Coloring Agents

Coloring agents are dyes, stains, dye-stains, chemicals, and paints.

Always ask for a product data sheet [PDS] for the coloring agent you wish to use. The seller is required to have one. Carefully read the PDS.

Dyes

Have no pigment, penetrates the wood, and changes the cell wall of wood. They dissolve in the proper solvent and never settle to the bottom of a can. You cannot trust the label of some commercial products to ensure that it is a dye. Even if the label states that it is a dye it may be a stain or a dye/stain. If there is no sediment in the bottom of a can then it is a dye. The large and small pores of wood will be nearly the same color when dyed. Thus, there is very little color contrast when compared to stains. Dying wood, allowing it to dry and then staining it is a common practice.

Types of Dye:

Water based dyes – This is the most lightfast colorant. Pigments and glazes help protect all colorants from changes caused by light. These are the easiest to use of all dyes. They include TransTint and Arti dyes. These are environmentally friendly and non-toxic. If you spray a water based dye add 20% alcohol to the mixture to get a better result.

Oil based dyes- These are mixed with either mineral spirits or lacquer thinner. They are not as colorfast as waterbased dyes. They may bleed through lacquer coatings.

Alcohol dyes- They made for spraying. They can be modified with a retarder for hand application. For hand application add a retarder such as butanol or glycol ether. These dyes have lightfast characteristics that vary widely. You
should dilute the dye with de-natured grain alcohol [first choice], de-natured alcohol, or methanol [very toxic].

**Metalized dyes** - These are made from metal and are excellent for their colorfast properties. The brand name of one is TransTint. The solvents vary from water to alcohol.

**Non Grain Raising [NGR] stains** - These should be classified as dyes. Many times they are metalized dyes. If the label states "UPS or glycol ether they are a NGR stain or dye.

As a general rule more than one ounce of a dye may be needed to do a chair as multiple coats may be needed to get the correct color intensity.

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**Stains**

Have a pigment[s] that lays on the surface of the wood and does not penetrate the wood very far. You cannot trust the label of some commercial products to ensure that it is a stain. Even if the label states that it is a stain it may be a stain or a dye/stain. If there is sedimnt in the bottom of a can then it is a dye or a dye/stain. See dye/stain for an explanation. If you use the word “stain” as a noun, stains have a pigment and dyes do not. There are three components to a stain: Pigment, binder, and solvent [carrier].

A pigment is a solid material that you can recognize as it settles to the bottom of a container. When using a stain if the color comes off you have not allowed enough time for the binder to set.

A binder is the material that causes the pigment to adhere to the wood. Binders can be a varnish, oil, lacquer, or a synthetic resin. A binder must be given adequate time to set [dry] for a stain to adhere. Drying time guidelines are [dependent on temperature and humidity]: 8 hours for an oil binder; and, 3 hours for a varnish binder. * Varathane is a brand name of an oil stain that uses soy oil. As a general rule Varathane brand stains have a lighter color as soy oil is lighter in color.

A solvent or carrier is the chemical compound that dissolves/dilutes the pigment and binder to make a stain work. Oil and varnish based stains use mineral spirits, naphtha [both aliphatic chemicals], or petroleum distillates. Lacquer uses xylene or toluene as carriers/solvents. Toluene is a carcinogen.

As a general rule one ounce of a stain will do a chair.
Dye/Stains
These are mixtures of dyes and stains. They have the same solvent and are a mixture of a dye and a stain. You cannot trust the label of some commercial products to ensure that it is a dye/stain. Even if the label states that it is a dye/stain it may not be. If there is sediment in the bottom of a can then it is a stain or a dye/stain. You can determine this by a “best guess” by approximation of the amount of sediment in the bottom of the can.

Chemicals
These are compounds such as lye and potassium dichromate. They attack the wood to cause a molecular reaction color change. They can produce colors that no stain or dye can produce. Using chemicals can be interesting to use but they are extremely dangerous. Carefully do research before you use these chemicals. Sodium hydroxide [Red Devil Lye] mixed with water [add an acid to water – not water to acid!] will give Cherry and mahogany a warm brown look. Potassium dichromate will turn mahogany to a warm brown.

The term “mordant” means that wood is treated chemically before the wood is dyed.

Paint
Paint is another material that has a pigment, binder, and a carrier. Shellac, varnish, lacquer, and waterbased coating can all be made into paints. Currently, the best paint is Valspar brand.

Changing colors of existing colors and coatings
This is accomplished by using Universal Tinting Colors [UTC], Mixols, or Japan Colors.

Universal Tinting Colors [UTC]
The components of UTCs are glycol ether and a pigment. They are compatible with solvent based varnish, urethanes, lacquers, oil based stains, and water based stains. They are NOT compatible with an alcohol based product such as shellac. If you use more than a 10% solution of a UTC it will never harden. That means use less than 10% of a UTC in the carrier. The best brand name of a UTC is Proline.

Mixols
These are another type of a UTC. Its components are glycol ether and a pigment. They are compatible with solvent based varnish, urethanes,
lacquers, oil based stains, water based stains, AND some alcohol based products such as shellac.

**Japan Colors**
These are great products for restoration projects. They are thick, heavy, concentrated solvent based pigmented compounds. They use alkyd resin binders. They are compatible with varnishes, lacquers, and oil based stains.

**Coloring Techniques**
The color of wood is changed by using any of the following techniques by the application of the color directly to wood as follows:

- Dye
- Dye on dye
- Stain
- Stain on dye
- Chemicals
- Dyes on chemicals
- Stains on chemicals
- Glazing – applying pigmented color on top of a coating
- Toners – mixing color into your coating before you apply the coating. You can make your own dye toner or pigmented toner.

**Sanding Sealers**
The first film forming coating that is applied to wood is your sealer coat. The mission of that coat is to lock the “whiskers” of wood into place so you can sand the whiskers off. Thus, use thin coats. The safest way to remove these whiskers is not sandpaper but the back of old sandpaper or a brown grocery bag. A lot times it makes sense just to make the sealer coat as a sealer coat.

Manufacturers produce a “varnish sealer” or lacquer “sanding sealer” which is a softer version of varnish or lacquer. Zinc sterate has been added to these sanding sealers to make them easier to sand.

**Use and problems associated with sanding sealers:**
Too thick of an application can cause problems. Usually, the result is that you will end up with a very soft finish under a ‘very hard finish that will cause the finish to crack. Another symptom is that the finish will appear milky.

Use a dewaxed shellac as a sealer coat to prevent pine knots from bleeding pitch through your coating.

Use dewaxed shellac as a sealer to prevent fish eye.
Use a vinyl sealer [found in some lacquer sealers] when finishing teak or rosewood because they will provide better adhesion because of the woods oiliness.

**Compatibility of sanding sealers:**
Make sure that your sanding sealer is compatible with the top coat. If not, a faulty chemical reaction will take place and your finish will fail.

Rules to follow are
- Varnish can be applied on top of lacquer
- Lacquer cannot be applied on top of varnish.
- Any top coat can be applied on top of dewaxed shellac.

**Filling Pores in Wood**
The purpose of grain fillers, also called pore fillers, is to create a closed pore finish. If you use pore fillers you will be unable to feel any texture in the wood.

**Types of Pore Fillers:**
- **Solvent based fillers** with Silex which is quartz rock. It is less likely to shrink than other types of fillers. You should use this type of filler when you are using shellac or any other solvent based coating. They come in a variety of colors. To change the color of solvent based fillers you must use Japan Colors, UTCs, Mixols, or oil based stains.

- **Water based fillers** set very fast. You can extend the setting time by adding glycol ether. They come in a wide variety of colors. To change the color of water based fillers you must use UTCs or Mixols.

- **The term liquid filler** is used when your topcoat is the filler.

- **Industrial materials** are sprayed as fillers and will fill the pores. They are not readily available to a woodworker.

**Methods of filling wood pores:**
- **Apply the filler directly to raw wood.** Doing so will stain your wood at the same time you are filling the pores. This is convenient when you want the large and small pores to have the same color.

- **Apply the filler on top of your sealer coat** when you want a contrasting color between the large and small pores of the wood. Using filler in this manner allows you to use a wider variety of colors. Example: small pores can be a golden brown and the larger pores can be a darker brown.
**Application of solvent based fillers:**

Practice on a one foot square piece of board first to avoid a disaster

If needed, add solvents to make the filler’s viscosity a cream-like texture.

Solvents could be mineral spirits [slow evaporation rate] or naptha [fast evaporation rate].

Apply the filler with a brush or a rag.

Use a plastic trowel to pack the filler into the wood’s pores. Trowel both with and across the grain and be persistent in doing so.

Use the trowel to remove most of the filler. This filler can be saved and placed back into the filler being used. It merely has to have its texture changed by the solvent being used in the filler.

Carefully read the directions on the filler can’s label to learn how long you must wait for the next step. Usually you wait 10 to 20 minutes, depending on the temperature and humidity.

Use burlap and wipe the wood, across the grain, to remove the excess filler. Use care to not pull the filler out of the wood’s pores.

If the filler is too hard to remove you can lightly dampen the filler with naptha on a rag and dissolve it off. Use care when doing this so you do not pull the filler out of the wood’s pores.

Wait 24 hours, or more, and then lightly sand any excess filler with sandpaper, using grits of 220 and 320.

If you need a second coating of filler wait three days before re-applying.

Wait three days before the application of a top coat of finish.

**Application of a water based filler:**

You use the same procedure as when using solvent based fillers but you must work much faster in both the application and removal of the filler.
Wood filler defects:

**Puffing** is the swelling of the filler after application of the next topcoat. This is caused because you did not wait long enough for the binder in the filler to cure and the solvents of the coating are dissolving into the filler.

**Graying** is when the filler turns grey in the wood’s pores. This is because you thinned the filler too much. Silex has a natural color of grey. The color change is not obvious until the filler dries.

**Furniture Finish Categories**

Finishes are defined by how they cure: solvent release; reactive coatings; and, coalescing.

Solvent release coatings dry totally by the evaporation of solvents [volatile] leaving behind the content of the solid coating [non-volatile]. Examples of these finishes are lacquer and shellac.

There two types of reactive coatings; those that need oxygen to cure, and those that require a catalyst to cure [two part coatings].

Those that need oxygen are curing oils like tung oil, linseed oil, boiled linseed oil, soya (soy oil), and others like varnish, urethane, and polyurethane.

Those that require a catalyst are; pre-catalyzed lacquer, conversion varnish, polyesters, and epoxy.

Coalescing coatings are already cured but pack themselves together as they dry. They are water based coatings.

**Properties of finishes to choose from are** straight oils, shellac, lacquer, catalyzed lacquer, varnish, conversion varnish, polyester, and waterbased.

**Straight oils**- tung oil, linseed oil, boiled linseed oil. These require lots of curing time between applications. They usually require a thinning with mineral spirits. They provide almost no protection against anything. They are penetrating finishes and are not film forming.

**Shellac** is made from the lacquifer of the lac bug indigenous to India. They produce, depending on the weather 30,000 to 50,000 metric tons a year. Price of shellac varies widely due to insect production. The lacquifer is processed and made into flakes and buttons which are then dissolved in ethanol. A “cut” of shellac is based on the ratio of shellac to ethanol. Example a one pound cut of shellac is one pound of shellac dissolved in one gallon of ethanol.
Shellac is rated by its color and wax content. Colors have many names the most common being blond [white], orange [amber], and garnet [dark]. Other colors are Kushmi [lighter], Bysacki [very dark], and Siam [reddish]. Blond shellac has a shorter shelf life than other shellacs whether it is in solution or in flake or button form.

Shellac can be purchased in liquid, flake, or button form.

Shellac can be purchased as either waxed or dewaxed. Dewaxed shellac must be used if you are going to put another coating on top of it.

Shellac makes wood very beautiful. It is easily repairable and reversible. It can be applied by padding, spraying, or brushing. It is easy to make from buttons or flakes. It is an excellent sealer for finish compatibility and fish eye problems. It becomes dust proof within minutes, can be rubbed out to any sheen, and is environmentally friendly.

Shellacs limitations are that it is the easiest of all film finishes to damage as it is not heat or chemical resistant.

Shellac’s formulas:
- ½ pound cut – makes a great pre-conditioner for wood such as birch and maple before you apply a dye.
  a. 1 pint = 1 oz. shellac to 16 oz. alcohol
  b. 1 quart = 2 oz. shellac to 32 oz. alcohol
  c. ½ gallon = 4 oz. shellac to 64 oz. of alcohol
  d. 1 gallon = 8 oz. shellac to 128 oz. alcohol

- ¾ pound cut - makes a great pre-conditioner for wood such as birch and maple before you apply a dye.
  o a. 1 pint = 1 oz. shellac to 10.67 oz alcohol
  o b. 1 quart = 3 oz. shellac to 32 oz. alcohol
  o c. ½ gallon = 6 oz. shellac to 64 oz. alcohol
  o d. 1 gallon = 12 oz. shellac to 128 oz. alcohol

- 1 pound cut
  o a. ½ pint = 1 oz. shellac to 8 oz. alcohol
  o b. 1 quart = 4 oz. shellac to 32 oz. alcohol
  o c. ½ gallon = 8 oz. shellac to 64 oz. alcohol
  o d. 1 gallon = 16 oz. shellac to 128 oz. alcohol
• 1 1/4 pound cut – this is the best cut for brushing until you have lots of experience
  o a. 1 oz. shellac to 6.4 oz. alcohol
  o b. 1 quart = 5 oz. shellac to 32 oz. alcohol
  o c. ½ gallon = 10 oz. shellac to 64 oz. alcohol
  o d. 1 gallon = 20 oz. shellac to 128 oz. alcohol

• 1 ½ pound cut
  o a. 1 oz. shellac to 5.33 oz. alcohol
  o b. 1 quart = 6 oz. shellac to 32 oz. alcohol
  o c. ½ gallon = 12 oz. shellac to 64 oz. alcohol
  o d. 1 gallon = 24 oz. shellac to 128 oz. alcohol

• 2 pound cut – this is the best cut for French Polishing
  o a. 1 oz. shellac to 4 oz. alcohol
  o b. 1 quart = 8 oz. shellac to 32 oz. alcohol
  o c. ½ gallon = 16 oz. shellac to 64 oz. alcohol
  o d. 1 gallon = 32 oz. shellac to 128 oz. alcohol

Lacquer originated from cellulose nitrate which was used for making bombs. Lacquer was first used on wood in 1920. It is normally made for spraying but can be modified so it can be applied by brush. Its components have additional resins such as alkyds, acrylics, phenolics, and urethanes as well as plasticizers and solvents.

It becomes dust proof within a few minutes, is more durable than shellac, rubs out to any sheen, it can be padded, brushed, or sprayed. It is reversible and repairable.

It is better than shellac but is still not excellent for heat protection and is not solvent proof. It is made with nitrocellulose which is explosive and the solvents in it are also explosive. To use it you need explosion proof fans, lights, and switches. Keep in mind that turbine spray guns have a spark driven motor.

Use a flattening compound for lacquer to get a satin look. This is available from Homestead Finishing.

Spray cans of lacquer contain alkyd resins. To thin these, use the same brand of thinner.

Use the same brand of a retarder to smooth out the surface.
A “rough” appearing surface is caused by holding the spray can too far from what is being sprayed. A normal distance to prevent this is about 6 inches. Distance is greatly determined by temperature and humidity.

**Catalyzed lacquer** an acid catalyst must be added to promote curing. It can be purchased as a “pre-cat”,[once opened it has a shelf life of 6 months] or a “post-cat” [available in spray cans].

They are extremely durable as well as heat and solvent resistant. They dry quickly and are dust proof within minutes.

They must be sprayed and they are very difficult to repair.

**Varnish** is a natural fossil that dissolves in alcohol and are referred to as “spirit varnishes.”

Today’s varnishes are made from alkyd resins and their components are resins, oils, driers, and thinners.

Resins are either alkyds [hard to rub out], rosin ester gum, phenolics [you can rub these to a high sheen but you must let them cure for at least 2 weeks], and urethane [usually have alkyds added].

Oils added to varnish can be tung [impert an amber color], linseed [impert a dark brown color], and Soya [impert a very clear tone].

Driers added are metallic salts that make oil cure faster. They can include cobalt or manganese which are sold as “Japan driers.” If used in small amounts, you can add Japan drier to varnish to make it cure even faster.

Thinners used in varnish are mineral spirits [evaporates slowly] and napthha [evaporates fastest].

Varnish is more durable than off the shelf lacquer. You do not need explosive proof equipment to use it. It is very attractive and comes in many forms such as crush on, rag on, and gelled.

The disadvantage of varnish is that it cures slowly so it is not dust proof [takes 2-4 hours], recoating times vary widely. It can be repaired but not as easily as lacquer or shellac. It does not rub out as well as shellac or lacquer.
**Conversion varnish** is very durable. It is extremely difficult if not impossible to repair or remove.

**Polyester finishes** are extremely durable, creates a lot of visual depth in wood. It is extremely difficult if not impossible to repair or remove.

**Waterbased finishes** have had many of the organic solvents replaced with water in order to become compliant with hazardous air pollutant [HAP] and volatile organic solvent [VOC] regulations.

Components of waterbased finishes are resins, glycol ether, ethylene glycol, surfactants, and defoamers.

Resins will either be acrylic which can be rubbed out or urethane which cannot be rubbed out.

Glycol ether is an organic solvent that acts as a “bridging” solvent which makes the resins be compatible with water.

Surfactants help make the water follow out. Ammonia is a commonly used surfactant.

Defoamers are fatty and oily materials added to defoam the coating due to the surfactants.

These are good because they put less solvents into the air, they add not color in the finish [may be good], the brush clean up is easier but clean up is difficult in a spray gun.

Both acrylics and urethanes are fairly durable.

They raise the grain of wood, add no color to the wood, if it comes in contact with metal it will causing rusting, it is slow to cure on days when the humidity is high, due to its chemistry it is not easy to manipulate. Finally, the technology of these compounds is constantly changing.

**Finishing Problems**

Finishing problems are either functional or organic; as follows:

**Runs or sags** are caused by application of the finish too thickly.
**Fisheye** is caused by surface tension differences in the coatings. Silicon is usually the culprit. You can prevent this by using dewaxed shellac as a sealer or barrier coat. If your finish is a pure silicone you must use a fisheye eliminator in your coating.

**Orange peel** is caused by a failure of the coating to flow itself out. This is caused by; spraying too fast, an overdraft of air over the surface; the temperature is too hot and you must add retarders, or spraying too far away from the target surface.

**Blushing** is caused by water on the surface of the wood or coating. The remedies are to add retarders or bridging solvents to your coating; or, add your coating when the humidity is lower.

**Blooming** is caused by the oil in the stain not being allowed to cure enough when you coated it.

**Pinholing** is caused by air displacement from the wood’s pores. It is caused by: application of the coating too thickly or heavily; using an improper brush for the coating; water or oil in the hose line of your spraying equipment; a temperature difference between the target wood and the coating [be sure and keep your hose off the floor when spraying]; or, a solvent imbalance of the coating and the thinner.

### Leveling Out a Finish
Leveling is cured by sanding between coats. It is important to get rid of dust, brush marks, orange peel, and padding marks. Use the grit of sandpaper to get rid of the defect as quickly as possible but use the finest grit possible.

You need to sand for adhesion between chemical hardening forming file forming oats [non-shellac and non-lacquer compounds].

You never sand for adhesion when using shellac or lacquer.

### Rubbing Out a Finish
Level out your last application of finish then you have several choices to continue:
- 0000 steel wool with soap and water
- Scotch brite pads
- Wet or dry sandpaper up to 12,000 grit
- Abralon pads
- Pumice, Rottenstone, or Tripoli and oil
Keep in mind that all of the above items will cause scratch marks so be sure that your finish is thick enough that you will not rub through it.

**Tools for application of finishes**

Use rags, brushes, and spray guns.

**Rags** should be lint free so loose fragments of the rag do not imbed themselves into the coating being used. They are an excellent choice for application of gelled coatings, oil and oil/varnish blends and shellac.

**French polishing** is term used for finishing with rag and not a material. French polishing is performed with either wax or shellac. The motion used is circular or a figure 8 if working into a corner.

**French padding** is a term for finishing with a rag while using a pendulum motion.

Polishing and padding materials are shellac, denatured alcohol, wool, linen, lint free cheesecloth, mineral oil, and 4-F pumice.

**To French polish** use a 2 pound cut of shellac. Prepare the wood by sanding to 180 or 220 grit. Dust off the surface. Raise the grain by adding water with a sponge. Once dry, the wood can be dyed. Make a tampon by soaking a piece of wool [a 4” square is normally a good size] in the 2 pound cut of shellac and then hang it up to dry. When the wool rag becomes dry and brittle it is ready to use.

**Step one** is to fill in the pores of the wood. Fill the pores with conventional wood filler or use the “old world” way. The “old world” way is to rub mineral oil into the wood and wipe off the excess. This will help your rag slide over the surface. Fold the wool [corners to center] the size and shape of an egg, wrap linen around the wool and this is what is called a tampon. Now, sprinkle denatured alcohol onto the bottom of the tampon and squeeze it in. Remember that the wetter the tampon the lighter the squeeze. Make a “pumice bag” using 4-F pumice. Now, tap some pumice on the surface of the wood. Rub the wood, with moderate pressure, in a circular motion. You should be able to hear a grinding sound as you create sawdust that is being mixed with oil and shellac that is being driven into the wood’s pores. You will occasionally need to add pumice and alcohol. The wood’s pores should appear to fill without building up a finish. Once the pores are filled it is time to start to French polish.
* Note that anytime you are not using the tampon you need to place it in an airtight container.

Step two is to body up the finish. Bodying means building a thick coat of shellac on the wood. With a new tampon, place some shellac into the tampon. Using your finger, apply a small amount of oil to the surface of the tampon that will come in contact with the wood. Hand pressure now becomes critical. Use a pendulum motion swinging across the wood. You are looking for a “cloud’ with a “comet tail” behind it. It will appear when you have the right amount of oil, shellac, and pressure. Once you see this “comet tail” you can begin to use a circular motion. Try to always maintain the “comet tail.” The cloud will become smaller and less distinct when you’re running out of shellac and oil. When the tampon does this you need to add more shellac or it is a good time to stop French Polishing.

Roping is a defect that will occur when you are applying too much shellac too quickly. The best way to reduce/eliminate this problem is to reduce the cut of the shellac.

Step three is rubbing out the finish. Use rottenstone or 4-F pumice inside cheesecloth. You can also wet sand or use rubbing compounds to obtain the desired sheen. It is normal to obtain a very high gloss when you French Polish.

Brushes are made up of a handle, plug, ferrule, and bristles. Bristles are either flagged or tapered. Flagged bristles are split on the ends and are good for solvent or oil based coatings. Tapered bristles are good for shellac and water based coatings.

There are two types of brushes: blond china hair bristles [blond china bristle with 15% ox hair in it], badger hair, and red sable hair. These are for solvent based coatings; and, polyester blends of nylon and polyester aka “Taklon.” These brushes work well with shellac ad waterbased coatings.

Preparing a brush for use: Hit the brush on the edge of the workbench to remove loose bristles. Dampen the brush with the proper solvent before dipping it into the can.

- Shellac – dip into alcohol [ethanol or denatured alcohol].
- Lacquer – dip into lacquer thinner
- Varnish or urethane – dip into mineral spirits
- Waterbased – dip into distilled water
Using a brush: Hold the brush by the ferrule and dip the bristles 1/3 of the way into the container of the coating. Watch for the wet mil thickness that you are applying to keep it uniform, tipping the brush is done after you have brushed on he coating.

If you are brushing a lacquer be sure and use a natural hair brush.

Robert Simmons Sapphire brand brushes are great for shellac and water based coatings.

A good source for brushes is through the Internet at Gary’s Art-O-Rama.

Cleaning the brush:

Shellac – Clean with alcohol. You can leave a small amount of shellac in the brush to help maintain the brush’s shape.

Lacquer – Clean with lacquer thinner and then soap and water

Varnish – Clean with lacquer thinner and then soap and water

Water based – Clean with soap and water

Spraying

Viscosity – How thick, or thin, the material is, in the can, at 72 degrees F., or the solid content of you coating by volume. Viscosity is measured with a #2 Zahn cup or a #4 Ford cup. The millimeter size of you fluid nozzle and needle relates to your viscosity.

Atomization – The breaking up of the liquid coating into droplets.

Air cap – How well it works with the fluid nozzle and needle to atomize your coating.

Transfer efficiency – How efficient your spraying equipment is working to put as much material onto the material on the substrate as possible.

Wet mill thickness – How thick you are applying the coating on the substrate.

Dry mil thickness – How thick the coating is upon drying.

- Solids by weight multiplied by the mil thickness applied
- Example: 30% solids times 4 mils wet
  .30 x 4 = 1.2 mils thick
To get an approximation of volume-solids from weight solids reduce the weight solids by 20%
Types of Spraying Equipment
Sprayers are identified as being bleeders or non-bleeders.

A bleeder continually bleeds air through the gun once the air is turned on. These are usually turbine units.

A non-bleeder has air passing through the gun only when you pull the trigger. These operate using air from an air compressor.

HVLP means a high volume low pressure system. These systems can be purchased as a bleeder type [turbine] or a non-bleeder type [compressor required]. These systems cannot deliver more than 10 PSI at the tip of the gun.

LVLP means low volume low pressure. It is able to deliver materials at lower PSI and is also able to deliver materials higher than 10 PSI at the tip.

Airless systems - These systems are just a pump that brings a liquid to the gun.

Air assist systems – These systems have been modified with a pump for atomization of a liquid.

Sources of Air Supply
Air sources are for sprayers are either compressed air or turbines.

Compressed air is usually not as portable as a turbine supply. The user must match the compressor to the size of the spray gun.

Cubic feet per minute [CFM]: You need to check the gun for its CFM@PSI measurement for the gun to function properly.

Good estimates are as follows:

- 1 ½ to 2 HP ----- 6 to 7 CFM
- 3 to 5 HP --------- 8 to 20 CFM
- 5 to 10 HP -------- 20 to 40 CFM
- 10-14 HP -------- 40 to 60 CFM
Turbines are more portable. They have different stages of motors for power. Currently they vary from ½ stage to 5 stage, as follows:

- One stage – 40 to 50 CFM and 3 PSI
- Two stage – 104 to 115 CFM and 4 PSI
- Three stage – 100 to 130 CFM and 4-6 PSI
- Four stage – 110 to 130 CFM and 8 PSI
- Five stage – 135 to 150 CFM and 10 PSI

**Sources of Fluid Delivery**

There are three sources for the delivery of fluid to the spray gun, as follows:

**The cup is on top of the gun** which is a gravity feed.

**The cup is underneath the gun** which is a cup gun.

**There is no cup on the gun** which is a remote pressure pot. This is a pressurized system with a remote cup that varies in size from a quart to a 55 gallon drum.

**Recommended settings for spraying**

**Thin material** [14-18 seconds]
Medium material [20 to 22 seconds]

**Dyes** – with thin material –
Use set number 0.5 mm or 71111
Use air cap 71051
Use fluid nozzle 71071

**1 ½ pound shellac** – with thin material –
Use set number 1.0 mm or 71333
Use air cap 71053
Fluid nozzle 71073

**Lacquer** – with medium material
Use set number 1.4 mm or 71444
Use air cap 71054
Use fluid nozzle 71064

**Varnish** – with medium material
Use 1.4 mm or 71444
Use air cap 71054
Use fluid nozzle 71064

**Urethane** – with medium material
Use 1.4 mm or 71444
Use air cap 71054
Use fluid nozzle 71064

**Spray Patterns:**

The size and shape of the pattern will indicate success or problems

What a spray pattern should look like:

Defective spray patterns and what causes them:

**The top heavy pattern** is caused by the horn holes being partially plugged or an obstruction on the top of the fluid tip

**The bottom heavy pattern** is caused by the horn holes being partially plugged or an obstruction on the bottom of the fluid tip

**The right side heavy pattern** is caused by the right side holes being partially plugged or dirt on the right side of the fluid tip.
The left side heavy pattern is caused by the left side holes being partially plugged or dirt on the left side of the fluid tip.

The center heavy pattern is caused by too low of a setting of the spreader adjuster valve. Another problem could be with the pressure feed, too high of a fluid pressure for the atomizing air being used or the material flow is in excess of the caps normal capacity. It is also possible that the fluid nozzle is too small for the fluid being sprayed.

A split spray pattern is caused by the air and fluid mixture not being properly balanced.

Spray Finishing Techniques

Spray pattern – The distance you are away from the target is your fan pattern size. A six inch spray pattern is six inches wide and six inches from the air cap.

Overlap – Try to maintain a 50% overlap in your fan pattern

Cadence – Try to maintain a rhythm or cadence count when you spray

Thickness – Try to maintain the same wet mil thickness

Troubleshooting Spray Gun Problems

No or slow fluid flow, intermittent spray, or fluttering spray.

Cause – proper size fluid set is not being used. To correct select the proper fluid set for the fluid being sprayed

Cause – the air cap is adjusted too far forward. To correct adjust the air cap to a “normal” position.
Cause – The gun fluid nozzle is not tight enough, is blocked by dried paint, or is damaged. To correct you need to tighten, clean, or replace the fluid nozzle.

Cause – The cup or pressure pot cover is not tight enough or the gasket is damaged. To correct you need to tighten or replace the gasket.

Cause – The cup or pressure pot fluid tube is blocked or damaged. To correct you need to clean or replace the fluid tube.

Cause – The air flow cup is blocked. To check you need to remove the cup (leave the cover connected), trigger the gun and check for air flow out of the cup lower pressure tube. If air is not flowing freely, clean the air passage tubes.

Cause – The needle packings are not properly adjusted. Fluid loss through the packings will affect fluid pressure and cause a fluid build-up in the gun body. To correct clean the gun body with solvent and the brush provided. Then, adjust the needle packings.

Cause – The needle is not properly adjusted. Fluid flow will be restricted if there is too much free travel between the trigger and the needle. To correct, adjust the needle.

**Fluid leaks at the fluid nozzle after the trigger is released.**

Cause – The needle is not seating in the fluid nozzle. To correct check for a loose fluid nozzle or a bent nozzle; tighten the nozzle or replace parts as needed. Also, check the needle adjustment. Finally, check the needle packings adjustments.

**Poor spray pattern.**

Cause – The air cap horn holes and/or fluid nozzle is plugged. To correct, soak the air cap and/or fluid nozzle in solvent. Then, clean the air cap horn holes with a non-metallic compound to prevent permanently damaging them.

**Orange peel finish.**

Cause – The coating droplets are too large. To correct maintain a proper spraying distance. Keep the turbine air filters clean to all a full flow of air. Do not use an air hose that is too long to provide sufficient atomization
pressure. If droplets are still too large, reduce the fluid or use a smaller air cap.

Cause – Coating droplets drying too fast to properly flow out of the gun. To correct, keep the object being sprayed out of direct sunlight. When spraying in warmer temperatures, use a slower evaporating solvent or a retarder.

Cause – Cold weather spraying. To correct, keep the fluid and the object being sprayed as close to room temperature as possible. When sprayed on a cold surface, most paints will become too thick to flow properly.

**Blushing, clear coatings appear milky.**

Cause – Moisture condensation is trapped in the lacquer when spraying in hot, humid conditions. To correct, allow the turbine to warm up a few minutes before spraying. Store the lacquer off concrete floors and at room temperature. Apply lighter (thinner) coats and allow for a proper drying time. Use a slower evaporating solvent or retarder. Do not spray in windy conditions.

**Fish eyes as small pools in a sprayed surface that will not fill.**

Cause – Silicone contamination from lubricants, grease, polish, or wax on the surface being sprayed. To correct, clean all parts with a cleaning solvent; use a solvent rag and a clean rag to wipe with. Replace rags as needed. If the problem persists, use a fish eye eliminator.

**Runs and sags.**

Cause – The application of too much covering per pass for the drying conditions. To correct, move the gun faster or decrease the fluid flow. Maintain the proper spraying distance. Reduce the amount of thinner or use a faster drying thinner.

**Solvent pops or bubbles.**

Cause – The sprayed surface is drying before the solvent gas can be released. To correct, apply the fluid in lighter coats to allow for proper evaporation. Use the recommended thinners. Follow the solutions for orange peel problems.
Finishing the Finish

To finish the finish that you have applied you have a choice between waxes and oils.

**Wax** - Be careful in your selection of a wax because some waxes contain silicone and you do not want silicone on wood.

Carnauba wax is the best choice in a wax as they are very durable.

Mineral spirits will remove wax from a finish without disturbing an existing film forming finish.

**Oil** - These are not recommended to use for finishing wood. Oils tend to attract and collect dust resulting in a gummy surface. Paraffin oils should never be used on wood.

Mineral spirits will remove oils from a finish without disturbing an existing film forming finish.

**Finishing Products Resource List**

**Mohawk products:**
Can be purchased online at [www.mohawkfinishing.com](http://www.mohawkfinishing.com). The website also lists retail dealers of the Mohawk products as well. Be aware that some Mohawk dealers do not stock the entire Mohawk line so do your research before you walk into a store. They may have to order materials for you. There is an $80 minimum order from the Mohawk website and you may pay more from the website than buying from a dealer’s store or a dealer’s website. One dealer that has no minimum order is [www.magicwoodrepair.com](http://www.magicwoodrepair.com).

**Behlen Products:**
Available at Woodcraft, Rockler and other wood working supply stores. Since Behlen is owned by the same parent company as Mohawk [RPM], you can sometimes find equivalent products with different names. For example, if you like the Mohawk Ultra Penetrating Stain [dye], the Behlen Solarlux Stain [dye] is the same stuff.

**TransTints Dyes:**
Available at Rockler, Woodcraft, Highland Hardware Atlanta online, Joe the Woodworker online, and [www.homesteadfinishingproducts.com](http://www.homesteadfinishingproducts.com).
<table>
<thead>
<tr>
<th><strong>Artist color</strong></th>
<th><strong>Transtint Dye color</strong></th>
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</thead>
<tbody>
<tr>
<td>Burnt Umber</td>
<td>Brown Mahogany</td>
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<tr>
<td>Raw Sienna</td>
<td>Golden Brown</td>
</tr>
<tr>
<td>Burnt Sienna</td>
<td>Reddish Brown</td>
</tr>
<tr>
<td>Raw Umber</td>
<td>Dark Mission Brown</td>
</tr>
<tr>
<td>Yellow ochre</td>
<td>Honey Amber</td>
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</tbody>
</table>

**Old Masters Stains:**
Their Full Bodied Wiping Stain is a pigmented stain that also is a good oil based glaze. They also sell a grain filler. Old Masters products are carried by many paint stores and some hardware stores. Check out a list of dealers at [www.myoldmasters.com](http://www.myoldmasters.com).

<table>
<thead>
<tr>
<th><strong>Artist color</strong></th>
<th><strong>Old Masters color</strong></th>
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<tbody>
<tr>
<td>Burnt Umber</td>
<td>Cedar</td>
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<tr>
<td>Raw Sienna</td>
<td>Puritan Pine</td>
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<tr>
<td>Burnt Sienna</td>
<td>Cherry</td>
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<tr>
<td>Raw Umber</td>
<td>Dark Walnut</td>
</tr>
<tr>
<td>Van Dyke Brown</td>
<td>Provincial</td>
</tr>
</tbody>
</table>

**Mixols:**
Pigment in glycol ether that will allow you to color oil and water based stains, shellac, oil based varnishes, and water based stains.

**Arti Water Dyes:**
Highland Hardware Atlanta on line.

**Shellac:**
Shellac flakes can be purchased at [www.homesteadfinishingproucts.com](http://www.homesteadfinishingproucts.com) or [www.shellac.net](http://www.shellac.net). Homestead also carries 5 pound cut shellac concentrates. Olde Mill Cabinet Shop is also a good shellac source. You can dissolve shellac flakes in Behlen’s Behkol or 180 proof grain alcohol form the liquor store [Everclear]. Beware that the chemicals in methanol is very toxic and can be absorbed from the air through the lungs and eye tissue.

**Brushes:**
Homestead Finishing sells the larger [1-1/2”] Golden Taklon brushes used for waterbased finishes and shellac. Try the Althena series 7100 [1-1/2”]. It is a Taklon with a rounded tip that works well in corners and on turnings. A Robert Simmons Sapphire or Sienna was brush is a good choice in a 1” or 1-1/2” size. Smaller Golden Taklon brushes can be purchased at art supply stores like Michaels. Also, look for Michaels’ brand American Painter brushes. Good “starter” Taklon brushes can be purchased at Wal-Mart.
Good varnish brushes are available from Homestead Finishing, Highland Hardware Atlanta, and badger “style” brushes at woodworking stores like Rockler and Woodcraft. Other good brushes are ox flow brushes and brushes made by Grammercy Tools.

Shellac Padding Materials:
Cover materials for a pad can be purchased from Mohawk Finishing as Trace Cloth. One of the best materials for the interior pad is a bit of wool sock or sweater. Old sweaters are available at Goodwill.

Waterlox Varnish:
Learn more at www.Waterlox.com. Their website also has a list of dealers. Waterlox is generally sold at woodworking stores and higher end paint stores. Make sure you buy a can of Bloxygen or wine preservative to keep your varnish from curing in the can.

Bloxygen:
Spray into a can of varnish or an oil based product to keep it from curing in the can. You can buy it at Rockler, Woodcraft, or Highland Hardware Atlanta.

You can also use nitrogen sold in wine stores as a “wine preserver” to keep open bottles of wine from oxidizing.

Liberon Steel 0000 Steel Wool:
This stuff feels like silk. It is great for rubbing out a finish. Available at Rockler, Woodcraft, or Highland Hardware Atlanta and any place that sells Liberon products.

Asphaltum/Tar Glaze Base:
Buy unfibered roofing tar or Gilsonite from Sherwin Williams and mix 2 teaspoons of tar with a cup of mineral spirits. To use this, wipe it on and after the mineral spirits evaporate spray over it to seal. Be careful if you try to wipe or brush over it as you can smear the tar deposit. This gives a nice “aged” look to your finish.

3M PPP System [Paint Preparation System] disposable spray paint gun cups:
Purchase from Rockler, spray gun retailers, body shops, and paint supply stores.

One drop bottles:
Potassium Dichromate & Van Dyke crystals:
You can buy these chemicals at Olde Mille cabinet Shop’s online store. Olde Mill is also a great source for hide glue, milk paint, shellac, etc.

HVLP Spray Finishing:
Good HVLP guns to consider include:
- Sata
- CA technologies
- Kremlin
- Binks
- Turbines – Graco, Fuji, Earlex

**Online Stores and Resources:**

Olde Mill Cabinet Shop:  [www.oldemill.com](http://www.oldemill.com)
A great source for: Van Dyke crystals; potassium dichromate; hide glue; milk paint; 4F Pumice; and shellac

Mohawk Finishing:  [www.mowhawkfinishing.com](http://www.mowhawkfinishing.com)
A full line of professional finishing products and furniture touchup products. Place small Mohawk orders at [www.magicwoodrepair.com](http://www.magicwoodrepair.com)

Homestead Finishing:  [www.homesteadfinishingproducts.com](http://www.homesteadfinishingproducts.com)
Spray guns, shellac, Taklon brushes, badger hair brushes, TransTints, and Mixols.

Highland Hardware Atlanta:  [www.highlandhardware.com](http://www.highlandhardware.com)
Tools, shellac, Taklon and badger hair brushes, Liberon Finishing products.

Finisher’s Depot:  [www.finishersdepot.com](http://www.finishersdepot.com)
They carry a full line of finisher’s products and touch up supplies.

Rockler:  [www.rockler.com](http://www.rockler.com)
They carry tools, Behlen finishing products, shellac, 4F Pumice, Liberon products, Bloxygen.

Woodcraft:  [www.woodcraft.com](http://www.woodcraft.com)
They carry tools, Behlen finishing products, Waterlox [some stores], shellac, 2F and 4F pumice, Bloxygen, and Mixol products.

Spray Gun Solutions:
Spray gun cleaning kits for your spray gun.
Van Dyke’s Restorers:  www.vandykes.com
Replacement hardware, touch up supplies.

Tim Puro:  www.MonroeFurnitureRestoration.com or
Tim@MonroeFurnitureRestoration.com

Mitch Kohanek:
Fresh Air Finishers
1200 North Concord Street
Suite 210
South St. Paul, MN 55075

Project:
The goal is to finish a small box with a glossy finish with an almost pore filled finish.  This box should be able to withstand a lot of handling.

• Brush on a 1-1/2 pound cut of shellac.  Wait 20 minutes and then immediately brush on a second coat of shellac.  Wait 30 minutes then immediately brush on a third coat of shellac.  Allow these coats to dry for at least one hour – longer if it is hot and humid.  If the sandpaper gums up it is not yet dry.

• Sand the shellac with 220 grit sandpaper.  The goal is to sand most of the shellac off.  Doing so will leave the pores filled with shellac.

• Brush on a 1-1/2 pound cut of shellac.  Allow this coat to dry for 1-2 hours.

• Scuff sand the brush marks out of the shellac if necessary.

• Brush on a 1-1/2 pound cut of shellac.  Allow this coat to dry 48 hours.

• Scuff sand the brush marks out of the shellac if necessary.

• Brush on a 1-1/2 pound cut of shellac.  Allow this coat to dry 48 hours.  You will be spraying lacquer over the shellac so you want it to be properly cured.

• Spray a coat of aerosol lacquer and allow it to dry for 30-60 minutes.

• Scuff the lacquer to make it smooth if you need to with 400 grit sandpaper.

• Spray another coat of lacquer and allow it to dry overnight.
• Scuff the lacquer to make it smooth if you need to with 400 grit sandpaper.

• Spray another coat of lacquer and allow it to dry 7-10 days.

• Lightly sand with P1000, P1200, and P1500 wet dry sandpaper using mineral spirits or water as a lubricant.

• Polish the box with automotive rubbing compounds such as Meguiars Swirl Remover or Mohawk’s Polybuff Step III, Levels 1, 2, and 3. [www.mohawk-finishing.com/catalog browse/asp?ictNbr=251](http://www.mohawk-finishing.com/catalog browse/asp?ictNbr=251)

• If you want a real durable lacquer buy this pre-catalyzed lacquer: [www.mohawk-finishing.com/catalog browse.asp?ictNbr=439](http://www.mohawk-finishing.com/catalog browse.asp?ictNbr=439)

• If you do not want to use a lacquer topcoat buy General Finish’s Endovar Gloss. This is a varnish and will impart a slight amber hue to the box. Three coats with a 400 grit sanding between coats should do it. With a small box it may be difficult to sand all of the corners and crevices.