ZONE TESTING SIMPLIFIED

Photographs and Text
by Gerry Russell

I DON'T KNOW ABOUT YOU, BUT EVERY TIME an interesting new film or developer comes on the market, I think, "I would really like to try that new film, but do I want to go through the Zone System calibration tests again?" Reluctantly, I would give in and slip into the darkroom to load film holders with the newest ZIP 400 super film. By the time I had all the Normal, Plus, and Minus developing scenarios verified and documented on paper, many hours, sheets of film, and quarts of chemistry had expired. I thought this was the way of photography, at least until I did some experimenting with a step tablet and devised a method for Zone testing that takes a minimal amount of time and three sheets of film. Now, it is a pleasure to try new products and still have time for printing.

Using this Step Tablet Method, I can determine, with reasonable accuracy, a range of Normal, Plus, and Minus development times; the effect on film curves from Normal, Plus, and Minus processing; and ISO correction values for Minus exposures. The time spent to assemble this data is about one hour. Although the results are not absolute, the time and energy saved more than makes up for the few sheets of film needed to verify the test results.

THE METHOD

The heart of the method is the Kodak #2 uncalibrated Step Tablet. The step tablet has 21 steps of 0.15 density per step and is contact-printed onto three separate sheets of 4x5 film. Each sheet is then developed in the desired developer for arbitrary times representing Normal, Plus, or Minus development. At the conclusion of processing, the step densities of each sheet are measured with a transmission densitometer and recorded in three columns, Normal, Plus, and Minus, correlated with the developing times. Each of the three columns of densities is plotted in turn on a graph of Density vs. Zones. The densities that fall on Zones VI through X are plotted again on a different graph of Density vs Developing Time. In most cases these two graphs provide all the information needed for N, N+1, N+2, N-1, N-2 developing times plus typical film curves and exposure corrections for Minus developing plans.

CALIBRATION AND EXPOSURE

Proper exposure of the film is absolutely critical, and a one-time calibration of the enlarger or other exposure system is required. Also, the test films must be processed exactly as your normal work is processed, any deviance will cause inaccurate test results. The exposure must be adjusted to place the first step from the densest end of the step tablet onto a sheet of film at a Zone I density of 0.10 with Normal development (see sample negative). Lamp brightness and Timer accuracy must be repeatable for each exposure or the resulting data may not be reliable. The tests shown here were exposed with white light from a LPL-VCCE enlarger and accurately timed with a Metrolux II timer. The enlargers, Halogen lamp, and regulated power supply provide a wide output spectrum and constant intensity. Other light sources may work if they are constant and sufficiently bright to expose the film in 1½ seconds or less. Longer exposures creep into the film's reciprocity curve, affecting the performance and skewing the data.

First, the step tablet must be modified to make a defined clear area on the negative next to the 0.10 density step to measure and zero out film base +fog (fb+f) on the densitometer. To prepare the step tablet, place it on a light box and put a double layer of mylar tape (the stuff color slide folks use for masking) next to the first step on the dark end of the step tablet (see sample negative). This will block any light from getting to the film in that area and also provide something to feel when orienting the step tablet on the film in the dark.

To begin the calibration procedure, raise the enlarger head to about the 16x20 height and focus on the baseboard with a negative installed in the carrier. Remove the negative after focusing. With the lens set at *f*5.6, or the largest aperture, place a sheet of film on the baseboard emulsion side up. Lay the step tablet down the middle of the film and hold the film and step tablet flat with a sheet of glass or a contact printing frame. Expose three or four sheets at different *f*-stops (e.g. 5.6, 8, 11, 16) for 1½ seconds each and develop for Normal contrast.

After processing is complete, zero out fb+f in the clear area and measure the density of the first step on each film to see how close you are to the target density of 0.10, or to see which way to adjust if a second test is indicated. Exposure can be adjusted by varying the exposure time (no longer than 1½ seconds), adjusting the brightness by raising or lowering the enlarger head and refocusing, and/or adjusting the *f*-stops. Do not adjust exposure by setting the aperture between *f*-stops, it makes repeating the calibration setup nearly impossible. I suggest doing the calibration with ISO 100 film. From this calibration, ISO 125 film can be tested by stopping down the enlarger aperture one third stop, or ISO 400 film can be tested by stopping down two stops from the calibrated setting. Once the proper Zone I exposure is determined the setup

FP-4+XTOL 5 1/2 min Minus | FP-4+XTOL 7 1/2 min Normal | FP-4+XTOL 11 min Plus

XTOL TEST / FP-4 PLUS

Density Record

ISO 125 Zones	MINUS 5 1/2 min	NORMAL 7 1/2 min	PLUS 13 min
(fb+f)	0.08	0.09	0.09
I	0.05	0.1	0.15
	0.09	0.15	0.22
II	0.13	0.2	0.3
	0.18	0.27	0.4
III	0.23	0.34	0.5
	0.29	0.42	0.6
IV	0.35	0.5	0.69
	0.41	0.57	0.78
V	0.48	0.65	0.87
	0.54	0.72	0.95
VI	0.61	0.8	1.06
	0.68	0.89	1.16
VII	0.75	0.98	1.26
	0.83	1.08	1.38
VIII	0.92	1.19	1.5
	1.01	1.3	1.62
IX	1.08	1.39	1.72
	1.17	1.48	1.82
X	1.27	1.59	1.94
	1.37	1.71	2.04

Table 1

calibration is finished. Document all enlarger settings, exposure times, and procedures so everything can be reset for future testing of a different film or developer without going through the calibration steps again.

Now, contact print the step tablet onto three sheets of the film to be tested using the proper ISO setting. Use the same Zone I exposure on all three and temporarily store them in an old film box while preparing the chemistry.

DEVELOPING TIMES

The three exposed sheets of film are intended to represent three modes of development, Normal, Plus, and Minus. With developing times unknown, it is necessary to do some educated guessing at what these three times may be. Normal developing times usually run from 6-9 minutes depending on the developer and dilution used, the rough average being 7½ minutes. From experience we know that Minus times are 2-3 minutes fewer than average and Plus times are 4-6 minutes more than average. From this information, I chose to develop the FP-4 Plus/XTOL combination used in the examples for this article at the arbitrary times of 5½ minutes for the Minus sheet, 7½ minutes for the Normal sheet, and 11 minutes for the Plus sheet (I could have just as well chosen 5, 8, 13 minutes, and the end results would be the same).

The arbitrary times may need adjusting if you know the developer is more or less active. Normal development for HC 110B is 5½-6 minutes that makes Minus development difficult without diluting the developer or going below 5 minutes. In this case, a higher dilution to increase Normal development to 7 or 8 minutes will keep the Minus development times greater than 5 minutes. Or a second test can be done to determine the Minus development times with diluted developer.

Processing the three sheets of film produces three negative images of the step tablet, one of low contrast (5½ minutes), one of medium contrast (7½ minutes), and one of high contrast (11 minutes).

ANALYZING THE DATA

The first step in analyzing the data is to measure and record all the densities from the three sheets of film (see table 1). The densities from the low-contrast Minus sheet are recorded under 5½ min, the medium-contrast Normal sheet under 7½ min, and high contrast Plus sheet under 11 min. Zones are listed in the left column with Zone I starting on the same row as the 0.10 density under the Normal time of seven and a half minutes. If the films are a little under exposed and the 0.10 density is on the second step under Normal, start there with Zone I. Then Zone II would be the fourth step, Zone III the sixth step and so on.

The density values from the Normal, Plus, and Minus negatives that are on the Zone rows (not between Zones)

in table 1 are plotted on a graph (see Figure 1) of *Density vs Zones* and connected together. The three lines on the graph will indicate the films response curve for Normal, Plus and Minus development and are an indicator of how well print values will separate along each curve. From the graph it is seen that the Normal curve crosses a target density of 1.20 near the middle of Zone VIII, indicating that seven and a half minutes is approximately the correct Normal developing time for this film/developer combination. If you choose a different target density for Zone VIII, the Normal film curve will cross that density line at a different point and indicate a different developing time. The Figure 1 graph also shows if there is any shouldering off at the top of the film curves, especially with diluted developers.

In Figure 1 we see that the Minus curve dips below the 0.10 density line about two thirds of a Zone to the right of Zone I. This indicates the amount of additional exposure, two thirds of a stop in this case, needed to shift the curve to the left to ensure a Zone I density of 0.10 or more at N-1 development. From this information the approximation is made that a N-2 developing plan would require a full stop and a third of additional exposure for this film/developer combination.

To determine development times for Normal, Plus, and Minus developing plans, the density values from Zone VI through Zone X at the top of Figure 1 are plotted on a graph (Figure 2) of *Density vs Time*. To make the plots, start with the Minus (0.92), Normal (1.19), and Plus (1.50) Zone VIII density values and put a dot where these densities fall above their corresponding development times. Connect the three dots with a line and label this line N. Reading down from where the line crosses the 1.20 density line, you will find the developing time for Normal (N) processing.

Next take the three density values under Zone VII and plot them on the graph in the same manner. Where this line crosses the 1.20 density line you will find the N+1 developing time. Continue on with the Zone VI densities for N+2 developing time, Zone IX densities for N-1 developing time, and Zone X densities for N-2 developing time. At the conclusion your graph should be similar to Figure 2 and provide developing times for N, N-1, N-2, N+1,and N+2 processing for that particular film/developer combination. Changing film, developer, or developer dilution requires a new set of three step tablet negatives and another hour of your time.

Depending on the film and developer combination being tested, the data may run off the graph in one direction or the other. If Normal developing times are expected to be 10 or 12 minutes, develop the three step tablet negatives for 7 minutes, 10 minutes, and 15 minutes. This will require rescaling the minutes on Figure 2 to cover the range of the data. If the Minus developing times fall below 5 minutes, you might consider diluting the developer to use as a one-shot and run the step tablet test again. This would provide a second graph with Minus developing times for the diluted developer.

The tables and graphs may be quickly done in pencil on *Quadrille* tablets. It is not necessary to do the plots on a computer, carefully doing them by hand is just as accurate.

THE CAMERA

About this point you are probably wondering what all this has to do with exposing film with a camera. Earlier in this discussion I alluded to taking special care to place the first step on the step tablet at a density of 0.10 and identify it as Zone I. In Zone System basics, the first step in finding your "Personal ISO Value" is to determine, using your camera and meter, the proper exposure for a film/developer combination that will also give a Zone I density of 0.10. Coincidental? Not at all. If you do not know your Personal ISO Value, now is the time to do it. About any Zone System book will explain this procedure in detail.

With both the step tablet negatives and your camera/meter system calibrated to a Zone I density of 0.10, all camera and meter errors are accounted for. In essence, calibrating the "Camera/Meter System" and the "Step Tablet Method" to the Zone I density

of 0.10 locks them together at a common point.

VERIFICATION

The Step Tablet Method told me that I needed to develop FP-4 Plus film exposed at Zone X for 5 minutes (N-2) to lower the negative density to Zone VIII, and at Zone VIII for 7 1/2 minutes (N) for a Zone VIII density, and at Zone VI for 13 minutes (N+2) to raise the density to Zone VIII. With these developing times in hand I exposed three sheets of film outdoors using a white matboard as a target, one at Zone VI, one at Zone VIII, and one at Zone X using my camera and spot meter (with my personal ISO value) to make the exposures. The three sheets were developed at the times indicated by the Step Tablet Method and the resulting densities were; Zone X, N-2 = 1.22; Zone VIII, N = 1.18; Zone VI, N+2 = 1.13.

Calibrating the Camera/Meter System and the Step Tablet Method to a Zone I density of 0.10, for a given film/developer combination synchronizes the two together at Zone I. If the Camera/Meter System and Step Tablet Method both expose Zone I equally, then other Zones must also expose equally. Using just three sheets of film to produce the graphs in Figures 1 and 2 makes zeroing in on the Zone System quick and convenient. ▲

	I	II	III	IV	V	VI	VII	VIII	IX	X
N+ (11 min)	0.15	0.30	0.50	0.69	0.87	1.06	1.26	1.50	1.72	1.94
N (7.5 min)	0.10	0.20	0.34	0.50	0.65	0.80	0.98	1.19	1.39	1.59
N- (5.5 min)	0.05	0.13	0.23	0.35	0.48	0.61	0.75	0.92	1.08	1.27

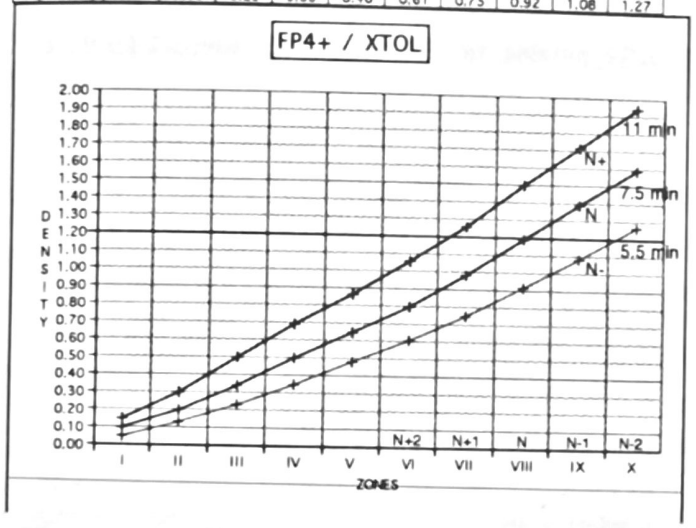


Figure 1 Density vs Zones

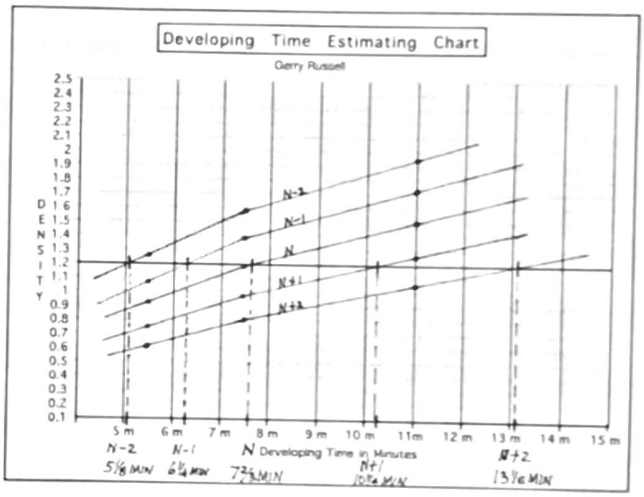
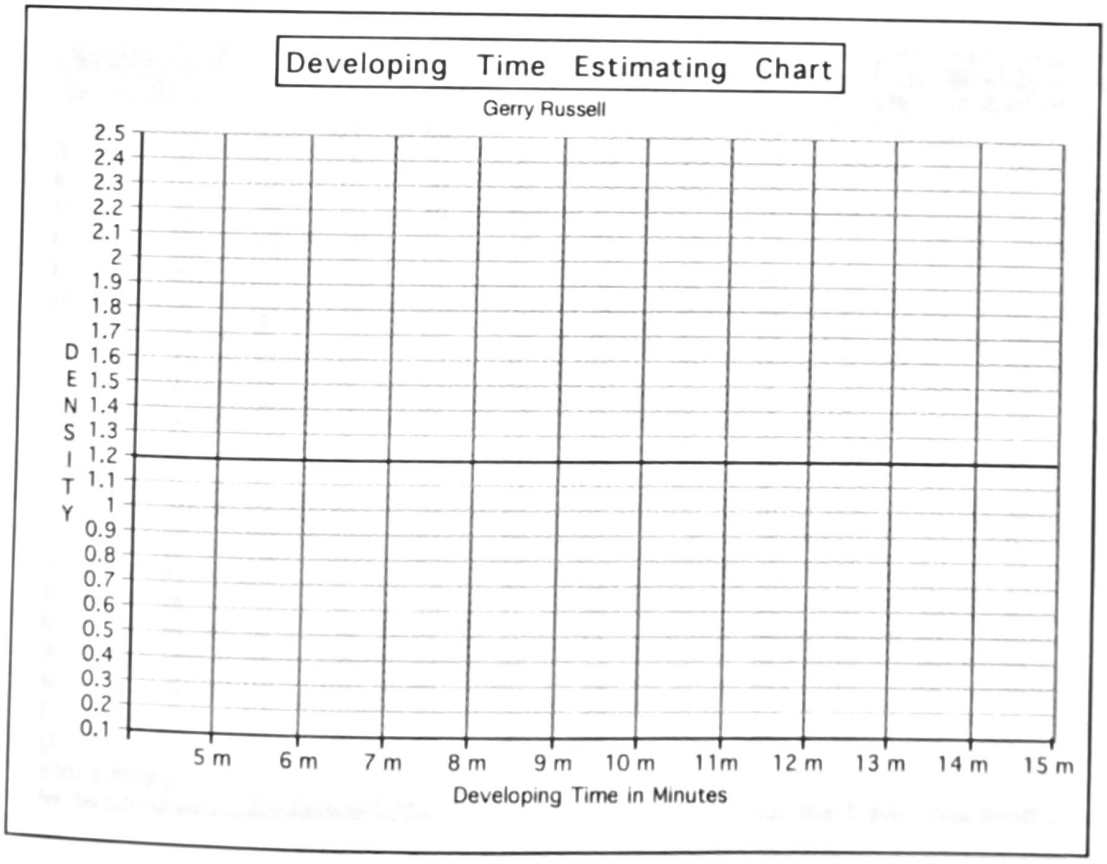


Figure 2 Developing Time Estimating Chart



Developing Time Estimating Chart for the convenience of *View Camera* readers. Feel free to copy and use.