Zone System

From Wikipedia, the free encyclopedia

The **Zone System** is a photographic technique for determining optimal film exposure and development, formulated by Ansel Adams and Fred Archer.[1] Adams described how the Zone System was developed: "I take this opportunity to restate that the Zone System is not an invention of mine; it is a codification of the principles of sensitometry, worked out by Fred Archer and myself at the Art Center School in Los Angeles, around 1939-40."[2]

The technique is based on the late 19th century sensitometry studies of Hurter and Driffield. The Zone System provides photographers with a systematic method of precisely defining the relationship between the way they visualize the photographic subject and the final results. Although it originated with black-and-white sheet film, the Zone System is also applicable to roll film, both black-and-white and color, negative and reversal, and to digital photography.

Contents

Principles

Visualization

An expressive image involves the arrangement and rendering of various scene elements according to photographer's desire. Achieving the desired image involves *image management* (placement of the camera, choice of lens, and possibly the use of camera movements) and control of *image values*. The Zone System is concerned with control of image values, ensuring that light and dark values are rendered as desired. Anticipation of the final result before making the exposure is known as *visualization*.

Exposure metering

Any scene of photographic interest contains elements of different luminance; consequently, the "exposure" actually is many different exposures. The exposure time is the same for all elements, but the image illuminance varies with the luminance of each subject element.

Exposure is often determined using a reflected-light[3] exposure meter. The earliest meters measured overall average luminance; meter calibration was established to give satisfactory exposures for typical outdoor scenes. However, if the part of a scene that is metered includes large areas of unusually high or low reflectance, or unusually large areas of highlight or shadow, the “effective” average reflectance[4] may differ substantially from that of a “typical” scene, and the rendering may not be as desired.

An averaging meter cannot distinguish between a subject of uniform luminance and one that consists of light and dark elements. When exposure is determined from average luminance measurements, the exposure of any given scene element depends on the relationship of its reflectance to the effective average reflectance. For example, a dark object of 4% reflectance would be given a different exposure in a scene of 20% effective average reflectance than it would be given in a scene of 12% reflectance. In a sunlit outdoor scene, the exposure for the dark object would also depend on whether the object was in sunlight or shade. Depending on the scene and the photographer’s objective, any of the previous exposures might be acceptable. However, in some situations, the photographer might wish to specifically control the rendering of the dark object; with overall average metering, this is difficult if not impossible. When it is important to control the rendering of specific scene elements, alternative metering techniques may be required.

It is possible to make a meter reading of an individual scene element, but the exposure indicated by the meter will render that element as a medium gray; in the case of a dark object, that result is usually not what is desired. Even when metering individual scene elements, some adjustment of the indicated exposure is often needed if the metered scene element is to be rendered as visualized.

Exposure zones

In the Zone System, measurements are made of individual scene elements, and exposure is adjusted based on the photographer’s knowledge of what is being metered: a photographer knows the difference between freshly fallen snow and a black horse, while a meter does not. Much has been written on the Zone System, but the concept is very simple—render light subjects as light, and dark subjects as dark, according to the photographer’s visualization. The Zone System assigns numbers from 0 through 10[5] to different brightness values, with 0 representing black, 5 middle gray, and 10 pure white; these values are known as *zones*. To make zones easily distinguishable from other quantities, Adams and Archer used Roman rather than Arabic numerals. Strictly speaking, zones refer to exposure,[6] with a Zone V exposure (the meter indication) resulting in a mid-tone rendering in the final image. Each zone differs from the preceding or following zone by a factor of two, so that a Zone I exposure is twice that of Zone 0, and so forth. A one-zone change is equal to one stop,[7] corresponding to standard aperture and shutter controls on a camera. Evaluating a scene is particularly easy with a meter that indicates in exposure value (EV), because a change of one EV is equal to a change of one zone.

Many small- and medium-format cameras include provision for exposure compensation; this feature works well with the Zone System, especially if the camera includes spot metering, but obtaining proper results requires careful metering of individual scene elements and making appropriate adjustments.

Zones, the physical world and the print

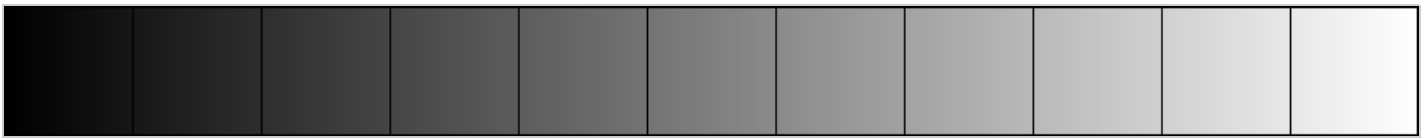
The relationship between the physical scene and the print is established by characteristics of the negative and the print. Exposure and development of the negative are usually determined so that a properly exposed negative will yield an acceptable print on a specific photographic paper.

Although zones directly relate to exposure, visualization relates to the final result. A black-and-white photographic print represents the visual world as a series of tones ranging from black to white. Imagine all of the tonal values that can appear in a print, represented as a continuous gradation from black to white:

Full Tonal Gradation

From this starting point, zones are formed by:

- Dividing the tonal gradation into eleven equal sections.

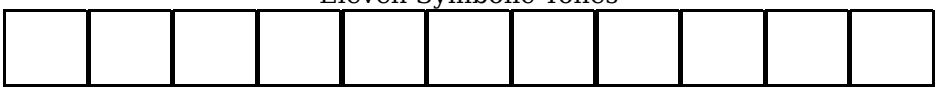


Eleven-Step Gradation

Note: *You may need to adjust the brightness and contrast of your monitor to see the gradations at the dark and light end of the scales.*

- Blending each section into one tone that represents all the tonal values in that section.

Eleven Symbolic Tones



- Numbering each section with Roman numerals from 0 for the black section to X for the white one.

The Zone Scale

0	I	II	III	IV	**V**	VI	VII	VIII	IX	X

Zones as tone and texture

Adams (1981, 52) distinguished among three different exposure scales for the negative:

- The full range from black to white, represented by Zone 0 through Zone X.
- The *dynamic range* comprising Zone I through Zone IX, which Adams considered to represent the darkest and lightest “useful” negative densities.
- The *textural range* comprising Zone II through Zone VIII. This range of zones conveys a sense of texture and the recognition of substance.

He noted that negatives can record detail through Zone XII and even higher, but that bringing this information within the exposure scale of the print is extremely difficult with normal processing.

Adams (1981, 60) described the zone scale and its relationship to typical scene elements:[8]

Zone	Description
0	Pure black
I	Near black, with slight tonality but no texture
II	Textured black; the darkest part of the image in which slight detail is recorded
III	Average dark materials and low values showing adequate texture
IV	Average dark foliage, dark stone, or landscape shadows
V	Middle gray: clear north sky; dark skin, average weathered wood
VI	Average Caucasian skin; light stone; shadows on snow in sunlit landscapes
VII	Very light skin; shadows in snow with acute side lighting

VIII	Lightest tone with texture: textured snow
IX	Slight tone without texture; glaring snow
X	Pure white: light sources and specular reflections

For cinematography, in general, parts of the scene falling in Zone III will have textured black, and objects on Zone VII will have textured white. In other words, if the text on a piece of white paper is to be readable, light and expose the white so that it falls on Zone VII. This is a general rule of thumb. Some film stocks have steeper curves than others, and the cinematographer needs to know how each one handles all shades of black-to-white.

Technique

Effective film speed

The ISO standard for black-and-white negative film, ISO 6:1993, specifies development criteria that may differ from those used in practical photography (previous standards, such as ANSI PH2.5-1979, also specified chemistry and development technique). Consequently, the Zone System practitioner often must determine the speed for a particular combination of film, developer, and enlarger type; the speed determination is commonly based on Zone I. Although the method for determining speed for the Zone System is conceptually similar to the ISO method for determining speed, the Zone System speed is an *effective speed*[9] rather than an ISO speed.

Exposure

A dark surface under a bright light can reflect the same amount of light as a light surface under dim light. The human eye would perceive the two as being very different but a light meter would measure only the amount of light reflected, and its recommended exposure would render either as Zone V. The Zone System provides a straightforward method for rendering these objects as the photographer desires. The key element in the scene is identified, and that element is *placed* on the desired zone; the other elements in the scene then *fall* where they may. With negative film, exposure often favors shadow detail; the procedure then is to

1. Visualize the darkest area of the subject in which detail is required, and place it on Zone III. The exposure for Zone III is important, because if the exposure is insufficient, the image may not have satisfactory shadow detail. If the shadow detail is not recorded at the time of exposure, nothing can be done to add it later.
2. Carefully meter the area visualized as Zone III and note the meter's recommended exposure (the meter gives a Zone V exposure).
3. Adjust the recommended exposure so that the area is placed on Zone III rather than Zone V. To do this, use an exposure two stops less than the meter's recommendation.

Development

For every combination of film, developer, and paper there is a "normal" development time that will allow a properly exposed negative to give a reasonable print. In many cases, this means that values in the print will display as recorded (e.g., Zone V as Zone V, Zone VI as Zone VI, and so on). In general, optimal negative development will be different for every type and grade of paper.

It is often desirable for a print to exhibit a full range of tonal values; this may not be possible for a low-contrast scene if the negative is given normal development. However, the development can be increased to increase the negative contrast so that the full range of tones is available. This technique is known as *expansion*, and the development usually referred to as "plus" or "N+". Criteria for plus development vary among different photographers; Adams used it to *raise* a Zone VII placement to Zone VIII in the print, and referred to it as "N + 1" development.

Conversely, if the negative for a high-contrast scene is given normal development, desired detail may be lost in either shadow or highlight areas, and the result may appear harsh. However, development can be reduced

so that a scene element placed on Zone IX is rendered as Zone VIII in the print; this technique is known as *contraction*, and the development usually referred to as "minus" or "N−". When the resulting change is one zone, it is usually called "N − 1" development.

It sometimes is possible to make greater adjustments, using "N + 2" or "N − 2" development, and occasionally even beyond.

Development has the greatest effect on dense areas of the negative, so that the high values can be adjusted with minimal effect on the low values. The effect of expansion or contraction gradually decreases with tones darker than Zone VIII (or whatever value is used for control of high values).

Specific times for N+ or N− developments are determined either from systematic tests, or from development tables provided by certain Zone System books.

Additional darkroom processes

Adams generally used selenium toning when processing prints. Selenium toner acts as a preservative and can alter the color of a print, but Adams used it subtly, primarily because it can add almost a full zone to the tonal range of the final print, producing richer dark tones that still hold shadow detail. His book *The Print* described using the techniques of dodging and burning to selectively darken or lighten areas of the final print.

The Zone System requires that every variable in photography, from exposure to darkroom production of the print, be calibrated and controlled. The print is the last link in a chain of events, no less important to the Zone System than exposure and development of the film. With practice, the photographer visualizes the final print before the shutter is released.

Application to other media

Roll film

Unlike sheet film, in which each negative can be individually developed, an entire roll must be given the same development, so that N+ and N− development are normally unavailable.[10] The key element in the scene is placed on the desired zone, and the rest of the scene falls where it will. Some contrast control is still available with the use of different paper grades. Adams (1981, 93–95) described use of the Zone System with roll film. In most cases, he recommended N − 1 development when a single roll was to be exposed under conditions of varying contrast, so that exposure could be sufficient to give adequate shadow detail but avoid excessive density and grain build-up in the highlights.

Color film

Because of color shifts, color film usually does not lend itself to variations in development time. Use of the Zone System with color film is similar to that with black-and-white roll film, except that the exposure range is somewhat less, so that there are fewer zones between black and white. The exposure scale of color reversal film is less than that of color negative film, and the procedure for exposure usually is different, favoring highlights rather than shadows; the shadow values then fall where they will. Whatever the exposure range, the meter indication results in a Zone V placement. Adams (1981, 95–97) described the application to color film, both negative and reversal.

Digital photography

The Zone System can be used in digital photography just as in film photography; Adams (1981, xiii) himself anticipated the digital image. As with color reversal film, the normal procedure is to expose for the highlights and process for the shadows.

Until recently, digital sensors had a much narrower dynamic range than color film, which, in turn, has less range than monochrome film. But an increasing number of digital cameras have wider dynamic ranges. One of the first was Fujifilm's FinePix S3 Pro digital SLR, which has their proprietary "Super CCD SR sensor" specifically developed to overcome the issue of limited dynamic range, using interstitial low-sensitivity photosites (pixels) to capture highlight details.[*citation needed*] The CCD is thus able to expose at both low and high sensitivities within one shot by assigning a honeycomb of pixels to different intensities of light.

Greater scene contrast can be accommodated by making one or more exposures of the same scene using different exposure settings and then combining those images. It often suffices to make two exposures, one for the shadows, and one for the highlights; the images are then overlapped and blended appropriately[1] (http://www.luminous-landscape.com/tutorials/digital-blending.shtml), so that the resulting composite represents a wider range of colors and tones. Combining images is often easier if the image-editing software includes features, such as the automatic layer alignment in Adobe Photoshop CS3, that assist precise registration of multiple images. Even greater scene contrast can be handled by using more than two exposures and combining with a feature such as Merge to HDR in Photoshop CS2 and later.

The tonal range of the final image depends on the characteristics of the display medium. Monitor contrast can vary significantly, depending on the type (CRT, LCD, etc.), model, and calibration (or lack thereof). A computer printer's tonal output depends on the number of inks used and the paper on which it is printed. Similarly, the density range of a traditional photographic print depends on the processes used as well as the paper characteristics.

Histograms

Most high-end digital cameras allow viewing a histogram of the tonal distribution of the captured image. This histogram, which shows the concentration of tones, running from dark on the left to light on the right, can be used to judge whether a full tonal range has been captured, or whether the exposure should be adjusted, such as by changing the exposure time, lens aperture, or ISO speed, to ensure a tonally rich starting image.[11]

Misconceptions and criticisms

The Zone System gained an early reputation for being complex, difficult to understand, and impractical to apply to real-life shooting situations and equipment. Noted photographer Andreas Feininger wrote in 1976,

> I deliberately omitted discussing the so-called Zone System of film exposure determination in this book because in my opinion it makes mountains out of molehills, complicates matters out of all proportions, does not produce any results that cannot be accomplished more easily with methods discussed in this text, and is a ritual if not a form of cult rather than a practical technical procedure.[12]

Much of the difficulty may have resulted from Adams's early books, which he wrote without the assistance of a professional editor; he later conceded (Adams 1985, 325) that this was a mistake. Picker (1974) provided a concise and simple treatment that helped demystify the process. Adams's later Photography Series published in the early 1980s (and written with the assistance of Robert Baker) also proved far more comprehensible to the average photographer.

The Zone System has often been thought to apply only to certain materials, such as black-and-white sheet film and black-and-white photographic prints. Adams (1981, xii) suggested that when new materials become available, the Zone System is adapted rather than discarded. He anticipated the digital age, stating

> I believe the electronic image will be the next major advance. Such systems will have their own inherent and inescapable structural characteristics, and the artist and functional practitioner will again strive to comprehend and control them.

Yet another misconception is that the Zone System emphasizes technique at the expense of creativity. Some practitioners have treated the Zone System as if it were an end in itself, but Adams made it clear that the Zone System was an *enabling* technique rather than the ultimate objective.

See also

- Densitometry
- Digital negative
- Grayscale

Notes

1. ^ *Encyclopedia Americana* **30**. Scholastic Library Publishing. 2006. p. 137. ISBN 0-7172-0139-2. "By 1939 he had devised the Zone System..." Robinson, Edward M. (2007). *Crime scene photography*. Academic Press. p. 72. ISBN 0-12-369383-7. "...Ansel Adams' zone system, formulated in 1939–1940."
2. ^ Dowdell, John J.; Zakia, Richard D. (1973). *Zone systemizer for creative photographic control, Part 1* (http://books.google.com/books?id=F8hTAAAAMAAJ&q=%22Fred+Archer%22+zone+system&dq=%22Fred+Archer%22+zone+system&hl=en&ei=OGL0TdiKEcbbiALLrZGmBw&sa=X&oi=book_result&ct=result&resnum=10&ved=0CFQQ6AEwCTgU). Morgan & Morgan. p. 6. ISBN 978-0-87100-040-8.
3. ^ Adams (1981, 30) considered the incident-light meter, which measures light falling *on* the subject, to be of limited usefulness because it takes no account of the specific subject luminances that actually produce the image.
4. ^ A typical scene includes areas of highlight and shadow, and has scene elements at various angles to the light source, so it usually is possible to use the term “average” reflectance only loosely. Here, “effective” average reflectance is used to include these additional effects.
5. ^ Adams (1981) designated 11 zones; other photographers, including Picker (1974) and White, Zakia, and Lorenz (1976) used 10 zones. Either approach is workable if the photographer is consistent in her methods.
6. ^ Adams (1981) distinguished among *exposure zones*, *negative density values*, and *print values*. The negative density value is controlled by exposure and the negative development; the print value is controlled by the negative density value, and the paper exposure and development. Commonly, “zone” is also used, if somewhat loosely, to refer to negative density values and print values.
7. ^ Photographers commonly refer to exposure changes in terms of “stops”, but properly, a stop is a device that regulates the amount of light, while a step is a division of a scale. The standard exposure scale consists of power-of-two steps; a one-step exposure increase doubles the exposure, while a one-step decrease halves the exposure. Davis (1999, 13) recommended the term “stop” to avoid confusion with the steps of a photographic step tablet, which may not correspond to standard power-of-two exposure steps. ISO standards generally use “step”.
8. ^ Adams’s description of zones and their application to typical scene elements was somewhat more extensive than the table in this article. The application of Zone IX to glaring snow is from Adams (1948).
9. ^ The effective speed determined for a given combination of film and developer is sometimes described as an “Exposure Index” (EI), but an “EI” often represents a fairly arbitrary choice rather than the systematic speed determination done for use with the Zone System.
10. ^ If a roll-film camera accepts interchangeable backs, it is possible to use N+ and N− development by designating different backs for different development, and changing backs when the image so requires. Without interchangeable backs, different camera bodies can be designated for different development, but this usually is practical only with small-format cameras.
11. ^ Discussion on how histograms can be used to implement the Zone System in digital photography (http://www.illustratedphotography.com/basic-photography/zone-system-histograms)
12. ^ Feininger, Andreas, *Light and Lighting in Photography*, Prentice-Hall, 1976

References

- Adams, Ansel. 1948. *The Negative: Exposure and Development*. Ansel Adams Basic Photography Series/Book 2. Boston: New York Graphic Society. ISBN 0-8212-0717-2
- Adams, Ansel. 1981. *The Negative*. The New Ansel Adams Basic Photography Series/Book 2. ed. Robert Baker. Boston: New York Graphic Society. ISBN 0-8212-1131-5. Reprinted, Boston: Little, Brown, & Company, 1995. ISBN 0-8212-2186-8. Page references are to the 1981 edition.
- Adams, Ansel. 1985. *Ansel Adams: An Autobiography*. ed. Mary Street Alinder. Boston: Little, Brown, & Company. ISBN 0-8212-1596-5
- ANSI PH2-1979. *American National Standard Method for Determining Speed of Photographic Negative Materials (Monochrome, Continuous-Tone)*. New York: American National Standards Institute.
- Davis, Phil. 1999. *Beyond the Zone System*. 4th ed. Boston: Focal Press. ISBN 0-240-80343-4
- ISO 6:1993. *Photography—Black-and-White Pictorial Still Camera Negative Film/Process Systems*. International Organization for Standardization (http://www.iso.org).
- Latour, Ira H. 1998. *Ansel Adams, The Zone System and the California School of Fine Arts*. History of Photography, v22, n2, Summer 1998, pg 148. ISSN 0308-7298/98.
- Picker, Fred. 1974. *Zone VI Workshop: The Fine Print in Black & White Photography*. Garden City, N.Y.: Amphoto. ISBN 0-8174-0574-7
- White, Minor, Richard Zakia, and Peter Lorenz. 1976. *The New Zone System Manual*. Dobbs Ferry, N.Y.: Morgan & Morgan ISBN 0-87100-100-4

Further reading

- Farzad, Bahman. *The Confused Photographer's Guide to Photographic Exposure and the Simplified Zone System*. 4th ed. Birmingham, AL: Confused Photographer's Guide Books, 2001. ISBN 0-9660817-1-4
- Johnson, Chris. *The Practical Zone System, Fourth Edition: For Film and Digital Photography*. 4th ed. Boston: Focal Press, 2007. ISBN 0-240-80756-1
- Lav, Brian. *Zone System: Step-by-Step Guide for Photographers*. Buffalo, NY: Amherst Media, 2001. ISBN 1-58428-055-7

External links

- A basic explanation (http://original.srphotography.co.uk/srpzone.html)
- A simplified Zone system for making good exposures (http://www.normankoren.com/zonesystem.html), also very practical
- Clarkvision (http://www.clarkvision.com/imagedetail/dynamicrange/index.html) More about digital dynamic range
- A Simplified Zone System (http://www.luminous-landscape.com/tutorials/zone_system.shtml)
- Guide to Exposure from the Zone System to HDRi (http://blog.rolfes.co.uk)