Garrett Wade White Paper

Wood Finishing

Few aspects of woodworking are more overlaid with mystique than wood finishing. Before beginning a project, a woodworker is likely to have made detailed plans for the physical construction of the piece, but often may have only the most superficial idea of how it is going to be finished and what the goals of that process should be – gloss, visual "feel", degree of protection etc... All too often, a generic stain, shellac, or varnish is purchased at the last minute, with little thought as to the purity of the ingredients, the compatibility of the various solvents, or any real point of view for the desired end result.

As any good cook knows, the quality of the ingredients is every bit as important in producing a superior meal as the preparation itself. This is no less true in laying down a superior finish. **In fact, the finishing stage of a project is every bit as important to the beauty and durability of a piece as is its construction.**

There is, of course, no single right answer when choosing among the various types of staining or coloring mediums, and in selecting the correct top coat. Think through your objectives for wear resistance, toughness, flexibility, moisture resistance, and for beauty and clarity of appearance. What is the purity of the ingredients in the finish that you are using? What about the thinners (reducers) or drying retarders you are planning to use? Are the top solvents compatible with what has gone on the piece before if it is not raw wood?

Adding to the confusion is the fact that every manufacturer's formulations are different, the quality of the ingredients notwithstanding. For example, you cannot use just any alcohol in combination with dry shellac flakes, if you want first class results.

Safety Matters

First of all, observe all safety precautions when finishing. Virtually all products used in finishing have some degree of inherent danger associated with them, including (but not limited to) poisoning, solvent inhalation in high concentration, flammability, and burns (from acids and other caustic products).

Keeping vapor concentrations at a minimum through adequate ventilation is one of the most important requirements when finishing. Specially designed respirators can also be of considerable help, especially when spraying. More flammable solvents require greater care in handling than those which are merely combustible. In addition to adequate ventilation, smoking, arcing fan motors, hobnailed boots, or any other possible source of sparks should not be allowed in the finishing area.

Furthermore, rags and other materials used in applying finishes which dry by oxidation (oils, for example) are subject to spontaneous combustion. The process of oxidation generally produces heat. In a confined space, this can be sufficient to ignite rags as they are drying. Be sure to wash them after use, or hang them out so that the oxidation process does not result in heat buildup. In addition, some solvents can cause skin irritations, severe nausea (or worse) if ingested, and blindness if splashed in the eyes. Wear proper gloves, a suitable apron, and eye protection when working with such products.

Follow the Golden Rule—Experiment & Keep Records

Unless you are very familiar with the stains and coloring agents you will be using (as they apply to the wood you will be putting them on), and with the effect the top coat finish will have on the stain color and the wood, it's a good idea to experiment first on a piece of scrap wood, preferably by finishing the scrap piece completely.

Get some wood tones of one type of stain (plus a few brighter colors), and test on some scrap. A color that looks atrocious on a light colored wood can look spectacular on a darker wood. Write down what you did. Whenever you want to get the same effect, return to your notes, and look at the relevant test pieces. Test-finish topcoats in the same way, on both raw and stained wood. When the finish has cured, try polishing it by rubbing it down to a dull finish.

Understanding Finishing Basics

Other than changing color, the main purpose of any finish is to create a protective barrier between the wood and the environment. A good one will keep out dirt and grime, slow natural shrinking and swelling of the wood, and prevent decay. The type of protection a piece of furniture needs depends on the wear and tear it will be subjected to and its environment (will it be near a window and in sunlight, for example).

The other principle for finishing wood is to enhance its beauty—to bring out the depth and richness of the grain and color, and to highlight details. The character of the finish you choose will have just as much effect on the final appearance as the wood you chose.

Gloss

Gloss is really not a question of what you use, but how you use it. Almost any finish, properly applied in a sufficient number of coats and then polished, can produce a mirror gloss. It can then be dulled to a satin or even a flat coating by rubbing it down with abrasives or steel wool. The degree of gloss that you want to achieve is strictly a matter of aesthetic taste.

Texture

The texture of the wood surface is as much a part of how your furniture looks as its color or sheen. Varnish will tend to level itself, filling the tiny pores and irregularities in the wood to create a smooth, flat surface with just a few coats. Thinner finishes, like shellacs and oils, tend to more faithfully transmit wood texture to the eye and touch. An oil finish will generally create a "warm" type of look.

Texture is not only determined by the final film, however. Fillers (such as Behlen's Pore-O-Pac) can also be used to fill the pores, allowing you to achieve a much flatter, smoother surface. This generally gives a higher gloss (and a more formal look) to furniture.

Application

Always work with the best materials that you can afford, using good brushes, clean rags and a well thought-out plan. Coverage for all finishes ranges from about 125 sq. ft. to 200 sq. ft. per quart, depending on how thickly each coat is

being applied, and what the coat is applied to. On raw wood the first coat will soak up a lot of finish, but succeeding coats will go a lot further.

Here are some general rules of thumb that will help:

1. Prepare your wood carefully. Do a final hand sanding (with the grain) using fine abrasive paper. But don't sand with a finer grade than is really needed to do the job. Dust well afterwards with a "tack cloth".

2. Use good brushes and equipment, and keep them scrupulously clean. A cheap brush that continually sheds bristles, or a spray gun that spits and sputters, will waste time and materials and add needless frustration to your job.

3. It's usually wise to make the first coat of any finish a highly thinned sealer coat, which will penetrate well, provide a good base for other coats, and allow you to easily sand off any fuzz.

4. For lacquers, use a sanding sealer or a thinned-out mixture of the final top coat. Very thin shellac can be used (except on exterior surfaces) under any top coat except lacquer, polyurethane, or water-borne finishes.

5. Multiple thin coats are always better than a few heavy ones, especially with varnishes. Drying is faster and more uniform, coverage is more complete, and final appearance is much better.

6. A thick layer of finish will skin over, and dry from the outside in. Trapped solvents are released at a progressively slower rate as they have to travel through the thickening outer layer of finish.

7. Remember that wood is a natural product, and its grain and pores are not uniform. You may see a spot that looks dry—even though you know you coated it. That dry spot has finish on it, but is absorbing it faster than the rest of the piece. Let the finish dry completely before re-coating it. After a few coats the problem will disappear.

Drying: A Critical Part of Finishing

It may look dry, it may feel dry, but it may not *be* dry. Drying is a curing process, and dry-to-touch has nothing to do with a finish actually being cured. Many finishes dry from the outside in. If you apply another coat before the previous coat dries, you may end up with a finish that will never dry properly.

"Pushing" drying time is the leading cause of finishing problems. Please take the time to read and understand this section thoroughly—its importance cannot be overstated. Using a piece of furniture before it is truly dry can damage the finish and ruin your work.

For a finish to dry, the solvents must first evaporate. The time this takes depends upon three things: thickness of the finish (thinner finishes allow solvents to evaporate more quickly); type of solvent used (lacquer thinner and alcohol evaporate very fast, water more slowly, and mineral spirits slower still); and humidity.

The second thing that takes place in some finishes (oils for example) is a chemical reaction called oxidation. The rate of oxidation is determined by thickness of the finish, type of finish, and humidity. All varnishes contain some oils.

It's a good idea to perform each finishing step on a small scrap piece as you proceed. In this way, you can test the scrap piece to see if it is dry, without risking damage to the real work. Lightly sand a small area of your test piece; most hard finishes, when dry, will give off a white powder when sanded. If the finish is gummy (if it rolls up or slides under the sandpaper), it isn't dry yet.

Temperature, Humidity & Drying Time

All drying processes are affected by temperature and humidity. The ideal temperature is 68 to 72 degrees, with 35 to 40% relative humidity. If your shop's temperature falls below 60 degrees, consider postponing your finishing for another day. Higher temperatures do not generally cause problems unless they rise well over 90 degrees.

Lower humidity rarely causes problems. Above 40%, however, drying times will be greatly increased for varnishes. Blushing (a milky-white discoloration) can occur in shellacs and lacquers under high humidity conditions. For lacquers, adding a retarder to slow drying time can help eliminate blushing. Varnishes will simply require more time to dry. If humidity is over 50%, wait for a drier day, if possible.

Wood Fillers & Finish Repair

Wood filler putties are available for filling damaged areas, and are used where appearance is less important. They can be colored to match the surrounding surface, but are not an exact match for wood, since they lack grain and cell structure.

Another kind of filling is more directly related to actual finishing. Many woods (Rosewood, Butternut, Oak, Ash, Walnut, and Mahogany, e.g.) have large, open pores when cut. To get the smoothest, flattest finish possible, these pores should be filled (usually after staining) with a silex grain filler – either solvent based or water based. Silex is a finely ground quartz stone that packs into the wood pores. The best grain fillers are silex-based, like Behlen's Pore-O-Pac.

First, stain or dye the wood to the desired color. This is important, as the filler tends to seal the wood surface, making it difficult to stain later. Remove all traces of filler on the wood surface, leaving filler only in the pores. If you thin with mineral spirits, wait 48 hours before sanding, and another 24 hours after sanding, before you apply the top coat. When using naphtha, let it sit overnight before sanding lightly with fine sandpaper.

Staining & Coloring

Most projects call for at least some wood coloring to bring out the wood's grain, increase color (or to make it more uniform), and to generally improve the aesthetic appearance of a piece.

By intermixing your stains (lighter or darker; thinner or thicker), mixing colors, and by skillful application and wiping, you can control your results. You will have much more control if you stain a number of times with a weaker solution, rather than just once with a stronger one.

Many stains available don't literally stain the wood, but instead color it, by depositing a fine layer of opaque pigment on the surface. These are made of finely ground powders suspended in a carrier. Because these pigments cannot penetrate the wood cells, they actually behave like a very, very thin paint.

They are easy to use, and usually leave a uniform color, regardless of the wood or grain changes. They can be used to great advantage when coloring a lower grade material, but are less desirable when working with figured woods where the grain pattern is interesting.

Another type of wood stain is made from dyes, and actually penetrates and colors the wood's cells themselves. Because they are dissolved in their carrier rather than suspended in it, these dyes act as transparent coloring agents, and allow the depth and detail of the wood grain to be shown to its greatest advantage.

Whatever method you use, it is an excellent practice to keep notes of your results. Place a bit of tape noting the stain type, concentration, etc., on the back of a wood sample, to keep for future reference. Maintaining notes on the type of wood it was applied to is important as well, as results can vary widely from species to species.

Traditional, Natural Wood Coloring

The deep, rich color of 17th and 18th century antique furniture is due partly to the age of the furniture, but also, crucially, to the use of specific natural coloring techniques by the original finishers. Two of the better known examples are Bichromate of Potash and Van Dyke Crystals.

Bichromate of Potash is one of the most important traditional woodworking chemicals, and perhaps the single most important one to have in your finishing repertoire. It comes in packets of powder, and can be mixed in varying strengths with warm water to produce different color intensities. Rather than dying the fibers (as with aniline dyes) or putting pigment particles on the surface (as with all stains), it reacts with the natural tannin in the wood. The resulting depth of color that can be achieved is stunning. Oak (for rich, golden browns) and Mahogany (for rich, "Georgian" reds) are two woods which respond particularly well, but others work very well also, including Walnut, Cherry, and Pine.

Note: Bichromate of Potash is highly toxic. Read the instructions carefully and take all sensible precautions. Use a mask and gloves when handling.

Van Dyke Crystals, which is a brown ("woodie") coloring agent, also comes in a powder packet, and has been a favorite coloring medium of finishers and restorers for centuries. A natural substance, it can be used not only to color, but also to shade or darken certain areas on the wood surface. Just add warm water until it reaches the strength you want.

Top Coats

What is called the Top Coat is really the final finish, and most can be used over any of coloring agents (top coat materials generally should not, however, be intermixed on the same surface). The use of a sealer coat is often a very important step. The functions of a sealing coat are manifold: from sealing the wood pores to sealing in a stain so it won't bleed through a top coat. Even though none of our stains should bleed through, it doesn't hurt to seal, as a precaution.

As a general rule, thinner top coats (and more of them) will produce a better drying finish—harder, more flexible, with better adhesion between layers—and usually look better, too.

Color Considerations

Most uncolored top coats will impart some tone to the wood. For example, if you stain a piece of Maple fire engine red with aniline dyes, and then finish it with orange shellac, the result will be red-orange. If you want to keep the color of the natural or stained wood from being changed by the top coat, use a finish which has little color of its own.

Lacquer, bleached shellac and water-white varnishes are nearly as clear as filtered water. Uncolored oil finishes generally are slightly amber. At the other end of the spectrum are many varnishes, polyurethanes and shellacs whose color can range from a yellow tint to a deep orange amber.

Lighter finishes are often favored for contemporary style furniture, while the deeper colors are often used in furniture reproductions to simulate both the finishes used long ago and an aged appearance. Some coloring agents (Sutherland Welles stains, for example) are even formulated specifically to impart an antique look.

Spraying Finishes

Because of the initial expense involved in spraying, some people decide against it, but it has many advantages. A sprayed finish is smooth, fast, even, and free from lap and brush marks.

Most finishes can be sprayed, but it is best for applying materials that dry primarily by evaporation. Many shops spray their dyes and stains to ensure uniform color coverage.

Remember to always work in a well-ventilated area, and to wear a respirator and eye protection. Never, spray near flames or fire.

Good technique is not hard to learn. For best results, maintain a fixed distance from the tip to the surface, and move the gun at an even, controlled rate. Spray the corners first (both inside and outside), and then cover the large areas. Try to achieve a thin, consistent coat that covers completely, but doesn't run or sag as it dries. You'll get better quickly with experience so it's best to practice on scrap pieces first until you feel you have sufficient experience.

There are two types of spray equipment: High Pressure-Low Volume and Low Pressure-High Volume. Although the results may be the same, the two systems operate very differently.

The more traditional high pressure-low volume system atomizes the finish as it emerges from the gun. This is a well proven spraying technique, but creates a floating over-spray of mist and bounce-back, which can be unpleasant, and wastes material. Water can also contaminate the air from the compressor.

The steady refinement in HVLP (low pressure, high volume) spray equipment has given finishers a welcome alternative to traditional methods, and has made spraying an option for shops that have neither the space nor budget to install traditional compressors and spray booths.

For those hobbyists or smaller professional shops that are serious about spraying, a low pressure system is the best way to go. This greatly reduces misting and bounce-back, and gives you much more control over flow of material and spray pattern.

Lacquer As A Top Coat

High grade lacquer possesses many attractive properties: clarity and depth of color, accentuation (to bring out the wood's properties), hardness (to resist impact), and resistance to alcohol, water, heat, oil, and mild acids.

Lacquers dry quickly by evaporation, leaving a finish that offers good protection against water, alcohol, most solvents, and general wear and tear. The disadvantage for the smaller shop, however, is that most dry so fast that they must be sprayed (Behlen's Brushing Lacquer is an exception).

Traditional lacquers are made of nitro-cellulose dissolved in a solvent, with other resins added. Although non-toxic when dry, in liquid form they are toxic, volatile and flammable.

Caution: Do not mix different brands or types of lacquers together.

Shellac As A Top Coat
Shellac is an organic material, derived from the secretions of the Lac Bug, found in the Far East. In its dry state, shellac is classed and priced according to its degree of purity and refinement.

Shellac has many advantages. It can be applied very thinly and quickly; it is durable, elastic and flexible; and it produces a beautiful lustrous finish (the famous French Polish finish is a shellac finish).

However, shellac is not heat, water, or alcohol proof, and has a relatively short shelf life. For this last reason, it should be mixed in fairly small quantities, and the container must be tightly sealed to keep the alcohol free of water. It is also a good idea to wax shellacked pieces, to create a secondary barrier to protect the finish.

You can, of course, get shellac ready mixed. But using the dry flakes (mixed with a top quality super-dry alcohol solvent) is the best way for the serious craftsman to ensure a pure, properly refined product. When making shellac from dry flakes, make a pint or quart of 4 lb. cut, and then thin as you would use it (1 lb. of shellac flakes dissolved in one gallon of denatured alcohol equals a 1 lb. cut). This is an easy process to master.

Shellac should be put on thinly (in a 2 or 3 lb. cut) when used as a top coat. It should run off your brush in a thin, steady stream, and feel thin when rubbed between thumb and forefinger. Apply it rapidly, flowing it on in long, full strokes. After waiting about an hour, sand lightly. Dust off and apply another coat. After final coat, allow to dry for several days, then rub and polish. All shellac is non-toxic when dry.

Varnish As A Top Coat
Despite its relatively long drying time, there are many advantages to the use of varnish as a top coat, such as heat and alcohol resistance, and scratch and mar resistance. Traditional varnishes are made with various resins, oils, solvents, and additives combined to create a tough finish.

Best applied with a very high quality brush, varnish must be given enough time to dry between coats and before use. Drying takes place by evaporation of the solvent as well as by oxidation of the oils in it. Your shop must be kept dust free when varnishing. A sealer coat, if desired, is best made up of a thinned coat of the varnish you are using, but you can use a "wash coat" of shellac.

In this age of instant gratification, lacquer is often chosen over traditional varnish, primarily because of its faster dry time, but varnish produces a softer, more beautiful finish coat, with a much richer luster.

Stir gently, and only when absolutely necessary, so as to minimize the possibility of forming air bubbles. Use only a clean, top quality flowing brush. Dip the brush into the varnish to about 2/3 of the bristle length. Tap the excess off on the inside of the container. Apply in a flowing motion with the grain. Watch for excess varnish at the edges.

Oil As A Top Coat
The easiest finish to use, oil is also the most forgiving, and the most natural of all finishes. Simply apply with a rag, allowing the oil to soak in for a brief period, and then wipe off the excess. Let dry overnight between coats.

An oiled finish is a very traditional one and produces that most natural appearance and the greatest tactile connection to the surface. Even with multiple coats, you will never feel that the surface has a film on it, separating your fingers from the wood. Whether to use it or not is really an aesthetic decision but we recommend that it always be given some consideration.

Tung oils provide the best protection of all the oil finishes. You will certainly apply multiple coats and the result can be nearly as tough as varnish. The trick is not to apply too much oil to the wood. Excess oil can get gummy, and should be wiped off at once. Alternatively, use low luster oils, applying an extra coat or two to reach the desired luster. Sutherland Welles makes, in our judgment, the best oils available – both for exterior and interior use. They are expensive but worth every penny.

Danish oil is a generic mixture of various oils, resins and solvents. Although not as tough and durable as Tung oil, it is easier to apply, tends not to gum up and gives a beautiful satin finish.

Linseed-based oils are formulated on a totally different basis and we recommend that you become familiar with them also, but they are not our preferred type of oil because they are not durable, dry slowly and can have a noticeable odor. However, they are relatively inexpensive.

Rubbing, Buffing & Waxing

Gloss is not so much a matter of which finish you use, but rather how it is used. In fact, you can get as shiny a finish with oil as you can with high gloss lacquer. Almost any finish, applied in a sufficient number of coats and polished, can be used to achieve a mirror gloss. The gloss can then be dulled to a satin or even flat dull coating, by rubbing it down with abrasives or steel wool.

Smoothing, rubbing down and polishing of finished surfaces are critical to final appearance. In addition to the finer grades of sandpaper and steel wool, there are other materials which you which you should have in your shop

Rubbing and buffing a surface can either produce a gloss or dull a surface, depending on the nature of the compound used. Automobile rubbing compounds are often excellent for this purpose, although some specialist wood finishing suppliers, such as H. Behlen Bro. manufacture rubbing and buffing compounds for professional wood finishers. *Note: not all finishes can be rubbed. Lacquers and varnishes rub well. Oils are generally never rubbed. Shellacs can be rubbed, but oil - not water - must be used as the lubricant.*

Waxes, of course, lay on top of the surface they are applied to, and generally increase gloss and attractiveness of the finish. They also provide some additional protection.

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