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Two-Bath Development:
Exposure and Development Strategy for Scanning

by Sandy King

Genesis of this Article

Large format black and white photographers have typically worked with some type of exposure and development system to optimize individual negatives for printing on a particular grade of silver gelatin paper, or with variable contrast papers. Ansel Adams and others like Minor White and Richard Zakia popularized and promoted the Zone system. Some years later Phil Davis developed and promoted the BTZS system. Both systems are still used by many photographers. Both Zone system and BTZS require pre-testing of film and paper, careful attention to field exposure, taking notes to identify how the negative should be developed, and specific development to obtain the desired contrast.

In the last decade or so there has bee a significant change in the workflow of many large format photographers. Instead of printing in the darkroom on silver gelatin papers many LF photographers are now scanning their negatives and printing digitally. The percentage of photographers working this way is now quite large, and is growing year by year.

A scanning to print digitally workflow essentially means that there is no compelling reason to continue to expose and develop with Zone or BTZS type controls. Excellent results can be obtained by simply exposing in the field for sufficient shadow detail, developing in a two-bath solution, scanning the negatives, and adjusting tonal values in Photoshop. This article is directed to photographers who develop their film only to scan and print digitally, or to scan and make digital negatives for contact printing. If you are in one of these categories two-bath development may simplify your working procedures, both in the field and in developing, and at the same time give you negatives that scan easier, are sharper, and have finer grain.

Theory of Two-Bath Development

In normal development the working solution contains two main ingredients, a reducing agent and an alkaline accelerator. In two-bath development the reducer is in Solution A and the accelerator in Solution B. The film is first placed in Solution A, where it soaks up the reducer but very little reduction takes place. The film is then transferred to Solution B, which contains the alkaline accelerator, and the image is formed. The final contrast of the negative is determined by how much of the reducer the film was able to soak up while in Solution A. In Solution B the highlights develop first and then stop because the developer exhausts in this area, but the shadows continue to develop for the remainder of the time the film is in Solution B.

The advantages of two-bath development are.

1.No loss of emulsion speed. Long toe films like TRI-X 320 that normally must be rated about a stop slower than box speed can be rated at box speed with two-bath development.

2.Compensation with high contrast scenes.

3.Most films developed in two-bath developers have a very long straight line in the curve, with short toe and shoulder. This spread the compensation over the entire curve, not just the shoulder, as is the case with most compensating type developers.

4.Surface development, which results in higher sharpness.

5.Very economical.

6.Exhaustion of the developer enhances adjacency effects, which increases apparent sharpness.

The following two film curves illustrate the ability of two-bath development to produce a more linear (straight-line) film curve than normal development. TRI-X 320 is known for its very long toe. Zone system photographers typically use a meter reading of ½ or less of box speed in order to bump the TRI-X curve up into the straight-line section, which gives better contrast in the shadows. Two-bath development gives a very long and linear straight-line curve that results in a real increase in effective film speed of about 2/3 of a stop over normal development. The ability to linearize the tonal scale is an outstanding effect of two-bath development that simplifies tonal control in scanning and post-scan processing.

History of Two-Bath Development

The procedure is fairly old and has many variations. Two-bath development preceded the 35mm camera but the popularity of the Leica and other miniature cameras in the 1930s and 1940s increased interest and led to sev-

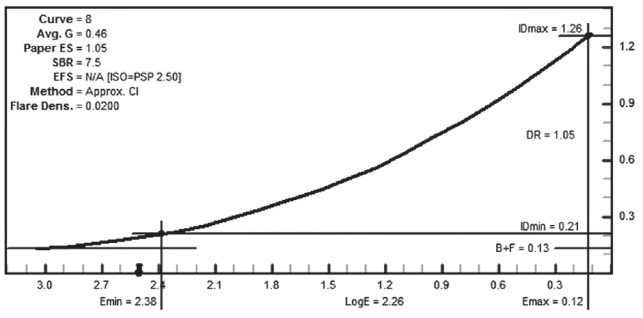

Figure 1 – TRI-X 320 developed in D76 1:1. Observe the long sweeping toe and upward flare in the shoulder that is typical of this film with normal development.

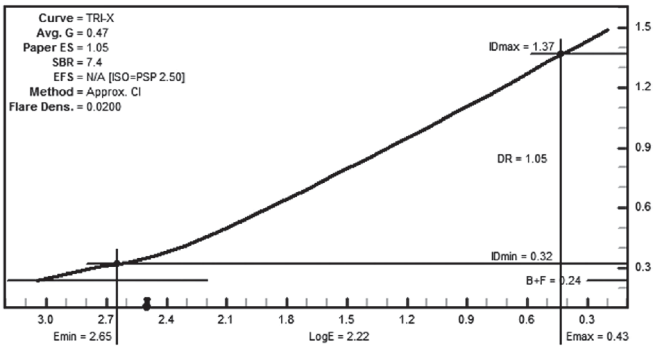

Figure 2 – TRI-X 320 developed in Diafine. Observe the long straight line. Also notice that the effective film speed is about 2/3 of a stop more than when the film is developed in D76 1:1.

eral new formulas, including the famous Stoeckler formula. Two- bath development compensates for the variations in subject contrast typically encountered by the photographer in exposing a roll of 35mm film. Negatives of low and medium contrast scenes develop to a good printing contrast while compensation is obtained with high contrast negatives.

Two-bath developers have also been used with large format sheet film, but not as general developers. Their use has for the most part been limited to development of negatives where some compensation for extreme contrast is required. Ansel Adams promoted a modified two-bath D-23 formula because he found it to be a positive method for control of high-value tones consistent with the application of the Zone system.

Purpose of this Article

As noted earlier, this article is directed primarily to those photographers who expose and develop film for scanning, not for those who print directly from the camera negative. There are several advantages of two-bath development for the scanning workflow.

1.Fieldwork is simplified because there is no need to determine subject contrast or identify individual negatives for a specific type of development. The only requirement is that the negative be given sufficient exposure to record shadow detail. Overall contrast and local control of tonal values is done when the film is scanned, or afterwards in Photoshop.

2.All negatives of the same film type can be developed together for the same time and temperature. In fact, in most cases even different films can be developed together.

3.The negatives can be developed to a fairly low average gradient, which reduces grain and optimizes sharpness. Photographers who use 35mm and medium format are well aware of the importance of developing to a low contrast to minimize grain and enhance sharpness.

4.Negatives developed to a low average gradient scan well, even with consumer flatbed scanners.

Two-bath development work equally well in providing highlight compensation whether used with traditional emulsion films like FP4+, TRI-X 320 and HP5+, or modern T-grain emulsion films like T-MAX 400 and T-MAX 100. It should be noted that negatives exposed in conditions of low subject brightness range will develop to a lower average gradient than film exposed in conditions of high subject brightness range. However, the relatively small difference in average gradient can easily be compensated for during the scan, or later in Photoshop when final tonal corrections are made.

Testing Two-Bath Developers

The two-bath formulas used in the testing for this article were Diafine and the Ansel Adam's divided D-23 formula. Diafine was chosen because it is the only two-bath developer commonly available in commercial kit form. The divided D-23 formula was selected because it is a very simple formula that can be easily mixed in the darkroom with a few common chemicals, and because it has a long history of use in large format work. Both formulas produce sharp negatives with a tight grain pattern. In my testing, I compared the two formulas for grain and sharpness because the differences for large format work, especially when developing to low average gradient, are not significant.

Diafine has great capacity and a long shelf life as the stock solutions are designed to be re-used. People routinely report using Diafine for up to a year, and for processing up to a hundred or more rolls or sheets of film. However, Solution B must not contaminate Solution A, and both solutions should be filtered occasionally. The developer is quite inexpensive so a more conservative approach of mixing fresh solutions after running fifty sheets or so through the soup, or after six months, is recommended. It is also recommended that the film be rated at the ASA value recommended by the filmmaker.

Divided D-23 should not be re-used. After development, discard both the used Solution A and Solution B. The stock solutions have shelf life of around three months in partially full bottles.

Method and Rationale of Testing

The goal of film testing carried out for this article was to provide development data that will allow other photographers to use any of the films tested in the field with a minimum of note keeping, develop the film with either Diafine or divided D-23, and produce optimum negatives for scanning.

There are two major parts to our testing, sensitometry and field-testing. In the first part, five films are tested with sensitometry and controlled development in order to determine time of development required to give an average gradient of approximately .45 - .50. Photographers familiar with sensitometry will immediately recognize that this is a fairly low average gradient, one that might be used for a Grade #3 silver paper using a condenser type enlarger. Developing film to a low average gradient ensures that the negatives are optimized for fine grain and sharpness, and they should also scan well. For exposure an EG&G sensitometer was used, with appropriate ND filters to adjust for film speed. Five films were tested, three traditional emulsion films (FP4+, HP5+ and TRI-X) and two T-grain films (T-MAX 100 and T-MAX 400). In the second stage of testing negatives were exposed in the field in different subject brightness condi-

tions. These negatives were then scanned and tonal adjustments were made in Photoshop to produce prints with acceptable density and range of tonal values.

Sensitometry

Two different development methods were used: 1) in tray or tank with 15 seconds of agitation at the beginning of development, followed by agitation for ten seconds at the 1/4, 1/2, and 3/4points of total development, and 2) rotary agitation with the film in drum on a motor base, similar to Jobo, with continuous agitation. The developers were used full strength with tray and tank development, but diluted 1:1 with water for rotary agitation. Time of development needed to reach a given average gradient was approximately equal

Procedure for development in tank or tray

1.Place film in Solution A and agitate with gentle inversions of the tank, or by rocking the tray, for fifteen seconds.

2.Agitate for ten seconds at the 1/4, 1/2, and 3/4 points of total development time.

3.Pour out Solution B, drain, and immediately pour in Solution B. Agitate for 15 seconds as with Solution A. Do *not* rinse between Solution A and B.

4.Agitate for ten seconds at the 1/4, 1/2, and 3/4 points of total development time.

5.Pour out Solution B.

6.Follow normal procedures for stop bath, fix, and wash.

Procedure for development in drum on motor base

1.Load film into the drum. Do not pre-soak.

2.Dilute Solution A 1:1, using about 60 ml of total solution for a 4X5 sheet of film.

3.Pour Solution A into the drum, and turn on the motor to begin agitation.

4.Pour out Solution A, drain, and immediately pour in Solution B, also diluted 1:1 with water. Do *not* rinse between Solution A and B.

5.Pour out Solution B.

6.Follow normal procedures for stop bath, fix and wash.

See the charts below for development time for Diafine and divided D-23 for the five films tested. One chart is for development in tray or tank with the developer used straight, the other for rotary development with the developer diluted 1:1. Developer was used at 72F in all tests.

Diafine-Development in tank or tray, with normal agitation. Developer used straight.

Average Gradient		Time in Minutes in Solution A and B
FP4+	.48	2.5 + 2.5
HP5+	.45	3 + 3
T-100	.46	3+3
T-400	.48	3+3
Tri-X 320	.48	3+3

Diafine- Development in drum with continuous agitation. Developer diluted 1:1.

Average Gradient		Time in Minutes in Solution A and B
FP4+	.49	3+3
HP5+	.44	4+4
T-100	.49	3+3
T-400	.49	3+3
Tri-X 320	.49	3+3

Divided D-23 - Development in tank or tray, with normal agitation. Developer used straight.

Average Gradient		Time in Minutes in Solution A and B
FP4+	.45	4+4
HP5+	.47	4+4
T—100	.47	4+4
T-400	.49	4+4
Tri-X 320	.45	4+4

Divided D-23 - drum with continuous agitation. Developer diluted 1:1.

Average Gradient		Time in Minutes in Solution A and B
FP4+	.46	4+4
HP5+	.46	4+4
T-100	.46	4+4
T-400	.49	4+4
Tri-X 320	.45	4+4

Field Testing

The first round of field tests was made in late April at a location in North Carolina not far from Winston Salem in the Uwharrie Mountains. The Uwharrie Mountains, which run in central North Carolina, were formed when a chain of volcanic islands was trapped within ancient surrounding land masses some five hundred million years ago. For this reason the geologic features are quite different from what is seen in the surrounding Piedmont area. At the summit of the peak we visited there are hundreds of gigantic boulders in all manner of shapes, some the size of small houses, strewn across the landscape. For perspective note the size of the boulders in comparison to the human figure in Figures 3 and 4.

The climatic conditions for the day, bright sun with occasional clouds, were almost perfect for putting the two-bath system to the test as it was possible to make identical exposures in two totally different lighting conditions, one with the sun shining, and another with the sun behind the clouds. I took meter readings and determined that the SBR was 9.5 with the sun shining, and 6 with the sun behind the clouds.

Kodak T-MAX 400 was used for this testing. Exposure was determined by a single incident meter reading, taken in the deepest shadows where open detail was desired, with the meter set to box speed of ASA 400. An incident meter reading in the shadows is one of the simplest and most reliable methods of determining exposure for most scenes. Other methods of metering are perfectly acceptable so long as the exposure is sufficient to give texture in the deepest shadows where detail is needed.

The two negatives taken for each set-up were devel-

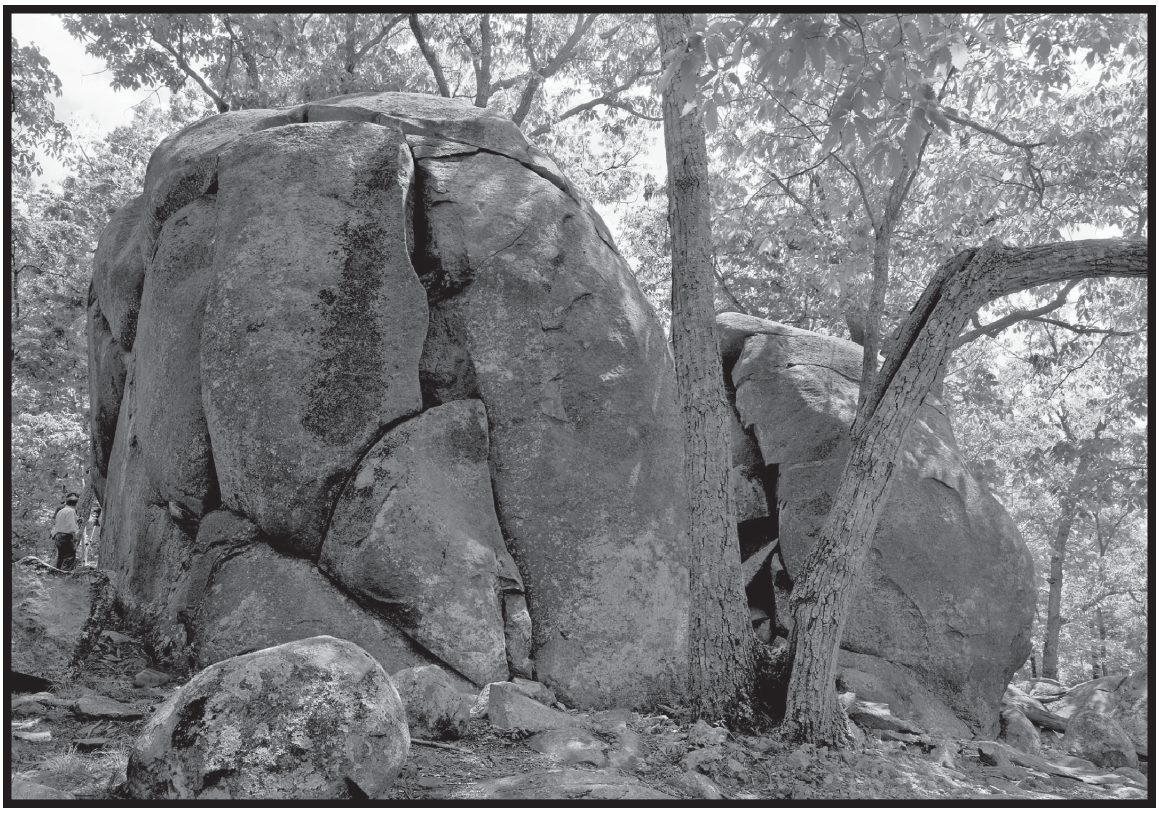

Figure 3 – View in the Uwharrie Mountains, with sun shinning.

Figure 4 – View in the Uwharrie Mountains, with sun behind clouds.

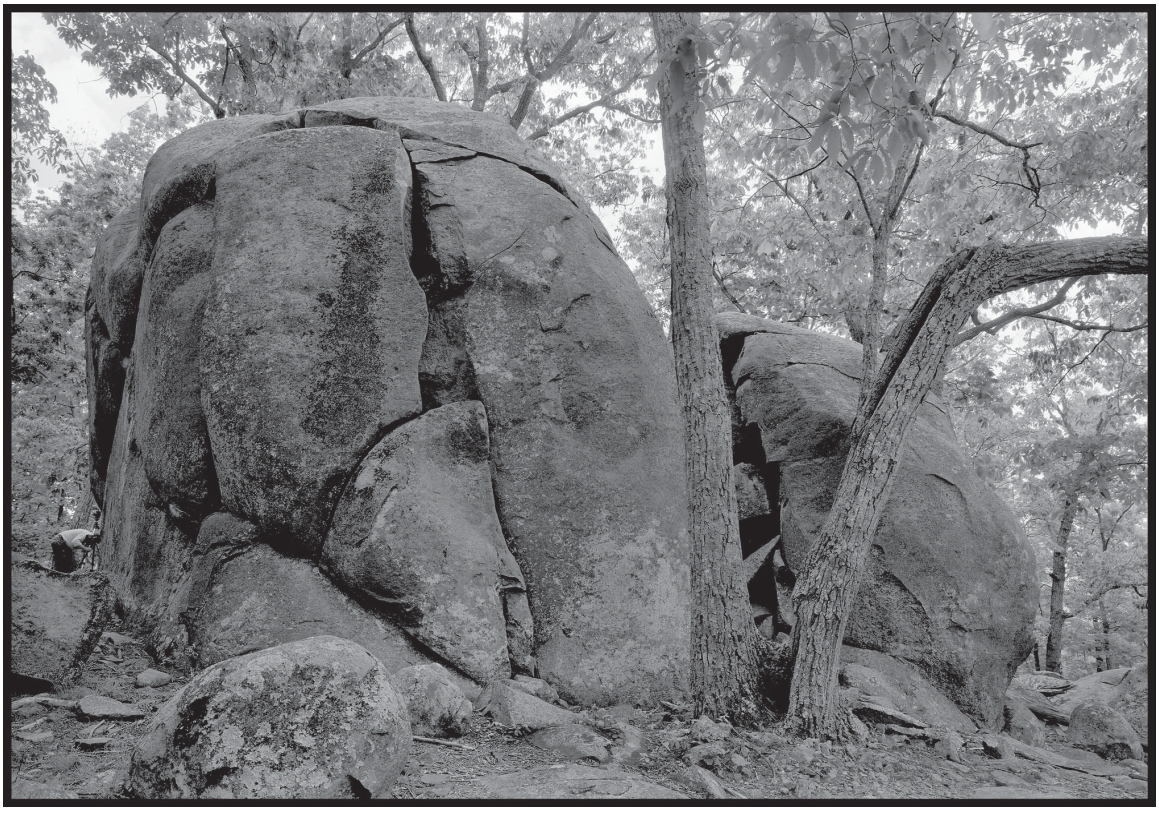

Figure 5 — View From Sunroom. Scene of Very High Contrast.

oped identically in divided D-23 at 72F with rotary agitation, four minutes in Solution A and four minutes in Solution B. When dry the negatives were scanned with an Epson 4990. The histogram was set at 0 and 255 for both scans to make sure there was no clipping in either the highlights or the shadows. After the scans were made the two files were opened in Photoshop and curves and levels were used to adjust each image. No attempt was made to perfectly match every feature in the scene in terms of tonal values, but merely to show that it is possible to make a good pictorial rendering of scenes of great contrast with two-bath development so long as the initial exposures are sufficient to record shadow detail.

Field Testing: Stage Two

The results of field tests in the Uwharrie Mountains show that two-bath development works well for in scenes of high, but not extreme, subject brightness range. How does it work in scenes where the SBR is extreme?

Since a T-grain emulsion film and divided D-23 were used for the test at Ridges Mountain it was determined to use TRI-X 320 and Diafine for the extreme SBR tests. The test exposures were made from the sunroom of my home. An incident reading indicated a range of EV 9.6, inside the room in the shadows, to EV 17.6, outside in full sun. I set the meter to ASA 320 and exposed for a time of 1/4 second at f/32, as indicated by the shadow value reading inside the house.

The film was then placed in a drum and developed with continuous agitation in Diafine, three minutes in Solution A and three minutes in Solution B. After development the film was processed normally and allowed to dry. The density range of the negative is 1.05, with the low value measured in the shadows of the small rocker, and the high values measured on the patio umbrella outside on the patio. The negatives were scanned with the Epson 4990, taking care to avoid any shadow or highlight clipping by keeping the histogram set to 0 and 255. In Photoshop curves and levels were used to adjust the tonal values. It is remarkable that two-bath development with Diafine was able to handle such an extreme subject brightness range and produce a negative that was very easy to scan and required very little work in post-processing in Photoshop.

Conclusion

The two-bath method is about as close as one can get to a magic bullet in development if scanning and printing digitally is intended. Field work is very simple as the exposed film does not have to be identified for special development and exposure can be based on a single meter reading for shadow values. The mechanism of two-bath development ensures that highlights will not be blown out, even in scenes of extreme contrast. Because the negatives are developed to a low average gradient they are sharp and easy to scan. And because of the linear straight-line type of compensation that is obtained with two-bath development correction of tonal values in Photoshop is relatively simple.

In closing I would like to express my appreciation to Stephen Schaub and Mark Thompson. Stephen, who runs a professional high-end printing service at Indian Hills Imageworks, shared with me some of his experiences with two- bath development using Diafine. You can see some of his testing of Diafine with different films at www.figitalrevolution.com. Mark, who works for the BKA Photo Group, www.bkaphoto.com/, supplied the Kodak film and some of the chemicals that I used in the testing for this article.

Glazer's Commits to ULF Films

Glazer's inSeattle has committed to handling both Kodak and Ilford/Harmon ULF film sizes.

"We see thismarket as a small but growing niche", stateds William Linnen at Glazer's. "One of our customers, Rob Vinnedge, approached us last Fall aboutthis and put us in contact with Scott Disabato at Kodak. They'd just completed a thorough study that showed them the vitality of the film market and were interested in investing more effort into this area."

It is surprising, but the ULF market is growing. Some of the camera manufacturers have stated that they are making more ULF cameras than standard 4x5 models.

Glazer's is coordinating special orders for such sizes as 14x17, 16x20 and whole plate (6.5x8.5) and other sizes are being ordered as well. T-Max 400, the newest version, is available from Kodak and Ilford is making both HP5+ and FP4+ available. Glazer's will be stocking many of the ULF sizes for the foreseeable future.

Glazer's is a very reputable dealer and has been in business for 65 years.

For more information please e-mail
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