

Wood Finishing

Mostly based off of Bob Flexner's book "Understanding Wood Finishing" 3rd Revised Edition.

Why Finish Anyway

- Sanitation – keeps soil and grime out of the pores.
- Stabilization – Prevents water absorption that creates warping and cracks.
- Decoration – Provides color, texture, and sheen.

Color

- Chemical Reaction - Bleaching or Chemical Staining
- Glazing – Apply a colorant between coats of finish
- Toning or Shading – Add colorant to the finish

Staining

- Colorant – Is it pigment or dye?
- Amount of colorant?
- Binder – oil, varnish, lacquer, or water base?
- Thickness – is it liquid or gel?

Note: Limit sanding to 180 or 220 prior to staining

Pre-Stain Conditioner

- A Washcoat of thinned finish to avoid blotching on softer woods.
- Despite the instructions it needs to dry overnight before staining.

Finishes – 2 types

- Penetrating Finish

Oil finish – Linseed, Tung, Polymerized, Oil/Varnish blend, Wiping Varnish (often marketed as an oil finish), Walnut, Mineral

Wax – Least protective of any finish

- Film Finish

Shellac

Lacquer

Varnish

Two-Part

Water Base

Linseed Oil

- Raw Linseed oil is rarely used anymore. Dries very slowly (weeks) and provided poor moisture protection.
- Boiled Linseed oil dries overnight but still has very poor moisture protection

Extracted from seeds of the flax plant. Both are a dark color. Least protective against scratches or water (except wax finish).

Tung Oil

- Requires five or more coats with a couple of days between coats to get a good finish that is fairly water resistant. Requires sanding between coats.
- Soft finish that does not resist scratching
- Some products marketed as a Tung Oil may be varnish with a little or no actual tung oil in them.

Extracted from nuts of the tung plant.

Film Finish

- Dry hard so can be built up to a thickness.
- Protects better against scratches, water, water vapor (humidity).
- Offer more options for coloration by adding color to the finish (Toning) or between coats (Glazing).
- Sheen can be controlled by rubbing the final coat with an abrasive or using a finish that has a flattening agent added.

How Finishes Cure

- Evaporative Finishes – by evaporation of the solvent

Cure time is dependent on the evaporation of the solvent. Each coat partially dissolves the previous coat entangling the molecules of each coat into one thicker coat. Shellac and Lacquer

- Reactive Finishes – as the thinner evaporates the molecules will bond with the previous layer by crosslinking or polymerization. Each coat doesn't dissolve the previous coat.

Cure time is dependent on the speed of crosslinking. Each coat must cure hard before the next coat. Varnish and two-part finish

- Coalescing Finishes – water based and depends on evaporation of the water for the layers to bond.

Comparing Evaporative, Reactive, and Coalescing Finishes

The way a finish cures tells you a lot about that finish. Here is an overview of the three types.

Type of Finish	Evaporative (shellac and lacquer)	Reactive (varnish and two-part finish)	Coalescing (water base)
Curing is totally dependent upon the speed at which the solvent evaporates	Yes	No	Yes
Coats dissolve into each other	Yes	No	Partially
Can pile coats on top of each other without waiting for the previous to dry	Yes	No	No
Difficult to damage	No	Yes	Difficult to scratch but easy to damage with heat or solvents
Very water and water-vapor resistant	No	Yes	No

Sanding Sealers

- Not needed to actually seal the wood or make the bond with the finish any better.
- It primarily acts as the first coat of a finish making it easier to sand after this coat resulting in a smoother finish. It also reduces grain raising, seals off oil, resin, wax, or odors in the wood.
- Sanding the first coat is always recommended but because varnish and lacquer are difficult to sand a sanding sealer makes it easier.
- Not needed for polyurethane, shellac, pre-catalyzed lacquer, or water based because they are easy to sand after the first coat.
- Downside – reduces durability, water resistance, and can crumble if struck hard, even with another finish on top of it.

Shellac

- Natural Resin secreted by insects called lac bugs primarily in India. Takes about 1.5 million bugs to make 1 lb of shellac
- Natural shellac resin is dark orange in color containing about 5% wax. You can buy as is or bleached out, with wax or without, in liquid or solid-flake form.
- Many colors and varieties of flakes are available which are dissolved in denatured alcohol.
- Dries to a gloss finish which can be rubbed with #0000 steel wool to flatten the sheen or can have a flattening agent added to the liquid.

Shellac

- Liquid Shellac is sold in 2, 3, 4-pound cuts (pounds of shellac to gallons of alcohol. Most often sold as 3-pound cut. SealCoat is 2-pound cut.
- Solid or flake shellac can be dissolved in denatured alcohol for finishing.
- Used as a finish and very often in a sealer.
- Shellac has a short shelf life. The older it is the longer it takes to dry.
- Allow 2 hours to dry between coats.

Shellac

Pros & Cons

PROS

- Bonds well over oil, wax, and resin and blocks odors
- Excellent barrier to silicone
- Denatured-alcohol solvent is less harmful to breathe and less smelly than most other solvents
- Dewaxed variety has excellent clarity and depth
- Amber variety adds warmth to dark and dark-stained woods
- Good rubbing properties

CONS

- Weak resistance to heat, water, solvents, and chemicals
- Only moderate resistance to wear
- Short shelf life

Lacquer

- Became available in the 1920's.
- Most are based on microcellulose, which is made by treating cellulose fibers in cotton and wood with nitric and sulphuric acids. Plasticizers are then added to improve flexibility.
- Can be damaged by extended contact with plastic materials such as tabletop pads and cushions for lamps.

Lacquer

Pros & Cons

PROS

- Very fast drying
- With the addition of slower- or faster-evaporating thinners, can be applied in all types of weather
- Much reduced runs and sags when spraying
- Excellent clarity and depth
- Excellent rubbing properties

CONS

- High solvent content (solvent is toxic, flammable, and air-polluting)
- Only moderate heat, wear, solvent, acid, and alkali resistance
- Only moderate water and water-vapor resistance

Lacquer

- Very fast drying. Can be repaired easily between coats. Can be recoated when spraying before the previous coat is completely dry.
- Stands out for the depth, clarity, and beauty it brings out in wood.
- Can be left in a spray gun for days without having to clean as the lacquer redissolves and cleans itself.
- Not as protective as other finishes. It is slow to build so it takes many coats to build a good finish. More subject to blushing and fish eye due to silicone on the wood.
- Solvents are very toxic, polluting, and flammable.

Varnish

- Made by cooking a curing oil with synthetic resin. Modern varnish uses soybean oil and safflower oil to cure better. They yellow less than the previously used linseed oil. All varnish yellows over time.
- Most protective and durable of most common finishes.
- Higher ratio of oil to resin is more flexible and used for outdoors (Spar or Marine varnish). Lower ratio of oil to resin is harder and used indoors.
- Easy to brush, miserable to spray. Fewer coats needed to build a finish.

Varnish

Pros & Cons

PROS

- Excellent heat, wear, solvent, acid, and alkali resistance
- Excellent water and water-vapor resistance
- Brushes easily with long open time

CONS

- Very slow curing, resulting in dust problems and runs
- Yellows over time

Two-part Finishes

- Most widely used are catalyzed finishes made from alkyd and amino resins.
- Conversion Varnish (catalyzed varnish) – most durable of the three.
- Post-catalyzed lacquer (post-cat) – has nitrocellulose lacquer added to conversion varnish.
- Pre-catalyzed (pre-cat) – same as post-cat but with a weaker acid that is added by the manufacturer so it can be packaged in a single container.

Two-Part Finishes

Pros & Cons

PROS

- Excellent heat, wear, solvent, acid, and alkali resistance
- Excellent water and water-vapor resistance
- Very fast curing
- Reduced solvent emissions compared with most finishes

CONS

- Hazardous chemicals and fumes
- Often difficult to incorporate decorative coloring steps
- Very difficult to produce invisible repairs
- Very difficult to strip

Water-Based

- New to the market
- Made with acrylic and polyurethane resins that dispersed in water
- May still contain up to 20% solvents
- Raises the grain of wood
- Easy cleanup of brushes, difficult cleanup of spray gun

Water-based

Pros & Cons

PROS

- Minimal solvent fumes
- Not a fire hazard
- Easy brush cleanup
- Nonyellowing
- Very scuff-resistant

CONS

- Produces bland, washed-out appearance on dark woods
- Very weather sensitive during application
- Raises the grain of the wood
- Only moderate heat, solvent, acid, alkali, water, and water-vapor resistance (about the same as nitrocellulose lacquer)
- All decoration steps are more difficult than with solvent-based finishes

Comparing Finishes

	Wax	Oil-Containing Finishes	Shellac	Lacquer	Varnish	Two-Part Finishes	Water Base
APPEARANCE							
Film build	0 to 1	0 to 1	1 to 5	1 to 5	1 to 5	1 to 5	1 to 5
Clarity	4	4	3 to 5	5	4 to 5	4	3 to 4
Non-yellowing	5	1 to 2	1 to 4	3 to 4	1 to 2	4	5
PROTECTION							
Water resistance	0 to 1	0 to 2	2	3	4 to 5	5	3
Water-vapor resistance	0 to 1	0 to 1	5	3	4 to 5	5	3
DURABILITY							
Wear resistance	0	0	3	3	4 to 5	5	4
Solvent and chemical resistance	0	3	1	2	4 to 5	5	2
Heat resistance	0	3	1	2	4 to 5	5	2
APPLICATION EASE							
Brush or cloth	3	5	3	1 to 3	5	1	3
Spray	3	5	4	5	4	4	4
Dust problems	5	5	4	4	0	4	3
SAFETY							
Health	5	3 to 4	4	2	3	0	4
Environment	4 to 5	1-5	4	0	1	0	4
Safety for food contact	*	*	*	*	*	*	*
REVERSIBILITY							
Repairing	5	5	4	4	1 to 2	0	3
Stripping	4	3	5	5	2 to 3	0	4
RUBBING QUALITIES	N/A	N/A	4	5	3	3	3

Legend: 0 = very poor; 5 = best

**All finishes are safe for food contact once they have fully cured.*

What's in it?

Throughout the book he stresses the lack of information given to consumer on many products you see on the shelf. From stains to sealers and finishes. Many are combinations of more than one finish.

How to Tell Which Finish You Have

	Raw and Boiled Linseed Oil	Tung Oil	True Polymerized Oil	Oil/Varnish Blend	Wiping Varnish
The label will almost always tell you correctly.	Yes	Yes	Yes	No	No
The label lists petroleum distillate (mineral spirits) as an ingredient.	No	No	Yes	Yes ¹	Yes
A thin coat gets tacky quickly under a blow dryer.	No	No	Yes	No	Yes
It cures soft and wrinkled when puddled on glass or on the lid of the container.	Yes	Yes	No	Yes ²	No
It cures hard and smooth when puddled on glass or on the lid of the container.	No	No	Yes	No	Yes

1. Maloof finish is an exception. It doesn't contain mineral spirits.

2. Oil/varnish blend cures harder and wrinkles less than linseed oil or tung oil.

Selecting a Finish

No best finish, only most appropriate finish for given situation.

- Appearance – potential film buildup, clarity, and color
- Protection – is protection from water and humidity an objective?
- Durability – Polyurethane is the most durable against scratches
- Ease of application – can it be sprayed, what is the speed of curing
- Safety – to you, the environment, the user
- Reversibility – ease of repair or removal
- Ease of rubbing – hardness, coats dissolve together

Selecting a Finish

Comparing Finishes

	Wax	Oil-Containing Finishes	Shellac	Lacquer	Varnish	Two-Part Finishes	Water Base
APPEARANCE							
Film build	0 to 1	0 to 1	1 to 5	1 to 5	1 to 5	1 to 5	1 to 5
Clarity	4	4	3 to 5	5	4 to 5	4	3 to 4
Non-yellowing	5	1 to 2	1 to 4	3 to 4	1 to 2	4	5
PROTECTION							
Water resistance	0 to 1	0 to 2	2	3	4 to 5	5	3
Water-vapor resistance	0 to 1	0 to 1	5	3	4 to 5	5	3
DURABILITY							
Wear resistance	0	0	3	3	4 to 5	5	4
Solvent and chemical resistance	0	3	1	2	4 to 5	5	2
Heat resistance	0	3	1	2	4 to 5	5	2
APPLICATION EASE							
Brush or cloth	3	5	3	1 to 3	5	1	3
Spray	3	5	4	5	4	4	4
Dust problems	5	5	4	4	0	4	3
SAFETY							
Health	5	3 to 4	4	2	3	0	4
Environment	4 to 5	1-5	4	0	1	0	4
Safety for food contact	*	*	*	*	*	*	*
REVERSIBILITY							
Repairing	5	5	4	4	1 to 2	0	3
Stripping	4	3	5	5	2 to 3	0	4
RUBBING QUALITIES	N/A	N/A	4	5	3	3	3

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