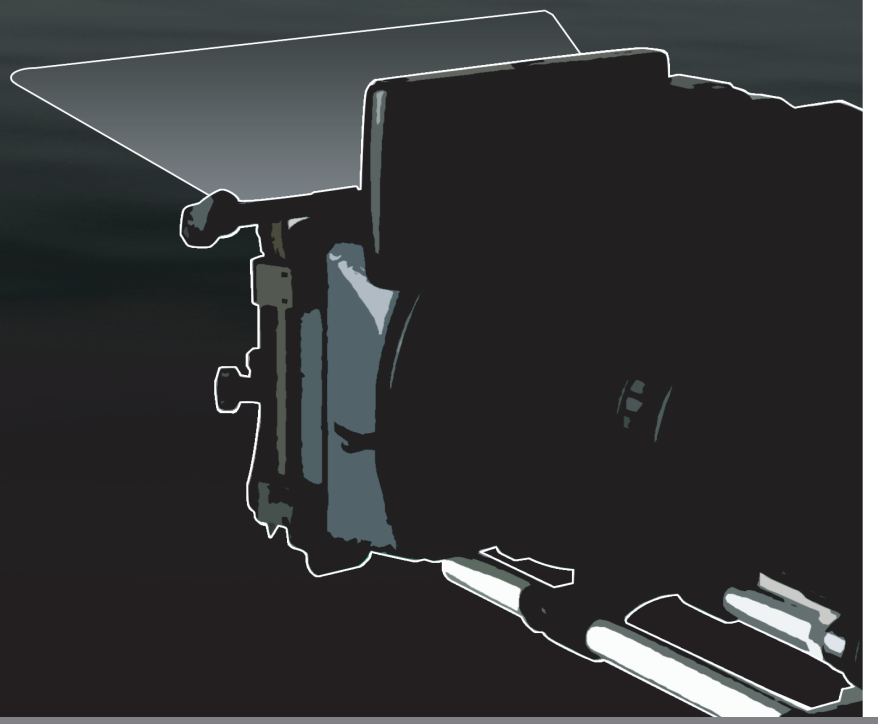
A DIGITAL CINEMA TRAINING™ FULL COLOR PUBLICATION

Digital Cinema Training
Filmmaking Focus DVD Series

DCT-FM1
FIELD MANUAL

Kelvin Scale and EM Spectrum · Color Temperature and White Balance · Tilts · Pans · Dollying · Zooming · Focus
Spot and Incident Light Metering · Color · Adapters · 18% Gray Card and TTL Metering · WS · MS · CU · Face room
Angle of Incidence/Reflectance · Focal Length/Distance · Lighting Contrast · Visual Continuity · Axes of Movement in Space
Inverse Square Law of Light · Monitors · D.O.F · SBR · Lenses · F/Stops · Composition: Thirds · Composition: Triangles · Headroom



Digital Cinema Training
DCT
Digital Cinema Training

F U L L C O L O R

FIELD MANUAL

Digital Cinema Filmmaker's Training Course Field Manual

The Digital Cinema Filmmaker's Training Course is a comprehensive guide to filmmaking in the new digital world. It combines old-world film savvy and 21st Century technology to create a new teaching tool never before created for filmmakers. Screenwriting, script formatting, editing, camera techniques, audio, and lighting are all covered in the comprehensive DVD series. These concepts are combined with today's compact affordable HD camcorders to produce a revolutionary product. Instead of boring lengthy lectures, the DVD series has the spirit of a tour of modern filmmaking.

This field manual serves as a field reference for the DVD guide only. *It will not replace the DVD guide*. The student is meant to view the DVD guide first, then use this field manual to refresh a certain concept or faded principle. We hope you the best of luck in your pursuits, and thank you for purchasing a product that was born of neccessity, and nurtured with dreams.

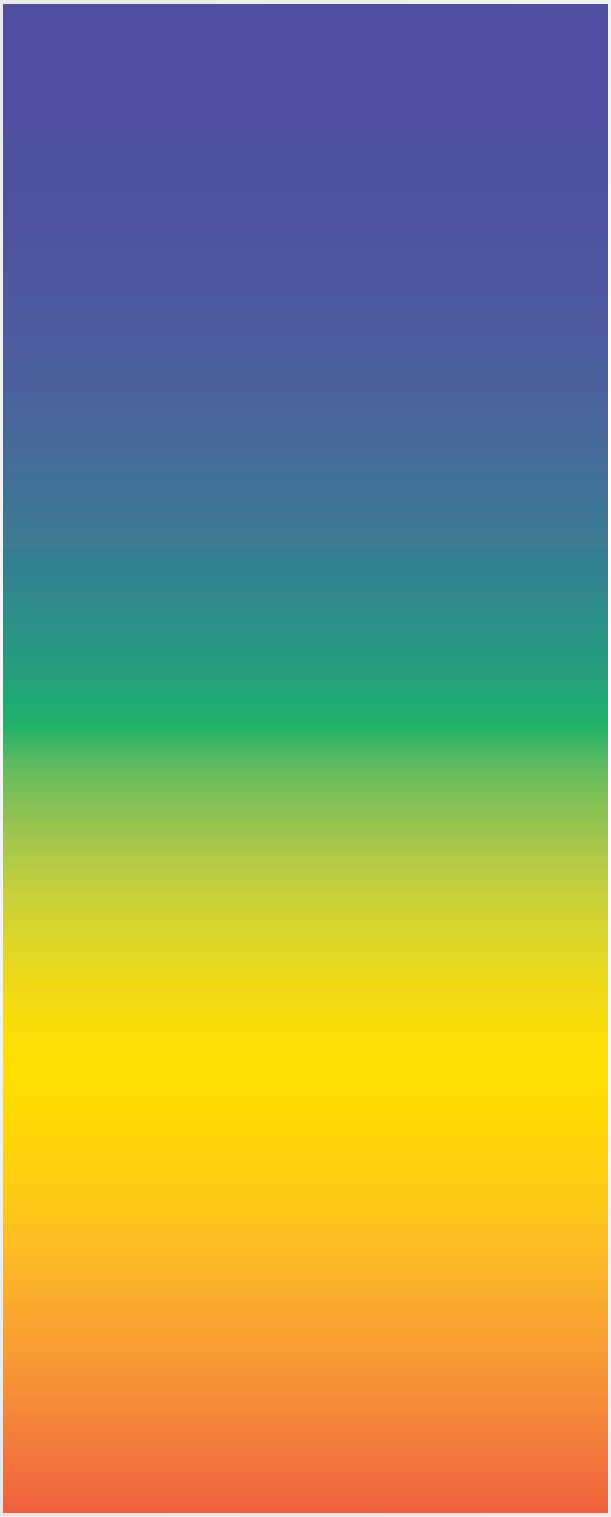
We hope it will aid you in your dreams as well.
DCC Creator,
Rush Hamden.

Dedicated to our parents, our friends, and all dreamers everywhere.

CONTENTS

KELVIN SCALE

The Kelvin scale is based on a scientific principle of heating a "black body" in a laboratory environment, and measuring its heat discharge color as it gets warmer. Just like the stars in the the sky, the hotter the test object gets, the bluer the color. A blue flame is much hotter than a red one.



10,000K - CLEAR SKY

7,000K - OVERCAST SKY

5,600K - HMI LAMPS

5,500K - SUN AND SKY

4,400K - FLUORESCENT LAMPS

3,200K - TUNGSTEN LAMPS

3,000K - SUNSET

2,800K - 60W INDOOR BULB

1,500K - CANDLE FLAME

All color representations may vary by age of manual and color of viewing light.
All values approximate and vary by weather conditions, locale, and age of lamps.

ELECTROMAGNETIC SPECTRUM

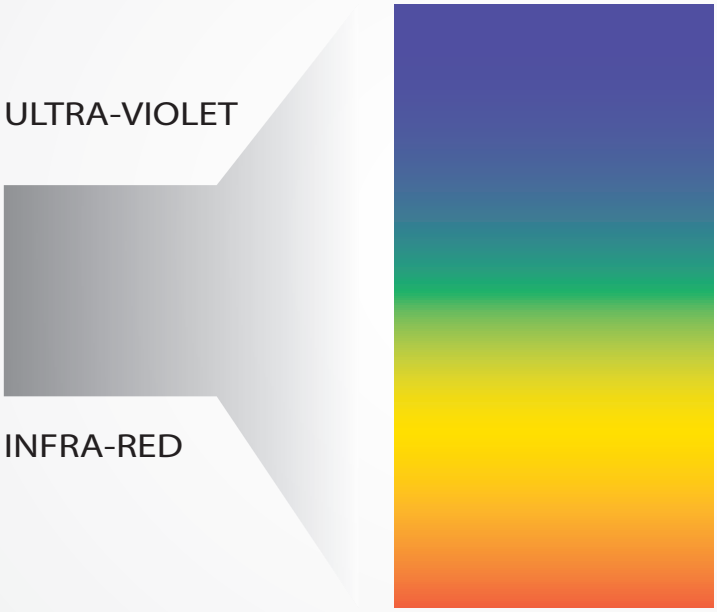
GAMMA RAYS

X-RAYS

Our human visual perception is limited to a thin band of electromagnetic wavelengths. With the use of machines, optical devices, and films, we can also perceive and record electromagnetic energy that is not normally perceptible to the human eye. For instance, X-Ray film, IR goggles, and UV-Sensitive CCDs.

VISIBLE SPECTRUM

ULTRA-VIOLET



5,600K - HMI LAMPS

5,500K - SUN AND SKY

3,200K - TUNGSTEN LAMPS

INFRA-RED

HI-FREQUENCY TRANSMISSIONS

LO-FREQUENCY TRANSMISSIONS

COLOR TEMPERATURE

One of the powerful features of professional video cameras is their ability to sample the color temperature of the light that is falling on a subject. Training your video camera on a neutral surface, and depressing the White Balance button, will sample the color of the light falling on that surface. This surface could be a professional white card with a high reflectance and pure white hue, or a professional photographic 18% gray card.

Under Daylight conditions (HMI, Outdoor) a subject will appear blue if a Tungsten 3200K white balance is used.

Switching to a Daylight setting on the camera (5,500K or 5,600K depending on manufacturer) or performing a manual white balance will produce the correct colors in the subject under Daylight color conditions.

Using the gray card for setting exposure levels will be discussed in the 18% Gray Card section.

WHITE BALANCE

When white balancing, make sure that the gray or white card is fully immersed in the light source that is falling on the subject. If necessary, aim the card at the light source to isolate it from other lights on the set that have other color temperatures. Fill the frame with the card. If you are using a white card, you may have to reduce exposure to get an accurate reading.

Ensure that the white or gray card is fully immersed in the light source.

Adjust exposure if using a white card, then select a USER A or USER B setting on your White Balance panel.

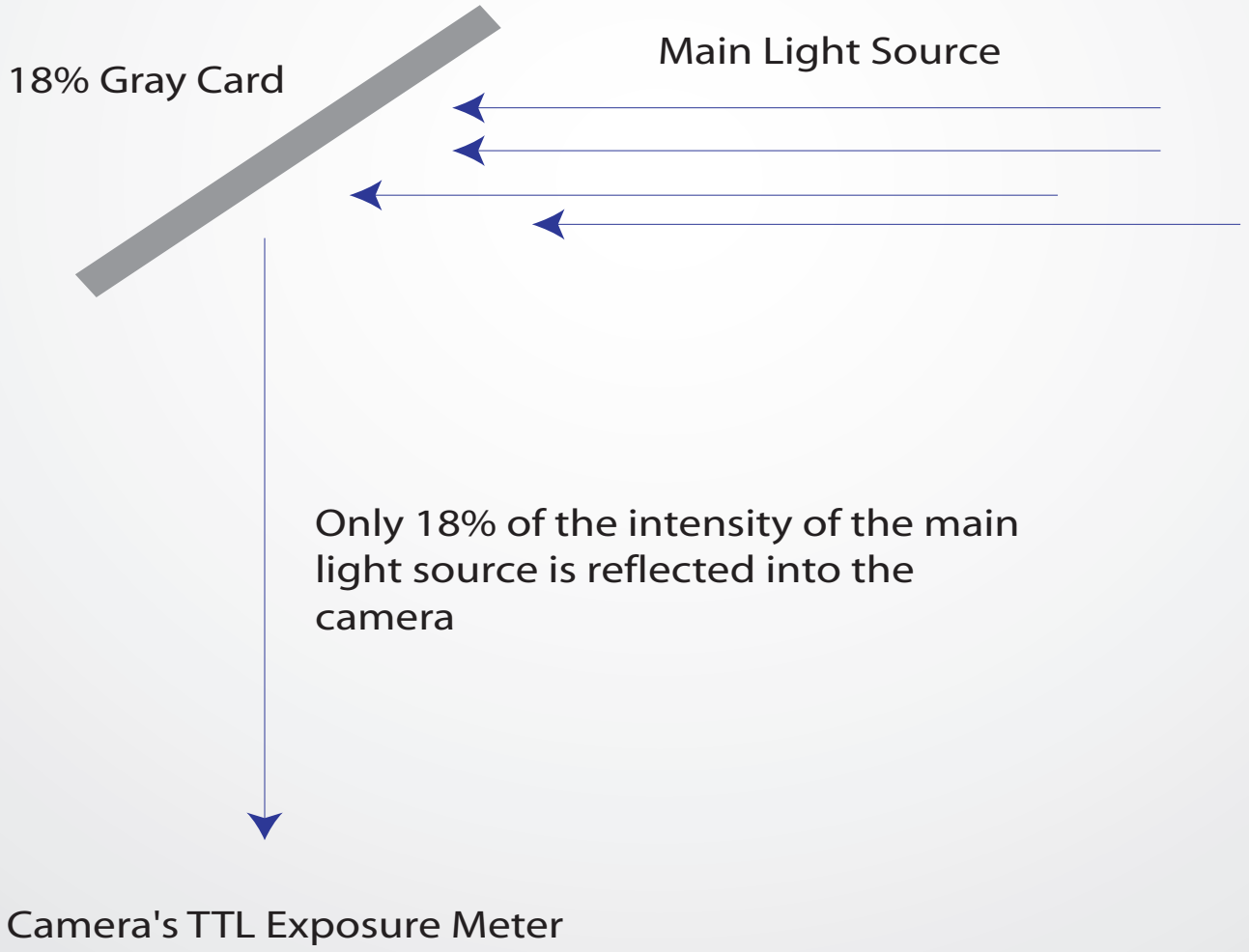
Zoom in and fill the frame with the gray or white card. Take a sample with the appropriate Manual White Balance button on your video camera.

Zoom out and confirm that the colors appear normal on a calibrated professional production monitor (See Calibrating Production Monitor section for more info).

18% GRAY CARD

The 18% Gray Card is a tool specifically designed to mimic an "average" outdoor scene in its reflectance of light. An "average" outdoor scene was determined to reflect a certain amount of the light falling on it. Visualize an outdoor panorama with sun and sky falling onto an open field. When framed as a wide shot, this scene will normally absorb 82% of the light falling on it, and reflect 18%. Hence the TTL (Through the Lens) meter on most photographic and video cameras is adjusted to respond to that amount of light, and gives a reading that sets exposure accordingly. If you were always filming a wide shot of field and sky in broad daylight, the camera's auto-exposure system will more than likely always make a good reading. However, most studio situations do not fall under these circumstances.

Enter the Gray Card. Placing it in the exact position of the subject, and angling it halfway between the camera and the main light source, will almost always yield an accurate exposure.



When white balancing, make sure that the gray or white card is fully immersed in the light source that is falling on the subject. If necessary, aim the card at the light source to isolate it from other lights on the set that have other color temperatures. Fill the frame with the card. If you are using a white card, you may have to reduce exposure to get an accurate reading.

Here is an example of a sunlit outdoor "average" scene. The TTL meter will correctly read the light reflected from the scene, and the image will have a good exposure even at auto exposure settings.

Here is how the meter sees the image. It is a collection of black and white values and midtones devoid of color. Black areas reflect no light, white areas reflect a great deal of light, and midtones reflect varying amounts in between. The scene will absorb approximately 82% of the light falling on it.

SETTING EXPOSURE USING TTL METER

Now that we have seen an "average scene", here are a couple of examples of scenes that are not average, and will not be metered correctly by the camera's built in TTL meter.

This is by far not an "average" scene,. The TTL meter will try to read the white background as 18% gray, therefore underexposing the image.

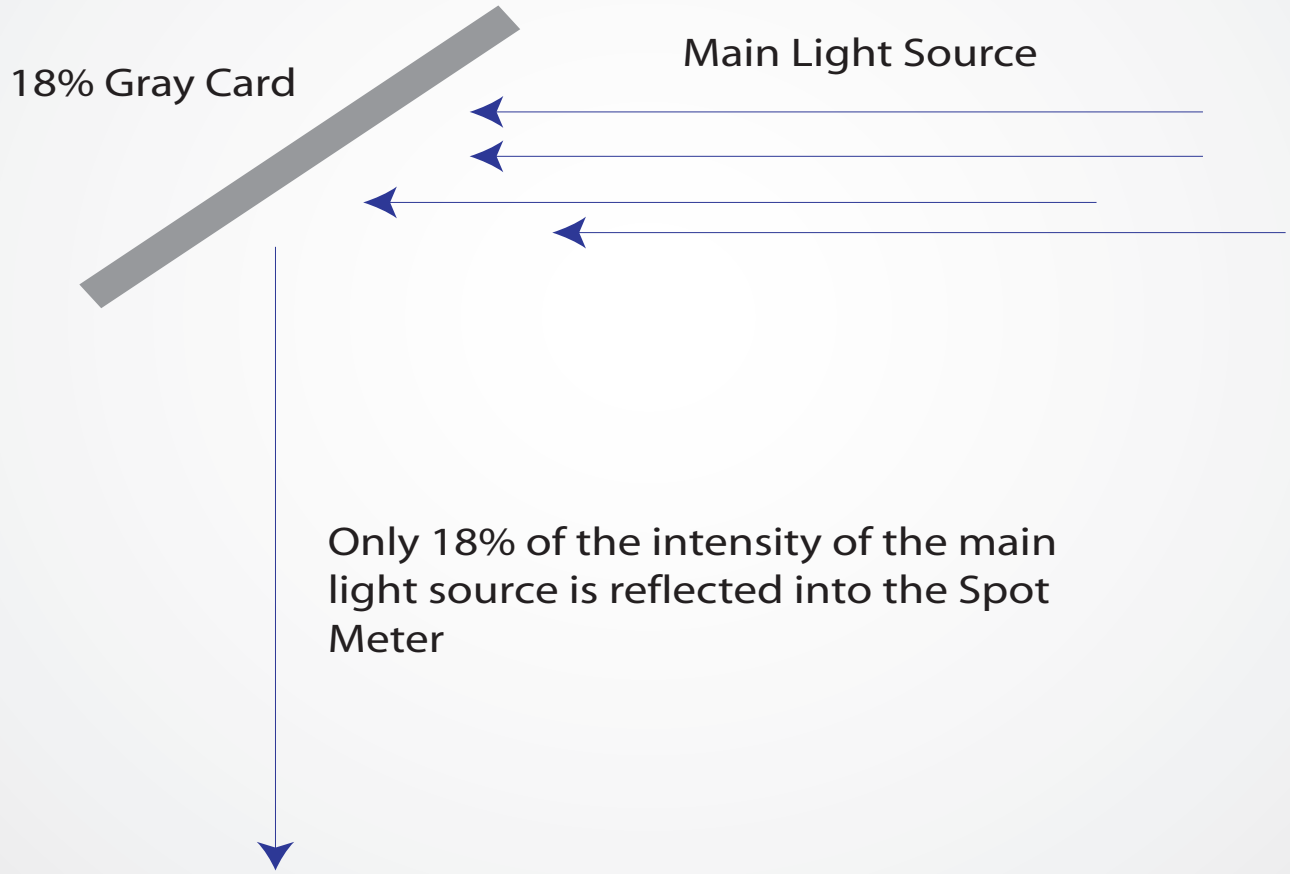
Having the subject hold an 18% gray card, zooming in to fill the frame with the gray card, taking a sample with your camera's built in Auto Exposure meter, then zooming back out will yield the correct exposure. You may have to make a small exposure adjustment to compensate for your lens's decreased sensitivity to light when fully zoomed. Some lenses lose as much as a whole stop (Half the light). Consult your manual to see the exact "speed" of your lens, in other words, its sensitivity, then adjust the exposure up to compensate.

This is another scene commonly encountered in the studio, where the model is against a dark background. The TTL meter will also try to read this black background as18% gray, and therefore over-expose the image.

Again, having the subject hold an 18% gray card, zooming in to fill the frame with the gray card, taking a sample with your camera's built in Auto Exposure meter, then zooming back out will yield the correct exposure.

SETTING EXPOSURE USING SPOT METER

Using a hand held Spot Meter will improve your accuracy, since you can take a reading off the 18% gray card without zooming in with your camera and calculating the absorbtion of the lens at an arbitrary zoom level. Simply set the meter's computer for the "film speed" of your video camera, and take a reading from right over the camera's lens. Consult your manufacturer for the ISO or "film speed" of your video camera, and be aware that the camera's sensitivity changes depending on whether you are filming in Interlaced, Progressive, or 24p mode (if available). It is important to take a reading along the lens, to minimize the chance of incorrectly reading a highlight on the gray card.



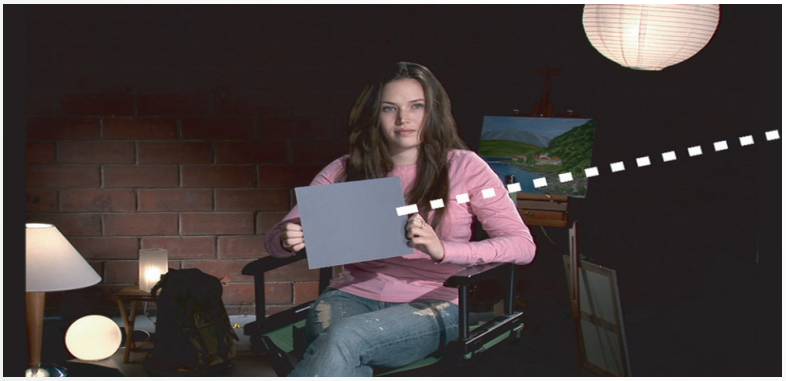
Hand-Held Spot Meter positioned near the camera's lens

Set to the camera's "film speed" i.e Sensitivity

SETTING EXPOSURE USING SPOT METER

Just as with the white balance, have your subject aim the gray card halfway between the main light and the camera. In fact, for the sake of speed, both the white balance and the exposure can be read by the 1st Assistant Camera Operator (AC) and the 2nd AC.

The AC takes a spot reading with a hand-held combination Spot/Incident meter. Notice his proximity to the lens.



The reading is taken along the lens' path.

Aim the center spot of the meter directly in the center of the gray card. Take a reading, and set the camera's iris dial to that exposure.

SETTING EXPOSURE USING INCIDENT METER

Using a hand held Incident Light Meter is the epitome of convenience. Your subject will not have to hold an 18% gray card, you will not have to zoom in with the camera to take a TTL meter reading, and you will not have to take a spot reading from the camera's perspective.

The 1st AC or the Gaffer will usually take an overall reading using an incident light meter. The reading is taken directly in front of the subject, with the bulb of the meter "out" or open. The meter is aimed directly at the camera, not halfway between the light and the camera.

The shape of the bulb approximates the shape of the human face, and is therefore calibrated to face the camera during a reading. Even if the subject is not facing the camera, face the bulb towards the camera.

The bulb of the meter is also coated to absorb only18% of the light falling on it. Therefore, it acts as an 18% gray card in three-dimensional space.

The capable Sekonic L-508 meter, superbly accurate and versatile, with its bulb out. It allows averaging readings, and has a memory function as well as a backlit LCD for dark situations. It will perform incident readings as well as spot. The spot meter has a zoom dial to focus in on the subject. This model does not have Cine functions vital to filming on 24p video cameras. The L-508C allows programming with the camera's frame rate.

Again, set the meter's computer for the "film speed" of your video camera, and take a reading from right over the camera's lens. Consult your manufacturer for the "film speed" of your video camera, and be aware that the camera's sensitivity changes depending on whether you are filming in Interlaced, Progressive, or 24p mode (if available).

In this example, the Director of Photography (D.P. or D.O.P) is taking an "overall" reading from both subjects' face positions. Notice that the bulb of the light meter is "out", therefore enabling an "overall" reading.

A reading is taken for the first subject.

A reading is taken for the second subject, revealing that he is getting less overall light than the first subject. This enables a quick adjustment of his key light, bringing his skintones up to the correct levels.

Bear in mind that the incident light meter does not take into account the tone of the subject's skin. It will always represent skin tones faithfully. Dark skin will read dark. If you want to lighten dark skin, adjust the exposure up by a half a stop, or add 50% more light to that subject. A spot meter is also useful to measure just how much light the subject's skin is absorbing.

SETTING EXPOSURE USING INCIDENT METER

When more accurate measurements are required from each individual light source, rather than an overall reading, the meter's ball can be brought into its light-proof housing. This blocks side-light from affecting its reading, and ceases to measure all the light falling a subject's face. Instead it concentrates only on the light falling from directly in front of the sensor. This is called Contrast measurement. Measuring the differences in intensities between the Key and the Fill light allows the setting of exact Lighting Contrast. For example, if the Key light is twice as bright as the fill light, this creates a 2:1 contrast ratio. Contrast ratios will be discussed further in the Lighting Section.

In this example, the D.P. has brought in the Incident Meter's bulb to take a contrast reading, measuring each light's intensity individually and committing that measurement to memory. The D.P. will set the exposure of the camera to whatever exposure he feels will either allow the greatest detail to be preserved in the shadows or the highlights. If he sets the camera to the exposure level derived from the Key light, he will have greater detail in the highlight areas of the face, but the shadow areas will be dark. If he sets the camera to the exposure derived from the Fill light, he will retain shadow detail, but the highlights will lose detail. The other option is to lessen the lighting contrast to 1.5:1 by increasing the intensity of the fill light. That will give a happier medium.

Remember that all cameras, film or video, cannot capture the incredible contrast ratios that possible by the greatest image capture device ever created: the human eye. Also, the camera does not have a mind of its own, unlike a human being. It cannot understand that because the subject's hair is dark, it is still there even though it looks black in the frame. The camera can only see what you light.

SETTING EXPOSURE USING INCIDENT METER

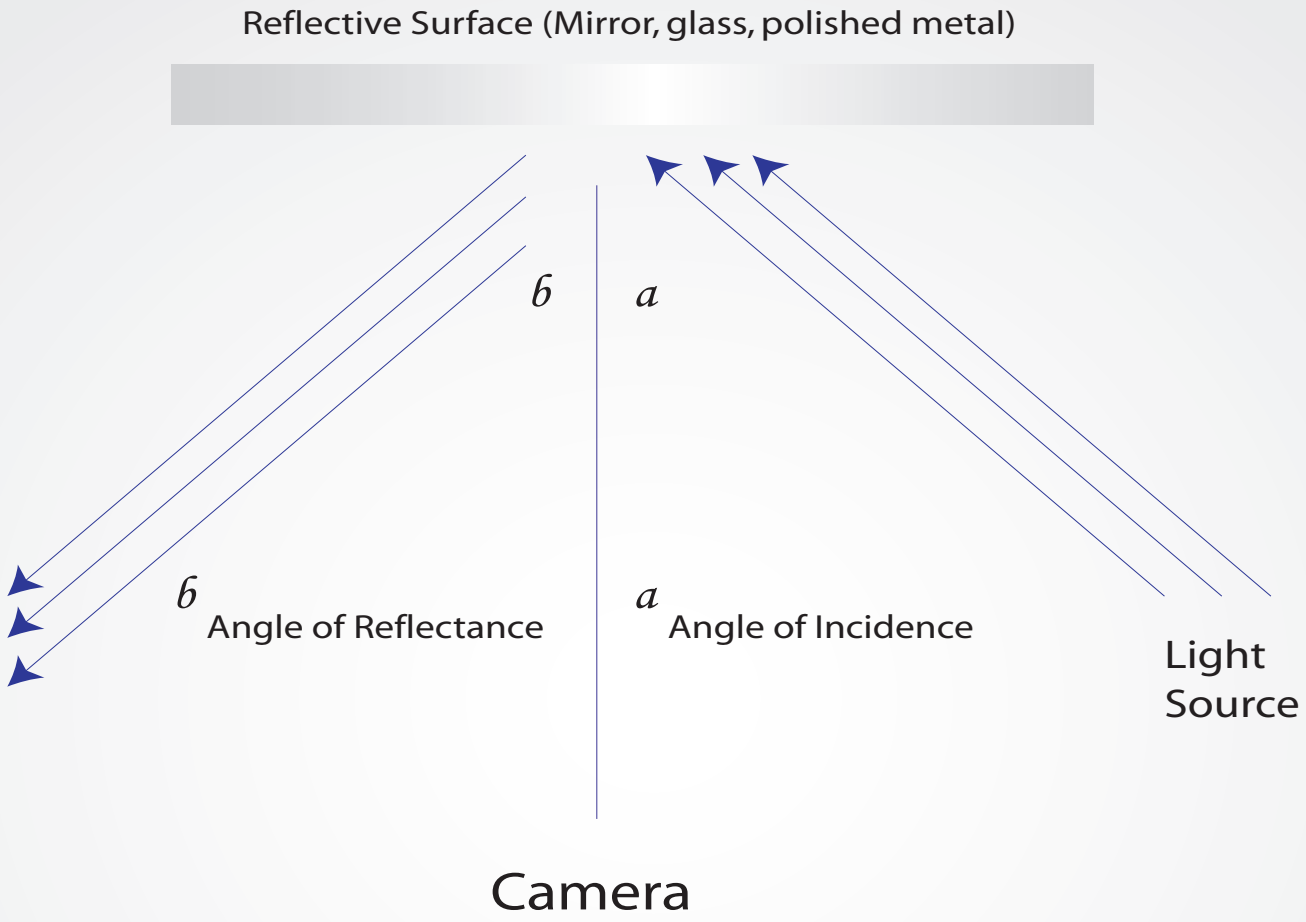
The 1st AC shades the Incident Light meter so that it will not accidentally read the Fill light.

He points the sensor directly at the Key light. If he were to want an overall reading instead, he woul extend out the ball and direct the sensor at the camera.

Do not accidentally block the light you are trying to measure when you take a contrast reading. Ask a grip to turn the light on and off , to ensure that you are reading the correct instrument.

ANGLE OF INCIDENCE/REFLECTANCE

When a light strikes a hard surface, it reflects in the exact opposite direction according to the following diagram.



Thus the angle of reflectance is equal and opposite to the angle of incidence.

What the diagram means is that when you are trying to film a glass surface, for instance, you have to place your light source far enough to the right so that it does not reflect itself back into the camera's lens. The magic angle is 45 degrees along the same plane, with another light at the same angle on the opposite side. The highlights cancel each other.

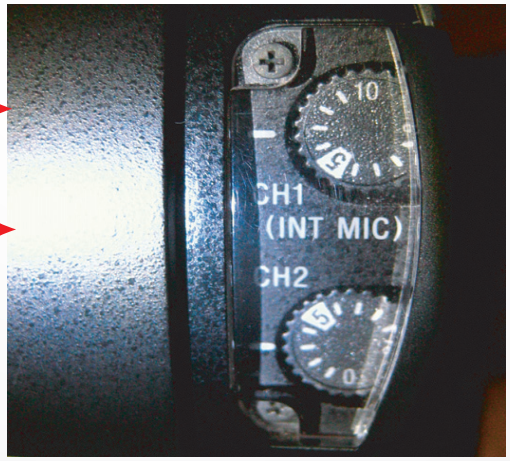
This is crucial when you have framed photos in the background of your image, and you cannot figure out how to prevent them reflecting your Key light back into the lens. Simply rotating them will cause the angle of reflectance to bounce in a more obtuse (flatter) direction.

When you see a very bright reflection of light in the subject that you are trying to film, or in the background, it is referred to as a Specular Highlight. It is a direct reflection of the actual bulb that is producing the light, in fact sometimes the filament inside the bulb.

Think of trying to take a flash-photograph of a metal bowl. It will reflect the lamp of the flash back into the camera's lens, because the lens is on its angle of reflectance.

Diffuse Highlight

Specular Highlight



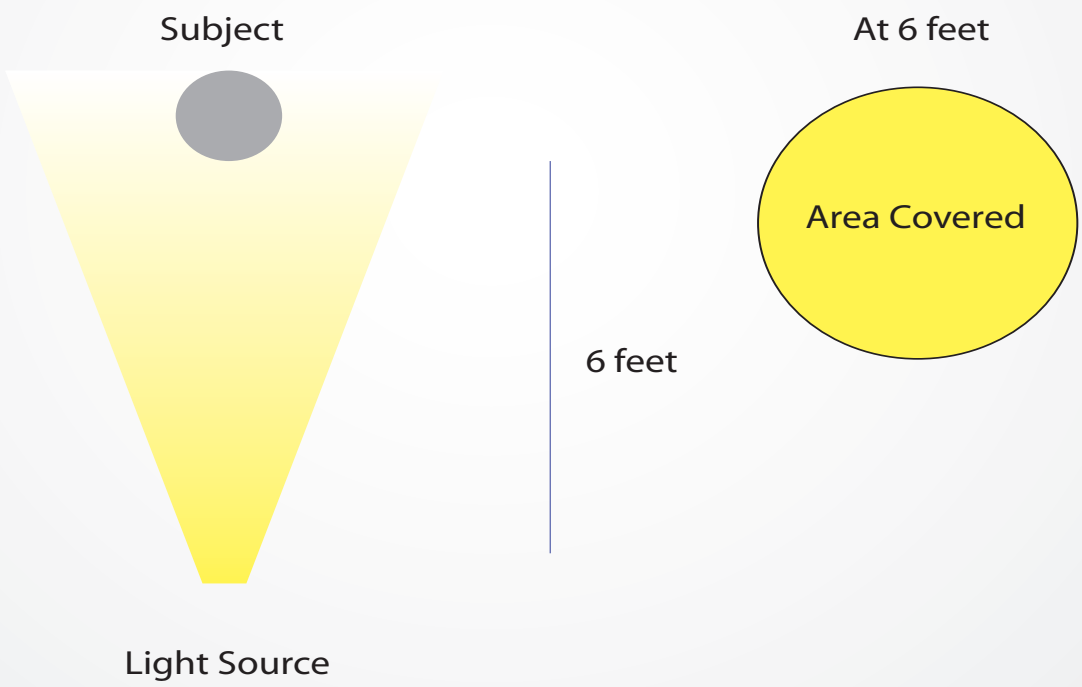
Making sure that your angle of incidence is not reflecting back into the camera's lens prevents Specular Highlights, and produces Diffuse Highlights. Diffuse Highlights carry the intensity of the light source minus its reflection. Therefore, you will see the artwork behind the glass, but not the lamp creating the light.

Also, this creates the need for Powder in Makeup to lessen the "shine" on the face, i.e. the reflection of the light source bouncing off oils in the skin and back into the camera's axis. Powder covers up the shine, changes the quality of skin, and makes it less able to reflect the light source back into the camera's axis along its angle of reflectance.

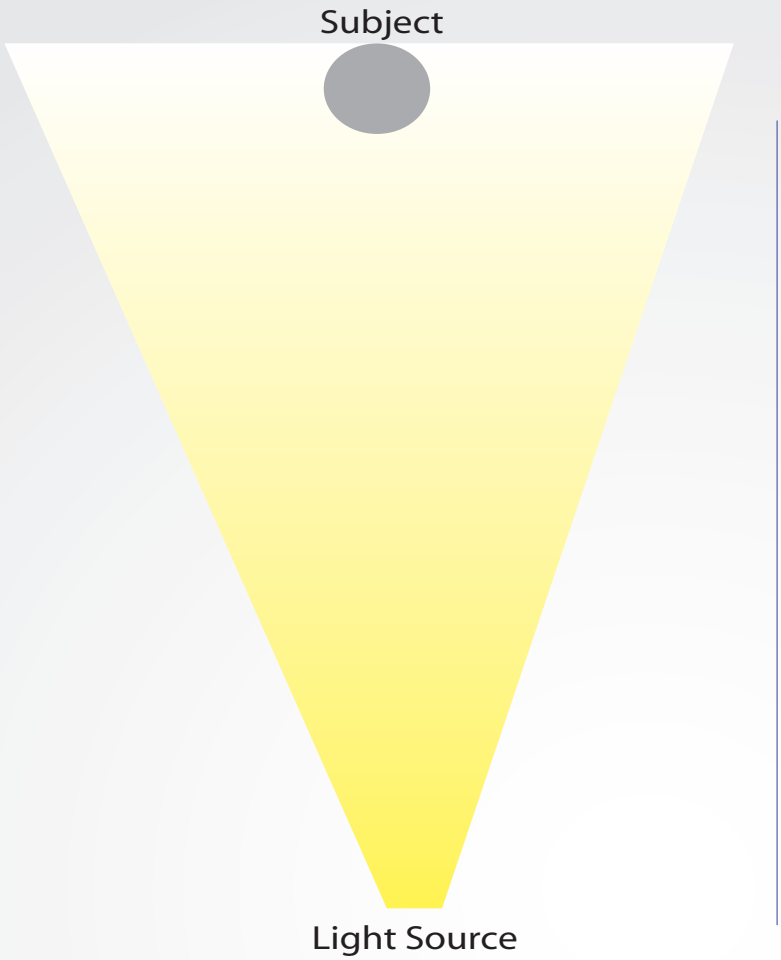
INVERSE SQUARE LAW OF LIGHT

Light decreases in intensity at the square of the distance from its source to the subject. While this sounds complicated it is simple. It means that if you want to halve the amount of light falling on a subject, you don't move it twice as far away. You just move it 50% farther. If you move the subject twice as far away, you are getting a quarter of the light on it, not half.

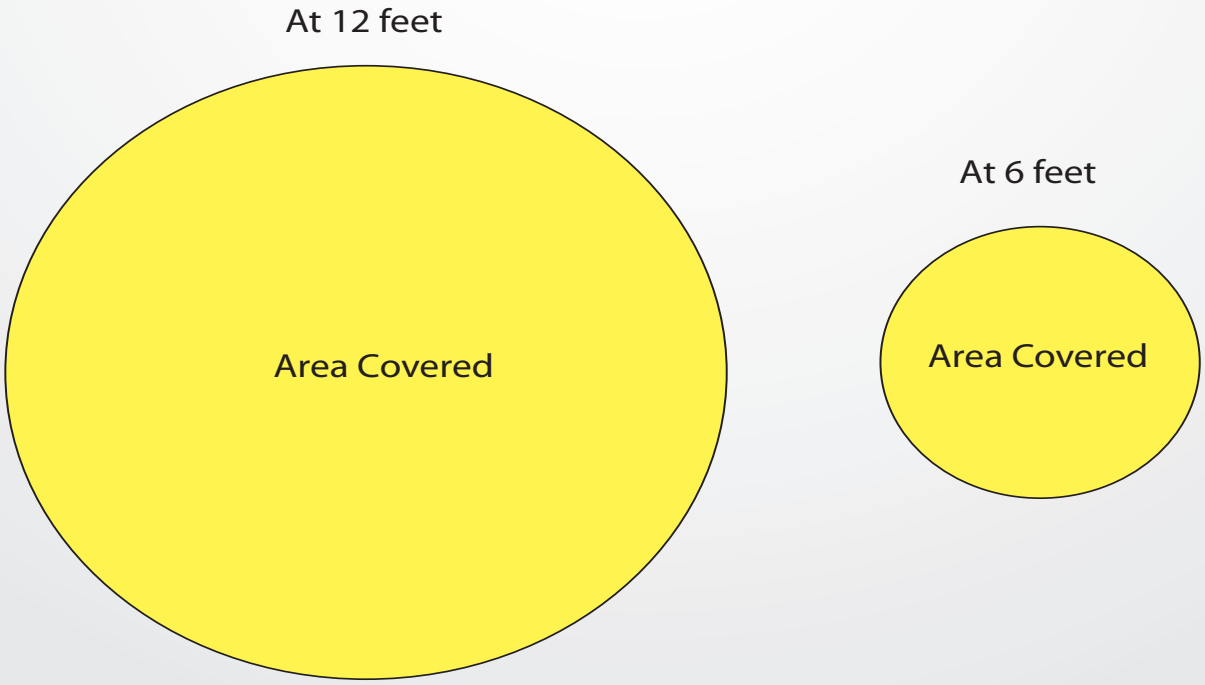
How does this apply in real life? You want to decrease the intensity of a light source 6 feet away from a subject. You have no spare net or scrim, and the light cannot be dimmed. You move the light 3 feet away from the subject, not 6 more feet, and you will get half the intensity at the subject.



INVERSE SQUARE LAW OF LIGHT



When light has to travel twice as far, it has to spread out over an area 4 times larger, thereby decreasing the intensity falling on the subject by 4 times.

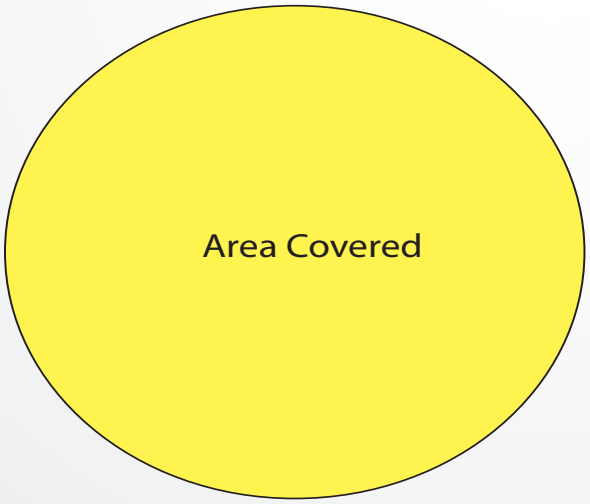


INVERSE SQUARE LAW OF LIGHT

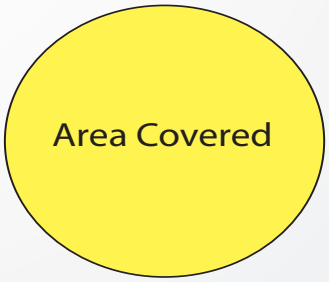
9 feet

When light has to travel 50% farther, rather than twice as far, it has to spread out over a smaller area 2 times larger, thereby decreasing the intensity falling on the subject by 2 times.

At 9 feet



At 6 feet



Once again, to halve the light falling on a subject, move the light 50% farther.

One final note about the inverse square law. Moving a light source 50% farther to get half the light intensity on a subject carries with it certain responsibilities. The subject will now see the light source as a smaller light emitter. Meaning, that if you had a small 2 foot by 2 foot soft box wrapping the light around a subject's face at 3 feet, moving it back another 1.5 feet may change the quality of the light falling on the subject.

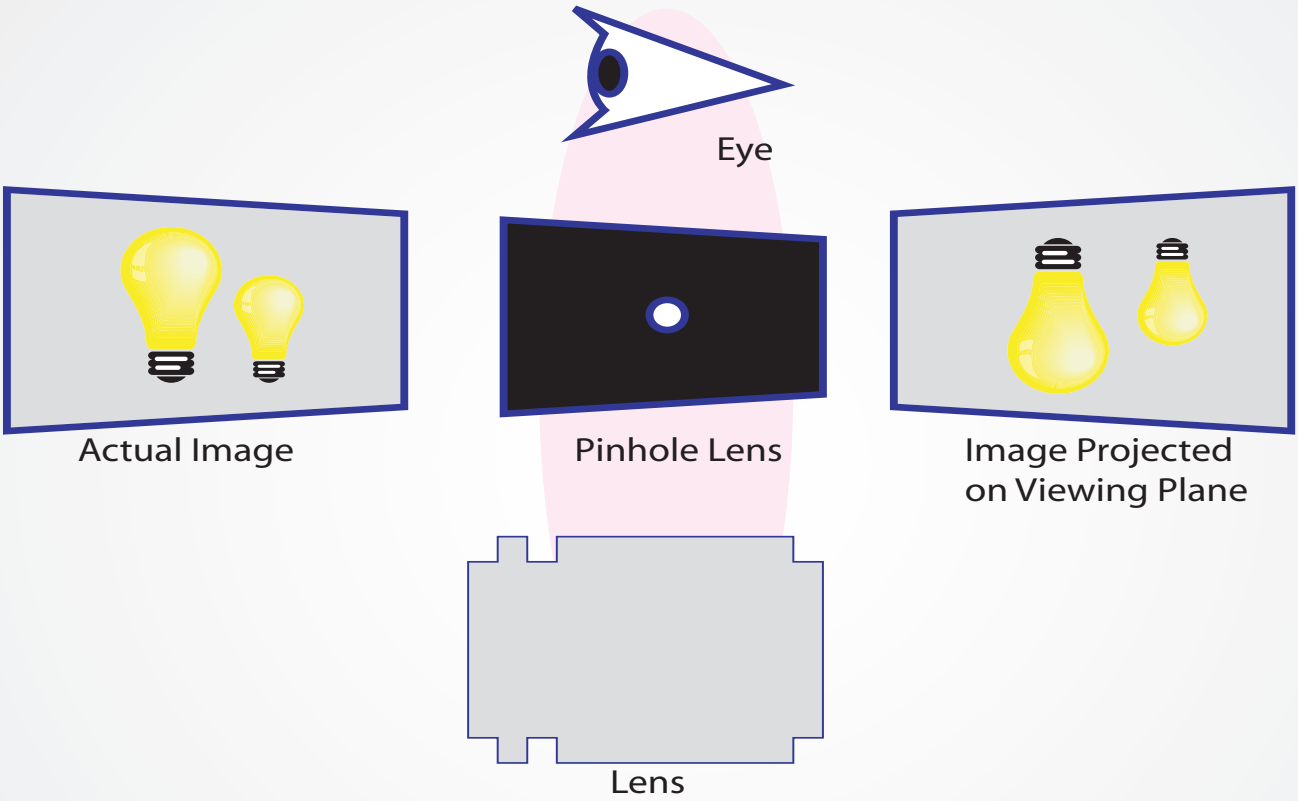
Sometimes a small move, as small as a few inches, is enough to change the quality of lighting that you have painstakingly sculpted on a subject. Moving the light source 50% farther may require the addition of a larger diffuser, perhaps 4 foot by 4 foot, to compensate for the increased distance.

This decreased size of the light emitter also creates a harder more specular highlight on a reflective subject. That is another reason to consider using black net or metal scrim to reduce the intensity of the light rather than moving the instrument back. In fact, moving a sculpted instrument should be the last resort, rather than the first.

At 3 feet, the subject would see the softbox larger. The light from the soft box would wrap around the subject.

At 4.5 feet, the subject would see the softbox as smaller. The light may not have the size necessary to wrap around the subject.

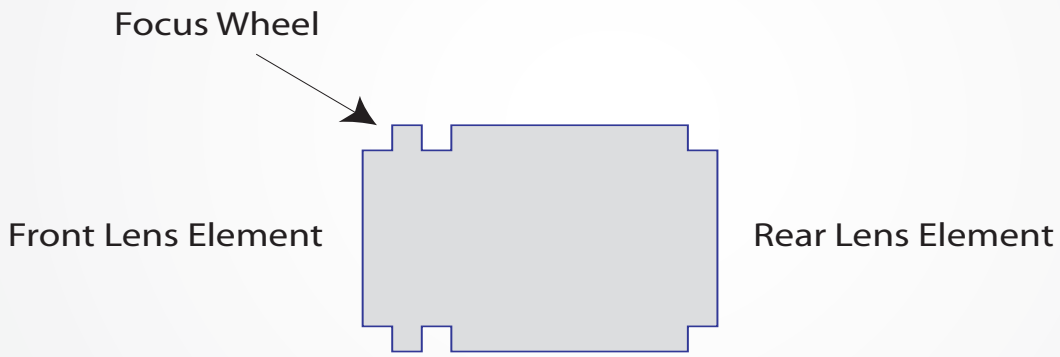
The key to understanding F/stops lies in first understanding the lenses that use the numbers. Lenses are simply better pinhole devices that gather more light. Pinhole cameras were the first cameras. Early painters made a wooden shack with a small hole in one side to gather light and project it on the inside opposite wall. They would then trace the picture with oil paint on a giant canvas. Ofcourse the image would be upside and reversed, just as with all cameras, and the inside of the human eye. Eventually, a smaller box with film in it was made, and with a long enough exposure, it could capture an image.



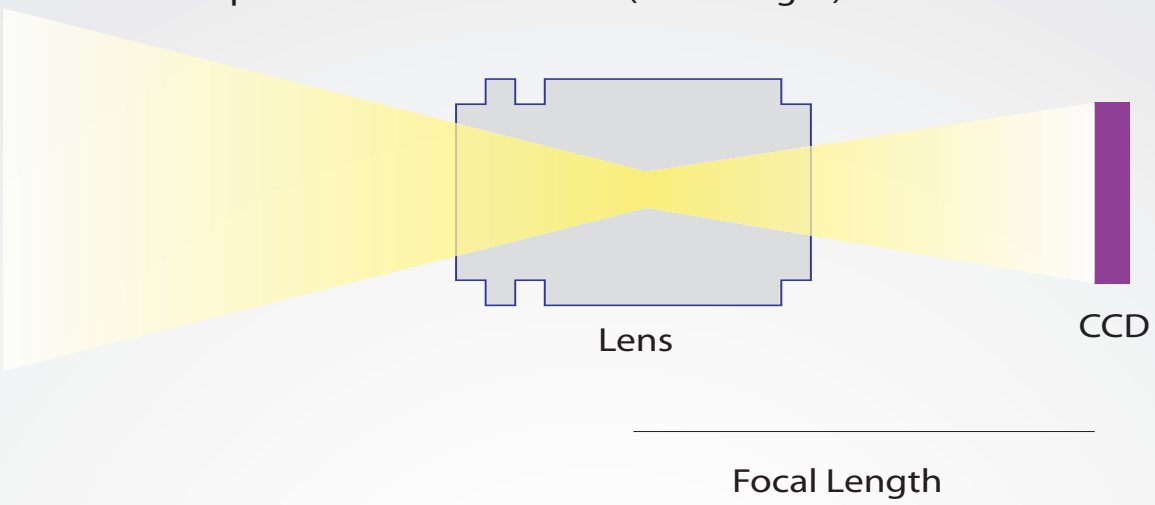
Even the human eye is regulated to decipher images upside down and reversed. That image is projected on the inside back wall of the eyeball. That is the image that the brain interprets, but translates it back into the proper aspect. The same goes for film and CCD image capture devices in cameras.

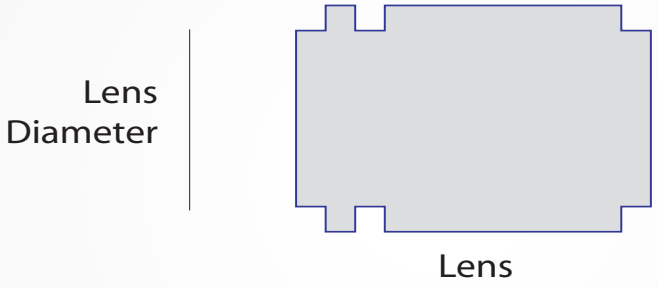
Of greatest importance to digital filmmakers, is lenses. Obviously, those are the only devices that can be easily and accurately used to gather light onto a film plane. The film plane in this case is the CCD (Charged Coupled Device). The CCD accepts the light gathered by the lens, upside down and reversed. The camera's electronics then reverse the image and flip it right side up.

Lenses are sometimes very simple, as in the case of a wide angle lens with no focus wheel (everything is in focus all the time). But the ones found in modern video cameras can be very complex. They have many elements that allow the lens to vary its focal length, or zoom. The best way to understand lenses though, is to start with non-zooming lenses, or "fixed focal-length lenses".



The lens' ability to gather and project light is determined by its diameter and distance from its optical center to the CCD (focal length).



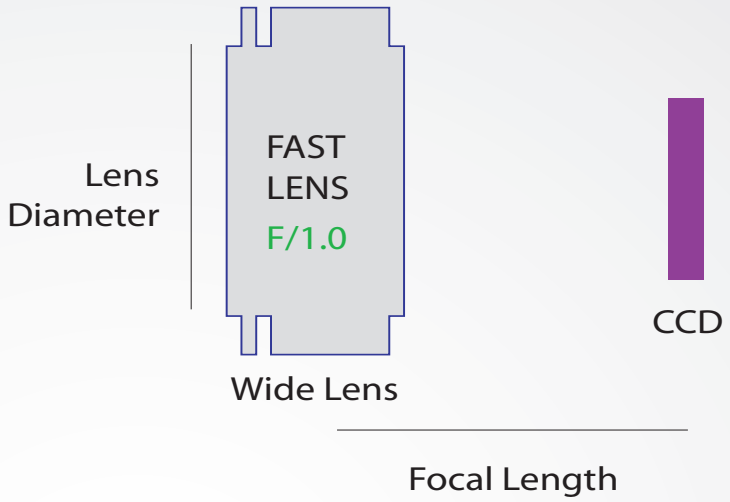


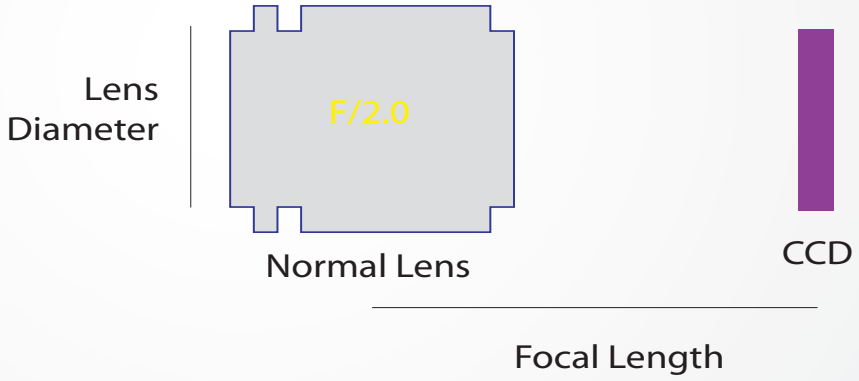
That relationship produces the "speed" of the lens, or the maximum amount of light that it can gather.

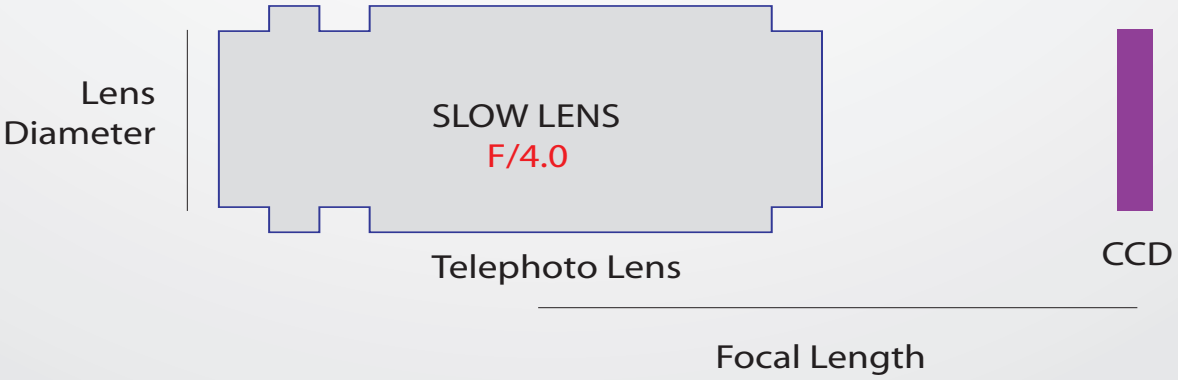
$$\frac{\text{Focal Length}}{\text{Lens Diameter}} = \text{Lens Speed}$$

So, if the lens's focal length is 4 inches, but its diameter is 4 inches, then it has a speed of F/1 (very fast lens). If the Lens' optical center is 4 inches away from the CCD (focal length) and the lens diameter is 2 inches, then the lens has a speed of F/2. Coversely, with a Focal Length of 8 inches and a diameter of 2 inches, the speed will be F/4 (slow lens).

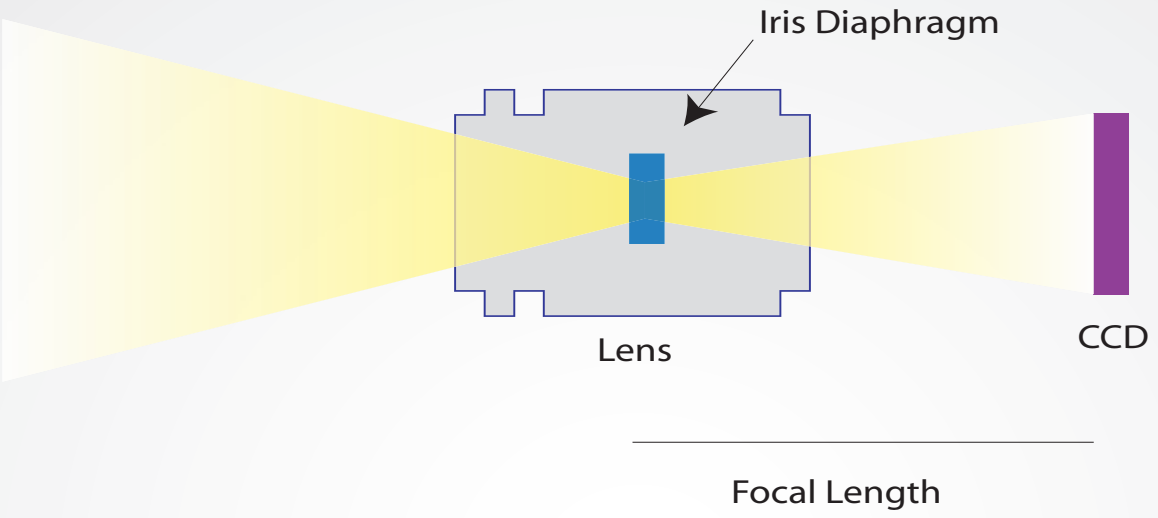
As the diameter of the lens increases, the speed increases, as long as the focal length remains the same. If the focal length increases, but the diameter remains the same, the speed decreases.

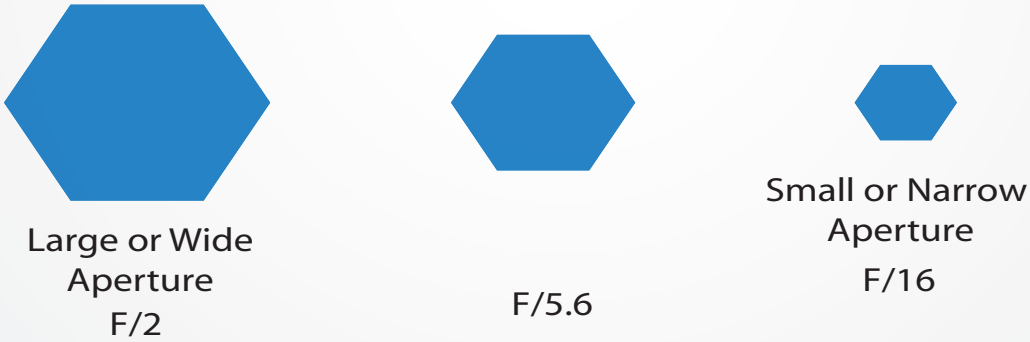






The relationship between the focal length and the diameter of the lens is further modified by the addition of a mechanical Iris Diaphragm (Iris for short) to control the amount of light travelling through the lens. The iris reduces the diameter of the lens by narrowing the opening that light can travel through. This new opening is called an Aperture, and has a new diameter smaller than the lens diameter.

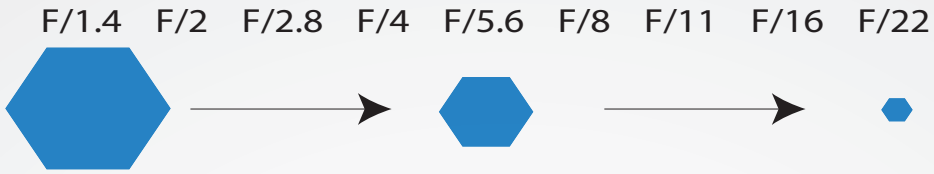




So, the Iris is the mechanical device that opens and closes, increasing or decreasing the Aperture, which is the actual opening. The steps of that increase or decrease are measured in F-Stops, for example F/2.0 or F/2 or f/2. They are named that way because with each step down, the light is being "stopped" from going through the lens.

The iris diaphragm can have many more facets, unlike a hexagon.

Few video lenses can open wider than F/1.4, which is a very wide aperture. Also few lenses can close tighter than F/22, which is a very narrow opening. The chart of F/stops is as follows:



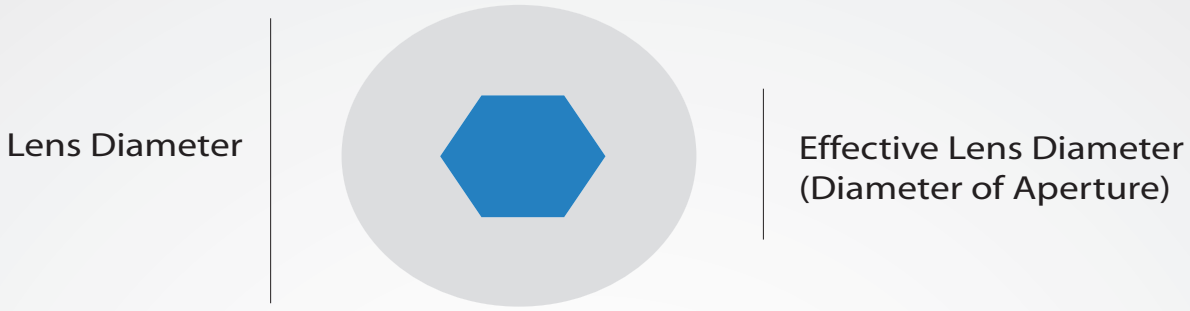
The most important fact to remember, is that with each F/stop down, the amount of light travelling through the lens is being Halved. Conversely, with each F/stop up, the amount of light is being Doubled. Thus, an iris set to F/2.8 is allowing 4x less light to pass through than when it is set to F/1.4. The aperture is decreasing by 4x.

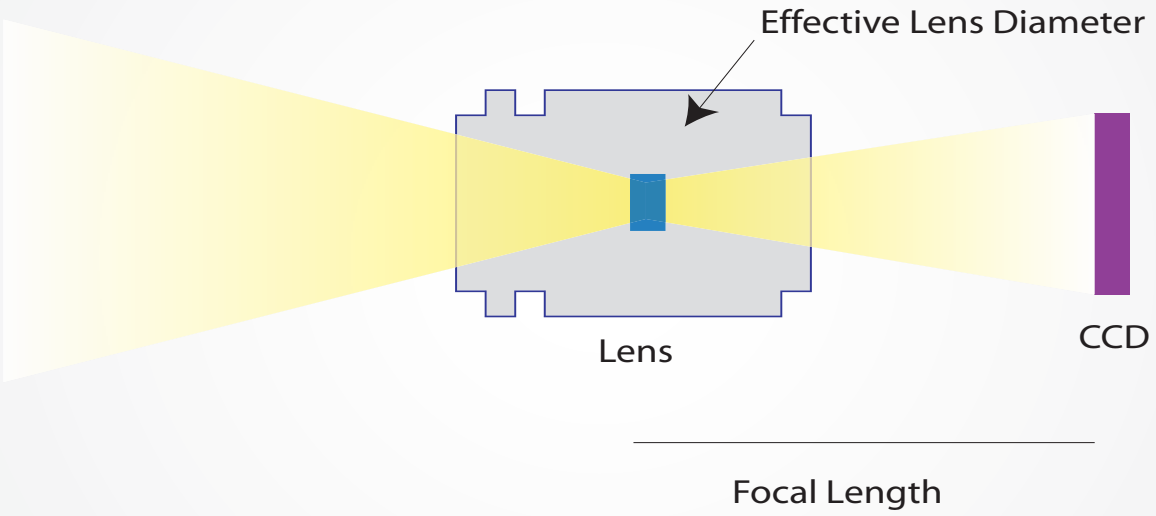
F/1.4 F/2 F/2.8 F/4 F/5.6 F/8 F/11 F/16 F/22

2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2

Here are some more examples:
F/1.4 is 2 x 2 x 2 = 8 times more bright than F/4
F/4 is 2 times less bright than F/2.8
F/22 is 2 x 2 x 2 x 2 = 16 times less bright than F/5.6

This aperture directly affects the diameter of the lens as calculated in the earlier focal length equation. The new diameter of the aperture is now referred to as the Effective Diameter of the lens at that F/Stop. Thus, Lens A will have an Effective Diameter of 1 inch at F/2.8. This ofcourse varies from lens to lens and for different manufacturers.





The same equation comes back into play, and the F/stop can be found when the Effective Diameter and the Focal Length are known.

$$\frac{\text{Focal Length}}{\text{Effective Lens Diameter}} = \text{F/Stop}$$

So, if the Focal length is known to be 4 inches, and the Effective Diameter created by the Iris is known to be 1/2, then 4 divided by 1/2 is F/8. This may sound complex, but it becomes more clear when it practiced again and again. The importance of this equation will become obvious when D.O.F is discussed.

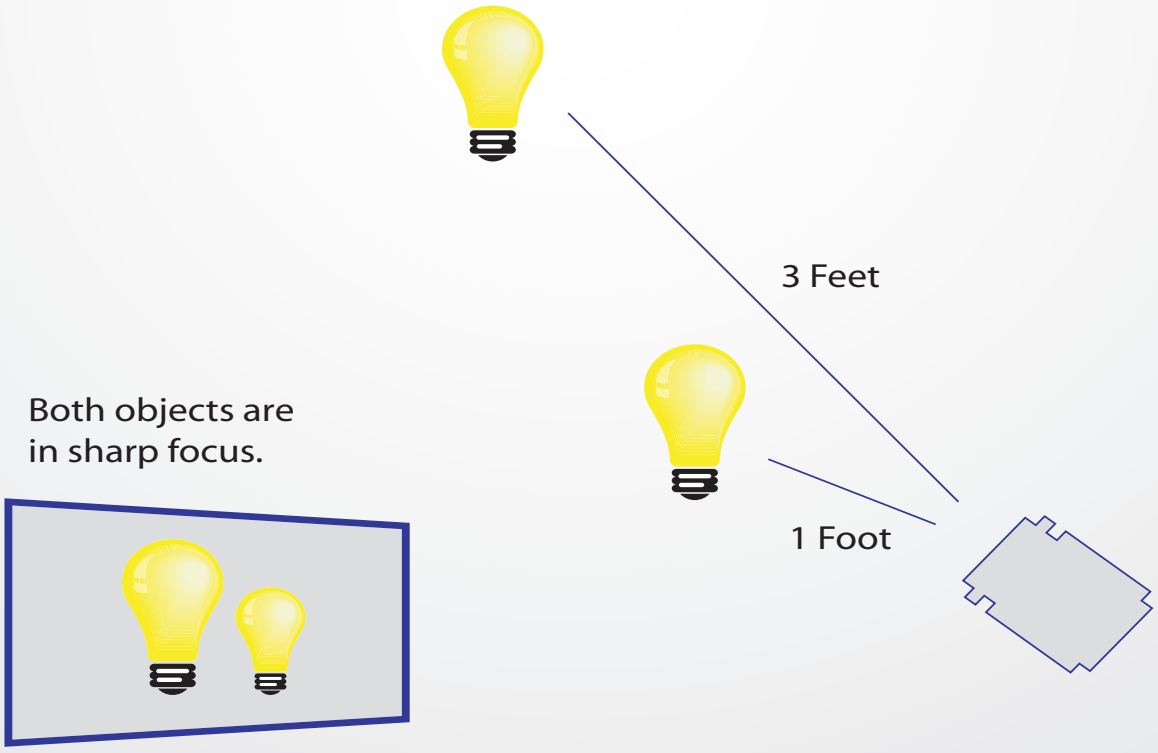
The iris diaphragm can have many more facets, unlike a hexagon.

Depth of FIeld (D.O.F) is one of the most important concepts in filmmaking. The reason is very obvious when you hold out your hand in front of face, and this book 3 feet away, then attempt to keep both of them in focus. It is impossible. You can either focus on your hand, or on the book 3 feet away.

The camera has the same hindrance, but it is able to some extent, to see things in focus together that the human eye cannot. Therefore, the camera can capture images that are not possible for a person to ever see in real life, unless that person is watching a movie or looking at a photograph. This is due to D.O.F, which can allow the camera to see an object 1 foot away and another object 3 feet away in perfect focus, if certain conditions are present.

This is the same principle that allows the concept of "Forced Perspective", when an object farther away than another appears smaller rather than farther away.

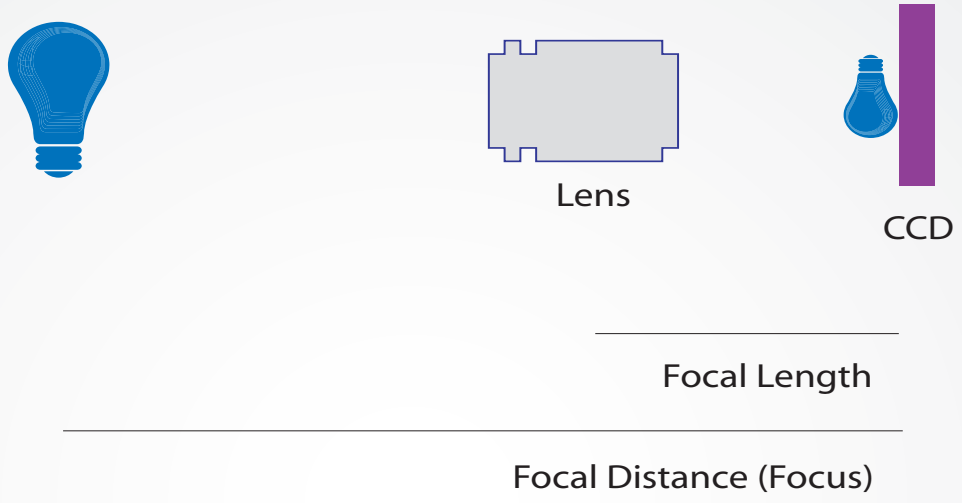
It is also the same principle that allows an actor to walk around a set, varying his distance to the camera by 4 feet or more, and still remain in focus with no adjustment by the Focus Puller.



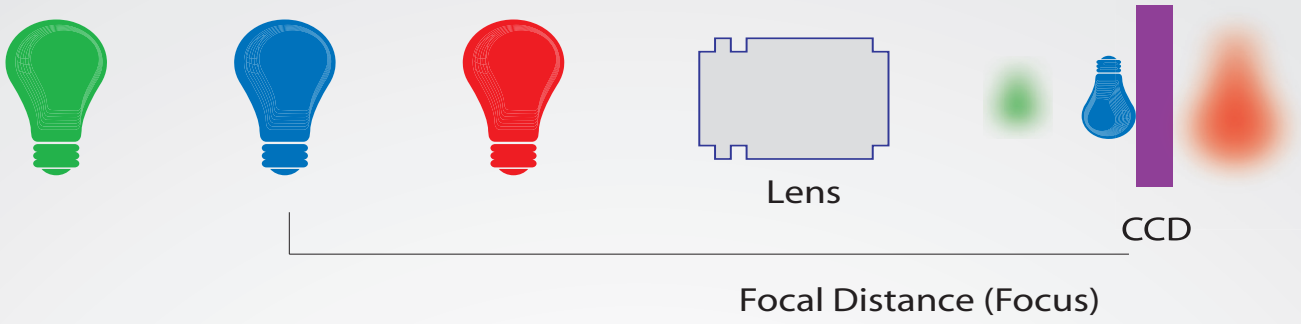
Both objects are in sharp focus.

But the size differs, the object farthest away is smaller than the one closer.

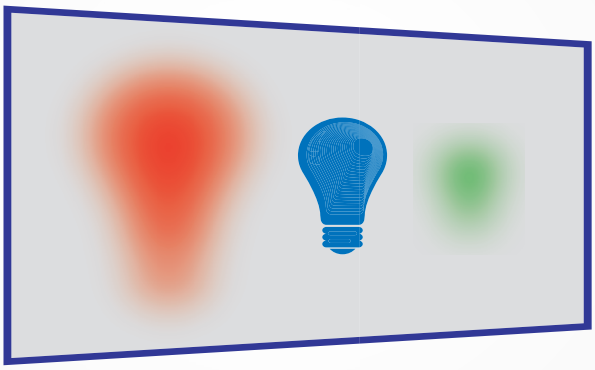
Before discussing D.OF, focal distance should be discussed. Focal Distance, otherwise referred to as Focus, is the distance between the subject and the film plane (CCD). That is the number that is inscribed in some lenses, and also the number that shows up in the camera's viewfinder or LCD, specifying that the subject is a certain distance from the camera. When a tape meaure reading is taken to backup the Camera Operator's judgement of focus, it is always taken to the film plane.



Focus is incorrectly interpreted as the distance from the lens's front element to the subject. It is actually the distance to the CCD. Refer to your camera manufacturer's manual to locate the CCD position on the body of the camera.



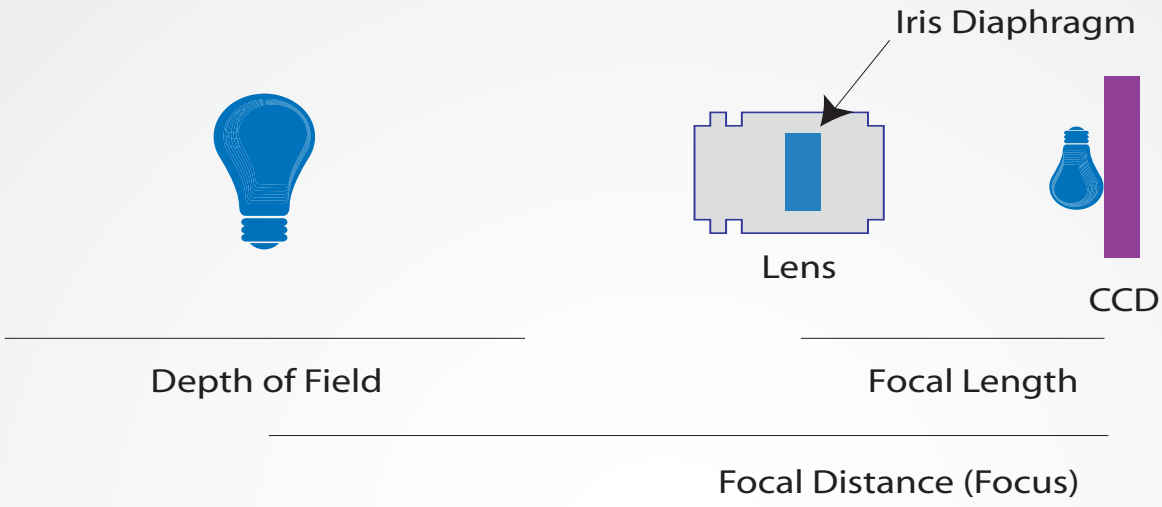
The camera's Focal Distance is set to bring the blue bulb into focus. Thus, only the blue bulb is in focus at the CCD plane. The other bulbs, red and green, are not in focus because they are not at the CCD plane. They are in front of and behind the CCD plane.

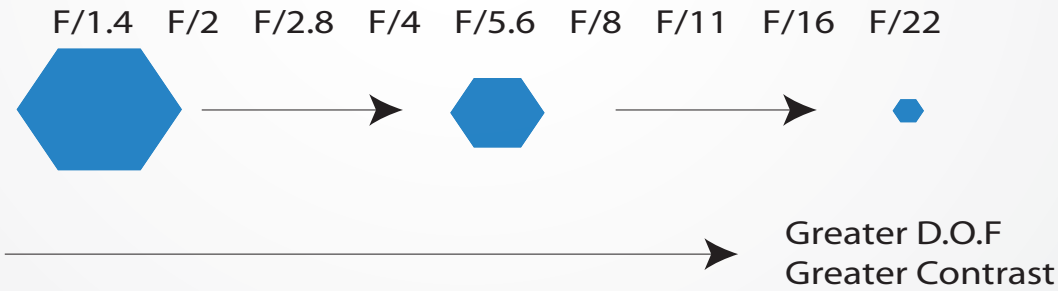


Imagine that only the filament inside the bulb can be seen. The filament of the blue bulb creates a point that is in focus at the CCD plane. The filaments of the red and green bulbs are not at the CCD plane, but behind and ahead, and therefore appear as circles (out of focus). These are referred to as Circles of Confusion. Circles smaller than 1/1000th of an inch (the filament of the blue bulb) appear to our eyes as a point, therefore, in focus. Circles larger than that appear out of focus. The more out of focus the filament is, the larger the circle of confusion. Thus the closer the red bulb gets to the camera, the larger and more out of focus it will be.

This relationship between the different sized circles of confusion is measured by the Depth of Field. Varying the Depth of Field variables can affect the depth of field and the sizes of the circles of confusion.

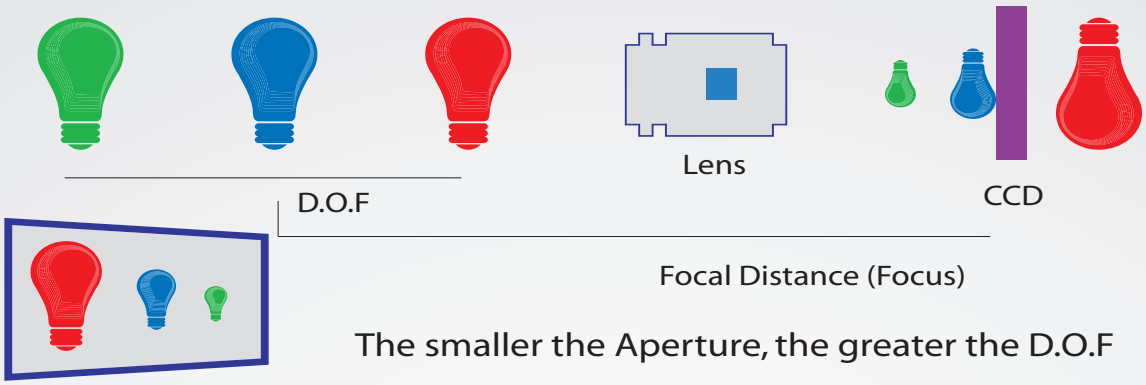
Now, the concepts learned about Aperture, F-stop, Focal Length, and Focal Distance will all come into play. The larger the Aperture, which is the opening created by the Iris Diaphragm, the smaller the depth of field. The smaller the aperture, the larger the depth of field. This is because smaller openings constrict and bend light in such a manner as the circles of confusion get smaller. So the smaller the aperture (higher F/stop) the greater the depth of field.





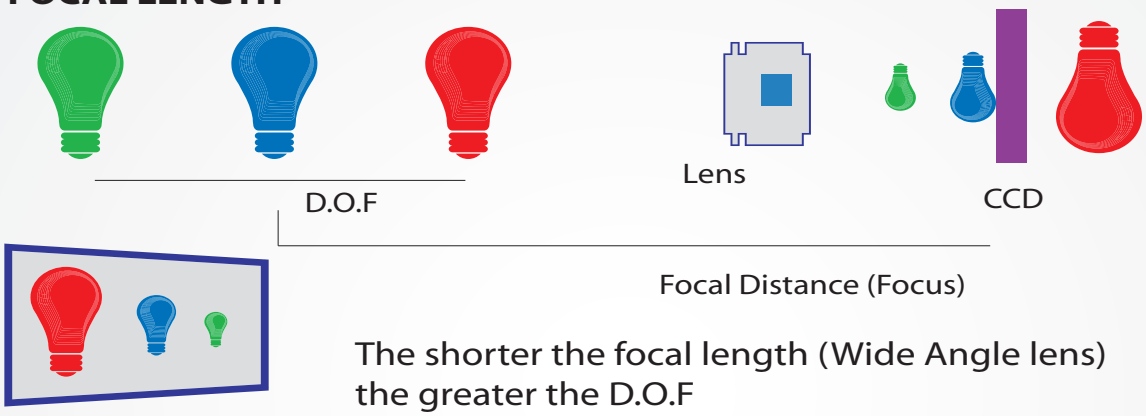
Also, the more objects in the frame appear in focus, the sharper the image. So, smaller apertures can make the image appear to have higher contrast, independent of the relationship of shadows, highlights, and midtones usually controlling image contrast.

APERTURE



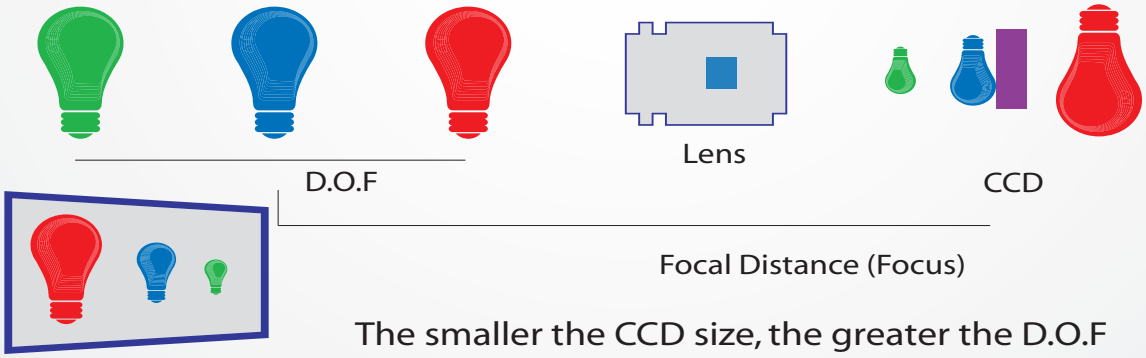
The smaller the Aperture, the greater the D.O.F

FOCAL LENGTH



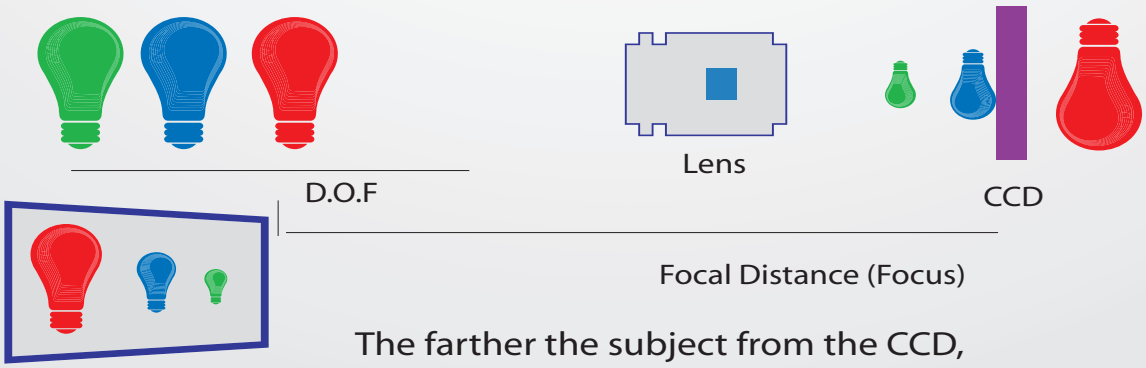
The shorter the focal length (Wide Angle lens) the greater the D.O.F

CCD SIZE



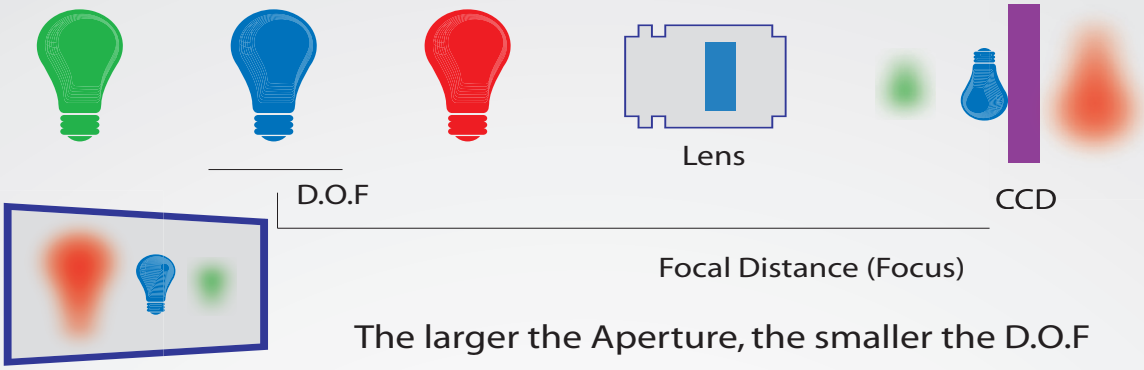
The smaller the CCD size, the greater the D.O.F

DISTANCE



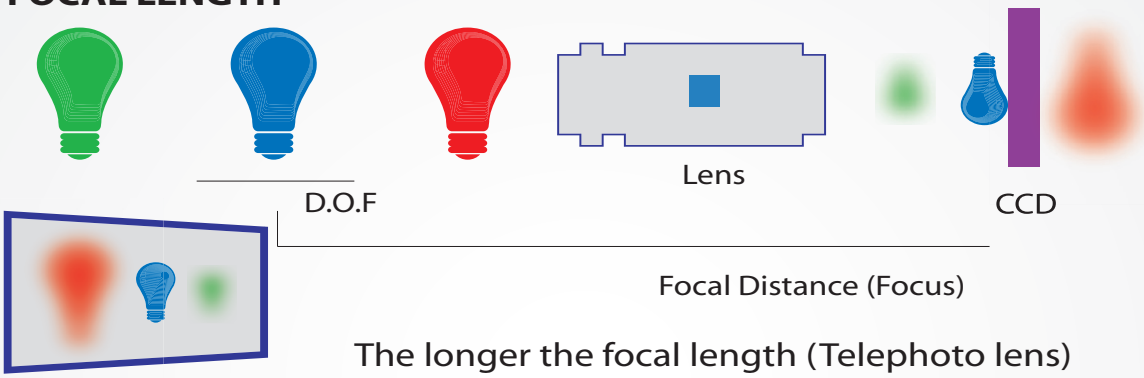
The farther the subject from the CCD, the greater the D.O.F

APERTURE



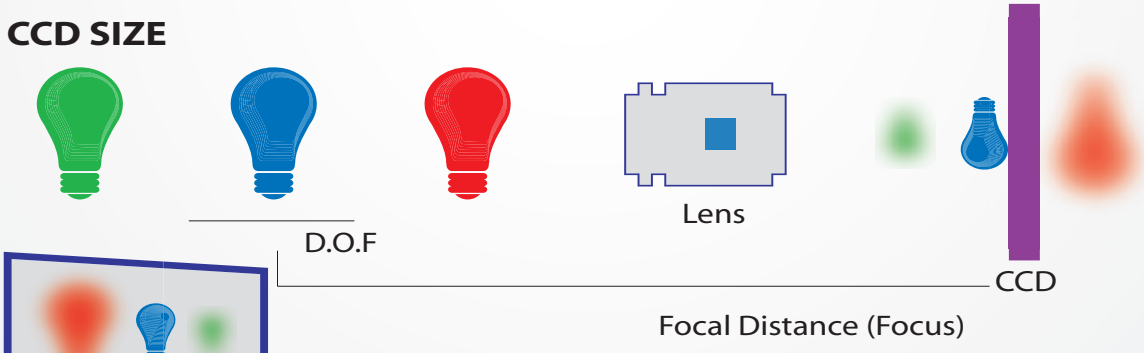
The larger the Aperture, the smaller the D.O.F

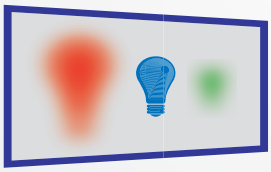
FOCAL LENGTH



The longer the focal length (Telephoto lens) the smaller the D.O.F

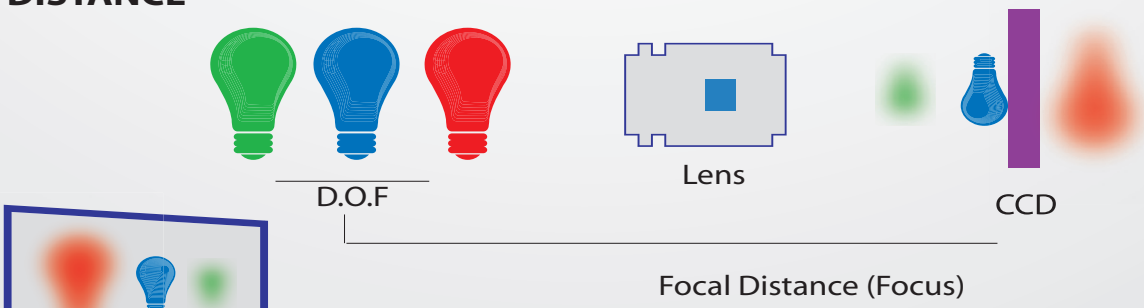
CCD SIZE

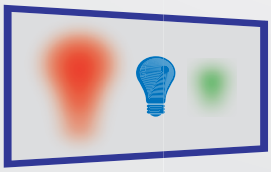




The larger the CCD size, the smaller the D.O.F

DISTANCE





The closer the subject to the CCD, the smaller the D.O.F

As digital filmmakers engaged in the art of filmmaking, we are generally presented with progressively smaller HD cameras with smaller CCD's that can film images sometimes rivalling those produced by larger more expensive SD cameras. There is a tradeoff, and understanding the benefits of smaller cameras and smaller CCDs, but the advantages of larger cameras with larger CCD's, allows us to make the most use of either.

The larger CCDs gather more light and promote less D.O.F. News camera operators would have rather had greater D.O.F, so that in uncontrolled situations, they can concentrate more on composition than focus.

Filmmakers using smaller digital camcorders would rather have the larger CCD's that gather more light and decrease depth of field, since they are eternally engaged in trying to separate the subject from the background and the foreground. A viewer may sit and stare at a photograph for 15 minutes, admiring every facet and detail. However, viewers rarely see a motion picture image longer than a few seconds. Therefore, isolating the subject becomes essential, so that the viewer is not distracted by other elements.

Isolating the subject can be done in many ways. Composition, lighting, wardrobe, color, motion, and shapes in the background. The scope of this section is depth of field. Thus, D.O.F can be used to isolate the subject by all the procedures outlined on page 34. In cameras with small CCD's, it is important to increase the focal length (zoom in), open the aperture (use a small F/stop), and decrease the distance to the subject (move in closer). When all these rules are followed, the background and foreground can be "thrown out of focus". In contrast, if you want to film a chair in the foreground, and make it seem larger than the piano in the background, reverse the procedure, and use the procedures outlined on page 33.

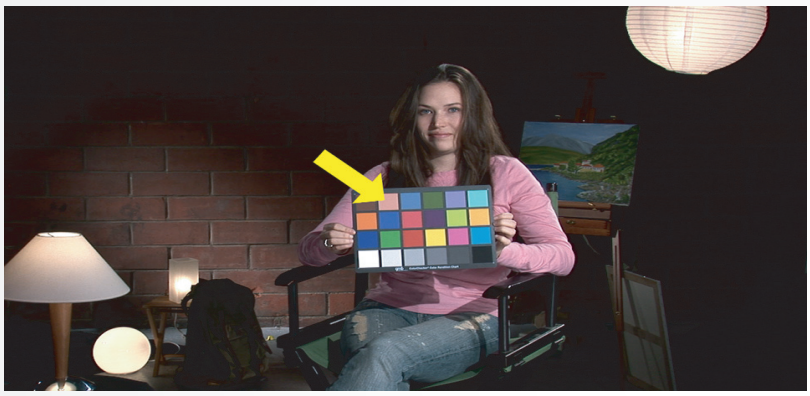
Also, check your camera's handbook for its Hyperfocal Distance. If you focus on a point, everything from half the Hyperfocal distance to infinity will be in focus.

This distance varies depending on F/stop and Focal Length. On vari-focal lenses (zoom lenses) this can be difficult to measure. However, if your camera has barrel markings for Focal Length, and the camera can be set to certain F/stops, and the manufacturer has provided a Hyperfocal chart, then you can make great use of it. You will know for a fact, that focusing at this point will render everything behind and halfway to it in perfect focus.

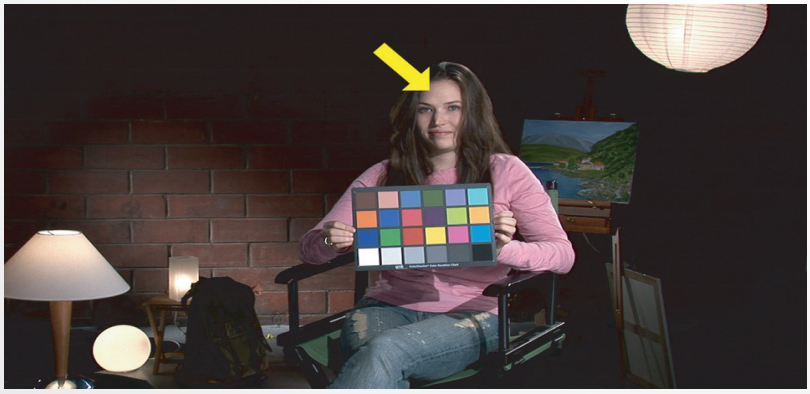
GRETAG MACBETH COLOR CHECKER ™

The Gretag Macbeth Color Checker Color Rendition Chart is a crucial device used to record the "true" colors of any scene regardless of the viewing medium that a camera operator uses to determine color in the field. It is a necessary reference when trying to adjust skin tones and other hues in post production. Even if an appropriate white balance is taken and the viewing monitor has been calibrated, errors can occur in the camera's or the eye's judgement of color and contrast.

The Macbeth chart takes the guesswork out of the equation. After the footage is digitized in the the Post Production Edit Suite, the chart can serve as a faithful sample of what colors "ought" to look like. It can be used to restore skin tones to a healthy hue, by sampling the closest corressponding hue in the chart, and measuring how far off the mark it is.



The Macbeth chart has colors that mimic those found in human skin and as well in nature.



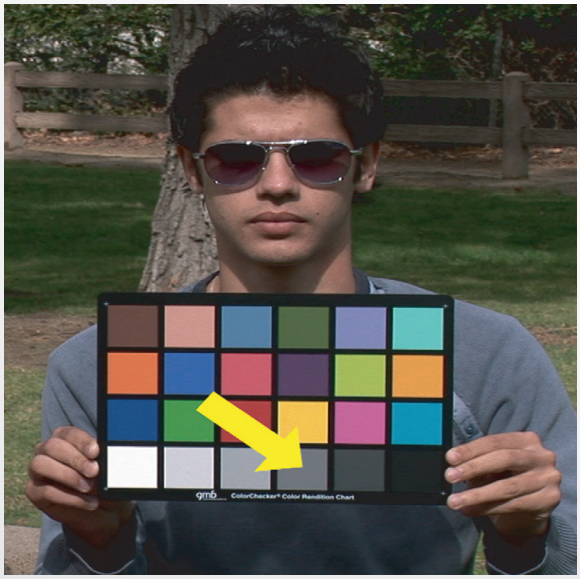
As an example, the Light Skin chip should read R=194, G=150, B=130 as measured in any nonlinear system which has an RGB Eyedropper function. These numbers are located in the Color Checker's user guide. Just about every professional video system has an eyedropper function, and even if it doesn't, a still capture of the video frame can be exported to a Photo editing software, where it can also be measured. When the eyedropper is placed over that chip, and it does not read those values, but instead, R=185, G=150, B=130 then the editor will know to boost the Reds to compensate for some error in the camera's judgement of color, or an error in makeup selection.

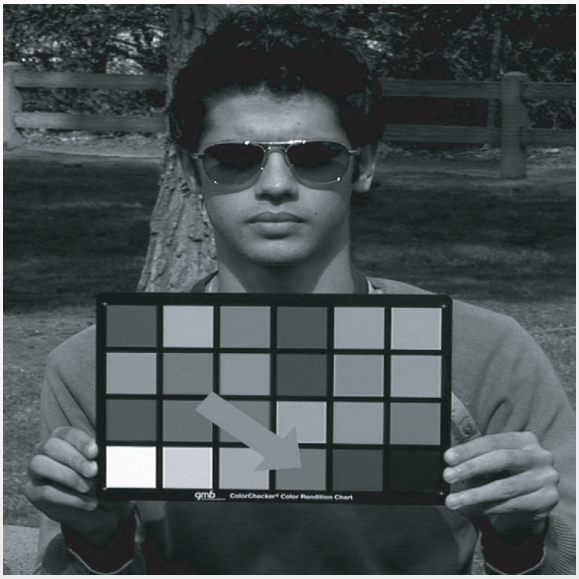
Remember not to touch the chips or expose the chart to light for prolonged periods of time. Also, the chart has an expiration date to guarantee the best performance.

Another function of the chart is the presence of a chip strip with White, Black, and 4 shades of Gray. A Spot Meter reading can be taken from the Middle Gray (18% Gray) Chip, third down from the right, to set a proper exposure. This mimics the function of the 18% Gray Card, allbeit in chip-size. You cannot fill the frame with it to take a TTL Camera Meter measurement, but it is large enough for a spot meter reading. Also, you will know for a fact in Post that the chip measures R=122, G=122, B=121 when read with the RGB eyedropper. You will also have RGB readings for Black and white levels, and can adjust phase using the Green and Magenta chips.

White (R=243, G=243, B=242)

Black (R=52, G=52, B=52)





In outdoor situations, the Color Checker can not only be used to reference the sometimes elusive tone of foliage, but also as a means of judging exposure using the 18% Gray chip.

MONITOR CALIBRATION

Monitor Calibration is a critical element of producing an image that is truly what the filmmaker imagined. The professional poduction monitor, be it a CRT (Cathode Ray Tube - TV type) or LCD (Liquid Crystal Display) is not simply a method of judging the composition in a format that is comfortable to the eyes. It also serves to present the image in a manner that is closer to what the home audience will see.

By far, the most important function it can serve, is to help the filmmaker control the color, contrast, and lighting of the set. True, Spot meters and Incident meters can ensure that the exposure is correct, and can check for SBR (Scene Brightness Ratio). Also, taking a proper White Balance reading and using the Gretag Macbeth Color Checker can ensure that the distribution of colors in the image is correct.

The difficulty arises when the wardrobe department brings in a shirt and asks the Director, "Is this the color that you wanted?" The director looks at the shirt, which appears blue to his or her eyes, and says, "Yes this looks good." The actor dons the shirt, gets into the set, and the crew films the scene. Later on in Post, while digitizing the footage in a balanced, calibrated environment, the scene with the culprit shirt is viewed. The Director looks at the monitor and says, "Hey, wait a second, that shirt wasn't purple when we filmed it!" The scene now has less impact since there is no harmony between the color of the wardrobe and the background.

Clothing and many other materials have pigments that when viewed under one color of light appear different when viewed under another. For instance, the Daylight conditions under which the director viewed the shirt differ from the Tungsten conditions under which the shirt was filmed. The pigment may have reacted differently. The director may have been staring at a white page, and with closed pupils, immediately looked at the shirt, making it seem darker than it really was. It could also be the level of contrast on the set differing from the viewing conditions outside. It could also be the direction of the key light or its quality (hard or soft). Also, the D.P. may have been using a color filter that the director was not aware of.

The important deduction from this example is that the only way to make critical daily decisions about wardrobe, lighting, and set decor, is to view the image through the camera with the correct lighting on a calibrated monitor.

This section will explain how to calibrate a professional monitor based on standard professional picture adjustments. These picture settings are important to knowing that what you see on the screen is truly what you are recording to tape or media.

To begin, it is important to note that the monitor should be connected to the camera using the highest quality shielded cables. A digital camcorder and a digital monitor should be connected using digital means if possible. This ensures that the camera is simply outputting ones and zeroes, digital information, and not entering the Analog realm.

If no such connection (like SDI) is possible, the next best option is Component Analog RGB or YPbPr. This cable has three components, Red, Green, and Blue cables. Each cable transmits its share of luminance (sum of the linear RGB components proportional to intensity) and chrominance (frequency and saturation) value for that color. This creates the highest quality analog color space possible for viewing.

The next best connection is SVHS or S-Video, also known as Y/C. It is also a component connection but instead of separating the values of each color, it simply separates Chrominance from Luminance. The last and least desirable connection is Composite video. This connection joins both Chrominance and Luminance for all colors into one cable, producing a reasonable image.

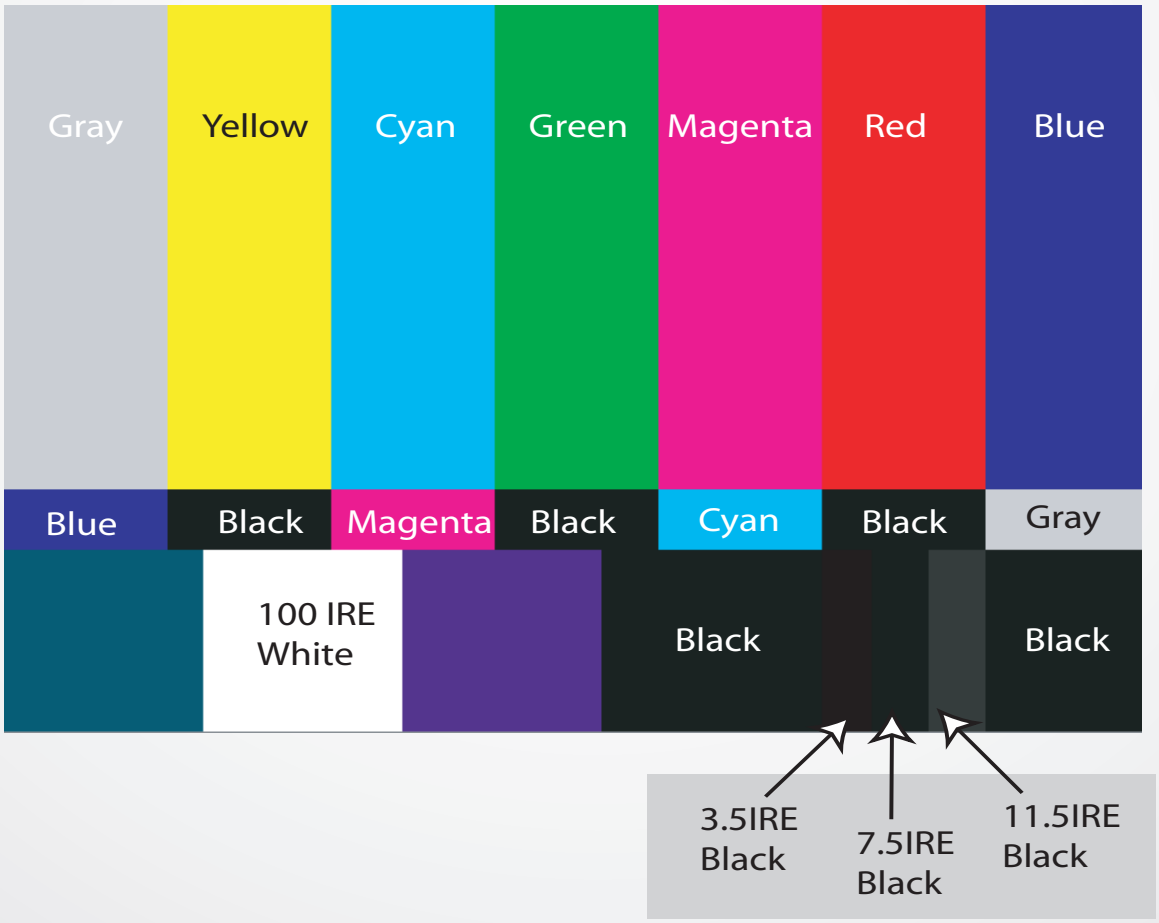
After connecting the camera to the monitor, the BARS button is depressed on the camera's body. The location of this button should be in the camera's user manual. Sometimes, it is assignable as a function or user button. Next the monitor is placed in an area that is shielded from any direct light, which will fool the eye.

From this point, the calibration procedure begins.

MONITOR CALIBRATION

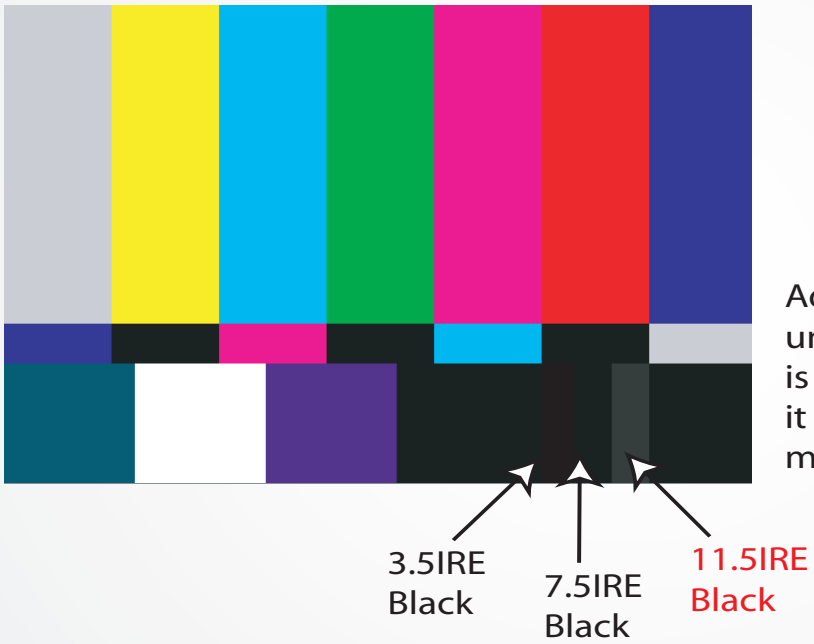
The following step by step calibration is a proven technique, time honored, and applicable for professional CRT and LCD monitors (and Viewfinders) with the Phase, Chroma, Brightness, and Contrast dials. It helps if the monitor has a Blue-Check (Blue Gun, Screens Check) button, but if it does not, just hold a Full CTB (Color Temperature Blue) gel to your eyes when you calibrate the color section. Make sure the monitor is in a shaded area, with no direct light falling on the screen, and that it has been operating for at least a few minutes.

Make sure to record 30 seconds of Color Bars at the head of the first tape of the day, from each camera. That will allow the editor to calibrate the video signal when digitizing the footage. It also occupies the portion of the tape that usually gets stretched during rewinding and fast forwarding, and ensures that no critical data gets recorded there. If you are using nonlinear recording media, get at least 10 seconds of bars for reference.



This set of 3 bars is known as the PLUGE, or Picture Line-Up Generation Equipment. It is used to calibrate the Brightness

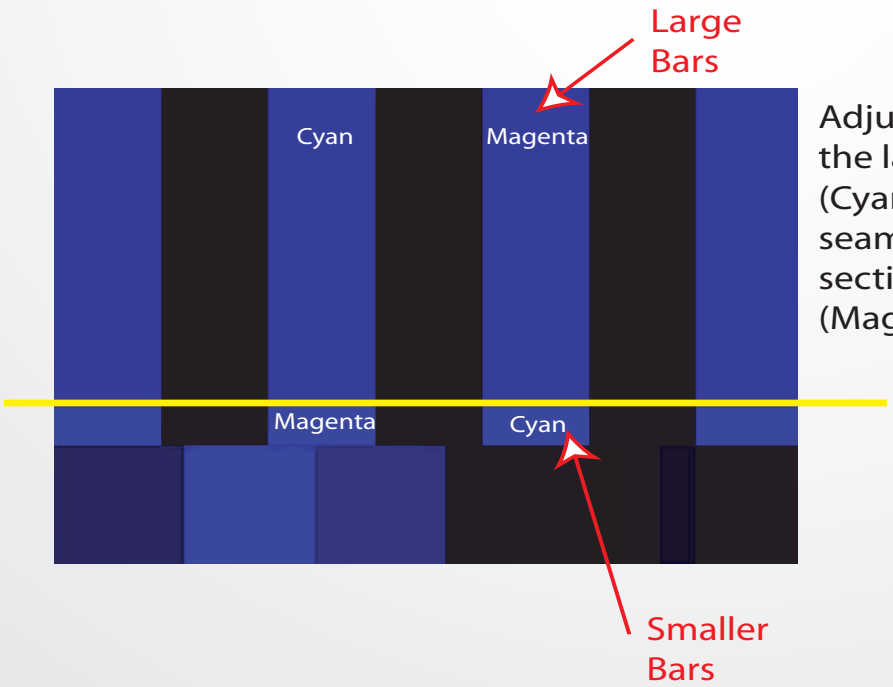
Turn the Contrast dial down to a medium viewing level, usually where the knob clicks.



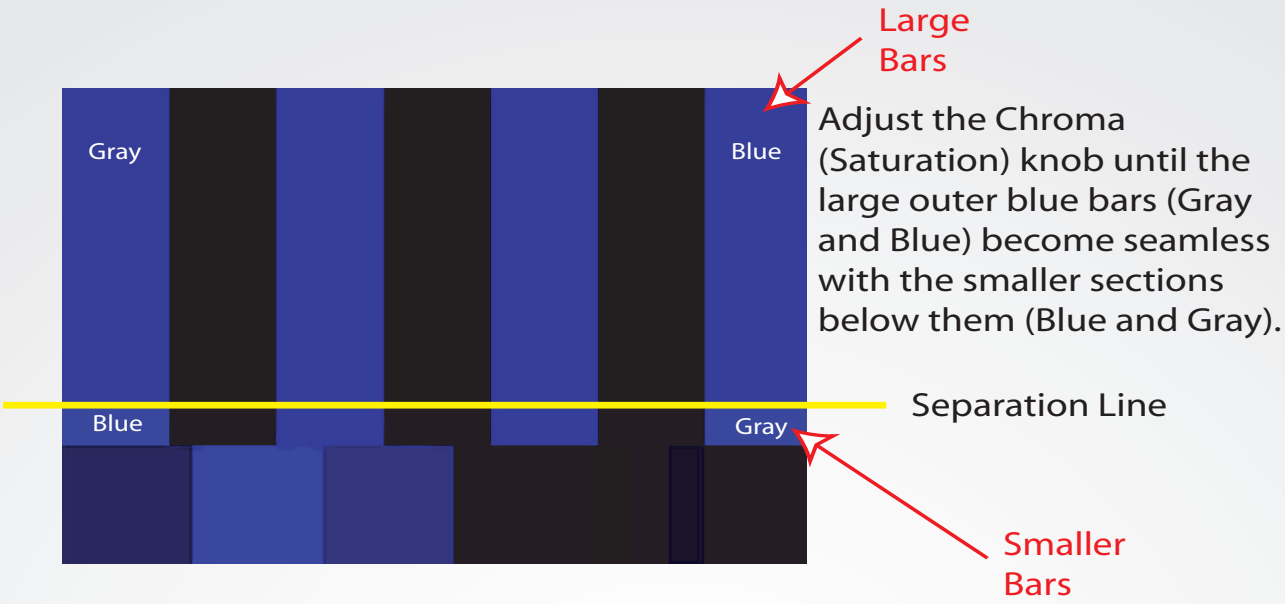
Adjust the Brightness knob until the 11.5IRE PLUGE bar is barely visible. This is why it is important to shade the monitor during calibration..

Turn up the Contrast all the way.. Then, adjust it down until the 100IRE White section does not blow out, or bleed into the surrounding sections. If that is too high, you can adjust it down to your comfort level. It will not affect your perception of Brightness of the scene.

Once more, here are the positions of all the colors. Now, select the Blue Only, Blue Check, or Screens Check switch. In case of a lack of such controls, hold up a full CTB gel in front of your eyes.



Adjust the Phase knob until the large inner blue bars (Cyan and Magenta) become seamless with the smaller sections below them (Magenta and Cyan).



Adjust the Chroma (Saturation) knob until the large outer blue bars (Gray and Blue) become seamless with the smaller sections below them (Blue and Gray).

The Inner bars may now fall out of seamless integration with the smaller sections below them. Adjust the Phase Knob one last time to fine tune the settings, and ensure that all 4 large bars are seamless with the 4 smaller sections below.

Once you have made all the color adjustments, deselct the Blue-Check button or switch, and you will see a well calibrated monitor. As a note, anytime you move your monitor or connect it to another camera, you should redo the procedure.

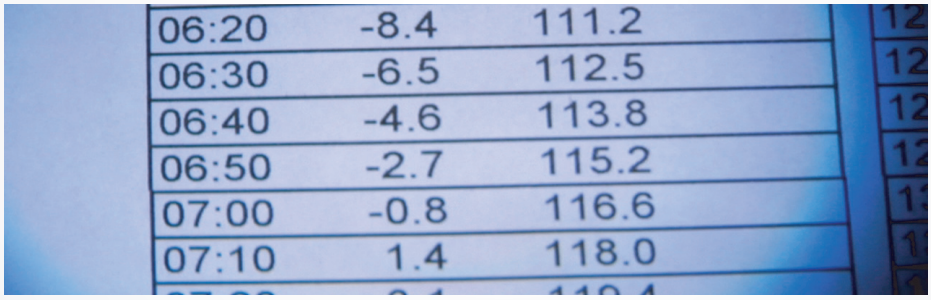
Some monitors may have internal issues that can't be fixed with a field calibration. If after this procedure, the colors still don't appear normal, you may want to have the monitor serviced.

SUNRISE AND SUNSET

Calculating and predicting the Altitude and Azimuth of the Sun at an point in the day can be essential to getting creative shots. Knowing when the sun is going to shine through a certain window in a house, and how long it will be there, can make scheduling easier. Instead of planning to be at a location an entire day to film one shot, the crew can be there for the hour before (setup), during (filming), and after (teardown) the sun passes through that zone.

Knowing when and where the sun will peek over the mountain at sunrise, and exactly where to set up the dolly tracks for a great sunset shot can take a shot from good to great.

Such freedom can be enabled by one of two methods: Software that calculates the exact sun path and direction anywhere in the world, compensating for magnetic declination; Or, downloading a text file from the internet that lists the Altitude and Azimuth of the sun every few minutes, and making your own calculations. If you can afford the software, by all means, purchase it, since it is a time saver. Here is the method to use the downloaded text file to derive the same information.



06:20	-8.4	111.2
06:30	-6.5	112.5
06:40	-4.6	113.8
06:50	-2.7	115.2
07:00	-0.8	116.6
07:10	1.4	118.0

Download the data regarding Sun Azimuth and Altitude for the filming area (usually by zipcode). The first row of numbers is the T.O.D (Time of Day) in 2400HRS format. The next line is the Altitude of the sun under or over the horizon line. A Negative number means that the sun is still under the horizon, and a positive one means that it has risen over. The third line is the Azimuth (Direction) in degrees.

The Azimuth data corresponds to the compass reading at the filming area. For example, at 0710 hrs., the sun will be 1.4 degrees above the horizon line, and at 118.0 degrees due South East.

If extreme precision is required in the reading, obtain a map marked by the U.S. Geological Survey (USGS) or download data from the National Geophysical Data Center, to find out the Magnetic Declination for the area.

This gives an adjustment to the compass reading, allowing the differentiation between Magnetic North (compass) and True North. Once that adjustment is figured into the reading, a true Azimuth reading can be obtained.

The adjustment is usually a few degrees west or east, depending on the area. An adjustment 8 degrees East means adding 8 to the compass reading. 6 degrees west, or -6 degrees, means deducting 6 degrees from the reading.

SUNRISE AND SUNSET

If the script requires shooting into the sunrise, using the sky as a background, shoot right before the sunrise. As soon as the sun rises, the contrast across the sky may be too great for the camera's DSP (Digital Signal Processing Circuitry) to handle. Digital movie cameras can have anywhere from 5-9 or more stops of latitude, but the sunrise may have more than that. However it may serve artistically. Also, the greater the intensity of the light, the more intense the fill light has to be to allow the subject's features to be seen.

The best solution is to shoot several takes, one before sunrise, and one after, then see which best fits the movie. To understand how the light is behaving across the sky, take a Spot meter reading from several points across the sky. When the contrast (relationship between highlight and shadow) across the sky reaches one that can be best filmed by the camera, roll it.

DO NOT take a spot meter reading from the sun. Eye damage may occur. Instead hold a sheet of paper behind the Spot Meter's ocular, and aim the meter until you see a bright spot emerging on the paper. Take a reading. Or, hold several sheets of full ND gel in front of the meter, take the reading, then add stops to your measurement based on how many sheet were in front of the meter. Bear in mind, that ND gel may not hinder UV rays going through the meter. Those are the harmful rays that will damage the eye. Proceed at your own risk. Using the camera is much safer, since an LCD is buffering the intensity of the sun. However, be sure to also protect the camera's lens by using ND filters in front of the lens.

If the script requires light from the rising sun to fall on the subject and provide Key illumination, take an incident reading at the subject's position, with the ball extended and facing the camera. Once the light has reached the sufficient level, shoot the scene.

Computing Altitude and Azimuth allows the scene to be set up precisely before the sun rises, so that when it does, the camera can roll.

Altitude and Azimuth of the Sun
Pacific Standard Time

h m	Altitude o	Azimuth (E of N) o	h m	Altitude o	Azimuth (E of N) o
06:10	-10.3	109.9	12:10	33.6	182.7
06:20	-8.4	111.2	12:20	33.5	185.5
06:30	-6.5	112.5	12:30	33.2	188.3
06:40	-4.6	113.8	12:40	32.9	191.0
06:50	-2.7	115.2	12:50	32.4	193.7
07:00	-0.8	116.6	13:00	31.9	196.3
07:10	1.4	118.0	13:10	31.3	199.0
07:20	3.1	119.4	13:20	30.6	201.5
07:30	4.8	120.9	13:30	29.8	204.0
07:40	6.5	122.4	13:40	28.9	206.5
07:50	8.2	123.9	13:50	27.9	208.9
08:00	9.9	125.5	14:00	26.9	211.2
08:10	11.6	127.2	14:10	25.8	213.5
08:20	13.2	128.8	14:20	24.6	215.7
08:30	14.8	130.6	14:30	23.4	217.8
08:40	16.3	132.3	14:40	22.1	219.9
08:50	17.8	134.2	14:50	20.7	221.9
09:00	19.3	136.1	15:00	19.3	223.9
09:10	20.7	138.0	15:10	17.9	225.8
09:20	22.0	140.0	15:20	16.4	227.6
09:30	23.3	142.1	15:30	14.8	229.4
09:40	24.6	144.3	15:40	13.3	231.1
09:50	25.7	146.5	15:50	11.6	232.8
10:00	26.8	148.7	16:00	10.0	234.5
10:10	27.9	151.0	16:10	8.3	236.1
10:20	28.8	153.4	16:20	6.6	237.6
10:30	29.7	155.9	16:30	4.9	239.1
10:40	30.5	158.4	16:40	3.2	240.6
10:50	31.2	161.0	16:50	1.5	242.0
11:00	31.9	163.6	17:00	-0.7	243.4
11:10	32.4	166.2	17:10	-2.6	244.8
11:20	32.9	168.9	17:20	-4.5	246.2
11:30	33.2	171.7	17:30	-6.4	247.5
11:40	33.5	174.4	17:40	-8.3	248.8
11:50	33.6	177.2	17:50	-10.2	250.1
12:00	33.7	180.0			

This is the complete chart for the day of filming, allowing the compass and clinometer readings for the entire day.

A quick internet search will reveal many photos and types of Clinometers and compasses. They may be purchased for under $100 for both or $400 each, depending on make and model. Some are digital with memory functions, and some are ornate brass with a classic feel.

If an altitude and azimuth reading is required during the day, for example to check when the sun will peek through a window, a Clinometer is required. It is a device that measures tilt of the sun (or any other object) in degrees with respect to gravity. The altitude data is taken and set into the clinometer. The device is then aimed at the sky, with the correct compass data. This will reveal the position of the sun at that azimuth for that T.O.D. This can be done from inside the room, to reveal where the light from the sun will strike, allowing the crew to move furniture with plenty of time to spare.

Depending on the season and longitude of the location, climate, and the size of the window, the sun may only peek through for a few moments. That is why precision is required, and preparation is tantamount. The subject must be rehearsed, and the background set, so that the moment is seized. That separates great filmmaking from good, and makes memorable scenes.

SCENE BRIGHTNESS RATIO (SBR)

Scene Brightness Ratio (SBR) is a function of the relationship between Highlights and Shadows in the scene. When one looks at a dark scene it may seem to have a proper light level, because the human eye adapts very well to darkness. The body does so by increasing rhodopsin in the retina, especially when the set is darkened and has been so all day. That is one of reasons that the eye cannot be trusted for judgement on contrast. Fatigue can also compromise judgement on a long production day. That is why Cinematographers carry around contrast monoculars, that quickly darken the set's lights for a few seconds so that they can take a mental note of the lighting. Another method is by performing contrast incident readings for each light. A quick look at a calibrated monitor can also fill in the gap.

However, there is no method as accurate as calculating the SBR. As long as the meter has been fed the correct ISO of the camera, and the shutter speed or frame rate programmed in, the F/stop reading from the spot meter can give a detailed blueprint of the set.

The first step is to make sure that the subject is in the correct stance and position. The instruments have been warmed up, especially HMI lights. There is no stray light falling on the set.

Ensure that all the lights are wamed up.

Readings are only examples, and may not reflect actual conditions.

F/4

F/22

The next step is to take a reading from the brightest highlight on the set that detail should be preserved in. That is a very important note. There will be brighter highlights, for example, in the background window, but they are not as critical as the white shirt that the subject is wearing.

Then, take a reading from the darkest shadow on the set that detail should be preserved in. Again, there will be darker shadows in image, for example from dark shoes or the black shelf, but they are not as critical as the shadows present on the subject's hair or face.

Either write down both numbers or commit them to memory. Use the F/stop chart below to figure out how many stops are between the Brightest Critical Highlight and the Darkest Critical Shadow.

F/1.4 F/2 F/2.8 F/4 F/5.6 F/8 F/11 F/16 F/22

2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2

The F/stop in the middle of that range is the Exposure, which in this case happens to be a half stop, F/8 1/2 (F 8 and a half). Examining the data, it can be deduced that the scene requires at least 6 stops of latitude to retain faithful detail from critical highlight to critical shadow. If the camera that is being used can retain that latitude, then the scene is ready to roll. If it can only retain a 5 stop latitude or less, the Fill light needs to be increased in intensity until the shadows read as F/5.6, or the Key Light needs to be decreased in intensity until the highlights read F/16.

Most professional HD cameras can process image latitudes higher than 5 stops, but in some cases the compression format may not support that latitude. Check with the manufacturer, or perform a test, and record a sample. Then, examine the footage on a calibrated monitor, and check whether the recording has been faithful to the original scene's latitude. Is there contour in the white shirt, or is it pure white? And the shadows in the hair; Do they present detail in the hair strands or are they a black blob?

Motion picture film can retain 10-12 stops or more. SD video cameras can usually retain 5-6 stops. Some DV cameras with intelligent DSP can retain 7 stops. Professional HD cameras can shoot 8-10 stops. But human vision trumps them all at 17 stops. That is why it is necessary to light the set and take SBR readings, to more closely approximate human vision, and match what the eye would see if life, compensating for the camera's processing ability.

That being said, many movies have been created with high contrast scenes that defy logical metering, with blaring windows and deep dark shadows. There is no limit set on creativity. The principles in this series are only there to serve as a guideline. They help inform the filmmaker just how far the rules are being broken. Then, educated decisions can be made on just how much to stray from the path. As filmmakers, it is our job to stray and find new ways to look at life. These rules are no different. They were meant to be broken.

After the scene's data has been taken, the background lights can be adjusted in intensity, up or down, to fit that range. Also, the camera's exposure can be adjusted slightly up or down to preserve more detail in the shadows or highlights. The backlights can be adjusted after reading the highlights they are generating on hair and clothing. If the highlight reading is greater than F/22, there will be no detail in it.

Considering that outdoor scenes are more difficult to control using lighting, there are other solutions to bring down blaring highlights. One is the use of intelligent framing. For example, take a spot reading of the sky, and frame out the brightest part. Isolate reflections from car bumpers, and arrange the blocking to use a subject for flagging the light from the camera. Increase the height of the tripod to decrease the presence of the sky in the image. Use reflectors to bounce light into the subject, thereby reducing scene contrast by raising the shadow level. Or use Graduated Neutral Density filters to reduce the sky's intensity gently into the horizon line.

Using ND Grad filters can dramatically impact an image. It reclaims lost highlights and overexposed areas of the frame without affecting the camera's exposure for the foreground.

SHOT TYPES (WS, MS, CMS, CU)

Selecting the proper framing for each individual shot of a movie is crucial to the flow and pacing. It is also necessary for an audience to be able to decipher what is going on in the image quickly before a cut is made into the next image. As stated earlier in this guide, a viewer can stare at a photograph or a painting for 10-15 minutes or longer when it is hanging on a gallery wall. A shot from a movie may remain on the screen for as little as a few seconds, before the editor finds it necessary to cut to another shot for continuity or pacing.

During those few seconds, the viewer should be able to recognize the basic elements of the frame, such as the subjects and what they are doing. Later in the guide, in the Composition section, more information will be given on framing and blocking. This section will explain general shot sizes.

Remember that the difference between a WS (Wide Shot) and a MS (Medium Shot) is not written in stone. It is up to the Director and the DP to establish what it means, scene by scene, when the Director asks for a MS, and the DP feels that a CMS (Close Medium Shot) would do a better job. However, it is well established that the CU (Close Up) is generally head and shoulders. Again, that is not written in stone either. As long as the communication between the Director and DP remains error free, the shot sizes will follow suit.

The Wide Shot (WS) can be just big enough to encompass the subjects and setting (place). Or, it can start from a bird's eye view. It is generally used as an Establishing Shot (establishes the setting and action). When the camera rolls for the entire duration of the scene, and covers all of the main action, it is referred to as a Master Shot. A wide shot can be moved on a dolly into the scene to become a MS.

The Medium Shot (MS) usually follows the WS, creating a more personal feel to the scene. The scene may also begin with a MS, then cut to a WS to reveal the setting. The cutting serves the script as best as possible. The MS can sometimes be filmed as small snippit of action, or it can be the entire run of the scene's action. That choice is determined by available resources and time. Choice in post production depends on complete shots with trim on both sides. However, choice in post does not weigh in as heavily as having to vacate a location in a certain amount of time. Usually the Line Producer or Location Manager sets the amount of time available for a scene, in direct assembly with the Assistant Director (AD) or 2nd AD.

The Close Medium Shot (CMS) provides an even more personal approach to the scene, allowing the audience to concentrate on facial expressions and emotions, without losing touch with the setting.

The Close Up (CU) is the cornerstone of digital filmmaking, since it allows the camera to capture as much emotion as possible with the available pixels. It is also the most personal shot type that heavily concentrates on the subject and not the setting. This particular CU is also a Two-Shot, meaning that one of the subjects has not been isolated in his or her own CU. Two-Shots can be tricky for Post. If one of the actors is doing something that does not match with the WS or MS, it is difficult for the editor to cut to the CU of the other actor and keep the scene's pacing. Sometimes in filmmaking, thousands of dollars are spent repainting an actor's eyes in Post, so that they don't look down at the Spike Mark (marks the actor's position in the blocking) on the floor. This expense can be averted by cutting to the other actor's reaction. If the only CU is a Two Shot, that is not possible. That is why it is sometimes referred to as a "dirty" CU. However, the CU Two-Shot is a very personal and powerful image, where two people can be either strongly united in harmonic symmetry, or strongly separated emotionally.

Filming CU's with a Wide Angle lens close to the subject can distort features. Avoid it unless it is being done for effect or to force perspective.

Two Shots can be powerful emotional devices.

It is important to note that when going from filming a WS to filming a MS, the camera can either change the Focal Length (Zoom) to get the tighter MS, or it can move closer on the tripod. The decision is creative, but generally, moving in creates better continuity.

During this transition, it is also essential to change the Height of the Tripod (Z-axis, or Vertical Perspective) and the Position of the Tripod (X-axis or Horizontal Perspective). Along with being visually more interesting, it also ensures that any small movements or shifts in the subjects' position or action is masked by this Perspective shift.

This is also crucial when filming two different WS's of the same scene, wherein one WS is best suited for one aspect of the action. A filmmaker is not limited to simple minded WS-MS-CU order.

Think of WWII films, where a WS is used to establish the scene, but it can cut to another WS after a shell explodes, then another WS to show troop mobilization in response, then finally cut to a MS to show groups of soldiers manning their positions for a counter attack, then another WS of the battery firing its barrage.

Remember, filmmaking rules were meant to be broken. Sometimes, three different MS's can serve the script better than a WS and a CU. The possibilities are endless, especially when blocking is factored in. Blocking can bring the actors physically to the camera, making a WS into a MS perspective. Sometimes it helps to think like a Stage Director, who has no lenses or post to use. The Stage is based on human movement, props, sound effects and lighting. Those are all elements that make a successful Master Shot. Don't be limited by the camera, use its incredible capabilities of compressing time, forcing perspective, cutting to parallel timelines, and guiding audience perspective second by second.

Wide Angle Adapters and Converters mount to existing lenses rather than directly to the camera. The devices widen perspective or narrow it farther than the capabilities of the lens attached to the camera. Here are two examples of Converters, which are lenses that don't require a shift in Focal Distance (focus) when changing Focal Length (zoom). Adapters, in contrast, require a focus shift. However, they usually have simpler optics and are therefore lighter carry. They may also grant wider perspectives due to their optical simplicity.

The Century Precision Optics Converters and Adapters are industry standard, and excellent optical performers. The glass that mounts onto the camera's lens has to be at least the same or better quality than the lens. Cheap converters will distort perspective and experience color shifts and double-vision. This converter is a 0.7x (hence VS07) which means that it gives a 30% wider field of view. The CV stands for Converter, and the HDS is High Definition - Sony.

Using a Teleconverter narrows perspective beyond the camera's ability, in contrast with Wide Converters which expand perspective. This one is a 1.6x (hence VS16), which means that it magnifies the view by 60%. As with all professional Teleconverters, there is some vignetting when it is mounted on a zoom lens at its shortest focal length. A small increase in focal length eliminates this vignetting. It is a normal aspect of using converters. The benefit is that a tighter shot can be obtained from a closer distance to the subject, thereby allowing the camera to isolate features in an ECU (Extreme CU). Also it allows a closer shot when it is impossible to move closer to the subject, such as when filming a car from a building. As with all converters, a focal distance shift is not required when shifting focal length.

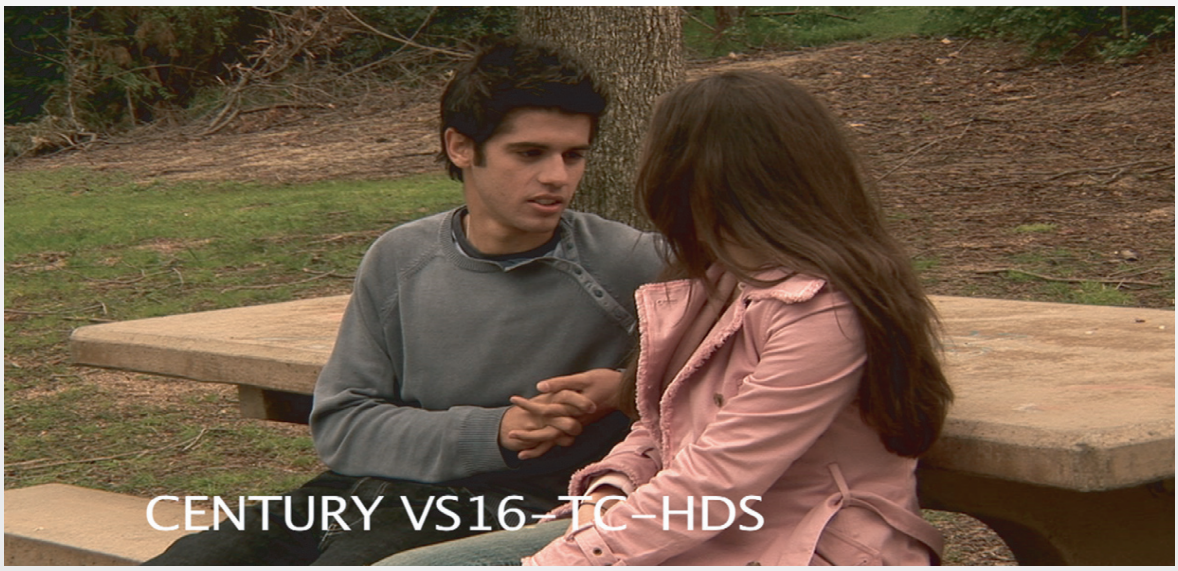


Image after being "stepped into" with the zoom to compensate for the vignetting.

PANS AND TILTS

The Pan is a side to side movement of the camera. It can track motion along the X-axis, swish horizontally, or start slowly then accelerate then end slowly (padded or ramped). It can reveal settings, new information, new characters, or new action. It can also be used to create a Panorama in the viewer's mind, which could otherwise not be achieved with a Static Shot (a shot where the camera does not move, pan or tilt). It could encompass a larger setting and place the viewer in the scene with a larger field of view.

The mind stitches the pan shot into one wide Panorama. Panning with subject motion is much more advantageous, since it does not fatigue the viewer's eyes. The viewer can concentrate on a single subject walking through the setting. If the pan is not executed with subject motion, it has to be much slower. Panning with the subject can happen at just about any speed. Think of a camera panning with a race car passing right in front. The eye accepts the Motion Blur in the background as long as the car is sharp and framed.

Contrast the static shot to the left with the increase in visual information and viewer realism obtained with the Pan below. Static shots can be used to build perfect frames, and Pans to immerse the audience in the setting and connect scenes. Each has its own advantages.

The Tilt is a very powerful move if executed properly. Like the Pan, it can reveal clothing, new information, new characters, or new action. It can also be used to track a subject moving in the Y-axis.

This is a sequence to show how the mind interprets a tilt up motion with the camera.

It starts at the bottom frame and tilts up. The brain stitches this information into a single image.

This allows the digital filmmaker to maintain a CU frame while revealing information to the audience.

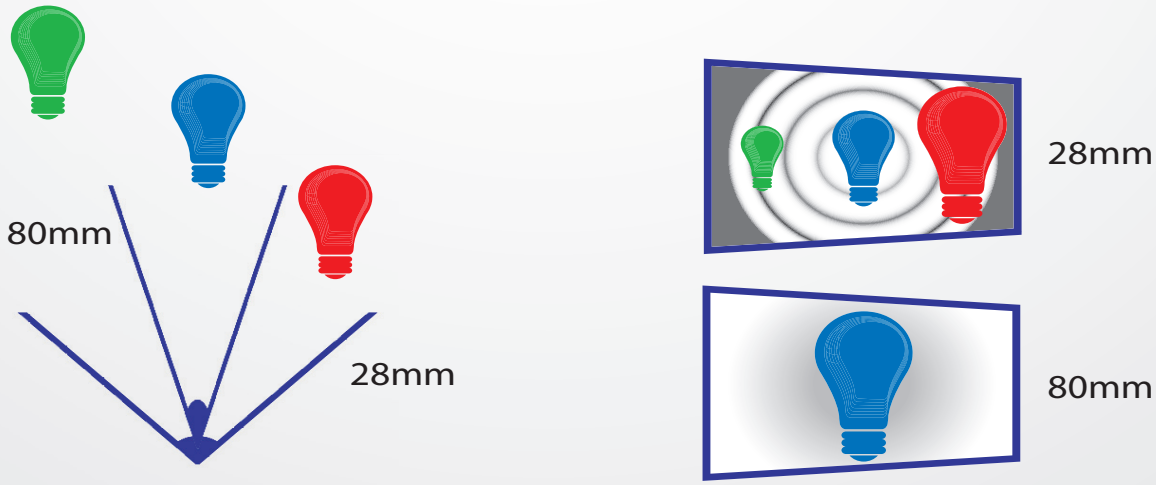
A tilt move can be executed just like a pan. It can track motion, swish vertically, or start slowly then accelerate then end slowly (padded or ramped).

In 24p acquisition, it is vital to tilt and pan at a speed that does not match the 24p flicker. Either faster or slower will yield an image that displays well.

ZOOMING

Zooming, or varying the focal length, is a facet of Vari-focal length lenses (VFL). The first lenses used for filmmaking were Fixed-focal length lenses (FFL), also referred to as Prime Lenses. They came in varying focal lengths, 18mm, 25mm, 28mm, 35mm, 50mm, 80mm, etc. For the purposes of convenience and cost, the VFL lens was introduced. It is much more complex, with many more elements than FFL lenses. This proved a detriment in certain ways, since it collected less light and made the camera heavier. It was not as robust, and the multitude of elements caused odd light flares. VFL lenses have come a long way, and their sensitivity has been drastically improved, with faster ones opening as wide as F/1.4 at the shortest length. Some still suffer from certain issues, such a light loss at the longest focal length. The lens can start with an F/1.4 at 20mm, but end at F/4 at 250mm. This light loss is not critical if the filmmaker is not zooming during the shot (a generally bad habit anyhow). The most important factor to remember is to research the camera's lens, and find out how much light loss if any happens along the focal length change. If there is plenty of light, it is not an issue. If the camera is already filming wide open (open aperture), then a 1 stop light loss at the longest focal length is an issue. It will necessitate a relight of the set, adjusting levels, or using Video Gain, which is not a positive move.

Zooming is essentially magnifying a certain part of the frame (center), like a magnifying glass, and forcing it to fill the frame. The narrower the perspective, more of the subject fills the frame. That is why Zooming during the shot stilts the viewer and feels fake. It is not a natural human characteristic to be able to Zoom into a detail. Human vision cuts from WS to CU to another CU, or moves closer by using the body (like a dolly). Zooming during the shot can be used for effect, but it will not replace a dolly.



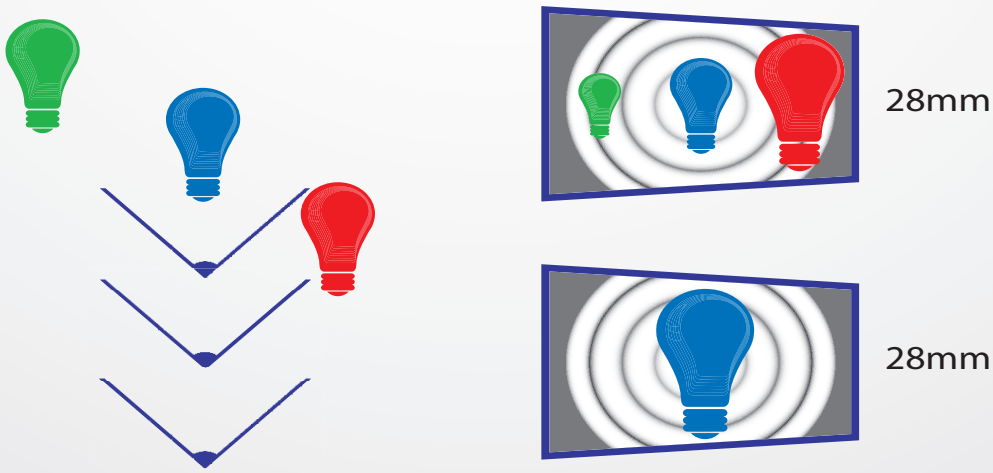
Zooming magnifies a smaller part of the image and fills the frame with it. The 28mm focal length is increased to 80mm, magnifying a portion of the frame. The problem is that the actual zooming action stilts viewers and feels unnatural. It also alters the background and defocuses it.

Dollying is the most natural method of changing shot size and perspective, accompanying motion, or assuming a Subjective Point of View. The camera, supported on a rigid platform and track, can Move in or Dolly in from a WS to a MS or CU at any speed, be it 60mph in a stunt vehicle or at 1mph to mimic a subject slowly walking towards a vehicle.

Dollying in can focus audience attention on action that is gradually diminishing in size, for instance, two people recovering from an argument, coming back into each other's arms. The dolly can slowly move beside, in front of, or behind, a subject strolling at the park, engrossed in thought. It indirectly reveals setting naturally, and maintains a consistent subject size while V.O. (Voice Over) plays.

Just about any device with wheels or track can act like a dolly. Cars, motorcycles, bicycles, wheelchairs, etc. However few devices replace the precision of a true dolly, with its heavy mass and Pneumatic arm that can also Jib the camera up and down a few feet.

The Dolly Grip pushes and pulls the dolly, and the precision or lack of precision in his or her movement translates to the camera. This is especially evident in 60i video, with its fast sampling of the world. 24p film and video mask small imperfections, as so does subject motion in the frame. Moving the dolly is an artform in itself, especially while trying to keep one eye on Spike Marks beside the dolly track specifying certain positions at certain times, and another eye on the subject's motion. Then repeating the same back breaking movement 200x in one production day.



Dollying mimics human motion naturally. It adds production quality, and enables precise movements. Coming closer with a lens is more natural than zooming in. Also, the background comes closer and remains in focus.

COMPOSITION: THIRDS

Creating good composition is akin to creating harmony in the frame. When all the lines, circles, shapes, colors, and subjects are in harmony with each other, the image is a good composition. Sometimes, just one of the past 4 items can be in harmony to make a good composition.

The Law of Thirds is an age old Painter's rule, that the subject of interest creates more harmony and becomes the focus of the composition when it is placed in the top or bottom third of the frame, and off to left or right third. Subjects can also be centered, but they fall under different rules then, those of Triangles and Rectangles. Centering a subject is generally agreed upon to be a bland treatment. The human eye wants to divide its world into thirds.

The Law of Thirds is more of a guideline, just like all filmmaking principles. It is conventionally acceptable that placing the subject off to one side and above the center line creates a more pleasing image. Centering a subject with too much space around is generally the bane of amateur filmmakers.

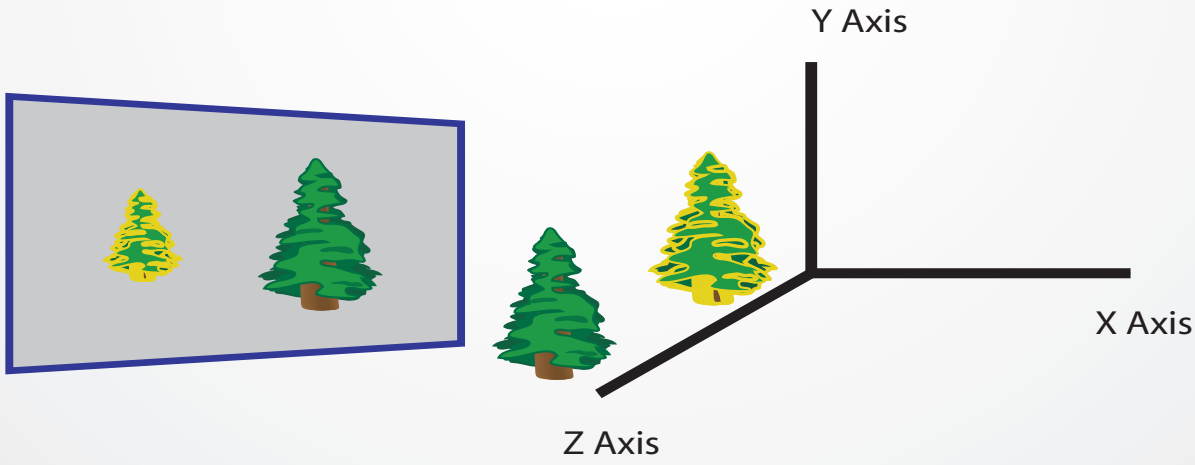
The idea that human faces and other subjects create shapes in space can be a hard pill to swallow. In reality, it may not be as prevalent, but on a viewing screen, it is. The shapes are created due to the movement of the eyes of the viewer, shooting from face to face trying to figure out what is going to happen in the frame. Think about how watching two CU shots, one with the subject framed left, the other with the subject framed right. Every time the movie cuts, the viewer's eyes travel to the eyes of the subject on the right, then to the eyes of the one of the left. Back and forth like a tennis game. It is natural and dissolves boredom with the image. The viewer's eyes can travel around the frame searching primarily for human eyes, then anything small and white in the frame., then bright color. In the presence of multiple faces, the viewer's eyes go to the top most face closest to the center, and directly to the subject's eyes. Then it moves to the other eyes. This can create shapes in space that alter mood in the scene. Triangular movements can be hard edged, circular ones comforting or dizzying, rectangular ones solitary or powerful. This is further enhanced by the shape that the subject is making in the frame, and the amount of space around him or her.

It is important to note than a subject in motion trumps all the rest. That's why it's possible for actors to Upstage each other by creating motion in an otherwise slow dramatic scene. This can be used to draw attention to the subject, though. A WS of a couple watching a television can be tipped towards the character that is munching popcorn.

In the presence of multiple faces, the viewer's eyes go to the topmost face closest to the center, and directly to the subject's eyes. Then it moves to the other eyes. The subject in the center of the first frame is dominating the short sturdy triangle in the first frame. The triangle in the second frame becomes tall and unbalanced as the scene progresses towards a potentially explosive event. In the third frame, the leftmost subject dominates the frame with her height, and creates an inverted flat triangle. All stability is gone, and now, both standing subjects' attention is directed menacingly at the seated subject. These shapes alter audience perception, and can be used to great effect.

COMPOSITION: FOCAL DISTANCE

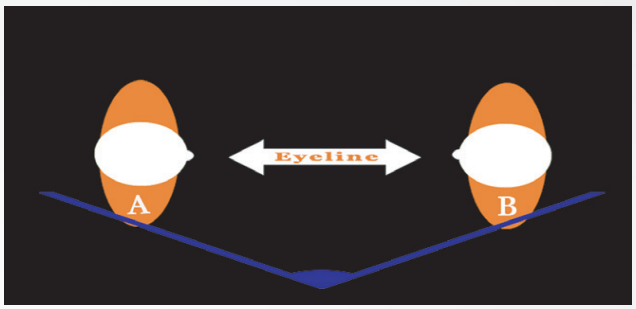
Varying the Focal Distance (Focus) in a shot is a dramatic movement that can be used to shift audience attention to another plane on the Z-axis. It can reveal new subjects, as in the example below, where the focus shifts or racks from the foreground subjects to the background subject.

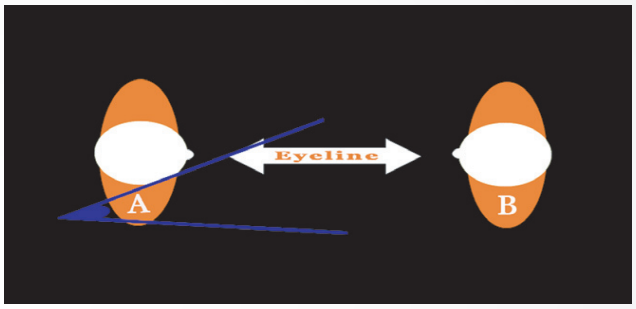


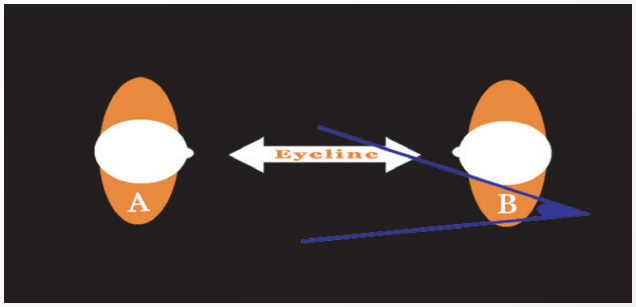
The Z axis is the line at which objects are closer to or farther from the camera.

VISUAL CONTINUITY: LINE OF SIGHT

When planning a scene, the filmmaker must choose which side of the subjects the camera will be on. This prevents Visual Jump Cuts, where it feels like both actors are looking in the same direction instead of at each other. That is referred to as being on the correct side of the line, or the right side of the line. The line is the Line of Sight, the invisible line created between subjects in the same scene who are looking at each other.



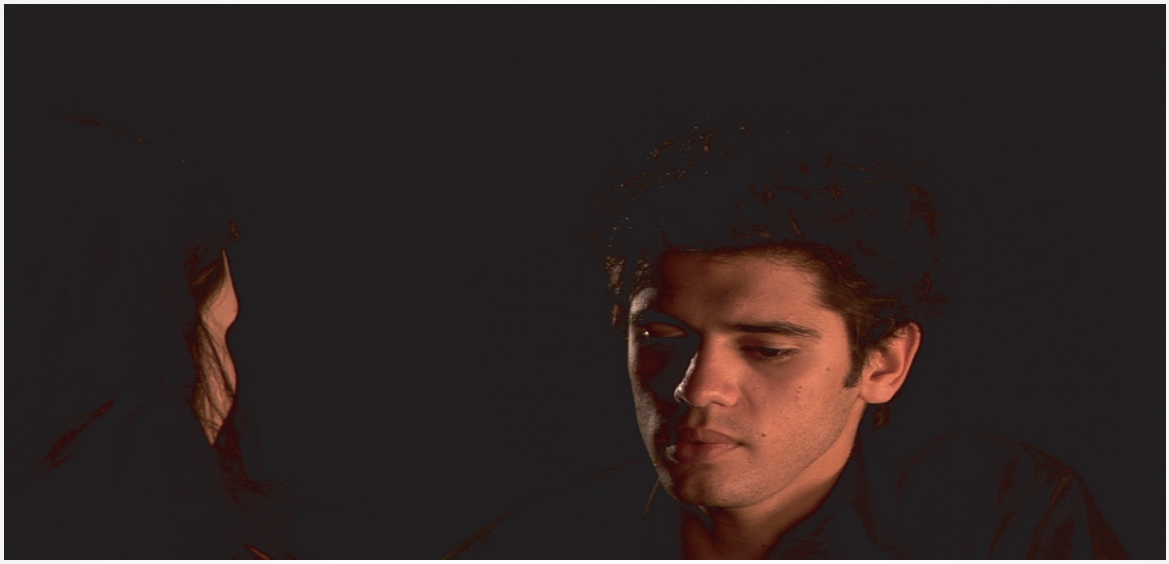




VISUAL CONTINUITY: HEADROOM

Headroom is that amount of space present above the subject's head in the frame. Taking into account that home viewers will see about 5-10% less image space around the frame, the filmmaker should be cautious not to "cut off the head" of the subject with the framing. That will make the frame look unnatural, like the head of subject is "too close" to the edge.

Conversely, too much headroom can also feel unnatural, making the subject look as if projecting from the bottom of the frame. Headroom selection is impossible to teach, it can only be learned with experience and trial and error. However, a calibrated monitor properly adjusted to show what a home audience will see, will tip the scales in the favor of the filmmaker.



Example of too much headroom: The subject's head projects from the bottom of the frame.

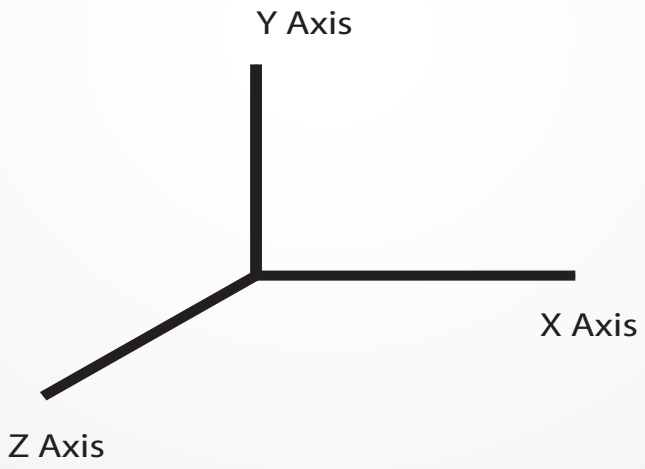
Like Headroom, Face room can heavily affect the appearance of the image. However, unlike headroom which is generally right or wrong, face room can be used artistically. Face room is also called Look Space. It is the amount of room that a viewer would expect the subject to have when looking away from the camera in any direction.

Face room can be exploited to set the audience on edge, by its absence. In the lack of face room, the audience is made to feel uncomfortable, as though the actor has no room to breathe. In conjunction with a proper performance, the absence of face room can make a strong emotional impact.

Absence of face room and headroom can make a strong impact when coupled with a matching performance.

AXES OF MOVEMENT

When a subject physically moves in the scene, it is along one or more of the 3 axes that govern 3 dimensional space. Each axis can have different meaning. To an audience that has read every book, magazine, and newspaper from left to right since childhood, left to right movement on the X-axis across the frame is easier on the eyes, and generally carries positive emotional attributes. The reverse is also true, right to left movement is uncomfortable. Movement up along the Y-axis defies gravity, and feels like it requires exertion. The opposite is also true, movement with gravity is easy on the eyes. Usually these movements are combined with Z-Axis movement, to and from the camera. Since the camera has one eye, it cannot see Z-axis movement as closer and farther. It sees it as growing and shrinking. The viewer's mind interprets the action as to and from, due to experience in the real world. Wide angle lenses and pooled lighting (walking in and out of pools of light) can enhance Z-axis movement, and vice versa. Telephoto lenses and flat lighting make the subject look like it's growing rather than nearing.



Z AXIS

Movement away from the camera diminishes the subject and also diminishes the dominance of the character.

Y AXIS

Movement from right to left is hard on the eyes, and accompanied with a corresponding performance, can make the audience feel that the character is going someplace they'd rather not be.

X + Y AXES

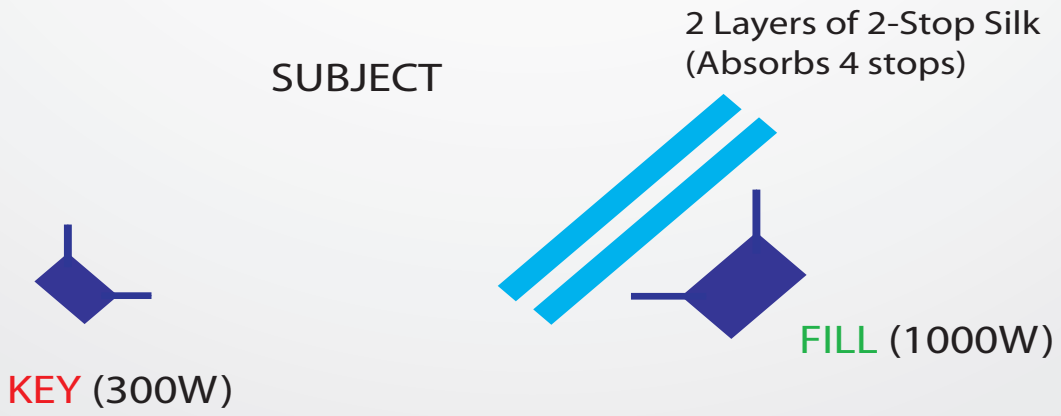
Movement from right to left and up is hardest on the eyes, since it is against the reading eye **and** gravity. It fatigues the eye to keep up with it. Imagine soldiers going over a trench into no man's land.

LIGHTING CONTRAST

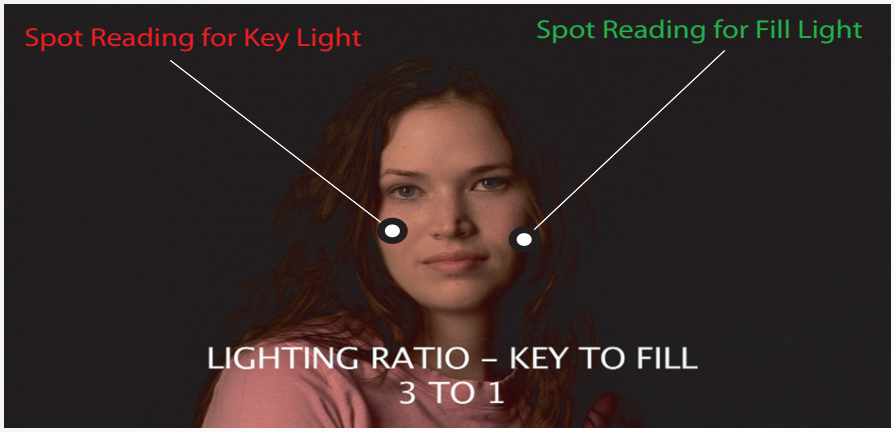
The Key light is the main light source falling on the subject. It can come from just about anywhere, in front of, behind, below, or above. It has to be the brightest light falling on the subject, and creates the main shadow. No other lights should create the same density of shadow on the subject, or of the subject on the background. To fill in this main light source, a Fill Light is used. The fill light is very soft, creates no shadows, and can be very dim (to create high contrast lighting) or very powerful (to create low contrast lighting.

The Fill light can sometimes be twice as powerful as the key, since it usually has to be bounced off reflectors or shone through diffuers. These Modifiers (reflectors, diffusers, flags, net) absorb much of its intensity in order to soften it. Hence, your main Key Light could be a 300W fresnel instrument directed at the subject from a Rembrandt position (3/4 up and 3/4 to one side), and the supporting Fill Light could be a 1000W fresnel instrument bouncing off the white wall behind the camera. The fill light should generally come from the camera and fill the shadows uniformly. That is not always done, and the position, quality, color, and intensity of the fill light is an artform.

Lighting Contrast is the ratio between these two lights, as measured by a light meter, either in incident or spot mode as discussed earlier. Generally, a Spot Meter is used, and measurements are taken from the Light side of the subject (lit by only the key) and the Shadow side (lit by only the fill). The difference between these two measurements is the Lighting Contrast (not Scene Contrast, which is SBR).



After a spot measurement, the Light side of the face is found to be at F/11

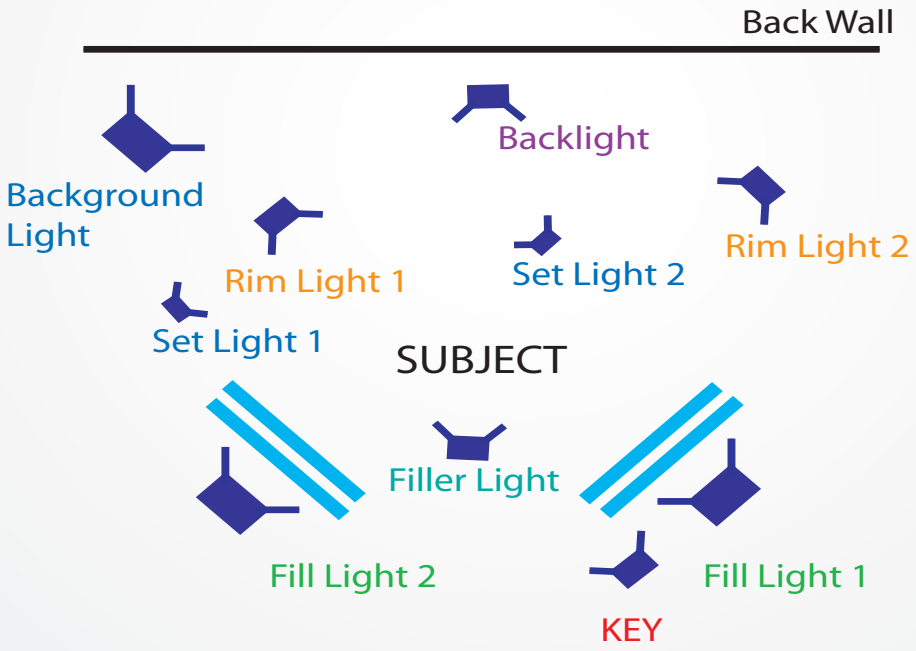


Key at F/11
Fill at F/5.6 1/3
(1 and 2/3 stop under the Key)

Key at F/11
Fill at F/8
(1 stop under the Key)

Key at F/11
Fill at F/8 1/3
(2/3 stop under the Key)

Now that the Key Light and the Fill Light positions have been discussed, here are 8 more positions that can enrich an image.



There is only one light that needs explanation because its naming is confusing. The Filler Light is not a Fill Light. It comes from below the camera, and fills in clothing and the subject's eye sockets.

Sequence begins with this frame and goes down the page.

The Key Light is the main light source.

The Background Light illuminates the Back Wall.

Set Lights illuminate objects on the set.

The Backlight separates the subject from the Back Wall, and illuminates the hair in line with the camera

The Rim Lights give the subject an edge.

Rim Lights are also called Kickers.

Fill lights fill in the shadows made by the Key light.

The Filler light fills in clothing and eye sockets.

Set Light 2 is a small pocket light illuminating the bag on the floor.

DCT-FM1

FIELD MANUAL