

Light & Film



Review

- How do you change perspective?



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- How do you change perspective?
Move your camera's position.
- What are the 3 ways to change a stop?



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Move your camera's position.
- What are the 3 ways to change a stop?
Aperture, shutter speed, ISO
- What is the plane of critical focus?



Review

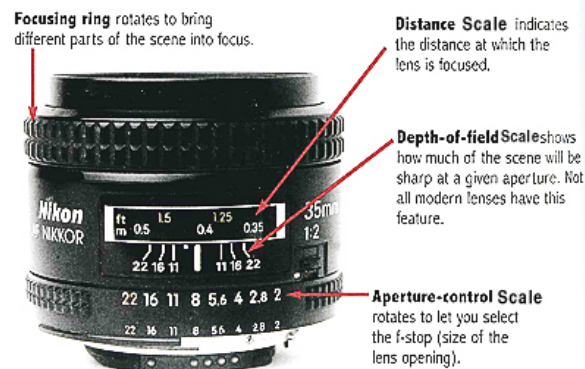
- How do you change perspective?
Move your camera's position.
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Aperture, shutter speed, ISO
- What is the plane of critical focus?
What you focus your lens on.
- What are the 3 scales on a lens?

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- What is the plane of critical focus?
What you focus your lens on.
- What are the 3 scales on a lens?
 1. Aperture or f/stop
 2. Depth of field
 3. Distance scales

∞ Infinity Symbol:

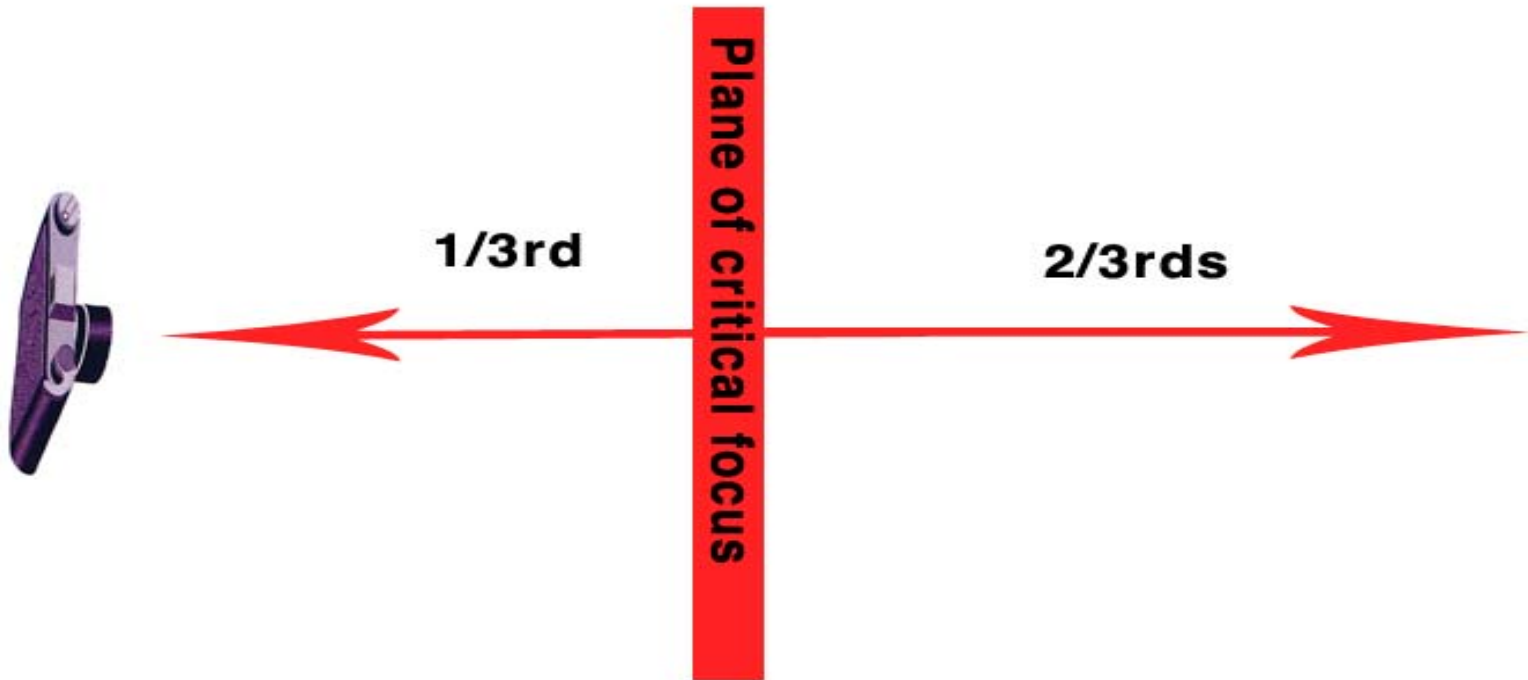
Infinity includes all objects at the Infinity distance from the lens about 50 feet or farther.



Review

Depth of Field and Plane of Critical Focus

At normal focusing distances, the depth of field extends about 1/3rd in front of the plane of critical focus, 2/3rds behind it.

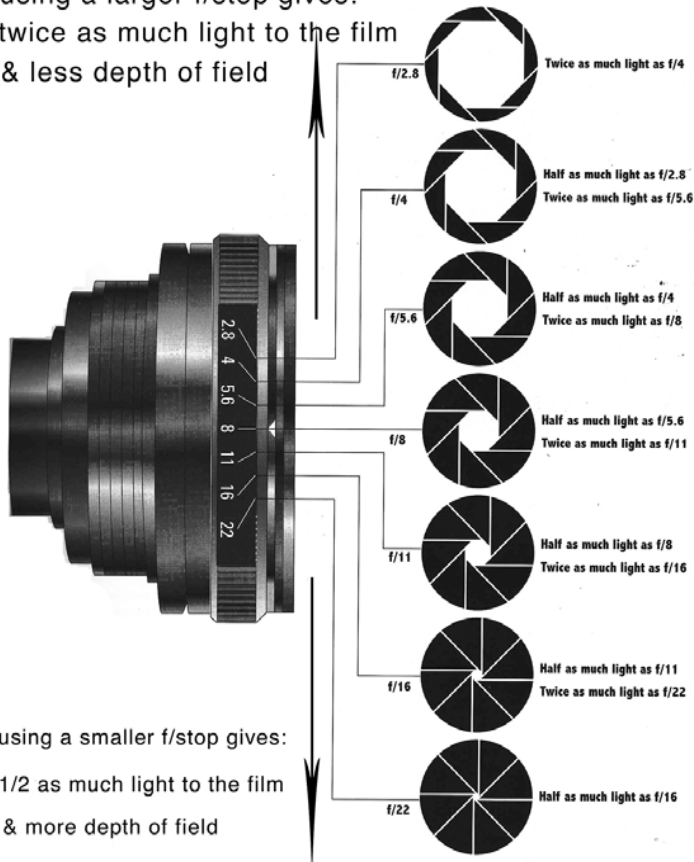


As you stop your lens down, sharpness increases from the *plane of focus* half as fast toward the camera as it does away from the plane of focus. Focusing 1/3rd of the way into a scene, utilizes the best depth of field.

Review

f/stops & shutter speeds

using a larger f/stop gives:
twice as much light to the film
& less depth of field



using a smaller f/stop gives:
1/2 as much light to the film
& more depth of field

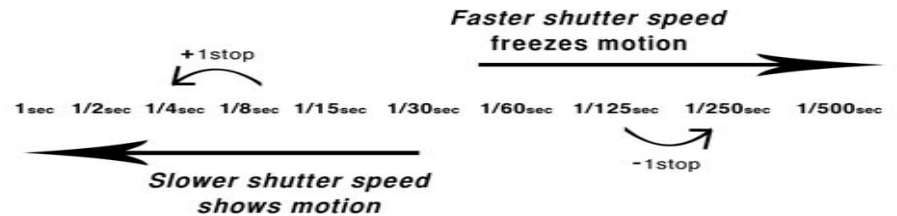


Photo Detective



1996

Bruce Ackerman

•Lens used?

Wide angle, normal, telephoto

•Type of Light?

Sun, Sky, Artificial.

Direction of: front (axis), side, overhead, back.

Quality of: soft/diffused, contrasty / harsh

•Aperture - f/stop used?

Large or small

•Shutter Speed used?

Fast or Slow

•Depth of Field?

Great or shallow

Photo Detective



1992

Roy Pope

- Lens used?

Wide angle, normal, telephoto

- Type of Light?

Sun, Sky, Artificial.

Direction of: front (axis), side, overhead, back.

Quality of: soft/diffused, contrasty/harsh

- Aperture - f/stop used?

Large or small

- Shutter Speed used?

Fast or Slow

- Depth of Field?

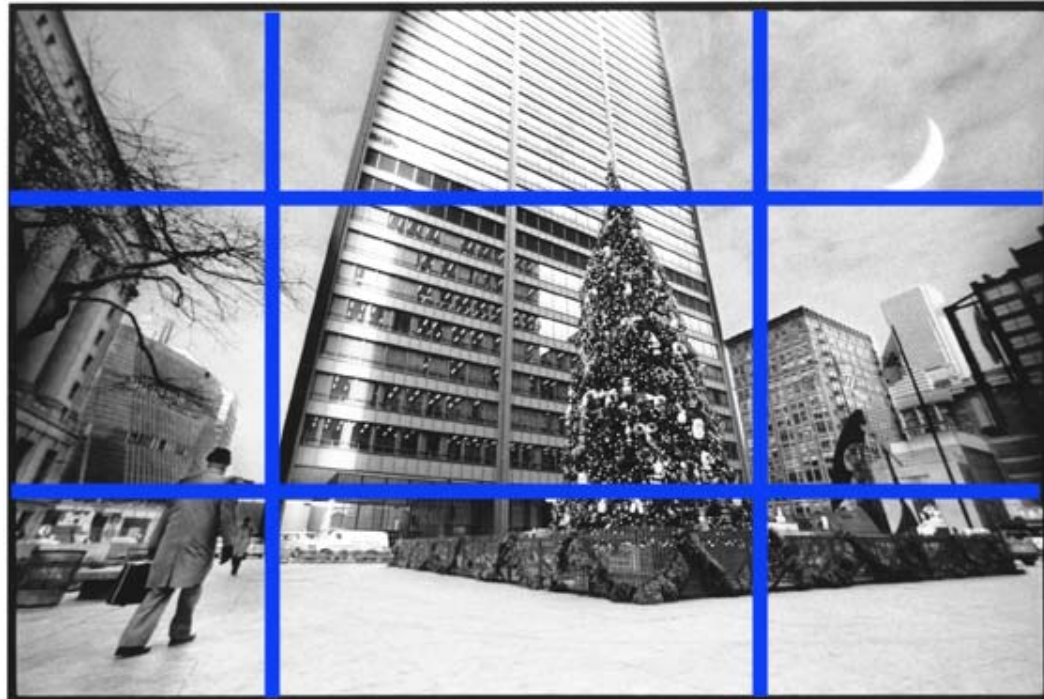
Great or shallow

Rule of Thirds

Proposed in the 19th century by painters of the period, important subject areas should fall on the intersection of the lines, or along the lines.

By placing the horizon near one of the grid lines in the frame will raise, or lower the horizon in the frame and give emphasis to either a dramatic sky or an interesting foreground.

Dealey Plaza, Christmas, Chicago, Il



1983

Roy Pope

Sunny 16 rule

Determining exposure without a meter

- If you find yourself in a situation without a meter, or the battery fails.

F/16 rule. In direct sunshine showing distinct shadows, using f/16 and a shutter speed of 1/over the ISO(film speed) will usually put you in the ballpark of exposure.

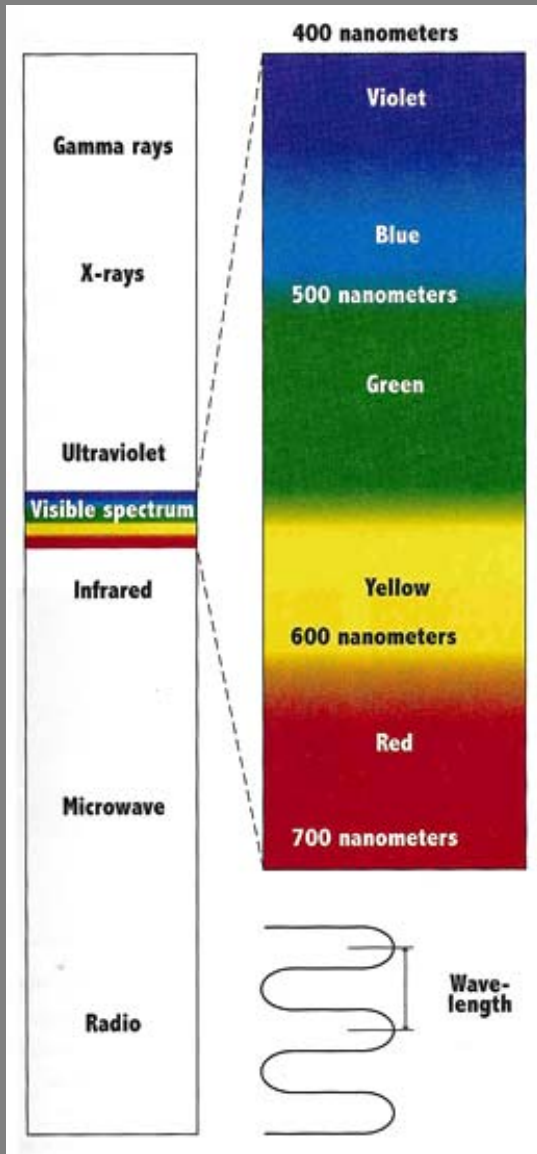
For Example. If you are using Tri-X film that is rated at ISO 400, and it is a sunny clear day producing distinct shadows. You would expose at f/16 at a shutter speed of 1/400. Since our cameras do not offer 1/400, use the nearest shutter speed, opting to give the film a little more exposure, and use 1/250.

In this example you would use **f/16 @ 1/400th** of a second.

Corrections to the f/16 rule when it isn't a sunny day:

- Hazy day (soft shadows) open up 1 stop
- Cloudy day (no shadows) open up 2 stops
- Heavy overcast or open shade open up 3 stops

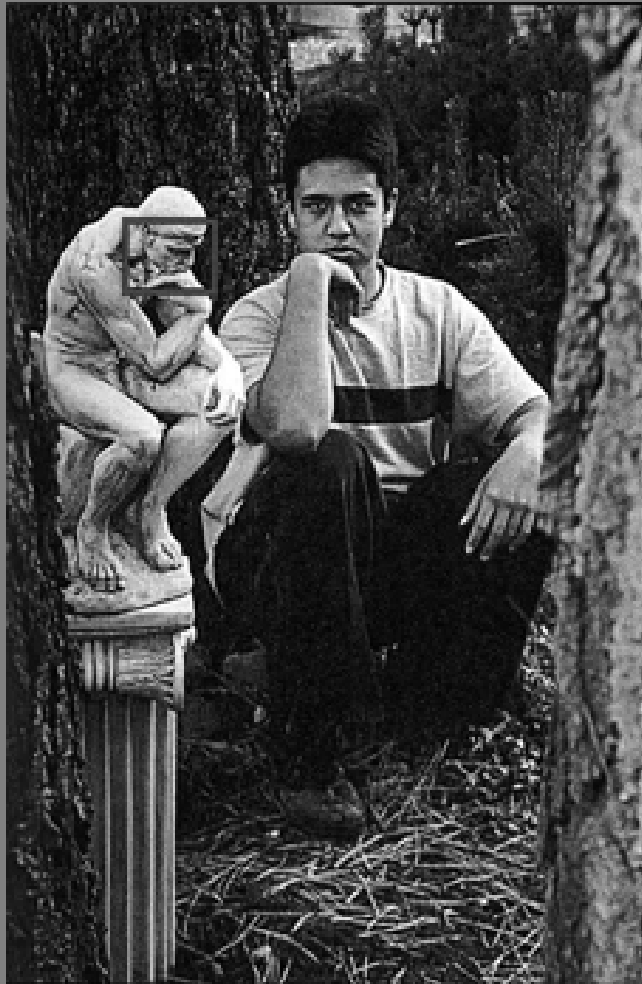
Light is a form of energy



Light is part of the electromagnetic spectrum, a wavelike energy in which the human eye, and most films, see wavelengths from about 400 to 700 nanometers (length of the wavelength).

When light hits film the silver compounds undergo a physical change. The more light that reaches the film, the denser the silver of the developed negative will be.

Film Speed & Grain



ISO 100 film speed



ISO 400 film speed



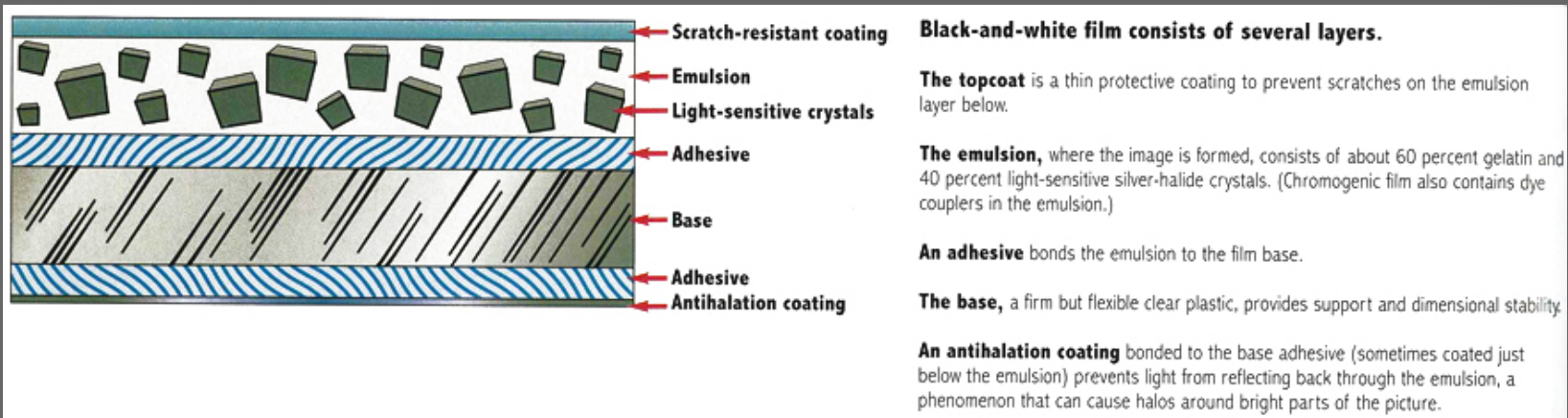
ISO 3200 film speed

ISO = International Organization for Standardization

- A film speed number tells how sensitive a film is to light. The higher the number the faster the film, the less light that is needed to expose the film.
- The faster a film is, the more grain that is apparent.
- T-grain films such as Kodak's T-Max have flattened the grains of silver. The flat surface exposes more of the crystal to light, and provides a film with significantly reduced grain for its speed.
- Chromogenic films are monochromatic films designed to be processed in color chemistry-C41.



B&W Film consists of 7 layers



Recording an image onto film involves a reaction between light, and silver halide crystals.

- Silver halide crystals are a compound of silver plus a halogen such as bromine, iodine, or chlorine.
- The crystals are irregular in shape, (if they were perfect in structure they would not react to light), and are suspended in the emulsion.
- When light hits one of these crystals a chemical reaction begins, and forms a Sensitivity Speck, which is called the *latent image*.
- When we develop the film, the *latent image* becomes the site where the developer changes the latent image into visible *metallic silver*.

Light Sensitive Crystals

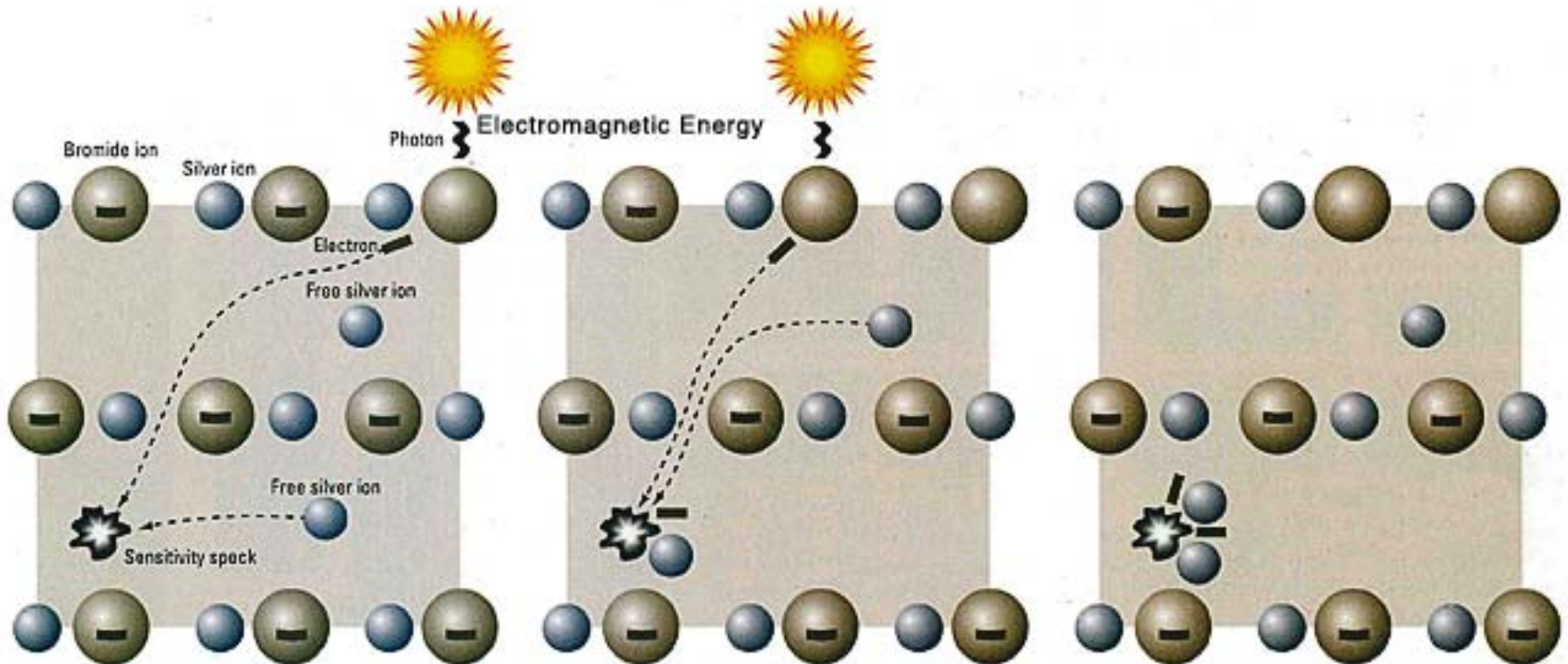


Image formation begins when a photon of light strikes a silver bromide crystal.

More silver migrates to the sensitivity speck as additional photons of light strike other bromide ions in the crystal and release electrons.

The presence of several metallic silver atoms at a sensitivity speck constitutes a latent image. This is the area where the developer will do its work.

Conversion of light & dark areas into negative silver

Original Scene



A BLACK-AND-WHITE NEGATIVE OF THE SCENE



PEGGY JONES Jizo (Statue of a Protector of Children), Japan

Parts of the scene that are struck by the most light are darker in the negative. These areas will be your highlight areas

Parts of the scene that are struck by no light remain transparent in the negative. These areas will be your shadow areas.

Negative Exposure

Each image from left to right received one stop less light



+ 2 stop

+ 1 stop

Metered Frame

- 1 stop

- 2 stops

Areas that appear dark in the negative will print as white. Areas that are clear in the negative will print as black.

Bracketing your exposures (giving more and less exposure in addition to the metered frame will give a choice of negatives.

Characteristic Curve

How a film responds to light.

Hurter & Driffield founders of sensitometry developed

a performance graph in 1876.

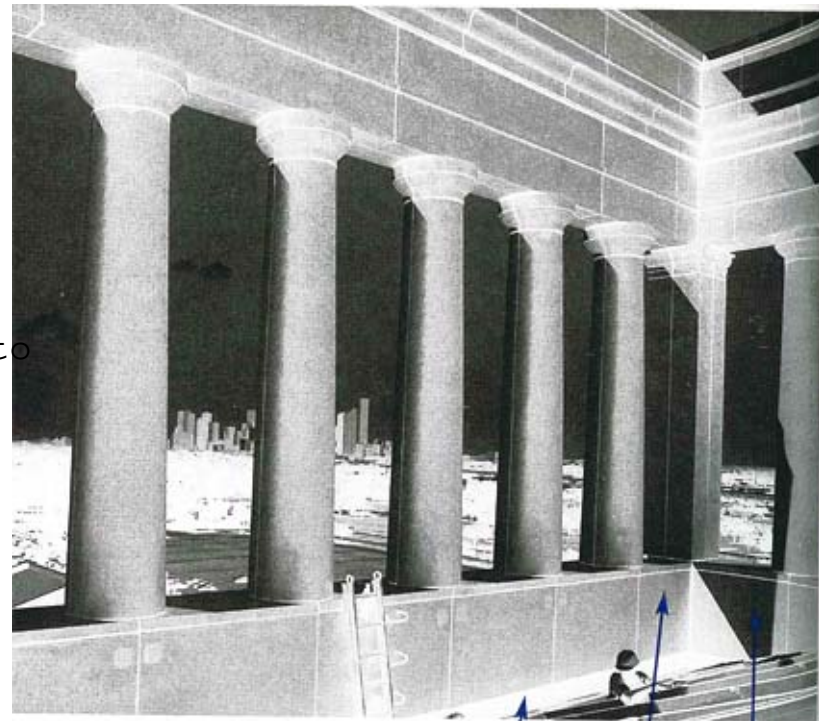
This graph is called a Characteristic Curve. The curve predicts a photo emulsions response to light.

The curve is made up of 3 areas:

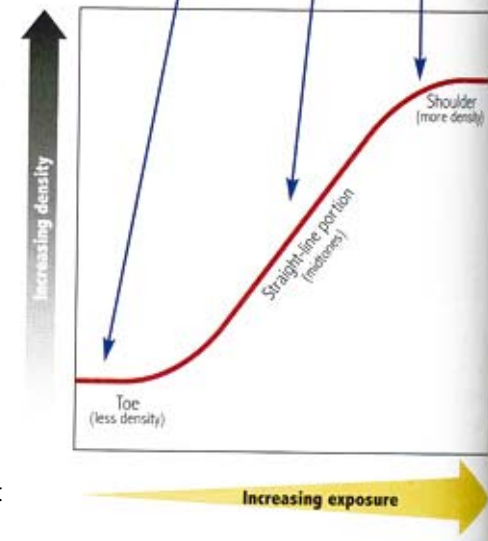
The Toe: consists of shadow densities (dark values in a print).

The Straight-line portion: consists of middle densities (middle values in a print).

The Shoulder: consists of highlight and white values in a print.



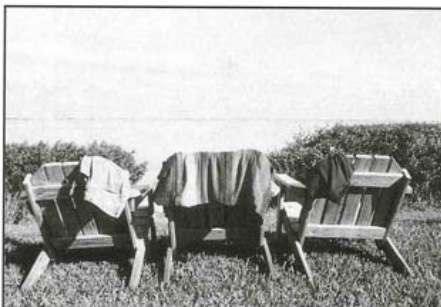
PAUL HESTER University of Houston College of Architecture, 1985



How black & white film sees color

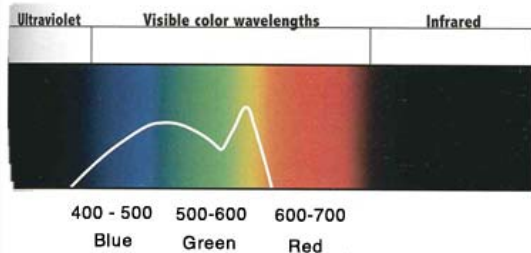
How do black-and-white films record the colors in a scene?

Depending on the film, colors may seem lighter or darker than they appear to the eye when looking at the actual scene. Compare the tones of the sky, water, grass, and colored clothing in the illustrations.



Orthochromatic film

Orthochromatic film is blind (not sensitive) to red. Red will record as black in the print.

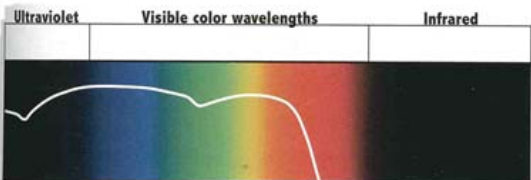


Panchromatic film

Panchromatic film records colors about the way the eye perceives them.

Pan = All
Chromatic = Colors

First film to respond to all colors.



Infrared film,

Infrared film responds to wavelengths that are not visible to human vision.

Film types

Exposure

3 ways to change exposure

Exposing film properly, letting the right amount of light into the camera, involves understanding just three things:

1. How the shutter speed and the aperture (the size of the lens opening) work together to control the amount of light that reaches the film.

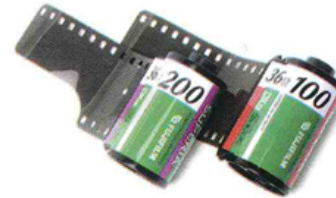
Shutter speed



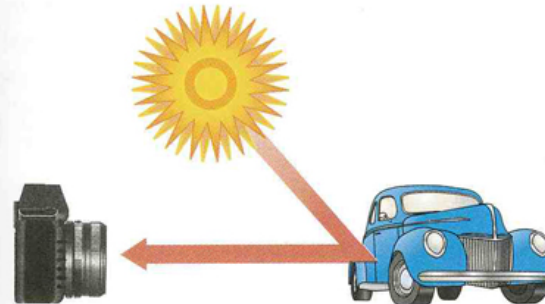
Aperture size



2. The ISO rating of your film (its speed) or the sensitivity of the CCD in your digital camera.



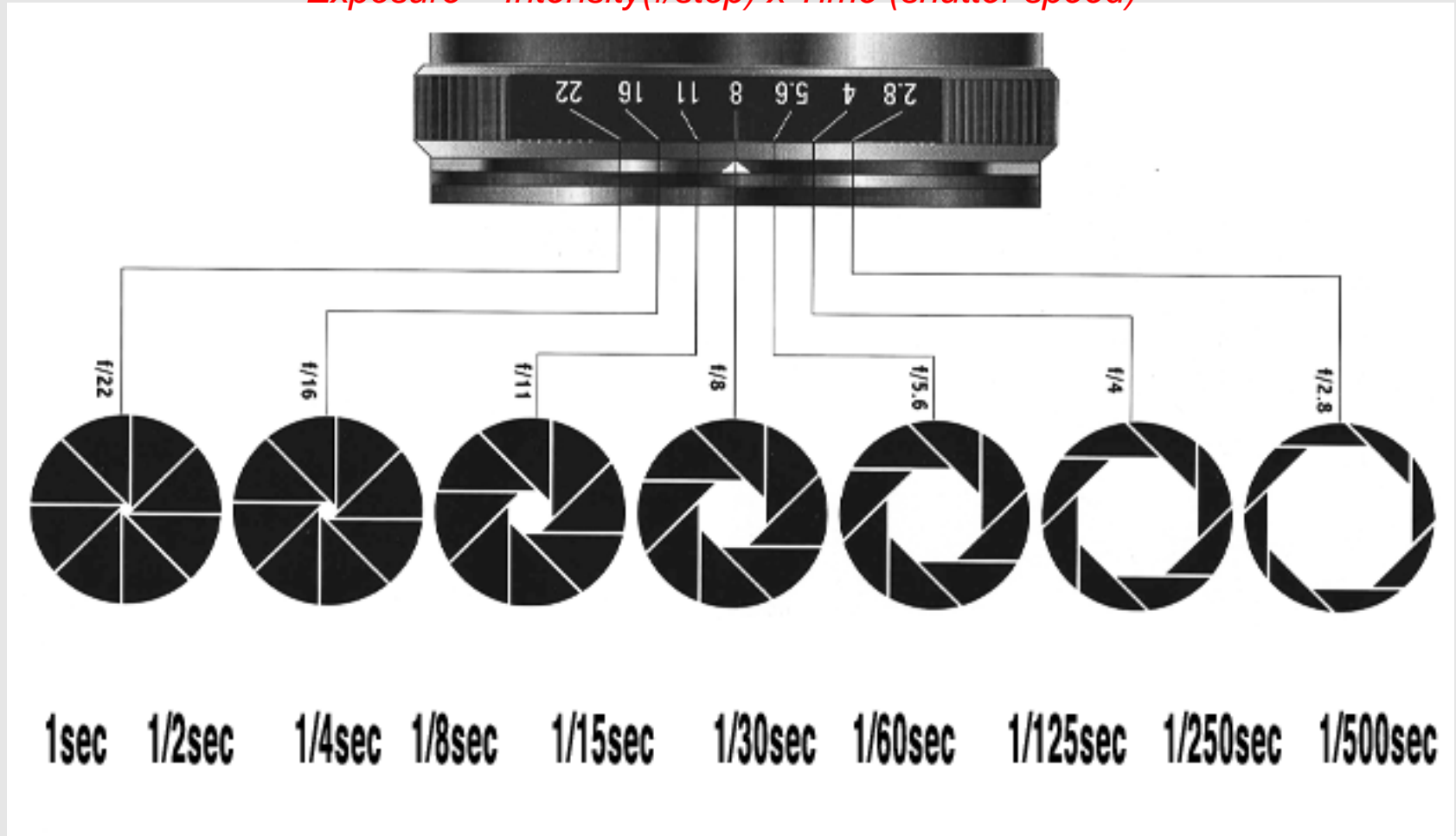
3. How to meter the amount of light and then set the camera's controls, either automatically or manually.



Equivalent Exposure Settings

reciprocal relationship

$$\text{Exposure} = \text{Intensity}(f/\text{stop}) \times \text{Time (shutter speed)}$$

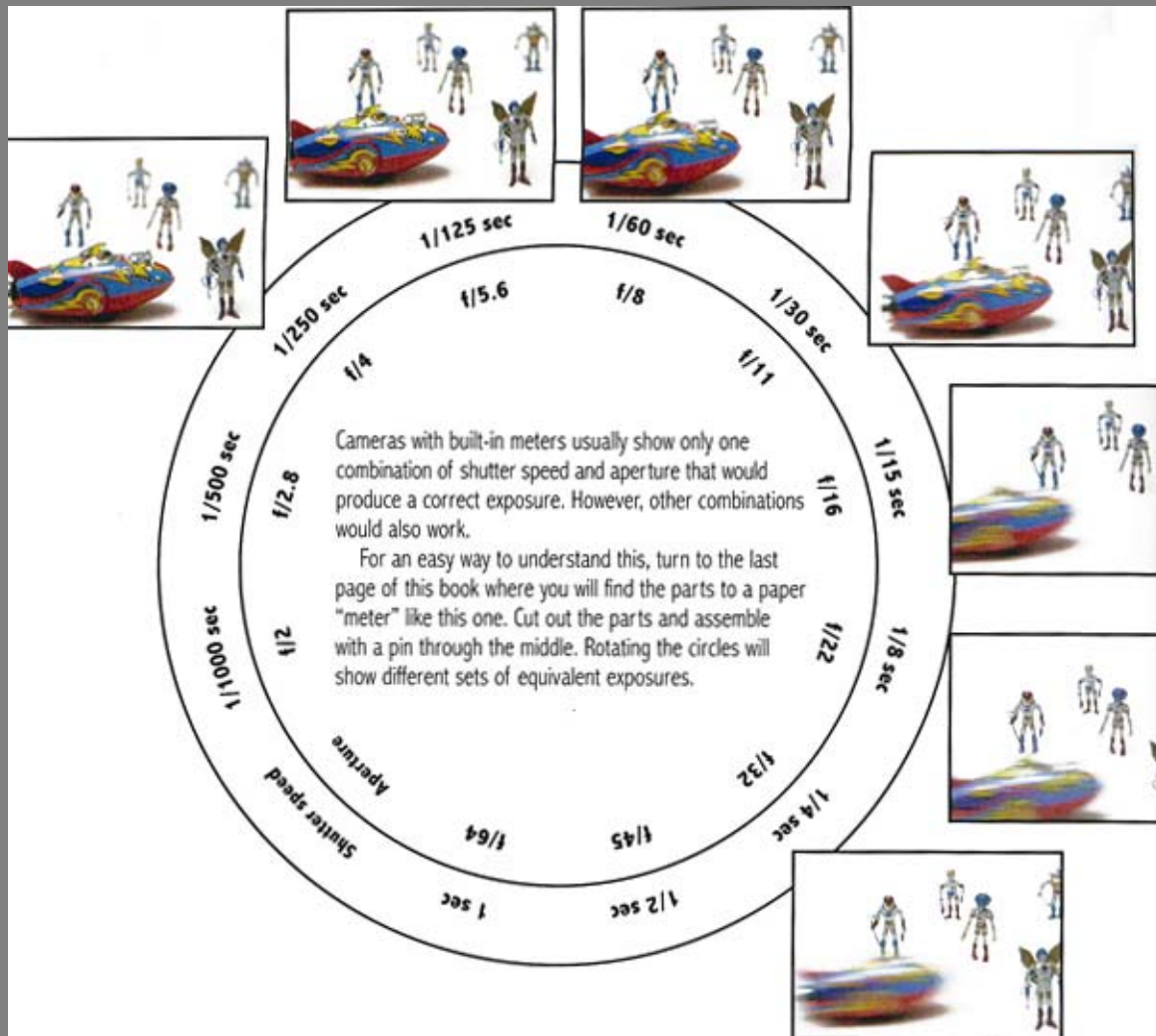


The area of two f/8s = the area of one f/5.6 which doubles the light entering the lens. Going from f/5.6 to f/8 would half the amount of light entering the lens.

If I open one stop, I would need to use one stop less of time to get the same exposure results.

Different Combinations: Same Exposure

Exposure = Intensity (f/stop) x Time (shutter speed)

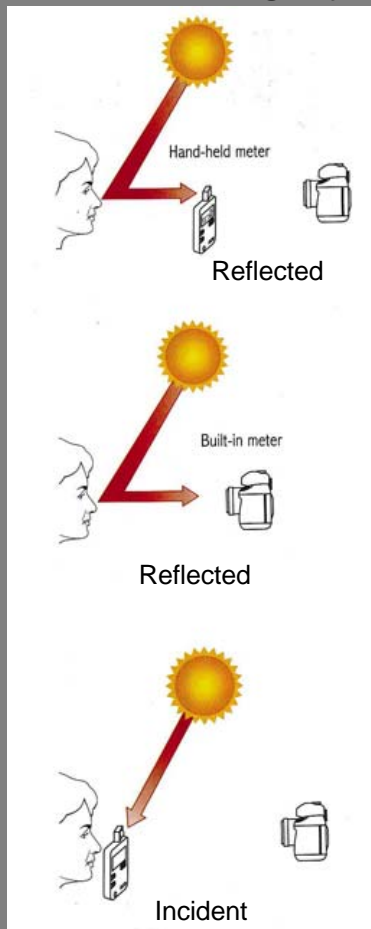


Incident & Reflected Light Meters

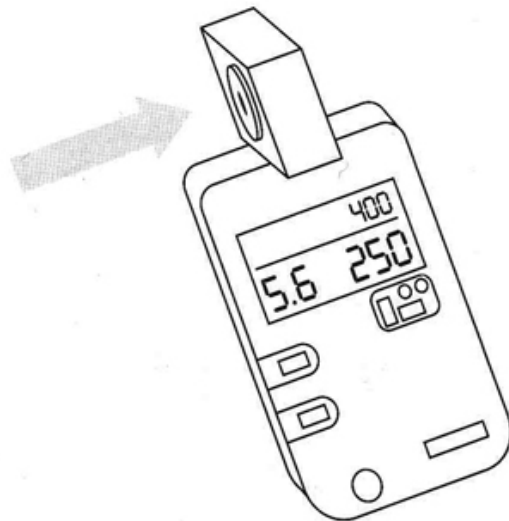
The name “light meter” is a bit confusing. We will call our light meters a “gray meter” because its only function is to tell us the proper exposure for 18% middle gray, or zone v.

All gray meters do the same thing: they average light within the viewing angle of the meter, and give you a proper exposure for 18% middle gray (zone v). That is all they do.

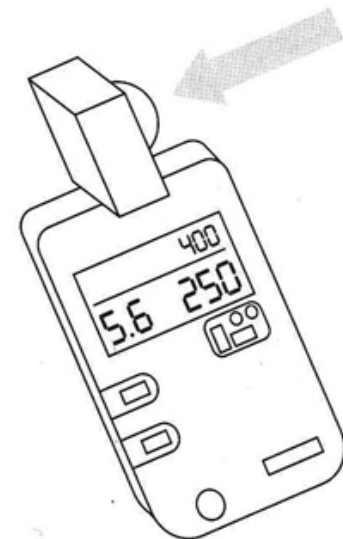
18% middle gray is the industry standard.



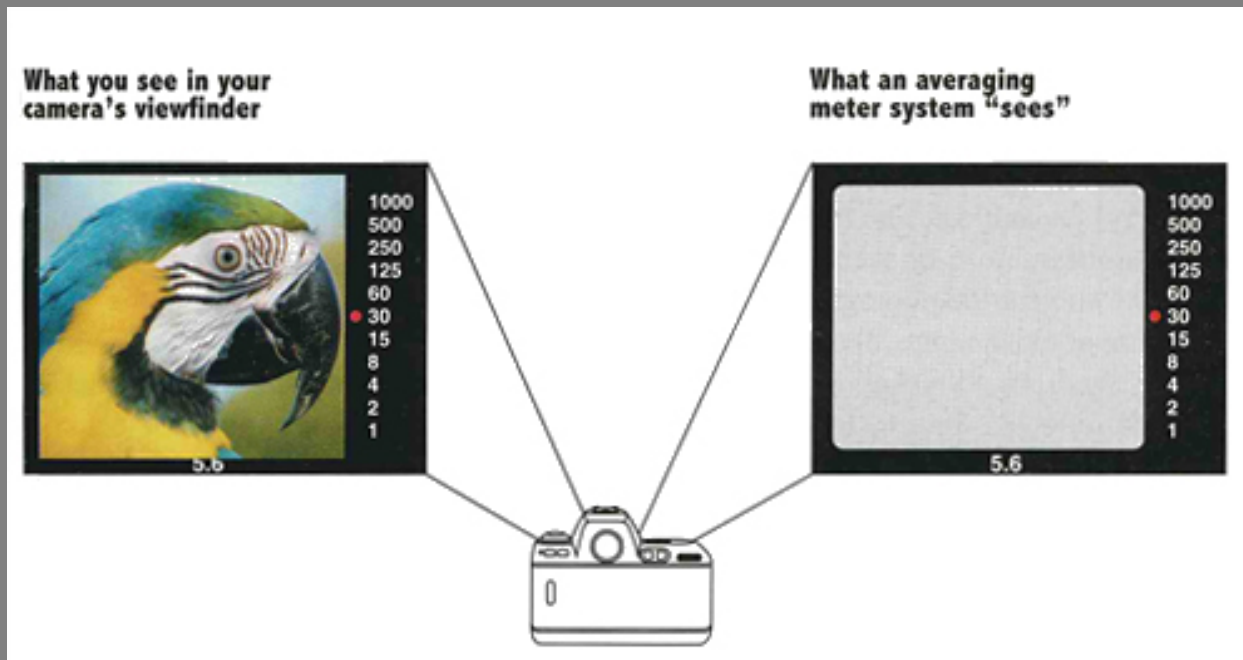
The sensor in a reflected-light meter measures the light reflected by a subject. Swivel-head meters let you read the display with the sensor pointed away from you and toward the subject.



An incident-light meter measures the light falling on a subject. A diffusing dome covers the meter's sensor. The dome must be pointed toward the camera.



What you see *verses* What the meter sees



Using meters



USING A REFLECTED-LIGHT METER BUILT INTO A CAMERA



USING A HAND-HELD, REFLECTED-LIGHT METER



USING AN INCIDENT-LIGHT METER

Substitution Meter Readings

Meter your subject up close when the important part of the subject is lighter or darker than its surroundings.

When you're unable to get close, use a substitution meter reading from your hand or a gray card.

If your hand is an average light tone, expose one stop more than your meter indicates.

Remember that your meter always gives an 18% middle gray reading.

METERING UP CLOSE

Metering up close gives good results when the most important part of the scene is much darker or much lighter than its surroundings.



With a meter built into a camera, move in until the main subject fills the viewfinder (be careful not to block the light on the subject). Take the reading, set the shutter speed and aperture, then move back to the original position to take the picture. With an automatic camera, set the camera for manual operation or override the automatic exposure.



With a hand-held, reflected-light meter, move in close enough to meter mostly the main subject, but not so close that you block the light. A spot meter, which reads a very narrow angle, can be used to meter a small part of a scene from farther away.

MAKING A SUBSTITUTION READING

A substitution reading is useful when you can't meter from up close or when you want a standardized reading.



Metering the palm of your hand makes a quick substitution reading, for example when photographing fast-moving situations. Hold your palm so that the light on it is about the same as on the people or objects you want to photograph. If the skin of your palm is an average light tone, expose one stop more than the meter indicates. If the skin of your palm is dark, use the indicated exposure.



You can calculate an exposure by metering the light reflected from a standard-gray test card. Place the card at the same angle to the light as the front of the subject. Meter the card from the direction that the camera will be when you are shooting. Don't meter at an angle if the camera will be shooting head on. When you meter any object at close range, hold the meter or camera so that it does not cast a shadow on the subject.

Metering Situations

METERING A SUBJECT AGAINST A BRIGHT BACKGROUND



An overall reading of a subject against a much lighter background often produces a subject that is too dark. Here, a bright waterfall was included in the metered area, and indicated a high light level. But the person in shadow did not receive enough exposure and came out dark.



Move in close to meter a subject against a much lighter background. Come close enough so that the meter reads mostly the subject, but not so close that you cast a shadow on the area you are metering.



A better exposure. After metering up close to the main subject, return to the original position to make the photograph at that exposure. Now the face is more accurately rendered. A camera that automatically sets f-stops or shutter speeds must sometimes be manually overridden, as it was here, to get the exposure you want.

METERING A SUBJECT AGAINST A DARK BACKGROUND



An overall reading of a subject against a much darker background can produce a subject that is too light. Here, the painter occupied a relatively small part of the scene and was in bright sun, while the large background was shaded. The painter received too much exposure and came out too light.



Move in close to meter a subject against a much darker background. Come close enough so that the meter reads mostly the subject, but not so close that you cast a shadow on the area you are metering.



A better exposure. After metering up close to the main subject, return to the original position to make the photograph at that exposure. Now the subject does not appear overly bright.

METERING A LANDSCAPE THAT INCLUDES A BRIGHT SKY



An overall reading of a landscape that includes bright sky can underexpose the scene. So much light comes from the sky that the reading produces too little exposure for the land elements in the scene. Here the sky is properly exposed, but the buildings are too dark and lack detail.



Tilt the meter down to exclude a bright sky when you meter a landscape. For a proper exposure for the buildings, light reflected from them should be dominant when the reading is made. Point the camera or hand-held reflected-light meter slightly down so that the meter "sees" less of the sky and more of the buildings.



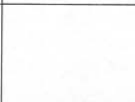

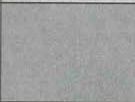
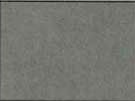







A better exposure. After measuring light reflected off the buildings, tilt the camera up to its original position. Now the buildings are lighter and reveal more detail. The sky is lighter also, but has no significant detail at either the lighter or darker exposures. Light areas, such as the sky, can be darkened when printing negatives or working with digital images, although they may be somewhat light in slides.

Tones and Zones

Metered Frame

How to expose black-and-white film for specific tones. If one area in a scene is particularly important, you can meter it, then find the exposure that will render that area as dark or as light as you want it to be in the final print.

<p>Five stops more exposure than indicated by meter. Maximum white of the paper base. Whites without texture, glaring white surfaces, light sources.</p>	
<p>Four stops more exposure. Near white. Slight tonality but no visible texture. Snow in flat sunlight.</p>	
<p>Three stops more exposure. Very light gray. Highlights with first sign of texture, bright cement, textured snow, brightest highlights on light skin.</p>	
<p>Two stops more exposure. Light gray. Very light surfaces with full texture and detail, very light skin, sand or snow acutely sidelit.</p>	
<p>One stop more exposure. Medium-light gray. Lit side of average light-toned skin, shadows on snow in a scene with both shaded and sunlit snow.</p>	
<p>Exposure indicated by meter. Middle gray. The tone that a reflected-light meter assumes it is reading. Neutral gray test card, dark skin, clear north sky.</p>	
<p>One stop less exposure. Medium-dark gray. Dark stone, average dark foliage, shadows in landscape scenes, shadows on skin in sunlit portrait.</p>	
<p>Two stops less exposure. Dark gray. Shadows with full texture and detail, very dark soil, very dark fabrics with full texture.</p>	
<p>Three stops less exposure. Gray-black. Darkest gray in which some suggestion of texture and detail appears.</p>	
<p>Four stops less exposure. Near black. First step above complete black in the print, slight tonality but no visible texture.</p>	
<p>Five stops less exposure than indicated by meter. Maximum black that paper can produce. Doorway or window opening to unlit building interior.</p>	



JOYCE TENNESON Dasha, 1999

Light meters expose for middle gray

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One stop less exposure. Medium-dark gray. Dark stone, average dark foliage, shadows in landscape scenes, shadows on skin in sunlit portrait.

Two stops less exposure. Dark gray. Shadows with full texture and detail, very dark soil, very dark fabrics with full texture.

Three stops less exposure. Gray-black. Darkest gray in which some suggestion of texture and detail appears.

Four stops less exposure. Near black. First step above complete black in the print, slight tonality but no visible texture.

Five stops less exposure than indicated by meter. Maximum black that paper can produce. Doorway or window opening to unlit building interior.

Adjusted Exposure to make the polar bear White.

Metered frame

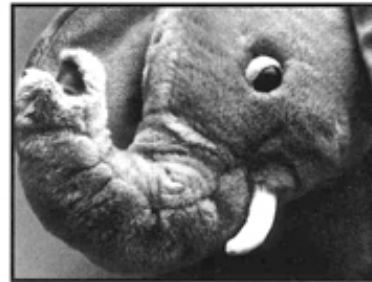
Adjusted Exposure to make the black gorilla Black



White polar bear given exposure suggested by meter



White polar bear given 2 stops more exposure



Gray elephant given exposure suggested by meter



Black gorilla given exposure suggested by meter



Black gorilla given 2 stops less exposure

Photo Exposure Log

Use separate box for each metered frame.

Subject Birch Trees	Subject Junk Yard Dog	Subject Coffee House lights
Roll or Sheet # 1	Metered Frame # 6	Metered Frame # 16
Metered Frame # 1	f/Stop 22 Speed 60	f/Stop 8 Speed 1/8
f/Stop 16 Speed 125		
Lens	Subject Ghost Town Scenic	Subject
Filter	Metered Frame # 11	Metered Frame #
Development	f/Stop 22 Speed 1Sec	f/Stop Speed

Use separate box for each metered frame.

Picture Making Checklist:

- ISO is set?
- Rewinder turns when you advance film?
- Lens is focused for desired image? Depth of Field(zone/hyperfocal focusing).
- Image is framed in the viewfinder?
- Light meter is properly set (needle or diode) in the viewfinder?

**Reciprocity on Frame 11 -made exposures @ 1 and 2 seconds*

Notes:

Location *Goldfield Ghost*
Date *Saturday, Oct. 31, 2006*
Time of day *6 pm*
Light conditions *Storm clouds, diffused light*

Reciprocity

COMPENSATING FOR RECIPROCITY FAILURE: EXTRA FOR LONG EXPOSURES

Indicated exposure	WITH MOST BLACK-AND-WHITE FILMS			WITH KODAK T-MAX FILMS	
	Open up aperture to	or Increase exposure time to	also Decrease development time by	Open up aperture	or Increase exposure time to
1 sec	1 stop more	2 sec	10%	1/3 stop more	No increase
10 sec	2 stops more	50 sec	20%	1/2 stop more	15 sec
100 sec	3 stops more	1200 sec	30%	1 1/2 stops more with T-Max 400; 1 stop more with T-Max 100	300 sec with T-Max 400; 200 sec with T-Max 100

At exposure times of 1 sec or longer, film does not respond exactly as it does at shorter shutter speeds. One unit of light falling on film emulsion for 1 sec has less effect than 10 units of light falling on the same emulsion for 1/10 sec. This departure from normal reciprocity during long exposure times means that exposures must be increased or the film will be underexposed, particularly in shadow areas.

To compensate for this, increase your indicated or measured exposure by the amounts shown in the chart above. Highlights are less subject to reciprocity failure during long exposures with some films, so to prevent too dense highlights when you increase exposure, decrease development time as shown in the chart.

Reciprocity: A film responds to light within a standard range of 1 second to 1/1000 second. There is a reciprocal relationship between exposure and light. For times beyond 1 second this reciprocal relationship breaks down because the film is less efficient in its ability to gather light.

To correct for this you will need to increase the exposure time as in the example in the chart above.

Exposing hard meter scenes

EXPOSING HARD-TO-METER SCENES

SITUATION	APPROXIMATE EXPOSURE FOR ISO 400 FILM	
Stage scene, sports arena, circus event	1/60 sec	f/2.8
Brightly lighted downtown street at night, lighted store window	1/60 sec	f/4
City skyline at night	1 sec	f/2.8
Skyline just after sunset	1/60 sec	f/5.6
Candlelit scene	1/8 sec	f/2.8
Campfire scene, burning building at night	1/60 sec	f/4
Fireworks against dark sky	1 sec (or keep shutter open for more than one display)	f/16
Fireworks on ground	1/60 sec	f/4
Television or computer monitor image: Focal-plane shutter speed must be 1/8 sec or slower to prevent dark raster streaks from appearing in photographs of the screen	1/8 sec	f/11
Leaf shutter speed must be 1/30 sec or slower to prevent streaks	1/30 sec	f/5.6

How to Bracket

Bracketing produces lighter and darker versions of the same scene and helps if you are not sure about the exposure. To bracket, make several exposures of the same scene, increasing and decreasing the exposure by adjusting the aperture, shutter speed, or both. Among several different exposures, there should be at least one that is correct. Professional photographers often bracket as protection against having to repeat a whole shooting session because none of their exposures was quite right. Bracketing is particularly useful when shooting transparency film, which has a very narrow exposure latitude.

To bracket by one stop, first make an exposure with

the aperture and shutter speed set at the combination you think is the right one or set by the automatic system. Then make a second shot with one stop more exposure and a third with one stop less exposure. In some situations you might want to bracket even more, giving two stops more exposure and two stops less.

Bracketing is easy if you set the exposure manually. For one stop more exposure, either set the shutter to the next slower speed or the aperture to the next larger opening (the next smaller f-number). For one stop less exposure, either set the shutter to the next faster speed or the aperture to the next smaller opening

(the next larger f-number).

NOTE: Bracketing is not always simple with an automatic exposure camera. In automatic operation, if you change to the next larger aperture, the camera will simply shift to the next faster shutter speed, resulting in the same overall exposure. Some cameras have features that override automatic exposure in order to provide bracketing. Other automatic cameras allow you to select a mode that automatically brackets for you. See page 97 for various means of overriding a camera's automatic system. See your manufacturer's instruction book for how to do so with your particular camera.

HOW TO BRACKET



Suppose an exposure for a scene is **1/60 sec shutter speed at f/5.6 aperture.**

Using any one of the combinations below will give exactly the same exposure:

Shutter speed	1/8	1/15	1/30	1/60	1/125	1/250 sec
Aperture	f/16	f/11	f/8	f/5.6	f/4	f/2.8

Bracketing for one stop less exposure. To lighten a negative (darken a slide) by giving one stop less exposure, use the next smaller aperture:

or the next faster shutter speed.

1/60
f/5.6 → f/8

1/60 → 1/125
f/5.6

Bracketing for one stop more exposure. To darken a negative (lighten a slide) by giving one stop more exposure, use the next larger aperture:

or the next slower shutter speed.

1/60
f/4 ← f/5.6

1/30 ← 1/60
f/5.6

A look at a 5 stop bracket

