## Halo and Shadow

The function of a retroflective camera system is to cast a key coloured light (usually green or blue) originating from the lens, in the direction of a subject being filmed in front of a retroflective screen. The emitted light covers the camera's entire field of view and thus where the camera “sees” the screen, the coloured key light is reflected directly back down the lens to the image sensor.

You may notice that when using a Chromatte drape or a Chromaflex that there may be darkness around or to the sides of the subject. This darkness, depending on the cause can be identified as halo or shadow or more usually a combination of both. Halo and shadow are both optical effects caused by the physics of the lens interacting with the retro reflective media and are the results of the source of light (specifically, the blue or green litering) being in a different location along the optical path, to the reflected light converging on the film or CCD plane of the camera.

If the iris of the lens was stopped down to create a single point of convergence for the incoming light and the light that was emitted to illuminate the retro reflective screen emanated from this same single point, there would then be no halo or shadow when using retro reflective systems.
By deviating or expanding laterally from this position (in the case of an iris), we create halo.
By deviating linearly from this position, we create shadow.

Halo

A function of the light source not being a single point in the center of the lens (rather spread out around the lens). This effect is exaggerated due to the iris not being a single point in the center of the lens but rather a variable sized circle of acceptance for the incoming light. Halo is distinctly different from shadow in that it gets brighter as you move away from the edge of the subject and since it is created by the optical imaging system, you can only evaluate it relative to your camera by looking through your camera, not by looking off-axis at the screen with your eyes.

Shadow

A function of the light source (even if it is a single point in the centre of the lens) being in front of or behind the point where light imaged by the camera appears to converge. Maintaining this relationship is made more difficult, by the fact that when you zoom a lens, this convergence point will move closer or farther away, while the retroflective light source remains stationary. Shadow is literally cast by the subject blocking the light that is otherwise illuminating the retro-reflective target. If the source (the litering) is behind the destination (ccd or film plane) then the camera will represent a narrower angle than the illuminator relative to the subject so the shadow of the subject will appear smaller than the subject. Likewise, if the source is in front of the destination, the camera will represent a

greater angle than the illuminator relative to the subject and the shadow will thus be greater than the subject.

As there are some obvious laws of physics working against this optimal setup, we attempt to get the best possible results by having the light source and destination both mechanically and optically as close to each other as possible.

The closer the subject comes to the camera  the more the effects of halo and shadow are exaggerated, so in many cases, a similar shot framing can be achieved with less halo and shadow by backing off the camera away from the subject and zooming the lens in (or using a tighter prime lens).

In both cases of shadow ( whether larger or smaller than the subject) it will probably be visible, and even if the shadow is the same size as the subject, if the light source and lens destination are not single points, there will also be halo.

Optimized camera set-up for required exposure range:

Halo is a function of the retroflective light source not being in the center of the lens, and the iris being opened wider exaggerates it. In situations where you can not reduce halo to an acceptable level, it is often effective to close down the iris to reduce its effect.  Consequently, there will be a reduction in exposure.  More light can be added to bring the exposure back to the previous level, without adding to the halo effect.

Optimized camera set-up for required zoom range:

Considering the fact that the destination point of the lens changes when you zoom, you cannot hope to have perfect linear placement of the litering across all zoom ranges. This sometimes results in one end of the zoom range having a greater shadow by product than the other.
In this case, assuming that the mechanical design will allow, it may be possible to shift the litering to a more optimal location along the lens axis causing the shadow to be reduced to a minimum where you need it most, at your most critical zoom range.

It is important to note that in most situations where halo and shadow appear, it is not because the scene can be shot in a way that allows one to completely avoid halo and shadow, but rather because the layout of the shot (including the retroflective screen, litering, subject and camera) has not been setup with the goal of minimising the effects of halo and shadow.
If the person responsible for creating the key is aware of the above issues, an optimal image may be achieved.