther up on the wrench body. And stop as soon as the head releases; failure to do so will result in continued tightening. The click is only a reminder; it does not totally free the ratchet mechanism.

Bob Pease stocks a good wrench. Pease, who's very well known in benchrest circles, told me that he'd been looking for a long time to find a wrench that, all things considered, fit the needs of the rifle shooter; I bought mine from him because I could relate! I like his wrench because it functions as "normal," meaning that it's easy to find all manner of gadgets to fit its 1/4-inch shank. The wrench itself is a good size: large enough to get hold of and small enough to fit into a cleaning kit.

Application

Tension should be set equally on the front and rear action screws. In reality, if the rifle has been bedded properly, there really shouldn't be any difference if front and rear screws are set differently, or, for that matter, the specific torque used. However, also in reality is that most rifles aren't perfectly bedded. Even a skilled specialist cannot always achieve zero-flex. "Flex," in practice, can be defined as the amount of separation that occurs between the stock and action when the screws are loosened (usually the front screw). Ideally, there won't be any, but 0.003 inches is considered good. When there is some flex present, then torquing the action screws serves to eliminate its consequences. Some folks find that their rifles shoot better when there's different amounts on the front and rear screws. If that's the case, shoot the gun that way, but realize that there's bound to be a problem somewhere with the bedding.

Just about everyone recommends 60 in.lbs. for bedded actions in a centerfire rifle. Good question why. There's really nothing magic about that number, but it's high enough to hold everything in check and take out the flex, but not so high as to break screws or imbed stock bushings.* Smallbore rifles, and non-bedded guns, usually shoot best at a lower torque setting; anywhere from 20-30 in.lbs. should give good results. Non-bedded guns generally shoot better when there's about 5 in.lbs. extra added to the rear screw.

Most people will set torque on the rear screw and then on the front screw. This is another good question as to why it's done this way. Again, if we're talking about an ideal bedding job, then it shouldn't matter. But with the normal tolerance that's likely to be there, drawing down the front screw last sets correct tension on what some people say is the most important element in a bedding job -- the front lug. If there is some flex and/or gaps present, tightening one screw might change tensions in the area that's nearer the other screw; it's better if any change occurs at the rear screw.

Some gunsmiths recommend leaving the torque set all the time; others think it best to loosen the screws after shooting, re-torquing them prior to the next range trip. There are two ways to look at this: first is the "don't mess with it" school of thought. No doubt, fiddling with something enough times can cause it to either break, wear out, or change. If your rifle was built and bedded properly, the torque set into the screws shouldn't change (there may be a period after a re-bed, however, where the screws will settle, and that's normal). But, the Felix Ungers in the world are happier if they re-set the screws before shooting; they like to know what they've got. Some real sticklers do it each yard line. Now, here's another part to the second part of the answer: there's a difference in wanting to follow this practice and needing to follow this practice. If your rifle shoots itself loose that often, then you've got a gun problem.

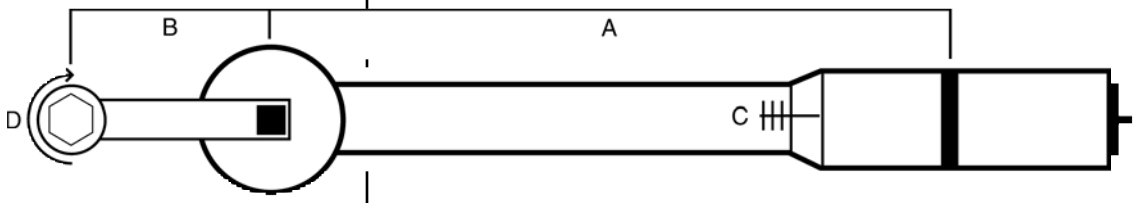
Think of a torque wrench as a measuring instrument and treat it as such. Most are pretty tough, but none take abuse. If you want to maintain the best accurate life from a torque wrench, it should be stored at its lowest setting; dial in the torque fresh prior to each use. No one will do that, me included, but that's the professional advice.

Particulars

In most shooting applications, the torque scale used is in.lbs. Simple math converts in.lbs. to ft.lbs. and vice-versa. For instance, 60 in.lbs. is the same as 5 ft.lbs. If you have a wrench that reads ft.lbs. and all you're using it for is to set that 60 in.lbs. on the action screws, you're probably fine in using it.

Always hold the wrench by its handle when you're using it; that's the only way it will give accurate results because a torque wrench is calibrated from the center of its handle. Most wrenches have an indication that shows where the center of the handle resides; that's where you grip it. Getting back to the definition of torque -- force times distance -- it's plain that x-model wrench, which may have a different handle length than y-model wrench, is calibrated uniquely.

Another important caution that's also related to the basic formula for torque is to understand the effect that extensions have on your results. "Down" extensions, such as an extra-long hex key attachment, won't really affect anything. But any sort of "out" extensions, such as those that increase the physical length of the wrench, must be compensated for. The formula is simple to work after you have a few things to feed into it. First, measure your wrench from the center of its socket to the center of its handle. Next, snap on the extension and measure from the center of the wrench socket to the center of the fastener. Take these numbers to the formula shown below under the illustration. Many manufacturers will provide the necessary constant in the literature dispensed with their wrench. I ran into the need for this calculation when I added a "crow's foot" to a wrench so I could use it to tighten the gas cylinder plug on my M14. The extension increased the effective length of the wrench 0.625 inches and resulted in a 1.5 ft.lb. difference in my wrench setting.



Use this formula to determine the setting adjustment necessary if you've attached a length-adding extension ("down" extensions, such as an extra-long hex key, don't really affect anything). The constant A, which is the wrench length, may be supplied by the manufacturer.

A = length from center of handle to center of drive
B = length from center of drive to center of extension
C = wrench setting
D = desired torque applied to fastener

$$C = \frac{A}{D\ (A+B)}$$