Filters

An introduction to photographic filters

Photographic filters are available in a seemingly endless variety.

TWO PRINCIPAL CATEGORIES

Filters fall into two general categories – those that are used with color film and filters for black and white film. Some filters work both sides of the fence, and can be used with either color or black and white. Colored filters for black and white film are of use with color film only when a major overall color cast is what you are seeking. A deep red filter, for example, will give an image on color film an overall red appearance, whereas with black and white film, its effects are usually dramatic.

WHY USE FILTERS WITH BLACK & WHITE FILM?

The normal aim of a photographer using black and white film is to accurately reproduce a colored subject in a range of grey tones. A red sweater should be reproduced in a different grey tone than a green sweater, for example. Differentiation of colors that would otherwise appear as the same tone of gray is the main purpose of colored filters with black and white film. Filters are very useful in interpreting colors into their equivalent grey tones.

However, filters can do more for your black and white photography. You can intentionally darken a light sky and dramatically whiten its clouds. You can reduce the effects of atmospheric haze in aerial photography, create special effects, improve skin tones, remove glare from shiny leaves, draw the viewer's attention to a particular aspect of a subject, increase contrast, eliminate or reduce reflections, reduce the amount of light striking all or part of the film, and so on. Filters, especially colored filters, are incredibly useful in black and white photography, and it pays to learn how and under what conditions to use them to enhance your images. You are in the right place to do that.

Square & rectangular filters are part of a system that permits

WHAT DO COLORED FILTERS DO?

Colored filters absorb light and transmit the light they don't absorb. A filter is yellow because it absorbs red and green light, and allows yellow light to pass through it.

We say an object - a banana, for instance - is yellow because it reflects yellow light. So, if we use a yellow filter when photographing a banana, the filter will allow all the yellow light to pass through it and reach the film.

But, what if we use a green filter when photographing a yellow banana? Will the green filter allow the banana's yellow light to reach the film? The answer is no, it won't. The yellow light is blocked. Well, if that's so, you may ask, how can a yellow banana be photographed through a green filter? Good question. The answer lies in remembering that yellow light is a combination of green and red

light. (See Light and its color.) So a green filter blocks the red portion but allows the green portion of the banana's reflected light to reach the film.
On color film, the banana would therefore register as being green because the red portion of its reflected light is absorbed and only its green light strikes the film. But, on black and white film, the banana would would register in a pale gray tone (because a filter lightens its own color), and the only portion of the banana's yellow light reaching the film is the green portion.
The banana's gray tone may appear so pale as to look over-exposed, but not as much as would the tone of any object that is pure green, like a pea. A filter that is the same shade of green as a pea will make the pea look so pale as to be almost white and completely over-exposed. If green objects become so lightened that they look overexposed when being photographed through a green filter, how do you make them look normally-toned? Another good question. The answer is that you must change the exposure so they look darker. You let more light strike the film. In other words, you increase exposure.
Okay, you say, then how can I possibly know how much I have to increase exposure to make the banana or the pea, and everything else in the picture, appear in a natural tone so it doesn't look over-exposed? A great question. And you probably expect a complex answer. Wrong! The answer is so simple. You adjust exposure in accordance with the *filter factor*.
It's even easier if you have an auto-exposure camera, since it does it for you automatically. You don't have to do a thing, except attach the filter. The camera's exposure meter reads the amount of light coming through it and adjusts exposure automatically.
If you have a manual camera, simply refer to the spec sheet that came with the filter when you purchased it to learn its filter factor, and change exposure in accordance with it.

WHAT IS A FILTER FACTOR?
Thought you'd never ask. Filters have different densities. A very dense filter absorbs more light than a less-dense filter. Filter manufacturers take these light-absorption characteristics into account, and figure out what exposure adjustment is needed to properly expose a scene based on the filter's density (the amount of light it absorbs). The necessary adjustment is termed a filter factor, and tells the filter-user how much to increase exposure. (We recommend you click on our Filter factor section to find out more.)
USE OF FILTERS IN COLOR PHOTOGRAPHY
A primary use of filters in color photography is in reproducing colors that match as closely as possible to the actual colors in a scene. Certain types of light may cause film to have a color cast that the human eye doesn't notice in the scene because our eyes adjust and compensate for different types of light, but film doesn't. Filtration can be used to color-correct the light before it strikes the film. Color film filters are therefore particularly useful, indeed often essential, with slide film (also called positive, color reversal or transparency film), since color accuracy when the picture is being taken is far more critical with slide film than with color negative film. Color negative film requires filtration less than both color slide film and black and white film since so much of the final image's appearance can be controlled and corrected at the printing stage.
Just as with black and white film, certain filters can also be used with color film to create special effects, eliminate glare and to achieve other image enhancements and intentional manipulations.
Filters most-commonly used with color negative film are the polarizing, neutral density, ultraviolet (UV), skylight and special effects filters, with the polarizer topping the list in terms of a filter's ability to alter and enhance our everyday photography.

Why are all these filters screwed together? See "Potpourri of filter tips" to learn the advantage of doing this with same-

EVERYTHING YOU NEED TO KNOW ABOUT FILTERS
Each of the many available filters for all types of film is discussed in detail in this section. Their benefits and drawbacks are explained, and the most important filters are highlighted, with tips and techniques for their use.

There is no great magic in the proper application of filters in photography. You just have to know what they do, when to use them to enhance your photographs and what effect they will have on exposure settings and tones. It's that simple.

All filters are not created equal

The most important consideration in purchasing a filter is its quality. Two new filters from different manufacturers may appear pretty much identical, but can be worlds apart in terms of their quality and their serviceability. There are cheap ways to make filters, and better ways, and it is important to know the differences.

LAMINATED FILTERS

Some colored filters are “laminated,” that is, made with two pieces of clear glass either sandwiched together with colored glue or that have a colored "gel" (gelatine film, which can be of excellent optical quality) placed between them. The glass can either be of optical quality or similar to the glass in a normal window.

One obvious characteristic of laminated filters is that they have four to six surfaces (because each piece that makes up the laminate has itself two surfaces), each of which can reflect light and affect the photographic image, particularly in backlit or sidelit situations. And if these surfaces are not perfectly flat and parallel to each other, the filter may act in the manner of a lens, altering the way in which light travels to the film. Over time, it's possible that the combined materials may de-laminate (separate) due to expansion and contraction. If this occurs, the filter may bubble, peal or become discolored, making it useless, except possibly as an experimental special effects filter that you may or may not ever use. The color of the gel may also shift or fade.

Colored gels can be used on their own as filters. Although many photographers tape them to the front of the lens, they can also be placed in “filter masks” – plastic or metal frames that hold gels – which are fitted to a filter holder that can be attached to a lens. They can also be attached in front of a light source, something that is frequently done in a studio. Gels don’t stand up well to moisture, heat or rough handling, and will fade over time. They must be kept in a dark, cool place, preferably protected between sheets of tissue paper. They are available in a huge variety of tones, and are relatively inexpensive to purchase.

ONE-PIECE FILTERS

Another manufacturing process produces a colored filter made from a single piece of optical glass that has had different pigments added to it while in a molten state to provide it with uniform color. The surfaces – there are only two, since it is a single piece of glass – are ground and polished so they are flat and parallel. Such filters won't fade, aren't subject to color shift, and of course can’t delaminate. They must be handled and stored carefully, though, and cleaned using a lens cloth, except that dust or grit should be blown off first.

One-piece filters made from plastics instead of glass can be relatively inexpensive, but are also susceptible to damage through normal handling. Their surfaces are delicate and can be easily scratched if placed in a pocket or even when cleaning. They don’t have the same quality rating as the better-made optical glass filters, but are quite serviceable for all but the most demanding photographers.

POLARIZERS MUST BE LAMINATED

All polarizing and circular polarizer filters must be made by a lamination process, in which a polarizing film is sandwiched between two layers of glass. They can't be made any other way.

COATING

Filters can be either coated or uncoated. Uncoated filters means both sides are simply bare glass which can reflect some light – as much as 9% – meaning that as little as 91% of the light striking the filter will go through it. The reflected light may also produce flare - stray light that can cause “ghosting” in the image. Ghosting occurs when a second faint image is reflected off the filter’s rear surface. Applying single layers of anti-reflective coating on both surfaces can cut filter reflection by half. Some manufacturers apply coating to only surface, generally the front side of the glass.

Coating is not applied to soft focus, fog, cross screen and prism filters since it won't improve their image quality.

MULTI-COATING
Multi-coated filters, with up to as many as five anti-reflective layers, are of sufficiently-high quality for the most exacting needs of professional and advanced amateur photographers, cutting reflection to as little as under 1%

COATING METHODS
Quality filter coatings have staying power. Coatings that are bonded to the surfaces of the glass under extremely high heat are greatly resilient to wear and will provide years of consistent use. But, coatings that are "painted" on the filter's surfaces or that are applied as a cold spray can wear off quite easily.

FILTER MOUNTS
Most circular filter frames (also known as mounts, rings or rims) are threaded to screw directly into the front of a lens. Such filters fit only lenses of the same diameter as the filter.
Some frames are made of plastic, which may cross-thread and jam if undue pressure is applied when attaching the filter. Quality filter frames are usually made of machined aluminum or brass. Aluminum has good durability and relatively-light weight, and is somewhat softer than brass. Some say brass is best, however manufacturers who use aluminum claim their filter frames will bend and absorb some of the shock if the front of a lens should accidentally strike something hard, thereby protecting the lens, whereas they say that a brass filter frame is so rigid that it will simply transmit the full force of the shock to the lens itself. Their point is that it's easier and cheaper to replace a filter than to repair a lens. Not a bad point. A potential downside to an aluminum rim is due to its relative softness, in that the filter may tend to jam or get stuck on the camera, making it difficult to remove. (You can always take off your shoe to remove a stuck filter. True, It works.)

FILTER SYSTEMS
Certain manufacturers make all their filters in only one standard width. They may be square, rectangular or circular in shape, and rimless. The filters slide into a filter-holder that can be attached to different-sized adapter rings made to fit all standard sizes of lenses. Photographers need only to buy one of each filter for use with all their lenses, provided they have the appropriate variety of adapter rings. It's a practical and economical concept. It keeps you from having to buy the same type of filter for each one of your lenses. Such systems are not only available for 35 mm cameras, but also for larger-sized formats.
The adapter ring is first screwed onto the lens, then the filter holder is snapped in place on the adapter ring. A square filter (about 3" by 3") can then be slid into one of two or three slots in the filter holder. Such systems can usually also accommodate round filters and may have a tighter slot for particularly narrow filters. The slots may be spring-loaded on one side so the filters don't fall out when turned upside down. Because there is more than one slot, filters can be stacked in combinations for different effects. The filter holder (and therefore the filters) can usually be turned. There is even a "universal ring" available to fit non-standard lenses or lenses with damaged threads.
Filter selection for such systems is extensive - 75 and more different filters and masks - including many special effects filters (multi-image, blur, rainbow patterns, and so on). Masks block off a portion of the image and are used for such effects as double-exposure. Filters may be made of glass, gelatin film, plastics or vinyl-chloride. Glass filters are more resistant to scratching.

Most filters in a filter system are square in shape, but the rectangular shape permits filters that have varying density to be slid up and down in front of the lens

CONCLUSIONS
Manufacturers who use high-quality, one-piece optical glass and apply heat-bonded coatings supply the best filters in terms of both image quality and long-term serviceability. Such filters, when properly cared for, may in the long run prove to be less expensive than filters that will require periodic replacement. Unfortunately, price makes perfection, and the best filters can be considerably more expensive than their laminated or plastic counterparts. Most of us will detect differences between images taken with a superbly-crafted filter and an el-cheapo filter. The photographer who buys the best filter has one less thing to worry about.

Budget-conscious photographers who are experimenting with filters would be wise to purchase less-expensive filters, test them out and then consider purchasing high-quality filters when they know which ones they will use most.
A filter system is an inexpensive way to acquire single filters that can be used with all of your lenses.

Filter factor

It tells you how much to increase exposure

EXPOSURE COMPENSATION
Most filters absorb some of the light that would reach the film if there was no filter in its path. Since less light strikes the film, exposure must be increased to compensate for this loss. This is achieved by opening the aperture wider or by increasing the time that the shutter is open. When you do this, it is known as "exposure compensation," because you are compensating for the filter's effect on exposure.
This additional exposure varies with the particular filter in use. Some filters, like the Wratten No. 25 deep red filter for use with black and white film, are so dense that they require exposure compensation of four stops, while others like the UV filter are transparent and completely-neutral with respect to visible light, and therefore require no compensation at all.
FILTER FACTOR
The amount of exposure compensation has been predetermined for every filter, and is expressed as a "filter factor" (sometimes also called an exposure factor, and also referred to as Exposure Magnification or EM values). A filter factor is a number that indicates to what extent you must increase exposure when you use a particular filter (by multiplying the unfiltered exposure by the filter factor number). A filter factor of 2, for example, means you will need twice as much exposure, and a filter factor of 3 means you will three times as much exposure.

HOW TO USE A FILTER FACTOR
You must first obtain a meter reading of the scene you wish to photograph without the filter. If you have a hand-held meter, this is easily done. If you are using a through-the-lens meter, take your reading with no filter attached.
If your filter has a filter factor of, say 2, which you know requires twice as much exposure, you must increase exposure by one stop, which allows twice as much light to reach the film. So, if your meter reading without the filter was 1/250 sec. at $f11$, you must either decrease the shutter speed by one stop to 1/125 sec. or increase the aperture by one stop to $f8$. If you take your picture at the new exposure setting with the filter attached, the film will be properly exposed.
A filter factor of 4 means the film require four times as much light to be properly exposed. You must therefore increase exposure by two stops, since each stop doubles the amount of light that gets through to the film. Using the example from the paragraph above, if your meter reading without the filter was 1/250 sec. at $f11$, you must either decrease the shutter speed by two stops to 1/60 sec. or increase the aperture by two stops to $f5.6$ for correct exposure with filter that has factor of 4.
But what if the filter factor is 3? How many stops is that? Well, a filter factor of 3 requires three-times more exposure. Since a one-stop increase doubles the amount of light reaching the film (for a filter with a factor of 2), and a two-stop increase quadruples the amount of light reaching the film (for a filter with a factor of 4), your exposure increase for a filter with a factor of 3 will be between one and two stops. It is, in fact, 1 2/3 stops. (*See the table below*.)

Filter factor	Shutter or aperture stops to open
1.25	1/3
1.5	2/3
2	1
2.5	1 1/3
3	1 2/3
4	2
5	2 1/3
6	2 2/3
8	3
10	3 1/3
16	4
32	5
100	6 2/3
1,000	10
10,000	13 1/3

THE EASY WAY

There is an easy way to compensate for filter factor. Take a normal exposure reading as if you were shooting without a filter, and adjust your camera settings accordingly. Now, multiply the filter factor by the shutter speed. For example, if the filter factor is 4 and your shutter speed is 1/500 sec, multiply 4 X 1/500 = 4/500 or 1/125. You can now use that filter by changing your shutter speed to 1/125 sec while keeping your aperture setting the same, and your picture will be properly exposed.

AN EVEN EASIER WAY

A fast, efficient way to compensate for the use of a filter is to divide the factor into the film speed. ISO 100 film divided by a filter factor of 2 equals 50. Set your camera's light meter at this new ISO rating when using the filter (unless your camera is an SLR with TTL (through-the-lens)metering, in which case, the camera's meter will automatically compensate for the filter, and provide you with a proper exposure reading).

WHAT IF I USE MORE THAN ONE FILTER?

Using two or three filters at the same time will require an increase in exposure based on the factors of each filter. It is calculated by multiplying the factors together. For example, the combined factor when stacking three filters that each have a filter factor of 2 is 2 X 2 X 2 = 8, which requires an increase in exposure of three additional stops.

FILTER FACTORS & CORRESPONDING STOP VALUES

The table above shows the number of stops to increase exposure for various filter factors when using daylight film.

DO I REALLY NEED TO KNOW HOW TO COMPENSATE FOR FILTER FACTORS?

Not if your camera has a built-in TTL (through-the-lens) light meter, since the camera's light meter accurately measures the light with the filter attached and automatically compensates for the light absorbed by the filter. (Be aware, though, that some filters, especially deep red, can fool your automatic light meter, and it is a good idea to check your camera's manual for information on metering through filters.)

If you use a hand-held light meter, however, or if your camera's light meter should fail and you still want to take pictures using, say, the Sunny 16 rule to figure correct exposure, you need to compensate for the filter factor.

FILTER FACTORS DIFFER IN TUNGSTEN LIGHT

Manufacturers usually provide one set of filter factors for use with daylight film (including electronic flash illumination, which simulates daylight) and one set for artificial illumination. The different wavelengths of tungsten light, which contains more red light, require different filter factors.

WHAT IF I DON'T KNOW THE FILTER FACTOR?

If you have no indication what the factor is for a particular filter and you aren't using TTL metering, you can use a hand-held meter, preferably with the translucent dome removed (or ideally the meter will have a flat diffuser). Take a normal exposure reading of the sky or another unchanging light source, then take another reading with the filter over the meter's sensor, making sure no light is getting in at the sides. The difference in the readings will give you the increase in the number of *f*-stops necessary for you to use the filter, and you can easily convert this to a filter factor number for future reference. Of course, if your light meter is set for the film speed you are using, you can use the second reading to obtain the required exposure settings. This is a bit rough and ready, but is better than guessing.

HOW ACCURATE ARE FILTER FACTORS?
Filter factors are applicable under average lighting conditions, and therefore should be considered as a reliable guideline, but should not necessarily be treated as definitive. You may find that applying a particular filter factor results in over or under-exposure most times you use a given filter, which means that the filter factor is inaccurate for much of your photography. You will need to further adjust your exposure one way or the other when using that filter. Once you know how much of an adjustment is needed, then you can assign your own factor to that particular filter for future reference.
The other thing about filter factors is that you can use some leeway in applying them. Intentional underexposure by half a stop or so will often improve a scene by adding more contrast when using certain filters. Experimentation will let you know how far you can veer away from the recommended filter factor, and what the effects are on your pictures when you do. Keep in mind, too, that a filter factor of 2 can even be ignored completely with the wide exposure latitude of most black and white films without affecting the film too much. Your negatives won't be perfect, but you will be hard-pressed to detect the differences, and the prints you make from them will be fine.

Colored filters for B&W photography

These solid-color filters are not for color film

Colored filters for black and white photography are of two types:
(1) Correction filters that correct the way colors are rendered in tones of gray, and
(2) Contrast filters, that increase or decrease contrast.
The photographic reproduction of any color can be altered by filters.
A FILTER LIGHTENS ITS OWN COLOR
A colored filter causes more light of the filter's color to strike the film, making that color appear as a lighter gray than it would without the filter. At the same time, it reduces the amount of light of the filter's complementary color, which will appear in a darker gray tone.
What is a complementary color? Essentially, it's any color's opposite color. Visit Light and its color for a thorough explanation, but for now, all you have to know is that a complementary color is one of a pair of primary or secondary colors that are in opposition to each other on a color wheel.

This means that a blue ball photographed through a blue filter will show up as almost white in the final image, but if the blue ball was to be photographed through a yellow filter (which is the complementary color for blue), it would render the ball as almost black.
The rule to remember is: ***Use the same color filter to lighten that color, and the complementary (or opposite) color filter to darken it.***
Our section entitled How colored filters work explains why this happens. Keep in mind that the intensity of the effect is controlled by both the density of the color filter in use and the subject's color saturation.
Exposure is affected by the amount of filtration. The denser the filter, the more the exposure must be increased to compensate for the light being absorbed by the filter. (See Filter factor.) Surprisingly, however, slight underexposure can often provide the filter with even greater effectiveness.
The most popular colored filters for black and white photography are yellow, yellow-green and green, with orange and red following hot on their heels.

YELLOW FILTER
Film is extra-sensitive to blue light. Black and white film records blues as slightly lighter, and yellows and greens as darker than might be anticipated. Because a yellow filter absorbs blue (its complementary color), it provides significantly greater contrast between blue and yellow or white subjects. A yellow filter absorbs UV and is useful in reducing haze, particularly in aerial or mountain photography. It is a good filter to use when doing underwater black and white photography. Snow scenes improve with a yellow filter.
Like most filters, the yellow filter is available in various densities. The greater the density, the greater the contrast between blue and white objects in a scene. For example, when shooting a scene with clouds in it

using a deep yellow filter, the clouds stand out as bright white against a dark sky. A light yellow filter will render the sky in a more natural-looking shade of gray.
The most-popular density of yellow filter is the Wratten No. 8, formerly designated the K2 filter. This light to medium-yellow filter is also sometimes called a Y2 filter, and has a filter factor of 2, which means it requires a one-stop increase in exposure. If a single filter could be considered the "standard" filter for black and white work, it would be this yellow filter. Many photographers who shoot black and white film have the No. 8 yellow filter attached to the lens for much, if not most, of their photography. It gives a natural look - normal tonal rendition - on black and white film to the sky, sunsets, distant landscapes, foliage, outdoors portraits against the sky and water scenes, and is ideal for architectural stone, sand and wood when they are illuminated by direct sunlight or a blue sky.
A deep yellow filter like the Wratten No. 9 (which is considered by some to be a medium-yellow filter and was formerly designated the K3), emphasizes reds and orange tones, which is excellent for brilliant sunsets in black and white, but not for portraits since it causes facial blemishes and freckles to stand out. (Switch to a lighter yellow filter for outdoors portraits, like the Wratten No. 8. It produces a more natural rendering of skin tones.) The No. 9 deep yellow has a filter factor of 4.

A very deep yellow filter (sometimes called a light orange filter), the Wratten No. 15 - which used to be designated the G filter - dramatically darkens blue sky and water scenes, and decreases the haze effect in far-off landscapes. It also emphasizes the texture of architectural stone, wood, sand and even snow when illuminated by direct sunlight or by a blue sky. This dense yellow filter is effective when copying documents on yellowed paper and is commonly-used with color infrared film for special effects.
Other less-commonly used yellow filters include:
Wratten No. 2B - pale yellow. Useful in absorbing ultraviolet radiation.
Wratten No. 2E - pale yellow. Absorbs UV radiation similar to the 2B, but also absorbs more violet.
Wratten No. 3 - light yellow. Mainly used in aerial photography to partially correct excess blue.
Wratten No. 12 - deep yellow. Also known as the “minus-blue filter” in the same way as the Wratten No. 32 is the minus-green and the Wratten No. 44A is the minus-red. This filter cancels blue light when exposing infrared-sensitive film, and is good for haze penetration, especially in aerial photography.

YELLOW-ORANGE FILTER

This Wratten No. 16 yellow-orange filter has a stronger effect on skies than do the yellow filters, increasing their darkness significantly but still within the realm of credibility. It is effective in reducing facial blemishes and skin spots for portraits, and absorbs a small amount of green. It has a filter factor of 3, requiring an exposure increase of one-and-two-thirds stops.

YELLOW-GREEN FILTER

Great for black and white landscapes, the Wratten No. 11 yellow-green (or yellowish-green, or yellow-greenish) filter not only darkens blue skies and whitens clouds, it also enhances green foliage in landscapes by slightly lightening it, giving it a natural appearance and often improving detail.
Formerly designated the X1 filter, it can also be used to correct for tungsten lighting, giving a natural tonal relationship with black and white film under tungsten light. It is a better filter than straight yellow for portraits of caucasians because it lightens their skin and shows facial blemishes less, and is particularly effective for outdoor portraits with the sky or foliage as a backdrop.
The yellow-green filter has a filter factor of 4, requiring an exposure increase of two stops. The denser dark-yellow-green filter (Wratten No. 13) has a filter factor of 5, necessitating an exposure increase of two-and-a-third stops. It's a good filter for dramatic portraits of men illuminated by tungsten light.

GREEN FILTER

Although the green filter is suitable for multi-colored subjects in general, color balance of the subject must be considered carefully because of this filter's tendency to cut out both blue and red at the same time. The green filter absorbs ultra-violet, violet, blue and red, subduing (darkening) red and bringing out greens in brighter tones. Nature’s greenery – its grass, shrubs, trees, etc. – improves in appearance when a green filter is used with black and white film.
Because reds and greens generally reproduce on black and white film in more or less the same shade of gray, a green filter (which causes reds to darken and greens to lighten) will separate the two colors in the image.
The green filter (Wratten No. 58, formerly designated the B filter) has a filter factor of 6, requiring an exposure increase of two-and-two-thirds stops. A deep green filter (Wratten No. 61, formerly called the N

filter) has a filter factor of 12, requiring three-and-two-thirds stops more exposure. The Wratten No. 99 green filter is equivalent to a green No. 61 plus a yellow-orange No.16 filter, and is useful in the printing industry.

ORANGE FILTER

An orange filter goes a step beyond the yellow filter in bringing out contrast between blue and white tones in a scene, rendering a sky in very dark shades of gray while clouds remain a bright white. Its high blue/green absorption also causes greens to come out much darker. The effect is highly dramatic, and may be overkill for most landscapes. However, because of its dramatic contrast, an orange filter can make an excellent picture with the right subject – a bright red factory belting out clouds of steam and smoke, for example.

Because a filter transmits more of its own color to the film and that color is rendered in a lighter shade of gray, an orange filter can be complimentary to skin tones and can make freckles and other blemishes seem to disappear. However, people with sun tans will appear paler.

The orange filter is somewhat more effective at haze reduction than the yellow filter, and can be very effective in shooting snow scenes or in underwater photography. It can be an excellent filter for black and white architectural photography, lightening the color of orange and brownish bricks, and is good for accenting detail in textures of trees, stone, sculptures and so on.

The orange filter (Wratten No. 21) has a filter factor of 5 and requires an exposure increase of two-and-one-third stops. A light orange (Wratten No. 15 - also known as a deep yellow) filter provides more contrast between cloud and sky than the yellow filter, but lightens skin tones so much that people can look anemic. A Wratten No. 22 deep orange filter has even greater green absorption than the No. 21.

RED FILTER

If an orange filter goes beyond yellow in terms of increasing blue-white contrast, a red filter takes it one step further. This is the dramatic, high-contrast filter for black and white photography. Red filters lighten red, orange and yellow, and greatly darken blues and greens. Skies and foliage come out incredibly dark. Shadows are deep. Skin tones are blanched, especially those of women. The red filter is also very effective in reducing haze, more so than yellow filters in far-off landscapes, and makes sunsets more brilliant.

If the film is slightly under-exposed when using a red filter to shoot an outdoors scene in broad daylight, the contrast is so great that you can achieve a night-time, moonlit effect, especially when used in combination with a polarizing filter. The red filter is also used for infrared photography with black and white infrared film, and with color film for underwater photography to restore red lightwaves absorbed by water. Like the deep yellow filter, it enhances textures in architectural stone, wood, sand and snow under a blue sky.

The red filter (Wratten No. 25, formerly designated the A filter) has a filter factor of 8, and requires an exposure increase of three stops. This filter is sometimes called the “red tricolor” when it is used for color separation work in three-color printing. (The “green tricolor” filter is the Wratten No. 58, and the “blue tricolor” is the Wratten No. 47B.)

A deep red filter (Wratten No. 29) is even more extreme. It will turn a blue sky black, and is useful in long focus shots to darken a pale blue sky on a distant horizon. (The sky just above the horizon is usually much paler than the sky overhead.) It has a filter factor of 16, requiring an exposure increase of four stops. This filter is also known as the “deep red tricolor” for its printing applications under tungsten light.

There is also a Wratten No. 26 red filter that is mainly useful with a No. 58 (green) filter for viewing low-relief, sculpted objects in three dimensions, and a Wratten No. 92 red filter used for densimetric measurement of color films and papers.

MAGENTA FILTER

Magenta is composed of half-red and half-blue, and is the complementary color of green. This means it will darken objects that are green (which is why it sometimes referred to as the “minus-green” filter) and lighten objects that are bluish-red, or blue or red.

With a Wratten No. of 32, this filter has a filter factor of 2.5, and requires an exposure increase of one-and-a-third stops.

VIOLET FILTER

The Wratten No. 34A violet filter has minus-green and plus-blue properties, meaning that it will darken objects that are green and lighten those that are blue.

BLUE FILTER

The blue filter, which is probably the least-used colored filter (probably because it tends to exaggerate haze - a feature that can be very effective in creating three-dimensionality in far-off landscapes), is sometimes used in black and white portraits, where it is particularly effective in close-ups when the subject's eyes are blue. Blue eyes become significantly lightened, almost hauntingly so. The blue filter absorbs some of the red cast from incandescent lights, and tends to darken red clothing.

A blue filter will lighten blue and deepen red, making lips appear darker and, unfortunately, also darkening any reddish skin blemishes. Yellow is the complementary color of blue. For subjects with blonde hair or very white skin, the blue filter keeps them from appearing too light since it darkens yellow colors.

Although its haze-accentuating characteristic may be useful in landscape photography by increasing the sense of depth, the sky appears quite pale, almost white, when a blue filter is used for landscapes.

When used with color film and underexposing by a stop or two, a blue filter can make a daylight scene look like it was photographed at night. It is also used by some photographers in photographing snowy scenes with color film.

The "true-blue" filter has a Wratten No. of 47 and was formerly called the C5 filter. This is the blue tricolor filter used in separating blue in three-color printing. It has a filter factor of 6, which requires an exposure increase of two-and-two-thirds stops.

There are at least three versions of deep blue filter - the Wratten No. 47B deep blue filter (also known as the "deep blue tricolor", which has a filter factor of 8, calling for an exposure increase of three stops, the Wratten No. 49 (which used to be designated as C4), and the No. 50 deep blue, which has a filter factor of 20 and needs an exposure increase of four-and-a-third stops. Then, there is the Wratten No. 98 blue filter, which is equivalent to the 47B deep blue filter plus the No. 2B yellow filter, and is used in making separation positives from color negative film, and for three-color printing.

Other blue filters include the Wratten No. 47A filter, which is light blue and is used in medical applications; the Wratten No. 38A, which absorbs ultraviolet, green light and a lot of red light and is used mainly in specialized photomicrography.; and the Wratten No. 44 and 44A filters, which are light blue-green, and are used for minus-red applications

(Blue lettering on green)

(Red lettering on green)

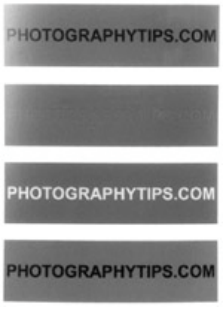
(Yellow lettering on green)

(Blue lettering on red)

Compare this color image with the black and white images below that were taken using colored filters.

OTHER FILTERS FOR BLACK AND WHITE FILM

Neutral-density, polarizing, ultraviolet (UV) and a number of other special effects filters can be used for both black and white and color film. Information about them can be found under their appropriate headings.



Photographed using a yellow filter. Notice how the red and green blend together in one shade of gray, but the yellow is lightened.

Photographed using a green filter. Notice how the green background is lightened overall, while red and blue are darkened.

Photographed using a red filter. Notice how the blue and green are rendered in almost the same shade of gray, but the red is significantly lightened.

How colored filters work

In black and white photography, a colored filter lightens its own color and darkens its complementary color. For example, green foliage is rendered lighter - as a vary pale, almost-white shade of gray - when using a green filter, but becomes darker when using a magenta filter. You may wonder why.

WHY DOES A COLORED FILTER LIGHTEN ITS OWN COLOR?

Hold a solid-colored filter to your eye and look at a scene illuminated by daylight. The entire scene you see through the filter takes on the overall color cast of the filter. If it is a green filter, everything you see has a green tinge. But, you will notice that objects are not blocked from your vision; they are simply more green. The filter allows green light to be transmitted through it, and blocks red and blue light by absorbing it.

So, when you take a black and white picture with a green filter on your lens, the picture is made almost exclusively from green light. Since red and blue light don't make it past the filter, the overall amount of light striking the film is reduced, and your exposure will not be correct. There won't be enough light. You must make up for the lost red and blue light by letting in more green light. You have to increase the exposure to properly-expose the film.

But, when you increase the exposure, even more light from objects that are normally colored green passes through to the film, because green light is not blocked by the filter. This means that green objects become over-exposed. This is why they appear paler than objects of other colors.

Objects that aren't pure green, but that contain some green, also become paler for the same reason. The green portion of their reflected light is over-exposed, and therefore the object appears paler. Yellow light, for example, is made up of equal parts of red and green light, and therefore yellow objects become paler in a black and white picture when a green filter is used.

FILTER DENSITY

Filters made with more or less of a solid color are said to be more or less dense. Color filters range from dark to light. By selecting different filter densities, you can control the degree to which filtration affects your picture. A lightly-tinged green filter will absorb some, but not all the red and blue light, whereas a dark green filter will only permit the smallest amount of red and blue to reach the film.

FILTER EFFICIENCY

When we said above that red and blue light don't make it past a green filter, that was a bit of an exaggeration. No green filter totally blocks all red and blue light. You will notice when you hold a green filter to your eye that a red object will still appear red, although its tone will have changed. In the mostly-green scene on the left, a small red rose still shows its color in spite of being seen through a green filter. In fact, no filter of any color perfectly absorbs its complementary colors or totally transmits its own color. Nonetheless, colored filters do function as described above.

Held a few inches in front of the lens, a green filter shows how much darker it renders part of the scene, making it necessary to increase exposure when using it.

Filters for color film

Color film filters are mainly for slide film

DIFFERENT FILMS ARE MADE FOR DIFFERENT LIGHT SOURCES
The type of light (daylight or artificial) striking your subject affects the way in which color is rendered on the film. It's impossible to make one film that will accurately record color under all light sources, so film manufacturers make some films specifically for shooting under normal daylight and others for photography under artificial light.
Different types of light are identified by their "color temperature" which is expressed in the Kelvin temperature scale (°K). (See Light and its color for information on color temperature.)
Daylight film is balanced for light that has a color temperature of 5500°K, based on the color temperature of the combined light from the sun and the sky at noon. Type A tungsten film is balanced for standard 500-watt photoflood lamps which have a temperature of 3400°K, and Type B tungsten film is balanced for quartz lamps or 500-watt photoflood lamps which have a temperature of 3200°K.

When a color film is used with a type of light for which the film is not balanced, (say, daylight film where the subject is illuminated by photofloods) colors will not be properly rendered. However, satisfactory color-balancing can usually be achieved through the use of filters. In other words, by using the correct color-balancing filter, you can use tungsten film in daylight or daylight film under artificial light and still achieve satisfactory color results.

COLOR-BALANCING FILTERS
Color-balancing filters (also sometimes called light balancing, color-conversion [CC], or just conversion filters) convert the temperature of light striking your subject so that it more closely matches the type of film in use. Amber-tinted filters are used for cool lighting, and blue-tinted filters are used for warm lighting. Many filters are available in differing grades, and are usually numbered to indicate their grade (or strength). Usually, the higher the number, the greater the filter's effect. Note that a grade 2 filter is not necessarily twice as strong as a grade 1; it just means it's the next grade up.
Color-balancing filters are far more applicable to color transparency film than to color negative film, since much of the needed color correction can be made when negative film is being printed. However, color-balancing filters can still be used with color negative film since their effects apply equally to either slides or negatives. You will just be making the printer's job easier

FILTERS COMMONLY USED WITH DAYLIGHT COLOR FILM
Color film intended for use in daylight can generally be balanced for artificial lighting through the use of the following filters.

- **1A**: known as a "skylight" filter, this filter absorbs UV radiation and reduces excessive blue. It is meant primarily for color slide film that is being shot at higher altitudes (aerials and mountain heights), but is also useful on overcast days or in bright shade. Since the filter is almost clear (it has a slightly-rosy tint), no exposure correction is necessary.
- **80A**: a blue filter that converts daylight film for use with incandescent tungsten studio lamps (3200°K lamps) - filter factor of 4 (increase exposure by 2 stops).
- **80B**: a blue filter that converts daylight film for use with photolamps (3400°K lamps) that give unfiltered daylight film a yellowish cast - filter factor of 4 (increase exposure by 2 stops).
- **81A**: a pale yellow (straw-colored) filter that has a more emphatic effect than the skylight (1A) filter, and is intended for use with electronic flash where the light it casts is too blue. It can also be used as a color-correction filter for tungsten film, and has a filter factor of 1.2 (increase exposure by 1/3 stop). Other filters in the 81 series tend to be brownish and will enhance color portraits by adding warmth to skin tones, making subjects appear to have a healthier, tanned appearance. They are also beneficial on overcast days by increasing overall color saturation.
- **81B**: This is probably the most-popular "warming" filter *(see note below)* and is also used with electronic flash when pictures are consistently too blue.

- **82A**: a light blue filter intended to reduce the warmth of early-morning or late-afternoon light by neutralizing its reddish cast - filter factor of 1.2 (increase exposure by 1/3 stop).
- **FL-D**: also known as FLD (the "D" stands for daylight), FL-Day or FL-W. This filter helps eliminate green cast when using fluorescent light - filter factor of 2 (increase exposure by 1 stop). Another film for use with fluorescent lighting is the **CC 30 magenta** filter. These filters are also useful for outdoors night-time photography in the city. (See the note below on Fluorescent lighting.)

FILTERS COMMONLY USED WITH TUNGSTEN FILM

Tungsten-type slide films are color-balanced to record optimally at 3200°K and 3400°K, so photographs made indoors on tungsten film with common household lighting will appear neutral or perhaps slightly warm in color.

- **81A**: a light yellow color-balancing filter - filter factor of 1.2 (increase exposure by 1/3 stop).
- **82C**: provides slightly-cooler results when using household lamps - filter factor of 1.5 (increase exposure by 2/3 stop).
- **85B**: an amber or orange filter that converts tungsten type-B film for use in daylight - filter factor of 1.5 (increase exposure by 2/3 stop.). Without this filter, tungsten film would have a bluish cast when shot in daylight. The amber filter is also useful in removing the blue tinge that results from using daylight film in the shade, under cloudy conditions or indoors using light from a north-facing window in fair weather.
- **FL-T**: Filters designated FL-T or FL-B help eliminate green cast when using tungsten-type film under fluorescent light. They have a filter factor of 2 (increase exposure by 1 stop).

A NOTE ON WARMING FILTERS

Warming filters, which are sold in a variety of strengths and tonal qualities, find all-round use from landscapes to portrait photography. They compensate for excessive blueness in shade, prolong morning light and can enrich the overall tonal quality of images. The Wratten No. 81B is perhaps the most-popular. The 81 series is straw-toned and available in various strengths. A lesser known, but pleasing warming filter is the 85C, which has more of an amber tone and simulates very early or late sunlight. KR series warming filters (from German filter makers) possess a different tonal quality than 81 series filters – it's more of a coral tint, which some photographers prefer, especially for portrait work.

DIDYMIUM FILTER

Also called **"enhancing filter,"** this filter's glass contains didymium.

Didymium is a mixture of two elements – praesodymium and neodymium. Neodymium is a rare-earth yellowish metallic element that will combine with other metals or salts to result in rose to violet-colored compounds. Interestingly, the salts of neodymium are used to color the lenses of glassblowers' goggles to filter out the sodium glare.

The didymium filter increases the saturation of orange, reddish and certain brown objects, making them warm, rich and intense while diminishing or at least having minimal effect on other colors. Scarlet (bright red, tending toward orange) and crimson (deep purplish-red), in particular, are maximized.

Think of the four seasons, and you can probably guess at its principal application, which is autumn photography, when the didymium filter is used for deeply-saturated fall foliage. However, it is also useful at other times of the year, in enhancing the reds in any scene, including sunsets. It can play havoc with skin tones, however, making them excessively warm.

MIXED LIGHTING

Undoubtedly, you will at some time come across lighting conditions that combine different color temperatures – an interior scene, for example, that is lit by both tungsten lamps and daylight streaming through a window, or an early-evening exterior scene that also has a good deal of artificial lighting in it. It is impossible to use one filter for both types of light.

To achieve proper balance for the type of film you are using, you can filter one or the other light source itself using filtering material made from large sheets of acetate film. This is a lot of work, since it's always easier to place a filter in front of the lens instead of the light source.

If you have a hand-held, ambient light meter, you can check to find out which of the lighting types is the dominant light source by measuring the incandescent light then turning it off and measuring the daylight. If the latter is dominant, use daylight-balanced film, especially if the center of interest is illuminated mainly by daylight. The tungsten lighting will still either warm the overall color or just portions of the scene, depending on its influence, but your resultant image should turn out all right. If incandescent light is the dominant source, use tungsten film and expect some bluishness in the areas illuminated mainly by daylight. If fluorescent lighting enters the mix, your problems are compounded, but the solution is the same, only it is based on measuring the dominance of three lighting sources.

A NOTE ON FLUORESCENT LIGHTING

Lighting from most fluorescent tubes tends to give film a green cast. The exception is the "full-spectrum" fluorescent tube, which gives off a wider, more-balanced light than other fluorescent tubes, and therefore provides acceptable results with color film. Corrective filtration is likely not needed when your subject is illuminated by full-spectrum fluorescent tube lighting, however it is always best to shoot a test roll.

With other fluorescent lights, different coatings on the tubes produce a range of greenish casts, making it almost impossible to predict precise results on film. Although the FL-D and FL-B filters produce good and sometimes excellent results, if absolutely-natural appearing color is a must in your image, you should expose a test roll using different strengths of fluorescent filtration. Keep a record of the filter strengths used for each frame, process the film and compare the results to determine the best filtration method.

Don't have the time to process a test roll? Don't give up. There are other options.

1) You can replace the existing fluorescent lights with tubes made especially for photography, like the full spectrum fluorescent lights mentioned above.

(2) You can filter the lights themselves using magenta gels or fluorescent-correcting gels made for the movie industry.

(3) You can switch to a color negative film like Fuji Reala that is made for daylight but performs well under various light sources, including fluorescent lighting, and that can also be color-corrected at the printing stage.

(4) Depending on the type of shot you're after, you can shut off most or all of the fluorescent lighting, and use flash, or use flash discriminately to overpower the fluorescent lighting in key areas.

OTHER FILTERS FOR COLOR FILM

The **sepia tone** filter produces a warm brown tone, simulating the appearance of early photographs from the turn of the century. Bright colors may reach the film unchanged, distracting from the desired effect, so subjects should wear muted, monochromatic (different shades of a single color) clothing for the best effect. Beige, light grey, white and tan colors will work best. An exposure increase of two stops is required to compensate for the light absorption of this filter. If you are shooting color negative film, notify the printing lab that the color cast is intentional so they will not attempt to adjust it to more normal tones.

The **red filter**, normally associated with black and white film, is useful in underwater photography with color film

Neutral-density, polarizing, ultraviolet (UV) and a number of other less well-known, color-balancing and special effects filters can be used for color film, and many can be used for both black and white and color film.

Neutral density filter

The light-reducing filter

Neutral density filter grade	Amount of Light transmitted	Filter factor	Shutter or aperture stops to open
ND 0,1	80%	1.25	1/3
ND 0,15	70%	1.5	2/3
ND 0,2	63%	1.5	2/3
ND 0,3	50%	2	1
ND 0,4	40%	2.5	1 1/3
ND 0,5	32%	3	1 2/3
ND 0,6	25%	4	2
ND 0,7	20%	5	2 1/3
ND 0,8	16%	6	2 2/3
ND 0,9	13%	8	3
ND 1,0	10%	10	3 1/3
ND 1,2	6.3%	16	4
ND 1,5	3.2%	32	5
ND 2,0	1.0%	100	6 2/3
ND 3,0	0.10%	1,000	10
ND 4,0	0.001%	10,000	13 1/3

You may encounter a photography situation in which the light is too bright for your film speed, preventing you from using a slow shutter speed without overexposing the film. For example, you may wish to photograph a brightly-lit waterfall at a slow shutter speed, say 1/8 sec., to intentionally blur the water, but the light is so strong that you can't use a shutter speed any slower than 1/60 sec. even with your lens stopped down to its smallest aperture. Your only alternative is to remove the film from your camera and replace it with a slower speed film, right? Not so. There is another solution. You can employ a filter that reduces the overall amount of light entering the lens, subduing all colors uniformly, allowing you to use the slow shutter speed that is needed.

Such a filter is known as a neutral density filter or ND filter, also sometimes called a gray filter. It is said to be neutral because it transmits all wavelengths of light equally and therefore has no effect on color. Because of this, a neutral density filter can be used with either color or black and white film to cut down the amount of overall light striking the film. Since its density is uniform across the entire filter, light reduction over the entire scene is also uniform.

ND filters are the camera's equivalent of colorless sunglasses. They simply reduce a scene's brightness without changing color. They are especially useful in very bright conditions where you would normally wear sunglasses, such as at the beach or on a ski hill under a clear blue sky. They can be used to either permit slower shutter speeds or wider apertures for scenes where less depth of field is desired.

A neutral density filter is used when:
1. you require a shallow depth of field (wide aperture) but your film speed is too fast and the light is too bright to permit it;
2. you want to use a slower shutter speed than your film speed will allow;
3. avoiding overexposure with a high-speed film, and
4. shading off the background.

DIFFERENT GRADES OF DENSITY

ND filters are manufactured in several different densities, permitting you to control the amount of light transmitted to the film. If one grade of ND filter does not quite block the amount of light needed for the exposure settings you wish to use, you can switch to a filter that has greater density and therefore reduces the amount of light even further.

Neutral density filters are numbered to designate the amount of light they transmit. For example, a filter with "ND 0,1" stamped on it transmits 80% of the light while the ND 1,0 filter transmits only 10%. The table above shows the gradation range and percentage of light transmitted by various ND filters.

DETERMINING WHICH GRADE TO USE

In the photography situation described in the first paragraph above, 1/60 sec was the slowest possible shutter speed without a neutral density filter, and 1/8 sec. was the desired shutter speed. The question is, what strength of ND filter should be used to permit a shutter speed of 1/8 sec.?

Here is how to get the answer: Count the stops it takes to change from a shutter speed of 1/60 sec. to 1/8 sec. You'll find there are three - 1/30 sec., 1/15 sec. and 1/8 sec. Now look at the table, which shows that to open by three stops, you will need the ND 0,9 grade of filter. Therefore, by fitting an ND 0.9 filter to your lens, you would be able to change shutter speed from 1/60 sec. to 1/8 sec. and obtain correct exposure.

Note: The same information is provided in a different manner by the filter factor. For the ND 0,9 grade, the table shows the filter factor is 8, which means you need to allow eight times more light to strike the film when the filter is attached for proper exposure. Opening by one stop doubles the amount of light, two stops quadruples the amount of light, and three stops permits eight times the amount of light to enter.

Gradated neutral density filter

A handy filter for landscapes

WHY AREN'T SKIES BLUE IN MY PICTURES?

You may have noticed that blue skies do not often turn out as blue in your landscape pictures, but usually turn out bleached white, as if it had been a cloudy and gray day. You probably wonder if you are doing something wrong. Well, you probably aren't doing anything wrong; you're just not doing it right.

Ever wonder why blue sky turns out so pale in your pictures?

THE SKY & THE GROUND REQUIRE DIFFERENT EXPOSURES

In a landscape, both the sun and the sky illuminate the ground. (The sky itself is a source of light.) If you aim your camera down to exclude any sky from the viewfinder so its light meter reads only the ground, and then point it up so it reads only the sky, you will have two different exposure readings, because the sky is brighter than the ground. If you take a picture of the sky only, it will be correctly exposed and the picture should be a nice blue on a clear day. But using the same exposure settings to shoot the ground will make the ground look quite dark.

Your camera's meter averages the exposure when you have both sky and ground in equal amounts in the viewframe so that the ground is a little bit darker than it would be if you exposed for it only, and the sky is rendered a little paler. If you are shooting slide film, this is probably how your landscapes look - sky too pale and ground too dark.

With negative film, the real impact on the sky occurs when your prints are made in the lab. The person doing the printing looks at your image, recognizes that the ground is too dark and adjusts the image's density to make the ground brighter. The problem, however, is that the whole image, not just the ground, is affected by the adjustment, and your sky is rendered much paler, losing much of its blue cast. The print could just as easily have been adjusted to make the sky darker, which would then look nicely blue, but the ground would look too deeply shaded. It's a trade-off, and most photo printers assume you want the ground to look properly-exposed.

How do you get around it? One answer that's very effective is to use a gradated neutral density filter.

A gradated ND (neutral density) filter will turn your skies blue again

THE GRADATED NEUTRAL DENSITY FILTER

A filter that is clear in one half while the other half gradually changes to a neutral density filter is called a gradated or graduated neutral density filter (also called a split neutral density filter or a gradated gray filter). Light passes unchanged through the clear portion of the filter, but is partially blocked by the denser part, making it a very handy filter to have, especially for landscapes that include the sky.

When you shoot a landscape that has sky in it, attach the filter to your lens so the denser (darker) part is on top, and ensure that the dividing line between the filter's dense half and its clear half (the "transition line") is level with the horizon. The dark upper part of the filter reduces the amount of light from the sky that reaches the film. The lower part, which is clear, allows for normal exposure of the land. The resulting print will then have a darker (and therefore bluer) sky and properly-exposed ground.

Since the dense portion of the filter is neutral - simply transmitting less light with no color changes - this filter works for both color and black and white film.

This filter is available as a circular filter that can be turned in its mount or as an unmounted 3" by 3" square or 4" by 5" rectangular filter that is part of an interchangeable filter holder system. (See Filter quality to learn about filter systems.)

The dense portion does not have to be placed so that it affects the upper part of your image. It can also be used at the bottom of the image or rotated so it affects only one side of the image, or even used in a diagonal position. A gradated ND filter placed to block a bright foreground can balance the amount of light between it and the background. For example, you might position the dense portion at the bottom when using flash so that your foreground will not be overexposed, or when there is, for example, a bright ski hill in the foreground with darker trees in the background.

The square and rectangular types of gradated ND filters can usually be adjusted up or down to affect more or less of the image, giving them a major advantage over circular filters. This flexibility provides more opportunities for creative photography because the transition line does not have to be in the middle of the frame, as it is with the circular filter.

It's important when using the gradated ND filter to place the transition line where it looks natural in the image, such as on a horizon line. If the transition line is visible - as it can be if placed over an area of continuous tone or if it bisects a uniformly-lit vertical object such as a column - it tends to disrupt the image's harmony. Viewers know they are looking at something unnatural, a line that doesn't belong.

Some gradated ND filters are available with either a soft or a hard edge where the denser portion begins. The soft or feathered edge allows a more gradual-looking transition.

Further, there are different degrees of density available in gradated neutral density filters, permitting more or less light to be transmitted to the film through the dense portion. The density choices are commonly one, two and even three stops, with the two-stop variety being the most popular.

Some manufacturers make a gradated ND filter that is divided 60/40 instead of 50/50. 60% of the filter is clear and 40% is gradated. The reason for providing photographers with this choice is that a great number of landscapes are photographed with more land and less sky, hence the need for a larger transparent area.

MINIMIZE THE APPEARANCE OF THE TRANSITION LINE

The effect of a gradated ND filter is quite pronounced when using a very wide-angle lens at a small aperture setting. The transition is distinct, whereas a picture taken with a telephoto lens at a wide aperture through a gradated ND filter is more subtle and the effect is more subdued. The smaller the aperture, the sharper is the boundary between the dense section and the clear section. Use the camera's through-the-lens viewfinder and stop down the lens (use your camera's Depth of field preview button) to check the effect before deciding on your aperture setting.

Keeping the filter as close as possible to the lens will maximize the transition's softness. There are also different types of transition lines available, most common being the "soft" gradation, which blends nicely into most scenes, even when using a wide-angle lens which tends to show the transition line more than longer lenses by narrowing it. A "hard" gradation might be useful with a telephoto in shooting a fairly-flat horizon when the transition line is placed on the horizon line. Another type of ND filter changes density gradually across the entire filter so there is no distinct transition line at all.

EXPOSURE

Determining exposure when using a gradated ND filter is no different than determining normal exposure without it. A built-in meter will give a reading that should prove to be correct without the need for adjustment. If you are using a hand-held light meter, take your reading from the area of the scene that will

be photographed through the clear portion of the filter. This is usually the darker part of the scene. You can also measure the highlight area of the scene and adjust your shutter and aperture settings based on the filter factor of the dense area of the filter. (See Filter factor). Don't forget to bracket exposures if the image is an important one that you want to get just right.
QUALITY
As with any filter, there are differing levels of quality available from different manufacturers. Some inexpensive plastic or resin filters may be advertised as being neutral gray, but may have a slight color cast to them. This doesn't mean that all resin filters, however, are inferior. Some are of excellent quality. Manufacturer's reputation and higher price are generally good indicators of a good filter.

Gradated filters that are colored

Selectively subdue light & alter color

A "gradated (or graduated) density filter" that is colored instead of gray in the dense portion of the filter will not only reduce the amount of light reaching the film through the dense portion of the filter, but will also change its color in that half of the image. The name for such a filter is generally shortened to just “gradated filter” and the word “neutral” is not part of its name because the filter isn’t neutral; it’s colored.

The idea behind these filters is that you can selectively color a portion of the light reaching your film while allowing the unaffected area of the scene to be rendered in its actual colors. A gradated filter that has salmon or tobacco coloring in the dense portion, for example, can be used to give the impression that the sun is setting.
In fact, some filter manufacturers make a gradated filter just for sunset effects, called, not surprisingly, the "sunset" filter. It has a dense upper section, a relatively-clear mid-section and a moderately-dense lower section to also give the bottom part of the picture a sunset effect. This can be important if the bottom of the scene is reflective, such as when there is water in the foreground.
A gradated blue filter can be used in place of a gradated neutral density filter to really bring out the blue color of a sky – particularly useful if the sky is overcast or if you are shooting into the light.
More than one gradated filter can be used at a time. They can be combined either in the same positions to affect only one portion of the image (useful if the effect of one filter is not enough) or in opposed positions to subdue light intensity and to add color (or different colors if two differently-colored filters are used) to both sides of an image.
Since the expected results can be pre-judged through the viewfinder of an SLR camera, the filters can be adjusted as you look through the viewfinder for the best effect.
Remember, as with the neutral density filter, the smaller the aperture, the sharper is the boundary between the denser (colored) section and the clear section. Use the camera's viewfinder and stop down the lens to check the effect before deciding on your aperture setting.
Some of the colors available (depending on the filter-maker) include blue, green, mauve, orange, pink, purple, red, sepia, tobacco, yellow, wine red and each color is usually available in at least two different densities.
Colored gradated filters, especially red, orange and yellow, can be used for black and white photography to change the contrast of a part of the image.
Colored gradated filters do not have to be clear in the non-gradated portion. Normal filters for color-balancing are also available in gradated versions.

Ultra-violet (UV) & skylight filters

The ultraviolet (UV) filter is clear & neutral.

Ultra-violet (or UV) radiation is invisible to the human eye, but can be seen by bees and butterflies, and most photographic film is sensitive to it. It is found in the electromagnetic spectrum next to visible blue wavelengths.

Ordinary glass absorbs much of the ultra-violet range, but its longest wavelengths (called the near-UV, because they are near the shortest visible blue wavelengths in the spectrum) can be transmitted through uncoated glass lenses to be recorded on film. It actually records on a different focal plane from that of visible light. UV registers on color film as an unsharp, undesirable blue or even as a magenta tint on portions of the image. If the UV is weak, it often can't be detected in an image, but if it is strong, the out-of-focus ghost image it registers on film can make a picture look unsharp.

Sunlight contains a good deal of UV radiation, which would normally make it a concern in outdoor photography except that the atmosphere at ground level absorbs so much of it that the UV content of normal daylight is negligible and of little consequence. But, at higher altitudes, where the atmosphere is thinner and absorbs less UV radiation than at lower levels, there is more of it to contend with, making it a particular concern for aerial and alpine photographers. The effects of UV can be exaggerated by atmospheric haze over great distances, which tends to scatter it and make it more pronounced, particularly when looking towards the light.

Many flash units also emit a good deal of ultraviolet light that can cause a picture to be bluer than the scene appeared when photographed. Most manufacturers, however, build an ultraviolet filter into the glass that covers the flash tube (called UV-corrected flash) that absorbs the UV radiation, preventing it from striking the subject.

The skylight filter is a UV filter with a pale rose tinge to it.

THE UV FILTER

Ultra-violet radiation can easily be controlled through the use of a UV or skylight filter that absorbs ultra-violet wavelengths. The UV filter is almost always a clear, neutral filter, having no effect on visible colors, although a pale yellow filter is sometimes also referred to as a UV filter (which it's not). Its use in eliminating the effects of UV radiation is more suitable to black and white photography than to color film.

SKYLIGHT FILTER (THE UV FILTER FOR SLIDE FILM)

The skylight filter is a UV filter with a pale rose tinge to it to warm images up. It is intended for use only with daylight-type color slide films to reduce excess bluishness. It is not needed with color negative film since any excess of blue can be controlled in color prints during the printing process.

BLACK AND WHITE FILM

Even though black and white film can record UV, its effect on black and white images is minimal and not of great concern. When using black and white film, the use of a yellow filter will effectively absorb UV light along with the visible blue.

IS THERE REALLY A NEED FOR UV FILTERS TODAY?

The answer is yes, even though many modern lenses are coated to screen out UV light waves, making a UV filter redundant. As UV-coated lenses come more and more into use, the UV filter will find less usage, and will only be needed for older, uncoated lenses.

But, because there are so many quality, older lenses in use and there probably will be for a long while (and because not every new lens is UV coated), the UV filter will stick around as a usable accessory.

Should you leave a UV filter on your lens?

Should you leave a UV filter on your lens at all times to protect the surface?

Will it affect my pictures or be totally neutral?

The more you read and hear about filters in photography, the more you will come across advice that an ultraviolet (UV) filter or a skylight filter (which is a UV filter with a pale rose tinge to it to warm color slide pictures up) can be left on your lens at all times to protect it from dust and surface damage, no matter what you are photographing, because the filter's density is so minimal that it doesn't affect exposure and because the UV filter is colorless and therefore has no affect on tone rendition. Seems to be good advice, doesn't it? After all, what harm can such a filter do? It is beneficial in screening out UV light and is totally transparent.

It is well-intentioned advice, and in most instances the permanent presence of a UV filter will not detrimentally affect your images. But, let's look at it another way. You wouldn't want to shoot all your pictures through a completely clear and colorless window, would you? Why not? Because you would be placing two extra reflective surfaces (meaning each side of the glass) between your lens and your subject, with the result that you could get unwanted reflections. These reflections may appear in your images as ghosting or flare.

Keeping a UV filter permanently on your lens is not much different than shooting through a totally-clear window. You will have two extra reflective surfaces between your lens and your subject, surfaces that are potentially harmful and generally unnecessary for much of your photography. (Many modern lenses already have a coating to screen out UV light waves, making a UV filter redundant. Besides, UV light is often not a major factor in much of our day-to-day photography.)

You may be better off to simply use a lens cap.

What about the protective aspect of the permanently-attached UV filter? The same people would say you can just as easily keep your lens' surface protected with a lens cap or any inexpensive filter, UV or otherwise, that can be removed when it is time to take a picture. If lens protection is a real concern because you have an environmental dust or dirt problem, and a permanently-attached UV filter is your solution, you will have to clean the filter anyway before you shoot. An easily-removed lens cap is perhaps a better solution.

THE BOTTOM LINE

It is difficult in most cases to discern the difference between a picture taken with or without a UV filter on the lens. So, it comes down what works best for you. If you find it easier to shoot quickly without having to remove a lens cap, but want to protect the surface glass of the lens, then keep a UV filter on instead of a lens cap. And keep an eye out for flare problems. If you're a purist and want to minimize the number of glass surfaces between the film and your subject, do away with the UV filter; use a lens cap for protection and a lens hood for flare prevention.

Polarizing filter

The indispensible filter for color & black & white

A polarizing filter (aka polarizer or polarizing screen) is an adjustable filter, with an inner ring that screws onto the lens and an outer ring that can be rotated. Turning the outer ring reduces or increases the filter's effectiveness. This means the photographer can control the degree to which the filter works, and the amount of change can be seen when looking through the viewfinder of a TTL (through the lens) camera. (Note: In some filter systems, the polarizer may slide into a filter holder that itself rotates, rather than screw onto the lens.)

HOW DOES IT WORK?

Although the sun's rays travel in straight lines, they deflect off of objects in their path. This stray reflected light will vibrate in a single plane off of certain reflective surfaces (a window, a road or a pond's surface, for instance) and becomes known as glare. When you aim your camera at such a surface from the side (at an angle of between 30 to 60 degrees), the polarizing filter acts on the glare, absorbing as much of it as you set the filter to absorb by progressively turning the outer ring. Shooting at angles between 32 and 34-degrees to the reflecting surface seem to be most effective in reducing glare. Only light that is properly oriented to the filter will pass through it. A polarizer is not effective on all reflective surfaces because some, such as bare metal, chrome or mirrors, don't change the light's polarization. But, it's darned effective on just about every other reflection.

A POLARIZER DARKENS CLEAR BLUE SKY

A polarizing filter is very effective on the minuscule surfaces of water vapor, smoke and dust particles found in the atmosphere, but only at certain angles to the sun. Perhaps the number one problem encountered in aerial photography is haze and the number one filter for haze removal is the polarizing filter. A polarizer prevents stray reflected light, such as is found in haze, from reaching the film, thereby increasing the sky's color saturation, often quite dramatically. And it does this without darkening other parts of the image (unless other parts of the image also reflect glare which the polarizer removes).

WHAT DO I HAVE TO KNOW TO USE IT MOST EFFECTIVELY?

The light from a clear blue sky is partially polarized. Clear sky can be rendered darker by using a polarizing filter in the area of the sky where polarization is strongest. And polarization is strongest over the arc of the sky that is 90° from the sun, and is weakest both close to the sun (0°) and farthest from the sun (180°). So, when shooting a scene that includes the sky, whether an aerial image or one taken at ground level, the lens must be aimed at a 90-degree angle to the direction of the sunlight for maximum effect in eliminating reflections from atmospheric haze, therefore darkening the sky. This means that *whenever the sun is directly on your left or right side as you aim the camera straight ahead, the polarizer will work best*. If you take a picture at an angle other than 90 degrees to the sun, only a portion of the sky may be polarized, resulting in a dark blue sky on one side of your picture and a lighter blue on the other.
Some polarizing filters have an indicator handle on the screen. When it is pointing at the sun, the sky will be its darkest.

If the foregoing sounded too technical, don't let it worry you, because you can actually see the polarizer's effect as you turn the filter and the sky becomes an increasingly deeper blue. Keep rotating it, and it will become lighter again. The change can be quite dramatic, increasing contrast and turning a pale sky into one that is deep blue (or a darker grey if using black and white film) by cutting through the light reflected from atmospheric particles. Take your picture when you feel the sky is appropriately dark

NON-SLR CAMERAS

If you use a viewfinder camera, hold the polarizer up to your eye to view the subject through it, then gradually rotate the outer ring of the filter to gauge its effect on the scene. When the degree of glare reduction or sky darkening that you want is reached, place the filter in front of the lens in *exactly* the same orientation as you had been looking through it. Be careful not to accidentally turn it or the effect may change. Some polarizing filters are made with markings on the rim to assist you in maintaining its proper position when attaching the filter to a viewfinder camera's lens.

LENSES THAT ROTATE AS YOU FOCUS

You may have a lens in which the filter ring at the front of the lens barrel rotates as you focus or zoom. If you have a polarizer attached, it will turn, too, and change the polarizer's orientation as you focus or zoom. When this occurs, remember to readjust the filter for the polarizing effect you desire after you have changed focus or zoomed.

A HAZE FILTER IS NOT A POLARIZER

A polarizing filter is not to be confused with a haze filter, although it is probably more effective at haze reduction, particularly distant haze, than a haze filter is. Although a polarizer works with both color and black and white film to reduce haze, to increase contrast and to eliminate glare, a red filter will have a greater effect on haze reduction for black and white images.

REFLECTIONS BEGONE

The polarizing filter's ability to reduce glare is invaluable in bringing out color that is concealed beneath unwanted reflections. A shiny leaf or a wet rock that to the naked eye glistens brightly with reflected light

will suddenly lose its glare when a polarizing filter acts upon it, and its true colors will come through. Reflections in window glass can be made to seemingly disappear and the person you couldn't see (or photograph) standing behind the window can suddenly become quite visible and quite photographable. You may not want to remove all reflection from a scene, since a fish in water may look like it is floating in the air if there is no reflection at all to indicate that it is in water.

A POLARIZER REQUIRES ADDITIONAL EXPOSURE

Because of its light-absorbing qualities, additional exposure is required when using a polarizing filter, no matter how the filter is rotated – generally one-and-a-half to two stops.

This means you will have to either decrease the shutter speed or widen the aperture, or do both to lesser degrees. For example, an exposure setting of 1/500 sec at *f*5.6 without a polarizer could be changed when using a polarizer (with a filter factor of one-and-a-half stops) to 1/250 sec and an aperture setting midway between *f*4 and *f*5.6 to obtain correct exposure.

If your subject is lit from the front, an exposure increase of one-and-a-half stops should do the trick. But if your subject is (1) lit from above or the side, and is relatively large in the viewfinder, or (2) if the polarizer is used to eliminate bright glare from your subject, then a two-stop exposure increase is called for. Far off landscapes or distant subjects that are side-lit or front-lit won't generally need the extra half-stop.

A built-in TTL (through the lens) meter is ideal in quickly making the necessary exposure adjustment since light measurement can be made while the filter is in place and being turned.

USE A POLARIZER AS A NEUTRAL DENSITY FILTER

Since exposure must be increased when using a polarizer and since a polarizer does not alter colors, it can be used in the same manner as a neutral density filter to reduce the amount of light, permitting you to use a slower shutter speed or a wider aperture for decreased depth of field.

POLARIZERS AREN'T THE ONLY FILTERS THAT DEEPEN BLUE SKIES

Other filters that can change a pale sky into a deep blue sky are the gradated neutral density (ND) filter and the gradated blue filter. If you have to choose between a gradated ND or blue filter and a polarizer, you will probably want to get a polarizer first, since it is very effective in making a clear sky turn blue and so useful in other ways. In black & white photography, yellow, orange and red are among the filters that darken skies. (See Colored filters for black and white photography.

TWO TYPES OF POLARIZING FILTER

Linear and circular polarizers are available. The linear type, which has its crystals arranged in a line-like fashion, is made for use with manual-focus cameras, and can throw off the exposure systems and auto-focusing of fully-automatic cameras. The circular polarizing filter has its crystals arranged in a circular pattern, and is recommended for most auto-focus cameras.

BUYING A POLARIZER

Be sure to buy the best quality polarizer you can afford. (We recently purchased one at more than $120 to fit a large lens. They can be quite expensive.) An inexpensive polarizer may be poorly-made and unable to stand up to rigorous use, or may not be neutral, and can cause color shift in your images. As with other types of filters, type of glass used, its flatness, coatings or lack of coating, and other manufacturing characteristics determine the filter's quality.

If your camera has interchangeable lenses, you might want to consider a filter system that permits you to use the same filters for different sizes of lenses, so you then will not have to buy new filters for every lens. Be sure to check your camera's manual to see if the manufacturer recommends a linear or circular polarizing filter before you buy a polarizer. If you are not sure, you can't go wrong buying one that is marked "circular" - although it will be more expensive - because it works on any camera.

If you are using a wide-angle lens, bring it with you (mounted on your camera) when you buy your polarizer or gradated filter, and try the filter on the lens before you buy it. Some filters, particularly polarizers, have frames (rims) so wide that they block light at the edges of a wide-angle lens, causing unwanted vignetting. There are special slim polarizers made to get around this problem, and they are usually more expensive. Sometimes called "thin mount" filters, they can be 3 mm wide versus 6 mm for a standard rim, and have no front threads, which means other filters cannot be attached to them and only a slip-on cap will hold in place. (We recommend you read our section on Filter quality before buying any filter.)

COLORED POLARIZERS
Some filter manufacturers make color polarizers that let you take polarized pictures with color, however they are most-commonly used in conjunction with a normal (neutral, or non-colored) polarizer. They can be turned just like a regular polarizer, but their effect is to gradually increase the amount of overall color in the image. They can provide nice effects with color film. The color of reflections can also be altered, or made to simply disappear as with a normal polarizer. Some color polarizers are made for use with black and white film and do not need to be used in conjunction with a normal polarizer.

POLARIZERS CAN BE USED WITH OTHER FILTERS
Polarizers and other filters, including color filters for black and white photography, can be used together, making it possible to control color rendition and glare at the same time. But keep the filter factors of both in mind when using a polarizing filter with another filter. The factor of one filter must be multiplied by the factor of the other - not added to it - to calculate their combined factor. The combined factor must then be multiplied by the exposure given by the meter.
Through-the-lens metering eliminates the need to make this calculation since it is done automatically with the filters attached to the lens.

THIS IS ONE FILTER YOU SHOULD HAVE
The polarizer's effect can be almost magical since it changes perception in ways the human eye can't, and the results of those changes can actually be seen through the viewfinder of an SLR and accurately recorded on film. This is one filter we recommend for every photographer who wants to increase color saturation and achieve a more dramatic look in his or her pictures. Once you become used to the changes that a polarizer can bring to your pictures, you'll wonder how you ever did without it before.

Creative use of filters

Although many filters are designed to make an image look realistic and natural or to solve a specific problem, these same filters can be used creatively to help you achieve dramatic, unnatural-looking or bizarre effects in your images. In addition, there is a whole range of filters and other lens attachments specifically designed to alter the natural look of a scene and create unusual, attention-drawing images.
SOLID COLOR FILTERS
If you regularly shoot in black and white and have an array of B&W filters (solid colored filters) at hand, an easy way to get started in creative filter effects is to shoot color film with your solid-colored filters. Most color images that have an overall color cast will look like the photographer made a mistake and forgot to take the filter off when switching from black and white to color film. That is obviously not the effect you are after. Click on B&W filters for color film to get off on the right foot.

SPECIAL EFFECTS FILTERS
Unlike the "must-have" working filters that are necessary to solve common problems, enhance images or make a scene seem natural-looking, special effects filters are selected at a much more personal level, based on individual taste and creative skill.
It is easy to make an image look hokey or kitsch-like by the tasteless application of the more extreme filters. Just slap on a six-faceted color prism filter and snap a picture of the cat to see what we mean. It is another matter to achieve a unique and tasteful image using special effects filters, requiring a good sense of composition and familiarity with the filter itself. That is the challenge photographers are presented with when using extreme special effect filters. Don't take it too seriously, however. The wilder special effect filters are the photographer's toys – they are for fun – permitting your sense of creativity to enter areas that would otherwise be closed to you. So have fun with them, and be prepared to laugh at some of the results you get

There are two extremes of special effect filter – the bizarre and the practical – with a large number of filters straddling the border between the two.

Diffusion filters that can soften wrinkles in a portrait or lend a dream-like mood to a scene are examples of practical special effect filters. So too are star-effect filters that cause points of light to streak out across an image, adding sparkle and life to a scene. There is a place for such filters in serious photography and many photographers make regular use of them.
Filter manufacturers seem to sometimes compete with one another to see who can make the most bizarre filter. There are some strange ones out there – special effect filters that dramatically alter scenes, distorting and sometimes making the subject almost unrecognizable – while others are subtle, improving an image by a relatively-minor effect.

Black & white filters for color film

Using colored filters creatively with color film

Most solid-color filters find their use principally in black and white photography (see Filters for black and white film), however they can also be used judiciously in color photography to improve or alter the mood of a picture. A blue filter, for example, can give the impression that a daylight landscape was photographed in early morning or late evening, particularly if there is fog or haze in the scene to mask the sun's location (by de-emphasizing the direction shadows fall) and to contribute to the mood. A green filter can provide an eerie look to a neon-lit street or a misty cemetery in early evening, and an orange filter can enhance a sunrise or enrich or sunset, and give life to an otherwise dull and dreary landscape.

THE IMAGE SHOULD LOOK BELIEVABLE

It is easy to overdo it when using a colored filter with color film, with the result that your picture will not look believable. If a scene could conceivably be the color of the filter under natural conditions, even if only briefly at certain times of the day or by stretching the imagination into the realm of slightly-possible, then it will likely be a believable picture.
A productive way to introduce yourself to this technique is to review the published works of other photographers in your local library or on the internet to see where and when they took pictures that may have been enhanced by a color filter, and then you can set out to emulate their work with a similar subject and time of day. You may find that you need to underexpose or overexpose to achieve a similar look, or that deep shadows need to fall on the subject you are shooting to give it the drama you are after. Experience through trial-and-error will allow you to visualize scenes that lend themselves to the use of a solid color filter, and you'll soon have viewers asking "How did you ever get that beautiful shot of the park (waterfall, barn, etc.)? I've never seen it look like that before."

EXPOSURE

Determine exposure in the normal way, as if you were shooting black and white film rather than color, and see what results. The picture will be properly-exposed, and will have an overall color cast that is the same as the color of your filter. But, if you are trying to create, say an early morning or late evening mood, when the eye is used to seeing much less brightness in a scene, your picture may be improved by purposefully under-exposing to create greater darkness in the scene. The combination of underexposure and a blue filter, for example, can make a daylight scene look like it was shot by the light of the moon.
If you give more exposure than your light meter suggests, your images will be lighter. This can work well for certain scenes and can destroy others. An arid region shot on a cool and overcast day with a yellow filter and overexposed by one or two stops may seem like a blazing hot desert.
If you are not sure whether to over-expose or under-expose to achieve the image you want, bracket your exposures by as much as two or three stops. It may seem wasteful at first to take so many pictures of the same scene at different exposures, but it's one of the prices of learning. When you see the results, it will be easier next time to zero in on the right exposure needed to create a similar effect.
FOCUSING WITH A DARK FILTER ATTACHED
If a scene is already dark because of the time of day, overcast conditions or because it is in shadow, you may find that your autofocus camera has trouble focusing with a dark color filter attached because so much light is being absorbed by the filter. Should this occur, simply focus manually.

Diffusion filters

For a soft-focus effect

Diffusion or "soft focus" filter types are perhaps the most numerous of the special effect filters, with more than a hundred varieties available. The idea behind them is to obtain a soft look by bending (refracting) some of the light from the subject so it is defocused while the rest remains in focus. Highlights are actually dispersed onto adjacent areas. The image still looks properly-focused overall, but its components are just enough out-of-focus that they are softened. Lines are slightly fuzzy and small details seem to disappear. The range of diffusion filters finds its main use in portraitwork, softening wrinkles, lending skin a more youthful, Georgia-peach appearance, softening hair and giving eyes a misty, romantic look. They are also used extensively to create a misty, dreamy atmosphere in landscapes and moody pictures. Technically, they are not really filters; they are lens attachments or devices placed between the lens and the subject, but since many are handled in the same manner as true filters, we refer to them as such.

An ordinary black nylon stocking can be used as a diffusion filter.

THE FIRST DIFFUSERS WERE PROBABLY STOCKINGS

Early photographers discovered that a fine mesh stretched over the lens could achieve a similar softening effect. A nylon stocking is made from such material. Some portrait photographers today continue to use this time-tested technique with great success. We know of one who specifies a brand, color and style of nylon stockingette for ideal portrait softening. Tulle can also be used for this purpose.

The material has a greater effect on the small details (a person's blemishes and facial lines) than it does on the overall image, which remains sharp, because so much of the light travels unchanged through the clear spaces of the mesh, while light that meets the fine lines of the material gets reflected, absorbed and refracted.

Black material minimizes highlights "halation" (the blurred effect at the edges of a light area) so that dark areas remain dark. White material increases halation, thereby lightening dark areas. A light-colored mesh can lower shadow contrast and even add its own color to the shadowed parts of the image, while the highlights remain unaffected.

WHY DOES A MESH OVER THE LENS WORK?

The edges of the net material refract light, bending it at an angle that changes its distance to the film so that the refracted light becomes out of focus. The amount of out-of-focus light is minimal in relation to the overall amount of light that travels in straight lines from the subject to the film, but it's enough to blur wrinkle lines and soften facial blemishes. The result is an image that looks properly-focused, but is forgivingly soft and gives skin an appropriately "fuzzy" appearance for a more youthful-looking portrait.

If the mesh is particularly fine and the lines are closer together, there are more fiber lines covering the lens, which makes the diffusing effect even greater.

The material must be stretched over the front of the lens and held firmly in place.

COMMERCIAL DIFFUSION FILTERS

Filter makers produce diffusion filters with fine lines engraved on them, based on the net-like material diffusion method. Such filters are sometimes called "pattern" filters because their wave or line patterns can usually be seen on the surface or sandwiched between the filter elements.

Also available are "haze effect" or "fog effect" filters, intended for landscape photography and some portrait work.

Diffusion filters are not all mesh-based. Other commercially-made soft-focus filters are manufactured from glass or plastic in several different types - dimpled, frosted, etched, etc. with differing degrees of diffusion. One type that has concentric grooves etched in glass increases diffusion as the aperture is widened.

DIMPLED FILTERS MAY BE THE BEST DIFFUSERS

A number of diffusion filters are optically clear except for a splattering of round or diamond-like dimples embedded in their surface. The better ones, which are covered with tiny droplets that act as lenses themselves, are considered to be an improvement on the mesh type of diffusion filter, mainly because the dimpled material is the same as the clear material, and therefore has a less-pronounced effect on shadow areas of the subject. They are said to be more effective in concealing facial flaws than mesh filters, too, because they refract light throughout their surfaces, not just at the edges. They also do not exhibit any change in the degree of softening with changes in aperture.

LENS CHOICE & APERTURE CAN AFFECT THE RESULTS

If you plan to use either a nylon stocking or a pattern filter, be sure to use a portrait lens (focal length can affect the results) and to keep your aperture sufficiently-wide so that depth of field doesn't cause the mesh lines to begin to show in the picture. Changes in aperture setting can sometimes change the degree of softening of the filter. Increasing exposure by about a half-stop will compensate for light absorption by most diffusion filters.

If you use a stockingette or other stretchy diaphanous material, the degree of diffusion is altered by the amount it is stretched. Be sure it is held securely in place so it doesn't move during exposure of the film. A rubber band will usually do the trick. Increase exposure by 1/3 to 1 stop. Because the effect is so unpredictable, bracket exposures for insurance.

WATCH THE EYES

Ideally, your subject's eyes will take on a romantic, "melting" look when using soft focus attachments. The last thing you want from a diffusion filter is for it to dull a subject's eyes, which can occur if the overall effect is too soft or if the eyes just happen to be in an area of high diffusion. While it involves trial-and-error with a stocking or net filter, a good-quality dimple diffuser seems to get around this problem quite nicely.

GIVE YOUR SUBJECTS A GENTLE GLOW WITHOUT A DIFFUSION FILTER

A form of soft focus that is said to surround your subjects with a gentle glow while keeping details sharp involves taking a double exposure.

Your camera must be mounted on a tripod and cannot be moved during this procedure. The first exposure is made using a small aperture (*f*/16 or *f*/22, for example) for good depth of field and sharp definition, and a shutter speed that is one stop faster than your light meter calls for. With your subject remaining in place and motionless, take a second exposure at a your widest aperture (e.g. *f*/2.8) and a shutter speed that is one stop faster than you would normally use.

Star filters

An eight-pointed star filter adds sparkle to this cityscape at dusk. Photo courtesy of Karen Meeks.

Most filter manufacturers supply filters that transform light sources in a scene - including reflected light - into star-like points with rays of light emanating from them. They call these filters star, star effect, starburst, star flare, cross, cross screen and twinkle filters, and perhaps one or two other names. Interestingly, they are not really filters, per se. The effect is created by a series of closely-spaced, thin lines etched into the flat, optical surface of an otherwise piece of clear glass.

ONLY LIGHT SOURCES ARE AFFECTED

Light sources in a scene are affected by the filter, but illuminated objects and overall definition remain unaffected. A street scene with twenty street lamps visible through the viewfinder will have twenty star-like effects, but objects that are lighted by the street lamps will look normal, assuming you have properly exposed for them.

The light source does not have to be brilliant to react to this filter; it can be a reflection on water or glass, birthday candles, car headlamps, a huge spotlight or the setting sun. They will all come out as "stars," however their size and brightness depend on the size, brightness and shape of the light source.

DON'T OVERDO IT

The effect provided by these filters is easy to overdo. Understatement is often best. A single diamond earring can take on new brilliance when a star filter is used, but a tray of diamonds will look like a laser-beam nightmare of too many stars.

No one wants to look at picture after picture of star-flare effects, but the right star-like light effect in the right location with the right subject can make a picture a true stand-out.

A scene with just one light source - a simple sunset, for example - can be dramatically changed with a star filter in place.

The filters work best when the points of the stars reach out over a dark background.

Night scenes are the most logical place to use star filters, although they work just as well at high noon on a brilliantly-lit ski slope.

YOU HAVE A CHOICE IN THE NUMBER OF STAR POINTS

Filter selection includes two, four, eight and even sixteen-point stars.

COMBINE THEM WITH OTHER FILTERS

Star filters can be quite dramatic when used in conjunction with color, gradated or sunset filters.

LIGHT SOURCE SIZE & APERTURE SIZE ALTER THE EFFECT

The appearance and effect of the star flare varies with the size of the light source and the *f*-stop used. Always check the effect beforehand in the viewfinder, and be sure with short focal length lenses that depth of field is not too strong - i.e. due to too small an aperture setting. You don't want the lines etched into the filter to be seen in the image, and that might occur when there is great depth of field, which occurs at a small aperture.

A four-pointed star filter was effective in adding liveliness and sparkle to this time-exposure.

Potpourri of filter tips

Helpful tips & hints about filters

FILTER CARE

Filters should be given the same care that you give your lenses. Avoid touching the surfaces of a filter with your fingers. Handle them by the edges only. Don't leave your filters for long periods of time in daylight; their dyes may change color. Keep them in their original containers, and store them in a cool, dry place. Keep them clean and dust-free to ensure sharp pictures, ideally using the same method of cleaning you use for your lens surfaces.

A camel hair air brush should be used to gently remove dust and grit from a filter.

WHAT IS THE BEST WAY TO CLEAN A FILTER?

1. Use a camel hair blower brush or compressed air to get rid of loose dirt or grit that may be lying loosely on the surface. Never wipe a filter with a dry wipe that can grind built-up grit into the surface, especially with gelatin or plastic filters that are easily-scratched.
2. Once dust or grit are gone, use a moistened cotton swab, a soft, lint-free cloth, lens cleaning paper or pure white facial tissue (Kleenex or Scott tissue without lanolin or other additives), moistened with a name brand lens cleaning solution for glass filters. Don't ever pour a cleaning solution directly onto a filter, and be careful not to get any solution on the edge of a laminated filter.
3. Use gentle, circular cleaning motions, outward from the center of the filter to the ring (or the edge of a square filter) and then lift the swab or tissue off in an upward motion against the ring.
4. To remove a fingerprint or other mark that is too stubborn for the lens

cleaner, dampen a soft cloth or tissue using neutral detergent, then very gently wipe only the soiled area, drying it with a second soft cloth or tissue.
5. Some types of cleaning fluids may affect plastic filters, so clean a small test area on the filter's edge first to check suitability.
6. Use distilled water, sparingly applied, to remove water spots or chemical splashes on a filter.

IS YOUR FILTER MULTI-COATED?
If your filter says "multi-coated" on it, then it is almost certain that it has a multi-coating. If it says "multi resistant" (or MRC), it has a multi-coating which is more resistant to scratches and wear. If your filter is not marked with any of these designations, then it's a good bet it does not have multi-coating.

SHOOTING TOWARDS THE LIGHT
When your lens is pointed towards the sun or a very bright light at night, remove a neutral filter (such as the UV or skylight) that you might normally keep on the lens at all times since the reflected light from the surface of the filter may form ghost images on the film.

Filters can be easily mis-handled. If we're in a hurry, we may tend to toss them in a side pouch of a camera bag or slip them into a jacket pocket, and then wonder later how they became scratched or damaged. They should be treated with care like any other piece of delicate gear.
Many camera bags have compartments designed to hold and protect filters. If you have only a couple of filters, these are handy and easy to use. Better protection is afforded if you keep them in the plastic case or cloth bag that they came in when purchased.
If you have a large number of filters of the same size, a handy way of packing them is to screw them all together. Attach a lens cap at one end and your cheapest filter at the other. They can then be treated like a lens, and stored in a lens pouch or padded pocket of your camera bag. A hard lens case makes a great place to store a stack of round filters.
The problem with stacking filters occurs from over-tightening; you're best to barely screw them together - just enough to keep them attached to each other.

If your filter doesn't say "coated," "mutli-coated," "multi-resistant" (or "MRC") right on it, then it is probably has no coatings on it at all. Always try to buy multi-coated filters for the best results.

OLD WIVES' TALES
You may receive advice that you should not take flash pictures when you have a polarizing filter mounted in front of your lens. We wonder, why not? Fill flash and a polarizing filter make an effective combination. When shooting an outdoors wedding, for example, you can record a nicely-illuminated bride against the backdrop of a beautiful deep blue (polarized) sky.

STUCK FILTER?
Have a stuck filter that just won't budge when you attempt to twist it off? Here are three ways of unsticking that filter.
1) A WIDE ELASTIC BAND
You can try encircling the filter with a wide elastic band to give you a better grip. It works well with overly-tight lids on jars, and usually does the job with filters, too. Firmly grip the elastic that's around the filter, but *turn the lens* for better torque.
2) USE A SECOND FILTER & SOME TAPE
Screw on *another* filter so you have two filters on the lens, then tape both filters together with masking or plastic tape. The tape provides a good grip and applies even pressure on the stuck filter when rotating both together to unscrew the filter from the lens.
Once both filters are off, simply remove the tape and separate them.

3) YOUR SHOE *(BELIEVE IT OR NOT)*
If neither the elastic band nor the tape works (which would be very unusual), there is an unorthodox but effective way to remove a stuck filter.

Take your shoe off, remove any grit from the bottom, use the sole to press firmly against the ridges of the filter, and give it a twist. Make sure the sole is facing up to keep any grit from falling on the filter. After all, a sole's surface is made to have a good grip, but a word of warning: your shoe must have a flat sole. A knobby, contoured or ridged sole may scratch or crack the filter.

AFRAID TO USE YOUR SHOE IN CASE YOU MIGHT CAUSE SOME DAMAGE?
Then use another piece of leather (like a wide belt, for example) that will give you the overall even grip on the outer ring of the filter that it takes. No leather around? Any clean, dry, rubbery material - as long as it is flat and will provide *grip* over the entire edge of the filter - should also do the job.

STACKING FILTERS
An individual filter may not provide enough of its effect to give the results you would like to have. When a single filter doesn't do the job, use more than one, and as many as three in combination. The order in which they are stacked is generally unimportant, but calculating their combined filter factors is, unless you are using TTL metering. The combined filter factor for multiple filters is calculated by *multiplying*, not adding, the factors together - for example, the combined factor when stacking three filters with factors of 2, 2 and 2.5 is 2 X 2 X 2.5 = 10, which requires an increase in exposure of three-and-a-third additional stops.

WHICH FILTER RIMS ARE BETTER - BRASS OR ALUMINUM?
Aluminum rings may bind to the aluminum housing of the lens, making it difficult to remove a tightly screwed-on filter. Since brass won't bind to aluminum, some manufacturers claim brass rings provide the superior choice for filters. However, aluminum is softer than brass. The makers of aluminum ring filters claim that the softer metal will absorb shock better, possibly saving your lens from damage when it collides with another surface. Both points make sense, giving you something to think about when buying your filters.

ORDERING COLOR PRINTS
When ordering prints from color negative films taken with color filters, mention to the print lab that the film was exposed using colored filters so they won't attempt to "correct" the prints.

SELECTING THE RIGHT WARMING FILTER
Are you about to buy a warming filter, but don't know which one will suit your tastes? Bring a selection of unfiltered slides with you to the camera shop. Look at your slides on a lightbox with different warming filters behind them, and you will get a pretty good feel for how the image would have turned out if you had used those particular filters. Choose the filters that seem to provide your slides with the most pleasing look.

ADAPTER RINGS CONNECT MIS-MATCHED FILTERS AND LENSES
Let's suppose you have a filter that screws into a 52mm thread, but the lens you wish to use it on has a 49 mm thread. It is possible to attach them together using the right adapter ring, also called a stepping ring. An adapter ring looks like a slim filter with its glass missing. To match the filter with the lens given in this example, you need an adapter ring that has a female thread that fits your filter (52 mm thread), and a 49 mm male thread that screws into your lens. Adapter ring sizes are usually designated on the outside of the rim by engraving the thread size of the filter with an arrow pointing to the thread size of the lens.
Adapter rings are available as step-up or step-down rings. The first permits the attachment of a filter to a larger-diameter lens, and the other to a smaller-diameter lens. Generally, you are better off adapting a larger filter to avoid vignetting.

DON'T ACCIDENTALLY LOOSEN YOUR POLARIZER
Because a screw-on polarizing filter is rotated when using it, the direction in which you rotate it can be problematic. If you rotate it in a clockwise direction (while pointing the lens away from you), you may not realize you could also be unintentionally unscrewing the filter, and it might suddenly fall off. Make it a habit to always rotate the filter screen in the same direction that is used when attaching it to the lens (counter-clockwise when holding the lens pointed away), and you will never accidentally unscrew it.