# Setting Camera Exposure in Terms of Ev

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## ABSTRACT AND INTRODUCTION

In the 1950s, several camera and shutter manufacturers adopted systems for setting camera exposure through a single number that reflected the joint effect of both shutter speed and aperture. This quantity eventually came to be known as *exposure value* (symbolized Ev).

In this article we see what this is all about and how it has been supported in practice.

## HISTORICAL BACKGROUND

### Polaroid

In 1948, Polaroid introduced the first Land Camera (Model 95), which gave "pictures in a minute". On this camera, the user sets the exposure by setting a single dial, which was marked in terms of a number Polaroid called "Light Value" (LV). That number reflects the joint effect on exposure of shutter speed and aperture. For any setting of the dial, a preordained combination of shutter speed and aperture is put into effect, a combination whose joint effect corresponded to the indicated LV.

LV works on a logarithmic scale such that a change in the value by one unit represents a 2:1 change in exposure ("one stop"). Larger Ev numbers mean less exposure.

The Polaroid Model 80, the first "smaller format" Land camera, introduced in 1954, also used the same Exposure Value system.

### Kodak

In 1954, Eastman Kodak introduced, on the Retina Ib, IIc, and IIIc 35-mm cameras, a system in which exposure could be set by reference to a single number, which reflects the joint effect on exposure of shutter speed and aperture. Kodak also called this number "light value" (LV"). This quantity was identical in concept to the LV used in the Polaroid system, but the number itself has a scale starting at a substantially different point (the same value of the Polaroid LV and the Kodak LV represents exposure differing by 9 "stops").

**Industry standardization**

In the late 1950s, the concept of a single number to represent exposure on a logarithmic scale became part of a broader system called The Additive System of Photographic Exposure (APEX) being developed as an adjunct to an emerging new American Standard for photographic exposure meters (released in 1961). The quantity Polaroid and Kodak had called "Light Value" would be given the name "Exposure Value", a name that certainly better expressed its significance than did "Light Value". The numerical scale adopted for Exposure Value was essentially identical to that of the Kodak Light Value.

**Follow on by the manufacturers**

This standardization work was well along in 1957, and in that year Kodak, on the Retina IB, IIC, and IIIC (note upper case suffix letters), changed the designation of the quantity from "Light Value" to "Exposure Value" (Ev). The scale remained unchanged from that for Light Value on the earlier models (since Ev had been defined as identical to Kodak's LV).

Similarly, in 1957, Polaroid (in their 95B and 80A Land cameras), replaced the Light Value system with the Exposure Value system. They had to change the dial markings, since Polaroid's LV scale did not correspond to the emerging Ev scale.

In 1958, German shutter manufacturer Prontor Werk (a subsidiary of Zeiss) announced that versions of their Prontor SVS shutter would now be available with provision for setting or indicating exposure in terms of Exposure Value (Ev), following the emerging industry standard.

In the ensuing years, many other manufacturers introduced cameras (or shutters) with some provision for setting exposure in terms of Ev.

**EXPOSURE VALUE**

The rest of our main discussion will be in terms of the industry-standard concept of Exposure Value (Ev). We will revisit Light Value at the end.

**Formal definition**

As mentioned earlier, the quantity *exposure value* (symbolized Ev) reflects the joint effect of both shutter speed and aperture—a property we call exposure[1].

Ev is defined with a logarithmic scale such that a change in the value by one unit represents a 2:1 change in exposure ("one stop"). Larger Ev numbers

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[1] In one of two distinct formal meanings of that word.

mean less exposure. For example, a shutter speed of 1.0 sec and an aperture of f/1.0 would constitute an exposure of Ev 0, as would also a shutter speed of 2.0 sec and an aperture of f/1.4. A shutter speed of 1/128 sec and an aperture of f/5.6 would constitute an exposure of Ev 12, as would also a shutter speed of 1/256 sec and an aperture of f/4.0.

This concept forms part of the Additive System of Photographic Exposure (APEX), defined in the 1961 American Standard for photographic exposure meters. The APEX system also defines logarithmic forms of several other parameters involved in the matter of exposure: exposure time (shutter speed), aperture (f/number), film sensitivity (speed), scene luminance (brightness), and incident light illuminance. All the APEX quantities include the word "value" in their names, a cue that the logarithmic form is meant.

The scales of these quantities are arranged so that the fundamental "exposure equation" is very simple and just involves the addition of quantities.[2]

**Setting exposure when we have no exposure meter**

This discussion assumes a camera on which we can set shutter speed and aperture separately (not as on the Polaroid cameras discussed above).

Imagine now that our camera is arranged so that, if a certain shutter speed and aperture are set, an indicator tells us the corresponding value of Ev. If we didn't have an exposure meter, but had a "cheat sheet" that told us the expected value of scene illuminance in terms of incident light value (Iv) for various situations (*e.g.*, "midday full sun in May at the latitude of Dallas"[3]), we could take that value and add to it the speed value (Sv) for the film speed in use (Sv 5 for ISO 100, for example) to get the recommended exposure in Ev. (The basic "incident light metering" exposure equation, in APEX form, becomes $Ev = Iv + Sv$. This is why Ev is defined such that a larger value indicates a lesser exposure.)

Then, on the camera, we would set shutter speed and aperture to settings that together would indicate this value of Ev. We could of course play the familiar tradeoff between shutter speed and aperture, and so long as that same value of Ev was indicated, we would have the appropriate exposure.

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[2] It provides for a camera or meter manufacturer to "tweak" the equation to match its concept of "correct exposure", not by changing a constant in the equation but rather by adopting different scales for brightness value or incident light value.

[3] The famous "sunny 16" rule of thumb for exposure is actually predicated on the incident illumination being Iv 9.6.

## Automatic maintenance of Ev

Now, imagine a camera on which we could actually set a dial to a certain Ev, which would assure that as we changed shutter speed, aperture would change to follow as needed to hold that Ev. This would give us an even easier way to play the tradeoff between shutter speed and aperture for the desired exposure.

## Use with an exposure meter

Next suppose that we did have an exposure meter, one of the type which, our having "dialed in" the applicable film speed, would give us its exposure "recommendation" in terms of Ev [4]. We could set that value of Ev into the camera and then play the tradeoff between shutter speed and aperture on the camera, not needing to hover over the meter's calculator to do that and then carry two numbers—shutter speed and aperture— to the camera.

## An illustrative full implementation

Here we see a Prontor SVS shutter, size 0, with provisions for indicating and setting exposure in terms of Ev. It is on the author's Graflex Century Graphic press camera (2¼″×3¼″ format size).

Aperture lever (scale on top of shutter)
Sync/self timer lever (M-X-V)
Cable release socket
Shutter release lever
Century GRAPHIC
Cocking lever
Shutter speed dial
PC terminal (flash sync)
Ev coupler lever
Ev scale
Ev indicator/ setting lever
101 mm
GRAFLEX GRAFLAR f/4.5
PRONTOR SVS
Special

The Ev coupler lever determines whether or not, as the shutter speed dial is turned, the aperture setting also changes to maintain the Ev shown (or set) by the Ev indicator. The coupler is disengaged if the photographer wishes to set shutter speed and aperture independently and just be able to see the

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[4] Perhaps in addition to allowing us to see on the meter's calculator dial combinations of shutter speed and aperture that would also give the proper exposure.

resulting Ev. It is engaged if the photographer wishes to "set" the exposure in terms of Ev and play the tradeoff between shutter speed and aperture by simply moving the shutter speed dial.

## NOT TOO LITTLE BUT PERHAPS TOO LATE

Clever as though the system of setting exposure in terms of Ev is, it was doomed to a short life by the period in which it emerged, when automatic exposure cameras were becoming readily available. Their users did not need to deal with setting exposure numerically, and had no interest in a system to facilitate this. Thus, provisions for cameras to indicate, or allow control of, exposure in terms of Ev faded away as new models came into existence.

## THE FATE OF APEX

Although as we have seen above the concept of the Exposure Value (Ev) had considerable play in actual camera design for a while, the other aspects of APEX were rarely heard of except in scientific or engineering contexts. This was basically because the average working photographer never dealt with "the exposure equation" other than through the working of the calculator dial on an exposure meter or the working of an Ev system on a camera.

Today the APEX system is all but forgotten (except again in scientific and engineering work), and we mostly only find its shadow in two places where we encounter Ev.

The first place is in the "exposure compensation" feature of automatic exposure cameras (formally called "exposure bias"). This allows us to instruct the camera to adopt a higher or lower exposure (that is, value of Ev) than the automatic exposure system would normally enact for the scene. This may be done to attain a certain photographic effect, or to deal with an unusual scene situation that causes the automatic exposure system to be "misled" as to the appropriate exposure. Because the effect of this adjustment is on the Ev that is enacted, it is often denominated in "Ev units" (*e.g.*, "I set the exposure compensation to +2 Ev"), and in fact the setting is sometimes called the "Ev adjustment".

The second place is a perverted and improper usage of the quantity "Ev" to indicate scene brightness. (We see this in such camera specifications as, "the autofocus system can operate with scene brightness down to Ev 5.") Of course Ev is not properly a measure of scene brightness, but of exposure.

There is a perfectly good APEX quantity for scene brightness, *brightness value* (symbolized Bv). But evidently, since Ev was the only APEX quantity most photographers had ever heard of, manufacturers, for comfort, hijacked it to describe scene brightness. They did that by declaring (explicitly or implicitly), "When we describe a scene brightness in terms of Ev, we mean

the Ev that our camera[5], set for a film speed of ISO 100, would adopt for the scene."

We do not encourage nor endorse this usage.

**BACK TO LIGHT VALUE, LV**

The Polaroid and Kodak Light Value systems are certainly obsolete, although they are still of interest to those who collect or study the cameras on which they were implemented.

Like Ev, LV is the subject of many misunderstandings and misexplanations. These are often just manifestations of the same misunderstandings that abound with regard to Ev, exacerbated by the fact that different  "LV" scales were in use (*viz.*, the Polaroid and Kodak LV systems).

Many authors incorrectly describe LV as being a measure of scene **luminance** (and then sometimes compound the error by giving a table in units of **illuminance**, the measure of ambient illumination). One author describes it as "an indication of scene brightness, adjusted for the film speed in use." In a purely numerical sense that description is correct, but hardly helpful in revealing the concept.

There have probably been other uses of the term "Light Value".

Light value (LV) is in any case not part of APEX.

**READ MORE ABOUT APEX**

The entire APEX system is described at length in the companion article, *APEX—The Additive System of Photographic Exposure*, by this author.

**ACKNOWLEDGMENT**

Thanks to Al Olson of the Large Format Camera Forum for his helpful information on the adoption of exposure setting in terms of LV and then Ev by Kodak on their Retina series cameras.

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[5] The qualifier "for our camera" is rarely stated, but is unavoidable. The reason is that the scale of Bv varies with the manufacturer's choice of an "exposure philosophy".