

# Successful Filtration



## Part 2

### Colour Temperature and “non-daylight” situations.

I should start this article by reiterating my key philosophy behind the use of filtration in landscape photography:

**“If you can tell you’ve used a filter, then your use of it has failed.”**

All filters should be used purely to allow the film to see the subject in the same way that the human eye does. In other words we are trying to recreate on film the scene as it appeared to us when we stood behind the camera.

There is a subtle difference, however, when we come to discuss the colour of light (as opposed to contrast management as discussed in Part 1 of this series of articles). This is because the most successful images always depend on the “quality” of the light illuminating them. I have often stated that “I do not photograph the landscape, but the light that illuminates it”. How often have you visited the location of a superb image you have seen, only to find that it doesn’t look as good as you imagined? When it comes to successful landscape photography, light is absolutely the key. In order to succeed you must gain an intimate knowledge of light, and the way your film will react to it.

#### **”Daylight” balanced film.**

At this point I should say that the problem of colour discussed here is most important to users of colour transparency film. Colour negative film has to be interpreted at the printing stage by the printer, and with no fixed reference point, the resulting print could come out almost any colour at all (and frequently does). With colour transparency, the final result is clearly visible to all and, as such, isn’t open to interpretation by the printer because a direct comparison between transparency and print can easily be made.

If you look on the box that your film came in, you will probably notice the words “Daylight Balanced” or something similar. In order to represent colour successfully, film manufacturers have agreed on a standard for the expected colour of light and most colour films are manufactured to respond successfully to this standard. This standard defines “photographic daylight” as:

“a mixture of direct sun and open blue sky illumination, as found in Washington DC, USA on a typical clear day between the hours of 10am and 4pm”.

Obviously we do not make most of our images in these precise conditions, so why don’t we need to use filters on nearly all our compositions? The simple answer to this is that it is often the non-standard conditions that attract us to making the image in the first place. For example, when photographing a beautiful sunset, it is the glorious reds, golds, pinks and yellows that we are trying to capture. The last thing we want to do is remove all this colour and go back to the standard “daylight”.

There are, however, certain conditions where a more subtle change is required if we want our images to reflect the way we saw the subject when making the exposure. This is because when we look at certain subjects with our eyes, our brains interpret the input and apply certain “corrections” based on our experience of different viewing conditions. For example, a sheet of white paper viewed indoors (under household light bulbs), outdoors in the sun and outdoors in the shade under a clear blue sky, always appears to us to be a sheet of white paper. To film it would appear as various shades of orange, white and blue respectively, because it is being viewed under light of varying colour.

In order to clearly understand what is happening here, we need to apply some order to the situation. We do this by applying mathematical values to the “temperature” of light, and arriving at a term known as “Colour Temperature”.

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*Page 1 of 6*

Please bear with me through this bit – it will all make sense at the end (I hope).

The Colour Temperature Scale	
Light Source	Colour Temperature Degrees K
Clear Blue Sky	20000
Hazy Sunlight	9000
Average Shaded subject in summer	8000
Overcast Sky	7000
Lightly overcast sky	6300
Electronic Flash	6000
Summer sunlight	5600
<b>"Daylight balanced film"</b>	<b>5500</b>
Carbon Arc light	5000
Early Morning Sun	4500
Late Afternoon Sun	4500
"Daylight" fluorescent lamps	4400
Clear Flash Bulbs	3800
Hour after dawn	3500
Hour before dusk	3500
Photoflood Bulb	3400
Tungsten Halogen lamp	3200
<b>"Tungsten balanced film"</b>	<b>3200</b>
Tungsten Floodlights	3000
150 watt light bulb	2900
60 watt light bulb	2800
40 watt light bulb	2650
Sunlight at sunset	2000

*Typical colour temperatures of various lights sources.*

One note of caution. The hottest temperatures on the scale relate to the BLUE end of the scale whereas the cooler end of the scale contains the RED colours. This is the opposite to what we might expect as we usually refer to Red colours as being “warm” and BLUE colours as being cool. Just to add to this confusion, the warmest (yellowest) filters are often referred to generically as “warm up” filters, but they actually reduce the colour temperature (move it towards red).

### Filter systems for colour photography.

The most widely used system for describing filters that effect the colour of light in stills photography is the “Kodak Wratten Series” of filters. Nearly all other filter manufacturers will state that their filters are equivalent to a filter designated on the Wratten scale. The full scale, the relevant “Mired” values (more later) and the associated filter factors are given here (Note: the filter factor is the increase in exposure in stops, required to allow for the amount of light cut out by the filter). The Wratten series of filters can be split in to two main types:

- Colour Conversion Filters – which make large changes
- Colour Correction Filters – which make subtle changes

(There is another type called “Colour Compensating” filters which I will cover in a future article)

### Colour Temperature and the Kelvin Scale.

In photography we borrow certain terms from physics in order to quantify the “temperature” of any light source by using terms that relate to so-called “black-body” radiation. Suffice to say that any “hot” light source will emit light, and the colour of that light will depend on the temperature of the source itself. For example an iron bar heated to 1000 degrees will emit light of a constant colour anywhere, anytime. In this way it is possible to give specific values to the colour of various light sources in a temperature scale that uses units called Degrees Kelvin. Degrees Kelvin can be considered as the same as degrees Celsius or Centigrade except that the scale starts at a level called “Absolute Zero” which is equivalent to minus 273 degrees Celsius.

So - 0 degrees C = 273 degrees K.

The Colour Temperature scale covers a far larger range than the colours that an iron bar could be physically be heated to. Some key points on the scale are given in the table on the left.

	Wratten Filter	Mired shift	Filter Factor (stops)
Yellowest	85B	131.00	2/3
	85	112.00	2/3
	85C	81.00	2/3
	81EF	52.00	2/3
	81D	42.00	2/3
	81C	35.00	1/3
	81B	27.00	1/3
least Yellow	81A	18.00	1/3
	81	9.00	1/3
least Blue	82	-10.00	1/3
	82A	-21.00	1/3
	82B	-32.00	2/3
	82C	-45.00	2/3
	80D	-56.00	2/3
	80C	-81.00	1
	80B	-112.00	5/3
Bluest	80A	-131.00	2

*The Kodak "Wratten" Series of Filters.*

### Filtration and "Mireds".

If we were only concerned with measuring the colour temperature of a particular light source then the Kelvin scale would be sufficient for most of our requirements. Unfortunately the key to this whole article is that we want to CHANGE the colour temperature by applying a filter and this causes other issues.

The fact is that any single filter will affect the colour of a light source differently depending on what colour it is in the first place. This sounds confusing, but if you think about it, if we were to view a yellow light source through a filter of the same colour we would detect virtually no change. If instead we looked at a blue light source then the change would be significant. In practice, for example, a Wratten 81B filter reduces daylight by 715 degrees Kelvin, but lowers the colour temperature of tungsten light by only 65 degrees Kelvin.

Fortunately there is a solution. This is achieved by dividing the Kelvin rating of a light source INTO 1 million to give its "MIREN" value. Similarly by dividing the mired value into a million converts it back to degrees Kelvin.

The MIREN value (pronounced "my-red") is an abbreviation of MICRO REciprocal Degrees, the key being the word reciprocal. The scale actually runs the opposite way to the Kelvin scale and blueish light sources have a low mired value whilst reddish light sources have a high mired value.

Just as light sources can have Mired values assigned to them, so can filters. The Mired values associated with filters are known as Mired "shift". This is because the filters at the yellow end of the scale have positive values and "shift" the colour of light higher up the Mired scale. Conversely filters that are bluish in colour have negative Mired values and "shift" the colour of light down to a lower Mired value.

This may seem a bit pointless, until you realise that any given filter will always "shift" the colour of light by the same Mired value, regardless of the colour of the light source. As well as this, when using multiple filters, it is possible to add their Mired values together to calculate the overall "shift" they will cause. In addition we can say that :

$$\text{Mired value of Light Source} + \text{Mired value of filter(s)} = \text{Mired value of result.}$$

## **Film colour balance using the above.**

As mentioned above, “Daylight” balanced colour film is expecting the light source to be:

“a mixture of direct sun and open blue sky illumination, as found in Washington DC, USA on a typical clear day between the hours of 10am and 4pm”

Now that we understand “Colour Temperature” and “Mireds” we can more accurately state that it expects the light source to be:

Colour Temperature = 5500 degrees K or 182 Mireds.

There are some special films designed specifically for photography under artificial lighting which are known as “Tungsten” balanced films. The more common of these which are available from a number of manufacturers are balanced to a light source of:

Colour Temperature = 3200 degrees K or 313 Mireds

The more observant of you may notice that the difference in Mireds between these two types of film is 313 – 182 Mireds which equals 131 Mireds. You will also see from the Wratten series scale that the 85B Yellow filter and the 80A blue filter have an associated Mired shift of 131 Mireds. It can be seen therefore that these filters are designed to correct for the use of Tungsten film in Daylight conditions, or the opposite – Daylight film under Tungsten lighting.

## **Using my filters in the “real” world.**

So how does all this mathematical discussion really impact on our photography?

As mentioned above, there are, certain conditions where a more subtle change is required if we want our images to reflect the way we saw the subject when making the exposure. Also we need to be aware that our brains automatically compensate for small shifts in colour, such that we cannot expect to easily see when some form of correction is required. This comes down to experience, and as noted in the article on ND grads, there is no substitute for accurate note taking and the subsequent assessment of results.

Here are two examples of situations that may require us to apply filtration to correct for the fact that the colour of light does not match what the film expects.

1. Photographing in open shade under a clear blue sky, particularly when the tones of the subject are very pale. In situations such as these, the subject is lit by a light source whose colour temperature is far higher than the film expects (anything up to 20000 degrees K). In these circumstances, the processed film will contain a distinct blue colour cast, which can be corrected at the taking stage by using one of the 81 or 85 warming series of filters. This effect can be particularly noticeable if you are photographing snow in open shade. We have all seen the way that snow can appear blue in images made under these circumstances. We MUST remember though, that we may desire the blue cast for our snow scenes, as it helps to convey the feeling of cold to the viewer.
2. Although film manufacturers make every attempt to achieve perfect colour rendition in all circumstances, some films are unable to achieve this when it comes to particularly long exposures. This is known as “Reciprocity Failure”. In order to help overcome this, manufacturers publish how to deal with long exposures for individual film types. For example, Fujichrome Velvia 50 (my film of choice) suffers from a tendency to include a green cast for exposures longer than 4 seconds (the longer the exposure, the worse the problem). Strictly speaking it is necessary to apply pure Magenta filtration to counteract this property (colour compensating filters), but in reality a filter such as the 85C will help.

The Colour Temperature Scale				
Light Source	Colour Temperature Degrees K	Mireds	Wratten filtration with Daylight film	Wratten filtration with Tungsten film
Clear Blue Sky	20000	50	85B	
	16667	60	85 + 81	
	14286	70		
	12500	80	85	
	11111	90	81 + 85C	
Hazy Sunlight	10000	100	85C	
	9091	110	81A + 81EF	
	8333	120		
	8000	125	81EF	
	7692	130		
Average Shaded subject in summer	7143	140	81D	
	7000	143		
Overcast Sky	6667	150	81C	
	6300	159	81B	
Lightly overcast sky	6250	160		
	6000	167	81A	
Electronic Flash	5882	170	81	
	5600	179		
Summer sunlight	5556	180		
	5500	182	No filter	
"Daylight balanced film"	5263	190	82	85B
	5000	200	82A	85 + 81
Carbon Arc light	4762	210	82B	85
	4545	220		81 + 85C
Early Morning Sun	4500	222	82C	
Late Afternoon Sun	4500	222	82C	
"Daylight" fluorescent lamps	4400	227	80D	
	4348	230		
Clear Flash Bulbs	4167	240	82A + 82C	85C
	4000	250		81A + 81EF
	3846	260		
	3800	263	80C	
	3704	270	82C + 82C	81EF
Hour after dawn	3571	280	80C + 82A	
	3500	286		81D
Hour before dusk	3500	286		
	3448	290		81C
Photoflood Bulb	3400	294	80B	81B
	3333	300	80B + 82	81A
Tungsten Halogen lamp	3226	310		81
	3200	313	80A	81
"Tungsten balanced film"	3200	313	80A	No filter
	3125	320	80A + 82	
Tungsten Floodlights	3030	330	80A + 82A	82
	3000	333		82A
150 watt light bulb	2941	340		82B
	2900	345		
60 watt light bulb	2857	350	80A + 82B	
	2800	357	80A + 82C	
40 watt light bulb	2778	360		82C
	2703	370		
Sunlight at sunset	2650	377		
	2632	380		80D
Sunlight at sunset	2564	390		82A + 82C
	2500	400		
Sunlight at sunset	2439	410		80C
	2381	420		82C + 82C
Sunlight at sunset	2326	430		80C + 82A
	2273	440		80B
Sunlight at sunset	2222	450		80B + 82
	2174	460		80A
Sunlight at sunset	2128	470		80A + 82A
	2083	480		
Sunlight at sunset	2041	490		80A + 82B
	2000	500		80A + 82C

Colour Temperatures of various light sources, their mired values and the filters to use to correct for daylight/tungsten film

Hopefully the text, tables and examples in this article will help to clarify the situation regarding filters, the colour of light and the films' response to it. I should finish by emphasising a few points :

The decision to use a particular filter must be a considered one. Any of the Wratten filters that we choose to use will effect the WHOLE of our composition, not just the problem parts. Warm up filters used in images that contain blue sky can have a disastrous effect, making the sky appear muddy and dull. It is possible to have graduated 81 series filters specially made (e.g. to warm up the landscape but not effect the sky) but these are very expensive and difficult to obtain.

Mixed light sources are very difficult to deal with. Photographers who specialise in architectural interiors for example will be all to familiar with the infinite colours that artificial lights produce. Add daylight to the equation and the balancing trick is especially difficult to overcome (this will almost always involve the use of a meter to precisely measure the colour temperature of the various light sources and may involve filtering the light sources themselves!)

Practice makes perfect; try using the Wratten filters and note down their successes and failures in your results. Used correctly they can greatly enhance your ability to capture your subject in the way that it appeared from behind the camera.

Remember that successful images are often all about emotion, mood and ambience. The colour of the light source is usually a key contributor to obtaining these successful images and sharing those emotions with the viewer. Don't be in a rush to filter it away!!



Note how horrible the blue sky looks through the stonger filters

No Filtration



Lee Filters 81A

Lee Filters 81B

Lee Filters 81C



Lee Filters 81D

Lee Filters 81EF

Lee Filters 85C

Footnote: I am in the happy position of owning and using a Canon EOS10D digital camera. The issues discussed in the above article are dealt with in an entirely different way in the digital age. It is possible to manually tell this camera that the light source is any temperature between 2800 and 10000 degrees K, thereby achieving the same result as the filters achieve with a film camera. This is a real advantage for digital photographers, especially as it is possible to shoot in RAW format and then adjust the Colour temperature at a later date i.e. to retrospectively apply the filtration!!!!!!