



Color Theory

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The Three Dimensions of Color

Value, hue and chroma are standard terms used in the color industry to describe the three dimensions of color. Understanding value, hue and chroma is necessary for successful color adjustment. Please refer to the following graphic of the Color Sphere when considering these dimensions.

Value (lightness or darkness)

This dimension refers to the degree of lightness or darkness of the color. The value scale runs up and down the north/south axis of the color sphere, with the whitest at the top, gradually darkening shades of gray in the middle and the blackest black at the bottom.

Hue (color)

This dimension, which is the color we see, moves around the outer edge of the color sphere. It moves from yellow, to red, to blue, to green. Colors can move counterclockwise on the hue scale (i.e. a blue can be moved toward the red side and become a purple). Colors also can move clockwise on the hue scale (i.e. a blue can be moved toward the green side and become aqua). By the same token, a red can be made either bluer (purple or maroon) or more yellow (orange). A yellow can be made redder (orange) or greener (chartreuse).

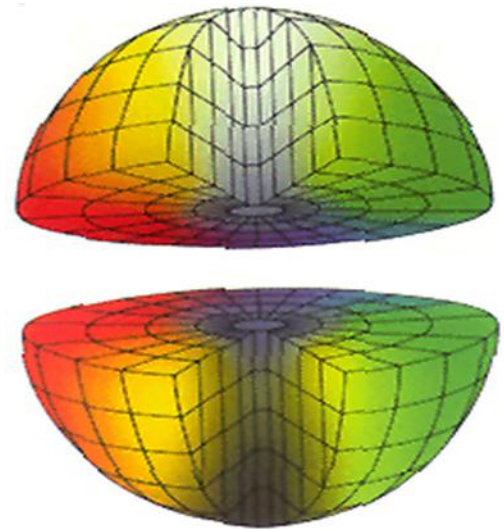
Chroma (intensity, richness, saturation)

Sometimes called saturation, chroma refers to a color's level of intensity and richness. This dimension moves along the spokes that radiate outward from the central gray axis of the color sphere. Weak, washed-out colors with the least chroma are at the core of the color sphere, while highly chromatic colors that are rich, vibrant and most intense are at the outer edge. A rich, pure red therefore is further away from the gray central axis than a red with less chroma.

Using the Three Dimensions of Color

Because a color change can take place in more than one dimension of color, understanding the three dimensions of color becomes important when you're noticing differences between the color of a vehicle being refinished and the color of the paint being used. That is, the color from vehicle paint to refinish may change in one, two or all three dimensions of color. It's important to know how to describe these color changes in terms of value, hue and chroma when making a match between the vehicle being refinished and paint.

When describing differences in color between the actual finish on a vehicle and the paint to be applied, always use the vehicle as the control and compare the paint to it. This gives you proper direction if the color has to be adjusted. You can change the color of your refinish paint; you cannot change the color of the vehicle. Consider the following scenarios:



Scenario 1

If there was a mismatch in hue, you would say: "The vehicle is (redder, bluer, greener, more yellow) than the paint." You would describe the mismatch similarly in terms of value and chroma.

Examples: "The vehicle is (darker, lighter) than the paint," (value). The vehicle is (more saturated, less saturated) than the paint." (chroma). When the comparison between the vehicle and the paint is stated in this way, you can easily see what needs to be done to the paint to correct the color difference.

Scenario 2

If, in terms of value, the vehicle is darker than the paint, the paint must be made darker to match the vehicle. If, in terms of hue, the vehicle is redder than the paint, the paint must be made redder to match the vehicle. And if, in terms of chroma, the vehicle is richer than the paint, then the paint must be made more saturated to match the vehicle.

Special Effects, Pearls and Metallics

The first metallic car colors introduced in the late 1920's were formulated by adding materials such as bronze powders to car paints. This began a trend of using metallics to give vehicles a "glamour look," which remained popular for decades. In the 1960's metallic paints were given dramatic highlights with the introduction of the fire frost aluminum flake.

Pearls, which were formulated in the 1960's, gained popularity in the late 1970's. Pearls give the vehicle finish a cleaner look than metallics because pearl flakes selectively reflect the most prominent color in the paint back in the direction of the light source. This causes the paint's base color to be projected more than any other color in the paint, which results in a paint color that is more intense. The use of pearls in today's colors allows the automotive market to offer colors that are cleaner and brighter with more sparkle than is possible with metallic flake. When painted in waterborne, the finish may appear even more brilliant.

The main difference between pearls and metallics: metallics reflect all of the light that shines into them, while pearls reflect back only the paint's primary hue.

Color Shift and Tri-Coats

Manufacturers are continually adding new special pigments into their color offerings in attempts to generate excitement around their vehicles, and meet consumer desire for a dramatic, changeable color effect. These pigments display a great deal of color shift and flop.

This new multi-effect paint features a fascinating sudden change in color and contrast. For example, a single finish can transition from a shining golden green to an extravagant rosewood, varied with amber and silver tints. This cascade of color effects is achieved with special pigments that break the light and reflect it in various ways. Color-shift finishes have no single color of their own - movement, light and differing viewing angles create a rainbow effect.

Another color effect being used today is what are commonly called tri-coats. These are special colors created by layering a selected base coat, followed by a midcoat (pearl or tinted clear) and topped with a clear coat. Different effects can be achieved by varying the amount of the pearl or tint over the base coat. The result - a dramatic finish unique to that vehicle.

These extraordinary effects are ideal for specialized stripes and graphics and are commonly used by custom vehicle enthusiasts and the aftermarket industry.

When Colors Flop

There is one more phenomenon you should be on the lookout for when you are comparing an original finish to a refinish color, and that is flop. Flop is a change in the value, hue or chroma of a vehicle finish when it is viewed from different angles. For example, viewed head on, a vehicle color may be a good match with your test panel. But when you move 45 or 60 degrees to the left or right, the color changes. Usually one or both of the side views is lighter or darker (value change), but any one of the three dimensions of color (hue, chroma, value) may change due to flop.

Flop variations occur with pearl and metallic colors. Solid colors do not exhibit flop. To understand why, think of the aluminum flakes and pearls in the paint as tiny mirrors. When light shines onto a mirror's surface, it is reflected back in exactly the opposite direction. Similarly, when light shines onto the aluminum flakes in a vehicle's finish, the flakes are reflected back in a straight line to the opposite direction. The brightness caused by this reflection is greatest when you are standing in the angle from which the light is reflecting. This brightness could drop off rapidly as you move away from this angle, depending on the pigmentation of the paint.

Metallic paints with non-transparent pigments have larger particles. These particles have more surface area to reflect light outward. For this reason, non-transparent pigments scatter some of the brightness to other viewing angles, and the brightness of the paint does not decrease rapidly when you change viewing angles. These colors are described as having low flop.

Metallic paints with transparent pigments absorb light, reducing the amount of light reflected outward. So if you view these pigments directly from the angle where the light is reflecting outward from the finish, you will see the highest level of brightness for that color. When viewed from any other angle, the brightness decreases rapidly. These colors are described as having high flop.

While high flop colors are attractive, you need to take special care to match the degree of flop in the area you are refinishing with the rest of the finish.

Techniques for Adjusting Color

There are several ways you can go about adjusting paint color. Here are some techniques that can help you reach your desired result.

When using a test panel, allow the paint enough time to dry. Be sure to allow proper flash and dry times between each coat, because paint usually gets darker as it dries. Remember - if you are testing a base coat/clear coat color, true color judgment cannot be made until the clear coat is applied over the base coat.

Your application technique could cause the color to vary. Painters who spray wet end up with a darker color than those who spray drier, especially with metallics and pearls (effect colors). Paint

applied in heavy wet coats dries more slowly, giving metallic flakes more time to sink deeper into the paint film. Because these buried flakes reflect less light, the paint looks darker. The reverse happens when paint is applied in lighter coats that dry faster. Choosing the correct basemaker or solvent for your application temperature also helps control color variation. Try these techniques before you decide to adjust the color.

Application (Spraying Technique)

To Make Darker

Hold gun closer to the job
Decrease gun speed
Don't wait as long between coats

To Make Lighter

Hold gun farther from the job
Increase gun speed
Wait longer between coats

Equipment

To Make Darker

Use a larger fluid tip
Decrease fan width
Decrease air pressure
Increase volume of material flow

To Make Lighter

Use smaller fluid tip
Increase fan width
Increase air pressure
Decrease volume of material flow

Shop Conditions

To Make Darker

Decrease temperature

To Make Lighter

Increase temperature

Solvent

To Make Darker

Use slower-dry solvent

To Make Lighter

Use faster-dry solvent

In the United States:
1.855.6.AXALTA
axalta.us

In Canada:
1.800.668.6945
axalta.ca

