The Zone System in Digital Photography

The Zone System was formulated by Ansel Adams and Fred Archer around 1939–40 as a photographic technique for determining optimal exposure and development for black and white (B&W) film.

The goal is to produce a negative that can be used to make a print that can display the full range of tones that the photographer visualizes belong in the final image.

The print brightness falls into a range from the darkest possible tone to the brightest possible white:

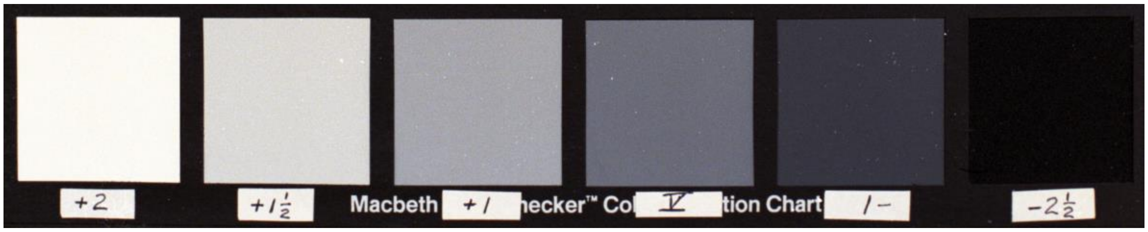
Zone	Description
0	Pure black - no detail
I	Near black, with slight tonality but no texture
II	Textured black; the darkest part of the image in which slight detail is recorded
III	Average dark materials and low values showing adequate texture
IV	Average dark foliage, dark stone, or landscape shadows
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 - paper white, no detail

These eleven zones are not aligned with exposure stops although the three middle zones (IV, V and VI) might be very close to what is captured within a three stop range around middle gray. That is where the image has the highest contrast and where it is easier to perceive detail

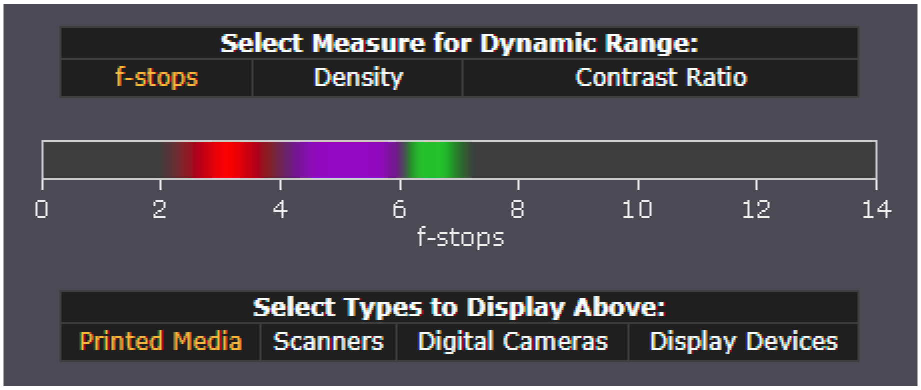
How does this relate to digital imaging? It may be B&W or it may be color but the final product is the same. You look at it as a print or on a display but you might never know or care whether the original information was captured on film or on a sensor.

Between Zones 0 and X there are nine zones that contain a gradual transition from dark to light. As the tones get closer to the middle it becomes easier to see tonality, texture and detail – in that order.

The nine zones where we can see tonality are not evenly distributed.

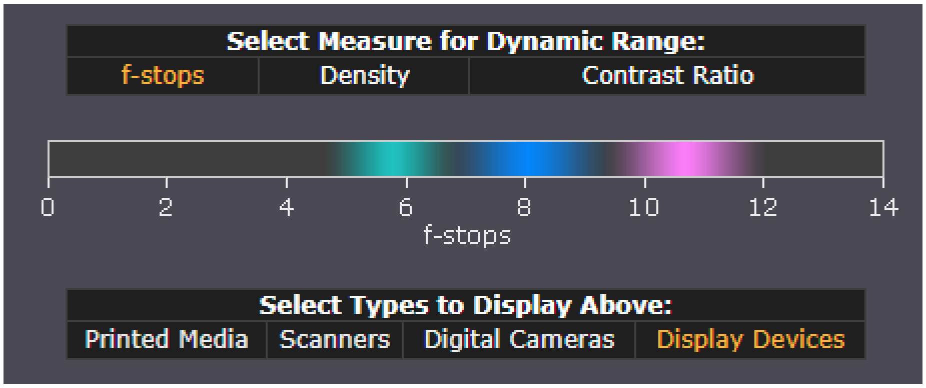


This is an image from a standard color checker with the white and black squares placed in Zones I and IX. The image was captured in broad daylight and the squares metered with two different spot meters. The readings show a dynamic range (DR) of 4½ stops. That is in agreement with information published in DYNAMIC RANGE IN DIGITAL PHOTOGRAPHY which also shows about the same result.



Since Zones IV, V and VI cover about three stops of DR, that leaves only 1½ stop remaining for a print to be distributed over the remaining six zones – I, II, III, VII, VIII and IX. Prints are best viewed in uniform light so lighting can't increase the DR. That means gradually less contrast as you approach the extremes.

But if you are looking at an image on your computer there is a little more DR.



There are almost seven total stops of DR. As was the case with projected slides or backlit transparencies, displays are better viewed under low light conditions. What happens with the extra 2½ stops of DR? Is the contrast loss more gradual outside the middle three zones? Or are there more than three zones in the middle with the about same contrast?

Because of the difference between a display and a print it may be challenging to create an image that looks the same printed as it does on a calibrated display. The ideal of “what you see is what you get” (WYSIWYG) may not be fully achievable.

But that does not alter the validity of the zone descriptions. They can still describe a print, even a color print, as well as a displayed image. It’s just that which zone a particular portion of the scene falls into might be a little different for the print than it is for a display.

An image might also look different printed on matte, glossy or semi-glossy photo paper. The extreme zones can shift.

They also shift when you recover highlights or shadows, change the contrast or brightness of the image or change the white or black point.

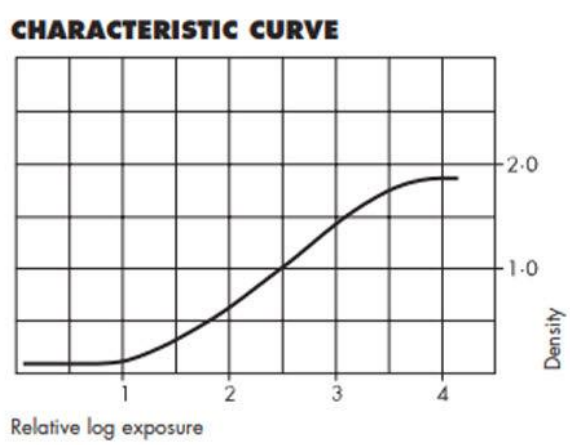
The brightest highlights on the screen (clouds, feathers, snow, sea foam) are neutral white. But if the paper is not neutral white they can't be made neutral by adding ink to them.

At the other end, the darkest blacks depend on the neutral color of the black ink (not a problem) and the way they reflect ambient light depending on the paper surface. Matte paper needs matte black ink because it works with the paper. It makes the blacks look deeper by suppressing the specular reflections from the paper fibers on the surface.

Finally, all of the colors and tones in between maximum black and paper white are affected by the ambient light, the paper's surface and color. That's where the paper profile comes in but its effectiveness still depends on the color and intensity of the ambient light.

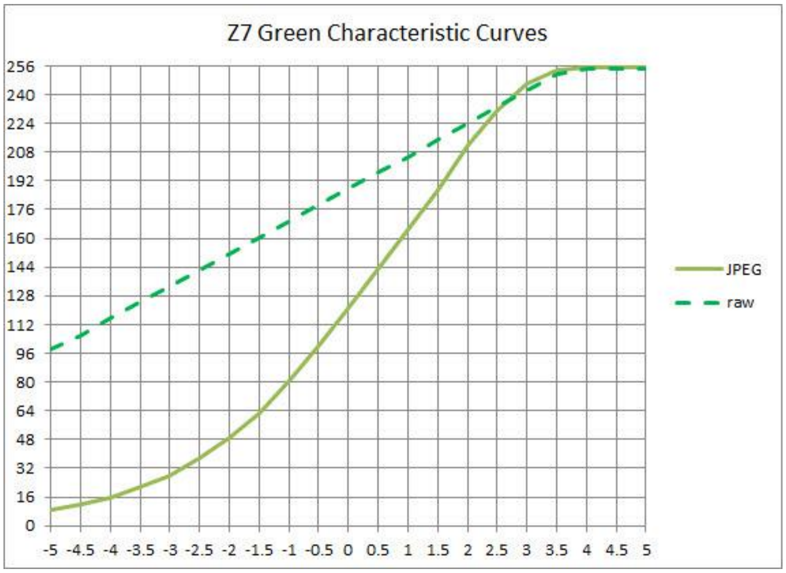
Characteristic Curves

Film does not have a linear response to light. A typical response forms a shape known as an “S” curve with a foot at the bottom and a shoulder at the top.



The film's response can be modified by changing development. This affects the highlights more than the shadows. But the general shape of the curve remains.

But raw digital response is linear up to the point where the raw values reach their limit. That would produce an image with a constant low contrast unless the raw conversion process modifies the contrast throughout the JPEG range. The Nikon Z7 is typical:



Exposures were taken at half stop increments from five stops below through five stops above middle gray. The raw values are potted against the JPEG range of 0 through 255.

No highlights could be recorded in the raw data above 3.5 which is three stops brighter than Zone V. But it's clear that the raw file has the ability to record information much darker than five stops below middle gray.

Middle gray is within Zone V which has a range of 100 to 143. In order to represent a full range of tonalities the JPEG values need to be bent into an "S" curve like the one for film.

The characteristic curves for a typical JPEG end up being pretty much the same as those for film. That's why the Zone System's print zone descriptions table can be used with digital images.