FILTER INFORMATION

Introduction

Use the filter and color temperature charts in this section as a quick reference and general guide. The values are approximate. They offer good starting points for trial exposures in critical work. For less demanding work, the recommendations may be adequate, but it is always best to run tests before shooting final footage. For photography with fluorescent lights, see the individual film's filter information in the section"KODAK Motion Picture Camera Films."

Types of Filters

Optical filters may be solid, liquid, or gaseous; only solid filters are discussed in this book. These consist mainly of colorants dissolved in a gelatin or in cellulose acetate. Each Kodak filter, gelatin or acetate, is standardized for spectral transmittance and total transmittance by special instruments which apply an optical form of limit gauge to these characteristics.

The dyes are obtained from a number of sources, and many have been synthesized. Like other dyes, the dyes used in filters may, in time, change under certain conditions of heat and light. In this publication, we will be addressing only *filters* for black-and-white films, color compensating, conversion, light balancing, and neutral density (No. 96).

Filters for Black-and-White Films

You can use a wide range of KODAK WRATTEN Filters with black-and-white negative films for many purposes. They vary the contrast and tonal rendering of the subject in a photograph, either to correct to the normal visual appearance or to accentuate special features. The total photographic effect obtained with a particular filter depends on four main factors: its spectral absorption characteristics, the spectral sensitivity of the sensitized material, the color of the subject to be photographed, and the spectral quality of the illuminant.

Filter	Filter Factors* for KODAK Motion Picture Films			
	Negative Films		Reversal Films	
	PLUS-X	DOUBLE-X	PLUS-X	TRI-X
No. 3	1.5	1.5	1.5	1.5
No. 8 (K2)	2.0	1.5	2.0	2.0
No. 12 (Minus Blue)	2.5	2.0	2.0	2.0
No. 15 (G)	3.0	3.0	2.5	2.5
No. 21	3.5	3.0	3.0	3.0
No. 23A	5	5	5	5
No. 8N5	5	5	6	6
No. 25	8	8	10	10
No. 29	25	20	40	40
No. 96	8	8	8	8

*All filters absorb part of the incident radiation, so their use usually requires some increase in exposure over that required when no filter is used. The number of times by which an exposure must be increased for a given filter with a given material is called the *filter factor*, or multiplying factor.

Filter factors published for Kodak products by Kodak are intended only as approximate guides. Published filter factors apply strictly to the particular lighting conditions used in the laboratory where the factors were determined. For scientific applications, especially, the quality of light can vary widely so that it may be desirable to determine the filter factor for actual working conditions.

To determine a filter factor, choose a subject having a neutral-gray area, or place an 18-percent gray card or a photographic gray scale in the scene to be photographed. Make one exposure without a filter. Then, with the filter where it will be for the exposure, and beginning with the unfiltered exposure setting, make a series of exposures. Increase each in ½-stop increments through a 2- to 4-stop greater exposure (very dense filters may need more). After processing the negative, match densities of the unfiltered exposure with the filter series either visually or with a densitometer. Choose the filtered exposure that is closest to the unfiltered. Some additional exposure adjustments may be necessary.

Below is a conversion table of filter factors to exposure increase in stops.

Filter Factor	+ Stops	Filter Factor	+ Stops	Filter Factor	+ Stops
1.25	1/2	4	2	12	3 2/3
1.5	2/3	5	2 1/3	40	5 1/3
2	1	6	2 2/3	100	6 2/3
2.5	1 1/2	8	3	1000	10
3	1 2/3	10	3 1/3	–	–

Each time a filter factor is doubled, the exposure needs to be increased by 1 stop. As an example, a filter factor of 2 requires a 1-stop exposure increase. A filter factor of 4 requires a 2-stop exposure increase. Use this example for filter factors not listed in the above table.

Color Compensating Filters

Color compensating filters control light by attenuating principally the red, green, or blue part of the spectrum. While controlling one color, the filter transmits one or both of the other two colors. Thus, color compensating filters can make changes to the color balance of pictures recorded on color films, or compensate for deficiencies in the spectral quality of a light source. For optimum results, use the single recommended color compensating filter rather than combining filters (for example, CC20Y + CC20M = 20R, so using 20R only is preferable). KODAK WRATTEN Gelatin Filters / Color Compensating Filters have excellent optical quality and are suitable for image forming optical systems—over-the-camera lens, for example. For less critical work, you may use KODAK Color Printing Filters (acetate).

Conversion Filters for Color Films

These filters are intended for use whenever *significant* changes in the color temperature of the illumination are required (for example, daylight to artificial light). The filter may be positioned between the light source and other elements of the system or over the camera lens in conventional photographic recording.

Filter Color	Filter Number	Exposure Increase In Stops*	Conversion in Degrees K
Blue	80A	2	3200 to 5500
	80B	1 2/3	3400 to 5500
	80C	1	3800 to 5500
	80D	1/3	4200 to 5500
Amber	85C	1/3	5500 to 3800
	85	2/3	5500 to 3400
	85N3	1 2/3	5500 to 3400
	85N6	2 2/3	5500 to 3400
	85N9	3 2/3	5500 to 3400
	85B	2/3	5500 to 3200
	85BN3	1 2/3	5500 to 3200
	85BN6	2 2/3	5500 to 3200

*These values are approximate. For critical work, check by accurate tests, especially if you use more than one filter.

KODAK Light Balancing Filters

Light-balancing filters enable the photographer to make *minor* adjustments in the color quality of illumination to obtain cooler (bluer) or warmer (yellower) color rendering. One of the principle uses for KODAK Light Balancing Filters is where light sources frequently exhibit color temperatures different than that for which a color film is balanced. When using a color temperature meter to determine the color temperature of prevailing light, you can use the table below, which converts the prevailing temperature to either 3200 K or 3400 K.

Filter Color	Filter Number	Exposure Increase in Stops*	To Obtain 3200 K from:	To Obtain 3400 K from:
Bluish	82C + 82C	$1^1/_3$	2490 K	2610 K
	82C + 82B	$1^1/_3$	2570 K	2700 K
	82C = 82A	1	2650 K	2780 K
	82C + 82	1	2720 K	2870 K
	82C	$^2/_3$	2800 K	2950 K
	82B	$^2/_3$	2900 K	3060 K
	82A	$^1/_3$	3000 K	3180 K
	82	$^1/_3$	3100 K	3290 K
Yellowish	81	$^1/_3$	3300 K	3510 K
	81A	$^1/_3$	3400 K	3630 K
	81B	$^1/_3$	3500 K	3740 K
	81C	$^1/_3$	3600 K	3850 K
	81D	$^2/_3$	3700 K	3970 K
	81EF	$^2/_3$	3850 K	4140 K

*These values are approximate. For critical work, check by accurate tests, especially if you use more than one filter.

Neutral Density Filters

In black-and-white and color photography, filters such as the KODAK WRATTEN Neutral Density Filters No. 96 reduce the intensity of light reaching the film without affecting the tonal rendition in the original scene. In motion-picture work or other photography, neutral density filters allow use of a large aperture to obtain differential focusing. You can use them when filming in bright sunlight or with very fast films. These filters control exposure when the smallest aperture is still too large. Also available are KODAK WRATTEN Gelatin Filters with combinations of neutral density and color conversion filters (for example, No. 85N3). These filters combine the light-conversion characteristics of KODAK WRATTEN Gelatin Filter No. 85 with neutral densities.

KODAK WRATTEN Neutral Density Filters No. 96

Neutral Density	Percent Transmittance	Filter Factor	Exposure Increase in Stops*
0.1	80	$1\frac{1}{4}$	$\frac{1}{3}$
0.2	63	$1\frac{1}{2}$	$\frac{2}{3}$
0.3	50	2	1
0.4	40	$2\frac{1}{2}$	$1\frac{1}{3}$
0.5	32	3	$1\frac{2}{3}$
0.6	25	4	2
0.7	20	5	$2\frac{2}{3}$
0.8	16	6	$2\frac{2}{3}$
0.9	13	8	3
1.0	10	10	$3\frac{1}{3}$
2.0	1	100	$6\frac{2}{3}$
3.0	0.1	1000	10
4.0	0.01	10,000	$13\frac{2}{3}$

*These values are approximate. For critical work, check by accurate tests, especially if you use more than one filter.

Approximate Correlated Color Temperature for Various Light Sources

Source	Degrees Kelvin
Artificial Light	
Match Flame	1700
Candle Flame	1850
40-Watt Incandescent Tungsten Lamp	2650
75-Watt Incandescent Tungsten Lamp	2820
100-Watt Incandescent Tungsten Lamp	2865
500-Watt Incandescent Tungsten Lamp	2960
200-Watt Incandescent Tungsten Lamp	2980
1000-Watt Incandescent Tungsten Lamp	2990
3200-Degree Kelvin Tungsten Lamp	3200
Molarc "Brute" with Yellow Flame Carbons & YF-101 Filter (approx.)	3350
"C.P." (Color Photography) Studio Tungsten Lamp	3350
Photoflood and Reflector Flood Lamp	3400
Daylight Blue Photoflood Lamp	4800
White Flame Carbon Arc Lamp	5000
High-Intensity Sun Arc Lamp	5500
Xenon Arc Lamp	6420
Daylight	
Sunlight: Sunrise or Sunset	2000
Sunlight: One Hour After Sunrise	3500
Sunlight: Early Morning	4300
Sunlight: Late Afternoon	4300
Average Summer Sunlight at Noon (Washington, D.C.)	5400
Direct Mid-Summer Sunlight	5800
Overcast Sky	6000
Average Summer Sunlight (plus blue skylight)	6500
Light Summer Shade	7100
Average Summer Shade	8000
Summer Skylight Will Vary from	9500 to 30,000

NOTE: Sunlight is the light of the sun only. Daylight is a combination of sunlight plus skylight. The values given are approximate because many factors affect color temperature. OUTDOORS: the sun angle, and the conditions of the sky–clouds, haze, dust particles–raise or lower the color temperature. INDOORS: lamp age (and blackening), voltage, type of reflectors and diffusers affect tungsten bulbs–all of these can influence the actual color temperature of the light. Usually a change of 1 volt equals 10 degrees Kelvin. But this is true only within a limited voltage range and does not always apply to "booster voltage" operation, since certain bulbs will not exceed a certain color temperature regardless of the increase in voltage.