EXPOSING FILM

Exposure is the action on the negative. Light strikes the film at certain points in the image. Where light strikes the silver halide grains, densities form. The more light, the greater the density. The greater the density, the more intense the exposure.

The factors that determine just how great a density will be on the negative are:

- **Exposure Time** is the length of time that film is exposed to light. In motion picture cameras, this is linked to the frame rate. When shooting sync sound at 24 frames per second, the exposure time is 1/48th of a second.
- **Film Sensitivity** is the ASA, or Exposure Index (EI), of a film. The faster the film, the larger and more sensitive the silver halide grains, and the higher its EI rating. It takes less light to make densities on faster films, and more light to make the same density on a slower film.
- **Aperture** is the size of the hole in the diaphragm through which the light passes in the lens.
- **Intensity of light** is a term that describes how much light that actually reflects off the subjects and is available for collection by the lens.

CONTROLLING THE VARIABLES

In order to achieve a normal exposure, we need to manipulate the above variables:

Variable	**Which is...**	**e.g.**
Exposure Time	expressed as a part of a second	1/48th
Film Sensitivity	expressed as a figure of exposure index	100 E.I.
Intensity of Light	expressed as a quantity of foot candles	100 f.c.
Aperture	expressed as an f/stop	f/2.8

Aperture

The aperture opening, sometimes referred to as the iris opening, is stated in stops (T-stops or f/stops) using the following numbers: 1.4, 2, 2.8, 4, 5.6, 8, 11, 16, and 22.

Stops

Stops can be thought of as calibrated foot-candles. They define the intensity (quantity) of light allowed to strike the film. A certain number of foot-candles bears little relevance outside its context as a variable in an exposure formula. When we say "one stop," we are expressing a quantity that is either twice as much light or half as much light.

T-Stops and F/Stops

When discussing lens aperture size, cinematographers usually refer to T-stops while still photographers refer to f/stops.

- The **f/stop** is a physical measurement of the theoretical ability of an ideal lens to pass light. By dividing the focal length of the lens by its iris diameter, the f/stop can be determined. Light, which is lost through the lens itself, is not considered in the f/stop calculation.

$$\text{f/stop} = \frac{\text{Lens Focal Length}}{\text{Diameter of Lens Aperture}} \qquad \text{f/1.4} = \frac{\text{50 mm}}{\text{36 mm}}$$

- The **T-stop** is a measurement of the actual amount of light a lens will pass after allowing for transmission losses due to absorption, internal reflections and light scatter. T-stops are determined for each particular type of lens since lens design, quality of the glass, number of elements and lens coatings do vary. Therefore, T-stops are more accurate than f/stops.

What relates the two is the lens' efficiency in transmitting light. If the lens could transmit all the light entering it, its T-stop and f/stop would be the same. Light meters mathematically calculate exposure in f/stops. Once you have determined the proper exposure, you can set the lens to the correct T-stop.

> Stops relative to exposure:
>
> - the smaller the number, the bigger the hole
> - the difference between the actual light that passes through the hole represented by any two consecutive stops is either double or half.

CALCULATING EXPOSURE

In motion picture cameras, the exposure time is linked to the frame rate, most often 24 frames per second. For that reason, we usually describe exposure time in terms of frame rate.

Identify the relationships between the variables in the following table:

fps	EI	f.c.	f/stop
24	100	100	2.8
24	200	50	2.8

Notice that the sensitivity of the film (EI) was doubled, so we required half as much light (f.c.) to arrive at the same exposure. Here's another:

fps	EI	f.c.	f/stop
24	100	100	2.8
24	50	200	2.8

CHANGING OTHER VARIABLES

You can change the f/stop, as well. Remember that opening the diaphragm of the lens by one stop actually doubles the amount of light passing through it. Conversely, closing it down by one stop halves the amount of light reaching the film.

fps	EI	f.c.	f/stop
24	100	100	2.8
24	100	200	4.0

Because f/4 allows half as much light to pass through the lens as does f/2.8, we must double the amount of light falling on our scene in order to arrive at the same exposure.

You can change more than two variables at once. For example:

fps	EI	f.c.	f/stop
24	100	100	2.8
48	400	100	4.0

Contrast refers to the tone separation in a negative (or print) in relation to a given difference in the light-and-shade of the subject from which it was made.

Latitude, in a photographic process, refers to the range of exposure that can be considered correct or useful.

Normal refers to an exposure judgement that accurately reproduces what we see. Usually we light faces of actors in order to make a normal exposure.

Generally speaking, the latitude of KODAK Color Negative Film is about 10 to 12 stops. That means that a face that is more than 5 to 6 stops darker than normal should appear simply as black, and a face that is 5 stops brighter than normal should look white.

To obtain the best exposure, err on the side of over-exposure to create a “bullet-proof” negative. It’s better to provide too much information on the negative than too little.

Process, or processing, is the act of developing the negative. By causing the exposed negative to interact with several chemical agents, like developer, fixer and bleach, we convert the latent image into a tangible, malleable color representation.

CAPTURE - IMAGE PROCESSING - OUTPUT

The entire analog image chain is designed to accommodate a normal exposure, normal processing, and normal printing. In fact, the system is nearly foolproof and endlessly forgiving when everything operates under normal parameters.

Cinematographers usually operate very close to that line of normalcy. Small adjustments in one or more of the image chain "links," however, can produce interesting outcomes that provide precise and repeatable control over a great number of image parameters.

NORMAL EXPOSURE

Always attempt to get the best latitude, grain, color, and sharpness from the stock that you’re using. A properly exposed negative will optimize all of these characteristics. Once you understand the film’s limits and capabilities,

you can be more confident while making tough, on-the-spot shooting decisions. Occasionally, you will deviate from the normal exposure. Based on whatever look you are trying to achieve, you may opt to over or under expose the stock.

Consistent exposure minimizes dependence on the laboratory's ability to compensate; as exposure correction always results in a trade-off in some area of image quality. Occasionally, cinematographers eschew normal exposure in deference to the look they're trying to achieve; they may choose to over-expose or under-expose the stock.

When corrected to a normal image, over-exposure results in:	**When corrected to a normal image, under-exposure results in:**
• Less apparent grain	• More apparent grain
• More saturated color	• Less saturated color
• Richer blacks	• Smoky blacks
• Increased contrast	• Lower contrast
	• Less perceived sharpness

> In his book *The Negative,* Ansel Adams states that under- and over-exposure refer to exposure errors, which is not always accurate. He preferred to use the terms increased or decreased exposure when referring to an intentional change from normal exposure.

"The stocks we're working with today are so amazing. Most people who aren't professionals can't tell the difference between Super 16 and 35 mm, even with a 500-speed stock."

—Uta Briesewitz, Cinematographer