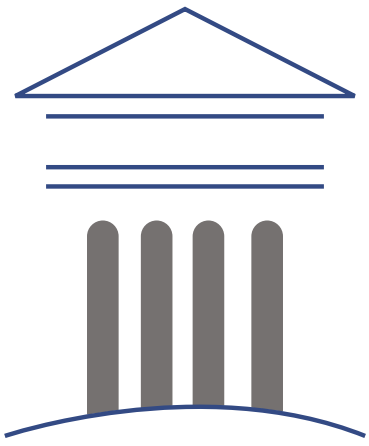
Parkerizing and Plating Lesson: 2194

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Beautiful engraved metal plates by Wm. Gamradt.

Objectives

After completing this lesson, you should

1. Be familiar with the advantages of nickel plating.
2. Fully understand the process of electroless plating.
3. Know the difference between Parkerizing, bluing, and browning.
4. Understand the different procedures for obtaining a satin and a high-gloss finish.

Introduction

Metal plating has been applied to firearms, mainly on handguns, for quite some time. However, with the appearance of stainless steel handguns and rifles, the metal plating process has lost some ground in the past few years. Still, most gunsmiths will get calls for plating jobs (mostly handguns) from time to time, and every practicing gunsmith should at least have a good knowledge of how the various jobs are accomplished.

There are firms that specialize in metal plating, and many gunsmiths merely farm out the work to these firms, rather than setting up for this process themselves, especially if the gunsmith has only a few plating jobs each year.

Parkerizing is another metal coloring technique that was first used by the U.S. Government on their Springfield service rifles to provide a more durable, rust-preventing finish than was possible with bluing or other metal-finishing processes of the time. The process consists of boiling the gun parts in a solution of powdered iron and phosphoric acid. In the process, minute particles of the parts' surface are dissolved and replaced by insoluble phosphates which give a gray, nonreflective, and rust-resistant finish. When Cosmoline is applied immediately after the process, the finish often turns green.

While Parkerizing is considered by many to be less attractive than conventional bluing on highly-polished steel, it is far more practical from a military point of view.

Some private firms are now specializing in Parkerizing firearms and most are doing a substantial business in restoring military weapons and giving porting firearms a nonreflective matte finish.

This lesson is designed to familiarize you with both techniques; that is, metal plating and Parkerizing. A good knowledge of both will put you one step closer to being a professional gunsmith.

Metal Plating

Nickel plating has long been a favorite finish for many handguns. It provides decorative effects, protection against rust and corrosion, and a wear-resisting surface. Although nickel has been the traditional favorite, other metals such as chromium, gold, silver, brass, and copper are also used. Chromium, for example, when applied to metal gun parts provides a surface harder than the hardest steel. It protects the base metal, reduces wear, lessens friction and, at the same time, provides an attractive appearance.

Most metal plating is accomplished by a process called electroplating, shown in Figure 1, which uses an electric current to deposit the plating over the base metal. In general, the object to be plated becomes the cathode (negative plate) in an electrolyte cell that contains (in some chemical compounds) the type of metal which is to be plated onto the base material. Anodes (positive plate) are used on all sides of the object so that electricity may flow from all directions to the article being plated and cause an even deposit of the plated metal. The exact chemicals, currents, voltages, temperatures, and general procedure will vary with the kind of metal being plated and the method used. For example, nickel plating often is done with an electrolyte-containing nickel sulphate or nickel ammonium sulphate, with the ammonium sulphate added to increase the conductivity; the addition of acid helps keep the anode rough; and something like glue or glucose rounds out the formula to make the plating extra bright. The anodes may be made of

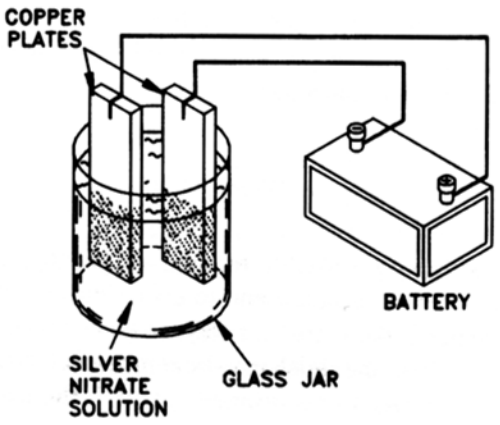


Figure 1: *When plating, anodes are used on all sides of the object being plated so that the electricity may flow from all directions to that object so that an even deposit of plated metal results.*

some material, such as carbon, which is not affected by the electrolytic action. When using this method, all the plated metal must come from the electrolyte and chemicals containing this metal must be added to the liquid at various intervals.

In other plating methods, the anode is made of the plating metal. For example, in plating with brass, the anode is made of brass. The brass dissolves from the anode into the electrolyte which is deposited from the electrolyte onto the cathode, or object to be plated. The object of this method is to get metal dissolved into the bath (electrolyte) as quickly as it plates out. As the anode metal dissolves, it generates a voltage; just as dissolving a metal generates a voltage in a conventional storage battery. Under ideal conditions, this generated voltage would equal the voltage consumed in depositing metal onto the cathode, so the external source would need to provide only enough voltage to overcome the resistance in the cell and the connections.

Before we get into the plating process, it should be observed that you may not want certain areas of a gun plated. A good example would be the sear engagement areas on a handgun hammer and trigger. Until recently, you had to plate those parts and then redress them to work as perfectly as they did prior to plating. Now, with the development of stop-off lacquer, you simply apply the lacquer to the portion of any part you do not want plated and plate the entire part normally.

When the plating process is done, take some lacquer solvent and wipe it on to the area lacquered prior to plating—the lacquer and any build up of plating comes right off. It's a good system for keeping the trigger pull "just the way you had it." This method can save you considerable time when plating any type of firearm part.

STRIPPING

Stripping is used to remove old plating, to brighten up oxidized surfaces, and to clean inaccessible places. In general, there are four ways to take nickel plating off a gun. First, the finish may be removed electrically: the object to be stripped becomes the anode, and a piece of metal such as brass or stainless steel is used as a cathode. Second, you can polish it off in much the same way as you would polish off old blue on firearms.

Pure nitric acid will also strip nickel from iron or steel without attacking the base metal as long as it is pure. However, conditions such as humidity change the purity of the acid, and then it can literally dissolve a gun in a few minutes. Nitric acid is also very dangerous to handle.

The fourth stripping system uses chemicals for the process. It is a companion system to the electroless nickel plating system offered by Brownells. It will not pit or etch steel. It has excellent stability and a long, active solution life. Because of an easy replenishment system, solution life can be further extended, and this cuts the operating costs. The components contain no cyanide, so they can be shipped easily via UPS. The solution operates at a slower rate of stripping than most other systems which give complete control, and it will remove most nickel plating on firearms.

To strip, the gun should be disassembled and a heavy emphasis should be placed on cleaning. This thorough cleaning prior to the stripping sequence removes all dirt, gun oils, and so on. The cleaning must be thorough to allow the stripping operation to work efficiently. The stripping steps are as follows:

1. **Pre-clean.** Use trichloromethane on cotton swabs and brushes to remove as much foreign matter, powder residue, gun oils, etc., as possible. Do not use a petroleum-based cleaner such as gasoline, kerosene, mineral spirits, or gun cleaner; they will leave a residue on the part.

2. **Flowing Water.** Use the same tank as used for plating process. Submerge parts for ten seconds and agitate to float away loosened residue.

3. **Acid-Cleaning Tank.** Submerge parts for three seconds and agitate. This further cleans parts and removes foreign residue, especially oil.

4. **Flowing Water.** Submerge parts for five seconds to flush acid cleaner from surface of metal.

5. **Nickel-Stripping Tank.** Submerge parts in stripping tank until all nickel is removed from the bright steel base metals. The stripping solution must operate at 200º-210° F. Water lost by evaporation should be replaced during the stripping cycle in order to maintain the original volume of solution. Parts will have to be removed from the stripping tank to be checked thoroughly to see that they are completely clean of the nickel plating.

6. **Flowing Water.** Submerge parts for two minutes to flush away all of the stripping solution. Allow stripped parts to air dry normally, or use compressed air to speed dry. The gun can now be polished or put back through the plating cycle. If you are not going to polish or plate



Figure 2: *A heavy-duty hot plate/stirrer is the ideal heat source for electroless plating operations. The heating element heats a container quickly and then maintains the heat throughout the operation.*

immediately, be sure to oil gun surfaces with water-displacing oil (a basic rust preventative which does not contain any of the exotic penetrants which could contaminate future bluing or plating of the gun).

BROWNELLS 1082 NICKEL PLATING STRIPPER

This section gives most of the information required in stripping, however for complete, detailed instructions refer to the Brownells' product information sheet, www.brownells.com/userdocs/learn/Inst-109ElectrolessNickel.pdf.

Three tanks are required for the #1082 stripping operation — the acid cleaning tank, the stripping tank, and the hot cleaner tank. The acid cleaning tank and the stripping tank cannot be the same ones used in the plating sequence — they must be different to avoid cross-over contamination. To avoid any problems, they should be marked "For Stripping Only", and preferably kept in a different storage area. Because similar chemicals and solutions are involved, the same, strict, personal safety precautions must be followed as specified in the plating section.

If a direct gas flame is used for the heat source, the Pyrex tank must be protected from thermal shock. (Special instructions are included with each Pyrex tank and explain in detail how to make a "sand bath" to protect the tank and keep it from breaking.) If you anticipate much plating, however, it is recommended that you purchase an electric hot plate stirrer like the one shown in Figure 2. This unit provides a reliable source of constant, even heat, plus thoroughly controllable agitation. It is specially designed for chemically stripping gun parts as well as electroless nickel plating.

The purpose of the acid cleaning tank is to clean only, and the solution should consist of 50% hydrochloric acid and 50% pure (distilled) water. The tank must be covered when not in use, and must be marked "STRIPPING ONLY" to prevent any mix-up with the plating tanks. To mix one gallon of solution for the acid cleaning tank, measure 2 quarts (64 fluid ounces) of distilled water and pour into the tank. Measure 2 quarts (64 fluid ounces) of hydrochloric acid and pour very slowly into the water already in the tank. Remember, always add the acid to the water and not vice versa. *When mixing this solution, always wear goggles and rubber gloves.*

Mix 8 oz. by weight (approximately 1 cup by volume) of Brownells Dicro-Clean 909 per gallon of distilled water. Heat to 180° F. and stabilize temperature. Suspend parts in the cleaning bath for 10-15 minutes.

To mix one gallon stripping solution: (Do these steps exactly in the sequence given!) Wash the Stripping Tank with clean water to remove any residue or possible contaminants. Pre-measure 1 gallon of water in your tank, and make note of its depth on your dipstick — or in your dipstick log. Dump and dry the tank. Measure 90 fluid ounces of distilled water (hot or cold) and pour into the Stripping Tank. Start agitation and heating. Measure one half pound of 1082-R and, very slowly, add to the water in the tank, allowing the agitation to dissolve the powder. Measure 26 fluid ounces of Concentrate 1082 and, very slowly, add to the Stripping

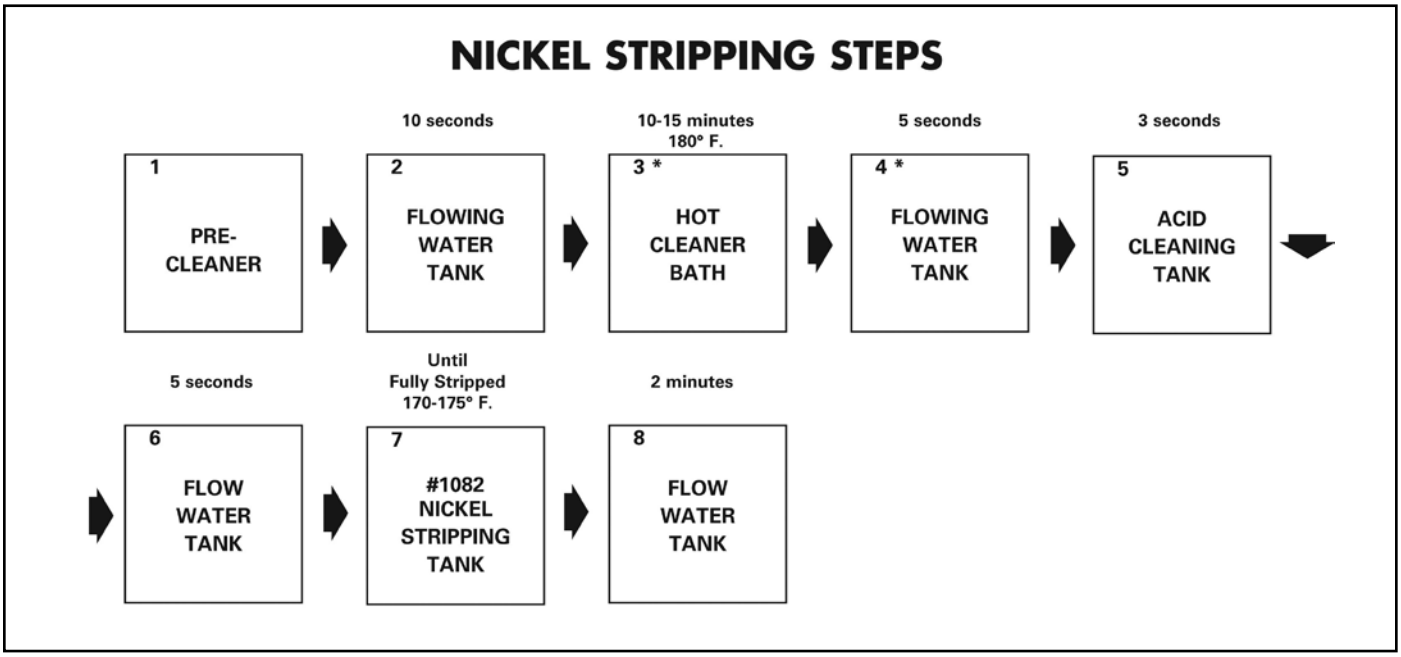


***Figure 3**: Flow chart of stripping operation.*

Tank. Add sufficient distilled water to bring the total solution volume up to one gallon as measured by the dipstick. Bring the solution up to the operating temperature of 170˚-175˚ F. Higher temperatures shorten bath life. Check the thermometer several times to be sure the heat setting is holding the temperature constant.

The Stripping Solution is now ready to use. During use, the stripping solution will darken noticeably and, after 2 to 3 hours of use, it will become the color of deep mahogany or very strong tea. This is normal and does not seem to affect anything. Parts should be suspended on iron wire. Do not use any other kinds of wire. Once parts are submerged in the stripping solution, they should not be removed until stripping is complete to avoid contamination, which will result in less than a perfect job.

Once the parts are submerged in the stripping solution, they should not be removed for any extended period of time to avoid contamination. However, the parts can be taken out of the tank for a very brief period of time for inspection (to see how the stripping is progressing) and returned directly back into the stripping tank. If absolutely necessary, it has been found that the parts could be removed with no apparent damage for longer periods of time, but they then have to be run through the Flowing Water Tank, the Acid Cleaning Tank, re-rinsed in the Flowing Water Tank and then put back in the Stripping Tank.

As water evaporates out of the stripping tank, it should be replaced. Use the dip stick method, or make a mark on the side of the Pyrex tank. Do not allow parts to stick above the solution level, as the fumes from the stripping solution cause very rapid rusting and pitting. This will not happen to parts that are left submerged. The rate of stripping will vary greatly depending upon the type and thickness of plate that is being removed along with other factors. Most will fully strip between 45 minutes and 1½ hours. If parts do not strip in 2 to 2½ hours, the solution is too weak and must be replenished. On some guns the nickel plate is deposited on top of a copper plate which was put on the metal first as an undercoat for the nickel. These pieces will strip slowly, and the solution will turn the copper dark in color. However, as the copper is stripped away, the dark surface will disappear and all the plating will be removed down to the bare steel surface. Agitation of the solution is important and is done at the same rate as for plating. If the solution is not agitated, stripping will be much slower because the stripping solution (remaining close to the metal) becomes saturated with removed nickel and slows down in removing more. Fresh solution must flow by the metal surfaces at all times to distribute the dissolved nickel throughout the full gallon of stripping solution. One gallon of fresh stripping solution will remove the nickel plating from about four Colt .45 semi-automatic pistols. After this, the solution normally must be replenished. To replenish the stripping solution, first make certain that no guns or parts are in the stripping tank. Then be sure the agitation system is working and the solution is being agitated thoroughly. Also, be sure the temperature is 170-175˚ Fahrenheit. Add 4 ounces by dry weight of 1082-R to the stripping solution. This replenishment

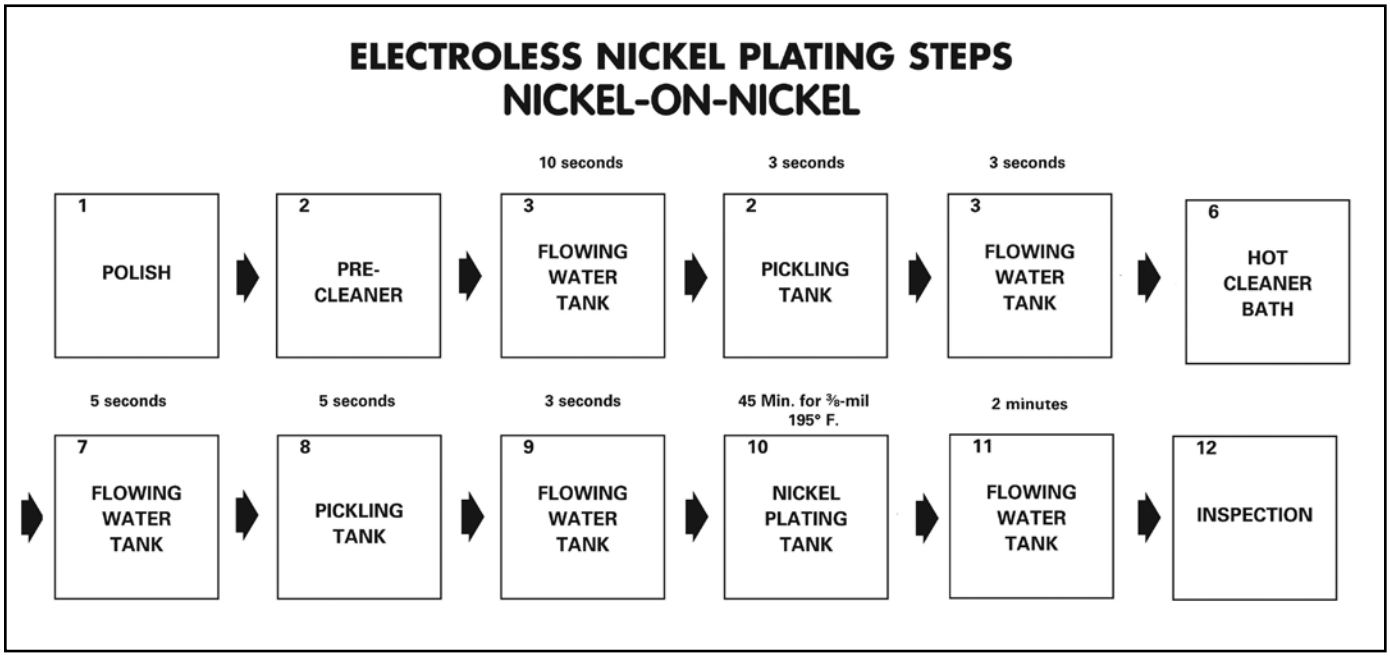


***Figure 4**: Electroless nickel plating steps.*

will normally allow the stripping of approximately the same amount of nickel as did the original fresh solution. However, after four replenishments of the stripping solution with Concentrate 1082-R, the solution will become super-saturated with dissolved nickel and will fail to strip any more. Dump the solution, wash the tank thoroughly with clean water, and mix up a fresh batch. After stripping is completed, turn off the heat, leave the solution in the tank and allow both to cool to normal room temperature while still sitting on the source of heat. *If you take the Pyrex tank off the hot plate and set it on a cold bench or counter top, it is possible that the thermal shock will break the tank.* Once cooled, do not store the stripping solution in the stripping tank. Pour it into a clean brown plastic chemical jug. Be sure to mark the jug "STRIPPER" and "POISON." Also, label that jug as to how many times the solution has been replenished. To reuse, simply pour back into the thoroughly clean stripping tank, bring up to heat, with agitation, to the correct operating temperature and begin the cycle.

Stripping (Figure 3) is a slow process and of all the sequences involved with nickel plating, the most worrisome, for very shortly after you put the plated piece into the stripping solution the piece turns a dark gray color and gets worse, and more mottled. Working as slowly as it does, it won't pit or etch the steel. And, you may not have to do even much more than touch-up polishing if you are stripping and replating a piece that is in good shape.

PLATING OPERATION

Twelve steps are required to plate a gun properly. These are outlined below and in the flow chart shown in Figure 4. Do not take any short cuts. Do each in turn, as given, for the time specified. Then go on to the next step. Layout of the plating room is completely optional, but do try to set up your tanks so a logical progression from tank to tank can be followed easily.

1. **Polishing**. Polish and prepare the metal exactly as for bluing. As in bluing a firearm, plating will not hide or fill scratches or pitting. A high gloss nickel finish requires metal preparation equal to "master-grade" bluing preparation, which means polishing right on down to No. 555-grit. A satin nickel finish can be achieved by using glass beading (very fine sandblasting), or a coarse wire scratch wheel with light pressure on the gun.

2. **Pre-Clean.** While this step is not an absolute must, it is highly recommended for best plating results. Use a degreaser and saturated cotton swabs to thoroughly clean all surfaces, including holes, crevices, and the like. This removes any old grease and accumulated dirt, silicone oils, other gun oils, and polishing residue — especially residue left by wax or grease-based polishing compounds. Do not use petroleum-based solutions like gasoline, kerosene, mineral spirits, or gun cleaner. If at all possible, thoroughly blow all parts clean with a medium to high pressure air gun to help clean off loosened gunk.



Figure 5: *This .32 ACP Colt semi-automatic pistol has been highly engraved besides being nickel plated.*

3. **Flowing-Water Tank.** Submerge parts in the flowing-water tank for about 10 seconds to help float away any particles of foreign matter loosened by the pre-clean step.

4. **Pickling Tank.** Submerge the parts in a solution of 10% nitric acid for 3 seconds. The parts will start to "gas" (similar to Alka Seltzer tablets). This further removes any foreign contamination.

5. **Flowing-Water Tank.** Submerge parts in the tank for 3 seconds and agitate to flush pickling solution from the surface of the metal. This step is extremely important.

6. **Hot Cleaner Bath.** Submerge parts in the tank for 10 to 15 minutes with an operating temperature at 180° Fahrenheit. Agitate occasionally to ensure good surface cleaning.

TROUBLESHOOTING CHART

MALFUNCTION		MALFUNCTION	
Probable Cause	**Remedy**	**Probable Cause**	**Remedy**
NEW BATH DOES NOT PLATE		**"CRATERED" SURFACE**	
1. Improper make-up.	Bring bath into specs if can determine mistake. If not, discard bath.	Plating solution agitation too fast.	Slow down agitator with speed control. Part must be stripped and replated. Will not polish out.
2. Incorrect bath volume.	Adjust bath if can do so correctly. If not, discard.	**"SANDY" SURFACE**	
3. Temperature too low.	Check thermometer; heat source. Must operate between 190°–200°F with 195°F optimum.	Took part out of plating bath and put back in during plating cycle.	Do not remove parts once put into plating tank. You will get a "false plate" which must be stripped and replated if careful polishing does not remove.
POOR SURFACE ACTIVATION			
1. Acid too old or too weak.	If so, remake.	**DISCOLORATION ON SURFACE**	
2. Oil contaimination in tanks.	Find source, clean up, then remake all baths.	1. Shaded "grey" streaks caused by parts touching, hanging loops tight, too large a part in too small a tank.	Use larger tank; run more than one batch. Use "O" shaped hanging loops.
3. Poor rinsing between cleaning steps.	Increase agitation or water flow.	2. Adding water during time part is in plating tank.	Water to top-off volume can be done only when no parts are in plating tank; then temperature must be restabilized to 195° Fahrenheit.
4. No nickel strike on stainless steel or hardened steels.	See special note on "Wood's Nickel Strike" to activate surface.		
"SMUT" FORMS ON SURFACE AFTER PICKLING		**SMEARS, STREAKING**	
Result of over-activation by pickling solution.	Wipe off parts with cloth and repickle for shorter time and/or reduced strength of pickling solution.	Surface not clean.	Remember, clean — clean — clean and clean again. Strip and replate.

Figure 6: Electroless plating troubleshooting chart. (Continued on next page)

MALFUNCTION		MALFUNCTION	
Probable Cause	**Remedy**	**Probable Cause**	**Remedy**
CONTAMINATIONS		**PLATING CAME OFF**	
1. Check for galvanized aluminum, copper, or brass in tanks, racks, hanging wires, or stir rods, leaded steel, heavily soldered or Check for Brazed parts.	Discard contaiminating metals & make baths.	1. Surface not clean.	Strip, reclean and plate.
		2. Tried to plate stainless steel or hardened steels.	See special note on "Wood's Nickel Strike" to activate surface.
2. Residual acid left from stripping.	Generally will have to discard bath.	3. You took it out of the plating bath to look at it and put it back in for some more plating.	You cannot do this for it will "false plate" and may come off. Strip and replate.
3. Containers, mixing cups, stir rods, etc. mixed between plate bath, and cleaning bath.	Generally have to discard solutions. Always use separate mixing/measuring cups and label for which bath used.		
RAPID DEPLETION OF A-1, B-1, 778		**PLATING TOO THIN**	
Poor chemical reaction, result of storage below 50° Fahrenheit.	Return to solution as described below. Ideal storage is 60°–90° Fahrenheit.	1. Tried to plate with depleted solution.	Check mil-usage record on storage jug. Make new solution then strip and replate.
		2. Check surface area-to-volume of plating bath ratio. One gallon does only 114 square inches 1/2-mil thick.	May require larger container and more solution volume.
WORKING LIFE DEPLETES TOO SOON		**PLATING TOO THICK**	
Plating solutions stored in tanks, open containers, and not light-proof containers.	MUST ALWAYS be kept in dark brown chemical jugs when not actually in use to preserve working life.	Too long in plating bath.	Reduce time in plating bath. One hour gives 1/2-mil; 45 minutes gives 3/8-mil; 1/2 hour gives 1/4-mil. Generally thick plating can be polished off with 555 White polish on loose muslin wheel adjusting pressure checking fit often. Be sure not to cut through plating.
SURFACE ROUGH WITH SCRATCHES			
Probably not polished to fine enough grit before plating.	Plating will not hide anything!		
ROUGH AND SCRATCHY SURFACE		**CASE HARDENED/CAST STEEL PLATES UNEVENLY**	
Dirt on surface of metal entrapped under plating.	Strip, really clean this time and replate.	1. Many case-hardened surfaces do not activate as well as unhardened steels.	Leave in pickle longer than normal until good gassing occurs.
"PEBBLY" SURFACE		2. High silicone content of some cast steels may inhibit plating.	Pre-clean to the point of "overkill" with Trichloroethane to remove silicone.
Plating solution agitation too slow.	Increase speed to just before cavitation or whirlpooling starts. Surface can be cleaned up with 555 White polish on loose muslin wheel and very light pressure.	3. Cast parts will usually not polish well enough for "Bright" nickel plating.	Suggest sandblasting cast surface before plating for a deluxe "satine" nickel finish.

Figure 6: (Continued)

7. **Flowing-Water Tank.** Submerge for 5 seconds and agitate to flush cleaning solution from the surface of the metal.

8. **Pickling Tank.** Submerge for 5 seconds to activate the surface of metal for plating. Parts will start to gas, indicating that the surface is activated. This step, in addition to cleaning, will make the nickel "strike" the metal surface, quickly assuring a good initial bonding to the surface.

9. **Flowing-Water Tank.** Submerge for 3 seconds and agitate to flush pickling solution from surface of metal.

10. **Nickel Plate Tank.** First determine thickness of the plate you wish to apply. For optimum results, 3/8" mil (1 mil = .001 inch) plating depth is considered to be the best for guns. This thickness will require 45 minutes of submersion in the plating solution. Start the agitation system and submerge the parts to be plated into the plating solution. (Make sure they do not touch each other or the sides of the tank.) Be sure that agitation is thorough, and that whirlpooling does not develop. The solution must operate between 190°-195°F optimum. Once the pieces are in the plating solution, do not remove them until the desired length of time has elapsed. If you do, even for an instant, you will ruin the plating job and have to start over. When the predetermined time has elapsed to plate the thickness desired, remove the parts from the plating solution.

11. **Flowing-Water Tank.** Submerge the parts for a minimum of 2 minutes and agitate to flush the nickel solution from the metal surface. There is no maximum time limit in this tank as the nickel plating process has been completed. Remove the parts from tank and allow them to dry naturally or use compressed air for faster drying.

12. **Inspection.** Check all parts and components carefully to assure an even plate of all desired surfaces prior to assembly of the gun. However, if a part or component is not nickel plated as desired, it cannot be put back into the nickel tank. The part must be stripped of all nickel and reprocessed from bare metal! If all parts and components are satisfactory, wipe all parts clean and dry with a soft cloth to remove water spotting or lingering wet areas in holes, etc. If a high-gloss finish is desired, you can buff the parts lightly on a loose muslin wheel to bring up the luster, or use a professional nickel-finish polishing cloth. If the buffing wheel is used, use only No. 555 White Polish-O-Ray and very light pressure, as any form of polishing will remove metal, and you will be removing the nickel plate you just put on. Semi-chrome polish can also be used to increase the luster of a high gloss finish. Reassembly of the gun is the final step.

The complete plating procedure consists of two phases, both equally important. First, is a preparation of the metal to enter the plating solution and second, the actual plating of the metal. Any attempt at short cuts in the procedure usually results in a poor plating job, and wasted time and material. At first, the process will seem lengthy, especially the cleaning steps prior to putting the piece into the plating tank. However, with a little practice you can complete the plating process in about the same amount of time required for a good bluing.

The preparation phase is a step-by-step sequence in getting the metal absolutely clean of all foreign residue down to the bare metal. When metal is stripped of all protective coating, it absorbs oxygen and oxidizes very quickly in the open air. Oxidation on the metal surface prevents good initial bonding of nickel to metal. Therefore, the time between each step should be as short as possible. Work quickly but at a steady pace between each step. Timing in the tanks, in seconds, does not require a stop watch. If you say the words, "One thousand and one" it takes about one second. Hence "one thousand and one, one thousand and two, one thousand and three," will take three seconds. Try it— it works!

Equally important is the flushing step between each tank. It prevents the carrying or "drag out" of chemicals from one tank to another tank which would result in chemical contamination of the second tank.

If you can blue guns, you can plate guns. It is only a matter of familiarization and practical experience. The major difference is that plating requires extreme measure to assure parts are clean prior to entering the plating solution. As with all types of metal finishes, it is best to make a test run by using scrap parts until you become familiar with the process instead of making the first plating job on a new gun. According to Brownells, the most common cause of poor plating jobs can be directly traced to lack of cleaning or contamination of solutions. Also see the troubleshooting chart in Figure 6.

It is possible to plate one or two parts for two hours and give them a one-mil plate build-up if desired. This can occasionally be done to tighten up loose fitting screws, pins, and other slightly worn parts. Plating past this one-mil thickness is not practical. And, be sure to remember that every surface will receive the same amount of plate and increase by the same thickness. So, while you may tighten up threads of a screw, you may also keep the head from fitting flush, or fitting the counterbore at all.

Agitation of the plating solution is critical, because too great an agitation will result in whirlpooling, which draws air into the plating solution. This extra air will "crater" the nickel plating being put on the metal surface and you will have to strip the piece and start over because the poor plating cannot be saved. Too little agitation will result in "pebbling" of the plated surface (little humps and random bumps). This is more easily remedied, for the part need only be polished carefully with 555 White Polish-O-Ray on a loose muslin wheel to remove the "pebbles."

Sandblasting of parts prior to plating is one of the most universally appealing finishes you can give your guns. Especially consider decorative use of sandblasting. For instance, sandblast the entire cylinder, then polish just the outside back up to bright, leaving the flutes sandblasted. Once plated, the contrast between bright and satin is very handsome.

Polishing prior to plating is more important than you can realize as you read this lesson. Every scratch, rough spot, or nick is highlighted by the plating; absolutely nothing is hidden, not even those things bluing will sometimes hide. So, consider the satin finish if you do not want to go to the trouble of doing the high degree of polishing required for a mirror-bright finish. Many shooters prefer the satin finish anyway.

Do not mix and add more fresh plating solution to a partially used batch. This is a tempting idea but do not do it, for you then lose track of the plating capacity of the total solution.

Because of the acids used, parts not directly under the surface of the plating bath will rust badly — worse than in the bluing room. The small amount of water that condenses on hanger rods and falls back into the plating bath is of no consequence. But do take precautions by keeping all easily rustable equipment and items out of the plating room.

If you are working on a rusty gun that you want to put through a rust or bluing remover solution, you must do so before you polish the gun. Most removers contain phosphoric acid which acts as a "pacifier" to steel, and will prevent it from plating. Polishing will remove this pacified surface, so you must polish thoroughly and completely. Then the precleaning, pickling, and cleaning steps in the plating sequence should properly "activate" the steel surface. If you notice that the part does not gas in the pickling tank immediately, you may have to leave it in for a few more seconds to be sure that the surface is sufficiently activated for the nickel plating to "strike" the surface and adhere correctly.

The troubleshooting chart shown in Figure 6, on pages 9 and 10, will help you to correct problems that may arise when using



***Figure 7**: Millions of break-top revolvers were manufactured in the Unites States around the turn of this century. Many of them were nickel plated and the gunsmith will be called upon to restore the plating on these handguns.*

Brownells Electroless Plating Method. When the chart advises to "strip and plate," it does not mean to run the part through the stripper and then directly back into the plating tank. It means to take the part through the stripping sequence, then through the entire 12 steps of the plating sequence! If you skip a step and put a dirty part back into the plating tank, it will not plate correctly. You cannot skip any step of any sequence.

SELF-TEST QUESTIONS

Please check your answers on page 16.

1. **What type of plating may be applied to a firearm that will offer a surface harder than the hardest steel?**
2. **When electroplating, which terminal of a direct current is the object being plated connected to, the positive or negative?**
3. **When replating a firearm, what usually must be done before polishing it for the plating operation?**
4. **When a firearm does not plate correctly, what is the most probable cause?**

Parkerizing

Parkerizing, or phosphate coatings, provides an excellent surface for holding a rust-inhibiting or lubricating compound. Oil is absorbed in the finish, and has the effect of a lubricant reservoir, which helps in the break-in of friction-bearing surfaces. Whereas, untreated surfaces of steel are prone to rust, phosphate coatings are much more resistant to the elements, making this type of finish ideal for military rifles like the one shown in Figure 8. Phosphating solutions consist of zinc, manganese, or iron dissolved in carefully balanced solutions of phosphoric acid. When iron or a reactive metal is placed in the phosphating solution, a light acid etching takes place.

Shortly thereafter, depending on the accelerators used, a very small amount of metal is removed from the surface, and a hydrogen process takes place, which in turn precipitates a phosphate coating on the steel, which is bonded to the metal. Once applied, the coating can act to resist corrosion, as well as to improve wear resistance.

The length of time the part is immersed and temperature of the solution can be critical, depending on the amount of solution used, as well as the type of the metal being treated. Zinc phosphate treatments will generally produce a deposit of zinc phosphate compound on the base metal. These normally have a coating range between 0.0005" to 0.0015" in thickness, and vary in density. The density and coating thickness are not reliable indicators of the corrosion-inhibiting qualities of the finished product. The appearance of the zinc phosphate coating is a gray matte finish, with the shade varying somewhat, depending on the chemical composition of the treatment bath, and the amount of ferrous or iron based material in the metal. The zinc phosphate coating itself has an outstanding corrosion resistance, due to the fact it provides a waterproof barrier. It is best not to deviate from the manufacturer's directions, as complications can arise.



Figure 8: *The M1 Grarand rifle was the "best" there was for combat used in World War II and the Korean War. Many owners now want these fine rifles restored to their original condition; this means Parkerizing the metal. Knowing how to correctly Parkerize gun metal can mean extra profits for your business.*

SAFETY

Most Parkerizing solutions have been professionally formulated and manufactured in compliance with all applicable safety standards. Information and recommendations concerning their use are based upon laboratory tests and field use experience. However, since conditions of actual use are beyond the control of the manufacturers, any recommendations or suggestions are made without warranty. It is the user's responsibility to see that the procedures are meticulously followed, and especially that the warning and cautionary notes are heeded. **READ THE WARNING INFORMATION ON THE CONTAINER.**

Make sure the shop is properly ventilated, and leave a window open for fresh air. Do not use or store chemicals near food or in a food preparation area. Wear rubber gloves, a full face shield, and a neoprene apron. Train your eyes to see an accident before it happens!

EQUIPMENT

Besides the Parkerizing solution, you will need a stainless steel tank large enough to accommodate the parts, a thermometer that will measure up to 180° F, a measuring cup (graduated in ounces), a pair of tongs with at least 8" handles, degreasing solution, applicators, sandblasting equipment, a source of heat, and a means of securing the parts in the solution.

Stainless Steel Tank. For most projects, a tank 6" x 6" x 40" long will suffice. You can obtain less steel in sheets and do the welding yourself or have it done at a local welding shop.

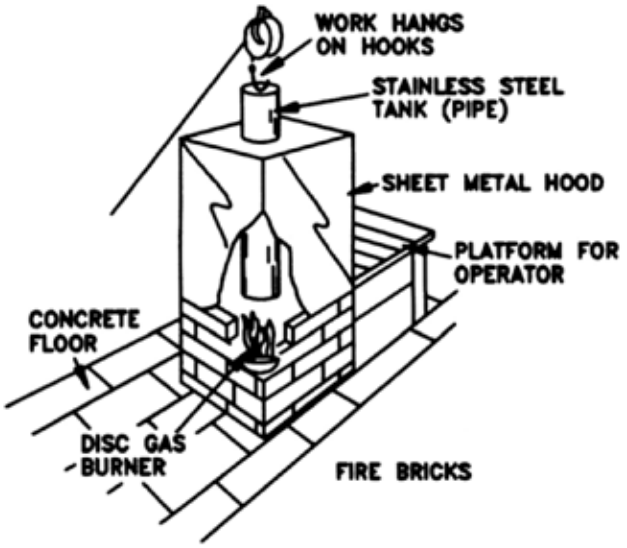


Figure 9: Vertical stainless steel tank system for Parkerizing.

The stainless steel sheets, however, should not be less than 22-gauge. Pre-made stainless steel tanks are also available.

An optional method is to obtain a piece of threaded stainless steel pipe about 6" in diameter and 4' long. Screw a 6" stainless steel cap tightly on the bottom end and rig it as shown in Figure 9. An asbestos-lined sheet metal housing will help to conserve heat. Because the tank is in a vertical position, it will take up less floor space than conventional horizontal tanks, and since the solution is heated at the bottom of the vertical tank, the heat will rise and circulate to maintain an even temperature throughout. The only problem is if a small part should fall to the bottom of the tank, the entire tank usually will have to be dumped to retrieve it.

Another drawback with the vertical setup is dumping the solution once it is spent. The entire tank must be pulled out of its housing and then dumped in a safe place. You could weld a stainless steel gate valve into the bottom side of the tank, but this will add to the expense. Another way is to weld a ring or hook at the top of the tank where another hook on a cable can be attached. This cable fed through a pulley above the tank will enable you to lift the tank, filled with solution, and keep it suspended until you can dump it. If a drain is nearby, fabricate the sheet metal hood so that one side opens as well as the top. Then you can dump the chemicals, as you gradually lay the tank over to one side. Remember, a 6" tank filled with Parkerizing solution is not going to be light.

Heat Source. Your local gas company (natural or LP) can advise and supply you with a simple pipe burner for horizontal tanks; use a ring-type industrial gas burner for the vertical tank. For the vertical setup, mount the burner close to the floor, but above a layer of firebricks for protection and insulation. Mount the tank so that the bottom is about 4" above the burner, with the tank enclosed in heavy sheet metal and lined with some type of furnace insulation to conserve the heat. Firebrick should be installed all around the burner up to the bottom of the tank to where the hood stops. Of course, you need to leave an opening in the firebrick for lighting the burner.

Although it is not necessary, you might want to fabricate a loose fitting sheet metal cap to fit over the top of the tank to conserve heat and energy. If so, it should be slotted in the center so that it will slide freely on the suspension wires on which the work is hung for lowering into the Parkerizing solution. With a 6" pipe, as many as four barrels and receivers can be Parkerized simultaneously. It is desirable to finish as many as possible at one time due to the length of time required to complete this process.

Small parts can be grouped on small hooks of stainless steel wire, or you might want to make a basket out of stainless steel screen wire. However, in doing so, the parts should be shaken frequently during the process to avoid constant contact, which might leave spots on the finished work.

Sandblasting. Rust or scale on the gun parts must be removed before putting them into the Parkerizing solution. The best way to do this is by dry abrasive blasting using glass beads. Silica sand may be obtained from your local lumber yard (where it is sold for mixing white plaster), or obtain glass beads from a local auto body repair supplier. The sandblasting equipment is not cheap, and it is going to take a number of Parkerizing jobs to pay for the equipment. So until you have enough business to warrant such an outfit, it will probably be better to "farm out" the sandblasting operation to a local auto body shop. Most shops will be glad to do the operation for a reasonable fee. In any event, glass-bead all parts until a chrome look is obtained and no dark spots remain.

After the abrasive blasting, do not handle any of the parts with bare hands. This will leave body oil on the parts and cause spotting. Always use rubber gloves for handling the parts just as recommended for most bluing jobs. Get the parts into the Parkerizing solution as quickly as possible after the abrasive treatment. Never wait more than 3 hours.

Treating. There are several suppliers of Parkerizing solution and all will vary slightly, so follow instructions provided by each. One type requires that you prepare enough solution to cover all parts sufficiently at a concentration of 4 ounces of Parkerizing solution per gallon of water (3% by volume). Mix the solution in a stainless steel tank, light the burner, and bring this solution to a temperature of between 160˚F and 170˚ Fahrenheit. The parts are then suspended in the solution by wires or hooks. The parts should not be touched with bare hands. Once the parts are suspended in the Parkerizing solution, allow the metal to react. Turn the parts periodically to get an even treatment, but be careful not to agitate the parts where they will rub or grind against each other.

As in hot caustic bluing, temperature is of the utmost importance at this time. Be sure to maintain a temperature of 160˚-170˚F. Nothing else will do! But remember: this temperature will vary with each manufacturer.

The parts should be left in the solution for about 40 minutes and then removed and immediately rinsed in cool running water for one minute. Drain excess water and dry with a clean absorbent cloth. Once the parts have dried, immediately dip them in a light oil bath or spray the parts with WD-40 or some similar oil. Wipe off all excess oil and the job is completed for a gray-type finish. Repeated applications of Cosmoline in place of the oil bath will usually provide a green tint to the finish.

As long as the bath is hot and the solution is clear, the bath can be used to Parkerize any number of guns. A cloudy solution indicates depletion of its active ingredients. Also, once the solution has cooled, do not attempt to reheat and use it. Dump the solution in a safe place once it has cooled. Check with your local health department about getting rid of any chemicals listed on the label of the container. *As with any chemicals, wear safety goggles or a face shield and avoid contact of the solution with skin.*

For information on Brownells' Manganese and Zinc Parkerizing products, you can read their product information here: www.brownells.com/userdocs/learn/Inst-482%20Parkerizing.pdf

SELF-TEST QUESTIONS

Please check your answers on page 16.

5. ***True or False*. Once the Parkerizing solution cools, it cannot be reused; it must be discarded.**
6. **What type of material should the Parkerizing solution tank be constructed of?**



Figure 10: *The .30 caliber M1 carbine is another rifle used during World War II and the Korean War that was Parkerized.*

Answers to Self-Test Questions

1. Chromium.
2. Negative.
3. The old plating must be stripped or removed before polishing begins.
4. The metal surface is not clean or has not been properly prepared.
5. True.
6. Stainless steel.

Lesson Questions

THIS IS LESSON NUMBER 2194.

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. **Other than the aesthetic value, what advantage does nickel plating offer?**
   a. Protection of the gun metal against rust and corrosion.
   b. Greater accuracy.
   c. Smoother operation.
   d. Better heat transfer.

2. **What type of acid will strip the nickel finish from parts without affecting the base metal, as long as the acid is pure?**
   a. Sulfuric acid.
   b. Nitric acid.
   c. Hydrochloric acid.
   d. Citric acid.

3. **Before replating a metal part that has been previously plated, what must first be done?**
   a. Use hand-polishing to get the old finish off.
   b. Blue or brown the parts.
   c. Oil the parts heavily.
   d. Strip off the old plating.

4. **When electroplating, what part of the electric circuit does the object being plated take?**
   a. The anode.
   b. The cathode.
   c. The overcurrent protection.
   d. The overload relay protection.

5. **What solution may be applied to gun parts to prevent them from being plated while in the plating bath?**
   a. Copper plating the parts.
   b. Any of the instant bluing solutions on the market.
   c. Nitric acid.
   d. Stop-off lacquer.

6. **Which of the following statements is true concerning plating gun parts by the electroless method?**
   a. The parts do not have to be degreased as with bluing or browning.
   b. The parts must be degreased and polished the same as when bluing or browning metal parts.
   c. The plating will cover the pits and scratches so the parts do not have to be polished.
   d. A battery or DC power supply must be available.

7. **What type of material is recommended for the tank that holds the Parkerizing solution?**
   a. Styrofoam.
   b. Pyrex.
   c. Cast iron.
   d. Stainless steel.

8. **A high-gloss nickel finish requires the metal surface to be polished down to at least one of the following grit sizes:**
   a. 80-grit.
   b. 240-grit.
   c. 360-grit.
   d. 555-grit.

9. **What type of "polishing" before plating will give a satin nickel finish once the plating has been applied?**
   a. Etching the metal in nitric acid beforehand.
   b. Polishing with 80-grit sandpaper.
   c. Using at least 1200-grit polishing compound.
   d. A glass bead blasting.

10. **If there are any blemishes in the metal during the plating process, the final plating will**
   a. Cover these blemishes so they will be unnoticeable.
   b. Highlight these blemishes and they will show up more than in most other types of finishes.
   c. Partially cover them.
   d. Not "take" at all on any of the metal surfaces.