Think Finish First

BY JEFF JEWITT

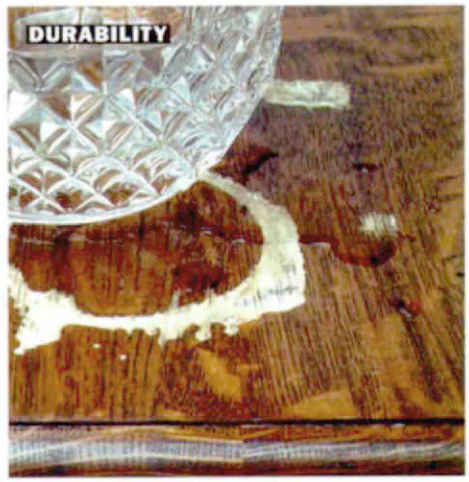
Before you start your next furniture project, consider a finish's appearance, its method of application and its durability

Finishing is one of the biggest bugaboos for many woodworkers. Though they remain undaunted by complex joinery or intricate and precise machining, scores of woodworkers still cringe at the thought of applying a finish to their work. "What's the best finish for my project?" is a question I often hear. Being able to answer that question confidently and comfortably is an important hurdle to overcome.

Finishing products can be grouped into manageable categories, based on general working qualities and the degrees of protection they offer: waxes, oils, varnishes, shellacs, lacquers and water-based finishes. Different finishes offer varying degrees of protection, durability, ease of application, repairability and aesthetics. Unfortunately, no single finish excels in all of these categories—a finish that excels in one may fail in another—so in choosing a finish you must accept trade-offs.

As a professional refinisher, I routinely ask my customers a series of questions to determine the best finish for their furniture. I've modified my standard questions for this article and added a few as a checklist (facing page) for woodworkers trying to decide which finish to use on their own projects. Answers to these questions will point you toward the right finish to use on a given project, based on how well you need to protect the surface, how well the finish will hold up, how easy it is to apply and how you want it to look.

TO DETERMINE THE BEST FINISH,



ASK THE RIGHT QUESTIONS

- **How will the item be used? Will it be subjected to a lot of moisture, solvents, food, scrapes and dents?**
- **What is your skill level, and how big is your work area? Does it stay clean, and is it heated and dry?**
- **What do you want the wood to look like? Do you want an "in-the-wood" natural look or a thicker film finish that accentuates depth?**
- **Will you be filling the pores to attain a highly polished finish?**
- **Will you be rubbing out the finish to achieve a particular sheen?**
- **Do you want the finish to alter the color of the wood? Is yellowing an issue? Do you want to minimize color changes as the wood ages?**
- **Safety and health: Are you sensitive to some solvents or concerned about flammability or the environmental impact of certain finishes?**
- **Toxicity of the finish: Will it be used near areas of food preparation?**

To get *a* better understanding of the choices, let's first take a look at the different categories of wood finishes.

An overview of what's out there

All wood finishes can be classified as one of two distinctly different types, based on how they dry, or cure. Evaporative finishes—such as lacquer, shellac and many water-based finishes—dry to a hard film as the solvents evaporate. (Water is not a solvent—it's a carrier for the finish emulsion.) These types of finishes will always redissolve in the solvent used to thin them, long after they've dried, so they tend to be less durable than reactive finishes. Most reactive finishes—such as linseed or tung oil, catalyzed lacquers and varnishes—also contain solvents that evaporate, but they cure by reacting with either air outside the can or a chemical placed in the can before application. These finishes undergo a chemical change as they cure, and after that they will not redissolve in the solvent originally used to thin them. Except for the pure oils, reactive finishes tend to hold up better to heat and chemicals.

Waxes—I don't consider wax an appropriate finish in and of itself. I use paste wax (carnauba mostly, sometimes beeswax) to polish furniture but only over other finishes, such as lacquer or shellac.

The true oils—Linseed oil and tung oil, the drying oils most often used in finishing, are readily available and relatively inexpensive. These finishes are called *true oils* to distinguish them from other products hyped as oil finishes and to separate them from naturally nondrying or semidrying oils used in finishes, such as soybean oil. These true oils change from a liquid to a solid through polymerization, a process that strengthens the cured finish.

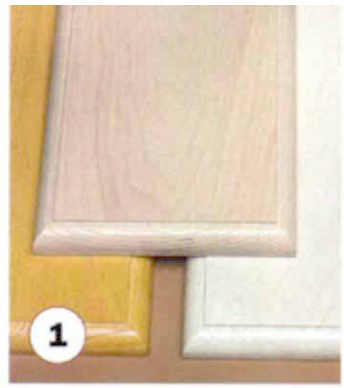
Linseed oil is available in several forms. Unrefined, it's called raw linseed oil, which is rarely used on wood because it dries so slowly. Finishers long ago discovered that by boiling the oil, the resulting product was thicker and dried more quickly. Even though linseed oil that has actually been boiled is still available—it's called heat-treated or polymerized oil—most of the boiled linseed oil sold these days is raw oil that has been mixed with chemical additives to speed up the drying time. For wood finishing, you should use only boiled linseed oil.

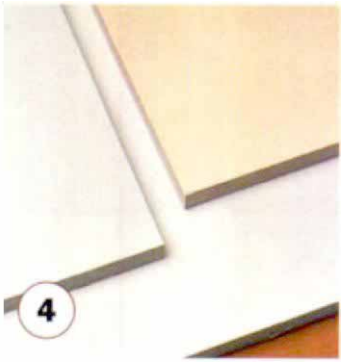
Tung oil is derived from the nuts of trees that are native to Asia but have been cultivated in other parts of the world. Tung oil is available in a pure, unrefined form and in a heat-treated or polymerized form. The heat-treating process makes the oil a bit more durable and speeds up the drying time. It also minimizes a tendency of tung oil to "frost" (dry to a whitish, matte appearance). Tung oil is paler in color and has better moisture resistance than linseed oil.

Both linseed and tung oils are penetrating finishes, which means they penetrate the fibers of the wood and harden. These are the easiest finishes to apply: Wipe them on, allow them to penetrate

Photos, except where noted: Michael Pekovich

APPEARANCE





1 *On light-colored woods, the color of the finish matters. On these samples of ash, the warm, amber tone of nitrocellulose lacquer (top) is just right. The orange shellac (left) and water-based lacquer (right) impart too much or too little color to the wood.*

2 *Do you want that tabletop filled? With the open pores of some woods (such as mahogany and walnut), and on large horizontal surfaces (such as dining tables), filled grain (top sample) will make a huge difference in the way a finish looks.*

3 *The kind of finish you choose will greatly affect the way it looks. Some people prefer the flat look of oil finishes (bottom); others prefer a film finish such as the acrylic lacquer (top) that reflects more light.*

4 *Most finishes turn yellow over time; some don't. To illustrate the difference, the author applied a CAB acrylic lacquer (left) and a standard nitrocellulose lacquer (right) over panels coated with white paint (bottom). The CAB acrylic lacquer is your best choice to avoid the effects of a yellowing finish.*

5 *Slow-drying finishes collect dust. Shellac and most lacquers dry so fast that small amounts of airborne dust don't pose a threat to the end result. Oil-based varnishes, on the other hand, are virtual dust magnets and can be problematic in dusty shop environments.*

6 *Use oil as a sealer to highlight depth. The swipe of linseed oil across this curly maple tabletop shows what a difference it makes in bringing out the figure in the wood. You can apply a topcoat of just about any other finish over a dried coat of oil.*

7 *A thinned finish goes on easier and looks better. Both of these samples of white oak have two coats of polyurethane varnish. The bottom sample was thinned to avoid the obvious buildup you can see on the top sample.*

the surface of the wood and wipe off the excess with a rag. These oils are usually not built up with enough coats to form a surface film, like that of varnish or lacquer, because the film is too soft.

Varnishes—Varnish is made of tough and durable synthetic resins that have been modified with drying oils. Labels on cans of varnish will list resins such as alkyd, phenolic and urethane, and the oils used are tung and linseed, as well as other semidrying oils such as soybean and safflower. Varnish cures by the same process as true oils—polymerization—but the resins make this finish more durable than oil. In fact, oil-based varnish is the most durable finish that can be easily applied by the average woodworker. Varnish surpasses most other finishes in its resistance to water, heat, solvents and other chemicals.

Varnishes that contain a high percentage of oil are called long-oil varnishes. These include marine, spar or exterior varnishes and some interior varnishes for sale on the retail market. Long-oil varnishes are more elastic and softer than medium- and short-oil varnishes that contain a lower percentage of oil. Medium-oil varnishes comprise most interior varnishes on the market. Short-oil varnishes (also known as heat-set varnishes and baking enamels) require extremely high temperatures to dry, so they're used only in industrial applications.

The type of resin used in the varnish determines the characteristics of the finish. Alkyd varnish is the standard all-purpose interior variety with decent protective qualities. Phenolic varnish, usually made with tung oil, is predominantly for exterior use. Urethane varnish, also called polyurethane, offers a better resistance to heat, solvents and abrasions than any other varnish.

Varnish is typically applied with a brush, although a highly thinned and gelled version, called wiping varnish, can be applied with a rag.

Oil and varnish blends—These mixtures, mostly oil with some varnish added, offer some of the best attributes of both ingredi-

A COMPARISON OF COMMON FINISH PRODUCTS

	Product	Ease of application	Repairability	Flame resistance	Health and safety	Water resistance	Chemical resistance	Scratch resistance
EVAPORATIVE finishes dry as their solvents disperse into the air. They will always redissolve into the solvent originally used to thin them, making them easier to repair but also a little less durable.	**Wax**	Excellent	Excellent	Good	Good	Poor	Fair	Poor
	Shellac	Good	Excellent	Fair	Excellent	Fair	Poor	Fair
	Nitrocellulose lacquer	Fair	Excellent	Poor	Poor	Good	Good	Fair
	Most water-based finishes	Good	Poor	Excellent	Fair	Good	Good	Good
REACTIVE finishes undergo a chemical change as they cure, making them not only more difficult to repair but also more durable (except for linseed and tung oil) than most evaporative finishes.	**Linseed oil**	Excellent	Excellent	Good	Excellent	Poor	Fair	Poor
	Tung oil	Excellent	Excellent	Good	Excellent	Fair	Fair	Poor
	Oil-based varnish (alkyd resins)	Good	Poor	Good	Poor	Excellent	Good	Good
	Oil-based polyurethane	Good	Poor	Good	Poor	Excellent	Excellent	Excellent
	Catalyzed lacquer (and conversion varnish)	Poor	Poor	Poor	Poor	Excellent	Excellent	Excellent

ents: the easy application of true oils and the protective qualities of varnish. (Watco-brand Danish oil, teak oil and a number of other finishes fall into this category.) It's difficult to ascribe accurate protective qualities to these products because manufacturers don't usually disclose the ratio of oil to varnish. Oil and varnish blends will dry a bit harder than true oils, and the finishes will build quicker with fewer applications.

Shellacs—While most people think of shellac as a liquid finish found at a paint store, in its pure form it's a natural resin secreted from a bug that feeds on trees, mostly in India and Thailand. The secretions, in the form of cocoons, are gathered and eventually refined into dry flakes, which are then dissolved in denatured (ethyl) alcohol to make the shellac solution that winds up in cans at the store.

Shellac is available in several varieties. You can buy it premixed, or you can buy it in flake form and mix it yourself with denatured alcohol, The premixed variety is available in orange (amber) and clear, which is shellac that's been bleached. With the flakes, shellac is available in a wider variety of colors and wax contents than with the premixed version (which contains wax). The wax in shellac decreases the finish's resistance to water and prevents some finishes from bonding to it.

Lacquers—Most professionals still regard lacquer as the best all-around finish for wood because it dries fast, imparts an incredible depth and richness to the wood, exhibits moderate to excellent durability (depending on the type used) and rubs out well. There are several different types of lacquer, and they exhibit different performance characteristics.

Nitrocellulose lacquer is the most common. If the label on the can says lacquer, it's most likely nitrocellulose, which is made from an alkyd and nitrocellulose resin dissolved and then mixed with solvents that evaporate quickly. This type of lacquer has moderate water resistance, but it's sensitive to heat and certain solvents. The biggest drawback is the finish's tendency to yellow as it ages, which shows clearly on light-colored woods.

Acrylic-modified lacquer is made from a mixture of a nonyel-

APPLICATION

1 *By atomizing the finish into a fine spray, you can achieve a smoother, more even finish faster than you can with any other method. You can spray shellac and oil-based varnishes (including polyurethane), as well as water-based, nitrocellulose and catalyzed lacquers.*

2 *Whether you use a disposable sponge brush or the more traditional bristles, laying on a coat of finish with a brush will require fewer applications. Careful technique means everything toward the goal of a neatjob. Brushes work best with oil- and water-based varnishes.*

3 *The time-honored French polish is essentially many coats of shellac put on with a rag. Besides oils, you can also apply varnishes using this method, which is time-consuming but almost foolproof. Wiping on a finish requires patience.*

lowing cellulose resin (called cellulose acetate butyrate, or CAB) and acrylic. This lacquer possesses the same general properties of nitrocellulose lacquer, except it is absolutely water-white, meaning it will not show as an amber color when applied over light-colored woods. Also, the finish won't turn yellow over time.

Catalyzed lacquer bridges the gap between the application traits of nitrocellulose lacquer and the durability of varnish. Catalyzed lacquer is a complex finish composed of urea formaldehyde or urea melamine and an alkyd that has some nitrocellulose resin added to make it handle like normal lacquer. The addition of an acid catalyst initiates a chemical reaction that forms a very tough, durable finish. Catalyzed lacquer comes in two versions: precatalyzed and post-catalyzed. Precatalyzed lacquer has the components premixed, either by the manufacturer or at the store when you buy it; post-catalyzed lacquer is a two-part system that you must mix in your shop, following precise ratios. Once the catalyst has been added, these lacquers have a fairly short pot life (the time in which they can be used).

Water-based finishes—Water-based finish contains some of the same ingredients as varnish and lacquer—notably urethane, alkyd and acrylic—but many flammable and polluting ingredients have been replaced with water. The chemistry in this product is complex. Because the resins don't have a natural affinity for water, they must be chemically modified or forced to combine with water.

Water-based finish is usually made with either an acrylic resin (sold as water-based lacquer) or an acrylic urethane mixture (sold as water-based polyurethane). As with varnish, the addition of the urethane makes the resin tougher and more scratch resistant, but water-based urethane does not have the same solvent and heat resistance as its oil-based counterpart.

What finishes are more durable?

The durability of a finish is measured by its resistance to water, chemicals, solvents (such as those in alkaline cleaners and acidic foods), heat and scratches. Wax, shellac, lacquer and some water-based finishes will be damaged if exposed to water long enough. Most of these products also scratch easily; however, they rub out well. (That's the flip side of scratch resistance.) Wax is surprisingly resistant to acids and alkalis. Aside from that, it is the least durable finish. Shellac is neither resistant to alkalis such as ammonia nor to alcohol. Of all the evaporative finishes, lacquer (nitrocellulose and acrylic, water- and solvent-based) fare the best in terms of overall durability. Oil-based polyurethane is the most durable finish you can apply by hand, and catalyzed lacquer and varnish are the most durable sprayed finishes.

Choose a finish to match your skill level

Your level of experience, the environment in which you work and whether you're set up to spray all play a part in deciding which finish to use. The temperature and dampness of your shop, as well as the amount of sanding dust in the air, will affect your choice. Dust falling onto a finish does not pose as great a problem with lacquer or shellac as it would with a slow-drying finish such as varnish. Shellac and lacquer are also the least temperamental when it comes to cold temperatures, and they can be modified with retarder additives for hot and humid conditions. Oils and oil-based products dry slowly in cold temperatures and humid conditions, and dust is always a problem when it has time to become embedded in the dried film.

Spray equipment requires a larger budget and, in most cases, expensive equipment to exhaust the overspray. There's also a learning curve with spraying, so it will likely take some practice before you get decent results.

The type of finish will notably affect the look of the wood

Do you want a natural "in-the-wood" finish? Or does your work demand an elegant, deep, glass-smooth finish? Is the color of the finish a problem, or will yellowing of the finish be a problem down the road?

Traditionally, woodworkers have turned to oil, wax or oil and varnish blends (such as Watco) for a natural-looking finish. None of these easy-to-apply finishes dries to form a hard surface film.

Photo, this page (left): William Duckworth

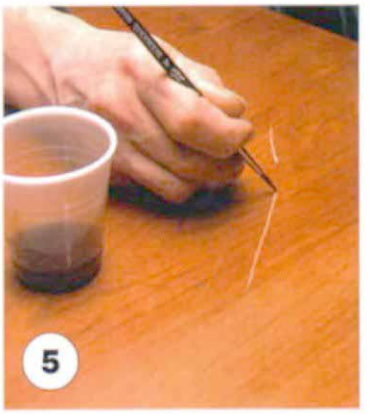
DURABILITY

1 *Catalyzed lacquers and conversion varnishes will hold up* **to heat** *damage better than any other finishes.*

2 *Alcohol is the original solvent for shellac, an evaporative finish, and will melt right into the dried film in no time.*

3 *Standing water (from a leaky vase or one that collected condensed moisture from the air) can wreak havoc on most finishes. Catalyzed lacquers and oil-based varnishes fare the best against moisture damage.*

4 *A dining table might make a nice racetrack—especially to a child who hasn't noticed his rubber tires are missing. Polyurethane and catalyzed lacquers resist scratches better than any other finishes.*



5 *Damage to an evaporative finish, such as the shellac on the surface of this cherry table, is relatively easy to fix.*

However, you can get a natural-looking effect with any finish-including varnish, shellac and lacquer—as long as you don't build it up more than a few coats and you rub out the dried film with steel wool. But if your goal is a filled-pore, deep, lustrous finish, you must use a hard, film-forming finish (varnish, shellac or lacquer). This type of finish is also mandatory when you have to perform complex coloring options like toning and glazing.

The color and the penetration of the finish itself may be an issue. Orange shellac and phenolic-resin varnish both have colors that may be too dark for woods that you may want to keep as light as possible. In addition, many finishes deepen or darken the wood surface. In most cases this is desirable, because it adds depth and increases luster. However, you may want to downplay any deepening effect. Some delicately figured woods (such as pearwood) will appear muddy when an oil finish is applied.

Oil and oil-based varnish, solvent-based lacquer and shellac all deepen the color of the wood and increase surface luster the most. These finishes wet the cells of the wood, penetrating into the surface. Other film finishes—notably water-based finishes and some catalyzed lacquers—tend to lie on the surface. By not penetrating it as much, they make the wood appear lighter in color,

The plastic look that's sometimes ascribed to polyurethane and catalyzed lacquers has more to do with the incorrect application of these finishes than it does with the finishes themselves. On open-pored woods (plainsawn ash or oak, for example) the application of thick varnish and lacquer can result in a soupy look on the surface. This is a consequence of the finish film bridging across the open pores rather than flowing into them. By thinning these finishes you can achieve more attractive results. My favorite method to apply oil-based polyurethane is to thin the finish 50% with mineral spirits and wipe it on.

A finish film that turns yellow with age will be noticeable with unstained, light-colored woods, such as maple or birch. An acrylic finish, water- or solvent-based, does not have this problem. Paste wax and some catalyzed finishes also will not yellow.

Think about safety and the environment

A solvent-based finish, such as varnish and lacquer, contains a good deal of organic solvents, which can affect the environment as well as your health. It's also highly flammable. If these particulars pose a problem for you, use a water-based finish to eliminate the fire hazard and to mitigate the environmental and health impact. Pure oil is a surprisingly good alternative to a solvent-based lacquer or varnish: Pure oil contains no solvents and comes from renewable resources. However, oil-soaked rags must be disposed of carefully. Shellac is also a good alternative. The solvent for shellac, denatured alcohol, is distilled from corn, and most people don't find the fleeting odor objectionable.

All finishes are nontoxic when fully cured, despite what you may have read or heard. Once the solvents have evaporated, any cured film is safe for contact with food. This does not mean that the finish itself is safe to gobble up. It means simply that additives such as heavy-metal driers and plasticizers are encapsulated well enough that they do not migrate into your food. Wax and shellac (apples and candy are coated with these) are the only edible finishes that I'm aware of, besides mineral oil, which is sold as a laxative.

Spraying wastes a great deal of the finish material, and the organic solvents are dispersed into the air. Brushing or wiping on a finish is a practical, though less speedy, alternative. □

Jeff Jewitt writes frequently for Fine Woodworking. *His latest book,* Great Wood Finishes, *was recently published by The Taunton Press.*

Photo, this page (bottom right): William Duckworth