Affordable Accuracy

By Bill Johnson

"Ha, ha, ha! You sure are a lousy shot!"

My friend Jorge had gotten to the target a few steps ahead of me and had a chance to look at first group fired by my new Springfield Armory Squad Scout (.308 Win.) rifle. Fresh back from a 9-month tour in Bosnia where I had been mobilized after 9/11, it was impossible to believe the rifle I had been dreaming about for so long wasn't performing, but there it was: a 6.5-inch group. While I know the Scout is no match rifle, I was expecting something in the 2-3 MOA range.

"No way! Something's screwed up!" was the only response I could think of. I've never been quick on my feet.

We were using Black Hills match ammunition loaded with the Sierra 168-grain HPBT bullet, so I was confident it wasn't the culprit, especially since it produces 1 MOA or better groups in my M21. Earlier, I had broken-in the Scout's barrel by firing 100 rounds through it without a single burp, cleaning the tube every five rounds for the first 50, then every 10 rounds thereafter. A look through the bore showed nothing out of the ordinary and copper fouling was almost non-existent. The Springfield Armory third generation scope mount was tight and properly installed, as was the Springfield Armory 6 x 50 range-finding scope. We were firing from a solid bench rest with a "Bud's Bag" sand-filled rest. There was no wind. I was out of excuses . . ..

I had bought the mount and scope as part of Springfield's "Scope-it" promotion. For $125 the deal was too good to pass up and I figured I could always use another scope. I installed the mount and scope on the Scout for the accuracy test, but intended to eventually install a C-More sight on the integral rail forward of the receiver as soon as I figured out a way to slip the purchase past my wife.

We fired the remaining 95 rounds of Black Hills ammo through the Scout, never managing to get a group smaller than 5.25 inches. We also shot at bowling pins out at 200-yards but only managed to hit a few of them. Both Jorge and I were confident of our technique, but watched helplessly as bullets struck all around the pins. Frustrated and out of ammo we took out our open-sighted IPSC ARs and commenced knocking the pins down. We then both fired sub-2" groups on paper at 100 yards with our open-sighted ARs from the sandbag, confirming that the problem was not our technique.

Back at home I disassembled and thoroughly cleaned the Scout and inspected every part for anything that might be degrading the rifle's accuracy. As far as I could tell, the quality of the Scout's fit and finish was good. I followed up by calling Springfield's support line and the technician there assured me the ammunition I was using was entirely appropriate for the Scout's 18-inch, 1:12 barrel. This is the same twist rate they use in their National Match barrels, which achieve outstanding accuracy with the Sierra 168-grain HPBT. His final comment got me thinking about this article: "It's not a sniper rifle. Without some serious tweaking, that's about all the accuracy you can expect."

For years, we've read about the "tweaking" a production rifle needs to become "acceptably accurate." The modifications include bedding the action, trigger jobs, re-barreling, blueprinting actions, component replacement, polishing internal parts, etc. All these things cost money and add to the total price of the weapon. Some are cheap and easy to implement, while others are very

expensive and require a gunsmith's expertise. Several of my guns could probably benefit from one or more of these "tweaks", but which tweak would improve accuracy the most? My wife constantly reminds me we are not made of money, so I've always had to find a way to get the biggest improvement for my meager gun allowance.

I decided to use the Scout and a stock Remington Model 700 in .308 as my "test guns" and make incremental improvements, quantifying the cost and measuring the effect of each "tweak" on accuracy. By performing a cost-accuracy (benefit) analysis following each tweak, I'd be able to identify what gives the most accuracy for the least money. I chose these two rifles because not all modifications to semi-autos can be applied to a bolt gun. Besides, it was a neat way to convince my spouse to let me get work done on *two* guns instead of just one, under the guise of "testing" and bettering gunkind.

Before beginning I decided to remove as many variables from the testing process as possible. First, I bought Oehler's model 35P chronograph by convincing my wife it was a piece of air-conditioning test equipment, thus avoiding having it charged against my gun allowance. Since deviations in velocity cause shot dispersion, the chronograph would verify the velocity and quality of the ammunition used during the test. During the test the 35P could flag out-of-bound shots and I could throw them out. As it turned out, this was unnecessary because the ammunition was consistent, but at least I got a new chronograph out of the deal.

To standardize the ammo during the test I prepared 1,000 rounds of .308 once-fired brass that I tumbled clean, sorted, sized, and trimmed to length. I also spent an entire weekend squaring the primer pockets and de-burring the primer holes. Once I had the brass prepped, I plugged in Federal's Match Rifle primers, charged with 43.3 grains of IMR-4064, and planted a Sierra moly-coated Match King 168-grain HPBT on top. This load's performance is almost identical to Black Hills' load and consistently produces accurate results at a fraction of the cost.

I invested my "savings" in a Caldwell "The Rock" heavy shooting rest and bench rest sandbags. This provided a very solid rest and reduced my contact with the rifle. I am, after all, the weak link in the firing process. I further insulated my shoulder from the rifle with a heavy shooting pad. At the moment of firing, the only part of me in contact with the rifle was my trigger finger.

Prior to the test I mounted my Springfield Armory Third Generation 6-20x56mm scope onto the Squad Scout. While doing this made the gun look ridiculous and me look like a total idiot to my buddies at the range, the extra magnification more than made up for my aging eyes, another variable. The M700 already had an excellent Leupold 6.5-20x40 target scope mounted on a Leupold QR base.

Next, I listed the possible improvements we could make to the guns with my gunsmith Larry Wright. Not all the modifications apply to both rifles and the prices will vary between suppliers and gunsmiths.

David Tubb's Final Finish System ($35). The .308 kits consist of 75 Sierra 190-grain bullets impregnated with an abrasive compound. The advertising promises that by firing them in sequence "you will soon be experiencing better accuracy, greatly reduced fouling, and much easier cleanup."

Trigger job or replacement ($50-$200). Gun companies deliberately build their triggers with heavy pulls in order to avoid litigation. Also, since they mass-produce their weapons, they don't spend a lot of time hand fitting and polishing small components. As a result, most out-of-the-box triggers are heavy, rough, and full of unpredictable creep.

Reducing Lock Time ($65). Many after-market manufacturers offer lightweight firing mechanism components that promise to reduce lock-time. While not available for all weapons (the Scout for example), they claim to increase accuracy. Some of the parts are made from exotic metals and are extremely expensive. For $359, one company makes a titanium "match grade drop-in trigger set" for the Ruger 10/22. (There are limits to my budget so if you want one of these tested, send it to me. I'll drop it into my $150 10/22 and mail you the test results.) In this test I installed a $65 SpeedLock firing pin and spring in the stock Remington Model 700. The company's brochure said the lighter pin and spring reduce lock time by over 20% but made no accuracy promises.

Bedding the action ($60-$100). Gun manufacturers can't afford to spend a lot of time mating actions with their stocks so the contact shifts from shot to shot, resulting in a shifting point of impact. Properly bedding the action allows it to contact the same points shot after shot, which results in better accuracy.

Recrowning the barrel ($80-$120). The crown of the muzzle is the last point of contact between the departing projectile and your weapon. If the muzzle is not perfectly square, or if there are minor imperfections during the mass production process, the projectile could be destabilized and wobble itself downrange. Clearly, this doesn't help accuracy.

Installing a Match Barrel ($200-$450). The most important ingredient to accuracy is the barrel. Unfortunately, replacing the barrel is also one of the most expensive "tweaks" you can apply to a new stock firearm and is not normally economical. In the case of a damaged or worn out barrel however, it may be the only improvement necessary. At this price, installing match barrels was not a reasonable option.

Blueprinting ($400-600). On the extreme high end of "tweaks", truing the receiver, squaring the bolt face and hand lapping the action can improve accuracy. At these prices, not for the faint of heart and not affordable on my budget. In any case, the accuracy improvements would be small and not recognized by the average shooter (me), but if you've got the bucks and want to grub out that last 0.1", blueprinting could be for you.

Establishing the Baseline

After setting up the chronograph and targets, I alternated firing ten rounds through the Scout and M700 to get the pattern on the paper, waiting one minute between each shot to allow the barrel to cool. The ammunition velocity in the Scout was consistent at 2500 fps with a standard deviation of only 13 fps. The M700 with an 8" longer barrel averaged 2604 with a SD of 19 fps. The weather was 48 degrees and perfectly calm.

While the rifles continued to cool, I used my stock M21 to validate the accuracy of the ammunition. After firing five fouling rounds, I fired one five round group into a .90" hole and a second group into .70". These results satisfied me with the quality of the ammunition and testing procedure.

I then fired three groups of five rounds with the Scout. Again, the ammunition was consistent with a standard deviation of only 17 fps. I had decided early on to fire groups of five instead of three because of the apparent randomness of the Scout. I wanted to reduce the chance of three "lucky" rounds producing an abnormally small group. This turned out to be a good decision because all the targets had "flyers" on shot number four, five or both. The groups measured 4.75", 4.37", and 4.19, meaning the average group measured 4.44, which I would use as the Scout's baseline.

The three groups for the M700 were *much* better, measuring only 1.75", 1.62, and 1.45", making the average group 1.61", which was the baseline for the M700.

Tweak #1 - David Tubb's Final Finish System

The most likely culprit on the Scout seemed to be the barrel. Even though my inspection of the bore didn't reveal any defects, I felt the Final Finish System held the greatest promise for improvement. At only $35 per kit, the final finish system was the least expensive modification and easiest to hide from my wife.

The .308 kits contain 75 bullets of five different levels of polish conveniently numbered 1 through 5 in a neat plastic container. I followed the instructions with only one exception. The manufacturer wants you to fire 50 of the bullets (10 of each level of polish) and use the 25 "bonus" bullets (five #3, ten #4 and five #5s) later if accuracy deteriorates. Since I could throw rocks into a tighter pattern than the Scout could shoot, I decided to fire all 75 bullets for maximum effect. I followed the manufacturer's directions for the M700.

With a one-minute pause between shots, and a thorough barrel cleaning between each string containing a different polishing compound, it took two hours to fire the 75 bullets through each weapon. The 190-grain Sierra Match King bullets were too heavy to stabilize in the Scout's 1:12 barrel and I hit only seven bowling pins at the 200-yard mark with the 75 shots. This did not build my confidence. The M700, with a 1:10 twist and 26" barrel, performed well with the heavier bullets, striking 71 of the 75 targets.

After firing the last polishing bullet, I cleaned the barrels thoroughly and fired five fouling shots with the test ammunition. Incredibly, the Scout's group measured 2.96". My confidence in American advertising restored, I fired three groups of five rounds for record. They measured 2.875, 2.75", and 2.375", for an average group size of 2.67". The M700 groups measured 1.15", 0.92", and 0.90", producing an average group size of 0.99". I had my sub-MOA rifle--barely.

In conclusion, David Tubb's Final Polish System improved the accuracy of the Scout from 4.44" to 2.67", or 39.83%. It improved the M700's accuracy from 1.61" to 0.99", or about 38.5%.

Finding: For $35 per weapon, this produced an exceptional accuracy improvement.

Tweak #2 - Trigger Work.

My out-of-the-box trigger on the Scout was pretty rough with a pull of 5.9 pounds. Even after a good cleaning and re-lubing it felt like it was full of sand.

The 700's trigger's pull wasn't too bad at 5.3 pounds, but still had some grittiness and creep. Larry and I felt there was room for improvement in both rifles.

I was sure the heavy pulls, combined with the excess creep and sloppy sear releases were contributing to the poor accuracy in both rifles. My original intention was to have Larry work on the Scout's trigger and replace the M700's trigger with an aftermarket part. The M1A has no drop-in replacement but Brownell's offers a "drop-in" trigger for the M700 that requires "minor fitting." The Timney's adjustability sounded great but the "minor fitting required" concerned me. My "fittings" have screwed up too many guns . . .. In the end, I had Larry tune the factory triggers on both rifles.

For $40 he cleaned up the Scout's trigger and returned it to me with a nice 4.5 pound pull and, more importantly, a crisp release. It was still not perfect, but was much better than the factory original. He performed a miracle on the M700. It now broke like a glass rod at only 2.5 pounds.

Off to the range . . ..

After a five shot warm-up, the Scout fired groups of 2.15", 1.85", and 1.75", producing an average group size of 1.92", representing a 28% improvement in accuracy. The M700 fired groups of 0.90", 0.57", and 0.50", producing an incredible average group size of 0.67", representing a 32% improvement in accuracy.

Finding: At about $50 a trigger job is a good investment and produced an exceptional improvement in accuracy in both rifles.

Tweak #3 - Bed the Action

The Scout's walnut stock was a pretty good fit but I decided to have Larry glass-bed the action and magazine well. In this respect I was lucky because Larry worked extensively with Marksmanship team at Quantico Marine Base and has bedded more than a few M14s. If anyone could do it right, I was confident that it was he.

The synthetic Remington stock was a pretty good fit and I could not detect any movement in the action, nor was there any contact with the free-floated barrel forward of the lug. Nevertheless, we decided that bedding the M700 stood a good chance of improving accuracy further into the sub-1/2 MOA range. I felt it was worth the gamble.

Six weeks later, I picked up the rifles and hauled them to the range. Admittedly, they both felt much tighter than before the bedding. The Scout, in particular felt like a single solid unit and had no visible gaps where the receiver met the walnut stock. When I took the rifle apart to inspect the bedding it actually fit so tightly that it was hard to separate the receiver from the stock.

After warming up the barrels with five shots each, I fired the Scout into groups of 1.2", 0.75", and an incredible 0.50", making the average group 0.82" representing a 57% improvement in accuracy. The first three rounds for the first group measured only 0.19", but the fourth round spread the group to 1.2", with the last round somewhere in the middle.

The M700 put the rounds into groups of .056", 0.56", and 0.88", keeping the average group size at 0.67", representing a 0% improvement in accuracy. Just to make sure I shot two groups at 200 yards that measured 0.56 MOA and 0.75 MOA, confirming both the high quality of the Sierra reloads and the accuracy of the rifle.

Finding: At $65, the bedding produced a dramatic improvement in accuracy and turned out to be an outstanding investment for the Springfield Scout. The M700 however, did not benefit from this improvement, probably because the fit between the action and stock were already extremely tight.

Tweak #4 - Improve Lock Time (M700 only)

While looking through Midway's catalog I found a replacement aluminum alloy firing pin and lightweight spring for the M700 manufactured by SpeedLock Systems. Their advertisement promised to reduce the lock time by 39% (from 2.6 milliseconds to 1.6 milliseconds), which, in theory would improve accuracy. Their argument is that a faster lock time will cause the bullet to impact closer to your point of aim when you pulled the trigger. Since everyone's rifle is moving, faster lock times get the bullet out of the barrel faster. According to the brochure: "by the time the firing pin has reached the primer on most rifles, the bullet has already left the muzzle on a SpeedLock Systems gun!" I've always been a sucker and at only $65 I felt it was worth the gamble & ordered one. Requiring special tools for installation, Larry only charged me $10 for installation,

bringing the total cost to $75. While I have no way to measure the exact lock time to confirm the manufacturer's claims, I felt I would be able to measure the effect on accuracy - the *true* indicator of whether it was worth the money.

Stock firing pin weight: 657.9 grains
Stock spring weight: 193.7 grains

SpeedLock's alloy firing pin weight: 277.3 grains
SpeedLock's CS spring weight: 144.8 grains

The three groups measured 0.75", 0.64", and 0.62", producing an average group size of 0.67", representing a 0% improvement in accuracy.

Finding: At $75, this may or *may not* be a good investment in a stock firearm. I'm waffling on this because I fired the groups entirely from a solid bench off the sandbagged rest. This is probably not a fair assessment of the Speedlock's potential because under those test conditions a faster lock time would probably not have a considerable effect on accuracy. Where a faster lock time *could* make a significant difference is while firing off hand. Since most hunters fire from the off hand positions, I decided to build a fixture to measure the effect of lock time on a weapon fired while in motion. Because of time constraints and complexity in building such a fixture, this will have to be the subject of a future article.

Squad Scout - Conclusions

The results of the experiment are summarized in the charts and tables below.

Clearly, the Squad Scout's performance improved significantly after lapping the barrel using David Tubb's final finish product. This produced a 39% accuracy improvement for only $35. By far, this is the biggest bang for the buck. If you only do one thing to your Scout, lap the barrel.

For another $40 you can expect a trigger job to get you another 28% improvement. For only 75 bucks (about 5.3% of the original purchase price) for lapping and a trigger job, you can cut the size of your groups in *half!* Not a bad return for your money.

My final tweak was to bed the action for $65, which again chopped the average group size by more than *half!* I was so surprised by the results of this improvement that I convinced a friend to let me perform the same experiment on his new M1A stock rifle. (He'll pay for the bedding, naturally.)

Were I to do this experiment over, the priority of improvements would be bedding, bore lapping, and trigger job.

Remington Model 700 - Conclusions

Before starting this experiment, I was not sure there was much room for improvement in the M700. While 1.6" wasn't great, it wasn't bad for an off-the-shelf rifle and I was pretty happy with it.

After lapping the barrel I was flabbergasted with the "new" sub-MOA tack driver. Admittedly, 0.99 isn't *much* of a MOA rifle, but there it was...for only $35! I seriously considered stopping there, afraid that any further "tweaking" might ruin a good thing. In the end, more *was* better.

The results of the trigger job were astonishing and I have to give full credit to Larry's gunsmithing skills. The trigger job is truly a work of art and makes all the difference in the world to the rifle's

performance and accuracy. For 75 bucks (14% of the original purchase price) the groups went from 1.6" down to .67 after only lapping and a trigger job. The bedding was an obvious waste of money since there was absolutely no improvement in accuracy. I attribute this to the design of the M700 using two receiver bolts that solidly lock-up the action to the stock.

For this test, which I fired entirely from a solid bench off of a sandbagged rest, the SpeedLock firing pin and spring had no effect on accuracy. I decided to measure the effect of this improvement off a moving jig during a future article. For this test, the SpeedLock upgrade had absolutely no effect on accuracy.

Were I to do this experiment over, the priority of improvements would be bore lapping and trigger job. I'll need additional tests to determine if the SpeedLock has any improvement on off hand accuracy. For that test, I convinced my wife I needed an unmodified weapon on which to make improvements and she let me order a new Remington 700 PS in .223 Rem. Life is good!