Pre-Exposure - Putting that Film Curve to Work

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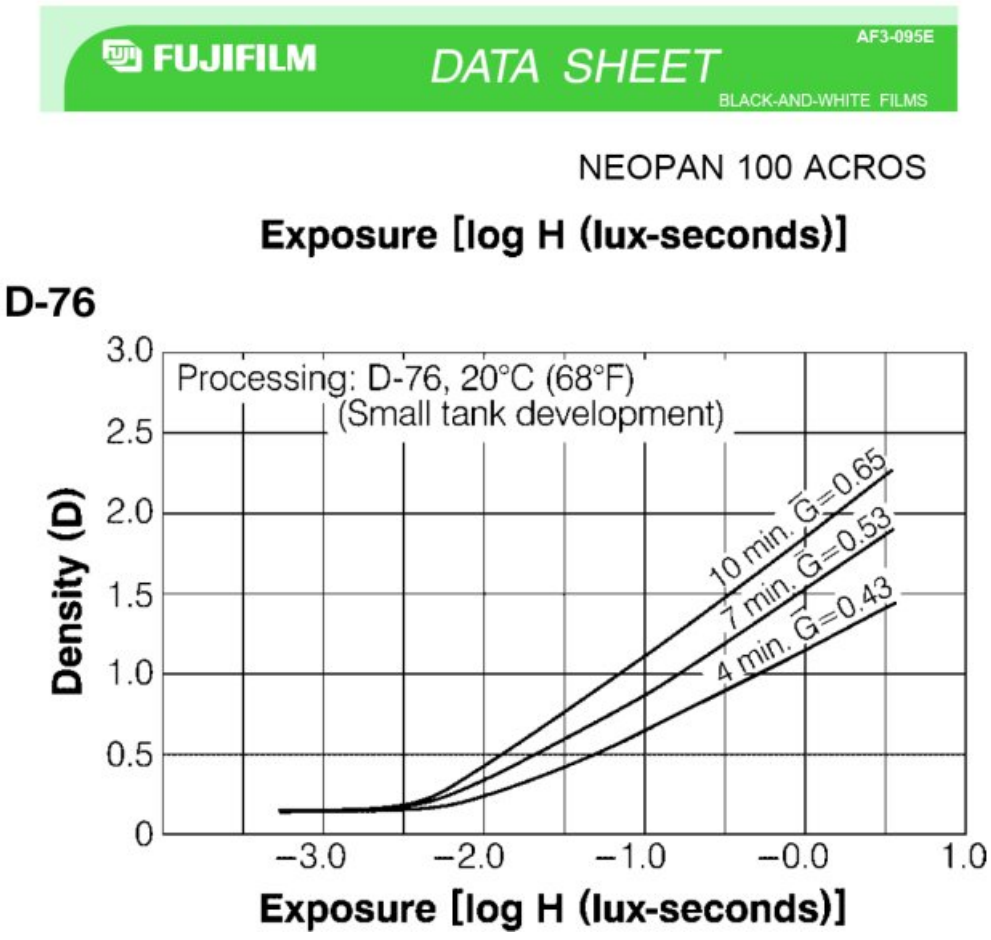
Have you ever wanted to shoot a night, low light, or astronomical scene with a fine grain film ?

A common tactic is simply to Push process the film by lengthening the development time, but there are trade offs here. For one thing, the grain is no longer as fine as it could have been. Then, absolute darks become fogged reducing contrast. Worse still are the highlights which can easily be over developed and loose detail while little improvement in the low light details is realized.

Here is an actual film characteristic curve to help you understand:



This is a film exposure characteristic curve that Fujifilm publishes in their data sheet for the Neopan 100 Acros fine grain BW film and shows the results of varying the development time at 20°C with Kodak D-76. The greatest impact of development time is seen at the areas of greatest exposure. Down at an exposure of -2.0, there really is not much difference and if you are hoping to bring out details where the exposure is a mere -2.5 or -3.0, development time has no impact and the density remains at the film's baseline fog level. Worse still is the film has nearly no sensitivity to the effects of light levels below -2.25, so any area of a scene at or below this exposure leaves no detail on the film.

Just as with Pushing the development time, another simple tactic is to lengthen the exposure time. If the light level is so low, longer exposures will, well should, yield an acceptable or discernible exposure. But, you need to remember that the horizontal axis of the film characteristic curve is a base 10 logarithm of the product of light level and exposure time. If you work out the math, for each 1 EV increase in exposure will only improve the exposure along the LOG10 H scale by 0.3. To bring an area of the scene from -3.0 to -2.1 requires a 3 EV increase in exposure, achieved by extending a 1 second exposure to 8 seconds. Just keep in mind that any scene elements that were originally sitting at 0.5 will now expose at 1.4 which is beyond the chart Fujifilm provides and potentially in the over exposed shoulder of the graph. Here are the calculations:

Shutter = 1 Sec		Shutter = 8 Sec		Difference
Scene Element Exposure	H	H	New Exposure	
-3.0	0.001	0.008	-2.10	0.903
-2.5	0.003	0.025	-1.60	0.903
-2.0	0.010	0.080	-1.10	0.903
-1.5	0.032	0.253	-0.60	0.903
-1.0	0.100	0.800	-0.10	0.903
-0.5	0.316	2.530	0.40	0.903
0.0	1.000	8.000	0.90	0.903
0.5	3.162	25.298	1.40	0.903
1.0	10.000	80.000	1.90	0.903

One aspect of film exposure that can easily be over looked is that exposure is accumulative. This can allow us to alter the performance of the film where we can achieve a greater response to low light areas of a scene while leaving the grain and overall sensitivity unchanged. The effective dynamic range or latitude becomes expanded. All this is realized by performing a Pre-Exposure, a minimal exposure sufficient to have every grain of the film starting out in the linear portion of the characteristic curve. In the example here with Fujifilm Neopan 100 Acros, that minimal exposure is -2 and here are the calculations:

Before Pre-Exposure		After Pre-Exposure		Difference
Scene Element Exposure	H	H	New Exposure	
-3.0	0.001	0.011	-1.96	1.041
-2.5	0.003	0.013	-1.88	0.619
-2.0	0.010	0.020	-1.70	0.301
-1.5	0.032	0.042	-1.38	0.119
-1.0	0.100	0.110	-0.96	0.041
-0.5	0.316	0.326	0.49	0.014
0.0	1.000	1.010	0.00	0.004
0.5	3.162	3.172	0.50	0.001
1.0	10.000	10.010	1.00	0.000

Notice how the Pre-Exposure has it's greatest effect on the lowest exposures and the effect diminishes as the exposure increases. Also note how the entire exposure range now resides within the linear portion of the characteristic curve. In fact, where Fujifilm Neopan 100 Acros normally has a latitude of 9.96 EV, the Pre-Exposure expands the effective latitude to 13.28 EV. Keep in mind that this presumes that the lowest exposure area of the scene is only at -3. Since the Pre-Exposure eliminates any potential of under exposure, every photon striking the film will now contribute to image formation. If the scene yields a minimal exposure of -4, the effective latitude becomes 16.60 EV. Yes, you can shoot a properly exposed scene with a 30

You need to plan ahead if you want to add Pre-Exposure to your bag of tricks.

First, your camera needs to have a shutter independent of the film transport allowing multiple exposures of a single frame. This is a normal characteristic if you are working with a view or field camera, as well as many antique cameras such as the Voigtländer Bessa. If you prefer working with 35mm film, check out the Vivitar V3800N 35mm fSLR.

Second, you will need a portable, uniformly flat light source. An example is the Gepe Slim Lite 5000 Illuminator which is calibrated to 5000K and a compensating filter will be needed for use with day light color film. You will find the compensating filter information on your film's data sheet.

Looking at the exposure characteristic curve, we see that the Exposure scale is logarithmic, but not in units familiar to photographers, so we'll need to do a little math. Along the vertical Density axis, we need to find middle gray, value of 1.5, then follow the chart to the right where the exposure curve intersects this value. For Neopan 100 Acros with 7 minutes of D-76 achieves a density of 1.5 at an exposure of 0. When you meter a scene with the in camera meter, this is the exposure you will get. As calculated earlier, we know that a Pre-Exposure of -2 will do what is needed. On other films, simply choose the minimum exposure of the linear portion the the curve.

Lets calculate the Pre-Exposure:

Pre-Exposure in EV = 3.32 * ((LOG10 H Exposure for a Density of 1.5) - (Minimum LOG10 H Exposure))

Pre-Exposure in EV = 3.32 * ((0) - (-2))

Pre-Exposure in EV = 3.32 * 2

Pre-Exposure in EV = 6.64

Which we can simply round off to 7.

Now, to shoot this Pre-Exposure: With the camera set to the film's speed, ISO 100 for Neopan 100 Acros, position your flat light in front of the lens, make sure the lens IS out of focus, and that the entire field of view is lit by the light. If shooting with color film, make sure the necessary color correction filters are on the lens. Take an in camera meter reading, lets say you get f/2.8 at 1/125th. Now with the camera set to manual exposure, adjust the camera's exposure to the meter reading down by the calculated Pre-Exposure, in this case 7 stops, for example f/22 at 1/250th and snap a shot of the frame illuminated by the light. There you go, the frame has been Pre-Exposed.

Just focus your scene and meter on the mid tones or spot meter to set the exposure of the high lights. You can remove any color correction filter if the scene allows. Forget about the darks and shadows as you know that detail will be captured properly aided by the Pre-Exposure, and shoot the photo.

An advantage of this technique is it can be used when ever you are dealing with low light or high dynamic range conditions. If you're shooting the interior of a room and want the room details while also properly exposing the view out side the windows. Pre-Expose the frame and set the camera to properly expose the light and scene through the windows, the captured photo will have it all. Another advantage is it allows you to use Pre-Exposure on a frame by frame basis as you find necessary.