ing through space, the Van Allen Belt that surrounds the Earth, the atmosphere, then the cloud cover and finally through the pollution in the air. The light is diffused, diffracted, dispersed and reflected, creating the illusion of an apparently blue sky.

Similarly, the rich golden light that we are accustomed to seeing at the 'magic hour'—that hour or so just before sunset—is an illusion of sorts. What we see is the particles of dust in the air intercepting and diffracting the light rays, not the light rays themselves. As the sun is setting on the horizon, the light rays must pass through air that is increasingly more dense with dust particles. This is evidenced by the long shadows that appear late in the afternoon. The dense layer of particles produces the luscious, often breathtaking sunsets to which we have become accustomed in photographs and motion pictures. The 'magic hour' light (a deep orange/yellow/red blend of colors) evokes a deep sense of warmth and well-being. (If you recall, we often equate red with passion!) So when we create filters for our light sources and for the camera lens, it is with an eye to recreating the visual elements that we find in Nature.

In discussing filters and filtration, it is important to define a filter. This discussion will center on conversion or color correction media, interference filters, and color enhancement or color media filters.

A color media filter blocks the passage of some portion of the visible output of any light source or light reflector by absorbing and transmitting selectively. As an example, let's look at a primary red filter. This filter passes all of the red associated light frequencies, blocking all others. The energy that is blocked is in the form of radient energy which is absorbed by the filter. A color filter is composed of two parts:

1) light refracting elements, usually dyes. These dyes were coated on in the past, but today are suspended in a semi-transparent base; the dyes are inorganic, primarily aniline, colorants that undergo a complex change in the manufacturing process and actually become part of the base that carries them.

2) the base, today made out of polymer plastics such as acetates, vinyls, polyesters and polycarbonates.[2]

The early generations of filters had their color coating applied to one surface of the base material, and were not dyed through-out. As the fixture heated up, the filter absorbed the radient energy. Over time, with repeated heating and cooling cycles, the color began to migrate to the hottest point of the filter surface, leaving the base exposed. Earlier generations of filters had a base that was made of dyed silk or gelatin. Gelatin is an organic compound that is derived from animal renderings. The abbreviation 'gel' has become the generic name for all media with a synthetic, plastic or polycarbonate base. This

TABLE 1: LIGHT LOSS ASSOCIATED WITH SOME COMMONLY USED FILTERS.

Fixture Type	Filter	Color	Approximate Light Loss in f-stops
Carbon Arc	Y1	Pale Yellow	1/4 stop
Carbon Arc	MT 2	Amber	3/4 stop
Carbon Arc	MTY	Orange	1/2 stop
Tungsten	Macbeth Glass	Deep Blue	1-1/2 stops
Tungsten	Dichroic	Medium Blue	1-3/4 stops
Fluorescent (warm)	Minusgreen	Pale Rose Pink	3/4 stop
Fluorescent (cool)	Fluorofilter	Orange	1 stop

includes neutral density, color correction, color media and just about every other plastic-based media used to control or filter light. The history of filters closely parallels the development of lighting fixtures. The earliest luminaires could make use of gelatin filters because the fixtures were low wattage and didn't produce a lot of heat. The problem with gelatin-based filters is that they become brittle and deteriorate as they are dried out by the heat of the lamp over time and, if exposed to water, dissolve. As luminaires increased in wattage, becoming hotter, filter manufacturers had to develop new base materials. In response to the changes in lighting technology acetates, vinyls and finally polyesters and polycarbonates came into use. For the sake of comparison, in terms of heat-withstanding ability, these newer bases would be ranked as follows:

1. Polycarbonates have become the industry standard, offering the best combination of properties for a filter base. They are heat stable to 163°C, very tough, tear-resistant, remarkably thin for their strength, and don't readily become brittle with age. On the manufacturing side, polycarbonates are readily available in a consistent thickness, take dye well to achieve thorough dispersion throughout the base, and are very tough when extruded into the film base.

2. Polyesters seemed destined to become the industry standard until polycarbonates came along. Polyesters generally resist deformation (wrinkling, buckling) up to 143°C. The two factors that mitigated against polyesters were their unsuitability for color casting and the widely used extrusion process. These two factors made it necessary to surface-coat the base. This method is inferior to body-coloring of the base because, as the filter heats up, the color media tends to migrate to the hottest point on the filter's surface, in effect, defeating the intended purpose of the filter.

3. Acetates have the advantage of being able to be surface-coated or body-colored. In either case, they produce filters that are very faithful to the intended color. Unfortunately, acetates tend to begin softening at 121°C, which is considerably lower than the temperatures generated by today's fixtures. Safety is another concern with acetates. They will sustain a flame if ignited; that is unacceptable by today's rigid safety standards regarding ignition and flame retention. To bypass this safety shortcoming, Cinemoid and Roscolene (both filters used for theatrical presentations) had to be modified and formulated out of copolymers to conform to safety standards.

4. Vinyls can be grouped together with acetates for our purposes, although they soften at an even lower temperature than do acetates. Not unlike acetates, vinyls will sustain a flame, so they too do not meet today's safety standards.

All color filters have two elements common to them: hue and saturation. *Hue* is the predominent sensation of color, i.e., red, green, blue, etc. This color normally corresponds to a narrow spectral bandwidth. *Saturation* (also known as chroma), intensity or purity refers to the extent to which a color has been diluted (paled or greyed) by the addition of white light. A given saturation of 100 per cent would represent a pure undiluted color. Saturation is also affected by mixing with black, which creates a shade. *Luminance* is a corollary of saturation and is of importance when selecting a color for production. Luminance is the true measured brightness of a surface. For example, snow has a high luminance value, and black velvet has an extremely low luminance value.[3]

(*Note*: This is not to be confused with the impression made on the eye which is defined as *Brightness*. Brightness is a subjective impression, not a quantitative term, used to indicate the quantity of light perceived as coming from the subject. This subjective impression is easily confused by physical and psychological effects. There is a quantitative scale that was developed to allow the precise measurement of all values of hue, saturation, luminance for precise matching and repetition.)

The Munsell Scale is a system of color notation, in which pages of sample chips methodically analyse progressively varied hues. Each hue is displayed at varying saturation (chroma) and luminance (value), thereby permitting each aspect to be numerically classified.[4]

The Munsell Scale is generally used for comparing pigments, but it is referred to here to relate the fact that what we perceive is often different from that which can be quantitatively measured. The C.I.E. Chromaticity Chart of Tristimulus Values