

Basic White Balance

© Scotty Elmslie

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Background

White balance has been an issue since the beginning of color photography. White balance is not a property of the scene being captured but rather of the light that illuminates the scene

Those of us who started with Kodachrome will remember that it was balanced for Daylight. If the light was different we had to use color filters to normalize the image. Slide film is like a JPEG straight from the camera. You have to get it right in the camera because it goes directly to the display.

Raw capture is like a negative film. The white balance is applied to the JPEG during the conversion from raw, either in the camera or later on the computer. The raw data is not affected by the white balance.

We need to be more conscious of the color of the incident light than we do about the color of the scene.

If you intend to use the JPEG image straight out of the computer, setting the white balance may be the only control you will have over the color of the image.

Raw capture

If you are not already capturing some or all of your images in raw form I encourage you to do so. Your own camera brand already supplies a free raw converter for your computer. There are plenty of other free programs available. It's much easier to correct color balance while going from raw to JPEG.

If you are capturing the image information in a raw file, setting the white balance is only the *first* control you will have over the color of the image. You can make many changes to the colors in the image later.

1 – Color Temperature and Tint

Your camera records three overlapping separate red, green and blue images. The overall color can be adjusted by changing the balance of two complimentary pairs – blue/yellow and green/magenta. This is done during the raw conversion.

Color **Temperature** – The blue/yellow balance is based on the color of light radiated from a black body like a hot iron or coal. Lower temperatures look red. As the temperature rises you see yellow, white and eventually blue. The temperature of Daylight is close to 5400° Kelvin – the useful range of temperatures is from about 1000°K to 9000°K. Daylight is a mixture of yellower sunlight with bluer skylight.

But the color of sunlight is not constant throughout the day. It depends on the clarity of the air, the time of day, the latitude, elevation and the season. The color of the sky will vary for the same reasons. In addition light may be reflected from land or sea onto low overhead clouds.

Each camera model or editor might use a slightly different temperature for Daylight but the differences are almost impossible to see. For historical reasons red and yellow are called warm and blue is called cold. We need to get used to the idea that a higher color temperature is considered cooler.

Black body radiation has a continuous spectrum which means that the intensity of light rises and falls smoothly from dark red to dark blue or violet.

Tint – The green/magenta balance does not have commonly defined units. Capture One uses a range from – 50 to +50 units. Another program uses a scale from -12 to +12. The ranges are arbitrary.

Temperature and tint together affect the red/cyan balance.

The sample in the center of this image uses the camera's Daylight white balance. The three images on the left are bluer and the three on the right yellower. This is the blue/yellow color temperature balance.

The three images on the top row are greener and the three on the bottom row are more magenta. This is the green/magenta tint balance.

The red/cyan color balance is controlled indirectly by temperature and tint. The images in the lower right and upper left are the result of combining temperature and tint to show the red/cyan balance.

The images in the lower left and upper right are purple and chartreuse. We don't usually think of them as being complementary but it looks like they are.



Fuji X100T ISO 200 1/1000 @ f/8 LV 15

Green+Blue = Cyan	Green	Green+Yellow = Chartreuse
Blue	Daylight	Yellow
Magenta+Blue = Purple	Magenta	Magenta+Yellow = Red

2 – Color meters

Since the primary driver of white balance is the color of light you might be tempted to spend between \$800 and \$2200 or more for a professional color meter.

But professionals use them mostly for studio work to get their light sources to match by using filters on the lights, reflectors and other light sources.

They are not much use for the average photographer shooting outdoors or in mixed lighting.

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A color meter will measure color temperature but it's not much help with tint.

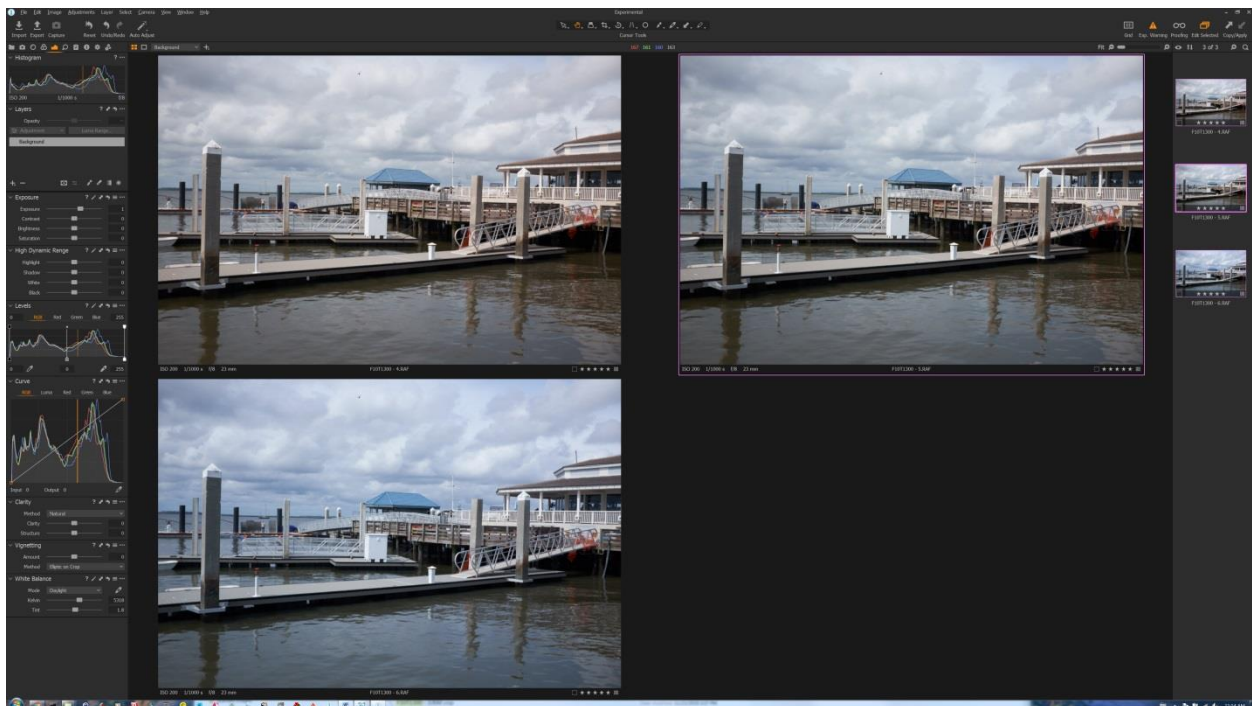
3 – Light from two sources – partly cloudy

There is seldom a single source of light, especially in daytime. You may have used the eyedropper tool in your editor to remove a color cast by clicking on a neutral gray or white spot in the image. The problem with that can be seen in this image.

In the upper right is the original image taken with the camera set to Daylight. But there are many gray and white targets to choose from.

In the top left image I picked the large piling on the left and the darker side that is facing the sky, not the sun. The result looks yellower than the Daylight version.

In the bottom left image I picked the piling on the right and the brighter side that was facing the sun. The result is bluer than the Daylight version.



The differences here would have been greater if the sky had not been as cloudy. The sunlight and the blue sky was filtered through some clouds.

Auto white balance might have produced an acceptable image only because the colors are not very pronounced.

4 – Light from two sources – broad daylight

This image looks perfectly natural using Daylight balance. The colors we see in direct sunlight and in the shade appear as we might expect.



Sony A7 II ISO 400 1/1250 @ f/11 LV 15.33

5 – Open shade using Daylight balance

But the shaded portion of the structure does not look right with Daylight balance.



Sony A7 II ISO 400 1/500 @ f/11 LV 14

6 – Open shade using Shade balance

It looks a lot more natural when you select Shade for the color balance.



Merriam Webster: “Battleship gray - a nearly neutral *slightly bluish* medium gray that is darker than pearl”

7 – Open shade using the eyedropper

Since the paint is supposed to be battleship gray, close to neutral gray, you might think that the eyedropper will pick the right balance.

The eyedropper can cause something that is *supposed* to have a slight blue cast to instead have an overall yellow cast depending on where you click.

It's also going to depend on how much light is bouncing off the deck and the direction the panels are facing.



Auto white balance will make the same mistakes as the eyedropper but it will include some of the non-gray colors in the average.

8 –Color Checker or Gray card

Do you want to blow between \$90 and \$250? You can carry around a color checker and put it into the scene. Or you can just get a simple gray card for about \$3.

A neutral gray card is indispensable when printing color film in the darkroom because the extra color step (from negative to print) can be very challenging. But where to put it and which way it faces is still a problem.

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9 – Sometimes you get lucky

This scene was staged by the Bartram Garden Club last year at the library. The lighting was halogen which has a continuous spectrum like tungsten but with a higher (cooler) temperature. The white tablecloth, wall and cards make ideal neutral targets for the eyedropper.



Fuji X100T ISO 400 1/30 @ f/8 LV 9

10 – Tungsten lighting

This image was taken with the camera set to Tungsten color balance according to the camera's menu.

Tungsten or incandescent light has a fairly wide range of color temperatures depending on wattage, the age of the bulb and whether it is clear or frosted to make it a particular shade of white.



Fuji X100T IS 1600 1/200 @ f/2 LV 5.67

Halogen lights are incandescent lights that provide a whiter light (bluer, higher temperature) than ordinary tungsten.

LED lights are much more efficient and last a lot longer than other lights but like fluorescent, mercury vapor and sodium vapor. The light intensity pulses at twice the frequency of the A/C power source (60Hz). If the shutter speeds is higher than 1/125 you can end up with uneven exposure. This can be a problem with indoor or nighttime sports.

The LED light spectrum is almost continuous depending on its Color Reproduction Index (CRI). The color temperature can be anywhere from warm Tungsten to Daylight. These rating should be on the box they came in.

Fluorescent light does not have a normal spectrum. There will be a green spike in the spectrum that needs to be dealt with. Other light sources like mercury vapor, sodium vapor also have unusual spectrums and generate light beyond our normal visible range that might not record correctly with a digital camera.

11 – Tungsten lighting with the eyedropper

Fortunately there was only one light source and plenty of neutral targets.



12 – Mixed light sources

Mixed lighting can be a nightmare for even an experienced photographer. Where color balance is important the photographer might go to great lengths to avoid it by filtering the light sources until they match.

Here there is blue light from the north sky, tungsten light under the umbrella and an LED three-way light (on low) within a colored lampshade. There is nothing neutral where you can use the eyedropper because the surfaces are all facing in different directions and getting a light from more than one source.



Nikon D610 ISO 400 1/125 @ f/2.8 LV 8

13 – Monitor calibration

Monitor calibration will get your colors to match a standard. It can adjust your monitor's brightness for the room's light level which should be a little darker than normal.


These tools can ensure that your images will look the same on any other calibrated display. What you see on your screen can also be as close as possible to what you get from a good photo printer.

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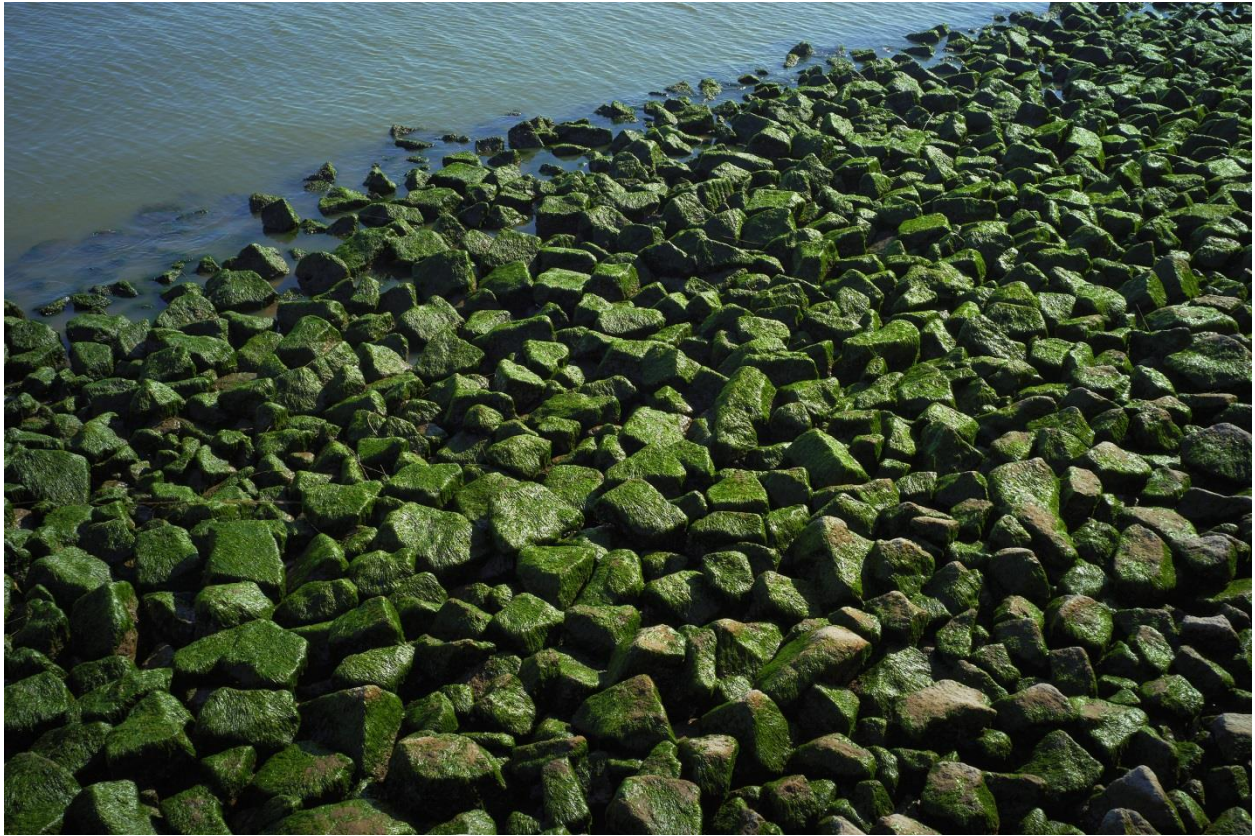
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Both products are available from each vendor.

14 – Subject color bias

You may find a scene with a predominant subject color. Auto white balance may try to bias the colors towards neutral gray, sucking the brilliance out of them. Leaving your camera set to Daylight color balance will prevent that.



Sony A7 II ISO 400 1/400 @ f/11 LV 13.7

15 – You might want to show the color of the light

This image was taken at the end of the day. Daylight color balance captured warm color of the sunlight.



Sony A7 II ISO 400 1/500 f/11 LV 14

16 – The primary subject and light source

In this case a small patch was lit directly by the sun. Daylight white balance preserved the colors that Auto white balance would have muted.



Nikon Df ISO 400 1/1000 f/8 LV 14

17 – Broad daylight is easy

You can safely leave your camera set to Daylight white balance nearly all of the time.



Nikon Df ISO 400 1/1000 @ f/11 LV 15

18 – Daylight when the sun is setting

Daylight white balance will preserve the golden light of sunset.



Sony A7 II ISO 100 1/50 @ f/11 LV 12.67

19 – The blue hour

Daylight white balance also keeps the blue hour blue.



Sony A7 II ISO 400 1/6 @ f/11 LV 7.7

20 – Night scenes

Daylight white balance does the same for night scenes with mixed light sources where the different colors of the lights may be part of the subject.



Sony A7 II ISO 400 1/6 @ f/11 LV 7.7

21 – Overcast and rainy conditions

Daylight white balance also preserves the mood of overcast and rainy conditions.



Sony A7 II ISO 125 1/250 @ f/18 LV 14.7

Is Cloudy white balance better or worse?

