

## PUSHING TRI-X TO THE LIMITS

TEST: Tri-X exposed at ISO 3200 and 6400 under very low light conditions and developed using 6 different developing techniques.

**Synopsis:** *I am practicing street and cityscape photography in low light using 35mm and medium format film cameras. Kodak Tri-X (under Arista Pro 400 brand name) is my film of choice. If I shoot under favorable lighting during the day, I usually rate it ISO 1600 and develop in Diafine. At night, I use it at ISO 1200. Using higher ISO rating at night would permit the use of smaller aperture openings and/or faster shutter speeds which all will contribute to technically better pictures. This is a comparative test of several developers I have readily available. The film was exposed under extreme low light conditions (two candles enclosed in semi-transparent glass); the subjects of the test scene are imitating the street environment. There are probably other, better developing techniques and also other films better suited to the task; it is just my choice based on convenience, cost and availability.*

### 1. NOTES ON THE TEST SETUP AND LAYOUT

#### 1.1 KODAK TRI-X / ARISTA PREMIUM 400 FILM

The film I use in the test is offered by Freestyle as cheap alternative to the popular professional B/W 400 ISO films. It is made in USA by “major film manufacturer” [1] and its properties closely resemble those of Kodak Tri-X. I did several tests using both films and according to my results in several different developers (Diafine, D-76, Rodinal and HC-110 to name the few) this is indeed Tri-X emulsion. The film is referred in the article below as “Tri-X”.

The standard ISO rating of modern Tri-X 400 TX film is ISO 400. It can be processed to the “effective speed”<sup>\*\*</sup> lower (pull-processing) or higher (push-processing), but it is optimized to yield best results when exposed at the standard (or “true”) speed of 400 ISO.

#### 1.2 TRI-X PERFORMANCE IN LOW LIGHT

In this test we will be evaluating the Tri-X 400 TX performance in very low light, trying different push-processing development techniques and comparing the results. It should be noted in the very beginning that the film is not designed for such low light applications. Another important matter is spectral sensitivity of the film. Tri-X is rated under daylight conditions where always a high proportion of blue light, so there is additional loss of speed under candle light, which has most of its energy in the red part of the spectrum.

It is also obvious that push development may bring the tonal values up *if* the emulsion initially *registered* the light. If no photons were transferred to the chemical bond in the emulsion, there is nothing to amplify and push processing will result in just some additional noise/grain.

#### 1.3 NOTES ON METERING

Metering the scene and getting exposure values is the most important step in the preparation of the test. The night street lighting which test scene is imitating is very different from the day time. The source of the day time light (the Sun) is powerful and distant; it is rarely shining directly into the camera lens<sup>\*\*</sup>. During daytime, the deepest shadows usually receive some amount of light due to reflections from the elements of the scene. The scene of this type can be metered by pointing the light meter to the main subject (reflected-light metering) or by pointing the light meter in the direction of the camera from the subject (incident light metering).

On the other hand, the night scenes usually have the light source(s) close to the subject, often embedded in the field of view of the camera. Shadows receive very little light and are very dark. Average metering described above will give wrong reading. It will measure the luminance of the light sources all right and the photographer will get nice pictures with the few shining street lights and no other visible details. The same effect can be achieved during the day by pointing a light meter to the sun and then taking the picture of it along with some other subjects<sup>\*\*</sup>. All the subjects will be pictured in the form of silhouettes or at least there will be very little details in the shadows.

The proper metering of the complex lighting scene like many of the night scenes can be achieved by measuring the light reflected off the medium-gray subjects like human skin (white skin usually reflects 36% of light) or from special 18% gray card placed in front of the subject. This will put the exposure into the midst of tonal range of the scene and allow film to register both highlights and (at least some of the) shadows.

The common error in estimating the effective speed of the pushed film is related to metering the night scenes based on the deep shadows. This method usually yields printable negatives with shadows fully resolved and overexposed highlights; it also gives the wrong idea on the ISO rating of the pushed film and its abilities to resolve details in shadows.

The metering in the test was done by measuring the light reflected from both the 18% gray card and from human skin (photographer’s palm) in front of the subject; the average number was then used in the test to adjust camera’s settings.

The “subject” in the test refers to the picture of American photographer Edward Weston on the cover of his book “The Day Books of Edward Weston”:

<sup>\*\*</sup> effective speed” – ISO rating of the film different from the standard rating as a result of push or pull processing.

<sup>\*\*</sup> as the old saying goes, “Look into the Sun twice: once with the right, once with the left and there are no more eyes”



Picture 1. Test scene setup. Olympus EP-1/14-45mm lens set to 14mm; electronic flash.

Picture 2 shows the scene under candle light, when it had been photographed for the purposes of testing:









Picture 2. Test scene setup. Voigtlander Bessa L/28mm f/1.9 lens; available light.

## 1.4 DEVELOPERS AND DEVELOPING TECHNIQUES

Table I summarizes the developers and developing techniques used in the test, along with images of the negative strips processed using the corresponding techniques.

**Table I.** Developers and developing techniques used in the test.

 <p>D1</p>	<p><b>D1: 2xDiafine</b> Diafine is popular two-bath compensating developer produced by Acufine [11]. Film gets 3-4 min in solution A and 3-4 min in solution B. This is my main developed for Tri-X and it pushes it to ISO 1250-1600 without noticeable side effects usually associated with 2-stop push. The technique employed in this test is a double use of the developer on the same film: after first A+B the film is washed and second A+B applied, then stop and fix as normal. This method, as reported in [1] gives extra stop push to the film bringing the film speed up to ISO 2500-3200.</p>
 <p>D2</p>	<p><b>D2: Semi-Stand development in R09 One Shot/Rodinal diluted 1:50</b> Rodinal [3] is venerable developer made by Agfa until recently. Now it is available as "R09 One Shot" [4]. There are few reports of developing Tri-X and Arista Premium 400 exposed at high ISO from 3200 to 12800 in this developer [5]. Under code name "D2" I am testing an extreme push to 12800 using semi-stand technique (20C/68F, 51 min, constant agitation first 30 sec, then agitation for 5-8 sec every 5 min) as reported in [5],[6].</p>
 <p>D3</p>	<p><b>D3: Stand development in R09 One Shot/Rodinal diluted 1:100</b> Rodinal [3] is a developer made by Agfa until recently. Now it is available as "R09 One Shot" [4]. There are few reports of developing Tri-X and Arista Premium 400 exposed at high ISO of 3200/6400 in this developer [8]. Under code name "D3" I am testing push to 3200 and 6400 using stand technique (20C/68F, 120 min, constant agitation first 30 sec, then very light agitation for every 30 min during 2 hours) as suggested in [8].</p>
 <p>D4</p>	<p><b>D4: HC-110 and Diafine</b> HC-110 is black and white developer made by Kodak [7]. Under code name "D4" I am testing two-stage development of Tri-X:</p> <ul style="list-style-type: none"> <li>✓ Stage One: Stand ("stand" means no agitation except the first 30 seconds) development in HC-110 diluted 1:100 for 25min</li> <li>✓ Stage Two: Normal development in Diafine.</li> </ul> <p>I used this before and supposedly it brings film's speed up to ISO 3200.</p>
 <p>D5</p>	<p><b>D5: "Super Soup" (Mixture of HC-110, Dektol, Ascorbic acid and washing soda)</b> Kodak Dektol is well-known photo paper developer; it had been widely used in the past as a film developer also. "Super Soup" is a mixture of HC-110 and Dektol plus few other ingredients, suggested by Donal Qualls [2],[9]. This very active developer supposedly able to bring Tri-X's speed up to ISO 6400. The recipe I used in the test is as follow: 31.5 ml HC-110 concentrate (American version), 7 gr Dektol powder, 2 gr Ascorbic acid, 1 tsp washing soda (sodium carbonate monohydrate) water to make 500ml.</p>
 <p>D6</p> <p>© <a href="http://Street-Foto.com">http://Street-Foto.com</a></p>	<p><b>D6: Diafine+Stand in Rodinal+'Super Soup'</b> The technique named "D6" is described by Larry Dressler in the article [10]. It is suggesting 3-stage development of Tri-X:</p> <ul style="list-style-type: none"> <li>✓ Stage One: Normal development in Diafine.</li> <li>✓ Stage Two: Stand development in Rodinal diluted 1:100 for 30 min.</li> <li>✓ Stage Three: 25min semi-stand development in "Super Soup"</li> </ul> <p>This labor intense development supposed to push the film to ISO 12800.</p>

## 1.5 CAMERA AND LENS

The camera used in the test was Voigtlander Bessa L [12] fitted with Voigtlander Ultron 28mm F/1.9 lens [13]. The camera was installed on a tripod using Manfrotto tripod head 322RC2 with quick-release plate. The field of view was adjusted using external 28mm viewfinder. The lens' distance scale was adjusted to 1 meter which was equal to the actual distance to the subject. The light metering was done using Gossen Luna-Pro Digital light meter [14].

## 2. NOTES ON PHOTOGRAPHING AND IMAGE PROCESSING

The scene was photographed during 2 sessions; 6 strips of film were used. 4 strips of film were exposed during the first session (D1-D4) and 2 strips were exposed during the second session (D5, D6). The field of view is slightly shifted from session one to session two; also the candles' flames changed resulting in some differences in lighting. All these differences are not strong enough to affect the results considerably and can be safely ignored.

The meter has shown exposure value of 3.0EV measuring light reflected from 18% gray card placed in front of the subject facing the camera.

Each strip of film received at least 4 exposures at E.I.: 3200, 6400, 12800, 25600 ISO. The aperture opening was fixed to f/8 to keep depth of the field constant; shutter speed had been adjusted from 1/4 sec to 1/30 sec (1/4; 1/8; 1/15; 1/30).

Immediately after the exposure cassettes with exposed film were put in a refrigerator and kept at low temperature before development.

Each strip was developed as described in the section 1.4 above.

Pictures were scanned using Nikon CoolScan V scanner at 4000 dpi in VueScan ver. 9.0.37/Windows on Dell Optiplex 620 under OS XP x64. The scans were processed in Adobe Photoshop CS4 for Windows on the same computer using 22-inch IPS monitor calibrated with X-Rite Eye-One color calibration system. The processing included: tonal curves adjustment, changing scanned files mode from 16-bit grayscale to 8-bit RGB. For the presentation purposes 100% fragments of each image were saved as separate JPEG files; small 800x600px JPEG versions of original files were also created.

## 3. RESULTS

### 3.1. D1: DIAFINE TWICE

The technique used in D1 had been described in the section 1.4 above. Out of 4 frames two (3200 and 6400) were scanned and presented below (see Pictures 3 and 4). Out of two, I rated 3200 picture as acceptable. It has pictured the subject well, have descent shadow details, and grain is also acceptable. 6400 version is underexposed: the subject is too dark; there are fewer details in shadows. Pictures 5 and 6 show the close-up view of the subject in the corresponding frames. It should be also noted that out of all six the D1 is the easiest, fastest and most economical development technique.

### 3.2. D2: SEMI-STAND IN RODINAL 1:50

The technique used in D2 had been described in the section 1.4 above. Out of 4 frames (3200 and 6400) were scanned and presented below (see Pictures 7 and 8). 3200 version is acceptable, but it is not among the best, and the image have distinctive look of pushed film. Some fog is apparent. Grain is acceptable. Pictures 9 and 10 show the close-up view of the subject in the corresponding frames. Development artifacts in the form of uneven development usually associated with stand development are noticeable in both 3200 and 6400 versions but they are much more apparent at 6400. It should be also noted that this method is labor intense but economical.

### 3.3. D3: STAND IN RODINAL 1:100

The technique used in D3 had been described in the section 1.4 above. Out of 4 frames one (3200) was scanned and presented below (see Picture 11). The frame has look of heavy pushed film; shadow details are compromised. Grain is bigger compared to D1 but acceptable. Picture 12 shows the close-up view of the subject in the corresponding frame. Development artifacts in the form of uneven development usually associated with stand development are noticeable. It should be also noted that this method is most time consuming out all 6 but it is economical.

### 3.4. D4: STAND IN HC-110 1:100 AND DIAFINE

The technique used in D4 had been described in the section 1.4 above. Out of 4 frames one (3200) was scanned and presented below (Picture 13). I rated 3200 picture as acceptable. It has pictured the subject well, have descent shadow details, and grain is also acceptable. 6400 version is underexposed so no attempts to scan it had been made. Picture 14 shows the close-up view of the subject. Development artifacts in the form of uneven development usually associated with stand development are barely noticeable. The method is labor intense and time-consuming.

### 3.5. D5: "SUPER SOUP"

The technique used in D5 had been described in the section 1.4 above. Out of 4 frames two (3200 and 6400) were scanned and presented below (see Pictures 15 and 16). Out of two, I rated 3200 picture as acceptable. It has pictured the subject well, have descent shadow details, and grain is also acceptable. 6400 version is underexposed: the subject is too dark; there are fewer details in shadows. The overall D5 6400 picture has more contrast and less shadow information when compared to 6400 in D1 (see 3.1). Pictures 17 and 18 show close-up view of the subject in the corresponding frames. It should be also noted that this is less economical and labor intense development technique; the developer is, in essence, a homebred recipe and should be mixed out of several components.

### 3.6. D6: DIAFINE, STAND IN RODINAL 1:100, "SUPER SOUP".

The technique used in D6 had been described in the section 1.4 above. The processed film strip is heavily fogged. Out of 4 frames two (3200 and 6400) were scanned and presented below (see Pictures 19 and 20). Despite the fog, I rated 3200 picture as acceptable. It has pictured the subject well, have descent shadow details. The grain is big but does not spoil the overall look of the picture. Some development artifacts in the form of uneven development usually associated with stand development are noticeable. 6400 version is underexposed. Details in the deep shadows are blocked by fog. Development artifacts are exaggerated. Grain is very big. The 6400 has distinctive look of heavily pushed film. Despite all of the above, 6400 picture is comparable to the other 6400 shots. Pictures 21 and 22 show close-up view of the subject in the corresponding frames. It should be also noted that this is the less economical, most labor intense and time consuming development technique out of all since it includes 3 stages and employ 3 different developers; one of the developers has to be mixed manually out of several components.

### 3.7 SUMMARY OF TEST RESULTS

The results summarized in the Table II below. The individual parameters are estimated on a scale from 1 ("close to the worst") to 5 ("among the best").

**Table II.** Test results

Developer: Price/Labor/Time	Overall look		Shadows		Highlights		Grain		Fogging	Development artifacts ("bromide drag")	
	3200	6400	3200	6400	3200	6400	3200	6400		3200	6400
D1: 5/5/5	4	3	4	2	4	2	5	3	4	5	5
D2: 4/3/3	3	2	3	1	4	3	5	3	3	3	2
D3: 5/5/1	3	1	3	1	4	2	3	2	4	2	1
D4: 4/4/3	4	2	4	2	4	2	4	3	4	3	2
D5: 2/3/4	5	3	4	2	4	2	2	2	5	5	5
D6: 1/1/2	4	3	4	3	4	3	1	1	1	3	2

## 4. CONCLUSION

### 4.1 CONCLUSION ON 3200 ISO RATING.

It is my opinion that D1 (Diafine developer used twice on the same film) and D5 "Super Soup" (homebred developer containing HC-110, Dektol, Ascorbic Acid and Washing soda) provide the best combination of overall quality and speed when the film is rated at ISO 3200. Out of two, D1 is more economical and less labor-intensive at the development stage. "Super Soup" gives to the picture slightly more vivid look with a little bit less shadow details, but the difference is minor and it is matter of personal preference which one to choose.

### 4.2 CONCLUSION ON 6400 ISO RATING.

None of the developers gave acceptable results for the film rated ISO 6400. Nevertheless, the same two developers – D1 and D5 came very close to the point where their results can be rated as acceptable. I can imagine the situations where 6400 speed can be safely used, especially in the case of tungsten or/and fluorescent type of lighting which are usual types of street lighting. These types of lighting have more energy in short-wave part of the spectrum compared to the candle flame and Tri-X can be rated at higher speed when exposed under these types of lights.



## 5. TEST IMAGES

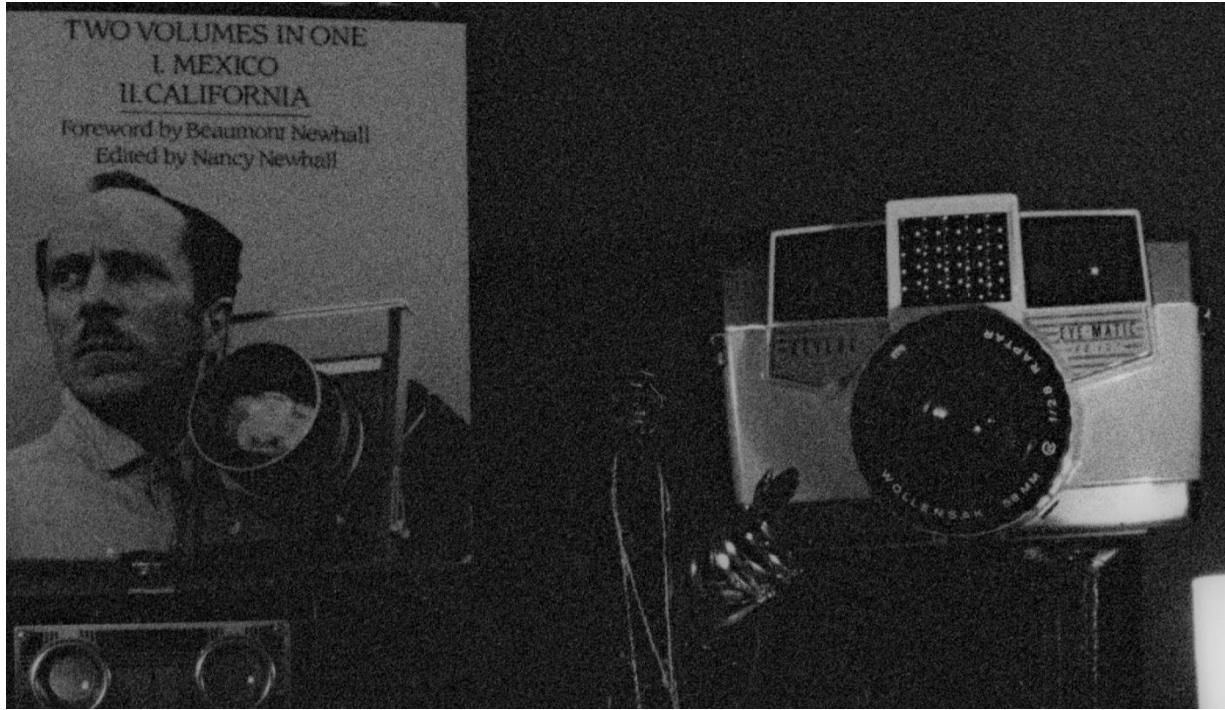
Test images presented on pages 6-15 can be downloaded from [15].



Picture 3. D1: E.I. 3200 in 2xDiafine



Picture 4. D1: E.I. 6400 in 2xDiafine



Picture 5. D1: Close-up on the central part of the frame; E.I. 3200 in 2xDiafine



Picture 6. D1: Close-up on the central part of the frame; E.I. 6400 in 2xDiafine



Picture 7. D2: E.I. 3200 in Rodinal 1:50 semi-stand



Picture 8. D2: E.I. 6400 in Rodinal 1:50 semi-stand





Picture 9. D2: E.I. 3200 in Rodinal 1:50 semi-stand; close-up on the central part of the frame.



Picture 10. D2: E.I. 6400 in Rodinal 1:50 semi-stand; close-up on the central part of the frame.



Picture 11. D3: E.I. 3200 in Rodinal 1:100 stand 2 hours.



Picture 12. D3: Close-up on the central part of the frame; E.I. 3200 in Rodinal 1: 100 stand 2 hours.



Picture 13. D4: E.I.3200 in HC-110 1: 100 stand 25min then Diafine.



Picture 14. D4: Close-up on the central part of the frame; E.I. 3200 in HC-110 1: 100 stand 25min then Diafine.





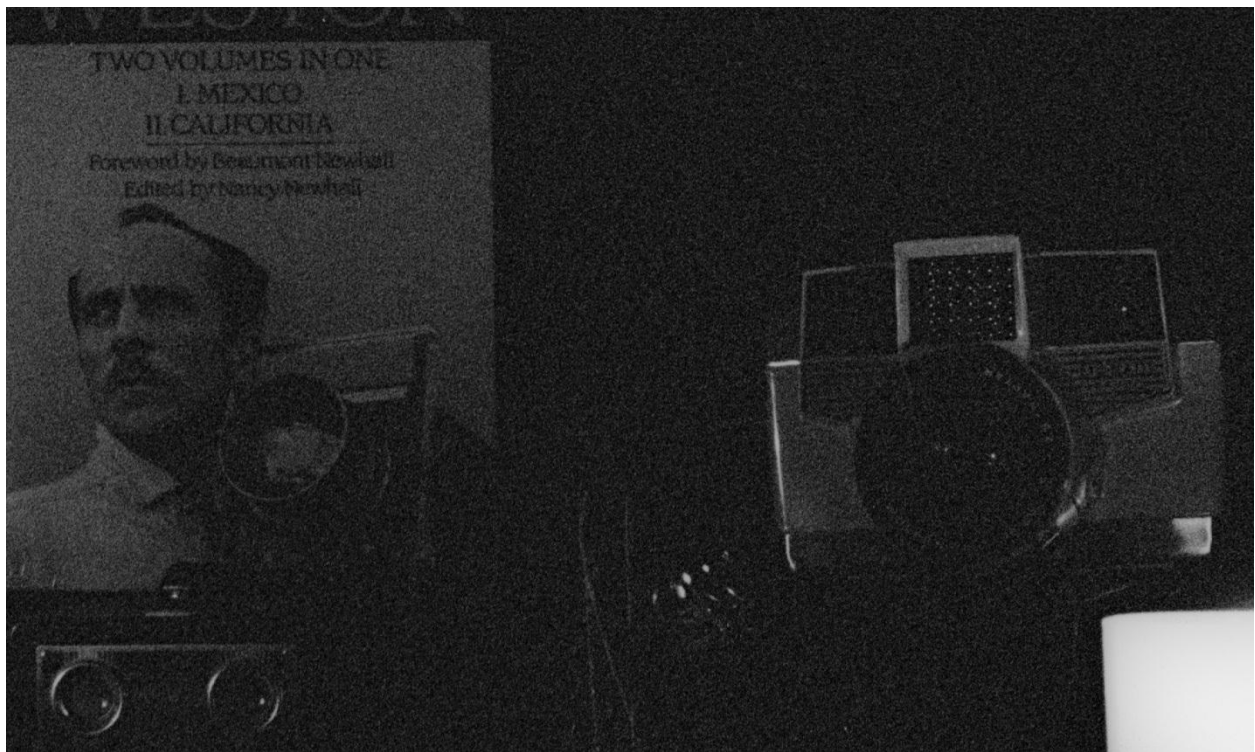
Picture 15. D5: E.I. 3200 in "Super Soup" developer.



Picture 16. D5: E.I. 6400 in "Super Soup" developer.



Picture 17. D5: Close-up on the central part of the frame; E.I. 3200 in "Super Soup" developer.



Picture 18. D5: Close-up on the central part of the frame; E.I. 6400 in "Super Soup" developer.

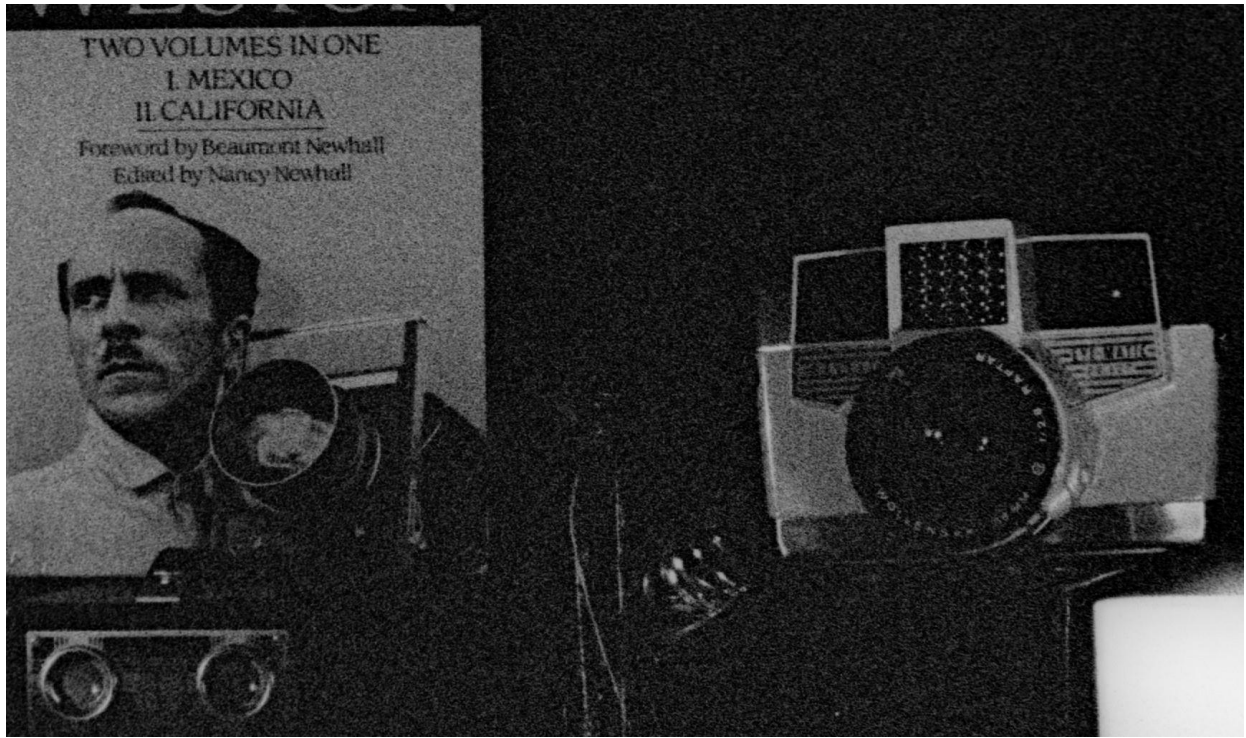




Picture 19. D6: E.I. 3200 in Diafine+Stand in Rodinal 1:100+“Super Soup”.



Picture 20. D6: E.I. 3200 in Diafine+Stand in Rodinal 1:100+“Super Soup”.



Picture 21. D6: Close-up on the central part of the frame; E.I. 3200 in Diafine+Stand in Rodinal 1:100+“Super Soup”.



Picture 22. D6: Close-up on the central part of the frame; E.I. 6400 in Diafine+Stand in Rodinal 1:100+“Super Soup”.

## 6. REFERENCES AND LINKS

- 1 Arista Premium 400 Film. <http://www.freestylephoto.biz/192364-Arista-Premium-BandW-400-ISO-35mm-x-36-exp>.
- 2 Donald Qualls. Tri-X in Diafine at 3200 ISO and Super Soup developer. <http://www.apug.org/forums/viewpost.php?p=304626>
- 3 Agfa Rodinal. [http://www.maco-photo.de/files/images/TA\\_Agfa\\_Rodinal\\_multil.pdf](http://www.maco-photo.de/files/images/TA_Agfa_Rodinal_multil.pdf)
- 4 Rodinal/R09 One Shot. <http://www.maco-photo.de/files/images/AFRO12.pdf>
- 5 Rodinal/R09 One Shot Developing Charts. [http://www.maco-photo.de/files/images/Rodinal\\_Entwicklungszeiten\\_090109.pdf](http://www.maco-photo.de/files/images/Rodinal_Entwicklungszeiten_090109.pdf)
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- 8 Stand development in Rodinal diluted 1:100. <http://www.rangefinderforum.com/forums/showpost.php?p=927796&postcount=47>
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- 10 Larry Dressler. Pushing Tri-X to 12800. <http://www.digitaltruth.com/articles/pushing-tri-x.php>
- 11 Acufine Developers. [http://www.digitaltruth.com/products/acufine\\_tech/acufine.pdf](http://www.digitaltruth.com/products/acufine_tech/acufine.pdf)
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- 14 Gossen Luna-Pro digital F Instruction Manual. [http://www.cameramanuals.org/flashes\\_meters/gossen\\_luna-pro-digital\\_f.pdf](http://www.cameramanuals.org/flashes_meters/gossen_luna-pro-digital_f.pdf)
- 15 TEST of 6 developers: Tri-X at EI 3200 and 6400. <http://www.pbase.com/amirko/trixhighisotest2011>