

# **“SLUGGING” and EVALUATING RIFLE BORES**

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One day several years ago, one of my customers brought in a rifle he wanted me to accurize so he could shoot it in the 1000 yard matches at our Iowa 1000 Yard Benchrest Club. He said he bought a new Remington 700 Sendero in 7mm Remington Magnum to shoot in our Factory Class, but it had accuracy issues and was copper fouling badly.

I had been “slugging” bores as part of my rifle accuracy evaluation procedures for awhile then and had been finding all sorts of things in barrels by doing that. When I “slugged” the bore in this rifle I felt a real tight spot about half way down the bore – definitely not good. When I looked in it with a borescope I could see heavy copper fouling in that area, so I cleaned the copper out and slugged it again. I could still feel a tight spot there although with the copper out it now looked normal in the borescope.

I test-fired one round and it instantly copper fouled heavily again in that same spot – I mean a hard copper ring all the way around the bore for about an inch. The barrel was obviously bad, but the customer didn’t want to take the time to send it back to Remington to see if they would warranty the barrel, so I did my basic match accurizing on the rifle and then lapped the bore until it slugged good, telling the customer to carefully break the barrel in again and then hope for the best.

Two weeks later at our next 1000 yard match he was there and told me it was shooting really good and the fouling problem had gone away. Later that morning our target crew came back from changing targets after the Factory Class had shot and they were all excited about one of the targets. It measured 2.860” and scored a perfect 50 points, setting two new range records for the Factory Class – which still stand to this day. You guessed it - it was this guy with his “problem” Remington Sendero that set those records.

One of the things I’ve done for years now on a daily basis in my shop is evaluate the bores in rifle barrels. I do it on used barrels in rifles that customers send me that have accuracy problems, of course, but I also do it on all new custom barrel blanks I get in from the top barrel makers. It is not difficult to do and in my mind it is so important that I have started to teach this to people all over the world through my instructional DVD’s and in my custom gunsmithing classes.

I evaluate barrels before I start chambering and installing them on the custom rifles I build because I would much rather find any barrel problems before I go to all the work and expense of fitting it to a rifle rather than find out later from my customer that the barrel isn’t shooting very good. Even more important is the fact that every problem barrel that I find and correct before it leaves my shop saves that customer a lot of his time, expense and frustration!

Believe me, barrels with problems do happen more often than most people realize, even with the highest quality barrels from the very top barrel makers in the world today. Barrels are a man-made

item that are primarily manufactured with machines which have to work within a tolerance range and which can have problems develop from time to time during a production run. Most custom barrels are also hand-lapped by the barrelmakers, which is supposed to uniform the bores and correct any problems, but if not done correctly can cause problems also.

Barrelmakers are also at the mercy of the steel companies which produce their barrel steel, and the steel itself can have problems that get past them occasionally.

Most (but not all) of the top custom barrelmakers use sophisticated equipment and procedures to evaluate their finished products, but they have to produce their barrels very quickly on a production basis, and problems do get past them occasionally because I sure find them from time to time. It is an extremely rare occurrence from some makers and unfortunately more common to others.

Some of the top barrel makers have earned excellent reputations by often producing record-setting barrels, but unfortunately after I started evaluating all the new barrel blanks coming into my shop from some of them I found an unacceptably high "reject rate" on their barrels, so I rarely use their barrels now because so much of the quality of my work depends on the quality of the components I use.

Please don't ask me which barrel makers I've frequently found problems with in the past, because I won't tell you – the past is the past and hopefully they've got their problems figured out by now. I really like these people personally, I just don't feel the quality of their product is always at the level I want, and I just can't afford the time and frustration it takes to deal with problem barrels.

In my opinion, a lot of these problems are being caused by the barrel-makers employees who are finish-lapping their barrels. It takes awhile to train an employee to lap a barrel properly and if he's really good, the barrels he produces will be top-notch almost all the time. But if he quits, then the barrel maker has to spend time training a new lapper to take his place and the quality may suffer during this time.

I noticed this several years ago when all of a sudden a high percentage of the barrels coming to me from one particular barrel-maker showed bore dimension issues. In my discussions about this with the owner of the company, I told him I wondered if his lapper was causing the problem. He told me his best lapper had recently quit and they were in the process of training a new guy, and this was where the problems were most likely coming from. He said that training and keeping good lappers is one of the toughest problems he has to deal with to keep his quality where he wants it.

Bore lapping is definitely something that can be learned, but it takes time to do it right, especially if there are dimension issues that need to be corrected in a particular barrel. Barrel-makers need to do this process very quickly on a production basis to be able to get the barrels out the door to us for the price they do, and for the most part they do an outstanding job of it.

Individual gunsmiths like myself or savvy do-it-yourselfers who don't have to do it fast to keep production going can take whatever time is needed to evaluate a bore, then go back and forth lapping it and re-evaluating it until it is as perfect as they can get it.

I've got a video coming out soon that goes into great detail showing how to lap bores in rifle barrels accurately without damaging the bore. I've done it for years with excellent results on both factory barrels and custom barrels with "issues" that I didn't want to take the time and effort to send back to the maker.

Gunsmiths and interested gun owners/do-it-yourselfers almost never have access to the high-dollar measuring equipment that the barrel-makers do, but they definitely can still use easily learned

methods to evaluate barrels and find quite a few problems that barrels sometimes have. This is what I teach in my videos and classes and what I am going to describe here.

There are two basic methods I use to evaluate barrels: a borescope to visually inspect the bore in a barrel, and “slugging” the bore with a lubricated lead slug. Slugging a bore lets you feel and measure even slight variations in internal bore diameter – I’m convinced you can feel variations as small as .0001”, which is smaller than what you can measure on the slugs.

I’ve tried several different borescopes, but the best by far in my opinion is the Hawkeye borescope by Gradient Lens Corp. I have 2 Hawkeye borescopes – a 7” which I use constantly for chambering and lathe work or any time a short one will work, and a 17” which I use for all other purposes. My 17” Hawkeye allows me to inspect the entire length of a bore in almost any length barrel by looking from both ends, even with the action attached.

It’s amazing what you can find with a borescope in some of these barrels, especially factory barrels and used or abused custom barrels, but I even occasionally find flaws in new custom barrel blanks with my borescope. Then you’ll have to decide whether it is something you can correct or improve yourself (like problems with most factory barrels since they generally won’t allow returns for anything except serious internal flaws or damage that is obviously their fault) or if it should be returned to the manufacturer for correction or replacement.

The other method of evaluating rifle bores is “slugging”. This is simply pushing a lubricated lead slug through a clean bore and feeling for any variations. You can also measure the slug to find out the inside bore diameter at different points. The ideal bore will feel very smooth and exactly the same all the way through, or maybe gently get ever so slightly tighter toward the muzzle end. What you definitely do not want to feel is loose and tight spots through the bore, abrupt changes in bore dimensions, or worst of all loose at the muzzle end where the crown is or will be. Barrels with these problems will almost never shoot very well, no matter who makes them or how carefully they are chambered. A bore with a “bell-mouthed” muzzle is also almost impossible to lap effectively because you have to enlarge the whole bore to get it the same size as the muzzle, and this larger diameter bore can negatively affect the seating depth of the bullets into the throat, and in some cases may be oversized enough that the bullets will be loose in the bore – no matter what, they won’t shoot good.

It is very important to clean the bore thoroughly, especially if it has been used, but even new unfired blanks should be cleaned first. If it has been fired, it’s a good idea to use an abrasive bore cleaner like JB or Iosso in the bore, especially in the throat area, to get rid of as much fouling as possible before slugging the bore since you’ll feel most of the fouling in the bore. Then lubricate both the slug and the bore with 20w50 motor oil, which I’ve found to be one of the best lubricants for this out of the many I’ve tried over the years.

One thing you will notice is that on almost all used barrels, even after you’ve thoroughly cleaned the bore, the slug will still feel tight in the throat area. I think this is more a friction difference than a dimension difference. The roughness of the throat starting to erode will make the surface have more friction, and this will make the slug push much harder when it gets to this area. Your first thought will be that the bore is smaller at this area, which it is if fouling is still present, but after finding this all the time on my own previously perfect match barrels I have come to the conclusion that it’s friction I’m feeling since this gets worse as the barrel gets older and throat erosion gets more pronounced.

I buy caliber specific lead “slugging bullets” from Neco. They are a cast lead “bullet” that is easily driven into the lubricated bore with a plastic hammer, and then pushed back and forth with brass rods to feel for problems. I use a Brownells screwdriver handle to push the brass rods since it fits over the end of the rod nicely and makes it easier to push the rod and feel what’s going on in the bore.

You have to be extremely careful not to cause any damage to the bore when doing this. I use brass rods of varying lengths to push the slugs through, and I radius the ends and polish these rods to help them slide through the bore without marking or damaging the lands. I buy my rods in 6’ lengths from MSC Industrial Supply and cut them to varying lengths starting with a 3” one to get the slug started, then get progressively longer to 10”, then 22”, and finally my longest rod is 37”.

The slugs start out pushing very hard and if you try it with just a long rod, you’ll end up bending and buckling the rod, so just start short and use progressively longer rods until the slug gets to the other end of the bore. Some bores, especially in factory barrels, are so rough and have so much friction that you literally have to use a plastic or rubber hammer on the brass rod (very carefully) to drive the slug most of the way through the bore on its first pass before it gets loose enough you can push it by hand. It’s amazing how much easier and smoother slugs push through good custom barrels and properly lapped factory barrels than they do through most factory barrels – no comparison!

When the slug is tight and pushing hard, you really can’t feel bore variations very good at all, so at first just push the slug back and forth until it loosens up and pushes easier. By the time the slug has made one or two passes through the bore, it is usually pushing easy enough to use just the longest rod. Once it gets easier to push you can start to really feel what is going on in that bore, and you’ll usually be able to push it back and forth 2-4 more times before it gets too loose and you lose your feel. Then you’ll need to “bump up” the slug to tighten it in the bore or use a new slug if you need to do any further evaluating.

It’s easy to “bump up” a slug in the bore. Just push the slug in one end of the barrel with the 3” starter rod, leave the 3” rod in the barrel against the slug, and slide the longest rod into the barrel from the other end. Then stand the barrel up on your workbench or a non-marring hard-surface floor with the 3” rod and slug at the bottom. Now tap the slug with the long rod a few times and this will expand the slug to be tight in the bore again. Do this gently or you can make it so tight that it’s hard to get it moving again.

If there are large variations (.001”-.002” or more) in the bore size like you’ll often find in factory barrels (I’ve even found custom barrels this bad, but it’s rare), you may only be able to get the slug through once or twice before the tight areas squeeze the slug down so much that it’s then too loose to be able to feel anything in the rest of the barrel.

If the barrel has been chambered and crowned already, you’ll have to very carefully start it in the crown end since it is very difficult to get it started at the chamber end without damaging the throat. Just be careful to center your rod so it won’t rub on the crown and you’ll be OK. I’ve done this hundreds of times over the years on used barrels and if done very carefully and correctly you will not damage the crown at all – but you have to be extremely careful!

It’s best to mark the rod so you stop the slug just short of going out either end as you push it back and forth. If the slug does come out, you usually can carefully re-insert the slug into the bore by aligning the grooves. Now push the slug back and forth and everywhere you feel a loose or tight spot, use a Sharpie to mark on the outside of the barrel where this is. This is especially important to do if you

are going to lap the bore, since you'll have to lap more in the tight areas to get them evened up to the looser areas of the bore.

Another thing you can do if you feel a difference in size at one end or the other, or to actually measure the bore diameter at loose and tight spots, is push a slug an inch or so into the muzzle end and then push it right back out, then do the same thing at the chamber end or at a tight spot in the bore with another slug. You may have to push the slug all the way through on a chambered barrel and then "bump it up" to tighten it in the bore at the chamber end if it is getting loose so both slugs will have about the same "feel" when pushing them out. Then use a micrometer (not a dial caliper since they aren't accurate enough for this) to measure the slugs for bore diameter. You'll be able to measure the difference between them to find out how much difference there is in bore size at loose and tight spots.

Another big advantage of slugging a new custom barrel blank is to figure out the best place to crown a barrel. You definitely do NOT want to crown a barrel where it is looser than the rest of the bore. If I slug a bore and it feels exactly the same all the way through, which I really like the best, I can then just cut and crown it anywhere and it will be perfect.

You will occasionally find barrels that get slightly tighter towards the muzzle end. Some barrelmakers purposely lap a very slight taper into their bores so they will get progressively tighter toward the muzzle end, and if they do this correctly it will work just fine. My opinion on this is that in theory this is great, but in actuality it doesn't always come out so good. Unfortunately over the years I have found a lot of problems with these taper-lapped barrels which in my mind is probably because this process requires extra lapping which can induce more human error into the process.

I frequently find other problems with new custom barrels when I slug them. Contoured sporter barrels are often tight at the chamber end and then they get noticeably looser a few inches ahead of that right where the barrel contours down. I also often find fluted barrels to be enlarged under the flutes. The slug pushes fairly hard until it comes to the flutes, then it pushes very easy until I reach the end of the flutes, where it gets tight again – I find this a lot, and it's not good!

I also frequently find that previously perfect barrels get enlarged at the crown end after turning the barrel down to install a muzzle brake, which definitely hurts accuracy. When you remove metal from the outside of the barrel for installing the muzzle brake - or for fluting or sporter barrel contouring – the bore has a tendency to enlarge under this area. I get around this by special ordering muzzle brakes with as large a thread as possible and then turning as little off the barrel diameter as I can. This works very well.

So as you can see, evaluating rifle barrels is an extremely valuable procedure that almost anyone can do. Using a borescope is literally an "eye-opener" because you can actually see so much of what's going on in a barrel, and slugging a bore is an accuracy evaluation procedure that I find extremely informative. Over the years I have learned an incredible amount of useful information about rifle barrels and accuracy since I started borescoping and slugging them. Start doing it yourself – you will be amazed at what you'll find and how it will help you!

Gradient Lens Corp    1-800-536-0790    [www.GradientLens.com](http://www.GradientLens.com) (Borescopes)

MSC Industrial Supply    1-800-645-7270    [www.mscdirect.com](http://www.mscdirect.com) (Brass rods)

Neco    1-800-451-3550    [www.neconos.com](http://www.neconos.com) (Slugging bullets)

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