

A Brief History of Finishes on American Guitars

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*The author applying clear finish in a spray booth.
Photo by Angelo Merendino Photography.*

Finishes used on fretted instruments like guitars, lutes, and violins play a key role in the performance and quality of the instrument. While there are countless debates on whether finishes detract or add to the sound quality, the main purpose of a finish is to protect the instrument and add to its aesthetic appeal. Without finish, a wooden instrument would react more quickly to changes in humidity and eventually self-destruct. Plus, a finish deepens the color of the wood, and adds depth and luster which makes it visually more appealing and more playable.

The immigrants that settled in America brought with them the finishing techniques and recipes that they learned in their native lands. Prior to the timeline of this

article, (Late 1800's) these finishes were mostly oils and plant gums and resins "cooked" into varnishes, as well as spirit finishes like shellac, which are simply resins dissolved in a solvent such as alcohol.

For our purpose I will start this timeline and history in the late 1800's because that's when company records were kept that reflect the materials purchased for finishing. I am deeply indebted to the Martin Guitar Company, because they kept diligent records, and these records have all been archived for study. With other companies, early records do not exist or are scant, but most guitar companies follow each other in finishing practices to a large degree so I am sure early finishing procedures among them were similar.

To help the reader understand finishing procedures a little better, I will talk briefly about the different finish categories. Early finishes (prior to the early 1900's) were all made from naturally derived products such as drying oils and plant and animal resins. In the 1910's and 1920's chemical companies started producing synthetic resins which have replaced most of the natural products.

Varnish

The word varnish comes to us courtesy of the Latin word "vernix" which means "fragrant resin", most likely sandarac. The earliest varnishes – sometimes called spirit varnish, were plant resins and gums dissolved in turpentine or alcohol (in early references called "rectified spirits of wine"). Eventually it was discovered that these resins could be melted and then incorporated into hot linseed oil and thinned with turpentine, creating a more durable and elastic finish. This product is the precursor to our modern oil based varnishes and polyurethane. In the modern sense when we say varnish, we are referring to an oil-based product.

Shellac



Unrefined Shellac - Seedlac (top) and Buttonlac (bottom)

Shellac is an animal by-product of a small insect native to India and parts of Thailand. It would belong in the same group as spirit varnish above. Shellac is simply the lac resin dissolved in alcohol, typically methanol, ethanol, or isopropanol. Ethanol is the preferred solvent, but because it is the same product as liquor, pure ethanol is taxed. Denatured alcohol was developed in the early 1900's to get around this. It's ethanol with a fair amount of other chemicals like methanol to make it unfit to drink. Shellac finishes have been widely used on musical instruments for centuries and continue to be used in a process called French Polishing which produces a beautiful thin, glossy

coating on wood, which is perfectly suited to guitars. French polish was the main finish used on Martin Guitars until 1900. Shellac was available at that time (as it still is) in assorted colors - brown or garnet as it's known today, orange, and white, which is one of the darker shades chemically bleached to remove the natural color. The darker colors preceded the shade top and sunburst finishes and were used on models called "orange-top". The main drawback to shellac though is that it is sensitive to heat, alcohol containing products and alkaline products like those found in some cleaners.

Lacquer

The main product we are referring to in the term "lacquer" is nitrocellulose lacquer, a synthetic finish pioneered by Dupont in the 1920's. The "lac" prefix in lacquer is derived from the same lac in shellac and the origin is "lakh" a Sanskrit word that means 100,000. The first product was called "Duco Lacquer" and starts showing up on Martin receipts in the 1920's. Although the original intended use for lacquer was the automobile industry, it quickly caught on in other production furniture and musical instrument finishing. Ever since its introduction, nitrocellulose lacquers have become the gold standard for guitars and subsequent modern finishes always something like "looks and performs just like lacquer" in their product descriptions. Its appearance coincides with the introduction of the first commercial spray guns, and spraying lacquer speeded up the finishing process exponentially. It was more durable than shellac and could be repaired easily. Within a few short years, by the late 1920's & 1930's all guitars were finished with lacquer, including Gibson and others.

Catalyzed Lacquer & Varnish

Catalyzed (also called conversion) varnish and lacquer belong to a group of finishes known as amino resin finishes. These finishes technically are not "catalyzed", but the name is used in the industry. In this type of finish a highly reactive amino resin is mixed with another resin such as a varnish alkyd or lacquer. An acid catalyst is mixed prior to application and the result is a strong, durable, and tough finish. Conversion varnish for example is the main finish now used in the US on kitchen cabinetry. Gloss Conversion varnishes have a less attractive appearance than lacquer, so conversion lacquer (lacquer

resin replaces the alkyd) was developed to solve that issue. Most companies in the US experimented with these finishes, particularly Fender which used a product called FullerPlast to fill the grain. Others use it for high wear areas. Martin uses conversion varnish on necks in some of their series. It is used more in Europe as a complete finish and is known as melamine lacquer.

Urethane



Polyester Sealer and Topcoat. Both are very tough and non-shrinking.

Urethane chemistry was discovered by Otto Bayer in the 1930's but never came into industrial or commercial use until the 1950's. There are many distinct types of urethanes, everything from oil-based polyurethane (a type of varnish) to adhesives and foam insulation, but the one that we are referring to in musical instrument finishing is called two-component urethane (catalyzed urethane is also used albeit incorrectly). Urethane is very tough, hard, and impervious to solvents. It's what is on your car. It first started appearing on Asian import guitars in the 1960's and 70's and never gained traction until it was used extensively by PRS guitars and others in the

80's. Its favored more for electric guitars, but when applied properly and in thin coats, makes an excellent finish for acoustic guitars. Although it is not used by Martin, Gibson and other big names on acoustics, smaller manufacturers like Bourgeois do use it. It is also my preferred finish. The downsides of this finish are that it's very difficult to repair shipping and other minor blemishes and it requires mixing and careful housekeeping to clean equipment.

Polyester

Polyester is a 3-part product that is the same chemistry as fiberglass resin. It made its appearance on Asian imports of the 60's and 70's and these finishes were typically very thickly applied. Its more suited to electric guitars and is not used much on acoustics as the final clear finish. It is however used extensively as a "basecoat" or grain filler because it does not shrink. Typically, another finish like lacquer or urethane is applied over it. A version of it can be quickly cured by UV light.

UV Finishes

UV finishes are sealers, fillers and topcoats cured instantaneously to a dry, sand-able state by UV lights. They are technically acrylated polyesters so are related to Polyester above but can be applied in thin enough applications, so they don't impede the tone. Although the chemistry came on the scene in the 1960's, the first company that really pioneered its use was Taylor in the early 1990's. Basically Taylor was told in a letter from the State of California that they had to stop using lacquer because of the high amounts of solvents released. At that time UV cured finishes were applied to flooring and wood furniture, but there was no technology available to apply them in a thin enough finish for Taylor's standards. According to Bob Taylor, "when we first approached suppliers we were told, oh – you want a piano finish" This rattled Bob somewhat as piano finishes are typically 4-5 times the maximum thickness of a guitar. So, Bob took it on himself to make them work, and indeed he did. He and his engineers

developed the curing chambers, lighting and even modified some of the products so they would work as grain fillers and topcoats. UV cured finishes continue to gain traction and the largest use today is as grain fillers and sealers. Lacquer or 2-part urethane are applied over them. Affordable UV cure finishes and equipment now make it within the reach of smaller output builders.

The Timeline of Finishes

1850-1900. According to Martin historians Dick Boak and Greig Hutton, most all Martin guitars up until around 1917 were French Polished except for some that were varnished. French Polish refers to a technique, not a specific product. This technique is sometimes referred to as “Friction Polishing”. Dull or satin finishes eliminate this last step, and the shellac can be sandpapered level after applying the last coat and then rubbed with pumice stone. Assorted colors of shellac that were purchased are referred to as Brown, orange and white (bleached).



Purchase receipt from 1869. Courtesy Martin archives

1900-1926. - Martin records indicate that Martin started using an oil-based varnish sometime after 1900. Shellac was still used on models up until 1917 due to its much faster drying. It's not clear how many instruments were done in varnish and shellac. They used an oil-based varnish, called “piano varnish” made from natural gums like copal. The best and top of the line instruments got varnished, while the lower tier models got shellac. During this time both varnish and shellac were brushed on. Martin records show purchasing a varnish made by the Glidden company called “Skin-Cote”. For shellac, orange, white (bleached) and brown (garnet) shellac were all used. After the last coat of varnish was applied, some models were French Polished to get high gloss. Buffing equipment that was used in the auto industry also made its way into the finish department and eliminated the use of French Polishing as the varnish could be polished to gloss. Dull and Satin models would be simply sandpapered and then rubbed with pumice stone for satin. Shellac and varnish were both applied by hand with brushes. Internal documents show however that Martin had problems with the varnish, many times it would not dry hard, and varnish is temperamental in extreme climate conditions.

A gloss finish from this period to our modern eyes would appear more semi-gloss or satin. Deep, lustrous gloss finishes that we see today really could not be attained until modern lacquers and buffing equipment arrived on the scene after the 1930's and 40's.

Sunburst guitars first appeared in the early 1920's on Gibson mandolins. The first one was called “Cremona Brown” and customer demand spilled over to archtops and later flat top guitars. Eventually Martin and others copied the trend.

Typical Varnish Finish

1. Water soluble dye stain applied (if needed, typically on mahogany necks and bodies)
2. Grain Filler* to fill grain.
3. Sealer coats of 1-1/2 pound cut bleached “white” shellac.
4. Sand Smooth
5. Seal with white shellac
6. Apply 2 coats varnish.
7. Rub with pumice stone and water for a satin finish.
8. Apply 1-2 coats Varnish in addition to above for a glossier finish with rottenstone and water.

*It is not clear as to exactly how the grain was filled prior to the introduction of commercial oil-based filler. Records show “filler” was purchased as early as 1902. One possibility is that pumice mixed with linseed oil or shellac as binder was used. Lampblack and other brown pigments would have been added to darken it. Watered down hide glue (called size) has also been mentioned, but no internal Martin documents refer to how the grain was filled but it usually was applied to the wood after staining. Commercial oil-based grain filler more than likely appeared during or after the use of lacquer and is referred to in purchasing records as “lacquer filler”. This product is typically applied after a stain and sealer are applied.

1925-1930 - Nitrocellulose Lacquer is introduced. Nitrocellulose lacquer is a synthetic resin made by chemically treating cotton. The resin is then soluble in solvents like acetone and butyl acetate. It is a very brittle resin so a plasticizer chemical is added to make it flexible so that it can “move” when the wood shrinks and expands with changes in Humidity. Nitrocellulose lacquers dry to the touch within minutes and can be recoated in as little as 30 minutes, so it is very production friendly. It also rubs out very well and can be repaired later with no evidence by simply applying more lacquer. It is the latter feature that makes it continue to this day as the finish of choice for the big companies except Taylor.



A big feature of lacquer is repairability. Here, thinned lacquer is applied to a lacquer finish to repair a scratch.

The use of lacquer coincided with the introduction of commercial spray guns by Devilbiss and Binks in the 1920's and 30's. Handheld rotary polishers (buffers) were also introduced. The introduction of these items shortened the cycle time for guitar finishes from weeks and months to about a week. In addition, the use of spray guns allowed evolution of the sunburst finish from the early yellowy-brown palette to an endless variety of hues and colors. By 1926 all Martin instruments were lacquered.

A typical lacquer finish schedule from this period on to today would be something like:

1. Apply stain or color to wood.
2. Seal with shellac or a modified lacquer called sanding or vinyl sealer.
3. Apply an oil based colored grain filler to fill and accentuate grain.
4. Apply another sealer coat.
5. Spray color for shade tops, toning or sunburst.

6. Apply between 6-10 coats clear lacquer*
7. Allow to fully cure and then sandpaper level and then buff to gloss.

*For satin finishes, satin lacquer is substituted, which is a clear lacquer with silica added to produce a stain effect. The finish is not sandpapered or rubbed.

The above would typically take 2 days and then the guitar would cure for a set time of weeks before final level sanding and polishing.

1950-1960 – The introduction of Electric guitars opened more possibilities with finishes, mainly because many are solid paint colors. Fender used nitrocellulose lacquer in the early days and in the 1960's began experimenting with faster ways to fill the deep grain on woods like ash. Conventional grain filling techniques using oil-based grain fillers shrink back and the exposed grain looks unattractive on a solid color. (We now affectionally call shrink back an aged or "reliced" effect these days). To alleviate this Fender started using non shrinking grain fillers, the most notorious one called FullerPlast, a catalyzed varnish made by Fuller Obrien paint company. The 1960's also saw the use of a type of lacquer used in the auto industry called acrylic lacquer, which does not yellow as badly as nitrocellulose and looks better with white and pastel finish colors. You can see the influence of the auto industry on the palette of paint colors used on guitars during this period. Sea Foam Green and Fiesta Red are well known car colors from the 1960's. Urethane also saw limited use, but for the most part both Fender and Gibson continued to use nitrocellulose lacquer, particularly for the topcoats.



1A properly applied Polyester and urethane finish looks anything but "plastic". Photo and guitar by the author

Urethane clear finishes and polyester make their debut on acoustic guitars imported from Asia. As mentioned above these finishes appear thick to the eye and have given the current use of these finishes a bad rap. PRS and others introduce catalyzed urethane finish and later acrylic/urethane on their electrics. They are applied over a polyester basecoat. One big advantage of urethane is its non-yellowing characteristic. On solid white guitars and ones with light soundboards, this is a big advantage.

1990 – UV makes its debut. In the early 1990's Taylor started using UV cure finish. One of the big strengths of this finish is that it is very high solids and doesn't depend on a lot of solvents and thinners to dry to a smooth film. That made the State of California happy. Back then a lot of the smaller companies like Santa Cruz and Collings and Breedlove followed Taylor but many could not overcome the technical challenges with UV and switched back to lacquer, at least for the topcoats. Taylor is the only company that uses UV cure from sealer to topcoat. This, combined with robotic buffing machinery allow for their high production output. In 2021 that was around 250.000 guitars!!!!

Current Finishing Trends



A catalyzed urethane finish on this Bourgeois Guitar has the aesthetics of lacquer but in a more durable finish. Photo courtesy of Bourgeois Guitars

Lacquer continues to be the all-around favorite among companies like Martin and Gibson as well as the smaller companies like Santa Cruz and Collings. Back in the 1990's we were told that lacquer would eventually be outlawed but it has not, mostly because manufacturers have come up with low-VOC versions. Taylor uses an all-UV finish and waterborne paint for some solid color guitars. Martin still uses an all-lacquer finish but uses a catalyzed varnish product on some necks. A lot of companies like PRS, Collings and Santa Cruz use a catalyzed product or polyester for the grain filler with a lacquer topcoat because of its looks and repairability as well as customer demand. At Collings you can even order your custom model with varnish!

Most guitar-makers, whether big or small, agree that the finish should be kept as thin as possible on the soundboard. This allows the top to move and transmit vibrations as efficiently as possible. At factories, monitoring the thickness of the soundboard finish is done with measuring equipment constantly to maintain a certain mil thickness. A mil is 1/1000 inch. Most everyone, large or small, strives for a mil thickness below 5 mil after buffing on soundboards. Some companies, such as Bourgeois are hitting below 5 mil on his aged tone models, using a catalyzed finish.



Checking mil thickness at Martin. Photo courtesy Martin Archives



Although nuances are difficult to photograph, this "aged tone" closeup shows a fully buffed gloss soundboard that still shows plenty of grain definition, usually only found on a lacquer finish. Photo courtesy of Bourgeois Guitars

Boutique Builders

Most of the well-known boutique builders I talk to send their instruments out for contract finishing. Richard Hoover at Santa Cruz echoed this advice to a new builder wanting to compete in the high-end guitar market. Others typically use lacquer or catalyzed urethane. A few use French Polish and waterborne. One interesting example though of a smaller guitar company is Adam Buchwald at Iris guitars. He uses no grain filler and an "off-the-gun" satin finish which is not rubbed out for his unique line of guitars. By eliminating a big part of the finishing process, he can reach a price point that's very attractive and still be profitable.

French Polish is still used to a considerable extent as it is low odor and non-hazardous and does not require a spray booth. Many classical builders use it exclusively.



This closeup of the back of an Iris guitar shows open grain and a satin finish. Photo courtesy Iris Guitars

For Further Reading

“The First American Furniture Finishers Manual” – a Reprint of “The Cabinet-Makers Guide” of 1827. Dover Publications. Edited by Robert D. Mussey, Jr.

“Martin Guitars: A Technical Reference” – by Richard Johnston, Dick Boak, Mike Longworth. Hal Leonard Publications.

“The Complete Illustrated Guide to Finishing” – by Jeff Jewitt, Taunton Press.

“Guitar Finishing – Step by Step” 2nd Edition – by Dan Erlewine, Don MacRostie (Stewart MacDonald)

“Hutton’s Guide to Martin Guitars – 1833-1969” – by Grieg Hutton, Centerstream Publications