Color

Color is a combination of the color of light that an object reflects and the nature of the material it is falling on.

The color of an object is a result of the wavelengths it does not absorb, i.e. the wavelengths it reflects. Therefore, a red object absorbs all colors except the color red, so that's the color we see when we look at the object.

Light is an additive system of color. Red, green, and blue are the primary colors of light. When mixed in pairs they produce magenta, cyan and yellow. Further mixing produces more colors. Total mixing produces white. White balancing the camera makes sure that white, which contains all of the digital colors, is correct for the lighting. When the value for white is correct, then the hues of all of the colors in the shot are correct.

Qualities of color

Hue: the wavelength of the color, or its place on the color spectrum. Humans can distinguish about 150 distinct hues. For general purposes, hue refers to what we see as the color itself: red, blue, green, orange, etc.

Value: the general lightness or darkness of the color

Chroma: the intensity or saturation of the color; it's relative brilliance or dullness. Turning the saturation down to zero in video produces a black & white image.

Warm and cool hues: The relative warmth or coolness of a hue, deriving from a psychological reaction to color. Red/red-orange is the warmest; blue is the coolest. Our subjective perception of the symbolic value of color enables the creation of specific themes and emotional content in a shot based on the warmth or coolness of the colors.

Color temperature: measured in degrees Kelvin and based on colors of a metal bar that is first heated to very high temperature and then allowed to cool. Color temperature is abbreviated with a capital K. Cool color temperatures are those over 5000K. These are bluish white. Lower color temperatures, around 2700 – 3200K are warm colors. These are yellowish white through red. Daylight is bluish light and has a cool, higher color temperature. Studio lights, indoor lighting, and candle light are more yellow, orange, or red. These have a warm, lower color temperature. Fluorescent lights throw a greenish color on your subject and have a middle color temperature of around 4500 – 4700K. See below for more details information on Color Temperature.)

Mixing colors: Primary colors are hues from which all other colors can be mixed. In light (as opposed to painting) the primary hues are red, green and blue. Secondary colors are those

made by mixing two primary colors. Red + blue = magenta. Blue + green = cyan. Red + green = yellow.

Additive colors: These are colors produced by mixing two beams of colored light, or by layering two or more colored gels, or by showing two colors in rapid succession. Computer monitors and television screens are common examples of additive light producing additive colors.

Subtractive colors: When pigments in an object absorb certain wavelengths of light and reflect others. The primary colors of subtractive light are red, blue, and yellow. Any object absorbs some wavelengths of color and reflects others. What we see as color are the reflected wavelengths. This is also the nature of print color where cyan, magenta, and yellow are considered the primary colors and, along with black (Y), are the basis of the four color printing process. The subtractive color model (where non-reflected colors are "subtracted," or absorbed) operates with CMYK and printing inks.

RGB: Red, green, and blue are the primary stimuli for human color perception. Our eyes work with light and react to various wavelengths by producing the sensation of color when our brains process the light. The RGB model very closely relates to the way we perceive color naturally.

Color space: This refers to the gamut, or range, of colors that cameras are capable of picking up. Film has a larger color space than video, but video is catching up. Video cameras also vary widely in their color space depending on make and model. Video monitors have a different color space than computer monitors.

Digital video color: The intensity of each color is measured on a scale from 0 to 255.

White balancing: The purpose of white balancing a video camera is to make sure the camera renders colors accurately, as they appear in real life. No camera can accurately render all color values in all lighting conditions, however. In a production, consistency counts as accuracy in terms of rendering color. The same red object, indoors and out, should have the same color in your shot, for example.

Lighting Gels and Filters

Color balancing with gels and filters: The terms *gel* refers to color material placed over lights or windows. *Filter* is the term for anything placed over the lens of the camera to control color and color value.

Why change the color of lighting using gels and filters?

1. To correct the color of the lights in order to color balance the video camera. Color balancing renders specific colors neutral and changes the overall color mixture of an image. In video, digital color balancing filters are often part of "cinema" modes in shooting and cinema filters in editing software. When you shoot in cinema mode, you are using a filter than you

cannot remove in post-production. Gelling the light gives you more control over the scene and you do not have to rely entirely on the color temperatures of the lights.

2. To match various lighting sources. Using a filter can make everything uniformly the same color. Three basic filters are *conversion, light balancing,* and *color correction.*

    a. *conversion gels* convert daylight to tungsten or tungsten to daylight. These are the most common gels.

    CTO (color temperature orange) gels will convert 6500K (cool blue light) to 3200K (warm orange/tungsten light). CTO gels will also warm up your scene. Using a full, half, or quarter CTO gel may change the scene so that the colors still appear natural, but the entire tone of the scene is warmer. You lose 2/3 of an f-stop with a CTO filter.

    CTB (color temperature blue) gels will convert tungsten warm hues to daylight hues. It's most common to use a CTB gel when you are shooting indoors with cool blue daylight coming from a window and need to combine that with tungsten lighting and you do not want competing warm and cool lights in your shot.

    b. *light balancing gels* also deal with combinations of warm and cool light but in smaller ranges and with more subtle corrections. They are used when only a slight correction is needed.

    c. *color correction gels* deal with the magenta versus green color range, which come into play when dealing with light sources other than tungsten. These are chiefly fluorescent lights. If the dominant light source is fluorescent, the color source is not steady but is the result of glowing gas excited by an electrical charge. Our eyes do not register the flicker caused by fluorescent lighting.

    The colors of fluorescent lights are heavy in green and while they may appear to be approximately correct, it is essential to white balance the video camera to avoid giving your image, especially in the brighter areas and in skin tones, a greenish tinge. Our eyes, once again, adjust our perception so that skin tones do not appear greenish. The camera, however, tells another story.

    Adding tungsten to a mostly fluorescent scene brings back a fuller color feeling to a shot that has a fluorescent lighting source. Using a magenta filter converts fluorescent light to a daylight color temperature.

    Kino Flo lighting is fluorescent lighting that is daylight balanced, so there is no greenish hue.

Camera Filters

Basic filter types

Diffusion: diffusion filters slightly alter the image making it softer, or more diffuse, reducing the amount of contrast in the image. Diffusion filters come in various densities. The amount of diffusion a filter will cause also depends on the f-stop. Focal length affects the amount of diffusion as well. A longer focal length lens will produce a more heavily diffused image.

Nets: also called *voiles*. Nylon stocking material can be used on the lens to create a subtler diffusion effect. The amount of diffusion depends on the fineness of the net's weave.

Neutral density (ND): these filters have no color range but simply reduce the overall exposure of the shot. Use ND filters for exposure control outdoors. Each ND filter setting represents changing the aperture by one f-stop. Using an ND filter allows for a narrow depth of field in bright lights by darkening the image and allowing you to open the aperture a little more, which creates the narrower depth of field. ND filters help prevent very bright areas of the frame from being blown out. Graduated or split ND filters allow you to reduce the exposure on only one area of the shot. If the sky is too bright, for example, or the clouds are blown out when you expose properly for what's at ground level, you can use a split ND filter to create different exposure values for the sky and for the ground. Most camcorders have built-in ND filters, which will change the exposure overall and are not graduated or split.

Contrast filters: used to reduce or soften the contrast in a scene. They work by making some of the image's highlights flare into the darker areas.

Color correction filters: these are placed in front of the lens rather than in front of the lights to correct for daylight or tungsten lighting conditions.

Polarizing filter: reduces or eliminates glare or reflection when shooting onto a glass surface.

COLOR TEMPERATURE

Different light sources are measured in degrees Kelvin based on the color they reflect from blue to orange. The temperatures listed below represent a range of color temperatures. Light often has more than one source, each varying in terms of color temperature. Always white balance.

Colored gels are used to balance daylight blues and tungsten oranges so that they match in your shot, and so that you can use the same color sense for daylight and indoor lighting as well as for situations where you use a combination of both, such as shooting indoors, with lights, near a window.

CTB (color temperature blue) gels – these are the most commonly used gels, converting the color temperature of tungsten (see chart below) to match daylight. They are made in varying intensities from very light (1/8th) to Double. The camera is set to daylight (in white balance settings). CTB gels absorb orange light, so the blue is what passes through.

CTO (color temperature orange) – correct daylight light to match the temperature of tungsten lights (studio lights). The camera is balanced to tungsten. CTO gels absorb blue light, so the orange is what passes through.

Magenta – magenta gels are used to subtract the green hue from non-professional (available or ambient) fluorescent lighting. Large sheets can be used to cover the lights themselves.

What are the specific ranges of color temperature?

Clear Blue Sky 10,000° Kelvin
Outdoor Shade 7000K
Cloudy Sky 6500
RGB Monitor 6500
Midday Sun 5500
Direct Sunlight 4800
Fluorescent 3200 - 7500
Moonlight 4000
Morning/Evening Light 3500
Tungsten/Studio/Lightbulbs 3200 - 3000
Sunrise/Sunset 2500
Candle Flame 1800 - 1000

You can find some of these specific color temperatures as menu items on the camera, that allow you to select/white balance by color temperature rather than doing a manual WB, or you can set them as presets in actual shooting situations.