Film Exposure Index - Personal Film Speed Test
(Requires a Densitometer)

This is a quick, easy exercise that allows each photographer to set his personal film speed with his camera, meter and developing method. The camera, metering method, film type, developer, developer dilution, developer temperature and development agitation method must remain constant for this test to be effective.

Load the camera with the film you intend to test. Advance the film to frame two or three making sure the film is advancing properly. The first two pictures will be your ID card and the film box. This lets you know who shot the film and what type of film it is. From here on out it is important to keep good notes. Write down the film ASA. Write down the Exposure Index you are using to shoot the film. This number may be different than the manufacturer rated ASA/ISO. For example: Tri-X is often rated at EI 200, EI 320 or EI 400 depending on the film developer and developing method.

1. Place a gray card in any even light (open shade is preferred). The north side of a building works well. The light must be even across the entire gray card.

2. Mount the camera on a tripod. This ensures that the camera does not shake at slow shutter speed settings. It also lets the photographer meter and photograph the gray card in the same position without moving the camera. Using a tripod is important to maintain consistency.

3. Position the gray card so that it fills the frame. There should be no background showing, just the gray card.

4. Focus on infinity. The gray card will no longer be in focus. This gives us pure gray tones in the viewfinder instead of extraneous textures. Focus is not important for this exercise.

5. Using the camera on all manual settings, set the ASA/ISO at four times the manufacturers recommended film speed. Expose the first frame at the indicated meter reading (make a note of the Exposure Index and the meter reading). The meter reading is Zone V. Stop the lens down five stops and expose the next frame. This is Zone 0. Now open the lens up one stop and expose the next frame. This is Zone I. You have now taken a total of three exposures at this Exposure Index.

6. Set the film speed at twice the manufacturers recommended ASA/ISO. Repeat the procedure for metering the card and taking a Zone V exposure, Zone 0 exposure and Zone I exposure. Keep notes on the frame number, Exposure Index rating and the exposure.

7. Continue to cut the film speed in half and repeat the procedure until you have reached one-eighth or one-sixteenth the manufacturers film speed. The sequence should be shot on the following exposure indexes for a film rated at ASA 400 by the manufacturer (ie. Tri-X, T-Max 400, HP5 Plus or Ilford Delta 400) the Exposure Indexes will be 1600, 800, 400, 200, 100, 50 and 25. For a film rated at ASA 100 (ie. T-Max 100, Ilford Delta 100) the Exposure Indexes will be 400, 200, 100, 50, 25 and 12.
8. Rewind the film and develop at the suggested normal time.

9. Read the negatives on the densitometer. *Your exposure index for the film and developer combination will be where the Zone I densitometer reading is .8 to .11 above the clear film reading.* The clear film reading is called the film base plus fog. A perfectly clear piece of film would read 0.0 on the densitometer. Since a 0.0 reading is physically impossible to achieve, we call the apparently clear piece of film the film base plus fog reading. Please note that some Ilford films (FP5+ and FP4+) have an unusually high film base plus fog, but produce excellent prints.

I tested T-Max 100 and had a .21 film base plus fog reading. My Zone I reading will now be between .29 and .32. This happened at somewhere between EI 100 and EI 50. The Zone I was .26 at EI 100 and .35 at EI 50. I extrapolated and now rate my film at EI 80 with D-76 developer used in a 1:1 dilution with water, developed at 72-degrees. I will not give you my film developing time because your results may not be the same as mine.

When in doubt always rate your film speed lower. It is always better to overexpose to make sure the shadow detail is recorded. Highlights may be controlled through development. The old adage of expose for the shadows and develop for the highlights holds true. Slight overexposure of the film helps record shadow detail. The shadow detail will be fully developed within half or three-quarters of the manufacturers recommended development time so all that keeps developing is the highlights. Under development keeps the highlights in control by not allowing them to fully develop and blow out the scene by bleeding into the shadows. Over exposure coupled with under development maintains a normal contrast level in the scene and still gives full detail in the shadows.

Please note that this exercise does not always hold true for Ilford XP2 Super and Kodak T400CN, Kodak Select and Kodak Portra Black & White films. Ilford XP2 Super and Kodak T400CN are chromogenic films (they use color dyes instead of silver halides). They are basically color negative films made to produce black and white prints. They are developed in color negative chemicals (process C-41) and printed as a traditional black and white negative. My recommendation is to do the exercise and see the results for yourself. I tend to rate XP2 and T400CN at EI 200 or EI 320 instead of EI 400, because I intentionally overexpose all my color negative films to gain more shadow detail and color saturation. It is also important to note that chromogenic films (films that use dyes instead of traditional silver halides) are not as sharp as silver based films due to the nature of the dyes being transparent and smooth edged instead of black (opaque) and sharp edged.
Pragmatic Film Exposure Index Test

An exposure index (EI) is the rating you have personally given the film. For instance, if you are shooting T-Max 100 at ISO 80 then you have given the film an exposure index of 80 instead of the manufacturers ISO of 100.

This is a good pragmatic film exposure index test that does not require a densitometer. Using your normal EI rating or the film manufacturers’ ISO rating, meter a person’s face for the skin tone and open up one stop to place a Caucasian skin tone in Zone VI. If you are shooting a darker skinned person keep the meter reading of Zone V. Now back up and shoot the portrait including the head and shoulders of the subject. Do not include anything below the waist because we are going to compare skin tones. Continue the exercise by shooting portraits at twice the ISO, four times the ISO, one-half the ISO and one-quarter the ISO. It is helpful to have the person hold a card with the film type, normal ISO and the Exposure Index you are using to shoot that particular portrait.

Go back to the darkroom and develop the film as you would normally. Then print one negative of each exposure index rating without using a filter. You may change the time to compensate for density of the negative, but keep all other factors constant (ie. enlarger, lens, developer, paper, filtration, etc.). Try to match the skin tone as closely as possible for each portrait. Do not concern yourself with the background or the tones in the clothing, simply try to match the skin tones as closely as possible.

Several things should become noticeable when you spread the prints out from lowest to highest EI ratings. First, pick out the EI that made the best print. This is now your new EI, it may not be the manufacturers ISO rating. Use this Exposure Index every time you shoot this film until you have the opportunity to do formal zone system densitometry tests.

Notice the contrast differences. Contrast is veiled on the over exposure side and increased when the film is under exposed. If you have to err, will you over expose or under expose? I would over expose to get the detail then possibly choose to under develop to control the highlights, but the great thing is that everybody gets to make their own choice by looking at their own work.

I chose to shoot T-Max 100. The EI that turned out the best was a toss-up between EI 100 and EI 50. I will continue to shoot T-Max 100 rated at my personal EI rating of 80 to maintain shadow detail.
The Zone System is a simple exposure and development system. It lets the photographer calibrate his camera and meter to his film and developer (and developing methods) to get the full advantages of all the materials he uses on a regular basis. It is based on consistent metering, exposure and development. This exercise is very similar to the personal exposure index exercise, but goes much farther in depth.

1. First things first, since there will be many people shooting and developing this exercise at the same time the first frame or two on the roll of film should either be a portrait of yourself or a picture of your ID card.

2. Set up a gray card in even light. Preferably in open shade.

3. Place the camera on a tripod.

4. Fill the viewfinder with the gray card. There should not be anything other than the gray card visible in the viewfinder.

5. Focus on infinity to get solid tone instead of texture. The gray card will be very blurry at this point.

6. Set the camera or meter ISO to your personal exposure index (EI) or the manufacturers recommended ASA/ISO.

7. Make sure the gray card is in even light (no mottled light or half shadows on the card) and meter it with your camera’s internal meter or a hand meter.

8. Shoot the first frame at the indicated meter reading (IMR) which is Zone V.

9. Stop down five stops to Zone 0 and shoot the next frame. Note: Stopping down five stops is decreasing the light by five stops which may either be done by increasing the shutter speed or increasing the f-stop on the lens. You may not have enough shutter speeds or f-stops to stop down five-stops without using a combination of increased f-stops and shutter speeds.

10. Open up one-stop and shoot Zone I. Opening up one-stop may either be done by decreasing the shutter speed by one stop or decreasing the f-stop by one stop.

11. Continue to open up one-stop and shoot a frame until you have taken 15 frames (Your ID Card or Identifiable Portrait (properly exposed), Zone V, then Zone 0, Zone I, Zone II, etc... through Zone 12).

12. Shoot three rolls of each film you intend to test in the manner described above. The rolls need to be shot in the same open shade lighting conditions at a time when the light is not shifting. Each roll can be shot in the matter of two or three minutes from the time you take your meter readings.
13. Develop the first roll at the manufacturer’s recommended time for your film, developer and temperature combination. This may be hanging up on a chart in the photo lab, be an instruction sheet in your film box, be found written on the inside of your film box or taken from the film manufacturer’s web site.

14. Develop the second roll for 20% less time than the first roll. When you do this all variables must be constant. The film should be developed in the same developer, at the same dilution, the same temperature with the same agitation process, fixed and washed the same amount of time, etc. Consistency is paramount for film processing.

15. Hold the third roll for processing at a later time.

15. Read the densities and plot the results on a density over time graph. Note where Zone VIII should be for your type of enlarger (condenser: 1.15-1.25 above film base plus fog or diffusion/cold light: 1.25-1.35 above film base plus fog). With our darkroom, we will be aiming for the diffusion light reading of 1.25-1.35 above film base plus fog.

16. Plot the point where Zone VIII density should be, then draw a line straight down to find your normal development time. Develop the third roll at the time you have just extrapolated from the graph, read the densities and plot it as verification.

17. Another method of verification is to shoot a roll of portraits (remembering to place Caucasian skin in Zone VI). Develop according to the times on your chart and print without using filters. If it verifies that the skin tone looks good on a grade two paper the exercise has been done properly.

An extra advantage to the graph that has been made is the Normal, Normal + and Normal - development times needed to properly use the Zone System of Development Expansion and Contraction. Trace the graphed Zones from one density to another and draw the line down to find the proper development times for expanding the contrast in a scene or contracting the contrasty highlights in a scene.

This exercise is great because you can effectively extrapolate your personal Exposure Index from the film that has been shot and developed as well as using the graph to verify exposure and development times. The graph also gives times for expansion and contraction of the Zone System.

It is the most important exercise in photography control taught and used in the course.

Your personal exposure index for the film and developer combination will be where the Zone I densitometer reading is 0.8 to 0.11 above the clear film reading.

** Density (information and detail captured on the film) is controlled through exposure. Contrast (tonal separation between shadow and highlight) is controlled through development.

We will plot the graphs in class and discuss everyone’s personal results before the last (third) roll of film is developed.

Our goal is to find out how our exposure, film, developer, and developing method combination works for us.
**Film Base + Fog** is basically clear film. It is the film that has not been exposed, or not received enough exposure to break the threshold of the light sensitive emulsion. We may refer to it as a **Zone 0** exposure.

The Film Base + Fog Reading usually falls between .15 and .35, some films are slightly higher and some films are slightly lower.

**Zone I** is between .8 to .11 above Film Base + Fog

**Zone V** is generally between .65 and .75 above Film Base + Fog

**Zone VIII** is between 1.25 and 1.35 above Film Base + Fog for Diffusion Enlargers
or 1.15 to 1.25 above Film Base + Fog for Condenser Enlargers

**Normal or “N” in the Zone System** refers to Normal Exposure and Normal Development. Normal exposure and normal development render a scene exactly as they appear the moment the picture is taken. If the scene has too much contrast then it will come through that way. If the scene is flat or lacks contrast then normal exposure and normal development will render the scene flat or lacking in contrast.

**Expanding Contrast** is over developing film so that you effectively give a lower contrast exposure a higher contrast print value. For Example: If your scene only has four zones of exposure/contrast in it then you may choose to expand the negative contrast by over developing to make a print that has more tonal range in it. This practice is commonly referred to as N+ (N Plus) development.

**Contracting Contrast** is under developing film so that you effectively give a higher contrast exposure a lower contrast print value. For Example: If your scene has six zones of exposure/contrast in it you may choose to contract the contrast by under developing the film to bring the negative down to a five-stop contrast range for printing on modern gelatin silver enlarging papers. Under developing film that you know has too many stops of contrast to print on modern silver gelatin enlarging papers will keep you from having blown out highlights that are very hard to print (burn-in). This practice is commonly referred to as N – (N Minus) development.

**Exposure** is the combination of light intensity (aperture / f-stop) and the amount of time the light has access to the film or paper (shutter speed or time). **Exposure = time x intensity**

**Opening-Up** refers to an increase in exposure. This may be done by decreasing your shutter speed (lower numbers) to let in more light or increasing the size of your aperture to increase the intensity of the light. Remember that a larger aperture diameter is referred to as a smaller f-stop number.

**Closing Down** refers to a decrease in exposure. Decreasing exposure may be done by increasing the speed of the camera shutter (higher numbers) to let in less light or decreasing the size of the aperture diameter by turning the aperture dial to a larger f-stop number and making the light less intense.
The Zone System

**Zone IX**  
Paper White ... No Detail ... 4 Stops More Light Than Zone V (IMR)

**Zone VIII**  
Last Sign of Detail in Light Values in a Print ... Sunlight on White Clothes ... Dairy Queen Ice Cream ... 3 Stops More Light Than Zone V (IMR)

**Zone VII**  
Fully Textured Light Area ... Light Blonde Hair ... Fisherman’s Sweater ... Grits ... French Vanilla Ice Cream ... 2 Stops More Exposure Than Zone V (IMR)

**Zone VI**  
Caucasian Skin in Light ... One Stop More Light Than Zone V (IMR)

**Zone V**  
18% Gray ... Middle Gray ... Green Grass ... Black Skin Tone ... North Sky ... IMR

**Zone IV**  
Open Shadows in a Landscape ... Shadow Value for Caucasian Portrait ... Brown Hair ... Fully Textured Dark Value ... One Stop Less Light Than Zone V (IMR)

**Zone III**  
First Sign of Detail in Dark Values ... First Suggestion of Texture ... Black Hair or Clothing ... Very Dark Shadows ... Two Stops Less Light Than Zone V (IMR)

**Zone II**  
Tonally Separate from Zone I, but No Detail Yet ... Three Stops Less Light Than Zone V (IMR)

**Zone I**  
Effective Threshold of Film ... Film Begins to Respond, but Will Appear as Black in Print From a Small Format Negative ... Four Stops Less Than Zone V (IMR)

**Zone 0**  
Film Base Plus Fog ... Clear Film ... Blackest Black ... Five Stops Less Light Than Zone V (IMR)

**IMR = Indicated Meter Reading, a Zone V exposure**

To place something that you have metered in a Higher Zone (Lighter than Middle Gray) you open up to let light in more light. To place something in a Lower Zone (Darker than Middle Gray) you stop down to let in less light.

Zone System Information provided by Craig Stevens
Negative Densities Correlated with Zones

The Zone system is based on the concept of visualization. The final print can be seen in the “mind’s eye” when making photographs. In order to produce a print with the desired qualities a negative must be made that contains the appropriate densities for the desired effect.

Listed below you will find the Zones correlated with some suggested densities. Just as each film and developer combination has its own unique characteristic curve, so each film and developer combination will yield slightly different densities. Remember, it's called the Zone System, not the pin-point system. All we are aiming for is our densities to be in the ball park of the suggested densities.

The densities listed here are from a particular film/developer combination. In this case it is 4x5" Tri-X Professional film tray developed with continuous agitation for 9 minutes at 68-degrees in Kodak HC-110 developer diluted 1:15 from stock solution.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Density</th>
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<tbody>
<tr>
<td>0</td>
<td>Film Base + Fog</td>
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<tr>
<td>I</td>
<td>.10</td>
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<tr>
<td>II</td>
<td>.22</td>
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<td>III</td>
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<td>VI</td>
<td>.88</td>
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<td>VII</td>
<td>1.07</td>
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<tr>
<td>VIII</td>
<td>1.30</td>
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<tr>
<td>IX</td>
<td>1.53</td>
</tr>
<tr>
<td>X</td>
<td>1.78</td>
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</tbody>
</table>

The densities above would represent a normally developed negative that should print well on a grade 2 “normal” contrast paper by contact or with a diffusion enlarger (cold light head, diffusion dichroic color head, or diffusion variable contrast head). To produce a similar print on the same contrast paper with a condenser light source would require a negative of somewhat lower contrast.

Zone System Information provided by Craig Stevens