



JAN 2015

DIGITAL ARCHIVE
EDITION

PRECISION ARMS WORKSHOP

AND THE AMERICAN GUNSMITH ARCHIVE

A TECHNICAL JOURNAL OF CRAFT, REPAIR & RESTORATION

01

ARCHIVE ISSUE NUMBER

INSIDE THE ARCHIVE

AR-15 BORE CLEANING

FIREARMS: AN ILLUSTRATED HISTORY • BRINGING A SPRINGFIELD MODEL 87A BACK TO LIFE • A GUNSMITH'S EDUCAT...

ORIGINAL METHODS. MODERN ACCESS.

ARCHIVE EDITION 133

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AMERICAN GUNSMITH

DIGITAL ARCHIVE EDITION • JANUARY 2015

ISSUE RECORD

ORIGINAL DATE	January 2015
VOLUME	Archive volume not stated
ISSUE NUMBER	01
SOURCE ID	ag-2c4a73114b917e97e8e0d70c

DIGITAL EDITION

PUBLICATION	American Gunsmith
EDITION	Digital Archive Edition
ARCHIVE STEWARD	Innovation Network LLC
CONTACT	editor@gunsmithmag.com

Editorial fidelity. Article titles, author attribution, issue relationships, source-page references, and article text remain bound to the archive corpus. Layout, covers, navigation, and conversion notes are newly produced for this edition. Historical statements remain part of the original editorial record.

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HISTORY

Firearms: An Illustrated History

BY AMERICAN GUNSMITH EDITORS JANUARY 2015

ORIGINAL PP. 2

Published in conjunction with the Smithsonian Institution, *Firearms: An Illustrated History* (DK Publishing, <http://bit.ly/1tcBxDz>) charts the evolution of the gun for civilian and military use, from the pistol and rifle, to the machine gun and artillery, from the development of early flintlocks and muskets to modern-day firearms. More than 300 firearms are highlighted along with pivotal moments in gun development and technology spanning seven centuries of history combined with excellent illustrations.

Photographic tours detailing the most intricate details of key weaponry and features on the world's iconic gun makers, including Colt, Smith & Wesson, Maxim, and Kalashnikov.

Features include two exclusive, colored prints of a Colt Single-Action Army Model 1873 and Smith and Wesson Model 10; a time line that spans a 700-year period of development from cast-bronze cannon to lightweight, nylon-stocked hunting rifles; profiles on all the legendary names in gun making, from Beretta to Winchester, with articles on the craftsmanship and mystique behind the brands; and a weaponry gallery of muskets, pistols, shotguns, rifles, machine guns, and artillery.

More than most gun owners, *American Gunsmith* readers will likely be well acquainted with much of what's in here, although I'm certain even the most experienced gunsmiths will likely learn something they hadn't known previously. The real benefit of this book is as a tool to educate others. Think of *Firearms* as a coffee-table book to entertain guests or new shooters with a rich history of firearms and their development.

For people that don't know much about firearms this is an excellent introduction and was the very sort of book I first discovered when I began developing an interest in guns and shooting. For those with more experience the book is a tapestry of personal arms, both military and civilian, that extends through crew-served machine guns and artillery and encompasses a complete historical overview illustrated with excellent photography.

ORIGINAL SOURCE PAGE

2

METALWORKING

Bringing A Springfield Model 87A Back To Life

The ultimate challenge to restore a badly neglected rimfire rifle.

BY DICK MAHEU JANUARY 2015

ORIGINAL PP. 3-5

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A friend brought me one of the most rusted firearms I have ever seen. It belonged to a cousin whose son had left it in a field behind a barn several years before. There it had lain in grass, mud, rain and snow until recently found. My friend asked me to look it over and decide if it was scrap or recoverable. Since it was going to be an ongoing project through the winter in between other work, I decided to give it a try since no particular time frame was involved.

The Springfield 87A is a semiautomatic, tubular fed .22 rimfire firing the .22 long rifle cartridge in semi-auto mode and .22 long and shorts in single shot mode. Single shot mode is activated by pushing the locking bolt (bolt knob) in to lock the bolt and operate essentially like a regular single shot bolt action rifle. Long and short .22 rimfires are unable to satisfactorily operate the action for semi-auto functioning.

It has the same basic action as the Savage Model 6 and its variants, as well as Springfield and Stevens models 76, 85 and

187 and their variants. This design has been around since 1938 and is well proven as a reliable semiauto rimfire mechanism. Having inspected my new project, I was ready to get into it. The barreled action was covered with surface rust throughout and deeply pitted. The inner magazine tube was missing and the outer tube also covered with surface rust and deeply pitted.

The trigger guard was extremely worn and a very dull gray color. Much of the original finish was worn off the stock and a couple of areas were very coarse and abrasive to the touch where the stock had been in mud for a period of time. Time to field strip this rifle. The first step is to unscrew the take down screw located on the bottom center of the stock. The barreled action can now be taken out of the stock, exposing all of the working parts of the action. Unscrew the recoil plug at the rear of the action.

On this gun, it was around, knurled plug. Some of them will bearound, oblong affair containing the safety mechanism. This proved to be quite a chore on this rifle as it

was well rusted in place! After trying all regular avenues, I resorted to a large pipe wrench to secure its release. Even with protection on the knurled section, the wrench did a job on the plug but I already had a fix in mind for later.

The functioning parts of the action were in relatively good condition and I decided to simply remove the release housing assembly and magazine guide assembly as complete units. They are both held in by two screws, 1/4 x 32 TPI for reference. These screws came out relatively easy and I left the assemblies intact for cleaning later on. A visual check of these assemblies did not find anything out of place or damaged. The hammer, breech bolt and accompanying parts were removed without incident.

Next, I removed the safety and safety spring from the right side of the receiver. It's held on with two screws. I then removed the outer magazine tube and its two mounts that are dovetailed in the bottom of the barrel. The front and rear sights were moved out of their dovetails in

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the top of the barrel. They can come out left or right. Remove the trigger guard from the stock. After removing the front and rear screws of the guard and soaking the guard with penetrating oil for a few minutes, I proceeded to pull down on the guard and it came out in my hand in pieces. The zinc alloy trigger guard had apparently deteriorated in the water and mud, becoming brittle. I ordered anew trigger guard and replacement for the missing inner magazine tube.

While parts for these rifles are not scarce, some parts sources seem to be drying up. My initial plan was to draw file the barreled action and outer magazine tube to remove the deeper pitting. I determined that the outer magazine tube was simply too thin for this action and decided to replace it. For some odd reason, the bore of the rifle had only minor surface rust and I was able to clean it up with bore solvent and a bronze brush. There are pluses and minuses to every job and this was a definite plus!

I started out by running the barreled action over a fine wire wheel brush on my bench grinder. This took a moderate amount of the surface rust off, exposing bare metal. Next, I chucked the barreled action in a lathe with a 3-way steady rest running at 150 rpm and used one-inch 60 grit sanding strips in a shoe shine rocking motion over the whole rifle to see how much of the pit-

ting would be removed. Approximately 20% of the pitting was removed with this method.

It was evident that draw filling was going to be the next step! I secured the action in protective jaws on my bench vise and commenced draw filling. Proper technique takes some time to learn and you must exercise patience and wisdom to minimize flats being produced on the barrel. I draw the file two handed toward myself with a gentle horizontal rocking motion, taking a very thin bite each pass. I started with a twelve inch flat smooth cut mill file and finished with a ten inch second cut mill file.

I spent the better part of two hours on this, bringing the pitting down to around 10% left on the metal. I then ran the barreled action over the wire wheel brush to clean up the draw filling residue and chucked it back in the lathe. I spent several hours running one-inch sanding strips over the entire barreled action, taking out the rest of the rust pitting. I used in order, aluminum oxide, wet or dry paper, 60 grit, 120 grit, 180 grit, 240 grit, 320 grit, 400 grit, 600 grit and 1000 grit.

This left the bare metal in a very smooth and shiny state, so I decided not to do any further polishing on my felt wheels. The metal was now ready for bluing after de-

greasing, done with clean lacquer thinner. Not currently utilizing bluing tanks, I used the same method I've had excellent results with for the past 15 years. The metal preparation is far more important than the method of bluing used. I hung the barreled action through a wire horizontally at eye level over my work bench for the bluing process.

The barreled action is rotated very easily on the wire to reach all areas. I use Brownells Oxpho-Blue purchased by the pint for the bulk of my bluing, applying the blue with cotton balls dipped in a plastic container. Be certain to use surgical gloves for this procedure. Bluing solutions are harmful to your health if induced or absorbed through the skin.

I heat up the barreled action with a hand held hair dryer on high heat, approximately three to four inches at a time and coat liberally with the bluing solution around the complete barrel. I obtain cheap, used hair driers at Goodwill and keep extras if they burn out. After covering the whole barrel in increments, I repeat the process several times until I get the deep blue color I want and halt the bluing action with very clean shop rags soaked in plain water.

If I have any spots that need retouching, now is the time for that. On this proj-

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ect, I didn't need to. I then rubbed down the entire barreled action with a clean, course shop rag (red rag) as this has a very nice polishing effect on the bluing, then put a liberal coat of Rem Oil on the entire blue job, repeated every day over the course of the project. The Rem Oil has a setting effect on the bluing. Any gun oil will do the same. The entire bluing process took me about 1.5 hours. It was now time to tackle the stock. I started out with a heavy coat of Zip-Strip paint and finish remover.

I let this set about 15 minutes and scraped it off with a dull putty knife. I do one side, the top, the other side and the stock bottom, repeating until all the finish is gone. Usually, I'll start out with sanding, however, this stock had a unique problem I have seldom encountered before. One small area on the bottom of the butt stock and bottom of the forend had absorbed some muddy water and then dried out. This had to be leached out of the stock, which proved to be big problem.

After utilizing the normal methods with whitening and acetone, heat and lacquer thinner, etc., the job was only partially done. The only method left would have been to place the parts in boiling water but I did not want to risk cracking or warping the stock, so I ended the leaching process. I then tackled the stock with 100 grit sandpaper followed by 220, then 320 grit. This smoothed the wood out nice for the staining. I elected a medium walnut stain and two coats covered the wood nicely.

I let each coat dry approximately 24 hours. I rubbed each coat out lightly with 0000 steel wool and wiped down with a clean rag. Now, the final finish. I have run the gamut over the years with just about every stock finish known to man. I have had good results with quite a few of them and decided along time ago technique has a lot to do with the final result. Lately, I have been using Minwax Fast Drying Polyurethane Clear Satin and chose that for this stock.

I put the first coat on thin with no runs and let dry 24 hours in a warm environment. I then rubbed it out with 0000 steel wool to a satin finish and repeated the process twice more for a total of three finish coats. I did an experiment many years ago cutting out 24 pieces of walnut from an old butt stock and sanding each piece to a smooth finish. I then applied one coat of finish to one piece, then two coats to another and so on and so forth, all the way up to 24 coats on the last piece.

Letting each piece fully dry and polish out with 0000 steel wool, I found that after six coats I could not appreciably detect any difference between coat #6 and coat #24. Others may swear a difference, but this gunsmith couldn't! I usually quit after three coats but sometimes will go to six on various specimens of wood. I procured the needed replacement parts, inner and outer magazine tubes and trigger guard from three separate sources. This is often the norm with older model firearms.

I then cleaned up the magazine guide and release housing assemblies, and reblued the sights and outer magazine tube mounts. I

reworked and reblued the takedown screw. That left one small project: The recoil plug rusted in place. After cleaning it up on a wire wheel brush, I chucked it up in the lathe and turned off the knurling. I could have easily knurled it again but chose to leave it smooth, drilling a hole in the rear circular portion for a spanner wrench.

I used a 9/64 inch center drill and drilled to a depth of 1/4 inch. I then modified the hub on a spanner wrench to fit the circumference and hole perfectly to tighten or loosen the recoil plug. I have done this before on several occasions and it works out well. I have probably a couple dozen spanner wrenches I have picked up over the years at old tool shops, flea markets inexpensively and these have come in very handy over the years for jobs just like this.

I then reblued the recoil plug and was ready to reassemble the rifle. After reassembly, oiling and check out with dummy cartridges, checking for proper feeding, extraction and ejecting, the project was ready for live fire testing. Everything worked great as when new. With a little tweaking of the sights, the rifle was right on the money at 50 yards. Working anywhere from 15 minutes to two hours at a time, this project covered about two and a half months to completion.

I figure I spent somewhere between 12 to 15 hours of labor on the entire project. All in all, this was a great restoration project and the owner couldn't believe his eyes when my friend took the gun to him. The Model 87A was truly brought back to life after its resting place in a muddy field graveyard! AG

FROM THE ARCHIVE

A Gunsmith's Education

Some notes from our barrel fitting series reveals the route taken by some world famous gunsmiths to master their craft.

BY CHICK BLOOD JANUARY 2015

ORIGINAL PP. 6-7

In initiating my recently-published series on precision barrel fitting I made a decision not to make an attempt to relate the full content of John Hinnant's book verbatim. It was tempting to tackle but it presented a risk I was unwilling to take. I didn't want to omit any vital data by error. Another decision was made. It was to cherry pick the book, by passing long sections of the working guide, some articles covering basic information, and others focused on more advanced topics.

This greatly reduced the danger of omissions. The subject volume in all the articles in my barrel fitting series is the second John Hinnant has written. It is an expansion of his initial work that I had leaned heavily upon in performing my first barrel/receiver/chambering job. Never mind how far back that was. I am not yet older than dirt.

Just be satisfied with this: The population of the state in which this is being written has become so dense per mile that hunting with centerfire, smokeless powder rifles became forbidden quite a few years ago. As a result, my large caliber rifle work declined to such a degree I was obliged to retire, and eventually sell, my trusted machine lathe.

This moral of that story is to check out the hunt- Additional Reading and Sources Reference The Complete Illustrated Guide to Precision Rifle Barrel Benchrest Actions

and Triggers "Blueprinting" "Lathe Installation & Check Procedure" Precision tooling Author/Publisher Date/Contact Fitting John Hinnant Stuart Otteson amazon.com Shooting Times November 2003 Precision Shooting May 1991 Manson Precision Reamers ing regulations in your state before investing large in tooling.

Add the regs in adjacent states as added protection for your bank account and added assurance against unpleasant legalities befalling the hunters among your customers. I'll offer one example demonstrating such legalities area distinct possibility. In my home state, no high power rifle can be used to hunt anything. It is either black powder, shotgun, bowhunting, or nothing. In addition, no firearm can be discharged closer than 400 yards from an inhabited dwelling.

In an adjacent state not quite so densely populated, high power rifles may be used but black powder rifles must be flintlocks. No percussion caps allowed. Fortunately, if you area whitetail, the deer population in that next door state stands a better chance of living longer than in this one. All members of the Bambi cult will rejoice at learning of the flintlock restriction.

But hear this, you revelers: All those handsomely landscaped homes in said next door state face a higher risk than yours of having their expensive shrubbery become deer food. I hope that fact might dampen

your partying a bit. On second thought, I doubt it. I think now is a good time to mention something about the American Pistolsmiths Guild (americanpistolsmiths-guild.com, Pistolsmiths? Don't sneer. You ought to see some of the rifles that come out of their shops.

That might well come as front page news to quite a few people but Guild members are widely known for keeping tolerances to plus or minus thousandths of an inch. They've been doing it for years. What's the real surprise? Few of those members attended a formal school, resident or otherwise, in acquiring their machine tool skills. Nope, they began learning these necessary skills by reading. The reading was followed by practice, practice, and more practice.

All of that was preceded by the countless hours spent holding to close tolerances with hand tooling. Some of the machine tooling you'll be wanting is demonstrated in John Hinnant's guide. All of it shown, and more, is available from Dave Manson Precision Reamers (mansonreamers.com, Dave is a member of the Guild and personally mans his booth at the SHOT Show. I never miss stopping by to say hello, listen in, and watch him demonstrate his newest offering in tooling.

He's a fountain of knowledge and readily shares what he knows with the knot of people who always seem to be present at

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the Manson Precision exhibit, be they gunsmiths, student gunsmiths, or simply folks interested to hear all about and/or see what's new. First, a confession. I admitted in the first article appearing in this barrel fitting series and will repeat here exactly why I chose not to attempt what would amount to a word-for-word copy. Frankly, you only received a taste to whet your appetites for getting serious about getting in on the potentially profitable practice of precision barrel fitting.

To prove my point, and give you an additional whet, read the immediately upcoming list. Taken from the top it reveals all the material detailed in the guide. A subject-by-subject list starts with learning the accessory tools for fitting rifle barrels. These include reamer wrenches, bolt lug lapping tool, receiver facing mandrel, dial indicator tail stock fixture, barrel vises, receiver wrenches. For your lathe work, learn lathe cutting tools, lathe cutting speeds and feeds, and about squaring the receiver face.

Next up is barrel turning and fitting procedure. Topics include facing off the center holes, drilling new center holes, turning a relief cut on the muzzle, the basic lathe

step, turning the breech O.

D., marking the breech and thread tenon length, turning the thread tenon diameter, turning the thread relief groove, facing the thread tenon to length, counter boring the breech face, shaping a coned breech, reaming a chamber, threading the thread tenon, determining correct chamber depth/headspace, finish chamber reaming and headspacing, chamber throat length, crowning the muzzle, milling the extractor cut, assembly of the barrel and receiver.

In addition to all the above, other useful topics include fitting a barrel to the single action, blueprinting a rifle action, chambering for the twenty-two rimfire cartridge, specifically the Ruger Models 10/22 and 77/22.

Congratulations. You have just gained a far better understanding and appreciation of why this writer, your courteous, kind, obedient, cheerful, thrifty, brave, clean and reverent technical editor, was more than a wee bit shy regarding omissions.

MAINTENANCE & REPAIR

AR-15 Bore Cleaning

A former Army Reserve Marksmanship Program Armorer delves into maintaining match grade AR-15s.

BY JOE CARLOS JANUARY 2015

ORIGINAL PP. 8-15

The “Gun Writer’s Union” requires every firearms journalist to write an article on the subject of bore cleaning and they have found me procrastinating. Part of the reason that I haven’t jumped into the topic is because with every gun writer out there having previously penned an article on the topic I felt that there wasn’t much left for me to say.

However, as I remember back over a decade of being the armorer for US Army Reserve Marksmanship Program I probably replaced as many barrels either because of neglect (causing pitting) or due to damage from improper cleaning as I replaced for being genuinely shot out. There are two really good reasons to clean the bore of any firearm. It improves accuracy and putting away a gun with a dirty bore is courting the formation of rust which will cause pitting, thus ruining a valuable barrel.

As a general rule, I would clean every time I fired the gun unless the round count was well below 20 and the gun was going to be fired a similar modest amount the following day. An example might be some hunting situations. Some experts claim that bore fouling is not cumulative, claiming no difference in the amount of fouling present after firing only one round compared to firing 500. That has not been my experience. If a team member retired and turned his guns in dirty, I inherited the mess.

It has taken me up to a day and a half of continuous work to get some of these badly neglected guns cleaned. I don’t claim that fouling gets so bad as to plug shut, but I do claim two shots foul more than one and 500 is worse. Severely fouled bores likely require abrasives such as J-B

Non-Embedding Bore Cleaning Compound in addition to copper solvents. I don’t believe J-B itself harms barrels, but back and forth scrubbing will cause rod flex that wears at the lands. I have seen many barrels destroyed by this.

Ask any gun barrel manufacturer and I’ll bet they’ll agree. Remember that the land sticks up only about the thickness of a sheet of paper above the groove. Despite being made of hard metal it can be worn down by the movement of the rod, even coated ones. Frequent cleaning reduces fouling buildup, makes fouling removal easier, and reduces the chance of bore damage. We also maximize accuracy.

In The Competitive AR15: The Mouse That Roared author Glen Zediker recalls an Army Marksmanship Unit clinic where they presented their studies concluding cleaning every 20 rounds was necessary for peak accuracy performance. At the National Matches at Camp Perry all the military teams park their travel trailers together. Walk by at the end of the day and the AMU shooters will be diligently cleaning their rifles. Then look at the scoreboard and see who wins a large share of the events.

Those trophies aren’t “bought” just by spending a half hour cleaning as it takes years of diligent practice and ruthless application of shooting fundamentals to win, but why throw all that effort away by failing to clean the bore? I have personally machine rest tested many rifles whose first ten shot group (following one or two fouling rounds) after cleaning was their best.

I would also clean the bore, regardless of round count, if the gun was going to sit more than a tiny handful of days (especial-

ly in damp conditions) before being used again. Most of us store customer guns in a safe. Make sure yours is equipped with a good dehumidifying rod! Reserve Team Mini Test When I took over the weapons maintenance of the Army Reserve Service Rifle Team I began by machine rest testing all their National Match AR-15s. Leadership had told all the shooters to thoroughly clean before turn in.

At first, I took that at face value but when my results were so dismal I started looking closer at the condition of the uppers and found most of them far from clean. I began cleaning all of them and retested. Groups shrunk by a noticeable amount. I have lamented ever since that I did not keep before and after cleaning data because 135 rifles would have been a nice sample size. Unfortunately, I was short sighted and could tell that even after cleaning I had inherited an awful amount of work to straighten out.

I didn’t miss my second chance to get some data on bore fouling, however. A big name ammo manufacturer sent me samples for testing. Obviously they wanted our business and the feedback of a military team. I picked out three uppers, all immaculately clean, making sure both chrome moly and stainless steel barrels, and cut rifled and button rifled barrels were included. I started by firing two ten shot groups through the uppers with known lots of ammo to act as control groups.

I had 14 test lots to evaluate so, including the two beginning control groups, that accounted for a total of 160 rounds through each upper. To finish off, I reshot the two beginning

AR-15 BORE CLEANING CONTINUED

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control groups and compared them to the clean gun starting groups fired with the same ammo. One gun's dirty bore groups were 43% larger than when clean. The second upper got fatter by 61%. The third odd-ball shot 34% smaller groups at the end than it did at the beginning. That gun had a brand new barrel on it that had just been broken in. I cussed that thing all day because it was shooting horribly, nearly two minutes of angle, and was threatening to take it off and throw it in the trash.

Finally, just at the end of the test, it tightened right up. I theorize that it probably had a burr on the gas port that finally shot off. I don't throw out data just because it fails to meet some preconception I may have, so I simply say that the average degradation in accuracy in my three barrel sample after firing a total of 180 rounds was 23% and let it go at that. That's a significant amount and I certainly wouldn't want to shoot a match with that kind of handicap.

Any statistician will tell you that my sample size is on the light side. Most of us would prefer at least a sample size of ten but I only had enough ammo to test three barrels. General Bore Cleaning Rules Carbon and copper are two forms of bore fouling and each is removed using slightly different techniques. 35" and caused a shooter to destroy anew barrel. Use a metal guide, such as the one pictured on the right measuring about 0.24".

Always remember, the removal processes can run substantial danger of causing damage to the bore. First, you'll need a quality one piece straight rod of the correct diame-

ter for the caliber. Don't use a .22 caliber rod to clean a .30 caliber firearm as smaller caliber rods flex more. More flex equals more potential damage. One of my two Anschütz squirrel rifles is a .17 HMR and its cleaning rod flexes so much I can't even drive a bore patch down the barrel from the breech.

I have to carefully insert the naked rod through the muzzle, put a patch on at the breech, and pull it back through the bore. It takes me forever to clean that thing. The rod needs to be just long enough to accommodate the length of barrel you are cleaning. Rods I use for 20" Service Rifle AR barrels are shorter than those for 26" barrels. Using longer rods to clean shorter barrels runs a greater risk of rod flex and accompanying damage. Rod handles must rotate freely.

You can save a lot potential crown damage by setting up two rods for each barrel length that you normally clean. The first rod is used with bore brushes and the second with a tip put on firmly with blue Loctite, keeping the tip from partly unscrewing over the course of the cleaning session. I have observed so many guys doing most everything right. They shove a patch through from the breech and remove it when it exits the muzzle but then in their haste to "get 'er done" they yank the rod back up the barrel.

Rod tips will loosen during use, drooping down with gravity when exiting the bore. If you yank that thing back there is a good chance of boogering the bottom surface of the crown. Why run the risk? Get a second rod! Also make sure you have a clean shop rag or paper towel to wipe the rod down fre-

quently while cleaning. Second is a quality bore guide. In Stoner platform guns these replace the bolt carrier and some are tight fitting with O-rings to help center them up. The best are made of metal.

I recommend either JP Enterprises or Wheeler Engineering. For you grown-ups, JP also makes a larger one for the AR-10. Avoid plastic bore guides. A competitor came to my Commercial Row shop at Camp Perry prematurely shot-out barrel. I bore scoped it and the back was almost completely void of fire cracking, indicating a modest round count. However, the lands were uneven at the back. I dropped a throat gauge in the back of the barrel and it went in clear to the handle!

As I continued to scope it I noticed other evidence of cleaning rod damage. I asked him to fetch his cleaning stuff. His one piece coated rod was the right diameter and not too long. I verified that it was straight and that the handle rotated freely. He said he used J-B but wiped the rod frequently. He had been using a plastic rod guide designed for the AR. The hole in the guide intended for a .22 caliber rod measured .35 caliber! This undoubtedly let his rod go crooked into the back of the barrel, damaging it.

He said he never felt anything abnormal, such as scraping the sides of the back of the barrel, during cleaning. Shooters can damage barrels without even realizing they are doing so. We gunsmiths can too! For rifles like the M1A, use bore guides that fit over or inside the front flash suppressor. Some are made of

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Original caption: Top: The M1A is cleaned from the muzzle. Note bore guide entering the flash suppressor, plastic, so occasionally measure the inside diameters to make sure they aren't getting too worn. If you think the back of the barrel is easily damaged by a cleaning rod going in crooked you don't even want to think about what will happen to the crown of the muzzle if subjected to similar rough handling. Don't lull yourself into a false sense of security regarding bore guides.

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Much like automobile seat belts and air bags, bore guides are good insurance but they are not foolproof. You still have to make a very conscious effort to drive the rod absolutely straight every time or it will go off at an angle and harm the bore. Next you will need a fair quantity of the right size bore patches, solvent of your choice, clean quality bore brushes, a clean chamber brush, some type of high pressure aerosol gun scrubber, and Windex without ammonia.

With bore brushes, make sure the windings in the middle of the brush never terminate at the front, exposing their rough ends that can dig into the bore. Ammonia-free Windex is used after each cleaning to remove two types of solvents. Petroleum-based bore solvents can contribute to carbon fouling. Copper solvents have ammonia in them and trace ammonia left in the bore can combine with chemicals in the burning of gunpowder to form a substance corrosive to barrel steel.

I use Hoppe's Bench Rest 9 Copper Gun Bore Cleaner to remove copper during normal cleaning after break in. Bench Rest can be left in overnight. So while it isn't as fast acting as some other copper solvents it is a lot more forgiving. I normally clean indoors and am always involved in other gunsmithing chores while waiting on solvents to react with copper. If a fifteen minute

project turns into thirty I don't have to worry about Bench Rest damaging a fine rifle bore.

That said, there are a lot of good bore solvents out there. Follow the recommendations of their manufacturers. Avoid mixing different brands of solvents. For example, avoid using Hoppe's No. 9 on a bore brush to remove carbon fouling (a good thing) and then following it with Shooter's Choice Copper Solvent or Sweet's 7.62 on a patch for copper fouling. Before email, Boots Obermeyer sent his customers a letter typed on a real typewriter and mailed with a real stamp.

He documented ruined gun barrels that had been damaged by the sort of example I just used above. It seems that mixing solvents can result in unintended compounds that can be harmful to the barrel. You can, however, use Hoppe's No. 9 on a brush to get the carbon fouling and follow it immediately with Hoppe's Bench Rest to get the copper, or use regular Shooter's Choice on a brush followed by their copper remover. Stay with the same brand of solvent.

I have never heard of J-B Bore Cleaner having any adverse reactions with solvents because it uses abrasives instead of chemicals to get fouling out. Literature Search In "Gas Gun Barrel Break-In" (October 2014) I lamented that almost everything in the literature about barrel break-in was tailored to guns without gas ports and blindly mim-

icking such technique won't prepare gas port area properly, leading to potential barrel damage. I see a similar situation regarding bore cleaning.

Almost all of our bore cleaning techniques date back to the turn of the 20th Century. Solvents have been improved but techniques are based on .30 caliber rifles. The Krag was adopted as the standard issue military firearm in 1892, followed by other .30 caliber rifles such as the Springfield, Enfield, Garand, M1 Carbine, and M14. Not until 1961 did our military use anything smaller. The adoption of the M16 saw the military drop way down to a .22 centerfire, among much nay-saying and predictions of doom and gloom.

All of the discontinued military firearms, with the exception of the M14, were sold as surplus to American shooters and sportsmen. Foreign military arms such as the .303 British and 8mm Mauser were imported and sold on American markets. When I started deer hunting in the 1960s I killed my first buck with a Model 98 Mauser that my dad had brought home at the conclusion of WWII. I remember all of the old surplus military firearms in common use in Pennsylvania woods, many of them using the issued iron sights.

From 1892 to 1961 American troops returned from service with the bore cleaning "skills" taught to them in basic training, all designed

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for .30 caliber firearms. They passed those "skills" on to their family and friends. When we finally changed to a .22 nobody questioned that perhaps our cleaning practices needed to be revised. I also remember Pennsylvania hunters in the 1960s lamenting "deer shortages" and sought to close doe season. About a half-century later, with an estimated Pennsylvania deer population exceeding 1.2 million, I still hear similar suggestions from big game hunters.

This flies in the face of the fact the state has the highest number of deer/car collisions nationwide, exceeding 100,000 with an average of 10 human fatalities annually while ranking ninth in total traffic miles driven in the U. S. Our annual harvest exceeds 300,000 deer.

I had the good fortune to study defensive pistolcraft at Gunsite when Jeff Cooper ran it and both bore cleaning and wildlife management always remind me of something he said over 30 years ago, "Times change quickly but men change slowly." What changes in basic techniques do we need to make for cleaning .22 calibers? First, the last three issue .30 calibers (Garand, M1 Carbine, and M14) required cleaning from the muzzle.

Most shooters realize that they need to clean the AR-15 from the other end but it doesn't hurt to reinforce this. Second, bore guides. I never saw one issued during my decades-long military career outside of the shooting teams. Bore guides are like studded winter tires on ice, great insurance but not foolproof.

I have seen plenty of AR-15 bores trashed even with properly-sized bore guides as they do a great job protecting the upper receiver but cleaning rod damage can still occur anywhere past the front end of the guide. Third is cleaning rod flex. This is the biggie but can be counter intuitive. It is hard convincing shooters that it is not the friction of bullets passing in the bore of a firearm that causes barrel wear.

It is even more difficult to convince them that a cleaning rod, even coated ones, flexing and scraping against the paper thin lands of a gun barrel will cause more wear than shooting. The smaller the diameter of the cleaning rod, the greater the flex. Just compare a .30 caliber rod to a .22 for stiffness. Big difference! Cleaning rod flex will manifest itself mostly with tight, new bore brushes.

Bore brushes are our most common abrasive cleaner for removing baked-on carbon fouling but tight ones offer stiff resistance and that can easily cause rod flex. I've measured some new .22 center fire bore brushes at about 0.235". Most lands are 0.219" and standard grooves are 0.2240". Think of that brush half way down the bore and the rod flex between the brush and the front of the bore guide, just in the critical throat area. That rod flex will cause the lands to wear unevenly and accuracy will degrade.

Thicker .30 caliber rods resist flexing with bore brushes more. I see more of a problem with shooters using rods that are too long and those cleaning longer barreled firearms requiring longer rods that flex more. When those long rods are at the back end of the stroke, the arms of most people are hyperextended to where the ability to keep the rod centered will be compromised to some degree.

Having been a drill sergeant, a competitive shooter, and a military armorer, however, I have had more than the average opportunity to watch others clean ARs. Some smaller shooters starting anew bore brush down from the chamber it can often strongly resemble a beginning driver attempting to operate a manual clutch. The vehicle starts and stops in spurts. I see that with bore brushes also. Some advice from gun barrel manufacturers to ease this. First, bore brushes offer the greatest resistance on the first use.

Thoroughly flush the crud out and reuse them until they wear out. A brush that has been recycled once or twice will just re-

quire more strokes than a fresh brush. Second, use plenty of nonammonia solvent on the brush and bore. Dry bores are harder to push a brush through. Stop brushing when it appears that the bore is drying out. Third, .22 brushes can be had in multiple sizes. Some are sized for tighter rimfire bores, measuring about 0.226".

Standard centerfire grooves are 0.2240", though I use a custom groove of 0.2245" on my 90 grain gain twist barrels. A rimfire bore brush would get the lands rather nicely but barely reach the grooves. Unfortunately, fouling occurs in both. On the plus side, rimfire brushes will offer less resistance and should cause less rod flex in a .22 centerfire firearm. Like a used full caliber brush, however, they will require you to use more strokes to get hard baked carbon fouling out.

Fourth, substitute nylon brushes and some of the new hotter "gee-wiz" solvents. The nylon brushes offer less resistance and cause less rod flex. Montana X-Treme Copper Killer works well with nylon brushes for copper, though nylon isn't as good about hard carbon fouling. Another time cleaning rod flex manifests is scrubbing the bore an abrasive pastes like J-B. Most folks push a patch of it forward until it almost exits the muzzle and then pull it back to the front of the chamber.

I see very little rod flex on that stroke. The flex comes the second time when you stop pulling it and begin pushing it forward. The rod is extended clear out the back of the bore guide and your arm is hyperextended, leaving less ability to guide the rod straight forward. You probably won't feel much flex but the lands of the barrel will. Cleaning rod damage can be diagnosed when the bore scope reveals one or two lands wearing down more than the others.

That is proof positive the rod isn't driven straight down the bore. Make a conscious effort to slow down and really try to send that rod straight!

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25") and cleaning rod (about 0.20") will still permit the rod to be driven crooked. Fouling Types Copper fouling gets all the press and most of the worry. I think that is because of its reaction with ammonia solvents and the bluish-green coloration it leaves on patches. The other component to bore fouling is carbon fouling. It doesn't shout out its presence like copper and often hides in the shadows and corners where lands and grooves meet.

Unless you have a bore scope you may not know for sure when you have it all out. Some shooters claim that the two types of fouling are laid down in layers and without vigorously removing the carbon part you won't be successful getting all the copper. Carbon fouling is baked on whereas copper is stripped from the bearing surfaces of bullets. Carbon needs some type of abrasive and copper is commonly removed with an ammonia solvent, although abrasives like J-Bare also effective.

I start with a quality metal bore guide in place by pushing about three patches wet with Hoppe's No. 9 through the bore to flush out powder residue. I go after the carbon fouling first with strokes of a clean, straight, quality bronze bore brush wet with more Hoppe's No.

9. Nylon bore brushes aren't aggressive enough to get the baked-on, hard carbon fouling out. Nylon is ideal with ammonia solvents and push easier, causing less rod flex. Don't use hot ammonia solvents with the bronze bore brushes.

Modern bronze is typically 88% copper alloyed with 12% tin. Hot ammonia solvents will attack the copper, the prime ingredient in the bore brush. Some folks have fancy formulas for how many brush strokes should be used based on the round count since the last cleaning. I just stroke until the brush seems to be drying out. Then I flush the bore out with a couple more patches of Hoppe's No. 9. Never try to reverse the direction of a bore brush when it is inside the barrel.

At that point I switch to attacking the copper with patches of the hotter Hoppe's Bench Rest. While I wait for the ammonia in the Bench Rest to chemically react with the copper in the bore I take the bolt carrier assembly apart and throw it and the charging handle in the ultrasonic tank and let it do the cleaning work. I run a patch of Bench Rest through the bore every 10 or 15 minutes for as long as I am getting coloration indicating copper is being removed.

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Most chemical reactions occur more vigorously in higher temperatures. I live in north central Pennsylvania and we enjoy about two days of summer in a good year. Having tried cleaning outdoors during colder seasons, it is nearly impossible to get the copper out. Even after soaking with solvents for protracted period the copper persists.

My bore cleaning is done inside and I sit my containers of copper solvent on a radiator (no open flame) to keep them warm when my furnace needs to run those other 363 days of the year. Once satisfied all copper has been removed, I clean the chamber with a clean chamber brush and high pressure aerosol gun scrubber. Note, many gun scrubber products contain chemicals that effectively “kill” a copper solvent’s ability to attack copper.

Don’t get in a hurry and clean the chamber between patches of the copper solvent as some of these aerosols inhibit the solvent, tricking you into believing all the copper is out. While you have the aerosol out, hose excess solvent from the muzzle and flash suppressor. Accumulated gunk can encourage the formation of rust or exacerbate first shot fliers. You may need to supplement the aerosol with cotton swabs or a shop rag.

Finish up the bore and kill all solvents with a patch or two of nonammonia Windex followed by about four clean, dry patches. J-B Bore Cleaning Compound is a paste with fine abrasive. I don’t believe the paste itself hurts bores at all. J-B is used in back-and-forth scrubbing, reversing the direction of the patch just before exiting the muzzle and a second time near the throat of the barrel.

Reversing the patch the first time near the muzzle from a pushing to a pulling motion doesn’t cause much rod flex but when reversing the second time at the back of the barrel from pulling to pushing a significant amount of rod flex will occur. That rod flex can cause a lot of damage to the lands of the barrel. Use a little less muscle and slow down your stroke to minimize rod flex. Almost every barrel will require cleaning with J-Bat some point.

Barrels are extremely variable and there are no hard fast rules or round counts for any symptoms. First, if you use more than a dozen patches wet with copper solvent and the bore still isn’t copper free, use some J-Band then return to the copper solvent. Second, a sudden loss of accuracy with no other factor being identified. This often happens with neglected bores and I saw it frequently as team armorer. My advice was to use J-Band try again.

FROM THE ORIGINAL PAGE

With few exceptions, that normally restored the gun to its former tack-driving accuracy. Lastly, a sudden unexplained rise in chamber pressure with blown primers. If no other factor accounts for the change

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this can mean a buildup of fouling just forward of the throat, most common with neglected rifles. J-Bin short back and forth strokes two or three inches in front of the chamber usually restored chamber pressures to normal. Preserving The Barrel Rust leads to pitting and can start within a handful of days. Corrosion can happen regardless of barrel steel type. One of the best ways to avoid it is to clean the bore, chamber, and barrel extension after each firing.

Then, if the gun is going to be stored for more than a few days, apply something to the barrel to ward off corrosion. Brownells conducted a great study on this topic a few years ago (bit.ly/1hh5ttU). WD-40 scored well, as did Boeshield T-9. For storage, I saturate a clean patch with Boeshield and work it back and forth a few times to burnish the bore's pores. Early in that burnishing process when the patch is really saturated with the liquid I deliberately let it exit the muzzle.

I pull it back into contact with the muzzle and crown and hold the cleaning rod by the shank and spin it several times, coating the crown. I have found that the crown is a common place for rust to form and even

modest pitting there spells death to accuracy. Every gun writer admonishes (it's in our union contract) that you should never pull a dirty patch back into contact with the crown of the barrel. I agree, but we have just cleaned the barrel so that patch of Boeshield T-9 won't be dirty!

Then I spray a good shot of the Boeshield aerosol directly into the chamber and barrel extension, turn the rifle around and hit the front of the muzzle, crown, and flash suppressor. The night before going to the range, spray the chamber, flash suppressor, and the front of the barrel with a shot of high pressure gun scrubber and follow with a patch of non-ammonia Windex through the bore and then a dry patch.

First Shot Fliers The one downside to bore cleaning is that your first shot or shots will go outside of a normal group. I don't know of any way to prevent this other than firing dedicated fouling shots until the barrel settles down. Police and military sniping situations, hunting, and some competitions can make dedicated fouling shots impractical or impossible. On top of that, different firearms require varying numbers of fouling shots.

I have watched this fouling business extensively with the AR-15 and the vast majority of guns, regardless of barrel steel, manufacturer, or type of rifling, seem to foul in just one shot. A rare gun may require two but I very seldom see one requiring more. My .17 HMR Anschütz squirrel rifle requires three shots and I have tested some M24 sniper rifles in .308 that wanted up to five fouling shots. What causes first shot fliers? There are many theories. One has to do with gun powder residue.

People smarter than I am in chemistry say that certain gun powders lay down a trail of residue upon firing that acts as a lubricant for the passage of the next bullet. Supposedly this offers less resistance to the next bullet and the second round after cleaning should exit the bore faster than the first. In Rifle Accuracy Facts author Harold R. Vaughn posits that we can expect an increase in muzzle velocity between 50 and 75 feet per second with the second shot.

I have seen low velocities with first shots after cleaning when running my chronograph so I was not surprised when I read others shared the experience. Like any other competitive shooter, for decades I cursed first shot fliers and their impacts on my scores.

As a shooter I felt that harsh ammonia solvents like Sweet's seemed to cause my first shot fliers to be more severe than when I cleaned with milder solvents, so I wondered if a scientific study would back up my theory and identify solvents that would help keep the first shot from wandering so far. I decided to start keeping records on first and second shot velocity. I didn't just grab rifles and head to the test shed to accomplish nothing more than gather chronograph data.

I simply recorded the readings as part of my normal test firing of guns over a two year period. During that period I sampled 132 barrels, stainless and chrome moly, cut and button rifled, three, four, five, and six groove. I also varied ammunition types of match, hand loads, and issue full metal jacket ball. All of the ammo in the test used naked bullets without moly coating. Various ball and stick powders were represented as were a number of common bullet manufacturers.

From a statistician's point of view it might have been better to eliminate all this stack up of variables but from a real world perspective these are the conditions that shooters are going to encounter. I also cleaned with a bunch of common bore solvents and used some substances that I know shooters use to condition their bores or preserve them against rust during storage. Of the 132 barrels tested, 88 behaved as Mr. Vaughn predicted. The second shot was faster than the first.

THE MOST DRAMATIC WAS A GUN WHOSE SECOND SHOT WAS FASTER THAN THE FIRST

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by 168 fps. Why did the remaining 44 (1/3 of the sample) behave differently with the first shot being faster than the second? I expected this to happen part of the time because of the natural variation in velocities that occur within any ammunition sample. All of my tests were conducted using 20" Service Rifle barrels with fat gas gun chambers. That combination is noted for causing variations in muzzle velocities of ammo shot in such barrels.

I figure any ammo that will shoot 10 rounds in such barrels with no more than 30 fps between the slowest and the fastest is pretty darn good. I often get ammo in here that spreads all to 100 fps in such barrels. That aberrant 1/3 of my sample may have been coincidence that for those 44 barrels (or at least some of them) I randomly happened to select what would have been the faster round and fired it first. Perhaps it had just a little more gunpowder in it.

Then I just happened to randomly select around that shot slower second. But that happened during the test we should expect it to happen in real life as well. I don't think we should overlook the possibility that sometimes barrels just don't behave according to expectations and they won't shoot the first shot after cleaning slower than the second or subsequent shots. I'll summarize my study by saying the chances of having the first round on a clean bore being faster are about 2:1.

The bore solvent that gave the least amount of average velocity spread in the study was Hoppe's. I recommend it. I remembered the theory about gunpowder residue creating a lubrication effect and tried two bore conditioners to see if they lay down a surface promoting more velocity in first shots. I burnished moly bore conditioner into the pores of the barrel, even though I was shooting naked bullets and followed that with dry patches to remove the excess. I also did the same with Tetra Gun Grease.

Tetra won out easily and velocities proved most consistent with it. Army Reserve shooters had been experimenting with Tetra Gun Grease to lessen bore fouling before the big, short-lived moly bullet craze. When moly bullets came along they dropped the Tetra, but when moly went out of style they forgot about Tetra. I hadn't. First Shot Flier Uncertainties Mr. Vaughn predicts the first shot following cleaning to be 50 to 75 fps slower than the second.

Using a 20" Service Rifle barrel and an 80 or 90 grain bullet as an example, an AR-15 would place that first bullet about 6" low at 600 yards and the 10-ring on the MR-1 target has a 12" diameter. If a shooter were unaware of this he might well place his first shot from a clean barrel just in 9-ring at 6 o'clock. If he called the shot good and adjusted off of it (a full minute) his second shot could easily end up just in the 9-ring at 12 o'clock.

His first two shots could put him down two points and he might be well on the way to losing the match. Those of us who have shot in the real world, however, know that first shot fliers don't just go straight down towards 6 o'clock per the velocity theory. I have seen them go to all four corners and everywhere in between. There remains a fair amount of uncertainty as to where that first shot will end up.

As long as ammo is kept consistent and cleaning methods don't change some guns are known to place that first shot in the same general area most of the time. Competitive shooters and snipers tend to keep fairly good data books. By referring to them you may be able to see patterns of placement for first shots. Hunters are not known for keeping good records. Perhaps they need to start. If you are shooting any gun with a flash suppressor, they love to cling to solvents and gobs of J-B.

Both will exacerbate first shot fliers. Be sure to spray out such areas and the face of the muzzle with high pressure aerosol gun

scrubber before heading to the range. Supplement with cotton swabs and a rag as necessary. If you are shooting in competition and the match allows sighters, always place more faith in the second sighter than the first. Remember to use the same kind of magazine for sighters as for when you shoot for record.

Keep your bolt carrier clean and well lubed as it has an influence on shot placement. In some matches and shooting disciplines competitors change ammo during the course of fire. As an example, High Power shooters often shoot a magazine-length 77 grain bullet for stages and change to a 80 or 90 grain round for 600 and 1000 yard courses. Changing gunpowders from ball to stick (or vice versa) or even changing bullet brands can cause the first shot following the change to be a flier!

Let's say a shooter is using 77 grain Sierra bullets and ball powder for his 200 and 300 yard lines and then switches to a Berger 90 grain with stick powder for long range events. This can cause the first shot to go out of the normal group. Shooters need to be aware of this additional flier possibility and make copious notes in score books relative to the location of the first shot when switching ammo types. Isonite and Melonite are trade names for salt bath nitriding processes.

The bath creates a nice blackened finish on the outside and inside of the barrel. Regular bluing doesn't cover the bore, just the outside. A lot of claims are made for these processes and I am not here to debate them. I started having barrels processed with a salt bath for the USAR Team in hopes that it would help me to eliminate some of the corrosion and pitting I was experiencing with barrels my shooters neglected.

I have had about 100 barrels processed and am pleased to report that not a single one of them had rust form inside the bore. A real side benefit I wasn't expect-

ing is that bores treated with either process clean up real easy! The less that you have to do to get the fouling out the less the potential damage to the paper thin lands. The nitriding process can be done on stainless or chrome moly but the plant will need you to identify the barrel metal you send them as the processing differs. You also need to perform a proper break-in before the salt bath.

Be sure to carefully bore scope the barrel after break-in to ensure that every last trace of copper has been removed in your final cleaning afterward. Any trace copper that remains can interfere with penetration of the chemicals in the processing. As far as the use of corrosion inhibitors I would use them exactly the same in nitrided barrels as other barrels. Like the bore guide, the salt bath is just an insurance policy and isn't foolproof.

Unfortunately, the process does add significantly to the end cost of a barrel so many customers will not choose the option. Complete your American Gunsmith collection. Or read up on a special subject! A limited number of the following

SHOTGUNS

Taming Slug Guns

Practical how-to to block shotgun kick.

BY BRIAN E. CAPPS JANUARY 2015

ORIGINAL PP. 16-18

One of my earliest memories involves a visit to the farm in rural Arkansas where my dad grew up. My grandfather kept an old Bay State break open .410 shotgun handy to add the occasional rabbit or squirrel to the dinner table. For whatever reason, I was fascinated and granddad offered to let me shoot it. He picked up a metal paint can lid from the barn and set it up in an open field. He knelt down next to me and, while holding the shotgun under my arm, had me pull the trigger.

I was overwhelmed by the blast and delighted by the million holes (or so it seemed) that had magically appeared in that old can lid. Down deep he must have realized what a life changing experience this had been and told me the shotgun would be given to me when he died. A few months later, true to his word, the shotgun was mine. I was four years old. Recently, I decided to return to my roots and put together a nice single barrel slug gun for deer hunting.

It would be light weight for long stalks and rifled for best accuracy. I searched for something simpler, lighter and, with my tiny budget, cheap. A gun show was coming up and I figured there should be an excellent chance of finding a good, used shotgun for less than \$100. Imagine my surprise when I spotted anew Rossi 12 gauge single shot for only a few more dollars! When I showed the shotgun to fellow gunsmith Verne Trester, he asked if I had gotten the chance to shoot it.

I told him no. "Good," he replied, "because it would have kicked the (expletive deleted) out of you." That brings up an area seldom considered: Proper gun fit, which applies to both rifles and shotguns. For me at least, the fit felt all wrong. Verne explained the angle of the rear portion of the stock would serve to make the kick

feel worse than it needed to be. The first and most commonly addressed dimension is length of pull.

This is the measurement from the center of the trigger to the rear of the butt plate or recoil pad half way between the top of the stock (heel) and bottom (toe.) Correct length of pull is not only an aid in hitting the target but shooter comfort as well. For example, a stock which is too long will slide from the shoulder onto the arm muscle and can cause bruising (and flinching.) In the process of hurting the shooter, this condition also has a tendency to cause the shot to go left of the target.

A stock which is too short can make the shot miss because the muzzle is being pulled to the right. Worst of all, if the shooter tries to compensate for a short stock by not pulling it tightly into his shoulder, the shotgun gets a "running start" and makes the kick seem even harder. Before any alterations are begun, remove the butt plate or recoil pad, or add thickness (pieces from a cheap yard stick can be sawed to length and taped to the end of the stock) for a final check.

The gun should be raised into position and the shooter can discover if the fit appears to be better. It will help speed the process of finding the correct length if the gun can be test fired. The shooter should aim at a dot in the center of a large piece of cardboard. This is similar to patterning but the goal is to have the aiming point in the center of all the little holes or the one great big hole. This will show if the gun hits where it is pointed or if adjustments will be required.

The gun may or may not have a recoil pad, so shooter comfort is quite important for getting correct feedback. I recommend Winchester Featherlite shotshells using a light load of shot and powder to keep recoil and noise to a minimum. For slugs,

use "tactical" or other reduced recoil ammo. I kept in mind the purpose for this gun and wore heavy clothing, specifically, my hunting coveralls. On the other hand, a duck hunting shotgun should be fitted while the shooter wears chest waders.

Different shooting conditions dictate different lengths of pull.

Field guns should generally have a slightly shorter stock as it makes mounting the gun from a carrying position much quicker, while the trap shooter and other target games have the luxury of having the gun already in place before hollering "pull." When the correct dimension is found the stock can be modified by cutting, adding a recoil pad (they come in a variety of thicknesses) or butt stock spacers (hard plastic pieces designed to add length.) Next are two additional measurements: The height of the comb (top of the stock) and the angle (pitch) of the butt plate.

A correctly dimensioned comb should allow the shooter to get a good sight picture without head lifting or having to shove their face into the stock. If the comb is too high, wood can be removed; if too low, install a comb raising kit. The comb raising kit is a neoprene pad with different thickness inserts to adjust the height. It easily slides into place making the adjustment process a quick one. This item also slightly softens the feel of recoil against the shooter's face.

Another cheapo idea is to trim a piece of two by four, cut the top portion of the stock down approximately 1.5 inches and glue the piece of two by four in place. Using a rasp, continue to remove material until the shooter's eye is in line with the sights by fitting and trying until right. I kept removing a bit of wood at a time until the alignment was correct and the gun hit where it's pointed. Then use Bondo or wood

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Middle stock with 2x4 raised comb. On bottom is a “stock” stock. putty to fill in any gaps, sand until smooth and hit with a coat of “rattle can” black. I’ll get around to doing the forearm one of these days. Another area related to shooter comfort is pitch angle, the angle of the butt of the stock to the barrel. I prefer to start with zero pitch angle, that being when the end of the stock is at 90 degrees to the barrel and the one that suits most shooters.

After the shooter gets used to the feel of his gun, plastic pitch angle wedges can be added experimentally to check for more comfort and accuracy. All shooters are different and I have yet to find an “average” shooter that a factory gun will fit perfectly. And, the better many shooters become, the more they seem to want to fiddle with the fit to gain an extra target or two.

With critical stock dimensions addressed, it was (using football terminology) time to work on “blocking the kick.” Since the stock had to be cut to length and correct the pitch angle anyway, I went ahead and added a good used recoil pad from my stash. Something else to be considered is porting the barrel. This modification redirects some of the gas pressure upwards, thus reducing barrel lift and felt recoil.

There is a nice jig available from Brownells for this task, well worth the expense if this work is done frequently. Keeping the small budget in mind, this can also be done with a drill press, a punch and a piece of masking tape. First, find a flat surface such as a piece of glass (the nearest window will do) and clean it well with brake cleaner. Lay out a piece of tape five inches long and start to work with a ruler and pen. The holes should be 0.093 (3/32) diameter and spaced at 0.200 inch intervals.

For starters, there should be 10 holes down the middle (more can always be added later) with each side, all keeping the same spacing. The finished pattern is removed from the pane of glass and attached to the clean and dry barrel with the middle mark on the very top lined up with the front bead. The porting holes should not be drilled into the choke, so the starting point should be 3-4 inches back from the muzzle.

Marking the holes with a punch can be tricky as the barrel needs to stay in place and even using a padded vise could be a problem. The solution turned out to be the sand bags I take to the range when sighting in a rifle. The barrel was worked into the bags and the first spot was marked. The process continued with an occasional reset of the barrel to insure all punch strikes

were at 90 degrees to the bore. The tape was stripped off and the drill press vise was readied by padding the jaws.

Good padding can be anything from leather (a cutoff piece of holster is my favorite) or lead sheet that is installed around chimneys for weather sealing. When this project is done, the mangled piece of lead can be cast into bullets. After a quick trip to the hardware store for fresh drill bits and center drill, the porting process was under- I’m a great believer in using a center drill to start the holes, much less chance of damage and a much neater looking job.

With the barrel clamped firmly in the vise, assuring the punch marks were oriented at 90 degrees to the drill press table, the assembly was set in place. With one hand I gently held onto the breach end of the barrel while lowering the spinning center drill with my other hand. If the barrel/vise is given some room to move, it will allow the drill to seek its own center in the punched spot. The top holes were all center drilled, drilled and cleaned up before the barrel was moved for the next series of holes.

The exterior portion of the holes were finished by gently touching them with a slightly larger sized drill bit to remove any burrs around their edges. The vise was then loosened and the bar-

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rel was rotated to allow the next series of holes to be drilled. When that part of the job was done, I got out a length of dowel rod and slit the end for a bit of abrasive cloth. Several passes up and down the inner surface of the barrel were needed to remove burrs left from drilling all the holes followed by a quick smoothness test. Push apiece of paper towel through the barrel. Any clinging bits of paper will highlight the rough spots.

A final polish with very fine grit cloth coated with a few drops of oil finishes this portion of the transformation. For those wanting a ported barrel, particularly rifled barrels, but are leery of drilling all those holes, check out Mag-Na-Port (magnaport.com). They do a beautiful, professional job on smoothbore and rifled barrels. While you can do smootbores as outlined here, don't try doing a rifled barrel at home as it will only end in disaster. Another way to soften recoil is with lead and mercury.

Starting with the simplest and cheapest, one or two holes drilled into the rear of the stock will accommodate a quantity of lead pellets. I use 7-1/2 shot as more will fit into a hole. The holes are filled with shot and the butt plate or recoil pad is reinstalled. In addition to softening recoil, this is also a great way to balance a gun if it's muzzle heavy.

The shooter needs to see how the balance feels and, when the proper amount of shot is discovered, mix in Acraglas with the lead in the holes and set aside to harden. Another way to lessen the kick is by way of a mercury recoil reducer, which is merely a 7/8 inch diameter tube partially filled with the heavy liquid. As this shotgun has along bolt attaching the stock to the receiver, this task was apiece of cake.

The bolt hole wasn't the required 7/8 inch diameter, so I fired up the computer, brought up eBay.com and found a set of large one-inch diameter wood drill bits for about \$25. Your local hardware store might have the same thing. When my package arrived, I took the stock and secured it in a padded vise and selected the bit one size larger than the original hole. Realizing this was a delicate process, I took time to drill slowly with frequent removal of the bit to clean out the wood chips.

After using gradually larger bits (doing it in one step is almost guaranteed to split the stock) the final drilling began. With the recoil reducer in hand, I continuing boring the hole until the reducer would fit in all the way. After determining how far the smaller hole extended into the stock, I cut apiece of heavy wall fuel line to that length, installed the mercury-filled tube on top of it and a thick rubber washer on top of everything.

This way everything is held in place but remains easily removable if there is ever a need to take off the stock. If the stock doesn't come with a bolt hole, Brownells has a recoil reducer drill fixture that turns a possibly tough job into a walk in the park. It's well worth the price. Shooting is done in all kinds of weather from bitter cold to a 98 degree, 99 percent humidity afternoon. As in many other sports, consistency is very important.

This can be difficult to achieve if the stock is slippery from sweat or rain. Fine checkering is certainly an art but, as I'm not an artist, I decided to go the cheap and easy route. A simple way to add some additional roughness without checkering or stippling is to apply spray-on grit (Brownells #083-044-001.) This stuff is exactly what it sounds like. Rather than paint, the can contains a liquid loaded with tiny abrasive particles.

The area to be coated should be masked off to cut down on over spray and the material applied. The area can cover traditional checkered areas the entire stock could be done. After a few moments drying time, it's ready for the hunt. The spray-on grit only works with certain finishes. It will not stick to ones that contain oil but works well with an epoxy-based coating. Planning ahead will prevent a problem. Now I have a sweet shooting, soft kicking, hard hitting slug gun. With deer in range, I'll be happy. AG

PISTOLS

Checking Out Revolvers

Maintenance tips for wheel guns.

BY ROBERT K. CAMPBELL JANUARY 2015

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Despite the auto loading pistol's popularity, I'm still seeing plenty of revolvers in my shop. Some have been butchered by the owner and others have honest wear. Modern revolvers have been subject to a number of cost cutting modifications and production procedures. While some say the modern revolver is as good, just different, I point to the fact that the pinned and recessed revolvers of a generation ago continue to bring a premium not only from collectors but from those interested in a hard use revolver.

Modern revolvers may be consistent due to CNC machine production but in some cases the material is cheaper. Let's look at the operation and checklist for working the revolver. Revolver Function Overview While this description is of Smith and Wesson designs, it applies to most double action revolvers. As the trigger is pressed to the rear the hammer is raised from rest. The cylinder stop drops to allow the cylinder to turn. The hand rises to engage the extractor ratchet and the cylinder begins to rotate.

The cylinder stop engages the cylinder, then the hand drops off the extractor ratchet as the cylinder locks. The hammer drops as the trigger reaches the end of its travel and releases the sear. The hammer moves forward

and the revolver fires. As the trigger is released, reset occurs. The hammer moves to the rear. The hammer is fully back at rest and held in position by the rebound slide. The cylinder stop and the hand now reset.

First, after triple checking to be certain the revolver is unloaded, press the trigger and check the double action trigger. The trigger compression should be smooth with no hitches and without unnecessary roughness in the action. The double action trigger action should be consistent for each trigger press. Next, cock the hammer when single action operation is an option and check the single action mode. The single action trigger should release smoothly.

Be certain the cylinder locks into the bolt stop as the hammer is moved to the full cock notch. When testing the single action operation I cock the hammer slowly and keep an eye on the bolt stop. The bolt stop should lock into the notch in the cylinder just before the hammer reaches full cock. Test each cylinder.

Sometimes the timing is off on just one and this can be a result of end shake or a bent Below center: By carefully cycling the action you will be able to feel the movements and determine if the piece is cycling correctly

(photo courtesy PAST.) The action was very tight and in good condition. crane. When testing the double action timing the bolt stop should lock just as the hammer falls. The bolt stop and hand will also be tested with this procedure.

While testing the double action press, keep the trigger down and rock the hammer back. Rock the cylinder and see if there is excess motion. The cylinder may have some play but too much slop is unacceptable. Move the cylinder laterally and check for play. Only a few thousandths of an inch in movement is acceptable. Release the trigger and let it move forward. This is a test for trigger reset. Some shooters like to clip a coil or two from the rebound spring and this test will indicate if this has occurred.

A few brisk pulls of the trigger in the double action mode executed rapidly will indicate if there is any problem. The trigger should return to position briskly after each trigger press. A tight trigger action is good; a too light or inconsistent trigger action is a sign of trouble. Another, sometimes overlooked, test is to cock the hammer in the single action mode and apply forward pressure. If the hammer falls forward you have a serious problem, indicating someone has ground the

CHECKING OUT REVOLVERS CONTINUED

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The old long action revolvers differ little from the most modern revolvers, the primary difference being most current revolvers use a transfer bar system. No it isn't but the operating principles apply to Dan Wesson revolvers as well. connecting surfaces of the hammer too aggressively, resulting in a dangerous situation. When doing a trigger job an inept individual may grind and not keep the original angles rather than just carefully polishing the hammer contact points.

Check the barrel cylinder gap with a feeler gauge. The ideal barrel and cylinder gap is often quoted as 0.006. Only occasionally will a gap be tighter, however, the gap is often larger on modern inexpensive revolvers. A measurement of 0.010 is not unusual. A quick check of a number of the revolvers around my shop and in the safe reveals a representa-

tive sample right on the money. A Taurus 605 .357 Magnum revolver had a barrel and cylinder gap of 0.006 on the five chambers.

A Smith and Wesson Model 66 was 0.008 on the cylinders. A Taurus Model 85 .38 Special was less consistent with three of cylinders right at maximum tolerance (0.010) with the other two at 0.011. There are two types of barrel cylinder gap to measure. After cartridge ignition the cylinder is pressed back by recoil against the recoil shield. At that instant barrel and cylinder gap is the widest. Lead spitting and the greatest velocity loss occurs at this point.

When the cylinder isn't under pressure there is a different reading. The difference may be 0.002 of an inch. If evident (more than 0.005) endshake may be fixed with bushings, such as from Power Custom (powercustom.com). Older revolvers often are tighter but the worst examples from early production are

often pretty bad. While few modern handguns are as tight as the older revolvers, production seems more consistent across the board.

When checking headspace look to the center pin at the end of the ejector and watch where it contacts the recoil shield. It is simple enough to use a spent case to check headspace by loading the chambers. Spent cases from the same gun being checked will slip back into the cylinder and chambers. Otherwise, first resize the case. Be certain there is clearance. The distance between the case head and the recoil shield should be about 0.008, with 0.010 about ideal.

You may measure headspace on the revolver without moving the cylinder to the rear but you do not learn as much. When checking headspace without pressure on the cylinder readings may be as high as 0.012. A

CHECKING OUT REVOLVERS CONTINUED

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Above center: Seldom is removing the barrel required. This revolver is the Dan Wesson, a kissing cousin of the Smith and Wesson. This one was involved in an accidental discharge. Trigger shoes are useful only for single action target shooting. greater gap may yield misfires, a potential problem with many .45 ACP revolvers. They are not as combat reliable as some make them to be and often need attention to fire reliably. Endshake, yoke and ejector wearing can cause excess headspace.

When the revolver is opened and the cylinder swung out on the yoke, the motion should be smooth and the operation should be free of binding. Press the ejector button. The ejector rod should be tight. They may work loose under firing and should be tightened periodically. The cylinder should rotate freely whether the barrel is pointed upwards or downward. The rotation should not feel gritty. Upon being closed the cylinder should not touch the rear of the frame.

As you slowly close the cylinder note that the yoke should line up properly with the frame and not require force to close. The cylinder

should not contact the barrel when the cylinder is closed and should rotate freely on its axis. 22 Magnum from Taurus tested out just fine for barrel and cylinder gap. Modern revolvers are often very consistent. Far 22 revolvers often come into the shop with a heavy trigger action. There is little that can be done because rimfire cartridges need a very solid blow to ignite.

Reducing the weight of the action will result in misfires. A common complaint with the revolver is that cylinder throat diameter isn't conducive to good accuracy. The fact is the modern Smith and Wesson revolvers are the finest ever produced in this regard, thanks to precise manufacturing. Older revolvers may have a problem. Too large a throat and you have gas blow by and the base of lead bullets may even be deformed. The throat should be about 0.0005 larger than the groove diameter of the barrel.

Remember a small or tight throat will swage the bullet down and it will more or less rattle through the bore, resulting in poor accuracy. It is easy to check the throats. Press a lead

bullet through the throat, then measure the bullet. It only works once, so you will need a number of bullets to check. An old trick with cast bullet shooters was to size the lead bullet by pressing them through the throat of the individual revolver rather than a sizing die and it worked pretty well.

The rule is that a tight throat can be reamed to a larger diameter but the larger, sloppy throat cannot be squeezed tighter. Fortunately loose throats in modern revolvers are seldom encountered. Tight ones sometimes are encountered but may be addressed with a reamer.

In the September 2012 issue I covered sideplates and sideplate screws ("Revolver Sideplates, Cleaning And A Surprise".) A simple test is to use a Chapman or other properly sized screwdriver and be certain the each sideplate screw is tightened down properly. Carefully

CHECKING OUT REVOLVERS CONTINUED

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Above center: Power Custom end shake bushings. examine the revolver to be certain it is in good, general operating condition. Check the sights, particularly on adjustable sighted revolvers. Be certain the front post isn't bent. Check the sight blades are in place on adjustable sight revolvers and are properly screwed to the frame. The cylinder release is sometimes loose, even with the screw missing. Grip screws may be missing or the wrong screw may be encountered.

The forcing cone should not be cracked and relatively free of carbon deposits. The chambers in the cylinder should be inspected carefully one by one. They should not be caked with powder or lead residue or rings of lead. The face of the recoil shield and the firing pin

tunnel should be free of build ups. When the revolver is examined, clean and lubricate it. A drop of oil on the The exterior, however, shows hard use. Below center: This revolver has taken a beating during recoil.

The revolver needs to be clean and examined for eccentric wear. 44 such as the one on top or an old I frame .32, bottom, the basic check list applies. hand and one the cylinder stop is all that is usually required. Be certain to carefully check the ejector star. Often unburned powder collects under the ejector star and will impede function. End Shake Bushings Any cylinder play more than 0.005 is end shake and needs to be fixed.

Pull the cylinder to the rear and measure the barrel and cylinder gap with a feeler gauge and then the barrel cylinder gap. Simply pop the yoke out. Taurus and Smith and Wesson differ but the end shake bushings work in both and will cure this in a problem revolver. Usually two bearings at 0.002 will do. Three yield 0.006. This tightens the revolver by pressing the yoke over the bushings and the main bushing on the yoke. The parts number at Brownells is #713-100-002WB.

After some forty years of working with the revolver I still find them fascinating for the intricacy of its lockwork, the precision workmanship of some and the reliability of the design. When they come into the shop keep an open mind and your eye on details. AG

READER FORUM

Reader Forum

BY AMERICAN GUNSMITH EDITORS JANUARY 2015

ORIGINAL PP. 23-24

Computers In The Shop I would like to comment on Wendell Deaner's "Computers In The Shop" article in the November 2014 issue. I agree with most of what's written there but wonder if the author is running an OS X, Windows, or GNU/Linux operating system? I feel you should have mentioned specifics about software used with the cash register that allows receipts and the scanner. As for going portable at gun shows there are a mess of things from sales displays to background checks that can be done.

One thing that would help all of us would be a legal way to do our R&D reports on a computer as well as show off the E4473 the BATF provides. It also should be noted that by using an email service like Gmail any communication sent can be stored and retrieved from anywhere which meets the Fed's requirements for electronic business communication. I converted to Ubuntu 14.04 LTS (a Debian-based GNU/Linux distribution) so I would not have to keep paying Microsoft and other the software vendors more money every year.

There are many free/open source and low cost options for word processors and office suites, cash registers, image manipulation, music, and just about anything else needed. I run Chrome Browser (part of the open source Chromium Project) which allows me to do most everything I could ever do with Windows and my profile is usable on any computer. I have one last Windows 7 computer that I run E4473 on.

It dual boots into Ubuntu and I will soon be loading Wine and running E4473 on that to get rid of the last of my Microsoft dependency. Richard Beggs Defcon One Arms Author Wendell Deaner responds. Thank you for reading our magazine and my article in particular. I always learn something from our readers. I was in the process of updating my computer system when I submitted this article and ended up

with OS X and Windows systems. My wife wanted a Mac Book and graciously promised I could use it.

I was against it but she prevailed. After the first few fumbling episodes I was able to use it well enough to suit my purposes. Since she has the real money in the family (I am a poor writer) I corroborated with my grandson and some of his friends to buy parts and build a computer. I have no regrets as it was an substantial upgrade from my old system and cost much less than buying the equivalent Windows 8.1 machine preassembled.

The software for inventory control and scanning is best supplied by the company that sets up your business system. This probably isn't inexpensive but will be amortized over time if you have a large shop. I have used systems like this in managing retail settings and was quite pleased with the results. Of course, it must be tweaked and maintained as necessary; after all, it is only a machine. I also use Chrome as a browser at the moment until something better comes along. I like it.

I've also started exploring backing up information in the cloud so I can access it anywhere. I have not tried Ubuntu but thank you for the heads up. I did try the Open Office suite and its Writer word processor for awhile and can recommend it, especially since it's free. However, some of the more finicky editors Ideal with and some of the platforms I am using to publish make using Microsoft Word a little more practical.

Charter Revolver Reassembly I recently had a Charter Bulldog Pup in the shop with a very rough second stage of the ejector rod. Disassembly of the cylinder, ejector rod, extractor star, and accompanying parts revealed some very rough surfaces that were quickly cleaned up.

During reassembly, you need about four sets of hands to align (1) the ejector rod pin hole; (2) the extractor star pin hole;

(3) the ejector rod bushing pin hole—all under spring pressure—to reinsert the small slave pin that holds the entire assembly in place. The problem with four sets of hands is that you run out of space! I did solve the puzzle, though, with the use of an extra Dremel tool collet I had in the tool box.

The Dremel collet was the perfect size, inside and outside diameter, to depress the ejector rod bushing into the extractor star area and keep it depressed while moving the ejector rod in perfect alignment with the slave pin holes. Once aligned, a small pin punch was inserted (with my third hand!) and then the slave pin was reinserted afterwards. I have put that collet in my specialty parts box and labeled it for Charter revolver cylinder reassembly.

I am sure there are actual tools made to perform this task but this might help the 'smith that doesn't want to buy a specialty tool for every gun type and application. Mark R. Hollensen Bench Mark Performance Services This should prove helpful to those working Charter revolvers. Thanks! H&R 349 A friend of mine has a old H&R 349 Gamester 16 gauge with an incomplete bolt. I haven't yet found a schematic to identify the missing parts and the various parts stores don't seem to have one either.

Searches online have also proved fruitless. Where can I get a schematic of the 349? Jim Lorange It is possible no schematic exists but we have never done an article on this particular shotgun so we can't be absolutely positive. If H&R were still alive as an entity instead of being ingested by the three-headed guard dog of Hades, now known as The Freedom Group, we could probably put you in contact with an H&R historian.

We're still working to crack the communications barriers of The Freedom Group and expect to do so soon. After that happens, we can get back on track

READER FORUM CONTINUED

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with not only H&R, but with Remington, Marlin and a host of others we have relied upon for accurate information in the past. H&R presents you with a special problem as the present entity didn't manufacture your 349 and no parts will be directly available. That's not unusual. H&R NEF would supply no parts for guns made by H&R 1871 and wouldn't sell any for guns made by H&R, period. It's pretty much standard industry practice these days.

Seek out a recent copy of Gun Digest and search for a listing of "Associations." Among these would be the Remington Society and probably one for H&R as well. There will be an address to which inquiries can be sent. It's only a starting point for what we think you're facing and how much you're willing to provide pro bono in the name of friendship. Springfield XD I have a Springfield XD series chambered in 9mm in my shop and can't move the front sight.

I have put it in a padded vise and tried to drive it out with a brass punch, added solvent to counter any locking agent and it still won't budge. I am afraid to hit it any harder for fear of damaging the slide. I have another XD chambered in .40 S&W and have adjusted the sight on it that was nowhere near as hard to move as this gun. Heating the slide is my next option unless you have any other suggestions. Kenneth W. Wright Wright Enterprises of Texas Do not heat the slide.

Springfield installs its sights tightly but they are not press-fit or sweated in. They also drift in either direction. The secret to removing them, if it can be called a secret, is to secure the slide rigidly between the padded jaws of a good quality, solidly-mounted bench vise. No wobble or play is allowed. A hard wood block filler is permissible to prevent malformation of the rails in cases where the slide is secured in the vise upside down, a technique sometimes employed by Springfield service technicians.

Your brass drift is OK. Forget any thought of trying the move these sights with a nylon punch. Those same technicians use a steel punch with its tip covered by a small piece of a business card and a heavy hammer. We suggest an application of penetrating oil be applied to the upper edges of the dovetail and the slide allowed to sit upright overnight before attacking it further. Savage (Springfield) Model 67F I have a Springfield Model 67F 12 gauge shotgun manufactured by Savage.

I am refinishing the stock and noticed that the old gun really needs a good cleaning but have been unable to find disassembly instructions for it and cannot see what needs to be done to remove the bolt, assuming it removes from the rear of the receiver. The owner wants to shoot the gun and wants to know if steel shot or any of

the modern lead replacements can be safely used. I advised him not to but am seeking your opinion.

The gun has no serial number so I know it is not new despite its new (probably re-blued) appearance. The bore is pristine and is chambered for 2 3/4 and 3-inch shotshells. The gun locks up tight and seems to function well. The safety works, gets a good solid sounding strike on a snap cap, and extracts and ejects soundly. The customer knows nothing about the gun except that he bought it cheap from a friend.

Donald Strickland After searching the Standard Catalog of Firearms, Blue Book of Gun Values, and the Web we finally were able to turn up a schematic of the Springfield M67 in the Jack First Inc. Gun Parts Book Volume 2. That might be of help to you in field stripping the shotgun. With the major metal components separated from the stock those components could be scrubbed and flushed clean without damaging the wood you're working to re-finish. If the gun has no serial number it might predate their required use.

Steel shot instead of another lead substitute could open up any fixed choke in the barrel. This is true in guns much newer than yours. If an owner's manual exists a copy of it could be secured by writing to John Callahan, Savage/Stevens Historian, Westfield, MA 01085. AG

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