

AN ARDUOUS JOURNEY THROUGH THE LILLIPUTIAN WORLD OF LANDS AND GROOVES

BY IRV BENZION

The arduous journey through the “Lilliputian World of Lands and Grooves” started nearly three years ago. As the journey began it was believed to be just a short lackadaisical romp, but that belief was short lived. For as we proceeded, vast new vistas of knowledge appeared, taking one this way and that down the avenues of discovery. In truth this article was written, rewritten and rewritten again and again over a three year period as new advances in the chemistry of bore cleaning compounds appeared on the commercial market.

What made the pilgrimage possible was a Gradient Lens Corporation Hawkeye® Bore Scope. For the first time, the inside of a barrel became visible to the naked eye. For the first time, the smears on a dry patch did not have to be examined and evaluated — for now one could actually see if the rifling was truly clean.



Our instrument of discovery a Hawkeye® Bore Scope and our pot of gold, Slip 2000tm, and Bore Tech miracle products.

Our odyssey begins in the late spring, 2003. After check-firing a number of varmint rifles that were to be taken on a week long jaunt to Montana after prairie dogs, the tedious job of cleaning was begun. Glancing up from the eye piece, and turning towards Moe

Scharhon, one of my shooting and hunting partners, I remarked in an exasperated tone, “It’s still not clean!” Our accepted routine of cleaning had

been performed, but smears of copper and layers of black carbon still remained visible in the rifling.

My involvement in the cleaning of firearms is not due to enamored interest in the process, but due to a desire to make the rifles shoot as accurately as possible. For me, shooting is fun — cleaning is work! So the best — read that the fastest, and easiest way to clean a firearm — is the true goal.

A Hawkeye® Bore Scope had been sent to me for evaluation by Ken Harrington, Gradient Lens' Reseller Manager. I was so impressed by that first encounter with the Bore Scope at the range the following day a call was placed and credit card numbers were given. I simply had to own one. To say that the Hawkeye® has excited my imagination and lent a desire to let others know what a superb addition it is to any shooter's collection of cleaning implements is a major understatement.

Returning from the Montana hunt, the rifles were set aside, as an extraordinarily fine summer concluded in the Pacific Northwest, and family involvements intervened. The "dog" rifles sat beckoning, so with the coming of the fall rains, and the recruiting of Moe and my other hunting partner, John Barnett, a plan was developed to determine the effectiveness of every bore cleaning solvent we could lay our hands on, and to reevaluate the techniques used in the cleaning process.

The battery of rifles waiting to be cleaned consisted of five .223s, four .22-250s, two .220 Swifts, and a 6mm Remington, most having been shot between 200 and 300 times. There were exceptions of course, as two of John's rifles topped the "dirtiness scale" with over 1200 fired rounds fired, each. Also to be cleaned was a semi-automatic belt fed .308 Browning 1919A4 that had had over a 1000 rounds down its tube at a rate which made the barrel shroud way too hot to touch.

The regimen decided upon was to first wet the bore with two patches soaked with one of the many name brand petroleum based bore cleaning solvents on hand. That was followed by a 50 to 75 strokes with a bronze brush, after which the solvent was allowed to stand for 5 minutes. Finally the bore was dry patched. Then each bore would be checked visually with the Hawkeye®.

If copper was found to be present, a couple of patches soaked in copper solvent would be pushed through the bore and the rifle set aside for five minutes to allow the solvent time to work. If instead the inspection showed a evidence of carbon fouling, the bore cleaner was reapplied. The process would be repeated as many times as necessary, depending on which type of fouling was found lingering in the bore. In some cases, as many as ten repetitions were necessary. When it appeared that all of the fouling that could be removed chemically was removed, J B's Bore Cleaning Compound was applied to a used bronze brush and was scrubbed back and forth in the bore 50 to 75 times. At which time bare metal would usually appear.

As can be seen, to get a firearm's rifling truly clean is real drudgery!

After the cleaning gala was concluded, curiosity continued to nag at me to persevere in the search for new chemicals that would make cleaning a rifle a lot less work. In the months following the three day cleaning jamboree a plan was conceived. In January the SHOT SHOW (Shooting, Hunting, and Outdoors Trade Show) would be attended with the mission to solicit every new cleaning solvent found for testing.

But first let's discuss the unit that provided the venue to enable the discoveries of our miniature land to become evident.

The Hawkeye® Precision Borescope

The Hawkeye® model that was purchased was the 17 inch deluxe version, complete with angle eyepiece and carrying case. Although one can get along without the angle eye piece, its use eliminates the necessity of bending over or squatting down to align the eye with the borescope and hence the bore's axis. To be able to stand upright and see the rifling of a firearm one is cleaning is well worth the angled eye piece's added expense. The angled eye piece is easily attached to the Borescope body by merely pulling back on the finger grooved ring and snapping it into place.

The Hawkeye® consists of three components: the body which has an eye cup that adjusts so that the image can be brought into focus and to which is attached a slender metal tube. The metal "optical" tube serves two functions; it transmits the image to the eye piece and, at the same time, transmits light forward to illuminate the interior of the bore.

The second component is a hollow metal “mirror” tube which contains a very small mirror on one end and a knurled knob on the other. The “mirror” tube is simply slipped over the “optical” tube on the body and by rotating the knurled knob on the mirror tube, the reflection in the mirror permits examination of the top, bottom and sides of the rifling at any point in the barrel. The knurled knob is notched relative to the position of the mirror so the comparative position of the rifling can be determined.

Protruding at right angles from the body is the attachment point for a light source. The standard light source is a modified Mini-Maglite®.

As stated by Ken Harrington, a word of caution is in order, these two tubes can be bent if not supported when inserting them into the bore and the little mirror can be broken if dropped or slammed against something hard. This is not to imply the unit is not sturdy, for it is, but care must be taken with this expensive, quality instrument.

Both the eye cup on the body and the angled eye piece can be adjusted to focus the unit. In practice the main focus on the Hawkeye® body was adjusted first, and then the adjustment tube of the angled eye piece was turned to produce a crystal clear image.

With the light source attached to the Hawkeye®, new panoramas are opened to the shooter — magnified 25 times. The sharpness of the edges of the lands were apparent, as were minute pits filled with carbon fouling found in one newer barrel. When looking forward from the lead to the muzzle on a well shot rifle, one might see the rounded edge of the lands slowly become square and sharp. Some barrels displayed tiny cuts and abrasions, both horizontal and vertical to the lands; a result of the rifling process. With little effort one can differentiate between an expensive barrel and one of lesser cost as the former’s bore is smoother with razor sharp edged lands. Fire crazing of a bore caused by hot powder gases that occurs after repeated firing and which acts as a collecting point for copper fouling was clearly evident in one rifle. (See Figure 1). In other rifles, fire crazing was observed starting at the lead and included the first couple of inches of the rifling making one surmise that this effect starts at the chamber end of the barrel and works forward. The condition of the chamber, as well as the throat, can be observed, and for the first time the very edge of the crown

can be checked — from inside the barrel.

Two types of fouling

To understand the panorama that unfolds through the Hawkeye's® eyepiece a shooter must first understand what fouling is. Basically there are two types of fouling; carbon fouling which is the result of the propellant gases created by the burning of the powder, and the smearing of copper based jacket material deposited on the rifling as the bullet proceeds down the bore.

Layers, they really do exist!

The borescope clearly proved the fouling occurs in layers. During the cleaning process one could observe a bright layer of copper which, when removed, revealed a black layer of carbon. When the carbon layer was eliminated, yet another layer of copper became visible.

It can be hypothesized that the abundance of “one step” cleaning products are a result of the purchasing choices of the shooting community who want a simple, effortless, no fuss cleaning procedure. Unfortunately, most of the combination carbon/copper cleaning solvents tested did not work as well as products designed to remove a specific type of fouling. If the product removed carbon it was usually not very effective on the copper, and vice versa.

It also saddens me to report that regardless of the current avalanche of advertising “hoopla” and the endorsement by some “big name shooters,” most gun cleaning solvents that claim to remove carbon do not work at all, or are only marginally effective.

The problem of course is how can an individual determine which of the myriad of commercial products available in the market place are effective? Without a Hawkeye® Bore Scope one can't!

What do you see through a Hawkeye®?

The first look at a fouled bore through a Hawkeye® yields a murky image, as if the rifling were being viewed through a veil of thin smoke or the bore had been smeared with a gray colored charcoal drawing pencil. An example

of a smoky visage is seen in Figure 2. Also visible in Figure 2 are light strips of copper fouling found in the corners of the grooves, and a thin coating of copper on the tops of the lands. This bore is only lightly fouled, having had only 20 or so rounds fired through it.

After the first cleaning cycle the smoky overlay is gone and, although the bore is still dirty, it has a sheen to it that can be seen in Figure 3. Additionally, Figure 3 is an excellent example of where powder fouling is interspersed with, and in some instances under the copper fouling. Note the dark, almost black, color of the multiple layers of carbon contamination, which suggests that if further shots were fired the color of the carbon build-up would darken. Also take notice of the heavy deposits of copper bullet jacket material on the right side of the photograph.

To really understand how much can be seen through a Hawkeye® borescope, examine Figure 4 closely. Pictured are examples of exceptionally dirty barrels from the 2004 Montana varmint expedition. The first three images display examples of heavy carbon fouling obscuring underlying copper layers. The fourth image is the interior of a Browning 1919A4 semi-auto barrel laden with copper after over a thousand rapid-fire rounds had been shot. Bore Tech's new copper solvent, Eliminator was applied to the 1919A4 barrel, and all the copper seen was removed with just two applications (see section on Copper).

A heavily fouled bore is exhibited in Figure 5. This close-up shows both copper and carbon fouling spread evenly over the lands and grooves. Notice that the fouling is not built up in a specific area as in Figure 2, but is the precursor to the total black bores shown in Figure 4 which undoubtedly would occur if additional shots were fired.

And finally eureka, a completely clean bore that shines brightly from the top of the lands down to the bottom of the grooves (Figure 6). This barrel is squeaky clean! The dark area at the top of the image is caused by light reflection.

Carbon fouling

Carbon fouling is extremely difficult to remove since it is insoluble and must be eliminated by either abrasion or by the use of surfactants and

detergents. The way surfactants work is to reduce surface tension and through a chemical electrical charge which breaks the bond between the carbon and the bore's steel, thus allowing the carbon fouling to be lifted free.

A prime example of how surfactants work is dishwashing detergents. A dish is immersed in soapy water and the detergent reduces the surface tension between the crusted food and the plate and with a swish of a sponge or dish cloth the plate comes clean.

The efficacy of a bore solvent which claims to remove carbon is a function of the efficiency of its surfactant components. (Bore solvent is an oxymoron, since carbon does not dissolve.) Most petroleum based cleaners use thin oils such as kerosene or penetrating oils hoping the oil will get between the carbon and the steel bore. The results of our tests proved that most brands of petroleum based cleaners do little or nothing to aid in removal of carbon fouling.

As in "doing the dishes" a little mechanical agitation (brushing with a bronze brush) is required to effect the carbon separation from the steel and to add oxygen to help activate the cleaner. A number of the combination carbon cleaner/copper solvent manufacturers are now recommending nylon brushes as a substitute for bronze brushes for this function. The reason for this change of position is that they have received numerous complaints from customers that the copper remover part of the solvent rapidly eats up bronze brushes requiring frequent brush replacement. In my experience nylon bristles are not stiff enough to provide the appropriate level of agitation needed for carbon removal.

Before the borescope allowed close observation of the interior of the barrel, it was my belief that brushing a bore was similar to using a wire brush on a rusted piece of metal — the carbon fouling in the bore would be stripped out by a bronze brush as if it were the rust. Not so! Scrubbing serves two purposes, in that it loosens the amount of carbon fouling released by the surfactants while at the same time allowing the solvent greater access to further fouled surface area.

Perhaps the greatest error most shooters make is patching out the bore after

brushing without allowing any time for the solvent to do its job. To emphasize this very important discovery let me restate it — a one must allow sufficient time to for the chemicals in any bore cleaner to work. Applying a solvent, brushing and then quickly patching it out is a waste of solvent, patches and elbow grease!

Marvels of modern science

The trip to the 2004 SHOT SHOW had yielded samples of two new bore cleaners; Hoppe's Elite Gun Cleaner and Bore Tech's Carbon X. A major technological break-through had taken place, yet surprisingly little had been published about them. It was the discovery of surfactants that would remove carbon, and when combined with detergents into water based compound, have in my opinion, created a whole new generation of bore cleaners.

For the first time there were carbon removers available that would actually dislocate the layers of carbon fouling! Both of the "Elite" and "Carbon X" were far, far more effective carbon removers than any of the petroleum based products previously tested. Another important feature is that these two products are odorless, non-toxic, and biodegradable.

Returning from the prairies of Montana and South Dakota both "Elite" and "Carbon X" were used to clean our well shot rifles. As before, two patches soaked in the new bore cleaners were pushed through the bore, and then each bore was scrubbed with a bronze brush for 25 strokes. The rifles were then set aside to allow the bore cleaner chemicals to work for about 20 minutes. It was ascertained by testing that there was no advantage to extending the barrel "soaking" time beyond a 20 minutes.

Although "Elite" and "Carbon X" were a major leap forward in reducing the effort required to remove carbon fouling, they still required five to seven cleaning cycles to get a bore clean. Still no magic bullet!

The Pinnacle

With the coming of winter in the Northwest there was time for reloading next year's supply of ammunition and catching up on my reading of the stacks of magazines which always seem to accumulate. So one rainy, blustery day after the New Year (2005) an ad was spotted in a magazine for

a product named Slip 2000tm's Carbon Cutter that claimed it would remove carbon easily. The following day a phone call was placed to purchase some of this "magic elixir." As luck would have it the call was made around noon, so instead of speaking to a receptionist, the owner of the company Gregg Conner took my call.

I told Gregg that I wished to purchase some of his company's products and explained that their attributes could be part of an article I was writing — if they lived up to their advertising. Gregg graciously offered to send a sample as he wanted to have his company's products included in our ongoing investigation.

Let me state unequivocally that Slip 2000tm's Carbon Cutter is the product which stands at the pinnacle in its ability to remove carbon fouling from gun barrels. At last there was a product that actually performed as claimed — it really and truly removes carbon!

In just one or two regimens it removed carbon deposits from moderately fouled bores down to bare metal. Used in conjunction with Bore Tech's Eliminator Copper Cleaner on heavily fouled rifles, the sight of shinny lands appeared within two to four regimens.

To show just how efficient Slip 2000tm's Carbon Cutter is, the AR-15 bolt from John Barnett's rifle which had over 3200 rounds fired through it was immersed in a jar of Slip 2000tm's Carbon Cutter for 20 minutes. Before the immersion of the bolt in the Carbon Cutter several of the most common and popular cleaning solvents in turn were applied. In each case none or very little of the carbon adhering to the bolt was removed.

Barnett's AR-15 bolt was crusted and coated and appeared as if it had been dropped in wet thick mud and allowed to dry. But in this case the mud was carbon. Upon removing the bolt from the jar of Carbon Cutter, the caked on carbon flaked off when rubbed with nothing more than a paper towel.

Another test of the efficacy of Slip 2000tm's products was the immersion of the gas piston from a Beretta 390 shotgun and a Browning Invector Plus choke tube. Again, the petroleum based cleaners were tried on the piston, to no avail. After waiting 20 minutes the piston was removed from the jar of

Carbon Cutter and the fouling was simply removed with a paper towel. As shown in Figure 7, the piston was shiny right down to its plated surface.

But yet another surprise awaited! The application of a bronze bore brush to the inside of the Browning choke tube easily removed the accumulated plastic wad material clinging there.

In one heavily fouled varmint rifle it was observed that deep within the rifling at the junction where the lands and grooves met there lurked a final thin layer of burnt on carbon. Although the rest of the bore was bright metal that final layer of carbon stubbornly refused to be removed chemically. An application of J B's Bore Cleaning Compound (available from Brownells) on a well used bronze brush was applied to finally eliminate the problem.

To answer the obvious question — a test was arranged to find out how the abrasive qualities of J B's stack up against Slip 2000tm's Carbon Cutter? Even after five applications J B's failed to get a rifle's bore down to bare metal. In my opinion Carbon Cutter had won the contest "hands down," but J B's was invaluable in the removal of that last stubborn carbon clinging to the corners of the grooves where chemical removal proved to be inadequate. It would seem logical to apply chemical removers first and only use an abrasive such as J B's to remove what the chemicals could not.

In a subsequent phone conversation with Gregg Conner, the question was raised that in his company's literature it was noted that two products, Carbon Cutter and Gas Piston Parts and Choke Tube Cleaner looked identical and were priced the exactly the same. Gregg told me that I had guessed correctly and that the two products were the same but were being marketed under different labels. It seems that Gregg, besides owning an industrial chemical company is a shotgunner and the original product was developed to clean his shotguns and chokes. Gregg further explained that the reason for the two labels was that the U.S. military and many law enforcement agencies, who are now customers, would be a little skeptical of a product labeled for cleaning shotgun gas pistons and choke tubes would work well on cannons, assault rifles and machine guns.

Lubricants

A fact to be cognizant of is that all of the new generation of carbon fouling removers are water based and are so proficient that they completely strip all imbedded oils from any metal they come in contact with. Therefore, when the carbon/copper removal phases are completed it is extremely important to apply a protective lubricant to the firearm to prevent the possibility of rusting. Notice should be taken that the word lubricant was used instead of oil. Here too there has been a major breakthrough in chemical technology that is superior to most of the petroleum-based products used by shooters.

Slip 2000tm's Gun Lube is a synthetic, biodegradable, non-toxic lubricant. Unlike petroleum based oils which have a flash point of about 200 degrees, Gun Lube's flash point is over 2000 degrees. What does that mean? It means that when used as the lubricant on the bolt of an AR-15, the lubricant does not burn off when the rifle is fired.

Additionally, Gun Lube does not combine with carbon to gum up and form sludge or crusting, it also does not collect common dirt, turning it into grime. Perhaps the most important gain from Gun Lube is that it enters the pores of the steel and makes future cleaning even faster and easier. This was verified by one of our tests. An AR-15 whose bore had received a coat of Gun Lube cleaned to bare metal using Slip 2000tm's Carbon Cutter in only one regimen, this after having 80 rounds fired through it.

Copper

Copper fouling is far more easily removed than carbon fouling, as it can be dissolved in a solvent. An analogy of that would be the dissolving of a teaspoon of sugar in a cup of hot coffee. Presently, most of common copper removers contain ammonia in strengths between 2 and 7%. Ammonia is effective, but it is also a toxic chemical, has an unpleasant odor, and can cause skin irritation.

Again, a new generation of solvents has been recently introduced that are vastly more efficient, are biodegradable, non-toxic and odorless; something many spouses will undoubtedly appreciate.

My first choice for a copper remover is a product from Bore Tech named "Eliminator" which puts ammonia based products in about the same class as buggy whips.

After passing an Eliminator soaked patch down a fouled bore for the first time, the patch showed a suspicious, tell-tale light blue-green color indicating the presence of copper fouling. In my experience, a blue-green color rarely appears by simply passing the first “wetting” patch of a copper solvent through a bore. Normally, a period of time has to elapse to allow the copper to dissolve before a subsequent patches display the revealing color.

My immediate reaction was that the color on the patch was a reaction between the Eliminator and the brass jag. The brass jag was replaced with a steel one to eliminate that variable, (something repugnant to the maintenance of fine rifle barrels); still the evidence of continued copper removal appeared. Eliminator solvent started doing its magic at once!

The correct way to use Eliminator is to push two successive wet patches down the bore, then allow the chemicals in the solvent an interlude of time for them to do their work. It was found that about 15 to 20 minutes on a heavy concentrate of copper was normally adequate. It was also discovered that brushing was not required as all of the agitation necessary for activation could be supplied by merely pushing the application patch back and forth down the bore

“Eliminator,” which contains no-ammonia, hence has no odor, is biodegradable, does not affect the skin, and is in my opinion the most efficient copper bore cleaner yet developed.

Summing Up

For the collector, varmint hunter, or accuracy shooter, a Gradient Len’s Hawkeye® borescope is an indispensable tool. Its introduction allows visual inspection of a bore to see if it is clean and to monitor its condition. After all the years of cleaning firearms, of scrubbing, of swabbing and brushing, now for the first time the condition of a bore can actually be clearly viewed. The Hawkeye® is not inexpensive, depending on model and accessories, the price ranges from six hundred to seven hundred and fifty dollars, about the price of a fine rifle. A borescope’s value lies in that it is not only a cleaning accessory, but it also allows one to check the bore of a used firearm before purchase.

Without the Hawkeye® the discovery of the effectiveness of these new carbon and copper removers would never have been possible. These new cleaning products really do work!

The question might be raised, "What were the other products that were tested?" The names of the myriad other products used in this study have been purposely omitted since Bore Tech's Eliminator, and Slip 2000tm's Carbon Cutter and Gun Lube were clearly far superior to all other products tested.

In the course of this trip through the Lilliputian World of Lands and Grooves, the Rangemaster at my home range, after having seen the borescope in action, asked me to return with the Hawkeye® to inspect a barrel he had at home, which he believed to be rough. During my return visit a few days later, as the barrel was being examined in the clubhouse, an experienced, elderly shooter observed our machinations with mild indifference.

The gentleman then began to expound on his personal cleaning methods and stratagems. He related that he cleaned his rifles immediately after firing and then re-cleaned them the next day and again a week or so later. He said that his method of cleaning had been used for a number of years, and that he knew all of his rifles were clean! He then said that he didn't see the need to spend a lot of money on an expensive gadget. And with that last remark walked out of the door with the wave of a hand in farewell.

A few seconds latter we looked up as the door was opened and this same individual returned, this time carrying a pre-64 Model 70. "Would you check the bore on this for me?" he asked.

"Sure, glad to," I replied.

Inserting the bore scope, I asked, "Has this one been cleaned?"

"Yes, it was not shot today so it is clean," was his reply.

"Well you better come take a look then," was my answer, as the bore was pitch black and the lands were covered with a heavy layer of copper.

The gentleman raising his eyes from the eyepiece and with frown covering his face said, "Where can I buy one of these?"

As was related early on in this article, after trying the Hawkeye® just once at the range, I had to own one too.

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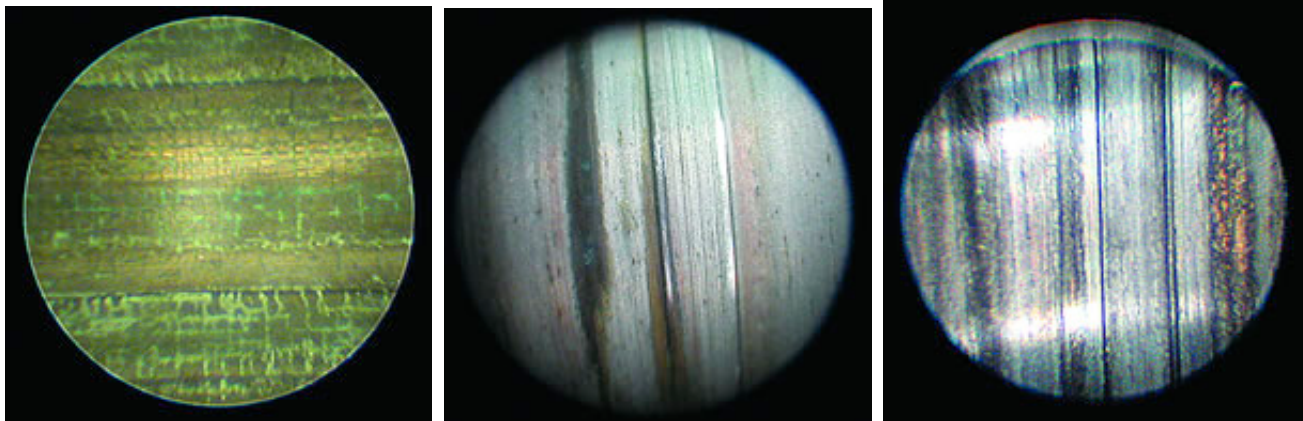
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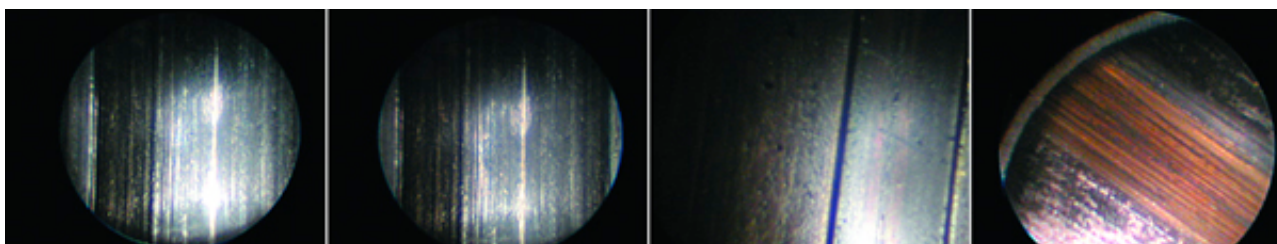
200 South Front Street
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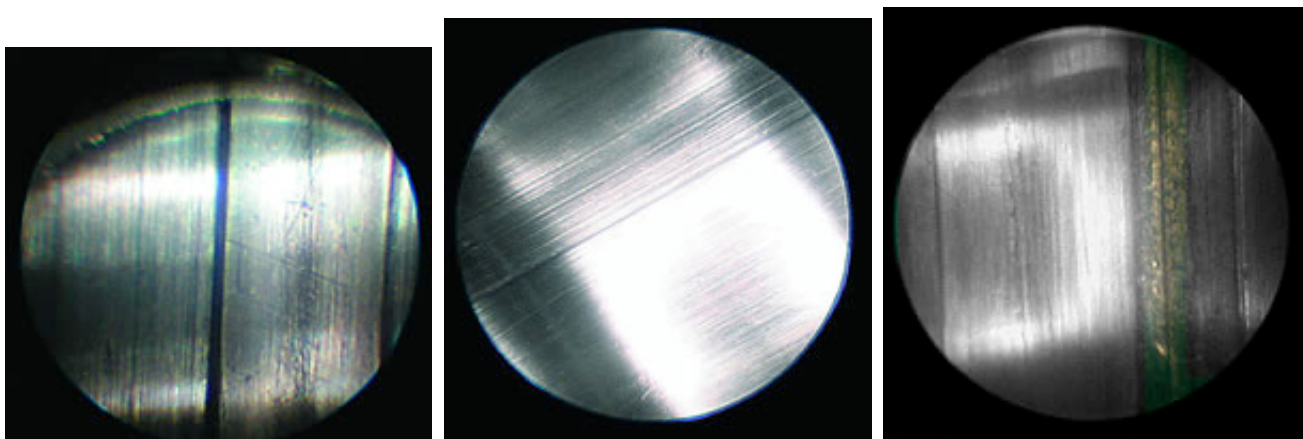
(Figure 1) Fire crazed markings covered with copper appeared in this well shot Remington BDL.

(Figure 2) This lightly fouled bore looks like it is being viewed through veil of smoke.

(Figure 3) Strips heavy carbon fouling are evident on the left and a band copper fouling is seen on the right.



(Figure 4) Notice black color of first three pictures and the underlining copper tint. The lands and grooves in picture four depict excessive copper fouling after 1000 rounds.



(Figure 8) Copper fouling hiding

(Figure 5) A heavily fouled black colored bore with scratches on the lands

(Figure 6) Eureka, a squeaky clean bore.

deep down within the lands of a partially cleaned bore. Something that could never have been spotted without the aid of a Hawkeye® bore scope.



(Figure 7) From carbon coated to clean in one easy step with Slip 2000tm's Carbon Cutter.