Wood Finishing

A discussion on clear film and oil finishes

Wood Finishing

What we'll cover today:

- Sanding Sealers
- Grain/pore fillers
- Reactive vs. non-reactive finishes
- Application techniques for common finishes
- Usage properties of various common finishes
- Coupon samples of some common finishes
- Safety precautions, i.e. flammability, toxicity, etc.

Wood Finishing

What are the characteristics of a great finish?

- A great finish protects the wood while enhancing its natural beauty.
- It does both while going largely unnoticed.

“A great finish will not save poor craftsmanship, but a poor finish will certainly ruin an otherwise nice piece of work.”

Wood Finishing

How to choose the right finish:

- Know how the item will be used. Near water, high temperature, high humidity, prone to abuse (table or counter top), primarily a display piece?

- What is your skill level and equipment availability?

- Do you want a close-to-the-wood finish or one that has more depth?

- Can you tolerate some yellowing over time?

- On a period piece is the finish appropriate to the era of the work piece?

Optional Prep Steps

Sanding Sealer and Grain Filler

Sealers and Sanding Sealers

What is a sealer?

- It is a liquid that creates a barrier between the wood or stain and the final finish and promotes adhesion of the final finish to the wood surface and faster finish coat buildup.

What is a sanding sealer?

- A true sanding sealer is a sealer that has zinc stearate added to it. This solid adds loft to the sealer allowing coats to build faster. It also does some minor grain filling. The downside is that it is soft and is not compatible with all finishes.

Sealers and Sanding Sealers

What does it do?

- Seals in contaminants and odors (both)
- Binds wood fibers (both)
- Fills some porosity (stearated)
- Sands easily for a smoother finish (both)
- Allows finish coats to build up much faster (both)
- May be used as a pre-stain conditioner (sealer)

Sealers and Sanding Sealers

Should you always use a sanding sealer?

- Not necessarily. But it's a good idea if you suspect contamination of the wood or if the wood is oily or has resinous knots.
- Most finishes do a pretty good job of sealing wood on their own.
- Polyurethane has fairly poor wood penetration and may gain some adhesion from a dewaxed shellac sealer.
- *Question: Will an oil finish that relies on penetration of the wood work as well if the wood has been sealed?*

Sanding Sealers

How is it applied?

- Brush a thin coat over raw or stained wood.
- Allow to dry the recommended time.
- Sand very lightly with fine (320+) sandpaper.
- Be careful not to go through stain.
- Apply no more than two coats.

Sealers and Sanding Sealers

Some useful stuff to remember:

- Under lacquer avoid stearated sealers and always use 100% de-waxed shellac.
- If applying lacquer apply very thin coats at first to avoid “burning through” shellac sealer.
- Consider using a sanding sealer on any porous wood that sucks up the first couple of coats of finish.
- Use any time there is a concern about contaminants such as silicone, wax, etc., or if the wood is “oily”, porous, or has a high resin content.
- Dewaxed shellac will stick to virtually anything, and anything will stick to it, so it’s an excellent sealer.
- Some finishes (poly in particular) may not stick to waxed shellac.
- If the wood has large open pores consider using a grain filler

Grain Fillers

What is a grain filler?

- Grain filler is a thick compound that will fill the pores in wood that has a large open grain structure such as oak or walnut.

- The purpose is to create a glass-smooth finish that does not telegraph the grain and pore structure up through the final finish coats.

- Grain fillers may be oil based (traditional) or water based (newer).

Grain Fillers

Other ways to fill grain:

- If you are using an oil based finish you can apply with sandpaper. Scrubbing will create an oil/dust slurry that will fill pores fairly well. There's quite a bit of information on this technique on the internet.

- It's possible to fill grain with your finish alone. To do this apply thin coats and sand down after each coat until your finish fills the grain. Be aware that most finishes shrink over time (weeks or even months). Don't be surprised to find that after a period of time those pores begin to become visible again.

Grain Fillers

Are grain fillers stainable? Maybe...

- Grain filler can be made of many materials, however most are not stainable. Some water based fillers claim to be stainable.
- Most grain fillers are opaque.
- Tinting can be applied to match wood color or to create some interesting contrasts.
- Crystalac makes a “clear” grain filler which eliminates having to tint, though it can give the wood a milky cast.

Grain Fillers

When do you stain? Before or after filling grain?

- With dye stains you should stain before filling.
- With pigment stains apply after filling. My limited experience says otherwise.
- Try before/after on some scrap to see which works for you.
- If you stain first use a sealer before filling.
- Staining before filling will require great care in the sanding stage.

The Order of Things

Stained Wood

Pre-stain conditioner
Stain
Sanding Sealer
Light sand
Grain Filler (optional)
Sand smooth
Sanding Sealer
Light sand
Finish coats

Raw Wood

Sanding Sealer
Light sand
Grain filler (optional)
Sand smooth
Sanding Sealer
Light sand
Finish coats

*If your filler is stainable then you have the option of staining before or after filling. Do **NOT** assume your filler is stainable. Test it first!*

Reactive vs. Non-Reactive Finishes

Reactive	**Non-Reactive**
Finish cures	Finish dries
Solvent won't affect cured finish	Solvent will dissolve finish
Requires sanding between coats	No sanding between coats
Slow curing time	Fast drying time
Varnishes, cat lacquer, paints, oils	Lacquer, shellac, waxes

Reactive finishes cure by reacting with oxygen or moisture in the air. Some, like polyurethane, also contain chemical curing agents.

Non-Reactive Finishes

Lacquer and Shellac

Lacquer

Types:	Nitrocellulose, Acrylic, Catalyzed
Solvent:	Lacquer thinner only.
Durability:	Moderate hardness, somewhat durable. Poor UV. Damaged by heat.
Waterproof:	Water resistant for short periods.
Chemical resistance:	Damaged by some solvents.
Repairability:	Excellent.
Appearance:	Transparent, high gloss.
Application:	Brush or spray.
Safety:	Volatile solvents. Very flammable. Use in well ventilated area. Wear respirator.

Lacquer

More on types - Nitrocellulose

- Most common. This is what you'll likely find at Lowe's, etc.
- Resin produced from nitrated cotton fibers and other cellulosic materials.
- Can be brushed, sprayed.
- May yellow somewhat with age.
- Prone to cracking with age, particularly if finish is overbuilt.
- Avoid extreme temperatures.

Lacquer

More on types - Acrylic

- Synthetic polymer resin developed in 1950s.
- Finish is water white and will not yellow.
- Fast drying.
- Not as prone to cracking if thickness limits are adhered to.
- Must be sprayed.
- CAB (cellulose acetate butyrate) is the most common. Mixture of CAB and acrylic resin and is more flexible, less brittle than nitrocellulose.
- CAB is available in a catalyzed form.

Lacquer

More on types - Pre or Post Catalyzed

- Alkyd resin combined with urea/melamine resins, catalyst (this is conversion varnish), and nitrocellulose.
- Pre-cat: Catalyst added by manufacturer
- Post-cat: Catalyst added by user on the jobsite.
- Must be sprayed.
- Very short shelf life, particularly post-cat.
- More durable than other lacquers.
- Thicker film due to higher solids content.
- Reactive finish but somewhat repairable due to nitrocellulose content.

Lacquer

Pros	**Cons**
Fast drying Sanding not required Damage can be repaired Easy to level sand and polish Beautiful appearance Fewer bubbles than poly when brushing	Tends to sag on verticals Thin with lacquer thinner only Needs sealer to avoid contaminants Nitro lacquers may yellow with age Toxicity, flammability Brushing difficult on large projects Damaged by some solvents Moderate hardness. Reactive films are harder.

Lacquer

Application Tips (brushing):

- Use only a natural bristle brush.
- Apply a de-waxed sanding sealer first to avoid fisheyes, etc.
- Keep your hands clean!
- Minimize sagging by thinning with a lacquer thinner.
- Each coat will partially dissolve the previous coat, so no between coat sanding is needed.
- To fix a sag let dry then level sand. Add coat.
- Let dry about 2 hours between coats.
- Cleanup with lacquer thinner only.

Shellac

Types:	Flake or premixed.
Solvent:	Denatured alcohol only.
Durability:	Softer than lacquer. Not very durable.
Waterproof:	No.
Chemical resistance:	Damaged by alcohol, ammonia, water.
Repairability:	Reversible with denatured alcohol.
Appearance:	Beautiful. Adds depth to wood.
Application:	Brush, spray, or French polish.
Safety:	Alcohol vapors (flammable).

Shellac may be contain wax or come de-waxed. If the container does not say "de-waxed" then you can assume it contains wax.

Shellac

Pros	**Cons**
Sanding not required Damage can be repaired Easy to level sand and polish Beautiful appearance Won't yellow Food safe when dry Odor free. Excellent for inside drawers, armoires, chests, etc.	Tends to sag on verticals Thin with denatured alcohol only Damaged by ammonia, alcohol, water, and some solvents. Moderate hardness. Reactive films are harder. Poor heat resistance Water causes white ring.

Shellac

Application Tips (brushing):

- Use a natural or synthetic bristle brush.
- Avoid multiple brush passes.
- If you miss a spot leave it. The next coat will cover it up.
- Clean synthetic brushes with household ammonia and water. Don’t waste expensive alcohol for this.

Shellac

Mixing your own:

- Shellac may be bought as solid flakes.
- Multiple colors - Blonde, Super Blonde, Orange, Amber, Garnet, others.
- Keep flakes refrigerated until use. Store in a non-permeable bag or glass jar.
- The “cut”: 2# cut = 2 lbs of flake per gallon, etc.
- Use high purity dry denatured ethanol.
- Alcohol will absorb water, so get a new can if yours is old.
- Mix flakes and alcohol and store in sealed container overnight.
- Shelf life is no longer than 6 months, but that’s pushing it. Test older mixes before using on your project.
- Flakes will be good for about 3 years.

Reactive Finishes

Varnishes and Oils

Varnish

What is varnish?

- Varnish is made from cooking a resin with a drying oil, and the resulting varnish is dissolved in a solvent such as mineral spirits.

$$\text{Resin + Drying oil} \xrightarrow{\textbf{Cooking}} \text{Varnish}$$

- Varnish is then packaged and sold in many ways.

- Resins include alkyd, phenolic, and polyurethane (alkyd/urethane). All three are synthetic.

- Drying oils used include linseed, tung, soybean (soya), safflower.

Varnish

Varnish is classified by oil content:

- The amount of oil used in producing a varnish will classify it as a long oil, medium oil, or short oil varnish.

- Long oil varnishes are softer but more flexible. Spar/marine varnish is a typical application. (50-100 gal oil/100lbs resin)

- Medium oil varnishes are harder, less flexible. Commonly used as a floor finish. (12-40 gal oil/100lbs resin)

- Short oil varnishes are very hard, but not very flexible. Commonly sold as “table top varnish” or “rubbing varnish”. (5-12 gal oil/100lbs resin)

Varnish

Resins:	Alkyd (polyester), phenolic, polyurethane.
Durability:	Hard finish. Durable. Exterior grades have UV protection.
Waterproof:	Good water resistance.
Solvent resistant:	Impervious to most common solvents.
Repairability:	Difficult.
Appearance:	Depends upon type. Generally good.
Application:	Brush, spray, wipe on.
Safety:	Wear respiratory protection equipment.

Varnish

Pros	**Cons**
Better protection than shellac, lacquer, or oils May be applied in several ways Available in catalyzed form	Sagging on verticals if brushed Long cure times Cannot be easily repaired Needs abrading between coats May be rubbed out, but only after several weeks.

Varnish

Types of varnish:

- Alkyd varnish - Alkyd resins are typically combined with soybean oil (less yellowing) to create the common varnish found in retail stores.

- Phenolic varnish - Found in some more expensive long-oil (tung oil) spar and marine varnishes. Also formulated as a short-oil varnish which is hard enough for table top use. Waterlox is an example of a high quality phenolic/tung oil varnish. Phenolic varnishes may yellow more than alkyd varnishes.

Varnish

Types of varnish:

- Polyurethane varnish - Basically an alkyd resin with urethane added to form a “uralkyd” resin. Most polyurethane varnish is cooked with soybean oil. Good water and chemical resistance. May be thinned 50/50 and wiped on. Most durable finish you can apply by hand. Difficult to rub out. Highest gloss is usually right out of the can

- Satin or semi-gloss polyurethane varnishes contain a flattener, usually zinc oxide. This can obscure the grain after several coats.

Tip: Use the gloss version until the final coat, then use the semi-gloss or satin finish. That way the grain will show through just fine, but you will achieve a low gloss finish.

Varnish

Types of varnish:

- Conversion varnish - This is catalyzed varnish made from alkyd resin combined with urea/melamine resins and catalyst. Essentially it is post-cat lacquer without the nitrocellulose, which makes it hard. Must be sprayed. Very resistant to heat, chemicals, abuse. Difficult to apply and must be sprayed under controlled conditions.

- Spar varnish - Made with alkyd and polyurethane resins. Higher oil/resin ratio to promote flexibility.

- Marine varnish - Spar varnish with U/V absorbers to resist sunlight. May be made with phenolic or polyurethane resins.

Varnish

Characteristics of varnish:

- Each coat is unique.
- Each coat should be abraded to ensure adhesion between coats.
- Aggressive sanding will expose “witness rings”.

Varnish

Varnish may be sold in a number of ways:

- Wiping varnish - varnish diluted with a solvent that may wiped on.
- Oil/varnish mix - varnish mixed with oil and some solvent applied by wiping. Excess must be wiped off to avoid wrinkling.
- You can tell which you have by putting a few drops on a piece of glass. If it wrinkles when it dries then it's an oil/varnish mix.

Varnish

Wiping Varnish	**Oil/Varnish Mix**
Formby's Tung Oil Finish	Watco Danish Oil
Zar Wipe-on Tung Oil	Deft Danish Oil
Val-Oil	Behlen Danish Oil
Hope's Tung Oil Varnish	Maloof Finish
Gillespie Tung Oil	Behr Scandinavian Tung Oil Finish
Waterlox	Minwax Tung Oil Finish
General Finishes' Sealacell	Minwax Antique Oil Finish
General Finishes' Arm R Seal	Velvit Oil
Daly's ProFin	Behlen Salad Bowl Finish
Jasco Tung Oil	Behlen Teak Oil
	Watco Teak Oil

Oil Finishes

Types:	Linseed (flaxseed) oil, Tung oil.
Durability:	Not very hard or tough. Minimal protection from scratches, abuse.
Waterproof:	Tung oil has better water resistance than linseed oil.
Chemical resistance:	Poor resistance to solvents.
Repairability:	Easy. Just add another coat.
Appearance:	Close-to-the-wood satin finish.
Application:	Easy. Wipe on.
Safety:	Never leave oily rags rolled up. They can spontaneously ignite due to accelerating oxidation of the oil.

Oil Finishes

Pros	**Cons**
Easy to apply. Penetrates well. Dries reasonably hard. Shows off the beauty of the wood. Buffs to a nice satin finish. An overcoat of varnish can be applied after 3-4 days for better protection.	Long cure times. Poor durability. While it dries hard, it's still too soft to build up a thick film. Cannot be removed except by completely sanding the area penetrated by the oil. Some yellowing or darkening may occur over time. If you need a glossy finish there are better products.

Oil Finishes

Linseed Oil:

- Boiling makes linseed oil partially polymerize, greatly speeding up the cure time.
- Today most linseed is not boiled but chemically modified with metallic driers that make them cure faster.
- True boiled linseed oil is still available (see Tried & True products for an FDA approved finish)
- Boiled linseed oil is the only form of linseed oil suitable for woodworking.

Oil Finishes

Tung Oil:

- Pure tung oil will cure, but it takes time.
- Partially polymerized tung oil will cure much faster.
- Pure tung oil is non-toxic, but the addition of solvents or other additives can change that.
- Tung oil has greater water resistance than linseed oil and even has some resistance to alcohol.

Oil Finishes

Tung Oil:

- Beware of something labeled “Tung Oil Finish” if you want a true tung oil.

- These products may or may not even contain tung oil.

- They are cleverly marketing the finish as something that looks like a tung oil finish. In reality they are usually just a wiping varnish or oil/varnish mix that may or may not have been made with tung oil.

- To be fair they work fairly well. They look like an oil finish but the varnish makes them more durable.

Oil Finishes

The non-existant oil: Teak Oil

- Another misleading product is “Teak Oil” or “Teak Oil Finish”.
- There is no such thing as teak oil. Teak trees are not slashed, squeezed, or tapped to extract their oil.
- Formulations vary widely. May be linseed oil, tung oil, oil/varnish mix, wiping varnish, or even wax and turpentine.
- They don’t dry any better on oily exotic woods.
- They don’t “feed” the wood. Wood doesn’t need feeding.

Oil Finishes

What the heck is Danish Oil?

- Who knows! Generally it's a drying oil, either linseed or tung oil, that may or may not contain varnish.

- Examples:

Tried & True Danish Oil - 100% boiled linseed oil with no additives

Watco Danish Oil - Oil/varnish mix made with linseed oil

Oil Finishes

What the heck is Danish Oil? (cont.)

- It’s not a bad finish - just know what you’re getting.

- Bob Flexner says “made by squeezing Danes?” No. It’s just marketing hype to make you think you’re buying something special.

	Ease of application	Durability	Color	Enhances Depth	Thinning/ Cleaning Solvent
Wax	easy	poor	clear to amber	no	mineral spirits
Oils (Danish, tung, linseed)	easy	fair	amber	yes	mineral spirits
Shellac	moderate	good	light amber	yes	denatured alcohol
Lacquer	moderate	very good	light amber	somewhat	lacquer thinner
Catalyzed lacquer	difficult	excellent	light amber	somewhat	specialty thinner
Varnish	moderate	very good	amber	yes	mineral spirits
Oil-based polyurethane	moderate	excellent	amber	somewhat	mineral spirits
Waterbased polyurethane	moderate to difficult	very good	clear	no	none/ammonia in water

That's it. Happy finishing!