



JAN 2014

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

DO YOU HAVE GAS? PART ONE

BILL'S BENCH • THE SAVAGE ARMS AXIS • INSTALLING A SHOTGUN BARREL BEAD • ULTRASONIC FIREARM CLEANING, P...

ORIGINAL METHODS. MODERN ACCESS.

ARCHIVE EDITION 121

DIGITAL ARCHIVE EDITION

Preserved for the bench.

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AMERICAN GUNSMITH

DIGITAL ARCHIVE EDITION • JANUARY 2014

ISSUE RECORD

ORIGINAL DATE	January 2014
VOLUME	Archive volume not stated
ISSUE NUMBER	01
SOURCE ID	ag-6d2ee04a1a7d0af9fdad057d

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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FINISHING

Bill's Bench

BY AMERICAN GUNSMITH EDITORS JANUARY 2014

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Tips from Gunsmith William L. Henwood of Quincy, California. Fixing Age-Hardened Recoil Pads Remove the pad and soak it in automatic transmission seal restorer, commonly available at an auto parts store. Pad removal is recommended because it is unknown what exposure to the liquid or fumes will do to the stock or its finish. Bill's Bench Monitor this soaking every hour as over exposure may turn the pad into mush. When the pad looks sufficiently, but not overly softened, clean it up with soap and water and reinstall.

Test Fire Pit Need a place to test fire guns without going to the range? Make a test fire pit at your shop and save yourself the trip. Start by digging an eight inch diameter hole feet deep four-and-a-half feet deep in a convenient location. Drop a five foot long, eight inch diameter pipe into the hole. Next, drill about 70-80 quarter-

inch holes into a five foot length of four inch diameter PVC pipe. Drop this PVC centered inside the eight inch pipe and fill the space between the two pipes with fine gravel.

Cut a slit in the middle of a piece of upholstery foam that is twelve inches square. To test fire, push 10-12 inches of the muzzle through the slit in the foam, place the muzzle into the pipe, covering the top with the foam. This pit will safely catch fired bullets and greatly abate muzzle blast. Of course, check and comply with local law enforcement to avoid any legal entanglements. Technical Editor Note A number of our Members have submitted questions for our Technical Editor with invalid email addresses.

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PEOPLE & COMPANIES

The Savage Arms Axis

The battle for supremacy among lightweight hunting rifles gets hotter with a new entry from an accuracy leader.

BY CHICK BLOOD JANUARY 2014

ORIGINAL PP. 3-8

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It seems what is true of neophyte hunters in Alaska is true of the same in Maine. Wander into any gun store south of the North Slope in our 49th State if you're in the market for a .348 Winchester hunting rifle. None of them lined up in the rack have been used more than once. In Maine, the .348 isn't equally abundant. Any rifle weighing over seven pounds is. The heavy weights just keep showing up. They've all been brought along by first time out-of-state hunters.

Depending on the season, they're after white-tailed deer, black bear or moose. I don't know if you've ever roamed some of the Maine woods, but they can get very dense. More than one game warden has told me the average range per clear shot is 50 yards. Still, the unaware keep arriving with eight pounders. The husky rifles usually are wearing sporting scopes more suitable for reaching out to mule deer or big horn ram.

The knowing and shrewd owner of a Maine gun shop will acquire several of his local client's favored hunting rifle to await as bargaining chips in the trades sure to occur upon the return of the hunters from away. Note: "From away" is where all who visit Maine are said to come from when spoken of by a nativeborn Mainer. My Dad was

born 5 pound Axis can be ordered in blued or stainless, with or without a 3-9X scope, in seven calibers, two youth models and out-of-the-box groups averaging 1" for less than \$500.00.

It replaces the Edge in the Savage hunting rifle line up. in Maine. He graduated from the University of Maine. I spent the first 18 summers of my life at Sebec Lake, located in the middle of Maine. I went to Maine fishing for brookies with Dad for thirty years. I go to Maine every year to see old friends and still surviving family. Yet, I remain referred to as being from away. The favored rifle I mentioned weighs about six pounds with a scope of no greater power than 3-9X and chambered for .35 Remington.

Why that caliber? Simply by using a heavier factory bullet makes the round suitable for taking any large game found in Maine. Local folks hunting the north woods won't be owning two or three game-specific rifles. Eighty percent of them couldn't afford it. The other twenty percent are too smart. Decades of success with a .35 Remington are hardcore proof it's the way to go. So, "If it taint broke, don't fix it" prevails.

Therefore, I hereby recommend to Savage Arms they add a .35 to the impressive list of Axis chamberings. The rifle already

meets the previously stated requirements of a dedicated Maine hunter's favorite. One, the Axis lessens or equals the \$500.00 cost of lightweight hunting rifles presently available.

Out-of-the box, sans its available 3-9X scope, it weighs in at 6.5 pounds and is what I freely choose to refer to as "Savagely Accurate." One reliable test reported printing of one-inch groups at 100 yards with factory loads of the lighter weight bullets (55 grain) off a sand bag rest. Even with heavier bullet loads, the average only opened up to 1.17 inches. Now that my old friend and acquaintance, Ron Coburn, has retired I will pass my recommendation along to Al Casper, the new Chairman of Savage Arms.

That's a promise. Not a threat. Accuracy Is No Accident Savage Arms has built its broadlyheld reputation for accuracy the hard way: They've earned it. The Axis is their newest offering. It happens to be a chip off the well-accepted Savage Edge hunting rifle. The Edge was built with a removable recoil lug, which served to retain flush contact between barrel and action. The recoil lug in the Axis is firmly anchored in the stock. It's possible to remove the lug but Savage would much prefer you leave it alone.

THE SAVAGE ARMS AXIS CONTINUED

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Since the Model 110 entered the hunting world over 50 years ago, all Savage center fire rifles have employed a barrel nut to set and maintain headspace. So does the Axis. All-around barrel wall thickness is established as being equal before button rifling of the bore is allowed in a Savage. That includes the Axis. Not all Savage rifles have a floating barrel. The Axis does. Twenty-two inches for adults, twenty inches for youth models. All hand straightened.

As expected, a little farther back in the rifle is the bolt. Attached to the front end of the bolt body is the bolt head. Attached to the bolt head are three—count 'em—sturdy locking lugs. Ever heard a hunter profanely bemoan the inability of getting off a second shot because the open bolt rattled in the receiver

and spooked the game? Bet you never will with the Axis. The bolt opens and closes smoothly, for sure. And those triple lugs put a silencer on open bolt rattle.

Field Stripping The magazine (10) is out, the chamber is empty, the safety is on and so is your eye protection. Pull the trigger back fully. Hold it back as you press down on the bolt release as far as it can go. You may have to do the just described with a finger on the trigger and the thumb of the same hand depressing It remains visible after the handle is lowered and the bolt locked forward. the release. Awkward? Somewhat. Stressful? It takes a large hand and strong, healthy thumb.

Otherwise, it can be maddening. Raise the bolt handle (12C) and withdraw the bolt completely from the receiver. The front and

rear action screws (19D and 19C) are turned in at the factory to about 40 inch-pounds. Back out the front and then the rear with a 5/32" Allen wrench. Remove the trigger guard section (19A). Careful, there's a trigger bracket spring close at hand. Keep it where it is. Remove the stock (18). Examine the guard section. At its lower rear there's a small tab.

When reinstalling the stock, the small tab gets inserted into a mating cut in the stock first. Then, the front end of the section is rotated up into position. An Axis has just been readied for a fundamental cleaning. Detailed Disassembly This section is coming up sooner than in some of my articles to men-

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tion a subject that should have been discussed in some detail, and probably more than once, in past issues: The Federal Firearms License and the gunsmith. I know you must have seen classified ads in a fair number of firearm-oriented publications. All had a similar “hook,” that being securing a FFL via the offices of the advertiser.

First, there is only ONE way to secure an FFL and that is through the licensing office of the Bureau of Alcohol, Tobacco, Firearms and Explosives (atf.gov). You contact them, ask for an application and they’ll send you the paperwork. Second, there is no such thing as a “gunsmithing” FFL because he or she actually takes possession of a firearm from its owner and must, by law, maintain records of the acquisition and ultimate disposition of that firearm in exactly the same manner a dealer follows.

Therefore, though a gunsmith may not include retail gun sales in the services currently offered or even plan to include them in the future, that individual has to apply for a FFL just the same. Check this out. If you have a friend who owns a gun, wants you to work on it and you don’t have an FFL, you can work on it as long as you don’t take possession. Meaning: The gun owner has to remain on the spot as long as you’re doing the work and take the gun from you as soon as you’re finished.

How’s that for gun control carried to the idiotic? Nevertheless folks, that’s the way things are. I apologize for the de- The front baffle washer (A) may look warped but it’s deliberate to provide a springlike quality to its function. lay in waving the red flag. Better late than never—I hope—but I had good reason here to delay no further. That reason is complete disassembly of the bolt assembly.

I’ve always insisted that no pistol, rifle or shotgun can be properly cleaned, inspected, and serviced when the bolt remains assembled. Savage agrees but agrees with a limitation. To wit, “No bolt head parts can be sold to other than to an FFL holder who is qualified to perform the work.” Whether you can satisfy the FFL limitation I can’t say. Your answer to the qualification query?

Tell the questioner all disassembly/re-assembly instructions were dictated by along time Savage factory gunsmith assigned the specific task by his management of providing them to appear exclusively in these pages. And so soon will. Bolt Disassembly The Axis has a loaded chamber indicator, also known as the back end of its firing pin (11G). It shows up whenever a cartridge has been inserted and the rifle cocked. Raise the bolt by lifting the bolt handle (12C) upward. Watch the end of the indicator.

It will withdraw into the bolt. Stop immediately with the bolt handle. The hole where the end of the firing pin used to be is now a 1/4" hex wrench opening in the bolt assembly screw head (12S). Loosen the screw, use your fingers to remove it all the way and slip the bolt handle off the bolt body. You have opened the doorway to the new, multi-component mainspring system (12BB, 12BC and 12BD) being introduced in the Axis.

Before picking the parts out to the rear starting with the rearmost spring (12BD) look at the schematic closely. Note the tip on the front end of spring (12BB). In reconstructing the bolt, the tip has to fit into a notch in the firing pin. I’ll let you in on performing that task a little later. It’s very important. For the present, pull the cocking piece free, withdraw the entire firing pin assembly from the bolt body and set it safely aside. A small schematic added to the main one details the bolt head (12K).

I’ve already alerted all readers that the head and all the parts within it require satisfaction of the FFL-qualified restriction. Having faith you will be able to overcome those bumps in the road, I’ll proceed. Move your attention to the bolt head retainer (103). It also plays a role in retaining the firing pin. The pin has to pass through the hole in the retainer when being reinserted in the bolt body (12G). Right now, you have to know how to remove

THE SAVAGE ARMS AXIS CONTINUED

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the bolt head retainer before you can get to work on the bolt head. This is how: Press the bolt head down on your bench top to push it inward and relax the front washer. Keep the pressure on and the retainer is at your mercy. Show none. Push and remove it. Do the same with the bolt head. This time, don't push. A mild pull will leave the body behind the head and all it contains in your hand. Extractor and ejector removal is not unlike the method followed in dozens, perhaps hundreds, of rifles.

The entire assembly consists of an extractor (12L), a 1/8" diameter steel ball, ejector pin (12P), ejector spring (12Q), extractor spring (12M) and ejector (12O). Pick up a small, thin blade driver. Insert the blade between the ball and back end of A During final assembly the cocking piece is pressed in until end of the tail snaps into its groove in the piece. Backing out the two hex-head screws

allows removal of the trigger guard and barreled action from the stock. the spring. Push the ball to the rear.

Slide the extractor out to the front. Remove the spring from the tail of the extractor. Keep an eagle eye out for the ball and spring when working on the extractor. The ejector also has a small spring to worry you. There's no tiny steel ball threatening a flight to freedom, but there's that ejector pin. It calls for a 16th punch and the pin is made of aluminum. Do not treat it as you would hardened steel. You're right! The Axis has no Accu Trigger.

Despite the highly successful performance and safety features of the mechanism, several planners at Savage were concerned there would be all too many owners taking the pull down to 2.5 pounds. Note they were worried about owners in general, not experienced hunters. No, as this is written there are no

plans to offer a factory-only modification to the receiver making retrofitting an Accu Trigger possible. No, you cannot secure Axis trigger parts individually. Yes, you can order a complete Axis trigger assembly.

Reassembly Tips Let's start with the role of the firing pin. Whaduhyamean, Mr. Technical Editor? We all already know the firing pin ignites the primer in the cartridge. No doubt of that but hold up on the letters of complaint to our editorial office. The firing pin in the Axis does a whole lot more than just touch off the round.

It also holds the front end of the bolt aligned in the bolt body and makes a home for the cocking piece, without which the bolt can't be cocked, as well as that A The tail of rear-most three-piece mainspring (A) has been positioned to enter the slot machined for it in the rear of the firing pin.

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Though no individual parts are available for its trigger, by removing one pin (A) a complete new assembly can be purchased. The assembly includes the safety (B), its only plastic component. odd looking but very reliable main spring set-up. Heaven help the gunsmith who doesn't understand the many roles played by the firing pin of the Axis.

Unlike the manufacturer of one rifle I'll speak more of in a future article, which happens to be a lightweight hunting iron in direct competition with all other lightweight rifles, Savage realizes the advantages of making it possible for a local gunsmith to service an Axis. If Savage believed otherwise you wouldn't be reading this article. Install the spring on the ejector tail prior to positioning the ejector in its slot within the bolt head.

Compress the ejector/spring subassembly into the head until the ejector is flush with the bolt face. Insert the ejector pin. While keeping light, rearward pressure on the ejector, slowly move the pin up and down until the ejector snaps into place. Beware the small, steel ball leaving the immediate area when reinstalling the extractor. Add the spring and be double wary. After placing 12J and 12I on 12K— in that order— half secure them in the bolt body with the bolt head retainer (103).

I say "half" because the subassembly won't be fully secured until the primer impact end of the firing pin has been passed through its hole in the retainer. You can't

see that happen but you can feel it. With the back end of the firing pin held upward, place 12BB and 12BC on the shaft. Maintaining the subassembly vertically, set it aside for the moment. Pick up retainer, orient its center hole to 90 degrees and keep it at 90 degrees when you start the retainer into the bolt body. Just barely start it in.

Pick up the firing pin subassembly and start it into the bolt body. Worry not. The thicker diameter of the firing pin will prevent the assembly from falling through the body if you lose your grip. Feed in the retainer slowly. Wobble the firing pin back and forth a little as you lower it into contact with the retainer. Sooner than later, the pin tip will find the hole it's supposed to pass through. Do not allow the firing pin assembly to ignore the hint.

Top off the installation with 12BD but do not reinstall the bolt screw. At this point, the cocking piece as yet to be touched since its removal. It's about to be. A hole in the firing pin awaits. Neither the cocking piece or the hole are threaded. The cocking piece is grooved in its middle. There is a definite order for returning the firing pin assembly to the bolt body and securing it with the cocking piece. The rear stem of the firing pin has a short longitudinal groove in it.

The tail of the forward spring fits in the groove and is slid forward until the tail moves down to protrude into the cocking piece hole. Add the firing pin washer and the rearmost spring to the firing pin stem.

With the pre-assembly complete, insert the assembly into the bolt body. You place the bolt handle on the body and start in the bolt assembly screw. B A Use the screw to move the firing pin assembly forward until the cocking piece hole is visible at the front end of the bolt body cut out.

Check to be certain the tail of the forward spring can be seen in its hole and install the cocking piece. It's a press fit. An audible "snap" will let you know the tail of the spring has found its groove in the cocking piece. Tighten the bolt screw, restore the barreled action to the stock, insert an empty magazine and, paraphrasing Larry The Cable Guy, you Got-R-Dun. Schematic Notes The schematic presented here is complete and accurate, showing far more parts than the drawing in the owner's manual.

Said drawing is incorrectly numbered with duplications, omissions and false identities. All pertinent parts are highlighted. I chose to avoid possible confusion by addressing only the parts you should be dealing with and again stress the need of an FFL to get them. I suggested strongly to my Savage contact that the manual schematic be replaced or a notice placed there-in that the one appearing here be made available via Savage Customer Service at no cost to an Axis purchaser. Only time will tell on that proposal.

AG



Savage Arms Axis (Specifications subject to change without notice) 12BD Rear Mainspring 12BC Firing Pin Washer 12BB Front Mainspring 12A Cocking Piece Pin 11G Firing Pin 12Q Ejector Retaining Pin 12P Ejector Spring 12O Ejector 12G RH Bolt Body 12I Washer-Front Baffle 12J Front Baffle 12K Bolt Head-RH 103

Bolt Head Retainer 12M Extractor Spring 12S Bolt Assembly Screw 12C Bolt Handle RH 12N Steel Ball 1/8 inch 12L Extractor 19A Trigger Guard 19C Rear Action Screw 19D Front Action Screw 10 Magazine Box 18 Synthetic Stock

FROM THE ARCHIVE

Do You Have Gas? Part One

reliable functioning of Stoner platform guns on the range, in the woods and in less pleasant social settings, such as fox holes.

BY JOE CARLOS JANUARY 2014

ORIGINAL PP. 9-15

The two most common questions I'm asked about match AR-15s have to do with trying to predict barrel life and how far to jump heavy bullets used in long range competition. Fortunately, "What's wrong with my AR?" is way down in the frequency of questions I field. That's a good thing because no AR-15 armorer really wants to hear that question. While there are a whole bunch of things that can go wrong with the rifle, these seldom happen. Eugene Stoner designed a great rifle. My degree is in Wildlife.

When attending Penn State the professors told us to always first study any existing body of research before going to all the work of setting up a study on some critter or new management notion; a good "work smarter, not harder" philosophy. When the editor asked me to write on this topic he mentioned a very well written article, "A Primer On AR-15 Problems" by RK Campbell in the March 2011 issue. I dug it out and read it, and strongly suggest that you do as well.

Another great source on the topic is The Complete Guide To AR-15 Accuracy by Derrick Martin. He devotes a whole chapter to the subject and offers a lot of good information on trouble shooting and repair on the various carbine versions. When that book was first published in 2000, gunsmiths were just getting the nuisances of the carbine figured out. In general, I think carbine design and manufacture has improved since and I don't hear complaints about function and repair nearly as often.

One tome that certainly helped was Glen Zediker's The Competitive AR-15: The Mouse That Roared. This was first printed in 1998 and mine is from the 14th print-

ing, indicating many shooters found it to be of worth. I suggest spending some quality reading time on the chapter on cleaning, especially the parts on lube. Zediker's The Ultimate Technical Guide was printed in 2008 and has a chapter ("Maintenance, Cleaning and Malfunction Cures") covering this specifically.

Another great Zediker reference is The Competitive AR-15 Builders Guide. If you use the correct parts as identified in The Mouse That Roared and put them together as per the instructions in Builders Guide your chances of having a relatively break proof gun are really enhanced.

All these references, even the sections that aren't specifically geared to diagnostics, assembly and maintenance, will help you understand how Stoner platform guns work and your greater understanding will lead to developing a routine to better troubleshoot problems. Some of the military manuals can be quite helpful and have great sections on assembly and disassembly. I also like them for tables on torque limits and similar specifications.

Living with the gun will teach you its few weaknesses and vulnerabilities like no other experience in the world. I have slept with Stoner platform rifles in nearly every English speaking nation in the world as well as in a few fox holes in some non-English speaking "garden spots" where, thanks to our politicians, our military seems to find itself all too frequently. Sleeping in fox holes while mortar rounds whistle overhead isn't nearly as "attractive" to me at my current age as it was when I was between 20 and 40.

If you feel the same way then I suggest you might want to consider a little compromise and just try competitive shooting. My friend, the late Jeff Cooper, once said, "A man will push himself harder in training to win a little gold medal than he will train to save his own life in combat." As in most things, I think that Chairman Cooper was right on.

I never trained nearly as hard before going into combat, even with a Drill Sergeant's boot up my butt, as I did to earn three Distinguished Medals, the President's Hundred tab, and the German Armed Forces Badge for Weapons Proficiency (Schützenschnur.) Training to win will stress both yourself and the gun, and you will learn much more about both in the process.

Standard Required Caveats "The Gun Writer's Union" requires all of us who write on the topic of semiauto malfunctions to say somewhere, "most malfunctions are caused by bad ammo, bad magazines, or failure to properly clean and lube". There, I have done said it and my obligation is fulfilled so I am not sanctioned or charged extra dues for failure to include it. Seriously, whenever I am asked to diagnose function problems for a customer I always ask for magazines and a sample of his ammo.

When it all arrives I give a good visual inspection to determine the condition and cleanliness of all three. The gun, obviously, also needs some lube. I do get a lot of questions about what lube to use. I usually answer, "I am a former military armorer and, therefore, a whore by definition. I have never seen a gun lubricant that I don't like."

DO YOU HAVE GAS? PART ONE CONTINUED

ORIGINAL PAGE 10

Most any lube is better than no lube. And I have never found a lube good enough that it is a substitute for cleaning for any length of time. I know that some people have strong opinions about which lube is best, usually with a list of good reasons to support their opinions. The next guy I talk to likes some other lube and gives pretty much the same reasons. I've just never gotten all that emotional about which lube to use as long as you are applying something.

I maintain that if you thoroughly clean the bolt carrier assembly, and wipe out the area where it lives in the upper receiver, and wipe off the charging handle and then apply some lube of your choice every time you shoot the weapon it should be reliable enough on its next outing. And it will be more accurate because the bolt carrier velocity will be constant resulting in consistent positioning of the cartridge in the chamber and equal pressures on the cartridge head from shot to shot.

If you abuse your firearm or insist on neglecting it, don't blame malfunctions on the brand of lube. After performing a visual inspection, if I don't discover anything obvious I like to actually fire the gun using the customer-supplied ammo and magazines. Depending on what type of malfunction I am seeing may point me in the direction of a quick diagnosis and repair. If it doesn't, I like to substitute known good ammo. If the firearm continues to malfunction, I substitute a known good magazine.

Continued malfunctions is a pretty good guess that Union mandated caution statement doesn't apply and you really do have a gun problem. Conversations with the customer also helps. Ask if the firearm has a past history of the same function problem, or if he has changed anything recently

like magazines or ammo and if the function problem began about the same time as something new was introduced.

Has he replaced any parts in the rifle at about the time the problem surfaced? "What's wrong with my AR?" is way down in the frequency of questions I field. That's a good thing because no AR-15 armorer really wants to hear that question. There are a bunch of things that can go wrong with the rifle but these seldom happen. Eugene Stoner designed a great rifle." Is there only one problem with the firearm or are there multiple, seemingly unrelated, issues?

Gas Problems In a social setting this is easy, because everyone in the room moves away from you. With firearms, not so much because problems not related to gas can give similar symptoms, just as smoke coming out of the exhaust pipe of your car can be caused by several culprits. Most gas related function problems in firearms are caused by not getting enough gas where it needs to go.

There are some neat problems that can occur if you have too much gas in a gun but we will save those for another time because they are way less common. A common symptom of not getting enough gas is failure to eject. Simply put, the bolt isn't propelled back far enough to allow the spent casing to exit the ejection port. But failure to eject can also be caused by a problem with the ejector itself. I always look at the most obvious connection first. If there's an ejection problem, look at the ejector first.

If the ejector checks out, go back to looking for gas issues. A handy diagnostic at this point is to charge the magazine with only one round and fire it. If the casing fails to eject and the bolt carrier doesn't lock back, lack of gas is looking more like

the guilty party. I had an interesting experience with these same symptoms and diagnostic trail recently.

All the same bread crumbs, however, she was also complaining about losing the second stage from her fancy National Match trigger at about the same time, saying her hammer was failing to recock part or most of the time. Her gun had a fairly short chamber, so perhaps she had blown a primer and that it had lodged in the trigger group, making the hammer offer more resistance to the rear travel of the bolt carrier.

A primer down in there often just stops the trigger from operating, not usually causing just one stage of a trigger to go out. Cocking the hammer confirmed it was gritty and difficult to pull back. Examination with a flash light revealed parts swimming around in the well where the trigger group lives. After pouring the two parts out, one was a very mangled coil spring and the other a fine hex head screw.

There was a hole in the top of her trigger, which was the female threaded area where the coil spring and adjustment screw for her second stage trigger let off used to live. Somehow the screw had backed out, and it and what had been a captive spring had fallen out. The spring had gotten up under the hammer was making the hammer jam up. The added resistance to hammer cocking caused by the spring being down under the hammer was slowing the bolt carrier and causing the ejection issues.

What at first blush appeared to be a gas problem turned out not to be as I failed to quiz her about "other problems with the rifle occurring around the same time" as the ejection problem. The trigger assembly was from around twenty years ago when the two stage National Match triggers were just getting popular and hadn't been made in years. Even in

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its boogered form the spring looked familiar to me, so I got out some personal two stage triggers made by Charlie Milazzo, the man of two stage AR triggers. He also used the 2 stage adjustment idea with a hex head screw and captive spring. The springs in the Milazzo triggers looked like the one from my customer's gun and both still looked familiar. Concentrating on match ARs I seldom work on regular rack grade ones these days and I guess that is what took me so long.

I dug out a conventional GI trigger and, staring me in the face, was a disconnect spring which looked just like those in the match triggers. I tried fitting it but the second stage failed to make the CMP and NRA-mandated weight of 4.5 pounds. I dug out another spring that looked about a coil longer, being new and simply hadn't taken a "set" and was easily able to adjust it to make legal weight.

Given that the set screw had backed out once I put a distinctive witness mark on the head of the screw and told my customer to check the rifle every time cleaned

it and that excess grease, oil and crud would necessitate repainting it from time to time using a common paint or nail polish to keep that mark easily visible. She's back in business and has more money in postage invested than the cost of the actual repairs. Function is now back to being 100 percent and what looked like a gas issue wasn't.

I ended up learning a valuable lesson about those second stage coil springs that may help you as well. While you will probably never take in a gun whose trigger has fallen apart like this one you may have one that just won't adjust up to make legal weight. Substituting anew GI disconnect spring for one that has taken a set may get you back in business. An easy win!

Army Reserve Experience Competition experience with the Army Reserve Marksmanship Program and elsewhere has furthered my knowledge of Stoner platform rifles. I learned a valuable lesson about the gas system while competing at Bisley Range in Surrey, England. This was probably 20 years ago and our team

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was competing in an international combat match with other NATO countries. Although the British issue ammo met 5.56mm NATO specification, our M16s were running funky and dirty with the stuff. My rifle didn't like it at all. We began diagnosing why I was having so much trouble and discovered that my fairly new bolt carrier never had the screws holding the bolt carrier key in place staked.

This allowed both screws to back out a little and there was a gap between the top of the carrier and the bottom surface of the key which was allowing gas that should have been impinging on the bolt to escape. The rifle was robbed of gas and I was in big trouble. I borrowed some high pressure aerosol gun scrubber, red Loctite and an Allen wrench from team members. We hosed off the gunk, let it dry and slopped it together with liberal amounts of Loctite and a strong hand on the wrench.

We didn't have a torque wrench to hit the 35 to 40 inch-pounds called for in the military manuals and would likely have erred way on the heavy side even if we did. Not only did the bolt carrier survive the next two weeks of shooting but I managed to win some events in the process. Nearly 20 years later that carrier is still 100% func-

tional. While I don't stake the screws in all that time, I would never go to another country with a carrier that didn't have them staked again.

One would think that hot gas passing through the key would overheat red Loctite but I have never had a lick of trouble. I did relegate the carrier just for practice after I got back, just in case. You will probably seldom run into a carrier with key screws that haven't been staked. I guess mine was just overlooked at the factory. Companies are more careful now and I haven't seen but one other carrier (it came from the same company) since that was missed.

You may have to stake a key in the event of performing a repair job, however. If a bolt carrier is dropped from much distance on a hard surface the key may be bent. Obviously, this can cause function problems. Of equal concern is accuracy. The alignment of the gas tube to the key is critical to accuracy. The smallest bit of misalignment will slightly cock the carrier and with it the bolt face.

Orientation of the cartridge in the chamber will vary from shot to shot as will pressures of the bolt face, ejector and extractor on the cartridge rim. I have found that fatter group

size and frequency of fliers often result. The military manuals explain how you can supposedly "iron out" key wrinkles using a 0.175" and 0.180" diameter punch and inserting it through the front, lightly tapping or applying pressure to straighten as needed.

The closest I can find is a 3/16" (0.1875") which is oversized by the manuals and seems just a bit too fat on keys I've tried it in. If you elect to repair using this route you will need to turn down the business end of the punch by about 0.008". Using this approach will prevent having to remove the original, already-staked key. Be sure to thoroughly check alignment of the gas tube with the key following your repair or accuracy will suffer.

If the severity of damage is too great or you don't want to mess around making up a custom tool, replace the key with a new one. They are not that expensive. Obviously, if you take this route the new replacement key will need staked. Less obvious is the fact that you will need to recheck the alignment with the gas tube when finished. When replacing the key note there are manufacturing tolerances involved so there is no

DO YOU HAVE GAS? PART ONE CONTINUED

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guarantee of proper alignment. It's useless bothering with premium barrels only to fail to get all the accuracy out of the rifle because you rushed assembly and let a misaligned gas tube slip through. A the references cited in Part One will show, there are differing ways to do this, however, everybody agrees you should not recycle the old screws. Buy new ones! Brownells carries them and they are cheap. You can also get them at hardware stores, sized 8-32 X 1/4.

The screws designed specifically for use on the AR have knurled heads, extra insurance to enhance the staking and making back out less likely. Reference sources differ regarding the use of adhesives. The military manual I have does not address them. Glen Zediker recommends red Loctite. I would be inclined to use the red #271 on the screw threads because it's designed for threads with green #638 better on flat bearing surfaces.

Young Manufacturing recommends Permatex High Strength Thread Locker available from Ace Hardware, part number 27010. The military manual says to torque the screws to 35 to 40 inch-pounds. Note this isn't the more common (heavier) foot-pounds those of us working on ARs are used to. You can Google up conversions from inch pounds to foot pounds but many of us may not have a torque wrench calibrated in the lighter inch pounds.

Brownells has inch-pound torque wrenches but most ain't cheap, however, Borka International offers a more affordable unit. Glen Zediker recommends exceeding the military torque limit but doesn't say by how much. Young Manufacturing lists 56 inch-pounds and I am inclined to go with that number. The screws made for this will likely take a 1/8" wrench size and whatever adaptors you may need to fit that to your wrench.

Glen Zediker points out that it is not a good idea to just jump on one screw and take it all the way to final torque in one ap-

plication. I would snug it up but not to the point where the torque wrench disengages. Then I would go to the second screw, take it all the way down and return to finish the first. The actual staking is a hotbed of contention with almost no agreement. The military manuals say to stake three times equally spaced around the head of each of the two screws.

I use a lot of Les Baer match bolt carriers in my custom rifles and they stake each screw twice, once at the front and back. Use the Starrett 5/32" Center Punch from the Brownells Tool Kit For AR-15 (#827-512-820). Brownells also sells the Carrier Key Staking Tool (#080- 000-638) which supports the carrier while sharpened hex screws press in at the top and form the stakes on each side of the screws. The tool does not use a punch and hammer method like the ones mentioned earlier. J. P.

Enterprises puts two stakes in each screw oriented on the sides and the work appears to be done in some sort of fixture. I use a lot of match carriers from Young Manufacturing and they adamantly oppose any staking at all, voiding any warranty if the customer or armorer stakes their screws. They do, reluctantly, advise that if one absolutely insists on staking to use the Brownells unit. Glen Zediker recommends the Moacks Tool by Michiguns Ltd.

Like the Brownells unit it eliminates the more common punch and hammer method and relies on turning four sharpened hex head screws into the sides of the key screw heads. Which method to use? I said earlier that I have no attachment to any particular method. The Brownells and Michiguns units aren't cheap but if you are going to be doing a fair amount of staking then either one might be attractive.

Customers expect certain things and staked key screws are one of them so pick the method that is affordable and best suits your shop practices. I would have absolute faith in any key put on with any of the recommended glues and staked in any

of the methods described will not come off. Young claims they have and that it was a by product of not enough torque, so I would use the 56 in. lb. that they recommend. Fort Devens Our next story comes from a team training session in Massachusetts.

I was called to the line to look at a flat top exhibiting what appeared to be intermittent low gas. The problem was that it was a hot line and they weren't about to shut down just because one person was having function problems with his rifle. They were running back to back courses of fire and the shooters were only given just enough time to charge magazines and they were right into the next match. So I would only get about 5 or 10 minutes on the gun before the shooter had to use it for the next string of fire.

That was just about enough time to shotgun it, check one thing, dump in a half bottle of oil, close it back up and hand it to him. My first check was the tightness of the carrier key and it was just fine. The next time I checked the bolt rings and they were also OK. The third time I got the gun my eye drifted to the front sight housing. There was the problem. The gas tube roll pin had just fallen plumb out!

As you know, there is a hole in the bottom of the gas tube that lines up with the hole in the front sight that brings the gas up from the gas port in the barrel. With that roll pin missing the gas tube was free to rotate right, left, or sometimes stop in the center where it should be, the reason why the problem was intermittent. The fix was easy and the firearm functioning flawlessly with the shooter still winning matches with it.

As I passed through the Ready Line I was looking down at shooter's guns as armorers are prone to do. There was a black AR-15 lying on top of a black soft gun case and about an inch from the front sight there was the black gas tube roll pin

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for the gun in question! Fortunately the shooter had not been called to the line yet and I was able to substitute anew pin so he didn't have to experience the same frustrations as the first soldier. Checking Rings One of my early checks is afield expedient "ring assessment." While not new, it is used by many folks in the AR business. Remove the bolt carrier assembly from the upper.

Hold the carrier at the back with one hand and grab the bolt lugs with the other hand and pull in opposite directions so the bolt will move forward until its movement is halted when the cam pin stops it. The bolt will be in the same position in the carrier as when ejection occurs during the cycle of function. Still holding the carrier at the rear with one hand, set the assembly on a flat surface. The carrier needs to be vertical, resting its weight on the front of the bolt.

If nothing collapses it is a good sign that the rings are in good shape. It doesn't mean that the rings are "right", however. If I had a gun that was exhibiting apparent low gas problems I would still remove the bolt and check the gaps in the rings. Make absolutely sure that the gaps are staggered or gas can still escape causing malfunctions with perfectly good rings. If the bolt "collapses" into the carrier as when it is in battery with a chambered round, it is an indication the rings are worn.

By no means will every carrier failing this test cause malfunctions as the test errs on the conservative side. I have seen guns fail

the test and continue to function flawlessly for thousands of rounds, however, if you have a gun with apparent low gas problems and it fails the carrier test, replacing the rings is sure a good step to take. If the gun continues to malfunction then you have eliminated the obvious and can continue looking elsewhere.

As a professional gun builder I don't have a lot of spare time for gun cleaning but I obviously recognize the value of keeping the gun clean to longevity, accuracy, and function. It is not unusual for me to clean a customer's carrier assembly a couple of times during its time here in my shop with an ultrasonic gun cleaner which frees me to perform other work. These units get crud out of little crannies better than any cleaning method I know of with very little effort.

The downside is that they align the gaps in the bolt rings with equal alacrity and predictability. If you clean with ultrasonics you probably already know that you are going to spend an extra minute staggering the ring gaps before you assemble the bolt into the carrier. How often should the bolt rings be replaced? As with barrel life, no one knows exactly because of the variables. Does the shooter dry fire often?

The bolt is moving back and forth (manually to cock the hammer) in the carrier in dry fire, rubbing the bolt rings against the "bore" (the hole in the carrier where the bolt lives) in dry fire too. How often does the shooter clean the bolt carrier assembly and does he do a thorough job? The carrier

accumulates crud which wears on the rings (friction.) Crud in the key will also cause premature wear out of the back of the gas tube.

Use of pipe cleaners and ultrasonic cleaners are helpful in doing a proper cleaning of the bolt carrier and key. How often does the shooter apply a drop or two of oil to the rings? In an NRA High Power Rifle 800 Aggregate course, I like to see oil going in around every 20-40 rounds. This is not necessarily directly to make the rings last longer but for function and accuracy.

Consistent bolt carrier velocity relates to uniformity of bolt positioning, orientation of the cartridge in the chamber, and equalizing how the case head sits on the bolt face, pressures of the extractor, and ejector. All this contributes to accuracy. I can tell you that when I machine rest test rifles I put oil on the rings every 20 rounds to control some of these variables. How well polished is the "bore" of the carrier (the hole in the carrier where the bolt lives)? This is subjective.

The bore can be polished using the same tools and techniques as the chamber and I will cover that in another article. What environment is the rifle shot in? I live in Pennsylvania and most of our ranges have nice com) bolt carrier on the left has four stakes located on the sides. Carrier in the center has key held in place with screws and Loctite. Les Baer Custom carrier has four stakes located front to back.

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The one on the right has collapsed, indicating rings may need replaced. green grass growing on the firing mounds during the summer. Contrast that to the sand in a state like New Mexico. I suspect that the type of propellant used in the cartridges being fired may influence ring and gas tube longevity with regard to the abrasiveness of the residue. I've read pistolsmiths recommending against shotgun powder in pistol cartridges because the shotgun powders left a more abrasive residue.

His comments were in regard to barrel wear but they certainly got me to thinking of the Stoner Platform and gas ring wear. I recommend that you close the ejection port cover (also called "dust cover" for obvious reasons) if range rules permit when not actively shooting. This keeps crud out of the action parts. Use of a soft case is another good idea as long as the inside of the case has less crud than the outside environment. I have seen some that were pretty filthy inside and a good vacuum will help that.

I am sure I am missing other important variables in bolt ring wear. I recycle my bolts because a bolt should outlast two or three barrels but put new rings in. I know guys who put new rings in at the start of every shooting season. Unless a gun is malfunctioning I would recommend not just gratuitously replacing rings right before an important match unless you have at least one range session prior to the match. Most anything you do with regard to the bolt carrier assembly can change your zero slightly.

Rings are cheap. Replace them any time you are having function problems and more often if you wish or if your customers expect it. As with bolt rings, some writers, gun owners and gunsmiths make much to do about gas tubes and how often to replace them. If you look at most gas tubes the back 1/8" or so is the full size of the tube body. I am measuring something on the order of 0.178-0.179" on ones I have in the shop. The tube diameter then steps down a little, 0.166" in those I've measured.

The length of that skinnier section can vary but 2.25" is about standard. Then the diameter of the remainder of the tube will go back up to that at the very back, somewhere around 0.178-0.179". Folks will tell you that when that swelled out short section at the back of the tube has worn down about 0.013" to where it is about even with the skinny section in front that this is proof positive the tube should be replaced.

If you have a stripped receiver in front of you, look at the hole which the gas tube passes when it is coming into the gun. You will see that hole is not round. It has four lobes that make it appear like a cloverleaf.

The theory is if the back of the gas tube is too skinny there will be a poor "seal" with the bolt carrier key and gas needed to function the gun will take the path of least resistance and exit the system by back-flowing through the cloverleaf because when the gun is in battery the front (mouth) of the key is right there at the cloverleaf. If I were diagnosing a gun with low gas issues and I ob-

served such a gas tube I would replace it and test fire to see if the gun begins to function correctly again.

One of the problems in correctly diagnosing gas tube wear when the gun is fully assembled is that you can only see about the bottom 90 degrees of the circumference of the gas tube as you observe it looking up through the bottom of the upper when the bolt is pulled back. This visible fraction of the gas tube may look just fine but the ¾ of the tube which you can't see may be worn more. Properly aligned gas tubes should wear evenly over their whole 360 degree circumference.

I find that far too many builders don't pay enough attention to getting the gas tube properly aligned with the key, however. Proper alignment has major effects on both group size and frequency and severity of fliers. I don't put numbers or schedules or round counts on when to replace gas tubes any more than I recommend doing so with bolt rings or barrels. There are many variables involved in all three which complicate things.

With the exception of oiling rings or the internal polish of the carrier, most of the variables relating to ring wear out also apply to the gas tube. Since gas tubes are about nine times the cost of a set of rings I don't want to replace one unless it is really necessary. Whenever replacing a gas tube be sure to ensure that the new one is properly aligned with the carrier key. Just because it is new is no insurance that it will automatically align right! AG

METALWORKING

Installing A Shotgun Barrel Bead

Whether installing a front or central shotgun barrel bead, positioning at top dead center is the key. Proper drilling and tapping, as well as drill and tap selection, is critical.

BY NORMAN E. JOHNSON JANUARY 2014

ORIGINAL PP. 16-17

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Bead selection on a shotgun depends on usage. Bead sizes vary, as do their thread sizes and typically range from 3-56, 4-40, 5-40 and 6-48. Bead material may include steel, brass, ivory, aluminum or transparent types. Once the bead selection has been made, choose the proper tap and drill, and then the method of drilling and tapping. Locating, Drilling and Tapping Use of a

milling machine or a good drill press with the barrel held in a firmly padded milling vise is a good choice.

With the barrel held in the milling vise, I use a 36 inch straight edge to locate top dead center for the screw hole and then carefully mark from both sides of center. From there I align the drill chuck directly over the mark and use a small center drill to start the hole. Bottom I then switch to the proper tap drill

and make the hole. The drill chuck is then used to guide the tap as the threads are cut. Caution should be exercised to avoid tap breakage. Advance the tap just a half turn at a time and then back off.

Shotgun barrel steel is not particularly hard but care must be used as the hole is tapped. It is best to use a drop of tapping fluid for the job.

INSTALLING A SHOTGUN BARREL BEAD CONTINUED

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Extreme care must be used or a simple job like this can ruin a good barrel. Setting The Barrel Bead Having used the correct tap, it's time to try the thread. The bead is easy to lose, so turn the thread in place over a flat surface as you check for thread fit and a depth. An over-

length thread must be shortened to barrel thickness. Finally, I use some form of thread bonding as the bead Complete your American Gunsmith collection. Or read up on a special subject! A limited number of the following

GRINDING

Ultrasonic Firearm Cleaning, Part One

How this time-saving tool works and its evolution to firearms cleaning.

BY RICHARD MACLEAN JANUARY 2014

ORIGINAL PP. 18-22

Even a novice gunsmith recognizes the damage that can be done to an expensive firearm with an ordinary screwdriver. They also know exactly why a correctly sized hollow-ground screwdriver is so effective at preventing damage when extracting hard-to-remove screws. Ultrasonic cleaners are another variety of tool that is gaining in popularity among gunsmiths, now that these devices have become more affordable. But just as the wrong screwdriver can ruin a firearm, so too can an ultrasonic cleaner if used improperly.

There is surprisingly little detailed, credible information on this subject and the classic gunsmithing books were written long before the invention of ultrasonic cleaning. These cleaning units can be a tremendous time saver for a gunsmith. They can perform certain operations that are all but impossible using solvents and manual brushing but they also come with potential issues. Many of the key warnings and relevant instructions are either absent from the manufacturer's literature or mentioned briefly.

Just as significant, the reasons behind certain precautions are rarely explained and these warnings are soon forgotten. Compound this dearth of information with the ego factor ("I'm smart and only need to glance at the manual") and you have a recipe for disaster. In this series, we'll explore all of the relevant dimensions of ultrasonic cleaning in the context of gunsmithing. There are hundreds of opinions about ultrasonic cleaning on various firearm forums.

They cover the spectrum from favorable to very negative and from sensible precautions to absurd recommendations. Although they provide an initial framework to guide our investigation, we'll rely on the experts to get the facts straight; the manufacturers of the units, firearm finishers, product suppliers, and leading manufacturers of weapons and accessories, such as tritium night sights.

We'll provide direct quotes from the early developers of ultrasonics for firearms and national experts on what ultrasonics can and cannot do and why. A draft of this article has been reviewed and scrutinized by numerous specialists—even Glock's United States legal department had a look. Because this is a subject area that has not been adequately covered in the past and much of it may be unfamiliar to even expert gunsmiths, we chose to fully explore ultrasonics in a twopart series.

This, the first, covers the background on ultrasonic cleaning, its evolution in firearm cleaning and the current state of the technology. The second part will explore proper cleaning techniques, what the experts say about ultrasonic cleaning, and essential tips that have, to the best of our knowledge, never been published before. It also contains an essential summary list of dos and don'ts and what to look for in a unit.

Ultrasonic Cleaning Origins Bouncing sound waves off of underwater objects has been around since the early 1900s and was propelled to the forefront during World War I for submarine detection. The energy levels and frequencies are considerably different than those of ultrasonic parts cleaners but the principle is the same.

Electricity is used to stimulate a disk made from a crystalline substance such as quartz and ceramic which, in turn, generates mechanical waves.

Your stereo speakers or headphones perform a similar function, only in air and in the sonic hearing range between 20 Hz to 20 k Hz. Ultrasonic is defined as frequencies that are above this threshold of hearing. The first report of the "piezoelectric effect" generating ultrasonic waves was in the laboratories of Radio Corporation of America (RCA) in the 1930s.

The scientists noticed that waves were generated around a radio crystal in a bath of liquid Freon but it was not until the 1950s that Bendix Corporation found practical application in cleaning. They discovered that if you pump in enough electric energy and at the right frequency, the waves generated are an effective surface scrubber. The waves alternately compress and expand the molecules of the liquid in which the generating units or "transducers" are suspended or directly attached.

There are currently two varieties of transducers. Magnetostrictive transducers generate waves when nickel or its alloys change dimensions in the presence of a varying magnetic field. Electrostrictive transducers generate waves in response to varying voltages via the aforementioned piezoelectric effect. These are currently made of ceramics (lead zirconate titanate) instead of quartz. During the expansion phase, bubbles are formed that are invisible to the naked eye.

The bubbles are subjected to enormous pressures during the compression phase and collapse with tremendous force, theoretically

ULTRASONIC FIREARM CLEANING, PART ONE CONTINUED

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estimated to be as high as 10,000 psi and 20,000 °F. Their microscopic size and the large volume of liquid in which they are formed absorb and buffer this energy release. Cumulatively there are millions of small expansions and implosions that both heat and mechanically agitate the liquid and produce the desired intense scrubbing action. The optimum frequency for ultrasonic cleaning depends on the application. Heavy parts in large tanks clean best at 25 k Hz. The optimum for firearms is around 40 k Hz.

Clocks and medical equipment do best at around 68 k Hz. Disk drives and semiconductor parts require the upper limit of 170 k Hz. While it may appear contradictory, lower frequencies exhibit a much more aggressive cleaning action. The bubbles formed are much larger, again at a microscopic level, and when they collapse, the implosions are powerful enough to knock the sand off of metal castings. Higher frequencies penetrate better in the inner workings of delicate components.

Higher frequencies have a more dense ultrasonic coverage on the cleaned surface, thus covering a higher percentage of the area to be cleaned. For example, in optics, silicon wafers, and surgical equipment, a higher frequency is required in order to provide a more thorough cleaning. Another important concept is power. In air it is measured in decibels (d BA.) In ultrasonic cleaning the power is expressed as watts per gallon.

The power (amplitude) of the waves generated must be sufficient to cause the pressure in the liquid at the point where a bubble forms to be less than the vapor pressure of the liquid. A few of the factors that influence the required power level to optimize cavitation are the type of liquid and its surface tension and temperature. In part two of this article we will discuss the importance of solution chemistry. Most industrial cleaners have a watt density of between 50 to 100 watts per gallon.

In general, smaller parts requiring more thorough cleaning need a higher watt density. There are exceptions for the cleaning of large parts in industrial tanks of over 50 gallons. Known as the "large tank phenomenon," only about 20 to 50 watts per gallon is required. Again, optimum power and frequency is not intuitively obvious and more is not necessarily better. It is important to understand this distinction if you are in the market for a used industrial unit.

A unit coming out of a dental office would probably work well on handguns and parts, but one used in the semiconductor or metal casting industry may not. Indeed, the aggressive action of low frequencies, in addition to the very harsh cleaning solutions and long immersion times in industrial applications, would ruin most gun finishes. Ultrasonic Cleaning Evolution In the very early days, these key parameters were not well defined for most cleaning applications, let alone firearms.

Bendix led the way and by the late 1950s, the public's eye was drawn to popular literature articles on ultrasonic applications. Other companies started to get into the commercial and industrial ultrasonic cleaning business. In 1980, Bendix sold off this division to a group of former employees who formed Swen Sonic Corporation, which later became Blue Wave Ultrasonics in 1990. Similarly, there have been scores of companies that have come and gone over the years.

Most have specialized in industrial parts, biomedical, and dental device cleaning. In alphabetical order, Blackstone-NEY Ultrasonics, Blue Wave Ultrasonics, Branson, Crest Ultrasonics, Gun Cleaners Division of Police Products Corporation, L&R Manufacturing, Sharper Tek, Ultrasonic Power Corporation, and Zenith Manufacturing are among the most widely known and respected brands.

The ultrasonic cleaning industry in the early days was filled with optimism, going so far as to predict that the technology would replace conventional clothes washing machines. If you stuck anything in the tank it would be cleaned, or so the thinking went. By the 1970s some of these commercial units were being tried ad hoc for firearms cleaning. The results were disappointing because the overall processes specific to firearms cleaning had not yet been perfected.

Specifically, the cleaning liquids were toxic (e.g., trichloroethylene), smelly (e.g., popular gun cleaning and ammoniated solvents), flammable (e.g., kerosene), and/or corrosive (e.g., strong caustics.) The "if a little cleaning is good, a lot of cleaning is better" philosophy reigned. Not only that, the units were adaptations of industrial units and very expensive. That started to change in the 1990s. By then, L&R Manufacturing was producing a product line specific to firearms.

Interest was growing, but it took two major developments to shift the firearms cleaning landscape to what is available today. Greg Infante, President of Police Products Corporation and marketing his systems under the name Gun Cleaners, picks up the story from here. "Since 1978 I have been in the firearms business as an FFL and later as a law enforcement dealer for H&K, supplying firearms to police departments. In 1994, I was in a major police department as part of a weapons upgrade project.

I noticed that the armorer had a Crest Ultrasonic unit containing what appeared to be a typical flammable gun solvent. Aside from the fire hazard, it smelled awful. I thought, 'There has to be a better way.' "Soon thereafter I contacted Crest and worked out an agreement to be their exclusive distributor for firearm cleaning units in exchange for my development and marketing of their equipment and chemicals into improved firearm clean and lube

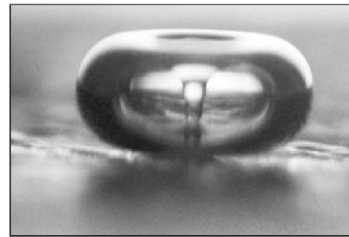
ULTRASONIC FIREARM CLEANING, PART ONE CONTINUED

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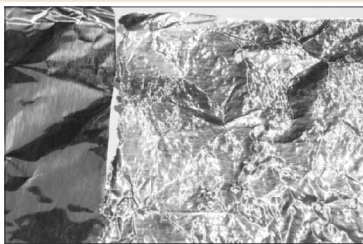
Left: The typical benchtop ultrasonic setup includes two baskets, one for cleaning and one for lubrication (upper tank). This Sonic Systems unit will clean gun parts up to 19" long or four pistols.

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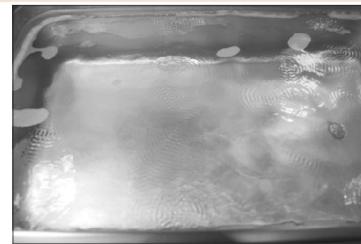
Below left: Ultrasonic bubbles are only 8 microns (μ), or 0.0003 inches at 40 kHz, but collectively, millions pack a punch and scrub efficiently. Source: Dr. Lawrence Crum, University of Washington.

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Below right: Soft, unsupported aluminum foil (left) is subject to both vibration and cavitation damage even after five minutes (right). Photos such as this have been used to support claims that firearm finishes will be damaged by ultrasonic cleaning. It's true—if used improperly, ultrasonic cleaning can damage finishes on some firearms.

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Below left: Cavitation bubbles are invisible to the eye, but the cleaning tank emits a buzz and the surface ripples from the waves.

ORIGINAL ARCHIVE IMAGE • PERMISSION CONFIRMED

) This Sonic Systems unit will clean gun parts up to 19" long or four pistols. 0003 inches at 40 k Hz but, collectively, millions pack a punch and scrub efficiently. Source, Dr. Lawrence Crum, University of Washington. systems. One of the first challenges was to develop cleaning and lubricating solutions that were nontoxic, nearly odorless, and very efficient.

In effect, we needed to hit the right balance between the power of the units and the aggressiveness of the cleaning solution. "For example, the surfactants used in the cleaning solution and the bath temperature significantly affect cavitation. It was not easy since one formulation might work well with a particular finish to remove some forms of crud but be useless on other finishes or hardened oils; some removed finishes.

We got the best results with all finishes by using a cleaning solution safe enough to put on with your hands but with cautions on long durations in the tank. It took a lot of tri-

al and error to come up with the current solution that has an extensive positive track record when used as directed. "The next challenge was to develop the overall process parameters such as time in tank, rinse, lubrication, and drying procedures.

A special waterremoving lubricant was also developed to be nonhazardous, odorless, and nonflammable that removes water through ultrasonic energy by emulsification rather than displacement with a solvent. Crest Ultrasonics had the technical resources to work with me to accomplish these goals and develop an extensive line of systems for any cleaning operation. I have also developed anew line of systems under my own Gun Cleaners brand with additional features.

Brownells sells our systems, and cleaning and lubricating) Photos such as this have been used to support claims that firearm finishes will be damaged by ultrasonic cleaning.

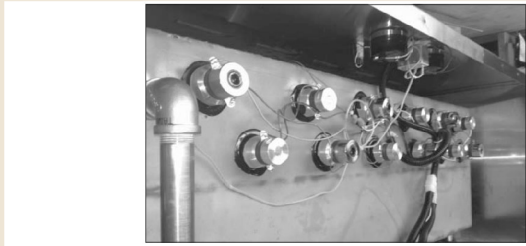
It's true, if used improperly, ultrasonic cleaning can damage finishes on some firearms. solutions, and the industry has pretty much adopted similar chemicals and processes." Simultaneous with the evolution of the chemistry and the process steps for firearms cleaning was the development of better, yet less expensive, hardware and tanks specifically designed to handle long guns.

For example, the internals have become more reliable with the addition of new designs incorporating higher powered and longer lasting wave generators. Fabrication techniques have improved to minimize the erosion of the generating diaphragms. Heaters became standard on firearm cleaning tanks. There is no doubt that foreign imports also have had a major impact on putting these improved units within reach of any professional gunsmith.

Indeed, small, inexpensive cleaners are currently available to clean brass for shooters. Both RCBS and Lyman now offer such units.

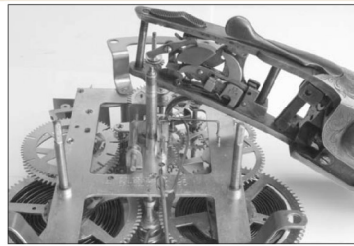
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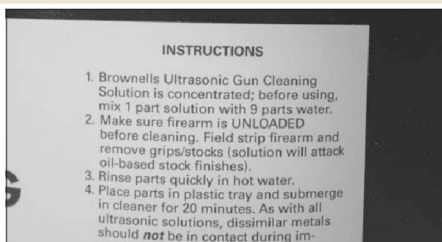
Above left: Advanced ultrasonic cleaning units use wave-generating transducers that vary or "sweep" above and below the set frequency. The system above uses two different transducers operating at two separate frequencies of 40 kHz and approximately 65 kHz, each sweeping ± 3 kHz. This improves cleaning and minimizes finish damage due to standing waves and hot spots. Source: Police Products Corporation.

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Above right: Disassembling an LC Smith inertia trigger group or an antique Ingraham clock mechanism is a time-consuming chore even to experienced clock repairers or gunsmiths. Both of these were inoperable due to hardened gunk. Five minutes of ultrasonic cleaning followed by oiling repaired both.

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Below left: Key improvements have been made in cleaning and lubricating chemistry over the past 20 years. Use only cleaning and lubricating solutions designed specifically for firearms and supplied by reputable suppliers. Never use ammoniated or caustic cleaning solutions or low-flash-point lubricants. Dilution ratios vary; cheaper is not always better if the "concentrate" is weak.

ORIGINAL ARCHIVE IMAGE • PERMISSION CONFIRMED



Below left: Key improvements have been made in cleaning and lubricating chemistry over the past 20 years. Use only cleaning and lubricating solutions designed specifically for firearms and supplied by reputable suppliers. Never use ammoniated or caustic cleaning solutions or low-flash-point lubricants. Dilution ratios vary; cheaper is not always better if the "concentrate" is weak.

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The system above uses two different transducers operating at two separate frequencies of 40 k Hz and approximately 65 k Hz, each sweeping ± 3 k Hz. This improves cleaning and minimizes finish damage due to standing waves and hot spots. Source, Police Products Corporation. Both of these were inoperable due to hardened gunk. Five minutes of ultrasonic cleaning followed by oiling repaired both. Current High Tech State The original ultrasonic cleaning units could only generate a single frequency.

Standing waves—the repeat bombardment of the same frequency wave to the surface location—can be an issue for parts that are very sensitive to cavitation attack, such as shiny, soft aluminum. Some units "sweep" the frequency over a few k Hz range to help prevent standing waves and degas the solution from

entrapped vapors that might reduce efficient cleaning. This technology allows a set frequency (e.g., 40 k Hz) to be raised or lowered about 2%.

In so doing, it continuously changes the conical ultrasonic wave form that is being emitted from the transducer. The sweeping frequency helps to reduce energy dead spots. High-end industrial cleaning systems were the first to incorporate this sophisticated feature, and now they are common on the larger firearm cleaning units used for rifles. Another development was the invention of wave generators that send out two or more frequencies simultaneously, such as those offered by Zenith Manufacturing.

Further innovation includes the use of arrays of two different transducers, each emitting a different frequency to cover a much broader

range than a sweep frequency can deliver. As discussed previously, Use only cleaning and lubricating solutions designed specifically for firearms and supplied by reputable suppliers. Never use ammoniated or caustic cleaning solutions or low flash point lubricants.

Dilution ratios vary; cheaper is not always better if the "concentrate" is weak.) Much of the damage reported from using ultrasonic cleaners has been due to firearms left in a unit for hours instead of just a few minutes. each frequency has a range of surface particles that it can best remove. Yet another development was the invention of electronics to optimize the running frequency of a system, according to its natural resonance. The natural resonance depends on factors

ULTRASONIC FIREARM CLEANING, PART ONE CONTINUED

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Far left and left: The price of ultrasonic cleaners has dropped dramatically with the introduction of imports. Both RCBS (left) and Lyman Products (far left) offer small units for brass cleaning. Source: RCBS and Lyman Products.

ORIGINAL ARCHIVE IMAGE • PERMISSION CONFIRMED



Above left: Two essential improvements to firearm ultrasonic cleaners are temperature control (left) and automatic timers (right). Much of the damage reported from using ultrasonic cleaners has been due to firearms left in a unit for hours instead of just a few minutes.

ORIGINAL ARCHIVE IMAGE • PERMISSION CONFIRMED



Far left and left: The price of ultrasonic cleaners has dropped dramatically with the introduction of imports. Both RCBS (left) and Lyman Products (far left) offer small units for brass cleaning. Source: RCBS and Lyman Products.

ORIGINAL ARCHIVE IMAGE • PERMISSION CONFIRMED

such as the transducer frequency, electronics, tank material thickness, transducer bonding agent, cleaning solution properties, cleaning solution temperature, atmospheric pressure, and other related system properties. Systems such as the Sharper Tek's Auto-Tune and Auto-Track system continuously search for the optimal running frequency. As the system properties change from day to day because of the particular jobs, the generator tunes itself to give the best operating frequency for optimal cleaning results.

In very specific industrial application, all these new bells and whistles are essential. Large high-end firearm cleaning units, especially those large enough to clean rifles, often contain these features, such as Crest True Sweep and L&R Manufacturing's Sweep Zone®. But even for economical benchtop cleaners suitable only for a single handgun, the cleaning solutions, process, and hardware have never been better and priced so reasonably.

Other Opportunities Let's face it, many individuals love to shoot but hate to clean guns. Yes, there are excellent products, such as Cylinder & Slide's "Dunk Kit" cylinder-slide-com that help loosen crud and leave a protective coating, but they all require field stripping and brushing and, more significant-

ly, do not always reach and remove the crud in the nooks and hard-to-reach areas. Some enterprising individuals have capitalized on this dislike for cleaning.

A number of large ranges, such as the LAX Firing Range in Inglewood, California, and the Classic Pistol Range in Southampton, Pennsylvania, have ultrasonic cleaning facilities where, for a few dollars (typically \$10 for pistols to \$30 for rifles) shooters can have their guns cleaned in a few minutes before they leave the range. Thinking beyond the box, why don't gunsmiths offer a similar "cleaning on steroids" service?

An additional benefit of owning an ultrasonic unit is that it can be used for so many other cleaning purposes besides just firearms and brass. If it fits in, it will be cleaned, not withstanding all the cautions described in this article. It's perfect for gunsmiths and shooters who are mechanically inclined in general and have other hobbies such as tinkering with old cars, especially carburetors, and antique mechanical clocks. For clock repairers, ultrasonics works miracles and are the only way to go.

A table with further guidance is available on the website (americangunsmith.wordpress.com) but comes with a word of caution. The advanced features on some units, especially

those involving impressive-sounding claims about sophisticated electronics and transducers, can be misleading. The buzzwords may represent little other than a more expensive unit with not much added value. Check to see what the terms really mean and if the manufacturer can back the words up with facts.

Manufacturers may be willing to discuss the potential weaknesses in their competition's claims. Do your due diligence. Conclusion Which brings us to the key point of all this background information. Cleaning firearms using an ultrasonic cleaner requires the right frequency, power level, and cleaning solution in a system properly loaded and operated for the proper length of time.

If you go significantly outside this set of parameters, you may at best get little cleaning action, or at worst, wreck the finish on a valuable gun. In the next installment we will cover how to get the best results from these units and reveal some key tips from the experts. AG) Much of the damage reported from using ultrasonic cleaners has been due to firearms left in a unit for hours instead of just a few minutes. Far left and Both RCBS (left) and Lyman Products (far left) offer small units for brass cleaning.

Source, RCBS and Lyman Products.

READER FORUM

Reader Forum

BY AMERICAN GUNSMITH EDITORS JANUARY 2014

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Since then, as a bowhunter, I now need a crossbow, as most my age (82) do. Of the various cocking aids used, the rope cocking device, which reduces pull weight by half, is very popular. I know several women who can cock a 150-175 pound bow. A high percentage of bowhunters prefer to perch high above their targets on a fairly small stand. Here both the rope cocking aid and various cranking systems are very popular due to convenience and ease of use.

Proper use of the knees in cocking a crossbow with a belt-hook system would take a load off the back. But, a large number of those who really need a crossbow are lucky if they can even flex their knees, say nothing of cocking a crossbow in such away, without the aid of the affordable leverage offered by the rope cocking aid or the nifty crank system. A rope cocking aid fits neatly into a pocket as well. Would your scissors jack system actually be usable from a tree stand?

Sure it could work, but I suspect it might be inconvenient. Safety is not to be overlooked either, particularly from high up in a tree stand. Cranks and rope cocking aids are almost a must up there. Any unnecessary contorting movements must be avoided. Thus far, I have not heard of a 300-600 pound or higher crossbow. Frankly, such a powerful crossbow built on today's

frame would virtually explode upon firing. I like seeing differing views on anything connected with hunting, shooting and gunsmithing.

Your comments reflect that of a thinking person that we need more of. Bruce Bibee Marlin Model 81 I have a marlin model 81 with a couple of issues. The first is the magazine tube is not retaining the rounds and they just fall into the stock. The second is it will not eject around. The extractor fit is good but I'm not familiar with the Marlin and can't figure out where the ejector is. The only schematic I have is the parts list in the Jack First catalog.

Samuel Garrison This rifle succeeded the Marlin Model 80 and was produced back in the 1930s. At that time, the ejector was a thin, single coil spring mounted on a base within the receiver. We believe the spring was later abandoned and replaced with a more formidable improvement but are not certain of when the change was made. As for the escaping rounds, the received end of the mag tube has likely outlived its usefulness and should be replaced. Call Brownells for a copy of their Parts Source List.

When it arrives expect your fingers to do a whole lot of walkin'.

READER FORUM CONTINUED

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Oblong Barrel A friend has a double barrel 12 gauge caplock muzzle loader. It looks like it has fallen on its right barrel and bent the first inch or so about 0.018 out of round. How can I fix this without spending a bundle on a tool from Brownells? You'll probably spend as much prep and time to equal the cost of the tool mentioned, but a mandrel the exact ID of the barrel can be used.

It initiates as a hard wood dowel or long, brass round and its end needs to be tapered to a lesser diameter with its extreme tip rounded. Insert that rounded end, well greased, into the barrel and tap it further in until the dent or bend has disappeared. You have to be really careful the mandrel doesn't get stuck in there. It would take a whole lot more than a worm, commonly used to extract an unfired ball from a smoke pole, to dislodge it.

Herters Model U9 I came across a Herters Model U9 rifle in .30-06 but can't find any assembly/ disassembly info for it. It's marked on the barrel "Herters Inc. Waseca Minn." and "Made in England and BNP" with a small circle with a line through it. Do you have any back issue that might cover this rifle or know of any book that would list it? Bill Katula Sr. Herters was active until 1980. The U9 was made in Yugoslavia. The J9 rifles were made in England. Both were Mauser action sporting designs.

The latter fact should be useful in your search for disassembly/reassembly as there are many books on Mausers. At least two are very specific regarding your needs, The NRA Guide to Firearms Assembly and The Gun Digest Book of Firearms Assembly/Disassembly: Part IV: Centerfire Rifles. We admit to being quite curious regarding your particular .30-06. To our knowledge, with the exception of the US-produced 1917 Enfield, the cartridge was never a favorite with European manufacturers.

It might well have been special ordered for export to Herters. Ruger Single Six I am working on a Ruger .22/.22WMR Single Six revolver (#62-03xxx) with a locked up action. With the cylinder removed the action can be worked with the exception that when the transfer bar rises into location it hits the firing pin and locks up all further movement. In addition, I have also observed that the during initial cocking of the hammer the cylinder latch does not lower, allowing the cylinder to rotate.

Because the arm on the cylinder latch extends up into the frame and action parts, I am unable to determine how the latch is engaged. I am not sure at this point whether I have one problem or two. C. A. Breese You can read of what we believe is causing your problem in an article on the new Ruger Single Ten, published here in December 2011. It involves reassembly of the base pin. The pin has a dished out section on its collar. When installed, this section must be adjacent to the bottom contour of the barrel.

The pin has to be fully inserted and locked in that position by the base pin latch. Otherwise, the transfer bar will encounter the firing pin and jam the action. Loose base pins are frequent culprits when Ruger single actions get stuck. What's really the matter is a matter of incorrect reassembly. Andrew Ciofani Marlin Camp Carbine Looking for a past issue schematic for Marlin Model 9 (Marlin Camp Carbine) in .45 ACP. I took it apart to clean and replace springs and have apart left over—never good.

John Mulhall Way back in 1992 we published one of our first disassembly/reassembly articles on the Camp Carbine. It was a 9mm Model but the .45ACP is mechanically the same. We don't believe reprints are available that far back but you can secure an owner's manual from Marlin. If you can't reach them in North Haven, CT, go to the Brownells website. They have downloadable schematics on it. AG

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