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INSIDE THE ARCHIVE

AR-15 SUB-CALIBER TRAINING

MAINTAINING TRADITIONS • SIG SAUER P290 • THE BASICS OF GUNDRILLING RIFLE BARRELS • CABLE CONTROL TRIGG...

ORIGINAL METHODS. MODERN ACCESS.

ARCHIVE EDITION 142

DIGITAL ARCHIVE EDITION

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MAINTENANCE & REPAIR

Maintaining Traditions

BY AMERICAN GUNSMITH EDITORS OCTOBER 2015

ORIGINAL PP. 2

Millions of Americans feel the tug to participate in what may be the ultimate interaction with the natural world: Hunting. For many hunters, it's a time for sharing long-established traditions with family members and friends. Those who are successful in their hunts will stock their freezers with nutritious, locally obtained meat. Many also will share their bounty with food pantries to provide meals to the less fortunate. All will gain from the experience.

The National Shooting Sports Foundation published the following list of ways to maintain hunting traditions. It's a good reminder for newcomers, experienced, and inactive hunters alike on how to establish or re-establish good traditions this hunting season. • Go hunting! It's sounds simple, but the activity itself, whether you successfully take game or not, is a senses-heightening, fulfilling experience.

Share your hunting experience with friends and family members—whether afield, in hunting camp or by introducing a newcomer to hunting at. Share a game meal at your table, a great tradition made sumptuous because the harvest and hunt coincide at this time of year. Today many people are making an effort to use sustainable, locally acquired foods, something hunters have practiced for along, long time. Tell your hunting stories. Write them down. Take photographs and videos. Post them online.

Share your stories on social media or with an online photo album. Such records help keep your traditions alive. Remind others that wildlife conservation is fund-

ed through the sale of hunting licenses and excise taxes paid on firearms and ammunition, a tax that hunters supported and Congress approved in 1937. Through the Federal Aid in Wildlife Restoration Act (also known as the Pittman- Robertson Act), \$6.8 billion has been collected for conservation.

Another good post-hunt conversation can be about the North American Model of Wildlife Conservation, one tenant of which is that wildlife is held in public trust for the citizenry. Use the firearm of your choice as long as it meets your state's hunting regulations. These days more hunters, particularly younger hunters, are using modern sporting rifles based on the AR platform.

If you prefer a wood-stocked, bolt-action rifle, that's understandable, but support the choice of firearm made by others such as modern sporting rifles. Set an example for ethical behavior. Before hunting, review your state's hunting regulations; during your hunt, practice good sportsmanship. The public overwhelmingly supports hunting, but unsportsmanlike behavior by even a few hunters can tarnish the reputation of hunting in general.

Practice safety in the field, when traveling with firearms and when storing them at home. Practice the four firearm safety rules: Treat every gun as if it were loaded. Always keep the muzzle pointed in a safe direction. Keep your finger off the trigger until ready to take your shot. Know your target and what lies beyond it. Fast X, • • • • • John M. Buol Jr. AmericanGunsmith.info

PISTOLS

SIG Sauer P290

Disassembly and reassembly of the first pistol SIG Sauer designed for CCW holders.

BY CHICK BLOOD OCTOBER 2015

ORIGINAL PP. 3-7

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There will be more concealed carry pistols reviewed for American Gunsmith. You may want to set up a file holding all for comparison. Would you ever compare Switzerland to the Wild West? No way. Not this place where exquisitely accurate time-keeping movements and the most mouth-watering of chocolates are born. Not this place where massive fortunes have been secreted in tight-lipped banks for decades. Not this place that historically remained neutral while world wars raged around it. Nay.

Any degree of household invasion is considered a no-no, a nein-nein or a non-non to citizens of this multilingual land erroneously credited with inventing nothing except the cuckoo clock. An uninformed visiting thug from any other nation might, there- Both can be serviced by following the instruction appearing in this article. When fully installed the upper edge of the

tool will be parallel with the slide. fore, believe the Swiss to be easy marks and set out to test the theory.

Still, the breaking and entering crime rate ranges from low to none. Most of you probably know why. If not, try this on for consideration. The reason, students, is fear. Switzerland practices universal military training. All males of a specified age span must serve. When enlistments are up they return home accompanied with a weapon they were issued. Most of these are rifles with fully automatic capability. Pistols and even submachine guns are not exempted.

Faced with the prospect of engaging not merely one but several small arsenals in a neighborhood, individuals intent on mayhem think better of it and abandon their plans. As a result, Swiss households do not fear the night. I wish that were true in this country. I know of at least one southeastern community in the United States (Kennesaw, Georgia) where household invasions

happen as infrequently as in Switzerland. That town has a law making a home-based firearm mandatory.

Hopefully a day not too far in the future will come when intelligence and political courage (if the two characteristics can ever exist simultaneously or otherwise) will result in statutes being enacted in all fifty states requiring a firearm to be present in every home. Regardless of the existence of such a law, it is the responsibility of every home owner maintaining a firearm for personal defense to practice all state and local regulations.

Primary among those would be separate and safe storage preventing access to children as there's no other reason strong locks and the means of attaching them to a firearm of any description accompany all guns shipped these days. Not necessarily secondary is a thorough knowledge of possible legal consequences to the owner when a gun is

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used for protecting the owner or another family member during household defense. The deepest well for gaining that knowledge from coast to coast wears the same sign: State Police. Become familiar with the legalities yourself and advise your customers to do the same. No, don't advise. Insist. It's in their and your best interests. Ah, I sense increasingly hostile vibrations. I have spoken too little so far of this article's primary subject. Forgive me.

Field Stripping Remove the magazine, pull the slide to the rear, align the slide stop notch with the stop (36), engage the notch with the stop to lock open the slide, A B The nylon bench block is available from Brownells. check the chamber and put on eye protection. Do not lose the chamber safety flag or the black plastic object wearing an arrow. Both are included with the pistol and play roles in its servicing.

The slide stop is retained by its spring (34) but in its present position it could be withdrawn from the pistol with some determination. A C This would allow forward movement of the slide and its removal from the frame. True enough, but more is coming about slide and stop removal in the next paragraphs. The black plastic tool is inserted in the pistol through the ejection port with the arrow on the tool pointing toward the muzzle, illustrated here B

SIG SAUER P290 CONTINUED

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Photo on left is of the front; on right is the rear. with how the set up should look before you push down on the slide stop (36). When you do, the slide will be released and brought to a snug halt against the tool. This makes the next disassembly step possible. The safety flag has one smooth leg and one with an abbreviated "handle." The end of the smooth leg is used to push out the slide stop. Lest you forget, the slide is still under stress from the recoil springs.

Hang on to it as it moves forward then remove it from the frame. Invert the slide. There are two recoil springs (15 and 16) on the spring guide (14). The guide and the two springs are pushed forward simultaneously until they can be lifted free. The barrel is raised up slightly by its breech end, rolled to the rear, removed and set aside along with the slide, frame, recoil springs and guide while you attend to the magazine (47).

After shooting sessions the P290's magazine should be cleaned along with the slide assembly and frame. Never forget that little

guns tend to get dirtier faster than big guns. The P290 is no exception but how quickly you have to provide the blade screwdriver (C) and the paper clip (D). the dirt accumulates frequently depends on the ammunition provided as its steady diet. I refer to the lower extremity of the magazine body as a "bumper." Drift, push or pull it far enough off to reveal the floorplate.

Use a punch or hardwood dowel to push the floorplate up into the magazine. Finish removing the bumper but don't let

SIG SAUER P290 CONTINUED

ORIGINAL PAGE 6

up on the floorplate pressure in the process. Once the bumper is totally out of the way, pull out the punch or dowel. If a tap on your bench fails to free up the magazine spring and follower they can easily be coaxed out with tweezers. The major, and some minor, components of the P290 stand ready for your cleaning expertise. Detailed Disassembly The slide is placed upside down with its sights on the bench and its muzzle end facing away from the operator.

Depress the firing pin lock (11) and push the firing pin (9) inward with a 1/16" punch. Maintain your hold on the punch while the block is lifted upward for removal. The block spring (10) can get lost at this point. Be careful. With the entire firing pin and firing pin block assemblies out of the way, start the extractor pin (7) downwards. Raise the rear of the slide enough to complete removal of the extractor pin later on. First, though, is the extractor spring. It is identified as #4 on the parts list.

Well, #4 is no more. The extractor spring will now and forever be called #5. Continue pushing down on the extractor pin to free the extractor (6). The spring is lightly seated behind the extractor and may attempt an escape. Knowing this in advance, you will prevent it and pluck the spring from the slide. Reposition the slide right side up between padded vise jaws. Drift out both front (1) and rear (3) sights from right to left.

Store all the slide components in a compartmentalized container labeled "P290 Small Parts" and move on. Place the frame with its right hand side facing up. Push the rear housing pin (44) all the way through in either direction. Slide the rear housing (30) out until it is halted by the trigger bar (31). Carefully rotate the housing free and set it aside. The grip panels (45 and 46) are engraved "Left" and "Right." They both slide in and out on slotted tracks within the grip frame. Derail and remove both grips.

Depress and hold in the magazine catch (40). Shazam! There's a hole in the catch stop (42). This calls for a DIY tool gunsmiths world-wide claim is the handiest in the universe. Seize a paper clip, straighten one leg and insert that leg into the hole. Totally remove the catch and the rear housing pin. The next high tech tool is a screwdriver with a thin blade. Insert the blade between the metal rails of the frame and the trigger bar (31). Twist the blade counter clockwise a little.

This action makes it possible to pull to the rear and away from the trigger (38). Remove the bar. In case you haven't noticed up to now, the rear of the trigger bar fits in to the hammer. Push out the trigger pivot pin (37) right to left with a 3/32" punch. Don't completely pull out the punch. Slowly back it out enough to free up the pin, then continue withdrawal of the punch to accomplish the same with the trigger spring (39). Dump all the parts you just turned loose into your P290 Small Parts container.

Back out the slide stop spring screw (55). Add it and the slide stop spring (34) to your collection of small parts. Turn the laser plug (33) counter clockwise 90 degrees to remove it. The resulting hole is where an optional laser attaches to the frame. If the P290 you're working with has no laser you can leave in the laser plug. The trigger bar spring (32) is located in a grooved pocket inside the grip frame. When you direct a bright light into the magazine well the pocket is quite apparent.

Next up: The rear housing (30). The accompanying photo shows how it has to look after being reassembled. A close study of the housing prior to disassembly will help in understanding how its upper components relate to one another. Remember that the hammer (18) is under moderate spring pressure. Pull the hammer fully to the rear and hold it there. Push out the hammer pivot pin (29). You'll be able to lift out the hammer, ham-

mer strut (20), and hammer strut pivot pin (21). Follow this by pushing out the sear pin (27).

I suggest complete removal of the pin after inverting the housing into the palm of your hand. This is recommended in the hope the sear (25) and its spring (26) will end up in your hand still attached to each other, allowing you to study how they must be reunited. More words about the sear and its spring appear in the upcoming paragraphs on reassembly tips. They should be of considerable help in the event the two components get separated in disassembly.

Also under the retaining influence of the sear pin are the firing pin disconnect (17) and trigger bar disconnect (19). If they fall out separately no damage has been done. The important thing to keep in mind is where the two were located on the sear pin so they are reinstalled in the same locations. There's a possibility the mainspring seat (22), hammer spring (23), and mainspring housing pin lock (24) will remain within the rear housing. A mild tap or two on your bench top should take care of the jam.

Reassembly Tips The sear spring fits in the sear with its bend at the top and its straight leg pointing down. A dab of Vaseline on the spring will assist in keeping it aligned with its hole in the sear. Inserting the sear pin assures this is alignment will be maintained. Better add a couple more dabs of Vaseline to the hammer spring and mainspring housing pin lock or you may not be able to reinstall the rear housing pin. The right side of the frame should be facing up.

Use tweezers to insert the trigger from the bottom. Introduce the trigger pin to the trigger. Hold the trigger forward. Place the spring on the trigger with its L-shaped leg facing forward. Hold the spring in position as the pin is pushed through to maintain alignment. Position the "L" leg as far forward as possible, then push it downward into position.

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Note, if you spend time closely examining how trigger components relate to each other before removing them from the frame you should have no trouble determining how far forward and downward the “L” leg should be moved during reassembly. SIG Sauer didn’t offer a CCW-type pistol until a rapidly growing market made it clear they were missing something. From that moment the days of company design engineers grew drastically longer. The initial model of the 290 was introduced in 2010.

It was a single action. Their first DAO model came along chambered in .380. The P290 in this article is a 9mm. It will win no medals at 25 SIG Sauer P290 (Specifications subject to change without notice) 8 Firing Pin Spring 9 Firing Pin 10 Firing Pin Block Spring 4 Extractor Spring 6 Extractor 7 Extractor Pin or 50 yards but its accuracy proves itself at the range most defensive firearms see action, such as inside seven yards.

From the beginning the P290 was designed to serve as an easily concealed, very reliable, very accurate law enforcement back up and personal defense pistol. That is exactly what it is.

AG 11 Firing Pin Block 12 Firing Pin Stop 13 Barrel 14 Recoil Spring Guide 15 Inner Recoil Spring 16 Outer Recoil Spring 17 Firing Pin Disconnecter 18 Hammer 19 Trigger Bar Disconnecter 20 Hammer Strut Pivot Pin 21 Hammer Strut 22 Mainspring Seat 23 Hammer Spring 24 Mainspring Housing Pin Lock 25 Sear 26 Sear Spring 27 Sear Pivot Pin 28 Ejector 29 Hammer Pivot Pin 30 Rear Housing 31 Trigger Bar 32 Trigger Bar Spring 33 Laser Plug 34 Slide Stop Spring 35 Slide Stop Spring Screw 36 Slide Stop 37 Trigger Pivot Pin 38 Trigger 39 Trigger Spring 40 Magazine Catch 41 Magazine Catch Spring 42 Magazine Catch Stop 43 Frame 44 Rear Housing Pin 45 Left Grip Panel 46 Right Grip Panel 47 Magazine

METALWORKING

The Basics Of Gundrilling Rifle Barrels

A little history on gundrilling and the use of modern machines and tools.

BY CHARLES J. MOORE OCTOBER 2015

ORIGINAL PP. 8-12

Prior to the Industrial Revolution, the hole through gun barrels was formed by forging red-hot iron skelp around a mandrel, then forge-welding the edges together. As you can imagine, this was a rather time-consuming and labor-intensive process. It was also the type of task which required the skill and experience of a master blacksmith to ensure that the job was done properly. It also limited gun barrels to the low-pressure black powder loads that would be safe in a wrought iron barrel.

The Industrial Revolution brought steam, and later electric, motors onto the scene and these inventions allowed the development of ever more sophisticated machining tools. At about the same time, there were also several innovations in the field of small arms development, most notably the self-contained cartridge and nitrocellulose (smokeless) powder.

The pressures that could be produced with the combination of smokeless powder and brass cartridge cases was awesome and demanded that gun barrels be made of stouter stuff than wrought iron. Fortunately, the machine tools of the period were fully capable of cutting the strongest steels known. Although the machinery of the period could be made to serve the purpose of creating gun barrels quite readily, the drills used to cut the holes through the barrel blanks were still in their primitive forms.

The twist drills used for most types of drilling were the first adapted to the task. These drills were manufactured with a small hole through the shank through

which oil could be pumped. The oil flushed the chips backwards out of the hole effectively, but the drills did not perform all that well. Twist drills have a tendency to wander off-center when employed to drill deep holes due to their geometry.

Twist drill geometry incorporates two opposed cutting edges of equal length which are set at equal angles in relation to the shank of the tool. This means that there is no net lateral force produced by a twist drill, at least not if the cutting edges truly are equal and opposite. The problem is that they can seldom be ground to be perfect mirror images of each other, and so the drills tend to wander a bit.

And the fact that their central webs prevent them from being truly free-cutting made it obvious that a more effective tool must be developed for the particular job of drilling gun barrels. The first improvement in gundrill design came in the form of a flat drill that was equipped with a collar behind the cutting edges. If properly started in the correct location, flat drills will cut reasonably straight holes.

The collars used on the drill shanks helped to keep the drills going in the right direction by following the portion of the hole that had already been cut. However, if the drill did begin to wander off-center, then the collars would ensure that they continued to deviate from their intended course by forcing them to continue cutting in the direction of the crooked portion of the hole. Also, only very small grooves could be formed in the collars to allow cutting oil and chips to flow out of the hole.

If the grooves were made too large the usefulness of the collar as a supporting structure would be compromised. The small grooves, in turn, mandated the incorporation of chip-breaking grooves on the cutting edges to keep the size of the chips small. This arrangement complicated sharpening the drill. There was still a lot of room for improvement in the tools used for gundrilling. At long last, the final form of the gundrill began to take shape with the D-drill.

This drill used a single cutting flute that extended all the way to the center of the tool so that the drill would be truly free-cutting. It also incorporated a single, large groove to allow for the passage of oil and chips out of the barrel blank. This tremendously eased problems with chip packing when cutting at industrial speeds. Later, Pratt & Whitney changed the geometry slightly, primarily by moving the point of the drill slightly to the side.

By moving the point of the drill off-center, a teat is created in the center of the barrel blank while drilling and the teat greatly aids in keeping the drill moving steadily down the centerline. This geometry also creates two opposing cutting edges on the same side of the drill's centerline. By altering the angles of these cutting edges, the cutting action can be made to induce a net force on the drill which will further discourage any tendency to wander off center.

The modern gundrill design had finally been realized. Gundrill Geometry There are several subtle design features of a gundrill that allow it

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to stay on a straight course during the process of drilling a gun barrel. As explained above, these features have been selected through a continual process of trial and error. New design features that improved the function of the tools were retained, with slight modifications, in subsequent designs. During each iteration of experimentation, new light was shed on what features a gundrill must have in order to drill the straightest possible barrel blank.

The geometry of our current gundrills is a testament to the ingenuity and innovation of the men who made the Industrial Revolution happen, for the design of these tools has changed little in the last 100 years. To those who are familiar only with conventional twist drills, the first and most striking feature of a gundrill is the shape and location of the cutting edge of the tool. Gundrills have a cutting edge on only one side of the drill body itself.

This edge lies at the front of a plane that is placed exactly on the centerline of the drill and it is sharpened all the way to the center of the tool. There is no central web on a gundrill as there is on a twist drill. The central web of a twist drill does not do a good job of actually cutting steel. It merely forces material out of its way by displacing the material in a lateral direction.

This dramatically increases the thrust force on the drill and makes it far more likely that a twist drill will wander off center. But a gundrill, with its single, centrally-located cutting edge, is absolutely free-cutting in its action and does not create any undue stresses on the tool or the workpiece that could cause the drilled hole to run crooked.

To further reduce the likelihood that the drill will wander, the cutting edge is divided into two equal length cutting edges that are set at opposing angles to each other. This tends to transmit a portion of the cutting force sideways, and these laterally directed forces cancel each other because of the opposing angles of the cutting edge. A key feature of the angles of the cutting edges is that the outer edge is set at a slightly steeper angle than the inner cutting edge.

The principles of physics tell us that all forces can be broken down into component forces which are at right angles to each other. Because the outer cutting edge is closer to parallel with the Far The facets on the nose of the drill are cut at various relief angles.

Some manufacturers use radial relief on the nose instead of flat facets. drill shank than the inner cutting edge, the lateral force induced by the cutting action of the outer edge will be stronger than the lateral force

produced by the inner cutting edge. The increase in cutting speed at the outer edge of the drill (cutting speed is a function of the rate of revolution and the radius from centerline) compounds the effect, producing a very definite net lateral force on the drill.

Because this force is strongest at the outer periphery of the tool, a gundrill actually pushes itself away from the hole on the cutting half of the drill and towards the hole on the non-cutting side. Since the drill cannot cut on that side, the drill can't possibly wander off-center in that direction.

As the guys in the beer commercial would say, "Brilliant!" There are a few conditions, primarily chip-packing and too-high cutting oil pressure, which can push a gundrill off-center towards the cutting half of the tool. If this occurs, the cutting speed at the very edge of the cutting surface will increase (again, cutting speed is a function of cutting radius) and this will produce an ever-increasing net force pushing the drill towards the non-cutting half of the drill.

Also, the cutting edges of a gundrill are sharpened to slightly past the lateral centerline of the tool. This means that, if the drill begins to wander in the direction that it can cut, it will begin to cut a very slightly oversized hole. Because there is a net force pushing the non-cutting

THE BASICS OF GUNDRILLING RIFLE BARRELS CONTINUED

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The drill has been installed into the carriage and the high-pressure oil line is hooked up. The drill shank is disappearing into the chip box and the barrel blank spindle lies beyond the chip box. side of the drill against the hole, the drill will very quickly self-correct its course as the non-cutting half of the drill will drift back the other way until it is in firm contact with the hole once again.

As long as the cutting oil pressure is maintained at a high enough level to quickly and completely flush the chips out of the way, a gundrill will run on auto-pilot down the rotational centerline of the barrel blank. Gundrilling Machines The commercial machines used to drill gun barrels are designed to perform only this one task to the highest degree of accuracy possible in the shortest period of time.

In order to drill the straightest hole possible, these machines rotate the barrel blank while the drill remains fixed in a stationary

position on a moving carriage. As the drill is moved into and through the barrel blank, cutting oil is pumped inside the shank of the drill and emerges at the tip. The oil then flushes the chips away from the cutting edges and carries them backwards out of the barrel through a V-groove that has been pressed into the drill shank specifically for that purpose.

Once clear of the barrel blank, the chip and oil slurry is captured and redirected by a chip box. On most machines, the slurry dumps out of the chip box into a chip pan under the machine. The oil then drains out of the pan and is filtered for recycling, while the chips remain in the pan.

If the object of a machining operation is to drill a very long, very straight hole in a barrel blank, spinning the drill to impart the necessary relative cutting motion between the drill and the barrel blank is not the best way to accomplish this goal. When a spinning drill begins to wander off-center, the

portion of the hole that has already been cut tends to guide the shank of the drill and causes it to continue progressing forward in the wrong direction.

However, if the barrel blank is being spun instead and the drill begins to wander off-center, then the hole will begin spinning eccentrically as it moves off of the centerline. Obviously, the shank of the drill will also be carried along by the hole. As the drill is carried in this eccentric circle, the shank will continuously flex, first one way and then the other.

This flexion causes the shank to load up somewhat like a spring, and the spring tension produced tends to help force the drill back towards the centerline of the barrel. This is why machines designed to drill gun barrels spin the barrel blank, rather spinning the drill. When drilling a barrel blank, the drills are fed very slowly into the solid steel bar. The drill ad-

THE BASICS OF GUNDRILLING RIFLE BARRELS CONTINUED

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vances only a few ten-thousandths of an inch per revolution of the barrel. This slow feed rate causes the chips produced by a gundrill to be very thin and light. This is an important consideration because the chips must be very easy to flush out of the hole by way of cutting oil injected at the drill tip. The cutting oil is pumped at high pressure through the hollow shank of the drill and emerges at the tip.

After exiting the drill, the oil finds itself at the head of the hole with nowhere to flow except backwards along the drill shank. The shanks of gundrills have a wide V-groove crimped into them to allow the passage of the oil. As the oil reverses direction to flow along the V-groove, it picks up the chips that are being produced and carries them out of the hole. Without this ability to clear away the chips, gundrilling machines would not be able to produce satisfactory barrels.

The chips absolutely must be flushed away from the cutting edge as soon as they are produced in order to avoid chip packing. Packed chips will counteract the forces produced by the geometry of the drill that keeps the tool on the centerline, and the drill will actually be pushed off center by the chips. The pressure and flow required to keep things running smoothly is determined by the diameter of the drill.

A small drill will obviously produce a small hole through which to force the chips backwards out of the barrel. This necessitates fairly high cutting oil pressures to ensure that the chips are flushed out effectively. By contrast, large drills produce spacious holes through which chips can easily pass, but the increased volume of the hole requires an increased volume of cutting oil to fill the void.

The pump used to supply the demand for oil, whether at high pressure or a high rate of flow, must have quite a bit of power to get the job done. For this reason, the motor used to power the cutting oil pump on a gun-

drilling machine is quite a bit more powerful than the motor used to drive the spindle that rotates the barrel blank. Because the drills are so freecutting and the feed used to drill is so fine, the spindle motor does not require much power to rotate the barrel blank at the required speed.

The final considerations for beginning a gundrilling operation are starting the drill precisely on the centerline and keeping the long shank of the drill from bowing during the drilling operation. A hardened steel bushing with an inside diameter no more than a few thousandths of an inch over drill diameter is used to ensure that the drill will begin cutting in the proper location. A solidly mounted fixture must be used to ensure that this bushing is held precisely on the centerline of the barrel blank.

Once the hole has been drilled deep enough for the entire periphery of the drill tip to enter the barrel, the self-correcting forces caused by the geometry of the cutting edge and the rotation of the barrel blank will keep the drill on course. Between the barrel blank and the carriage that holds the drill driver, a device called a whip guide is placed about midway along the shank of the drill. The whip guide is another bushing which is just over drill diameter.

Because the drills used for gundrilling are very long in relation to their diameter, the drill shanks tend to bend to the side under the cutting load. The whip guide is designed to prevent this and keep the drill shank nice and straight so that it cannot flex, because flexing would encourage the drill itself to run off course. However, the whip guide is most useful on gundrilling machines which spin the drill (these machines generally drill things such as crankshafts, not gun barrels).

Gundrills are inherently out-of-balance due to the V-groove pressed into the shanks, and the shanks will definitely flex if the drill is being spun.

THE BASICS OF GUNDRILLING RIFLE BARRELS CONTINUED

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58 caliber muzzleloader barrel nearly fill a 2 1/2-gallon bucket. Troubleshooting Drill Runout Despite the self-correcting design of gundrills and the development of machines specifically designed to use them, there are things that can go wrong during a gun-drilling operation. If one of the parameters of the operation is not as it should be, the result can be a crooked hole that does not run through the center of the barrel blank.

This condition is called runout and if it becomes excessive, the barrel blank will not be worthy of continuing on to the reaming and rifling operations. Many have tried to correct crookedly drilled bores by using long reamers to try to straighten things out, but results are extremely variable and usually not too impressive. If the hole in a barrel blank isn't properly drilled, then that particular barrel blank is a likely candidate for the scrap heap. The primary cause of drill runout is chip packing.

If the cutting oil pressure and flow aren't high enough to flush the chips out of the hole before they can accumulate, then chip packing will be the inevitable result. As mentioned above, chip packing counteracts the forces which are intended to act upon the drill to keep it on centerline. Once these forces have been neutralized, then the force of the packed chips pushing against the barrel wall will take over, and these forces are definitely not designed to keep the drill on center.

Even if the oil pressure is correct at the beginning of a drilling operation, chip packing can still result at some point during the

drilling operation. As drilling progresses, the cutting oil will become hot as a result of the continuous friction of the cut. The oil temperature will commonly exceed 100° F by quite a lot before the hole has been drilled to full depth. As the oil temperature increases, its viscosity will begin to decline. Cutting oil is necessarily thin to begin with.

As it heats, it begins to flow like water. Since the oil is now easier to pump than it was before, the pressure on the delivery line will drop. A drop in oil pressure inside the barrel blank, especially when the oil is hot and thin, can cause the oil to flow past the chips instead of picking them up and carrying them out of the barrel. For this reason, the oil pressure should be monitored when drilling a gun barrel and increased to the necessary level if it begins to drop.

The other major cause of drill runout is improper operation of the gundrilling machine, meaning that either the speed, the feed, or both are excessively high for the size of gun-drill being used or the type of material being drilled. Excessive rotational speed or drill feed will cause the cutting forces acting upon the drill to be greater than they should be. This can lead to unpredictable results and a decided lack of barrel-to-barrel consistency.

One barrel may come out of the machine well within tolerances, while another is a complete mess. Excessive speed and feed can also cause premature cutting edge erosion and an overall shorter working life for the gundrill. Of all of the parameters involved in gundrilling, feed rate is the one

that must be followed most closely. The reason for this is that the feed rate has a major impact on the thrust force encountered by the drill.

Feed rate also determines the thickness of the chips that are coming off of the cutting edges. If the chips being produced become too thick, they will be harder to flush out of the hole and that can lead to chip packing. Assuming that all goes well during the drilling operation, a nicely drilled barrel blank will be the result. Bore runout does not have to be, and usually isn't, zero from one end of a thirty inch barrel blank to the other. But it doesn't have to be.

As long as the runout is gradual and there are no crooks or dog-legs in the bore, the runout can be effectively eliminated during the barrel profiling operation. As long as the runout of the bore does not exceed 0.015" the drilling operation can be considered a success, however, runout exceeding 0.015" indicates the operating parameters of the machine should be examined carefully to determine the cause of the excessive runout before drilling any more barrel blanks.

The preceding discussion was intended to be a general overview of gundrilling. My book, *Steel Helix* (steelhelixrifle.com), provides a thorough discussion of making rifle barrels from solid bars of steel, including the design and operation of a home-shop built machine for making rifle barrels. AG

FROM THE ARCHIVE

AR-15 Sub-Caliber Training

Options to stay sharp in the off season.

BY JOE CARLOS OCTOBER 2015

ORIGINAL PP. 13-19

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Those of us who live north of the Mason-Dixon Line experience long hard winters that are not conducive to outdoor shooting. While ice skating is not as common these days as it was back in my misspent youth, skiing, snowmobiling, and ice fishing are all popular. None of those activities require the fine motor skills of delivering an accurate shot, however, and that is difficult to do outdoors in sub-zero weather.

Those of us in the north found ways decades ago to shoot indoors during the winter. 22 LR conversion for the 1911 is a popular winter training tool. Below center: Author's father liberated this .22 LR training rifle used by German troops in WWII. 22 LR conversion. Right, barrels for dedicated .22 LR uppers don't use conventional .223 barrel extensions. Builders must machine the raised flange into their barrels so they are held captive in the receiver by the barrel nut. Some of us have ranges right in our basements.

For those whose architecture (or the missus) doesn't support that, we have lots of gun clubs with indoor ranges, commonly at 50 feet with .22 LR. Some indoor ranges allow centerfire pistol shooting but it is not unusual for "hardball" (Full Metal Jacket) ammo to be discriminated against. Many indoor ranges run leagues, hosting local and postal matches. Other shooters view indoor shooting as

an off-season opportunity to retain their skills until they can get back outdoors at longer distances.

They prefer their indoor firearm to resemble outdoor, long distance guns. Not long after the Colt .45 was adopted as our official service pistol in 1911 it became extremely popular in outdoor NRA bullseye shooting. Shooters wanted a similar pistol in .22 LR with the same trigger pull, sights, and ergonomics as the .45 and Colt gave it to them. Called the Ace, the .22 pistol went through various design changes over the years. The use of .22 LR military training rifles was widespread worldwide.

My father brought back a German .22 LR single shot training rifle that looks and feels like a 98 Mauser following WWII. Not long after Eugene Stoner worked out the design of the AR-15, Colt came out with a .22 LR conversion for it. All the owner had to do was replace the bolt carrier and magazine with the .22 LR units. Unfortunately, accuracy of these AR-15 conversions was never very good. First, bullets for the .22 LR are not quite as fat as bullets for the .223 Remington or 5.56mm.

Normal dimensions for .22 rimfire barrels has 0.2170" lands and 0.2220" grooves. Centerfire .22 caliber barrels commonly have

0.219" lands and 0.2240" grooves. While the Ace conversion units for the 1911 and other dedicated .22 LR trainers had barrels with the correct internal dimensions and shot fairly accurately, the conversion units for the AR retained the parent barrel and there is too much slop for rimfire bullets.

Second, the parent AR had a .223 chamber, an enormous discrepancy compared to .22 LR, requiring a .22 LR chamber be incorporated at the front of the conversion unit. Attached to the front of that was an integral .223 steel dummy casing. When the .22 LR round was fired bullets went through this dummy casing with no support, keeping things only roughly in line with the too-big center fire barrel for about two inches before crashing into the rifling. Third, twist rates are different.

Dedicated .22 LR barrels usually have twist rates of 1:16" while Stoner originally designed the AR with 1:14, which was changed to 1:12 for arctic weather stability (Russia was a big worry when the M16 was being developed) and again to 1:7 with the M16A2. Finally, these units are known for severe bore fouling. We stagnated with the Colt, M261, and Atchisson (manufactured by Ciener) rimfire kits and the poor accuracy that they were known for. In

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22 LR conversions. Above center: M261 conversion less dummy chamber insert as used by the author and Compass Lake for dedicated .22 LR uppers. Also shown is a ten round magazine inserted in a standard AR magazine. CLE Bob Sled magazine locks the bolt back. the mid 1980s I approached Krieger Barrels about making a dedicated .22 LR barrel for the AR-15. They did and I still have it. It worked out very well and it wasn't too long before I heard other shooters getting gunsmiths to make something similar.

When I took over the Armorer position for the Army Reserve in early 2000 I remembered what a great training tool my custom unit had been during cold Pennsylvania winters and I looked for some to issue to my shooters. Derrick Martin of Accuracy Speaks and the All Guard Team published The Complete Guide To AR-15 Accuracy in 2000 and he devoted a chapter to custom dedicated .22 LR conversions.

When I finally got a purchase budget I was able to follow up with Derrick and had him to build some .22s on the Atchisson unit with the same barrel contour as our competition rifles, float tube, and quarter minute sights. Ergonomically, they were identical to our centerfires and fit any AR lower. The guys really liked them and are still in service on the USAR Team. The Guard mobi-

lized Derrick to the Gulf and had Compass Lake Engineering build units in his absence.

Accuracy Speaks and Compass Lake used Douglas blanks for the conversions. Eventually I got enough of the conversions in service with other blanks and determined Krieger and Lilja (in that order) delivered more accuracy. If you are planning to buy a blank for one of these projects remember that .22 barrels have no barrel extension on the back like a regular .223 and that raised flange is necessary for attachment to the upper receiver via the barrel nut.

Lacking this extension on the .22 LR the builder must incorporate a raised flange integral with the rest of the machining from a blank. To accommodate the fatter dimension of the flange you need to buy a blank no less than 1 1/4" outside diameter to allow for machining. I would get it about 24" long to finish at 20". Compass Lake offers their dedicated .22 LR uppers in either A2 upper receivers and 20" Service Rifle length or on a flat top Match Rifle configuration with a 24" barrel.

If you buy a dedicated .22 LR upper from either Accuracy Speaks or Compass Lake they will weigh and balance just like the real deal and that is critical for valid cross training. I build my dedicated .22 LR AR-15

uppers like Accuracy Speaks or Compass Lake with three major exceptions. First, I use a premium Krieger barrel.

Other custom builders will also give you a premium blank upon request (and sometimes along back order period waiting on the barrel factory to fill orders.) Second, I use only the DPMS Lo-Pro heavy walled upper receivers and include a carry handle with quarter minute match sights, double pinned at extra cost. The Lo-Pro has much thicker the walls than a standard flat top. About the last inch of any barrel mounted in an upper receiver is enclosed inside the receiver itself.

About the front third of that enclosed part is inside the threads for the barrel nut and the thickness of that section of receiver is set to match the nut. The rear two-thirds is enclosed by the receiver walls themselves. The theory is thicker receiver walls provide better and more rigid support for that back barrel section resulting in more uniform (and perhaps dampened) barrel harmonics.

You might not think that a little pipsqueak .22 LR would generate all that much barrel whip to profit from the thicker walls of the DPMS receiver but since I switched from standard upper receivers to the thicker Lo-Pro I have noticed .22 LR group shrinkage on the machine rest. I am also switching to this receiver for centerfire match rifle uppers and groups are also running a little tighter. I want to

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get a little more data on the effectiveness of the thick walls on accuracy before passing final judgment but so far I am optimistic! The Lo-Pro receiver fits standard AR-15 lowers but I don't know if thicker receivers are legal in NRA or CMP Service Rifles as they do constitute an external modification. Thick walled receivers are legal elsewhere and I use them for match rifles.

Like the Lo-Pro, Sun Devil (sundevilmfg.com) thick upper receivers fit standard ARs and are cosmetically better, especially on Sun Devil's lower. One additional advantage of a Sun Devil matched set is the tensioning screw in the lower receiver that acts like a Accu-Wedge on steroids to tighten upper to lower fit. Glen Zediker praised these receivers in his newest The Competitive AR15: The Ultimate Technical Guide.

The third different thing I do is properly stabilize the back of the barrel in the upper receiver using a combination of shim stock and Loctite The aiming black is too large and the scoring rings are not properly scaled for diffi-

culty. Use National Match Air Rifle 200 yard reduced targets (right) instead. Below center: 200 yard targets scaled to be shot indoors. Top to bottom, 25 yard, 50 feet, 33 feet. On bottom is the Crosman MAR177. Above center: Can you identify the imposter in this photo?

Top and bottom are .223 centerfires, center is a dedicated .22 LR. The match rifle and dedicated .22s are built on DPMS Lo-Pro receivers. 45 ACP upper and magazine shown with Figure 14 "Hun's Head" targets. Green 290, removing slop that results in about a 1/3 reduction in average group size in all AR-type rifles. I have found that most Stoner accuracy enhancing techniques work across the board. See "The Relationship Of Barrel Extension Diameter To Accuracy In The AR-15" in the March and April 2013 issues.

Dedicated .22 Training You can certainly train rapid fire strings with these .22's indoors but there are disadvantages. First, most rapid fire strings call for a rapid reload and most .22s don't lock back on the last shot. While it is

simple enough to reach up and work the charging handle to chamber around following a reload, doing so might program "bad code" in the shooter's mind.

Derrick Martin suggests charging an extra round in the first magazine and practicing a "hot" reload with a chambered round with a press of the bolt catch, just as with the centerfire rifle. Jeff Cooper noted, "A man will push himself harder to win a little gold medal than he will train to save his own life." What we practice stays with us when under stress, even if that stress is "just" trying to win a little gold medal.

Second, there is a lot less recoil with the .22 LR than with the .223 and training rimfire rapids requires less recoil recovery, which may give the sensation of taking too long shooting the centerfire gun. Many shooters will overcompensate, shooting too fast and scoring lower because of the panic of thinking they are running out of time causes them

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Using a standard A2 sight adjustment tool, the gunsmith can install sights with narrower posts. Below the MAR177 is a ten round circular magazine and weighted facsimile that helps give the balance and ergonomics of a real service rifle. not to dress up shots well enough. Finally, while there is a reduced standing and sitting target for 50 foot shooting, I can't find a reduced 300 prone rapid fire target. Dedicated rimfires really shine training standing.

You can get a Bob Sled magazine from Compass Lake for single feeding slow fire and it will hold the bolt back like normal. Ray-Vin has free targets for printing on their website scaled for 50 feet and 25 yards. Rimfire has longer barrel time since most standard velocity is only 1,085 feet per second compared to .223 77 grain bullets at 2,770 fps. Shooting good standing scores with the rimfire requires more followthrough and will greatly improve scores with the centerfire.

Not long after the Reserve Team began using dedicated .22 uppers some of our members were getting good outdoor training with them at 100 yards using MR-31 (scaled 600 yard) targets With a 1 3/4" ten ring, it's no small marksmanship task to center a group there with the short AR-15 iron sight radius. This also provides wind doping practice for full distance. In terms of quarter minute

clicks, compensating for wind and mirage at 100 yards with the .22 closely mirrors 80 grain centerfire bullets at 600 yards.

Using the specs of standard velocity Eley .22 ammo (1,085 fps, 40 grains, ballistic coefficient 0.145) the handloads.com ballistic calculator confirmed we were pretty close to being right. The .22 at 100 yards drifted a little less than the 80 grain at 600 yards measured in minutes of angle. If a shooter did a good enough job Lower right shows approximate pellet impact when windage parts of the rear sight stick. The 10, 9, and 8 rings are all black in this target.

The three targets across the top were fired with different lots of Vogel pellets. The first two on the left were fired with standard .177 (4.50 mm) pellets and top right is a Vogel 4.495 mm pellet. Second row left is Final Match pellets, center is with Champion's Choice (flier at 5 o'clock is from a slightly marked pellet) and at the right is RWS. The two bottom targets on the left were fired with Crosman's Premier Super Match.

This was fired with one MAR177 and I several others tested with nearly identical results. Bottom right marks approximate point of impact when the sight sticks clear to the left. Nickel is a reference for size. of programming his brain with the .22 at 100 yards, in the same conditions he would tend to under

dope at the 600 yards just a bit. When we started to convert to the 90 grain bullet I ran the numbers a second time and the comparison with a .22 LR at 100 yards is nearly identical. This is a big deal!

Availability of 100 yard ranges is greater than 600. Even if you do have a 600 yard range available, you'll need pit service as trying to train without instant target feedback is nearly worthless. You can train by yourself at 100 yards and see the impacts in your spotting scope without a pit pig. If you have a .22 and haven't tried this I strongly urge you to do so ASAP. You may have been overlooking a valuable training aid.

Other Options I mentioned that one of the down sides to the .22 LR uppers was lack of recoil. Olympic Arms makes centerfire pistol uppers such as 9mm and .45 ACP. The 9mm obviously has more recoil than the .22 but the .45 ACP is nearly identical to the real deal. These are basically submachine gun uppers and accuracy is like the original .22 conversions with the fake .223 casings on the end. Like all Stoner rifles, they improve with properly stabilizing the back of the barrel in the upper receiver.

Given the carbine length, ergonomics are like the M4. For military combat matches, we had rapid engagement phases such as head targets at 25 yards and I just

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The empty case of the excellent Erie Railbender is just there for sizing purposes as alcohol and firearms don't mix. Above center: Checking windage tracking on an MAR177 using the Ray-Vin gauge. happen to have a 25 yard range in my basement. The Olympic Arms .45 ACP was just the ticket for me. There are other .22 uppers and whole guns appearing (and sometimes disappearing) rapidly. Some resemble AR-15s, others not so much. Brownells sometimes has examples.

A lot of these have 16" barrels and if you are shooting a carbine they make some sense. If you shoot a regular 20" barrel normally, however, I would not recommend a carbine as the ergonomics would suffer just too much. Crosman MAR177 The Crosman Modular Adaptive Rifle is a pre-charged pneumatic (PCP) AR-15 upper. Over the years other outfits tried making AR-15 air rifle but none of them filled the bill. Overly light triggers, poor ergonomic matches with the real rifle, sights not the same, you name it.

Not to mention high prices! I did a real double take when I handled the Crosman units. I feels and looks like the real deal, is a flat top, and has an AR-type carry handle fixed to the back. The overall length and weight were very similar to a 20" AR. Shooters reported stellar reviews. One of the things I like most is using your actual

lower, giving an identical trigger pull. I have been a federally licensed firearms dealer for over 40 years and I contacted Crosman about getting set up as a dealer for the MAR177.

The 2013 retail price on the MAR177 was \$600 and I am able to sell them for half the cost of a .22 upper, making them affordable. In fairness, the .22s offer more options, such as rapid fire and simulated long range practice. Other than the MAR177 upper itself, you'll need properly scaled targets. This includes the bull (aiming black) giving the same apparent size as full distance. Despite how the math may work out, this can be a bit subjective between shooters.

The scoring rings also need to be scaled to the distance and capability of the gun so the shooter gets reliable feedback. If the accuracy of the gun and the scoring rings are in balance a shooter should fire about the same score with a sub-caliber device. I would not attempt to fire an MAR177 on standard AR-5 ten meter air rifle targets because they are designed for expensive target rifles with entirely different sights, light triggers, and different ergonomics.

There are different 33 foot NMAR (National Match Air Rifle) targets specifically for the MAR177 through the Civilian Marksmanship Program (thecmp.org) made by Kruger (krugerus-targets.com) and sold

by MK Tactical (mktactical.com). Targets include scaled 200 and 600 yard versions for standing and prone, respectively. These can also be used at 33 feet with .22s as well and the MAR177 can be shot on 50 foot and 25 yard versions as well. You'll also need away to fill the air reservoir.

Crosman sells a device that looks like a bicycle pump, retailing for \$156.25. Crosman reps warned this takes a lot of work and they're not kidding. If you want to avoid the exercise session involved with the hand pump, Crosman markets a scuba tank and adapter for about \$400. When trying to decide if I wanted to stock these, I Googled "Scuba Shops or Dive Shops" and a number of them within a two hour drive.

My county is 97% forested with only one stop light and I have never seen a scuba diver since I moved here about 33 years ago, so I think most of you would locate even more scuba shops around you. Regarding air, the manual says you get about 120 shots per fill. There is a little gauge on the gun itself for air pressure. There is a bottom suggested limit and Crosman says going below that risks lodging a pellet in the bore. There is also atop gauge not to be exceeded for safety.

Stay between those two red lines and your 120 shots provides a fair amount of standing practice. If you plan on shooting less there is

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Above center: Remove the elevation wheel and drill a second rear hole exactly matching the existing front hole. Trim a standard US spring to the same length as the existing front spring. no advantage to filling the gun to the top limit of 3,000 psi. I fired test groups over my Oehler chronograph at full and almost empty pressure and detected no accuracy difference, no change in vertical point of impact, and no velocity degradation with a uniform spread.

The factory says you can get about 600 fps and mine clocked 539 fps. I don't consider that a problem at all. My extreme velocity spread between the fastest and slowest pellet was only 11 fps. I don't know of a single service rifle competitor on the circuit that wouldn't kill to have his 600 yard ammo that consistent in velocity! The factory recommends storing the MAR177 with no air in the reservoir and instructions cover how to bleed it out.

My tests show you don't have to bust a gut filling the thing clear full for an average practice session. Put as much air in as needed and have complete confidence in the air rifle's accuracy and uniformity of velocity. You'll also need pellets. I did an accuracy test using several of the uppers and a variety of pellets not long after I received my stocking shipment from Crosman, shooting ten round groups at 33 feet from a machine rest. Group sizes ran 1/4-1/2".

Putting the accuracy in perspective, those groups in MOA would be between a little over 2 MOA and about 4.5 MOA. The groups are tight but none of us would accept a four minute gun for real distance shooting, however, accuracy is relative. Since the scoring rings of the targets are properly scaled, shooters are getting about the same scores with the MAR177 at 33 feet as their center-fire Service Rifle at 200 yards.

I don't claim to be air rifle smart by any stretch and my initial machine rest testing was the first time I ever fired an air rifle. Scott Pilkington, one of America's authorities on air rifles and designer of the MAR177, told me that air rifles are very "lot specific" in their pellet preference. .22's also have a reputation for being lot specific in accuracy performance and I see that on my machine rest when testing dedicated .22 LR AR-15 uppers. A note on pellets.

When I was loading the little circular magazine to shoot a group with Champion's Choice pellets I noticed a slight mark on the little hollow base of one pellet. It also resisted going into the magazine a little. That pellet ended up being a flier. With the exception of RWS that is packed individually, other pellets are bulk dumped into a tin container, so there is an opportunity for them to get boogered and that is most likely what happened with that bad pellet I identified.

Being new to pellet shooting, I wanted to try it and it resulted in a flier. The lesson to anyone shooting these things is that obvious de-

formities in the pellets will likely result in degraded performance and one should cull such pellets. In hundreds of rounds of testing it was the only blemish and the only flier I shot so your odds of getting good pellets are very high.

In summing up the accuracy testing, I found all of the MAR177s tested would clean the reduced standing target at 33 feet with most any quality pellet. Perhaps part of the reason for the accuracy of the MAR177 is the Lothar Walther barrel which enjoy a good reputation among air rifle accuracy enthusiasts. As a military armorer for over a decade I tried to test every custom barrel on the market, including Walther. I don't have an axe to grind with any barrel maker.

Every one of them I have experience with was anxious to please and went out of their way, including Walther. I personally know a shooter who set national records with Walther barrels and some swear by them. To me, that simply means one good shooter got one good barrel. My accuracy testing with a batch of Walthers caused me to drop them from consideration for use in Service Rifles. They may be fine for air rifles, however.

Glen Zediker in The Competitive AR15 is even less reserved in his comments on both Walther and Wilson. A USAR shooter won the President's Match at Camp Perry one year with a Wilson barrel and that was one good shooter with one good barrel. Like Mr. Zediker, I dropped Wilson barrels fairly early after testing. I'll expand on my bar-

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rel test results in a later article that will have every barrel maker in the United States except for two taking out contracts on me! We had a similar incident about a decade ago when an AR company with four initials in their name came out with a dedicated .22 LR upper. Their price was well below custom ones from Accuracy Speaks and Compass Lake and government purchasing regulations will take the low bidder.

I got stuck with these uppers that averaged of 3.9 MOA with multiple lots of high quality matchgrade ammunition. The barrels used were made by a low-bid barrel maker that normally produces black powder barrels. Their black powder barrels don't have a bad reputation but the .22 bores were rough as a cob and shot terrible. After a bunch of work I was able to cut the group sizes to about 2/3 of what they were when they came in my shop.

That still made them well over double the group sizes of the quality Accuracy Speaks and Compass lake uppers. I have learned that cutting cost corners in this business frequently results in accuracy degradation. To make matters worse, the upper had two extractors and the one on the right side had a bad habit of going into orbit of its own volition with very modest round counts, often under 100. That really ticked me off, so I contacted the company and complained.

In spite of run arounds and unfulfilled promises, I never got any replacement extractors and they soon withdrew the uppers from the market. They stayed in their fox

holes all this time but have recently reintroduced a dedicated .22 upper. If they are anything like the previous offering, let the buyer beware! Last, but not least, you will need a bullet trap appropriate to the distance, target, rate of fire, and caliber of firearm you are shooting.

If you are just shooting a .177 caliber pellet rifle at 33 feet, your requirements may be met with something you might find at a Walmart. I have a 15"x15" Detroit Bullet Trap for use with the Olympic Arms .45 ACP in my basement. I practiced on Figure 14 targets, firing four shots in three seconds from at 25 yards from "Standing Alert Position" (stock in the shoulder and muzzle down at 45 degrees.) Obviously this takes a bigger and stronger bullet trap than a pellet rifle.

MAR177 Sights The front sight post is about 0.072", give or take a couple of thousandths, standard A2 sight width and popular with current military and older shooters. The threads in sight base are compatible with replacement posts. The rear sight has an aperture of about 0.046" and is one of the more common sight options. There is no hood but under consistent lighting I am not sure it needs one. Older shooters like the 0.046 and some go on up to 0.052".

To me, shooting indoors under artificial lighting never gave the clear sight pictures I get outdoors and I think the fat rear aperture might help clear that up. The elevation is supposed to be quarter minute (about 1/32" at 33 feet) and windage is half

minute. Shooters normally find differing adjustments confusing but 1/16" windage movement seems plenty fine at 33 feet. The last step I perform before any custom gun leaves my shop is gauging the sights.

When I was the armorer for the Army Reserve I likely spent nearly as much time tinkering with sights as replacing barrels. The fine 1/4x1/4 threads wear out fast and the slightest speck of dirt can cause havoc. I checked sight tracking on the MAR177. It says on the box "Made in the USA with some foreign components." I can sure guess what one of the "foreign components" might be and from what country it might hail from! On the very first one tested the elevation wheel didn't want to budge at all.

It was jammed up and it didn't take but a quick visual inspection to find the cause. The elevation wheel was jacked at a terrible angle, way high in the front where the spring loaded detent pushed up on the underside. I got my feeler gauges out to measure the severe tilt. I disassembled and measured the diameter of the threaded stem (the part fitting under the sight base) and compared that to the corresponding bore hole in the carry handle. It was way too fat, permitting the stem to sit crooked.

At that point I was tempted to substitute a quality sight base with a standard diameter stem. I dug one out and it wouldn't fit. Now the hole wasn't big enough for the standard American part. It would (Continued on page 22)

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have been easy enough to ream the hole but I would add the expense of the new sight base. I figured the problem could also be fixed by adding another spring and detent under the rear of the elevation wheel to even out the front and rear pressures. Remove the elevation wheel and set your drill press to stop at the same depth as the existing front hole so the spring pressures become equal, then install a second spring and detent in the new rear hole to match the front set.

When I put anew American coil spring in there I found that the front Chinese spring was a couple of coils shorter. Absolutely nothing to spec in this rear sight! I cut coils off the American spring so it was of equal length, reassembled everything, and the elevation wheel sat level the way it should and the sight moved more normally. Fortunately, my inspections indicate there aren't many sights with these elevation problems.

In the future I'll ship offenders back to the factory and let them replace the whole carry handle. Shipping carry handles back with this next problem probably won't work because every one I've inspected had this problem! There is an enormous gap between the right edge of the sight base and the left side of the windage knob. When shooters make windage adjustments they often press in to the left on that knob when doing so, forcing the windage screw left.

The coil spring buried in the windage knob is supposed to exert enough pressure to correct this. Sometimes on the MAR177 and some ARs the screw sticks, yielding point of impact to the left, and then creeps gradually back with each shot, stringing shots horizontally along the way. The fix works for ARs as well. Get 250x375 shim washers in assorted sizes from 0.001" and 0.002" (for fine tuning) and some 0.016" and 0.020" sizes.

No two sights seem to want the same number of shims, with some needing four thicker shims and others requiring only a few. Your feeler gauges on that gap between the sight base and windage knob will help get a ball park idea. It's faster if you leave the actual sight off while rough fitting. If you get too many shims stacked up you'll have difficulty driving the roll pin back through the windage knob and the sight will run hard for the customer.

If you fail to use enough you'll still end up with some unwanted left windage. A little practice and you'll get it just right. I like to finish off with another tracking check with the gauges any time I tinker with a sight just for insurance. I am performing this windage correction on all MAR177 sights. The sights are the only weakness that I have found on this otherwise very well designed unit. AG

RIFLES

Cable Control Trigger Release

Trigger control has always been a critical issue in developing extreme rifle accuracy. This can be improved with a remote control trigger release, where the shooter's hands don't directly touch the rifle. Crafting some form of trigger release is quite rudimentary and the cost is low.

BY NORMAN E. JOHNSON OCTOBER 2015

ORIGINAL PP. 20-22

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Why is some form of trigger release needed? Though a cable control type of trigger release may not be used during actual hunting or benchrest competition, it becomes a very effective aid during the critical testing of a rifle, particularly with more accurate benchrest or target rifles using lighter triggers. The most common method in effectively testing a rifle for optimal accuracy is to rest the front and rear of the stock on very stable supports.

These usually consist of a precision front bag rest and special sandbags with laterally positioned ears at the rear of the stock. In this way the rifle is carefully positioned and adjusted so the scope reticle is precisely on target with little or no help in guiding it with the hands or shoulder. Such human guidance almost certain to have a marked difference from shot-to-shot on target due to the inability to duplicate the hold and trigger pull from one shot to the next.

To obviate the human element in accurate shooting, triggers are set to lighter pull weights. Such pull weights may range from

as little as two ounces to around two pounds or so. The most common methods of trigger release involve having the sights pre-aligned on target with the scope reticle fixed on the aim point and pulling the trigger straight back with only the tip of a finger contacting the rifle. No shoulder or hand contact is used as the rifle recoils rearward against the shooter's shoulder.

Of course, all the while the trigger is being pulled, the shooter views the scope reticle precisely on target. If performed correctly, extremely small groups on target are the usual result. Major disadvantages of this mechanism are the upside down position requiring finger tip use to utilize the cam. This type of trigger does little in delivering a more steady release in precision benchrest shooting and rifle testing.

This is all well and good for the really light trigger but when somewhat heavier triggers come into play, some hand and shoulder rifle contact is required and this is where as little as a one pound trigger pull disturbance can cause rifle movement on trigger

release, particularly with lighter weight rifles. As the rifle is fired with triggers weighing more than a pound or so, an equal amount of thumb and/or hand pressure is applied to the rifle stock to compensate for the errors in the trigger pull.

Sometimes varying degrees of shoulder pressure are applied in trying to accomplish a more steady trigger pull, usually with little improvement. This is where the cable control trigger release comes to the rescue. No part of the hand or body comes in direct contact with the rifle until the butt plate moves rearward into the shooter's shoulder or other form of stop. The cable control device is simply a means of attaching a common camera cable shutter release to the trigger guard, enabling it to work the trigger.

This very effective device can be made up by the innovative gunsmith at a very low cost for materials.

CABLE CONTROL TRIGGER RELEASE CONTINUED

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Properly placed slots and grooves allow the block to be clamped to the lower trigger loop and attach the cable release. Making Trigger Releases I had a sketched a few ideas on paper for cable trigger releases and finally went with a simple aluminum block machined with a slot to fit the underside of different style trigger guards. A groove, set at proper

angle, was then made at the top of the block to hold and direct the cable release pointer against the trigger.

The pictures show the simplicity of the design and further clarify details in machining and usage. The brass clamp screw seen below clamps the unit to the trigger guard. Testing

As I made up the trigger release unit, I fitted the attaching slot to a number of different trigger guards for universal application. The slot is formed with a shallow radius to fit average trigger guards, particularly Remington Model 700 and Winchester Model 70 series rifles, and

CABLE CONTROL TRIGGER RELEASE CONTINUED

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this turned out to fit nearly all rifles. I was really excited to try it on some of my better rifles capable of extreme accuracy capable of 1/4 to 1/2 minute of angle precision and it functioned without a hitch. It's really quite different to shoot a rifle with our often-interfering hands totally off the firearm. Anticipation of the muzzle blast and recoil into the shoulder were a different experience as I viewed through the scope. This brought out the best in each rifle I tested.

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When heavy magnum-type rifles are shot this device is less useful and shouldering the rifle to receive such recoil will be necessary. Conclusion Not all of our endeavors are going to result in success but it's encouraging when they do. I see the cable control trigger release as one of these. AG

METALWORKING

Reader Forum

BY AMERICAN GUNSMITH EDITORS OCTOBER 2015

ORIGINAL PP. 23-24

Bedding Remington Receiver Rings I do enjoy the gunsmithing articles Norman Johnson is so well-known for and this time it's no different. Of course, I'm referring to "Bedding The Model 504 Remington Receiver Ring" in the May 2015 issue. I'd like to send along my most sincere thanks for writing about our Steel Bed. I think some people are a bit intimidated by doing any kind of bedding work but your article shows and tells exactly what needs to be done, how to do it, and why.

Your job on this receiver ring is certainly clever. What a great resource to refer to and use in the shop. Frank R. Brownell, III Author Norman Johnson responds. It is commendable that a company of such stature will take the time to contact magazines and writers. Thanks for reading my article! AR-15 Sight Alignment Tool I'm writing about "All About AR-15 Sights" by Joe Carlos in the August 2015 issue. He shows the use of a "simple pointer gauge" used for the initial front sight horizontal alignment.

I have been trying unsuccessfully to locate one. Can you advise where I can obtain one? If it is a locally manufactured tool, what is the diameter, length, and other pertinent specifications? It looks simple to make but no need to reinvent the wheel by trying to reverse engineer from a photo. I would also like to thank Mr. Carlos for his excellent articles. The details provided plus the reasoning and results are far ahead of any others I have read on the AR platform.

I agree 100% the only way to zero a rifle is to put lots of rounds down range to find out where it shoots, hot, cold, and with different ammo. When I saw the photo it was exactly what I was thinking of to get the initial alignment. Author Joe Carlos responds. Thanks for your kind words about

my articles! The pointer that was in the article was one I purchased from DPMS about a quarter century ago. I checked their web site and couldn't find it, so I called and asked for one of their tech representatives.

He said he has been with the company about seven years and has never seen one, so it appears that DPMS is no longer offering this. At the time I was buying my pointer from DPMS I remembered Arma Lite offering a similar pointer. I got on their web site next and found Part Number 15901133 called "Front Sight Alignment Tool." I spoke on the phone with one of their representatives and he described the shape and use of the tool and I believe it is what you are looking for.

Montezuma, IA I have tried almost everything out there from simple bore sighting, to inbore lasers, and this pointer. I have even live fired customer's firearms. In spite of all that effort the most common complaint I get is that the customer has to spend a few minutes and a few rounds of ammo to get a proper final zero on their rifle. So the final onus lies with the gun owner to arrive at his specific zero. All the gauges and lasers can hope to do is get the rifle somewhere on paper.

Rebarrel Remington 760 I have a 1951 Remington 760 Gamemaster chambered in .30-06. The rifling at the muzzle is gone, probably due to years of cleaning from the muzzle. Needless to say, it won't group for crap. I am unable to rebarrel this myself. Where do you recommend I send this rifle to have it rebarreled? Start by calling Remington in Ilion, NY. Ask for Customer Service remington.com/pages/support/repair-services.aspx.

If they can't do the job reasonably soon and at reasonable cost, Brownells free-upon-request parts source list has some contact information on rebarrel- Ken

Angst ing services. Numrich (gunpartscorp.com, lists the barrel and Jim Green (downeastgunworks.com, works on these. Repairing Broken Stocks Norman Johnson's article "Repair And Restoration Of Broken Stocks" was a superb feature article in your August 2015 issue.

Not only is it concisely written, the photos accompanying it enhanced the clarity of the repair process. It's reportage such as this that makes American Gunsmith a must read for all firearms enthusiasts. Keep up your commitment to excellence! Maj. Kris Vasilo U. S Air Force (ret.) Thank you for the amiable comments on my article. As writers, we really appreciate such comments; particularly those submitted by individuals who know what's been done.

I broke my first gunstock on an M1 Garand while performing bayonet practice in the Marine Corps. The armorer just tossed the stock in the trash pile. Sir, thanks for taking the time to comment. Norman E. Johnson USMC (ret.); Life Member, DAV Recoil Pads For Synthetic Stocks Reading RK Campbell's "Recoil Pads For Synthetic Stocks" (August 2015) I was somewhat disturbed by the installation of the recoil pad using epoxy. Mr. Campbell may be assuming he will never see that stock for a pad again.

On hard used guns these pads may only last five to ten years. I have replaced many Remington factory Limbsavers before guns reach ten years old. Epoxy is permanent. Bruce Millheim Bath, PA I have read with interest the articles on pad installation on synthetic stocks that have been cut down thinking someone had a better way than how we do it. Next one I do I will take some pictures and write a short piece on it as our procedure allows changing pads at will when worn out or if a different length of pull is needed.

READER FORUM CONTINUED

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I really do like Mr. Campbell's idea of the filler but the epoxy just makes me shake my head and hope one of those don't come into my shop for me to remove. Randy Iles Iles Custom Gunsmithing Author RK Campbell responds. Your point is well taken. As for epoxy, well, this is how I was taught and it is stable and isn't going anywhere. I can always learn a better way. As for the filler, glad you like it, it works.

H&R 999 Sportsman I am trying to fit anew lever and spring assembly on an H&R 999 Sportsman and I am having a problem with the spring. I have followed the instructions from Numrich Gun Parts Corporation but the spring always breaks and comes loose from the lever. Are there any special methods or tips for doing this correctly? Samuel Garrison The 999 is listed among many other obsolete H&R revolvers in Volume 2 of Jack First Gunshop's catalog.

The schematic there-in shows the lifter (hand) assembly is a one-piece affair that includes the spring. An extremely small pin, not identified in the drawing, secures the spring to the body of the lifter. We don't mean to cast aspersions of the serviceability of components received from Numrich or your budding abilities, but small, flat springs can be very prone to breakage if improperly heat treated or roughly mishandled. We see three options.

First, you could take the matter up with Numrich and order a replacement unit. Second, drift out the retaining pin in a broken unit you have on hand with a very small drift punch or short length of drill rod. Finally, you could retrieve the remainder of the spring from the lifter, have it tack-welded back on to the spring, grind and polish the weld true smooth, then reinstall the spring with its retaining pin to the lifter.

Allen, MI Easier, and quicker is to call Jack First explain the problem you've been having and order a fresh lifter assembly for the revolver. Gun Oil Stu A number of

years ago you ran an article about making a homemade product similar to the submersible Dunk-Kit cleaner. As I remember, it had kerosene, Marvel Mystery Oil, and two or three other things. It worked great, I gave much of the formulation to friends, and put the copy of that issue away so I wouldn't lose it. Yep, it is so safe that now I can't find it.

Any chance of rerunning the formula or doing an update comparison? Ray C. Bouffard April 1998 was the issue. The formula is: 2/5-parts kerosene, 2/5 mineral spirits, 3/20 Marvel Mystery Oil, 1/20 Rislone. Provided as you requested but with a caution. This mix includes several petroleum-based products. Depending on the polymer employed in making plastic for a gun component, these petroleum products can have a negative effect on the plastic causing it to fail.

Conversely, Dunk-Kit contains no petroleum-based elements. It was developed by Bill Laughridge of Cylinder & Slide (cylinder-slide.com, for cleaning polymer frame pistols without fear of damage to their structural integrity. S&W CS9 I have a S&W CS9 Chief Special that malfunctions with the slide failing to return to battery. Do you know where I can get an owners manual or detailed disassembly information? Mark Ernst The popular back up was once a caliber .38 revolver, the Model 60 Chiefs Special.

It was eventually replaced by the S&W Third Generation CS9 pistol and is presently no longer available to the public. Detailed Third Generation disassembly information is in The Gun Digest Book of Automatic Pistols Assembly/Disassembly or you can secure an owners manual from S&W Customer Service. From what we've seen on the S&W website, the manual contains no schematic. We know S&W has discontinued including schematics for some of their handguns but Customer Service may be able to turn one up. AG

SEARCHABLE ISSUE RECORD

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