Light is the key to recording an image on film or videotape. Whether the light record is created photochemically or electromagnetically, the cinematographer’s first concern is to determine if there is enough light to record the image. The cinematographer’s attention next shifts to how the light can best be shaped to fit the dramatic needs of the story. Thus, creative control of the image involves not only the means to measure the light accurately but also the means to manipulate it. This chapter deals with the tools needed to accomplish those tasks.

**Measuring the Light**

To obtain the correct exposure, the amount of light reaching the film emulsion or electronic imaging device must be carefully governed. Too much light will result in an overexposed image; too little light will result in an underexposed image. The adjustable diaphragm in the lens (see Chapter 3) is used to obtain the correct exposure setting. To calculate that setting, a cinematographer uses a light meter to measure the amount of light falling on or reflected by the subject. A needle on a scale or dial can present this information, but many modern light meters produce a digital readout of the light reading.

**Incident Meters**

An incident light meter measures the amount of light falling on a particular person or area of a set. Commonly used incident meters, such as the Spectra and Sekonic, have a plastic hemisphere (which looks like half a Ping-Pong ball) over the light-sensitive cell on the meter (see Figure 5.1). To use an incident meter, hold it next to the subject with the light-collector bulb pointed at the camera position. The intensity of the light reaching the hemisphere creates a light reading that can be measured. Usually, the top half of an incident meter swivels so that the person taking the light reading can read the scale without casting a shadow over the light-sensitive photocell.
An incident meter is generally considered the standard meter for professional cinematography. It is accurate, easy to use, and highly reliable. Because it measures the light hitting a specific area, it is not fooled by reflected light. Therefore, it gives an objective light measurement from scene to scene. An incident meter is especially helpful when setting lights to a particular intensity for more than one camera setup.

**Reflected Light Meters**

A reflected light meter measures the amount of light reflected by the subject, providing an overall light reading for the entire scene. It gathers light from a relatively wide angle of view, creating a light measurement that is the average of the range of brightness levels within the scene.

It can be a separate unit—and, in fact, some incident light meters can be adapted for use as reflected light meters (see Figure 5.2). As such, it should be held near the camera position pointed toward the subject being filmed. Usually, however, a reflected light meter is built into a camera, where it measures the light coming through the lens (usually a zoom lens) and can automatically adjust the iris to the proper setting. Because it is behind the lens, the reflected light meter will compensate for any light lost to filters or to the many elements within the lens itself.

Some video cameras use a zebra stripe pattern, visible within the viewfinder, to show areas at the upper limit of the camera’s exposure range. Others blink the words low light in the viewfinder when there is not enough light for an acceptable image. Automatic exposure systems are extremely easy to use, which is one reason they are virtually standard on consumer-level cameras. They can be invaluable in situations in which the light cannot really be regulated or when shooting entails rapid, uncontrollable shifts in exposure levels, as in sports or documentaries.

**Spot Meters**

A spot meter (see Figure 5.3) is a reflected light meter with a narrow angle of view.
acceptance, often as little as one degree. Instead of averaging brightness across the entire scene, it provides a reading of a small, individual spot within the composition. A spot meter usually is shaped like a small camera. It has a pistol grip, eyepiece, and viewfinder to enable the operator to target the exact spot (usually designated by a small circle in the viewfinder) being measured. This is particularly useful when you are comparing brightness levels of different parts of the scene.

Although they are reflected meters, spot meters can provide the same information as incident meters because they read light for small areas. In this way, they combine the best features of incident meters and reflected meters.

Getting Correct Exposure

Light meters are simply tools. They cannot think, nor can they know what you are trying to expose for within a shot. The brightness levels in a particular shot might range from f/2.8 to f/22 (or beyond), and this can pose problems for any type of light meter. In-camera meters try to solve this problem either by averaging the light readings from the entire scene or by metering a smaller area in the center of the frame, which is called center-weighted metering. It is also possible to use a handheld meter to take readings of different areas within the frame and then work out the average mathematically. What is important is interpreting the light readings to suit your purpose.

Problems with Automatic Metering Systems

Certain lighting situations can easily fool reflected light meters, whether they are handheld or built into an automatic metering system in the camera. Strong backlighting causes the most common problem. A shot of the face of a person who is standing in shade that is in front of a bright, sunny background can result in a reading that greatly underexposes the face. The meter averages the light for the entire scene, not just the face, and produces a reading that overvalues the bright background (see Figure 5.4). The opposite could occur in a shot of the face of a subject standing in bright light against a large, dark background.
Using a spot meter or an incident meter is one way to get a correct reading of the area of the frame you are trying to expose. A zoom lens with an in-camera metering system can also be used as a kind of spot meter. By zooming in and filling the frame with the person’s face, you can obtain the correct exposure setting. Then you must manually override the automatic exposure system (if that is possible with your camera) or change the lighting setup (if that is possible).

Some cameras have a backlight control that opens up the iris one f-stop (or more or less) to compensate for strong backlighting. Other cameras have an exposure lock that enables you to lock in a particular f-stop setting, thus overriding the automatic iris system. Another technique for obtaining correct exposure is to bracket your shots. Provided you can manually adjust the iris, you simply shoot the scene with several different f-stop settings.

Because different types of light meters have different strengths and weaknesses, it is probably wise to supplement an in-camera reflected meter with a handheld incident meter. When working outdoors, many cinematographers prefer a reflected light meter. They usually choose an incident meter when working indoors, where the lighting can be totally controlled.

**Footcandles, F-Stops, and EI**

Most light meters are calibrated to produce readings in either footcandles, or f-stops, or in both. A footcandle is an international unit of illumination. It represents the amount of light falling on a sphere 1 foot from a light source of 1 candlepower. In effect, a footcandle reading on a light meter is a measurement of light intensity.

If the light meter provides an f-stop reading, it must have some means of translating the light intensity in the scene to a lens f-stop that is accurate for the particular camera being used.

When metering for film, this usually means that it is necessary to set the exposure index (EI), or ASA, of the particular film stock being used (see Chapter 3). A film stock with an EI of 400, for example, is twice as sensitive to light as a film stock with an EI of 200. Thus, the proper f-stop depends not only on the amount of light available, but also on how sensitive a particular
film stock is to light. With exactly the same light (that is, the same footcandle reading), an EI of 100 might require an f-stop of f/8, whereas an EI of 200 would require f/11. Each f-stop change (from f/2.8 to f/4, f/5.6, f/8, and so on) cuts the light that reaches the film in half. The EI is set either by slipping a slide in front of the photosensitive cell or by turning a dial.

Calculating the exposure index for a video camera is more complicated but not as necessary as with film. The light sensitivity of a video camera cannot be boosted by changing the imaging device (as in buying a roll of faster film). Its responsiveness to light is, in effect, built into that particular imaging system, usually the CCD or CMOS sensors. Of course, many video cameras can boost the image signal electronically (a 6 dB increase in gain approximately doubles the exposure index). At the normal setting, however, many video cameras have an exposure index that is in the range of 100.

**Contrast Range**

---

Contrast refers to the varying levels of brightness and darkness within a particular scene. A high-contrast scene would have extremely bright and dark areas with almost no gradations in between. In comparison, a low-contrast scene would be relatively flat, with the brightest and darkest areas of the scene at roughly the same luminance level. Normal contrast would exhibit a rich, full range of brightness levels between the darkest and brightest parts of the scene.

---

By taking a light reading of the brightest and darkest areas of the scene, it is possible to calculate the contrast range, the ratio of the brightest value to the darkest value. For example, if the brightest area in the scene is eight times brighter than the darkest area of the scene, the contrast ratio for that scene would be expressed as 8:1 (a range of light three f-stops wide). A 16:1 contrast ratio would produce a range of light roughly four f-stops wide (see Figure 5.5). Calculating the contrast ratio is relatively simple with a spot meter, but any reflected light meter can be used for this purpose by moving in closer and measuring the amount of light reflected by different objects across the scene.

***Insert Figure 5.5 here.***
All film stocks and electronic imaging devices are limited in the range of brightness they can accurately reproduce. That range or **latitude** is designed into a particular film stock or video imaging system, although the contrast ratio in film can be altered during the developing process. Negative film stock has greater latitude than reversal film stock, and film generally has greater latitude than electronic imaging systems, although HDTV cameras are approaching the latitude of film. A shot exceeding the latitude of a particular imaging device will create areas of brightness or darkness in which all distinguishing details are lost. Thus, measuring the range of brightness within a scene is important not only for obtaining correct exposure, but also for creatively manipulating the lighting for a scene.

**Using a Monitor to Help Evaluate Exposure**

Having a television **monitor** on a set can be somewhat helpful in evaluating exposure. The viewfinder of a video camera can show how light or dark a scene is, and a stand-alone monitor, such as the one used with **video assist** (see Chapter 3), can do the same. However, a monitor can sometimes cause problems when used for image evaluation. It is seldom a satisfactory substitute for a light meter because the actual quality of the image being viewed depends on how accurately the monitor is calibrated. For example, if the brightness control of the monitor is set too high, an image that looks all right on the monitor may actually be too dark. With portable gear that is constantly knocked around in transit, image reproduction is seldom trustworthy. A light meter provides a comparable measurement of light values from one lighting setup to the next. Trying to use a monitor for this purpose is haphazard at best.

**Using a Waveform Monitor to Evaluate Exposure**

A **waveform monitor** is a far more accurate way of measuring and evaluating lighting. This piece of equipment is standard in any television studio, and it is also available in portable versions for use in the field. These portable units can operate on either DC (batteries) or regular AC power. In addition, there are computer programs that can be loaded into a laptop and attached to the camera to give waveform monitor readings.
When a video signal from a camera is looped through a waveform monitor, the monitor’s screen presents a graphic representation (see Figure 5.6) of the signal (the waveform). That signal is superimposed on a scale divided into 140 IRE units (IRE refers to the Institute of Radio Engineers). The picture information falls in the area between zero IRE units (the darkest area of the scene) and 100 IRE units (the peak white area of the scene). The blackest areas of the scene are actually set slightly above zero, at 7.5 units. The negative area at the bottom of the scale (between zero and –40 IRE units) displays information about the technical aspects of the signal.

***Insert Figure 5.6 here.***

The waveform monitor provides more information about the brightness and contrast range of a scene than any light meter can. The area between 7.5 and 100 IRE units provides information that you can use to adjust the camera’s imaging system (20 IRE units equal approximately one f-stop, hence a latitude of approximately five f-stops). Any area of the scene exceeding 100 IRE will be overexposed, and any area of the scene below 7.5 will be too dark to render visible detail. Obviously, this information can be used to set up and adjust lights. The waveform monitor displays the exposure levels for every point in the scene, like a full-frame spot meter. It also shows precisely which areas of the scene are above or below the contrast range the camera is capable of reproducing. Some of the more professional video cameras display a crude waveform in the viewfinder, but this does not present the same kind of detailed information as a waveform monitor.

**The Color of Light**

Thus far we have been concerned primarily with different ways to monitor and measure light intensity. The color of light in the scene is also an important concern for the cinematographer. Different light sources produce different colors. Being able to measure and compensate for those color variations is as much a part of quality image making as controlling exposure.

**The Electromagnetic Spectrum**
Our eyes can see only a small portion of radiated energy in the **electromagnetic spectrum**. Electromagnetic energy is measured according to **wavelengths** and ranges from the microscopically small wavelengths of cosmic rays to electrical power waves several miles long. Visible light is only a tiny portion of that spectrum, ranging from the shorter violets to the longer blue, green, yellow, and red wavelengths. The wavelengths just below and above the visible spectrum, X-rays and infrared, cannot be seen by the eye but can be recorded on special film (see Color Plate 4).

Our eyes see different wavelengths as different colors. White light is composed of all the visible wavelengths. When white light falls on an object like a red flower, it reflects the red wavelengths and absorbs the other wavelengths (primarily the greens and blues). If the color of the light illuminating that flower is changed, our perception of that flower’s color will also change.

The way we perceive colors is based on both the particular wavelengths (colors) of light illuminating an object and the wavelengths of light that the object absorbs. This fact has important implications for cinematography. It means that a filter can be used to modify the light by absorbing certain colors and letting other colors pass through.

**The Kelvin Scale**

What we perceive as the white light of the sun is actually made up of roughly equal parts of red, green, and blue light. The color of sunlight is constantly changing, according to the time of day or the way that light is reflected through clouds or smog in the air. As the sun sets toward the horizon, the longer red wavelengths and denser atmosphere create a redder color. If the noonday sun is reflected through a cover of clouds, the light may seem almost blue.

A **color temperature** scale was developed to provide a precise and accurate measurement of different colors of light. This scale is expressed in degrees **Kelvin (K)**. As a theoretical black body source is heated, it will give off light. Imagine a chunk of iron heated over a powerful flame. As the metal begins to heat, it will start glowing red. As it gets even hotter, it will turn orange, and then white, and finally blue-white.
These changes can be measured on the Kelvin scale. The sun at noon, for example, has a color temperature of about 5,500 degrees Kelvin, whereas the color temperature at sunrise could be as low as 1,800 degrees Kelvin. This can be a little confusing because we tend to think of red light as hot and blue light as cold. But in terms of color temperature, the lower the color temperature, the redder the light; the higher the color temperature, the bluer the light (see Color Plate 5). A special type of light meter, called a color temperature meter, registers the specific color of light in degrees Kelvin (see Figure 5.7).

***Insert Figure 5.7 here.***

**Tungsten and Daylight-Balanced Light**

Our eyes (and brains) have the ability to compensate for large changes in the color of light and still see seemingly accurate, believable color. Film and video cameras cannot do this, however. Color film stocks and electronic imaging devices can only produce correct colors within a relatively limited range on the Kelvin scale. This is accomplished in film and video in a somewhat different manner, but the basic principles are the same.

In film, you can compensate for color changes by purchasing a film stock that is color balanced for use in either daylight (5,500 degrees Kelvin) or tungsten light (3,200 degrees Kelvin). When used with lights rated at 3,200 degrees Kelvin, tungsten-balanced film will produce correct colors. If that same stock is used outdoors, color rendition will be skewed by the much bluer 5,500-degree Kelvin color temperature of the sunlight. Using tungsten-balanced film stock outdoors requires an orange color conversion filter. These orange filters effectively convert the more bluish sunlight outdoors to the color balance of the tungsten film. Conversely, a daylight-balanced film stock can be used outdoors without a filter. But using that same daylight-balanced stock in the more reddish tungsten light requires a color temperature blue filter to obtain the correct color balance (see Color Plates 6 and 7).

Whenever you place a color conversion filter on a film camera, it absorbs some of the light, so you must compensate by opening the iris further. The degree of compensation required
for different grades of filters is usually expressed as a filter factor, a number based on the amount of light transmitted through the filter. The filter manufacturer normally supplies exposure compensation tables and an explanation of the filter grading system. Film manufacturers also indicate how filters change the EI or ASA. For example, one Kodak color negative, tungsten-based film has an EI rating of 300 without a filter, but an EI of 200 when it is shot with the orange filter needed for daylight shooting.

Video does not have daylight-balanced CCD sensors. Video imaging systems are balanced for tungsten light. Using a video camera outdoors in daylight requires the same type of orange filter used in film, but because it is built into the camera, it is not easy to see. Some video cameras have a built-in filter wheel that enables the operator to dial in the correct filter for a variety of lighting sources. Such cameras typically have a setting for tungsten lights at 3,200 degrees (actually no filter), a setting for daylight (5,500 degrees), and perhaps an intermediate setting at 4,500 degrees. Some cameras may have only two settings, one for daylight and one for artificial light, that are often represented by graphics of the sun and a lightbulb. Many video cameras sense whether the camera is being used in artificial or outdoor light and automatically set the filters accordingly. It is beneficial for the operator to be able to override this automatic feature, however. Because the filter is built in, the camera automatically compensates for the loss of light it causes.

**Small-Scale Color Corrections**

The human eye can detect changes in color temperature as small as 100 degrees Kelvin. For this reason, you often must correct for slight variations in color that are much smaller than the broad changes made by color conversion filters. Another category of filters, called light-balancing filters or color-compensating filters, has been designed for this purpose. They can be used on the film camera to compensate for subtle shifts in color temperature. Generally, these filters are paler in color than the heavier color conversion filters used to correct between sunlight and artificial light. Their colors tend to fall at either the blue end or the red end of the color spectrum. Cinematographers often use them to warm up (a yellow to red filter) or cool down (a
blue to purple filter) a particular light source. However, this involves carrying and using a case full of filters, something that can slow down production.

In video, obtaining this kind of small-scale color correction is much easier. In fact, it is precisely the type of color correction produced by white balancing (see Chapter 3). Once the camera is set for tungsten light or daylight, white balancing fine-tunes the color, adjusting the camera precisely to the color temperature of any light source. In effect, the automatic white circuit knows what white is (almost equal amounts of red, blue, and green), and white balancing simply adjusts the system to reproduce white at the specific color temperature of the light in a scene. You can also use the white-balancing circuit to produce the kind of warming and cooling effects created by light-balancing filters. By white balancing the camera on a colored card rather than a white one, you tint the entire scene. When you do this, you are, in effect, lying to the white-balancing circuit of your camera. White balancing on a light blue card, for example, produces a color tint toward the opposite end of the color spectrum (that is, a warmer orange), whereas balancing on an orangish-orange card produces a cooler, more bluish tint.

Another way to handle color correction is during postproduction. Most nonlinear editing programs contain provisions for a degree of color correction, and there are entire systems to handle complex color correction (see Chapters 10 and 12). Increasingly, professional movie makers are waiting until postproduction to handle color corrections when they can undertake them in a more leisurely, consistent manner.

The Vectorscope

In video, a vectorscope is used to monitor the color information in the video signal. It is used primarily to match the color between cameras in multi-camera productions and to analyze and adjust color during postproduction.

The screen of a vectorscope presents a graphic display of the color information in the video signal. It shows the hue (the specific tint, such as blue, yellow, or orange) and the
saturation of that hue (the degree to which the color is mixed with white light). A royal blue, for example, contains less white light than a baby blue. In other words, the royal blue is more saturated than the baby blue. Portable vectorscopes (see Figure 5.8), or computer programs that simulate vectorscopes and can be loaded into a laptop, are used in the field to analyze the color characteristics of various scenes, but a vectorscope is generally less valuable than a waveform monitor as a location production tool.

***Insert Figure 5.8 here.***

**<H1>Filters for Light Intensity and Contrast**

Among the most common filters used on cameras are neutral density filters. They reduce the intensity of the light reaching the imaging system without altering the color of the light in any way. Designed primarily to bring the light down to a level that the camera can handle, they are most commonly used for shooting in very bright light. Neutral density filters are calibrated according to their density, the amount of light they block. An ND-3 filter, for example, reduces the amount of light transmitted through it by one f-stop, an ND-6 by two f-stops.

A graduated neutral density filter is a special type of neutral density filter that darkens only part of the frame, usually the top. This is helpful on bright, sunny days when the sky is too bright to allow correct exposure of the foreground. If you expose for the foreground (probably the most important area of the shot), you will overexpose the sky, hence the need for a graduated neutral density filter. Such filters have a clear area that gradually becomes a neutral density gray. You align the neutral density half of the filter with the sky at the horizon, which allows proper exposure of the sky and clouds without affecting exposure at ground level in the foreground.

Neutral density filters reduce all wavelengths of light equally, so they do not change the color temperature of the light transmitted through them. This neutrality means they can be combined with many other types of filters. For example, an ND-6 filter can be combined with the orange color correction filter to reduce the light transmission by two f-stops. Many video cameras
contain this type of combined neutral density–color conversion filter. Cameras that have an icon for clouds and another for the sun usually have a plain orange filter for the former and a combined orange–neutral density filter for the latter.

**Polarizing filters** are used to minimize the intensity of reflections from water or glass. The amount of polarization depends on the angle of light between the camera lens and the surface of the glass or water. Shooting at about a 30-degree angle to the reflective surface and then rotating the filter for maximum absorption of glare usually yields the best results.

There are also numerous filters to deal with contrast, for example **low-contrast filters**. They are among the most useful filters for exterior shooting and are frequently credited with creating a film look in video. On a bright, sunny day, the direct sun casts extremely hard shadows. It also produces a much greater range of brightness levels in the scene. As a result, the camera cannot properly expose the shadows and the highlights. This is where a low-contrast filter is most useful. It uses light from the highlights within the scene, scattering the light to brighten up the shadow areas, usually without reducing sharpness. This can be invaluable in any high-contrast lighting situation and can be particularly helpful in video.

**Soft-contrast filters** also reduce contrast but preserve a darker shadow area than low-contrast filters. They diminish the highlights without lightening the shadow area. The bottom line for both low-contrast and soft-contrast filters is reducing the contrast range. Whether you do this by brightening the underexposed areas of the shot or by darkening the overexposed areas is less important than the fact that you have reduced the contrast range to a level the imaging system can handle.

There are many other types of filters that can be placed on cameras to affect light. For example, they can turn bright points into star patterns, or diffuse light, or make images look wavelike. These filter effects and many others can also be achieved during postproduction and that has become the more common practice.

---

**Mounting Filters**

Regardless of their purpose, filters are normally made out of either gelatin or
Glass filters are the least expensive and come in small sheets that you can cut to the proper size for the camera lens or filter holder. Glass filters may have a gel or dye between two sheets of optical glass or they may have dyes added directly to the glass during manufacturing. Some “glass” filters are actually made out of plastic.

Glass filters normally mount in front of the lens and must be of the proper size and type for a particular piece of equipment. Some glass filters screw directly into threads on the front of the lens. Others mount on the lens with a special adapter ring and are held in place by a lens hood or matched retaining ring. You can also mount glass filters in a matte box, sometimes called a filter box. It is an adjustable bellows that attaches to the front of the camera body and extends beyond the lens. Squares of filter glass simply drop into the matte box.

Gelatin filters can also be mounted in a matte box or attached to the front of the lens with an adapter and retaining ring. Some film cameras have a filter slot behind the lens. A gelatin filter is cut to fit into a small metal holder and then inserted in the filter slot behind the lens. You can also place large sheets of gelatin filter over windows or fit them into holders on the front of lighting instruments to change the color temperature in mixed lighting situations (see Chapter 6).

One type of glass filter, the ultraviolet (UV) filter, is particularly effective mounted over the lens. It blocks ultraviolet rays but is clear and has no effect on regular light frequencies. Many cinematographers leave UV filters on cameras at all times to protect their expensive lenses from scratches. If the UV filter becomes damaged, it can quickly and cheaply be replaced.

**Lighting Instruments**

The lights used in film or television production come in a seemingly infinite variety of sizes and shapes. They are categorized by the type of bulb they use, by the intensity and quality of light they produce, and by other characteristics such as the way they are mounted or how they control the light they emit.

**Lamps**

Three types of lamps (sometimes referred to as bulbs) are commonly used in...
lighting instruments for professional moviemaking: tungsten-halogen, HMI, and high-frequency fluorescent. These are standard lamps, whether you are shooting with a film camera or a video camera. In addition, there are other lamps are also used, such as common household bulbs and LED lamps.

---

**Tungsten-halogen lamps**, also called *quartz-halogen* or *tungsten* or *quartz* lamps (see Figure 5.9), have a bulb made of quartz glass (to withstand the heat), are filled with a halogen gas, and contain a tungsten filament. When electric current passes through the filament, it heats up and produces light. The more resistance the filament has, the brighter the light glows, and the more power it consumes. This difference is expressed in *watts*, a measurement of the amount of electric current a particular lamp draws. Thus, a 1,000-watt bulb produces more illumination and requires more power than a 500-watt bulb. The purpose of the halogen gas is to create a sort of restoration cycle. The halogen helps to deposit the evaporating tungsten back on the filament as the lamp burns. The result is a lamp that maintains its color temperature (3,200 degrees K) and light output. Be especially careful to avoid touching the surface of a tungsten-halogen bulb. Oil from the fingers, or any foreign material for that matter, will weaken the quartz envelope and cause it to burn out much more quickly. The bulb might even explode when it gets hot. When changing a quartz bulb, you must use a glove or a piece of cloth or paper to protect it. Quartz lights have been used for film and TV for many years, but they create a lot of heat and consume a *great deal* of energy.

***Insert Figure 5.9 here.***

Situations that call for daylight-balanced lighting of about 5,500 degrees Kelvin often use *HMI lights*. (HMI is the abbreviation for *hydrogen medium-arc-length iodide*.) HMI lamps (see Figure 5.10) have a restoration cycle similar to that of a quartz light and maintain their color temperature and light output for long periods. They are frequently used as a supplemental light outdoors or to illuminate large areas. They are expensive, however, and require a bulky ballast unit (high-voltage power supply) to produce consistent lighting. In some lighting situations, HMI lights are impractical or too expensive. In these cases, it may be necessary to convert regular
3,200-degree Kelvin tungsten-balanced lamps to the color temperature of daylight by attaching a blue filter to the front of the light housing. Because these filters reduce the light output of the lamp by 30 to 40 percent, additional lighting instruments may be necessary to obtain the same amount of illumination.

***Insert Figure 5.10 here.***

A newer type of lamp is the high-frequency fluorescent, often referred to as a kino after the early manufacturer, Kino Flo (see Figure 5.11). These are not to be confused with traditional fluorescent lights—the kind commonly used in schools and office buildings. Those are difficult and unpredictable as a light source for shooting film or video, mainly because their color rendering is unpredictable due to their wide variety of color temperatures. However, high-frequency fluorescent lighting outputs red, greens, and blues in a manner that guarantees consistent color temperature. In fact, the lamps can be manufactured to be either 3,200 degrees K or 5,500 degrees K. To switch from one to another, you simply change the lightbulb. Kino lights also eliminate the flicker problem common with regular fluorescent lights; while office lights oscillate at 60 cycles per second, high-frequency lights (as their name implies) average between 25,000 and 40,000 cycles per second. This makes for a constant pattern that is completely acceptable for film and video recording. The lamps are very low energy because they operate through a chemical reaction involving stimulated phosphors. As a result, kino lights use 90 percent less energy and generate less heat than tungsten lights, and the bulbs last for 10,000 hours, as compared to about 400 hours for tungsten.

***Insert Figure 5.11 here.***

Sometimes ordinary household incandescent lamps can be used to augment lighting, especially if they are in a light as part of a scene. Most of them have a color temperature of 2,800 degrees K—close enough to 3,200 degrees K that they can blend in with tungsten lamps. In addition, some companies have developed lamps using LED (light-emitting diode) technology similar to that used for many flat-screen TV sets (see Figure 5.12). These lamps are user programmable in that they can be changed to produce any color temperature desired. They
also have lower power requirements and longer bulb life than tungsten.\textsuperscript{9}

***Insert Figure 5.12 here.***

<<h2>>Classification of Lights

...Lighting instruments are often classified by the quality of the light they produce and how the light can be shaped by the lighting instrument itself. \textit{Hard} and \textit{soft} are common terms for describing light quality. A \textbf{hard light} has a narrow angle of illumination and produces sharp, clearly defined shadows, whereas a \textbf{soft light} scatters the light to create a much wider angle of gentle, diffused illumination.

...HMI\textsuperscript{s} and tungsten lamps can be either, depending primarily on the lamp housing. For example, a tungsten bulb can be placed in a \textbf{soft light reflector} that blocks the light directly in front of the lamp and bounces it back into and off the reflector’s surface. The result will be a soft, diffused light with the degree of softness determined in part by whether the reflector’s surface is highly polished or matted (see Figure 5.13). A tungsten bulb placed in a \textbf{parabolic reflector} will produce a more concentrated beam of hard light because all the illumination is directed outward without being bounced off any surfaces. Fluorescent and LED bulbs tend to be soft, although some of the newer fluorescents have a variable beam of 60, 70, or 90 degrees. Both fluorescents and LEDs come in a ring configuration that can fit around a camera lens to provide soft light to the primary area the camera is shooting (refer back to Figure 5.12).***

***Insert Figure 5.13 here.***

...Lighting equipment manufacturers and rental houses frequently categorize different types of lights according to their primary function. From this perspective, lighting instruments are often classified as \textbf{key lights}, \textbf{fill lights}, or \textbf{scenery (or background) lights}. Key lights provide the main source of illumination in a typical lighting setup, so they tend to be hard lights (usually quartz) with a beam width that can be focused. Key lights come in a variety of closed-face (usually with a lens) and open-face designs.

...Fill lights supplement key lights, reducing the shadows and contrast range in relation to
the key light. Fill lights usually produce a softer, more diffused light. That can be provided by any of the lamp types. They are often open faced and are usually more limited in their ability to vary the angle of illumination. Many, in fact, have a fixed focus.

Scenery lights add depth and control contrast between the subject and the background or set. They are often a form of soft light and provide flat, even lighting over a wide area.

Describing lights by their function has definite limitations. A lighting instrument can serve many purposes.

A light sold as a key light can easily be used as a fill light. The real issue is not what the light is called, but whether it does what you want it to do in a particular situation.

Lights are also classified as to whether they are **spotlights** or **floodlights**. The former usually illuminate small, concentrated areas, and the latter cast a diffused and even beam of light over a fairly large area. However, many spotlights are variable and can cover either a small or large area.

The **Fresnel spotlight** is one of the most widely used lights in professional film and television production (see Figure 5.14). You can vary its beam width by adjusting a control knob or lever on the back of the light that moves the bulb-reflector unit toward or away from the Fresnel lens. At the **spot** position, the lamp is farthest from the lens. This converges the light rays and produces a narrower, more concentrated beam. At the other end of the adjustment range, the **flood** position, the lamp moves closer to the lens (see Figure 5.15). Flooding creates a wider and somewhat more diffused beam of light that illuminates a broader area. Common uses of Fresnels are as key lights or to light essential areas of the set, but their controllable beam width means they can be adapted for almost any application. They come in many wattages and with various types of lamps.

***Insert Figure 5.14 here.***

***Insert Figure 5.15 here.***

Some variable beam spotlights do not have lenses. For the lightweight and highly portable spotlights used for location lighting, an open-face design is commonplace (see Figure
Although providing less beam control than a Fresnel, this type of instrument allows the beam width to be varied from spot to flood.

Lens-less, open-face lighting instruments come in many other varieties. Most of these lights are some form of floodlight. One of the oldest types, a **scoop**, contains a single bulb in a bowl-shaped metal reflector (see Figure 5.17). Scoops range in diameter from 10 to 18 inches.

**Broads** are rectangular floodlights that typically use quartz or fluorescent lamps in an open-face housing (see Figure 5.18). They produce a broad beam of relatively diffused light and are often used for fill lighting.

Many lighting equipment manufacturers sell portable lighting kits for location use. Such kits usually contain three or four small lighting instruments with stands, extension cords, and other accessories in a carrying case (see Figure 5.19). Location kits typically use quartz lamps ranging from 500 to 1,000 watts, and most portable instruments are open-faced broads, although small Fresnel spotlights are also available.

**Mounting Equipment**

In the studio, lights usually hang from a **grid** of pipes on the ceiling. Elsewhere, the most common mounting device is a **light stand**. Stands are made of metal, have tripod bases, and vary in size from the light alloy stands found in portable lighting kits to heavy-duty **C-stands** equipped with casters. They can be telescoped to a height of 6 to 8 feet (see Figure 5.20).

Telescoping **boom arms** (see Figure 5.21) and **extendable lighting poles** often hold lighter, more portable instruments. **Space-clamps** (see Figure 5.22) hold lights on shelves and similar structures. **Wall plates** or **base plates** are sometimes used to attach lights to flat
Alligator clamps (also called gaffer grips) are spring-loaded clamps that can be used to secure a lightweight instrument almost anywhere. One of the most widely used light-securing devices, a **C-clamp**, attaches lighting instruments to a lighting grid or lighting pole. The screw in the C-clamp locks the clamp securely to the support.

**<H2>Controlling Light**

If lighting is going to be used expressively, it must do more than simply provide enough illumination to ensure proper exposure. It must in some way be controlled so that it falls in the proper places and assumes the desired shapes. A number of lighting aids have been developed to control and direct the light.

**<TXP>Barndoors**, for example, block off the beam of light, preventing unwanted shadows and keeping direct light out of the camera lens. They are thin metal sheets on a frame that attaches to the front of the lamp housing. They are available for most lighting instruments in either a two-leaf or four-leaf design (refer back to Figures 5.14 and 5.16). **Snoots** serve a similar purpose. They are metal funnels of different diameters that attach to the front of the light and restrict the beam to a circle pattern. Other light-directing accessories, such as **flags**, **dots**, and **fingers**, are made with heat-resistant opaque cloth or thin metal sheets. Filmmakers put them on stands and place them between the light and the subject to create shadow areas or to keep light from reaching certain surfaces (see Figure 5.23).

One of the most valuable light-directing accessories is a **reflector** (see Figure 5.24). It bounces light (for fill) back into the scene from a bright light source like the sun or a powerful key light. Reflectors are mounted on stands or held by grips during production. Any movement of a reflector, however, whether caused by a person holding it or the wind, will create a moving light pattern and may make the light unusable.
Some portable lighting kits use an **umbrella reflector** (see Figure 5.25) to create an extremely soft light source. The umbrella attaches to the light stand, and the light is turned into it. The beam bounces off the umbrella’s reflective interior surface, producing a highly diffused pool of light. A piece of white cardboard, a sheet of white Styrofoam, a space blanket, or even crumpled aluminum foil taped with **gaffer tape** to a cardboard backing can provide a homemade reflector. Professional reflectors typically have a different surface on each side of a sturdy base: a hard, highly reflective side that redirects the light without scattering it, and a more matted side that redirects and softens the light bounced from it.

Placing a light-diffusing material in front of the light source changes the quality of the light a lamp emits. Common light-diffusing materials such as fiberglass, silk, frosted glass, and plastics can alter light quality according to the diffusion characteristics of the material employed. Diffusion materials can be mounted in a filter holder in many lighting instruments (see Figure 5.26) or they can be attached with clothespins. They can also be placed on a stand between the subject and the light source. Because they are often used with hot lights, the stronger, more heat-resistant materials are preferred. Large diffusers can be suspended on frames over the entire set for location shooting.

A **scrim** is an accessory for reducing light intensity without changing the color balance of the light transmitted through it. Scrims are made of translucent black fabric or stainless steel mesh similar to a common household window screen. They mount in a holder on the light, or they can be placed on a stand between the light and the subject. Outdoors, large scrims such as a **butterfly scrim** (Figure 5.27a) suspended on a large frame reduce the intensity of sunlight in an area as large as 20 square feet. Scrims are available in varying thicknesses. Single scrims (Figure 5.27b) cut the light by one half-stop, and double scrims (Figure 5.26c) cut the light by a full stop. Half-scrims cover only half of the instrument’s opening.
Dimmer boards control the intensity of the light, but they are somewhat bulky and therefore are rarely used for remotes. Dimmers use varying resistance to change the amount of voltage reaching the lamp. However, reducing the voltage changes the color temperature of most lamps, so dimmers can adversely affect color rendition.\textsuperscript{10}

One of the most obvious ways to change light intensity requires no special equipment or supplies. It involves simply moving the light closer to or farther away from the subject being illuminated. As the light is positioned farther away, the intensity of the light decreases. The falloff is not proportional to the distance, however. According to the \textbf{inverse square rule}, the intensity of the light decreases by the square of the distance from the subject. In other words, moving a simple light source (such as a candle) from 10 feet to 20 feet from the subject will reduce light intensity on the subject by roughly four times (see Figure 5.28). Most lighting instruments, of course, have some means of directing or focusing the light rays, which alters this formula. In actual practice, this axiom simply means that close-ups of actors require less light than medium or long shots, for which the lights must be placed farther away to remain out of the frame.

A number of computer programs can aid in the control of light. They can, for example, undertake the calculations for the inverse square rule or help you determine whether you should use a single or double scrim. You can use them to keep track of where you positioned reflectors or what settings you used for a dimmer board and then refer to that information if you need to re-create the lighting effect. They can show you how the lighting will look if you vary the wattage of the bulb or place a colored filter over a lamp. Most of these computer aids can easily be programmed into a cinematographer’s personal digital assistant or laptop computer.

**Electric Power Requirements**

Artificial lights require electricity to function. The three basic sources used to power lighting equipment in film and television production are batteries, gas-powered generators,
and household current. Battery-powered lights are becoming more common as battery technology improves and lights require less power. High-frequency fluorescents are particularly conducive to battery power because of their low energy use. Generators can provide large amounts of electricity for prolonged periods of time. They are used primarily by professional production companies to illuminate large areas (and power many lighting instruments) with a power source that can be transported to virtually any location.

For the majority of productions, the most common power source is the current supplied to a house or building by the utility company. Portable lighting instruments are usually designed to operate with the 120-volt current available from wall outlets in buildings or homes. Lamps of different wattages draw greater or lesser amounts of power. Exceeding the power limits that a household electrical system can provide will cause an overload, resulting in tripped breakers and, sometimes, burned connectors or cables.

Power circuits in most buildings or houses have breakers that handle either 15 or 20 amps per electrical circuit. If the lights plugged into a circuit exceed that limit, the circuit breaker will cut off the current. To determine the amperage rating for a circuit, you must find the breaker box or boxes and read the breaker limit. All electrical outlets and lighting fixtures at the location are routed through these breakers, and each power circuit has its own breaker switch. If you blow a circuit, the switch will flip to the middle, neither off nor on. Unplug the lights that blew it, and reset the circuit breaker by flipping the switch off, then on. The circuit is working if the breaker stays in the on position.

Obviously, it is vital to know which wall outlets are controlled by each breaker switch so you don’t overheat a circuit. If that information is not written in the breaker box, you will need to compile your own map of the circuits. To do this, plug a light into each wall outlet in a particular room and switch the breakers off and on to determine which outlets are on which circuit. An inexpensive night-light is ideal for this purpose. A single circuit may have wall outlets in several rooms, such as a hallway, bedroom, and bathroom.
Once you have mapped a circuit, you will need to do some simple mathematics because circuit breakers (and most generators and batteries) are rated in amps, but appliances and bulbs are labeled in watts. Fortunately, a relatively simple formula converts watts and amps: \( \text{amps} \times \text{volts} = \text{watts} \). The power voltage in the United States is about 120 volts. But to make the calculation even easier, use 100 volts instead of 120. This provides a margin of safety to keep from blowing circuits and also makes the multiplication simpler because you can multiply the number of amps given on the breaker box by 100. This tells you how many watts you can safely plug into the circuit. For example, if the circuit can carry 20 amps, you can plug in 2,000 watts’ worth of lights (2,000 watts = 100 volts \times 20 \text{ amps})

This would mean you could plug in four \( \text{500-watt} \) lamps, two \( \text{1,000-watt} \) lamps, or any other combination of lamps adding up to 2,000 watts. Of course, you can use this much only if nothing else is plugged into the circuit. If a refrigerator or other power-consuming equipment is operating, you must deduct the number of watts each uses.

If the circuit in a room you are lighting cannot provide enough power for all your lighting instruments, you will have to route power to your lights from a different circuit. Extension cables used for this purpose should be of a heavy enough gauge to handle the wattage they are expected to carry. Common household extension cords are too lightweight and can be dangerous. Long extension cable runs can also reduce the voltage supplied to the lamps and may affect color rendition. A 1-volt drop in power supplied to an incandescent lamp lowers the color temperature by 10 degrees Kelvin.

As noted earlier, renting a generator is the common solution to limited location power. Generators are not cheap, but some rental houses provide student discounts, and in many cases a rented generator may be the only way to assure reliable power. Another option might be to negotiate with a neighbor to buy power from them. Finally, another option available from most lighting rental houses is a range plug. This plug is different from the standard two- or three-pronged Edison plugs. It plugs into the \( \text{240-volt} \) outlet used for electric stoves and clothes dryers and breaks it down into two \( \text{120-volt} \) legs. In a house with limited circuits it can be
Professional film and television crews typically hire a licensed electrician to help deal with electrical problems. An electrician can bypass the breaker box and route the power into a separate distribution box that has its own breakers. This enables power cables to be run directly to the distribution box and to be routed where they are needed without the constant risk of tripping circuit breakers. Bypassing the circuit breaker box, however, should be done only by a qualified electrician.

**Lighting Safety**

Setting up and operating lighting equipment, especially on location, requires planning and care. Lights must be securely mounted, and barndoors or filter holders should be locked in place or taped to any supporting structure for additional stability. Electrical cords and extension cables should be taped down with gaffer tape or paper tape or be covered with rubber matting to keep people from tripping and pulling the lights down (see Figure 5.29). Power cables coming from the light should be secured to one of the legs of the light stand.

A fully extended tripod-base light stand is inherently unstable, and you should secure the legs with sandbags to keep them from tipping over (see Figure 5.30). Some heavy-duty light stands have anti-sway bars to increase their stability or come with rings at the base for securing power cords. Pointing one leg of the light stand in the direction the lighting instrument is facing helps to distribute the weight more evenly and improves the stand’s steadiness.

Because lighting instruments get hot, never place them near flammable materials such as curtains or upholstered furniture. An overloaded circuit or inadequate extension cable can also cause a fire. The placement of gels, filters, or diffusing materials on the lighting instrument also requires careful attention. It is imperative to attach these light-shaping materials in such a way that the heat can escape from the bulb and surrounding area.

Even if a lamp (especially a tungsten bulb) has only been on for a short period, it may be
too hot to touch. If it is not possible to let the light cool down, use insulated electrician’s gloves to adjust barndoors or to change scrims or filters. Turn tungsten lights off as soon as production is completed so they have time to cool before being packed away. Be careful when removing tape from floors or walls; it is easy to damage wallpaper or painted surfaces as the tape is peeled away.

For the safety of the actors and others on the set, announce when you are going to turn on a light and tell people to look the opposite direction. That way people will not damage their eyes by looking directly into the light as you are turning it on.

Most of these safety precautions are just common sense. In the hurry of production, however, with time running short and pressure building, cutting corners is a real temptation. That is when accidents occur. To protect the crew and cast from injury, you must always handle electrical power and lighting instruments in a careful, systematic, and professional manner.

In addition to well-maintained lighting instruments and the proper securing devices, a number of items should be part of your location lighting kit. These include a fire extinguisher, insulated gloves for each crew member handling lights, burn ointment, rubber matting, gaffer tape, and spare bulbs. Finally, the quality and safety of location lighting are directly related to the amount of advance planning. Scouting a location for power requirements before the shoot tells you what to bring.

<EOC>Notes
<END>1. The zebra pattern stripes are visible in the viewfinder over the areas of the picture that are near the 400-100-IRE unit level, the uppermost limit of brightness. Zebra stripes are adjustable and could be set to a level, for example, of 65 to 70 IRE, the approximate level for Caucasian skin tone and a level that is not so close to the camera’s clip levels.

2. Another measurement often used, especially in Europe, is lux. One lux is roughly one tenth of a footcandle.

3. Here is a one procedure for establishing an exposure index for a video camera. This requires a chip chart and waveform monitor in addition to the light meter and camera you will be using. After lighting the chip chart evenly, open the camera’s iris to the point at which the white
chip on the chart is at 100 IRE units on the waveform monitor. After checking to see which f-stop that requires on the camera, change the ASA slide or dial on the light meter until you reach the same f-stop reading as the one on the camera. You then can use that slide or setting as the exposure index for your camera.


5. The actual percentages needed to make white are 59 percent green, 30 percent red, and 11 percent blue.


7. The filter factor is the inverse of the fraction of the light transmitted (for example, $\frac{1}{1.4}$ is two f-stops). You can divide filter factors into ASA and make all subsequent exposure calculations based on the new or recalculated ASA. With a filter factor of 4, for example, the ASA might be 320 without the filter but 80 (320/4) with the filter.


Chapter 5 Captions

<FN>Figure 5.1 <FC>One of the workhorse incident light meters that has been used for moviemaking for many years. (Photo courtesy of Sekonic) PICKUP PHOTO. Old 5.1

<FN>Figure 5.2 <FC>This meter can be used for both reflected and incident light readings. (Photo courtesy of Sekonic) PICKUP PHOTO. Old 5.2

<FN>Figure 5.3 <FC>A spot meter with a digital readout. (Photo courtesy of Sekonic) PICKUP PHOTO. Old 5.3

<FN>Figure 5.4 <FC>A lighting situation such as this easily fools an automatic iris. The iris will close too much because of the large amount of light in the scene’s background. A center-weighted light meter offers some correction. Other cameras have backlight compensation systems that increase exposure to make up, at least in part, for strong backlight. PICKUP PHOTO. Old 5.4

<FN>Figure 5.5 <FC>The range of f-stops is a result not only of the variance of light falling on the scene, but also of the varying reflections of different surfaces within the scene. A single light source can result in different ranges, depending on the nature of the subject. NEW ARTWORK. Provided camera ready on CD-R as 05.05 contrast

<FN>Figure 5.6 <FC>The display on the waveform monitor allows the picture to be represented on a luminance scale. The bright areas in the picture register near the top (near 100 IRE). The monitor displays the darkest areas at the bottom, where the black level (7.5 IRE) is normally set. This is often called the pedestal level. If image brightness exceeds 100 IRE or falls below 7.5 IRE on the waveform monitor, the image will be distorted. PICKUP PHOTO. Old 5.5

<FN>Figure 5.7 <FC>A color temperature meter with digital readout. (Photo courtesy of the Minolta Corporation) PICKUP PHOTO. Old 5.7

<FN>Figure 5.8 <FC>A small battery-powered vectorscope. (Photo courtesy of Leader Instruments Corporation) PICKUP PHOTO. Old 5.8

<FN>Figure 5.9 <FC>A tungsten-halogen bulb in a highly portable lamp housing. (Photo courtesy of Mole-Mole-Richardson, Hollywood, U.S.A.) PICKUP PHOTO. Old 5.9
Figure 5.10 <FC> An HMI light, shown with its ballast, produces daylight-balanced light with less heat and lower power requirements than incandescent lights. (Photo courtesy of Mole-Richardson Company) PICKUP PHOTO. Old 5.10

Figure 5.11 <FC> Two high-frequency fluorescent (kino) lamps. (Photo courtesy Kino Flo, Inc.) PICKUP PHOTO. Old 5.11

Figure 5.12 <FC> An LED light that mounts around a camera lens. (Photo courtesy of Ringlite) NEW PHOTO. Provided on CD-R as 05.12 ringlite

Figure 5.13 <FC> A softlight reflector with the lamps recessed along the bottom. (Photo courtesy of Strand Lighting) PICKUP PHOTO. Old 5.12

Figure 5.14 <FC> A Fresnel spotlight with barndoors attached. (Photo courtesy of Lowel-Light Manufacturing, Inc.) PICKUP PHOTO. Old 5.13

Figure 5.15 <FC> (a) A spotlight in the spot position with the bulb moved toward the back of the lamp housing, and (b) a spotlight in the full flood position with the bulb moved toward the front lens. PICKUP ART. Old 5.14

Figure 5.16 <FC> An open-face quartz spotlight with barndoors. (Photo courtesy of Sachtler Corporation of America) PICKUP PHOTO. Old 5.15

Figure 5.17 <FC> A scoop. (Photo courtesy of Strand Lighting) PICKUP PHOTO. Old 5.16

Figure 5.18 <FC> A quartz lamp broad on a lightweight stand. (Photo courtesy of Mole-Richardson, Hollywood, U.S.A.) PICKUP PHOTO. Old 5.17

Figure 5.19 <FC> A portable location lighting kit with lights, stands, barndoors, and other accessories. (Photo courtesy of Mole-Richardson, Hollywood, U.S.A.) PICKUP PHOTO. Old 5.18

Figure 5.20 <FC> (a) A lightweight telescoping light stand, and (b) a somewhat heavier light stand. (Photos courtesy of Mole-Richardson, Hollywood, U.S.A.) PICKUP PHOTO. Old 5.19

Figure 5.21 <FC> A softlight on a boom arm. (Photo courtesy of Lowel-Light Manufacturing, Inc.) PICKUP PHOTO. Old 5.20
Figure 5.22 A high-frequency fluorescent mounted with a space-clamp. Suspended over a table, it would provide even light for all actors seated at the table. (Photo courtesy of Lowel-Light Manufacturing, Inc.) PICKUP PHOTO. Old 5.21

Figure 5.23 A portable light with flags attached to flexible shafts. (Photo courtesy of Lowel-Light Manufacturing, Inc.) PICKUP PHOTO. Old 5.22

Figure 5.24 Several reflector variations. (Photo courtesy of Lowel-Light Manufacturing, Inc.) PICKUP PHOTO. Old 5.23

Figure 5.25 A lightweight umbrella reflector. (Photo courtesy of Lowel-Light Manufacturing, Inc.) PICKUP PHOTO. Old 5.24

Figure 5.26 The diffusing material standing behind this fluorescent Kino Flo lamp will scatter the light when it is placed on the lamp. (Photo courtesy of Kino Flo, Inc.) PICKUP PHOTO. Old 5.25

Figure 5.27 A butterfly scrim (a) can diffuse light over a much larger area than a single or a double scrim. Made from stainless steel, a single scrim (b) and a double scrim (c) fit into a variety of accessory holders. (Photo (a) courtesy of Matthews Studio Equipment, Inc.; photos (b) and (c) courtesy of Mole-Richardson, Hollywood, U.S.A.) PICKUP PHOTO. Old 5.26

Figure 5.28 The inverse square rule. The intensity of the light varies according to the square of the distance from a simple light source. PICKUP ART. Old 5.27

Figure 5.29 Taping down extension cords can prevent injuries and reduce the chances of lights being pulled over. PICKUP PHOTO. Old 5.28

Figure 5.30 A sandbag can be used to secure top-heavy light stands. (Photo courtesy of Matthews Studio Equipment, Inc.) PICKUP PHOTO. Old 5.29