

Staining Wood



Understanding Stains

Don't let the dizzying array of choices get you discombobulated.



Photos by the author

For most stains the best application method is to apply a wet coat of stain using a rag, brush, paint pad or spray gun and wipe off the excess before it dries. It's necessary to point this out because there are TV ads that show brushing stain and leaving it. This procedure leaves colored brush marks, usually obscures the wood, and often leads to the finish chipping or peeling.

Go to any home center and you will probably be offered a choice of four types of stain: oil, varnish, water-based and gel (though the shelf arrangement and labeling of these stains rarely makes this clear).

Go instead to a paint store that caters to the professional painting and finishing trades and you will likely find lacquer stains and NGR (non-grain-raising) dye stains in addition to all or at least some of the stains available at home centers.

Shop at a woodworkers' store or from a catalog that caters to woodworkers, and to many of the stains already mentioned you can add water-soluble dyes and sometimes alcohol- and oil-soluble dyes.

Instead of buying any of these products to color wood, you could use "natural" stains such as the juice from walnut husks (boiled in water) or berries, or even coffee or tea. Or you could use a chemical such as lye, ammonia or potassium dichromate. (Natural stains fade rapidly; chemicals offer limited colors and are dangerous to use and difficult to control.)

You could also use a shading stain, toner or glaze to stain wood, though each of these is designed to be applied in between coats of finish. (I'm not going to discuss these products, or natural or chemical stains here.)

There are many types of stain. In this regard stains are like saws. (There are also many saws: table, band, jig, scroll, radial-arm, miter, sabre, hand, etc.) Each cuts wood just as all stains color wood.

But it is not likely you would use a table saw to cut a curve or a scroll saw to crosscut 8/4 oak. Each saw performs some cuts better than others; likewise, each type of stain handles and colors in its own unique way. To have full control of the coloring process, you need to understand how stains differ and what each does best.

Oil Stain

Oil stains are the most widely available and are the type most people think of when they think of stain. These are the easiest to use because the linseed oil base or "binder" (sometimes a mixture of linseed oil and varnish) allows plenty of time to remove the excess before the stain dries – even on large projects.

You can identify oil stains by their thinning and clean-up solvent: mineral spirits (paint thinner). Most manufacturers list it as "petroleum distillate." Minwax uses the more technical (and user unfriendly) name: "aliphatic hydrocarbon."

Unfortunately, oil stains are often referred to as "pigment stain" or "wiping stain" and this introduces confusion.

Though some oil stains contain only pigment, most contain pigment and dye, and many contain only dye. Moreover, many varnish, water-based, gel and lacquer stains contain only pigment, and these are rarely referred to as pigment stains.

Oil stains can be wiped, of course, but so can all stains – especially if the project is small. So technically, all stains can be wiping stains and the term loses its usefulness.

Choose an oil stain to apply under any finish except water based, and in all cases where you don't need any of the special characteristics offered by other stains.

by Bob Flexner

Bob is the author of "Understanding Wood Finishing" and a contributing editor to Popular Woodworking.

Varnish Stain

Varnish stains resemble oil stains in every way but one. Varnish stains use only varnish (sometimes polyurethane varnish) as the binder, so varnish stains dry hard while oil stains don't. Therefore, a varnish stain can be brushed on wood and left to dry without wiping whereas excess oil stain has to be wiped off or the finish applied on top may chip or peel.

Think of a varnish stain as alkyd paint with less colorant added.

Fortunately, most manufacturers label their varnish stains to distinguish them from oil stains because varnish stains use the same thinner as oil stains: mineral spirits. If you aren't sure whether a stain is varnish or oil, put a puddle of stain on top of the can or on another non-porous surface and see if it dries hard after several days in a warm room. Thick oil stains never harden.

Varnish stains are more difficult to use than oil stains because there is less time to wipe off the excess. Brushing and leaving the excess usually leaves prominent colored brush marks.

Traditionally, varnish stains were used most often to overcoat already stained and finished furniture, and woodwork that had become dull or scuffed. Because the stain hardens well, it didn't require a topcoat of finish in these situations and the brush marks were disguised by the already existing color.

Choose a varnish stain to overcoat an already stained and finished surface that is dull or scuffed, or if you're wiping off excess on a small project.

Water-based Stain

Water-based stains use water-based finish as the binder and replace most of the organic thinner with water. So these stains pollute less, are less irritating to be around and are easier to clean up than oil or varnish stains.

You can identify water-based stains by their thinning and clean-up solvent: water.

Water-based stains are usually best under water-based finishes because these finishes don't bond well over oil or varnish stains unless you give them a week or longer to thoroughly dry. Unfortunately, water-based stains are more difficult to use because they raise the grain of the wood and they dry fast.

Sanding off raised grain inevitably leads to sanding through color in places. To avoid this, raise the grain and sand it off before applying the stain, or "bury" the raised grain.

To raise the grain first, wet the wood with a wet cloth. Let the wood dry overnight. Then sand off the roughness and apply the stain. To bury raised grain, simply apply the first coat of finish over the stain and raised grain, and then sand smooth.

Overcoming the quick drying time is more difficult. You can add a slow evaporating solvent (usually propylene glycol) provided by some manufacturers or you can add lacquer retarder. But adding either reduces the color intensity of the stain and defeats the purpose of using water-based products – to reduce exposure to solvents.

A better method is to divide your project into smaller parts and apply and wipe off the stain on each before going to the next. You can also have a second person follow you, quickly wiping off the excess.

Choose a water-based stain for use under a water-based finish.

Gel Stain

Most gel stains are oil- or varnish-based, so they thin and clean up with mineral spirits. They are identifiable by their thickness, which is similar to mayonnaise. This makes them rather messy to apply, but gel stains solve the single biggest problem in wood finishing – blotching on pine.

Blotching is uneven coloring caused by varying densities in the wood and is the only problem that can't be fixed by stripping and starting over. The only way to remove blotching is to sand it out, which is very time consuming, or paint the wood, which is seldom a desired solution.

So gel stains serve a very important role in wood finishing. And they are much more predictable and easy to use (only one product to apply) than applying a wood conditioner

PIGMENT AND DYE

Pigment and dye are the two primary colorants used in stains (chemicals being the other).

Pigment is ground earth or colored synthetic particles sized to imitate earth. The particles have weight so they settle to the bottom of the can if not kept in suspension by stirring.

Dye is a chemical that dissolves in one or more specific liquids (different dyes dissolve in different liquids). So dye becomes a part of the liquid and doesn't settle out.

You can tell if a stain contains pigment, dye or both by inserting a stirring stick after the stain has sat undisturbed on a shelf for several days or weeks. Pigment will have settled to the bottom; dye will still be in solution.

Because pigment has size it can't penetrate into wood. But after you wipe off excess stain, some pigment remains in pores and sanding scratches that are larger than the size of the pigment particles. This explains why sanding to finer grits produces a lighter coloring: less pigment can lodge.

Because dye dissolves in a liquid, it has no size and penetrates along with the liquid. So dye colors wood more uniformly.

You can't endlessly darken wood with pigment unless you leave some to build on the surface (equivalent to painting). But dye can be applied in many coats to darken wood as much as you want without obscuring the wood or creating any build – as long as there is no binder in the dye that would itself build.

Dyes that don't build are NGR, water-soluble, alcohol-soluble and oil-soluble. Oil, varnish, water-based, gel and lacquer stains with dye included to add build.

All dyes, whether dissolved in solvent or containing an added binder, fade in bright light, especially sunlight and fluorescent light. You should avoid the use of dyes if your project will be placed in these conditions.

— BF



When excess stain is wiped off, pigment lodges in pores and sanding scratches highlighting them (left) while dye penetrates everywhere along with the liquid and colors more evenly.

before staining. (See "Wood Conditioner Confusion," October 2005, issue #150, to understand why the directions on most brands don't produce good results.)

Choose a gel stain when staining pine or similar soft woods.

Lacquer Stain

Lacquer stains use very fast-drying binders and solvents. Professional finishers often choose these types of stains because the finish can be applied within approximately 30 minutes, and the stain can be added to lacquer to make a "toner" for adjusting color between coats of finish.

You can identify lacquer stains by the strong, pungent odor caused by solvents such as xylene and various ketones, which will be listed on the cans.

Lacquer stains are difficult to use because of their very fast drying. Professionals usually work in pairs, with one person spraying the stain and the other following right behind wiping off the excess.

Choose a lacquer stain if you are spraying and want to reduce the time between staining and finishing, or if you plan to add a colorant to your lacquer.

NGR Dye Stain

NGR stands for "non-grain-raising" and refers to a type of dye that's usually dissolved in very fast evaporating solvents. As with lacquer stains, NGR dyes are favorites with professional finishers because there is little waiting between staining and finishing and the stain can be added to lacquer to make a toner.

All NGR dyes are packaged in liquid form and most contain methanol and sometimes other toxic solvents. No pigment or binder is included. Some NGR dyes are packaged in concentrated form and can be thinned with water, alcohol or lacquer thinner. (If thinned with water, they perform closer to the water-soluble dyes discussed below.)

Choose an NGR dye stain if you want a deeper or more even coloring than can be achieved with pigment. Also choose NGR if you want to reduce the time between staining and finishing or add a dye colorant to lacquer to make a toner.

CHOOSE THE RIGHT STAIN FOR THE JOB



TYPE OF STAIN	HOW TO IDENTIFY
Oil Stain	▪ Listed thinner and clean-up solvent is mineral spirits ("petroleum distillate," "aliphatic hydrocarbon")
Varnish Stain	▪ Listed thinner and clean-up solvent is mineral spirits ("petroleum distillate," "aliphatic hydrocarbon") ▪ Labeled to indicate varnish, polyurethane varnish or hard-drying
Water-based Stain	▪ Listed thinner and clean-up solvent is water
Gel Stain	▪ Consistency is thick like mayonnaise
Lacquer Stain	▪ Strong odor ▪ Xylene and/or ketones are listed as solvents
NGR (non-grain-raising) Dye Stain	▪ Dye packaged in liquid form ▪ Usually contains methanol
Water-Soluble Dye Stain	▪ Dye packaged in powder form ▪ Instructions are to dissolve in water

Water-, Alcohol- and Oil-soluble Dyes

These dyes are packaged in powder form, which makes them easy to identify. You have to dissolve them in the proper solvent.

Of the three, the most useful is water-soluble dye because it provides more time for wiping off the excess and there's no exposure to irritating solvents. (Handle grain raising and fast drying the same as with water-based stains, described earlier.) Alcohol-soluble dye is sometimes used by touch-up specialists precisely because of its very fast drying. Oil-soluble dye is rarely used anymore (except in oil stains). It's been replaced by NGR dye.

Choose a water-soluble dye if you want deeper or more even coloring than can be achieved with pigment. **PW**

COLOR INTENSITY

All types of stain can vary in color intensity depending on the ratio of colorant (pigment, dye or chemical) to liquid (oil, varnish, solvent, thinner, etc.). The higher the ratio of colorant to liquid, the darker the stain colors the wood. You can change the ratio in any stain by adding pigment, dye or thinner.

Sometimes you hear that you can make wood darker by leaving a stain on the surface longer before wiping off the excess. The explanation given is that the stain penetrates deeper. This is not true. What happens is that more thinner evaporates increasing the ratio of colorant to liquid. *—BF*



The color intensity of a stain is determined by the ratio of colorant to liquid. A full-strength commercial oil stain darkens wood more (left) than the same stain thinned 50 percent with mineral spirits (right).

MOST IMPORTANT PROPERTY	WHEN TO USE	COMMENT
▪ Dries slowly so provides plenty of time to wipe off excess	▪ Under any finish except water base ▪ You don't need a special property of another stain	▪ Allow overnight drying before coating over with a finish
▪ Dries hard so doesn't need a topcoat when coating over a stained and finished surface	▪ On small surfaces ▪ You want to leave excess to build ▪ When coating over an already stained and finished surface	▪ If wiping off excess, work rapidly or have a second person help
▪ Reduces exposure to solvents	▪ Under a water-based finish ▪ To avoid exposure to solvents ▪ You want easy water cleanup	▪ If wiping off excess, work rapidly or have a second person help
▪ Eliminates blotching on softwoods such as pine	▪ Staining pine or similar softwood	▪ Compared to a liquid stain, gel stain reduces depth on many hardwoods
▪ Dries very rapidly	▪ For very fast drying ▪ To make a toner with lacquer	▪ You have to wipe off the excess within a minute or two, so it helps to work with a second person
▪ Colors more uniformly and intensely than pigment	▪ For very fast drying ▪ For deeper and more even coloring than can be achieved with pigment ▪ To make a toner with lacquer	▪ Spray the stain evenly and leave it, or work with a second person if wiping off excess
▪ Colors more uniformly and intensely than pigment	▪ For deeper and more even coloring than can be achieved with pigment ▪ To avoid exposure to solvents	▪ Brushing a water-based finish over the dye may dissolve and smear it ▪ Apply a barrier coat of shellac or varnish (a "washcoat") in between

Wipe, Don't Brush

Wiping is the efficient way to apply stain.

The purpose of this article is to emphasize what I've said in passing many times in this column: It's much more efficient to wipe stain onto wood with a rag than to brush it.

Wiping is fast, almost as fast as spraying (without the downside of having to clean the spray gun). Wiping is also every bit as effective in all situations except possibly into recesses such as inside corners, fluting, deep carvings and the like.

Don't get me wrong. I'm not against brushing stains. I just don't see why anyone would do it, especially on large surfaces, and even more especially, when using any stain other than a slow drying oil-based stain. All other stains, including water-based, lacquer and all the dye stains, dry too rapidly to allow time to both brush on and get wiped off of large surfaces before the stain begins drying.



Wiping on. *The most efficient method of applying stain is to wipe it on using a soaking-wet cloth. Notice on this stereo cabinet, which was made without a back, I'm not having any problem getting the stain into the inside corners.*

The Basics

The basic rule for getting good results with any stain is to apply a wet coat and wipe off the excess before it dries.

You can use any tool – rag, brush, paint pad, roller or spray gun – to apply the stain. You can even dip the object into stain or pour the stain onto the wood and spread it around. It's only important that you wipe off all the excess before the stain dries.

If you let the stain begin to dry in spots before wiping off, you will get a type of blotching that is different from the blotching caused by uneven densities in woods such as pine, cherry and birch. You'll get a blotching caused by thick dry spots of stain next to clean areas where the still-wet stain wipes off easily.

If you're brushing one of the fast drying stains, not only might you cause blotching when you wipe off the excess, you may get lap marks caused by brushing more stain over stain that has dried.

Brushing is the slowest method of applying stain. So not only might you get blotching or lap marks, you're also wasting time.

It's more efficient to wipe stain than to brush it, and you're less likely to have color problems.

The Exception

There is one exception, however. Brushing can be more efficient for getting stain into inside corners and other recessed areas.

PHOTOS BY THE AUTHOR

To use a cloth (or a sponge) successfully requires getting it very wet. I've noticed that many woodworkers resist getting their cloth wet enough so the stain flows into recessed areas. If this is your problem, you can solve it by having a cheap throwaway brush or sponge brush handy to quickly work the stain into the hard-to-get-to places.

But a brush is unnecessary. You can get stain everywhere with a cloth as long as it is soaking wet. In 20 years of refinishing old furniture, most of which required staining, I don't remember ever using a brush to apply a stain. And I rarely used a spray gun because of the time involved cleaning the gun.

I almost always used, and continue to use, a very wet cloth.

Fast-drying Stains

Most woodworkers use oil-based stains, which dry so slowly it's rare to have wipe-off problems. But some use water-based stains, some use dye stains and many professionals use lacquer stains.

Water-based stains (all stains that list water for clean-up) dry hard as quickly as the water evaporates. This can happen very rapidly in hot temperatures.

Dye stains (for example, Lockwood, Moser, TransTint and Solar-Lux) dry as quickly as the dye solvent, usually water, alcohol or acetone, evaporates. Again, they dry much faster in warm temperatures.

Professionals typically apply lacquer stains onto large surfaces such as kitchen cabinets by having one or two employees following right behind the application person wiping off the excess stain with large cloths.

You can do the same, of course, by getting a friend to follow after you apply.

But you still wouldn't brush on the stain. Attempting to brush one of these fast drying stains onto a large surface is a sure ticket for uneven coloring.

(If you find yourself with some dried patches of stain, quickly apply more stain, maybe to smaller areas at a time, and work faster to get the excess removed. The additional stain will dissolve what is there.)

Why People Brush

I can think of only two reasons woodworkers brush rather than wipe stain onto their projects: cleanliness and the Minwax television ad.



Wiping off. *An oil-based stain dries slowly, which allows plenty of time to get the excess removed with a clean cloth before the stain dries. Had I been using a faster drying water-based, lacquer or dye stain on such a large object, I would have had a second person following closely behind my application wiping off. It's not important to apply or wipe off with the grain as long as you wipe off all the excess. But on critical surfaces such as tabletops I typically make my last wiping-off strokes go with the grain just in case. The grain will disguise any streaks I may leave.*



Blotching caused by fast drying. *Lacquer, water-based and dye stains dry rapidly. So they could lead to this type of blotching if some of the stain dries before you have time to get it all wiped off.*



Brushing into recesses. *If you don't get your cloth wet enough with stain, you'll have trouble getting the stain into recesses. You can always use a brush to help do this.*

It's cleaner to brush than to wipe with a cloth that drips onto the floor and even onto your clothes if you aren't careful. But drips can be cleaned up, and you can wear old clothes or an apron for protection.

Cleanliness is no excuse for brushing.

Cleanliness can't be the only reason for brushing, however. For many years I've taught hands-on finishing and restoration classes and watched with amazement as virtually everyone in the class pulled out a brush (usually a foam brush) for applying their stain. Why aren't they using a cloth?

A surprising number have explained they thought a brush was best because they saw one used on the Minwax television ad, which has run off and on for years. This ad shows someone slowly brushing a stain onto a panel, each stroke lined up perfectly side-by-side with the previous, and no trailing off as the brush runs out of stain.




100

Staining Wood

A primer on coloring.

A wood stain is a colorant (pigment or dye) and a binder (some sort of finish) with a lot of thinner added so the excess stain is easy to wipe off. This leaves some color in or on the wood.

A stain can also be just dye and thinner with no binder added.

Pigment is ground earth or colored synthetic particles, so it requires a binder to glue it to the wood. Pigment settles to the bottom of the can and has to be stirred into suspension before use.

Dye is a colorant dissolved in a liquid, so dye penetrates along with the liquid and doesn't need a binder. Coffee and tea are examples of weak dyes.

Purpose of a Stain

There are three good reasons to use a stain:

1. Make a cheaper, less interesting (usually lighter) wood look like a more expensive (usually darker) wood such as walnut, cherry or mahogany.



Why stain? *One of the principal reasons to stain wood, especially lighter woods such as this birch plywood, is to make them resemble more desirable darker woods, in this case walnut.*



Pigment. *Pigment settles to the bottom of the can and has to be stirred into suspension before use. Because the pigment particles are solid, they require a binder (some type of finish) to glue them to the wood.*

2. Match the color of an existing object.

3. Change the color of the wood to create a décor you or someone else has in mind.

You don't need to use a stain unless you want to change the color of the wood. If you do apply a stain, you do it before applying the finish.

Types of Stain

Common categories of wood stain include the following:

- Oil stain (which thins and cleans up with mineral spirits).
- Water-based stain (which thins and cleans up with water).
- Gel stain (which is thixotropic, like mayonnaise – it's thick in the can, but can be spread and wiped off easily).
- Dye stain (which is a colorant dissolved in a liquid).
- Combination stain and finish (which doesn't color as effectively and is streaky with brush marks if brushed and not wiped off).
- Lacquer stain (which is a very fast-drying stain used by professionals who spray it and wipe quickly; often applied by two people).

The primary differences in stains are as follows:

- *Ease of application.* Oil stains are the easiest to apply because you have plenty of time to wipe off the excess. All the other stains dry quickly so you have to work fast or on smaller areas at a time.
- *Drying time.* Lacquer stains, and dye stains dissolved in solvent (not water), can be coated over within minutes. Water-based stains can be coated over after about an hour. Gel stains, and dyes dissolved in water, require four to six hours before coating over. Oil stains should be allowed overnight drying.
- *Grain definition.* All stains provide good grain definition if the excess is wiped off, because more colorant is left in the grain. Dye stains produce slightly less definition than pigment stains.
- *Color control.* Dye stains provide the best control of color – that is, getting the color darker without obscuring the figure of the wood. Dye is see-through; you can apply as many coats as you want and still see the wood's figure. Pigment hides.

CONTINUED FROM PAGE 60



Types of stain. *There are six common types of stain. From left to right are examples of oil stain, water-based stain, gel stain, two types of dye stain – liquid (both concentrated and thinned) and powder, combination stain and varnish, and lacquer stain.*

Conditioning the Wood

The purpose of "conditioning" or "washcoating" wood before applying a stain is to reduce blotching, which is uneven coloring caused by varying densities in the wood. A wood conditioner or washcoat is any finish thinned to about 10 percent solids so it doesn't fully "seal" the wood. Some of the stain can still penetrate.

The woods that blotch are softwoods such as pine and tight-grained hardwoods such as maple, birch and cherry. There's no point in applying a wood conditioner/washcoat to medium- or coarse-grain woods such as walnut, mahogany or oak.

Varnish wood conditioners (the common ones found in home centers and paint stores) are varnish thinned with about two parts mineral spirits (paint thinner). You can make your own. The key to getting the wood conditioner to work is to let it dry fully before applying the stain – at least six hours, better overnight.



Washcoat. *A washcoat, which is any finish thinned to about 10 percent solids, can be used to reduce blotching, but it also reduces the intensity of the stain's color. On this sample, I applied a varnish washcoat (wood conditioner) to the left side of the panel and let it dry overnight. Then I applied a stain to the entire panel.*



Wiping. *The basic rule for applying all stains is to apply a wet coat and wipe off the excess before it dries. It's much faster to apply stain with a cloth than it is to brush on the stain.*

Stain Application

The basic rule for applying all stains is to apply a wet coat and wipe off the excess before the stain dries. Unless the wood is naturally blotch-prone or you haven't sanded the wood well enough to remove all gouges and scratches, you will always get an even coloring.

You may need to divide your project into smaller sections or have a second person wipe as you apply to get good results using one of the faster-drying stains. It's much faster to wipe the stain onto the wood with a cloth, wearing gloves of course, than to brush it. (I can't remember ever brushing a stain.)

Application Problems

Common problems and ways to avoid them:

- The stain dries in spots before you get it all wiped off, leaving an uneven coloring. If you are quick enough, you can wipe with more stain on smaller sections at a time to re-liquify the stain so you can then wipe it off evenly. Otherwise, strip with lacquer thinner, acetone or paint stripper and restain smaller parts at a time or get a second person to help.
- The color of the stain doesn't match what you expected from the name on the label. Names are simply manufacturers' interpretations. There are no industry standards.
- The color of the stain on your project isn't the same as on the color sample in the store. Woods color differently. Always try the stain on scrap from your project and make adjustments (add pigment or thinner) as necessary to get what you want.
- Glue from squeeze-out or fingerprints seals the wood, which prevents stain penetration. Sand or scrape off the glue through the stain and restain that area, or leave the splotch and disguise it by painting in the correct coloring after you have applied a coat of finish.

Stain problems such as blotching and getting the color wrong can be extremely difficult to fix. You can usually remove some of the color by wiping with the thinner for the stain. If the stain contains a binder (it isn't simply dye), you can use a paint stripper. But nothing short of sanding will remove all the color.

The difficulty correcting stain problems is surely one of the reasons so many woodworkers avoid staining altogether.

PWM

Bob is author of the new book "Flexner on Finishing," available from Popular Woodworking Books.



