KODAK PROFESSIONAL TRI-X 320 and 400 Films

Kodak alaris

TECHNICAL DATA / **BLACK-AND-WHITE FILM**

February 2016 • F-4017

KODAK PROFESSIONAL TRI-X 320 and 400 Films are high-speed panchromatic films that are a good choice for photographing dimly lighted subjects or fast action, for photographing subjects that require good depth of field and fast shutter speeds, and for extending the distance range for flash pictures.

TRI-X 400 Film (400TX) is available in 135 and 120 and 135 sizes. You can retouch the 120-size film on the emulsion side. TRI-X 400 Film is recommended for push-processing applications.

TRI-X 320 Film (320TXP) features excellent tone gradation and brilliant highlights. It is especially well suited to low-flare interior lighting or flash illumination. It is also useful for portraiture with low-contrast backlighting outdoors.

TRI-X 320 Film (320TXP) is available in sheets on a 7-mil KODAK ESTAR Thick Base. You can retouch this film on the emulsion or base side.

FEATURES	BENEFITS
• Fine grain	• Good for producing high-quality images
• Wide exposure latitude	• Rich tonality maintained with overexposure and underexposure
• High sharpness	• Good for applications that require a moderate degree of enlargement
• High resolving power	• Good rendition of detail

STORAGE AND HANDLING

Load and unload your camera in subdued light.

High temperatures or high humidity may produce unwanted quality changes. Store unexposed film at 24°C (75°F) or lower in the original sealed package. Always store film (exposed or unexposed) in a cool, dry place. For best results, process film as soon as possible after exposure.

Protect processed film from strong light, and store it in a cool dry place.

EXPOSURE

Daylight

Use the exposures in the table below for average front-lit subjects from 2 hours after sunrise to 2 hours before sunset.

Lighting Conditions	Shutter Speed (second) and Lens Opening	
	TRI-X 320 Film	TRI-X 400 Film
Bright/Hazy Sun on Light Sand or Snow	1/500 *f*/16	1/500 *f*/22
Bright or Hazy Sun, Distinct Shadows	1/500 *f*/11*	1/500 *f*/16†
Weak, Hazy Sun (Soft Shadows)	1/500 *f*/8	1/500 *f*/11
Cloudy Bright (No Shadows)	1/500 *f*/5.6	1/500 *f*/8
Heavy Overcast, Open Shade‡	1/500 *f*/4	1/500 *f*/5.6

* Use *f*/5.6 at 1/500 for backlit close-up subjects.
† Use *f*/8 at 1/500 for backlit close-up subjects.
‡ Subject shaded from the sun but lighted by a large area of clear sky.

Filter Corrections

Multiply the normal exposure time by the filter factor.

KODAK WRATTEN Gelatin Filter	Daylight Filter Factor	Tungsten Filter Factor
KODAK PROFESSIONAL TRI-X 400 Film / 400TX		
No. 8 (yellow)	2	1.5
No. 11 (yellowish green)	4	3
No. 12 (deep yellow)	2.5	—
No. 15 (deep yellow)	2.5	1.5
No. 25 (red)*	8	5
No. 47 (blue)*	6	12
No. 58 (green)*	6	6
Polarizing Filter	2.5	2.5
KODAK PROFESSIONAL TRI-X 320 Film / 320TXP		
No. 8 (yellow)	2	1.5
No. 11 (yellowish green)	4	4
No. 15 (deep yellow)	2.5	2
No. 25 (red)*	8	5
No. 29 (red)*†	16	10
No. 47 (blue)*	6	10
No. 58 (green)*	8	8
Polarizing Filter	2.5	2.5

* Filter recommended for making separation negatives.
† For TRI-X 320 sheet film only.

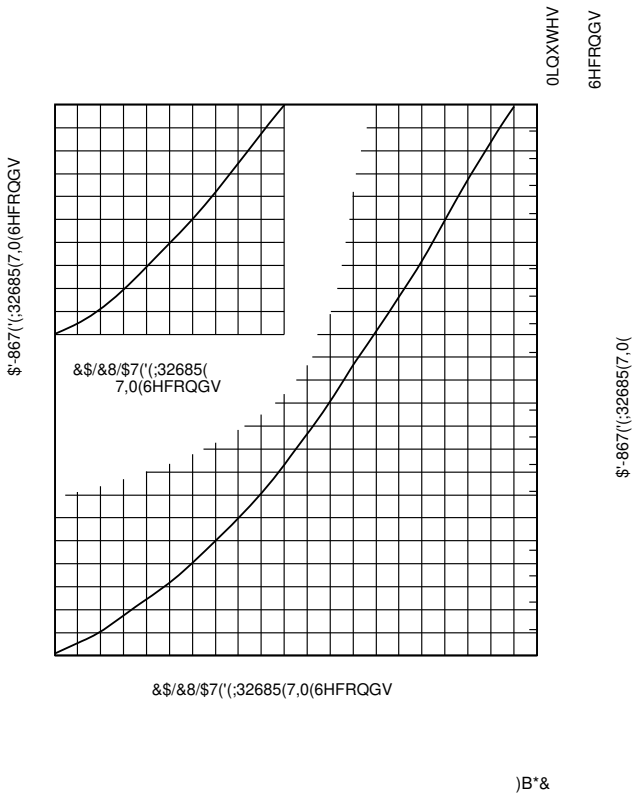
© 2016 Kodak Alaris Inc.

Exposure and Development Adjustments for Long and Short Exposures

At the exposure times in the table below, compensate for the reciprocity characteristics of this film by increasing exposure and adjusting the development as shown.

If Indicated Exposure Time Is (Seconds)	Use This Lens-Aperture Adjustment	OR	This Adjusted Exposure Time (Seconds)	AND Use This Development Adjustment
1/100,000	+1 stop		Change Aperture	+20%
1/10,000	+1/2 stop		Change Aperture	+15%
1/1,000	None		None	+10%
1/100	None		None	None
1/10	None		None	None
1	+1 stop		2	-10%
10	+2 stops		50	-20%
100	+3 stops		1200	-30%

It may be difficult to use the table to estimate the adjusted times for calculated exposure times between 1 and 100 seconds. The graphs that follow will help you find the adjusted times for calculated exposure times between those given in the table.



DARKROOM RECOMMENDATIONS

Handle unprocessed film in total darkness.

Using a safelight *will* affect your results. If absolutely necessary, after development is half complete, you can use a safelight equipped with a KODAK 3 Safelight Filter (dark green) with a 15-watt bulb for a few seconds. Keep the safelight at least 4 feet (1.2 metres) from the film. Run tests to determine that safelight use gives acceptable results for your application.

For information on safelight testing, see KODAK Publication No. K-4, *How Safe Is Your Safelight?*

PROCESSING

The following starting-point recommendations are intended to produce a contrast index of 0.56. Make tests to determine the best development time for your application.

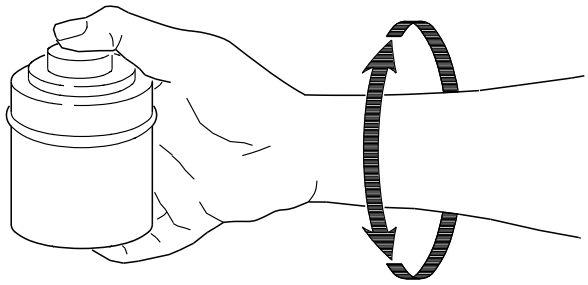
Note: Tank development times shorter than 5 minutes may produce unsatisfactory uniformity.

MANUAL PROCESSING

Small-Tank Processing (8- or 16-ounce tank)

With small single- or double-reel tanks, drop the loaded film reel into the developer and attach the top to the tank. Firmly tap the tank on the top of the work surface to dislodge any air bubbles. Provide initial agitation of 5 to 7 inversion cycles in 5 seconds; i.e., extend your arm and vigorously twist your wrist 180 degrees.

Then repeat this agitation procedure at 30-second intervals for the rest of the development time.



Large-Tank Processing (1/2- to 3 1/2-gallon tank)—Rolls and Sheets

Agitate continuously for the first 15 to 30 seconds by raising and lowering the basket, rack, or spindle 1/2-inch. Do not agitate the basket, rack, or spindle for the remainder of the first minute. Then agitate once per minute by lifting the basket, rack, or spindle out of the developer, tilting it approximately 30 degrees, draining it for 5 to 10 seconds, and reimmersing it. Alternate the direction of tilting the basket, rack, or spindle.

TRI-X 400 Film / 400TX

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time (Minutes)									
	Small Tank*					Large Tank†				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
T-MAX	6 3/4	6	5 3/4	5 1/2	4 3/4	NR				
T-MAX RS	4 3/4	4 1/2	4 1/4	4	3 1/2	5 1/2	5	4 3/4	4 1/2	4
HC-110 (B)	4 1/2	3 3/4	3 1/2	3	2 1/2	5	4 1/2	4	3 1/2	3
D-76	8	6 3/4	6 1/4	5 1/2	4 3/4	9 1/4	7 3/4	7	6 1/2	5 1/2
D-76 (1:1)	10 3/4	9 3/4	9	8 1/2	7 3/4	12 1/4	11	10 1/2	9 3/4	8 3/4
XTOL	8	7	6 1/4	5 3/4	4 3/4	9 1/4	8	7 1/4	6 1/2	5 1/2
XTOL (1:1)	10	9	8 1/2	8	7 1/4	11 1/2	10 1/2	9 3/4	9 1/4	8 1/4

* With agitation at 30-second intervals. Development times shorter than 5 minutes may produce unsatisfactory results.
† With manual agitation at 1-minute intervals. Development times shorter than 5 minutes may produce unsatisfactory results.

NR = Not Recommended.

Tray and Large-Tank Processing —Sheets

Provide continuous agitation; rotate the sheets 90 degrees as you interleave them. Prewetting sheet film may improve tray process uniformity.

TRI-X 320 Film / 320TXP—Sheets

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time (Minutes)				
	Tray*				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
T-MAX RS	3	2 3/4	2 1/2	NR	NR
HC-110 (B)	3 3/4	3 1/4	3	2 3/4	2 1/2
D-76	6 3/4	6	5 1/2	5	4 1/2
D-76 (1:1)	10 1/4	9	8 1/2	7 3/4	6 3/4
XTOL	6 3/4	6	5 1/2	5	4 1/2
XTOL (1:1)	9 1/2	8 1/2	7 3/4	7 1/4	6 1/4

* With continuous agitation.

TRI-X 320 Film / 320TXP—Sheets

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time (Minutes)									
	Large Tank*					Large Tank With Gaseous Burst†				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
T-MAX RS	4	3 1/2	3 1/4	NR	NR	3	2 3/4	2 1/2	NR	NR
HC-110 (B)	4 3/4	4 1/4	4	3 1/2	3	3 3/4	3 1/4	3	2 3/4	2 1/2
D-76	8 1/2	7 1/2	7	6 1/4	5 1/2	6 3/4	6	5 1/2	5	4 1/2
D-76 (1:1)	12 3/4	11 1/4	10 1/2	9 3/4	8 1/2	10 1/4	9	8 1/2	7 3/4	6 3/4
XTOL	8 1/2	7 1/2	7	6 1/4	5 1/2	6 3/4	6	5 1/2	5	4 1/2
XTOL (1:1)	12	10 1/2	9 3/4	9	7 3/4	9 1/2	8 1/2	7 3/4	7 1/4	6 1/4

* With manual agitation at 1-minute intervals.
† With gaseous-burst agitation (1 second every 10 seconds) that provides pressure to raise the solution level 5/8 inch (16 mm). Development times shorter than 5 minutes may produce unsatisfactory uniformity.

Rotary-Tube Processing

Follow the agitation recommendations for your processor. The design of the machine and the agitation will significantly affect the development time required to obtain optimum contrast. The times given below are starting-point recommendations. Make tests to determine if results are acceptable for your needs.

TRI-X 400 Film / 400TX

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time (Minutes)				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
T-MAX	6 3/4	6	5 3/4	5 1/2	4 3/4
T-MAX RS	4 3/4	4 1/2	4 1/4	4	3 1/2
XTOL	8	7	6 1/4	5 3/4	4 3/4
XTOL (1:1)	10	9	8 1/2	8	7 1/4
HC-110 (B)	4 1/2	3 3/4	3 1/2	3	2 1/2
D-76	8	6 3/4	6 1/4	5 1/2	4 3/4
D-76 (1:1)	10 3/4	9 3/4	9	8 1/2	7 3/4

TRI-X 320 Film / 320TXP—Sheets

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time (Minutes)				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
T-MAX	NR				
T-MAX RS	2 3/4	2 1/2	2 1/4	NR	NR
XTOL	6	5 1/4	4 3/4	4 1/2	4
XTOL (1:1)	8 1/4	7 1/4	6 3/4	6 1/4	5 1/2
HC-110 (B)	3 1/4	3	2 3/4	2 1/2	2 1/4
D-76	6	5 1/4	4 3/4	4 1/2	4
D-76 (1:1)	9	8	7 1/4	6 3/4	6

FINAL STEPS

65 to 75°F (18 to 24°C).

Step/Solution	Time (min:sec)
Rinse—with agitation:	
KODAK Indicator Stop Bath	0:30
Fix—with frequent agitation:	
KODAK Fixer	5:00 to 10:00
KODAK Rapid Fixer	2:00 to 4:00
KODAFIX Solution	2:00 to 4:00
KODAK POLYMAX T Fixer (1:3)	2:00 to 4:00
Wash:	
Running water —OR— Rinse with water KODAK PROFESSIONAL Hypo Clearing Agent Running water	20:00 to 30:00 0:30 1:00 to 2:00 5:00
FInal Rinse:	
KODAK PHOTO-FLO Solution	0:30
Dry—in a dust-free place	

PUSH PROCESSING

Push processing allows you to expose the film at higher film-speed numbers for conditions such as low-level light, stop action, or existing light. However, there will be a loss of shadow detail and an increase in graininess.

Because of these films' exposure latitude, you can underexpose by one stop and use normal processing times. Prints will show a slight loss in shadow detail.

You can underexpose by two stops if you increase development time by push processing. Prints will show an increase in contrast and graininess with further loss of shadow detail. However, results should be acceptable for many applications. Expose a test roll to determine the film speed that gives the best results for your application.

You can underexpose TRI-X 400 Film / 400TX by three stops if you increase development time by push processing. Prints will show an increase in contrast and graininess, and an additional loss of shadow detail. However, results should be acceptable for some applications. Expose some test rolls to determine the film speed that gives the best results for your application.

TRI-X 400 Film / 400TX

KODAK PROFESSIONAL Developer or Developer and Replenisher	Small Tank; Agitation at 30-second intervals									
	EI 1600 (2-Stop Push Process) Development Time (Minutes)					EI 3200 (3-Stop Push Process) Development Time (Minutes)				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
T-MAX	9 1/2	8 3/4	8 1/4	7 3/4	7	NR	NR	NR	NR	8 1/4
T-MAX RS	8 1/2	7 3/4	7 1/4	6 3/4	6	—	9 1/2	9	8 1/4	7 1/2
HC-110 (B)	7	6	5 1/2	5	4 1/4	—	—	—	—	—
D-76	11 1/4	9 1/2	8 3/4	7 3/4	6 1/2	12 3/4	11	9 3/4	9	7 1/2
D-76 (1:1)	14 3/4	13 1/4	12 1/2	11 3/4	10 3/4	17 1/2	16	15	14 1/4	12 3/4
XTOL	11 1/4	9 3/4	8 3/4	8	6 3/4	—	11 1/2	10 1/2	9 1/2	8
XTOL (1:1)	14 1/2	13 1/4	12 1/4	11 1/2	10 1/2	—	15 1/2	14 1/2	13 3/4	12 1/4

NR = Not Recommended.

TRI-X 400 Film / 400TX

KODAK PROFESSIONAL Developer or Developer and Replenisher	Large Tank; Agitation at 1-minute intervals									
	EI 1600 (2-Stop Push Process) Development Time (Minutes)					EI 3200 (3-Stop Push Process) Development Time (Minutes)				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
T-MAX RS	—	8 3/4	8	7 1/2	7	—	—	—	—	—
HC-110 (B)	8	6 3/4	6 1/4	5 1/2	4 3/4	—	—	—	—	—
D-76	12 1/2	10 3/4	9 3/4	8 3/4	7 1/2	—	—	—	—	—
XTOL	12 3/4	11	9 3/4	9	7 1/2	15 1/4	13	11 3/4	10 1/2	9

TRI-X 400 Film / 400TX

KODAK PROFESSIONAL Developer or Developer and Replenisher	Rotary Tube; Continuous agitation									
	EI 1600 (2-Stop Push Process) Development Time (Minutes)					EI 3200 (3-Stop Push Process) Development Time (Minutes)				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
T-MAX	9 1/2	8 3/4	8 1/4	7 3/4	7	NR	NR	NR	NR	8 1/4
T-MAX RS	8 1/2	7 3/4	7 1/4	6 3/4	6	—	9 1/2	9	8 1/4	7 1/2
HC-110 (B)	7	6	5 1/2	5	4 1/4	—	—	—	—	—
D-76	11 1/4	9 1/2	8 3/4	7 3/4	6 1/2	12 3/4	11	9 3/4	9	7 1/2
D-76 (1:1)	14 3/4	13 1/4	12 1/2	11 3/4	10 3/4	17 1/2	16	15	14 1/4	12 3/4
XTOL	11 1/4	9 3/4	8 3/4	8	6 3/4	—	11 1/2	10 1/2	9 1/2	8
XTOL (1:1)	14 1/2	13 1/4	12 1/4	11 1/2	10 1/2	—	15 1/2	14 1/2	13 3/4	12 1/4

NR = Not Recommended.

TRI-X 320 Film / 320TXP—Sheets

KODAK PROFESSIONAL Developer	Tray; Continuous agitation				
	EI 1250 (2-Stop Push Process) Development Time (Minutes)				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
XTOL	9 3/4	8 3/4	8	7 1/2	6 1/2
XTOL (1:1)	13 1/2	12	11	10 1/4	8 3/4

TRI-X 320 Film / 320TXP—Sheets

KODAK PROFESSIONAL Developer	Large Tank; Agitation at 1-minute intervals				
	EI 1250 (2-Stop Push Process) Development Time (Minutes)				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
XTOL	12 1/4	10 3/4	10	9 1/4	8

TRI-X 320 Film / 320TXP—Sheets

KODAK PROFESSIONAL Developer	Rotary Tube; Continuous agitation				
	EI 1250 (2-Stop Push Process) Development Time (Minutes)				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
XTOL	8 1/2	7 1/2	7	6 1/2	5 3/4
XTOL (1:1)	11 3/4	10 1/2	9 1/2	8 3/4	7 3/4

MACHINE PROCESSING

Large Tank Rack-and-Tank Processors

The development times for large-tank rack-and-tank processors are based on a machine speed that transfers the film every 2 minutes. The times given below are starting-point recommendations for KODAK PROFESSIONAL T-MAX RS Developer and Replenisher and KODAK PROFESSIONAL XTOL Developer. Make tests to determine if results are acceptable for your needs.

Large-Tank Rack-and-Tank Processing			
KODAK PROFESSIONAL Film	EI	KODAK PROFESSIONAL Developer or Developer and Replenisher	Time (min) at 72°F (22°C)
TRI-X 320 (rolls and sheets)	320 640	T-MAX RS	4 to 6
TRI-X 400	400 800	T-MAX RS D-76 XTOL	4 to 6 5 to 7 5 to 7

Replenishment Rates

T-MAX RS Developer and Replenisher—Add 45 mL (1.5 ounces) of replenisher solution for each 135-36 or 120 roll or 8 x 10-inch sheet of film processed. Stir or recirculate the solution after each addition of replenisher solution.

Note: Do not use T-MAX RS Developer and Replenisher to replenish T-MAX Developer. They are not designed to work together.

XTOL Developer—Add 70 mL (2.4 ounces) of replenisher solution for each 135-36 or 120 roll or 8 x 10-inch sheet of film processed. Stir or recirculate the solution after each addition of replenisher solution.

RETOUCHING

You can retouch KODAK PROFESSIONAL TRI-X 400 Film (135 and 120 sizes) on the emulsion side. You can retouch KODAK PROFESSIONAL TRI-X 320 Film (sheet sizes) by applying liquid dyes to the base or emulsion side.

IMAGE STRUCTURE

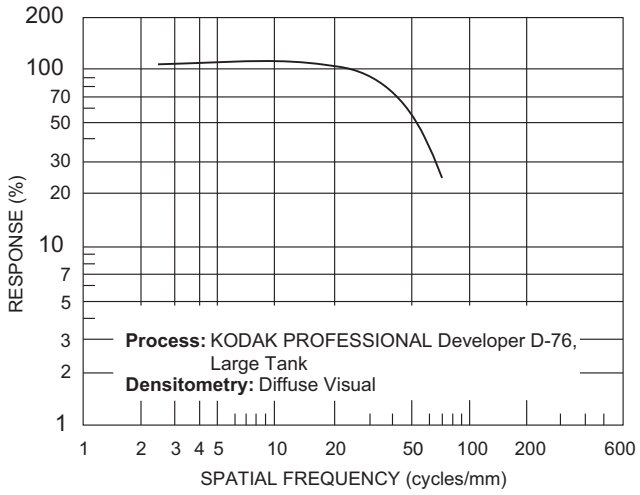
The data in this section is based on development in KODAK HC-110 Developer (Dilution B), 68°F (20°C).

KODAK Film	Diffuse rms Granularity*
KODAK PROFESSIONAL TRI-X 400 Film	17 (fine)
KODAK PROFESSIONAL TRI-X 320 Film	16 (fine)

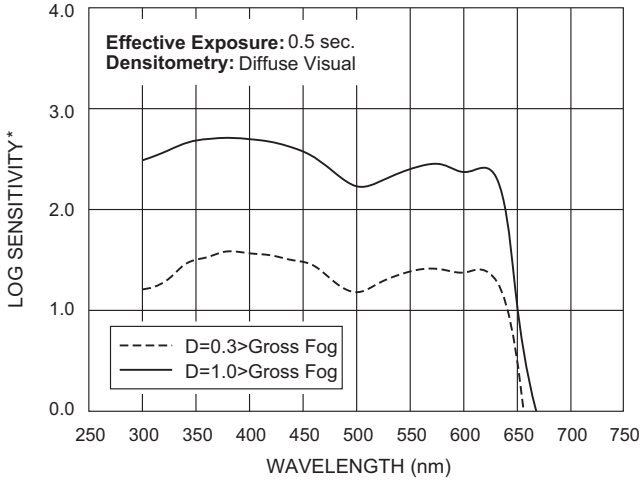
* Read at a net diffuse density of 1.0, using a 48-micrometre aperture, 12x magnification.

CURVES

Modulation Transfer Function

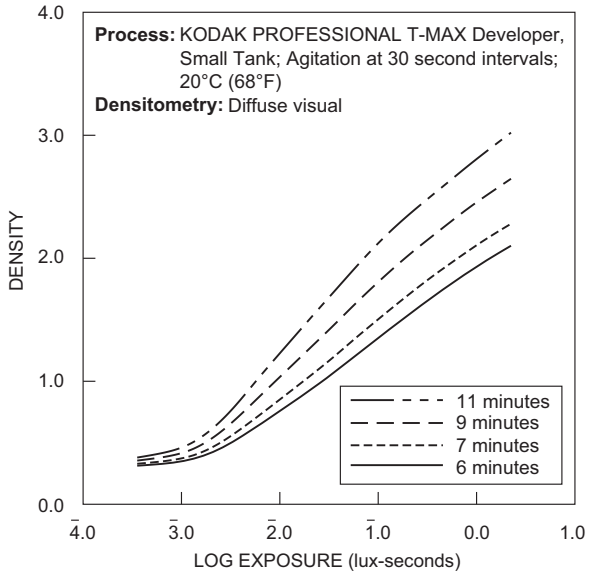


Spectral Sensitivity Curves

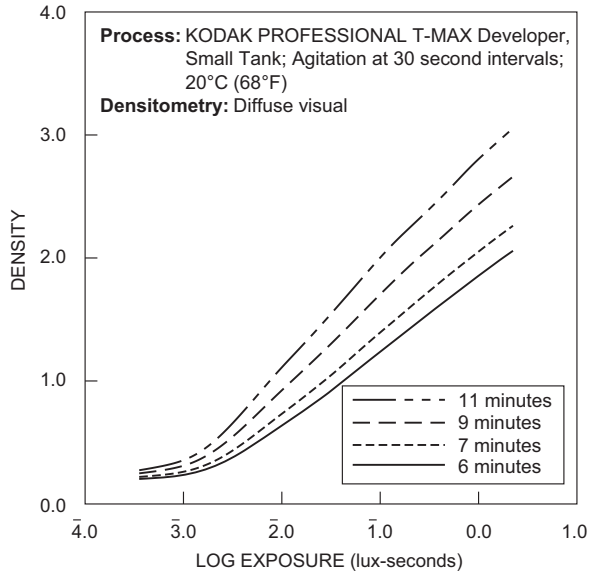


*Sensitivity = reciprocal of exposure (erg/cm^2) required to produce specified density

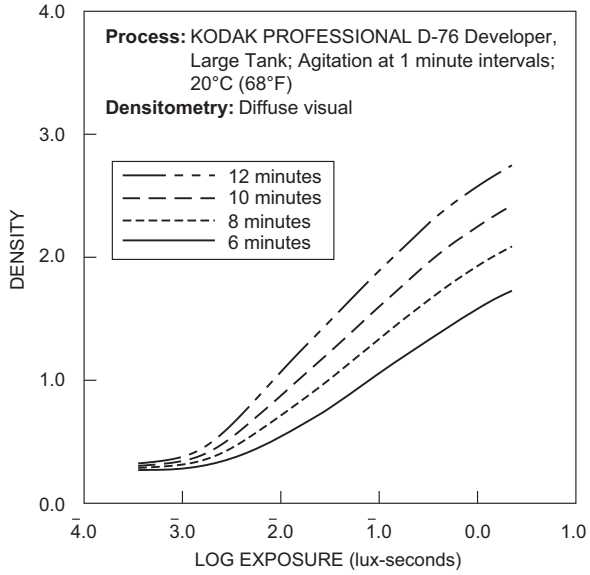
Characteristic Curves
KODAK PROFESSIONAL TRI-X 400 Film / 400TX, 35 mm



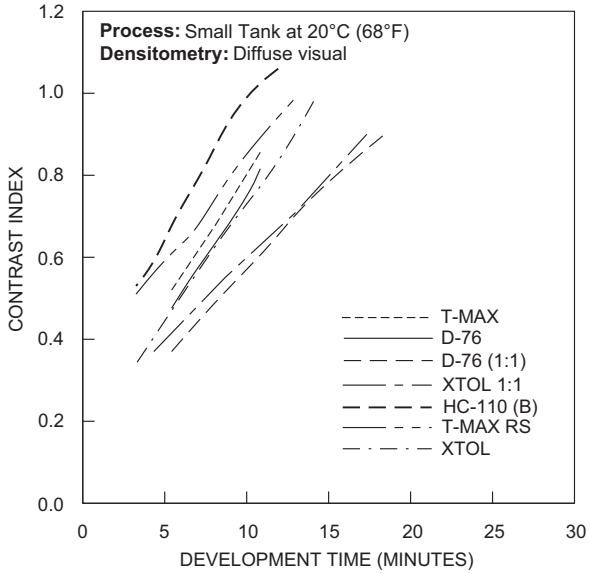
Characteristic Curves
KODAK PROFESSIONAL TRI-X 400 Film / 400TX, 120-size



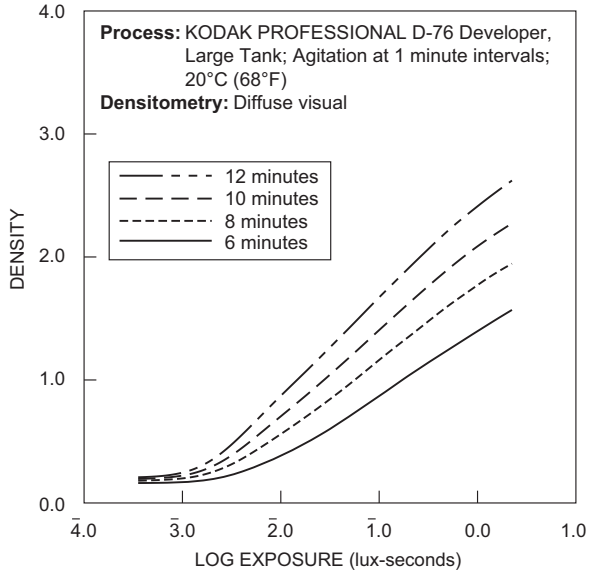
Characteristic Curves
KODAK PROFESSIONAL TRI-X 400 Film / 400TX, 35 mm



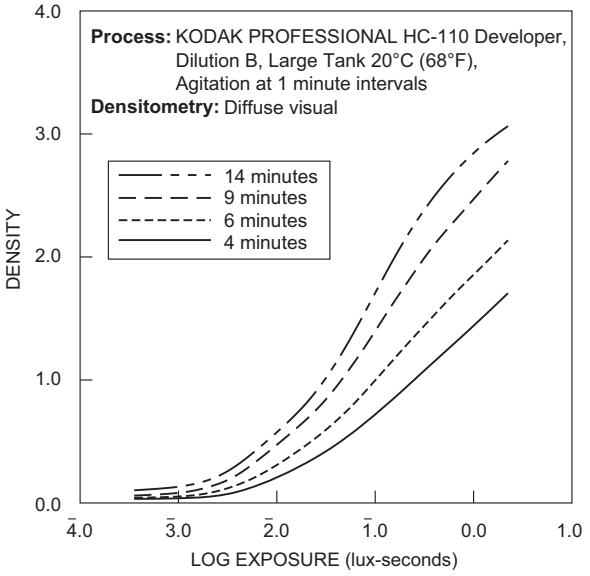
Contrast Index Curves
KODAK PROFESSIONAL TRI-X 400 Film / 400TX, 35 mm and 120-size



Characteristic Curves
KODAK PROFESSIONAL TRI-X 400 Film / 400TX, 120-size

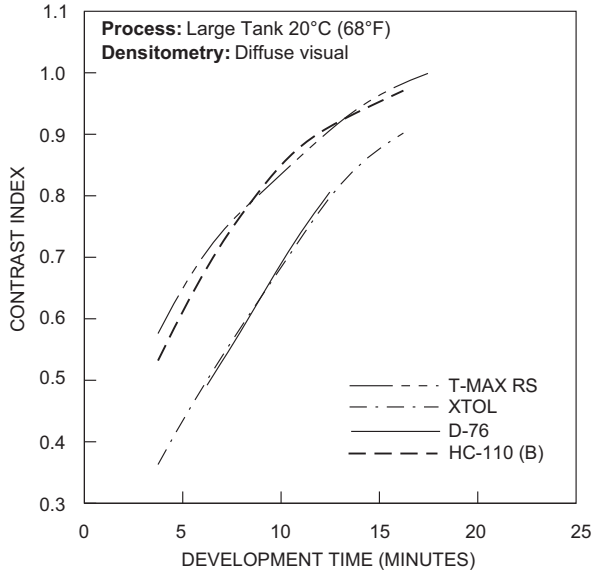


Characteristic Curves
KODAK PROFESSIONAL TRI-X 320 Film / 320TXP, Sheets

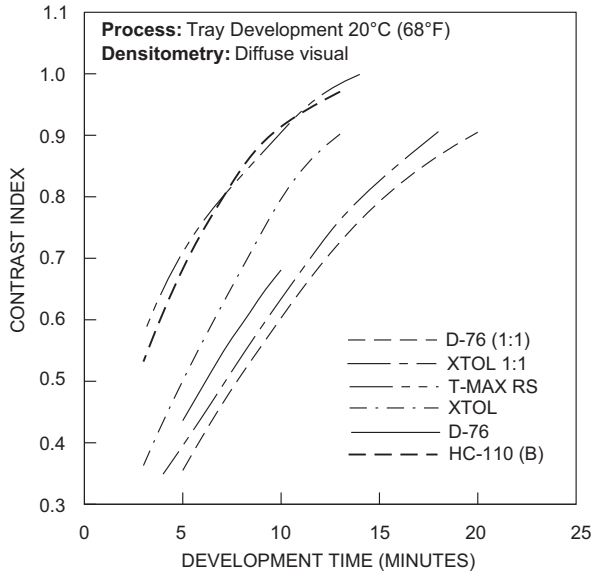


KODAK PROFESSIONAL TRI-X 320 and 400 Films

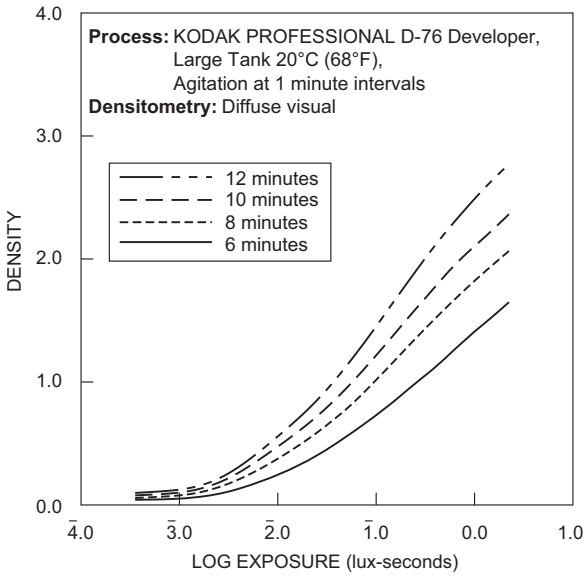
Contrast Index Curves
KODAK PROFESSIONAL TRI-X 320 Film / 320TXP, Sheets



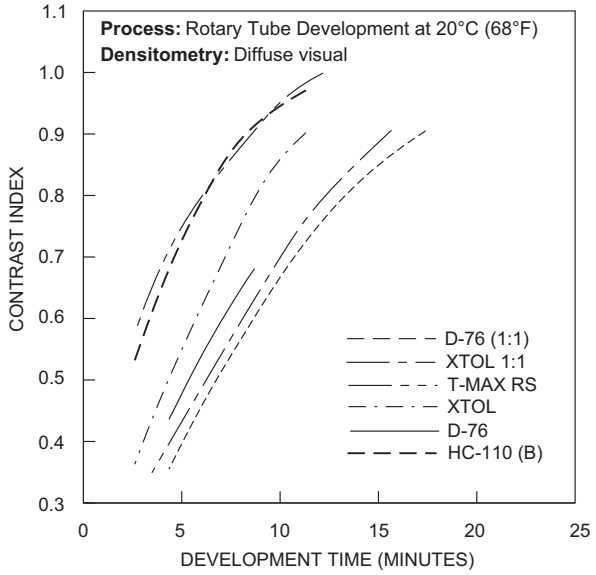
Contrast Index Curves
KODAK PROFESSIONAL TRI-X 320 Film / 320TXP, Sheets



Characteristic Curves
KODAK PROFESSIONAL TRI-X 320 Film / 320TXP, Sheets



Contrast Index Curves
KODAK PROFESSIONAL TRI-X 320 Film / 320TXP, Sheets



© 2016 Kodak Alaris Inc.
TM: D-76, HC-110, Photo-Flo, T-Max and Xtol
The Kodak, Kodak Professional, Estar, Kodafix,Tri-X and Wratten trademarks are used under license from Eastman Kodak Company.

Revised 2-16

KODAK PROFESSIONAL TRI-X 320 and 400 Films
KODAK Publication No. F-4017