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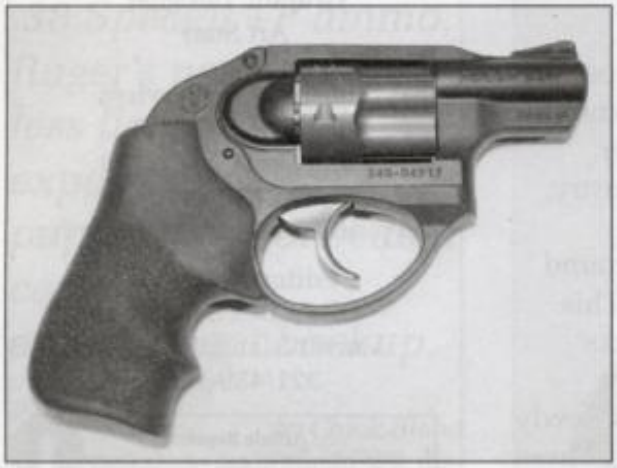

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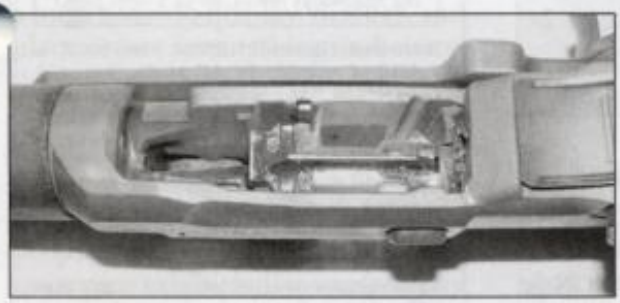

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The Technical Journal of Firearms Repair and Maintenance

Firearm Finishing Methods: A to Z

Today's gunsmith can offer his customer choices in metal-finishing methods that range from traditional and "down to earth" to Space Age and literally "out of this world."

by Richard MacLean

Many shooters don't realize that a beautiful blue-black finish on a gun is primarily decorative and provides little protection against the elements. Rather, it's the oil that's doing the work of weatherproofing. In the days prior to bluing, guns were "browned" through the natural formation of red ferric oxide on iron. This oxide eventually formed a rich patina after it was repeatedly rubbed and re-oiled during use. The qualities of natural browning prompted gunsmiths to develop techniques to speed up the rusting process and satisfy customer demand. The chemical bluing and browning methods that came next were quick methods that created an appealing lusterless finish that reduced the possibility that the glint off a gun would give away the shooter's presence to the enemy or to a game animal.

The following horror story serves to illustrate the poor protective qualities of bluing. Over several decades, a Class-3 FFL dealer from Arizona amassed a museum-quality collection of Model 1921 Thompson submachine guns. Early Thompsons are highly prized for, among other things, the quality of their deep blue finish. A wealthy individual in Tucson caught wind of the collection and made an offer the dealer could not refuse. While the paperwork was being processed by the ATF, the proud new owner built a concrete walk-in vault to house his entire collection. The guns were transferred into the secure vault—with the concrete as yet not fully cured—and several days later it was opened to reveal dozens of guns with a fine coating of rust.

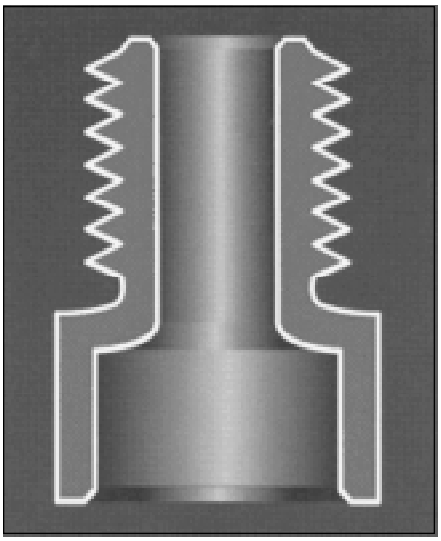
The Evolution of Firearm Finishes

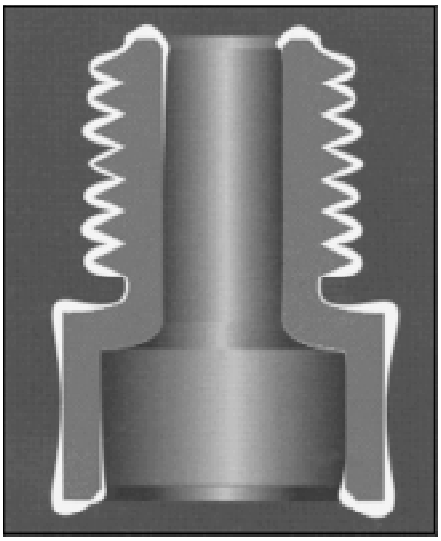
By the 1800s, gunsmiths and manufacturers were already well along in perfecting methods to blue, brown, and color case-harden firearms. They also began to plate firearms, particularly handguns, with nickel and later with chrome to provide both esthetic appeal and corrosion resistance. With the processes employed at the time, these metals did not adhere well to steel, and early coatings were known for peeling off. To plate with nickel or chrome properly, the steel had to be first copper plated or otherwise prepared with an intermediate coating.

With the newest chemical processes, however, hard chrome can be plated directly to the base metal. Used extensively since World War II, hard chrome has been used to line the bores of cannons and machine-gun barrels, as well as on engine parts such as valves, crankshafts, piston rings, and cylinders walls.

Currently, the issue with hard-chrome plating is that the solution contains hexavalent chrome (chrome +6), which is a known carcinogen. Hard-chrome plating has not been banned outright by the EPA and remains in use today, because of its superior hardness and durability for industrial applications where alter-

Below: *A Robar employee removes and rinses off a rack of freshly plated parts from the autocatalytic plating bath.*





Right: *Autocatalytic plating provides a uniform thickness.* ***Far right:*** *Electrolytic plating yields a less uniform coating with buildup on shoulders and less coverage on internal dimensions.*

native coatings will not meet specifications. As recently as April 2009, Under Secretary of Defense John Young instructed the DOD to minimize the use of Chrome +6. The obligation is placed on the user to show that a proven substitute is not available. Some gun finishers such as Tripp Research have discontinued hard-chrome plating.

Cadmium and copper-cyanide plating are under similar, close scrutiny. Zinc plating from an alkaline or acid bath is still considered benign and accepted by government agencies at this time. When alloyed with nickel or aluminum, zinc is replacing cadmium in many applications.

Parkerizing was another quick and cheap method developed to dull the finish of military weapons and provide some corrosion protection. Parkerizing is a zinc-, iron-, or manganese-phosphating process invented in 1869 but not widely used until WWII. The added protection over bluing or browning is due to the granular surface's ability to absorbs and hold the oil or Cosmoline.

By the late 1900s, gun finishes, especially on military weapons, started to include sprayed or dipped coatings such as epoxies and baked-on polymer coatings. In addition to offering corrosion protection, the application of these coatings was relatively fast and inexpensive. These finishes generally don't have the visual appeal of a well-blued firearm, and earlier varieties were also not very chip-resistant. Modern polymer coatings are so widely used and offered in such a variety of colors (pink for the ladies and even camouflage patterns for hunters) that they now receive a much greater acceptance for their corrosion resistance, durability, and even esthetic appeal.

Autocatalytic (electroless) methods that employ chemical reactions to plate metal were invented during World War II, but only recently have grown in popularity over electrolytic plating (by electrical energy). The absence of an external electrical source during the autocatalytic plating process produces a uniform coating thickness that can be precisely predetermined and controlled. For applications where extremely tight tolerances are required such as on sniper weapons and custom target rifles and pistols, this property can be critical. For standard-issue military firearms, close clearances are avoided in areas exposed to dirt, yet close tolerances are still required in certain areas such as bolt heads.

Today, even polymer coatings have gone high-tech with the introduction of coatings containing molybdenum disulfide and/or Teflon® (PTFE) particles. They offer both lubrication properties and corrosion resistance that far exceeds anything offered by other polymers. Available in both satin and matte finishes, these coatings approach the beauty of the best traditional deep-blue finishes.

Blackening of stainless and alloy steels to eliminate reflective glare has also reached new heights with a chemical treatment that oxidizes the chrome at the surface to produce chrome sulphide. Methods to passivate stainless steel or anodize aluminum and other nonferrous metals that already have corrosion-resistant properties have also improved over the past decade.

Electrolytic plating processes continue to be used to coat firearms with gold, silver, chromium, and bright nickel. As the commercial says, "some things just get better with age." That might be true of metal-plating processes, but I would hasten to point out that metal plating also gets better with proper technique, careful surface preparation, and good quality control. The "hard-chrome" plating process discussed above is not the same as the decorative chrome plating used on bumpers and other auto parts—that peels like tinfoil with age and abuse. "Black chrome" is another variation which is not quite as durable as hard chrome, but has a more tactically desirable non-reflective finish and greater esthetic appeal to some.

Offering Something Special

Clearly, there's a broad spectrum of options available today from which manufacturers, gunsmiths, and customers can select. All of the aforementioned metal finishes are readily available, often locally, to gunsmiths throughout the U.S. Unless they're in the business themselves, most gunsmiths farm out their finishing and refinishing work. First, it is not practical to properly maintain a wide range of treatment baths to deliver uniform results with relatively few firearms per month. And second, even painted-on and baked-on coatings, such as camouflage patterns, require a fair

degree of skill to achieve superior results. Such proficiency comes with a sustained effort and not occasional use.

Problems with firearm finishes are almost always related to surface preparation and/or plating solutions or coatings that are not at the proper strength or consistency. Inexperienced finishers may think that their parts are clean, but coating experts know that they must be cleaned beyond a shadow of a doubt. These experts also have the equipment to accurately monitor the potency of their solutions.

The bottom line is, if you're going to ship a firearm off for a new finish, you might as well offer the customer the full range of available finishes and you'll probably want to use a professional finishing service with a proven track record (see the "Sources" table on page 18). The first step in this process is to educate the customer on the advantages and disadvantages of each finish. Most will probably already have strong preferences based on past experience, articles they've read, or from their examination of other owners' firearms that looked interesting. The issue here is that they may not be aware of the full spectrum of options and the relative advantages and disadvantages of each.

The table in this article (**Figure 1**) is a good qualitative starting point to explain the range of possibilities. The chart illustrates the relative performance among these options based on my personal experience and preferences, as well as input from plating experts.

A few words of caution are needed, however, regarding the chart in Figure 1. Individual gunsmiths may have their own relative ranking, especially in the case of esthetics. Moreover, all of these options come in a variety of finishes, hues, patterns, colors or patinas. Even something as basic as Parkerizing can vary tremendously depending on the type and strength of the solution and the oil applied after treatment. And again, much also depends on the skill of the company doing the finishing.

Even within specific categories, the cost can vary nearly twofold because of the final finish (from matte to bright). In addition, the precise performance measurements can vary between platings and coatings. For example, abrasion is measured on the Taber abrasion index for plating and on the tensile-hardness scale for coatings. Thus it can be difficult to make apples-to-apples comparisons.

The cost of a finishing job is also significantly affected by whether the finisher is responsible for disassembly and reassembly or if only component parts are being coated. The chart is mainly meant to illustrate one approach to begin the discussion of possible alternatives, as well as their strengths and weaknesses. Having actual examples on hand to show to customers is especially helpful.

Most gunsmiths are familiar with most of these finishes, with the possible exception of emerging proprietary coatings, which brings us to the subject of this article: firearm finishing has entered the Space Age. For example, manufacturers such as Glock are touting their proprietary sub-coating treatment for hardness, Tenifer™, a form of carbonitriding. Other trade names such as Melonite™, Sursulf™, Arcor™, Tufftride™, and Koline™

Figure 1. Comparison of Metal-Finishing Methods

Finishing Method	Corrosion	Lifting/Peeling	Abrasion/Chipping	Hardness	Lubrication	Aesthetics	Relative Cost
Anodizing/Passivate	◕	●	◔	◑	◑	◑	◑
Blackening/Bluing of SS	●	●	◑	◔	◑	◑	◑
Bluing/Browning	○	●	○	○	○	●	◑
Rust Bluing/Browning	○	●	○	◔	○	●	◑
Parkerizing	◔	●	◔	◔	◔	○	◕
Bright Nickel	◕	◔	◑	◕	◔	◕	◑
Electroless Nickel	◕	●	◕	◕	◑	◕	◑
NP3	●	●	●	●	●	◕	◑
Color Case Hardening	○	●	◔	◔	○	●	○
Gold, Silver Plating	◕	◔	◑	◔	◔	●	○
Hard Chrome	◕	●	●	●	◕	◕	◑
Black Chrome	◕	●	◕	◕	◑	◕	◔
Polymer Coatings (Generic)	◑	◔	◔	◔	◑	◔	●
DuraCoat™	◑	◑	◑	◑	◑	◑	◕
Polymax™	◕	◕	◑	◑	◕	◑	◕
Roguard ™ (Molybdenum Disulphide)	◕	●	◕	◕	●	◑	◕
Teflon®-Based	◑	◑	◕	◑	●	◑	◕
TactiKote™	◑	◑	◕	◑	◕	◑	◕
Table Key: Poor to Excellent	○	◔	◑	◕	●		

employ similar chemical-bath nitriding processes that embed nitrogen into an iron-containing alloy. While these manufacturing-based coatings and treatments are not generally available to gunsmiths, there is a growing list of processes that are within easy reach.

For instance, powder and baked-on coatings that incorporate nanoparticles of ceramics and Teflon® are now available. So-called "diamond-like coatings" (DLC) are now starting to emerge with materials such as carbides or nitrides of titanium, boron, and tungsten. DLC finishes hold tremendous promise, but they are currently very expensive and the plating processes are evolving and are not yet as reliable as alternatives that offer similar results. For this reason, these coatings are not listed in the comparison table. For the purposes of this article, I'll limit the discussion to NP3, an electroless plated nickel/Teflon matrix used by the aerospace industry that has been thoroughly developed and tested in firearms applications.

The Evolution of NP3

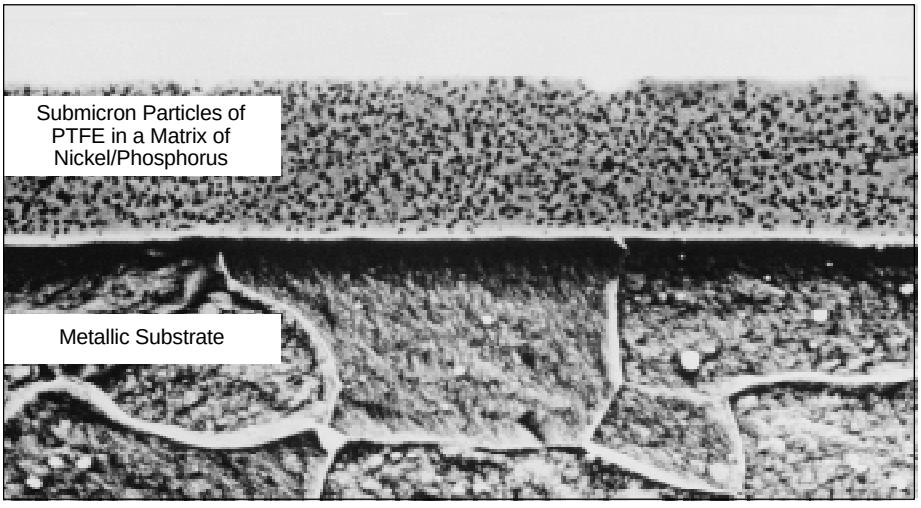
In the 1980s, drilling platforms in the North Atlantic were having problems with galling of the stainless-steel unloading couplings. To solve the problem, the Dutch firm, Akso Nobel, invented an electroless-nickel/Teflon coating, but they needed help getting it out of the laboratory and into production. The UK company, Fothergill Engineered Surfaces, joined them in a partnership to commercialize and market the product.

A local supplier of plating chemicals stopped by Robar Companies, a Phoenix-based custom-gunsmithing and metal-finishing firm, and provided the owner, Robbie Barrkman, with some information on nickel-Teflon coatings. Barrkman immediately understood its potential in gun finishing, and obtained the exclusive licensing rights for weapons coating. The "NP" in NP3 stands for "nickel-polytetrafluoride" and the "3" is part of the formula. He was joined by Dr. Paul Ebdon, the individual originally responsible for commercializing electroless nickel-Teflon in the UK with Fothergill Engineered Surfaces.

Right: *After autocatalytic plating, parts are rinsed in deionized water and then given a stress-release heat treatment in an oven at 220 degrees F.*

Robar's coating business began to grow, helped along by a cover story on NP3 that appeared in 1987 in *SWAT* magazine, and a separate coatings business, Coatings Technology, was spun off that same year. What made Coatings Technology's business really take off was its entry into the aerospace field. But in order to enter this specialized market segment, Robar first had to seek NADCAP certification. NADCAP stands for National Aerospace and Defense Contractors Accreditation Program. The NADCAP program is similar to ISO 9000 certification, only much more rigorous. "Mil Spec" is a term that gunsmiths are familiar with, but it is a minimum standard, and a plating business is not even audited unless it is doing military contract work.

Below: *A scanning electron microscope at 3,000 magnification reveals the structure of NP3. The particles of Teflon (PTFE) appear as black dots in the top layer.*



Right: *The 100-year-old M1911 design enters the "Space Age" with an NP3-plated receiver and magazines combined with a molybdenum-disulphide (Roguard™) coated slide.*

The trend today is to have NADCAP certification, which helps to increase the chances of successfully bidding on a military contract.

The NADCAP process creates a quality mindset in the NP3 business that otherwise probably would not exist. From the gun coating side of the business, it means that customers get the exact same treatment on their parts as components destined for some exotic aerospace application, since the identical process is used for both. The parts literally share the same plating racks.

Another benefit of this rigorous systems approach is that Robar has gotten excellent comments (and has received no citations) from the ATF when the agency has done their routine audits. Robar has an 07 gun manufacturer's license, and keeping track of all essential paperwork is crucial for maintaining this license, of course, as any gunsmith can appreciate.

The NP3 process is similar to autocatalytic nickel plating, with a few notable exceptions. Parts are first logged in and given unique identification codes, then the surfaces are prepped by blasting with aluminum oxide or glass beads. Once the parts are racked for plating, the next steps are degreasing, rinsing, a proprietary "actuator" step, and plating in an emulsion of nickel, phosphate, and PTFE. From there, the parts are rinsed and soaked in deionized water and stress-relieved in the oven. Finally, the parts are removed from the rack, sorted, checked for quality assurance, assembled, and shipped.

Robar's aerospace business has enabled the company to acquire the equipment and trained personnel that would probably be impossible to justify based solely on gunsmithing applications. This is simply a fact of today's competitive business environment—you need to have some niche or advantage if you are to survive.

Which brings me to my final point: Offering your customers a choice of the latest Space-Age coating technology is another means you can use to improve *your* business and increase *your* profits. ■

Metal-Finishing Sources

Company	Website/E-Mail	Services
Accurate Plating & Weaponry Newville, Alabama 334-585-9488	www.apwcogan.com customerservice@apwcogan.com	Hard chrome plating; Liquid printed camo finishes; Bluing; Black chrome plating, Electrolytic nickel, Cerakote™
Bear Coat Longmont, Colorado 800-375-0846	www.bearcoat.com service@bearcoat.com	Teflon®-based polymer coatings
Elite Custom Guns Indian Trail, NC 704-821-6406	www.elitecustomguns.com eliteweaponry@alltel.net	Hard Chrome, Nickel, Bluing, Parkerizing, 24k Gold, DuraCoat polymer coatings
Ford's Custom Gun Refinishing Crystal River, FL 352-564-0001	www.fordsguns.com fordscustom@tampabay.rr.com	Conventional electroplating; Multi-colored anodizing; Gold plating
Metalife Grand Valley, PA 814-436-7747	www.mahovskysmetalife.com ron@mahovskysmetalife.com	Hard chrome plating, Electroless nickel, Bluing
Metaloy Berryville, AR Fax only 866-863-1097	www.originalmetaloy.com metaloy1@windstream.net	Hard chrome plating; Polymer finishes (TactiKote®)
Robar Companies Phoenix, AZ 623-581-2648	www.robarguns.com info@robarguns.com	NP3; Electroless nickel plating; Polymer finishes, Molybdenum disulphide (Roguard), Camouflage (Polymax); Bluing; Parkerizing; Blackening of SS
Techplate, Inc. Anaheim, CA 714-634-9254	www.techplate.com plating@techplate.com	Hard chrome; Parkerizing; Bluing; Bluing on Stainless; Teflon®; Gold; Silver; Electroless and Electrolytic nickel; Anodizing; Polymer coatings