Of Lenses and Prisms: Optimizing Lens / Camera Performance

by Bentley Miller

This article is the first in a series on lenses, their design and function, and how they affect the craft of lighting for television.

Since this is a primer, it will provide some basic information about lenses which we will build upon in further articles. (I must confess that before researching this article, I only knew the minimum that one needs to know about lenses to function in our craft of lighting. In television production, the selection of lenses for specific characteristics, other than long or short lens designation, is given short shrift. Unfortunately, now that I have learned more through researching this article, I now realize how much more there is to learn.)

My aim in this introductory article is to show what a lengthy process camera/lens alignment is, when done properly, to optimize camera lens performance. In successive articles we will delve into lenses, and how their design and factors affect the lighting lens/camera combination.

Light, as we know it, comprises an entire spectrum of wavelengths—from which the invisable ultra-violet, through the visable spectrum which we are most familiar with, on into the infra-red region. If we were to characterize the spectrum with colors, we could dub ultra-violet as deep blue to the point of appearing purple, the visable spectrum as largely yellow, extending to infra-red, a ruby red color. This analogy is included to give you a visual reference, something to hang your hat on when we discuss light transmittance. I mention infra-red and ultra-violet light because they have a bearing on lens design/function, even though normally invisable to the naked eye. For the purposes of this particular discussion, we will concern ourselves only with the visable spectrum.

Light can be directed, shaped, controlled, altered and split into its component wavelengths. In the craft of lighting for television it is our principal tool. Perhaps the most simple example of the ability to control light in the craft of lighting is the scoop. Using the elliptical bell shape that comprises the body of the instrument makes it possible to cast a relatively soft form of illumination. The bell shape of the scoop deflects and bounces light rays within the instrument, softening the otherwise harsh nature of the source. To draw a more direct parallel between a light source and a television zoom lens, we can look at the familiar spotlight with its fresnel lens. The spot utilizes the combination of a parabolic mirror to shape and intensify the beam, a carriage assembly to spot or flood the beam, and a fresnel lens to modify the quality of the light source. The principle is similar to that of a television zoom lens. The marked difference between a luminaire and a lens is that a luminaire *projects* light; a lens takes light in, focusses it and transmits it precisely to the image plane (prism block or dichroic assembly), where it is passed along to the electronics which convert the light into an electronic signal that is representative of what the lens has captured. To say the least, this is an infinately more complex task as it involves channeling the entire visable spectrum and filtering out that part of the spectrum which is invisable to the naked eye. Further complicating matters is the requirement of zooming from wide angle to telephoto, which has the net effect of changing many of the optional parameters that would be static in a fixed focal length lens.

Now that we have some background information, lets move on to a detailed explanation of the camera/lens optimization process.

Camera/Lens Set-up Procedure

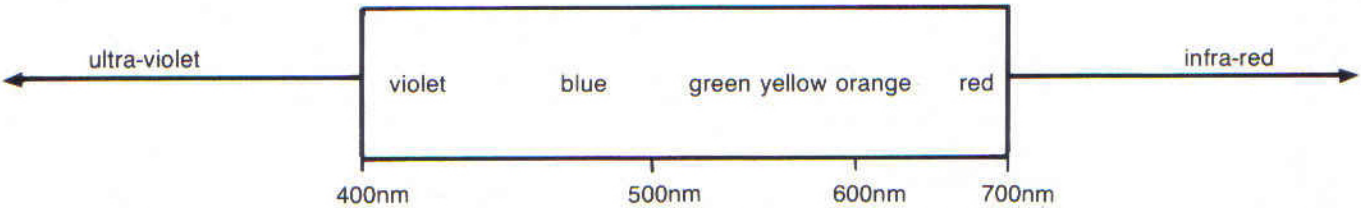
There is a step-by-step procedure for mountng a lens to a camera to optimize performance.

- *STEP ONE*: mount the lens on the camera body, secure it with the locking ring.
- *STEP TWO*: make the appropriate adjustments (back focal length) to each of the three camera tubes.
- *STEP THREE*: using a registration chart, register the red and blue tubes, using the negative of the green tube as your reference.
- *STEP FOUR*: initiate the white balance function, using a white card or EIA logarithmic reflectance chart under the lighting conditions which you will be shooting.
- *STEP FIVE*: initiate the black balance function, be it automatic on the camera or via a CCU (camera control unit).

Now you're ready to shoot—well, almost! The process is actually considerably more detailed than this, as you'll see!

Back Focal Length/Flange Back

Television production is a craft composed of many visual disciplines, not the least of which are camera and lighting. Lighting, no matter how artfully or skillfully executed, will appear second-rate without precise, consistent alignment of the camera/lens system. A lens built for a film camera has a single, precise, fixed image plane (which is the plane of the film) and is also the plane of reference for back focal length. Unlike a film camera lens, a television zoom lens has an adjustable back focal length to accommodate the different back focal lengths on various camera bodies. Back Focal Length is defined as the distance from outside face of the rear-most element of a lens to the image plane. The adjustable flange back device is the mechanism which makes it possible to adjust back focal length. This →



The complete electromagnetic spectrum is actually much greater than the limited wavelengths displayed here, but for our purposes we are concerned only with the visible part of the spectrum and the wavelengths that are closely associated with the visible spectrum.