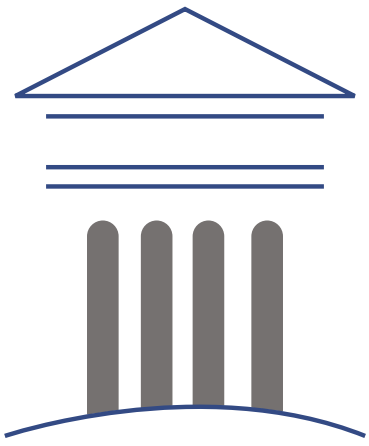
# Bluing Gun Metal
# Lesson: 2192


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## Objectives

After completing this lesson, you should

1. Understand the various methods of bluing gun metal.
2. Know how the parts are carded after the solution is applied.
3. Know how to help retain the heat in thin parts during the bluing process.
4. Be familiar with the parts that cannot be blued with the hot caustic method.

## Introduction

Firearm refinishing is one of the most rewarding phases of gunsmithing work. Besides its monetary rewards, gun bluing also helps the gunsmith learn about various types of guns. As the guns are being disassembled for polishing and bluing, the operating characteristics of each gun become familiar. After repeated handling of the more popular guns, the gunsmith knows almost immediately just what parts are worn, broken, or need replacing.

Few gunsmithing operations are as gratifying as seeing a rusted and badly abused firearm turn into a beautiful, rich, blue-black finished firearm. For those unfamiliar with the firearm bluing operation, the process is like magic. It turns a worn firearm into one that looks brand new. But the person doing the work knows that the process is not an act of magic. Rather, it is accomplished by a masterful job of brightly polishing all the surfaces, keeping the corners sharp, and not funneling the screw holes. The gunsmith also makes certain that all parts are thoroughly cleaned with a degreasing solution before bluing. The results are rewarding — a perfect blue-black finish on the steel that will last for years.

## CHEMICAL USE SAFETY

All chemicals carry varying degrees of hazardous exposure. It is essential that you undertake basic safety precautions when dealing with dangerous compounds.

- First and foremost, know what you are dealing with! There are different types of chemicals which come in various forms: liquid, gas, vapor, dust, fume, or mist. Before handling any chemical, understand its properties, how it is used, and how it must be handled to avoid harmful exposure.
- Know what to do in case of emergency! Using safe practices when cleaning up leaks or spills and knowing when to call emergency help will minimize harmful effects.
- Always wear protective gear when dealing with any chemical. A rubber shop apron, gloves, and boots , as well as a face shield and hat should be worn at all times.
- Mix all chemicals in well-ventilated areas, preferably outdoors.
- In case of contamination, wash all skin thoroughly, and , if necessary, dispose of clothing. If clothing can be safely laundered, wash separately after rinsing items outdoors using a hose or washtub.
- Never bring food into an area where chemicals are being used or stored. Wash hands, or shower and change clothes before eating.
- Keep the work area free from contamination by properly cleaning up spills immediately, and appropriately disposing of hazardous material.
- Know the proper way to store or dispose of any leftover chemicals.
- Make sure at least one other person is available to undertake emergency measures should you become incapacitated from harmful exposure.

# Basic Bluing

The earliest bluing solutions consisted of a mixture of nitric acid and hydrochloric acid with steel shavings or iron nails dissolved in them. The process used in applying solution to the gun metal is generally known as the slow rust bluing 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 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. Afterward, the rust is rubbed off with steel wool or a wire brush to reveal a light gray or bluish color underneath.

The surface, still free from oil, is again swabbed with the solution and allowed to rust another day. When this second coat of rust is removed, the metal beneath is an even darker shade of blue. The process is repeated until the desired color is obtained, taking anywhere from one to two weeks on the average, depending upon the metal and the humidity in the air. The parts then are boiled in water for about 15 minutes to stop further rusting action, and finally oiled. The result is a beautiful, long-wearing metal finish.

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




***Figure 1**: Some of the cold-bluing solutions on the market.*



***Figure 2:*** *If you are called upon to restore older firearms to their original condition, like this early Winchester Musket you must know how to niter blue to obtain an authentic finish.*

Hot water bluing is based on the fact that steel rusts more rapidly when hot than when cold. This is due to a more rapid absorption of the oxygen that forms ferric oxide, or red rust. Therefore, new formulas were developed that reacted favorably on metal that was polished, degreased, and then heated in boiling water.

Other bluing methods were developed—niter bluing, charcoal bluing—but the major development in gun bluing occurred around the turn of the century when the black oxide, or hot caustic bluing process was patented. This method requires that the parts be polished in the conventional way, but instead of applying the solution to the metal parts, the parts are dunked into a tank of the boiling solution. Once in the tank, the bluing process is essentially a 15-30 minute process of boiling the parts in the strong alkaline solution. The process works exceptionally well on a wide variety of steel and is much more economical for mass production than any other process. Another advantage of this method is that the number of guns that can be blued at one time is limited only by the size of the tank and the heating facility.

During the early part of the twentieth century, an instant or cold bluing process became popular with do-it-yourselfers. The trend is still popular today. The cold bluing solution is a mixture of acids and copper nitrate. The copper nitrate forms a plating on the metal and the acids turn the copper black the instant it touches bare, degreased metal.

There are many kits on the market that contain everything necessary to blue guns at home. If care is taken, the result can be quite pleasing. The main problem is durability. None of these cold bluing solutions will hold up for any length of time, and eventually the gun will be coated again with red rust.

However, these cold bluing solutions do have a place in every gun shop — for touch-up jobs. The cold bluing solutions on the market will most definitely blacken metal, if the metal is properly prepared. Of these solutions, Birchwood-Casey's Perma-Blue Paste, or G96 Gun Blue Creme are good choices for a first attempt at touch-up gun bluing.

## COLD BLUING TECHNIQUES

Cold bluing chemicals will not blue case-hardened steel, stainless steel, aluminum, or other nonferrous metals. Case-hardened steel can be readily detected by the mottled colors running through the surface of the steel. If these colors have faded, the metal will usually have a chrome appearance. Stainless steel barrels are usually marked as such. Aluminum or other nonferrous metals will not react when touched with a magnet.

The chemicals used in cold bluing solutions are poisonous and should be treated accordingly. Many of the chemicals will affect bare skin, so it is recommended that rubber gloves be worn when using them. Skin-tight surgical gloves, available from drug stores or medical suppliers, are ideal for cold bluing. They allow free movement and feel, yet give adequate protection from harmful chemicals.

There are dozens of cold bluing solutions available on the market, some of which are shown in Figure 1. Because many of them vary in strength and application technique, the manufacturers' instructions should always be followed. In general, no heat is required to apply the bluing solution, but the metal surfaces must be oil-free for best results. After cleaning the surface to be blued with a solvent, the bluing solution is applied in even strokes over the surface with cotton swabs, left on for a few minutes, and then wiped off. Successive coats are applied until the desired finish is reached. Then the area is thoroughly swabbed with gun oil.

As mentioned previously, the cold or instant bluing method is recommended only for touch-up jobs. In a pinch, it will produce a nice-looking, complete blue job if correct procedures are followed: proper polishing, removing all pits and scratches from metal, degreasing, and applying the solution evenly. When completed and oiled, the final result will appear quite similar to a factory hot caustic bluing job, especially immediately after the job is finished and the metal surfaces are oiled. However, this appearance does not last as long as some of the other methods.

## HEAT BLUING TECHNIQUES

Heat bluing is used extensively in the gun shop, mainly to blue small parts such as screws, drift pins, etc. This method is especially useful when replacing one screw or pin that would not warrant "firing up" the hot caustic bluing tanks. The oil-and-heat method is one of the favorites for bluing such parts, and the procedure is simple.

Polish and degrease the parts to be blued in the usual manner. Use a piece of stovepipe wire or a pair of long-nose pliers to grip the part to be blued and heat the part with a propane or similar torch until it is a dull red color. Then, quickly plunge the part into a small container of oil or transmission fluid. It should turn a nice temper-blue color. If you want the color darker, repeat the operation. Be careful of the oil igniting, and do not touch the heated part while still hot.

Heat, or temper, blue was used extensively on some parts of the earlier firearms manufactured by Winchester, Marlin, and others. To obtain this temper blue, such methods as torch heat, charcoal, sand, and niter were used as the heat-transfer media. The excellent finish found on Winchester firearms, however, was the result of good steel and perfect polishing, rather than the bluing process (Figure 2) .

**Niter Bluing.** The niter process of bluing steel is a quick and easy method for bluing small parts such as screws, triggers, hammers, etc. Of course, it can also be used for receivers and other large parts, but the expense of setting up for the larger parts will far outweigh the cost to purchase equipment for the hot caustic bluing method.



***Figure 3**: A lead melting pot will suffice to hold the niter bluing solution when bluing only small parts like screws and triggers.*

In using this method, there are several precautions that should be followed to prevent bad burns and/or damage to eyes. **Always wear a face shield or safety goggles, heavy clothing, and gloves to protect the skin.**

**The main reason for this protection is if any oil or water (just one drop) should fall into the hot niter mixture, 700˚ molten lava will spray out, causing severe burns!** The next precaution is to make absolutely certain that the parts to be blued are free of water and other liquid before placing them into the solution.

To begin, you need a cast-iron container large enough to hold the parts so they will be completely covered by the bluing solution. A lead melting pot, like the one shown in Figure 3, is okay, as long as it is completely clean. A small gas or electric hot plate will serve for the necessary heat. You will then need enough potassium nitrate, commonly called saltpeter, to fill the melting container.

The parts to be blued are polished and cleaned to remove all traces of grease. Be sure that the parts are completely dry before immersing them in the bluing solution; especially check blind screw holes for possible trapped liquid.

Set the melting pot onto the source of heat, and sprinkle a little of the potassium nitrate in the pot. When it has melted, at about 700˚, sprinkle more in. Continue this until you have enough melted potassium nitrate, or niter bluing solution. Attach a black iron wire to each small part to be blued, and once you are certain that no liquid is present on the part, gradually lower it into the melted bluing solution.

Let the part remain in the molten solution until a uniform color of the desired shade is obtained. This usually takes from 10 to 30 minutes, depending upon the size of the part. The part is then removed from the solution and immediately plunged into warm water. In a few seconds the part will cool; then wipe the part off and oil it thoroughly.

If you have done your part on the polishing and degreasing, you should have an attractive, rich, blue-black finish.

**Charcoal Bluing.** Charcoal bluing, used to color some metal parts on early firearms, is another form of temper or heat bluing. The finished color ranges from a light blue to a dark blue-black, depending upon the temperature of the charcoal. This bluing method was used mainly on small parts such as screws and pins that did not lend themselves to easy rust bluing.

Your first attempt at charcoal bluing can be done with a small cast-iron melting pot over a gas camp stove. A few bricks of commercial charcoal are placed in a cloth bag and pulverized with a mallet until small granules about the size of peas remain. These are then dumped into the melting pot to be heated. You do not want to get these coals red-hot, just hot enough so that an even temperature of about 600˚-700˚ F is held.

The parts to be blued are polished as usual and degreased. Attach black iron stovepipe wire around each part so that it can be removed from the charcoal without being touched. If

the temperature is correct, the parts should be ready about 10 minutes after being placed in the heated granulated charcoal.

Pour a can of car transmission fluid into a separate container large enough so that the fluid will completely cover the objects being blued. Using the wire so as not to burn yourself, lift one of the parts from the charcoal and inspect it. If it has taken on the proper blue-black color, then quickly immerse it into the container with the transmission fluid. Wait until it cools and then remove it and place it aside.

Repeat this procedure with all the parts. If the initial inspection shows an improper color, place the part back into the charcoal. However, once the part has been dipped into the transmission fluid it will have to be degreased before returning it to the charcoal.

The process is completed by wiping off the parts with a clean rag and then oiling them. If care is used in the polishing, degreasing, and preparation of the charcoal mixture, you should have a nice, authentic-looking satin blue-black finish when completed.

Clyde Baker, in his comprehensive book, *Modern Gunsmithing*, gives a slightly different method. He recommends making a container of heavy sheet iron large enough to hold the largest part to be blued. Since no liquid will be used in the container, it is not necessary to have tight seams; merely fold the corners. Fill the container with pulverized wood charcoal in lumps about the size of a small pea, and heat the container until the charcoal is partly burning throughout, but not red-hot. Attach a rod or wire to the part to be blued and bury it in the glowing mass, allowing the rod or wire to stick out to be used as a handle. In 5 or 10 minutes, lift the part out and examine it. If it is the right color, take a large, clean cotton rag, ball it up, dip it into some powdered lime, and rub the part vigorously all over. Put the part back into the glowing charcoal as soon as possible. Repeat this treatment every 7-10 minutes, using plenty of lime and rubbing it into every part, working very quickly. Be extremely cautious so as not to burn yourself. Continue this treatment until a rich blue-black color has appeared, then let it air-cool before applying a light gun oil to the part. The parts have to be polished and cleaned as any type of bluing.

Either one of these methods will work fine on small gun parts. If you have complete control of the temperature, an entire gun may be blued this way, but getting an even color throughout is not an easy task without the proper equipment. Therefore, we recommend this method only for screws, triggers, pins, and other small parts.

Detailed information on hot caustic and other bluing methods, including the equipment needed, is covered later in this lesson.

## SELF-TEST QUESTIONS

Please check your answers on page 18.

1. **What two important steps must be applied to gun metal before applying cold bluing solution?**
2. **During slow rust bluing, how long is the metal allowed to rust before applying a second coat of bluing solution?**
3. **Will cold bluing work on case-hardened metals?**
4. **During niter bluing, what precautions must be taken before the parts are placed in the bluing solution?**

# Hot Water Bluing

Hot water bluing formulas were closely guarded by professional gunsmiths of the day. It seemed that gunsmiths had each developed their own formula. Even different manufacturing plants had their own "secret" method of getting the desired results. However, most of the formulas were based on a solution consisting of sodium and potassium nitrates, potassium chlorate, and bichloride of mercury, mixed in distilled water. One well-known formula is as follows:

- ¼ oz. potassium nitrate
- ¼ oz. sodium nitrate
- ½ oz. bichloride mercury
- ½ oz. potassium chlorate

Mix the above ingredients in a clean, wide-mouthed glass jar. Then, slowly add 10 oz. of slightly heated (120° F) distilled water into the container holding the mixed dry chemicals. Stir with a glass rod continually until almost cool, and then pour the contents into a dark brown glass or plastic bottle with a tight plastic cap. Keep the mixture in a dark, cool place.

Chemicals are expensive these days when purchased in small quantities, and you will save money by purchasing one of the commercial bluing solutions. Brownells sells Belgian Blue or you can search for gun shops in your area that may sell this hot water bluing solution at www.gunshopfinder.com. This solution is excellent and you should experience very few problems, provided you follow the instructions exactly.



***Figure 4**: Brownells makes a complete tank set for bluing.*

## POLISHING EQUIPMENT

To prepare the metal for hot bluing, remove all pits and polish the metal to the desired sheen. You will need a 10" mill bastard file and file card if the gun has rust pits, nicks, or scratches too deep for abrasive paper to remove.

Purchase at least three sheets each of the following grits of open-coat aluminum oxide abrasive paper.

| | |
|---|---|
| 80-grit | 240-grit |
| 150-grit | 320-grit |
| 400-grit | 500-grit |

The 400 and 500-grit silicon wet/dry paper is used for the final polishing.

If your local hardware or automotive supply store does not have them, you can order them from Brownells Inc., 220 S. Front St., Montezuma, IA 50171 or at www.brownells.com.

## BLUING EQUIPMENT

If you have a bench vise and two watertight metal containers large enough to hold the parts to be blued, you already have much of the material needed. However, if not, get two 6" x 6" x 40" bluing tanks. One will do, but two are better, and the kit shown in Figure 4 contains most of what you'll need. Make sure the tanks are made of metal or stainless steel, but *never galvanized metal.*

A package of steel wool and a stainless steel brush made of .005" hand-tied stainless steel wire are necessary for removing the rust from the gun. Clean rubber gloves are recommended during the bluing operation to insure that your skin will not come into contact with the metal. All of these materials are shown in Figure 5.

Several good degreasing solutions are available, but a can of household lye (sodium hydroxide) will do the job adequately. If you use a commercial cleaner, always follow the directions on the package.

A source of heat can be the kitchen range, but you will do better to work in the basement or garage and use a camp stove or gas-fired hot plate for your heat source.

Chemicals added to city water supplies will sometimes have an adverse effect on the final bluing job. Some "hard" well water can do the same thing. Therefore, either buy distilled water or try catching 8-10 gallons of rainwater in plastic dishpans.



*Figure 5: Besides bluing tanks and a heat source, some of the items shown here are also required to obtain a professional bluing job using the hot-water method.*



*Figure 6: A clean jar containing the bluing solution should be suspended in one corner of the tank by a black-iron wire. Be careful not to splash any of the tank water into the jar.*

You will need some tapered dowels to plug the bore of the barrel and some black stovepipe wire to attach to each part during boiling. The dowels may be made of wood, plastic, or similar material. Finally, you will need a pack of cotton balls and a wooden clothespin or two for holding the cotton.

Do not be discouraged by the hard work. Remember that the result is a bluing job that is superior to many factory finishes.

## PROCEDURE FOR HOT WATER BLUING

Regardless of whether you use the Belgian Blue or mix your own formula, the procedure for hot water bluing is the same.

**Polishing**. Aside from keeping the metal surfaces free of oil, polishing is the most important step in getting 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, etc. The surface of the metal must be perfect before the bluing solution is applied.

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 corners, funneling screw holes, or otherwise "grinding them up" too much.

The beginner should stick to hand-polishing. Hand-polishing will insure that all contours, lettering, markings, and square edges are properly preserved. About 12 hours of hand-polishing are required to complete all parts on the average rifle or shotgun. If many pits are present, this time may be doubled.

The first step is to disassemble the gun down to the last screw and drift pin. If you are unfamiliar with the takedown procedure, exploded views and instructions are available from various sources for most firearms. If you have no printed instructions, jot down notes as you disassemble the gun and perhaps even 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 be sure that no aluminum alloy parts are present. This can easily be determined by using a small magnet. If the magnet does not react, then the part is nonferrous — aluminum, brass, or a similar alloy — and these parts should be set aside with others not to be blued. Besides the nonferrous parts, other parts will include springs and other small elements not visible in an assembled gun.

With all the pieces to be blued in one pile, thoroughly clean each one with a solvent such as acetone. Then start polishing the parts as discussed earlier in this course.

Once all the parts are polished, you are ready to start heating 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 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 being blued. These are the result of microscopic rust spots developing while the gun is being held after polishing and prior to bluing.

**Cleaning**. Once the parts have been polished, pour enough clear water into one of the tanks to completely cover the gun and all its parts. Add the right amount of cleaning solution — Dicro-Clean No. 909 or 1 tablespoon of household lye to 2½ gallons of distilled water or rainwater. Then suspend the gun and gun parts by black iron stovepipe wires. Make sure that all parts are at least 1" away from the bottom of the tank and also away from the tank sides, otherwise, blotchy bluing will result. Small parts can be individually suspended by black iron wires or else placed in a black iron or stainless steel basket which is then suspended in the tank. Let the parts soak in the cleaning solution for about 5 minutes.

**Boiling the Parts**. While the parts are being cleaned in the alkali cleaner, clean rain or distilled water is being heated in another tank. A clean glass jar containing the bluing solution is suspended in one corner of the tank, as shown in Figure 6, so that part of the jar is underwater (heating the bluing solution). Be careful not to let any water in the bluing tank splash into the jar; this will weaken and contaminate the bluing solution.

After the cleaning period is completed, remove the parts from the cleaning tank and quickly transfer them to the rinse tank. The rinse tank contains clean rain or distilled water which is not heated. After rinsing, the part is immediately put into the hot-water tank (the one containing the jar of bluing solution).

The water in the hot-water tank must be kept at a hard, rolling boil from here on out, if the best results are to be obtained.

Let the parts boil for a full 15 minutes the first time to insure an even heat throughout and then lift the largest of the parts out of the boiling water. The part should dry in a split second if it has been heated enough. If not, put it back into the boiling water and boil it a little longer. Do not worry about getting the parts too hot; the only danger is not having them hot enough.

**Applying Solution**. When the part dries, suspend it in mid-air by the wire; or, in the case of the barrel, which should have wooden or plastic dowels in each end as holding plugs, rest one wood plug on a table and hold the opposite plug in your gloved hand. Then, as quickly as possible, dip a swab into the hot bluing solution in the suspended jar and dampen the swab. Do not saturate the swab, just dampen it. Apply the solution in long, even strokes. The parts should be hot enough so that when the solution is applied it dries immediately and leaves a light grayish-brown coat on the part.

After each part has been coated, return it to the boiling water for about 5 minutes. Then, remove the part again and swab more of the solution onto the hot metal surfaces. Do this to each of the parts in turn.

**Carding**. Following the second application, you will see a darker coat of gray, flecked with rust, forming on the metal. Before returning the part to the hot-water tank, rub the parts with clean steel wool or use a motor-driven wire wheel, as shown in Figure 7, to remove the rust particles. For tight places, uses a clean stainless steel brush. This process is called carding. Do not rub the parts too vigorously because that could remove the thin coat of light grayish-brown blue.

After all parts have been carded, return them to the hot-water tank for another 5 or 6 minutes, and repeat the previous steps. As you put on more coats of the bluing solution, the brown or grayish-brown gradually turns to a rich, velvety blue-black color. This might require as few as 4 coats on a .22 rimfire barrel, or as many as 10 or 12 coats on harder steel. According to Clyde Baker, stainless steel requires 30 or more coats of bluing solution.

**Final Boiling**. After the last coat has dried on the parts and has been removed with steel wool, wire wheel, or stainless steel brush, place the parts in the boiling water once more and boil them for about 20 minutes to stop all further rusting. The parts will dry almost immediately upon being lifted from the water. When cool, oil all the parts. Other than assembling the various parts, the job is now finished.

**NOTE**: On some metals, especially those blued for the first time, an etching solution might be needed to open the pores and permit the color to "take" properly. In most cases, a solution of one part nitric acid to seven parts distilled water works fine — even on hard steels. When bluing stainless steel barrels, instead of the etching solution, you can mix your own acid. First, mix ½ oz. silver nitrate with 13½ oz. of distilled water. **NEVER POUR WATER INTO ACID; IT WILL ERUPT VIOLENTLY!** Then, add ½ oz. mercurous nitrate, and finally, 5½ oz. of nitric acid. Put the solution into a brown bottle and do not expose it to light any more than is necessary.

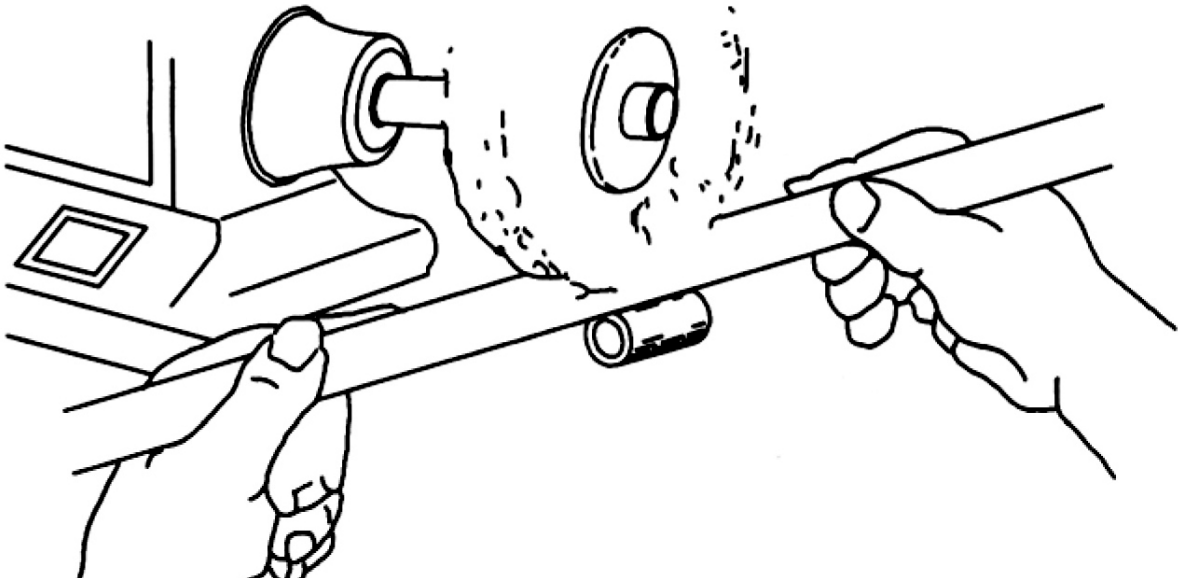


***Figure 7**: To card off the light coat of rust that forms after bluing, use steel wool, a stainless steel brush, or a motor-driven wire wheel. Be sure to remove only the loose rust and not the thin coats of color underneath.*

**Etching**. To etch the metal surfaces, heat the gun and gun parts in the boiling water prior to applying the bluing solution. When hot, lift them out and quickly coat each part with the etching solution, using a clean sponge or rag. Work very quickly. Splash on plenty of the etching solution and try to cover the entire surface in one or two strokes. Keep going over all the parts to keep them wet. In a very short time, usually only a few seconds, the surfaces will take on a slightly frosted, silvery appearance. Inspect each part carefully. If any areas seem to be uneven, coat these again and hold a few seconds. Otherwise, plunge the parts instantly back into the boiling water and continue the bluing procedure as discussed previously.

**Bluing Small Parts**. Small gun parts such as screws and drift pins are sometimes more difficult to blue than the rest of the gun because they lose their heat quicker when lifted from the hot water bath. One way to overcome this is to have your swab damp with the bluing solution before lifting a part out of the water. Then, immediately after it surfaces, coat the part with the solution. Try to coat the part when it is no more than 1" out of the water.

## SAFETY PRECAUTIONS!

Like most firearm coloring methods, the chemicals used for hot water bluing can be dangerous. Most formulas can be fatal if swallowed and many cause severe burns. Therefore, be extremely careful when working with any of these chemicals. Wear rubber gloves and safety glasses, and avoid inhaling any of the fumes.

If any of the chemicals come into contact with the eyes, flush with water for at least 15 minutes and get medical attention immediately thereafter. If chemicals are swallowed, give water or milk and egg whites if available. Repeat if vomiting occurs and get medical attention immediately.

Keep these chemicals in a safe place away from children or pets or where they may be mistaken for something else. If you mix your own solution, be sure to label the container POISON and keep it in a safe place.

## TROUBLESHOOTING HOT WATER BLUING

Hot water bluing solutions depend upon heat for their action. Therefore, the solution and metal must be kept hot during the entire operation. Work as fast as possible in applying the solution, so that the temperature will not drop rapidly. When the bluing solution is applied, it should dry almost instantly. If it does not, either the solution or the steel is not hot enough. The obvious correction is to raise the temperature of both, but once water boils, that is the highest temperature it can reach. So leave the metal parts in the boiling water longer if they appear not to be hot enough.

If there are small parts which do not "take" the bluing solution readily, you should hold them for an instant over an open flame before applying the bluing solution. You can dip small pins and screws into the hot solution rather than trying to swab it on. Very thin parts such as magazines will not hold the heat long enough as they are, so it is a good idea to fill them with metal blocks, rods, or other clean metal objects to help hold the heat longer.

Steel varies in different guns, and in some cases the bluing solution will be too strong for the gun metal. In this case, when the solution is applied, a heavy brown rust will appear. To correct this condition, weaken the solution with a few drops of distilled water. If the solution is too weak, discard the solution and add fresh solution to the clean jar suspended in the boiling water.

One of the worse problems with hot water and slow rust bluing is the bleed-out of water onto the surface of the metal. Blind screw holes, dovetail notches, and other parts will retain water when the parts are lifted from the boiling tank. This water will eventually dissipate onto the metal surfaces and thin the bluing. Compressed air is the best remedy for this situation. Merely give the trouble spots a shot or two of compressed air to force the trapped water out.

Remember, a good hot water bluing job can be obtained only if everything is just right. The main secret of successful hot water bluing is cleanliness and heat. Therefore, special attention should be given to both.

## SELF-TEST QUESTIONS

Please check your answers on page 18.

5. **What is the name of one type of hot water bluing solution?**
6. **After the cleaning bath, how long should you boil the gun parts before lifting them out of the boiling water and applying the first coat of the bluing solution?**
7. **After the first two coats of hot water bluing solution have been applied, how long should you boil the parts between the remaining coats?**
8. **What must be done to the metal surface between boiling and coating the parts with hot water bluing solution?**

# Slow Rust Bluing

Most experts agree that slow rust bluing produces the most durable blue-black finish obtainable on gun metal. In fact, many manufacturers used this method of finishing on all their guns prior to World War II (Figure 8). Then, as mentioned previously, the hot caustic bluing method became the most logical for mass production. The main problem with slow rust bluing was the time element. It takes from 3 to 10 days to obtain a good slow rust finish on firearms. This time element is too long and, consequently, too expensive for most of today's gunsmiths and customers. However, there are some custom-built rifles that still boast the coveted slow rust finish, as shown in Figure 9. Here's how to obtain it.



***Figure 8:*** *If the gunsmith is called upon to restore antique firearms, a good knowledge of slow rust bluing is essential.*

Use the same preliminary procedures as discussed for hot water bluing; that is, metal preparation, cleaning, etc. Then fill each of two bluing tanks with enough water to cover all parts completely. In one tank, add a cleaning solution according to the instructions on the package; conventional household lye in the proportion of two tablespoons of lye to each gallon of water will work well. Bring the solution to a boil and then put all the parts in the tank and suspend them so that none touches the bottom of the tank. Leave the parts in the boiling solution for about 5 minutes; too long a time will cause premature rusting. Then, immediately transfer the parts into the tank containing the clean boiling water.

Let the parts remain in the clear water for 2 minutes, remove them, then hang them up to dry and cool. At this point, your hands must never touch any portion of the metal which is to be blued. Also make sure that the clean boiling water is kept at a hard rolling boil. When the parts are dry and cool, take a clean cotton swab, saturate it with a slow rust bluing solution, and rub over the parts with smooth, even strokes.

In recent times, there have been so many different slow rust bluing solutions that it is difficult to recommend any one brand. Stoeger's Gunsmith Bluer was a favorite for years before it was discontinued. Then it was once again placed on the market in the early 1980s, only to be discontinued again in 1987. You might try Brownells and Dixie Gun Works for the names of the ones currently available. The one that most gunsmiths use is Pilkington Classic American Rust Blue, which is available from Brownells Inc.

Regardless of the solution used, the process is generally the same. Apply some solution to the swab and squeeze out any excess. With long, even strokes and moderate pressure, swab all areas to be blued. Do not use an excessive amount of solution. The rust bluing solution will also act as a rust remover if too much is applied. After all areas have been covered, hang the parts to rust in a damp, humid place for about 6 hours. In some areas, the air is too dry for the gun to rust properly. Therefore, a steam cabinet must be made to help this rusting process along. The cabinet can be kept simple. The one shown in Figure 10 is made from ¾" plywood with a hinged door. A lamp holder and a 100-watt incandescent lamp are used to heat an enameled pan filled with water. The gun parts are then hung from hooks in the cabinet above the steam to accept the heat and steam. About 1½ hours is all the time necessary to get the parts rusting properly when the steam cabinet is used. Take the parts out of the cabinet after this amount of time, and let them continue to rust for a few more hours outside the cabinet.



***Figure 9:*** *The custom rifle by Bishop was slow rust blued to give the gun metal a durable satin finish, a finish that is currently unobtainable from most factories.*

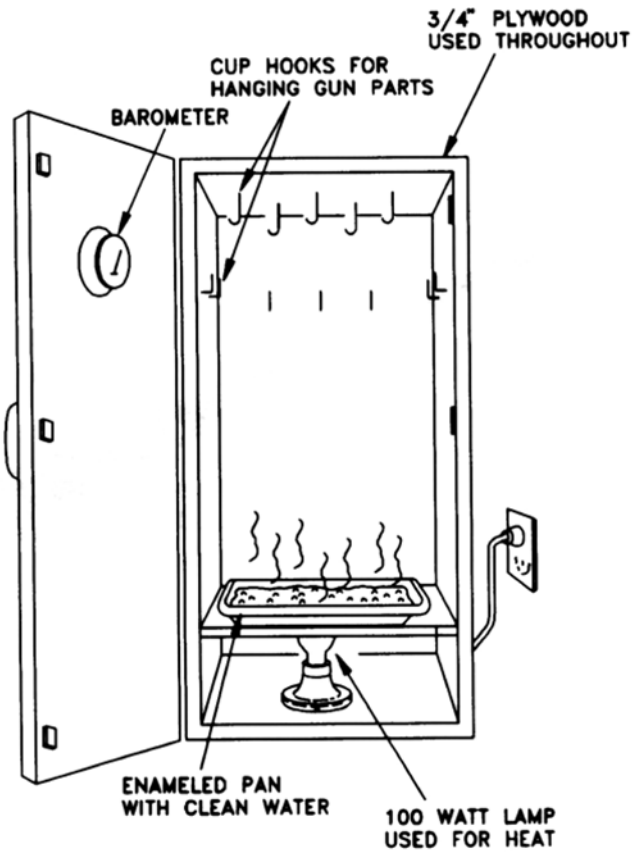



***Figure 10:*** *Details of a slow rust bluing cabinet – necessary in climates with insufficient moisture.*

Applying more bluing solution too soon will cause pitting, so wait at least 3 hours between coats.

Fill one of the tanks with clean water and again bring it to a rolling boil. After all parts coated with the bluing solution have rusted the required length of time, return them to this tank for about 20 minutes. After boiling the parts, hang them up to dry and cool. All accumulated water droplets in corners, screw holes, etc., should be blown away with compressed air. When the parts have cooled, remove all rust with a clean steel wool or a powered wire buffing wheel. For tight places, use a clean stainless steel brush. This first carding may give you any color from a light gray to a light blue; it may be splotched, or uniform. Do not let this bother you. Each succeeding pass will deepen the color and make it more uniform. When all parts are thoroughly carded with steel wool or brush, repeat the application with the bluing solution: boiling, applying the solution, rusting, boiling, and carding.

The number of passes necessary to obtain the desired depth and uniformity of color will depend on the hardness of the metal. You may get by with as few as three passes on 22-caliber rimfire rifles, while nickel- steel barrels might require as many as 10 or 12, but the average will be five passes. After the metal reaches the depth of color desired, give the just-carded parts one more carding — this time using a steel-wool pad, saturated with an oil such as WD-40. Do not be afraid of wearing off the bluing with steel wool; this bluing is so tough you will not disturb it even with steel wool.

For easy reference, here is a checklist of steps to follow when slow rust bluing:

1. Disassemble the gun, separating parts to be blued from those that are not to be blued.
2. Remove all pits and deep scratches by draw filing.
3. Polish the metal parts using abrasive paper from size 80-grit to 500-grit. (See instructions under hot water bluing.)
4. Degrease the parts in a hot lye or other cleaning solution.
5. Boil the parts in clean water.
6. Apply the bluing solution evenly and allow parts to rust from 4 to 8 hours (more if necessary), but never overnight or longer than 12 hours.
7. Card off rust with steel wool, a stainless steel brush, or soft carding wheel on a power buffer.
8. Repeat the last three steps until the desired finish is obtained.

When the job is completed, you will know how much hard, meticulous work was required; and if you did your part well, you will also know that the finish on the rust-blued firearm equals, if not surpasses, the finest finish on any factory-blued model.

Once you have mastered the previously mentioned bluing methods, you will find the popular hot caustic bluing method a breeze to master. However, the other methods will still have a place in the gun shop.

## SELF-TEST QUESTIONS

Please check your answers on page 18.

9. ***True or False*. When using the slow rust bluing method, you should always wait overnight between boiling, carding, and adding new coats of bluing solution.**
10. **When using the slow rust bluing method, what can happen if you apply the bluing solution too frequently?**
11. **How long should the parts be boiled in water after the final application of the slow rust bluing process?**
12. **If your environment is too dry to rust guns parts adequately during the slow rust bluing process, what should be used to correct the problem?**

# Hot Caustic Bluing

Unless you choose to be highly specialized in your gunsmithing work or you plan to do commercial bluing, you will eventually go to the hot caustic method of bluing firearms. This is the process used by the majority of firearm manufacturers, as well as most professional gunsmiths. The number of firearms that can be blued at one time, using this method, is limited only to the size of your bluing tanks.

A relatively good bluing job can be accomplished with just one bluing tank, a source of heat, some cleaning solution, and a few pounds of bluing salts. However, for the best results, especially for the professional, a six-tank system best. Heatbath Corp., Du-Lite Corp., and Brownells Inc. all offer ready-to-install systems, all of which are easy to set up. There are few differences in the various systems and bluing salts available. All produce a "factory-type" finish on gun steel, as shown in Figures 12 and 13. The decision of which system to buy depends on individual preference towards service and price. The quality of the bluing job will depend almost entirely upon the gunsmith.



***Figure 11**: The Du-Lite. multi-tank bluing system is ideal for the professional shop. The same system can be used for hot-water bluing as well as other methods.*

## BLUING EQUIPMENT

Each tank should be at least 8" x 8" x 40" in size for the most efficient work. The tanks should be made of 11-14 gauge black iron or steel welded at the seams. Each tank should also be flanged around the open edges to prevent excess dripping or "creep." The oil tank must have a drain board attached to it and also a rack on which to hang guns and parts while the excess drips off.

A good quality drain plug on each tank also helps enable easy cleaning. If possible, each tank should be connected to a drain. The cold-water rinse tank should have an overflow pipe and a water inlet pipe to provide the best possible work by providing a constant flow of fresh, clean water during the bluing operation.

The operator will need safety goggles or a face shield, a suitable apron, and rubber gloves. Black iron stovepipe wire is the favorite for suspending the parts in the bluing tanks. Never use galvanized wire. You will need an accurate thermometer that reads temperatures from 0º F to at least 310˚ F. A sufficient quantity of bluing salts, alkali cleaner, and hot soluble oil will complete the basic setup. In choosing the oil, be extremely careful to obtain the correct type. Some oils will ignite and are unsafe for heating. At least one gunsmith's shop has burned to the ground due to the oil in the tank igniting. Therefore, use only oils that are designed for hot caustic bluing and follow the directions supplied by the manufacturer or distributor.

Of course, new ideas and techniques are always being developed, but they should be approached with caution until they have been proven both safe and effective.

When using the six-tank system, work left to right with the following sequence of operation:

- Hot alkali cleaner tank
- Cold-water rinse tank
- 285˚ F bluing tank
- 300˚ F bluing tank
- Cold-water rinse tank
- Hot soluble oil tank

The hot caustic bluing process produces a black to blue-black finish on gun steel. The surface condition of the gun part will be the determining factor of the quality of the ultimate finish. Parts to be finished must be absolutely clean and free from oil, grease, and rust.

The gun parts may be cleaned by scrubbing with any good cleaner and hot water. If mild acids are used to remove rust or scale, the parts should be washed in soap and water to neutralize the acid.

With the six-tank system, cleaning is accomplished in tank No. 1, followed by a cold water rinse.



*Figure 12: Different manufacturers use bluing salts from different sources. This Colt Diamondback was blued with salts obtained from Heatbath Corporation.*

**Making the Bluing Solution**. To make a 6" depth of bluing solution, proceed as follows:

1. Start with about 3" of cold water in each bluing tank.
2. Add bluing salts in small quantities, allowing each quantity to dissolve thoroughly before making further additions, until about 30 pounds of material have been added to each tank.
3. Light the gas burner (half capacity at first, increasing as temperature approaches working temperatures).
4. Add cold water slowly through the splash guards (from the reservoir) until the depth of solution is approximately 5" and allow the solution to come to a boil.
6. Continue to add bluing salts to each tank until a boiling temperature of 285° F is obtained in the first bluing tank (tank No. 3). Also add salts to tank No. 4 until the boiling temperature reaches about 300° F.
7. After these temperatures have been reached, they are maintained by adding water slowly from a reservoir to compensate for the water lost through evaporation, making sure a good rolling boil is maintained at all times. Additional bluing salts are added only to maintain the desired working level of the solution.

**Operating Procedure**. The tank setup shown in Figure 14 is good for hot caustic bluing. Clean the parts to be blued by hand or immerse them in hot alkali cleaner. If using the alkali cleaner, never leave parts in for more than one minute or they might rust. Parts can rust in the cold water rinse too; never leave them immersed for more than 30 seconds. After the parts to be blued have been properly cleaned by hand, or with the alkali cleaner in tank No. 1, and rinsed in tank No. 2, they are immersed in tank No. 3 (285° F tank) for 20-30 minutes. The parts are then removed from this tank and transferred to tank No. 4 for another 20-30 minutes. Do not let the parts dry off between tank No. 3 and tank No. 4. The work is then removed and rinsed immediately in cold water in tank No. 5 before placing in tank No. 6 for immersion into the oil bath. Boil the parts in the oil bath for about 20 minutes, then remove them. When they are cool enough to handle, wipe them off with a clean shop cloth. Reassemble the gun and the job is complete.

Barrels, magazine tubes, and similar parts can be suspended in the solution with black iron stovepipe wire. Smaller parts such as screws and pins can be placed in a black iron basket and immersed into the bluing solution. Make sure the basket is not soldered; it must be welded. And do not use galvanized or nonferrous metal.

Caustic bluing solutions are designed for bluing ferrous metals and their alloys only. Aluminum, magnesium, die-cast parts (including most of the investment casting receivers and frames), tin, galvanized metals, brass, and copper cannot be blued with this system. Furthermore, parts that are soldered with lead-tin (soft) solders, such as many of the double-barrel shotguns, cannot be blued by the hot caustic method.

If brass sights are attached to the barrel, they can be immersed without problems, but it is still best to remove them if at all possible.

**Imitation Heat Blue**. Most gunsmiths now use the hot caustic bluing method almost exclusively and seldom have the time to experiment with alternate methods. However, these same gunsmiths are often called upon to restore older firearms when the owner wants an authentic-looking metal finish. One hot caustic bluing formula that gives results close to the original niter blue is as follows:



*Figure 13: Firearms manufactured by the Winchester Repeating Arms (and more recently, U.S. Repeating Arms) have used Du-Lite hot caustic bluing salts almost exclusively.*

To each gallon of pure water add a mixture of:

- 65 oz. sodium hydroxide
- 30 oz. sodium nitrate
- 5 oz. sodium nitrite

To mix, first determine the size of your bluing tank and the amount of water required to bring the water level up to about the halfway mark. Let's say, for example, this requires four gallons of water. Therefore, you would need four times the amount of chemicals described above: 260 oz. of sodium hydroxide, 120 oz. of sodium nitrate, and 20 oz. of sodium nitrite. Mix these ingredients together before adding them to the water. Add the four gallons of pure water to your bluing tank, turn the heat on low, and slowly add the dry powders, a little at a time, stirring the solution to help the chemicals mix with the water. Be sure to use all safety precautions as with any type of bluing: face shield, rubber gloves, apron, etc. If you add the chemicals too fast, the solution will heat too quickly and erupt or boil over. Let the chemicals dissolve slowly. The solution should start boiling at about 285° F. If not, add a little more water; if the solution boils at a lower temperature, add more bluing salts. However, when adding water, use a water shield and let the water trickle into the tank; too much will cause the solution to erupt. Always be cautious when adding either water or salts to the tank — especially water.

Once the solution is at a rolling boil and the temperature is between 285° F and 295° F, degrease the parts to be blued and suspend them in the bluing solution with black iron wires or in a suitable parts basket. Make sure all parts are at least 1" from the tank sides and bottom, and that the temperature of the solution does not rise above 295° F.

The time required to obtain the desired finish will vary with the type of steel. Some gun metal will color within 5 minutes, but other parts may take as long as 30 minutes. Inspect the parts about every 5 minutes until the desired color has been reached.

When the color is deep enough, remove the parts from the bluing solution and immerse them in clean, boiling water for about 5 minutes, let cool, and then oil with any conventional gun oil. You should have a rich blue-black finish very close to the original niter blue found on firearms manufactured 50-100 years ago.

This solution, like most hot caustic solutions, will destroy solder, brass, aluminum, etc. The action of nonferrous metals will also destroy the effectiveness of the solution. Small traces of sulfur in the water will do the same thing.

Be sure to take all precautions and use the recommendations for conventional hot caustic bluing when using this method. Commercial bluing solutions and outfits usually include instructions and precautionary measures.

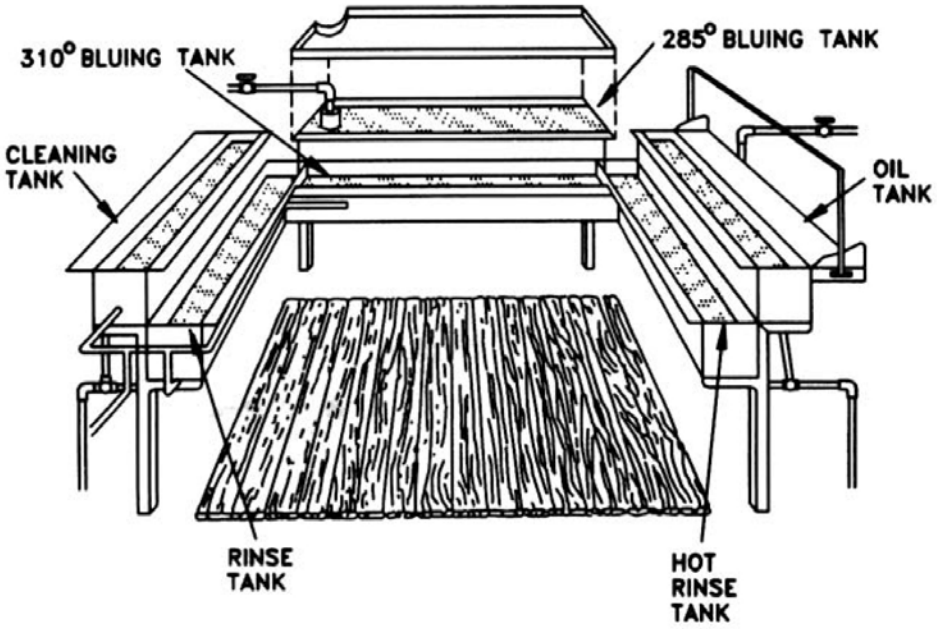



***Figure 14**: A setup like this can be used for niter bluing, hot-water bluing, and hot-caustic bluing.*

## TROUBLESHOOTING HOT CAUSTIC BLUING

Some types of firearms — U.S. Krag, Mauser, and some others — will often come out of the bluing solution with a reddish or purple tint. To avoid this, first bring the bluing salts up to normal operating temperature. This is to make sure that the salts are of the correct concentration. Then lower the temperature of the bath by cutting back the heat of the burners and allow the solution to cool down to about 235° F. When this temperature is reached, immerse the barrel/receiver and other parts in the salt bath. Then turn the heat up slightly and bring the temperature of the bath back up to the normal operating temperature, but make certain this is done very, very slowly. The receiver and other hard parts will blue at the lower temperature and the softer parts at the upper temperature. After the receiver has blued at the lower temperature no harm is done to the surfaces by the higher temperature.

Frequently, a green film will form on the surfaces of the metal parts, caused by the bath temperature being too high for a particular type of metal. This film can be removed by gently carding the metal surface with steel wool and water while the parts are held over the cold-water rinse tank. Once removed, the parts can then be put back into the hot bluing tank and continued to blue after lowering the operating temperature.

To ensure the best possible bluing jobs, closely adhere to the following:

- Clean the oil and film from top of water tanks.
- Use a magnet to check if the parts are steel.
- Keep baskets and black iron wire clean; do not set in oil.
- Avoid bluing springs if possible.
- Wear safety goggles or a face shield at all times.
- Do not allow metals to stay in cleaner or hot rinse too long; doing so will cause rust.
- Do not plug barrels when bluing by the hot caustic process.

## SELF-TEST QUESTIONS

Please check your answers on page 18.

13. ***True or False*. When using the hot caustic bluing method, the bores of shotguns and rifles should be tightly plugged.**
14. **When using the hot caustic bluing method, the lower temperature tank should be heated to approximately how many degrees F?**
15. **When using the hot caustic bluing method, the higher temperature tank should be heated to approximately how many degrees F?**
16. **Name two rifle actions that may turn a reddish or purple color when they are blued by the hot caustic bluing method.**

# Answers to Self-Test Questions

1. The metal must be polished and degreased.
2. 6 to 24 hours.
3. No.
4. The parts must be free of any water or oil to keep the solution from erupting.
5. Belgian Blue.
6. A full 15 minutes.
7. 5 minutes.
8. The loose rust must be carded off.
9. False. The parts should never be allowed to rust more than 12 hours between coats.
10. It may etch the metal and cause pits.
11. 20 minutes.
12. A steam cabinet.
13. False. Bores of shotguns and rifles should not be plugged when using the hot caustic bluing method.
14. 285˚F.
15. 300˚ F.
16. U.S. Krag and Mauser.

# Lesson Questions

THIS IS LESSON NUMBER 2192.

Make sure you print your name, student number, and lesson number in the spaces 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. **What basic mixture did the earliest bluing solution consist of?**
   a. Nitric acid and hydrochloric acid with metal shavings dissolved in it.
   b. Spencer acid with iron nails dissolved in it.
   c. Sulfuric acid with cobalt dissolved in it.
   d. Distilled water and table salt.

2. **What is the most popular bluing method for firearm manufacturers?**
   a. Hot water method.
   b. Slow rust method.
   c. Hot caustic method.
   d. Niter method.

3. **When niter bluing, what solution temperature will give the best results?**
   a. 200˚ F.
   b. 500˚ F.
   c. 550˚ F.
   d. 700˚ F.

4. **When using the hot water bluing method what must sometimes be done prior to applying the bluing solution in order for the metal to "take" the solution?**
   a. The metal should be heated in sand.
   b. The metal should be etched with an etching solution.
   c. The metal should be roughed up with some coarse sand paper.
   d. The metal should be cooled.

5. **Which of the following is an acceptable cleaner for cleaning metal parts prior to bluing?**
   a. Copper sulfate.
   b. Spencer Acid.
   c. Belgian Blue.
   d. Dicro-Clean No. 909.

6. **Which of the following may be used to card the loose rust from metal gun parts during the hot water or slow rust bluing process?**
   a. Steel wool.
   b. Sandpaper.
   c. Oiled rags.
   d. Bench grinder.

7. **When bluing thin items like magazine tubes by the hot water method, what must you sometimes do to ensure that the parts will hold the heat while the solution is being applied?**
   a. Hand-polish the parts.
   b. Increase the temperature of the boiling water.
   c. Sandblast the tubes.
   d. Insert a metal backing rod inside of the tube.

8. **What is currently the most popular slow rust bluing solution?**
   a. Stoeger's Gunsmith Bluer.
   b. Jim's Gun Shop Belgian Blue.
   c. Pilkington Classic American Rust Blue.
   d. Bill's Place Old German Rust Blue.

9. **Which of the following should not be blued by the hot caustic bluing method?**
   a. Soft soldered double-barrel shotguns and guns with soft soldered ribs.
   b. Guns with silver soldered ribs.
   c. Guns with any type of weld on them.
   d. Plain-barrel single-shot shotguns.

10. **To maintain proper temperatures of the bluing solution when using the hot caustic bluing method you will need a good thermometer. What calibration should this thermometer be?**
   a. 0-100º F.
   b. 0-200º F.
   c. 0-250º F.
   d. 0-310º F.