A NEW ERA IN POLARIZING FILTERS

BY STUART SINGER

Polarizing filters can help you improve the image quality of any scene that contains unwanted glare or reflections, or that is illuminated with specular light (reflected light sources). In addition to using polarizing filters to reduce and eliminate glare or "kicks" caused by reflected light, many directors of photography use polarizing filters to increase and enhance reflections.

In general, polarizing films are used to:
- Eliminate glare and reflection on shots into and across water
- Reduce reflections on bright objects, such as chrome
- Control reflected images and capture truer color through glass, especially car windshields
- Penetrate haze

In addition, polarizing filters are effective for:
- Darkening skies for dramatic impact
- Adding to the drama and appeal of food shots (particularly meat or liquid)
- Increasing the color saturation of any object with a glossy surface

Although all polarizers will accomplish such tasks to some degree, the effectiveness of different polarizers varies widely. To understand why one polarizer works more effectively than another—and to get maximum impact from your polarizing filter—it helps to know how a polarizer is made, and exactly what makes it work.

Unpolarized vs. Polarized Light
Light made up of rays which vibrate and travel randomly in all directions, such as that given off by the sun or an incandescent bulb, is said to be unpolarized. Light which vibrates predominantly in a single direction (or axis), such as light reflected off a shiny surface, is polarized light. Nature produces polarized light in basically three ways: reflection, scattering and double refraction. The human eye cannot differentiate between polarized and unpolarized light. To help you visualize their differing properties we'll use the following rope/fence/tree scenario.

Picture that you've attached one end of a rope to the trunk of a tree, about three feet above the ground, and have pulled the other end of the rope away from the tree as far as you can. Now consider the rope to represent rays of light. If you were to shake the rope up and down (vertically), the vibration you induce would travel towards the tree in a single (polarized) up and down motion. If you shake the rope side to side (horizontally), the vibration you create would also move towards the tree in a single (polarized) motion, even though the motion is at right angles (90 degrees) to the vertical direction. Both of these examples represent the vibration of polarized light in a predominately single direction. Now imagine the same rope being shaken in many directions at one time. The vibrations induced scatter in all directions, thereby replicating the behavior of unpolarized light.

Now, imagine that there is a picket fence between you and the tree. The rope you are holding passes through a vertical space (slot) between pickets, to the tree on the other side. If you were to shake the rope in all directions at once (vertically, horizontally, diagonally), any vibrations from the side to side and diagonal motions would hit the fence pickets and not pass through the slot. Only the vertical vibrations (which run parallel to the slots) would pass through the fence and reach the tree. In effect, polarizing filters work to block certain rays of light in much the same way a picket fence blocks certain vibrations from the rope.

How Polarizers Work
Polarizing filters consist of a linear polarizing material sandwiched between two pieces of flat glass. In better polarizing filters, the polarizing material features closely spaced, nearly microscopic parallel lines called palings. In our rope/fence/tree scenario, the palings are represented by the wooden pickets of the fence.

Picture the glare caused by sunlight reflecting off a horizontal chrome car bumper. The glare is made up of reflected and scattered light, which is partially polarized in the horizontal direction (for the most part). To reduce the glare, you would utilize a polarizing filter, and rotate it so that its top palings were approximately perpendicular (90 degrees) to the bumpers. In such a position, the polarizing filter would only transmitt (allow to pass) light rays that are parallel to the vertical direction, just as our picket fence would allow through only those rope motions parallel to the slot between the pickets. As shown in the above example, use of a polarizing filter will result in great reduction in the glare caused by the horizontally reflected polarized light.

The Value of an Effective Polarizer
Many variables affect the performance of a polarizing filter. While polarizing filters available today encompass both ends of the quality spectrum, superior filters feature superior design, premium materials and manufacturing processes which enhance their performance and effectiveness. For example, high-quality brands are made from crystal-clear optical glass which has been diamond cut and polished with great precision, and feature a high-quality, precision polarizing foil.

The most relevant gauge of a polarizer's effectiveness is what optical engineers refer to as the "extinction ratio" (ER), more
commonly known as “efficiency.” A filter’s polarizing efficiency is determined in most part by the width, spacing and uniformity of its palings. A polarizing filter that has many closely spaced palings is more efficient than one that has fewer, less closely spaced palings. Thus, the more efficient the polarizing element, the greater its ability to control (or block) any light which is not parallel to the filter’s palings. The most efficient polarizing filter available today (the most recently introduced Schneider B+W True-Pol) has an ER of over 374, which is twelve times greater than the best that was previously available, which has an ER of 31.

Today’s best polarizing filters enable you to achieve a level of optical performance never before available to cinematographers. In addition to their increased ability to control glare and reflections, today’s higher quality polarizing filters eliminate many problems associated with polarizers in the past. Cinematographers have often avoided using polarizing filters in front of long focal length lenses (which have critically short depth of field). Such lenses are subject to distortion and changes in focus caused by the imperfect plane parallelism found in some poorly manufactured glass or “plastic resin” filters. Plane Parallelism—the precise flatness and exact parallel relationship between the front and back surfaces of a filter—is difficult to achieve in filters, unless they are manufactured with the same skill and quality materials as fine lenses.

For an accurate test of the performance and quality of your polarizing filters, stack two of them and shine a light through the pair. High quality polarizers featuring optical grade glass and neutral gray foils will exhibit no hint of color, while polarizers using lower grade glass will cast a greenish hue. Next, hold one filter stationary while slowly rotating the other. You should see the density of the light passing through the filters change from slightly gray (partial attenuation) to absolute black (maximum attenuation). If you cannot achieve absolute black at maximum attenuation (90° alignment of the palings) light is still passing through the filters, indicating poor performance and a compromise in the quality of the filter’s design and manufacture.

It’s clear that now, more than ever before, selecting the right polarizing filter can make a huge difference in motion picture image quality. The improved design, manufacture, materials and performance of today’s most advanced polarizing filters have finally brought them up to par with the finest motion picture camera lenses.

The figures above demonstrate that use of polarizing filters will result in great reduction in the glare caused by horizontally reflected polarized light. Glare is caused by sunlight which is reflected off a surface. The glare is made up of scattered light, which is partially polarized in the horizontal direction (for the most part). To reduce the glare, using a polarizer filter, rotate it so that its top palings are approximately perpendicular (90 degrees) to the surface. In such a position, the polarizing filter would only transmit (allow to pass) light rays that are parallel to the vertical direction.

Stacking two filters on top of one another and shining a light through should demonstrate the quality of the filters. As you hold one filter stationary and rotate the other, you should see the density of the light passing through the filters change from slightly gray to absolute black. If you don’t achieve absolute black, light is still passing through the filters indicating poor performance.