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ORIGINAL METHODS. MODERN ACCESS.

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FROM THE ARCHIVE

Old Technology, Stale Designs, Part One

BY AMERICAN GUNSMITH EDITORS JUNE 2014

ORIGINAL PP. 2

An editorial by Paul Mazan. I am getting tired of gun magazines crammed full of stories about AR-15s, 1911s, Glocks and Glock look-alikes. The American firearms industry used to be known for innovation. Unfortunately, this hasn't been the case for decades now. New firearm design innovations since have largely come from other countries. The American market is living on old designs and variations.

John Browning's 1911 pistol has been copied and offered by just about everyone who's ever made a firearm, continues to dominate the American market, and is over 100 years old. Our bolt-action sporters owe their existence to the 19th Century designs of Mauser. The AR-15 design is over 50 years old and its only real competitors, such as the AK-47, are even older. New Glock look-alikes are not innovations, they're plagiarism.

For years, "exciting" new products from the major manufacturers have been limited to equipping their old designs with different stock materials, metal finishes or triggers. Granted, I love the Models 70, 700, 77, 1911, M&P, 870 and 11-87—but let's face it, they're all ancient. From a gunsmith's perspective, the stagnation of technology makes life easier. However, it disturbs me that nobody within the industry has a fresh idea.

Is it because we don't attract innovative thinkers or because shooters are resistant to change and companies are afraid to take chances? I suspect it is both. Personal

experience indicates most sales personnel in the industry are not shooters. When they come to SHOT Show or NASGW the conversations I overhear are not about shooting, they are about golf. Conversations are often about the industry-sponsored golf outing they attended the day before.

As our once shooting-oriented company founders have gotten old and sold out to corporations we have gone from being passionate about firearms and shooting to the corporate passion for profit. When I first noticed golf becoming the sport of choice among many industry professionals and wondered why they didn't sponsor shooting events instead, I thought it wise to get them involved with the products they were selling.

However, in talking with more of them I discovered these industry professionals simply did not care to attend a shooting venue and wouldn't show up a day early to do so. While individual entrepreneurs hire people with a passion for firearms, corporations hire people based on previous sales success in other industries. That is the reason there is so little innovation and why we are seeing the gun culture die in the companies that make guns.

Next time I'll discuss some examples of conversations I have had with reps that illustrate my point. All took place several years ago as I no longer attend the shows, but are still relevant.

FROM THE ARCHIVE

Precision Barrel Fitting, Part Three

Why squaring the receiver face is mandatory before joining it to a barrel.

BY CHICK BLOOD JUNE 2014

ORIGINAL PP. 3-5

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Suppose you weren't working on a barrel fitting job. Suppose you were making a wooden picture frame. If any one of your four frame sides isn't squared and true on its ends there will be gaps instead of tight joints where the frame angles meet. In such a situation, these gaps can be filled and blended smooth before the frame is painted. The last time I looked, I found no rifle barrels or receivers made of wood so we won't be able to cover such mistakes as easily.

The first guns were made prior to metallurgy being advanced enough to cast tubes. Cannon barrels then were slat constructed similar to casks and kegs. The result was then heavily banded with metal. These bands were applied primarily at the breech but I have seen etchings of them spaced out along the tube during one of my visits to the Tower of London. Sometimes the banding It must be accurately turned with all diameters and center holes concentric. Any uncorrected misalignment will cause a loss in accuracy.

The process takes minimal time but can be the most important machining step taken inn precision barrel fitting. worked. Sometimes it didn't. When it didn't, it

wasn't enemy arrows that knocked down defenders. It was splinters. The point being made here so far has been an alert. I'll make it a warning: Never begin any barrel fitting steps before the receiver has been squared. The process is simple and can be done in about ten minutes.

Leave it undone and any imperfection of the receiver will be amplified when the barrel is attached. As for a few examples, consider that if the receiver tilts down, up, to the right or to the left, any barrel joined to it will tend to point low, high, right or left, only more so. Sometimes the sight system installed might be able to compensate, but it is safe to say the receiver will never be center bore with the barrel. Or, if you prefer, visa versa. Actually, the procedure for squaring the face is simple.

It can take as few as ten minutes. Drawing 18 shows you the setup for turning. You may have noticed the receiver wears no external parts. They have all been removed including the trigger assembly. Whassup? Having stuff attached to and sticking out from the receiver during turning would

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The table it refers to was reproduced in an earlier article in the barrel fitting series. be dangerous for the operator and ruin the receiver if, for example, the trigger group whacked some part of the lathe. I add, the potential damage is frequently reciprocal. manufacturing operation always keep top of mind the requirement just made regarding center holes and diameters. Make step-by-step notes The receiver facing mandrel illustration is your road map for making a mandrel.

Avoid trying to square a receiver face without one. All center holes and diameters made in the fabrication of a mandrel are required to be absolutely concentric. Receiver threads must be precision turned. Throughout this mandrel As indicated in this tool application chart, all metal removal excepting the left and right finishing shapes is accomplished with the tool point. This includes boring and internal threading. to support your memory from here on in.

The blank round stock to be transformed into your mandrel can be held in a three-jaw chuck, but a four-jaw self-centering one is much preferred. You'll discover

why as this article proceeds. Center drill one end of the round. Reposition the round leaving about half its thread relief end secured in the chuck. Turn the blank to the proper thread diameter. Mark the thread area. Turn the remaining length of the round to be a very close fit with the receiver bolt way. Turn the receiver threads.

Reverse the workpiece end to end. The diameter of the round may have to be reduced to be secured in the jaws. Then, indicate the piece to be on center, plus or minus 0.0005. Center drill the remaining end of the round and turn the result to match the bottom of the receiver threads, minus 0.025 to 0.030. The mandrel is now complete. Of course a self-centering threejaw chuck could be used.

The problem is most of them return to center with a plus or minus of 0.001 to 0.002, while their four-jaw counterparts return to 0.0005. Therefore, the three-jaw is not recommended. Squaring The Receiver Face Setting up will require more time than the work. Either a general pur-



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Actual work on the barrel such as crowning and chambering will be addressed soon in future articles. Breech diameter, contour, length and taper are usually specified by caliber and cosmetic specifications provided to the barrel maker when the order for it is placed. pose cutting tool or a dedicated facing tool can be used.

Whichever you select must have its left side face set at a 5 to 10 degree angle to the receiver face. The point of the tool, not its side, will do all the cutting.

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PEOPLE & COMPANIES

Building The 90 Grain AR-15, Part Three

BY JOE CARLOS JUNE 2014

ORIGINAL PP. 6-10

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All of my 90 grain AR-15 loading data was developed in Wylde chambers, being a good compromise chamber when shooting both 77s at the 200 and 300 yard lines and 90s for 600 and 1000 yard lines. I used new military Western Cartridge Company or Lake City brass with crimped primers in all load development. Always work up gradually from well below any recommended loads, watching closely for signs of pressure.

Measure your chamber using a Stoney Point (now owned by Hornady) overall length gauge and an 80 grain Sierra Match-King bullet. Yes, I know we are shooting 90s but the standard of measurement was developed ages ago before 90 grain .22 caliber boat tail bullets were even invented. If your chamber is a true Wylde it should measure 2.475" overall, from case rim to bullet tip. Don't worry much as long as you're within 0.010", plus or minus, but be ready to adjust your loads if you have a much larger discrepancy.

Shorter chambers require reductions in powder charge weights. Remember, gunsmiths chambering these barrels may work on hundreds a year and reamers wear out.

They may order Wylde replacement reamers but not all reamer companies deliver the exact same dimensions. I use competition bullet seating dies with micrometer adjustments so I can vary my bullet seating depth in 0.001" increments to hit the sweet spot. My initial average jump for these boat tails is about 0.004", roughly the thickness of a sheet of copy paper.

I have guns set all the way from 0.000" to 0.010". When I take Stoney Point readings I don't shove the bullet up hard into the back of the barrel. I push it gently until it contacts and then stop. Everyone's measurements will vary from those taken by another person. Make sure your barrel and chamber are immaculately clean before attempting to use the Stoney Point.

For 90 grain boat tails I recommend starting with my 0.004" jump and work back and forth initially in 0.002" increments until you see which way your gun wants to go. Then you can fine tune down to 0.001". Once you find your bullet seating sweet spot you can probably leave it set there for an entire shooting season. Boat tails are not like VLDs and don't require chasing the throat.

Note, when setting jump and establishing sweet spot bullet seating lengths you will be using the actual 90 grain bullet in question, not the Overall length gauge in center is used to identify what chamber is in a gun. Headspace attachment on bottom is used to adjust sizing dies for proper 0.003" shoulder bump. 80 grain SMK which is just used to communicate lengths with other loaders. You will need to have the comparator and appropriate bullet insert attached to the caliper to establish this.

I know this may sound a little confusing and esoteric at first. Read Glen Zediker's Handloading for Competition. I am planning a series of articles on making ammunition in the future. Stay tuned. Brass Issues Some notes on brass, shoulder bump, concentricity, primer retention and neck tension. Brass used in my load work ups was all new WCC or LC military with crimped primers, shot once and thrown away.

If you are using used brass or brass without crimped primers, your primer retention issues will be likely more severe and you may have to reduce charges. A bolt carrier weight may help but if you are going to use one

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From left, a K&M 0.2235" expander, custom mandrel by Northern Competition beside the die body from Sinclair that it fits into and Redding Type S full length sizing and neck sizing dies with an interchangeable bushing in the foreground. make sure it is in when working up loads and zeroing. I recommend removal of carrier weights for 77 grain rapid fire shooting as they can induce malfunctions.

I use quality Lapua brass in many cartridges and really like it, however, I avoid it in the .223 because it is thicker and heavier than the military brass. I don't think you can get Lapua with factory crimped in primers. My experience has shown that you have to reduce powder charges about a half grain when using Lapua brass. For 90 grain slow fire ammo I run a pretty light neck tension of about 0.001" to 0.0015" and heavier neck tension, obviously, for 77 grain rapid fire ammo.

To obtain that, I run a hardened 0.2235" mandrel down the snout of the casing. Northern Competition should be able to furnish you with such a mandrel, stocking 0.224" sizes and can easily turn down to a half thousandth. You can also custom order from K&M Services To get the same kind of

neck tension on a military casing that has been fired in your chamber, use a 0.247" outside neck bushing.

Neck size the casing only (no need for full length sizing for slow fire) and bump the shoulder back about 0.003" so it feeds and extracts well. Use a headspacing attachment to determine when you have the 0.003" bump right. Use a quality competition neck sizing die. My tests have shown about a 21% improvement in group size when properly outside neck turning cases. Use a hand tool and follow the manufacturer's instructions.

When reloading neck turned cases, substitute a 0.246" neck bushing to keep the same neck tension. Cartridge concentricity is key in competitive shooting and especially important in any fast twist barrel (1:8 to 1:6.5".) I recommend never shooting any round, 77 or 90 grain, in competition that has more than 0.003" of run out. Porter Precision and Hornady both market tools to straighten out-of-round cartridges.

In order to get reliable adjustments, practice using these devices to The Sinclair gauge in center just identifies misalignment of bullet to casing. straighten rounds that gauge 0.004" or more initial run out. Powder I use Alliant Reloder 15 or Vihtavuori N140 powders in 90 grain loads

for 20" service rifle barrels, having tried others in the same burning range, such as Hodgdon Varget, Accurate AA2520 and VV N540.

Such powders all pressured up about the same as RL15 and N140 but usually shot slightly fatter groups and exhibited higher maximum extreme velocity spreads, resulting in vertically strung groups, especially at 1000 yards. The Army Marksmanship Unit may have used VV N550 in their 20" barrels back in the early 2000s when they were shooting 90s, which is slower burning than the others. My experience indicates it shoots fatter groups and exhibits noticeably higher maximum extreme velocity spreads.

It may be that a 20" barrel is just too short to get such a slow burning powder to perform optimally. N550 is a fine stick powder so you can get more of it in a .223 case. Start at about 25.0 grains and cautiously work up to no more than about 26, watching pressures as you approach the higher levels. One of the few persons I know to have ever blown up an AR-15 did so with a 90 grain Sierra backed with a charge of N550 exceeding 26 grains.

If you are trying to hit 2,600 fps muzzle velocity and can't get RL 15 or N140 to stay within pressure limits, you can

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Author's favorite powder is Vihtavuori N140 in the small container. Beware of the high energy powders on right as the author experienced early and heavy fire cracking, diminished accuracy and inconsistencies in velocity with them. probably switch to N550 and make it. The downside may be fatter groups and higher maximum extreme velocity spreads, however, each gun is different so it may be worth seeing how N550 performs in yours.

Both high energy Vihtavuori powders (N540 and N550) burn at hotter flame temperatures than most American powders. When I was using button rifled chrome-moly Pac-Nor barrels the imported powders ate them for lunch. I had any number of such barrels shoot out at 500 round counts! Bore scoping revealed heavy and deep fire cracking from the throat down the bore for about six inches, roughness that was tearing the fragile Sierra jackets to shreds. If you are going to use these powders I recommend cut rifled barrels.

Stainless barrel steel seemed to resist the roughening somewhat better. Everything in shooting is a trade off and shooting 90s is no exception. VV N140, however, will not damage barrels excessively, is very accurate and gives consistent velocities. It is my first pick for 90s.

Bullets JLK 90 grain VLDs are the original bullet from Jimmy Knox that was around for years before the Army Reserve Team discovered that 5R rifling patterns (1:6.5" twist) offered by Bartlein, Satern, and Rock would optimize the performance of this 90. When the AMU was shooting this bullet in the early to mid 2000s, the 5R hadn't been offered in 6.5 twist yet. I am pretty sure that the AMU would have done better with the 5R barrels that are available today.

Some USAR Pattern Krieger four groove barrels (0.218" bore with 0.2245" deep grooves) will also shoot the JLKs well. I have not had much luck getting the Brux four groove barrels to shoot it, however. The Pac-Nors don't like either VLD bullet. JLKs are now available from Swampworks Inc. (swampworks.com, and the new owner, Steve Milholland, only makes one or two runs of 90s a year so order well in advance. The JLK requires "chasing the throat" because it is a VLD.

The JLK has the highest ballistic coefficient (.580) of any 90 on the market and are probably the most costly. You will want to hit a muzzle velocity of about 2,600 fps for optimal 1000 yard performance. Try charges of 23.5-24.4 grains of either RL15 or VV N140 depending on the preferences of your specific barrel. This bullet seems to like a fairly heavy jam into the rifling. Plan

on 0.005-0.010" of engagement. This seems to be a reliable bullet and I don't know of anyone who has ever blown one up.

It will give you about 28.6% wind-proofing advantage over the 80 grain SMK. Berger (bergerbullets.com, 90 VLDs now have a thicker jacket but most of my experience with this bullet was with the old thinner jacketed version. I have had good luck getting the Berger to shoot in across section of barrels. About the only barrels that didn't like either it (or the JLK) were the two Pac-Nor offerings. The B. C. Is a respectable .551.

Go with the same charge, velocity and throat recommendations as the JLK, though the Bergers seem to like a little less aggressive jam into the rifling. This bullet is usually available for mail order from Sinclair and Midway. The Sierra (sierrabullets.com 90 grain Boat Tail is readily available from many gun shops and mail order sources. When this bullet was introduced in 2005 many folks hoped it would replace the venerable 80 grain SMK as the mainstay in the AR-15 for long range competition.

Although Sierra cites me as providing the first creditable report of the bullet blowing up, others very quickly shared the dubious experience and the bullet got a really bad reputation on the firing line. Due to some confusion as to exactly what bullets were blowing up, the reputa-

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Which bullet do you want to be shooting in rapidly changing wind conditions? tion of other 90 grain bullets became collateral damage. The B. C. of the Sierra 90 is .504 (their 80 grain Match- King is only .420) and in order to keep it reliable to 1,000 yards the factory recommends a 2,650 fps muzzle velocity, 50 fps faster than the others. I was able to get the recommended 2,650 fps and remain within safe pressure limits. Try 23.8-24.4 grains of RL15 or VV N140.

Achieving that kind of velocity in a 20" service rile barrel, however, resulted in some really rough obduration and other stresses on the bullet, and blow ups were common. I have never had an accuracy problem with this bullet, just reliability issues. The original Krieger constricted 0.218" bore with a standard .2240" groove ate Sierra 90s for lunch. I worked with the bullet and barrel makers for about two years and I came as close to getting it to work as anyone.

The Pac-Nor 5P and conventional 3 groove chrome-moly barrels, especially if electropolished by Black Star, were reasonably "Sierra friendly," but not entirely "Sierra proof." The Krieger USAR Pattern (0.218" bore with deep 0.2245" grooves), if electropolished, was probably

the second friendliest barrel configuration. Electropolishing reduced constriction and smoothed out any remaining tool marks in the bore that could snag at bullets on the way by, weakening them. There was always that nagging doubt, however.

If you have ever blown up a bullet you won't soon forget. There is enough pressure on the shooter on the line trying to deliver a good score. Adding to this the uncertainty that all twenty bullets might not reach the target is just not fair. I have spoken to folks at the Sierra factory about this bullet many times. They know how to fix it. So why haven't they? They say that they still sell a few bullets from the last factory production run dating nearly back to the origin of the bullet in 2005.

I suppose if customers were willing to drop muzzle velocities back at least a couple of hundred feet per second and just shoot the bullet to 600 yards a person might be able to keep the jackets intact. Obviously doing so would degrade the "wind proofing" of the load a little. Most of the wind bucking ability of this cartridge comes from the high B. C. of the bullet, however. If you are thinking about using the bullet this way I recommend setting the jump to be about 0.004".

Chase the throat just like a VLD and never let bullet jump exceed 0.020". Exceeding 20/1000" of bullet jump seemed to exacerbate bullet blow ups when I was working with it. Persons wanting to shoot occasional 1000 yard matches with their 6.5 twist rifles could shoot one of the VLDs. Sierra's second stated reason for not fixing the bullet has frequently been the limited sales. My counter argument to Sierra has always been that this is a chicken/ egg issue.

I believe that a market may still exist but the reason Sierra 90s are not selling is their reputation for blow ups. Sierra should know their market better than we do. I talked to them about the bullet again a few months ago while I was working on this series of articles. They said that the future could either see them just withdraw the bullet entirely or fix it. At the time we spoke it could go either way. Berger also makes a thick jacketed 90 grain boat tail. The B.

C. of this bullet is .512 which results in about 17% of wind proofing over an 80 grain SMK. This is the bullet I think the majority of you will be most interested in. Berger recommends a muzzle velocity of 2,600 fps to keep this bullet accurate to 1000. A few years ago Blackstar was forced to stand down their barrel electropolishing process. They used an acid and the storage and disposal of that acid came under strict control by various environmental agencies.

The cost of doing business became so restrictive that Blackstar was forced out of business. So, I decided it was also time to explore other 90 grain bullet options. I contacted Berger to see if they would be interested in producing a quality, user friendly, 90 grain boat tail. They could see that there was a noticeable void in the current market and readily agreed. Given the bad reputation in the High Power community for bullet blow ups, we agreed that a thick jacket would be a must.

About six months later, in October 2008, I received my first shipment of the new bullet. Given my previous history of bullet blow ups the first thing I did was torture test them. I abused that bullet in about every way I could think of. Jumped it long distances, seated it deep and shallow, heavy powder charges, you name it. While performing load work ups in the past six years I have shot well in excess of 10,000 of these bullets in about 100 different barrels from most all of the manufacturers.

FROM THE ORIGINAL PAGE

I have yet to blow up a single one. I have found this to be a really good bullet. I have only one minor criticism of this bullet and that is it "pressures up" a little more than either the Sierra B. T. or the two VLDs. This pressure issue may due to its

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BUILDING THE 90 GRAIN AR-15, PART THREE CONTINUED

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thick jacket and its greater bearing surface than either VLD. Obviously, this requires less powder charges to assure primer retention. I can usually get away by cutting powder charges by about a half grain but in some cases I have to cut a full grain. I have never had to go below 23.2 grains of powder with this bullet in any barrel when using new military brass with crimped primers. Typical loads will be 23.5- 23.8 grains of RL15 or VV N140.

I can seldom hold primers with charges exceeding 24.1 gr. in summer temperatures approaching 100 degrees. This will result in muzzle velocities of between 2,500-2,600 fps depending on the specific characteristics of the barrel in question. So, some of these guns will shoot the Bergers from 600-1000 yards with the same load while others will be coming in a little slow for optimal 1000 yard performance. Closely watch your chronograph if you are interested in shooting these at 1000.

Unfortunately, this bullet was furloughed by Berger in January of 2013 along with a lot of other really good bullets. The factory still has all the equipment to make limited runs of the bullet for those in a buying position to order enough to warrant tooling back up. If you are having trouble finding this bullet, contact me at or see me on Commercial Row at Camp Perry during the CMP Service Rifle phase of the Nationals in Building 910-A and I'll provide you with a source.

Barrel Recommendations The Berger 90 grain boat tail will shoot well in almost all of the barrels described in Part Two of this series. Three barrels really shine, however, and I am building all of my guns with these. For ATC shooting, the "USAR Pattern" is available from Krieger or Bartlein. In the Krieger this will be a four groove configuration with their normal 0.218" tight bore with the deeper 0.2245" groove option.

The Bartlein equivalent will be either a four groove or a 5R with a tight 0.218" bore and a deep 0.2245" groove. In both cases specify the half thousandths deeper 0.2245 groove when you order the blanks. Normal AR-15 groove depths are 0.2240" but those don't perform as well with the Berger 90 B. T. as the deep groove option. With Krieger and Bartlein you normally just get a blank which has to be sent off to be turned and chambered.

I get both of these in chrome-moly steel and have them coated inside and out with Isonite from MMI Trutec (trutecind.com). Unlike bluing applied only to the outside of gun barrels, Trutec salt bath nitriding also protects the bore. Barrels treated with this process clean up easier than any barrels I have ever worked with and resist corrosion. There are some claims of improved wear with coated barrels and I am evaluating that presently. As mentioned previously, the deep 0.2245" grooves help with pressure issues.

You may be able to hit 2,600 fps with some of these barrels. Just watch your chronograph. Using the Krieger and Bartlein bore options I'm seeing both are currently showing very good wear characteristics. Using new factory match 77 grain ammo my rapid fire performance is a dead tie between my old 1:8 twist 80 grain gun and my newer 6.5 twist. I think that ammo quality may be the limiting factor here. Wind proofing with the 90s is about 17% greater and my group sizes are 7.7% tighter.

With the Krieger and Bartlein options listed above, fliers happen half as often with the 90 grainers at half the severity as the 80 grain loads. This is very important! If you vary from the two options listed above your chances of shooting fliers goes up as does their severity. Both deep groove tight bore options were developed originally to be "Sierra friendly". It was only by meticulous record keeping that I discovered how well these two barrels optimize the 90 grain Berger boat tails.

For those of you who want to be sure of hitting 2,600 fps with the Berger 90 grain boat tail for 1000 yard shooting you will want to go with the 6.6 twist Brux narrow land option. The narrow lands really cut pressures effectively while maintaining accuracy. I get these with Wylde chambers and have them coated with Isonite. I load these with 24.4 grains of either RL15 or VV N140.

These barrels will also shoot 77s well if you want to use them for regular ATC shooting, though their throats seem to erode faster than the Krieger and Bartlein options. Given the amount of 1000 yard Service Rifle shooting that most people do in a year, this may not be a big issue. Norm Brux says he has about 1,000 narrow land barrels of all calibers in circulation and has many reports of 4,000 round longevity. Norm's narrow land barrels come with tall 0.218" lands and conventional 0.2240 grooves.

Another excellent choice for shooting 90s at 1000 yards is the Bartlein gain twist. Starting the bullet rotating slowly at the chamber helps overcome inertia, thus lowering pressure, allowing a bit more powder (about half grain in my experience) to pick up muzzle velocity about 50 fps. I am loading the same powder charges in my gain twist barrels (24.4 grains) and achieving velocities of 2,600 fps with no chamber pressure issues. That keeps bullets really strong (1,249 fps) clear to 1000.

I suggest that you order the Bartlein Gain Twists with the tall 0.218" land and deep 0.2245" groove. I believe the Bartlein gain twist barrel may give you better wear characteristics than the Brux narrow land barrel. The Bartleins also shoot 77s for rapid fire really well. I have been torture testing some of the old Sierra 90s in the gain twists and haven't yet blown one up.

RKS Enterprises up in Canada also supplies six groove, single point cut gain twist blanks as specified above in less than half the time if you're in a hurry. AG

HISTORY

Reshaping Too Large Cheek Pieces

How to create a better looking rifle stock, whether it is a two piece or standard.

BY DOMINIC PISANO JUNE 2014

ORIGINAL PP. 11-13

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'm I using anew stock turner for my work, Al Lind, a rather well known custom rifle maker. His website, Al Lind Gunmaker. com, spells out that his stocks are machined in the classic American style but are deliberately left oversize on the outside so we can implement our own design ideas and allow for individual tastes and design concepts to be incorporated. This is an excellent approach. I sent him a not-too-shabby English walnut blank for a pre-64 Winchester M70 that I was building for my son.

It was a beautiful piece of English walnut, however, the stock was returned with several features which I do not care for. Let me explain. Over the years I have taken certain measurements from stocks which I thought to be the ideal in terms of design and function. These have been carefully recorded so that I developed a record of the most beautifully designed stocks regardless of the inherit beauty of the wood.

Now I understand that one can not just simply go by some mathematical formula and wind up with a thing of beauty. There are many other factors involved. I use the annotated measurements as a guide, a frame of reference if you will, whenever I take on a project for a client. Thus, we both know before hand what our goals are in terms of the finished product. These measure-

ments are taken from the trigger location to the cheek piece and shadow line, as well as the profile of the wrist/pistol grip.

Given what I consider ideal dimensions, I thought the machined stock was hugely oversized, especially the cheek piece area. I like the rear edge of the cheek piece to be ten inches from the trigger location with the shadow line an appropriate distance beyond and in a pleasing curve that follows the outline of the original cheek piece. The cheek piece as received was well beyond the ten inch requirement that I had mind, which was exactly what was stated on Lind's web site.

It was now up to me to take advantage of the oversize situation and create, if you will, a beautiful stock. Time to go to work. First and foremost, I sharpen all of my chisels. There's nothing quite as aggravating as finding out your chisels won't cut during an exacting task. I know it's a pain in the neck task, but believe me, it will save you time and frustration in the long run as any general upset can damage your ability to do your best work.

I decided to tackle the reshaping of the cheek piece at the first part of my effort to create a beautifully shaped stock. I chose the cheek piece because it was the bigger task and I

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thought best to get it done while still fresh and focused. I carefully began the task of shortening the cheek piece by drawing a line conforming to the cheek piece shape of the actual cheek piece approximately 10 inches measured from the trigger. Once that was done I chiseled away as much excess wood as possible. I believe the term is "hogging out the wood." I then alternately used chisels, rasps and surform tools to cut the new cove (ogee) which runs down to the shadow line.

I like to outline the shadow line at this point because it gives me a sneak preview, if you will, of the final result. Then it's just a matter of gradually forming the new cheek piece and shadow line. I use my rat tail files to start the new cove, beginning with the small one, working up to the medium, then the large. The surform rasp is used whenever I can to smooth things out.

As the cove develops I use larger and larger half round rasps to bring the shadow line as even as I can make it all around the edge of the cheek piece. This is a good time to take a break and step back to review progress prior to putting the finishing touches on the shadow line of the cheek piece.. Once again, using a variety of rasps

(a pattern maker's cabinet rasp is ideal for this task) and depending on where the excess wood is located, rasp away.

I generally put the stock away until the following day at this point to do the final work on the cheek piece. The new shortened cheek piece is then ready for final shaping. For this task I use several different tools, such as safe edge files and noclog files in different sizes, and around surform rasp. I want to clean up the new shadow line and make it flow smoothly from the top end, near the heel around to the front end, and near the wrist.

I do most of this work with the safe edge rasp and the aforementioned no-clog files which also have a safe edge. No-clog files do not tear away wood as do regular files and rasps with individual teeth. They actually plane the wood away because they have semi circular cutting edges. Clean up any unevenness anywhere the old shadow line left off and the new is being shaped. This is where the no-clog files come in handy.

When it comes time to even up the former shadow line with the area just behind it, I am very careful not to take away too much wood. And I make certain which way the grain is flowing, keeping in mind the natural curve of the stock behind the cheek

piece. I need to be certain it matches the curve on the off side of the stock. Believe me this an easy mistake to make and one that is nearly uncorrectable. I use a very large no-clog file for this task.

When I think the job is complete I look at the shadow line to determine if there are any rough or uneven spots. If there are I use 100 grit abrasive paper wrapped around a dowel or small rubber hoses of various diameters to make the corrections, working slowly and carefully. From time to time as the situation warrants, a half round no-clog file is used to smooth things out.

The last thing is to tightly wrap a piece of 100 grit abrasive paper around a small piece of wood that has been carefully squared off and clean up the edge of the shadow line. Of course when I do this task on the rear of the shadow line I'm sanding across the grain. Sorry folks, it can't be helped. I use progressively finer abrasive paper in grits up to 220 to reduce the scratches caused by sanding across the grain. The final clean up is with the safe edged no-clog file.

This tool can cut across the grain if used with care and leave everything silky smooth. Then I sand smooth with 320 and 400 grit abrasive paper

RESHAPING TOO LARGE CHEEK PIECES CONTINUED

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Original caption: Bottom: Close up of the completed cheek piece. ing and finishing. They are coarser than wood files. No-clog files cover every operation from rough shaping to final contouring of combs and grip areas. With heavy pressure the wood rolls off at an incredible rate. For finish work the weight of the file alone will make sawdust cuts and cuts smoothly across the grain.

wrapped around a sanding block, working with the grain. If you are careful and have a good eye for form you'll be pleased the results. I'm ready now to move on and complete the task of creating a custom classic stock out of a machined stock. N.b. Patternmaker cabinet rasps are made especially for wood filing where a smooth finish is desired. Edges are cut (have teeth) and taper slightly from tang to front. The unique tooth design eliminates most "filling" problems and doesn't gouge into wood or snag cross grain.

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These are probably the most useful wood rasps for "almost final" shap- The stock is complete except for finish.

The primary feature is their no-clog design and safe edge. The safe edge on files and rasps does not have any teeth. These are excellent tools for outlining (e.g. the edge of a shadow line) where you want to trim wood away from the edge but not from the flat part just next to it.

FROM THE ARCHIVE

Assessing Barrel Wear, Part One

While more like reading tea leaves than hard science, there are clues in determining barrel wear.

BY JOE CARLOS JUNE 2014

ORIGINAL PP. 14-17

How long will a new barrel last? How long will its accurate life be? Glen Zediker in his book, *The Competitive AR-15*, summed it up best: "No one has an answer for how long a barrel will last. No one." Two of the most common questions I get as an AR-15 armorer are, "How far should I jump my long range bullets?" and "How many rounds is my AR-15 barrel good for before it shoots out?" We will cover the first question in a future article.

I usually answer the second with, "I have seen brand new barrels go out in as little as a few dozen rounds while others last into five figures." The person asking assumes I am either being flip, evasive, or that I just don't know. I plead "Not Guilty" to the first two but admit freely to the third assumption. As Mr. Zediker said, no one else has the answer either. Most barrels wear out in the throat area where the bullet starts contacting the lands.

Intuitively, most folks think that friction is the culprit, however, most barrel makers feel it is the hot, erosive gasses eating at the metal. Gradually, the point of bullet contact with the lands moves further forward, making bullets jump greater distances without any support before they enter the rifling. These same gasses also cause a gradual roughening of the back of the barrel which can be abrasive to the bullet. Often, a condition called "fire cracking" will occur.

Actual rough cracks form, usually running with the "grain" of the barrel. A bore scope is a handy tool when performing diagnos-

tics on a barrel. Wear, especially fire cracking, can look very ugly in the scope, however, I find that a fair number of unsightly barrels continue to shoot well in spite of appearance. With the bore scope, be on the lookout for any lands wearing at a faster rate than the others back in the throat area. This may allow bullets to tip away from the center axis of the bore.

Such uneven wear may be caused by a less than stellar chambering job or cleaning rod damage. Barrels normally wear out at the throat. In a 20-inch Service Rifle barrel, the forward 18 inches of rifling usually shows very little wear, contrary to the normal perception that barrels wear out due to friction.

I have literally shot out a number of Service Rifle match barrels, cut 5.5" off the back, rechambered, threaded and reinstalled the barrel extension, arriving at a carbine length barrel that shot just as well (with a shorter carbine-length gas tube) and just as long as the original parent barrel! You can perform a similar sleight of hand when a 26" March Rifle barrel shoots out by converting it to a 20" Service Rifle barrel. Why throw away a \$400 investment when there is lots of life left in it?

It would be like hauling your car to the junk yard just because it got a flat tire. Throat wear can be quantified either by crude throat gauge readings or in a bit more detail by taking Stoney Point readings. The Stoney Point, now made by Hornady and called an "Overall Length Gauge," is a necessity for VLD bullets

which require nightly precision measuring of throat erosion and setting the bullets out longer each day to compensate.

Called "chasing the throat," this can result in stellar performance but requires diligence and attention to detail. Predictors "Aren't you beginning to feel time gaining on you? It's like a predator. It's stalking you. Oh, you can try and outrun it with doctors, medicines, new technologies, but in the end time is going to hunt you down and make the kill." —Dr. Tolian Soran, *Star Trek VII: Generations* How long before time hunts down your barrel and makes the kill?

I can provide some subjective and general rules of thumb that will help you a little. Predictor 1: Barrels with tall .218" lands will usually last longer than barrels with the more common .219" lands. Predictor 2: Barrels with wider lands will usually wear better than narrow land tubes. Predictor 3: The type of powder will come into play. Usually ball powders burn a little cooler than stick powders.

The stick powders that burn the hottest and damage bores the most severely seem to be the imported, "high energy" types. I tried these powders in button rifled chrome-moly barrels when I first started working up loads for 90 grain bullets and they ate the barrels for lunch. The backs of the barrels were rough and fire cracked and often only lasted a mere 500 rounds before

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Starting from the top is a bore scope. On the right, a throat gauge for the AR-15 and its big brother for .308 M1A on the left. Below that, a Stoney Point gauge and digital caliper. accuracy was completely lost. I also found that the high energy powders gave poorer chronograph standard deviations and shot fatter groups than the cooler burning "regular" powders. One company making these high energy powders claims higher velocities with lower pressures. I found no evidence of that.

In fairness, I admit to not having chamber pressure measuring equipment and use primer retention as my judge and grant this is not as accurate as expensive lab grade pressure testing equipment. Predictor 4: About 20 years ago Boots Obermeyer told me that in the .223, with the powders we use and the pressures we operate at, he felt that stainless barrels would erode smoother than chrome-moly. The experience with imported, high energy powders seemed to bear that up.

After I started wearing out chrome-moly button rifled barrels at only 500 rounds I switched to button rifled stainless and my round counts went up two or three fold. With conventional powders, however, I see little to no difference in the roughness of

erosion between the two steel types. If for some reason you use the imported high energy powders, I recommend stainless barrels. If you use "regular" powder I see no reason to choose stainless over chrome-moly.

Predictor 5: If your gunsmithing business ever gets in a slump and you are hard up for cash, get two barrel makers together in the same room and ask them who uses the better grade of steel and whose barrels will last longer. You will be able to sell all the tickets you have seats for and pocket the cash because I guarantee a real fight is going to break out.

The cut-rifled barrel makers will tell you that the button-rifled camp has to use softer steel because they aren't removing any metal in making their grooves, they're displacing metal by swaging. The button-rifling companies will jump up and down and swear that their steel is just as good and that their barrels will outlast the cut-rifled barrels because the swaging process allegedly leaves a greater surface hardness in the bore, which sounds plausible.

I'm not going to try to referee the squabble between barrel makers but I will refer back to my experiences with high energy pow-

ders. When the chrome-moly button-rifled barrels started to fail at those low 500 round count figures, in addition to switching to stainless button-rifled barrels I also tried cut-rifled barrels of both steels. I had no problems with the cut-rifled barrels in either steel.

In general, I tend to agree with Glen Zediker once again in that I believe cut-rifled barrels last somewhat longer than button-rifled ones but am unable to quantify how much. Predictor 6: Barrels with chambers born with shorter throats will significantly outlast those with longer throats. You will likely see this more with magazine-length ammo than with long range ammo that is fed one round at a time by hand.

Since the long range ammo doesn't have to fit in a magazine the bullets can and should be seated much further out, nearly contacting the throat. The shorter jump contributes significantly to accuracy. Predictor 7: Slow twist barrels will last longer than fast twist ones. Having bullets "stall" at the back of the barrel increases both pressure and the time that those hot erosive gasses

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are eating away at the throat. Bullets "stall" because of inertia. The resting bullet does not want to move forward nor does it want to start rotating at a couple of hundred thousand RPMs. Slow twist barrels offer less resistance to the rotational portion of inertia and the bullet moves out of the throat quicker and with less pressure. If you shoot long bullets you have to spin them faster to get them to stabilize. Eighty grain bullets want a twist rate of about one revolution every eight inches.

The longer 90 grain bullet needs a faster twist rate of 1:6.5". To get those long, heavy bullets moving out of the throat faster you may want again twist barrel. I am using gain twist barrels in all 90 grain guns I build and my customers and I like them a lot. In 20" Service Rifle length barrels I begin my twist at the front of the chamber at 1:13" and finish up at the muzzle at 1:6.5". In 26" match rifle barrels I start at 1:14" at the back and terminate at 1:6.9" at the muzzle.

For more information on all the advantages of gain twist barrels, refer to my article, "Revisiting Gain Twist," in the November and December 2013 issues. If you want to shoot 80 grain bullets the above barrels will work fine or you can use again twist starting at 1:16 in front of the chamber of a 20" Service Rifle length tube and terminating at 1:8 or 1:7.7" at the muzzle.

To see again twist barrel that has been split in half lengthwise, visit my store front on Commercial Row (Bldg. 910-A) at Camp Perry during the Civilian Marksmanship Program Service Rifle matches. Predictor 8: Barrels that are cleaned properly and frequently usually last longer. If you clean your barrel following every range session you will get the fouling out easier and before it builds up. Neglected barrels will have heavier build ups of fouling, often requiring the use of abrasive cleaners to get clean.

I don't worry about the abrasives themselves but they are usually used in a back and forth stroke where the direction of the

patch is reversed inside the bore. This can result in some awful cleaning rod flex, causing the rod to scrape the lands and wear at them. Those lands are only about the thickness of a sheet of paper above the grooves and can be easily damaged!

Predictor 9: Shooters who spin their cartridges for concentricity and who manage run out will see longer service from their barrels than those competitors who just take the ammo out of the box at random. The popular Wylde chamber jumps 77 grain, magazine-length ammo about 0.116" when it is new. That is a lot! Imagine that same gun a year or two down the road when it has a couple of thousand rounds on it. Allowing for throat erosion the jump could easily be 0.25" by then.

Perfectly concentric ammo has the bullet lined right up with the center line of the bore. Ammo with run out (bullets not seated perfectly straight) will send the bullet off at an angle to the center of the bore. Picture it like a water hose. A bullet fired from a car-

ASSESSING BARREL WEAR, PART ONE CONTINUED

ORIGINAL PAGE 17

tridge with run out in anew Wylde chamber is going to enter the bore off center and be deformed. If fired in a worn Wylde chamber that now has 0.25" of jump is going to hit further from the center of the bore and it is going to be traveling faster. The combination will booger it more and it will hit further from where you intended it to. Look at the two test groups pictured here. Both were fired from the same gun on the same day using the same ammo lot.

The barrel in question was worn to a bullet jump of about 0.25". The fat 1-7/16" group at the top was fired with 77 grain, magazinelength ammo selected at random from a box of 50 rounds. The 3/8" ten shot group at the bottom was fired from the most concentric 10 rounds of the 40 remaining cartridges in the box. No barrel maker can produce a barrel that will shoot optimally with crooked ammo and no gunsmith can make a gun that will perform well with bad ammo either. Concentricity management is not new.

To learn more about the subject visit the Nielson Brothers web site (NielsonBrothersArms.com). Their research was done with .22s but their conclusions and their predictors are equally valid to center fire rifle and handguns. Smart hombres! In reviewing their research pay particular attention to the text and pictures regarding how the orientation of the base of the bullet contributes to accuracy.

It is fairly intuitive and easy to mentally picture the tip of a bullet seated off center in the casing crashing at an angle into the back of the barrel, causing accuracy damage. We are less inclined to think about the base of a bullet seated at an angle in the casing, however. The bullet base needs to be perfectly perpendicular to the axis of the bore, especially when it exits the muzzle.

Depending on the degree of run out, the base of a bullet seated crooked in the casing will be out of plum with the bore to just as great a degree as the tip, we just don't think about it. When the base of a

bullet that is not perpendicular to the axis of the bore exits the muzzle, part of the base will still be inside the muzzle while part of it has exited due to being crooked. High pressure gasses will also exit at the same time on that side and will push the bullet at an angle.

That push will not be in line with the center of the target and will cause a flier or just contribute to a fat group. This is a condensed version of what is on the web site and their pictures really help grasp the contribution that bullet bases and concentricity make to group size. Round Counts Some of the military teams use round counts to determine when to rebarrel a gun. When I was the armorer for the Army Reserve I occasionally got questions about the applicability of that scheme to the Reserve environment.

I doubt that it would work for a reserve team with shallow fiscal pockets and I discourage civilian shooters as well. Arbitrary round count barrel rotations have to be set low in order to catch the guns that shoot out early. For example, if I test ten given barrels and one of them shoots out at 1,500 rounds while the other nine go all the way to 4,000, I would have to set my rebarreling schedule at something slightly below 1,500 to make sure I catch all of the worst case scenario barrels.

In this example I would be removing nine perfectly good barrels capable of shooting match winning scores for another 2,700 rounds each and wasting about \$4,000. How far from reality is this? Years ago I bought about a dozen stainless barrel blanks from a well known barrel maker. All of them were button rifled the same day in one special run and final machining was done at the same time on the same equipment, with my Wylde reamer used to chamber all of them.

When they arrived at my shop I broke them all in using non-invasive techniques. I then I installed the barrels, worked up loads, and issued them to two different shooters, both using 90 grain bullets for

long range. Shooter A loaded with a high energy powder, cleaned his barrel with one of the new, harsh "gee-wiz" solvents and the barrels were completely shot out after 500 rounds. Shooter B burned cooler Varget powder, used Hoppe's solvents and the barrels were still going strong after 1,500 rounds.

In fact, there was no accuracy fall off as when new! Why did one barrel shoot out so prematurely while the other gave more normal wear and performance? Was it the hot burning powder or solvent? Or was it some unrelated variable that we failed to identify? It is likely that none of us will ever know but the whole scenario causes me to have little faith in trying to predict barrel wear out based on round counts.

If you are still not convinced and hear that big military shooting teams (with deep pockets) is using a specific round count for rebarreling rotation, ask the following. What is their chamber length? Let's say they are using along 2.50" chamber and you are using the shorter (and likely better) Compass Lake one at 2.45". All things being equal, their barrels are going to shoot out earlier than yours and if you follow their rotation scheme you will be rebarreling much too early.

What brand of barrel are they using and which rifling method does the manufacturer use? What is the land to groove ratio of their barrel compared to yours? What is the land height? How often do they clean and what solvents and procedures do they use? Do they manage the concentricity of their ammo and do you? Do they chase the throat and seat long range bullets out further to compensate for erosion? Do you? What kind of powder do they use? What is the twist rate of their barrels and is it conventional or gain twist?

Given these variables, do you still want to follow someone else's round count rotation for rebarreling? We'll discuss more indicators to help assess and prevent barrel wear in Part Two. AG

MAINTENANCE & REPAIR

Shop-Made Mini-14 Gas Block Wrench

Working on the Ruger Mini-14 gas block should not be part of routine maintenance, however, when that time comes you need a plan, and perhaps a special tool, to make the job go smoothly.

BY JOHN BAXTER JUNE 2014

ORIGINAL PP. 18-22

While cleaning my Ruger Mini-14 Ranch Rifle I noticed a little surface rust forming on the inside corner of the lower gas block. I had never removed the gas block before as this is not a recommended step in the normal cleaning process. Care must be taken when removing the four socket head cap screws as Ruger stakes the screw to the upper gas block at the factory. Simply removing the screws can damage the threads in the gas block as the staked portion of the screw rotates through.

By alternately loosening the screw a quarter turn and tightening it again, the staked portion of the screw will eventually wear down, allowing removal. The first screw I tried in this process turned very easily with a ball nosed 9/64" hex wrench. I shifted to the opposite side of the gas block and found one screw turned under a more reasonable breaking torque. The remaining two screws would not budge.

I tried snugging up the first two screws in hopes that this would relieve some of the pressure but the two screws remained locked in place. I did not want to tap the screw heads with a hammer for fear of damaging the scope and I did not see a good way to heat the screws without risking the gas block finish. Instead, I applied more torque with the hex wrench, and predictably, the screw head stripped out. Some people will advocate drifting a Torx driver into a stripped cap screw head.

This strikes me as a good way to deform or destroy the Torx driver and would require removing the scope from the rifle. Instead I decided to go with the sure fire method and drill the head off of the screw. Fortunately, this approach works very well with socket head cap screws as even a stripped screw head will center the drill bit easily. The bit diameter is chosen based on a size between the minor (root) and major (outside) thread diameter. Ruger uses #8 screws with 36 threads per inch.

This is the unified fine thread (UNF) pitch for the #8 screw size. Note that the 8-32 unified course thread (UNC) is more common and will probably be the only choice in most hardware stores, however, the 8-36 UNF is common to a gun parts supplier. A number 27 drill bit (0.144" diameter) is a good size for this job. It is best to fixture the gun in a drill press to avoid drilling at an angle but a hand drill will work if careful attention is paid to keeping the bit properly aligned.

After removing the head from the first stuck screw, I was relieved to find that the remaining stuck screw backed out normally. Once the gas block was apart, the remains of the stuck cap screw came out from the upper gas block with serrated needle nosed pliers. I chased the gas block threads using an 8-36 tap, which can also be purchased from any gun parts supplier. Since the gas block is threaded all of the way through, a standard tap can be used; there is no need to use a bottoming tap.

I ordered four new screws which are sold specifically for the Mini-14. At \$2.00 each these are a small investment. How to properly tighten the gas block on a Mini-14 is a subject that is well explored in online blogs. Some advocate experimenting with different values of bolt torque to optimize accuracy. Others believe that simply snugging the bolts by hand is sufficient. Additionally, there are a number of aftermarket gas blocks that offer improved barrel harmonics. I do not intend to explore all of these variables.

After all, my Mini-14 was shooting just fine with one gas block screw practically loose. That said, I do believe in using the proper torque when reassembling guns. This turned out to be a bit of challenge with the gas block though, as the rear screws are located under the front sling swivel. Although it is possible to place a hex wrench straight into the rear screws with the swivel rotated toward the muzzle, the wrench will bump up against the swivel with each point on the hex.

I decided a ball nosed wrench would be the best option to avoid nicking the finish on the swivel. I do not own a set of socket drive hex wrenches with ball nosed ends. I did find a 1/4" socket drive 9/64" wrench, but without a ball nose. A brief search at my local hardware stores was not successful either—none of the socket-drive hex-wrench sets I found contained the 9/64" size. The most straightforward approach would be to cut down a ball nosed hex wrench from a full set and in-

SHOP-MADE MINI-14 GAS BLOCK WRENCH CONTINUED

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stall it in the 1/4" socket drive, however, I didn't want to ruin my hex wrench set and buying another set just to get one wrench seemed like a waste. Instead, I decided to make my own ball nose hex wrench. I found a regular 9/64" hex wrench in my collection of loose wrenches and used a cutting wheel to remove the short leg. I opted to use a hand held motor tool with a grinding wheel to modify the wrench, which would be held in the headstock chuck on my engine lathe.

I mounted the motor tool in a router base adapter and made up a simple fixture to attach it to the tool post on the lathe's compound feed slide. While this makes for a convenient way to position and advance the cutting stone, it is not very sturdy. Light passes are definitely required to avoid breaking the grinding tools. However, this method allows the motor tool to be positioned anywhere from perpendicular to in line with the work and fed into the work using the carriage, cross slide or compound slide.

The hex wrench was held in a 3 jaw chuck in the headstock. It is not necessary to run the lathe for this project but the chuck provides a

convenient way to securely hold and position the hex wrench. The plane of the grinding wheel axis is parallel to the lathe bed, so the chuck The author decided to make a ball-nosed socket drive hex wrench to avoid marring the finish. needs to be rotated such that one of the wrench's hex edges is straight up, which presents a flat face on the front and back.

The motor tool was set to 45 degrees for the first pass. I opted to work on the face behind the chuck as this provided more clearance. The chuck was rotated through the six sides of the wrench. The compound slide was then adjusted to 25 degrees and the process repeated to create a shallow angle extending to a point just short of the socket cap depth. This completed shaping the wrench for the interior of the screw. Next, the relief necessary to clear the top of the screw must be formed.

The motor tool was positioned to 45 degrees and positioned with the outside corner of the grinding bit in line with the end of the socket cap screw. The cross slide feeds to grinding bit into the work. I took the slide in 0.015"

after the initial contact. This depth provides enough clearance to let the hex wrench angle in the screw head without excessively weakening the wrench. The completed ball nose wrench was then pressed into the 1/4" socket drive with thread lock to secure it in place.

As I already mentioned, the proper amount of torque to be applied to the gas block screws is a matter of some debate. I believe there are two primary limiting factors in gas block torque: Stripping out the hex—either on the wrench or the screw head, as I already proved—or cracking the gas block. The gas block is designed to have a gap between the upper and lower halves. The upper half rests directly on the barrel but the lower half is seated against the gas port bushing.

This bushing ports the combustion gas from a small hole in the underside of the barrel to gas pipe piston where the gas pressure will act on

SHOP-MADE MINI-14 GAS BLOCK WRENCH CONTINUED

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The screw shank was then easily removed. (tension from torque) higher than the force exerted by the gas pressure acting on the gas port bushing. A minimum torque value can be calculated using the cartridge pressure and actual part dimensions. The gas port bushing has a 0.16" diameter on the sealing face. Although the actual seal area is probably much less, using this diameter will provide a worst case scenario. Assuming the gas pressure reaches the SAAMI maximum of 55,000 psi the slide assembly to cycle the action.

The gas block screw torque resists the force from this pressure. The bolts need to have a preload during firing, the force on the gas port bushing will be $(\pi \times 0.16^2 \div 4 \text{ in}^2) \times 55,000 \text{ lbf/in}^2$, or about 1,100. To calculate the amount of torque required for a given

bolt load, multiply the major thread diameter (0.161" in this case) by the load and then by the frictional coefficient, which is a dimensionless parameter typically ranging between 0.12-0.20.

Use a value of 0.20 for unplated screws; the lower values apply when coatings or lubricants are used. Also, we need to account for the fact that we have four screws, so our equations becomes $\text{Torque} = (\text{load} \times \text{diameter} \times \text{friction coefficient}) \div 4$. Here, this is $(1,100 \text{ lb.} \times 0.161 \text{ in.} \times 0.2) \div 4$, or 9 inch-pounds of torque. This value assumes that the gas block load is evenly distributed and does not take into account the vibration from shooting or transportation that might loosen to screws over time.

However, it does give us a general idea of the lower torque limit required to maintain a seal when the rifle is fired. Note the impact of the frictional coefficient in this equation. If we changed the frictional coefficient from 0.20 to 0.12 by using a thread lubricant, the force output would increase from 1,100 lbs. to over 1,800 lbs. For this reason, it is important to use only a thin film of oil to protect the screw threads from corrosion and to apply the film in a uniform fashion.

The Allen Manufacturing Company of Hartford, Connecticut (allenhex.com) recommends a maxi- Top A motor tool attached to the lathe cross slide held a grinding wheel to form the ball nose shape. Bottom

SHOP-MADE MINI-14 GAS BLOCK WRENCH CONTINUED

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Make sure the gap is the same on both sides when reassembling the gas block. mum tightening torque for a high strength of 48 inch-pounds. This value needs to be lowered if the screws are threaded into a lower strength material such as aluminum. This is much too high for our application, as each bolt will produce a theoretical load of 1,490 lbs for a combined load of almost 6,000 lbs! This load would almost certainly break the gas block.

Most recommendations for gas block screw torque range from 22 to 36 in-lbs with the norm at 26 inlbs. Those of us who plan to check the gas block screw torque during normal cleaning can get by with a torque value on the lower end of this range, provided the screws do not show signs of backing off. For guns that are less likely to have the screw torque checked regularly, a torque value on the higher end of the range is advised.

A removable thread lock The gas port bushing sits in the counterbore. can also be used to assure the screws remain in place. Care must be taken to assure that the screw and lower gas block threads are clean and free of any oil because the thread lock requires direct contact with the metal to form a bond. However, a thin coat-

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This allows the gas port bushing to engage the counterbore and hold the assembly together. ing of oil on the gas block is required to protect the finish. In my opinion, cleaning the screw threads while not compromising the protective film on the rest of the gas block is problematic at best. I suspect this may also be the reason Ruger decided to stake these screws in the first place. To reassemble the gas block, first insert the gas pipe piston with the counterbore facing up into the lower gas block.

Next, insert the gas port busing through the hole in the lower gas block and align it with the counterbore in the gas pipe piston. Next, place the lower gas block assembly into the barrel and assure that the top of the gas port bushing is fully seated into the counterbore in the underside of the barrel. The gas port bushing must fully seat into both the gas pipe piston and the barrel counterbores or you may damage the rifle. Align the upper gas block and thread in the four screws by hand.

Double check the gas port bushing alignment and adjust the screws to make the gaps on both sides the same. I used a set of feeler gauges placed between the screws to assure the gas block halves were straight. Torque the screws in a crossing pattern to no more than half of the final desired torque on the first pass. Make sure the gap is equal on both sides; if it is not, adjust the screws and re-torque. Increase the torque to three-quarters of the final torque, and then to the final value.

Repeat the final torque once more to make sure all the screws are tight. If you decide to periodically check that the screws are properly tightened, apply the desired torque using the same crossing pattern. Watch and feel for any rotation of the screw head. Noticeable movement indicates the screw has lost a significant amount of torque and a closer inspection of the screws and gas block is warranted.

To remove the gas block, first loosen each of the screws slightly (no less than half the original torque) in a crossing pattern and

then back the screws out completely. This will help to insure that the gas blocks separate evenly. If the screws do continue to loosen over time, try reducing the amount of oil on the threads or increase the assembly torque within limits. Also, be sure to use bolts specifically made for this application. Weaker screws will elongate over time and reduce the bolt load.

Ruger does not recommend servicing the gas block if it is functioning normally, so careful consideration should be given before disassembly. There are a number of risks, including damaging the gas block threads with a staked screw and damage to the barrel or gas block if not properly re-assembled. These risks can be minimized by tapping the gas block threads, carefully aligning the components and properly torquing high grade screws to secure the assembly.

Tightening the screws without damaging the rifle is made easier with a shop made socket-drive ball-nosed hex wrench. AG

MAINTENANCE & REPAIR

Reader Forum

BY AMERICAN GUNSMITH EDITORS JUNE 2014

ORIGINAL PP. 23-24

Remington Repair I have a Remington 700 with a plastic tip and some marks on it. I called Remington and they said it couldn't be sanded and must be replaced. The stock looks very nice and I still think the tip could be fixed. What do you think? How do I remove the plastic tip? We checked to see if Remington had changed their method of attaching wooden end pieces to their stocks. They have not.

The piece is doweled to remove the tip is to cut it off, redowel a replacement and the forend, remount and band sand/polish the new union. Tape is placed over the wood to protect it during sanding/polishing. Since your 700 has a plastic end piece, the means of attaching it to the wood is no different. Neither is the replacement procedure except for the sanding.

Tape is still used but the plastic is polished using a coarser grit to begin then working down to finer and finer grits until the degree of final finish has been achieved. Marlin 88 A customer brought in a Marlin Model 88 .22 semi auto rifle that he took apart to clean. The disconnect spring fell out and it looks simple enough to put back in but I am finding out that is not the case. I cannot find anything on the proper way put it back in.

Clarence Funneman It's our understanding that the M88 was the first .22 LR semi-auto to be produced by Marlin. No schematic is shown in the second volume of Jack First's catalog, which leads us to believe that none exists. You could call Jack First and request to speak with a technician and secure the information. There is also the Marlin Firearms Collectors Association (marlin-collectors.com) that has come to the aid of some of our readers.

Other firearm association addresses can be found in Brownells catalog or the rear pages of a current Gun Digest. We recommend a current issue due to changes in association contact information. Shotgun Parts I had an old Central Arms Company side by side 12 gauge come in that would not cock. Simple enough to find the problem, as the cocking levers had broken. The problem I am having now is finding a set of new ones. The broken pieces flew away in the field.

I tried welding and shaping what I thought they should look like with no luck so far. Any chance you know where I can get some cocking levers? Robert Pryor Well, with old cars you know right off who built it. Consider yourself lucky that "Central Arms Company" remains visible on the old timer. We think Central might have been one of those gun builders, like Crescent Arms, who put together guns for anyone hankering to have their name on one. Hardware stores and sporting goods outlets for example.

Heck, Crescent might have made the Central Arms double brought in to you. A major problem rears its ugly head with some long out-of-production side by sides: Damascus barrels. As you know, a modern load let off in a wound barrel can unwind it real fast. A good place to check out whether or not the gun brought in carries Damascus tubes is to remove the forend and scrub off the finish under it. If you discover twist marks, you're looking at a barrel formed around a mandrel and hammered together.

No modern loads should be used. The cures are new barrels or full length Briley inserts. The latter reduce the gauge but are perfectly safe with the newest of factory, non-magnum hunting loads. As for parts,

contact Dixie Gun Works or Dixie is a well-known provider of parts for some really old smoke poles and might have parts acceptable to yours. Arisaka I have an Arisaka that has been rebarreled to 6mm. It has excessive headspace. Due to the bolt nose configuration and extractor cut I'm unsure how to proceed.

I know that the receiver threads were originally metric but I've read some people will thread the barrel shank at If this is the case, removing the receiver might be a problem. I'm really needing to know the best way to do the barrel setback and cut the extractor cut to fit the extractor. I hate to call my customer to return his rifle not repaired. Jack Maye Michael Walsh First things first. You didn't mention the specific cartridge the new barrel is chambered in.

If it is a 6mm Remington Magnum you're strongly advised to contact SAAMI and check out the pressure it will generate compared to the WWII Japanese military 6mm. An original Arisaka receiver may not be able to withstand magnum pressure. Second point, whomever rebarreled the rifle apparently resolved any external barrel and internal receiver thread problems but it's pretty lousy the same individual didn't recut the breech extractor recess and assure proper head space as part of the job.

Thirdly, and usually, setting back a barrel requires lathe turning material off the barrel shoulder, assuring the barrel/receiver interface remains dead true and reuniting the two major components. Significantly greater detail appears in John Hinnant's book, *The Complete Illustrated Guide to Precision Rifle Barrel Fitting*, available from Midway USA. com or the author at johnsharonhin-

READER FORUM CONTINUED

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Winchester 1300 I have a customer's Winchester Model 1300 in the shop. When cycled, the slide plate would come out of the recess on the bolt and release the firing pin and spring, causing the gun to jam. I changed the angle of the edge on the slide plate and the forward recess of the bolt, making both edges match and forcing the plate into the bolt for more positive locking.

When I test fired the gun everything stayed together as long as I held forward pressure on the forearm, however, if the forearm was not held firmly the plate would again ride up over the bolt. Does the angle of the firing pin retaining tab of the slide plate need to be adjusted? It does not appear to be exactly 90 degrees to the firing pin axis. Can the bolt be drilled and tapped for a retaining screw to hold the slide plate to the bolt like the 1200s had?

I suspect that something is causing the slide plate to lift up in the front when fired. This is most likely the cause of the wear on the leading edge of the slide plate which I have corrected. Now I need to correct the initial problem. Richard K Spencer We thought you might have one of the "Speed Action" Winchester 1300s that opened the bolt as much as 3/8 inches on firing by design.

After checking out your problem with a Winchester/Browning service center we've changed our mind and have taken their suggestions made after we read your whole query to them. Yes, the bolt can be drilled and tapped for a retaining screw as present in the Model 1200, but Winchester bolts are wicked tough. Real drill walkers and tap busters. The slide arm bridge (slide plate) leaves the factory with a 90 degree angle at its front end.

Altering that angle to prevent the bridge from coming into any contact with the bolt lug. Said lug sometimes leaves the factory with a 90 degree angle built in to its bottom step. 80 degrees lessens the problem of the bridge and bolt becoming entangled. We believe the degree changes were made in newer versions of the

1300 you have on hand. Winchester Request I am requesting information for trigger adjustment on anew Winchester Model 70 with metal encased trigger housing.

Roy Ruston The fully encased trigger mechanism has come into wide-spread favor with firearm manufacturers as a first line of defense against trigger jobs attempted by the unskilled. In most litigation involving accidental discharges the cause can be traced to botched trigger alterations. As a further defense, most factory set trigger screws are hidden behind proprietary, colored epoxy compounds.

Any disturbance of the epoxy is an instant tip-off to factory service personnel that the mechanism has been tampered with. This normally leads to a cancellation of any warranty still in effect. We found a schematic for anew Model 70 Winchester on the Gun Parts Corporation web site (gunpartscorp.com). Working our way through the owner's manual in which it appears revealed an illustrated section on adjusting the trigger for pull, overtravel and take-up.

Though not visible in any of the illustrations, we can assume there's some colored epoxy present over at least one of the adjustment screws. For the reasons outlined above we suggest you leave the OEM trigger untouched and replace it with a Timney #112 Winchester unit. It is adjustable from 1-1/2 to 3-1/2 pounds pull plus take-up and overtravel with manufacturing tolerances within 0.0005 inch. However, do not discard the OEM trigger assembly.

Should the rifle ever have to receive factory-only service remove the replacement and reinstall the factory trigger prior to shipment. Otherwise, the rifle might be returned to you with a fresh OEM unit installed and the Timney nowhere in sight. We'll add that, in our opinion and that of others who carry firearms afield, to hunt a 1-1/2 pound trigger pull is entirely too light for the purpose. AG

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