The Study of Gunsmithing



Sonoran Desert Institute

MODULE NUMBER 6

Metal Polishing, Refinishing, and Engraving



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Special contributor: Lee Shaver, Gunsmith

MODULE NUMBER 6

Metal Polishing, Refinishing, and Engraving

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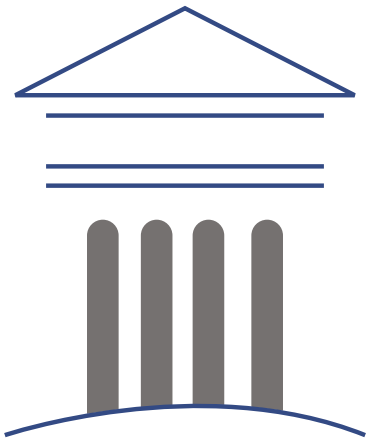




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Beautifully engraved handgun by Bruce A. Gleason from the Firearms Engravers Guild of America.

Objectives

After completing this lesson, you should

1. Be familiar with hand and power polishing and mass finishing.
2. Know how to cross-polish.
3. Understand how to draw file a barrel and receiver.
4. Know how to hold screws for polishing.

Introduction

The quality and beauty of any gun finish depends a great deal on the preliminary preparation of the steel before the finish is applied. Metal coloring will not hide pits and blemishes, which will only be colored and, in many cases, will show up even more once the bluing or other finish has been applied.

Ideally, gun metal — whether new or refinished— should retain the original contours, comers, and planes, with no rounding of sharp edges or loss of outline and serial numbers. Care should be taken so that screw holes will not be funneled or otherwise disfigured during the polishing process. The texture of the steel should be smooth and even and show no tool marks, nicks, or polishing scratches.

There are four popular methods of finishing gun metal prior to bluing, plating, Parkerizing, and the like: hand-polishing, power buffing, mass finishing, an sandblasting. Of the four, the beginner should stick to the hand-polishing methods until they are thoroughly mastered. Then, and only then, should the beginner think of using a power buffing wheel on a firearm. Practice on some scrap pieces of metal. Power buffing is encouraged, but not until sufficient experience is gained to ensure a good polishing job without changing the contours of the metal being polished.

GUN METAL FINISHES THROUGH THE YEARS

Metal refinishing seems to be the most critical task involved in restoring valuable firearms. Engravings, sharp corners, and lettering can be obliterated in seconds with a power buffing wheel if you are not careful. Deep pits in metal are difficult to remove without altering the original shape or removing some of the original markings. The methods that were used to color gun metal varied from era to era. To get an authentic finish, you must know these methods. Listed below are brief descriptions of the bluing methods used on firearms for the past 100 years.

Slow Rust Bluing. Around the early part of the nineteenth century, a modified browning process came into use that resulted in a blue-black finish, illustrated in Figure 1. This modified finish became known as bluing in the United States.

The earliest bluing solutions consisted of a mixture of nitric and hydrochloric acids with steel shavings or iron nails dissolved in them. The process used in applying the solution to the gun metal is generally known as the *slow rust process*.

In general, the slow rust process consists of polishing the metal parts to be blued to the desired luster and then degreasing the parts by boiling them in a solution of lime and water, or lye and water. Without touching the metal parts with the bare hands or otherwise letting them become contaminated, the metal is swabbed with the bluing solution in long, even strokes until all parts are covered. The metal is then allowed to stand and rust from 6 to 24 hours. The rust that forms is removed, or carded, with steel wool or a wire brush to reveal a light gray or bluish color underneath.

The surface, still free of oil, is again swabbed with the solution and allowed to rust another day. When this second coat of rust is carded, the metal beneath reveals an even darker shade of blue. The process is repeated until the desired color is obtained, which usually takes one to two weeks. Then, the parts are boiled in water for about 15 minutes to stop further rusting, and then oiled. The result is a beautiful, long-wearing gun finish, illustrated in Figure 2, that is still admired by collectors of high-quality firearms. However, the time required for this process makes it impractical for the average gunsmith unless it is used on a high-quality, double-barreled shotgun which would make the extra hours and cost worthwhile.

Hot Water Bluing. The time required to obtain a perfect finish on a firearm by the slow rust process forced gunsmiths and manufacturers to seek a faster and easier process. The process developed has been called many names, such as *20-minute bluing, express bluing,* and the like, but *hot water bluing* is the generally accepted term.

Hot water bluing developed from the idea that steel rusts more rapidly when it is heated due to the absorption of oxygen. As a result, a chemical formula was developed for rusting gun metal. In the hot water bluing process, the metal is polished and degreased. Next, the metal is heated in boiling water. After 5-10 minutes, the metal parts are removed from the water and allowed to dry. The parts dry almost immediately due to the heat of the steel. The bluing solution, often heated, is then applied to the hot metal in long, even strokes. Rust forms at once on the metal. Before carding, the parts are again put into the boiling water for five more minutes. The first carding usually produces a light gray color on the metal parts and each successive coat deepens the color until it is a dark, blue-black color. Depending upon the metal, it can take anywhere from 4 to 12 coats to obtain the desired finish.

Hot Caustic Bluing. Around the turn of the century, the black oxide process of bluing was patented. Although it did not gain popularity in the firearms industry until later, it is now used in practically every gun shop and by every firearm manufacturer in the United States. Once the parts are polished and cleaned, the metal is boiled for 15-30 minutes in an alkaline solution. Hot caustic bluing works exceptionally well on a wide variety



***Figure 1**: To restore the original finish on this Evans deluxe lever-action rifle, you will have to use the slow rust bluing process.*



Figure 2: *This Savage Model 1912 rimfire single-shot rifle is another firearm that was originally finished with the slow rust bluing method. In fact, almost all firearms manufactured during this time period were slow-rust blued.*

of steel. Another advantage of this method is that a large number of guns that can be blued at one time, depending upon the size of the tanks and the heating facilities. This method, however, cannot be used on all guns. Older firearms, like the one in Figure 3, can be damaged by the heat.

Bluing salts were introduced in dry form in the mid-1930s. When mixed with water, the salts formed a bluing solution that was then applied to the gun metal. Black oxide salts are still available today, manufactured as "Oxynate 7."

Carbonia Bluing. In the early twentieth century, Colt, Smith & Wesson, and some other firearms manufacturers, produced a bluing method known as the *carbonia process* which produced a bright, mirror blue finish, as illustrated in Figure 6. The parts to be blued were suspended on rods inside a large, metal container. The container was partly filled with a special chemical in powdered form, and heated to 700˚F while it was being rotated. As the powder fell onto the hot metal surfaces, a brilliant blue formed, considered by some to be the finest in the firearms industry. However, the process is complicated and requires considerable expense to set up. In addition, it is more dangerous to use than most methods. As a result, the carbonia process is fairly obsolete.

Parkerizing. To obtain a more durable finish than bluing, the military used a process, beginning with its Springfield 1903 service rifles, called *Parkerizing*. The process consisted of boiling the parts to be finished in a solution of "Parko Powder," composed of specially prepared powdered iron and phosphoric acid. During the process, small surface particles on the parts are dissolved and replaced by insoluble phosphates which are rust-resistant. The resulting finish is a gray, non-reflectant surface. Though this is less attractive than the color resulting from bluing, the hue is more practical from a military standpoint because it camouflages the gun by not reflecting light.

Plating. Nickel plating has been a popular finish for handguns and certain small parts of long guns since the turn of the century. The finish is applied by a process called *electroplating*, in which an electric current is used to deposit the nickel onto the steel surface. The steel part to be plated is suspended in a solution containing a high concentration of nickel along with a bar or sheet of pure nickel. The negative wire from a battery or other source of direct current is connected to the steel part (making it the cathode) and the positive wire is connected to the nickel bar (making it the anode). By carefully controlling the current, the nickel in the solution is deposited onto the steel. At the same time, an equal amount of nickel is removed from the nickel bar to replenish the amount taken out of the solution.

Case-Hardening. Case-hardening is the process by which soft metal parts of iron or steel can be hardened to make them more durable and wear-resistant. When these parts are properly case-hardened, the surface resists wear even better than tempered tool steel, while the soft, tough metal inside provides strength.



Figure 3*: If you used the hot caustic bluing method on this J.P. Sauer shotgun, chances are the barrels would become unsoldered. Use either the hot water or slow rust bluing methods on all old double-barrel shotguns.*

Color case-hardening, which adds patterns of color as well as strength, is accomplished by heating the metal in a cast-iron vessel containing carbonaceous materials until it turns a cherry red color. The metal is immediately plunged into cold water. The process continues, alternating the hot and cold treatment until the desired hardness is achieved. Years ago, pulverized bones, hoofs and horns of animals, and soot were often used as an additive. Today, bone meal is frequently used. These substances change the structural formation of the metal and bind the fibers into a fine-grained mass.

SELF-TEST QUESTIONS

Please check your answers on page 19.

1. ***True or False*. The value of any antique gun will increase if it is refinished.**
2. **What is the name of the bluing process used to blue Smith & Wesson revolvers prior to World War II?**
3. **What are the two bluing processes that are generally accepted when bluing early double-barrel shotguns?**
4. **Which bluing method should definitely not be used to blue soft soldered, double-barrel shotguns?**

Basic Polishing

Beside keeping the metal surfaces free of oil, polishing is the most important step in obtaining a rich, velvety finish on your gun parts. Without proper polishing, you might as well forget bluing the gun and leave it as is. The coloring of the metal will never cover up pits, scratches, and the like. The surface of the metal must be perfect before the bluing solution is applied. Nothing else will do.

Many professional shops use power tools for buffing or polishing the metal parts. However, it takes lots of experience and practice to do a good job of power polishing without rounding sharp comers or damaging screw holes. The beginner should stick with hand-polishing, which will ensure that all contours, lettering, markings and square edges will be properly preserved. It takes about 12 hours to hand-polish all parts on the average rifle or shotgun. If many pits are present, it could take much longer.

Roy F. Dunlap points out in his book, *Gunsmithing*, that a hand-polished gun looks better than a power-polished one since corners and angles can be maintained with no loss of outline. An excellent final finish can be obtained on metal when hand-polished to a high degree of smoothness. Metal polished by power to the same degree of finish before bluing will not turn out as well.

The first step is to disassemble the gun completely. If you are unfamiliar with the takedown procedure, exploded views and instructions are available from various sources for most firearms. When you have no printed instructions, jot down notes as you disassemble the gun and perhaps take close-up photos of intricate parts. Then you will have some reference to follow when you are reassembling the firearm.

Wipe the parts clean, examine each for wear, and ensure that no aluminum alloy parts are present. This can be easily determined by using a small magnet. If the magnet doesn't react, then the part is nonferrous — aluminum, brass or similar alloy — and these parts should be set aside with others not to be blued. Besides the nonferrous parts, other parts not to be blued will include springs and other small elements not visible in an assembled gun.

With all pieces to be blued in one pile, thoroughly clean each one with a solvent, such as acetone. Then clamp the barrel or barreled action in a padded vise. Be careful that you do not clamp down too hard and damage the gun parts.

If some of the parts have pits, nicks, or scratches that are too deep for the abrasive paper to remove, use a 10" bastard file to smooth all metal surfaces. With the tang of the file in the left hand and the tip in the right hand, draw the file toward yourself over the metal surface to be smoothed as shown in Figure 4. *Draw polishing* is used to produce a very smooth and true surface. To draw file, hold the file at right angles to the direction of the strokes. Draw filing keeps any polishing related scratches or undercuts in the line of draw.

The amount of pressure you use on the file is very important; too little will scratch the metal, while too much will clog the file and cause deep gouges in the metal. On the return stroke, do not let the file touch the metal; cutting should be done only on the draw stroke. In other words, with the file positioned at the most distant spot on the barrel, draw the file smoothly toward you, using enough pressure to smooth the metal without scratching it. At the end of the stroke, lift the file from the metal and arc it back to its starting position, then use pressure and draw the file toward you again. Repeat this procedure until all pits and scratches are removed. However, you must be careful not to take off too much metal, especially on thin shotgun barrels and locking points on receivers.

The barrel is now ready for cross-polishing to remove the many "flats" that will be left after draw filing. With a pair of scissors or a bench knife, cut a strip of 80-grit abrasive paper about 1½" wide and polish the barrel as though you were shining a pair of shoes, as shown in Figure 5. Your first few strokes will reveal the flats left by the draw filing. Continue this operation over the entire length of the barrel with the 80-grit paper until all of the flats disappear and the barrel looks like it has just been

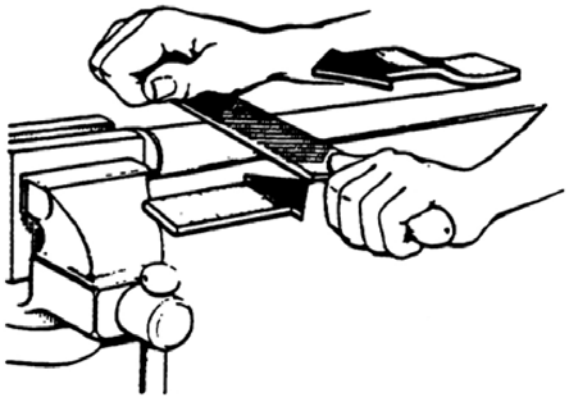


Figure 4: *Draw filing will quickly remove pits from gun parts, but caution must be taken not to scratch the metal surface or take off too much metal.*

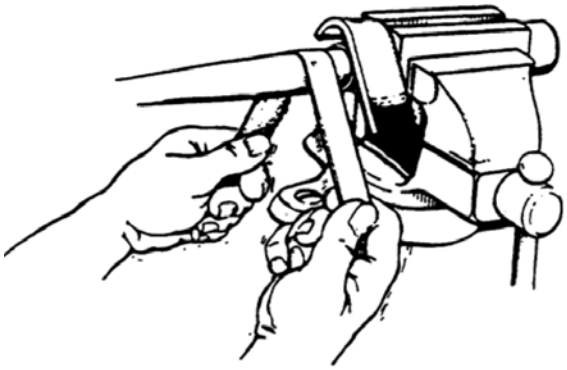


Figure 5: *Use 80-grit abrasive paper to remove the flats left by draw filing. Notice that the barrel polishing procedure is similar to shining a pair of shoes.*

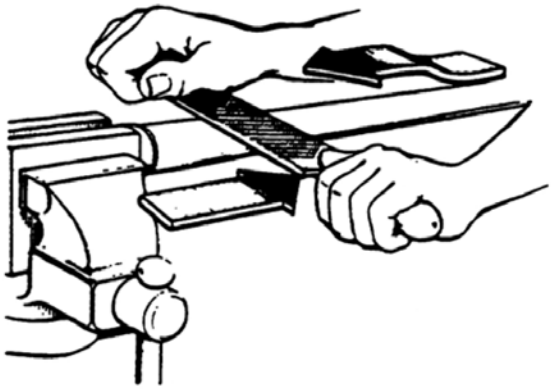


Figure 6: *Method of folding abrasive paper for draw-polishing. Styrofoam back is sometimes used because it will mold to the contour of the barrel or gun part.*

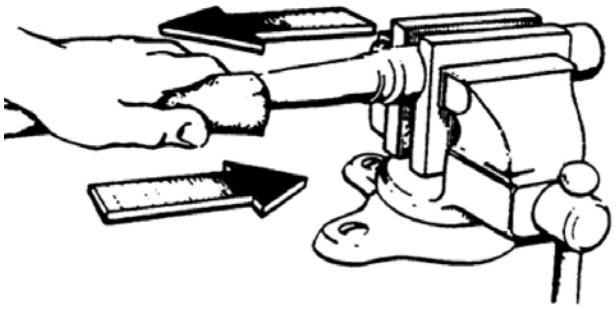


Figure 7: *When draw-polishing, move the folded abrasive paper back and forth, up and down the barrel to remove the marks left from the previous cross-polishing.*

turned in a metal-turning lathe. You may have to use several pieces of the abrasive paper to achieve this polished condition.

Next cut a 1½" strip of the 150-grit paper and fold it a couple of times so that it fits the palm of your hand as shown in Figure 6. With the open edges parallel to the bore, start polishing the barrel lengthwise (Figure 7). Continue polishing in this manner until all cross-polishing marks from the previous operation are removed. Instead of the palm of your hand, some gunsmiths like to use Styrofoam as a backing for the abrasive paper; the Styrofoam will mould to the contour of the barrel.

The above procedures should be repeated, using progressively finer grits of abrasive paper. Make sure all polishing marks from the previous polishing are removed before proceeding to the next finer grade of paper, and in a different direction than the preceding step.

Once the barrel has been polished, its position in the vise should be reversed and the receiver polished in a similar manner. Make certain that the newly-polished areas are well protected from the vise jaws; heavy leather padding offers good protection. Then continue with the trigger, lever or trigger guard, and the like. Because of their shape, most of the smaller parts will be most adaptable to cross-polishing. Just be sure that all polishing marks from the previous grit size are completely removed before using a finer grit size.

Protect all of the newly-polished surfaces from rusting with a light coat of oil until you are ready to apply the bluing solution.

Screw heads are best polished by securing them in the chuck of an electric drill or drill press. While the screws are rotating, run a file over the head (if pitted), then complete the polishing this way with the various grit sizes of abrasive paper. In doing so, try to maintain the original contour of the screw head. The file can take off a lot of metal quickly, so be cautious.

Once all the parts are polished, you are ready to start heating up your tanks. However, if there is going to be any delay between the polishing and bluing, certain precautions must be taken. A freshly-polished gun is a prime target for surface rust if it is not going into the cleaning or the hot water tank immediately. A delay of a few days or even a few hours, under some conditions, between final polishing and bluing can result in fine silver spots showing up on the gun after it has been blued. These are the result of microscopic rust spots developing while the gun is being held after polishing and prior to bluing.

POWER BUFFING

The equipment required for power buffing can vary tremendously, depending upon the amount of work that has to be done and the amount of money allotted for the equipment. Many professionals start out with only a bench grinder. Others

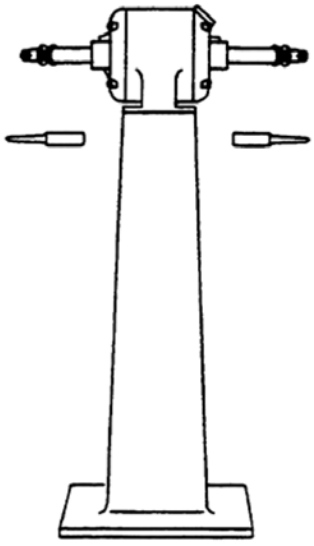


Figure 8: *The power buffing motor mounted on a metal pedestal is the ideal setup for power buffing metal gun parts.*

start out with many power buffers, like the one shown in Figure 8, to save time in changing wheels.

Cloth or loose buffing wheels come in a large number of sizes and special shapes to quickly buff special contours. They are really a series of muslin discs sewn together (Figure 9). Some wheels may have only a few pieces of cloth while others may be so thick that they involve hundreds of layers. These wheels, although extremely soft, revolve at high speed and the resulting centrifugal force is constantly at work, keeping them "flat" against the surface being buffed.

When using a bench grinder, one end of a double-ended shaft contains a conventional grinding wheel, while the other shaft has a muslin buffing wheel. Therefore, the one machine can be used for both purposes. The main disadvantage is that each time a new grit size is required, the buffing wheel has to be changed. With only this arrangement, some buffing compound, and a barrel-spinning fixture, many guns can be polished for bluing at very little cost.

On the other end of the ladder is what might be considered the ideal setup for the professional gun shop. Several Baldor pedestal buffers should be installed in the buffing area of the shop. Stitched and loose muslin wheels, each containing different size of buffing compound, are installed. Number 555 gray and white polish is normally used on felt polishing wheels. Other specialty wheels might include those that have been grooved to accept curvatures of gun barrels and receivers.

The buffing room should also contain a belt sander (Figure 10) and an assortment of belts from 60 to 400-grit, along with smaller wheels for polishing trigger guards and similar items.

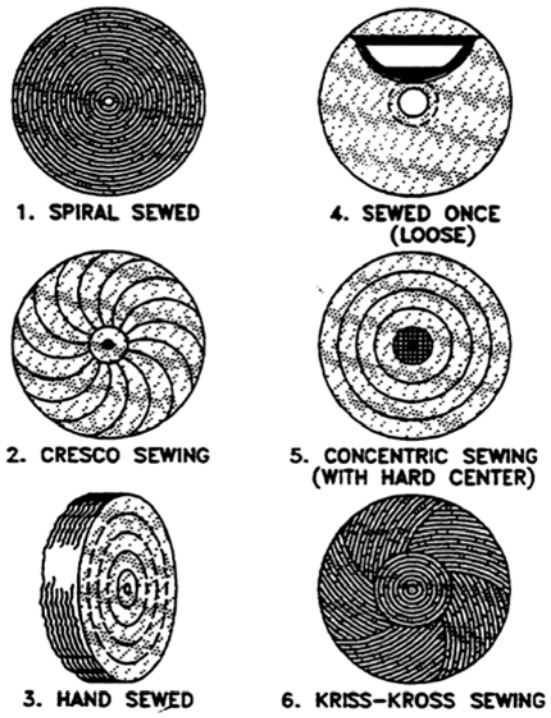


***Figure 9**: Various types of power buffing wheels. The spiral sewed (1) will hold uniform face longer. The cresco sewing (2) will wear down in layers. Hand sewing (3) is used on very thick wheels. Loose wheels (4) are used for high luster and will follow the contour of an object being polished. These wheels will also funnel screw holes, so be careful. Concentric sewing with hard center (5) is used for fast cutting; the hard center is used on tapered spindles. Kris-Kross (6) sewing gives almost the same results as spiral sewed wheels except the action is slower.*

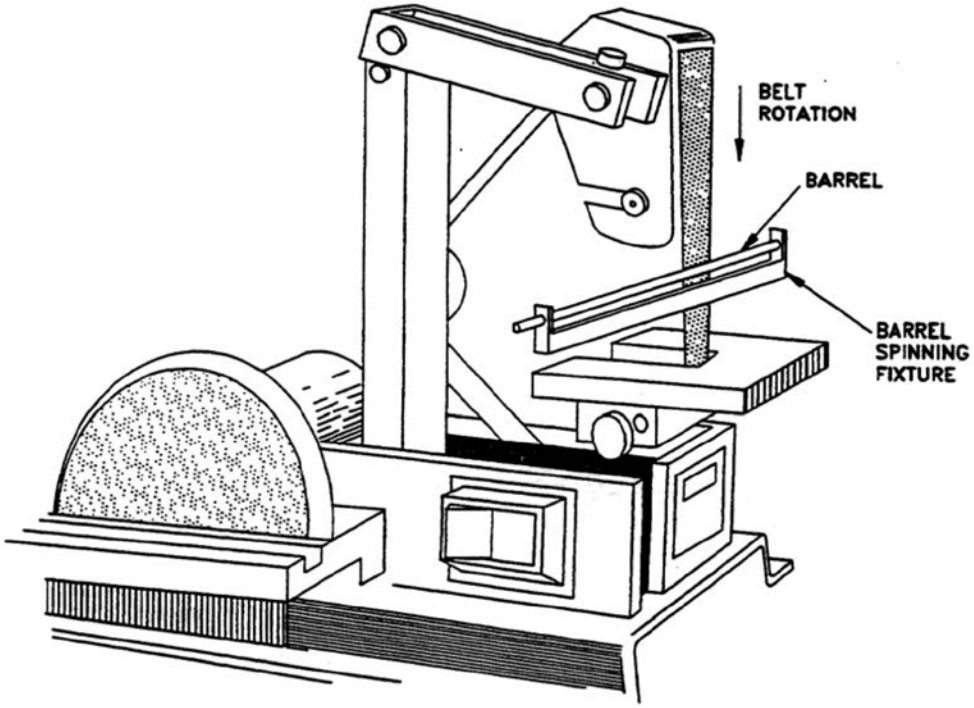


***Figure 10**: The power buffing room should contain a belt sander for quickly removing pits. The operation shown here is called "spinning." The barrel is positioned between centers in a spinning fixture which allows the barrel to rotate with the sanding belt. A good, even finish is assured.*



Figure 11: *A sandblasting apparatus is a great help in removing rust and preparing the metal surface prior to power buffing. It is an almost essential piece of equipment, if you plan to Parkerize firearms.*

These can be mounted by means of a special adapter on the Baldor buffers, or used in a Dremel Moto-Tool. A bead blasting or sandblasting cabinet and apparatus should also be on hand in the polishing area (Figure 11).

Some shops even have vibrator buffers set up for final polishing. The parts to be polished are placed in barrels or drums containing the abrasive; the parts are then left to vibrate overnight. The next morning the parts will be brightly and evenly polished, ready for the bluing tank. Pits and other metal defects cannot normally be corrected in a vibrator polisher, but it does an excellent job on the final polishing.

To illustrate how a professional gun shop may handle the polishing of a rifle or shotgun for bluing, the following describes the normal procedure.

The firearm to be blued is first completely disassembled. On ribless single-barrel firearms, the barrel or barrel and receiver are secured between centers on a special barrel-spinning fixture (Figure 12). Until recently, most shops made their own fixtures out of lengths of pipes, fittings, and lathe live centers. However, in recent years, a fixture has hit the market that can be highly recommended: the barrel spinner manufactured by Clymer Manufacturing Co., Inc. This spinner is lightweight and can be purchased for a reasonable price; in fact, probably for less than you could make yourself. Clymer is a well-known name in gunsmithing circles due to its excellent chambering reamers.

Once the barrel is positioned between centers in the spinning fixture, and depending upon the condition of the surface, the barrel is then placed against a polishing wheel or belt and allowed to spin as the barrel is worked up and down along the face of the polishing wheel. If the barrel is pitted, the gunsmith will normally start out with the belt sander, which will cut a lot of metal quickly, and then progress down to about size 320-grit, again on the belt sander. However, for the master mirror shine, the work should be taken down to 555-grit.

Other parts are polished in a similar way. Receivers and tangs, for example, are usually held in the hands and worked in a circular motion across the buffing wheels, first in one direction and then another. When polishing, be careful not to polish out serial numbers and other lettering that is found on the typical firearm. Make sure that all corners are kept sharp and not rounded, and that the original lines of the part are maintained. If in doubt in a particular area, go to hand-polishing.

One of the more common faults with power buffing is the funneling of screw holes. Even experienced polishers will have this happen if the holes are not protected. Many shops keep a set of extra screws for most firearms to be inserted into the vacant holes. For holes in the receiver that are not threaded, use spring clips or locknuts to secure the screws in place while polishing.

In general, power polishing entails starting with the coarsest grit and polishing the surface of the metal in a given direction. With the next finer grit on a different buffing wheel, polish at 45° angles to the first pass. By following this procedure through the finer grit numbers, the final surface is unequaled for quality and perfection. There are many different ways to obtain good results. Experiment until you find one method that suits you the best.



Figure 12: *A barrel spinner is useful in polishing.*



***Figure 13**: Many modern firearms use aluminum alloy parts. Special care must be taken when polishing these parts for refinishing.*

The following is a step-by-step description of the methods one gunsmith uses to prepare the metal for rebluing a Savage .22 single-shot barrel/action:

1. The first step is to disassemble the barrel/action completely.

2. The first polishing pass is made with stitched muslin wheels using 140-grit polishing compound. The barrel is held at a 45° angle to the bore and all old blue and rust pits were polished away. The lettering is not polished.

3. The next pass is made with loose muslin wheels using 240-grit. The barrel is held so that polishing marks with the 240-grit polishing compound are at a 90° angle to the 140-grit polishing marks. This pass completely removes the polishing marks made by the 140-grit compound. The lettering is not polished.

4. The last pass is with 400-grit. First, the lettering is polished using a hard felt wheel. Then with the loose muslin wheel, the barrel is held with the bore at a 90° angle to the polishing wheel and polished from one end to the other, turning the barrel slightly as each end is reached until the whole surface is polished.

Before beginning any work on the metal buttplate for a rifle, the metal is first inspected to evaluate the condition of the engraving and lettering and the severity of the blemishes that are to be removed.

In evaluating this buttplate, it is found that the engraving needs to be recut before polishing to prevent any loss of lines to the engraving.

Once recutting is completed, draw filing is used to remove deep pits in the metal. Avoid the engraved area and maintain proper contours. Once draw filing removes all the major blemishes, the surface is hand-polished using 180-grit in the opposite direction until all previous lines and marks are removed. This process is repeated — first in one direction and then in the other — using finer grit abrasive cloth until all previous lines and marks are removed.

While polishing or draw filing, it is important that all screw holes are maintained at the proper taper and that the holes do not become funneled. Sometimes screw holes become funneled due to improper installation of a screw or poor polishing. When a screw hole is funneled to the point that it is bad, the hole must be widened (retapered) and fitted with a new screw with an oversized head machined to match the new taper of the hole.

The polishing on the buttplate is complete after using 500-grit paper, 600-grit wet paper and finally 1000-grit abrasive paper with oil. At this point, the metal is ready to be engraved and blued by any of the various methods.

POLISHING ALUMINUM

First of all, you must realize that there are many different aluminum alloys and also many tempers (hardness) of those alloys, and they all respond to polishing differently. As a result, polishing time, technique, and results will vary from alloy to alloy (Figure 13).

The basic procedure is as follows: Sand as needed to remove scratches, machine marks, and such, finishing up with a worn, greased 400 or 600-grit belt if power sanding or 600-grit wet-or-dry (used wet) if hand sanding. Clean the piece thoroughly to remove any traces of sanding grit and grease. This step is a must. Just a wipe with a cloth is not enough. Use solvent or detergent and get any grease and grit residue off or you will end up with scratches later on.

Begin polishing with 555-grit black compound on a stitched muslin wheel with about a 1" wide face (group $^{3}/_{8}$" wheels together). The 555 black compound will take out the sanding scratches and give the aluminum a nice glow. Depending upon where the piece will be used, and how hard an alloy you are working with, it might be possible to stop after 555 black. For

harder alloys and pieces that will be highly visible, change to a 1" wide, stitched muslin wheel and 555-grit white compound. This will change the color from a glow to a bright chrome-like shine. For a final touch, use a loose muslin wheel, lightly loaded with 555 white compound.

Here are some "Do's and Don'ts" to improve your final results:

- Don't skip grits as you work through the sanding process.
- Don't press the work hard into the buffing wheel. Doing so will build heat in the workpiece and the polish. The result will be streaks of polish deposited on the workpiece. Use a light touch.
- Don't overload the wheel with polish.
- Do clean your wheel with a cleaning brick and reload frequently. Minute bits of aluminum will gradually mix with the polish and build up a glaze on the surface of the wheel. If glaze is not removed, you will end up polishing with aluminum residue instead of polish.

Concerning Power Sanding Equipment. The following also applies to disk, belt, or orbital sanders. You must apply belt grease to the last grit. There are special belt greases available; many stick-type tapping compounds are also recommended as belt greases. Light greases like Lubriplate work well and, in a pinch, you can even apply some 555 white to the belt, disk, or sheet to act as a grease. Why? Power sanding generates a tremendous amount of surface heat and this heat causes aluminum to oxidize instantly forming a hard, oxide coating. Polishing compound 555 black cannot cut through this layer easily. The wheel will drag and pull and the resulting surface will look splotchy and uneven.



Figure 14: *Here's a good sand-blasting device for both the small and large gunsmithing shop. Everything needed is included except an air compressor.*

SANDBLASTING

Bead blasting or sandblasting gun surfaces is becoming more and more in demand. The process offers an excellent way to polish thin, pitted areas such as magazine tubes on rifles and shotguns where the metal is too thin to buff out the pits. The pits will remain, but the matte, non-glare finish that results from bead blasting will not make them stand out, as they would on a highly polished surface.

The sandblasting apparatus shown in Figure 11, on page 10, is ideal for the professional shop, but will cost about $1000 plus the cost of a compressor. However, there are also portable sandblasting machines, like the one shown in Figure 14, on the next page, that are relatively inexpensive — less than $250. They will do any pressure/abrasive cleaning, using silica sand, steel grit, aluminum oxide, glass beads, pecan shells, or detergent and water. The most expensive item needed for sandblasting is an air compressor, which will run from $500 to $2,000 or more. For indoor use, a sandblasting cabinet is needed to hold the abrasive. These are usually provided with a glass door and electric light to enable the operator to view the work as it is being cleaned. The cabinet also should contain a pair of sandblasting gloves so the operator can hold the various objects as they are being worked on.

POLISHING SMALL PARTS

Inside radius polishing of trigger guards, magazine tube rings, and similar gun parts often requires much time because of the varied sizes and intricate shapes involved. A Moto-Tool with small revolving polishing disks is one way to solve the problem, but when many polishing operations are required, it is most beneficial and cost effective to install a permanent setup on a spindle polisher.

An effective unit can be made from a medium-duty, universal motor with a 1/3 horsepower rating. It may be a single-end shaft model with an output of 1725 to 3450 rpm. It is preferable to have a resilient mounting system to limit vibration and should have no restrictions on its mounting position. Because of its intended function, the motor should be dust-resistant and drip-proof. The shaft should be prepared to accept a ½" keyed chuck which will greatly facilitate changing mandrels and specialized polishing equipment.

A belt-driven spindle/grinder/polisher is shown in Figure 15. Note the spindle chuck on the right-hand shaft. This is designed to hold small polishing wheel mandrels for polishing the inside radius of gun parts. If a motor shaft is used, the setup can be enhanced by using a motor-mounted rocker

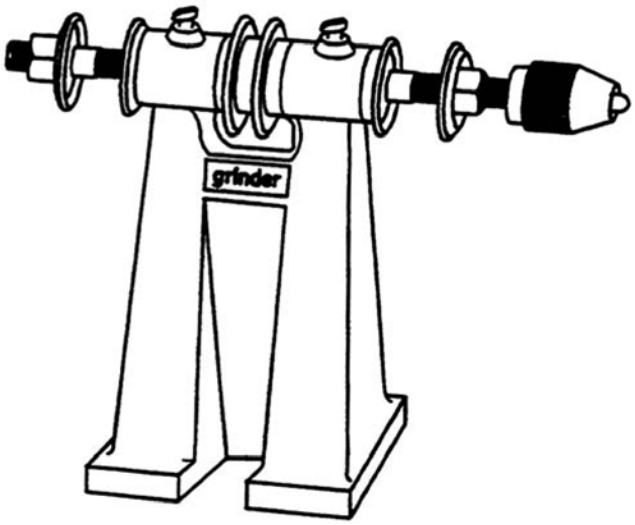


Figure 15: *A spindle/grinder polisher has many uses in the gun shop, especially for polishing the inside radius of trigger guards, magazine-tube rings, and similar gun parts.*



Figure 17: *Typical 1" belt sander. The narrow belt is ideal for polishing the inside radius of small gun parts.*

control switch, a reversing switch, and a variable speed control. These additional features greatly expand the unit's flexibility but are not mandatory. A split-shaft mandrel is sometimes used to hold polishing flaps of various types and grit sizes, as shown in Figure 16.

A 1" belt sander like the one shown in Figure 17 is another power tool ideally suited for polishing small parts. The unsupported belt spans can be used to contour and polish irregularly shaped parts. Using the table in conjunction with the backed-up area of the belt, flat and square profiling may be accomplished. Controlled radius polishing is made possible by using the exposed upper carrier wheel with more than 40% of its circumference available for profiling and polishing.

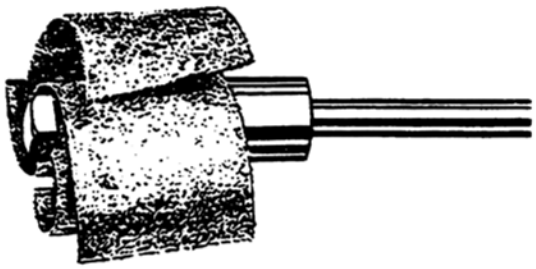


Figure 16*: A split-shaft mandrel is suited for using abrasive flaps for polishing the inside radius of gun parts.*

SUMMARY

Regardless of the type of finish you intend to apply to the gun metal—bluing, Parkerizing, browning, etc.— the metal must be properly prepared to accept the finish. Sand or bead blasting is a quick method that leaves a dull matte finish on the surface. However, polishing and buffing is the most popular way to prepare metal to accept the desired finish.

Cloth or loose muslin buffing wheels come in a number of sizes and special shapes to buff practically any shape of metal object prior to coloring or plating. Most are extremely soft, but when revolving at high speed (from 1700 to 3600 rpm) centrifugal force keeps them "flat" against the surface being buffed, permitting a relatively great amount of pressure to be applied.

Depending upon the size of the buffing wheel, it may be used in a small hand grinder (Moto-Tool) for polishing small gun parts, or on a large double-shafted motor, or on large revolving shafts containing many buffing wheels. However, the most practical size for shop use is about a 1-horsepower double-shafted motor that can contain two buffing wheels — one on each shaft end.

What is known as a packed buffing wheel is sometimes used for color-buffing nickel, gold, and silver. It is formed by placing cardboard disks of smaller diameter in between the cloth disks.

Pieced buffing wheels are made of remnants smaller than ordinary full disks. These are held together by continuous spiral stitching over the entire surface which results in a wheel that is somewhat more unyielding than buffing wheels assembled by other means.

The form of sewing on a buffing wheel is most important, as this determines the hardness of the wheel in most cases. The stitching can be spiral, crescent, radial, or other — each of which has its particular use in certain buffing applications. The speed of the buffing wheel is also important. The rule of thumb is the larger the wheel, the slower the speed. That is, the larger-diameter wheels should operate at a slower rpm to acquire the same speed in feet per minute of the smaller wheels.

In general, the gunsmith pulls the parts upward against the wheel using pressure; the amount of pressure depends on the particular metal and how easily it cuts. Very little pressure in polishing is needed for any metal except steel. For removing pits in the surface of the steel, the polishing wheels cut more quickly if the part is moved in a circular motion and up or across the wheel. If there are deep pits, it is usually best to cut these out with a belt sander using progressively finer grit sizes until the metal is smooth. It can then be finished on the buffing wheel.

When polishing round, hollow objects, such as a gun barrel or magazine tube, much time can be saved by using a spinning fixture. When using this fixture the finish will also be smoother with practically no visible abrasive marks when taken down to size 400-grit buffing compound.

POLISHING PRECAUTIONS

Although it is a normal practice in gun shops, using the lathe for polishing and grinding is not recommended. Under such conditions, fine, abrasive dust gradually finds its way into the lathe bearings and eventually causes trouble. This dust also accumulates on the lathe ways and can scratch them, which affects the lathe's accuracy.

When buffing, always wear a face mask and have adequate ventilation. It is also advisable to use a vacuum tool rigged to the wheel guard to carry off dust that forms from the buffing and polishing operation. A pair of leather gloves is also essential to protect the hands from wheel burns.

The operator must avoid sharp edges on objects to be polished. If caught just right, a buffing wheel will rip a piece from hands instantly and sling it against the floor or across the room with great force. Obviously, this can damage the workpiece and people who might be in the area. Never buff a gun part that contains wires such as those used for hanging the parts in the bluing solution. Always remove the wires before buffing. If the wires are not removed and become entangled in the revolving shafts, and are near your hands, the force of the wire wrapping around the revolving shaft can cut off your fingers.

SELF-TEST QUESTIONS

Please check your answers on page 19.

5. **What type of metal polishing is recommended for the beginner?**
6. **If you plan to power buff with three grit sizes, 140, 360, 555, which should be used first?**
7. **Which size buffing wheel should revolve at the lower rpm, a 10" or 4" diameter wheel?**
8 **What is the technique used to produce a smooth and true surface?**
9. **When should you start using power buffing equipment on good gun parts?**
10. **What are two types of personal safety equipment that should always be worn while power buffing?**
11. **What technique would you use to prepare the metal surface of a badly-pitted magazine tube for bluing?**
12. **What technique would you use to leave the metal surface a dull matte finish prior to rebluing or Parkerizing?**

Mass Finishing

Many of the firearm manufacturers—and even some private gun shops — use barrel tumbling and vibratory finishing methods to prepare metal parts for bluing. Mass finishing stands alone in its ability to perform many processing steps at once. Media compositions and shapes, along with improved equipment, have evolved to the extent where it is now possible to perform as many as ten simultaneous operations on gun parts.

A vibrator sanding drum large enough to hold a complete gun can be very costly, but many gunsmiths have had luck polishing small pans with a vibrator designed to polish brass cartridges for reloaders, like the one in Figure 18. If these are used, remember that the walnut shell abrasive that comes with them is not good for polishing steel parts; it is good for brass, but not steel. A polishing medium with more cutting abrasives should be used. These are available from a local body shop supply house or an industrial supplier.

The workpieces might be, for example, a batch of magazine tube rings for a .22 caliber semi-automatic rifle. In a single finishing operation, the medium can remove die marks, improve metal fatigue life, and impart a high-luster finish. Performing each job separately would obviously be uneconomical by today's metalworking standards. This is why the mass finishing process is growing at a rapid rate.

Important in the success of mass finishing is the consistent finishing action which guarantees uniformity of surface finish of every workpiece in the work load. Proper selection and control of all elements involved in the process—equipment, medium, compounds, water, and time cycles—must be synchronized correctly for the best results.



Figure 18: *Vibrator cartridge-case polishers are being used in gun shops for polishing small gun parts prior to bluing and are available at Midway USA. Be selective in choosing the appropriate polishing medium.*

Conventional mass finishing equipment can be categorized by the purpose and function it performs according to the following:

- Vibrators should be operated at the frequency and amplitude that provides best movement of the work load.
- High-pressures-force equipment should be set for the proper G force for the given application. G forces of 25 or greater are recommended for the fastest surface removal, 10 to 20 Gs for intermediate action, and 5 Gs for polishing.

MEDIUM DEVELOPMENT

During the past 30 years, rapid development in equipment and medium technology improved compositions for the more aggressive vibrators and high-pressure-force equipment.

Preformed, ceramic-bonded shapes such as triangles, stars, spheres, cylinders, and diamond shapes have appeared in the marketplace. Since their inception, a large variety of these shapes and compositions have been developed to finish parts with a minimum amount of wedging problems (Figure 19, on next page). Ceramic preforms are now available with compositions of aluminum oxide, silicon carbide, natural abrasives, or without any abrasive content.

Within the past 20 years, medium manufacturers introduced lightweight, preformed resin-coated media to remove burrs, flash, gates, and parting lines while maintaining smooth micro-inch finishes on soft ferrous and nonferrous parts. This process is often referred to as producing preplate finishes and is most often used on zinc and aluminum die-castings.

MEDIUM SELECTION

The scope of mass finishing is large and diverse, requiring a number of medium specifications to accommodate the many finishing requirements. Manufacturers and suppliers are well qualified to advise users on the proper recommendations for finishing their products.

Because of the many considerations in selecting the type of abrasive medium to fit a particular job, it is important that users familiarize themselves as much as possible with the different abrasive materials available — what they are and what functions they perform under various conditions.

The first prerequisite is to review the workpiece's material, shape, size, and weight. Also determine the part requirements: removal of burrs, sharp edges, tool marks, flash, grinding lines, and heat-treat scale, forming, producing surface finishes to specific requirements, and improving metal fatigue life.

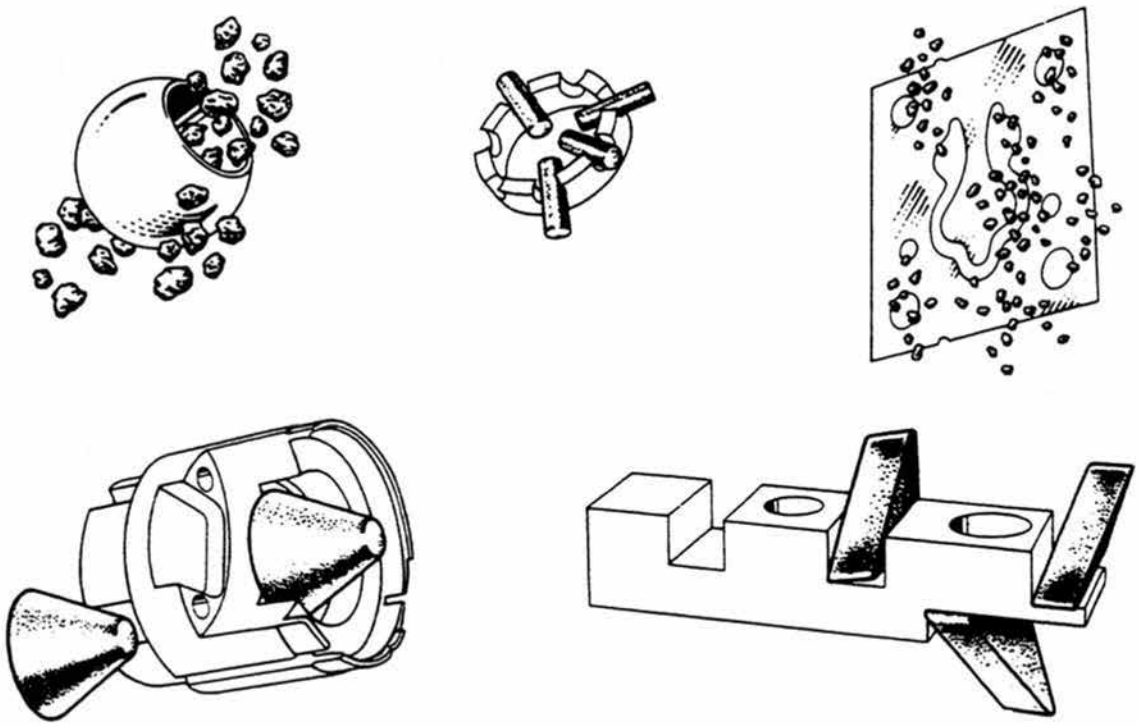


***Figure 19**: The abrasive medium should match the job. Here are just a few of the many shapes of media available. They are designed in reach in every crevice and slot, and will do a fine job of polishing with the least amount of effort.*

A systematic approach should be used in selecting the composition, shape, and size of abrasive to process a particular part. The abrasive compositions are generally classified as aggressive, intermediate, or mild acting. Aggressive abrasives are used when maximum stock removal is required. Intermediate abrasives are used when a combination of stock removal and smooth surface finishes are necessary. Mild abrasives are employed when minimum surface removal and high luster are desired.

With synthetic abrasives, the aggressiveness can be controlled accurately. Crystal structure and density will determine the aggressiveness of the random-shaped abrasive medium. The type of abrasive, the amount of abrasive in relation to bond, abrasive density, and bond hardness determine the aggressiveness of the ceramic and resin-bonded medium.

Composition. Those familiar with grinding operations usually associate the use of aluminum oxide with ferrous metals and silicon carbide with nonferrous metals. But this is not true in mass finishing. Aluminum oxide is used in most applications, regardless of the type of metal being processed. Other abrasive materials used include silicon carbide, corundum, quartz, pumice, and garnet.

Shape. The shape of the medium to be used is determined by the shape of the part being processed. Slotted parts are best finished by triangular-shaped media. Parts with holes or rounded areas would be best processed by round-pin or spherical-shaped media. In most instances, stampings or parts that have plain basic shapes with few areas for the medium to lodge in are best processed with random-shaped media.

Size. The size of the medium to be used is determined by the size and weight of the part being processed. The larger the part, the larger the medium. The reason for this is to displace the weight of the parts, which keeps the parts in a uniform mixture and prevents nicking. The areas of the part which require processing also determine the abrasive medium size. If the area is restricted or not easily accessible, it is necessary to use a medium small enough to reach in this area.

Another very important consideration in selecting the best size and shape of medium is the ability to separate the medium from the parts when the job is completed. Abrasive size is not too critical when processing ferrous metal parts because they can be separated magnetically. But with nonmagnetic parts which require screen separation, medium size determines the ease of separation.

Another factor in selecting the size of medium is the amount of metal removal required. The larger the size of the abrasive medium, the more weight and energy generated and, consequently, the greater amount of metal removal. Therefore, the amount of metal removal can be controlled simply by selecting different sizes of media.

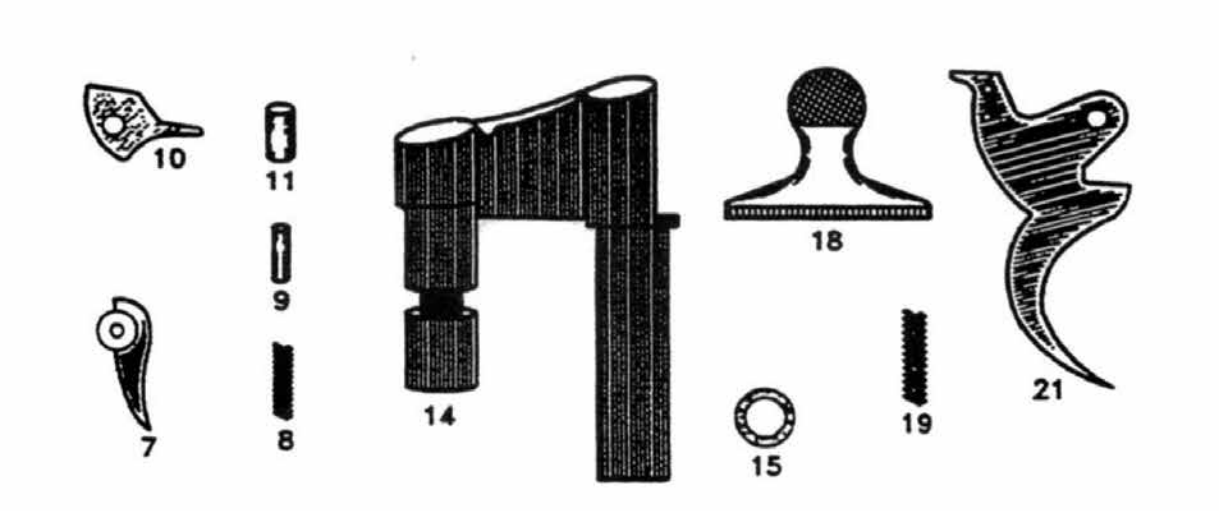


***Figure 20**: Some hard to polish gun parts that are ideally suited to vibrator or tumbler polishing.*

There are additional benefits in knowing how much metal can be removed by the various compositions and sizes of media. A very important benefit is the control of dimensional tolerance. Today, dimension is so important that it is not uncommon to see dimensions controlled to millionths of an inch.

The type of machine being used also dictates medium selection. It is quite common to use the most aggressive abrasive medium in tumbling barrels and the more durable medium in vibratory and centrifugal machines. All of the abrasive composition can be used in all the various types of machines.

Frequently, a manufacturer's equipment capacity and production requirements influence the abrasive composition used. If a manufacturer's work load exceeds the machine capacity, the most aggressive abrasive medium available must be used. This way, the mass finishing time cycle can be kept to a minimum and maximum production can be obtained from the machines.

Some manufacturers have an excess of machine capacity over production volume. This allows the use of a more durable, less aggressive abrasive medium. The time cycles are increased, but these manufacturers have the advantage of a lower cost per finished part because of a longer medium life.

COST SAVINGS

The reason a manufacturer turns to mass finishing is to eliminate the necessity of handling each individual part, and a finish not obtainable by any other method, at a considerably lower cost, is obtained (Figure 20). The amount saved depends, naturally, on the cost of the abrasive medium and compound used. From a cost standpoint based on lowest cost per pound of medium (which is also affected by medium weight and wear rate), the following guidelines are recommended:

- Use a random-shaped medium as first choice, provided it does not lodge in the part.
- If the part presents a lodging problem, then the second choice is the preformed ceramic-bonded medium.
- If the part cannot be processed with either of the first two materials, use a preformed resin-bonded medium.

WET FINISHING

Water levels are extremely important in industrial mass finishing because a high percentage of all operations are done with wet solutions. In rotational barrel finishing, low water levels are recommended for fast cuts. For polishing, the water should be level or slightly over the top of the mass. With vibratory equipment, "flow-thru" water systems should have a constant water stream to produce optimum results. Low water levels are recommended in a "captive" solution where there is no "flow-thru" system.

The water level should be over the top of the workload when using high-pressure-force equipment because the water helps dissipate the heat generated by the high frictional forces. Low water levels — just high enough to form a muddy mixture— are recommended for spindle machines.

Abrasive or grinding compounds are finding wider use because they can increase the cutability of the medium charge and because they can be used in self-tumbling applications (part on

part, without a conventional-type medium). These compounds are classified as either abrasive or nonabrasive. The nonabrasive compounds, for example, come under three general classifications: alkalis used as rust inhibitors, descaling compounds used for removing heat-treat scale, and burnishing compounds for imparting color and luster to parts.

However, for general gun work, most gunsmiths seldom use mass finishing exclusively. Gun barrels, for example, are normally polished on a spinning fixture, using either a belt sander or polishing wheel. Small, hard-to-polish parts, such as triggers, pins, and the like are often placed in a polishing medium inside a tumbler at night, and the next morning they are ready for the bluing tanks. Others use the mass finishing system exclusively, except for removing pits. Areas containing pits are first draw filed and polished in a conventional manner. Then, all parts are placed in a vibratory barrel and allowed to vibrate for 6 to 12 hours. They are usually ready for the bluing tanks after this time.

SELF-TEST QUESTIONS

Please check your answers on page 19.

13. **What type of device is recommended for polishing small gun parts in the small gun shop by the vibrator method?**
14. ***True or False*. Walnut shells are good for polishing steel gun parts.**
15. **What method of mass finishing is used in the majority of industrial applications?**
16. **When using a vibrator drum, what shape medium should be your first choice?**

Answers to Self-Test Questions

1. False.
2. Carbonia bluing.
3. Slow rust and hot water bluing methods.
4. Hot caustic bluing method.
5. Hand-polishing.
6. The coarsest size grit (140) should be used first.
7. The 10" wheel should revolve slower than the 4" wheel.
8. Draw polishing.
9. When you have obtained enough practice on junk parts to feel confident with your work.
10. A face mask and leather gloves.
11. Sandblasting.
12. Sandblasting.
13. A vibrator cartridge-case polisher.
14. False. They are okay for polishing brass.
15. Wet finishing.
16. A random-shaped medium should be your first choice.

Lesson Questions

THIS IS LESSON NUMBER 2191.

Make sure you print your name, student number, and lesson number in the space provided on the Lesson Answer Form. Be sure to fill in the circles beneath your student number and lesson number.



REMINDER: A properly completed Lesson Answer Form allows us to evaluate your answers and send the results and additional study material to you. Do not hold your Lesson Answer Forms to send several at one time. You may run out of study material if you do not send your answers for evaluation promptly.

You may also complete your exam online at www.sdi.edu, click on the *online exams* tab.

1. **The four popular methods of preparing gun metal for finishing are**
   a. Bead blasting, sandblasting, walnut blasting, and pecan blasting.
   b. Hand-polishing, power buffing, mass finishing, and sandblasting.
   c. Grits 140, 180, 240, and 320.
   d. Belt sanding, muslin wheel buffing, grinding, and disc sanding.

2. **When preparing gun metal for rebluing and the surface has nicks or pits that are too deep for hand-polishing, what operations should you take?**
   a. Buy new parts.
   b. Abort the polishing operation.
   c. Draw file the pitted areas before polishing.
   d. Use the finest grit size of abrasive paper.

3. **During hand-polishing, what size grit abrasive paper should follow the draw filing operation?**
   a. 80-grit.
   b. 120-grit.
   c. 140-grit.
   d. 240-grit.

4. **How are screw heads best held for polishing?**
   a. In a cross-fed milling vise.
   b. In a bench vise.
   c. With the fingers.
   d. Securing them in an electric drill or drill press.

5. **Before the parts of a gun are polished, what are the first two steps?**
   a. Copper plate the parts.
   b. Use some touch-up bluing solution to see how the metal reacts.
   c. Completely disassemble the gun and thoroughly clean the parts.
   d. Make sure the firearm is complete and assembled tightly before starting to polish it.

6. **What type of tool is recommended for power polishing gun barrels?**
   a. A spinning fixture.
   b. A disk sander.
   c. A small Moto-Tool.
   d. A split-shaft spindle.

7. **If the gunsmith has power equipment available, and the metal is highly pitted, which of the following will the gunsmith normally start out with?**
   a. A split-shaft spindle polisher.
   b. A belt sander.
   c. No. 555 white buffing compound on a muslin buffing wheel.
   d. No. 320-grit abrasive paper.

8. **When hand-polishing and using different grit sizes of abrasive paper, how should the polishing progress?**
   a. First in one way with one size grit, and then at right angles to the first with a smaller size grit.
   b. All polishing, in all cases, should be done in the same direction with each grit size.
   c. Start with the smallest size grit (like 555) and progress to the largest size grit such as size 80-grit.
   d. Start with a medium-size grit and work to a larger size grit.

9. **What is usually the most expensive piece of equipment when setting up for sandblasting?**
   a. The sandblasting gloves.
   b. The blasting media.
   c. An air compressor.
   d. A sandblasting cabinet.

10. **What is one method of construction that often determines the hardness of a buffing wheel?**
    a. The method of stitching.
    b. The diameter of the wheel.
    c. The rated rpm of the wheel.
    d. The thickness of the wheel.