Polarizers

Neutral, Tinted or Tainted?

By Joe Englander ©1995

Polarizers are the most useful accessories for color or B&W photography. Technically polarizers are not actually filters, they are screens. Color photographers frequently use them to "saturate" colors; B&W photographers too frequently are unaware of the polarizers' potential for controlling contrast and could just as frequently use them instead of harsh red filters to darken skies.

Just a quick review of the theory behind their function. Whether your physics teacher explained light as particles or as waves, certainly you've heard that light oscillates. It oscillates in many directions at once at right angles to the direction the light is traveling. Most non-metallic surfaces, in reflecting light, polarize it to some extent. When light is polarized it oscillates in one plane only instead of the many planes that are perpendicular to the direction the light is traveling. What a polarizer does is to only allow light to pass through it that is oscillating in a particular plane. Other light traveling in other planes is blocked. Think of it as passing a sheet of paper through a venetian

6x7 OF ALL TESTED POLARIZERS AND .6ND FILTER
THIS ILLUSTRATION IS SLIGHTLY OVEREXPOSED TO REVEAL THE DIFFERENT COLORS OF ALL THE "NEUTRAL" POLARIZERS.
NOTE ALSO THE DIFFERENCE IN COLOR OF FILTERS BY THE SAME MANUFACTURERS.

blind. If the sheet is parallel to the slats, it goes through with no problem; if the sheet is not parallel, it doesn't go through. Of course it is possible to have concentric slats, and if the paper is parallel to the slats, it will still pass through. This latter example is a loose description of a circular polarizer. Its slats are circular instead of planar. It still works on the same principal as the linear polarizer.

If the light has already been polarized by reflection, and that orientation is different than that which the polarizer filter favors, then that light will be blocked. So what a polarizer actually does is block polarized light so you can "see through a reflection" in a window or on the surface of a lake. To demonstrate the blocking effect of a polarizer, try this experiment using two stacked polarizers. Orient the first polarizer the way you normally would, then rotate the other polarizer. You'll see it block the light of the first until all light is blocked and everything is black.

Since the blue north sky is polarized to a large extent through the reflection of light by dust and vapor in the atmosphere, polarizing filters can be used to "darken" it by not letting that light through to the film. This is probably the most frequent use made of these filters. And it works equally well in color or black-and-white. In neither case does it cause any color shift the way a red filter in B&W would darken *both* green and blue. So in B&W, a sky can be darkened without dumping trees into unnaturally dark shadow values.

The saturation of colors attributed to using a polarizer comes from two actions. First, by using a polarizer to remove the "white light glare" of reflections, you are able to expose your film for the color of the object itself. If you do not use a polarizer and give proper exposure, the "white light glare" mixes with the object's color, diluting it. So by removing the dilution, you have purer color and thus more saturation. The second action is underexposure. Every photograph, polarized or not, appears to be more saturated when it is slightly underexposed. This is the reason typically given by KR64 users for shooting at EI 80. A slight underexposure of Velvia really makes for some interesting "saturation."

Somehow back in the dark ages when polarizing material was only sold in sheets, the "filter factor" was specified as being 2.5, and ever since then almost every writer has accepted that factor as a fact for glass camera filters. Some manufacturers, such as Heliopan, who specify a factor on the filter itself, and many famous authors such as Ansel Adams, Charles Swendlund, the editors of the Time-Life photography series, *The Joy of Photography*, *More Joy of Photography*, and *The New Joy of Photography* (all by the editors of Kodak!), Carl Shipman in the Canon EOS Handbooks, and many, many others have all used that same factor—2.5x. I think that factor is inadequate by 1.5(!) and has led to a lot of underexposed—and thus "oversaturated" photographs. In my opinion a polarized image should differ from an unpolarized one only in the removal of reflections—most of the other typical differences are actually due to an error in exposure. I will tell you how I arrived at this conclusion and invite you to do your own tests.

First of all, I use a densitometer. I measured a sheet of polarizing material. It measured 0.4. That translates into 1.3 stops or a filter factor of 2.6. *But*, most glass polarizers I read on the same densitometer had a value of close to 0.60. And that translates into 2 stops or a filter factor of 4. The orientation of a polarizer does not change its filter factor nor did it affect my densitometric readings. I didn't stop there; I also exposed film. Some of those images are reproduced here. In every case, when comparing polarized photographs with the "control" or unpolarized photograph, the 2-stop factor looked more natural. With a 2-stop allowance, reflections are removed and there is some increase in saturation. With only a 1.3- to 1.5-stop increase, the same reflections were removed, the film was underexposed and saturation was consequently significantly increased.

Furthermore, although a circular polarizer may be necessary for the automatic focusing systems of some cameras, I believe it is not necessary for any other reason, because no camera I have tested—Canon, Nikon, Leica, Contax, Minolta—ever produced a properly exposed transparency from autoexposure, no matter whether the filter was the much more expensive circular or the more common linear. In most cases the autoexposures were underexposed by at least 1/2 stop. Compare the illustrations made with both circular and linear polarizers: With most brands of filters, automatic exposure produced the same results whether with circular or linear.

Want to test it yourself? Set up a scene dominated by a nonreflective surface. Take careful notes of your exposures. Take a photograph without a polarizer. This is your control image. Put a polarizer on. Shoot several frames with the polarizer at different orientations and bracket each exposure. Pay particular attention to whether your camera meter is choosing different exposures for different orientations. The filter factor for polarizers is a constant no matter how much polarization is affected. The density of the nonreflective surface should be the same in the control frame and in the properly exposed polarized frame. It will be if you allowed 2 stops for the polarizer; otherwise, whether you're in auto or using some other factor, the density of the nonreflective surface will change. Overall I think you'll find that you've always got to allow 2 stops more exposure when using a polarizer than when not, no matter what your meter says. Tiffen in its very small printed material allows for 2 stops. Heliopan and B+W fudge in their materials by indicating a variable factor of 1.5 to 2 stops.

The other major assumption made by almost every writer and stated by every manufacturer's representative with whom I spoke was that polarizers have no effect on the color of the scene. Each manufacturer said that their polarizers were absolutely neutral. Just a quick glance at the accompanying illustration [page 9] and you'll begin to question that line. The color of each polarizer I received for review was different. Even the colors of polarizers from the same manufacturer were different. Remember, some of these polarizers cost more than $200, so I think you have a right to be somewhat picky about what represents "no effect" on the colors of a scene. Right now, I'm not even concerned with the "colored" polarizers, just the "neutral" ones. In order to have a standard for comparison, I chose the Kodak .6ND gel filter. I purchased a brand-new, in-date filter just for this comparison. I chose the .6ND because it so closely matches the density of most of the polarizers. The square .6ND gel is the neutral standard. Theoretically the filter that

matches it most closely will be the one which produces the least color shift. According to my readings, that would be the B+W *warm*! Compare the B+W warm picture of the Capitol with the unfiltered version.

Besides the performance of the filter itself, polarizers need to be considered mechanically. And, to some extent at least, the mechanical performance affects cost. The first mechanical option has to do with how the polarizing material is stretched and sealed between glass. Those filters designated Kaesemann—as those distributed by Hasselbad, Linhof, Sinar and others—are made by stretching the polarizing material between optical glass and then edge-sealing it. Both B+W and Heliopan offer Kaesemann filters. Bob Salomon from HP Marketing, the purveyors of the Heliopan, recommends their use for all long lenses or those with large front elements for optimum sharpness.

Both B+W and Heliopan use anodized brass mounts which are carefully machined and work like butter when screwed into the aluminum threads of most lenses. Other manufacturers use anodized aluminum which can stick to the anodized aluminum of lenses. The smoothest operating filter I worked with—for this test *or ever*—was the Heliopan warm. The second was the B+W warm. The other versions by these manufacturers were equalled in smoothness by both the Hoyas and Tiffens.

Finally, you may want to give some consideration to the mechanical height of the filters because, with wider lenses, the filter mount may intrude into image corners or diminish the angle of view available for view camera lenses. One of the reasons cited for the creation of "warm" polarizers was to avoid the necessity for doubling a warm filter and a polarizer which might create internal reflections and could cause vignetting. As a point of information, the combination of a Tiffen 81A and a Tiffen linear results in a height comparable to that of the Heliopan warm polarizer, while the Tiffen warm was one of the thinnest filters of all.

	Total Height	*Depth to Glass From Back of Filter*
B+W circular	.44	.162
B+W warm	.44	.165
Helio linear	.46	.169
Helio circular	.46	.169
Helio warm	.55	.181
Tiffen linear	.35	.125
Tiffen circular	.40	.133
Tiffen warm	.35	.105
Hoya linear	.38	.175
Hoya circular	.38	.170

Photographers need to be pragmatic in their use of equipment, using what works and double-checking assumptions. You can't assume a filter is neutral, you have to see if it produces neutral results. You can't assume a single filter is necessarily thinner than two stacked filters. You've got to decide what you want and which tools will deliver the goods for you. You have to decide how much having the silkiest operating filter is worth to you. Do you want your polarizer neutral, tinted or tainted?

Here are all the densitometer readings:

	Visual	Red	Green	Blue
Wratten .6ND	.60	.62	.62	.62
B+W circular	.51	.55	.52	.48
Heliopan linear	.62	.69	.63	.57
Heliopan circular	.58	.64	.58	.53
Tiffen linear	.50	.52	.49	.50
Tiffen circular	.51	.50	.52	.47
Hoya linear	.45	.47	.45	.43
Hoya circular	.54	.56	.55	.53
Tiffen warm linear	.62	.58	.62	.62
Helio warm linear	.60	.60	.61	.56
B+W warm linear	.56	.57	.57	.58

Compare the unfiltered picture to any of the polarized images. Closely examine the color of the Capitol Building; look for slight color shifts. Check out the color of the statue. Watch the shift in the sky. Some of the images look a little green, some a little bluer. Those that go blue might enhance blue sky, but do yellow flowers look better when blued? Compare between polarized images. Some of the polarized images could go very cold. Perhaps that's why the B+W warm looks so neutral.

Regarding sharpness, I could detect no differences in performance between all filters tested. With some longer lenses, there did seem to be a need to refocus with some of the filters and not with others, but the resulting images were comparable with the other filters.

Joe Englander has been photographing and exhibiting for the past 20 years. Working primarily in the 8x10 format since 1980, he has been producing both color and black-and-white photography for commercial and artistic projects. Joe has been teaching photographic workshops since 1981