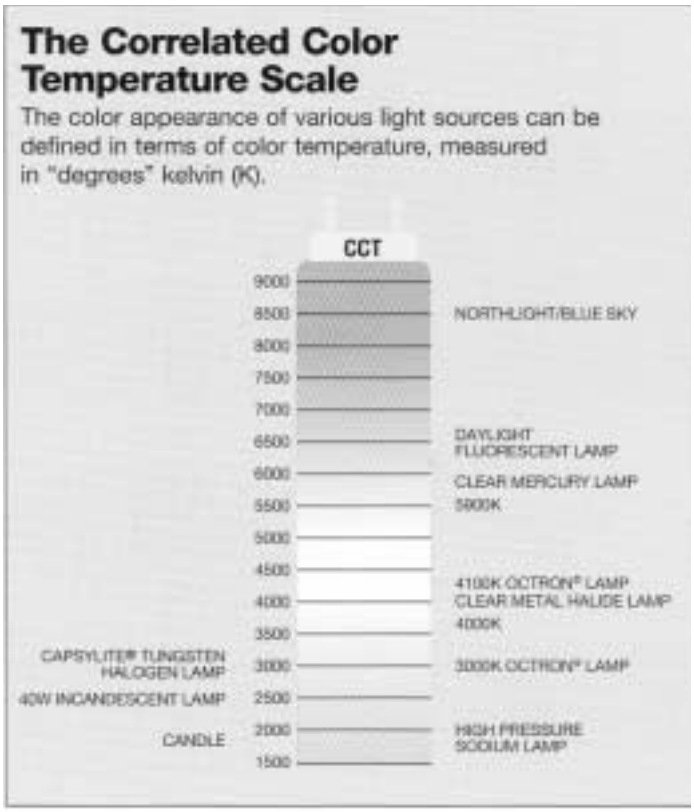
Color Correction - It's all about the red and the blue to get white

By Ted May



A long time ago a man named Lord Kelvin was heating a carbon ribbon referred to as a "black body radiator." As the carbon was heated, Lord Kelvin was noting the color change and assigning a degree system as a reference to the visible colors changes. Think of the heating element on your range top. It is blackish grey until you turn on the current, then it starts to glow a dull cherry red, much the same as lord Kelvin's black body radiator. The color becomes a bright red, then orange at top output. Imagine heating the carbon ribbon much higher than any range top element, the carbon will go through many subtle color changes, through the reds, oranges, yellows, until it becomes white hot, luminous and radiates energy in the visible spectrum as light. This is the way Thomas Edison's early carbon filament lamps produced light by heating the filament until it glowed bright enough to produce light. This is called incandescent, the basis for all tungsten filament based lights we use today.

Color temperature is accurate when we refer to an incandescent source measured in degrees Kelvin which is like Fahrenheit or Centigrade, actually Kelvin is Centigrade (Celsius) plus 273 degrees. Diagram 1.1 A match flame is approximately 1700 degrees Kelvin. A candle flame is about 1850. A 100-watt light bulb runs around 2900 degrees Kelvin. Quartz Halogen studio lamps produce 3200 degrees Kelvin which is the usual norm for what we refer to as "tungsten balanced." Tungsten balanced light has more red content. We can assign color temperature to daylight and artificial daylight sources as well. We must remember however that natural daylight is all over the place in color temperature due to the time of day. Sunrise or sunset drops as low as 2000 degrees Kelvin. The "magic hours" of one hour before sunset or 1 hour after sunrise gives us beautiful light around 3500 degrees Kelvin. Average daylight color temperatures around midday run from 4300 to 5800 degrees Kelvin, which has more blue content. Overcast sky increases the blue content by filtration and raises the color temperature to 6000 degrees Kelvin. Artificial daylight as produced by enclosed arc sources such as HMIs (halogen mercury iodide) film and television lights, runs close to average daylight of around 5600 degrees Kelvin.

All of these numbers might seem quite confusing at this point, however we normally only run into a few light sources in day to day video shoots. A video camera needs to be "white balanced" to align the gains to make sure white appears white, and other colors are true.

Many consumer cameras now have active auto or continuous white balancing. The problem comes when we try to get an accurate white balance in mixed color temperatures. Normally a white card should be used on all cameras in the same light to color match them through white balance. When mixed color temperatures from different light sources mix, we may not be able to get a good white balance or the auto balancing cameras are constantly "searching" for the correct white balance.

Mixed sources may be as simple as daylight coming in through the windows, mixing with the tungsten-balanced light from your conventional fixtures like PAR cans and ellipsoidals. However with so many lamp types on the market today, you may be running into several color temperatures at once in the chapel including one source we haven't touched upon, fluorescents! Diagram 1.2 You see normal fluorescent tubes do not produce light like other sources such as heating a tungsten filament that produces a continuous spectrum of light output, which is easy to assign a color temperature to. Most cool white or similar "energy saving" fluorescent tubes have a nasty excess green wavelength spike which will produce poor color rendition and inaccurate white balance.

Herein lies the problem, what to do when you have mixed sources and are broadcasting or taping video? Basically the solution is to have all the same color temperature lights. Ideally the simplest solution is to go with your predominate sources which in most situations is likely to be tungsten light like your incandescent fixtures such as PAR cans, elipsoidales, and incandescent house lights or down spots. The past several years have also produced a plethora of specialty fluorescent tubes which are color correct and can match to either tungsten, 3200 degree, or daylight 5600 degree. Be advised there is various color temperatures you can specify within a certain range of temperatures, which will help you match more precisely to other sources. How do you determine color temperature? Diagram 1.3 The answer is with an expensive little tool called a Minolta Color Meter III that measures the amount of red or blue in mired shift needed to get from one color temperature to another. Do you need one of these? The answer is probably not, however if you are attempting to match your light sources in the chapel, you should consult with a local lighting professional that is familiar with television lighting and color temperatures and color correction which is another method of adjusting and matching dissimilar sources.

Aside from matching light sources by substituting lamps, your other option is to use color correction filters which are similar to the colored gel materials you use to color your PAR can lights for the Easter show. Basically these gels consist of CTO (color temperature orange) which matches daylight sources to tungsten balanced sources and CTB (color temperature blue), which matches tungsten sources to daylight sources. If that isn't enough, we have plus and minus greens which can be used to match fluorescents to daylight or daylight to fluorescent, however I would not recommend attempting to color correct your fluorescent tubes, rather you should always replace them with the proper match to your most prevalent lighting source. Even your local home improvement store stocks a wide range of different color temperature fluorescent tubes and will be happy to explain and show you the differences.

In reality, there will be very few of you attaching color correction gel to any of your lighting

fixtures. This method of color matching is best left to the professional production people. It is highly recommended that you try and simply replace the lamps necessary to match all your sources together without resorting to color correction gel. After all this "crazy talk" about color temperature and color correction, we need to get back to what we want and that is correct color rendition to allow the video cameras to properly white balance and match one another under similar light sources of either all daylight or all tungsten balanced light. Is this always practical? Absolutely not. Say you have large high windows in the chapel and night services with all incandescent lights is fine, however the Sunday morning service allows daylight to come streaming in with an obvious blue hue as seen on your video monitors. At this point you may want to consider permanent Plexiglas color correction filters to be installed in your windows to transform daylight to match to the tungsten balanced light from all your conventional fixtures. If you have a glass walled chapel you are broadcasting from every Sunday, then I would recommend going with all artificial daylight sources such as HMI type lighting instruments which you can get in configurations similar to your conventional lights. Keep in mind that enclosed arc sources can be hundreds and even thousand of dollars more than conventional tungsten balanced fixtures.

One last thought, if you have moving lights in your church, be advised that they are an enclosed arc source producing close to daylight (blue) color temperature of light. When mixed with conventional tungsten balanced fixtures, you will notice the color difference when they are directed towards on camera talent. Some moving or intelligent lights such as SGM have thought of this and offer built in color correction filters (CTO), which will match them precisely to your tungsten balanced conventional sources. Once everything is matched you will notice a big difference in the quality of your telivised services and events with better color rendition, camera matching and improved white balance. So the bottom line will be that the viewers at home or the viewers of the video tapes will not be adjusting their television sets to compensate for the excess red or blue to get a good color rendition especially in the white and grey areas such as clothing, gowns, robes, walls, banners and yes, even a wide range of flesh tones. Life will be made easier for your video crew and they are likely to thank you for the improvements. Of course your quality of production will be greatly improved and you will have a more professional and cohesive look to your video production. Even the occasional video shooter at weddings will likely benefit from matched color temperature sources of light.
If you are in the planning stages for a new church, please keep this article in mind when working with your lighting professional and architects providing you will be broadcasting or taping on a regular basis. If you are a non-broadcast church and only occasionally or never videotape should you worry about color temperature and matched sources? Probably not. Most people do not notice or care about the subtle nuances of the color of light. More often, people in your congregation will notice the beauty of the stained glass and the wonderful colors cast by the sun through the colored glass, not whether you are correctly mixing daylight or tungsten or fluorescent sources. And to close, please keep in mind that viewing color is very subjective to the human eye and everyone sees color a bit different and at this point we do not have replacement video cameras for the eyes God has given us!
Diagram 1.1, ACM 7th Edition
Diagram 1.2, Sylvania Publication STL0103
Diagram 1.3, Set Lighting Technicians Handbook 2nd Ed. Box,Harry C.