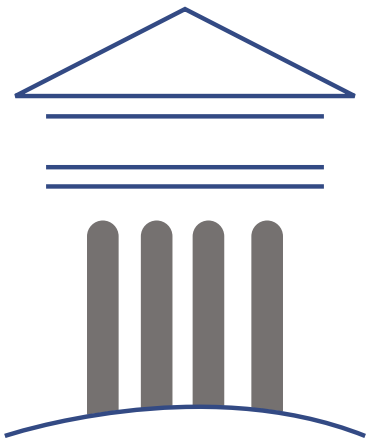
Browning Gun Metal
Lesson: 2193

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Objectives

After completing this lesson, you should

1. Be familiar with the basic browning methods.
2. Understand what atmospheric conditions are necessary in order to produce rust.
3. Know the various name brands that are available for browning gun parts.
4. Have an understanding of the procedures for coloring stainless steel.

Introduction

In the early history of firearms, guns that were exposed to the elements became covered with a brown coating, a result of iron oxide or red rust. When rubbed, the loose, top layer of rust came off, but the stained metal remained brown. Each time the gun metal was rubbed, a deeper and more even hue of brown appeared. This coloring process provided a functional camouflage since the new metal did not flash or reflect light.

The concept of browning—coloring the gun brown by letting rust collect on the metal—was very popular by the 1700s. Many gunsmiths had perfected ways to cause rust to form on the gun metal. Usually, the rusting process was accelerated by using a salt and water solution on the metal. The rust was then removed using steel wool (a process called carding). Numerous coats of the solution were applied to the gun metal, and the resulting rust carded until the preferred color finish appeared.



***Figure 1**: Damascus barrels consist of a combination of forged iron and steel, which is braided in different forms into a band. This band is then wound around a mandrel and welded to form shotgun barrels. The technique has not been used on new firearms since the turn of this century.*

The basic browning process is still used today to restore old firearms to their original finish. Shotguns with twist steel or Damascus barrels, like the ones shown in Figure 1, or muzzle loading firearms, shown in Figure 2, require browning as a part of their restoration. Many modern black powder guns are refinished using the browning process.

The professional gunsmith should have a good knowledge of browning techniques. This lesson describes several browning techniques that are economical and reliable.

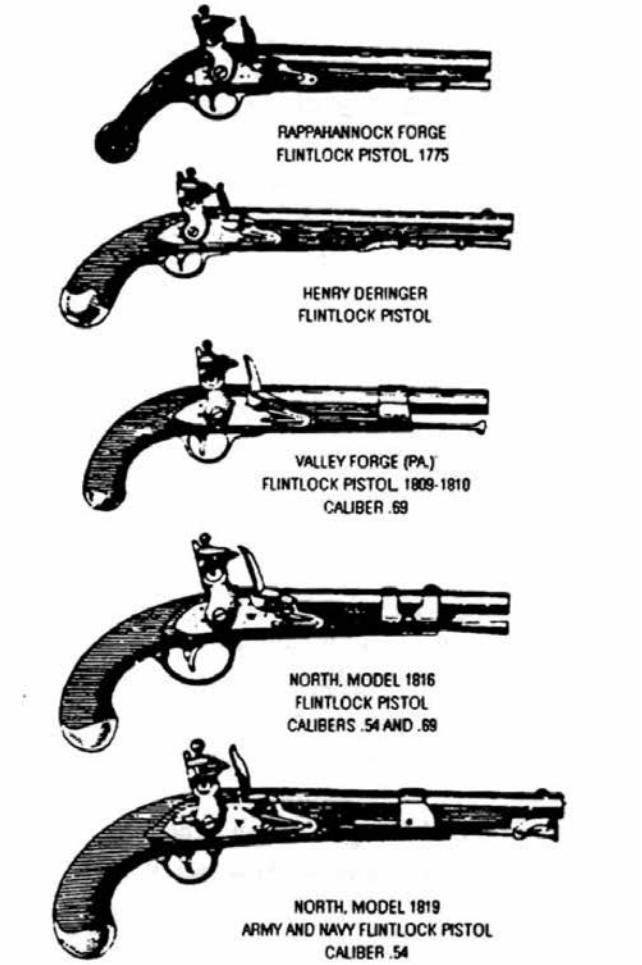


***Figure 2:** Early flintlock pistols all contained a brown, rather than blue or blue-black, finish. The style continued until the latter part of the last century.*

Basic Brown

A simple browning technique requires a solution to table salt and distilled water. Add 5 tablespoons of common table salt to a pint of distilled water. Mix with a glass rod and store in a clean bottle or jar.

The metal to be browned is prepared by removing all the old rust and finish (in the case of refinishing) and by polishing the metal to the preferred luster, either by hand or by using power equipment.

Make two wood dowels that fit in both ends of the barrel. Thoroughly grease the bore with gun grease, pump grease, or similar grease to prevent the inside of the barrel from rusting. Drive the wood dowels tightly into the ends of the barrel, as shown in Figure 3. If the shotgun barrels are thin, do not drive the wooden plugs in too tight; you might split the end of the barrel.

Next, degrease the metal parts with a commercial cleaner or by boiling them in a solution of commercial cleaner and water. Once this is done, your bare hands should not touch the parts until the process is completed. Wear rubber gloves as a precaution, but handle the parts only by the wooden dowels or by black iron wires attached to the parts.

If you have iron tanks large enough to hold all of the parts to be browned, the grease and oil can be removed by boiling the parts in a solution of water and lye, measuring 1 tablespoon of lye per gallon of water.

Once cleaned, liberally swab on the salt solution with a cotton pad or sponge. Make sure that all surfaces are covered. Try to avoid runs and streaks because they will show up on the dried parts.

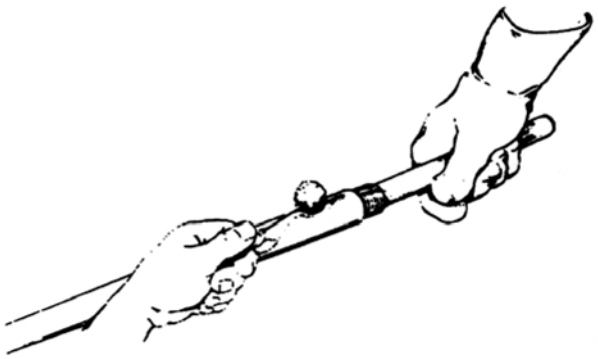


***Figure 3**: Barrels should be plugged with tapered hardwood dowels to prevent water from entering the bore and to allow a means for holding the barrel.*

Let the metal parts rust. If you have a basement that is cool and damp, simply hang the parts there to let them rust for 12 hours or more or until a coat of coarse rust has formed on all metal surfaces. If you live in a relatively dry climate, the rusting process will take much longer. However, you can overcome the elements and construct an ideal setting for browning a gun. Build a small wooden box large enough to hold the metal parts. Line the box with wet burlap sacks. Place the parts in the box so that they are suspended in mid-air – they must not touch the sides or bottom. Cover the box and let the parts rust until the desired coarse rust has formed. This usually takes 6-12 hours.

Use 00 steel wool that has been cleaned thoroughly so the oil that is usually applied at the factory to prevent rust during shipment is stripped off. Card off the rust that has formed on the metal parts. Use a stainless steel brush (that has also been cleaned) to get into tight places. When all of the loose rust has been removed, apply more of the salt solution to the parts and let them rust again until a coarse rust forms on the surface.

Repeat this process 10-12 times or until you get the desired shade of brown. This last carding should be done very thoroughly. Make sure you get every bit of rust off the metal surfaces, around crevices, etc. Then boil the parts in water for about 20 minutes to stop the rusting process. While the parts are drying, immediately coat all surfaces with a good gun oil.

The exact shade that results from the above method will vary. It depends upon the type of metal and the number of times the solution is applied. In general, though, the color of brown is the shade of muddy water. To improve the appearance, soak the parts in a very weak solution of copper sulphate and distilled water prior to oiling the parts. Use a solution of .02% copper sulphate in the distilled water. The resulting finish will be a plum brown, which is desired on antique weapons like old Kentucky rifles.

Since rust browning is not an exact science, the color will sometimes vary to extremes. For example, after the parts are boiled for 20 minutes in water following the last solution coat, the parts might turn blue or blue-black. To absolutely prevent the parts from turning this color (it will not happen often), pour hot water over the metal parts before oiling and do not boil them. Immediately pour the gun oil to the surface, and continually inspect the metal to see if more rust appears. If more rust does appear, card it off and add more gun oil to the metal surface.

DIXIE GUN WORKS FORMULA

Dixie Gun Works Inc. (www.dixiegunworks.com)has a good and inexpensive commercial solution for browning, made according to a 100-year old formula. It can be substituted for the salt water in the salt water solution method or the solution can be immediately applied to heated parts. This solution is especially useful on some Damascus twist barrels.

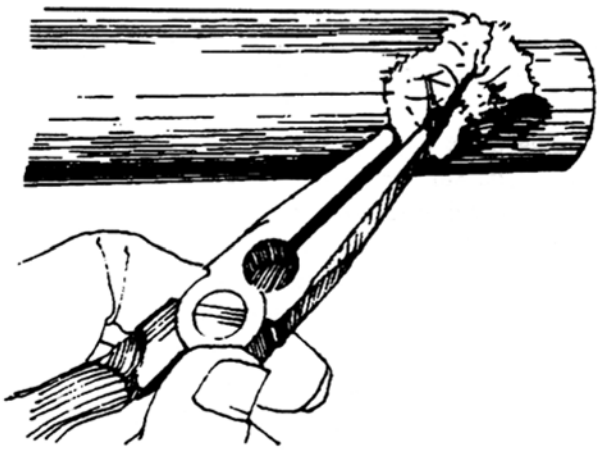


***Figure 4**: A pair of long-nosed pliers is used to hold a clean piece of cotton to apply the browning solution.*

To use the Dixie Browning Solution, first prepare the metal surfaces by polishing. Grease the bore and plug the barrel with wooden dowels. Drive the dowels in tightly, but loose enough for easy removal. Degrease the parts with a solution of baking soda and water. Once the parts are degreased, wash them with clean water and let them dry. As with all rusting types of bluing, the parts must not be touched with bare hands during the browning process. Handle the parts by the wooden dowels or use iron wires. Wear clean cotton gloves or rubber gloves to make sure your skin does not come into contact with the parts.

Holding a clean cotton swab or a cotton ball with a pair of long-nosed pliers, as shown in Figure 4, or a clothes pin, dip the cotton into the browning solution and squeeze it against the side of the bottle, leaving only a small amount on the swab. Apply the solution to the gun parts sparingly and evenly until all surfaces are covered. In 6 to 12 hours, a thin red rust will form on the metal surfaces. (In extremely dry areas, construct a "sweat box" as previously described).

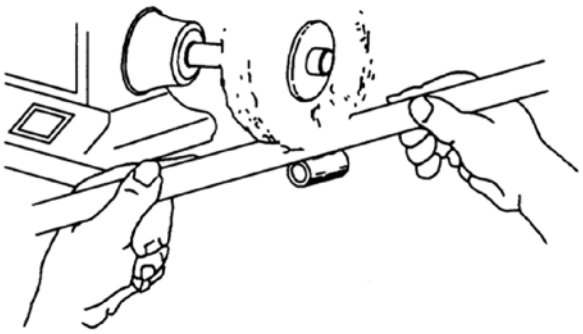


***Figure 5**: Steel wool can be used for carding the loose rust between browning applications, but a power-driven wire wheel is better – especially for the last carding operation.*

Once rusted, card the parts with 00 steel wool and a stainless steel brush until all of the loose rust is removed, as shown in Figure 5. Do not remove too much rust or you will expose the bare metal. Remove only the loose rust. Practice will determine just how much rust to remove. Repeat the application and carding processes until the preferred shade of brown appears. However, do not wait as long (6-12 hours) between cardings as you did for the first coat.

The final carding should be done very thoroughly. Stop the rusting process by boiling the parts for 20 minutes in water or by wiping very carefully with hot soapy water.

Let the parts dry and then coat them with lubricating oil. When the parts cool, wipe off excess oil and let them stand in a warm room for 24 hours before handling.

Dixie Gun Works explains that, with a little practice, anyone can turn out a professional-looking job with this browning solution. It is even possible to bring out the twist steel patterns frequently found in old Damascus shotgun barrels.

The color and rusting time required will depend on the humidity, room temperature, and the type of steel or iron being browned. The process can be hastened by heating the part. Heating the part to be browned produces an instant brown color, but this color might not be as durable nor as attractive as the color produced by the slower process.

LAUREL MOUNTAIN BROWN

The Laurel Mountain Forge Barrel Brown and Degreaser, shown in Figure 6, is available from Brownells, Inc. Again, the metal parts to be browned must be prepared the same way as any other metal parts prior to browning. The surface of the metal must be perfect before the browning solution is applied.

In most methods of bluing or browning gun metal, it is necessary to make sure that all parts are absolutely free of grease, oil, or foreign matter. Once the procedure starts, be careful not to touch any of the parts to be browned with your hands. The Laurel Mountain solution has a degreaser included in the solution, but it is still recommended to degrease the metal before applying the solution.

Begin by oiling the bore of the gun to prevent the inside from rusting. Seal the bore with tightly-fitted plugs made of rubber, plastic, or wood.

To apply the solution, use a piece of cotton cloth folded in a pad four layers thick and about one inch square. Moisten the pad thoroughly with the browning solution and apply it to the barrel. Be sure to apply the solution in long, even strokes from muzzle to breech. After applying this first coat of browning solution, set the barrel aside for three hours to allow the solution to work. Then apply a second coat. Make certain your applicator is only damp. If too much solution is applied after the first coat, it might remove some of the previous coat, causing the finish to be uneven or spotty.

After leaving the second coat on for three hours, rub the surface of the barrel or other metal part with a piece of coarse cloth, like an old towel, dipped in hot tap water. This removes the surface scale that has built up and "evens" the brown; it is similar to carding in conventional slow rust browning methods.

After scrubbing the barrel, flood the surface with hot tap water and dry. Do not boil the parts. The surface will turn black, rather than brown, when boiled. Repeat the cycle of applying the browning solution, leaving it on the part for three hours, and scaling the barrel until the desired color has been achieved. This will probably take 4-5 coats.

If you cannot get back to work within three hours, do not apply another coat after scaling. Just scale the barrel and put it aside until you are ready to resume browning.

To stop further action after achieving the desired finish, scrub the surface of the barrel using hot tap water with a little baking soda. Rinse the barrel with clear warm water and allow to dry. To finish the barrel, apply wax or boiled linseed oil.

If a rougher antique finish is desired, apply wet coats of the browning solution to the surface at 12-hour intervals. When leaving the solution on the metal this long, usually 2-4 coats is sufficient, depending on climate conditions. To maximize roughness, do not scale the surface between coats. After the desired depth of color has been obtained, wash the browned parts with water and baking soda in the normal manner to stop further browning. This method works especially well on small parts.



***Figure 6**: The main items for browning gun steel with the Laurel Mountain Forge Barrel Brown and Degreaser are the browning solution, applicators, and the parts to be browned.*

If you would rather have a rust blue finish instead of a brown finish, the Laurel Mountain solution can still be used. Just boil the parts in pure water between scalings. Boil each part for five minutes or until the finish darkens. Scale the parts as discussed previously. Repeat the process until you have the desired hue.

BROWNING OLD MILITARY ARMS

During the mid-1800s, the U.S. armories browned the barrels of all rifles, like the 1873 Springfield shown in Figure 7, prior to releasing them to service. However, the locks, ramrods, band springs, triggers, and screws were not browned during this period. They were normally case-hardened and oiled.

The solution used by U.S. armories during this period contained the following ingredients:

- 1½ oz. grain alcohol
- 1½ oz. tincture of ferric chloride
- ½ oz. mercuric chloride
- 1½ oz. ethyl nitrate
- 1 oz. copper sulfate
- ¾ oz. nitric acid

Mix and dissolve these ingredients in a quart of soft water; store in a dark glass bottle.

In mixing this solution, you may have trouble finding ethyl nitrate. This chemical has recently been taken off the market. Several experts prefer to omit this chemical since the results are the same with or without ethyl nitrate. However, the process might take a little longer if ethyl nitrate is not used. Many gunsmiths prefer to use a 2% nitric acid solution in distilled water, which produces the same results as the ethyl nitrate solution.

Polish the parts to be browned in the usual manner, then carefully clean them. A small quantity of powdered lime rubbed over the entire barrel will degrease the metal sufficiently. Use wooden plugs to plug the muzzle of the barrel and the vent hole.

Apply the solution to the barrel in even strokes, using a clean sponge or rag. Expose the barrel to air for 24 hours, then card it with steel wool or a wire brush, removing all loose rust. Be careful not to remove the stain on the metal beneath the loose rust.

The mixture is then applied again to the metal, and, in a few hours, the barrel is sufficiently corroded for carding. The same process of carding the metal and applying the solution should be repeated 2-3 times a day for 4-5 days, by which time the barrel will be dark brown.



Figure 7: This Model 1873"Trapdoor" Springfield rifle was browned at the United States Armories before it was released to troops. If you want to restore such firearms, you must know how to brown gun metal.

When the barrel is sufficiently brown and the rust has been carefully removed from every part, about a quart of boiling water should be poured over all parts so that the action of the acid mixture upon the metal is destroyed, and the rust is prevented from rising. When the barrel cools, it should be rubbed with linseed oil.

You might want to varnish the browned gun parts after applying the linseed oil. To do so, mix one ounce of shellac with .1857 ounce of dragon's blood (resin extracted from fruit) and a quart of alcohol. Apply to the browned metal.

To remove old browning, varnish and grease the parts, and plug the vent and the muzzle of the barrels. Immerse the browned parts for one hour in boiling lime water or lye (about one tablespoon per gallon of water). Wipe dry and put the barrel and other parts in vinegar, held in a plastic trough, for about 45 minutes. The browning can then be rubbed off with a rag.

INSTANT BROWNING SOLUTIONS

There are several instant browning solutions, like the one shown in Figure 8, and they are basically used the same way. In general, the parts to be browned are first polished and cleaned. A propane torch or other heat source is then used to slowly heat the parts just enough to "spat" a drop of water (about the same temperature as a regular clothes iron). After reaching the correct temperature, the browning solution is applied in thin, even strokes with a cotton swab. The surface of the metal is then left to rust for about 15 minutes.

Flush the surface of the metal with hot water. When dry, lightly card off the loose rust that appears. Heat the metal once again, and apply the browning solution as before. Let the solution work on the metal for 10-15 minutes. After this, flush with hot water and card. Repeat these steps until you have the desired finish.

When using the instant browning solutions, the manufacturer recommends not to cover a very large area all at once because the metal must be evenly warm to accept the finish. One of the best sources of heat is an old kerosene lamp held under the metal parts until they reach the preferred temperature. Although you can use a propane torch, the part can get too hot and the finished job will be spotty.

Remember that most of the chemical browning solutions are poisonous and can be harmful if misused. Read and follow the instructions on each container carefully.

SPECIAL CASES

Twist steel or Damascus barrels are ideal candidates for browning. Browning brings out the beautiful wavy patterns of the twist. However, after using any of the slow rusting methods described previously for the twist steel or Damascus barrels, the patterns might not show up very well. In these cases, additional treatment is necessary to bring out the full beauty of the twist pattern. First, rub the barrels with a linen rag that is coated with chalk paste or any fine abrasive powder. Wipe the barrels clean and oil with gun oil or use conventional paste wax. However, for such specialized work, the gunsmith must have sufficient experience before attempting to work on a very detailed, fine arm. Since there are so many pattern variations, a gunsmith has to know and recognize the pattern in order to solve a specific problem.



Figure 8: Birchwood Casey Plum Brown Barrel Finish is one of the many instant browns on the market.

MARK LEE EXPRESS BROWN

The Mark Lee Express Brown #2 formula is becoming very popular with professional gun shops for obtaining either a soft, velvety sheen or a high luster brown on firearms of all types.

To use the Mark Lee formula, first prepare the metal surface as discussed previously: polish and degrease. Degreasing is essential in getting fine results. Pre-clean the parts by soaking them in a solvent, such as lacquer thinner. After this, soak the parts in an industrial strength alkali cleaner such as Brownells' Dicro-Clean No. 909. Scrub the parts with a brush during the cleaning process.

Remove the parts from the cleaning solution with tongs or hooks; never touch them with your bare hands at any time during the browning process. Rinse the parts with hot water and then immediately dry with compressed air, a hair dryer, or blot them with paper towels. Wear either clean cotton gloves or surgical gloves during the entire operation to prevent body oils from contaminating the metal.

To continue the browning operation, you will need the following:

- Cellulose sponge or cotton swabs
- Small plastic or glass container
- Propane torch, heat lamp, or some other heat source
- Fine steel wire brush (.003"-.005") or very fine degreased steel wool

Pour the browning solution into a small glass or plastic container. Warm the metal parts to be browned to about 200˚F with your heat source. Dip your applicator (sponge or cotton swab) in the browning solution and apply very thin coats to the warmed parts. A coating of rust will immediately form. Allow the solution to dry (approximately 30 seconds). Now use fine (0000) steel wool to remove the loose residue on the metal. Make sure all residue is removed, but do not rub too hard or you will remove the faint brown color underneath.

Warm the parts again, apply a thin coat of the browning solution, let them dry, and then remove the loose residue with steel wool. Repeat this step 6-10 times until the desired color develops.

Almost any shade of brown to black can be obtained with the Mark Lee formula by using hot water and varying the number of coats applied. For example, if you want a deep brown color, apply the browning solution to the warm parts as discussed previously. After building four to six coats on the metal parts, continue to apply addition coats, but rinse the parts in very hot tap water between each application. If you want black parts, boil the parts for about 20 minutes after the last coat.

Once you have the shade on the metal parts that you want, you must neutralize the browning action. To do so, soak the browned parts for 1½ hours in a solution of 1½ pounds of baking soda to each gallon of water at room temperature. After soaking, remove the parts, rinse with hot water, and dry. If necessary, remove any remaining residue with a terry cloth towel, fine steel wool, or a wire brush. To complete the job, oil the parts with a good gun oil.

WATER FOR BROWNING

Many experts believe that pure water is absolutely necessary for the best browning and bluing jobs. Chemicals added to city water supplies might have an adverse effect on the final results, such as visible light streaks. Hard well water can do the same thing. In the slow rusting methods of bluing or browning, using distilled water is highly recommended. If you only do the occasional bluing or browning jobs, then it would be best to just purchase several gallons of distilled water.

Another way to get pure water is to have your pharmacist order a water deionizing column. This is a clear plastic, cylindrical container packed with purification crystals. There are couplings at either end for surgical tubing. Simply run tap water slowly through the column into a clean receptacle — a clean plastic or glass jug works well. Deionizing columns come in various sizes; the larger the column, the greater the expense. However, if you plan to do a fair amount of browning or rust bluing, the money spent is worth it.

A filter can be connected to the plumbing to purify the entire water system for a faster rate of water supply. Of course, this type of filter is quite expensive. For a gun shop that turns out many rust-blued jobs each week, a high-end water filtration system is the best way to go.

SELF- TEST QUESTIONS

Please check your answers on page 14.

1. **What are wooden dowels used for when browning firearms?**
2. **What is the purpose of steel wool when browning firearms?**
3. **After polishing and cleaning the surface to be browned, what is the next step before instant brown solution is applied?**
4. **If it is too dry in your area to rust the metal for browning properly, what can be used to accelerate the rusting process?**

Coloring Stainless Steel

Stainless steel barrels are not new. The Winchester Repeating Arms Co. introduced stainless steel barrels for their famous Model 12 slide-action shotgun, shown in Figure 9, many years ago. Cold mineral acid was sometimes used on stainless steel barrels to color them. However, contamination of the surface from smut and the possibility of dimension loss have made the use of acid obsolete in coloring gun barrels. When the blackening wore off these barrels, most gunsmiths of the day used flat black paint and did not oxidize the steel.

However, in the past twenty years, many stainless steel guns have come out on the market. Many of these are left in their natural "mill finish," while others have been colored by a blackening process.

One blackening method used for stainless steel guns is known as the Du-Lite 3-0 process. To set up the Du-Lite 3-0 process to blacken stainless steel, you need equipment similar to what is used in the conventional hot caustic process. You need an alkaline cleaning bath (Du-Lite #45 or an equivalent) heated to 180˚F or higher with an active running water rinsing tank. A surface activator solution, either hot or cold, is also needed.

In general, a Du-Lite 3-0 blackening bath is made in an externally heated steel tank. Concentration of the bath must be regulated to obtain a boiling solution (240˚-250˚F). This will require 4½-5 pounds of Du-Lite 3-0 salts per gallon. A convenient method of making up the bath is to fill the tank to about one-half of final capacity, then add 3-0 salts with constant stirring until the desired temperature of the boiling solution is obtained. Continue to add salt and additional water until the working level of the solution is reached. With 400 series steels, the best result is usually obtained at a boiling point of 245˚F or above. With 300 series steels, a temperature of 240˚- 245˚F usually is most satisfactory. If the temperature is too low and the bath is boiling, add more salts.

If steels in the AISI 400 series (no nickel) are to be processed and rigid dimensional tolerances are to be observed, color these steels with Du-Lite Aldak 30, an alkaline medium. The solution is made at a strength of 3 to 4 pounds per gallon. It is contained in an externally heated plain steel tank and the temperature must not exceed 240˚F. The 400 series steel is placed in the hot Aldak 30 solution and held there until a gray cast appears. This should only take about 15 minutes. Remove the work at once, rinse in cold running water, and then place in the 3-0 boiling blackening bath for 30 minutes. When the color is satisfactory, the work is removed, dried and left unfinished, or lightly brushed on a Tampico Wheel.

EBONOL SS-52

Ebonol SS-52 is another alkaline, oxidizing-type blackening compound, which produces black coatings on stainless steel and high-alloy steels normally difficult to blacken. Ebonol SS-52 solutions produce a mixed oxide-sulfide black coating by simple immersion.

The appearance of the black finish is dependent upon the surface of the steel being coated. Shiny black coatings are produced on buffed or polished surfaces. Uniform matte coatings are produced on brushed or etched surfaces.

The dimensional changes involved in blackening are extremely small (less than 0.01 mil.). The thickness of the black oxide coating ranges from 0.06 to 0.1 milliliters.

Ebonol SS-52 is supplied as a powder and is shipped in 30-, 125-, and 400-pound drums. The powder is dissolved in water to make the operating solution about 4¾ pounds of powder to one gallon of water. The operating temperature is 250˚-260˚ F, and the metal is colored within 5-15 minutes.

Mixing. Clean the tank thoroughly before making up the solution. Be sure all rust and scale is removed since rust will dissolve in the blackening solution and will tend to redeposit on the work, causing a red film.

Fill the tank about half full with cold water. While stirring with an iron paddle, slowly add 4¾ pounds of Ebonol SS-52 for each gallon of final solution. Continue stirring until the salts are almost completely dissolved; no solid lumps of salts should be on the bottom of the tank.

Add water to raise the level two inches above the desired solution level; do not fill to the final level because the solution expands on heating. Apply heat, and continue to stir until the solution comes to a boil. The Ebonol SS-52 solution should



Figure 9: *The Winchester Model 12 slide-action shotgun was one of the first firearms to come from the factory with a stainless steel barrel. This same model, however, was also offered in conventional Winchester Proof Steel.*

start to boil at 250˚F. If boiling occurs below 250˚F, slowly add Ebonol SS-52 salts while heating until the desired boiling point is obtained. Then, lower the heat input so that the solution boils gently.

Temperature. The blackening solution must boil within the recommended operating temperature range, 250˚-260˚F. The solution will boil at other temperatures if the concentration of the salts is not correct, but successful blackening will not occur.

As water evaporates from the bath, the solution will become more and more concentrated and the boiling point will rise. When the boiling point reaches 260˚F, water must be added to dilute the solution, which will lower the boiling point to 250˚F. Do not try to adjust temperature by means of heat input. The temperature of a liquid in an open container cannot exceed its boiling point. Control of the boiling point is done only by the addition of water (or salts if the boiling point is too low). The heat should be adjusted so that the solution always boils with a gentle roll. However, when adding water, remember that the solution operates above the boiling point of water. Be careful when adding water to avoid spattering and eruption of the solution.

The boiling point is controlled by the addition of water. Thus, an automatic temperature controller which regulates water input instead of heat input will maintain both the correct boiling point and the correct concentration of Ebonol salts.

Operation. Work to be blackened must be clean and free of all rust and scale. The following cleaning cycle is recommended:

- Soak clean in hot alkaline cleaning. Rinse in running water.
- Activate in 50% muriatic acid at room temperature for 30 seconds-5 minutes.
- Rinse in running water.
- Blacken in Ebonol SS-52 for 5-15 minutes at
- 250˚-260˚F.
- Rinse in running water.

It is important that the steel is properly activated prior to blackening. The required immersion time in the 50% muriatic acid varies from 30 seconds to 5 minutes, depending upon the particular alloy and any surface treatment it might have undergone.

COLORING MISCELLANEOUS METALS

As more aluminum and other non-steel parts are used in modem firearms, more and more gunsmiths are faced with the problem of coloring the non-steel parts while the rest of the gun is blued. Aluminum parts absolutely cannot be put through the hot caustic bluing tanks because they will melt. Anodizing is the only way aluminum can be "blued."



***Figure 10**: Birchwood Casey Aluminum Black is used like cold touch-up blue.*

Anodizing is the process by which aluminum is coated with a layer of oxide by giving the aluminum electric charge in an appropriate solution. The process is conducted in either a chromic acid or sulfuric acid solution. The chromic acid process is seldom used to color gun parts because the parts are usually dyed black. In each method, the hardness and porosity of the coating can be controlled by the concentration, temperature, and current density. The protective value of the coatings can be improved by sealing, which consists of treatment with hot water containing chromates, or with live steam. This hydrates part of the aluminum oxide and seals the pores. Coatings made in sulfuric acid can be dyed with organic compounds to produce colors (many of which are resistant to sunlight).

Unfortunately, the expense of setting up a complete anodizing system is too great for the average gun shop. However, there are ways of achieving the same results without the anodizing system.

The most obvious solution is to send the aluminum parts to firms specializing in anodizing aluminum, and do the remaining work on the steel parts (bluing or browning) in your shop. When you get the parts back (in about 30 days) you can combine them with the parts you blued to reassemble the gun.

Birchwood Casey's Aluminum Black, shown in Figure 10, is one blackening agent on the market that is used like cold touch-up blue. It produces a gray to black finish immediately and requires no special equipment. It is hard to get an even finish on large parts and should be used only for touch-up work.

To use Birchwood Casey's Aluminum Black, first degrease the part with some type of cleaning solvent. Remove the oxide with 00 steel wool before applying the solution. Once the surface is clean, apply the Aluminum Black solution generously to all surfaces with a cotton swab. Allow one minute for the chemical to work and then wipe lightly with a clean cotton cloth until the surface is dry. After it is thoroughly dry, polish the surface with a clean, soft, dry cloth to remove the adhering powder.

If a darker shade is preferred than was obtained with the first coat, apply more solution, wipe dry, and polish again. These steps can be repeated as often as necessary until the desired color is obtained. Apply a wax or oil to the surface once the last coat is applied.

From time to time, the gunsmith will be asked to color certain gun parts a color other than black or blue-black. These jobs will be infrequent, but it is good to know how to do this. The following formulas and methods have been used over many years successfully. However, some experimentation might be required to obtain the desired color, shade, etc.

CAUTION: Please bear in mind that many of the chemicals used in the following formulas are dangerous for home use. Whenever possible, have them mixed by a pharmacist, chemist, or other qualified person.

Blackening Aluminum. Mix the following solution to blacken aluminum:

- 1 oz. of white arsenic
- 1 oz. of iron sulphate
- 12 oz. of hydrochloric acid
- 12 oz. of distilled water

Mix the dry powders first and then add the acid. Carefully and slowly, pour the acid solution into the distilled water.

Clean the aluminum part to be colored with pumice and water and then place it in a commercial cleaner such as Dicro-Clean No. 909 and rinse immediately. Immerse the part in the above solution, which should be slightly warmed, until the part turns black. Polish lightly with fine steel wool and wax or oil.

Blackening Brass. Dissolve bits of copper scraps in nitric acid diluted with an equal amount of distilled water in a glass container. Be careful with the nitric acid because it is extremely caustic. Do not breathe the fumes! Immerse the brass object in the solution until it turns the desired hue. Remove and wash well with water. The brass will be a dull black. If a sheen is preferred, rub the finish with linseed oil.

Black on Brass. Dissolve 1 oz. copper nitrate in 6 oz. distilled water and apply to the brass. Heat the brass. By heating, the copper nitrate changes to copper oxide, producing a permanent black finish. Instead of heating, the following solution can be applied over the copper nitrate coating:

- 1 oz. of sodium sulfide
- ½ oz. of hydrochloric acid, concentrated
- 10 oz. of distilled water

Mix by first dissolving the sodium sulfide in the distilled water and slowly add the hydrochloric acid to the mixture. When applied to the copper nitrate coating already on the metal, it changes the coating to black copper sulfide.

Golden Matte on Brass or Copper. Carefully immerse the object in a solution of one part concentrated nitric acid and three parts water in a glass container. Rock the solution gently. Wipe the object clean under running tap water. When dry, polish the surface with wax or lacquer.

Antique-Green Patina on Brass or Copper. To obtain this type of finish, mix the following solution:

- 3 oz. of potassium bitartrate (cream of tartar)
- 1 oz. of ammonium chloride
- 7½ oz. of copper nitrate
- 3 oz. of sodium chloride (table salt)
- 13 oz. of boiling water

Dissolve the salts in the boiling water and apply the hot solution to the object with a piece of sponge or clean rag wrapped on a stick. When the desired effect is obtained, wash and dry.

Another method of achieving the antique-green patina finish on brass is to paint the object daily for three or four days with the following solution:

- 3 oz. of copper carbonate
- 1 oz. of ammonium chloride
- 1 oz. of copper acetate
- 1 oz. of potassium bitartrate
- 8 oz. of strong vinegar

Yellow-Orange, Blue, Red-Brown on Brass. To get colors ranging from yellow to blue, immerse the object in the following solution. Increase the concentration for more blue tones.

- ½ oz. of sodium hydroxide (lye)
- 1 oz. of copper carbonate
- 24 oz. of hot water

If you want red-brown shades, briefly dip the object in the following solution:

- ¼ oz. of copper carbonate
- 7½ oz. of household ammonia
- ¼ oz. of sodium carbonate (baking soda)
- 48 oz. of water, near boiling

Cold-rinse the object and dip for a moment in diluted sulfuric acid (very carefully). Experiment for different shades.

Bronze on Copper. Mix the following solution to get a bronze finish on copper.

- 1½ oz. of ferric nitrate
- 1-2 oz. of potassium thiocyanate
- 32 oz. of distilled water

Heat the solution. The metal object must also be heated before immersing in the solution. This can be done by dipping the object in hot water. When the object is hot, dip in the chemical solution until the color is satisfactory. Rinse in running water and dry in the breeze of a fan.

Red-Bronze to Brown on Copper. To change copper to this color, mix the following solution:

- ½ oz. of sulfurated potassium (liver of sulfur)
- ¾ oz. of sodium hydroxide (lye)
- 32 oz. of distilled water

Heat the solution and dip the object in it. When the preferred color appears, rinse, dry, and lacquer.

Steel-Gray on Aluminum. To change aluminum to this color, mix the following:

- 8 oz. of zinc chloride
- 1 oz. of copper sulfate
- 32 oz. of boiling water

Immerse the object in this solution until the preferred tone is obtained. Rinse the parts carefully in a 2% solution of lye in water and then rinse thoroughly in clear water.

Near-White and Matte Colors on Aluminum. A soft-etched, imitation anodized finish on aluminum can be achieved by dipping the part in a solution of 1 tablespoon or more of lye to a pint of water. To color the aluminum, dip the part in a household dye solution. Rinse in hot water, dry, and coat with wax or lacquer.

SELF-TEST QUESTIONS

Please check your answers on page 14.

5. **What is the name of the stainless steel blackening process distributed by Du-Lite?**
6. **What is the minimum temperature recommended for the Du-Lite #45 alkaline cleaning bath?**
7. **What is the minimum temperature recommended for the Du-Lite 3-0 blackening bath?**
8. **What is the maximum temperature recommended for the Du-Lite 3-0 blackening bath?**

Answers to Self-Test Questions

1. To plug the bores to keep browning solution and water from entering; plugs are also used to handle the barrel without touching the metal.
2. Steel wool is used to card the loose rust during the browning process.
3. The metal surface must be heated to about 200˚F.
4. A sweat box enables the parts to rust faster.
5. Du-Lite 3-0 process.
6. 180˚ F
7. 240˚ F
8. 250˚ F

Lesson Questions

THIS IS LESSON NUMBER 2193.

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. **When using the various instant browning solutions on the market, how hot should the metal be before applying the solution in even strokes?**
   a. Hot enough to change the metal surface color to a straw yellow.
   b. Hot enough to barely "spat" water when a drop is applied to the surface.
   c. Hot enough to change the metal surface color to a light blue.
   d. Hot enough to change the metal surface color to a dark cherry red.

2. **What is one atmospheric condition that is required to rust brown gun metal?**
   a. Moderate to high humidity.
   b. Low humidity.
   c. A very dry climate.
   d. An extremely cold climate.

3. **Besides polishing the metal, what do all browning methods have in common?**
   a. The browning solution mixture.
   b. The temperature of the solution.
   c. Degreasing the parts.
   d. Nothing.

4. **What are two conditions that control the final color of steel when using the Mark Lee Browning solution?**
   a. The time period of carding.
   b. The time period between coats.
   c. Number of coats and water temperature.
   d. The amount of solution applied on each coat.

5. **Wooden dowels are used when browning firearms to**
   a. Keep from burning the hands.
   b. Plug the barrels and offer a means of handling the parts without touching the bare metal.
   c. Test the browning solution prior to applying it to the steel.
   d. Spin-polish the barrel prior to applying the solution.

6. **When using the instant browning solutions to brown gun metal, what usually happens if the metal gets too hot prior to applying the browning solution?**
   a. The final finish is usually uneven with unwanted streaks.
   b. The solution will not take; the metal will remain white.
   c. The metal will turn a blue-black instead of brown.
   d. The metal will brown faster, allowing you to finish the job quicker.

7. **If your water supply has chemicals in it that may adversely affect the quality of your browning jobs, which of the following is one good solution to the problem?**
   a. Purchase distilled water or connect a filtration system to your water supply.
   b. Write a letter to the utility company.
   c. Change utility companies.
   d. Move to a different location.

8. **Two brand names of stainless steel blackening processes are**
   a. Birchwood Casey and Laurel Mountain.
   b. Mark Lee and Dixie Gun Works.
   c. Du-Lite 3-0 and Ebonol SS-52.
   d. G596 and Express 400.

9. **What is the operating temperature range of the Ebonol SS-52 process?**
   a. 120-150˚F.
   b. 250-260˚F.
   c. 285-295˚F.
   d. 300-310˚F.

10. **If the temperature of the Ebonol SS-52 solution gets above the recommended operating temperature, what must be done to lower it?**
   a. Lower the heat of the burners.
   b. Add more of the SS-52 powder.
   c. Turn the heat up to evaporate water from the solution.
   d. Add water to the solution.