The Relationship Of Barrel Extension Diameter To Accuracy In The AR-15, Part 1

Slop in fitting the barrel extension to the upper receiver can rob your rifle of its potential accuracy.

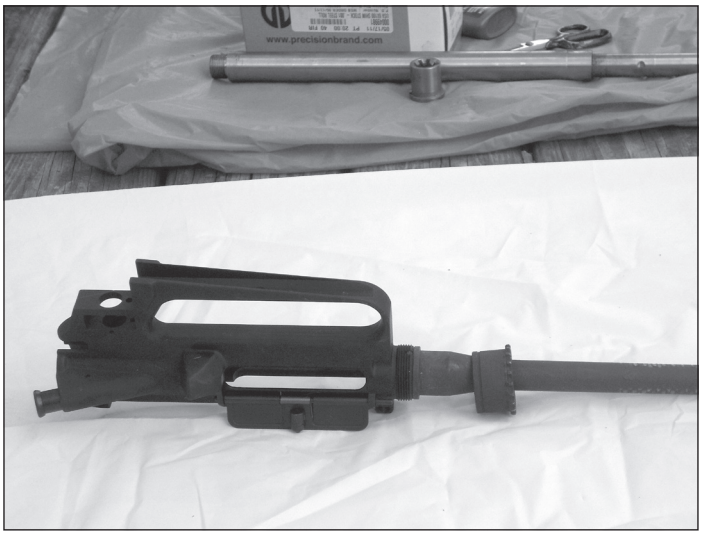
by Joe Carlos
photos by Gretchen Huffman

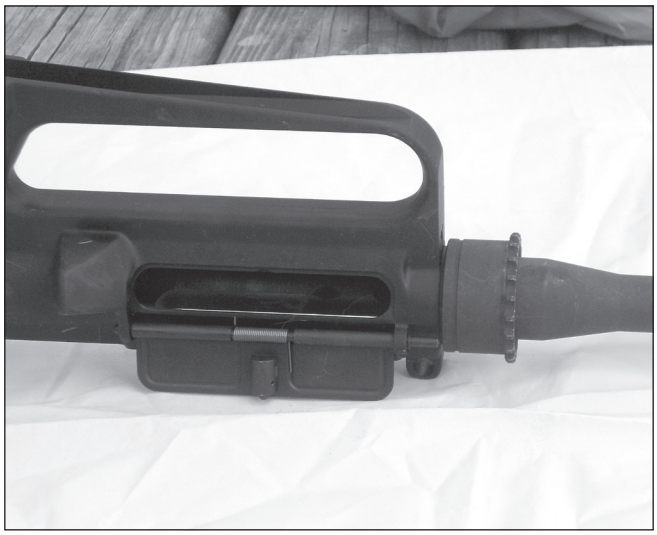
Stoner platform guns don't assemble the same way as most other rifles. Take bolt guns for example. In M24 sniper rifles the front of the receiver has a female thread machined into it and the back of the barrel has a corresponding male thread and the barrel physically screws into place during assembly of the rifle. Contrast this to the M16. The barrel extension is not integral with the barrel. It is not a part of the barrel. It is a cylindrical piece of metal about 1 1/8" long machined separately. At one end of the barrel extension there is a raised collar, often called a flange, all around its circumference which abuts against the front of the upper receiver when everything is assembled and in place. The barrel is threaded at the rear (much like a bolt gun barrel) and it physically screws into a female thread in the barrel extension. That barrel extension simply slips into the front of the receiver upon assembly—it is not directly threaded into the receiver in any way.

Since it is a slip fit there is a lot of play. Anyone who has ever rebarreled or watched someone assemble an AR-15 upper will note that up until screwing the barrel nut in place the barrel will wiggle around, giving a lot of potential accuracy robbing slop.

The next step in the assembly process is to screw the barrel nut on to the front of the receiver. This captures the barrel extension by pressing that raised collar against the front of the receiver. Note that the raised shoulder (flange) on the barrel extension just abuts against the corresponding face of the front of the receiver. Screwing the barrel nut in place removes most of the visible play that I mentioned before. The role of the barrel nut is more effective in removing forward to rear movement of the barrel than up and down or sidewise play inside the receiver, however. If either the flange on the barrel extension or the corresponding front surface of the receiver fail to be perfectly square where they abut, accuracy problems will likely be exacerbated. Note, trying to correct the up and down or side to side

Below left: *AR-15 barrels don't screw directly into the receiver. They screw into a barrel extension that slips into the receiver.* ***Below right:*** *Everything in place just prior to assembly: The receiver, barrel with extension in place and barrel nut.*





Above left: *Next step in the assembly process: The barrel extension is slipped into the receiver.* ***Above right****: Receiver with barrel held in place by barrel nut.*

movement of the barrel extension inside the receiver by increasing torque on the barrel nut enough to line up the next timing notch is not the correct fix. Doing so may damage the receiver and it will likely affect the harmonics of the barrel. Do not try this gorilla approach. Instead, follow the procedures in this article. We will address correct barrel nut torque as it relates to accuracy in a future article.

Securing the barrel as I have just discussed provides enough accuracy for most military battlefield applications. It is also fairly simplistic and doesn't require a lot of sophisticated tools or gunsmithing skills. Military armorers can rebarrel a rifle much easier (and probably with less training) than the previous M-14 issue rifles.

The Epiphany

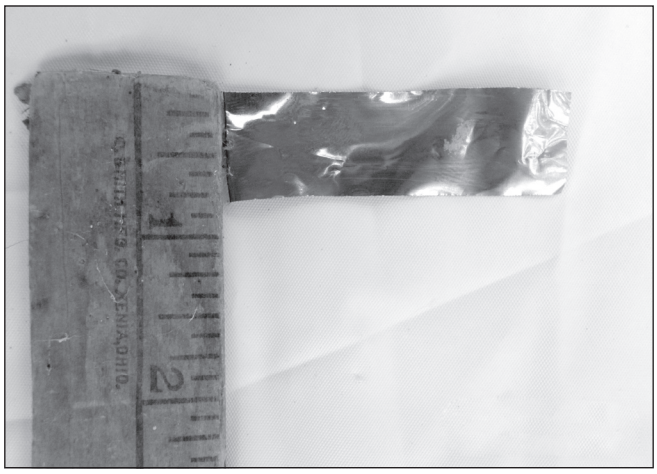
Forty years ago when I began shooting competitively I had no desire to become an armorer nor did I think I ever would. Gradually I began working on some of my own guns simply because I wasn't able to find someone else that I trusted. Soon, other members of the Army Reserve Shooting Team began asking me to work for them. Eventually I became so busy working on guns that I no longer had the time to train and I dropped out of competition. I did carry the observations and lessons learned as a shooter to my new job, however, and I believe it has helped make me a better armorer.

One such observation was made over 20 years ago in Australia in the late 80's or early 90's when the All Army Reserve Shooting Team was at Belmont Range competing against foreign military teams in an international combat match hosted by the Australian Army Rifle Association. I remember coming back to the tent late one afternoon and everybody was cleaning their M16's. One guy must have left his bore guide stateside because the back of his barrel extension was all slopped up with excess solvent and oil. He discovered that if he firmly held the upper receiver with one hand and put pressures on his barrel with the other hand he could see air bubbles and movement in the excess fluid that corresponded to the flexing pressures that he applied to the front of his barrel. Like little kids, everyone else had to try it too and a fair number saw the same tell tales that their barrel extensions also exhibited a lot of slop. We all came to the conclusion that any movement at the back of the barrel would cause erratic and exaggerated vibrations and a less than stellar return to consistent registration points at the muzzle between shots. This, in turn, would result in fat groups, fliers, and wandering zeroes. What to do about the problem remained uncertain, however.

Fast Forward

"Look on my works, ye Mighty, and despair."—Percy Bysshe Shelley, *Ozymandias*.

Now, fast forward to the early 2000's. I was just taking over as the armorer for the All Army Reserve Service Rifle Team. The team owned 135 M16A2 NMC uppers. 50 uppers had recently been purchased from a very highly respected civilian custom shop and the remaining 85 had been built by the most prestigious full-time military armorers. I needed a base line so I began machine rest testing the entire population. Given the lineage of these guns I expected to see some impressive groups. I was very disappointed. Average 10 shot group sizes exceeded one MOA. Out of the whole population of 135 uppers only 39 would shoot minute of angle with any lot of ammo. For the most part, shot out barrels were not the problem. Remember, 50 of the barrels were brand new. Throat gauge readings and log book entries revealed that very few of the remaining 85 bar-



Above left: *Cut shim stock to about 2 ¼" long for trial fitting without Loctite.*
Above right*: Cut shim stock about ¾" wide.*

rels were worn out. They were just all performing less than optimally.

So, how to fix the problem? I was aware that Derrick Martin over on the National Guard side of the house was applying red Loctite to the barrel extensions of his guns during assembly. Derrick is the owner of the custom gun shop Accuracy Speaks (accuracyspeaks.com) and wrote the very informative book The Complete Guide To AR-15 Accuracy. He described using red Loctite in his book. Derrick is a well respected gunsmith and when I heard (some time in the 1990's by word of mouth prior to the publication of his book) that he was using Loctite I began with the red also. Since red is mostly a thread locking compound I soon migrated to green #620. According to Loctite, the #620 is designed to withstand high temperatures, like one would expect near the chamber of guns shooting 10 shot strings of rapid fire. The 620 was designed for slip fits where gaps are large. It is thicker than the red Loctite and seems to fill gaps between the barrel extension and the corresponding inside surface of the receiver quite well. I had been using the green Loctite on AR-15's that I had been building for civilians and felt that the extra few minutes it took to apply it was time well spent.

I had inherited no spare parts when I took over the armorer job for the Reserves but shot out barrels were not the problem anyway. I decided to rebuild some of the worst shooting uppers using the green Loctite. After the rebuilds I retested them on the machine rest using the same lots of ammo as the first tests and quickly saw improvement. I eventually rebuilt all 135 of the uppers using green Loctite. Compared to the original 10 shot groups the average improvement in accuracy was a very substantial 18.6%. Not only were groups tightened but the incidence and severity of fliers was lessened. Shooters could see that their rifles were shooting noticeably better and customer satisfaction was very high.

Over the next decade I continued to make improvements and when I left the team a little over a year ago to pursue my civilian market I had succeeded in cutting group sizes about in half from what I had inherited. All 135 of the team's guns would shoot sub minute 10 shot groups with some type of ammo. How I accomplished this will be the subject of future articles.

While I had the 135 guns apart performing the rebuilds I measured and recorded the diameters of their barrel extensions. My records show a pretty wide range spanning from 0.9965" on the skinny end up to 1.0005" on the fat end. The barrel extension is not considered a precision part. It doesn't move (or, it is

Below: *Using standard household scissors to cut thin 0.001" shim stock.*

not supposed to) and, up until recently, most manufacturers apparently took a rather caviler attitude regarding quality control. What can you expect from a $20 part? When I compared the barrel extension diameters of rifles that tested below average in accuracy to those that shot better than average I found that the bad barrels had skinnier extensions (causing more slop at the back of the barrel). So the conclusion is that undersized extensions contribute to fat groups, fliers, and degraded performance in general.

Having said that the following caveat begs to be written. The fit of the back of the barrel is important but it is trumped by barrel quality. A poor quality barrel is not going to magically transform into a tack driver just because the gunsmith spent a little extra effort in the shop ensuring that the back of the barrel is properly stabilized in the receiver. On the other hand, even the best barrel will never deliver its potential if it is thrown into the receiver with no effort made to ensure a tight fit. Also, remember that receiver dimensions vary as well. There are noticeable differences in receivers even when purchased for the same source. This includes the space where the barrel extension lives so variations in dimensions of stock barrel extensions may conspire with variations in receiver dimensions to result in some awful fits if you ignore the tips in this article and continue to build rifles "the regular way."

Improvements

During the decade that I relied solely on green Loctite I always wondered if there was a way to improve even more on the fit of the barrel extension to the receiver. I thought about approaching machine shops to see if they would make up some oversized barrel extensions but figured that the cost would be prohibitive. I also wondered if using shim stock would result in a better fit and went that route.

I use very thin 0.001" stainless shim stock cut about ¾" wide. Standard household scissors can be used for this as the thin stock cuts like paper. The barrel extension has about one inch of bearing length, not including the flange, and cutting the shim stock a little on the narrow side gives me leeway to keep it centered and not extending out from either the front or back. The average length of my shims is about 2 ¼". I start with that length and attempt a trial fitting, first without Loctite, to see if the barrel will go into the receiver with the shim stock in place. If I still have a lot of slop I cut another replacement piece of stock a little longer. If the fit is too tight to go in place I gradually trim the length until everything goes tightly in place.

My average length shims partially encircle about 2/3 of the bottom and sides of the barrel extension. I think that is a better approach than to use a shorter, thicker shim that might have the tendency to create a high spot for the barrel to pivot and vibrate around. I avoid getting the thin shim stock up around the extension pin or the corresponding cut out in the receiver as it is easily torn during assembly.

After the trial fit I apply green #620 Loctite all around the barrel extension and the corresponding inside surface in the receiver. Insure that all surfaces have been immaculately degreased first. I put the shim stock in place (around the bottom 2/3 of the extension) and then apply more green Loctite to the outside surface of the shim, carefully working the barrel with shim into place in the receiver. Any excess is cleaned off before torturing the barrel nut in place. Then I go inside the receiver and wipe off excess Loctite from the back of the extension so everything is nice and clean.

A couple of caveats are in order. First, I recommend avoiding the faster drying slip fit #638 Loctite for this application. The #620 sets up slower. Your first few attempts may well end up taking 20 minutes to get the hang of things and a faster drying adhesive would likely be detrimental.

Second, absolutely avoid letting shim stock curl up between the back of the barrel extension flange and the front of the receiver forming a high spot for the barrel to vibrate around. I find it helps me to initially position the shim stock to just barely hang out over the back of the barrel extension. Try about 1/8" or 1/16" of overhang to start with and fine tune, if necessary, to match your exact assembly procedures. That way when everything is pushed into place as the shim slips back toward the flange a little there still remains a healthy gap between the two upon final assembly.

If you do find the shim slipping too much while you are working the barrel into the receiver just apply a little finger pressure and it will stay in place. Too much overhang can cause some shim to extend out the back of the extension inside the receiver which could cause malfunctions with the bolt carrier. If this occurs just use the point of a knife to trace (scar) the shim along the back of the extension and then tear the excess shim stock off using tweezers.

This might sound intimidating. Expect your first couple of attempts to take upwards of twenty minutes. With practice, however, you should easily be getting good results in just about five minutes. If it is just too difficult for you, simply ask most any kindergarten or first grade art student to assist. It will be "child's play" for them!

Finally, Loctite says the #620 will adequately set up in about 24 hours. In some cases I have found that to be somewhat on the optimistic side and let everything undisturbed for several days before firing the gun.

Next time we will go into more detail on expected accuracy gains using the combination of Loctite and shim stock. Then we will talk about newly introduced custom barrel extensions from Bat Machine that may save you time and result in a better rifle. AG