

The Relationship Of Barrel Extension Diameter To Accuracy In The AR-15, Part 2

Further quantifying the accuracy gains from the proper fitting of the barrel extension to the receiver, rebarreling and the new custom BAT Machine oversize extensions.

by Joe Carlos

photos by Gretchen Huffman

I built up dummy AR-15's using a dozen barrels randomly selected from assorted custom barrel makers, all with standard barrel extensions. I machine rest tested them first with no shims or Loctite, firing three ten shot groups from each gun using different lots of ammo. Then I disassembled everything and reassembled the guns using shim stock and green #620 Loctite as discussed previously and tested them again using the same lots of ammo. Comparing the results the net gain was an astonishing 35% average reduction in group size!

If you recall, I had determined years prior that just using green Loctite as a stand-alone without the shim stock resulted in an 18.6% average re-

duction in group size. So, using simple math skills, I credit the addition of the shim stock to nearly doubling the results by adding about 16.4% of accuracy gain. Improving accuracy by 35% is well worth the 5 to 20 minutes of shop time and I am sure your customers would agree. If you have any doubt look at the test groups fired from two guns selected at random that appear in this article. The top groups (without fitting on the left and after fitting on the right) are from an entry level National Match gun set up for 80 grain bullets and the two groups on the bottom are from a rifle set up for 90 grainers.

BAT Machine

As mentioned before, at one point I had thought about approaching machine shops to see if anyone would custom produce oversized barrel extensions as a potential solution to the excess slop inherent with stock units. I never perused that route but Bruce Thom from BAT Machine (bat-machine.com, 208/687-0341) came up with the idea independently from me. They are currently producing quality extensions in 0.999", 1.000" and 1.001" sizes. These are top notch extensions that are round where they are supposed to be and square where they

Below left: When disassembling, if the barrel fails to tap out of receiver it is probably held in with Loctite. *Below right:* After heating the barrel with a torch, tap the receiver away from the barrel.



should be. Most important, their diameters don't vary one bit! Their cost is comparable with garden variety extensions on the market which vary greatly in size.

When I first spoke to Bruce about the BAT extensions I asked if he had done any comparison testing to see what accuracy gains would result by substituting their fatter extensions for the garden variety. He had not and we both agreed that quantifying this would be a major undertaking. One would first have to assemble a complete dummy gun employing barrels equipped with standard extensions. Said dummy guns would have to be machine rest tested and then disassembled. The stock barrel extensions would need to be removed and BAT custom extensions would have to be substituted on the barrels. The dummy guns would then need to be reassembled and tested a second time with the same ammo lots and groups compared.

I did the study but, considering the work involved, I only tested five barrels instead of the normal ten or more barrel sample size that I like to use. The larger the sample size the

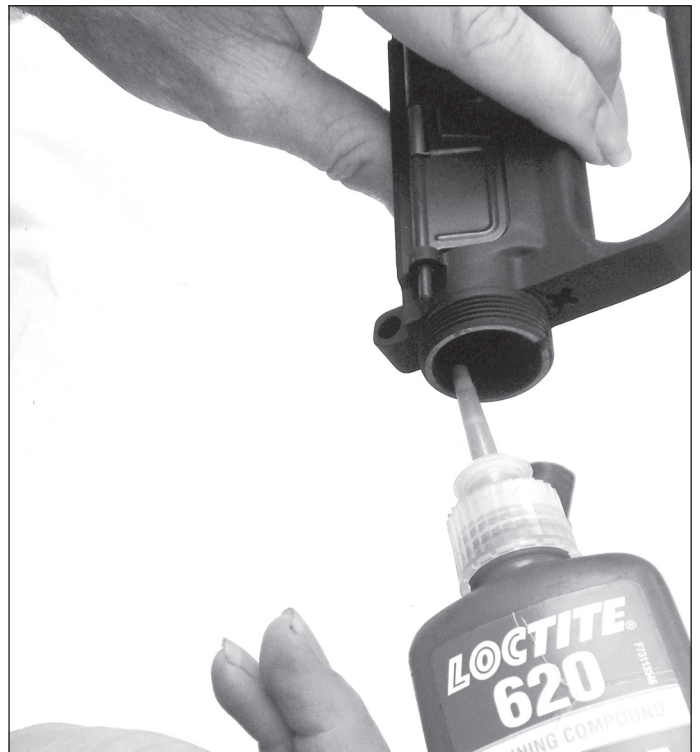
greater likelihood of getting a good prediction. I used the same upper receiver, bolt carrier parts and match BAT Machine barrel extension for all the test firings in the study. All parts and bores were immaculately cleaned between each of the five test firings. Each dummy gun was tested using three different ammo lots firing ten shot groups in a machine rest. The same procedure was followed in the retests with the BAT extensions.

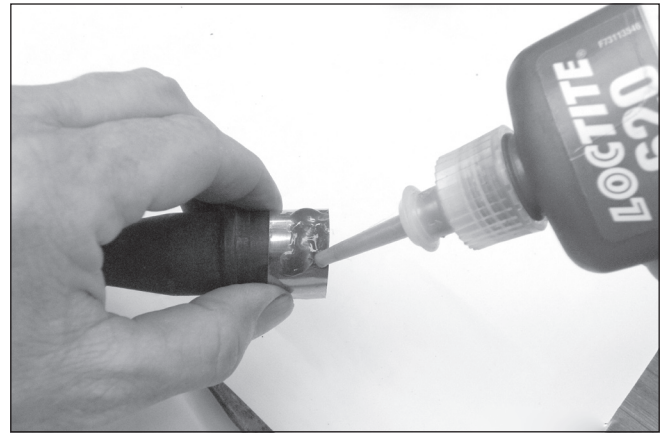
My first shipment of extensions was the 0.999" size. It was evident that the upper receiver I had chosen at random still had a lot of slop. I only tested two barrels which gave me a very modest average improvement of 3.4% and I stopped testing at that point. When my second shipment of BAT extensions arrived I found that the 1.001" size resulted in a nice mild press fit in my upper receiver. I retested the first two barrels a third time with the fatter 1.001" extension and tested three additional barrels. My average five barrel accuracy gain was 16% ranging from 8.7% to 22.4%. Predictably, the barrel gaining only 8.7% in accuracy came from the manufacturer with a compara-

tively fat stock extension whereas the one with the greater 22.4% gain had a more skinny extension from the factory. Loctite was not applied for any of these tests. My goal was to quantify what average accuracy gain could be expected from just the BAT extensions themselves. I had previously determined that employing Loctite would add about an additional 18.6% in group reduction.

When I was using shim stock in connection with Loctite to improve accuracy the shim stock was contributing 16.4% of the total 35% group reduction with Loctite contributing an 18.6% average reduction. So, my tests of the BAT match barrel extensions which resulted in a 16% average accuracy improvement, without Loctite, comes in very close to the mathematical prediction for shim stock. Therefore, I would expect the combination of BAT extensions (with a light press fit into the receiver) combined with Loctite to result in a net gain of about the same as shim stock used with Loctite. If you recall, I had already quantified that, arrived at with a twelve barrel measured sample size.

Below: When disassembling a barrel that has been installed with Loctite, heat the back of the barrel with a torch. **Right:** Apply green Loctite to the inside of the receiver.





Getting The Right Sizing

Receiver dimensions vary quite a bit. The BAT extensions need to be closely matched to the individual receiver to obtain the maximum accuracy gain. This was demonstrated quite dramatically during my first two test firings and shown with the 0.999" extensions that still resulted in too much slop. I believe the best results will be seen when a light press fit is achieved. To get the full benefit, however, you will still need to coat both the extension and the upper receiver with Loctite. I recommend the thinner #638 for this application. You will need to be within ½ thousandth (0.0005") on extension sizing to get the proper fit. I suppose that if you took enough accurate measurements of your uppers you might be able to predict this. I simply have an assortment of BAT extensions in their various sizes and use a trial and error method to pick the size for the particular receiver I am trying to match. The entire selection process takes me about one minute to perform. I select the fattest extension that I can get in and out of the receiver by hand and I go to the next size up from that (0.0005" larger). That extension will usually start into the receiver by hand but not go all the way in. When I use the barrel nut wrench I feel almost no resistance to take the extension in the rest of the way to battery. Don't get carried away with this! You are trying to accomplish a light press fit and if you go much more than ½

Above left: Apply green Loctite to barrel extension before shim stock is put in place. Above right: Green Loctite is applied to the outside surface of shim stock.

thousandth you run the risk of damaging your receiver. The receiver is made of aluminum and the walls are not very thick where the barrel extension lives.

Most of my receivers are Rock River. I had 18 of them in stock and one old (20+ year) ArmaLite that was brand new and never used when I performed the following sizing tests for this article. The range of sizes I found broke down as 0.9990": 1 (the old ArmaLite), 0.9995": 1, 1.0000": 2, 1.0005": 14 and 1.0010": 1.

If you have Rock River receivers in stock that were purchased in the summer of 2011 your results may somewhat mirror mine. Receivers purchased earlier or later, and certainly those of other manufacture, will likely vary. If there are questions regarding any of the data or procedures from this article feel free to e-mail me at NCC1701@penn.com. I usually have a table or two set up on Commercial Row at Camp Perry during Rifle CMP week and will have a variety of BAT Machine extensions with me. If you stop in with your cleaned up receiver I can probably get you sized for an extension within about two minutes if I am not too busy. I will also have some test targets that graphically show the relationship of stabilizing the back of the barrel to accuracy. Feel free to stop in.

A professional gunsmith or armorer can afford to stock extensions of varying sizes. This probably won't work for the home hobbyist, however. If you are an amateur gun builder and are contemplating substituting a custom fit extension on a barrel that the factory has already equipped with a stock extension my recommendation is to not proceed. Special tools are involved. Also, there will be timing issues. When I did my five barrel study I had to substitute BAT extensions for ones originally timed by the barrel makers. None of the five barrels timed up right when the BAT extensions were substituted. Some timed short and some too long. That does not mean that the BAT extensions were not made to spec. There were variations in the threaded portion of the backs of the five barrels. Timing of barrel extensions is best left to professional barrel makers. The right way for the hobbyist to do this is to size the extension first and pick one that results in a light press fit to your receiver and send that extension to the barrel maker to have timed to a new barrel. If this is not done right the front sight will be off and the gas port may not line up properly resulting in both zeroing issues and malfunctions.

Rebarreling

If you work on AR-15's long enough you will probably encounter one

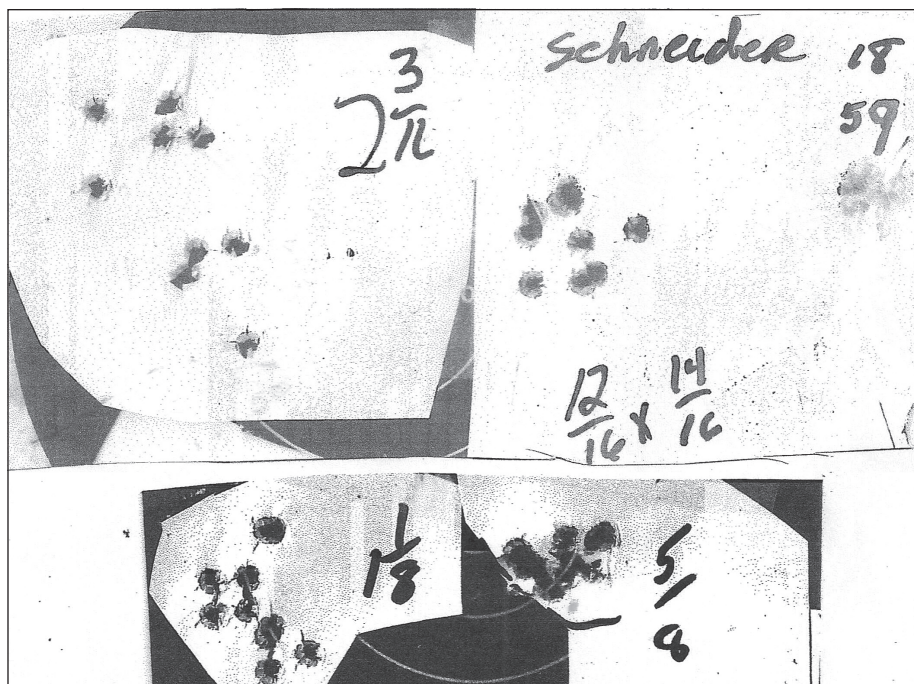


Above: Recommended clean up tools and supplies: Barrel extension tool (center) with gasket remover and metal gunsmith's tooth brush on left and old knife and either fine emery paper or steel wool on right.

that comes in for rebarreling where the old shot out barrel is Loctited in as described in this article. Simply disassemble the rifle in the customary manner through removal of the barrel nut. If the barrel fails to tap out of the receiver in the usual way it is an indication that it is held in

with Loctite. To prevent melting your receiver block I recommend reversing the gun so it is held in the vise by the barrel which will eliminate the receiver block. Apply heat for a few minutes to loosen the Loctite and then tap the receiver away from the barrel.

Below: Typical starting accuracy on the left and gains from stabilizing the barrel extension on the right. The top targets show before and after results with a rifle set up for 80 grain bullets, the bottom targets with 90 grainers.



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If you are using a BAT Machine custom barrel extension you will want to recycle it as these outlast barrels. Like bolts, you can reuse barrel extensions several times. Use the appropriate tool to screw it away from the barrel. Since some barrel makers use red Loctite on the threads so it is best to attempt to do this while the barrel is still warm just after removal from the receiver.

Clean up both the barrel extension (if you are going to recycle it) as well as the corresponding inside surfaces of the receiver. I suggest using gasket remover, stainless steel gunsmith's tooth brushes, steel wool and even old knife to get out the heaviest buildups and stubborn problem areas. Avoid leaving trace Loctite that can become high spots for barrel extensions to potentially pivot around. Finish by normal degreasing procedures and reassemble using the instructions previously explained in this article. Follow up by shooting the best scores of your life! Or, if you are a gunsmith that doesn't compete, expect your customer satisfaction to go up measurably.

Conclusions

If you are building Stoner rifles with fancy front end rail systems to hang optics, lights, and electric can openers on, getting the barrel extension stabilized probably is not a consideration. However, for some high end varmint, Designated Marksman or competition rifles proper barrel extension fit can noticeably improve accuracy in any Stoner platform. I have used Loctite on the extensions of AR-15 dedicated .22 LR rifles, .45 ACP conversions and AR-10s for about two decades with success. I have built hundreds of uppers in those years and never had a single barrel test worse upon final assembly using these techniques than it pre-tested using "normal" assembly methods. Although I have not set up any studies to quantify this, my gut feeling is that guns that exhibit more barrel whip probably profit more by proper fitting of the barrel extension

than lighter recoiling guns. For example, I would expect an AR-15 with a regular skinny GI barrel to whip more than a fat barreled competition CMP gun. Likewise, it is probable that a heavy whipping AR-10 barrel would profit more by fitting it to its receiver than a fat .22 LR barrel. If you use a hasty or loop sling and attach the sling swivel directly to the rifle barrel via the front sight housing, as opposed to attaching it to some type of float tube I would expect you to, you'll see a lot of improvement from stabilizing the back of the barrel as well. Using the "regular" method of assembly without Loctite and shims or oversized match extensions will leave a lot of flex at the back of the barrel when you apply sling tension.

Regardless, always use the appropriate Loctite in connection with either shim stock or custom barrel extensions to help "weld" the barrel extension to the inside of the receiver in all Stoner rifles you are assembling. Fitting the barrel extension to the receiver is a cheap solution, both in terms of dollars spent as well as shop time. Other than maybe installing a fresh, tight-fitting Accu-Wedge, keeping the gun clean or spinning ammo for run out, I can't think of many techniques that are as economical in making the Stoner platform perform better.

Whether to use Loctite in combination with shim stock or matched oversized extensions will be dependent on your individual situations. If you are a professional gunsmith and have a BAT Machine extension timed to a barrel that you have in stock but it doesn't fit properly to a given receiver, in my experience I have been able to spin one BAT off and substitute another with adequate timing. I can't say that with extensions from any other source. So far, the BATs have been extremely uniform and I have them in stock from several runs. Please note that specifications can change in the future. BAT also makes extensions for AR-10s for those of you in the business of building those.

Since much of the foregoing discussion has been about barrel extensions let me briefly climb on my soap box. If you shoot these Stoner Platform guns and want to harvest all the potential accuracy that the techniques described in this article can afford you please remember to clean them nightly. That includes using a chamber brush and one of the high pressure gun scrubbing aerosol cleaners to remove the residue from the chamber and barrel extension. Otherwise you will not put equal pressures on the cartridge from shot to shot and it will orient differently in the chamber and rob you of potential accuracy. Apply sound marksmanship fundamentals, pay attention to upper/lower fit and use the best concentric ammo you can find.

The techniques described in this article concentrate on eliminating slop in the fit of the barrel extension to the receiver. They improve accuracy likely by lessening and uniforming barrel whip and by bringing the muzzle back to a consistent registration point for each shot. Make no mistake that with or without performing this work the entire receiver likely flexes upon firing and this probably helps limit accuracy in Stoner platform rifles. The receiver walls surrounding the barrel extension are skinny. I know of few rifles where the barrel was supported poorly. Remember, the gun was designed for combat and not precision paper or varmint punching. If you are shooting Service Rifle at NRA or CMP matches, stabilizing the barrel extension is an internal modification and entirely legal by the rules. With few exceptions, such as rear sight hoods, you can't make external changes from GI guns when shooting these matches. NRA Match Rifle rules and other disciplines offer greater leeway in making external modifications, however. We will discuss some of these options with regard to further stabilizing the barrel in a future article. 