

FINISHING SECRETS

Techniques and
Methods of Work

Moving Toward Green Finishes

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 - Pigment and Dyes
 - Sealers (First Coat)
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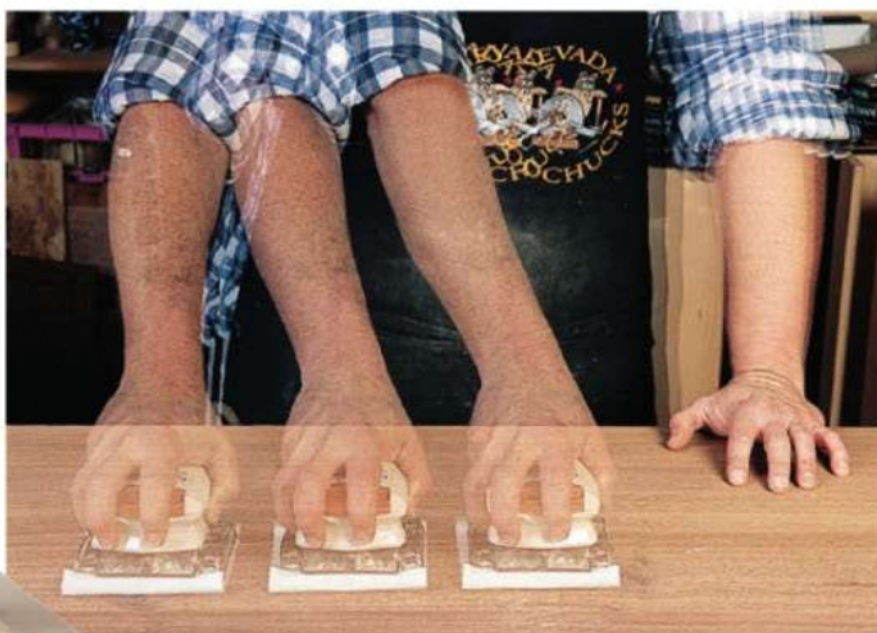
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Introduction



Michael Dresdner, a finisher's best friend.

STANDING AT THE FINISH LINE

Days or weeks of work, sometimes even months, all come together in the project in your shop. Careful matching of grain and machining of parts, skillful joinery, scary

glue-ups, and hours spent making sure your piece is ready for its finish. And now, brush or rag in hand, you stand at the crossroads and realize — there's no turning back.

This is often the point in our readers' experience that a decision is made to consult with Michael Dresdner, one of the premier finishing experts in the country and a gentleman who has been sharing his wealth of finishing knowledge with our subscribers for a good many years.

And here, in one place, are many of his offerings from over the years. Why a whole magazine on finishing? The answer is simple: regardless of how great a technical woodworker you are, if you apply a lousy finish, your project will look, well, lousy.

The advice and direction Michael has written for us over the years is a treasure trove of information that provides easy-to-follow steps to finishing success. Michael is that rare combination of a true, technically sound expert and great teacher and communicator. Plus, he started out in the finishing world by doing the work day by day in various finishing shops. His practical experience puts his advice right where you need it — in the shop, with easy to follow step-by-step directions. There is nothing theoretical here, just good solid practical instruction. If your finish is cloudy, blotchy, gummy, sagging, running, full of bubbles, rough, peeling off, too thin, too thick, fish eyed, cracking, hazy, blushing or in some other way flawed (most of which are covered in the following pages), your project will not look good. On the other hand, if your finish looks good, your projects will look good. Michael Dresdner will help you make that happen.

A handwritten signature in black ink that reads "Larry N. Stoiaken".

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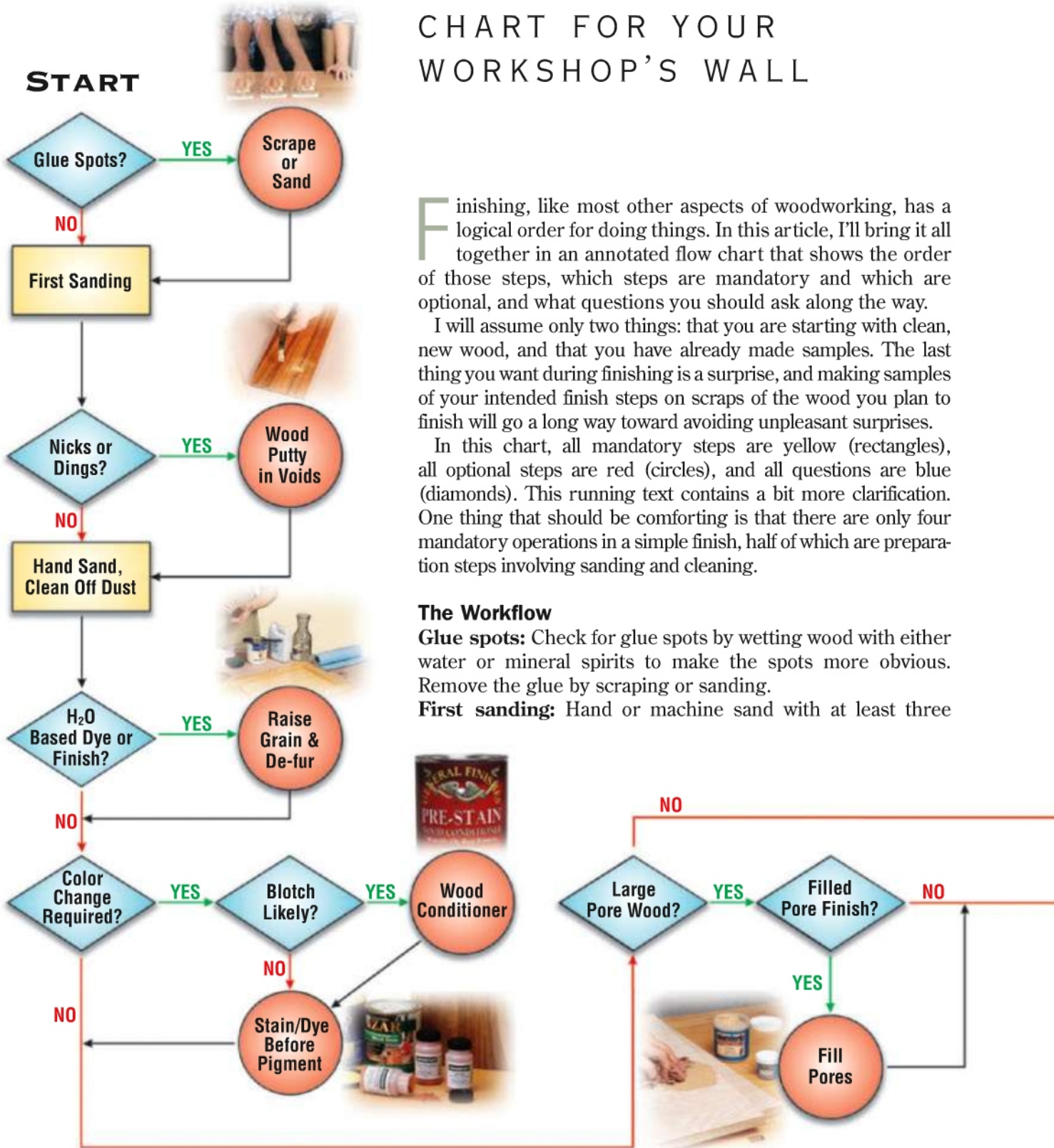
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Finishing Flow Chart

AN ANNOTATED FLOW CHART FOR YOUR WORKSHOP'S WALL



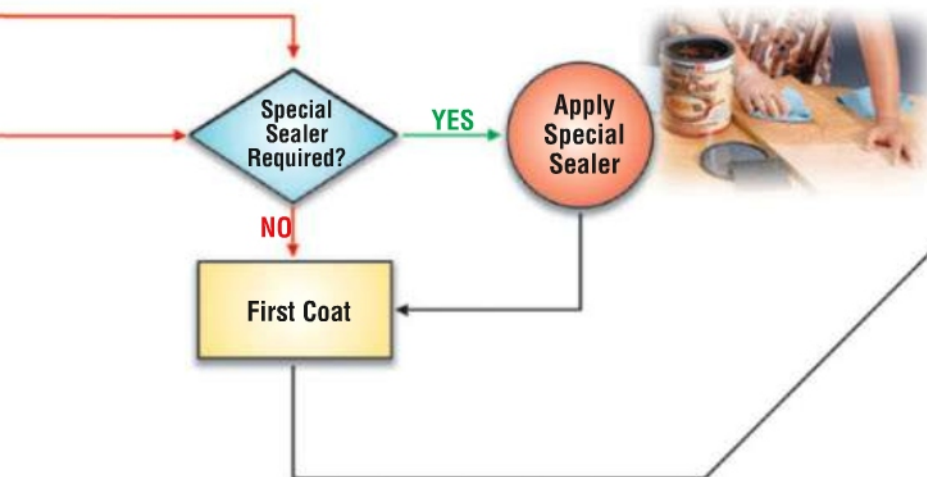
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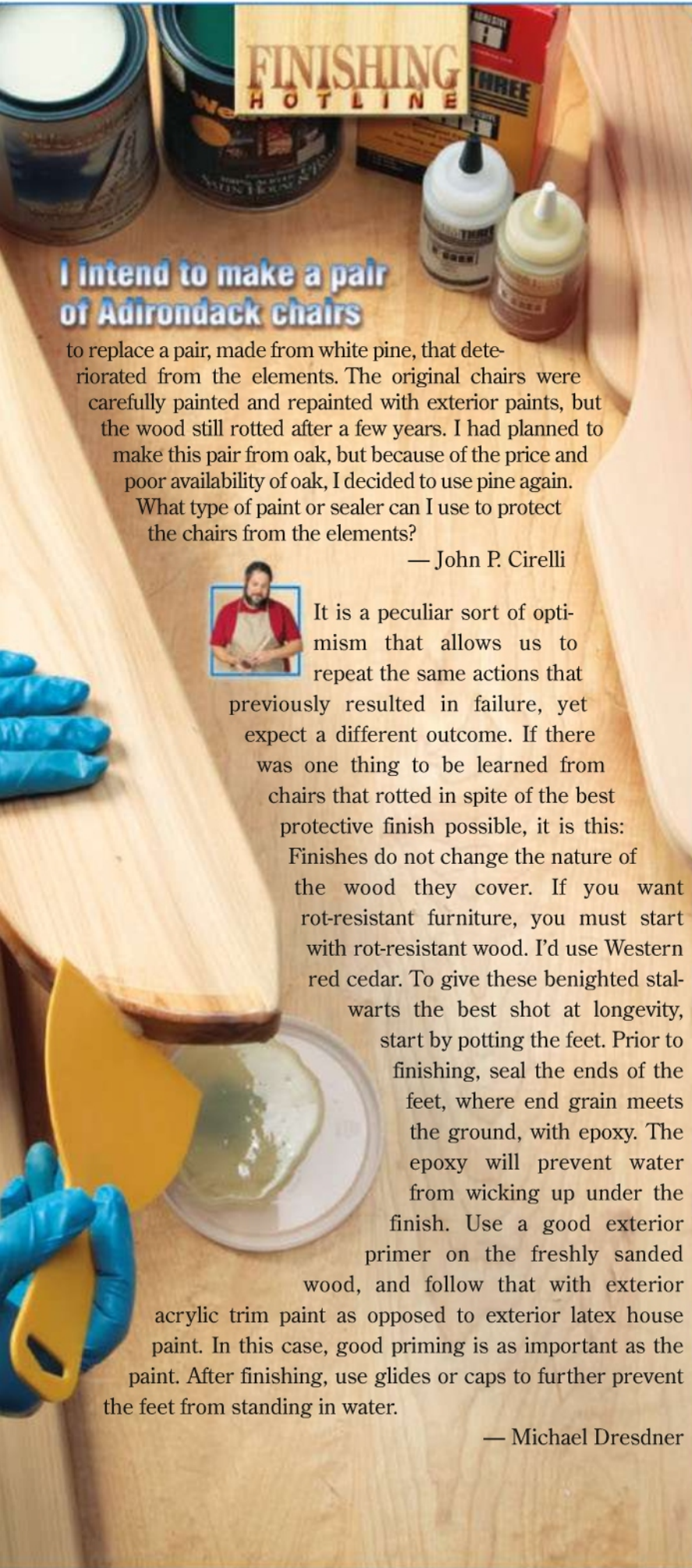
Fill pores: Open pore finishes on large pore woods are both common and attractive. However, if you prefer the look of a glass-smooth surface, fill the pores with inert pore filler. Seal the wood with a very thin coat of dewaxed shellac or Zinsser

A wooden jewelry box with a heart-shaped cutout on the lid, revealing a ring inside.

```
graph TD; Start([Start]) --> Step1[1. Rub Out Finish]; Step1 --> Dec1{Nibs or Wrong Sheen?}; Dec1 -- YES --> Step1; Dec1 -- NO --> Step2[2. Topcoats]; Step2 --> Dec2{Additional Color Modification Needed?}; Dec2 -- YES --> Step3[3. Glaze or Tone]; Step3 --> Dec2; Dec2 -- NO --> Dec1; Step3 --> Dec3{Touchup Needed?}; Dec3 -- YES --> Step4[4. Touchup]; Step4 --> Dec3; Dec3 -- NO --> End([End]);
```

The flowchart illustrates the finishing process for a wooden bowl. It begins with 'Rub Out Finish'. A decision point 'Nibs or Wrong Sheen?' leads back to 'Rub Out Finish' if 'YES', or proceeds to 'Topcoats' if 'NO'. From 'Topcoats', a decision point 'Additional Color Modification Needed?' leads to 'Glaze or Tone' if 'YES', or back to 'Nibs or Wrong Sheen?' if 'NO'. From 'Glaze or Tone', a decision point 'Touchup Needed?' leads to 'Touchup' if 'YES', or proceeds to the final 'End' if 'NO'. The 'Touchup' step loops back to 'Touchup Needed?'. Images illustrate each step: rubbing out finish, applying topcoats, glazing, and touchup.





I intend to make a pair of Adirondack chairs

to replace a pair, made from white pine, that deteriorated from the elements. The original chairs were carefully painted and repainted with exterior paints, but the wood still rotted after a few years. I had planned to make this pair from oak, but because of the price and poor availability of oak, I decided to use pine again.

What type of paint or sealer can I use to protect the chairs from the elements?

— John P. Cirelli



It is a peculiar sort of optimism that allows us to repeat the same actions that previously resulted in failure, yet expect a different outcome. If there was one thing to be learned from chairs that rotted in spite of the best protective finish possible, it is this: Finishes do not change the nature of the wood they cover. If you want rot-resistant furniture, you must start with rot-resistant wood. I'd use Western red cedar. To give these benighted stalwarts the best shot at longevity, start by potting the feet. Prior to finishing, seal the ends of the feet, where end grain meets the ground, with epoxy. The epoxy will prevent water from wicking up under the finish. Use a good exterior primer on the freshly sanded wood, and follow that with exterior acrylic trim paint as opposed to exterior latex house paint. In this case, good priming is as important as the paint. After finishing, use glides or caps to further prevent the feet from standing in water.

— Michael Dresdner

SealCoat™, or use a thinned coat of your intended topcoat. Apply the filler, remove it, and when it's dry, sand lightly to remove any filler residue on the surface. Let water-based filler dry overnight, and allow three days for oil-based filler.

Applying Sealer and Topcoat

Sealer or first coat: Usually, the first coat of finish will act as the sealer, but in some cases, special sealers are helpful. Zinsser SealCoat is a good choice for the following situations: refinished (as opposed to new wood) surfaces, woods that contain anti-oxidants (all dalbergias and some cedars), extremely porous woods, knotty or resinous woods, surfaces emitting odors, dyed woods and any surfaces that may have been contaminated with wax, dirt or grease. If a special sealer is not needed, simply apply the first coat of finish at this point.

Touchup: Here's where you touch up any missed glue spots, putty spots that came out too light or color irregularities. Putting touchup under glaze or toner coats helps hide it better. Applying it after the first coat prevents it from seeping into the wood and spreading, and it allows subsequent coats to seal in the touchup.

Glaze or tone: You can add color between layers of finish with glaze, a thick pigment stain, or with toner, a clear finish laced with dye.

Topcoats: Apply as many coats of your favored finish as is needed for durability and appearance. Sand lightly between coats to remove nibs, brush marks or spray pattern marks. Sand to improve adhesion only if you have waited more than a week between coats of varnish, polyurethane or water-based coatings. Adhesion sanding is never required for shellac or lacquer. With catalyzed finishes, follow the specific manufacturer recommendations.

Rub out: It is almost impossible to get a final surface smooth enough, so I always plan to rub out the finish. Sand lightly with very fine paper to level nibs. Rub with 0000 steel wool and paste wax for satin finishes, or use finer grit sandpaper, followed by rubbing and polishing compounds, for gloss.





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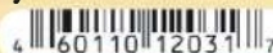
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Start To Finish: The Endurance Test

QUESTIONS OF DURABILITY, APPLICATION AND APPEARANCE SHOULD INFLUENCE EVERY FINISHING DECISION.

Picking the “right” finish for your most recent wood-working triumph seems like a daunting process, what with all the confusing array of choices on the paint store shelves. However, with a logical approach and a “scorecard” to help, it is a fairly easy process.

Durability

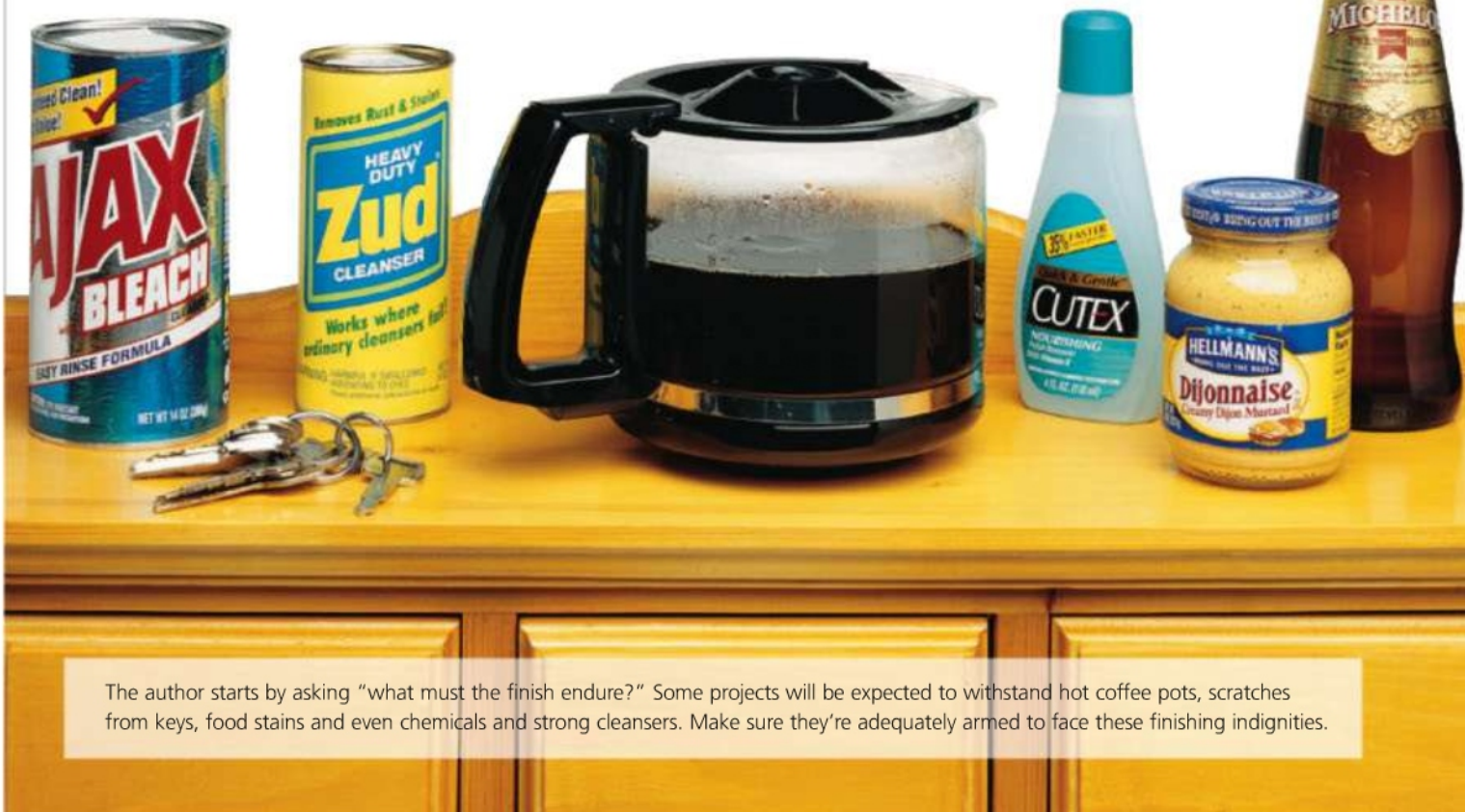
The three primary questions you need to answer before you begin your finishing are: durability (what must the finish endure),

appearance (what should it look like) and application (how do you want to apply the finish...rag, brush, spray gun, pad, etc.).

Perhaps most important of the three, “What must the finish endure?” is the question I ask first. Not all pieces will get the same treatment. An art turning, for example, will be handled gently and rarely over its lifetime, and it can get by with nothing more than a coat of oil or wax. By contrast, a kitchen table or counter-top may be asked to endure hot

coffee pots, scratches from cutlery and china, food stains, and even chemicals and strong cleansers. Patio furniture finishes will have to tolerate wide swings in humidity and temperature, while floors and baseboards will want a tough finish that takes and “hides” dents. Some kitchen objects, like wooden spoons and cutting boards, may do best with no finish at all.

You’ll know best how gently or roughly the furniture in



The author starts by asking “what must the finish endure?” Some projects will be expected to withstand hot coffee pots, scratches from keys, food stains and even chemicals and strong cleansers. Make sure they’re adequately armed to face these finishing indignities.

3 FINISHING QUESTIONS

Approach every finishing job by answering these three questions:

- 1) **DURABILITY:** what indignities must your finish endure?
- 2) **APPEARANCE:** what do you want your project to look like?
- 3) **APPLICATION:** how do you want to apply the finish...spray gun, rag, brush, pad, etc.?

your house will be handled. I use the following guidelines as reminders of what is typical for various pieces of furniture and what the finish might have to endure.

Bathroom and dressing room: humidity swings, nail polish remover and alcohol (in perfumes).

Fireplace mantles: high heat and humidity variations.

Kitchen cabinets, tables or counters: heat, scratches, food stains, chemical cleaners and abrasive cleansers.

Floors: serious abrasion, dents and heavy wear.

Living room/bedroom furniture: moderate to light abrasion.

Patio furniture: wide humidity and temperature changes, water and sun (UV damage).

Bookcases, picture frames, boxes and ornamental wood: light wear (most any finish will be appropriate here).

Another major consideration when it comes to durability is how thickly the finish is applied. A very thin finish, no matter what its nature, will not protect as well as a thicker version of the

same finish. There are limits, of course. Most finishes will crack or "check" if they are applied too heavily. A good rule of thumb is to keep finishes below 8 mils to prevent checking, and above 3 mils for good durability. A mil is .001" (one thousandth of an inch). By way of comparison, a typical sheet of copier paper is just under 4 mils. One sprayed coat typically adds about one mil when dry, a wipe-on coat less than half of that, and a brushed coat about 2 mils. If you sand between coats or rub afterward, that will reduce the thickness. A wash coat on the raw wood counts as zero mils.

Appearance

Of course, stains will change the color of wood, but clear finishes also alter how wood looks. Most waterborne lacquers and polyurethanes are completely clear to slightly blue-gray. They will add almost no color to white woods like maple, holly or spruce. Shellac and lacquer are slightly amber and will add a bit of warmth and color to the wood.

Oil, Danish oil, and oil-based varnishes and polyurethanes tend to add the greatest amount of amber color, especially with several coats applied.

There is a more subtle effect that shows up in certain woods. With figured woods, like curly or bird's-eye maple, you can actually use the finish to intensify the figure, or "pop the grain," even without adding any stain. The best grain popper I've found is boiled linseed oil, but shellac, lacquer and most oil-based varnishes work almost as well. If you apply one or two coats of oil to a piece of figured wood, it will add depth and make the figure fairly jump out at you. This characteristic is called "chatoyance," from the French "like a cat's eye." If you've ever seen the semi-precious stone called "Tiger-Eye," you'll notice that as you change your viewing angle, the light and dark bands of color change places. You can get a similar effect by adding linseed oil to certain woods, such as figured maple and ribbon mahogany.

continues on page 16...



Most finishes can be applied in a variety of ways. Here editor in chief Rob Johnstone experiments with spraying shellac on a prototype after a little encouragement from the author.

Application

The truth is that most finishes can be applied in most any manner. Shellac, for example, can be wiped on with a rag, brushed or sprayed. The same is true of Danish oil, varnish and most waterbornes. But some finishes lend themselves more to one applicator or another, and some are even specifically

formulated for a particular application method.

Waxes and jelled finishes are specifically designed for wipe-on/wipe-off application, and they are too thick to spray or brush. Though most any varnish or polyurethane can be wiped on instead of brushed, some are particularly designed for easy wiping and thin application and will say so on the can. Certain lacquers and conversion varnishes are designed for spraying and will dry too fast to be spread with a brush or rag.

In many cases, you can decide how to apply the finish after you choose the one you want to use. But be aware that some coatings work best with a particular applicator, and let that guide your choice. Also, remember that wiping a finish on and off will leave you with a thinner protective layer per coat than either spraying or brushing.

Making the Right Choice

Once you choose the characteristics you need for the piece you are

finishing, you simply have to match them up with the finish that fits. That is easier said than done. To do that, you need to know the characteristics of the finishes themselves — which ones have good heat, stain, or scratch resistance, which can go on by rag, which are typically thin or can be applied thicker, which offer good chatoyance, and so on. To make that a bit easier, I've included a "scorecard" (see below) that rates the common finishes by their characteristics.

One More Caveat

There is one other consideration you might want to take into account when approaching a finishing job: repairability. I did not add it as a major question because in most cases we are not concerned with how easy a finish will be to repair. For those cases where it matters, I have added it as an item to the "scorecard" that appears below.



FINISHER'S SCORECARD: COMMON FINISHES AND THEIR CHARACTERISTICS

Wax — thin; apply by rag; easy to repair; poor chatoyance; sheds water but takes water marks; poor solvent, scratch and heat resistance; fair stain resistance.

Oil and Danish oil — thin; apply by rag; easy to repair; good chatoyance; good water, heat and solvent resistance; poor scratch resistance; fair stain resistance.

Shellac — apply thin or thick by rag, brush or spray; easy to repair; good chatoyance; poor heat and alkali resistance; good water and scratch resistance; fair solvent resistance; good stain and acid resistance.

Lacquer — apply thin or thick by brush or spray; easy to repair; good chatoyance; poor to fair heat resistance; good water, scratch, stain and solvent resistance.

Oil varnish — apply thin or thick by rag, brush or spray; not easy to repair; good chatoyance; good water, heat, solvent, scratch and stain resistance (if thick).

Polyurethane (oil base) — apply thin or thick by rag, brush or spray; not easy to repair; good chatoyance; good water and stain resistance; excellent solvent, heat and scratch resistance.

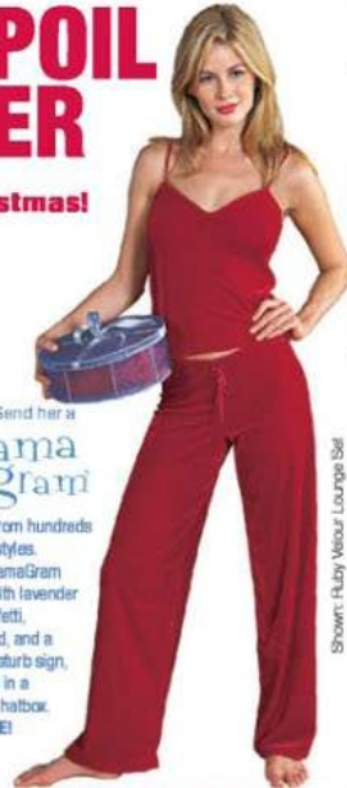
Waterborne acrylic-polyurethane — apply thin or thick by pad, brush or spray; moderately easy to repair; poor chatoyance; good water, stain, solvent, heat and scratch resistance.

Two-part coatings (catalyzed lacquer, conversion varnish, automotive polyurethane) — apply thick by spray; very difficult to repair; excellent water, stain, solvent, heat and scratch resistance; chatoyance varies.

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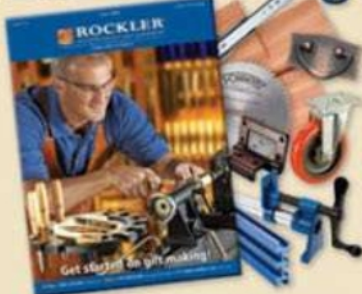
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Sanding: The Real Key To A Great Finish

WHILE IT'S UNAVOIDABLE, SANDING DOESN'T HAVE TO BE DRUDGERY. OUR EXPERT CAN HELP YOU SAND SMARTER.



Every sanding operation has an objective: something specific you want to accomplish. The author breaks down the process into four steps and details the objective to each.

Sanding. Ugh. If that's how you feel, you are in good company. Nobody likes doing it; yet most people sand too much and still don't get the results they deserve. Woodworkers often blame the choice of finish or their application technique for less-than-perfect finishes when in fact they are fighting with poorly prepared surfaces. How a finish feels and looks may have more to do with how you sanded the wood than how you applied the finish. I can't eliminate sanding from the finishing process, but I can tell you

how to do it, and what to use, so that you'll get a beautifully prepared surface in the quickest time with the least effort.

What's the Point?

Each sanding operation has an objective: something specific you want to accomplish. You need to know what the objective is for each step, along with the fastest way to achieve it.

Step One is to remove tool marks and machine marks from the wood. If you just finished using the planer, jointer, saw, hand plane or chisel, there are

most likely some marks. Perhaps the surface is uneven or not quite flat, or curves are too bumpy. Use a coarse (80- or 100-grit) aluminum oxide paper, sanding diagonally, to flatten or contour the surface. As soon as the tool marks are gone and the surface is smooth and flat, stop sanding and move on to step two.

Step Two also has only one objective, to remove the coarse scratches left by step one. Switch to 120- or 150-grit aluminum oxide paper to remove the scratches left in Step One. If you are sanding by hand, change directions so you are sanding diagonally at 90 degrees to the last sanding. As soon as all the old 80-grit scratches are gone, stop.

Step Three is similar to Step Two. Use 180-grit aluminum oxide paper to remove the scratches left by the last sanding, then stop as soon as the 120-grit scratches are gone.



While sanding is the key to a great finish, knowing how to sand efficiently is the key to woodworking enjoyment.



Hand sanders are meant to be moved only about 1" per second. Moving the sander too fast or "scrubbing" will also cause pigtails.

Step Four, the final sanding step is simply to straighten out the 180-grit scratches. The quickest way to do that is to use the same grit paper. Only this time, I switch to garnet paper and sand with the grain until the diagonal 180-grit scratches are gone. In most cases, 180-grit garnet will leave the surface smooth enough to finish, but some very hard woods, like boxwood or ebony, may require finer sanding steps. If you can still see obvious and offensive scratches in these very hard woods, continue sanding to 220- or even 320-grit.

Sanding by Machine

To put it bluntly, sanding by machine is easier than sanding by hand. The same rules still hold though, with some minor exceptions. To flatten or shape wood with a belt sander, run it diagonally to the grain just as you would with a block. Be careful, though. Belt sanders can be aggressive and are not really the right tool for finish sanding.

Vibrating or random orbit hand sanders, either electric or air powered, are a better choice. They cut by rotating in tiny circles, so what direction you move the machine in is irrelevant. It is always cutting more or less across the grain. For that reason, they are great for all sanding steps except the final



If you want your piece to stain evenly, sand it uniformly. The left side of this board was sanded only to 120-grit, and the right side to 180. The same stain wiped across both resulted in two different intensities of color.



Always read the back of your sandpaper. It will provide the information you need to make good sanding choices.

pass, which should be done by hand, with the grain, and if possible, with garnet paper. The one problem associated with these is "pigtails," small curlicue scratches that show up only after you have stained or finished.

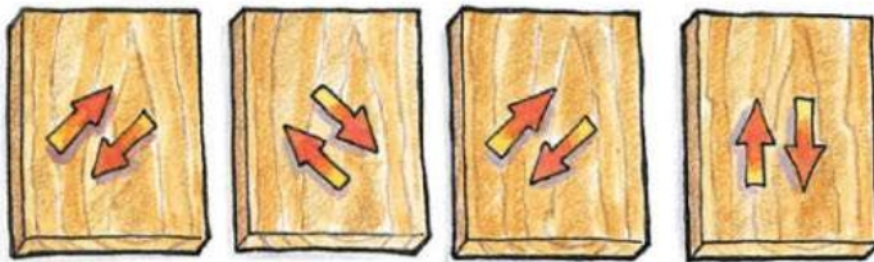
The secret to avoiding pigtails is to lighten up and slow down —

literally. Don't press down on the sander or it will slow down the speed of the head, causing pigtails. Use only the weight of the sander itself along with the weight of your hand. And move it slowly. Moving the sander too fast or "scrubbing" with it will also cause pigtails. Hand sanders are meant to be moved only about 1" per second. This page is about 11" long. Try moving your hand as if you were sanding so that it takes 11 seconds to get from top to bottom. Slow, isn't it? But if you move your sander like that, you won't get pigtails, and you'll need to sand each area only once per grit without going back over it. I know it is frustrating, but calm down and daydream when you sand and you'll get a better job. As I said, lighten up and slow down.

Sanding Media

Using the right stuff also contributes to quick results. The problem is that store shelves are littered with different types and configurations of sandpaper. Sorting them out can be confusing. Start by turning your sandpaper over and reading the back. Inside a double line is the manufacturer's name. (Here, it's 3M™.) Below that is the information box, starting with 110N, the manufacturer's product number. Then comes the nitty gritty.

continues on page 20...



Starting with a coarse grit (80 or 100), work successively up through finer grit sandpaper. Use a pattern of sanding in alternating angles across the grain, until you finish with 180-grit (the author prefers garnet paper for the final pass) or finer, working with the grain.

Types of Grits

Our example is garnet paper, and it says so clearly. However, it is not always so obvious. Some companies use code words for certain types of grit. Adalox, Aloxite, Imperial, Metalite, Production, and Three-M-ite are all words used for aluminum oxide. Silicon carbide grit may be called Tri-M-ite, Durite, Fastcut, or Powercut. I use aluminum oxide grit for sanding raw wood. It's a sharp mineral that cuts fast and stays sharp. Silicon carbide will work well too, but it is usually more expensive and there is no real advantage to it. But for my final sanding, with the grain, I switch to garnet. Used garnet paper is also handy for "burnishing" end grain so that it absorbs less stain — a common problem when staining both flat and end grain.

The Paper Itself

Next comes the paper's weight. Paper backing goes from A, the thinnest and most flexible, through C, D, E, and F, the thickest. I prefer thin paper backings. They don't "crack" when you fold them and easily conform to curves. When I do want a flat sanding surface, I back them up with a sanding block. Of course, not all sandpaper is made with paper. Other common backings include fiber (disks), cloth (belts), waterproof paper (wet-or-dry sheets) and polyester film, which is also waterproof (disks, belts and sheets).

Closed coat sandpaper means that grit covers 100 percent of the surface of the sandpaper. Open coat means that only 40 percent to 70 percent of the surface is covered. In other words, there are spaces between the pieces of mineral grit. Since each sharp piece of grit acts like a small cutting tooth, the spaces between act like the gullets in a saw blade, clearing out sanding dust (called "swarf") as you work so that the paper does not clog. For woodworking, we use only open coat papers.

Grit Size

Also printed on the paper is the number indicating the size of grit and, accordingly, how coarse the paper is. That seems simple enough, but it turns out there are different grading systems. In the CAMI or ANSI system, the most common, low numbers mean coarser paper, and higher numbers mean finer paper. The FEPA system uses the same numbers, but with a P in front of

them. The grits are identical from 220 and coarser, but increase at a different rate for finer paper. As a result, CAMI graded 600 paper is about equivalent to FEPA graded P1200 paper, but 180-grit is equal to P180. Next is the micron system, whose numbers get larger as the paper gets coarser — just the opposite of the other two systems. Micron papers have the Greek letter "mu" after the number. And, of course, there is the old standby, the naming system that uses words like extra coarse, medium and ultra fine.

Sponges and Blocks

Sandpaper comes in square sheets, stick-on disks backed with pressure sensitive adhesive (PSA) or hook-and-loop fasteners, belts, and even blocks and sponges. The latter are fairly recent additions to the pantheon of sanding choices. Sponges coated with abrasive grit are waterproof and, unlike sandpaper, can be rinsed out and reused. They easily conform to whatever shape you are sanding without tearing or wrinkling. The only down side is that they are substantially more expensive.

Sanding is not fun, but if done correctly, it will improve your finishing results dramatically. And as much as any other aspect of woodworking, a good finish reflects well on the builder.



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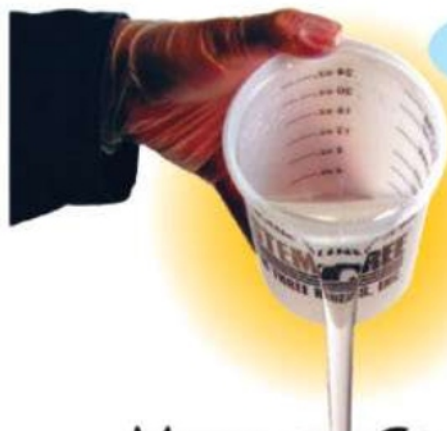
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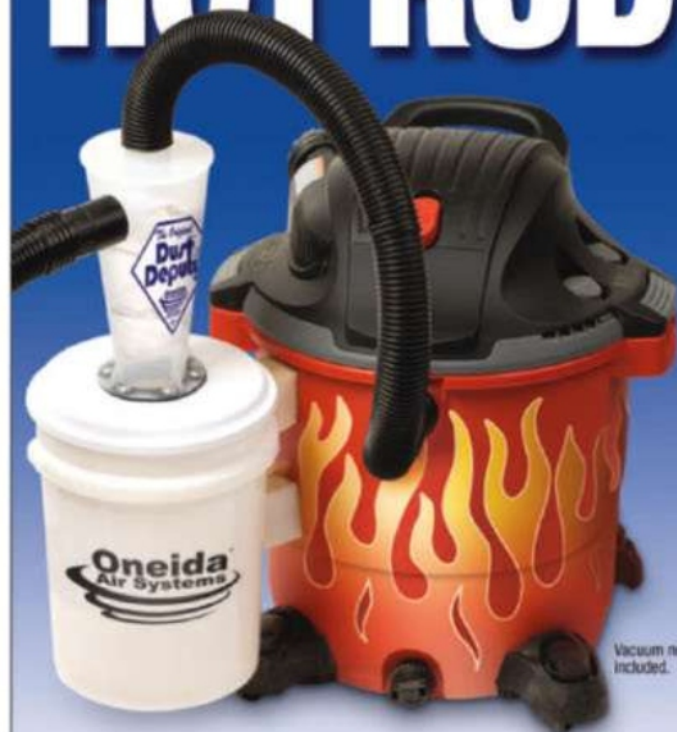
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Projects that require considerable preparation and set-up time routinely get knocked off the workbench in favor of those that can be taken care of promptly. The products shown here are just a few solutions that not only repeatedly save time or effort, but also let you tackle projects without further delay.

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44S01.22 Boxed Set of 5 (¼"-1") **\$ 89.50**

44S01.23 Boxed Set of 7 (¼"-1½") **\$124.00**

2. 21-LED Flashlight

Measuring 1⅜" × 3½" and packed with 21 LEDs, it is exceptionally bright, acting more like a small spotlight than a flashlight. Comes with 3 AAA alkaline batteries.

67K74.47 21-LED Flashlight **\$7.50**

3. The Finishing Turntable™

This convenient accessory not only elevates a project during finishing, but the rotating base lets you turn the project to work on all sides without changing your position. Twelve movable non-stick pyramids allow you to quickly change the arrangement of contact points to suit the workpiece. Measures 16" in diameter by 2¾" tall, and supports up to 100 lb. Pyramid color may vary.

88K58.75 The Finishing Turntable™ **\$39.50**

4. Grip-Tite™ Sockets

The more force you apply to the ratchet handle, the more tenaciously the fingers on these ⅜" drive sockets grip. Made of nickel-plated chrome-vanadium steel. The set of seven (⅜", 7/16"/11mm, 1/2", 9/16", 5/8"/16mm, 11/16", and 3/4"/19mm) comes in a storage case. Made in the USA.

25K17.17 Sockets, boxed set of 7 **\$25.50**

5. Robertson® Drive Bit Set

Color-coded for easy identification, these Robertson screw drive bits are manufactured with accurate tool-steel square-recess drive tips for precise fit, and durable powder-coat carbon-steel shanks. The set includes bits for screw sizes #2 to #14.

19J20.03 Robertson® 12-pc. Bit Set **\$9.50**

6. 90° Angle Driver

Converts any rechargeable drill into an offset, quick-change screwdriver, letting you use a power drill in places that can't be reached with a straight driver. Includes #1 Phillips, #2 square drive, and ¼" slot bits. 6" overall; weighs 8½ oz.

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7. Veritas® P724 Plumb Bob

Finely made from brass with a stainless-steel tip, this plumb bob is about 37/16" long with a slim body just under 7/8" in diameter. The 8' long braided nylon cord is threaded through the removable crown to ensure perfect balance. The black anodized aluminum case is fitted with a rare-earth magnet to hold the bob securely when not in use. Drawstring bag included. Made in Canada.

05K95.12 Veritas® P724 Plumb Bob **\$26.50**

8. Universal Sharpener

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Steaming Dents And Filling Gouges

SUREFIRE ADVICE FOR REPAIRING THOSE LITTLE DEFECTS BEFORE YOU FINISH.



"Finding a putty that will take stain exactly the same as the wood," says the author, "is the Holy Grail of finishing."

When you sand a project prior to finishing, the goal is to get the surface smooth and level. But, like potholes on the freeway, our projects are often plagued with depressions and divots that show up during final sanding. These fall into two categories: dents and gouges. Dents are depressions in the wood where the fibers have been crushed but not broken. Gouges are voids where wood fibers have been cut and where wood is missing. A significantly different repair technique is used for each one.

Steaming Dents

Wood fiber is like a bundle of straws, and dented wood is like an area of collapsed straws. Steaming swells them back into shape, usually making them completely disappear. If you are not sure whether the depression is a dent or a gouge, try steaming first. If it does not come out completely, treat it like a gouge and fill it.

To steam a dent, put a drop or two of distilled water



Removing a dent using steam is a simple, two-step process that requires distilled water, an iron and a damp cotton cloth.

into the depression, and let it soak in for a few seconds. Add at least enough water to fill the dent. Meanwhile, wet a clean, cotton cloth and wring it out. Lay the damp cloth over the water-filled dent and press a hot iron onto the cloth. The damp cloth will prevent the iron from scorching the wood. The heat will convert the water, which will have absorbed into the wood, into steam. The expanding steam will remove the dent. Remove the iron as soon as the cloth gets dry. If the dent comes only partway out, repeat the process a second time. When the wood is dry, resand the area before you stain or finish, using the same grit paper as you used for your final sanding.

Filling Gouges

Because wood is actually missing in a gouge, the only solution is to replace it with something, and that something is putty. Wood putty comes in powdered form that's designed to be mixed with water, and in both water-based and solvent-based ready-to-use formulations. You'll find it in a wide range of colors at home improvement stores and woodwork-

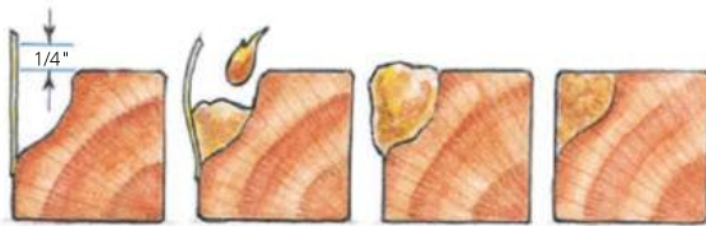
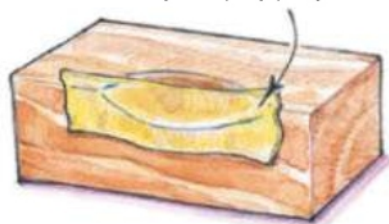


Match the putty to the lightest background color of your wood.



Put a dollop of putty and a few spots of artist's colors on a piece of glass or laminate to create a mixing palette for making your own custom-colored putty.

Tape is used to form a little dam to control your epoxy putty.



To properly fill a gouge along an edge, first build a little dam with masking tape. Keep the tape about 1/4" higher than the wood surface. Add drops of filler into the void until it is slightly proud and bulges the tape dam slightly. When the epoxy is cured, remove the tape and file or sand it flush.

ing outlets. The various brands and types of putty are more alike than different, but they're cheap enough that you can experiment with a few.

Because putty must be sanded, it is applied to raw wood prior to staining. Take a small amount out of the container and use a putty knife to press it into the gouge, knothole or chip that needs filling. Leave it slightly proud of the surface, because it will shrink a bit as it dries. Make sure it is dry, then sand the putty flush to the surrounding area. Sand until the putty is exactly the shape of the original gouge. That way, you know you have gotten all the putty off the surrounding area. If you are not sure if the putty is hard enough to sand, test it by pressing your thumbnail into the center of the putty spot. If it gives or indents, let it dry further.

Matching Colors

Even fairly uniform wood is actually a variety of colors, due to grain and figure patterns. As a result, a fairly large putty spot often shows up as a dark or light "pond." For this reason, I find it is best to match the putty to the lightest background color of the wood. After the wood has been sealed, you can go back and add grain lines and figure colors with a fine touch-up brush and some artist's colors. The combination of the appropriate light background and some adroit touch-up can yield an almost invisible repair.

Of course, it is not always easy to find exactly the right color of putty to match the background of every piece of wood. Fortunately, you can make putty either lighter or darker by mixing artist's colors into it. Use water-based artist's acrylic colors with water-based putty, and artist's oil colors with solvent-based putty. You'll find both at any craft or art store.

Put a small amount of putty onto a piece of glass or a scrap of plastic laminate, add a few dollops of the colors you think you'll need, and mix them in with a putty knife a little at a time until you get just the right tint.

Putty Under Stain

Finding a putty that will take stain exactly the same as the wood it is on is the Holy Grail of finishing. Some

putties absorb more stain than others, but some woods absorb more stain than others, too. Matching up the two is difficult at best, and sometimes impossible. If you are planning to stain your project, take a scrap of the same wood, make a gouge in it, and fill it with the putty you plan to use. Sand it when it is dry, then stain it. The putty will either be darker or lighter than the surrounding wood or, if you are living in a state of grace, it will be exactly right. Adjust the color of the putty as needed so that it is correct after the stain goes on. This may take several tries, so be patient.

Epoxy and Polyester Putties

Any putty will work for voids in flat surfaces, but you'll need something stronger to rebuild damage on an exposed edge or corner. For that, you can mix liquid epoxy, use a polyester body filler, such as Bondo®, or buy a special epoxy-based wood putty. Both epoxy and polyester fillers tend to be fairly runny, so you'll need to make a "dam" out of masking tape to hold them in place until they harden.

Epoxy wood putty, like the SculpWood® in the photo below, starts as two soft clays. Mix the same size ball of each together with the other by kneading them in your gloved hands. Once mixed, press the soft clay into the void and shape it to match the missing profile. It will cure hard and can be filed, carved, sanded and finished. When I have to rebuild a corner, I add a tack or two to anchor the putty so that it won't break off after it sets. You can even use epoxy or polyester fill to "cast" small replacement parts, such as broken pieces of carvings. These alternative putties are more difficult to color, and are best reserved for pieces that will be stained dark or painted, unless your touch-up skills are finely honed.



A moldable epoxy putty results from mixing two clay-like components together. Form the epoxy clay to the shape of the missing part, using anchor tacks to make sure the putty stays put.

Pigment Stains

CONFUSED ABOUT THE PROPERTIES OF PIGMENT STAIN? LOOK NO FURTHER THAN A CAN OF ORDINARY HOUSE PAINT.

Pigments are the most common coloring agents in all stains. Well over 90% of all commercial stains contain pigments, and some, including all exterior stains, contain no other colorant. Understanding what pigments are, how they behave, and how you can make them work for you is probably the single most important thing I can share with you about staining wood. For starters, I'll give away the secret ending: pigment stain is actually just thin paint.

What is Pigment?

Let's begin with the basics. Pigment is essentially ground-up dirt. Colorful dirt, admittedly, but still ground-up dirt. Imagine that you were to take a handful of dirt from the ground and sprinkle it into a glass of water. Give it a quick stir and you have a glass of muddy water. In other words,

you've made something that will cause brown stains on light colored wood. Mind you, the dirt did not dissolve; it merely became suspended in the water. Your proof is that if you let it sit a while, the dirt will settle to the bottom and you will have to stir it again. That is your first clue in identifying pigment stains; the pigment can settle. If a can of stain says that you must stir it before (and often during) use, it contains pigment. Sometimes you can scrape some of the settled pigment from the bottom of a can that has sat for too long and see what it looks like congealed. The only ones that don't require stirring are the gels that are too thick to let the pigment settle or stains that contain only dye. (For more on dye stains, see page 30.) Unlike dyes, pigments will not fade in the sun, so they are the exclusive coloring agent in exterior or interior/exterior stains.

How Pigments Color Wood

If we were to smear some of our mud mixture onto a piece of light colored wood, it would make it more brown. The dirt would find pores, rough spots and even sanding scratches in which to lodge. That's what happens with pigment stains too. In fact, the more porous the wood is, and the coarser the sandpaper we use before staining, the more sites pigment finds to lodge and the darker the stain becomes. That's why end grain, summer wood in softwoods and the large pores of cathedral grain in oak and ash take in so much stain. The pigment finds nooks and crannies to inhabit, just like the butter in the old English muffin commercials.

On the other hand, if you wipe a pigment stain onto a finely sanded piece of rock maple, a wood with very small, tight pores, almost all of it will wipe right back



Your first clue in identifying pigment stains: the pigment can settle to the bottom.



If you scrape some settled pigment from the bottom of a can, you can see what it looks like when congealed.

off. The type of wood and how finely you sand it both have a great impact on how much pigment stain will lodge in it. In short, the more pigment you leave on or in the wood, the more color you get. To some degree, you can intentionally leave more sitting atop the wood, but that has its downside, as we'll see.

What's in Pigment Stains?

Remember our piece of wood graced with mud? Once the water evaporates, we could easily brush the dry dirt back off the wood, but you can't brush real pigment stains off wood so easily. The reason is that in addition to the pigment and the solvent (dirt and water, in our case), commercial pigment stains contain a third ingredient. The third ingredient is called a "binder," and it is some type of finish that acts like a glue to make the bits of ground-colored dirt stick to the wood. The binder can be anything that dries to form a film capable of holding pigment, and also capable of sticking to wood. Most stains use linseed oil or oil-modified resin as the binder, while pigmented water-based stains usually use acrylic resin.

Artist's oils and artist acrylic colors work the same way. They contain high concentrations of pigments mixed with either linseed oil, soy oil or acrylic resins. If you add mineral spirits to the oil colors or water to the acrylics, you will have made pigmented

stain from common art supplies.

Japan colors, which are merely artist oils with driers added, work the same way, while universal tinting colors work much like acrylics, but they will mix with both water- and oil-based solvents. If you are inclined to mix your own pigmented stains from scratch, these are some materials you can use.

The Dirty Little Secret

Now we know that there are three basic elements in pigmented stains: solvent, pigment and binder. Quick, tell me what are the three basic elements in a can of paint? If you said "solvent, pigment and binder," you are correct. So, what is the difference between paint and pigmented stain? Mostly the percentages of each of the ingredients. Stain has more solvent, and may have less binder or pigment, depending on the particular stain.

Want proof? Take some paint, preferably a color you would choose as a wood stain, and dilute it 50/50 with solvent; water for latex, mineral spirits for oil-based paint. Wipe or brush it onto a piece of wood, then wipe it off and it will look like a stained piece of wood. In fact, that's a great tip for those times when you can't find just the right color stain and you don't want to mix it yourself. Choose the right color paint chip from that endless wall of color options, take it to

the paint counter and have them make up a quart of custom colored paint in either latex or oil. Take it home and thin some out and you have the perfect color stain with no mixing required.

If You Know Paint, You Know Stain

Everything you know about paint applies to pigmented stains as well. If you put on a thin coat of paint (stain), whatever is beneath it, including the wood grain, will show up. Once the paint (stain) is dry, you can put on a second coat if you care to make it darker, but the more you put on, the more the grain will be obscured. You can apply the paint (stain) in thinner or thicker coats, but if you put it on too thick you might incur much longer drying time before you can recoat.

Since pigmented stain reacts differently depending on how the wood is sanded, it is vital

continues on page 28...



Staining softer summer wood can create a "photo-negative" effect.

that all areas be sanded the same way with the same grit paper. I like to do my final sanding with 180-grit garnet paper, going with the grain. Sanding the end grain with used garnet paper makes it a bit less likely to absorb excess stain. You can apply pigmented stain to raw or sealed wood, but it will wipe off of sealed wood more easily, leaving less stain and a more subtle color change.

Applying Pigment Stains

The best way to apply any commercial or pigmented stain is to flood it on with a brush, rag or nylon pad, then wipe it off while

it is still wet. That will give you the most uniform coloration, leaving only stain that has found lodging in pores and sanding scratches. If it is not dark enough, let it dry overnight and stain again the next day, but this time, brush it on and wipe off only what is required to make the color uniform and intense. It takes more skill to leave the stain heavy and still have it come out even, but it also gives you more control over the color intensity.

Stains that contain all pigment and no dye are not prone to blotching problems on resinous hardwoods like cherry, or on

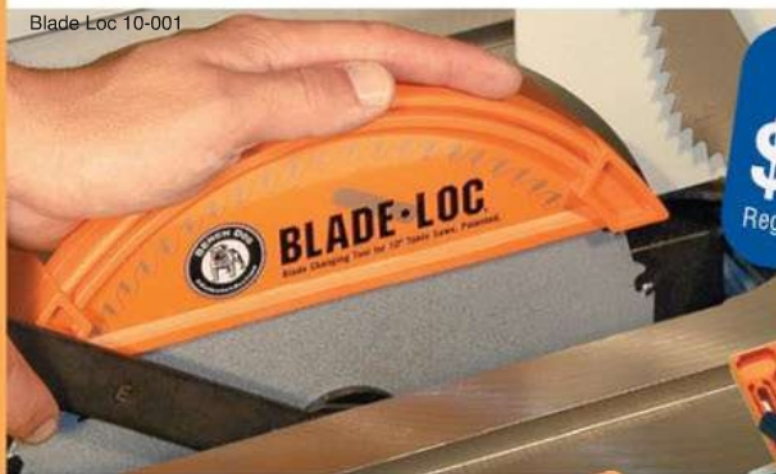
pine, spruce and other softwoods. However, if the wood has radical grain changes, like rotary cut birch plywood, poplar and some other hardwoods, wherever end grain shows up, more stain will be absorbed.

Stain will also lodge more in the softer summer wood of softwoods. That will result in a photo-negative effect, causing the normally lighter colored summer wood to be darker than the winter wood. Efficient sanding will minimize both these conditions, as will sealing the wood first with a thin coat of dewaxed shellac or Zinsser SealCoat™.



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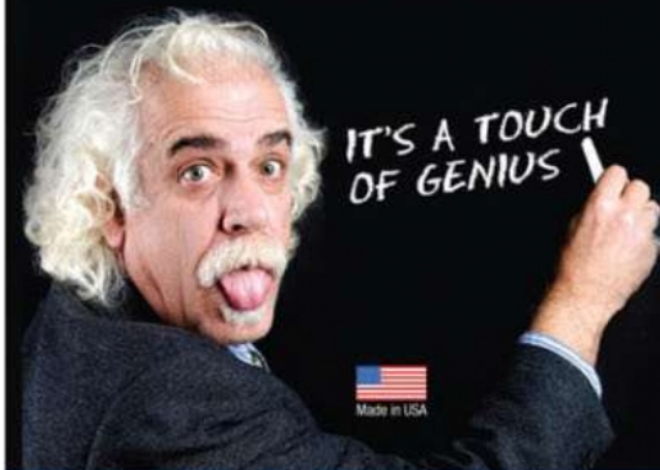
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Colors To Dye For

WHETHER YOUR GOAL IS GRAIN CLARITY, COLOR CHOICES OR BLOTCH CONTROL, DYE COULD BE THE ANSWER.

Most off-the-shelf wood stains contain a combination of two different types of coloring agents: pigments and dyes. Pigments work best on ring porous woods, like ash or oak, while dyes work best on dense, close pore woods, like maple. Wouldn't it be nice if you could use each one separately to gain more control over your coloring options? Well, you can.

Defining Terms

Before we go any further, let's stop and define some terms. A stain is

anything that is used to color raw wood. That's not to say you can't add color to wood that has a coat of finish already on it. You can. But that is called glaze, or shading or toner.

Chemical stains are compounds that react with wood to create color changes, like ammonia darkening oak. All other stains are liquids or gels that have some sort of coloring agent in them. As mentioned, there are two primary types of coloring agents used: pigments, which are ground-up particles of colored "dirt" suspended in liquid. (For more on pigment stains, see page 26.) In this article, I want to talk specifically about dye stains.

What is a Dye?

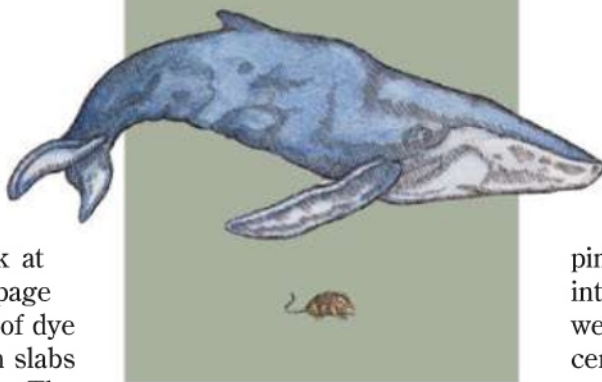
Dyes are organic colorants that dissolve in some solvent. That's not the same thing as pigments, which are ground-up chunks of color that are suspended in liquid. Suspended particles, like pigments, settle to the bottom of a container, but dyes do not. Imagine adding a bit of sand to a glass of warm water, and a bit of salt to another. The sand mixture would disperse when you stirred it, but eventually, the sand would settle to the bottom. The salt would dissolve and never settle to the bottom. Dye acts like that saltwater solution. The color dissolves into a translucent solution and never settles out.

Natural dyes have been around for ages, but most dyes we use today are synthetic. The first synthetic dyes were derived from coal tar in 1856 by an Englishman named Perkins, so historically speaking, they are fairly new.

Mixing dye is as simple as adding powder or concentrate to the right liquid. Add more dye for a stronger solution and less for a weaker one.



If a typical dye particle were the size of a mouse, a typical pigment particle would be the size of a whale.



Size Matters

First and foremost, dyes look different than pigments, and the easiest way to see that is to look at samples. In the photo on page 32, I used the same color of dye stain and pigment stain on slabs of figured maple and oak. The pigment was able to lodge in the nooks and crannies of the large pores of the oak, but mostly wiped off the finer grained maple. However, the dye soaked deeply into all areas of both woods. This is because dyes go into the wood to color its fibers, while pigments sit on top of the wood. Why? Dye particles are vastly smaller than pigment particles. If a typical dye particle were the size of a field mouse, a typical pigment particle would be the size of a whale. Staining is one area where size does matter.

All commercial stains containing pigment also contain a binder that acts like a thin coat of finish, sealing the wood as you stain.

Dyes can be simple colorant in solvent, leaving nothing but color in the wood once the solvent evaporates. Therefore, dyed wood acts like raw wood and must be finished over. Dyes are compatible under any finish, and dyed wood can be restained with another dye or a pigment.

Finally, there is the issue of clarity. A very dark application of pigmented stain will start to look like a painted surface. But, due to the clarity of dyes, you can make wood very dark and still retain the look of wood. (For example, see the maple boards on 32.) When you go dark on dense wood, dye is the ticket.

Making Stains from Dyes

Ready to give them a try? It's quite simple. Dyes are sold as powders meant to be dissolved in a particular solvent, as liquid concentrates that will go into several solvents, and as ready-to-use stains. The powders come in water-, alcohol- or oil-soluble versions. Of the three, I find water-soluble dyes to be the most user friendly for staining

raw wood. So, for your first try, I suggest water-soluble dyes. Add up to an ounce of dye powder to a pint of warm water for a very intense dye. To make the dye weaker, use less powder or concentrate, or add more water. For custom colors, dissolve each dye in solvent first, then mix the liquids a bit at a time to get the color you want. Test the mixture on scrap wood, and keep track of your formula in case you want to repeat it later.

Water-soluble dyes dissolve in warm water almost immediately and completely. Alcohol-soluble dyes go into denatured alcohol, but they may take several hours to dissolve completely. I let them sit overnight, then strain out any sediment through fine cheesecloth. Oil-soluble dyes will break down in most petroleum distillates — naphtha, lacquer thinner, toluene, etc. Let them sit overnight and strain them as above.

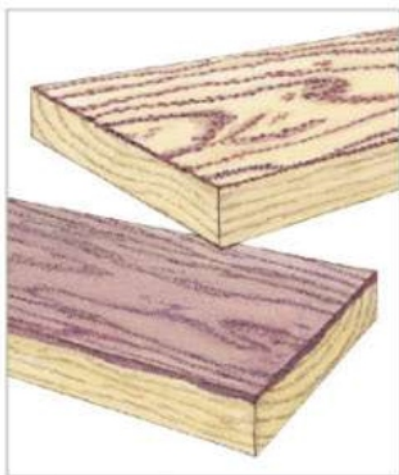
Once you've mixed liquid dye, try it on scrap wood to see the color. As the dye dries, the color will fade and start to look "chalky," but don't worry, it will come back to life once a coat of finish is added. The true color is how it looks when wet.

Flood It On, Wipe It Off

One simple method works best with dyes: flood it onto the raw wood and wipe it off while it is still wet. That lets the dye soak

continues on page 32...





Pigmented stains strongly affect the open grain but are wiped away from the more dense wood fiber. Dyes soak deeply into open grain but color the fiber of the wood as well.

into the wood but takes off anything sitting on top, resulting in uniform coloration. I like to use nylon abrasive pads, a foam pad or a sponge to apply the dye, because it stays wet longer than a cloth. Flood on plenty of dye and work quickly so it does not dry before you wipe it. If it does dry too fast and leaves lap marks or uneven areas, rewet the entire surface with the dye solution and wipe it again to even it out.

Control the color not by how you apply it, but by how you mix it. If it is too strong, add more

solvent. If it is too weak, add more dye. You can restrain as often as you like, changing the color as you go. You can even lighten the dye after it is on the wood by scrubbing with its solvent. For example, lighten a water-soluble dye by scrubbing the wood with clean water and wiping it off with paper towels. In fact, you can remove most, if not all, of the dye by washing the unsealed wood with full-strength laundry bleach. You can use dye to tint a finish. Add a few drops of liquid dye concentrate or mixed alcohol-soluble dye to shellac or lacquer for a translucent tinted coating.

Problems with Dyes

As easy to use as dye stains are, there are some problems to watch out for. The first is splotching, or uneven staining. Some hardwoods, such as cherry, and most softwoods, like pine, contain pockets of resin that can be dissolved by petroleum distillates. Oil-soluble dyes dissolved in such solvents are absorbed more readily into these resinous areas, causing large patches of dark stain where no grain or figure accounts for it. The easiest way to avoid this is to



One of the chief advantages of coloring wood with dye is the virtually unlimited range of achievable colors. You can even restrain dyed stock with different successive colors (above) until you reach the desired hue.

use a solvent that will not dissolve the resin. Water-soluble dyes will not cause splotching on these woods because the resin patches are not water-soluble.

Fading is another common problem with dyes. Most dyes fade in strong sunlight, so dyes are not a good choice for exterior staining.

Dyes will also bleed into a finish that has the same solvent as the dye. For example, if you use a waterborne coating over a water-soluble dye, expect some of it to bleed up into the first coat of finish, or to come off on the brush or pad you are using to apply the coating. This is not usually a big deal, but in extreme cases it can cause the stain to become uneven. If you use water-soluble dyes under waterborne coatings, seal the dye first with a thin wash coat of dewaxed shellac. It will seal in the dye and prevent bleeding.

So go ahead and give dyeing a try. A more colorful finishing future is sure to result.



The pigmented stain on the bottom of each board lodged in the large pores of the oak, but mostly wiped off the denser maple and the denser areas of the oak. The dye stain on the top of each board penetrated deeper, coloring the wood and bringing out the figure in the maple.

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Bleaching Wood: Staining In Reverse

CHEMICAL OPTIONS FOR LIGHTENING WOOD COLOR AND ERASING STAINS.

Staining means adding color to wood. Bleaching, its logical opposite, is the process of chemically removing color from wood. You can remove accidental stains, intentional (but ill-advised) wood dyes, or the original colors that nature placed in wood, using one of three basic bleaches. Here's a description of each, a guide on how to mix and use them and an explanation of what they will do.

Safety and Use Guidelines

All these bleaches are water-based, and all finishes repel water. Hence, all bleaching must

be done on raw (unsealed) wood. If you're trying to remove a stain from a finished piece of furniture, you must strip the finish first. It's also a good idea to lightly sand the wood to make sure the bleach can easily penetrate it.

More important, these bleaches are either acids or bases, and as such are reactive. That means they can harm us, so use gloves and goggles, and work in a well-ventilated room. Any gloves will do, but don't get these bleaches on your skin. You might also want to wear a vinyl apron, or choose clothes you are ready to abandon.

Bleaches eat cloth and natural bristles, so apply them with synthetic bristle brushes or nylon abrasive pads (such as

Scotch-Brite™). Always apply bleach to the entire surface of the wood, not just the area with the stain. "Spot" bleaching can cause permanent watermarks or hard-to-blend light spots in the wood. Typically, you allow the bleach to work until it dries, but you can stop the bleaching action at any time by diluting the surface with plenty of clean water. Because it contains water, bleaching raises the grain of wood, so plan on sanding with 320- or 400-grit paper once the wood dries.

Laundry Bleach

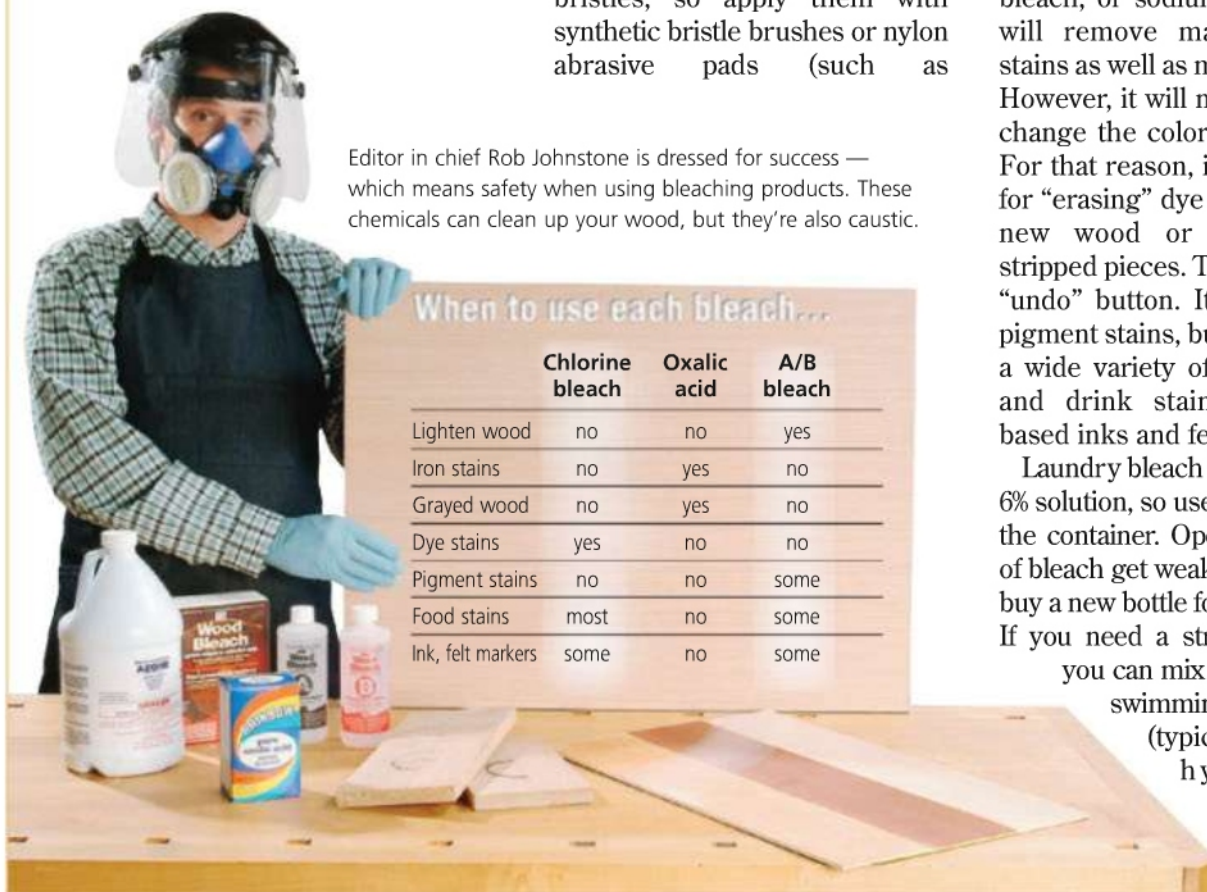
Old-fashioned chlorine laundry bleach, or sodium hypochlorite, will remove many accidental stains as well as most wood dyes. However, it will not substantially change the color of wood itself. For that reason, it is a great tool for "erasing" dye stain, either on new wood or old dyes on stripped pieces. Think of it as the "undo" button. It won't remove pigment stains, but it will remove a wide variety of common food and drink stains, some dye-based inks and felt-tip markers.

Laundry bleach is sold in a 5% or 6% solution, so use it straight from the container. Opened containers of bleach get weaker with time, so buy a new bottle for stain removal. If you need a stronger solution, you can mix your own using swimming pool chlorine (typically calcium hypochlorite) mixed in water. These dry

Editor in chief Rob Johnstone is dressed for success — which means safety when using bleaching products. These chemicals can clean up your wood, but they're also caustic.

When to use each bleach...

	Chlorine bleach	Oxalic acid	A/B bleach
Lighten wood	no	no	yes
Iron stains	no	yes	no
Grayed wood	no	yes	no
Dye stains	yes	no	no
Pigment stains	no	no	some
Food stains	most	no	some
Ink, felt markers	some	no	some



Oxalic acid can remove iron stains from wood. Use proper precautions while mixing; flood it onto the wood; let dry; then use clean water to remove the residue.



Chlorine bleach, applied top and bottom, will remove a variety of accidental stains but won't remove pigmented stains. Here, the swimming pool version... Clorox® on steroids — is shown on maple, walnut and mahogany.

granules are sold at all different active bleach concentrations, so you'll have to read the label and do the math.

Don gloves, flood the bleach on evenly and liberally, and let it dry. Remove any salt residue the next day by washing the surface with plenty of clean water, then wipe off the excess water and let the wood dry overnight.

Oxalic Acid

Sold as a dry crystalline powder, oxalic acid will remove blue-black iron stains that show up on oak and other high tannin woods, as well as some iron-based inks. Iron stains can come from hardware, cans or bits of steel wool that show up as tiny black dots in the oak pores. Widely sold as deck brightener, oxalic acid reverses the silver-gray of oxidized wood, but it won't change its original color, nor will it affect most wood stains or dyes.

Oxalic acid is toxic and irritating to skin and mucous membranes in its dry form. Wear a dust mask and goggles while mixing it into water, and again when you sand the wood after the bleach has dried. Make a 6% solution by mixing about a tablespoon of it into one cup of warm water. Once it is mixed, it is fairly benign and won't smell much. Flood it onto the wood, let it dry, and wash off the salt residue the next day with clean water.

Two-part Wood Bleach

This is the one bleach that actually lightens the color of wood. Wood bleach will also knock out some, but not all, pigment stains but, curiously, won't affect most dyes. It is the most dangerous of the lot. Each component will burn your skin on contact; handle with care.

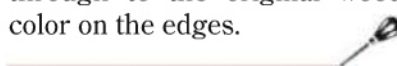
Wood bleach is sold in two containers, usually labeled A and B — respectively, sodium hydroxide (lye) and hydrogen peroxide (not the 3% peroxide sold in pharmacies, but a wicked 35% concentration). Wet the wood thoroughly with the lye solution, followed quickly by the peroxide. When the two wet solutions come in contact with one another, they create a strong oxidizer that bleaches the color out of wood. It is important that the wood is still wet from solution A when the B is applied, so speed is of the essence.

Pour each component into a glass, plastic or porcelain container for application. Wear gloves and goggles, and use synthetic



brushes to apply the bleach. Some brands suggest mixing the two components together, then applying the solution. Again, speed is important, because the strongest action comes just after the two chemicals meet. Don't let the bleach contact metal, particularly steel wool, or it will quickly erupt into a Vesuvius of caustic foam.

Let the wood dry overnight, and repeat the process if the wood isn't white enough. Once you're happy with the results, wash the surface with plenty of clean water to neutralize and remove the alkaline residue. Be careful when sanding: the bleaching doesn't penetrate deeply, and it's easy to sand through to the original wood color on the edges.



Two-part bleach is the most dangerous. Use it with caution.



Fuming Wood

DARKEN OAK AND OTHER TANNIN-RICH WOODS THE CLASSIC WAY WITH AMMONIA.

Gustav Stickley popularized the Craftsman, or Arts and Crafts, style in furniture and, with it, fumed oak. He preferred quartersawn oak, believing it to be stronger and more stable, but disliked the distinct appearance of ray cells, which only got more pronounced when the wood was stained. Today, we prize that figure and call it “tiger stripe,” but Gus wanted to minimize it. The one way he found to darken both the vertical and ray cells was with ammonia fuming. As a result, fuming oak fascinates many hobby woodworkers today, even though the Stickley

Company, which is back in business, does not fume at all anymore.

How it Works

Fuming is chemical staining that occurs when tannin in wood reacts with ammonia vapors. Ammonia colors woods that contain tannin, but not those that don't. Predictably, the higher the tannin content, the more dramatic the color change. That's why sapwood, which is low in tannin, does not change color as much as heartwood, and why white oak, with its higher tannin content, fumes more dramatically than red oak.

Typically, you place ammonium hydroxide, or liquid ammonia, in

an open container within a closed fuming booth. As the ammonia evaporates, it forms two gases, ammonia (NH₃) and water vapor. The active ingredient in fuming oak is ammonia gas, not ammonium hydroxide. That's why wood darkened by fuming looks different than wood darkened by simply being wiped with liquid ammonium hydroxide.

Fumability Factors

Fuming is not just for oak. Any wood that contains tannin will get darker when fumed, including oak, walnut, mahogany, chestnut, ash, cedar and cherry, to name a few. Woods low in or

For small pieces the author recommends a Rubbermaid container sealed with duct tape as a fuming chamber, but safety gear is a must.



Plastic pipe tents break down easily to change size and shape. A thermometer and heat lamp let you hit the right temperature.



Tannin reacts differently to ammonia gas than to liquid ammonium hydroxide. Fumed wood must be darkened by evaporating ammonia gas.

devoid of tannin, such as birch, maple, basswood or pine will show almost no change. However, there's a way to fume non-tannin wood: add tannin to the wood before fuming. An easy method is to apply a wash of strong black tea to the wood. It will raise the grain and increase the tannin content, and thereby darken the color. Denser sticks of wood tend to contain more tannin than lighter ones. When choosing wood for a fumed project, try not to mix heavy and light wood in the same piece.

Getting Started

John Brock, a friend who's done a lot of fuming over the years, shared some of his experiences with me, offering a lot of good advice on how to go about fuming safely. It all starts with a fuming tent — anything from a sealed room for large items, to a Rubbermaid® storage container for small ones. John usually makes custom tents that are just the right size and easy to heat. "My tents," he explains, "consist of a wood or plastic pipe frame covered in clear plastic sheeting and sealed airtight with duct tape. I usually leave the bottom open so I can place it over the piece I'm fuming. I also leave some extra plastic rolled and stapled on the bottom edge of the frame to act as a seal. Next, I make the base of the tent from a sheet of plywood covered with black plastic."

The clear and black plastic combination is important, as you will soon see. John loads the tent



with pieces that have been finish sanded, removing all hardware, as ammonia can react with metals. He wears an organic respirator, gloves and goggles, and starts a fan behind himself to blow the vapors away. You'll find 28% ammonia solution at regraphics supply houses for about three dollars a gallon. Pour some into one or more small, shallow bowls, slide them under the tent, and quickly cover it. Avoid any contact with the ammonia vapors. Ammonia gas is quite hazardous, but fortunately, it elicits such a strong reaction when you smell even a tiny whiff of it, that you will be unable to remain in the same room with the fumes. If you forget to wear a respirator and goggles, it will quickly remind you.

Controlling the Color

How fast your fuming occurs will affect the resulting color. Higher concentrations of ammonia and warmer temps speed up the process. Slow fuming results in a greenish-gray brown color. Quicker fuming tends to minimize the greenish tint and yields a warmer, more grayish brown.

"The real breakthrough to excellent results," John told me, "was the addition of a heat lamp." After loading the tent, he sets the heat lamp to shine through the clear plastic onto the black base. This raises the temperature in the tent to 80° F and lowers relative humid-

ity. A drop in humidity makes the wood "thirsty," so it more quickly absorbs the ammonia vapors. John likes a dark, warm color on the wood, and 36 hours at 80° gets him there. "Without the heat lamp," he notes, "I was unable to get the depth of color I wanted."

Unload and Finish

When it's time to unload, turn off the lamp, suit up with safety gear and remove the ammonia. An exhaust fan clears the smell, but the fumed wood will hold a slight odor for a few hours. A very light finish sanding may be needed, and the fumed wood should sit a couple of days to let the moisture content drop.

"After fuming," says John, "the wood will look brownish gray and not very pleasant. Don't let that worry you. To see what it will look like under a finish, wipe a little naphtha on the wood and look at it in a strong light. It is beautiful and very complex. I finish with shellac, or oil followed by shellac, to maximize the chatoyance and 'pop' the wood grain." However, any finish will go over fumed wood. And, of course, you can always use fuming as a first step toward getting the exact color you want. Gustav Stickley used a variety of dyes to adjust color after fuming. You can do the same, with dyes or pigment stains, especially on sapwood areas.

Sealer: The First Coat Of Finish

OUR EXPERT DEMYSTIFIES THE OPTIONS AND PURPOSES OF SEAL COATINGS.

I suspect far more people are confused about sealer than understand it. As a result, questions abound, such as: “Is it the same thing as pore filler?” (No) “Should I use sealer before my topcoat?” (Sometimes) “Is there a universal sealer that will work with every finish?” (Yes) It’s time to clear the air and explain what sealer is, what it isn’t, and when to use it.

What is Sealer?

Sealer is the first coating applied to raw wood. While its use is always optional, it can be very helpful in some situations, performing all or some of the following functions:

- locking in contamination on the wood surface, such as grease, oil, wax or sap and antioxidants that occur naturally in the wood

- preventing spongy wood from excessively absorbing repeated coats of finish
- reducing grain raising under water-based finishes
- acting as a tie or barrier coat to allow otherwise non-compatible finishes to go over one another
- increasing adhesion of the topcoat to the substrate or stain
- preparing an old finish for recoating with a different topcoat
- making it easier to sand the first coat of finish
- providing a superior moisture barrier

Sealer Versus Sanding Sealer

If you’ve ever sprayed nitrocellulose lacquer directly onto poplar or cedar, you know these woods absorb quite a bit before the film starts to build. The hard lacquer is difficult to sand once you do

get enough on to seal the wood. To deal with this problem, sanding sealer was developed.

Sanding sealer is made by adding zinc stearate — a soft, fluffy soap — to lacquer. This causes the lacquer to build up faster, sealing spongy wood quickly. The steared sealer sands easily and acts as a lubricant to boot. Because this coating is softer than the lacquer that goes above it, use only one or two coats. Building up a lot of sanding sealer can make the harder lacquer above it more prone to chipping and cracking.

Because sanding sealer builds fast and sands easily, some folks try to use it as pore filler, building up coat after coat and sanding it back until the pores are filled. This is not a good idea. Pore filler is inert, but most sealers continue to shrink over time, just as finishes do. The extra material in

Not every sort of topcoat finish benefits from a first coat of sealer. Oil and oil-based polyurethane do not, while water-based polyurethane definitely does.





The author prefers to flood sealer on liberally by hand (left), then wipe off the excess with shop towels. Wear gloves for this procedure. Stearated sealer builds up quickly and sands easily — although it creates a lot of dust. One or two coats are sufficient.



the deeper pores shrinks proportionally more, causing the pores to show up again as depressions in a matter of months.

Universal Sealer

Different types of sealers are often specifically formulated for particular coatings and tasks. For instance, both vinyl and urethane sealers increase adhesion on some substrates, add moisture resistance and block anti-oxidants. But choosing a sealer for your everyday work need not be a confusing task.

Fortunately, there is a universal sealer that will do everything on the list above, and it is compatible with every wood and between all coatings. Made by Zinsser, SealCoat™ Universal Sanding Sealer is a modified dewaxed shellac with a long shelf life. (Freshly mixed dewaxed shellac is an appropriate substitute.)

When to Use Sealer

Strictly speaking, any finish that forms a film on wood can be used as a sealer. Some coatings are so good at this task by themselves that they are called “self-sealing” finishes. Other finishes are not, and they benefit from special sealers.

Shellac and oil-based finishes (including Danish oil, varnish and polyurethane) work so well by themselves that they do not

require any special sealer under them. Some finishers prefer to thin the first coat of these materials to make them dry quicker or sand easier, but that is strictly a personal choice.

Lacquer and water-based coatings, on the other hand, work better over sealer. The right sealer will lock in contaminating oils and waxes, reduce the number of coats needed by preventing excessive absorption, improve adhesion and reduce grain raising under water-based coatings.

The wood also plays a part. With very dense woods, such as rock maple, you can usually omit the sealer. However, spongy or absorbent woods like poplar, red alder and most softwoods, can benefit greatly from sealer, especially under lacquer. The sealer coat envelopes the porous wood, preventing the first few coats of lacquer from being excessively absorbed.

Some problem woods, like rosewood and cocobolo, contain anti-oxidants that prevent certain finishes from curing. These need sealer under oil-based coatings, but not necessarily under lacquer or shellac. Fortunately, it doesn't hurt to use the correct sealer, so when in doubt, err on the side of safety.

Applying Sealer

You can apply sealer as you would any coating, with a brush,

gun or pad. The problem is that after one coat, end grain and spongy areas may still be “hungry” and insufficiently sealed, while denser flat grain areas are starting to build up too much coating. I prefer to flood the sealer on liberally by hand, using a nylon abrasive pad as an applicator, then immediately wipe it off with paper shop towels while it is still wet. Wear gloves and work small areas at a time so the sealer does not dry before you wipe it off.

The advantage of this method is that it allows end grain to absorb as much sealer as it can, but wipes any extra off flat grain surfaces that tend to absorb less. Once the sealer is dry, the entire piece is uniformly sealed, and the next coat of finish will lay out the same in all areas.



The author's favorite sealer, Zinsser's SealCoat — a long-lived de-esterified shellac, works for all sealing applications.

Shellac: Simple And Sweet

THE “MIRACLE” FINISH THAT COMES FROM HUMBLE ORIGINS.



I suspect that if shellac were introduced today as a newly invented modern finish, it would be hailed as a near miracle. It boasts a wealth of characteristics that woodworkers routinely seek in a finish. Shellac is non-toxic, self-sealing, user-friendly, easily repairable, very fast drying, and can be applied by rag, brush, spray gun or even dipping. It brings out the beauty of wood, and the primary solvent for it is grain alcohol — virtually the same stuff we quaff in beer, wine and liquor. But that's not all; it is such an effective barrier coat for almost all the contaminants that wood is prey to that some folks call it a “universal sealer.”

A Bit of History

In fact, shellac is anything but new. Its recorded use goes back some 3,000 years, and the water-soluble dye that comes out of the first washing of raw shellac was long prized for the bright scarlet color it gave to silk, leather and wool. We no longer harvest shellac for its dye because we have synthetic ones. Over the years it has been used not only as a coating for fine furniture and other objects, but also as an adhesive in musical instrument repair, an insulator and for a range of solid objects from jewelry to the precursor of our CDs — Edison's early records and cylinders. In fact, the invention of Bakelite (phenolic resin plastic) came about as an attempt to make “synthetic shellac.” These days the bulk of shellac in the U.S. is used for coating medicine to make pills easier to swallow and as “confectioner's glaze” to make fruit and chocolate shiny. One of its more curious uses is in “time release” medicine. Shellac is highly resistant to acids but will break down

Bug Doots: Tiny laccifer lacca swarm on trees in their larval stage, creating a protective crust. The encrusted branches are then harvested, the earliest stage of shellac.

in basic (alkaline) solutions. Our mouth and stomach are acidic environments, but our intestines are basic. If part of a medicine is coated with shellac and part uncoated, the uncoated portion will go to work almost immediately in your stomach, while the coated batch won't start working until it makes its way down to your intestines. Clever, eh?

Is it Really Bug Doots?

Shellac is produced by laccifer lacca, a tiny bug that swarms on certain trees in India and Thailand. This parasite infests the trees in its larval stage and makes itself a protective crust during its development. At the end of the bug's life cycle, the fully encrusted branches are harvested and “seedlac,” the crudest form of shellac, is scraped off and crushed. Washing the seedlac removes the water-soluble



dye, but some non-soluble dyes stay behind in the resin itself. As a result, shellac comes in a variety of colors, depending on the type of tree, the geographical area and even the time of year it is harvested. The most common is orange shellac, but colors range from dark garnet through very light super blonde and platina.

Seedlac contains the shellac resin, about 5% wax which the bugs create as “breathing tubes” and the random bits of tree bark, twig wood and bug legs that get caught in the scraping process. It is then either melted or dissolved in alcohol and strained. The cleaned resin can be dripped onto a sheet and cooled as buttons, but more commonly it is dried and stretched or rolled into sheets, which are broken up into flakes. It can also be filtered to remove some of its color, get bleached with chlorine to create “white” shellac or have the wax removed.

Uses for Shellac

We woodworkers have plenty of reasons to prize shellac. It makes a beautiful non-toxic finish for chairs, cabinets, cradles and cribs, bookshelves, boxes, beds, picture frames, musical instruments, turnings and anything that gets normal but not excessive wear. Shellac has very good resistance to acids, water, stains and scratches, but it won't hold up to high heat or alkalines, such as ammonia-based window cleaners. I would not choose it for areas that are near heat sources, like fireplace mantles or

cabinets above stoves, or for a kitchen counter or table that might be a repository for a hot coffee pot. But most anywhere else, shellac would be a beautiful option.

Perhaps the most important use for shellac in the woodshop is as a sealer. Technically speaking, the first coat of any finish seals the wood, but shellac does far better than most in that department. Refinishers know that a coat of dewaxed shellac after stripping will seal in old stains, wood resins, knots, wax, grease and even silicone oil, which causes those annoying pockmarks called “fisheye” that show up in later coats of lacquer. Shellac can act as a barrier between incompatible finishes. It can improve adhesion between two dissimilar coatings because it sticks well to most any surface, and most finishes stick well to it.

Waterborne coatings present their own problems, and shellac as a sealer makes many of them go away. Water-soluble dye will bleed up into coats of waterborne finish, but a thin coat of shellac will prevent that. It will also act as a “tie” coat to improve adhesion to oil-based stains, and it will even add some depth to darker woods that sometimes look “washed out” under waterbornes. It's a wonderful way to forestall fisheye and other contamination problems that sometimes prevent waterbornes from laying out smoothly. Shellac will even prevent the water from raising the grain of the wood.

Applying Shellac

I routinely use a wash coat of dewaxed shellac as a sealer under lacquer, waterborne coatings and sometimes even polyurethane. My method of hand applying the sealer coat results in more uniformity. Typically, when you apply the first coat of finish to wood, it sits nicely atop the flat grain areas, but gets completely sucked into the end grain. As a result, the end grain looks raw while the less porous flat grain looks shiny. So even though you applied a uniform coat, you end up with an uneven one due to selective absorption of the wood.

To prevent that, I flood the first coat of shellac on, then wipe off the excess while it is still wet. Thin the shellac first by adding denatured alcohol until the mixture is about the consistency of skim milk. By flooding it on liberally, the end grain has a chance to absorb as much shellac as it can. When I wipe off all that has not been immediately absorbed on both the flat and end grain areas, the result is a uniformly sealed piece.

The first coat of shellac will raise the grain of wood very slightly. I let it dry about an hour and sand very lightly with 320-grit paper — just to smooth it a bit. After that, subsequent coats of shellac don't need to be sanded, since the alcohol in each successive coat will redissolve the first one enough to give perfect adhesion. You can apply more shellac with a brush, spray gun or even with a cloth pad, a process called French polishing.

Try Mixing Your Own

Mark a lidded jar with a line indicating how much shellac you will need for your project. Now make a second line halfway to the first. Fill up to the lower line with loose dewaxed shellac flakes, then pour in

denatured alcohol to the upper line. Screw on the lid and shake the jar frequently for the next two hours or so, then leave it overnight. By morning it should be ready to use, but stir it to make sure all the shellac is dissolved. Remember to put a date on the jar and use it within six months.



Shellac is excellent as a sealer under other finishes as well. In that case, use only dewaxed shellac, since some finishes won't adhere well to the wax in orange shellac. Liquid shellac sold in cans contains wax. To get dewaxed shellac, you must buy it in flake form and mix it yourself, or buy aerosol cans, which contain the dewaxed version.

Some Tricks of the Trade

As nice as it is, shellac can sometimes be a bit tricky. Because it has a high surface tension, it may pull away from the pores of large pore woods like oak and ash after brushing or spraying. If this happens, there are ways to make it lay out better. First, simply add some denatured alcohol. Thinner shellac flows out better, but also dries faster. To slow it down, try finishing in the early

or late hours of the day when the shop is cooler. Alcohol evaporates slower at lower temperatures. If that is not enough, you can substitute Behkol solvent, from the Behlen company, for some of the alcohol. Behkol is a slower drying alcohol mixture. For even better flow and leveling, there is a surface tension reducer on the market called "Shellac Wet." Just a few drops of it will make the shellac lay flat.

One final warning: Like all materials, shellac has a shelf life. Older shellac will take longer to dry and will create a softer film. Zinsser puts a fill date on the bottom of their cans, and you should use it within two to three years of that date. But the more alcohol in the shellac, the shorter its shelf life. Thinned shellac will last only about six months.



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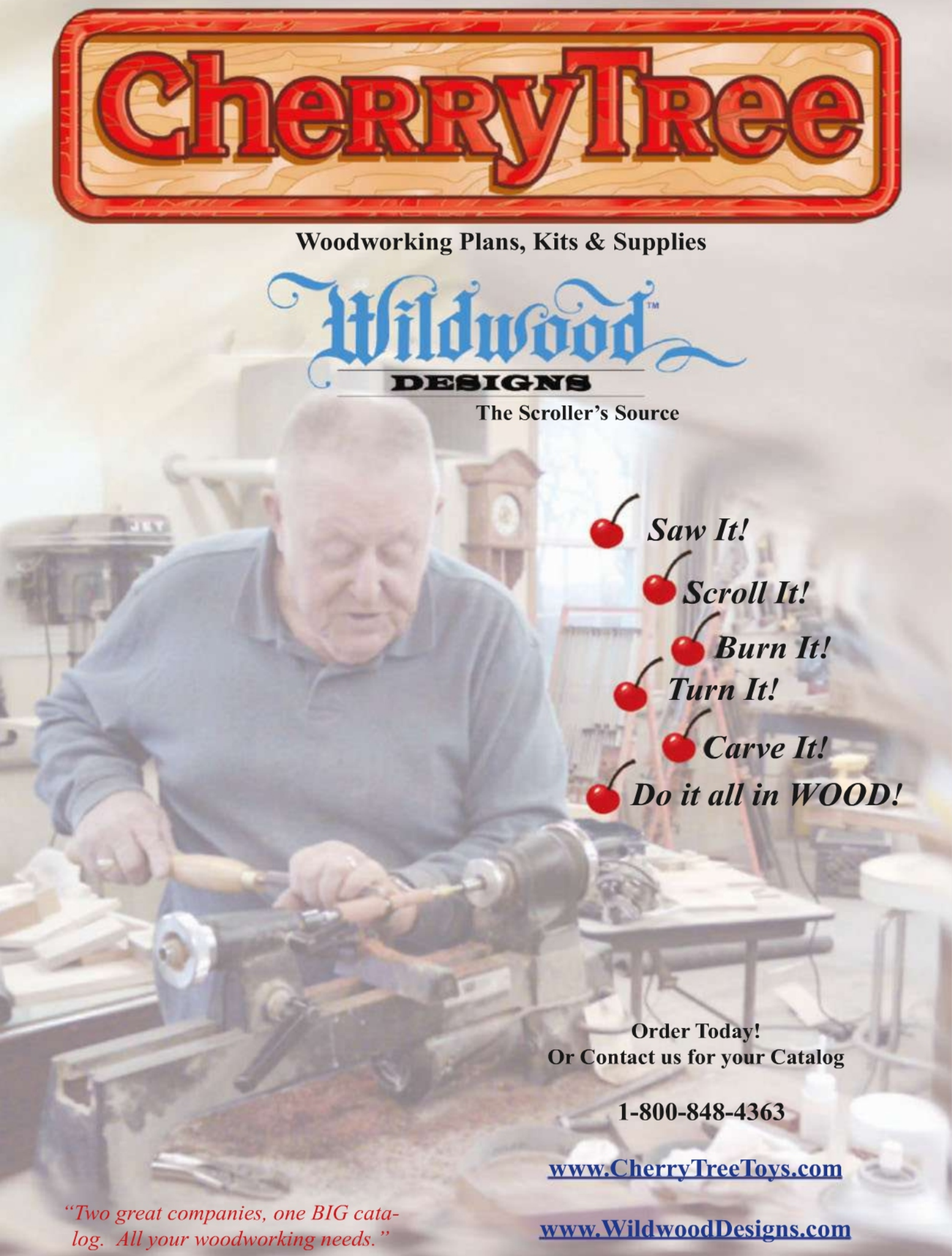
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Polyurethane: Oil-based Or Waterborne

OUR EXPERT SETS THE RECORD STRAIGHT REGARDING POLYURETHANE'S TWO DISTINCT PEDIGREES.

Like many other finishes, polyurethane is named for its primary resin, though some cans labeled “polyurethane” also contain other resins. Resin is what remains behind to form a film once the solvent has evaporated. The resin defines the nature of the coating. In general, polyurethane or urethane resins (the terms may be used interchangeably) provide finishes with good durability, including resistance to heat, abrasion, chemicals, stains and solvents. Polyurethane is tough enough for kitchen tables and cabinets, bathroom vanities, walls, doors, floors, all types of furniture and virtually any woodworking project. Woodworkers mainly use either oil-based or waterborne polyurethanes. Both have good qualities, but they are very different in many ways, giving rise to a hotly debated disagreement over which is superior.

Oil-based Versus Waterborne

The primary differences between the two relate to how they are made. Oil-based, whose proper name is “oil-modified urethane,” is produced by reacting common finishing oils, like linseed oil, with a chemical that causes the oil to form larger molecules. A good rule of thumb is that larger molecules mean more durable finishes. The result is something that looks and acts like oil-based varnish, but is tougher.

Polyurethane gel is simply a thicker version of the same thing.

Waterborne polyurethane is an emulsion of resins in water and solvent. It dries fast and behaves more like lacquer than varnish. As a result, it benefits from a different application technique than oil-based, but there are also differences in durability, odor, flammability, safety and even appearance. Let's compare the two in each major performance category.

Durability

Oil-based polyurethane wins this one hands down. It has better heat, abrasion, chemical and solvent resistance than its water-based cousin, and for a very good reason. Most water-based polyurethanes are actually a mix-

Oil-based and waterborne polyurethanes differ in durability, odor, flammability, safety and appearance — which is why there's a debate over which one is superior.



ture of two or more resins, usually acrylic and polyurethane. Acrylic resin has properties similar to lacquer, including its susceptibility to some strong solvents, chemicals and heat. It is added to the finish for two reasons: acrylic is less expensive than polyurethane resin, and it brings better brushing and spraying properties to the mixture.

The combination of the two resins puts water-based polyurethane somewhere in between lacquer and oil-based polyurethane on the durability scale. Exactly where depends on how much of the mixture is acrylic resin and how much is polyurethane. Some brands are largely polyurethane, while others are mostly acrylic, so there can be significant differences from brand to brand. The question is, how much polyurethane is in your polyurethane?

Drying Time

This one goes to the water-based side of the scoreboard. One coat of oil-based polyurethane will take several hours before it is dry to the touch, but most water-based versions will get there in 10 minutes. The faster setup time means it is easier to get a dust-free finish with water-based polyurethane.

Odor, Cleanup and Safety

Once again, water-based comes out ahead. It emits less offensive odor and cleans up with soap and

CHARACTERISTICS	OIL-BASED	WATERBORNE
Durability	Excellent	Good to very good
Dry to the touch	Several hours	10 to 20 minutes
Odor	Substantial	Low
Flammable	Yes	No
Cleanup / safety	Mineral spirits rags may be spontaneously combustible	Soap and water rags are safely disposable
Appearance	Amber, good chatoyance	Clear, sometimes cloudy, gray or pale
Best applicators	Natural bristle brush, nylon abrasive pad, spray gun	Synthetic bristle brush, paint pad, spray gun

The primary differences between oil-based and water-based polyurethanes relate to how they are made. Oil-based, whose proper name is "oil-modified urethane," is produced by reacting common finishing oils, like linseed oil, with a chemical that causes the oil to form larger molecules. A good rule of thumb is that larger molecules mean more durable finishes.

water. Oil-based polyurethane smells more and requires mineral spirits for cleanup. Most oil-based polyurethanes are flammable, whereas none of the water-based ones are. Perhaps worse is that oily rags can be spontaneously combustible, so just in case, lay them out one layer thick to dry prior to disposing of them.

Appearance

Beauty is in the eye of the beholder, so this category has no definite winner, but there are obvious differences in how the two types look. Oil-based polyurethane is amber and will add subtle color to wood, while water-based is clear and adds no color at all. This is especially noticeable on light woods, like maple, which stay white under water-based polyurethane but get amber with oils. The flip side is that oils penetrate into wood better, resulting in greater chatoyance, or shimmer and depth, than you'll get with water-based. Oil-based polyurethane looks richer and more vibrant, especially on dark and highly colored woods,

where water-based coatings can look pale or washed out.

There are two other characteristics unique to water-based coatings that exacerbate appearance problems. Water-based polyurethane can bridge over 180-grit or coarser sanding scratches, leaving minute air spaces below the finish in the scratches. These can make the finish look pale and cloudy unless the raw wood has been sanded to 220-grit or finer. On some woods, such as poplar and oak, certain water-based coatings can draw extractives from the wood that react with the polyurethane, turning it slightly gray. You can get around both these problems by sealing the raw wood first with Zinsser SealCoat™. It provides an excellent sealer coat under water-based polyurethane and makes the wood look better to boot.

Application

Wiping on oil-based polyurethane will give you a thin, woody finish with no brush or spray marks, but

continues on page 46...



Oil-based polyurethane (front) adds an amber color and chatoyance; water-based polys (back) are clear.

water-based does not work well as a wipe-on. You can brush or spray both types of polyurethanes, but each works best with a different applicator, method and spray technique. Here are some guidelines to get you started.

Wipe-on: Use either gel or liquid oil-based polyurethane straight from the can without thinning it. Dip a fine nylon abrasive pad into the polyurethane and scrub it onto the surface of the wood. Wipe off all the excess before it dries. Apply one coat per

day. Three coats will afford adequate protection, but you can add more for a deeper looking finish.

Brush/paint pad: Use a natural bristle brush with oil-based polyurethane, and thin each coat about 10 or 15 percent with mineral spirits. Thinning will help you get a smooth, bubble-free finish. Water-based coatings require synthetic bristle brushes, since natural bristles will splay and go limp in water. I find that on flat surfaces, however, a paint pad works better. It coats faster, creates fewer air bubbles in the finish and allows you to apply thinner coats, which makes water-based coatings level better. Apply a minimum three thin coats of either type of polyurethane.

Spraying: Thin oil-based polyurethane 50 percent with acetone, not mineral spirits. Spray an extremely light mist coat onto the wood, let it dry for about 10 minutes, then spray a very light wet coat. The fast-drying acetone will cause the mist coat to get tacky. This tacky coat will help the thin wet coat hang without running or dripping.

Spray unreduced water-based polyurethane through a small fluid tip (.040" to .050"), applying very light coats. The surface will look as if it is not wet enough and has a slight orange peel texture, but resist the impulse to spray heavier. Leave it overnight and it will level out. Spraying too heavily will result in a rough texture as well as drips and runs on vertical surfaces. Spray at least three or four thin coats of either type.



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Working With Water-based Finishes

WATER-BASED FINISHES OFFER MANY BENEFITS, AND KNOWING THEIR UNIQUE CHARACTERISTICS WILL ENSURE SUCCESS.

Water-based finishes have taken the wood-working community by storm, and for good reason. They are similar to solvent-based finishes in durability, but smell less, give off fewer solvent fumes and are non-flammable. That's enough good news to make them worth looking into, but they do have a few quirks and drawbacks to consider.

The Nature of the Beast

The first thing to clarify is that water-based or waterborne finishes (the two terms are used interchangeably) are NOT water-soluble. A water-soluble finish would dissolve in water after it was dry and would not be waterproof. All water-based finishes are waterproof. In fact, the resins in water-based finishes are quite similar to those in standard solvent-based finishes.

Another misconception is that waterbornes are solvent free. Waterbornes have just enough solvent to form the film but are diluted with water to make them thin enough to spread. Where lacquer might be 75% solvent, water-base will have less than 10% solvent along with 60% water, and several additives to make the mixture work. These are very complicated formulas, and it is best not to thin them with water.



Over-applying is one of the top problems with water-based finishes. To prevent this, use a foam paint pad, as shown above.

Types of Waterbornes

Most water-based coatings are made using acrylic resin, polyurethane resin or a blend. The vast majority of coatings are a combination of the two resins, even though they may be called simply “polyurethane” or even “clear finish.” Polyurethane resin is tougher and more durable, while acrylic resin adds clarity and good brushing and spraying qualities. Acrylic water-based coatings are about as durable as furniture lacquer, and water-based polyurethanes are about equal to oil-based polyurethane. The blends vary in durability, but most are tougher than lacquer and similar to polyurethane.

Most solvent-based finishes are slightly amber in color, but waterbornes are clear. Those

that contain a lot of polyurethane resin may have a slight blue-gray tint, but that will only be apparent when many coats are applied over very dark wood or stain. Waterbornes keep light woods blond and won't “yellow” white or light color stains. They also stay clear over time. Some are available in both interior and exterior formulations, and the ones designed for outdoor use will say so on the label.

Water-based coatings form a finish in two distinct stages: first water evaporation, and then solvent evaporation. After you spread the finish on the wood, the water starts to evaporate, leaving the solvents and the resin. This lets the mixture stick together to form a sort of brickwork of finish globules. The solvent evaporates last, leaving behind a dried layer of resin.

Drying Time

The coatings can be dry to the touch in as little as ten or fifteen minutes and feel hard enough to use in a day or two. A small amount of solvent stays behind, however, and evaporates very slowly. Until it is gone, the finish is not yet as tough as it will be once it is fully cured. For that reason, you should avoid using any cleaning chemicals or solvents on the finish for at least a month.

Compatibility

Water-based coatings will adhere well on clean raw wood, over dye stains and over some pigments, but some brands may peel off of some stains. If there is any grease, oil, wax or other contamination on the wood, the finish may create uneven puddles called fisheyes. You can avoid both of these problems by sealing the stained or raw surface first with a thin coat of dewaxed shellac or wax-free Zinsser SealCoat™. One thin coat brushed, sprayed or wiped on and off will seal in any contamination and guarantee that the finish will adhere over any stain. The same treatment works if you

want to add a coat of water-base over an existing finish, such as old varnish or polyurethane. Clean the surface, sand lightly, and seal it with de-waxed shellac.

Applying Waterbornes

The most common problem I see among waterborne users is that they put on too much. Apply it too thickly and it will not lay out well, and it might even turn cloudy from excess water trapped in the drying film. The best advice I can offer you, whether you are spraying or brushing, is to put on less than you think you should. Each coat should leave the surface barely wet. Let it dry overnight.

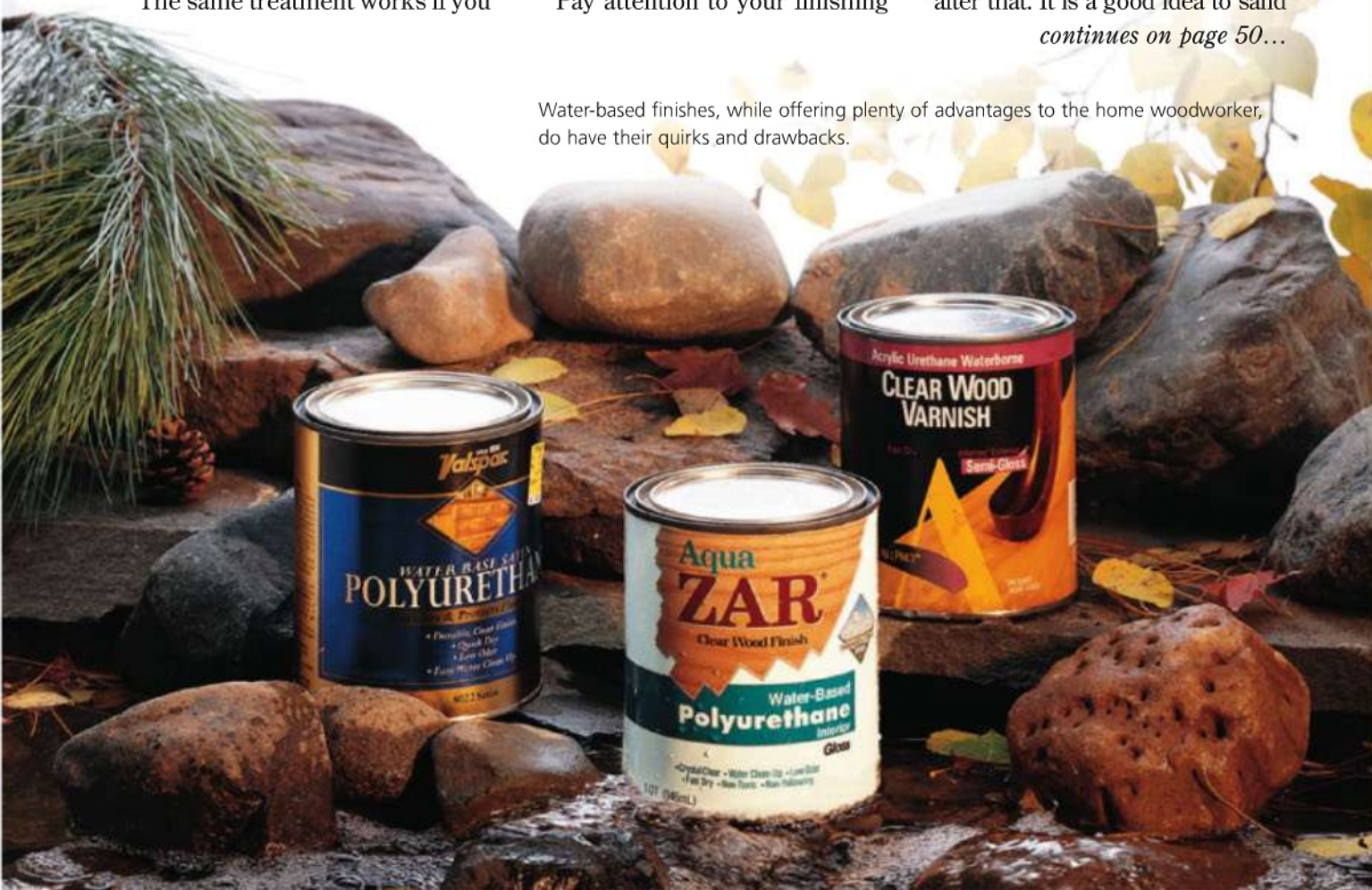
Pay attention to your finishing

environment too. Water-based finishes are more finicky than solvent-based ones, and they prefer a warm, dry room. You'll get better results if the temperature is 70 degrees or warmer, and the relative humidity is around 50% or lower. Cold temperatures (below 60 degrees) or very high humidity (above 80%) can prevent the finish from curing properly and will make it harder for the film to level itself.

The water in the mixture will make the first coat of finish raise the grain on raw wood, making it feel rough to the touch once it is dry. Sand it lightly to bring down the "fur" and it will not rise again after that. It is a good idea to sand

continues on page 50...

Water-based finishes, while offering plenty of advantages to the home woodworker, do have their quirks and drawbacks.



lightly between each subsequent coat anyway. The low solvent content means the finish can't redissolve the coat below it, and a light sanding with 320-grit sandpaper will both smooth the surface and help increase adhesion. Avoid the white/gray self-lubricated sandpaper, since it can create fisheyes in the next coat. Instead, use the gold self-lubricated paper from 3M. It is designed for sanding waterbornes.

Brushing

You can brush, spray, roll, sponge or pad on water-based finishes, but some tools and techniques work better than others. For large, flat surfaces, I find that a paint pad is ideal. It allows you to cover large areas quickly and, because the nap is so short, it makes it more difficult to flood on too much finish. You'll get fewer air bubbles in the finish (called "foaming") and a much smoother end result.

Start by stirring the finish well, then strain it through a paint filter or old nylon stockings. Water-based coatings sometimes form "gel specks," which are tiny globs of coagulated finish that look like pale tadpoles. Straining will eliminate them. Pour some finish out into a flat pan, dip the pad, then scrape off some excess so that the pad is wet, but not dripping. Stroke the pad over the wood, then go back over it ONCE, immediately to blend it out. After that, leave it alone. Going back over it again will only make it worse.

For those areas where a flat pad won't work, switch to a nylon or "Taklon" brush. With all water-based materials, you must use synthetic bristle brushes, since natural bristles will "splay" and become soft and unruly in



For those times when you simply can't get rid of those tiny air bubbles in the finish, try adding about one ounce of half and half cream per quart of coating.

water. Of the synthetic bristles available, nylon is softest and will leave the fewest brush marks. Pre-wet the brush by soaking it in water for a minute or two, then shake out all the excess. Dip the bristles about a third of the way into a pan, and brush smoothly in the direction of the grain. You can go back over it immediately to smooth it out, but only once.

Brush carefully; flipping the bristles through the wet finish briskly will create air bubbles. Don't brush back and forth, and don't go back over the finish after it starts to set up. The stuff dries very fast, and rebrushing or scrubbing will create foam and make the surface rougher.

For those times when you simply can't get rid of those tiny air bubbles in the finish, add about one ounce of half and half cream per quart of coating. It will act as a defoamer, eliminating bubbles.

Spraying

Water-based coatings spray much like other materials, with a few minor differences. Starting with the gun itself, make sure the tip and all fluid passages are stainless steel or plastic, since plain steel will rust. I find that a smaller tip size works better — 1 mm to 1.3 mm.

As with brushing, spray lighter coats than you are used to spraying with solvent-based finishes. Nitrocellulose lacquer is

usually sprayed at well below 20% solids, while waterbornes are typically 30% or higher. One coat of water-based will be equivalent to one or two coats of lacquer. It's quite easy to get runs and drips on vertical surfaces, and spraying less will help with that, too. Don't worry if it looks a bit pebbly, since it will usually flow out by morning.

Keep the gun tip about 8" from the wood to avoid overspray, and stick to one or two coats per day to allow plenty of drying time between coats. If you must thin the finish, I recommend a small amount of Flood Floetrol® rather than water. It will slow down the drying time and make it lay out more smoothly.

Even though they aren't flammable, water-based coatings contain solvents, so you still need a spray booth and a ventilation fan. You may be able to use a more gentle fan, since there are fewer solvents. A strong flow of cool air over the wet finish can chill the surface and prevent it from flowing out smoothly.

Cleanup

If you've ever tried to clean a brush or spray gun using soap and water, you probably noticed that instead of dissolving, the finish turned into a gooey mass. That's because water-based finishes tend to coagulate if too much water is added to them — another good reason to avoid thinning the stuff. Instead, add some household ammonia to the cleanup water. It will help break up the finish and let you scrub the brush or gun clean. Incidentally, that ammonia trick also works when cleaning up water-based finishes' "first cousin": latex paint.





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What's Up With Oils And Waxes

ARE OILS AND WAXES REALLY FINISHES?
WHY CHOOSE ONE OVER THE OTHER?
OUR EXPERT EXPLAINS YOUR CHOICES.

Many woodworkers turn to oils or waxes for their first attempt at finishing, and for good reason. They are easy to apply, give almost foolproof results, require no applicators beyond a rag and leave wood looking both rich and natural. Turners especially love them because they adapt perfectly to finishing wood still turning on the lathe.

If there is one Achilles' heel these popular finishes suffer from, it is their lack of durability. You would probably not choose a simple oil or wax finish for a bar top or kitchen table that will be assaulted with scratches, hot coffee pots or strong solvents, but they are perfect for bookcases, jewelry boxes, turnings, picture frames, blanket chests and a host of similar objects.

Oils (top in photo) and waxes are great finishes for novice and expert woodworkers alike. One important safety note: Oily rags can indeed spontaneously combust. They must be COMPLETELY dried before they can be thrown away.

While a wax finish can go on any type of wood, avoid putting oil (or Danish oil) on aromatic cedar or any of the dalbergia woods (rosewood, cocobolo, tulipwood). These woods contain an antioxidant that will prevent the oil from curing.

Wax

Sold in liquid, paste and solid stick forms, waxes are formulated in a host of colors. You'll find them in clear, amber, a range of wood tones and even white, which can be used to create limed or pickled effects. Some waxes are softer, some are harder, but even the hardest waxes are softer than lacquers and varnishes. The fact that they are soft means they

offer very little protection against scratches and wear. Of the ready-to-use paste waxes, one of the hardest, and also one of my

favorites, is Briwax (rhymes with "dry wax") from England.

Waxes are derived from a variety of mineral, vegetable and animal sources. As a finish, waxes don't penetrate wood, but rather sit atop it. They will prevent it from oxidizing (turning gray) but don't particularly enhance the wood. In other words, once a coat of clear wax dries on the wood, it will look like freshly cut, but unfinished, wood.

In its natural state, wax is a solid at room temperature. Liquid or paste wax typically contains some solvent, and the wax "cures" as the solvent evaporates. Virtually all waxes will dissolve in mineral spirits or naphtha, which is handy to know should you ever need to remove wax, either from wood or on top of a finish. Most waxes melt at very low temperatures, so they don't offer much in the way of heat resistance. However, they do shed water, which helps them resist food and drink spills. You can apply wax over any other finish and it will give the surface a soft sheen and smooth feel, but don't put other finishes over wax.

To apply liquid or paste wax, simply rub it on and wipe it off. I like to apply paste wax with Scotchbrite® pads or fine steel wool, then wipe with paper shop towels. If you wipe the wax off immediately, it will leave a dull sheen as it dries. For more shine, let it dry, then buff it with a soft cloth.



Watco®, the granddaddy of Danish oil finishes, is more durable than oil or wax, but just as easy to apply.



Oil Advantages

When I was young, we would put a spot of oil on brown bag paper, then hold it up to the light. The oiled section let more light in, making the paper translucent. Paper is made from trees, so it is no surprise that oil will do the same thing to wood. In fact, one of oil's strongest advantages is that it penetrates into wood, curing in and among the surface fibers. This is because oil is made of molecules small enough to seep down into the wood rather than merely sit on top. As a result, oil makes wood look richer and more translucent without adding a film on the surface.

There are two decidedly different types of oils that woodworkers use: drying and non-drying oils. Drying oils will change from liquid to a solid film when exposed to oxygen in the air. Nut oils (linseed, tung, etc.) are drying oils, but vegetable (peanut, olive) and mineral oils are non-drying. Edible mineral oil is popular on food contact items, like cutting boards. However, non-drying oils stay wet indefinitely, and will wash off when the board is scrubbed with soap and water. Because they do not dry to a solid film, non-drying oils are considered a wood treatment, but not a finish.

The most common and least expensive of the drying oils is linseed oil. It will dry by itself, but it

does so slowly. To speed things up, formulators add heavy metal salt "driers" to raw linseed oil, which causes it to cure faster. The result is called "boiled linseed oil," in spite of the fact that it is never boiled. Tung oil dries a little bit faster than linseed oil on its own, but it too is sometimes modified to cure more quickly.

The best method I have found for applying oil is to flood it onto the wood, adding extra to keep the surface wet in areas where the oil is quickly absorbed. After 10 minutes, wipe off everything that has not been absorbed. Don't add solvent.

For a smoother, richer finish, repeat the process, this time sanding the oily wood with fine wet-and-dry sandpaper. This will create a slurry of oil and wood dust, filling tiny pores and leaving the surface even smoother.

Danish Oil

What goes on as easily as oil and also makes wood look terrific, but dries quicker and is more durable? Danish oil, often lumped in as an oil finish, is actually a thin oil and varnish mixture. The oil helps bring out wood's beauty, while the varnish resin offers somewhat more protection against chemicals, heat, scratches and stains than either oil or wax.

Typical of this group is Watco®, both the oldest and best-selling. Many woodworkers create their

very first finish using Watco, and return to it frequently. It comes in a variety of colors as well as natural (clear). The directions on the can are excellent: apply it liberally to the wood, let it soak in for 15 minutes, reapply, then wipe off the surface.

Use Watco either as a one-coat penetrating finish, or to add as many subsequent coats as you like. Applied no more than one coat per day, you can build up a finish as thick, beautiful, and durable as varnish, with no brushes to clean or brush marks to rub out. The good news is that a multi-coat Watco finish is durable enough for most anything you make, even kitchen cabinets or a dining room table.



You can create a classic limed oak look by applying white paste wax and wiping it off, leaving extra in the corners and recesses. Above, a brown wax darkens wood.

Rubbing Out A Satin Finish

HERE'S HOW TO GIVE YOUR TOPCOATS A VELVETY FINISH WITH CAREFUL WAXING.

Would you like to know the secret to a smooth professional finish that cries out to be touched? It's rubbing out, a simple process that you'll want to do on every piece that you finish. Whether you brush or spray, it seems that no matter what you do to avoid it, you'll always get some bits of dust, air bubbles, brush marks or orange peel in the last coat. A good rub-out is the solution.

What is Rubbing Out?

Rubbing out, or simply "rubbing," is the process of smoothing the surface of a finish after the last coat has dried. Done right, it leaves the surface looking uniform, but more important, it imparts a smoothness that is a delight to the touch. Rubbing can remove small nibs or bits of dust, smooth overspray, reduce orange

peel or brush marks, or even up irregularities in sheen — the measure of how shiny or dull the surface looks. This process is most important on surfaces that are easily seen or touched, like the tops of tables, desks or sideboards, but you can rub any and all areas of a piece if you like.

Technically speaking, you can change the sheen by rubbing, but it is not a good idea. You can take a gloss surface and rub it down to satin, and you can rub a matte surface up to satin, but it is a whole lot easier to start with a satin finish if that is what you want the final rub to be.

Which Finishes Get Rubbed

Contrary to popular belief, any type of finish can be rubbed, including shellac, lacquer, oil varnish, polyurethane,

conversion varnish and water-based coatings. Some may take more "elbow grease" and some are easier, but all are candidates. What's important is to wait until the finish is cured before you rub. For example, you can usually rub shellac or lacquer to satin just a couple of days after the last coat has dried, but oil varnish may need a week or more to get hard. You can even rub very thin coatings, like oil finishes or very thin wipe-on varnishes, but it takes a lighter hand so that you don't wear through the finish.

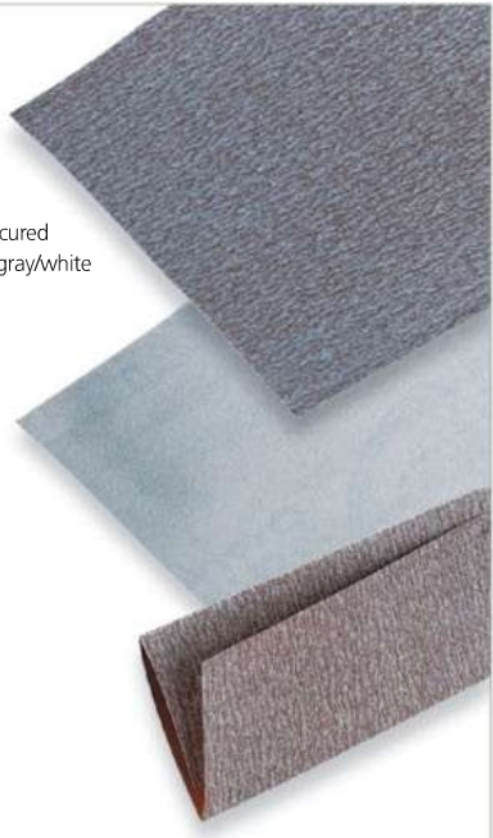
While you can rub too soon, there is no limit in the other direction. For example, you could rub the finish on an old tabletop to bring back its original sheen, feel and beauty. Simply clean off any dirt, wax or grease on the surface with a TSP solution or mineral spirits, then rub just as you would a new finish. The only limitations are that the finish must be thick enough so that you don't wear through, and in good shape with no areas that are peeling or lifting. After all, rubbing is an abrasive process, and as such it can dislodge any loose finish.

Rubbing to Satin

The object in a satin rub is to leave a uniform set of fine scratches on the surface of the finish — something like the look

With just a few basic supplies you can rub a finish to a smooth satin sheen that is silky to touch.





The first step in “rubbing” is gently sanding the cured finish. The author recommends using either the gray/white or gold self-lubricating 400-grit sandpaper.

of “brushed” brass. Let the coating cure at least two days for fast drying finishes like shellac and lacquer and at least a week (longer if you can wait) for oil varnish and polyurethane. Water-based finishes vary, but I’d play it safe and wait three weeks or longer. Some water-based finishes are sensitive to the solvents found in paste wax, and it may take weeks for them to fully cure. There are just four simple steps to a satin rub and, like most finishing, the first one involves sanding.

Start by Sanding

Use 400-grit or P800-grit stearated (self-lubricating) sandpaper to rid the surface of any raised nibs or rough spots. Don’t sand any more aggressively than you must — the point is simply to remove any rough areas and dust nibs. In many cases, it will take only seconds to remove the stray nibs, but surfaces with slight orange peel or brush marks will need a bit more attention. Fold the paper in thirds and use just the weight of your hand to lightly scuff-sand the finish. Be very careful near the sharp edges of the furniture to avoid sanding through.

Steel Wool and Wax

Take a pad of 0000 steel wool and dip it into some paste wax (any brand will do). The wax will help lubricate the rubbing pad and make the fine scratches more uniform. Hold both hands

flat, one atop the other, on top of the pad. Press down and rub the surface with the grain. On an inlaid or parquet top, simply choose one direction to rub, usually along the length. Start by carefully rubbing the ends, but hold your hand flat and fingers straight so you don’t roll over any sharp edges. It’s easy to miss the very end when you do the primary rub, so hitting them separately first makes sense.

Now go back and, with substantial pressure on the pad, rub back and forth with the grain. Rub in a perfectly straight line and avoid “Chinese bridges.” Make long, even strokes from one side of the panel or top to the other. Overlap slightly on the next stroke, just as you would when brushing or spraying finish. When you have made your way going side to side from the front edge to the back edge, continue rubbing and head back the other way. When you return to your starting edge, you’ll have made one full pass. I do six full passes, adding extra paste wax if the pad gets too dry. Don’t worry about applying too much wax — we’ll be removing it directly.

Wiping Off the Bulk of the Wax

With a soft cloth, or some of those ubiquitous blue Scott shop towels, wipe off all the wax you can as soon as you are finished rubbing. Don’t wait to let the wax dry or you will have to buff it off, and that will make the surface shiny. Our objective here is

to keep it satin. Get off as much as you can wipe immediately. Now take your thumb and, pressing firmly, swipe it across any part of the rubbed top. Chances are, it will leave a smear, indicating that in spite of our best efforts, there is still too much wax left on the surface. A smeary top is not what we are after, so the last step is designed to remove all the excess wax.

Removing Excess Wax

Sprinkle a bit of cold water over the entire surface, or mist some on with a pump sprayer. Take a new 0000 steel wool pad and, using no more pressure than just the weight of your hand, go back and carefully repeat your rub pattern one more time. Go side to side from the edge nearest to the farthest edge. Now stop, flip the pad to the clean side, and continue this gentle rub back to your starting edge. You’ll notice that the pad has picked up quite a bit of wax. That’s because the cold water helped congeal the wax so that the steel wool could cut it off rather than continue to smear it around. While most will

continues on page 56...

be removed, a very thin coating — just enough, in fact — will be left on the surface. It should be enough to make the surface feel good, but not enough to smear. Now wipe off the water with some clean towels and feel the surface. It should be smooth as silk with a uniform satin sheen.

Rubbing Wipe-on Finishes

This rubbing method works great for any finish, provided it is thick enough to withstand all that steel wool work. After all, even 0000 steel wool removes finish, albeit slowly. But you can get the same nice look and feel over very thin coatings and even wipe-on finishes. Oil finishes sometimes come out smooth and



Rub the very edges of your piece first, as indicated by the blue arrows. Then use long, straight strokes (shown in purple) to rub the rest of the piece. Complete six passes.

dust-free all by themselves. But if you use shellac or polyurethane gel as a fast build wipe-on coating, you can wax it and smooth it in one quick step.

As before, sand VERY lightly with 400-grit or finer sandpaper, just to remove any dust nibs or rough spots. Once again, dip a 0000 steel wool pad into paste wax — use plenty — and rub, using only moderate pressure with the grain of the wood. Do only one pass in one direction, then wipe off all the wax aggressively with clean towels as soon as you finish. That's it. The wax will add a smooth feel and even appearance to the thin coating, and your furniture will still retain that "woody, natural" appearance typical of very thin finishes.



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Brushing Up On Finishing

ALL BRUSHES ARE NOT THE SAME. HERE'S HOW TO PICK THE BEST FOR FINISHING.

What's more efficient than a spray gun, more versatile than a roller and more relaxing than any other method of applying a finish? The answer is "a brush" — that old standby that is constantly being challenged by newer application methods, yet never quite replaced. A good brush can apply most any type of finish, thick or thin, on any type of surface without wasting material or creating overspray and, with proper cleaning and care, will continue working year after year.

Choosing a Brush

Before we talk about different types of brushes, it makes sense to get our terminology straight. Take a look at the illustration (next page) for the names of the different parts of the brush.

Most of the brushes you find at the paint or home store are paint brushes, not varnish brushes. Paint brushes are cut flat on top while varnish brushes are chisel shaped at the ends of the bristles. Paint and varnish brushes can be straight or angled (skewed), and which you use is a matter of taste and comfort.

When you press a chisel-end varnish brush down at the correct angle, the ends of the bristles will form a smooth, thin line along the wood (see photo on page 60). It will look as if there is only a single layer of hair at the end of the brush in contact with the wood, thus spreading the varnish smoothly with few brush marks. This quality is less important when you apply thicker paints, so paint brushes are usually not chisel ended.

Types of Bristles

Brush bristles can be made of either natural hair or synthetic fibers. Water causes natural hair to splay when it gets wet, so synthetic fibers are best for waterborne coatings and paints. I like nylon bristles for clear waterborne finishes, because they are the softest of the synthetic fibers. Polyester, nylon polyester mixtures and other synthetic bristles are good for thicker paints, and they are great all around choices.

Natural bristle brushes are made from a variety of different types of animal hair, and they often are named after the animal who unwillingly supplied it. Badger, sable, ox and squirrel hair brushes really do come from those poor critters. China bristle is made from the hair of a Chinese hog, and Camel brushes (note the capital letter) are soft bristle brushes



To create the chisel shape of a varnish brush, the hairs must be set into the ferrule in graduated ranks or rows (see Plug Detail at upper right), a process that contributes to its higher price. A topnotch 2" varnish brush may cost upwards of \$30.

Natural white China bristles are generally softer than natural black China bristles; however, some manufacturers do dye their white bristles black. Angled brushes, like the ones at left, let you get into tight two-directional corners.

developed by a man named Kamel. They were originally made of squirrel hair, but these days are made from soft pony hair. My favorite all around natural hair brush for lacquer, shellac and varnish is China bristle. Incidentally, there is no real difference between black and white China bristle, and white or gray hair is frequently dyed to make black bristle.

Shapes and Sizes

There are situations when a certain size brush is important. I use a small, angled sash brush to get into the recesses in a raised panel door. However, for the most part, the best brush size is the one that fits comfortably in your hand.

The ends of the tips of most brushes are flagged. That's the brush maker's term for what hairdressers call "split ends." The flagged ends help prevent brush marks in thin finishes and are an advantage for all solvent and oil-based coatings. However, they tend to cause foaming with clear waterborne coatings. Choose a tapered- or tipped-end bristle brush for those jobs.

Quality Counts

A good-quality brush will have plenty of long, springy, supple hair that doesn't shed or fall out. On a varnish brush, the ends will be flagged and the hair will be set in ranks, not cut, to make the shape of the chisel end. When you deflect the brush end at the correct angle (about 45 degrees) it

will form a clean, thin line where the bristles meet the wood.

A poor-quality brush may be shy on hair, and the bristles may be short, uneven, too soft or too stiff. It might shed hairs when you run it through your hand. The chisel end of a varnish brush may be uneven, or be cut instead of set in ranks. When you deflect it, you'll get a ragged, uneven line where the hair meets the wood.

Properly cared for, a good brush will last many years and give you a lot of pleasure and good finishes. Cheap brushes cost more in the long run due to poor application quality, short life, hairs in the fin-

ish and frustration when you're using them. Of course, if you invest in a good brush, you'll need to learn how to maintain it. What baffles me is how many good woodworkers think good chisels are worth the time to sharpen and store, but use throwaway brushes rather than learn to clean and care for good ones.

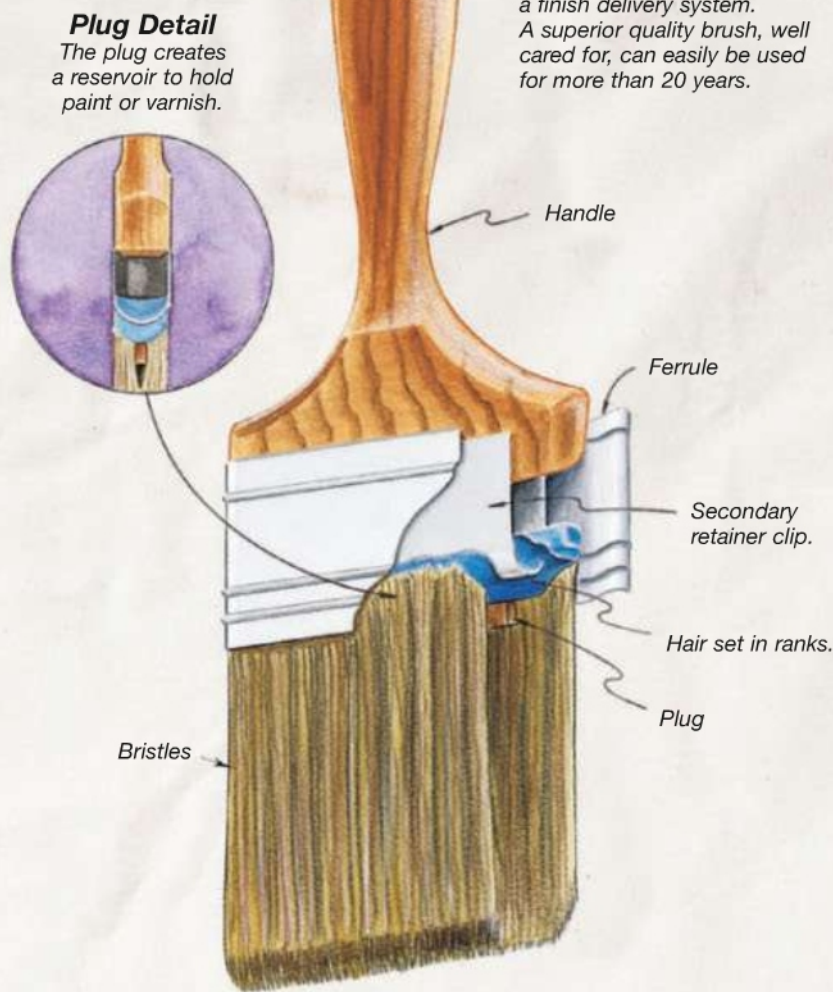
Brush Basics

If you are ready to spring for a good brush, let me walk you through the steps of using and caring for it so you will get your money's worth.

Before you even open the
continues on page 60...

ANATOMY OF A PAINTBRUSH

A "paintbrush" is more than a bit of hair glued to a stick. A quality brush is constructed in such a way that it becomes a finish delivery system. A superior quality brush, well cared for, can easily be used for more than 20 years.





When held correctly, a paint brush is an extension of your hand and the bristles an extension of your fingers.

Holding and Cleaning the Brush

As with any tool, a brush is an extension of your hand. I hold a brush by grabbing it on the ferrule, with my fingers facing the same direction as the bristles. Hold the brush at about 45° to the surface, deflecting the bristles slightly. As you move the brush, increase the deflection pressure to feed out more finish. Take your time and watch how the finish flows off the brush.

finish, soak the bristles of the brush all the way up to the ferrule in whatever solvent is right for the finish. Wait a minute or two, then squeeze out the excess solvent, but don't spin the brush or try to dry the bristles.

Stir the finish and pour some into a straight-sided pan. Dip only the lower third of the bristles into the finish. Touch the tips of the bristles gently to the side of the container to prevent drips, but don't scrape the brush across the edge.

As you work, the finish will creep up the bristles, and it will thicken and dry, eventually forming a crust near the ferrule. Don't let that happen. It will make cleanup difficult and will stiffen the bristles, making them less effective.

When you see the finish getting higher and thicker up the bristles, stop and rinse the brush out in a pan of whatever solvent you soaked it in. Squeeze out the excess solvent, as before, and go back to work. In 30

seconds, you will have a brush that is as clean, wet and supple as when you first dipped it into coating.

Clean the brush by massaging the bristles in the appropriate solvent. When it looks clean, shake off any excess solvent and wash the bristles with plenty of soap and warm water, scrubbing them into your hand to create lots of lather. When the bristles are clean and all the solvent is washed out, rinse them to remove the soap (or shampoo), and spin out the excess water.

Roll up the clean, wet brush in a piece of clean brown bag paper about twice as wide as the length of the bristles and 10 times as long as the width of the brush. Flatten the paper and reshape the brush by folding the extra paper over about one inch past the ends of the bristles. When you return the next day, the bristles will be as supple and clean as the day you bought the brush and perfectly shaped.

If you have any brushes that already sport a dry crust of old paint below the ferrule, all is not lost. Soak the bristles up to the ferrule in paint remover until the finish comes off easily, then follow with a rinse in mineral spirits before you move to the sink for the final cleaning.



HOW TO HELP YOUR BRUSH LAST A LIFETIME



Roll up the ferrule and the clean wet bristles in brown paper bag material.



Feel for the end of the bristles and fold the paper over about 1" past the end of the bristle.



A piece of tape or a rubber band around the ferrule will hold the paper in place until the bristles are dry.

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Clear Shellac qt.



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No elaborate instructions are needed, and mistakes are easily corrected. In spite of all the wonders of 21st century clear finish chemistry, there is still no other finish that enhances the depth and natural beauty of wood grain like shellac. Wood that has been finished with shellac looks soft and natural, not plastic-coated. The finish will not yellow or darken with age like polyurethanes, and it's simple to maintain.



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Understanding Spray Guns

LEARN THE INS AND OUTS OF ADDING A SPRAY GUN TO YOUR FINISHING PROCESS.

Compared to the bulk of woodworking, finishing is a rather low-tech endeavor. There's not much investment in tools or equipment unless you decide to spray — at which point the investment can be substantial. If spraying is something you've considered, it makes sense to look at whether or not you really want to go there, what is involved if you do and how to get the best results.

The real advantage to spraying is speed. Spray guns can apply more finish faster to larger or more complicated surfaces than any other method of application. But there is a price for speed. Spraying wastes more material, involves higher equipment costs and uses more electricity than any other application method. Part of the reason is that guns have a relatively low transfer efficiency compared to brushes, pads, rollers and rags. For hobby finishers, spraying is not a necessity. You can be a superb finisher without ever touching a gun, but that doesn't mean you shouldn't. As with all woodworking, spray guns are one of the tools that can help

you achieve an end, and spraying is a technique you might want to have under your belt. That brings up reason number two: spraying is fun. Lots of fun, actually.

How Spray Guns Work

A spray gun works like a carburetor. It forms liquid into tiny droplets and mixes them with moving air to create an airborne mist. Pulling the trigger releases a controlled pattern of air and finish toward the wood. Most guns have controls to change the size and makeup of that mist pattern. The primary controller is the trigger. The further back you pull it, the more fluid is released into the airstream. The large knob at the back of the fluid pin is a governor. By turning it clockwise, you create a stop that limits how far the trigger retracts, which in turn limits the amount of finish flowing through the nozzle.

Either above the fluid knob or to the side of the tip there's usually a smaller knob. This one adjusts the size and shape of the mist pattern. Turn it clockwise to get a smaller, rounder pattern, and turn it counterclockwise for a larger, oval one.



On almost all spray guns, rotating the air cap 90 degrees will change the fan pattern from a horizontal oval to a vertical oval.

Some HVLP guns change from round to oval pattern by rotating the air cap 45 degrees.

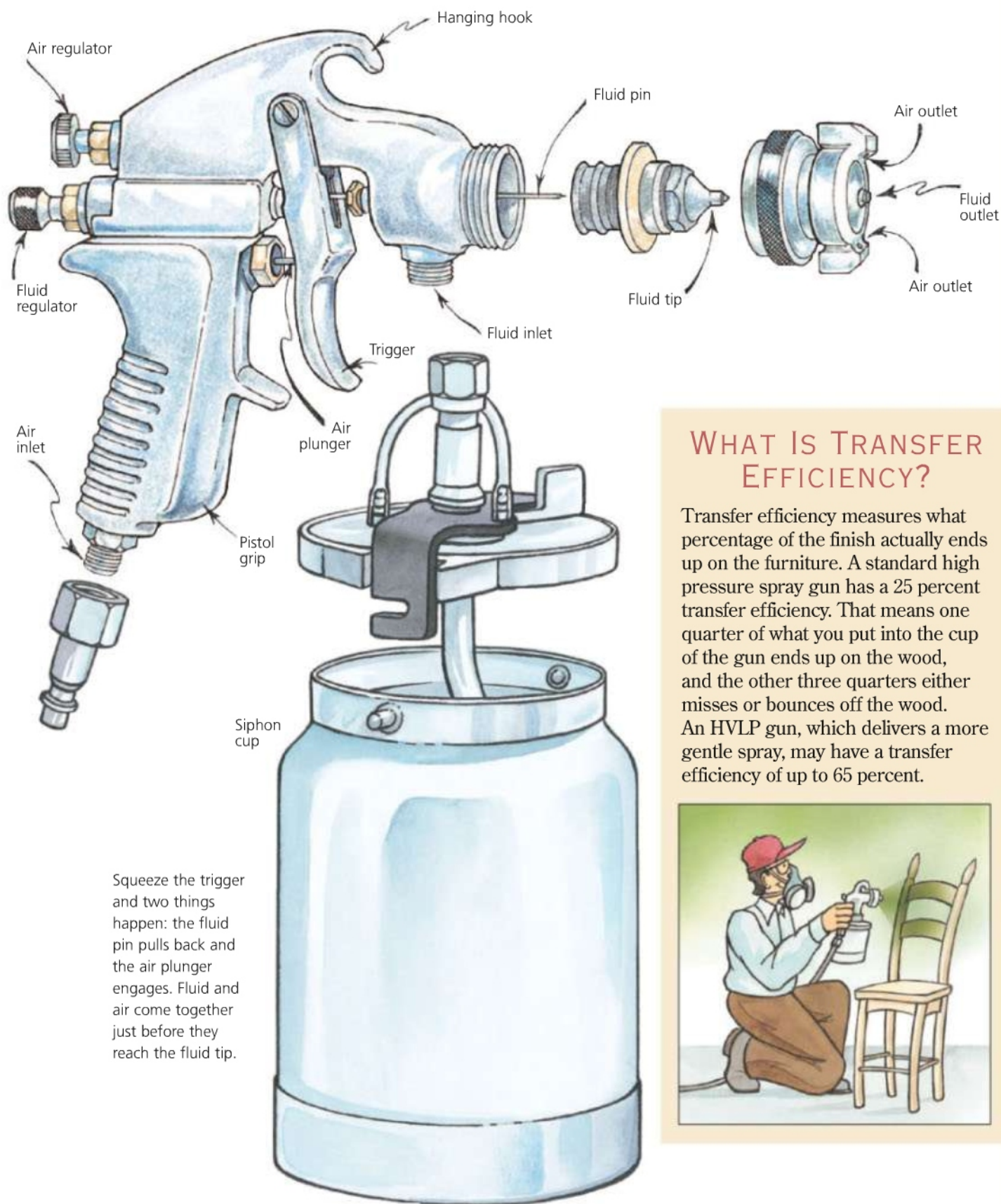
Types of Spray Guns: Standard

There are three common types of spray guns sold to woodworkers. Two of them operate in conjunction with a compressor, and the third is powered by a turbine.

Up until the 1980s, the standard spray gun in the field was one that used high pressure compressed air. A standard gun is highly versatile and will spray any material, thick or thin, merely by changing the air pressure going into the gun and the gun's settings. It uses a relatively small volume of compressed air and will work with even a small air compressor. Since it is attached to the compressor via a 3/8" air hose, it is only as portable as the compressor and limited by the length of the hose. Standard guns have a

continues on page 64...

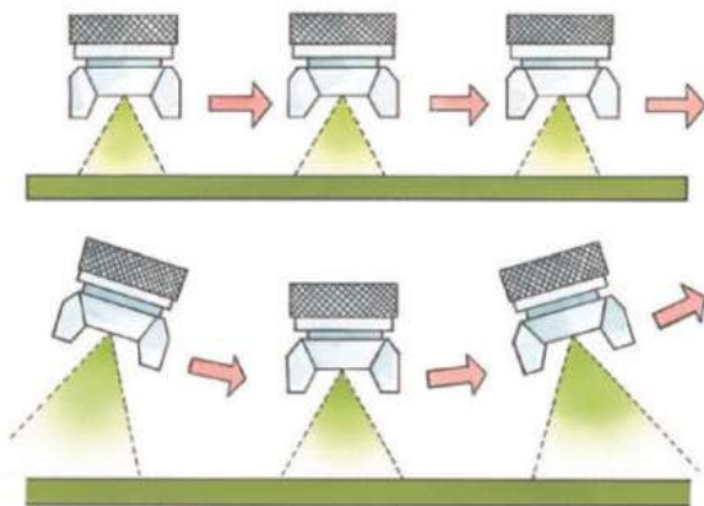
Type of Gun	Type of Compressor	Portable	Transfer Efficiency	Versatility
Standard	small air	limited	25% or lower	high
Conversion HVLP	large air	no	45% to 65%	high
Turbine HVLP	turbine	yes	65%	medium



WHAT IS TRANSFER EFFICIENCY?

Transfer efficiency measures what percentage of the finish actually ends up on the furniture. A standard high pressure spray gun has a 25 percent transfer efficiency. That means one quarter of what you put into the cup of the gun ends up on the wood, and the other three quarters either misses or bounces off the wood. An HVLP gun, which delivers a more gentle spray, may have a transfer efficiency of up to 65 percent.





To achieve the results you want, move the gun evenly in a straight line (top). Resist the impulse to swing the gun up at the end of the board (bottom).

fairly low transfer efficiency at 25 percent or less and need a strong, efficient spray booth to keep overspray from becoming a problem. This is the least expensive of the three types of guns, and it is a good option if you own a compressor and want to spray several different types of materials.

HVLP Conversion Guns

Standard guns use fairly high air pressures but very little air. In contrast, HVLP guns use lots of air (high volume) at relatively low pressure: typically 10 psi (pounds per square inch) or less. The acronym HVLP stands for High Volume, Low Pressure. Conversion HVLP guns convert moderate volumes of high pressure air into low pressure air and should really be called MVLP guns.

These guns typically require a 5hp or larger compressor. They are tethered to it via a 3/8" air hose, and that means they are not really portable. Because you can increase the air pressure at the tip by turning up the pressure going into the gun, conversion guns are very versatile and can spray most any material, thick or thin.

They also boast a much better transfer efficiency at 35 percent to 65 percent — because they generate much less overspray. These guns are typically more expensive than their standard counterparts but may save you

money by wasting less finish. They're great for any type of finish, provided you own a large enough compressor.

HVLP Turbine Guns

Imagine a turbine blowing lots of warm air but at only five to ten psi. The turbine consists of a motor spinning from one to four fans, each inside a housing. The size of the motor controls how much air is moved (usually 80 cfm or more) and the number of fans, called "stages," determines how much pressure is generated. A one-stage turbine may create only five psi at the gun, while a three- or four-stage may get up to eight or even 10 psi. The gun itself is connected to the turbine by a rather large (1" diameter) hose. The turbine, hoses and gun are usually sold as a package and can easily cost upwards of \$600. No compressor is needed.

These are lightweight, highly portable self-contained units that plug into a standard 110 volt outlet, making them ideal for on-site

spraying as well as shop work. They have a high transfer efficiency and may save money by reducing finish waste, but they lack versatility. There is no way to turn the pressure up, so you are limited by whatever the turbine produces. One that gives you only five or six psi at the gun may have problems spraying thicker finishes or even some water-based coatings.

Cup and Fluid Tip Options

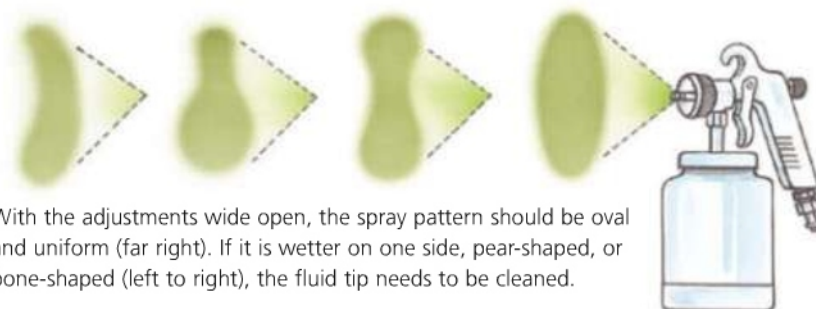
Two important factors to consider in your choice of gun are the cup configuration and the range of fluid tips that are available.

Cups come in three different configurations. With a gravity feed cup, the finish flows down into the air path, thanks to gravity. That means all the air in the gun is used for atomizing the finish, not moving it out of the cup. This format is the easiest to clean and my personal favorite.

In a siphon feed, air moving across the mouth of a small tube creates a vacuum, to siphon fluid up from the cup. Most HVLP guns do not have sufficient air pressure to power a siphon cup, but they are common on standard guns.

Finally, there's the pressure feed. Some of the moving air is diverted into a sealed cup, creating enough pressure to force the fluid up the tube to the nozzle. It takes only three or four pounds of pressure to move the finish.

The fluid tip is important because different types of finish work best with different sizes of tips. Lacquer and paint will spray



With the adjustments wide open, the spray pattern should be oval and uniform (far right). If it is wetter on one side, pear-shaped, or bone-shaped (left to right), the fluid tip needs to be cleaned.

nicely through a large 0.070" (1.75 mm) tip, but I find many water-based finishes and thin varnishes work better through a smaller .040" (1 mm) or .055" (1.3 mm) tip. Better manufacturers offer a range of fluid tip, needle and air cap sizes to make the gun more versatile. If you plan to spray acid catalyzed lacquer, conversion varnish or water-based coatings, make sure all the fluid passages, including the tip and nozzle, are stainless steel. Regular steel will rust. This is standard fare on high quality guns.

Each type of gun has its strengths and weaknesses, and which is right for you depends on your needs and how you plan to use it. No matter what you choose, there is no guarantee that high prices mean good quality — but for the most part, you get what you pay for. A good gun, even though it costs more up front, will be well worth it.

How to Spray

Before you spray anything onto your project, check out how your gun is working. Start with nothing but solvent in the cup, and spray some out onto a large piece of cardboard. Use the cleanup solvent for what you intend to spray, or simply use clean water. (If you use water before anything except water-based finish, you'll have to "chase" the water afterward by spraying some denatured alcohol.)

With the adjustments wide open, the pattern should be oval and uniform. If it is not, it means the fluid tip needs to be cleaned (see *Drawing* at left). Turn the small adjustment knob from oval to round and back again while spraying to see the different patterns it makes. Set it to the pattern you want. A round pattern, which will deliver more material to a single spot, is great for getting into inside corners and spraying narrow stretchers



Break down your gun by removing the air cap, fluid tip and needle. Soak them in solvent until they are clean.

and chair parts. For spraying a panel, a long oval is better.

Practice pulling the trigger more or less as you move the gun. The more you pull it, the more liquid will emerge. Set the gun to a vertical pattern if you want to move the gun from side to side. Use a horizontal pattern when moving up and down. Change from horizontal to vertical by rotating the air cap 90 degrees. Move the gun evenly in a straight line and always keep the tip about 8" from the surface of the wood. Resist the impulse to swing the gun up at the end of the board. Overlap each pass about one half the width of the last pass.

Now empty out the thinner and fill it with what you intend to spray. Most materials designed for spraying should work without thinning. If yours needs to be thinned, it will form an "orange peel" pattern. Spray water-based coatings and oil varnish lightly so that the surface is just barely wet. Solvent-based lacquer can be sprayed heavier, until the surface is glossy wet. Practice will tell you a lot. Too wet and it will run and sag. (Beginning sprayers almost NEVER spray too dry.) Learning to spray is not any more difficult than learning to use a brush, but both take at least a little bit of practice.

Cleaning the Gun

When you are done spraying, open the cup and empty out the remaining finish. Pour in about a cup of the cleanup solvent for the finish and spray it through the gun

to clear out anything left in the fluid passages. Break down the gun by removing the air cap, fluid tip and needle and soak them in solvent until they are clean. Remove the cup and clean it separately by rinsing and wiping it out. Scrub out the fluid passages with a pipe cleaner dipped in solvent. When all the parts are clean, put a dab of petroleum jelly on any threaded parts and put the gun back together. The needle gasket nut should be snugged up only hand tight. I like to add a drop of machine oil to the needle packing now and then.



HOW BIG?

Any compressor will produce enough pressure (measured in pounds per square inch) to run any gun.

However, the size and efficiency of the compressor determines how much air volume (measured in cubic feet per minute) it will produce. Standard guns typically need 2 to 5 cfm at 35 psi: even a 1hp compressor is likely to be adequate. HVLP conversion guns may require from 7 cfm to 18 cfm at 60 to 80 psi and need a larger compressor. I've found that the gun tech sheets often understate their needs, while compressor plates often overstate output abilities. Therefore, buy a compressor that seems larger than what you need.

Both portable and stationary air compressors can be suitable for spraying, provided they can produce the required air volume for the gun.



Green Finishing

PRACTICING
LOW-IMPACT
FINISHING
CAN INVOLVE
MATERIALS,
METHODS
OR BOTH.

Green is a popular term these days, used to mean any thing or process that is less damaging to our environment, and ultimately to us. In the finishing world, that entails two very different concepts: green finishes, which are those finishing materials deemed to be either personally or environmentally greener, and green finishing, which deals not with the finishes, but the finishing process.

Since either can give us a healthier environment, I'll talk about both, beginning with green finishes. You should know, though, that the second alternative — green finishing — is a much simpler and cheaper way to go green. It allows us to continue using all the finishes we currently like and still make an impact, and quite possibly the largest impact of all.

Green Finishes

The simple definition of a green finish is one that has a more benign chemical profile than the traditional finish it is designed to replace. What makes them green varies with whoever is labeling them as such. Like beauty, green is often in the eye of the beholder.

continues on page 68...



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WHAT'S A VOC, WHAT'S A HAP... AND WHY SHOULD I CARE?



In the alphabet-soup world of finishing, the acronyms VOC and HAP stand for Volatile Organic Compound and Hazardous Air Pollutant respectively. The term "organic" in the chemical world means that it is based on tetravalent carbon. For finishing, organic solvents are those that contain carbon, which is just about everything other than water. Volatile simply means they will evaporate at standard temperature and pressure.

Since not all VOCs are hazardous, and since not all hazardous materials are VOCs, the term HAP picks up those things that fall in that murky area. As far as finishing materials are concerned, the two are typically measured together, and with only a few exceptions, are one and the same.

Why Are They A Concern?



Specifically, VOCs were found to be ozone generators. When exposed to sunlight, VOCs in the air form ozone, which is an ingredient of smog. The problem is that not all VOCs are ozone generators. Some are not, and even among those that are, some are very slow or weak ozone formers while some are very fast or strong ones. Thus, not all VOCs are created equal.

Because of that, some volatile organic compounds which do not generate ozone have been declared exempt. That means that even though they are VOCs by definition, they are not legally regarded as VOCs as far as coatings and strippers are concerned. Acetone, methylene chloride, methyl acetate and parachlorobenzotrifluoride (PCBTF), which was originally marketed under the trade name Oxsol 100, are all examples of exempt VOCs. Thus, you can buy zero VOC lacquer that is 75 percent volatile organic compound solvent, yet is legally free of VOCs. In this case, the solvent is usually a mixture of acetone and PCBTF.

How Are They Different?



The issue with VOCs, as far as the EPA is concerned, has to do with whether or not they generate ozone. It's that simple and that specific. HAPs, on the other hand, focus on hazard to both humans and the environment. As you can see, it is a much broader term.

That said, there are VOCs which may be hazardous to the environment as ozone generators, but not hazardous to humans, and vice versa. For example, methylene chloride, the main ingredient in many paint removers, is not considered a VOC because it is not an ozone generator. Thus, the EPA allows it in formulations without penalty. However, it is harmful to humans, and if you use it, you must take the appropriate safety precautions. Thus, it is a HAP but not a VOC.

Acetone, on the other hand, is not an ozone generator either, nor is it considered by the EPA to be particularly harmful. It is neither carcinogenic nor does it appear to cause any other serious illness. For that reason, the EPA sees it as neither a VOC nor a HAP.

That does not mean there is no danger connected to it. Acetone, like many other ketones, is very flammable, so it is a fire hazard. In contrast, methylene chloride is nonflammable — so nonflammable, in fact, that you can add it to flammable compounds to make them nonflammable.

Isoparaffins, the ingredients in "odorless" mineral spirits, are a good example of a third category. They are ozone generators, but are not particularly hazardous to humans. Thus, they are restricted by the EPA, but generally do not require extreme handling cautions.



Some finishes, like shellac, are green by their very nature. Others contain varying amounts of VOCs and HAPs — the sidebar above explains what that means to the average woodworker.



Because there is no universal standard, some finish manufacturers, such as UGL, have created their own internal definitions as to what an environmentally sound finish is. This allows consumers to understand exactly what the company means by "green."

For instance, one company I spoke with was dedicated to reducing or eliminating formaldehyde in their formulas. Although the EPA does not restrict formaldehyde as either a VOC or a HAP (see sidebar on page 67), it is believed to be a sensitizer that can cause allergic reactions similar to flu symptoms in some people. Others seem unaffected by it.

Nevertheless, OSHA, which is concerned not with the environment but with the personal safety of factory workers, has put restrictions on how much formaldehyde they may be exposed to. As a result, the coatings industry has been voluntarily reducing it in their formulas.

Another company formulates their coatings to eliminate anything that might cause any allergic reaction in sensitive people. To that end, they not only reduce VOCs and HAPs, but also other compounds, even inorganic ones, that could cause a reaction. (See sidebar, previous page.) Several companies, in fact, insist they make or sell products that have the least adverse effects on human health and the health of the planet: two concepts that sound good but whose meanings are clearly open to debate. Still others use the term green to mean low VOC coatings, while another group of companies use it to mean coatings made from natural materials, irrelevant of the VOC content.

Let's look at a few common coatings and see how they stack up. I've listed them more or less from greenest to least green, but be warned: this is not a simple yardstick but rather a complex equation. In many cases, it is a judgment call as to which is really greener, and in some cases we are reduced to splitting hairs. The good news is that no matter what type of coating you like to use, there is probably a greener version of it.

Traditionally Green Finishes

Some coatings are, and have always been, surprisingly green. Milk paint, for example, contains no VOCs or HAPs and is made of completely natural and sustainable ingredients. Natural oils, such as pure linseed oil and pure tung oil, also fall into this category. Waxes, at least in their solid state, also qualify, since most of the ones we use are either plant waxes, like carnauba and candelilla, or insect waxes, like beeswax and shellac wax. However, most paste waxes — the ones that come in tins — contain some VOC solvent to make them softer and easier to apply.

Shellac is another natural, insect-made product that has a very favorable profile. The resin itself is not only renewable, but so harmless as to be edible. The most common solvent for it is ethanol, or grain alcohol, the same alcohol that appears in beer, wine and hard liquor. While ethanol is technically a VOC, it is a slow enough ozone generator that many contend it should be made exempt. In any case, it is relatively safe for the finisher, who at worst runs the risk of becoming inebriated from huffing too many fumes.

Ultra Low and Zero VOC Coatings

Nitrocellulose lacquer, long the darling of furniture manufactur-

Formaldehyde in Finish

For the record, formaldehyde shows up in only one group of finishes we woodworkers use: the so-called catalyzed and pre-cat lacquers and conversion varnishes. It is not in shellac, lacquer, oil varnish, water-based lacquers, oil- or water-based polyurethane or even two-part automotive polyurethanes or polyesters.

Cabinetmakers who use catalyzed finishes are justifiably concerned about their workers and generally insist they wear protective gear when spraying these finishes. However, there is little concern about the end-user of the finished product. That's because the formaldehyde dissipates within a month. By the time it comes into your home, it is no longer offgassing formaldehyde.

It's worth noting that some interior plywood offgasses formaldehyde, depending on the type of glue used. Sealing the plywood with a film-forming finish blocks its release. Thus, while one type of finish can release formaldehyde, almost any other finish can block it.

ers, contains about 75% solvent, almost all of which is both a VOC and a HAP. Several strategies have emerged to lower that number, sometimes to zero. You can now buy zero VOC lacquer, which oddly enough still contains about 75% solvent. The difference is that it is formulated with exempt VOCs, meaning those that are not ozone generators. Typically, the solvent package is a mixture of parachlorobenzotrifluoride (PCBTF) and acetone, the latter of which appears less harmful to us than some of the solvents it replaces. Thus, zero VOC lacquer may actually be safer to use, not just less ozone generating.

A totally different approach, and one that works particularly well with two-part cross-linking coatings (a specific chemical formulation), is to raise the solids and lower the solvent level. These so-called ultra-high solids coatings can range from 85% solids to almost 100% solids, the latter containing little or no solvent whatsoever. Typically, these are either chemically cured polyesters or UV cured acrylics and polyesters. Most are designed to be sprayed and are sold only to the industry, not to hobby woodworkers.

Even at that, their safety is a bit of a mixed bag. While they contain almost no VOCs, they carry dangers to the workers indoors. That's because they often emit free monomers that are hazardous. Monomers are resins, not solvents, but the molecule is so small that it can become airborne, and thus can be breathed in. As a result, those who use such coatings generally suit up in hooded coveralls with clean air pumped in to the hood.

Water-based Coatings

Contrary to popular belief, water-based coatings are not water-soluble, nor do they con-

tain water-soluble resins. That's a good thing. If they did, you would be able to remove any evaporative water-based finish with water after it dried. Imagine wiping a counter with a wet sponge and having the finish wipe off. If not water-soluble, then what are they?

Water-based coatings are those in which some of the solvents of a traditional coating have been replaced with water. Almost any type of coating can be made water-based; there are water-based lacquers, shellacs, polyurethanes, one and two-part cross-linking coatings, and even water-based UV cured coatings.

Water-based does not mean that the coating contains no solvents. It merely means some of the solvent has been replaced by water. The majority of clear water-based finishes contain glycol ethers, all of which are considered VOCs. While some are quite harmless, others are hazardous to humans, including a very common one,



Just because a finish is called "water-based" does not mean it is solvent free. Are water-based products greener than others?

EB (sold under the trade name Butyl Cellosolve), which is believed to be a teratogen (a substance that can cause birth defects). Water-based polyurethanes typically contain n-methyl-2-pyrrolidone (NMP) or gamma butyrolactone (BLO) as well as glycol ethers, both of which are also considered VOCs and HAPs.

Still, water-based coatings contain far lower amounts of VOCs than their solvent-based counterparts. For example, a typical nitrocellulose lacquer will contain upwards of 75% solvent, most of which is VOCs, while its water-based counterpart will contain only 10% or less. There are even zero VOC water-based coatings.

continues on page 70...



Another chapter in the green finishing story is the new focus on nontoxic paints. There is an ever-expanding list of products available for both interior and exterior use.





Beeswax, often sold and used as a solid block of wax, is a very green finish. Even mixed paste waxes are fairly green, usually containing limited amounts of VOC solvents.

Pros and Cons

Although water-based coatings are lower in VOCs, clear water-based finishes are also a bit weaker. For instance, water-based polyurethane has about the same abrasion resistance as oil-based, but it has lower solvent, chemical and heat resistance. One could make the argument that if the finish does not hold up as long and you must refinish more often, the extra

solvent involved in early refinishing offsets any savings you made initially. Of course, refinishing also means more time and money spent. But there is a way around that. More and more, single-component, self-curing water-based coatings are being offered to kitchen cabinetmakers, and they match oil-based polyurethanes in durability. They've long been offered as floor finishes and are slowly becoming more popular for furniture as well.

While water-based coatings are generally considered greener, there are aspects to them that make them less green, at least in some minds. The resins used in water-based coatings are typically synthesized from petroleum, a nonrenewable resource that has a fairly high carbon footprint, thanks to the energy needed to extract and ship it. By contrast, the resins in oil-based varnish and polyurethane are made from modified linseed, tung or soy oil, all renewable-source plant oils grown right here in the U.S. The tradeoff is natural, renewable, local resins with a higher dose of VOC solvents versus synthetic,

foreign imported petroleum-derived resins with a lower dose of VOC solvents. As I said, this is not an easy equation.

Oil-Based Coatings

Danish oil, teak oil, spar varnish and the whole field of oil-based varnishes and polyurethanes, both liquid and gel, make up the next category. In general, these finishes are relatively safer for us than for the environment. They contain ozone-generating VOC solvents, and thus are not good for the environment. However, the ones they contain, such as mineral spirits, are fairly safe for us, at least in the limited amounts to which we are exposed. Their high solids content, often 45% or so, means what solvents they do contain are in more limited amounts than what you would find in lacquer, for example.

Although the solvents are petroleum-based, the resin portion is made from natural seed oils, usually linseed, soya or tung. Such oils are renewable crops grown here in the U.S., and they require little processing to go from raw oil to resin. What's better is that

Does My Going Green Really Matter?



If you are not part of the problem, nothing you do differently will make you part of the solution.

As far as finishing materials are concerned, most of you are not part of the problem. Most hobby woodworkers go through less than 10 gallons of finish per year. At that rate, switching to water-based finish from solvent or oil-based would be akin to someone who drives only one mile per week trading in his or her car for a hybrid. It's silly and arguably counterproductive as well.

The reality of the situation is that, compared to the big ozone-producing generators, which include our cars, the electricity we use and the agriculture that provides our food, finishing amounts to small potatoes indeed. Some years ago, I was at a meeting of finish chemists being addressed by an EPA representative on the subject of limiting ozone generation from VOCs in coatings. Upon being challenged, the representative admitted that the solvents in clear wood coatings account for less than one percent of the country's total ozone generation problem. In other words, if all wood finishing stopped tomorrow completely, the improvement would barely be measurable and might fall well within a normal margin of error. With that in mind, it makes little sense for most of us to buy fancy equipment or go through a long learning curve just for the sake of using lower VOC materials. We're far better off adopting green finishing techniques than switching to greener finishes. That strategy not only prevents waste, thus helping our carbon footprint, but saves us money to boot — and in this economy, that's nothing to sneeze at.

these coatings are almost never sprayed, but rather are applied either by brush, or by wiping on and off, as in the case of Danish oils and gel polyurethanes. Those application methods have a very high transfer efficiency (see "Waste Not, Want Not" below), which means very little is wasted and only a minimum of solvent is used.

Traditional Lacquer, Etc.

Traditional lacquer contains lots of VOCs and HAPs, some of which are not only strong ozone generators but are harmful to humans as well. These solvents are also usually quite flammable, providing yet another safety issue. What is worse is that they are typically formulated for spraying, a very wasteful application process that not only wastes coating, but also uses up a lot more solvent in both thinning and cleanup. Catalyzed lacquer, conversion varnish and pre-cat lacquer have all of the above disadvantages and may contain formaldehyde and hazardous acids as well. For that reason, these coatings are considered the least green option.

Steps Toward Green Finishing

I promised you that there is an easier, cheaper alternative that lets you use nearly any finish and still come out greener. It's called green finishing. The good news is that by slightly changing the way you use finishes, you can be greener and save money to boot. Green finishing employs two means to lower VOCs: reducing waste, often through low-tech application, and recycling solvents.

Waste Not, Want Not

The first step in reducing waste is to buy wisely. In other words, try to buy only the amount of fin-

ish you need for the job. Too often, leftover finish ends up crusting over or otherwise going bad and gets thrown away. That does neither the environment nor your pocketbook any favors.

A less obvious way to reduce waste is to choose an application method with a high transfer efficiency. Transfer efficiency is the percentage of the finish you buy that actually ends up on the wood. Most standard spray guns have about a 25% transfer efficiency, meaning about 75% of the finish gets wasted, mostly blown out through the spray booth fan or trapped on the filters. Even those systems that boast higher transfer efficiency, such as HVLP turbine rigs, only reach about 65% transfer efficiency. That's still a lot of waste.

Compare that with a wipe-on gel polyurethane. If you're like me, you apply it with a piece of nylon abrasive pad. One pad will do an entire roomful of furniture without wearing out, and when you are all done, very little remains on the pad to be dried out and thrown away. The waste comes only in how much you wipe off, and with attention, you can keep that to a minimum as well. Since applicators and wiping rags are allowed to dry out, then get thrown away, there is no solvent used for cleanup.

Using a brush to apply finish approaches near 100% transfer efficiency. The only amount of finish that does not make it onto the wood is the tiny bit you must clean out of the brush bristles



Green Application

 When it comes to being environmentally responsible, how you apply a finish can be equally as or more important than the product that you use.

when you are all done. As for the cleaning solvent, that can be kept to a minimum through recycling.

Recycling Solvents

That brings us to the other way we can be greener no matter what finish and solvent we use. Solvents may not be forever, like diamonds, but they are reusable again and again. The mineral spirits you use to clean your brush or the lacquer thinner you use to clean spray guns can be poured into a lidded container and shelved. Over time, the heavier foreign matter will settle to the bottom. When that happens, decant the clearer liquid atop and reuse it for cleaning the next brush or gun. You will lose some each time to evaporation, but you will be surprised at how much you can reduce your VOC consumption by recycling your cleaning solvents.

By now it should be obvious that by avoiding waste and recycling solvents, you not only reduce your carbon footprint on the earth, but also save money in your wallet. After all, if you are buying fewer cans of finish and solvent, you are coming out ahead in every way.





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Tricks Of The Trade



Rosin Up That Workbench

A good workbench should last a lifetime, so it's worth the effort to keep it clean. Here's how one reader protects his bench during finishing and glue-ups. Years ago, he bought a roll of pink rosin underlayment paper from a home center. You can find it in the flooring section. It's quite water-resistant and provides a good barrier to glue, paint, stain and varnish. He lays two short pieces side by side and tapes them down to the bench. If the paper is still in good shape when he's through, he saves it for the next messy job. A roll of rosin paper is cheap, and he says it seems to last him forever.

Tack Cloth Substitute

If you always seem to run out of tack cloths in the middle of a finishing job, one reader tells us he borrowed his wife's disposable duster refills in a moment of desperation. To his surprise, these soft pads remove sanding dust just as effectively as regular tack cloths do — and they're much cheaper to buy. They also leave no residue behind.



The hand wipes container comes with a hole pre-installed, and it's perfect for holding your favorite paintbrush.

Brush Cleaning Canister

Here's a very easy way to keep your finishing brush suspended in a cleaning or thinning solution. Just wash out an empty plastic hand wipes container with a feed-through lid. Pop off the top and fill it with solvent, then push the brush handle through the hole in the lid. The "fingers" around the hole will hold the handle firmly so the bristles won't rest on the bottom. It makes brush cleaning easy and self-contained.

Apply Wipe-on Poly With Cotton Pads in Pantyhose

One reader discovered a much better applicator than balled-up cotton rags for applying wipe-on polyurethane. All you need are a few circular make-up remover pads and some old knee-high

pantyhose. Slip two or three of these cotton pads inside the stocking and wrap up the excess. The cotton accepts a good charge of poly that's still easy to control, and the pantyhose keeps the cotton fibers out of the finish coat. It also lays down a nice, level coating without streaks.





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