



# Color Shift: Exposing the Mystery Behind Inconsistency in Finishes

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WE31

## COLOR SHIFTS

Even with the best intentions and best practices, we can still experience Color Shift.

Learning to identify what actions and subtleties we do each day in finishing that can lead to the color shift can help prevent the madness from repeating itself over and over.

### The Business side of Finishing

We all have common finishing problems. Protect yourself with clear, precisely written contracts with your customers BEFORE you begin to finish. Get a sign off with your customers' expectations and understanding along with your commitment to meet agreed upon finish. NEVER ASSUME your customer understands how color will naturally change, sheen variances and lighting influences.

ALWAYS provide a visual sample or examples of the type of finish they are looking for. This will insure clear communication of what to expect and what is acceptable to both parties.

Finishing is many times the most demanding job in any shop

- Choosing the proper finishing material to use for the application and appearance
- Performing consistent sequences of events and timing
- Affected by weather- humidity and temperatures
- Always seems to be rushed – never have enough time
- Fix/cover up mistakes made prior to the finishing room
- Can be very labor intensive
- No room for error

A great finish is contingent on many factors:

- **Story Board** constructed, signed off on and followed
- **Standard Operating Procedures (SOP's)**
- **Environment** - clean conditions and well ventilated finishing area and spray room
- **Finisher**- conscientious, meticulous and methodical
- **Equipment** well maintained, clean and in good working condition
- **Applications** and **Dry times** are consistent

What can cause color shift

**\*\*Design \*\* Wood species \*\* Sanding \*\* Dyes \*\*Stains \*\*Colorants/pigments \*\* Clear coats \*\*  
\*\*Primers \*\*Pigmented topcoats \*\* Temperature \*\* Sun- Age of wood \*\* Skipping steps \*\* Light source  
\*\*Applications \*\* Dry times \*\* Sheens \*\* Moisture content \*\* Film thickness \*\*Spray system\*\***

**DESIGN** will impact your ability to finish.

When designing, have the color and finish in mind. Remember that finishing is a system or series of steps that need to be followed. Bottle necks can occur from difficult situations. Try to consult with the finisher on efficient ways the finish can be accomplished and incorporated into the design.

Consider color, texture, grain and grade of the wood when specifying.

- **Color** – woods natural tone WILL influence the final color. A lot can be done with Stains, but use them to enhance not overcome a color.
- **Grain** – If you want a lot of grain to show use woods that have more pronounced grain appearance. I.e. Ash instead of maple
- **Distress** – If an old look is desired perhaps use a wood that contains knots verses a clear grade.
- **Texture**- Sandblasted and wire brush effects are popular right now. Be sure to get the depth of texture you desire before you start the finishing process

The greater the difference in color, the more work it is going to take to correct it.

Have a “team or shop meeting” at the beginning of the job to discuss the project to have everyone on the same page.

Different layups of veneer or grain direction can affect color appearance. SHIFT HAPPENS

**SAMPLES** are the beginning to the end. No one really likes making samples. Many hours are spent on silly pieces of scrap wood to get a “color” our customer will approve.

- How many samples do you make before charging extra?
- Are you getting paid for your samples?
- Make sure you are “realistic” with your dry times when making the samples. DO NOT RUSH
- Make them all the same size
- Make a cover overlay (light will change your color)
- Have a disclaimer and printed label with company name and space for description of finish and date

Samples Label should contain: Cover sheet

*Date Color name Customer Wood species Sanded Finish Sheen Disclaimer*

### **Value in Samples**

Use the samples as an **Opportunity** rather than an **Obstacle**. They can be used as a marketing and sales tool, production aid, and insurance policy.

**ALWAYS** make a Story Board on your samples or have a separate step panel to show how the sample was developed.

**A STORY BOARD can be used to “SELL” your work.**

A sample is the first thing a customer sees of your work.

- It will be the tool that justifies your price
- A physical example of your work.
- It allows them to touch, see and feel the quality of your finish that of which you will be judged on.
- Helps the customer understand the amount of work that goes into the finish

**Why is a step panel Important? Consistency and Time savings!**

Following a story board every step of the process will insure that consistent results occur.

Check your color against the “standard” with each piece; make the adjustment when needed **BEFORE** you move to the next step.

**Application and dry times MUST be consistent**

### **DIFFERENT WOOD, DIFFERENT FINISH**

Wood will change from the moment it comes from the saw mill to the last coat of finish to several years later and beyond. Color shift never ends.

- The changes that exists in the same species of wood is difficult to achieve consistency
- Like many materials, wood changes in sun light, some fade to a grayish hue, others darken. Some woods even undergo chemical changes that chemically change its color
- All woods will change color and darken over time with exposure to light. Even a “non-yellowing” finish cannot stop this from happening. The wood will still change color beneath the coating. UV blockers can be added to the coating to slow this process, acting similar to sun tan lotion, but just like suntan lotion will not stop you from getting a tan, it will control how much your skin is affected.

**Substrate Color** is part of the overall color of the finish. Stain cannot cover up significant differences in substrate color (sapwood for example).

- Stains work by adding color without obscuring the grain definition and character of the wood
- The substrate is a large part of the final color
- No “miracle” stain will produce a uniform color over substrate that varies widely in color, or an assembled piece made up of different wood species.

Ideally wood should be sorted and selected for color and appearance before/during the assembly process.

### **COLOR/CHARACTERISTIC OF WOODS**

**Hard Maple** - Very hard and dense. Hard on tools and cutting surfaces and has a very smooth surface. Primary wood used is actually the sapwood which ranges from white to blonde Heartwood is light brown Grain is straight, with a very fine texture. Although it takes finish well, it is Difficult to stain. Wiping stains will appear blotchy. Usually an NGR/wipe combination or spray stain is used.

**Soft Maple** - The term “Soft Maple” is used widely simply to separate it from hard maple. Soft Maple is similar to hard maple but not quite as hard or dense. Slightly darker in color than hard maple and tends to have more mineral streaking. Slightly lower in cost than hard maple

**Red Oak** - Very hard and durable. Sapwood is light. Heartwood is red brown with many shades in between, with pink, gray, and green hues. Grain varies depending on how the wood is cut, (plain vs quartersawn). Medium coarse texture and open pores. Takes finish well but is prone to bubbling due to the very open pore structure. Stains easily

**White Oak** - Harder and denser than red oak. Sapwood is white. Heartwood is gray brown- brown Grain varies depending on how the wood is cut, (plain vs quartersawn). Medium coarse texture and open pores. Takes finish well but is prone to bubbling due to the very open pore structure, but less so than red oak. Stains easily

**Walnut** - Good hardness and stability. Sapwood is very light. Heartwood is light to dark brown and may have a purpleish cast. Fine to medium texture and pore. Takes finish well. Stains work well. Often Walnut is finished natural due to its inherent beauty. Using a Sap stain helps make the color more uniform.

**Pine** - Is softwood. Light weight, moderately strong, dents easily. Sapwood ranges from white to yellow. Heartwood is light brown and may have a reddish hue. Fairly straight grain with medium texture. Takes finish fine but may require an extra coat. Need to use shellac or a stain blocking primer to keep knots from bleeding through solid colors. Wiping stains will appear blotchy and end grains will tend to go very dark. A spray-no wipe stain is a good choice here.

**Cherry** - Good hardness and strength. Sapwood is light to very white. Heartwood is light to dark reddish brown. Fairly fine and close grain, not as dense as maple. Takes finish very well. Will darken quickly and noticeably with exposure to light. Wiping stains will be somewhat blotchy, not as bad as maple. Multi-step systems and spray stains work well.

**Alder** - Lightweight, easy to work and sand. Dents easily. Sapwood and heartwood look similar and are light reddish-brown. Fine to medium grain structure. "Drinks in" finish usually needs one more coat of finish than other hardwoods. Wiping stains will appear blotchy. Spray stains and glazes work well

**European Beech** - Good hardness and strength. Relatively easy to work with. Pale cream color with sometimes pink or brown hue. Fine to medium grain structure. Takes finish very well. Has a lot of movement in service. Wiping stains will appear blotchy, especially on end grain. Spray stains work well

**Birch** - Good hardness and strength. Lighter than hard maple. Sapwood is white. Heartwood is light-reddish brown. Fine grain structure. Takes finish very well. Wiping stains will appear blotchy. Spray stains work well.

**Ash** - Known for its hardness but fairly easy to work and sand. Sapwood is light to white, heartwood is light brown/brown. Medium to coarse grain structure. Takes finishes well. Stains very well, similar to oak.

**Hickory** - Very hard and strong wood. Hard on tools and dull them quickly. Sapwood is white. Heartwood is brown with a red hue Grain is straight, coarse, and has open pores. Takes finish well. Somewhat prone to bubbling in the grain due to the open pore structure. Stains work fine but is most commonly finished natural, due to its inherent rustic look.

**Mahogany** - Hard strong and stable. Known for its natural beauty and color. Exhibits a luminous cats eye effect called "chatoyancy". Sapwood is pale but is usually culled out in the milling process. Heartwood ranges from pale pink to a dark reddish brown. Grain is straight, and fine to medium texture. Takes finish well. Somewhat prone to bubbling due to tiny open grain. All stains work well.

**Poplar** - Moderately strong. Fairly soft and dents easily. Sapwood is almost white. Heartwood is a creamy yellow to brown color. Very often has greenish streaks. Straight grained with a medium texture. Takes finish fine. Typically used as a paint grade wood and not stained. Wiping stains will appear blotchy. Mineral streaks can bleed through if a stain blocking primer is not used. Surfaces can become fuzzy when machine worked

Color shift happens when applied to same species different substrate. Whether it's Solid, Plywood, Veneer, Old, New, Heart wood or Sap wood.

**SANDING** – Always affects the results of color shift.

- **Type of Mineral** – Garnet, Aluminum Oxide, Silicon Carbide, Ceramic

Different types of minerals cut the surface differently even though they are the same grit. This tearing or cutting of the fibers differently will affect how the stain and finish will appear and adhere.

- **Type of Backing** – Film, Cloth, Paper, Mesh

Backing will affect the performance of the paper, the backing weight will affect to its flexibility and wear.

- **Type of Grit** – 100, 120, 150, 180, 220

Different grit scales will affect performance and appearance. Different Minerals in same grits will not produce same results or appearance.

- **Type of Back up pads** – Hard, Medium, Soft

Sanding is about contact, the more even the contact to the surface the more consistent the scratch. Hard back up pads are used for leveling or flat surfaces. Medium back up pads should be used for general purpose sanding. Soft back up pads are best used for curves, veneers or sealer sanding.

- **Hand vs Machine**

Two grit jump! Power tools moves much faster giving you a two grit difference. If you use 180 grit on machine you would need to use 240 grit by hand to achieve the same scratch. Machine sanding will produce consistent sanding only when properly maintained and supplied with adequate air (CFM/PSI)

- **Paper vs Sponge**

Sandpaper sands and cuts, sponges scuff. 100 grit sandpaper will produce a 100 grit scratch however 100 grit on a sponge will give you a 220- 240 scratch.

**SPONGES GRAIN/GRIT SCRATCH SCALE:** *Coarse*= 60-80 *Medium*= 120-150 *Fine*= 220-280

*Very Fine*=280-320 *Super Fine*= 450-600 *Micro Fine*= 800-1200 *Super Micro Fine*=1800-2500

Sanding consistent with both white wood sanding and sealer sanding will affect the consistency of your color. Be sure to check your work against the step panel. If several people are sanding, be sure to train the employees on the type of tools and sanding material you wish them to use to ensure consistency.

Air supply to tools will affect performance of the sander and appearance of the color. Average DA sander uses 15-18 cfm @ 90 psi. Use high flow connectors, 5/16" to 3/8" ID hoses and no longer than 25'

## DYE APPLICATION

Dyes have a low concentration of solids; this makes it easy to penetrate into the substrate easily however they can only penetrate so far before the fibers structure becomes saturated. Once total saturation occurs the color will puddle (looking like fisheye pools) and turn black.

Always apply dyes at low atomizing air pressure, with a quality spray gun, use a step panel, record flow rate, needle size, air pressure and fan pattern/distance. Angle of the gun toe/heal will cause stripes.

Dyes can be used to even out different color substrates. When trying to achieve the same HUE from different substrates make a step panel first on darkest specie, and then create story boards on the other woods to match the base tone of the darker specie. Dyes will not show real color until the finish is applied, thus this is why a step panel half-finished is important to achieve consistency. Waterborne dyes raise the grain more however they give deep vibrant color.

- **Dye/Stain** – Applying the dye on the substrate before the stain allows the dye to influence the color but the stain will be the dominate color.
- **Dye/Washcoat/Stain** – Applying a washcoat between the dye and the stain will flip the color. The dye now will be the dominate color.
- **Dye in Sealer** – Dye may be used to color clear sealers and topcoats without obscuring the grain and clarity of the finish. This process will produce a slight color hue change and give more depth in the finish if not overdone.
- **Dye mixed in Stain** – Addition of dye into compatible stains will give the color a deeper penetration and slight flip to colors appearance when viewed from an angle or in certain light.
- **Flow rate** – Concentration of dye applied to the surface will affect the color, saturation and appearance. Always record the flow rate when setting up the spray gun and check your settings against your step panel.
- **Air Pressure**- Atomizing air will change the Transfer Efficiency to the panel, this affect your color concentration and shift will happen
- **Acetone** – Using acetone to reduce dyes will allow for fast dry, faster evaporating solvent will make the dyes penetrate deeper, slightly darker. Faster solvents can also cause possible halos in corners and striping.

**TONERS** – Used to even out color, shift color, and highlight areas.

- **Dyes Toners** –Addition of dyes into sealers or topcoats to produce a slight color hue change and give more depth in the finish. The color change is slow and affects the hue and sheen slightly. A red stain could be changed to a warm brown color by using a green toner. Using the same red stain but applying a blue toner will give you a cool brown color.



- **Pigment Toners** - Addition of pigment (colorant pastes) into sealers or topcoats to produce a more opaque color change obscure grain and clarity. Looking at a color head on with pigments in a toner the color looks fine; however look at that same color from the side and it will appear painted. The color change is fast and affects hue and sheen. *NEVER ADD WIPING STAINS INTO SEALERS OR LACQUERS AS TONERS.*

**WIPING STAINS** - Transparent or semi-transparent coatings that colors the wood and accentuate grain by creating definition and bringing out the woods natural character. They are applied directly to the raw wood surface and are usually the first step in the finishing process after white wood sanding. Color shift will happen in wiping stain when;

- **Dwell time** – Allowing the stain to penetrate into the substrate for different time rates will affect the color. Wipe on/off will produce light color; longer dwell time will produce a darker color.
- **Wiping technique** – Wiping excess stain off with a clean rag vs. dirty saturated stain rag will give you consistent color and better adhesion. Type of rags, Cotton, cotton blend or polyester will absorb and affect color left behind.
- **Conditioner** – Wiping a clear base stain on the surface of the wood before the stain color will control some of the blotchiness that can occur in open grain or pores areas. Conditioners fill the open “thirsty pores” so the color stains penetrate more consistent as well as less than if not conditioned. When conditioning you must allow it to dry before applying the color stain to receive the affect and appearance you’re after. If conditioner is left to long before color stain is applied the effects of the conditioner can be lost and color can shift. Be consistent in time frames.
- **Sanding** – The type of sanding material and grit will affect both color and appearance. Sanding all substrates to the same grit will not always produce the same color. Solid wood should be sanded with a lower grit to open the profile, plywood sand one to two grits finer than the solid wood to even the colors, veneers sand one to two grits finer than the plywood to blend in with the other two substrates without getting too dark. I.e.; solid 120, plywood 150-180, veneer 220-240

Time frame from sanding to staining can affect color appearance. Wood is always moving, moisture, humidity, temperature, what and how you sand today will not have the same profile tomorrow.

- **Pigment load** – Stains have a binder that controls the pigment load excepted. When using a stain that is in excess of the pigment load or intermixing incompatible colorants or stains, inconsistency and adhesion will occur. Then real SHIFT HAPPENS.
- **Substrates** –Staining solid wood, stain penetrates less. Plywood, stain penetrates deeper, reflects the appearance of the type of core underneath and can show slight blotchiness due to cut of veneer layup. Veneers will become saturated quickly so fine sanding is necessary to avoid dark blotchy stain areas.

**CLEAR COATS** – Clear finishes not only seal and protect the wood; it also supplies the sheen and depth we see. With every coat, it’s like laying down a layer of glass; the finish will acts like a lens and magnify what is under it.

Clear finishes are made with different alkyds, resin, solvents etc. that will alter the “clarity” of the coating.

- **Clear** coatings (Root beer) have a slight amber cast to them, which will produce a warmer look on stains but a dirty look when applied over whites.
- **Water White** (Ginger ale) clear coats can cast a slight blue cast on wood tones producing a little cooler look and a brighter white.
- **Non- yellowing** (Seven up) clear coats cast a clear transparent effect that shifts the underlying color the least.

All clear coats WILL affect the final color. The film thickness of that coating will determine how much it magnifies the color and grain figure below.

**WATERBORNE CLEAR COATS** – Have a slight milky cast, sometimes blueish haze and tend to washout some color. Some species of wood like Walnut, Mahogany and Cherry can have an ashy or plastic look in appearance depending on the manufactures coating. Depending on the blend, straight acrylics (ginger ale) may cause grayish hue, as you blend acrylic resins with acrylic urethanes they become clearer. (seven up)

**PRIMERS** – The primers main function is to FILL and HIDE the substrate mineral streaks, pores, and to prepare a consistent color and fill for the final Pigmented Topcoat. Not all primers are the same in color, solids or make up of fillers which will influence the primers coloring.

The primers color and coverage to the substrate WILL affect the final color. SHIFT HAPPENS. When developing your sample be sure to use the same primer on the sample as the final piece. Sanding the primer more or less, film build of primer, and the amount of thinner used will all affect the final color.

**PIGMENTED TOPCOATS** – The final pigment topcoat when in a “white base” will stay more consistent due to the white base (hiding) and small amount of colorant needed to achieve a light to pastel color. Color Shift will happen when DARK colors are made in a “clear” base. The colorant added to the paint base is all you have for hiding and coverage so multiple thin layers need to be applied to achieve consistent coverage and uniformity. Applying too fast and too heavy with a dark color and SHIFT will happen. Remember that many paints darken as they dry, and if a post catalyzed paint, be sure to test the color with the product catalyzed before committing to the match. The color will shift once catalyzed.

**MIXING** – Thoroughly mixing stains, glazes, pigmented coatings and even clear coatings is paramount. Frequently, consistently, routinely mixing is important to retain consistent distribution of all pigments, resins and flattening agents.

- **Catalyst** –Incorrect measuring of catalysts can affect sheen, hardness, durability and can cause acid bloom, not to mention also integrity of the coating.
- **Stains/Glazes** – Colorant dispersion is paramount to consistency. Frequently agitate the stain and glaze while working with it. When NOT using the stain or glaze, COVER the can. Cans left open will allow

solvent to evaporate and thus change the workability and color will darken. NEVER ADD WIPING STAINS INTO SEALERS OR LACQUERS AS TONERS/SHADERS.

- **Sheen** – Finishes are generally Gloss when first manufactured, the amount of flattening agent added into the formula will change the final sheen. These flattening agents will settle to the bottom of the can and need to be gently agitated throughout the application process to ensure consistency in sheen and color. The higher the sheen the Brighter the color, Lower the sheen the color blends more and less vibrant.
- **Paint** – Like the stains it is important to thoroughly and consistently agitate the material. Some colorants float more than others and can surface in the can and the spray gun. Inconsistency in air pressure when spraying pigmented lacquers, wrong tip size, too much reduction or lack of correct CFM for the spray gun will/can affect the consistency of color.
- **Mixing containers** – DO NOT USE printed mixing cups that have logos printed on outside of the cup as “ladles” for dipping into lacquers, paints or polyesters, these can BLEED into your finish. Stay away from drinking cups that have a wax lining on the inside or outside of the cup, which can cause fisheye.

**SOLVENTS** – Number one offender. Wrong solvent, too much solvent, not enough solvent. Solvents are like spices in cooking, they make ALL the difference in whether you’re a short order cook or a chief. Wrong solvent can take your Italian dish to Cajun in a matter of seconds. Blends of solvents will determine how it flows, thins, dries, retards etc. Reducing with solvents will affect color change in the can, application and hiding. ALWAYS use the recommended solvent from manufacture with their coatings. SHIFT really happens with solvents. They are the secret silent un-expecting VILLAIN.

**COLORANTS** –Using wrong colorants in the coating can cause color float, fisheye, blushing, adhesion or just sink and not mix in at all. Too much colorant in a formula will cause inconsistency and adhesion issues. There are many types of colorants, Acrylics, Universal, Glycol, pastes, Dyes, Aniline powders and Gilsonite.

**SHEENS** –Sheens affect the color and depth of the coatings appearance. Duller sheens look flat and cooler, less vibrant. Higher sheens bring out the warmth, yellows and create the illusion of more depth. Sheens will also affect clarity, the more flattening agent in the product the more possibility of a haze or cloudy appearance.

- **Film Thickness**- Sheens are affected by the film thickness, the smoother the film the higher the sheen. You can have several layers using a dull finish; but achieve a higher sheen. The closer the finish is to the wood the duller the sheen. One or two coats of a gloss finish with little film build will still appear dull or satin.
- **Solvents** – The addition of retarders will elevate the sheen. The addition of wrong solvents can change the sheen to drop out to a dead flat or spike to a gloss.
- **Dry Times** – The true sheen will be achieved once the coating is completely dry and cured back. Judging sheen minutes or hours after it is applied will not be a correct read.

- **Humidity** - Humidity can affect dry time as well as the appearance of coatings sheen. When the air is saturated with water solvents will evaporate more slowly, causing the coating to dry slower. High humidity can also cause blushing, and even wrinkling in certain situations.

**ORDER OF APPLICATION** – The order of application, dry times and layering must be consistent. Changing up systems or skipping steps will ALWAYS cause a shift in color and appearance.

**MOISTURE CONTENT** – Color penetration will be affected by the moisture content in the wood. Lighter color with more moisture and Darker color in low humidity.

**TEMPERATURE** – Color and Finish adhesion and penetration will vary in temperature changes. The colder the substrates the harder it is to achieve even color, flow of finish, sheen and adhesion. Catalyzed finishes should be applied in 65 degree or higher temperatures to ensure optimum performance of the coating.

**DRY TIMES** – Proper dry time is paramount for consistent color, structural performance and integrity of the finish. Different dry times or dwell times of the stain and dyes can be jeopardized when the finish is applied to early due to the solvents possibly blending together and “dilute” the colors appearance. DO NOT RUSH PROCESS

**LIGHT SOURCE** – **Daylight**, natural light. **Incandescent**, (Home light) is strikingly bright or clear. **Florescent**, soft color used in stores lighting. The use of a light box will help in comparison of color variation and detection of metamerism. The light that the piece is viewed in should be the light source the color is MATCHED in.

**TEXTURE** – Texture will affect the overall appearance of the colors detail. You can achieve the HUE of the color when putting it on a different texture but not the correct appearance.

#### **Three key points to remember;**

1. ALWAYS create and follow a step panel/Story Board
2. Importance of dry times, documentation and procedure
3. Importance of selecting compatible finishing systems

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