Borden Accuracy

Thoughts on Torquing Small Screws

We often get asked questions regarding torquing of the scope base/rail screws on our actions. It has become accepted practice ion the firearms industry to focus on specifying torque values for all screws on a rifle. It is not prudent to use that technique on all screws on a bolt action receiver. Our screw holes in the top of the action for mounting bases, rings, and rails are milled and thread milled to a very tight tolerance that actually results in the threads being fitted to the small 8x40 screws. With such a thread fit, there is higher friction and more variability of torque than with standard industry thread fits. We do the fitted threads to result in more holding power and location accuracy and precision. Small screws are susceptible to variability in torque value due to thread finish, screw condition and lubrication. Therefore there can be considerable error when using a torque wrench on such small screws and having fitted screws can increase that error. We recommend using a high quality TORX wrench (like WIHA) for tightening the screws in vases, rings and rails in our actions and use feel to determine when the shoulder of screw has bottomed and then when screws stretch has started. The screws should be tightened until preload on the screw can be felt.

Here is what Cameron Murphy at Murphy Precision (murphyprecision.com) has to say about the topic:

Begin quote:

Short version:

- #6-48 screws - 15 in-lbs, and use blue or purple loctite for best results. (For X-BOLT actions only -- The (4) front screw holes are very shallow, so only use 10 in-lbs on those (4) screws.)
- #8-40 screws - 20 in-lbs, and use blue or purple loctite for best results.

- Alternative method: Tighten screws until snug (~3-4 in-lb), then tighten another 1/4 turn. This will get you very close to the target tightness range.

Long version:

All base mounting screws need to be tightened "enough". If you don't get them tight enough, bad things like having your scope mount come loose or even fall off can happen.

The two main techniques to ensure this doesn't happen is to 1) Tighten them sufficiently so the screw stretches elastically, or 2) apply a thread locking product to the screw (Loctite, etc). Even better, combine them, and apply thread locking compound to a properly tightened screw.

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Ok, you're probably thinking "I don't want them too loose", I'll just tighten the snot out of them." While that sounds like fun, you'll soon run into trouble when the heads of the screws fail and fall off, leaving you with just the threaded shank, possibly stuck in the hole.

The goal of all torque recommendations is to establish a repeatable amount of stretching of the screw, stressing it to 60-80% of it's yield strength. This will ensure the greatest possible clamping force, while avoiding bad things like head separation, or stripping of the threaded surfaces. The stretching of the screw enables it to stay tight, even when shock loads (like rifle recoil) work against it. This prevents loosening and unscrewing from happening during vibration.

Now that you know that you want the screw to stretch some, how do you actually achieve this "just right" level of stretch? You can either tighten the screw to a preset torque value, or you can tighten the screw a controlled amount past "snug". Personally, I recommend tightening the screw approximately 90 degrees, or 1/4 turn past "snug". This will stretch the screw to roughly 65% of it's yield strength, without requiring an expensive, possibly inaccurate torque wrench, or being dependant on thread lubrication. The main downside to tightening by "Torque value" is that the actual stretching of the screw for a given torque level depends greatly on the friction between the threads. 15 in-lbs applied to a perfectly clean and degreased screw, in a perfectly clean hole might only allow for 60 degrees of over-rotation, and a looser than optimal screw. In contrast, a screw lubricated with a high quality, EP grease might allow for 120 degrees of over-rotation for at the same 15 in-lbs, resulting in a screw that is close, or at the point of failure.

When in doubt, tighten less, and use thread locking compounds. If at any point while tightening the screws the force required starts to go down, STOP!!! You are either stripping the threads, or the screw head is beginning to fail. Carefully back-off and remove that screw, and throw it away. It shouldn't be reused. If you doubt your screws, or need a replacement, please contact us, and we will be happy to supply replacements.

End Cameron Murphy Quote.

Here is what Eric Kiesler at Brownells has to say about the same subject:
Begin quote:

Torque Specifications for Gunsmiths

By Eric Kiesler

Most of us here in the Tech Department at Brownells recall the days on the bench when not many people cared

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to know what the torque specifications for the bolts on their rifles were. Traditionally, mechanics and some armorers concerned themselves with torque specs, but not the gunsmith. Times are changing; it's hard to say whether this has been caused by a crossover from other industries, or just an increase in the general knowledge of the shooter. One of my many mentors, Chief George Thacker always used to say, "The gunsmith is a Jack of all trades!" I think he's correct now more than ever.

When I refer to torque specs for the gunsmith, fundamentally what we are talking about is applying preload to a fastener, or tightening a bolt. On the surface this might seem to be a simple enough proposition; however there are a number of variables to consider. When one properly torques a fastener, this "preload" results in a stretched bolt. The tension caused by this stress is the force that holds the joint together and for a firearm it is usually a shear force that will be testing the strength of the fastened joint. Generally, a torque wrench is used to gauge the amount of torque applied to a fastener, or the amount of elongation of the fastener may also be measured to gauge torque. In instances where the gunsmith is torquing a fastener to resist shear loads, (i.e. scope mounting) measuring fastener elongation would be the most accurate method for determining proper torque. A torque wrench is a very convenient tool (we have lots of torque wrenches: Adjustable **(#018-000-001)**, **(#792-000-001)**, and Fixed **(#792-000-002)**. However, they are not capable of factoring in the inevitable friction encountered when torquing; this results in inaccuracy.

The friction encountered varies depending on the surface finish of the fastener and the threaded hole it is going into. The number of times the fastener has previously been torqued, and the likeness of the external and internal threads are also factors to consider. Additionally, the number of threads of engagement, material composition, as well as the amount and type of lubrication all need to be considered. As you can imagine, it's virtually impossible to compute for these variables. This may worry some, but only on the rarest of occasions are the scope mounting screws subjected to forces that might test their holding ability. I have not done the math, but when you combine heavy recoiling cartridges with the current breed of scopes with large objective lenses and night vision optics, the 6 x 48 screws are being tested, but not severely. There are some lengthy algebraic equations you could use to figure how much force the particular scope/ring combination on a rifle of a given cartridge (ft lbs of recoil) will generate. I will not be going into that, it is the sort of thing that a scope mount designer not the gunsmith should have to worry about. For those who wish to delve into Zen and The Art of Torquing, I recommend the **Machinist's Handbook (#435-001-010)**.

Typically, a fastener required to resist shear loads will the smallest possible for the job by design. The preload applied to this fastener result in friction forces greater than the shear force the joint will be subjected to. Perhaps the simplest way to determine the torque spec of a given fastener is to (using a torque wrench) determine the strength of the fastener (get the screw to crack/fracture) than torque it to 50%-60% of its fracture strength. This will likely be more than enough holding power for any firearms application.

Many shooters want to be able to torque the action screws on their rifles. In this instance, we are not applying torque in order to resist shear. If you have a birch wood stock and 1 x 28 threaded guard screws, you would

splinter the stock long before you have reached the “correct” preload for that fastener. While a scope mount screw with a torx head may be able to withstand the application of the maximum preload for a fastener of its size and composition, a slotted headed fastener identical in all other ways would not be able to withstand the same amount of preload since the slotted head would deform.

The main purpose for having a torque specification on an action screw is to offer the end user (who may not have the technical expertise or opportunity to verify that the action is properly seated in its stock) some sort of reference for the sake of expediency. If you consider the myriad of torque specs offered by the major firearms manufacturers this becomes obvious. Presently, Remington’ website is offering a spec of “no more than 45 in/lbs” on the action screws of the 700 VS and 10-15 in/lbs on the standard 700. In the past we have garnered guard screw specs from Weatherby (65 in/lbs), Winchester (25 in/lbs), and HS Precision (45 in/lbs). I expect that all of these specifications are potentially subject to change when production changes are made during any retooling or redesign. It has always been my opinion that having a consistent torque on the action screws is more important than the number of foot lbs.

We recently obtained some ring and base screw specs from Leupold: base screws 14 in/lbs, ring screws, 15-17 in/lbs, and 45 in/lbs on the windage screw, 65 in/lbs on the cross bolt for the Mk IV ring. Previously, they told us that base screws with 6 or more threads of engagement would require 22 in/lbs, 6 or less 12 in/lbs.

For the gunsmith a torque specification is more of a guideline than a rule.

Let’s consider the 15-17 in/lb specification offered by Leupold for their ring. Currently they’re using 8 x 40 torx head screws, applying 15-17 in/lbs would not cause the fastener to stretch and impart preload to the joint; but it will likely hold the scope tight enough to keep it from slipping and not damage the tube. However, if the front and/or rear ring was made out of spec, or if the height of the scope bases do not concur, or you are using an off brand scope, you may need to impart more torque to the ring screws to get them to hold the scope properly.

There are plenty of standardization organizations out there (ANSI, ISO, ASTM, and SAE) to help. We don’t currently have membership and are unable to offer any of their information, but it is generally the fastener manufacturer who will be able to tell you what certification their product has. For large automotive fasteners this is rarely a problem, the small screws gunsmiths see are rarely designated like this. Generally, the screws contained within our screw kits are made of 1038 steel and match SAE grade 8 specifications; and I recommend the traditional German Torque Specification: Gooduntight!

If you have any questions, please feel free to get in touch with any of us here in the GunTech department either by phone or by email at guntech@Brownells.com.

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