



guide to finishing: Part 1

Wood Preparation



Get that great wood surface as perfect as possible; it paves the way for a great result.



Author Jim Kull also monitors the discussion group on wood finishing at our www.woodonline.com Web site.

You chose a terrific design, you did some outstanding joinery, and your project went together just perfectly. Now you're ready to apply a finish. Or are you? A second-rate job of preparing the surface can make the finish look like it was applied with a broom, ruining the look and feel of the whole project. Get the preparation right, and you're on your way to a finish that will make people say, "Wow!"

Let us help you take your projects to the next level with the procedures and insider's tips accumulated over the years by veteran finisher and instructor Jim Kull.

Sand it smooth

The first step in a good sanding job is to choose the right sandpaper. Buy good quality paper because the inexpensive kind will dull quickly and can load very rapidly with sanding dust.

The caption with **Photo A** provides a brief introduction to your sandpaper choices. Start with 100 grit in most cases; use 150 next; and stop at 220. Sometimes you might want to use even finer paper on end grain, but remember that higher grits can create a burnished surface that won't accept stain properly.

Make simple sanding blocks, like the one in **Photo B**, to smooth flat surfaces. You can sand concave and convex areas, such as molded edges, without a block. However, a backing material that matches the desired shape makes the job neater and easier. Dowels, profiles made of rubber, and countless other shapes will work just fine.

Sanding dust—the technical term for it is "swarf"—must be removed as you sand, and between grits. The cleaner you keep your surface, the more effective your sanding will be. Grit and dust that remain on the surface tend to ball up and clog your paper. This "corning" will create broad, deep scratches that are difficult to remove.

If your electric sander includes a



Rely on garnet paper, easily identified by its orangish color, for most pre-finishing sanding. Tan-colored aluminum oxide sandpaper will do the job, too. Choose "open coat" paper, which has more space between the grit particles than the "closed coat" type. The sanding dust can escape temporarily into these open spots, so your sanding is more effective and produces smoother results.

Good sandpaper carries a grit number on the back of each sheet, such as 100, 150, 180, or 220. A larger number means finer grit, which produces smaller scratches on the wood. "A" weight paper is the lightest, most flexible kind. It's a good choice for most jobs.



Hand sanding produces the best results with a block of hard rubber or cork backing the paper to give it just a bit of flexibility. If you hold the sandpaper with your fingers, you'll remove more material from softer areas, creating valleys. Buy a sanding block from a catalog or woodworking outlet.

For a quick and easy alternative, you can use a block of wood, as shown here. Glue felt or cork on one face to serve as a slightly flexible pad between the block and the paper. Size it to fit your hand, and use it with a quarter sheet of paper.

A vacuum with a hose and a brush attachment, as shown here, does a good job of cleaning dust from your project. Blowing compressed air also takes the dust off the wood, but it's best done outdoors. If you do it in your shop, the dust goes into the air, creating a mess and a health hazard.

A commercially made tack cloth, or a rag or paper towel dampened with paint thinner, will remove dust fairly well. Turn it frequently to a fresh side, so you're not just spreading the dust around.

Paint thinner dries quickly, and a trace of it left on the surface won't affect any further finishing efforts.

However, some commercial tack cloths may leave a residue that will affect the finish, especially water-based coatings.



dust-collection bag or vacuum attachment outlet, be sure to use it. (When we tested random-orbit sanders in issue 123, we found that hooking up the shop vacuum does improve dust control.) Check **Photo C** for more about other options.

Spot problems early

As you prepare to finish, you'll find that paint thinner is one of your best friends. What you see with a wet coat of paint thinner is what you will see with a finish, as shown in **Photo D**. Blotches, scratches, glue spots, and other flaws will leap out at you, just begging to be fixed.

Paint thinner evaporates fairly quickly and leaves no contaminant on the wood. You can use any kind of finish without problems, after the thinner dries. Here's how to handle three typical defects:

Scratches. If you see scratches or machine marks from sanding, you might not have sanded adequately with your last grit of paper. Resand, and check again. If you still find prominent scratches, go to the next finer grit, and sand the wood thoroughly once again.

Blotches. If you examined a board with a microscope, you would see many tiny holes called "pores." Woods with fine pores, including pine, cherry, birch, and maple, tend to blotch when stained. This uneven coloration is a result of variations in the density of the wood. Anything put on the surface tends to absorb more in the softer areas than in the harder areas of the wood. The greater the absorption, the darker the color. Your paint thinner will reveal potential blotching problems.

To avoid blotching, make a homemade conditioner, as described with **Photo E**. Most commercial conditioners, as well as homemade mixes using lacquer or varnish, will leave a slight amber cast.



Plywood and dimensional lumber may take stain differently even though they are the same species of wood. When you wipe on paint thinner to look for sanding and gluing flaws, you'll spot this difference, too. Softer areas will look darker. Sand those areas with a higher grit—the smaller scratches won't capture as much stain.

For the same reason, use a higher grit on softer woods if you have mixed woods in your project. For example, in a project that combines oak and soft maple, sand the oak to 150 and the maple to 180.

The same is true for end grain with any wood. Sand the end grain with a paper one grit higher than the last one used on the face grain, to compensate for the end grain's tendency to soak up more stain or finish.

For a colorless conditioner, or one that will be coated with a water-based finish, use a thin coat of clear shellac. You'll find pre-mixed, canned shellac at most home centers and hardware stores. This product is too thick for a conditioner, so mix 1 part shellac with 4 to 5 parts denatured alcohol to make the amount you need for your project.

Glue spots. Whether it's due to normal squeeze-out or an unnoticed drip, dried glue will produce an unsightly spot in the finish. Let the glue start to set, then scrape it off with a sharp blade, and wipe the wood with a damp rag.

Again, paint thinner will make glue spots visible before you finish. If they show up after you have applied stain or a topcoat, you'll have to scrape or sand to remove them.

Fill the gaps

Despite our best efforts, we often have to deal with gaps at joint lines, cracks in the wood, nail holes, and other surface flaws. With the proper techniques, you can make those shortcomings disappear.

Whenever possible, fill wide gaps and cracks with slivers of the same kind of wood used in your project, as shown in **Photo F**. You can buy various brands of pastelike wood filler that will disguise smaller gaps. It won't take stain like wood, but a repair that runs parallel to the grain will blend in nicely. Use a mix of your final finish and sawdust for smaller gaps, as shown in **Photo G**.

Holes call for different tactics. Putties and sticks of all kinds come in various colors and are designed to match your wood. Unfortunately, as they dry, the color tends to leach into the surrounding wood. Like the fillers, none of them will take stain the same as the wood in your project. So don't use them during your preparation work. Wait until



You can buy conditioners that even out the density of the wood and minimize blotching. However, you can accomplish the same thing with a homemade concoction. Unless you're planning to use a water-based finish, condition blotch-prone woods with a highly diluted coat of the final finish prior to staining.

For example, if you've chosen an oil-based polyurethane as your finish, mix one part poly with five parts paint thinner. Apply a liberal coat of that mix and allow it to dry. Lightly sand the wood with 220-grit sandpaper, and you have evened out the density. You'll leave the mix in the softer areas, and sand it off the harder areas. Always test your mixture and procedure on a scrap piece before trying it on the actual project.



The best gap-filling material of all is real wood. Choose that option when the void is large enough and regular in shape, like the one shown here.

Use a chisel to take a sliver from another piece of matching wood, making it deeper than the gap. Rub the sides of the sliver on sandpaper until it fits the width of the gap perfectly. Force glue into the opening with a knife or a piece of paper, then slip the filler into place.

After the glue dries, use the flat face of a chisel to trim the protruding filler piece flush with the surface of your project. Follow that with light sanding.

To fix gaps, cracks, and small holes, make your own filler by mixing sanding dust with hide glue, linseed oil, or a bit of your final finish. Here, we used polyurethane varnish and powdery dust that we reclaimed from the bag of our belt sander.

Make your filler into a thick paste, and force it into the gap with a putty knife. Sand it to aid in drying and to level the surface. Use the same grit that you used for your final sanding step.



Here you see the sanding slurry from a wide area, scraped into one spot for visibility. You don't need to do that when you wet sand, just sand thoroughly, forcing the slurry into the pores.

The next day, sand again. The oil/varnish mix won't be dry yet, so some of the new sanding dust will blend with the original slurry and further fill the pores. Let the piece dry for a couple of days before proceeding to the final sanding and finishing.

you've stained and applied a coat of finish, then use a putty that matches the finish color.

To seal or not to seal?

The first coat of any finishing product, including stain, seals the pores of the wood, and locks some wood fibers in an upright position. The only reason for using a sanding sealer is to make it easier to sand off those fibers.

However, sanding sealers also create problems. They can interfere with the adhesion of subsequent coats, they resist stain penetration, and their softness makes a poor base for a finish. So, in general, skip the sanding sealer.

Pack those pores

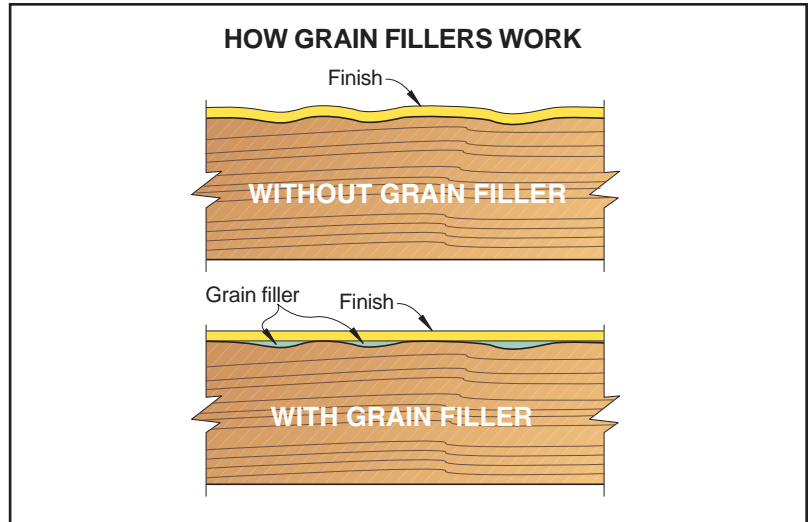
Why would you want to fill the grain of wood? The illustration on *page 6* shows you why. No matter how thoroughly you sand wood, small pores remain, preventing you from attaining a perfectly smooth base for your finish. The finish itself will solve the problem in fine-grained woods, but if you're working with a coarse-grained species, such as oak, walnut, or mahogany, filling the grain makes a big difference. After filling, it's much easier to produce a glass-smooth surface that's a pleasure to look at and delightful to touch. Here are four choices for filling grain.

Filling with finish only. You can fill the grain with repeated applications of a finish. Sand after each coat has dried, leaving finish only in the pores. Traditional varnishes, polyurethane varnish, and lacquer will work, but shellac excels. After two or three applications, you should have a smooth surface as a base for a hard, film-forming finish.

Sanding with a finish. Apply an oil/varnish mix to the wood—tinted to highlight the pores, if you choose—then sand this liquid with 220-grit sandpaper. You'll produce a slurry like that shown in **Photo H**.



Apply paste filler to the wood with a small squeegee. Work across the grain and leave just enough to cover the surface. Remove any streaks by rubbing across the grain with a rag or a piece of burlap. Wait two or three days until the filler has dried completely, then sand the surface lightly. Or, instead of sanding a large, flat area, you might want to consider scraping. It's faster and leaves a smoother surface. The surface is now ready for stain or a clear topcoat—whichever will give you the finished look that you want.



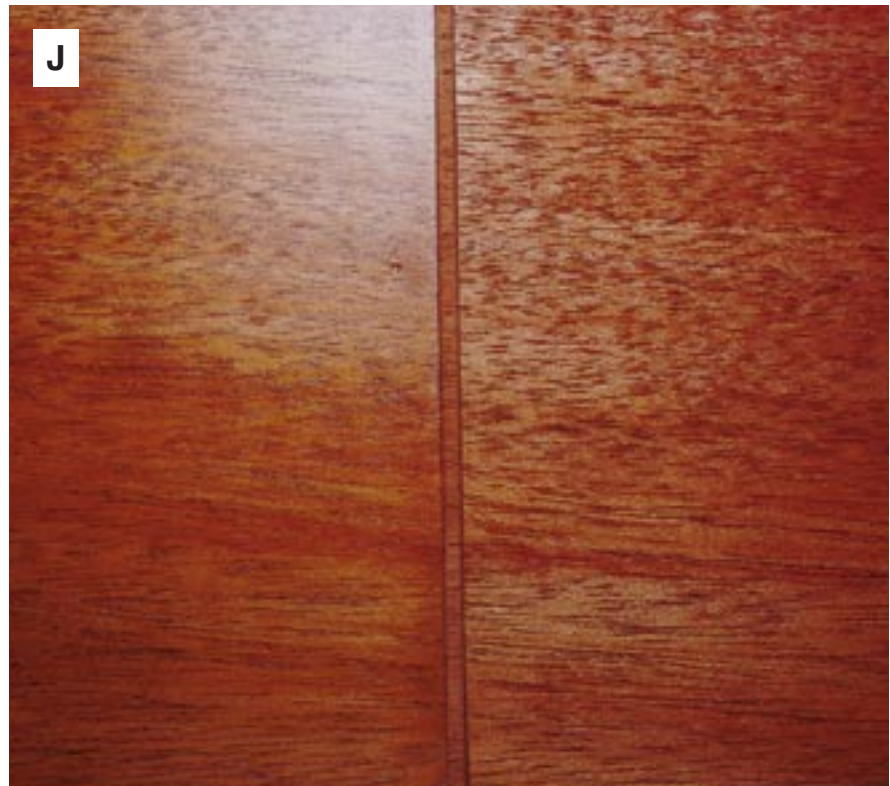
Applying paste filler. Some oil-based paste fillers come from the can as thick as peanut butter. Thin them to the consistency of heavy cream with paint thinner or naphtha, then proceed as shown in **Photo I**. You can see in **Photo J** the difference that filling makes in the first coat of finish.

A dark filler will serve to highlight the grain. You can buy colored fillers, but it's easy to make your own by adding stain to the filler.

If a filler is a different color than the stain you plan to use, the wood must be stained first, sealed, then filled. When sanding the filler, take great care to avoid sanding through the stain.

Water-based paste fillers. These fillers dry quickly, and will take a water-based stain, but possess some disadvantages, too. Because they dry so rapidly, you're limited to a small work area. It's tough to remove water-based filler that has dried.

If you plan to stain over water-based fillers, note that oil-based or varnish-based stains won't work.



This mahogany sample shows the difference between unfilled pores, on the *right*, and pores that have been filled with paste filler. We gave the area on the *left* two coats of filler, sanded it after each coat, and sprayed lacquer on the entire board. The filled portion has a much smoother look and feel.



Here's The nitty-gritty on electric sanders

If you're just starting to buy power tools, which electric sander should you choose? Machine sanding falls into three broad types—belt, orbital, and random-orbit. If you can afford only one sander, you'll get the most value with a random-orbit model.

A belt sander will remove large amounts of material very rapidly but you need experience to operate it well. When you're learning, it's all too easy to create dips and prominent sanding marks. Also, sanding belts can be a bit expensive.

Most orbital, or finishing, sanders have square or rectangular pads, suitable for one-quarter sheets of sandpaper. This type of sander tends to be

the least expensive to purchase and, because you can cut your own paper from sheets, the least costly to operate. It can create swirls that are difficult to remove, but you can minimize that problem by applying very little pressure to the sander and moving it slowly across the workpiece.

A random-orbit machine uses a sanding disc, either self-adhesive or hook and loop. These machines leave sanding marks, but the scratches are much less noticeable than those created by a belt sander or an orbital sander. Minimize the marks by moving the sander slowly and in a regular pattern with the grain. If you have a two-speed or variable-speed random-orbit sander, use a low

speed for sanding and a higher speed for polishing. Operating the sander at low speed will not significantly slow the sanding process, and will produce fewer machine marks.♣

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The WOOD® Magazine Guide to Finishing: Part 2

Staining Dyes, Pigments, and the Secrets to Creating the Color you Want



You've assembled and sanded your project, the can of varnish sits within reach, but this time you want something different than the usual look. You want this piece to match the top-end furniture in the best store in town or the antique in the living room.

Or maybe you want to even out the varying colors of different boards that you've used, make a common wood look exotic, or add richness and depth to your project's appearance. If you have any of these goals in mind, it's time to do some staining.

Staining relies on two types of colorants: pigment and dye. We'll help you choose the right product for the job and apply it correctly.



We began our series with a look at wood preparation in Part 1. In Part 3, we'll delve into clear topcoats.

A multiple-choice test

Which type of colorant should you select? You have plenty of choices, such as those shown in **Photo A**. Your decision depends on the look you want to achieve, the type of wood you're using, and the final topcoat you plan to apply.

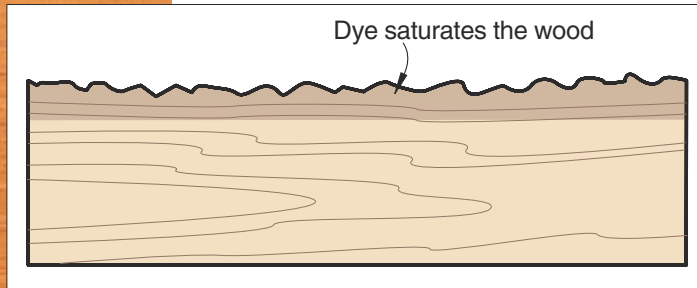
Pigmented stains offer the most flexibility in your choice of a topcoat. Once the stain dries, you can apply almost any finish over it. For example, you can use an oil-based or water-based finish over either a water-based or oil-based stain.

The stain must be dry before you proceed with finishing. Temperature, humidity, and moisture content of the wood all affect drying time, so don't rely on the can instructions. Use your nose. If you can smell the solvent, the stain isn't dry.

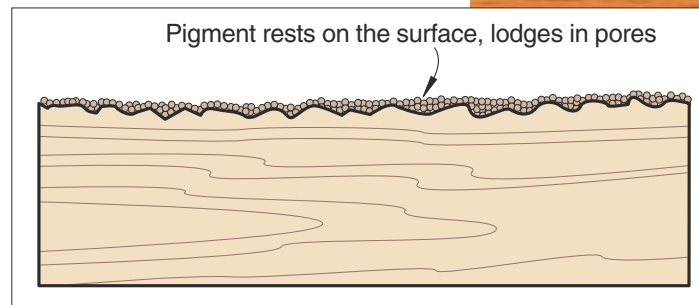
Dyes are a bit more dicey. If you brush or wipe on a finish containing the same dissolving solvent, you can cause streaking and will partially lift the dye into the finish. This can create a wonderful depth to the color, but might lighten it, too. If you have the necessary equipment, you can spray on the topcoat without causing any problems.

1

dye

**2**

pigment



For general staining, use either a pigmented stain or a dye. These two types work differently, as shown in the **Figures 1** and **2**, and produce noticeably different results, as you can see. Most paint or hardware stores carry pigmented stain. You might have to visit a woodworking specialty store, or go the mail-order route, to find dyes. For example, the Woodcraft catalog carries Trans-Tint dyes in several colors, priced at \$15.99 for a 2-ounce bottle that will make about 2 quarts of colorant. Call 800/225-1153.

Pigmented stains tend to blotch on woods with uneven density, such as maple, birch, cherry, and pine. Dyes tend to penetrate evenly all over the wood, regardless of their density.

Here, you can see the difference between dyes and pigmented stains. The oak board at right received a coat of golden oak dye, while the other board, lower right, was tinted with a golden oak stain.

Like paint, a pigmented stain goes on the surface of the wood and penetrates very little. Paint contains enough pigment to make it opaque. Stain has similar pigments, but in lesser amounts, so that it is relatively transparent.

Pigments are suspended in a binder—an additive that dries, and creates a seal between the stain and the wood. The most common oil-based binder is linseed oil. Water-based stains employ a non-oil binder. All pigmented stains have to be stirred thoroughly to mix the pigments with the binder, or you will get streaky coloring.

Dyes differ greatly from pigmented stains. Dyes are transparent, penetrate into any kind of wood, and give it an even tone all over.

You can buy dyes pre-mixed, powdered, or as liquid concentrates. Manufacturers design each powdered dye or liquid concentrate to dissolve with a particular solvent: water, alcohol, or a petroleum product, such as paint thinner. You must use the proper solvent with each type of dye. A dye intended to be dissolved in water usually can't be dissolved in alcohol.

Concentrated liquid dyes will work with more than one solvent. Alcohol-based dyes dry the fastest—perhaps too fast for general use. Water-based dyes are the easiest to apply and the safest to use.

B

As you strive for the perfect hue, be aware that all color products will fade. Pigmented stains fade the least and the slowest. Among the dyes, the oil-based and alcohol-based versions fade the fastest and the water-based fade the least. Don't use dyes in direct sunlight applications because they'll fade quite rapidly in those conditions.

Application is easy

Applying a stain is essentially the same with either a pigment or a dye. Test the stain on a scrap piece, then flood the surface of your project, and wipe off the excess to even out the color.

One of the keys to staining is learning how to allow for changes in color from wet stain to dry. Often, a woodworker will notice the change, and decide that additional coats of stain are necessary—usually a mistake. If the wet color was correct, leave it alone. The wet color of the stain will return as soon as a coat of finish is applied, as shown here.

Some stains dry faster than others, and once the stain dries, you'll have more difficulty removing the excess. Water-based pigment stains tend to dry faster than the oil-based pigment stains. Often, the color will get a dry, powdery look when the stain dries. It's nothing to worry about.

After wiping, allow the stain to dry completely and wipe the surface again to remove any residue. Remember that the appearance changes when the stain dries,

and then changes again when you apply a clear topcoat, as shown in **Photo B**, above.

You can use either liquid or powder when you choose to dye a

C

piece of wood. Make sure to mix powdered dyes thoroughly, and then filter them, as shown in **Photo C**, above. Generally, the color you apply to a piece of wood will remain the same regardless of the number of coats. The color will darken but remain transparent. Pigmented stains become darker and more opaque with each application.

When you mix a powdered dye with water or alcohol, no matter how thoroughly you stir, some of the dye particles never will dissolve. After mixing, allow the dye to settle. Stir it again, and then filter the mixture through a coffee filter, cheesecloth, or nylon hose to remove those undissolved particles. Always wear a mask when working with dry dyes, which become airborne easily. They can cause respiratory problems and even allergic reactions in some people.

You can mix stains and dyes for a custom color, as long as they have the same solvent. For best results, mix the same type and brand of product. Also, mix each color separately before combining them. Don't add a powder or concentrate of one color to the mixed version of another.

D

Preventions and cures

Even though the actual application is easy, can things still go wrong? Yes, they can. But you can avoid most problems, once you know what to expect.

Raised grain. The biggest problem with water-based products is that they raise the grain of the wood. Go ahead and raise the grain intentionally, and then carefully remove the resulting whiskers, as shown in the **Photo D**, above.

Uneven color. A perfectly good board might vary in color, and most stains won't cover up the

Water-based stains and dyes tend to “raise the grain” of wood. Tiny fibers swell up and remain standing like whiskers. If you apply a coat of finish over those whiskers, it will feel like sandpaper.

The easiest way to deal with raised grain is to make it happen before you apply a water-based stain or dye, then eliminate it. First, wet the wood with water from a spray bottle, and allow it to dry completely.

Then, sand or scrape off the fuzzy raised grain. For a simple and efficient scraper, just remove the blade from a utility knife. Hold the blade almost vertically, as shown here, and gently scrape the surface.

E

differences. See **Photo E**, above, for a discussion on evening out color.

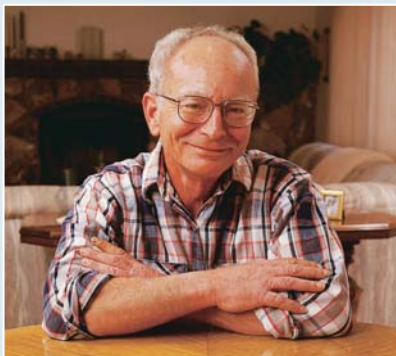
Blotching. Some woods acquire an uneven look when stained. Apply a conditioner first, and you'll get a much more consistent result. Check out **Photo F**, page 8, for examples that illustrate the blotching issue.

Dark end grain. End grain absorbs more pigmented stain than the rest of the board. To compensate, sand end grain with one grit higher paper than you use on the other surfaces. Then, coat the end grain with a conditioner. A dye stain solves the uneven coloring problem with no conditioner needed.

Wrong color. Sometimes you won't be satisfied with the look of a stain on your project. If it's the right shade, but too light, apply another

Wood varies in color, and no stain will even out those differences completely with one coat. The biggest problem occurs in such woods as cherry and walnut, in which the sapwood is a much lighter color than the heartwood.

If you want a dark color on the entire project, apply your stain just to the sapwood, as shown on this piece of cherry. After it dries, apply a coat of the same stain everywhere. If you want a natural finish, find a stain that's the same color as the heartwood, and use that stain to tint only the sapwood.



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F



coat of the same stain. If it's the wrong shade, you can hide it with a darker stain.

If your stain is too dark, and still wet, you can remove much of it by scrubbing the surface with the appropriate thinning solvent. Use water for water-based stains, and rely on mineral spirits for oil-based stains.

If the stain already has dried, and it's water-based, you'll have to strip it all off with water and start over. You can remove some or all of a dried oil-based stain with lacquer thinner. If not enough comes off to suit you, remove it all with a stripping product, bleach out any remaining spots, and start over.

You can remove some of the color from a dry dyed surface by wiping it with the appropriate dissolving solvent. Be careful, though. You run the risk of creating streaks in the color.

Woods such as pine, cherry, maple, and birch vary significantly in density within a single board. This inconsistency can create "blotch" when you apply stain. Softer areas absorb pigmented stain more readily than harder areas, making the soft spots darker and more opaque.

You can minimize or prevent blotching by using a conditioner before you stain. A conditioner is a coating that seals the pores of the wood, and makes the difference shown here. We applied Minwax conditioner, then red oak stain to the pine sample on the left, while the one on the right received only the stain.

You also can make your own conditioner. For example, if you're going to finish with polyurethane varnish, make a conditioner from five parts thinner and one part poly. Apply this conditioner, allow it to dry, sand it gently with 220-grit sandpaper, remove the dust, and apply your stain.

G

Variations on a theme

We've concentrated on pigments and dyes, but five other types of staining products also deserve discussion. In certain situations, you might consider a dye/pigment stain, a colored oil/varnish mixture, a gel, an all-in-one product, or a non-grain-raising dye. The most versatile of these are the **dye/pigment** types, as shown in **Photo G**, above. And, in some situations, a **gel** is the best way to get a beautiful result, as shown in **Photo H** on *page 10*.

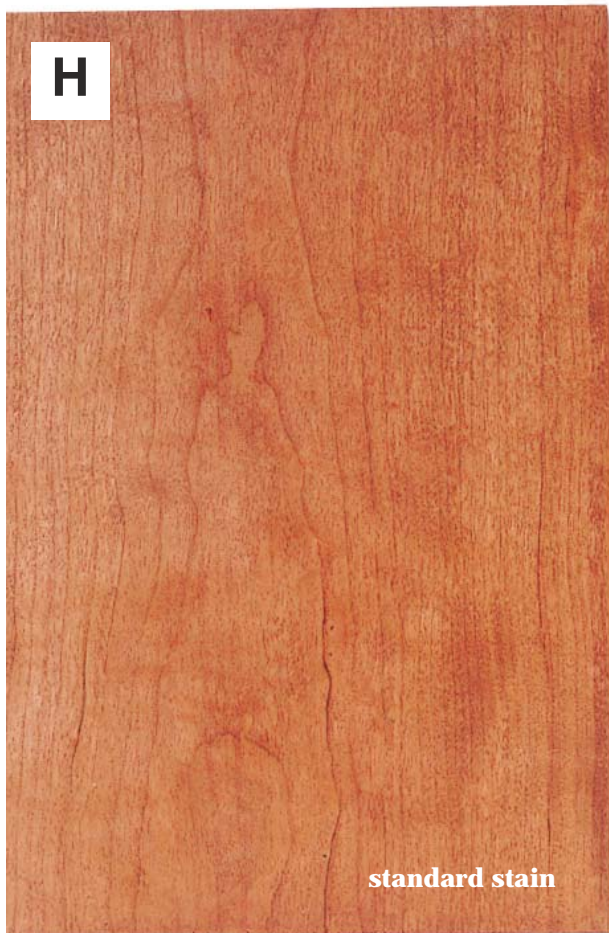
Colored oil/varnish materials often are referred to as Danish oils. They combine oil, varnish, thinner, and a dye-like colorant. Easy to apply, they offer a fairly even penetration into the wood and a moderately durable binder that will serve as a finish.

Dye/pigment stains contain both kinds of colorant, and usually have separated by the time you take them off the store shelf. The dye is in solution, and the pigment has settled out. They require complete stirring to remix the pigment and achieve the intended color.

You can determine if you have a dye/pigment stain by inserting a stick into the unstirred can. If the stick has color along its body and a glob on the end, as shown here, it's a combination product. The dye penetrates the harder portions of a piece of wood, and the pigment settles into the grain and pores. A dye/pigment stain tends to soften blotching, but to really minimize blotch, use a conditioner first.

A dye/pigment stain offers you several staining options. Unstirred, the upper portion of the can will provide a dye type of stain. You can apply it as a stain or add it to a compatible finish to use in toning, which we'll discuss in the third part of this series.

Stir the can a bit, and you'll get a slightly different shade of the same color. Stir it completely for yet another shade. Finally, the settled pigment, left unstirred, works great for glazing, another topic for part three of this series.



All-in-one products are finishing materials, such as polyurethane varnish, with color added. They can be oil-based or water-based, and the colorant can be dye or pigment. They are designed to color and finish with a single application. These are generally surface products and perform much like paint. They can be tricky to apply because they tend to dry quickly and you can overwork them very easily. Successive coats make them darker and more opaque. Lap marks are very difficult to avoid. In short, avoid these products for general finishing.

Non-grain-raising dyes are water-based products that you thin with alcohol or lacquer thinner, making them compatible with oil-based

Gels are pigments, dyes, or a combination of the two, combined with oil-based or water-based finishing materials. Essentially, a gel is paint, coating the surface without penetrating.

Gels tend to obscure the grain, but they do reduce blotching, as you see here. The sample board on the left received a standard stain, while the one on the right was coated with a gel.

Gel stains also work well for “glazing.” The technique of glazing allows you to apply color between coats of finish, or to apply an artificial grain to literally any surface. For example, you can make two different woods look alike, or make cardboard look like oak. See WOOD® Magazine, Issue 129 for a thorough explanation of the “faux finishing” process.

finishing materials. They dry very quickly, which eliminates one of the advantages of a typical water-based dye. Most home woodworkers can get along just fine without them. ♣

Written by **Jim Kull** with **Jim Pollock**
Photographs: **Marty Baldwin**
Illustrations: **Roxanne LeMoine**

Another world of colors to explore

Most woodworkers will find all the colors they need in the standard assortment of cans at a home center. But if you have a specific custom look in mind, or you just want to experiment, you can fine-tune those colors. One way is to mix the standard products, always making sure to combine only those with like solvents.

A more controllable approach is to add basic colors to the commercial products, or directly onto the wood. You can use Japan colors or artist's oils if your stain and topcoat are oil-based, or mix acrylic artist's colors into a glazing medium if you're using water-based products. Art stores and hobby stores carry artist's oils, acrylic artist's colors, and glazing medium. You can buy Japan colors from Woodworker's Supply starting at \$10.50 per half-pint (800-645-9292, woodworker.com)

A color wheel will help you figure out how to arrive at the hue you have in mind. A traditional color wheel shows you how to use red, yellow, and blue to make all of the other colors. You can buy a 9¼" version for about \$7 from The Color Wheel Co. 541-929-7526, less than \$20, colorwheelco.com

However, furnituremakers rely more on the earth-tone colors shown on the wheel pictured here. This wheel is available from Woodcraft (800-225-1153 or woodcraft.com) or Rockler (800-279-4441



When you start dabbling in custom-look colors for your projects, here's a basic approach that many woodworkers don't consider. The acrylic colors at left, the artist's colors at right, and the color wheel can help you create the exact color you need to turn a standard-issue project into something special.



We used a premixed glaze, available at home centers, plus acrylic colors to get the results shown here on oak. The left piece received a coat of raw sienna, the middle one got an application of burnt umber, and the sample on the right shows what happens when you blend the two colors together.

rockler.com). Various combinations of raw umber, burnt umber, raw sienna, burnt sienna, Van Dyke brown, white, and black will produce a range of beautiful

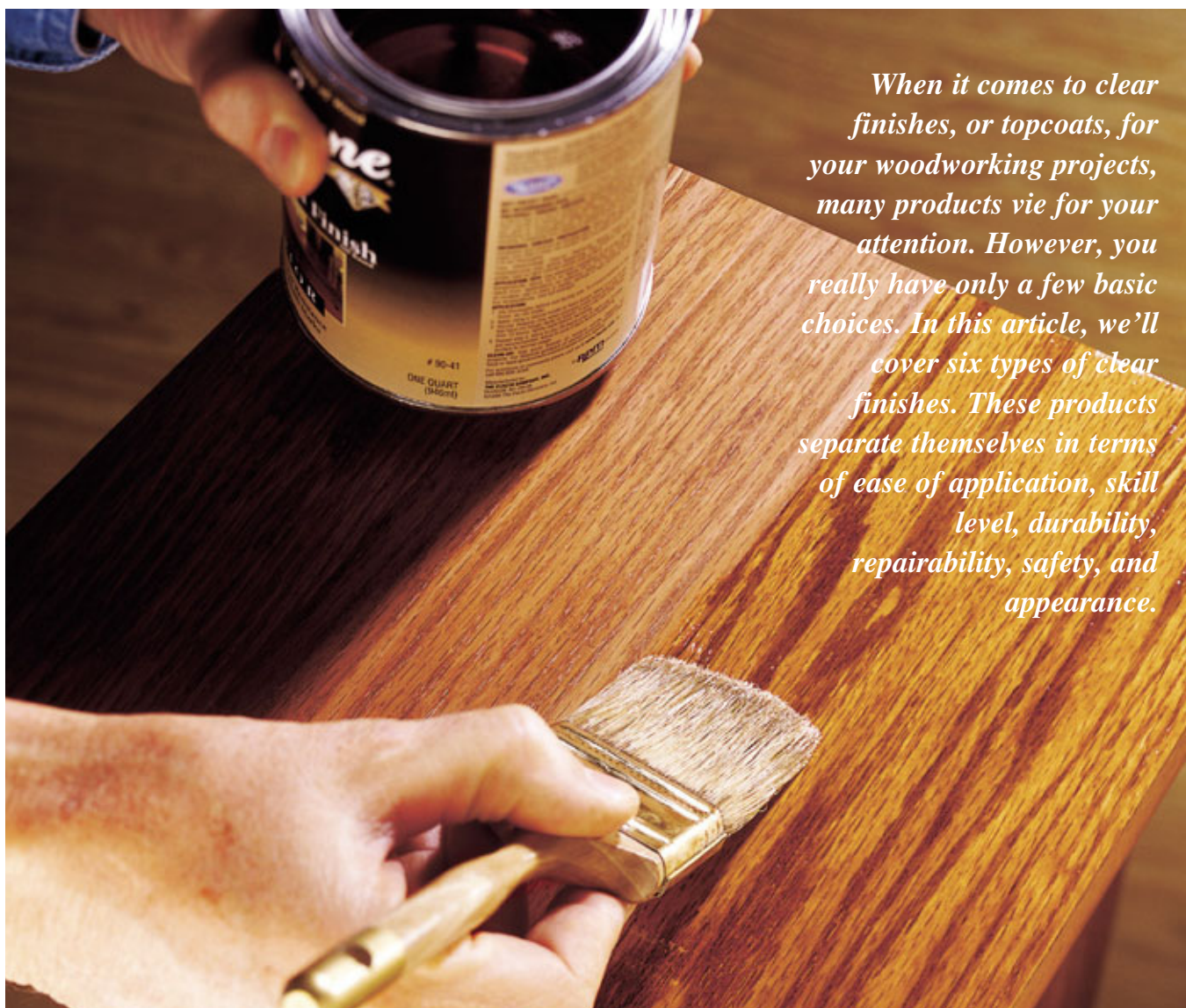
furniture colors. Experiment on a storyboard—and write down the recipe as you go along.



The WOOD® Magazine Guide to Finishing: Part 3

Clear Choices

*Protect and beautify your projects
with a durable topcoat.*



When it comes to clear finishes, or topcoats, for your woodworking projects, many products vie for your attention. However, you really have only a few basic choices. In this article, we'll cover six types of clear finishes. These products separate themselves in terms of ease of application, skill level, durability, repairability, safety, and appearance.



FINAL INSTALLMENT OF A START-TO-FINISH SERIES

We discussed wood preparation in DS-028 and staining in DS-029; now it's time for the final step in finishing your projects—applying a clear topcoat. You'll make the wood look great while protecting it from spills, heat, dirt, scratches, and wear.

For an easy finish, try oil

Oil-based finishes are the most widely available of the consumer finishing products, and by far the easiest to apply. Simply wipe on a generous coat, as shown in **Photo A**, let it soak in for several minutes, wipe off the excess, and let it dry.



Your top choices for oil finishing are boiled linseed oil and tung oil, but remember that they won't stand up to hard use. Both give wood a "glow," and are somewhat amber. Over time, linseed will darken and/or amber more than tung. Linseed offers a glossier appearance and builds far better and easier than tung.

Tung oil is clearer and more water-resistant than linseed oil. However, it costs more, dries more slowly, and tends to turn white as you build coats.

You also can buy linseed and tung oils that the makers have altered chemically by heating them to high temperatures in an oxygen-free environment. They're identified with the word "polymerized" on the label. Polymerized oils dry faster, cure much harder, and develop more water resistance. Because of their faster drying characteristics, polymerized oils are difficult to apply to a large surface. They build well but tend to crack.

B

Unfortunately, no true oil finish offers much in the way of water or heat resistance. But it does a terrific job of bringing out the color and grain characteristics of the wood. Add protection with a topcoat that builds a film on the surface—such as lacquer or varnish—and you have the best of both worlds.



Boiled linseed, tung, and soya are the most common oils used in finishing. Boiled linseed and tung serve as straight oil finishes and soya appears as an ingredient in other finishes.

Oil plus varnish gives a hand-rubbed look

Blend oil, varnish, and thinner, and you have a “Danish oil,” “tung oil finish,” “antique oil finish,” or almost anything else that’s labeled as an oil finish. A side-by-side comparison of these products reveals few, if any, differences among them. To determine whether a given product is an oil/varnish mix or a wiping varnish—a finish



You can’t always rely on the label to tell you what kind of finish is inside the container. For example, “tung oil” shows up on the label of various finishes that may or may not contain tung oil as an ingredient. And many products with “oil” in their name actually are varnishes that have been thinned with mineral spirits, making them easy to wipe on. The biggest area of confusion comes in determining whether a product is an oil/varnish mix or a wiping varnish. To test, pour a bit of the finish on a piece of glass, and let it dry overnight. If it appears wrinkled, like the one at left, it’s an oil/varnish product. If it dries smooth, it’s a wiping varnish.

we’ll discuss shortly—follow the procedure shown in **Photo B**.



You easily can create your own oil/varnish mix with equal parts of boiled linseed oil, thinner, and varnish. Alter this ratio to suit your tastes. If you increase the oil, you slow down the drying time. If you increase the varnish, you make the mix more resistant to water, heat, and abuse. If you increase the thinner, the mix penetrates better and dries faster, but requires more coats to provide protection.

Some commercial oil/varnish mixes contain an added color. Or, you can tint any of the clear

oil/varnish mixes by adding oil-based stain or a compatible dye. Be aware that if you add a stain to either a commercial product or your own recipe, you’re adding oil, too. Adjust your ratio accordingly.

Oil/varnish mixes do not provide a high degree of protection, and can’t give you a glossy finish, but they’re easy to apply and repair. A couple of coats of an oil/varnish mix followed by a paste wax coat produces a wonderful, hand-rubbed, satin appearance.

Apply an oil/varnish mix like a true oil finish. Flood it on, let it soak in, then make sure to wipe off any excess. On some woods, especially



large-pored species such as oak, this finish tends to “bleed back” and pool on the surface. Keep wiping to remove these spots until the finish has dried. Left untouched, the excess finish skins over and produces a scaly effect; then you’ll have to sand the finish back or remove it completely.

Oil/varnish mixes dry slowly, especially in high humidity. Don’t build them up beyond two coats.

You can repair most surface damage with sandpaper and more oil/varnish mix. If the surface has been waxed, remove the wax with mineral spirits before you apply another oil/varnish coat.

Varnish: The king of durability

Varnish reigns as the most resistant and durable film finish among those that are generally available to the home woodworker. Manufacturers combine oil and resin, cook the mixture, and produce a finishing material that’s very tolerant of heat and water. However, all varnish finishes are difficult to repair.



Depending on the type of oil and the resin, varnish varies in color from clear to a deep amber. Most varnishes combine an alkyd resin with oil—either linseed or one of the less expensive oils, such as soya. The amount of oil in the varnish determines its hardness. “Long oil” varnishes, such as spar varnish, contain a high percentage of oil. This high oil content makes the varnish more flexible and able to withstand the rigors of weather. A “short oil” varnish, such as those labeled for interior use, tends to be harder. This



When you brush on varnish, use a good-quality brush. Buy a China bristle with a chisel shape and split ends.

You’ll encounter two major problems in brushing—brush marks and bubbles. Most brush marks result from going back over the surface too often. Most varnish starts to skin over very soon after it hits the surface, and further brushing creates flaws. Bubbles come from a variety of sources, including a poor-quality brush and careless brushing habits. Also, don’t create bubbles by shaking the can; stir its contents gently.

If you still have trouble, thin the varnish so the bubbles have time to pop before the varnish dries. Start with about 10 percent naphtha and gradually increase the ratio, if needed.

D

makes it more susceptible to chipping, but allows for a glossier surface.

You can buy varnish in many forms. The only difference between a polyurethane and any other kind of varnish is the addition of a bit of polyurethane resin. This resin makes the varnish slightly more scratch-resistant.



Brushing is the most common method of applying varnish, but it takes practice to do a top-flight job. See **Photo C** on page 4 for the tips you need.

When you brush on varnish, gently scrape the surface between coats to remove any bumps. Take the blade from a utility knife, hold it nearly vertically between your

Paper towels or the cotton cloth from a T-shirt works wonderfully for applying a wiping varnish. Wipe on each coat quickly, as if you were wiping down a tabletop with water. Don't go back over the surface or you'll drag the varnish and create lines. If you see that you missed a spot, ignore it. You'll get it on the next coat. Allow the varnish to dry for a couple of hours, then test it with a touch of your finger. If you don't leave a print, it's ready for another coat. Apply at least six additional coats of wiping varnish for added depth. Allow the finish to dry overnight, and then scrape it gently with a utility knife blade before applying the final coat.

forefinger and thumb, and keep the pressure light.

Buff down the surface with gray Scotch-Brite, 0000 steel wool, or 320-grit sandpaper before applying your final coat. This may sound like a lot of work, but it really isn't. None of the steps takes very long. It's the waiting between steps that takes time.

It's a pleasure to apply varnish by wiping it on, but this works best with the addition of thinner to the varnish. You can buy a wiping varnish, like the one we're using in **Photo D**, or make your own by mixing equal parts of varnish and thinner. Naphtha makes a good thinner because it dries faster and clearer than mineral spirits.

E

You can spray varnish, but you'll run into some significant drawbacks. Whatever your spray method, the overspray winds up everywhere. Because varnish is a slow-drying product, it becomes a dust magnet, and soon can create a crust on everything in your garage or workshop. However, you'll find that varnish in an aerosol spray can does come in handy for small projects.



A few companies make a gel varnish, a thick product designed to be wiped on. It is strictly a surface film, and offers little penetration. Gel varnishes are susceptible to chipping and very difficult to repair.

Professionals like lacquer

Furniture manufacturers and woodworking pros choose lacquer for most of their finishing work. It dries quickly, saving valuable

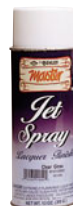
production time. Lacquer presents problems for the home woodworker, however. The volatile fumes are unhealthy to breathe, and also pose a risk of fire or explosion. You need adequate ventilation while applying

Large projects, or frequent use of lacquer, might lead you to invest in a spraying set-up, including a high-volume, low-pressure (HVLP) gun like the one shown here. Always wear a vapor mask when spraying lacquer, and never spray where there is any risk of explosion. And remember, you can spray small projects with a handy, inexpensive aerosol can of lacquer.

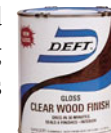
Don't bother sanding between coats of lacquer, unless you find rough spots. Each coat will soften the preceding coat and create an excellent bond. Most lacquer turns amber over time, much like varnish. Lacquer offers a reasonable degree of durability and resistance to heat, water, and cleaners. It's easy to repair because a fresh coat dissolves into the existing coat.

You can buy lacquer in a few colors, or tint it yourself with a variety of colorants, including dyes. The hardness of lacquer makes it ideal for rubbing out with fine abrasives to a mirrorlike finish.

most finishes, and this requirement becomes even more critical when you use lacquer.



Most lacquer gives the best results when sprayed (see **Photo E**). Brushing lacquers contain additives to retard the drying speed.



Don't forget shellac; it's safe and tough

Shellac is neither an oil-based finish nor a water-based finish. Shellac comes from the secretions of the lac bug. These secretions are a resin that's formed into flakes and then dissolved in alcohol. Different grades produce different colors; see the examples in **Photo F**.

Shellac ranks as the most environmentally friendly of the finishing products. Manufacturers use the resin to coat candies, glossy pills, and even fruit. It reigned as the finish of choice prior to the development of lacquer. If you find a film finish on furniture made before about 1920, it's probably shellac. The survival of such furniture, with the original finish still intact, proves the durability of shellac. However, it offers relatively poor resistance to water, alcohol, heat, and cleaners that contain alkali.

Once mixed, shellac starts to deteriorate, and finally reaches a point where it won't dry. You can't predict when that will happen. Some premixes claim a 3-year life span, which starts on the day the shellac is mixed by the manufacturer. The can could sit on a shelf somewhere for most or all of that time, so check the date on the bottom of the can to see either the manufacturing date or the 3-year expiration date.

For the most dependable results, buy shellac in flake form, mix the flakes with denatured alcohol to make the amount you need, and dispose of any that's left over when you're done finishing your project. This may seem wasteful, but the most expensive finish is one that has to be removed because it is old and will not dry.



F



Natural shellac is orange-brown, but you have choices when it comes to the refined product. Darker shellac, such as buttonlac and seedlac, does a wonderful job of replicating antique finishes. Here you see the difference in color between amber (orange) shellac, on the left, and clear shellac, on the right. Orange, or amber, shellac adds a wonderful tone to darker woods, such as walnut. Clear shellac adds almost no color and yellows very little over time.

Shellac can be sprayed, brushed, or wiped on. Because it dries fairly rapidly, spraying works well. You can buy shellac as flakes or as a premixed liquid. The premixes tend to be about a 3-pound cut, which describes a ratio of 3 pounds of flakes per gallon of alcohol. A thinner 1-pound cut makes all forms of application easier, but requires more coats to achieve the same result as a heavier cut.





G

If you need a finish that adds no color to the wood, consider a water-based product. However, this clearness also presents a disadvantage. Apply a clear coat to a dark wood or a wood that has been stained dark, and it acquires a washed-out appearance. The amber quality of some oil-based finishes brings out the color and grain characteristics better in these cases. You can overcome the washed-out look of water-based finishes by adding just a touch of color to the finish, as shown here. Dyes and universal tinting colorants work well for this procedure. Don't add much. It just takes a touch.

If you do save some shellac, or have a premixed can, test it before you commit to its use. Put a coat on some scrap to see how well it dries.

Test water-based products before you dive in

Water-based finishes, such as the one we're tinting in **Photo G**, possess much different strengths and weaknesses than the oil-based finishes. The



situation constantly changes, as manufacturers modify their oil-based products to be more environmentally friendly, and reformulate water-based finishes to stand up better to heat, water, and cleaners. As a result, oil-based finishes are becoming slower to dry and more difficult to apply, while water-based finishes become easier to apply.

Apply water-based finish with a spray gun or aerosol can, if

possible. Some water-based finishes are formulated to be applied with a brush—check the label to make sure. If it's suitable for brushing, you also can wipe it on.

Most water-based finishes are acrylic mixtures. Some of them also contain polyurethane resin, added to make the finish more scratch-resistant. These additives also tend to make the water-based finish somewhat opaque and slightly blue.

Water-based finishes exhibit extreme sensitivity to heat and humidity during application. High humidity can cause a white haze known as "blush," and can slow the drying time. If the blush does not go away, you'll have to strip the finish and start over.

Heat speeds drying and makes application tougher. During hot weather, take care not to overwork the finish. Water-based finishes are tough to strip, and tend to be sensitive to certain cleaners. Also, you'll have a hard time removing white rings caused by water. ♣

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Author Jim Kull also monitors the discussion group on wood finishing at our www.woodmagazine.com Web site.



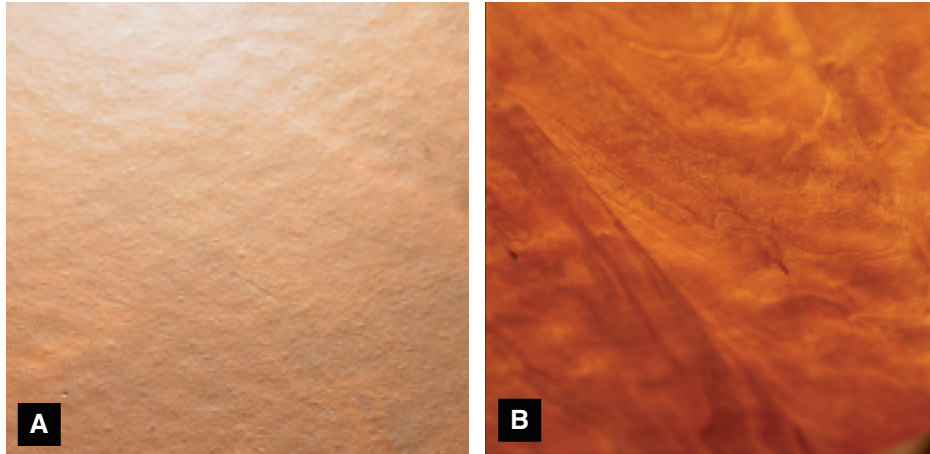
The WOOD® Magazine Guide to Finishing: Part 4

Rubbing Out A Finish

Use fine abrasives to give your projects the professional look.



**THE LATEST INSTALLMENT
OF A START-TO-FINISH SERIES**
We covered wood preparation in DS-028, staining in DS-029, and clear topcoats in DS-030. Now you can fine-tune the final clear coat to perfection with the tips shown here.



It's not uncommon to see orange peel in a sprayed finish, as shown at left. After rubbing, you wind up with the smooth, glowing surface at right.

You used the right finishing products and techniques, you've put the final coat of finish on your project, and you like the way it looks. What next? Maybe nothing; in some cases, it's time to carry your project out of the shop and share it with the world. However, the chances are pretty good that you didn't end up with an absolutely perfect finish on that last coat. On closer inspection with our eyes and fingers, most of us can find dust nibs, brush marks, orange peel from spraying, or just a general roughness to the surface.

Make those imperfections disappear by rubbing out the finish. What is rubbing out? It's the use of fine abrasives to smooth the finish and fine-tune its sheen. When you rub, you take control of the all-important final coat, just

as you controlled the shaping and smoothing of the wood underneath. We can't offer you a surface to touch, but you can see the difference rubbing makes by comparing **Photos A and B**.

You can rub virtually any surface, but we suggest sticking to highly visible, often-touched areas, such as tabletops and doors, for your first efforts. The rubbing is easier and the rewards greater.

Patience is a virtue

The first requirement for rubbing out is a finish that's thick enough to be worked without wearing through. This usually calls for several thin coats, properly applied. Next, you need patience. Let the finish dry thoroughly before you do any rubbing, and remember that you can't rub to a high gloss until the finish has

completely cured. Depending on the finish, temperature, and humidity, curing can take as long as a month.

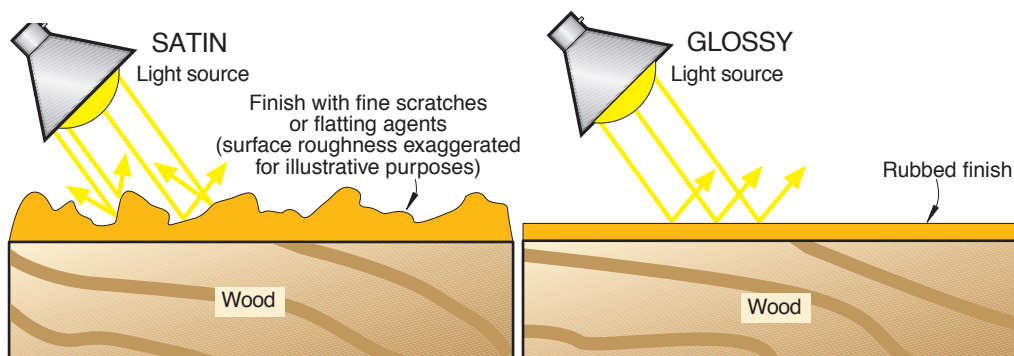
When you intend to develop a high-gloss finish, it's especially important to start with a super-smooth wood surface. Fill the pores and grain by using a paste filler or wet-sanding your finish. For detailed information on this process, see downloadable seminar 028, Guide To Finishing Part 1: Wood Preparation. For the other parts of this four-part finishing series, visit the Downloadable Seminars section within the WOOD Store at <http://woodstore.woodmall.com/dow.html>.

You also need the right rubbing materials, such as those shown in **Photo C**. All of the abrasive products create scratches in the



We found rubbing compounds at an auto parts store; got the lamb's wool pad at a home center; ordered the felt block from WoodFinishingSupplies.com; and bought sandpaper, Abralon pads, and nonwoven abrasive pads at a Woodcraft store.

1 HOW RUBBING CHANGES SHEEN



film surface, and the size of the scratches affects the reflection of light, as shown in **Drawing 1**. Finer abrasives create smaller scratches and higher sheens. Coarser abrasives create larger scratches and lower sheens.

A gloss finish is like optically perfect glass, reflecting light directly back at you. Any finish other than gloss contains flattening agents in the form of tiny silica chips. These agents create a random reflection of light, which

produces a softer, less shiny look.

You can lower the sheen of a film finish, but you can't take it to a higher sheen than you started with. For example, a semigloss finish can be rubbed down to a satin or flat sheen but cannot be polished up beyond semigloss.

A high-gloss finish offers more choices. You can take it down to any lesser sheen, including dead flat. If you decide that you've gone too far, you can polish it back up, returning all the way to a high

gloss, if you choose. Note, however, that lower sheens tend to minimize flaws while higher sheens exaggerate them.

You need a hard, brittle finish, such as lacquer or shellac, to attain a high gloss. Varnishes and water-based products tend to cure softer and generally do not polish to much higher than semigloss. With oils and oil/varnish mixes, you're limited to satin.



D Small scratches showed in this walnut table finished with an oil/varnish mix, so we rubbed it with an abrasive pad, using dark brown wax from Briwax. (Item number 85C28 in the Woodcraft catalog, priced at \$12.50; call 800/225-1153 to order.)

Sometimes it's simple

Let's start with the simplest form of rubbing out: applying a coat of paste wax to an oil/varnish mix. Once the finish has cured, use a white nonwoven abrasive pad to wipe on wax that contains both soft beeswax and the harder carnauba wax, as shown in **Photo D**. When you're finishing light-colored wood, try Trewax Indian Sand. You can buy a one-pound container at www.wellspend.org for \$10.28, plus \$7.83 for shipping.

As you rub, you round over any dust nibs in the finish, giving the

surface a smooth feel. You run little risk of cutting through the finish as you give the surface a soft, satin glow.

A film finish—varnish, lacquer, or shellac—usually contains more flaws than an oil/varnish mix. The likely culprits include dust nibs, brush marks, bubbles, drag marks, and runs.

When the problems are minimal, rubbing out can be as easy as the process just described. Doing this to a film finish introduces microscopic scratches to the surface that create a satin sheen. Open

pores, raised areas, and other flaws remain, but the satin sheen makes them less obvious. You can substitute mineral spirits, soap, or any other lubricant in place of the wax, but it's nice to correct flaws and apply wax at the same time.

More flaws? More steps

Now let's tackle a thicker finish with a few more flaws. The most common flaws—especially with varnish, which dries quite slowly—are dust nibs in the surface. Use the blade from a utility knife to eliminate most of



Sanding lacquer with fine wet/dry sandpaper and no lubricant turns the top layer of finish into a white, powdery dust. Change paper often to avoid scratches from corning. When you're done with this step, clean the surface with a rag or a blast of air.

them after each coat dries. Hold the blade between your thumb and forefinger, nearly vertical, and gently scrape the surface with a pulling motion. Be very gentle and avoid putting any blade marks in the finish. You can sand out these nibs, but the blade method lets you work faster and with less effort on flat surfaces. Curved or decorative areas require sanding.

Scraping also eliminates the risk of sanding through the finish at the edges of flat

surfaces. Finishes tend to pull away from any edge and flow toward the center, leaving the coating significantly thinner along the edges and making sand-throughs more likely. Spraying a finish can compensate for this by building up the edges; but it's difficult to build a smooth, feathered edge when applying a brushed or wiped finish.

After scraping you still need to sand to get a level surface and eliminate any other flaws. Speed

up the process by sanding the finish level midway through the application of finish coats.

Silicon carbide paper wrapped onto a block covered with felt, cork, or rubber works best for leveling, as shown in **Photo E**. If you want to sand dry, steared silicon carbide paper (usually gray) is generally a good choice. Stearated paper contains a soaplike material that keeps the paper from clogging.

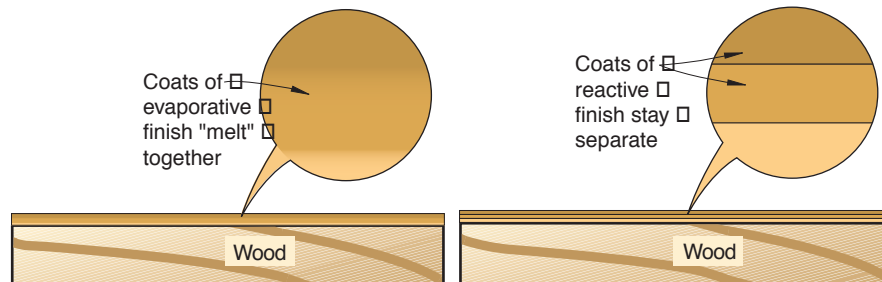
However, you're better off using nonstearated wet/dry 600-



F When you don't have much finish to work with, it's all too easy to rub through it and expose the bare wood, as shown here on a handheld mirror.

2 EVAPORATIVE AND REACTIVE FINISHES

Each new coat of an evaporative finish, such as lacquer and shellac, fuses into the previous one, so rubbing is simple. Reactive finishes, such as varnish, dry in layers; rubbing through one layer into another can create unattractive, irregular lines.



grit paper (which is usually black) with water-based finish or polyurethane varnish. Also, use non-stearated paper whenever you plan to add more finish.

If you prefer to use a lubricant when sanding a finish, rely on nonstearated paper. Lubricants help to float away the particles that cause corning, the formation of small, hard balls of finish on the paper. Corning can create visible scratches in the finish.

Your lubricant choices with wet/dry paper include water with a bit of soap, paint thinner/mineral spirits, naphtha, wax, and oil. Experiment with them to get a feel for their characteristics. You'll find that soapy water allows the fastest cutting, but also the greatest level of corning. Oil slows the cutting, but allows the least corning.

Faster cutting sounds like a time-saver, but it easily can lead to sand-throughs, like the one shown in

Photo F. All lubricants tend to disguise sand-throughs. You might go through the finish and not even realize it until the lubricant dries, creating damage that's hard to fix.

To achieve an even surface, sand lightly, clean it, and shine a bright light on it. If you see shiny spots, the surface isn't level. Continue sanding the entire surface, not just the shiny spots.

Each coat of an evaporative finish—such as lacquer and



A lamb's wool applicator like the one shown here gives you room to grip with two hands and apply pressure as you rub. The rubbing agent being used on this tabletop is a fine automotive compound.

shellac—softens the previous coat, creating a bond that amalgamates into essentially one coat, as shown in **Drawing 2**. However, each coat of a reactive finish—varnishes and some water-based products—dries as a separate layer, which can create problems in sanding and polishing. If you sand unevenly, you might cut through one layer into another, resulting in irregular shapes with white edges.

Once you've leveled the surface so that it feels good to the touch, and looks good, apply a coat of paste wax. Use an abrasive pad as described previously.

Keep going for gloss

When you want to put a high gloss on a lacquer or shellac finish, begin by leveling it as discussed previously. Then continue rubbing

with finer abrasives until you're satisfied with the appearance. You can use sandpaper in the 800- to 1,500-grit range, a mix of papers and compounds, compounds alone, or "micro meshes," which range up to an amazing 12,000 grit.

Rubbing and polishing compounds labeled for woodworking or automotive care are easy to find, and do a great job on wood finishes. Most rubbing compounds are orange, and produce a satin finish. Follow with a white polishing compound to attain a glossier look.

You can apply these materials by hand or with a machine. A felt block or a floor finish application pad with a short nap works great for applying rubbing compounds. A lamb's wool pad works well for buffing with polishing compounds,

as shown in **Photo G**. Stop by the hardware store, and pick up a lamb's wool applicator designed for floor finishes.

Save time on large, flat surfaces by using a dedicated buffing machine or your random-orbit sander. Many random-orbit sanders have optional heads for rubbing and polishing—check your owner's manual. Take care not to polish through the finish, exposing bare wood, or to build up excessive heat, which can destroy almost any finish.

Finally, apply a well-buffed coat of quality paste wax. This coating protects your finish against wear. ♣

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Hetherington Photography
Illustrations: **Roxanne LeMoine**

Sources for rubbing supplies

Can't find what you need at the hardware store or home center? Here are a couple of outlets for the good stuff.

- Woodcraft: 800-225-1153, or go to www.woodcraft.com.
- thefinishingstore.com.

RUBBING BASICS

FINISH TYPE	LEVELING	FLAT OR SATIN SHEEN	GLOSS
Oil or oil/varnish	320-grit wet/dry sandpaper, using finish as lubricant	Buff with white abrasive pad and paste wax	Not possible
Polyurethane varnish, spar varnish, water-based finishes	600-grit wet/dry sandpaper or white abrasive pad on random-orbit sander	Buff with rubbing compound, or white abrasive pad and paste wax	Not recommended
Lacquer and shellac	600-grit wet/dry sandpaper or white abrasive pad on random-orbit sander	Buff with rubbing compound, or white abrasive pad and paste wax	After reaching satin sheen, rub with fine polishing compound or 800- to 1,500-grit sandpaper

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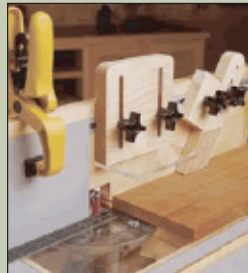
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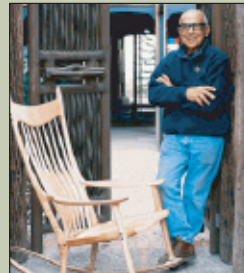
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