KODAK PROFESSIONAL T-MAX 400 Film

Kodak alaris

TECHNICAL DATA / BLACK-AND-WHITE FILM

February 2016 • F-4043

KODAK PROFESSIONAL T-MAX 400 Film / 400TMY is a continuous-tone panchromatic black-and-white negative film especially useful for photographing dimly lighted subjects or fast action, for extending flash distance range, and for photographing subjects that require good depth of field and fast shutter speeds with maximum image quality for the film speed. It is also useful for scientific and biomedical work, especially when fluorescence photography is required. It has high speed (ISO 400/27° in most developers), very high sharpness, very fine grain, and very high resolving power; it allows a high degree of enlargement.

FEATURES	BENEFITS
• High-efficiency, Multi-zone KODAK T-GRAIN Emulsion	• World's finest grained 400-speed black-and-white film • Allows for greater enlargement
• Optimized Light Filtration technology	• World's sharpest 400-speed black-and-white film • Renders distinct edges and fine detail
• 400 speed	• Additional speed for low light or fast action

SIZES AVAILABLE

Catalog numbers and packaging may differ from country to country. See your dealer who supplies KODAK PROFESSIONAL Products.

DARKROOM RECOMMENDATIONS

Do not use a safelight. Handle unprocessed film in total darkness. *Do not* develop this film by inspection.

Note: The afterglow from fluorescent lights may fog this film. Make sure your darkroom is *completely* dark before you handle unprocessed film.

STORAGE AND HANDLING

Store unexposed film at 75°F (24°C), or lower, in the original sealed package. For protection from heat in areas with temperatures consistently higher than 75°F (24°C), you can store the film in a refrigerator. If film has been refrigerated, allow the package to warm up to room temperature for 2 to 3 hours before opening it.

Load and unload roll-film cameras in subdued light, and rewind the film completely before unloading the camera. Total darkness is required when you remove film from the magazine or load and unload film holders.

Store exposed film in a cool, dry place, and process it promptly.

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

EXPOSURE

The nominal speed of KODAK PROFESSIONAL T-MAX 400 Film is EI 400. It was determined in a manner published in ISO standards. Because of its great latitude, you can underexpose this film by one stop (at EI 800) and still obtain high quality with normal development in most developers. There will be no change in the grain in the final print, but there will be a slight loss of shadow detail and a reduction in printing contrast of about one-half paper grade.

When you need very high speed, you can expose T-MAX 400 Film at EI 1600 and increase the development time. With the longer development time, there will be an increase in contrast and graininess with additional loss of shadow detail, but negatives will still produce good prints. You can even expose this film at EI 3200 with a longer development time. Underexposing by three stops and using three-stop push-processing produces a further increase in contrast and graininess, and additional loss of shadow detail, but the results will be acceptable for some applications.

The speed numbers for this film are expressed as Exposure Indexes (EI). Use these exposure indexes with meters or cameras marked for ISO/ASA or ISO/DIN speeds in daylight or artificial light.

The developer you use to process this film affects the exposure index. Set your camera or meter (marked for ISO/ASA or ISO/DIN speeds) at the speed for your developer given in the table.

KODAK PROFESSIONAL Developer or Developer and Replenisher	Use This Exposure Index
T-MAX	400 / 27°
T-MAX RS	400 / 27°
XTOL XTOL (1:1)	400 / 27° 400 / 27°
D-76 D-76 (1:1)	400 / 27° 400 / 27°
HC-110 (B)	320 / 26°

Note: The developers and exposure indexes in bold type are the primary recommendations.

Under most conditions, you'll obtain highest quality with normal exposure at the rated exposure index and normal development. For high-contrast scenes, you'll obtain highest quality if you increase exposure by one or two stops and process the film normally.

If normal development produces negatives that are consistently too low in contrast, increase the development time slightly (10 to 15 percent). If negatives are too contrasty, decrease the development time slightly (10 to 15 percent). See "Adjusting Film Contrast."

If your negatives are too thin, increase exposure by using a lower exposure index; if too dense, reduce exposure by using a higher exposure index.

Pushing Exposure* with KODAK PROFESSIONAL T-MAX Developer, KODAK PROFESSIONAL T-MAX RS Developer and Replenisher, and KODAK PROFESSIONAL XTOL Developer		
1-Stop Push	2-Stop Push	3-Stop Push†
EI 800/30° Normal Processing	EI 1600/33° 2-Stop Push Processing	EI 3200/36° 3-Stop Push Processing

* Pushing exposure results in slight losses of quality compared with normal exposure and normal processing. You can also use other Kodak developers for pushing this film; however, T-MAX Developer, T-MAX RS Developer and Replenisher, and XTOL Developer produce higher-quality tone reproduction (better shadow detail) under these conditions.
For high-contrast scenes, such as spotlighted performers under harsh lighting, expose and process as indicated in the table. However, when detail in the deep-shadow areas is important to the scene, increase exposure by 2 stops and process your film normally.

† Pushing exposure and processing by 3 stops increases contrast and graininess and decreases shadow detail further. Expose and process a test roll to determine if the results are acceptable for your needs.

Adjustments for Long and Short Exposures

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

If Indicated Exposure Time Is (Seconds)	Use This Lens-Aperture Adjustment	OR	This Adjusted Exposure Time (Seconds)
1/10,000	None		None
1/1,000	None		None
1/100	None		None
1/10	None		None
1	None		None
10	+1/3 stop		Change Aperture
100	+1 1/2 stops		300

Filter Corrections

Increase exposure by the filter factor or the number of stops indicated when you use filters. For greatest exposure accuracy with a through-the-lens meter, take the meter reading without the filter over the lens, and then increase your exposure as shown in the table.

KODAK WRATTEN Gelatin Filter	Daylight			Tungsten		
	Increase Lens Aperture By (f-stops)	OR	Increase Exposure By (Filter Factor)	Increase Lens Aperture By (f-stops)	OR	Increase Exposure By (Filter Factor)
No. 8 (yellow)	2/3		1.6	1/3		1.3
No. 11 (yellowish green)	2		4	1 2/3		3
No 12 (deep yellow)	1		2	1/3		1.3
No. 15 (deep yellow)	1		2	1/3		1.3
No. 25 (red)	3		8	2		4
No. 47 (blue)	3 1/3		10	4 1/3		20
No. 58 (green)	2 2/3		6	2 2/3		6
Polarizing Filter	1 2/3		3	1 1/3		2.5

Note: Filter factors for other Kodak black-and-white films are different.

PROCESSING

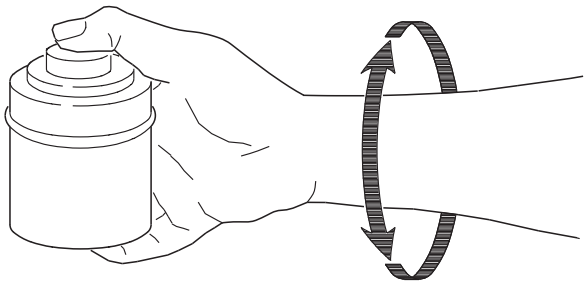
These starting-point recommendations are intended to produce negatives with a contrast appropriate for printing with a diffusion enlarger. To print negatives with a condenser enlarger, you may need to adjust the contrast by reducing your development time; see "Adjusting Film Contrast." Tank development times shorter than 5 minutes may produce unsatisfactory uniformity.

MANUAL PROCESSING

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

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.



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Note: The development times in the tables are suggested starting points.

Small Tank Processing, (8- or 16-ounce tank)—Rolls

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time in Minutes				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
T-MAX*	NR	6 3/4	6 1/4	6	5 1/2
T-MAX (1:7)†	—	—	—	—	8 1/4
T-MAX (1:9)†	—	—	—	—	13 3/4
T-MAX RS*	NR	5 3/4	5 1/2	5	4 1/2‡
T-MAX RS (1:7)†	—	—	—	—	6 3/4
T-MAX RS (1:9)†	—	—	—	—	11 1/4
XTOL	7 1/4	6 1/2	6 1/4	5 3/4	5 1/4
XTOL (1:1)†	10 3/4	9 1/4	8 1/2	7 3/4	7
D-76	8 1/4	7 1/2	6 3/4	6 1/4	5 1/2
D-76 (1:1)	11 1/4	10 1/4	9 1/2	9	8
HC-110 (B)	6 1/4	5 1/2	5 1/4	4 3/4‡	4 1/2‡

* The recommended standard dilution is 1:4.
† We do not recommend using more dilute solutions of these developers than indicated in the table. Dilute developers require longer development times; they give slightly higher film speed and a slight increase in graininess.
‡ Development times shorter than 5 minutes may produce unsatisfactory uniformity.

NR = Not Recommended

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.

Note: The development times in the table are suggested starting points.

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

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

NR = Not Recommended

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

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

NR = Not Recommended

Note: Do not use KODAK PROFESSIONAL T-MAX Developer to process sheet films.

Tray Processing—Sheets

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

Note: The development times in the table are suggested starting points.

Note: Do not use KODAK PROFESSIONAL T-MAX Developer to process sheet films.

Tray Processing—Sheets

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

* Development times shorter than 5 minutes may produce unsatisfactory uniformity.

NR = Not Recommended

Rotary-Tube Processing—Rolls and Sheets

Note: The development times in the table are suggested starting points.

Rotary-Tube Processing—Rolls

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time in Minutes				
	65°F (18°C)	68°F (20°C)	70°F (21°C)	72°F (22°C)	75°F (24°C)
T-MAX*	NR	6 3/4	6 1/4	6	5 1/2
T-MAX (1:7)†	—	—	—	—	8 1/4
T-MAX (1:9)†	—	—	—	—	13 3/4
T-MAX RS*	NR	5 3/4	5 1/2	5	4 1/2‡
T-MAX RS (1:7)†	—	—	—	—	6 3/4
T-MAX RS (1:9)†	—	—	—	—	11 1/4
XTOL	7 1/4	6 1/2	6 1/4	5 3/4	5 1/4
XTOL (1:1)†	10 3/4	9 1/4	8 1/2	7 3/4	7
D-76	8 1/4	7 1/2	6 3/4	6 1/4	5 1/2
D-76 (1:1)	11 1/4	10 1/4	9 1/2	9	8
HC-110 (B)	6 1/4	5 1/2	5 1/4	4 3/4‡	4 1/2‡

* The recommended standard dilution is 1:4.
† We do not recommend using more dilute solutions of these developers than indicated in the table. Dilute developers require longer development times; they give slightly higher film speed and a slight increase in graininess.
‡ Development times shorter than 5 minutes may produce unsatisfactory uniformity.

Note: Do not use KODAK PROFESSIONAL T-MAX Developer to process sheet films.

NR = Not Recommended

Rotary-Tube Processing—Sheets

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

* The recommended standard dilution is 1:4.
† We do not recommend using more dilute solutions of these developers than indicated in the table. Dilute developers require longer development times; they give slightly higher film speed and a slight increase in graininess.
‡ Development times shorter than 5 minutes may produce unsatisfactory uniformity.

Note: Do not use KODAK PROFESSIONAL T-MAX Developer to process sheet films.

NR = Not Recommended

FINAL STEPS

Rinse at 65 to 75°F (18 to 24°C) with agitation in KODAK Indicator Stop Bath or running water for 30 seconds.

Fix at 65 to 75°F (18 to 24°C) for 3 to 5 minutes with vigorous agitation in KODAK Rapid Fixer. Be sure to agitate the film frequently during fixing.

Note: To keep fixing times as short as possible, we strongly recommend using KODAK Rapid Fixer. If you use another fixer, such as KODAK Fixer or KODAFIX Solution, fix for 5 to 10 minutes or twice the time it takes for the film to clear. You can check the film for clearing after 3 minutes in KODAK Rapid Fixer or 5 minutes in KODAK Fixer or KODAFIX Solution.

Important

Your fixer will be exhausted more rapidly with this film than with other films. If your negatives show a magenta (pink) stain after fixing, your fixer may be near exhaustion, or you may not have used a long enough time. If the stain is slight, it will not affect image stability, negative contrast, or printing times. You can remove a slight pink stain with KODAK Hypo Clearing Agent. However, if the stain is pronounced and irregular over the film surface, refix the film in fresh fixer.

Wash for 20 to 30 minutes in running water at 65 to 75°F (18 to 24°C) with a flow rate that provides at least one complete change of water in 5 minutes. You can wash long rolls on the processing reel. To save time and conserve water, use KODAK PROFESSIONAL Hypo Clearing Agent.

Dry film in a dust-free place. To minimize drying marks, treat the film with KODAK PHOTO-FLO Solution after washing, or wipe the surface carefully with a photo chamois or a soft viscose sponge.

PUSH PROCESSING

Push processing allows film to be exposed at higher speeds, however, push processing will not produce optimum quality. There will be some loss in shadow detail, an increase in graininess, and an increase in contrast. The degree of these effects varies from slight to very significant depending on the amount of underexposure and push processing. The results are usually excellent with a 2-stop push, and acceptable with 3-stop push depending on the lighting and the scene contrast.

Note: No increase in development time is required for a 1-stop push.

Note: The development times in the table are suggested starting points.

Small Tank Processing, (8- or 16-ounce tank)—Rolls

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time in Minutes		
	EI 1600		EI 3200
	68°F (20°C)	75°F (24°C)	75°F (24°C)
T-MAX	8 1/2	7 1/4	8 1/4
T-MAX RS	8 1/2	6 1/4	7 1/4
XTOL	8 1/2	6 1/2	7 1/4
XTOL (1:1)	12 1/4	9	10
D-76	9 1/4	7	NR
HC-110 (B)	7 1/2	6	NR

NR = Not Recommended

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

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time in Minutes			
	EI 1600		EI 3200	
	68°F (20°C)	75°F (24°C)	68°F (20°C)	75°F (24°C)
T-MAX RS	9 3/4	7	NR	8 1/4
XTOL	9 3/4	7 1/2	11	8 1/4

NR = Not Recommended

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

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time in Minutes			
	EI 1600		EI 3200	
	68°F (20°C)	75°F (24°C)	68°F (20°C)	75°F (24°C)
T-MAX RS	9 3/4	7	NR	8 1/4
XTOL	9 3/4	7 1/2	11	8 1/4

Note: Do not use KODAK PROFESSIONAL T-MAX Developer to process sheet films.

NR = Not Recommended

Rotary-Tube Processing—Rolls

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time in Minutes		
	EI 1600		EI 3200
	68°F (20°C)	75°F (24°C)	75°F (24°C)
T-MAX	8 1/2	7 1/4	8 1/4
T-MAX RS	8 1/2	6 1/4	7 1/4
XTOL	8 1/2	6 1/2	7 1/4
XTOL (1:1)	12 1/4	9	10
D-76	9 1/4	7	NR
HC-110 (B)	7 1/2	6	NR

NR = Not Recommended

Rotary-Tube Processing—Sheets

KODAK PROFESSIONAL Developer or Developer and Replenisher	Development Time in Minutes		
	EI 1600		EI 3200
	68°F (20°C)	75°F (24°C)	75°F (24°C)
T-MAX RS	8 1/2	6 1/4	7 1/4
XTOL	8 1/2	6 1/2	7 1/4
XTOL (1:1)	12 1/4	9	10
D-76	9 1/4	7	NR
HC-110 (B)	7 1/2	6	NR

NR = Not Recommended

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 T-MAX RS Developer and Replenisher and XTOL Developer. Make tests to determine if results are acceptable for your needs.

Large-Tank Rack-and-Tank Processing		
EI	KODAK PROFESSIONAL Developer or Developer and Replenisher	Time (min) at 72°F (22°C)
400/27° 800/30°	T-MAX RS or XTOL	6 to 8

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.

Push Processing: Large Tank Rack-and-Tank Processors

The development times for these processors are based on a machine speed that transfers the film every 2 minutes. The times given below are starting-point recommendations. Make tests to determine if results are acceptable for your needs.

EI	KODAK PROFESSIONAL Developer or Developer and Replenisher	Time* (min) at 72°F (22°C)
800/30°	T-MAX RS or XTOL	6 to 8
1600/3°	T-MAX RS or XTOL	8 to 10

* Development tme depends on agitation and tank size.

CONTRAST ADJUSTMENT

If you want to increase or decrease film contrast from its normal value, you can adjust your standard development time. Your standard development time is the time that produces normal negative contrast based on your processing equipment and conditions, agitation, and processing technique.

The table below provides adjustment factors for several developers. The factors are based on a developer temperature of 75°F (24°C) for KODAK PROFESSIONAL T-MAX Developers and a temperature of 68°F (20°C) for the others. The "standard" for each developer is indicated by 1.0. To increase or decrease film contrast or to use a different developer temperature, find the adjustment factor in the table. Multiply the standard development time by this factor to find the development time to use for a different contrast or developer temperature (or both).

Note: These tables apply to negatives you will print with a diffusion enlarger. If you use a condenser enlarger, shift your selection one column to the left.

Development-Time Adjustment Factors				
Temperature	20% Less Contrast	Normal Contrast	20% More Contrast	40% More Contrast
KODAK PROFESSIONAL T-MAX Developer and KODAK PROFESSIONAL T-MAX RS Developer and Replenisher				
68°F (20°C)	0.9*	1.2	1.4	NR
72°F (22°C)	0.8*	1.1	1.3	1.7
75°F (24°C)	0.7*	**1.0**	1.2	1.5
KODAK PROFESSIONAL Developer D-76				
65°F (18°C)	1.0*	1.2	1.4	1.6
68°F (20°C)	0.8*	**1.0**	1.2	1.4
70°F (21°C)	0.7*	0.9	1.1	1.3
72°F (22°C)	0.7*	0.8	1.0	1.2
75°F (24°C)	0.6*	0.7	0.9	1.0
KODAK HC-110 Developer Replenisher (Dilution B)				
65°F (18°C)	0.7*	1.2	1.6	2.1
68°F (20°C)	0.6*	**1.0**	1.4	1.8
70°F (21°C)	0.6*	0.9	1.3	1.6
72°F (22°C)	0.5*	0.8	1.2	1.5
75°F (24°C)	0.4*	0.7	1.0	1.3

* If you select one of these factors, add one stop to your camera exposure.

NR = Not recommended

RETOUCHING

You can retouch KODAK PROFESSIONAL T-MAX Film in 120 and sheet sizes by applying liquid dyes to the base or emulsion side.

IMAGE STRUCTURE

The data in this section are based on development in KODAK Developer D-76, at 68°F (20°C).

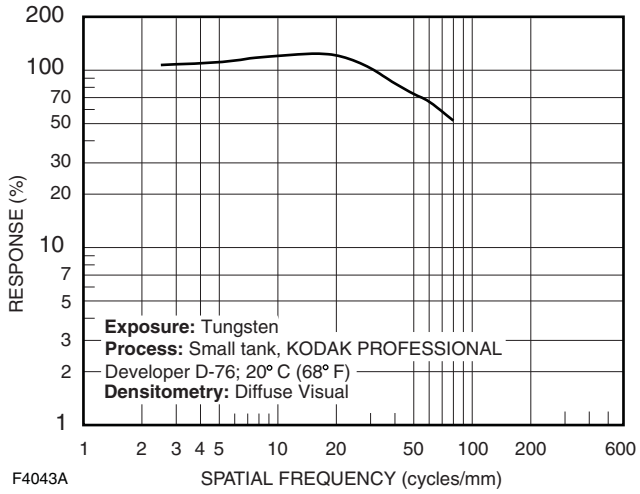
Resolving Power*	Diffuse rms Granularity†
50 lines/mm (TOC 1.6:1)	10
200 lines/mm (TOC 1000:1)	

* Determined according to a method similar to the one described in ISO 6328, *Photography—Determination of ISO Resolving Power*.

† Read at a net diffuse density of 1.00, using a 48-micrometre aperture, 12X magnification.

CURVES

Modulation Transfer Function Curves



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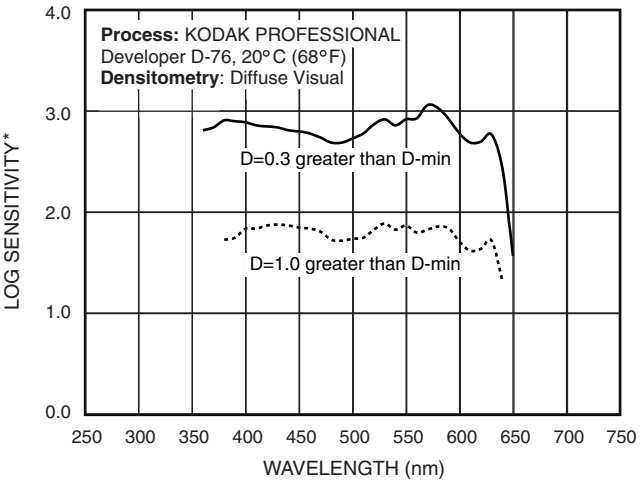
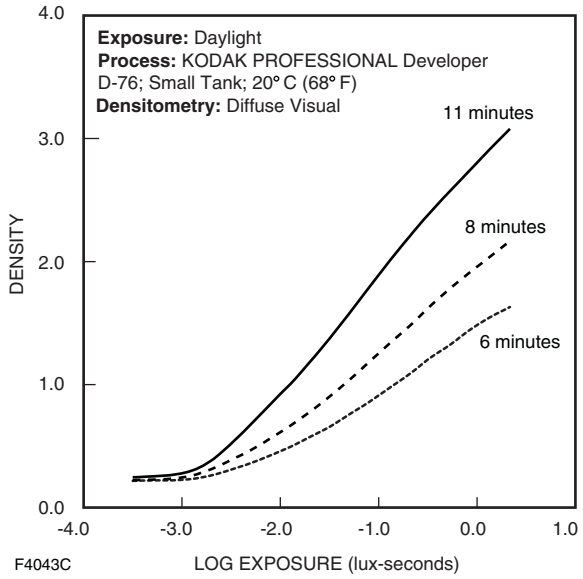
Spectral-Sensitivity Curves

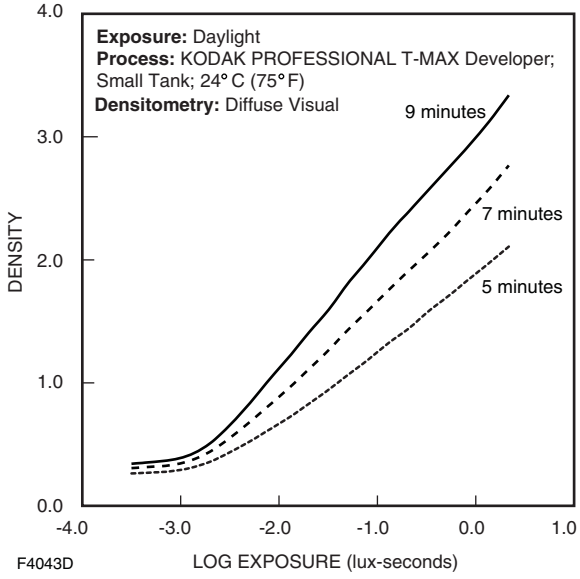


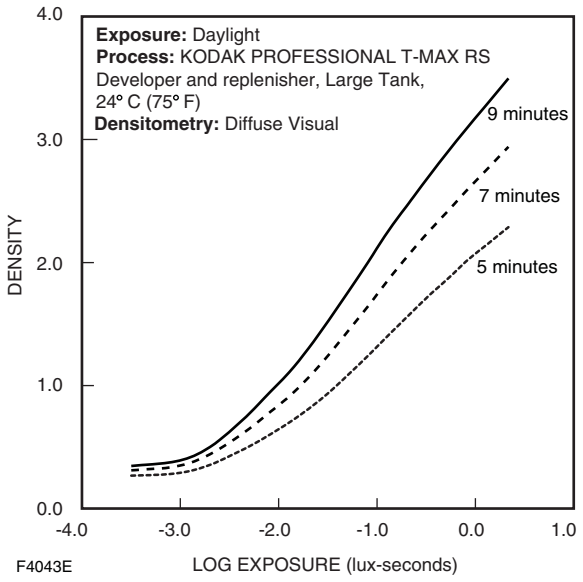
*Sensitivity = reciprocal of exposure (erg/cm^2) required to produce specified density

F4043B

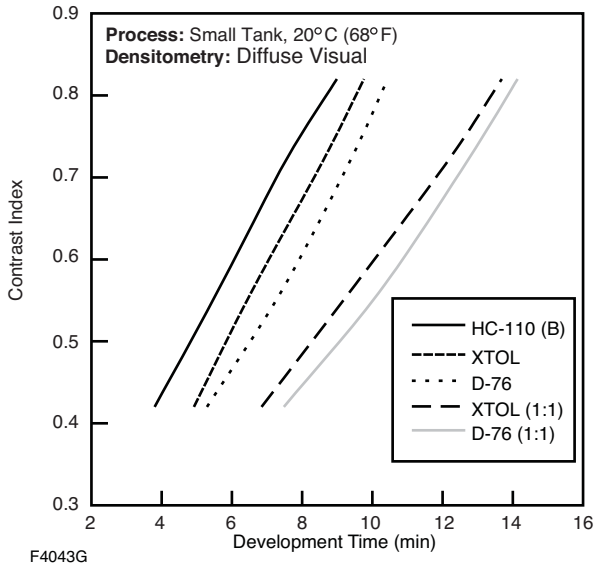
Characteristic Curves

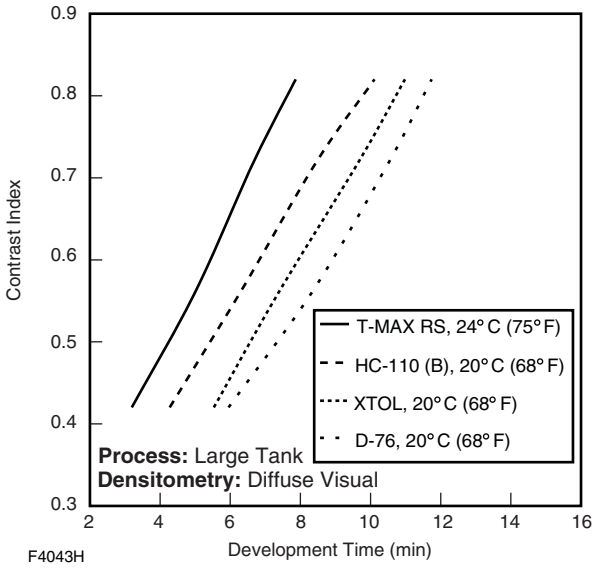


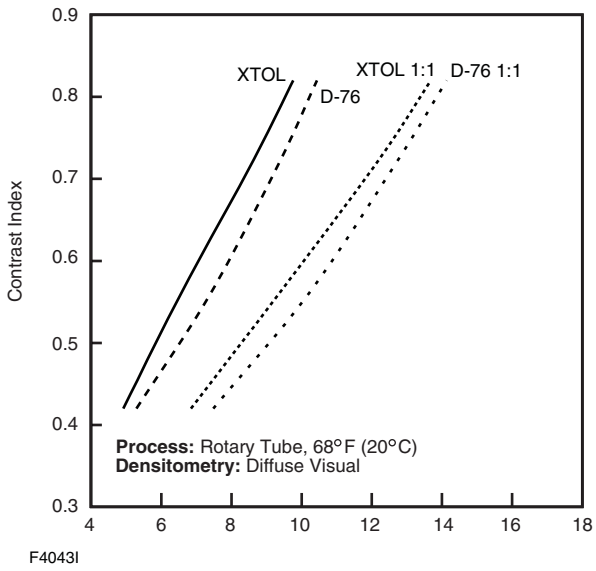


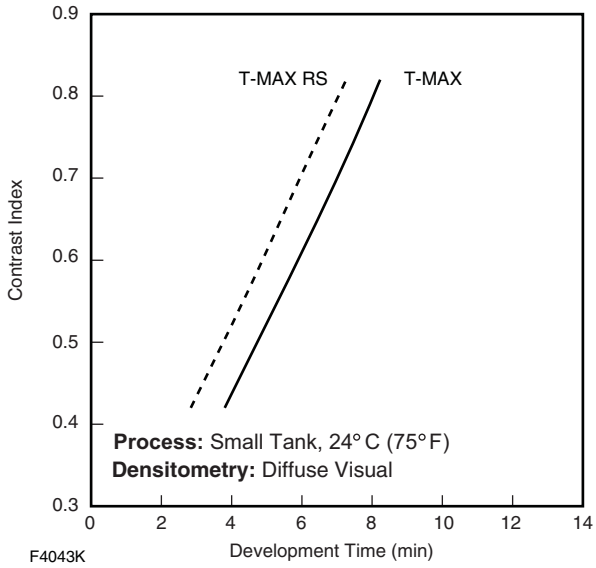


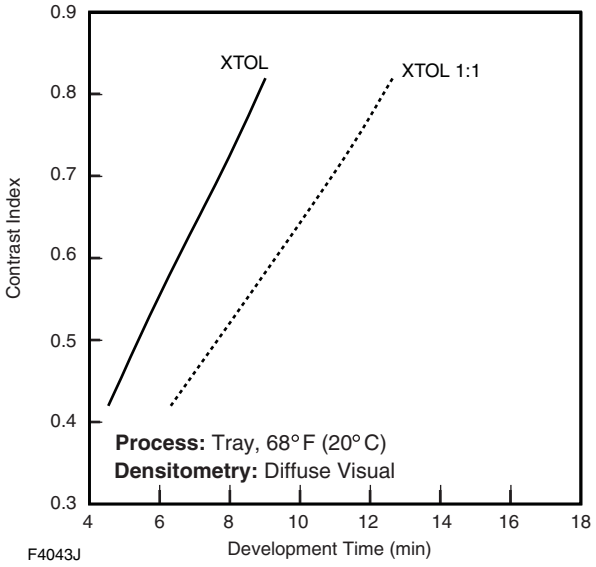
Contrast Index Curves











* The blue sensitivity of KODAK PROFESSIONAL T-MAX Films is slightly less than that of other Kodak panchromatic black-and-white films. This enables the response of this film to be closer to the response of the human eye. Therefore, blues may be recorded as slightly darker tones with this film—a more natural rendition.

Revised 2-16

KODAK PROFESSIONAL T-MAX 400 Film
KODAK Publication No. F-4043