Black-and-White Tips and Techniques for Darkroom Enthusiasts

CONTENTS

	Page
Pathways to Black and White	3
Black-and-White Films	10
KODAK Black-and-White Films	10
How to Produce a Great Black-and-White Negative	12
Black-and-White Film Processing	13
KODAK Developers for Processing Black-and-White Films	13
Using Replenished Black-and-White Film Developers	15
All About Push-Processing Black-and-White Films	18
Film-Handling Tips	21
Film-Processing Tips	25
Black-and-White Papers	27
KODAK Black-and-White Papers	27
Why Use Variable-Contrast Papers?	29
Archival Aspects of Resin-Coated Papers	30
Test-Exposure Prints and Strips	32
KODAK Chemicals for Processing KODAK Black-and-White Papers	33
Test Solutions for Print Stop Baths and Fixing Baths	37
Hand-Coloring Prints on KODAK P-MAX Art RC Paper	38
More Information	39

PATHWAYS TO BLACK AND WHITE

The pathway you choose to produce a finished black-and-white image will depend on your original and your specific application. The most basic pathway is to make a positive black-and-white reflection print from a black-and-white negative. The following information describes many techniques for arriving at your final image.

KODAK BLACK-AND-WHITE FILMS

Kodak offers a wide variety of black-and-white films, including *continuous-tone* (or pictorial) films and *copy* (or laboratory) films in a variety of sheet and roll sizes.

Continuous-Tone Films. General-purpose continuous-tone films, such as KODAK TRI-X Pan Film and KODAK T-MAX Professional Films, are usually used to make black-and-white enlargements on conventional black-and-white papers. However, you can also use some of these films to make positive slides or display transparencies in a range of contrasts.

Kodak also makes a variety of continuous-tone black-and-white chemicals for processing these films.

Copy (Laboratory) Films. Kodak makes a variety of films for producing copy negatives, duplicate negatives, positives, and images with special contrast properties.

Copy negatives are usually made by photographing black-and-white reflection prints. For best results, use KODAK T-MAX 100 Professional Film or a special copy film, such as KODAK Professional Copy Film.

Duplicate negatives are copies of other negatives. You can make a duplicate negative in two ways. The first way is to make the duplicate negative directly in one exposure by using a special-purpose film such as KODAK PROFESSIONAL B/W Duplicating Film SO-132. The second way is to expose the original negative onto another negative film to obtain an interpositive, and then expose that interpositive onto a second piece of film.

In some copy applications, you may need to use a conventional developer in a non-conventional way or use a special-purpose developer. This applies especially when you need to alter the contrast of the original. You may want to experiment with some special-purpose developers such as KODAK Developers D-19 and D-8, KODALITH Developers, and the KODAK T-MAX 100 Direct Positive Film Developing Outfit.

KODAK BLACK-AND-WHITE PAPERS

Kodak papers are either *fiber-base* or *resin-coated* (RC), and are available in *graded* or *variable-contrast* types. Their most common function is to make black-and-white reflection positives (prints) from black-and-white film negatives.

Fiber-Base Papers. These papers are made from a chemically pure paper base coated with a bright-white barium sulfate layer over which the emulsion is coated. The base is highly absorbent and requires relatively long wash times to remove processing chemicals.

Resin-Coated Papers. These papers are coated with a waterproof resin on both sides, which prevents processing chemicals from penetrating the paper base. Therefore, processing and washing times are much shorter.

Graded Papers. You can control the level of contrast with these papers by selecting the appropriate grade number. A grade 2 paper is normal. For higher contrast, use grade 3, 4, or 5. For lower contrast, use grade 0 or 1. Not all contrast grades are available in all paper types. Graded papers are primarily used in applications such as portraiture, where negative contrast is controlled by standard lighting and processing conditions.

Variable-Contrast Papers. You can control contrast levels with these papers by using filters, such as KODAK POLYMAX Filters, to alter the blue/green ratio of the exposing light. POLYMAX Filters are available in kits and in sets of 90 and 150 mm squares in grades -1 through 5+ that produce 12 contrast levels ranging from very low to extremely high. In many cases, using these filters with variable-contrast papers will produce contrast ranges much greater than those available with graded papers.

Special-Purpose Papers. To make black-and-white prints from color negatives, you can use KODAK PANALURE SELECT RC Paper or KODAK EKTAMAX RA Professional Paper.

PANALURE SELECT RC Paper is processed in conventional black-and-white chemicals, but EKTAMAX RA Paper requires processing in KODAK EKTACOLOR RA Chemicals for Process RA-4. EKTAMAX RA Paper is designed for the convenience of finishers who want to make black-and-white prints without having to maintain a black-and-white process. It's an alternative to conventional black-and-white papers, and is not designed for long-term keeping.

To Make B/W Positive Slides from B/W Negatives

Start with an Original Image on Any of These KODAK Films	To Produce a Final Image Exposed Onto One of These KODAK Films/Materials	Color Sensitivity*	Process in KODAK Developer†
Continuous-Tone B/W Negative Technical Pan EKTAPAN T-MAX 100 Professional PLUS-X Pan PLUS-X Pan Professional VERICHROME Pan TRI-X Pan TRI-X Pan Professional T-MAX 400 Professional T-MAX P3200 Professional Commercial	**Continuous-Tone Positive Transparency**		
	EASTMAN Fine Grain Release Positive 5302	Blue	D-76, DEKTOL
	Technical Pan (all sizes)‡	Pan, extended red	HC-110, D-76
	Line-Copy High-Contrast Positive Transparency		
	EKTAGRAPHIC HC Slide KODALITH Ortho 2556/6556, Type 3 KODALINE Rapid 2586	Ortho	D-11, KODALITH Super RT
	Technical Pan (all sizes)	Pan, extended red	DEKTOL, D-76, HC-110
	Continuous-Tone Display Positive (contrast depends on original)		
	PROFESSIONAL DURAFLEX RA Print Material (reflection)	Pan	EKTACOLOR RA Chemicals for Process RA-4
	PROFESSIONAL DURATRANS RA Display Material (transparency)		
	PROFESSIONAL DURACLEAR RA Display Material (transparency)		
	Fine Grain Positive 7302	Blue	D-76, DEKTOL, D-11 (depending on contrast)

* **Color-Sensitivity Classifications—**
Blue-sensitive films are sensitive only to ultraviolet radiation and blue light. You can use a safelight with a KODAK OA Safelight Filter (greenish yellow), OC Safelight Filter (light amber), or 1A Safelight Filter (light red) during handling and processing. These filters permit a fairly good light level for darkroom work.
Orthochromatic films are sensitive to ultraviolet radiation and blue and green light. You can use a safelight with a KODAK 1A Safelight Filter (light red) during handling and processing. This filter also permits a fairly good light level in the darkroom.
Panchromatic films are sensitive to all colors of light as well as ultraviolet radiation. They produce gray-tone rendering of subject colors that approximate their visual brightness, and can provide a variety of gray-tone renderings when you expose them with filters. No safelight is recommended, although you can use a KODAK 3 Safelight Filter (dark green) with black-and-white films other than T-MAX Professional Films for a few seconds during processing. This filter transmits only enough light to determine contours, not detail.
Extended red films are panchromatic films with extended red sensitivity. Do not use a safelight; handle these films in total darkness.

† **Note:** This list includes the Kodak developers most commonly used to process these films. See the developer or film instructions for processing and special agitation procedures.

‡ For low contrast, use KODAK TECHNIDOL Liquid Developer. For high contrast, use DEKTOL or HC-110 Developer.

To Make B/W Negatives from B/W Negatives or Prints

Start with a B/W Original Image	To Produce a Final Image Exposed Onto One of These KODAK B/W Films	Color Sensitivity*	Process in KODAK Developer†
Continuous-Tone B/W Print	**Continuous-Tone Copy Negative**		
	T-MAX 100 Professional	Pan	T-MAX, T-MAX RS, XTOL, D-76, HC-110
	Professional Copy	Ortho	HC-110, DK-50
High-Contrast or Line-Copy B/W Print	**High-Contrast B/W Negative**		
	Contrast Process Ortho	Ortho	D-8, HC-110
	Technical Pan (all sizes)	Pan, extended red	DEKTOL, D-76, HC-110
	Line-Copy B/W Negative		
	EKTAGRAPHIC HC Slide KODALITH Ortho 2556, Type 3	Ortho	D-11, KODALITH Super RT
	Technical Pan (all sizes)	Pan, extended red	DEKTOL, HC-110
Continuous-Tone B/W Negative	**Duplicate B/W Negative**		
	PROFESSIONAL B/W Duplicating SO-132	Ortho	DEKTOL, DK-50

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Orthochromatic films are sensitive to ultraviolet radiation and blue and green light. You can use a safelight with a KODAK 1A Safelight Filter (light red) during handling and processing. This filter also permits a fairly good light level in the darkroom.
Panchromatic films are sensitive to all colors of light as well as ultraviolet radiation. They produce gray-tone rendering of subject colors that approximate their visual brightness, and can provide a variety of gray-tone renderings when you expose them with filters. No safelight is recommended, although you can use a KODAK 3 Safelight Filter (dark green) with black-and-white films other than T-MAX Professional Films for a few seconds during processing. This filter transmits only enough light to determine contours, not detail.
Extended red films are panchromatic films with extended red sensitivity. Do not use a safelight; handle these films in total darkness.

† **Note:** This list includes the Kodak developers most commonly used to process these films. See the developer or film instructions for processing and special agitation procedures.

To Make B/W Contrast-Reducing Masks

Start with This Original Image	To Produce This Result with This KODAK B/W Film	Color Sensitivity*	Process in KODAK Developer†
Contrasty Continuous-Tone B/W Negative	**Contrast-Reducing Printing Mask**		
	Pan Masking 4570	Pan	HC-110, DK-50
	T-MAX 100 Professional		D-76, XTOL
Contrasty Continuous-Tone B/W Positive	**Contrast-Reducing Printing Mask**		
	Pan Masking 4570	Pan	HC-110, DK-50
	T-MAX 100 Professional		D-76, XTOL
Color Negative	**Contrast-Reducing Printing Mask**		
	Pan Masking 4570	Pan	HC-110, DK-50
	T-MAX 100 Professional		D-76, XTOL
Color Transparency	**Contrast-Reducing Printing Mask**		
	Pan Masking 4570	Pan	HC-110, DK-50
	T-MAX 100 Professional		D-76, XTOL

* **Color-Sensitivity Classifications—**
Blue-sensitive films are sensitive only to ultraviolet radiation and blue light. You can use a safelight with a KODAK OA Safelight Filter (greenish yellow), OC Safelight Filter (light amber), or 1A Safelight Filter (light red) during handling and processing. These filters permit a fairly good light level for darkroom work.
Orthochromatic films are sensitive to ultraviolet radiation and blue and green light. You can use a safelight with a KODAK 1A Safelight Filter (light red) during handling and processing. This filter also permits a fairly good light level in the darkroom.
Panchromatic films are sensitive to all colors of light as well as ultraviolet radiation. They produce gray-tone rendering of subject colors that approximate their visual brightness, and can provide a variety of gray-tone renderings when you expose them with filters. No safelight is recommended, although you can use a KODAK 3 Safelight Filter (dark green) with black-and-white films other than T-MAX Professional Films for a few seconds during processing. This filter transmits only enough light to determine contours, not detail.
Extended red films are panchromatic films with extended red sensitivity. Do not use a safelight; handle these films in total darkness.

† **Note:** This list includes the Kodak developers most commonly used to process these films. See the developer or film instructions for processing and special agitation procedures.

To Make B/W PositiveTransparencies from B/W Negatives or Prints

Start with a B/W Original Image	To Produce a Final Image Exposed Onto One of These KODAK B/W Films	Color Sensitivity*	Process in KODAK Developer†
Continuous-Tone B/W Negative	**Continuous-Tone Positive Transparency**		
	T-MAX 100 Professional	Pan	T-MAX 100 Direct Positive Film Developing Outfit‡
	Rapid Process Copy	Blue	DK-50
Line-Copy B/W Print	**High-Contrast B/W Positive Transparency**		
	PRECISION LINE, LPD4 or LPD7	Ortho	D-11, KODALITH Super RT, DEKTOL
	Technical Pan (all sizes)	Pan, extended red	T-MAX 100 Direct Positive Film Developing Outfit‡
Line-Copy B/W Negative	**High-Contrast B/W Positive Transparency**		
	Technical Pan (all sizes)	Pan, extended red	DEKTOL, D-76, HC-110
	EKTAGRAPHIC HC Slide KODALITH Ortho 2556/6556	Ortho	D-11, KODALITH Super RT

* **Color-Sensitivity Classifications—**
Blue-sensitive films are sensitive only to ultraviolet radiation and blue light. You can use a safelight with a KODAK OA Safelight Filter (greenish yellow), OC Safelight Filter (light amber), or 1A Safelight Filter (light red) during handling and processing. These filters permit a fairly good light level for darkroom work.
Orthochromatic films are sensitive to ultraviolet radiation and blue and green light. You can use a safelight with a KODAK 1A Safelight Filter (light red) during handling and processing. This filter also permits a fairly good light level in the darkroom.
Panchromatic films are sensitive to all colors of light as well as ultraviolet radiation. They produce gray-tone rendering of subject colors that approximate their visual brightness, and can provide a variety of gray-tone renderings when you expose them with filters. No safelight is recommended, although you can use a KODAK 3 Safelight Filter (dark green) with black-and-white films other than T-MAX Professional Films for a few seconds during processing. This filter transmits only enough light to determine contours, not detail.
Extended red films are panchromatic films with extended red sensitivity. Do not use a safelight; handle these films in total darkness.

† **Note:** This list includes the Kodak developers most commonly used to process these films. See the developer or film instructions for processing and special agitation procedures.

‡ The KODAK T-MAX 100 Direct Positive Film Developing Outfit is for producing continuous-tone positive black-and-white slides from T-MAX 100 Professional Film and for producing high-contrast positive black-and-white slides from KODAK Technical Pan Films.

To Make B/W Presentation Slides from Printed Text or Graphics

Start with a B/W Original Image	To Produce a Final Image Exposed Onto One of These KODAK B/W Films	Color Sensitivity*	Process in KODAK Developer†
Typewritten or Computer Print-Out (White Background)	**High-Contrast Presentation Slide or Reverse-Text Title Slide (Black Background)**		
	Technical Pan (all sizes)	Pan, extended red	DEKTOL, D-76, HC-110
	EKTAGRAPHIC HC Slide KODALITH Ortho 2556/6556	Ortho	D-11, KODALITH Super RT

* **Color-Sensitivity Classifications—**
Blue-sensitive films are sensitive only to ultraviolet radiation and blue light. You can use a safelight with a KODAK OA Safelight Filter (greenish yellow), OC Safelight Filter (light amber), or 1A Safelight Filter (light red) during handling and processing. These filters permit a fairly good light level for darkroom work.
Orthochromatic films are sensitive to ultraviolet radiation and blue and green light. You can use a safelight with a KODAK 1A Safelight Filter (light red) during handling and processing. This filter also permits a fairly good light level in the darkroom.
Panchromatic films are sensitive to all colors of light as well as ultraviolet radiation. They produce gray-tone rendering of subject colors that approximate their visual brightness, and can provide a variety of gray-tone renderings when you expose them with filters. No safelight is recommended, although you can use a KODAK 3 Safelight Filter (dark green) with black-and-white films other than T-MAX Professional Films for a few seconds during processing. This filter transmits only enough light to determine contours, not detail.
Extended red films are panchromatic films with extended red sensitivity. Do not use a safelight; handle these films in total darkness.

† **Note:** This list includes the Kodak developers most commonly used to process these films. See the developer or film instructions for processing and special agitation procedures.

To Make B/W Reflection Prints from B/W or Color Negatives

Original Image	Finished Print on KODAK Paper		Process in KODAK Developer*
Continuous-Tone B/W Negative	**Graded Fiber-Base Print**		
	Contact-Printing Paper: AZO		DEKTOL, POLYMAX T
	Projection Paper:	ELITE Fine-Art†	DEKTOL, POLYMAX T
		EKTALURE†	EKTAFLO, Type 2; DEKTOL
		KODABROMIDE†	DEKTOL, POLYMAX T
	Graded RC Print		
	KODABROME II RC		DEKTOL, POLYMAX T
	Reflection Print Suitable for Oil Coloring		
	RC: P-MAX Art RC		DEKTOL, POLYMAX T
	Fiber: EKTALURE†		EKTAFLO, Type 2; DEKTOL
	Selective-Contrast RC Print		
	POLYCONTRAST III RC		DEKTOL, POLYMAX T
	POLYMAX II RC		DEKTOL, POLYMAX T
	Selective-Contrast Fiber-Base Print		
	POLYMAX Fiber		DEKTOL, POLYMAX T
	POLYMAX Fine-Art		DEKTOL, POLYMAX T
	EKTAMATIC SC		DEKTOL
Continuous-Tone Color Negative	**Graded RC Print**		
	PANALURE SELECT RC		DEKTOL, POLYMAX T
	EKTAMAX RA Professional (for Process RA-4)		EKTACOLOR RA Chemicals for Process RA-4

* **Note:** This list includes the Kodak developers most commonly used to process these papers. See the developer or paper instructions for processing and special agitation procedures.

† To be discontinued by December 1999.

GLOSSARY—

Continuous Tone An image that exhibits a smooth gradation of tones or shades of gray from light to dark. Continuous-tone images may be positive or negative and have high or low contrast.

Contrast The difference in brightness between the lightest and darkest tones of an image or scene. Images or scenes that exhibit very light to very dark tones with few intermediate tones are called “high-contrast.” “Low-contrast” images are usually characterized by a short range of tones—such as middle gray to dark gray, without any black or white.

Copy Negative A negative made from a positive print for the purpose of making additional prints by conventional photographic means. Can also be used to correct defects or adjust the contrast of an original image to make subsequent printing easier, such as when hundreds of prints must be made from a negative that is difficult to print.

Duplicate Negative A negative made from a negative that matches the contrast and characteristics of the original as closely as possible. Often made when an original is too valuable to be subjected to frequent handling. Usually made from direct-positive materials or by the “interpositive” method.

Internegative Usually a negative made from a transparency for the purpose of making prints by conventional photographic means.

Interpositive A specific type of transparency, or film positive, that is the first step in a two-step negative duplication. A negative is printed onto a negative-working film that reverses the tonal values. The resulting film positive is then printed onto negative film, which restores the tonal relationships of the original negative. Requires rigorous control to maintain the exact contrast of the original.

Line or Line Copy An image exhibiting only solid blocks or lines of tone with no tonal gradations, such as text on a page. These images may be positive or negative.

Mask An intermediate image made from a negative or transparency to alter the characteristics of the original. The mask is sandwiched in register with the negative or transparency to increase or reduce contrast.

Negative A developed photographic image in which the tonal relationships of the original scene are reversed—light tones are recorded as dark and dark tones as light. The negative is then printed to restore a normal, or positive, image.

Negative Working A photographic material that reverses the tones in an image. Conventional photographic materials are negative working because light-sensitive compounds usually darken or increase in visual density with increasing exposure to light. Therefore, a negative-working camera film reverses the tones of the original scene, and a companion negative-working print material reverses the tones again, back to their normal, or positive, relationship.

Positive A photographic image with light-to-dark tonal values similar to those in the original scene. The result of the photographic process is usually a positive image. If it is on paper or a similar opaque support, it’s called a print. If the positive image is on a clear support, such as glass or film, it’s called a transparency or slide.

Positive Working A photographic material that retains the tonal values of the original scene (rather than reversing them). Light areas in the original create light areas in the camera film, etc. Also called “direct positive” because it does not require a separate printing (interpositive) step as negative-working films do.

Print A print is usually a positive image on an opaque support, such as fiber-base or resin-coated paper. The image is viewed by light reflected from the print surface.

Transparency A positive image on a transparent or translucent support, such as film; also called a “film positive.” The image is viewed by light transmitted through the support.

BLACK-AND-WHITE FILMS

KODAK BLACK-AND-WHITE FILMS

KODAK Film	Description	Film Speed		Color Sensitivity	Sizes
		Daylight	Tungsten		
Continuous-Tone Film					
Technical Pan (TP)	For applications that require high-definition records. Suitable for making high-quality enlargements at magnifications of 25X or even 50X; making continuous-tone originals or copy negatives; making black-and-white reverse-text and title slides; copying faded originals; and personal microfilming. Micro-fine or extremely fine grain (depending on developer), extremely high resolving power. Variable contrast, extended red sensitivity.	25	25 to 125	Pan, Extended Red	135, 120, long rolls, sheet
EKTAPAN (EKP)	A convenient film to use for producing black-and-white and color negatives of the same subject. Fine grain, medium resolving power. Moderate degree of enlargement. Retouching surface on both sides.	100	100	Pan	sheet, 3½-in., long rolls
T-MAX 100 Professional (TMX)	For detailed subjects when maximum image quality is needed. Extremely high sharpness, extremely fine grain, very high resolving power. Allows a very high degree of enlargement. Expanded exposure latitude.	100	100	Pan	135, 120, sheet, READYLOAD Packet, long rolls
PLUS-X Pan (PX)	Good choice for all-around picture-taking with 35 mm cameras. Extremely fine grain, excellent sharpness, high resolving power.	125	125	Pan	135, long rolls
PLUS-X Pan Professional (PXP; sheet PXE)	Excellent general-purpose film for 120 and 220 film sizes. For use under most lighting conditions except dim existing light. Retouching surface on the emulsion side for PXP; retouching surface on both sides for PXE. Extremely fine grain, excellent sharpness, high resolving power.	125	125	Pan	120, 220, long rolls, sheet
VERICHROME Pan (VP)	Extremely fine grain, very high sharpness, excellent exposure latitude.	125	125	Pan	120
TRI-X Pan Professional (TXP)	Especially suited to low-flare interior tungsten or flash lighting. Retouching surface on both sides. Excellent gradation and brilliant highlights. Medium contrast, moderate degree of enlargement, wide exposure latitude.	320	320	Pan	120, 220, sheet
TRI-X Pan (TX)	All-purpose panchromatic film for subjects requiring good depth of field and high shutter speeds, and for extending the flash distance range. Fine grain, high sharpness, medium contrast, moderate degree of enlargement, wide exposure latitude.	400	400	Pan	135, 120, long rolls
T-MAX 400 Professional (TMY)	High-speed panchromatic film especially useful for dimly lighted subjects, fast shutter speeds, extended flash range, and good depth of field. Can also be exposed at speeds of EI 800 and EI 1600. Very high sharpness, extremely fine grain, high resolving power. High degree of enlargement.	400	400	Pan	135, 120, sheet, long rolls
PROFESSIONAL T-MAX Black-and-White T400 CN	Multi-purpose film for processing in **Process C-41** with color negative films. For printing on either black-and-white papers or color negative papers. Also for making short-term, intermediate-use prints on KODAK EKTAMAX RA Professional Paper. Wide exposure latitude. Pushable in Process C-41. Extremely fine grain and high sharpness.	400	400	Pan	135, 120
T-MAX P3200 Professional (TMZ)	Multispeed panchromatic negative film that combines very high to ultra-high film speeds with finer grain than that of other fast black-and-white films. Wide exposure latitude. Excellent sharpness and shadow detail, fine grain.	EI 800 to 25,000*	EI 800 to 25,000*	Pan	135

KODAK Film	Description	Film Speed		Color Sensitivity	Sizes
		Daylight	Tungsten		
High-Contrast Film					
EKTAGRAPHIC HC Slide (HCS)	Orthochromatic film designed for copying line drawings and text for making reverse-text black-and-white title slides. Extremely high contrast; speed depends on developer used.	12	8 to 25	Ortho	135
Contrast Process Ortho	For copying black-and-white originals or black printed or written material on white, blue, green, or yellow paper. Records intermediate tones in lines of etchings, handwriting, and similar originals when developed to a moderately high contrast. Fine grain, very high contrast, very high resolving power.	100†	50	Ortho	sheet
Special-Purpose Film					
PROFESSIONAL B/W Duplicating SO-132	Orthochromatic, direct-positive film for one-step duplication of continuous-tone black-and-white negatives. Long tonal range for high-quality duplicates.	Very slow (see instructions)		Ortho	sheet
Professional Copy	Copy film with increased highlight contrast for copying black-and-white continuous-tone originals. Fine grain, medium resolving power.	25†	12	Ortho	sheet
Commercial	For copying continuous-tone black-and-white originals and similar applications when red and green sensitivity are unnecessary or unwanted. Blue color sensitivity. Very fine grain, high resolving power.	50	8	Blue	sheet
High Speed Infrared (HIE; sheet HSI)	Fine grain, moderately high contrast. Infrared-sensitive to approximately 900 nm; maximum sensitivity from 750 nm to 840 nm. Filter necessary for most applications.	50‡ No. 25 Filter	125‡ No. 25 Filter	Infrared	135, long rolls, sheet
EASTMAN Fine Grain Release Positive 5302	Blue-sensitive film that provides excellent definition, even with a high degree of magnification. For making black-and-white slides from 35 mm color transparencies (two-step process with KODAK T-MAX 100 Professional Film). Extremely fine grain, high sharpness, high resolving power.	Printing speed 250		Blue	long roll
Fine Grain Positive 7302	Blue-sensitive film that provides excellent definition, even with a high degree of magnification.For making larger black-and-white transparencies from continuous-tone or line negatives. Extremely fine grain, high sharpness, high resolving power.	Printing speed 250		Blue	sheet

* EI 12,500 and 25,000 with processing in KODAK T-MAX Developer or T-MAX RS Developer and Replenisher. Run tests to determine suitability.
† Speed with pulsed-xenon arc.
‡ With a KODAK WRATTEN Gelatin Filter, No. 25; see the film instructions.

Pan—Panchromatic
Ortho—Orthochromatic

Note: For more information, see KODAK Publication No. E103BF, *KODAK PROFESSIONAL Black-and-White Films,* available from dealers who sell Kodak products, or you can contact Kodak in your country for more information.

HOW TO PRODUCE A GREAT BLACK-AND-WHITE NEGATIVE

KODAK T-MAX Professional Films and KODAK POLYMAX II RC Paper provide a great combination for making the best possible black-and-white prints. To make the most of the potential of these products, you want to be sure you start with a great negative.

After all, a great negative is the first step toward a great print! You can increase your chances of producing those great negatives if you establish a benchmark for the way you work. Follow the procedure below, and set your standards for success.

FIRST, A FEW TRIAL RUNS

Select a scene in which the subject and lighting will stay the same over a half hour, or set up a studio still life where you can control the lighting. The subject should be easy to meter—with little doubt about the appropriate aperture and shutter speed for a given film-speed rating.

- Load your camera with the film you use most often in your photography—the logical one to use to set your benchmark. Then set your meter at a film speed four stops lower than the actual speed of the film. For example, with T-MAX 400 Professional Film, use 25.
- Meter the scene, and set your exposure as indicated by the meter. Expose one or more frames of film. Advance the film, cover the lens, and trip the shutter to produce a blank frame. Then close down the aperture by one stop (or increase the shutter speed) to record the same subject at a film speed of 50.
- Repeat this procedure at progressively higher speeds until you have exposed the film at a speed about four stops higher than you'd ever expect to use with that film.
- Expose several more rolls of film in exactly the same way.

SEE FOR YOURSELF—IT'S PART OF THE PROCESS

Now process one of the rolls by following your usual procedures (developer choice, dilution, agitation, etc.) at the temperature you normally use. The specific development time is not particularly important as long as you record it.

Place the processed film on a light table and visually judge which image is "correct." *Confirm* your selection by printing the negative that looks correct on POLYMAX II RC Paper with a grade 2 filter, *and* by printing the negatives with one stop more and one stop less exposure (the adjacent negatives on your test roll).

This printing step is critical. The "best" negatives for different films can look very different. The only way to be sure which will make the best print is to print the negatives. With this first roll, you might determine that the fourth exposure yields the best print. (With T-MAX 400 Film, this would be the exposure made at EI 200.) The development time you used for this roll would then be your best time for film you expose at EI 200.

Repeat the procedure by processing two more of the exposed rolls with different development times, adding or subtracting two minutes. Examine the negatives on a light table, and determine which ones will print best on POLYMAX II RC Paper. This will determine your best development times for two more exposure indexes. Then fill in the gaps or expand the range of development by processing the remaining exposed rolls at other development times.

THE RESULTS ARE WORTH IT

This test may take a half day of your time, but it will be time well spent. You'll know the optimum development times for the film at a variety of speeds—development times that are optimum for *your* equipment and techniques.

As long as your equipment and techniques stay the same, you can be confident of your results.

THE BASICS OF A GOOD NEGATIVE

The published processing recommendations for Kodak black-and-white films are intended as starting points for establishing your optimum times. Experiment by modifying the starting-point time and temperature to determine what produces the best results with *your* processing and printing equipment and techniques.

And remember, consistent quality requires consistent control of time, temperature, agitation, and other variables.

If you don't have a lot of experience with a particular film or film/paper combination, simply judge your technique by the print it produces.

KODAK DEVELOPERS FOR PROCESSING BLACK-AND-WHITE FILMS

KODAK Developer or Developer and Replenisher	Characteristics	For Processing KODAK Film	Availability			For Use In
			Packaged Liquid Concentrate	Packaged Powder	Replenisher	
T-MAX	• Designed for non-replenished systems • For use with roll films only • For normal or push processing • Produces enhanced shadow detail	T-MAX Professional PLUS-X Pan PLUS-X Pan Professional VERICHROME Pan TRI-X Pan TRI-X Pan Professional High Speed Infrared	X			Small tank, large tank,* rotary-tube processor
T-MAX RS†	• Recommended for replenished systems • For normal or push processing of roll and sheet films • Produces enhanced shadow detail	EKTAPAN T-MAX Professional PLUS-X Pan PLUS-X Pan Professional VERICHROME Pan TRI-X Pan TRI-X Pan Professional	X		X	Small tank, large tank, tray, rotary-tube processor, rack-and-tank processor
XTOL	• Suited for all professional black-and-white films in a variety of equipment • Ascorbic acid developer • Very high image quality at full emulsion speed • Convenient room-temperature mixing • Fine grain and high sharpness • Robust, abuse-tolerant, and clean working • Long, stable useful life	Technical Pan (non-pictorial applications) EKTAPAN T-MAX Professional PLUS-X Pan PLUS-X Pan Professional VERICHROME Pan TRI-X Pan TRI-X Pan Professional High Speed Infrared		X	X	Small tank, large tank, tray, rotary-tube processor, rack-and-tank processor
D-76‡	• For general use • Yields full emulsion speed and good shadow detail with normal contrast • For replenished and non-replenished systems • Replenish with KODAK Replenisher D-76R • For normal or push processing of roll and sheet films	Technical Pan (non-pictorial applications) EKTAPANT-MAX Professional PLUS-X Pan PLUS-X Pan Professional VERICHROME Pan TRI-X Pan TRI-X Pan Professional High Speed Infrared EASTMAN Fine Grain Release Positive 5302 Fine Grain Positive 7302		X	X	Small tank, large tank, tray, rotary-tube processor, rack-and-tank processor

KODAK Developer or Developer and Replenisher	Characteristics	For Processing KODAK Film	Availability			For Use In
			Packaged Liquid Concentrate	Packaged Powder	Replenisher	
HC-110	• Produces results similar to those produced by KODAK Developer D-76 • Highly concentrated liquid • Replenish with KODAK HC-110 Developer Replenisher • For replenished and non-replenished systems • Suitable for commercial, industrial, and press photography • For normal or push processing of roll and sheet films	Technical Pan (non-pictorial applications) EKTAPAN T-MAX Professional PLUS-X Pan PLUS-X Pan Professional VERICHROME Pan TRI-X Pan TRI-X Pan Professional Contrast Process Ortho Professional Copy Commercial High Speed Infrared	X		X	Small tank, large tank, tray, rotary-tube processor, rack-and-tank processor
MICRODOL-X§	• Produces fine grain and high sharpness • Produces a slightly brownish image tone • Replenish with KODAK MICRODOL-X Replenisher • For most roll and sheet films	Technical Pan (non-pictorial applications) EKTAPAN T-MAX Professional (rolls) PLUS-X Pan PLUS-X Pan Professional VERICHROME Pan TRI-X Pan TRI-X Pan Professional	X	X	X	Small tank, large tank, tray
DK-50	• Moderately fast developer that can be used straight or diluted 1 part concentrate to 1 part water • Provides normal contrast, average to slightly higher than average graininess • Excellent for portrait and commercial work • For roll and sheet films • Replenish with KODAK Replenisher DK-50R	EKTAPAN PLUS-X Pan Professional TRI-X Pan TRI-X Pan Professional PROFESSIONAL B/W Duplicating Rapid Process Copy Professional Copy Commercial High Speed Infrared		X	X	Small tank, large tank, tray
D-19	• Provides higher than normal contrast and speed, higher than average graininess	Technical Pan (non-pictorial applications) High Speed Infrared		X		Large tank, tray
D-8	• Much higher than normal contrast, speed, grain	Contrast Process Ortho		X		Tray
TECHNIDOL Liquid	• For processing KODAK Technical Pan Films in pictorial application • Produces exceptionally fine grain • Yields high sharpness and images with enhanced edge effect	Technical Pan	X			Small tank, tray

* If you use T-MAX Developer in a large tank, use time compensation. For information on time compensation, see KODAK Publication No. J-86, *KODAK T-MAX Developers*.

† Use the mixed solution as a working tank solution or a replenisher.

‡ For greater sharpness, you can use this developer diluted 1:1. Using the diluted developer requires longer development times, which produce a slight increase in graininess.

§ For greater sharpness, you can use this developer diluted 1:3. Using the diluted developer requires longer development times, which produce a slight increase in graininess and speed.

USING REPLENISHED BLACK-AND-WHITE FILM DEVELOPERS

The following pages give suggestions that will help you achieve better process control with three popular Kodak developers commonly used in replenished processing systems.

KODAK T-MAX RS DEVELOPER AND REPLENISHER

This is a moderately active two-part liquid developer and replenisher that offers enhanced shadow detail in normally processed and push-processed films. Here are tips for getting the best performance from this developer in replenished systems:

What is a "Fresh" Developer vs. a "Seasoned" Developer?

A freshly mixed tank of KODAK T-MAX RS Developer and Replenisher contains none of the development byproducts that start to accumulate with the first roll of film processed. As you process more film, the concentration of these byproducts (bromide, oxidized developer, etc.) builds and reduces the activity of the developer. The buildup would quickly lead to exhaustion of the developer if you didn't add replenisher as each roll of film is processed.

The replenisher plays two important roles:

- It replaces important chemicals consumed during development.
- It dilutes the byproducts formed by development.

As the tank becomes "fully seasoned," dilution by the replenisher compensates exactly for new byproducts released by development. At this point, the concentration of bromide and related chemicals reaches a "steady state." Barring accidents, you can operate the tank for a very long time with virtually no further change in the "steady state" concentration of development byproducts.

How Long Does It Take for a Fresh Mix to Reach a Seasoned Condition?

It depends primarily on the size of the tank, the replenishment rate (mL of replenisher added per square foot of film processed), and the number of rolls processed per day. It will take from several days to several weeks to reach a fully seasoned state.

What Happens When the Tank Changes from a Fresh to a Seasoned State?

Two key changes occur. If the development time remains constant during this seasoning-in process, small losses in real film speed and film contrast will occur. A speed loss of about 1/2 stop and a contrast loss of 10 to 20 percent are typical for a well-maintained process.

You can detect both effects if you monitor with process control strips, such as KODAK Black-and-White Film Process Control Strips (CAT 180 2990) and plot your readings. As you use a freshly mixed tank of T-MAX RS Developer and Replenisher, film speed and contrast drop for a while and then level off at their "seasoned-in" values. These downward trends on control charts that occur as a new mix seasons are of no real consequence. However, some careful workers will want to avoid them, as described below.

How Can I Avoid a "Seasoning-In" Period?

You can pre-season a fresh tank mix. When you prepare the new tank solution, you can add key development byproducts to achieve a level close to that of a normally seasoned tank.

The following two prescriptions will accomplish this. Remember, these procedures are optional. If you are not bothered by a small speed and contrast shift as natural seasoning occurs, you can ignore these procedures.

Instant Seasoning of a Fresh Tank, Method 1. Prepare T-MAX RS Developer and Replenisher as you normally do, and fill the tank to about 98 percent of its volume. Make note of the volume you put into the tank. Then add 1.7 mL of KODAK DURAFLO RT Developer Starter for every litre of solution in the tank (or 6.5 mL of starter per gallon). Mix the solution well. It will be seasoned to a near-steady-state concentration of important development byproducts.

Instant Seasoning of a Fresh Tank, Method 2. Use the same technique as in Method 1, above, but use KODAK First Developer Starter, Process E-6, instead of DURAFLO RT Developer Starter. The appropriate amount of First Developer Starter is 3.4 mL per litre or 13 mL per gallon of tank solution.

Note: Whichever method you choose, modify only the contents of the fresh tank. Do not modify your replenisher solution.

What About Replenishment Rates?

We recommend adding T-MAX RS Developer and Replenisher at a rate of 45 mL of solution for each 135-36 or 120 roll or 8 x 10-inch sheet (or equivalent) of film processed. This is an average figure. The best value to use will depend on tank size and utilization.

If you are setting up this developer for the first time, we suggest that you use one of the pre-seasoning procedures described on page 13 and initially set the replenishment rate at 70 mL per roll rather than 45 mL per roll. Plot the process, and when it has been stable for two weeks, decrease the replenishment rate to 60 mL per roll. If the control charts continue flat for two weeks, decrease the rate to 50 mL per roll.

Keep decreasing in increments of 10 mL per roll until you notice contrast and speed beginning to trend down, signaling underreplenishment. Then readjust the rate to its previous level and stay with that rate. Generally, the rate will be about 40 to 50 mL per roll, but you may find your process requires somewhat higher or lower replenishment, again depending on tank size, utilization, and other factors.

Can I Modify T-MAX RS Developer and Replenisher to Provide Longer Development Times?

You can use KODAK T-MAX RS Developer and Replenisher over a wide range of temperatures. It does not give significantly better results at one temperature than it does at another. The most important consideration in selecting a temperature is the ability to maintain it easily year-round.

In warmer climates, a relatively high temperature can be easier to maintain. However, if development times fall below five minutes, the risk of nonuniformity increases. To lengthen development times while continuing to operate at a higher temperature, you can decrease the developer activity by adding acetic acid to the developer. The acid lowers the pH of the developer, which calls for an increase in development time.

There are practical limits to how much you can lower the pH without causing other effects. Method 1 and Method 2, below, offer two acceptable options for lengthening development times.

Decreasing Developer pH, Method 1. To each gallon of **both** tank solution and replenisher, add 15 mL (0.5 fluidounce) of KODAK 28% Acetic Acid. Generally, this will extend development times by about 25 percent over the unmodified developer and replenisher.

Decreasing Developer pH, Method 2. Add 30 mL (1.0 fluidounce) of 28% acetic acid to each gallon of tank solution and replenisher. This will increase development times by about 50 percent over the unmodified developer.

KODAK XTOL DEVELOPER

This is a new two-part powder developer for processing Kodak and other manufacturers' normally exposed, pushed, or pulled black-and-white films. It offers full emulsion speed and easy mixing. Use it as both a developer and a replenisher.

Do I Need to Season a New Tank Solution? How Would I Do It?

If you choose not to season a new tank solution of XTOL Developer, your initial development times should be about 10 percent shorter than the published starting-point recommendations. As the tank approaches a steady state, the appropriate times will become closer to those recommendations. (For detailed time/temperature tables, see KODAK Publication No. J-109, *KODAK XTOL Developer*.)

If you choose to season a fresh working tank solution, mix the developer according to the instructions. Fill the tank with developer. Then add 6.5 mL of KODAK Developer Starting Solution (CAT 146 6382) per litre of tank volume. Or you can use 1 mL of KODAK EKTACHROME R-3 First Developer and Color Developer Starter (CAT 102 0072) per litre of developer. Stir or recirculate the solution until it is uniform.

How Can I Convert to XTOL Developer from Another Developer?

Before changing to XTOL Developer, run several KODAK Black-and-White Film Process Control Strips (CAT 180 2990) through your current process at each of your standard development times. Measure and note the contrast index (CI) of these strips. Drain and clean the developer tank of the processor.

To make a fresh tank solution, follow the mixing instructions (and season the solution as described above, if desired). Run several more control strips, adjusting the developer time or temperature (or both) until you identify a condition that matches each of your previous CI results.

If you process a broad film mix that requires a wide variety of development times, you may want to establish a few standard batch cycles, such as 5, 6, 7, 10, and 12 minutes. Then assign each film to the nearest of the batch conditions, based on the standard times.

Replenishment. Use the developer solution as a replenisher at a starting-point rate of 70 mL per 135-36 or 120 roll (or 80 square inches [516 sq cm]) of film processed. Monitor the process with control strips, and adjust the replenishment rate down in 10 mL increments to keep the process on aim. Use the lowest rate that will maintain process control.

KODAK DEVELOPER *D-76* AND REPLENISHER *D-76R*

The following paragraphs provide tips for modifying Developer D-76 for maximum speed.

How Can I Get Maximum Film Speed with Replenished KODAK Developer D-76?

Replenished developers for use with black-and-white films typically provide less real film speed than do fresh or one-shot versions of the same developers. You will see this decrease in effective film speed as a slight loss in shadow detail with film exposed at the rated ISO speed.

The following procedure is an optional method of replenishing KODAK Developer D-76 to minimize this speed loss and maintain shadow detail similar to that obtained with fresh or one-shot developers.

This method involves a replenisher solution and replenishment rates different from those normally used. It is not intended as a replacement for the traditional process. It is an alternative to provide greater effective speed with Developer D-76 in a replenished mode.

Mixing the Optional Replenisher. Prepare solutions of KODAK Developer D-76 and KODAK Replenisher D-76R according to the instructions. Then combine 5 parts of the developer with 1 part of the replenisher. For example, you might combine the mixes from a 10-gallon developer package and a 2-gallon replenisher package. Mix the solution until it's uniform.

How Do I Use the New Developer and Replenisher System?

The next table lists development times for a typical rack-and-tank processor operated at 68°F (20°C). These are starting-point recommendations. You may need to customize them for your situation (processor, agitation, water supply, etc.).

The "optimum development time" in the table is the exact time your processor requires for ideal development. "Batched development time" reflects an effort to sort all the films into one of a smaller number of time slots. Although batched times will not always be exact, they permit improved production efficiency.

Replenishment Rates. The starting-point recommendation is 70 mL of the modified replenisher solution per roll of film (80 square inches, one 135-36 roll, or one 120 roll).

Keeping Properties of the New Replenisher. Use the modified replenisher within one month of mixing. Also, replace the working tank solution with fresh chemicals after one month's use or after using a volume of replenisher equal to twice the tank volume, whichever occurs first.

Notice: Observe precautionary information on product labels and on Material Safety Data Sheets.

Development Times for Modified Developer D-76 in Rack-and-Tank Processors at 68°F (20°C)

KODAK Film	Exposure	Optimum Development Time	Batched Development Time
T-MAX 100 Professional	Normal Push 1 Push 2	8.0 9.0 11.5	8.0 10.0 12.0
T-MAX 400 Professional	Normal Push 1 Push 2	7.5 8.5 9.5	8.0 8.0 10.0
T-MAX P3200 Professional	EI 800 EI 1600 EI 3200 EI 6400	10.0 11.0 13.0 16.0	10.0 12.0 14.0 16.0
PLUS-X Pan	Normal Push 1 Push 2	6.0 7.0 10.0	6.0 8.0 10.0
TRI-X Pan	Normal Push 1 Push 2	7.5 8.5 9.5	8.0 8.0 10.0
Other Black-and-White Film	**Exposure**	**Optimum Development Time**	**Batched Development Time**
AGFAPAN APX 25	Normal Push 1 Push 2	5.5	6.0
AGFAPAN APX 100	Normal Push 1 Push 2	6.5 7.5 10.0	6.0 8.0 10.0
AGFAPAN AP 400	Normal Push 1 Push 2	8.0 9.0 11.0	8.0 10.0 12.0
ILFORD Pan F	Normal	7.5	8.0
ILFORD FP4 Plus	Normal Push 1 Push 2	6.0 7.0 10.0	6.0 8.0 10.0
ILFORD HP5 Plus	Normal Push 1 Push 2	6.0 7.0 9.5	6.0 8.0 10.0
ILFORD 400 DELTA	Normal Push 1 Push 2	6.0 7.0 10.0	6.0 8.0 10.0
ILFORD 100 DELTA	Normal Push 1 Push 2	5.5 7.0 9.0	6.0 8.0 10.0
FUJI NEOPAN 400	Normal Push 1 Push 2	7.5 9.5 11.5	8.0 10.0 12.0
FUJI NEOPAN 1600	EI 1600	7.5	8.0

ALL ABOUT PUSH PROCESSING BLACK-AND-WHITE FILMS

If you've never pushed a black-and-white film to the limit, you've missed out on some real fun—and some wonderful visual effects. Here are a few guidelines and ideas for experimenting with some amazingly versatile products.

WHAT EXACTLY IS "PUSH PROCESSING"?

Suppose you want to take some photographs at a late-night soccer game. You have a 300 mm *f*/2.8 lens and KODAK T-MAX 400 Professional Film. You must handhold the camera, so you need to shoot at 1/250 second or faster. Meter readings around the field before the action starts indicate that to work at these camera settings, you need a 1600-speed film. The only film you have is 400-speed. What can you do?

Enter push processing: Load the T-MAX 400 Film and use 1/250 second at *f*/2.8, as if you had a 1600-speed film.

Back at the lab, you develop the film for a longer-than-normal time ("push" the process). The negatives print similarly to film that is exposed and processed normally. However, the prints are grainier than usual and they lack some shadow detail. But it sure beats going home with no images.

IS PUSH PROCESSING BASICALLY A TECHNIQUE TO USE WHEN THE AVAILABLE LIGHT IS INADEQUATE?

Correct. Push processing has long been a popular technique, especially with photojournalists who shoot night or indoor sports where the action is fast and the lighting is poor. It's also useful for candid photography when you don't want to call attention to the camera by using flash.

Faster films, like KODAK T-MAX P3200 Professional Film, have reduced the need for some push processing; you can expose this film at its normal speed in these situations. However, it didn't take long for photographers to push this film to speeds of 6400 or 12,500 (or beyond) to take their cameras into places they'd never been before.

ARE THERE OTHER USES FOR PUSH PROCESSING?

Yes. Oddly enough, pushing can offer an advantage in a number of well-lit situations. For example, consider an outdoor tennis match at midday. You can easily shoot a 400-speed film at 1/500 second to stop action or us *f*/16 for good depth of field. But you might prefer to use a 100-speed film, pretend it is 400, and then push-process.

Push processing increases film graininess, but a 100-speed film pushed to 400 is not as grainy as a true 400-speed film exposed and processed normally. This technique sacrifices some shadow detail, but in many sports situations, such as tennis, golf, swimming, etc., shadow detail is not terribly important to the image. In situations like this, you can end up with better overall image quality by underexposing and push-processing a slower film than by making the more natural choice of a faster film.

HOW SERIOUS ARE LOSS OF SHADOW DETAIL AND INCREASED GRAIN?

It all depends on your requirements for image quality. Many purists would not even consider these techniques because of the associated grain and shadow degradation. Yet to say "never" to push processing is to deny yourself many photo opportunities.

The more you underexpose, the harder you must push the process, and the more grain and shadow detail suffer. How far is too far? You'll need to experiment with various degrees of underexposure and pushing to learn your aesthetic limits, realizing these change with the situation. Few people would pass up a once-in-a-lifetime photo opportunity because it requires push processing and some degree of image degradation.

BUT CAN YOU QUANTIFY THE PENALTIES?

Roughly, think of it this way: A one-stop push—exposing a 100-speed film at 200, or a 400-speed film at 800—will be difficult for most people to detect if it is done well. A two-stop push, such as 400-speed film exposed at 1600, is clearly detectable, in both lost shadow detail and increased graininess of the print. Three stops is generally the upper limit.

Many sports photographers have used a three-stop push for years. They rate KODAK TRI-X Pan Film at 3200 and push-process. The grain is genuinely gritty and the loss of shadow detail is substantial, but again, it beats having no newspaper coverage of an important event.

WHAT IS THE WORLD RECORD FOR PUSHING?

The most extreme situation we know about is using KODAK T-MAX P3200 Professional Film rated at 100,000. This was a certifiably special case related to a criminal investigation. Authorities needed a late-night aerial photograph that would establish the relative position of two groups of people. The print was not a prizewinner by our standards, but it provided the information to secure a conviction. By that definition, it was a successful photograph.

DOES ALL THIS MEAN THAT BLACK-AND-WHITE FILM HAS NO FIRM SPEED VALUE?

Absolutely not. Any film has one, and only one, ISO speed. This value is determined with a particular developer under very rigid conditions. However, this developer and the special conditions are not available to the average photographer.

The speed of a film in the real world is a function of many choices made in processing the film: the developer, the developer dilution, development time, developer temperature, and agitation.

Kodak lists Exposure Index (EI) values for its films, and these values are different for different developers. For example, T-MAX 400 Professional Film has an EI value of 400 when developed in fresh KODAK Developer D-76, but it has an EI value of 200 when developed in full-strength KODAK MICRODOL-X Developer. (These EI values are based on normal development for negatives intended to print on grade 2 paper in a diffusion enlarger.)

With longer development times, such as those used in push processing, EI values actually do increase, but only slightly. Underexpose a film by two stops and give it a two-stop push, and the real film speed will typically increase by perhaps a half stop. This means that the film is really underexposed by only 1½ stops, not two stops. But it is underexposed.

The intrinsic speed of a film is largely set at the time of manufacture. You can trade much of this speed for other features (like finer grain with MICRODOL-X Developer) or simply lose it in a poorly maintained developer. However, increasing speed significantly is extremely difficult.

ARE SOME FILM/DEVELOPER COMBINATIONS BETTER THAN OTHERS FOR PUSH PROCESSING?

Yes. We've already mentioned the option of intentionally choosing a slower film, and the fact that many people push even turbo-charged materials like T-MAX P3200 Professional Film. In practice, though, the films most often pushed are 400-speed films. The choice of which 400-speed film is an important consideration.

A few years ago, Kodak did an interesting survey. We purchased black-and-white 400-speed films manufactured by Kodak, Agfa, Ilford, and Fuji. All the films received very precise sensitometric step-tablet exposures. We then mailed them to 119 pro labs all around the world for processing. When the films came back, we determined the exact exposure needed to produce a density of 0.10 above base plus fog, the ISO speed point.

For any one of the films, we saw a variety of speed numbers that reflected the processes of the various labs. But the film that most consistently provided the best speeds was T-MAX 400 Professional Film. The advantage ranged from modest to substantial, depending on the comparison, but in a world where fractions of a stop matter, this film offered a clear advantage.

A variety of so-called "push developers" is available. These developers are specially formulated to extract the maximum photographic speed from black-and-white films. A distinguishing characteristic of such developers is that they tend to produce very grainy results. KODAK T-MAX Developer and T-MAX RS Developer and Replenisher are exceptions. They are the "push" variety, but they don't exact a significant penalty in film graininess. Both offer maximum film speed, but with grain that is just slightly more noticeable than that produced by KODAK Developer D-76.

WHAT ABOUT DEVELOPMENT TIME AND TEMPERATURE?

Temperature is a matter of convenience. Pick a value that you can keep consistent, and stay with it.

Development time? The big caution is do not overdo it. When you underexpose film and develop it normally, all scene elements develop to lower densities. The negative is thin with little density range, and needs a higher-contrast printing paper. The objective of push processing is to expand that negative back to a normal density range so that it will print on a normal paper grade. Pushing beyond this buys no additional shadow detail; it only makes the negatives difficult to print.

If you underexpose film by one stop, you may choose not to push the process at all. The negatives will be a little thin and may require a paper one-half to one grade higher than you ordinarily use. With film underexposed by two stops, try extending the normal development time by about 25 percent, and extend the time by 50 percent for film underexposed by three stops. (Use less of an increase to produce negatives that will print normally with a condenser enlarger.) These guidelines are specifically for T-MAX Professional Films. You may need more of a push for other films.

Experiment with some non-critical film. Your goal is to find a development time that permits printing with a paper grade and printing exposure times similar to what you normally use for normally exposed and processed films.

ANY OTHER SPECIAL CONSIDERATIONS?

A couple of things are worth exploring. Consider diluting the developer more than usual. For example, consider using T-MAX Developer at 1:7 or 1:9 instead of the usual 1:4. Also consider using less frequent agitation—maybe once a minute (or even less) rather than every 30 seconds. These tactics require lengthening development times even further, because they both slow down development. However, the extra time buys a little bit more shadow detail (real film speed) without sacrificing the highlights. It also produces a slight sharpness improvement. The disadvantage is that film graininess also increases a bit more.

ANY PITFALLS?

Yes, two. You may tend to push too hard and overdevelop the film. This only makes printing needlessly difficult.

The second pitfall concerns film developed in replenished developers. Any replenished system contains development byproducts, and these byproducts reduce real film speed. A film that is an honest 400-speed film in a fresh one-shot developer is more likely to be a true 250- or 320-speed film if that same developer is reused and replenished.

Replenished systems may not be very well maintained (i.e., they are underreplenished) and the speed losses can be more significant. That 400-speed film may be only 200 or even lower. If you need to use a commercial lab that operates a replenished line, the film you think is two stops underexposed may be far more underexposed relative to that process.

Finding a lab that is running KODAK T-MAX RS Developer and Replenisher can be a help. The process will have some speed loss as the developer seasons, but contrast will remain the same. A seasoned process will give consistent results, so you can run tests to determine the best combination of exposure and processing for your application.

WHAT ABOUT PRINTING PUSH-PROCESSED NEGATIVES?

If the push was appropriate, printing times and paper grades will be very similar to those that you use for ordinary negatives. The problems will be lost shadow detail and increased grain, and—especially if the push was overdone—burned-out highlights.

KODAK POLYMAX II RC Paper is particularly well suited to printing pushed negatives. Its unique curve shape offers real help. The contrast at the shadow end of the scale is purposely inflated. This tends to separate the weakest shadow detail and render it more distinctly in the print. At the same time, the paper reproduces highlights with slightly lower contrast. This accomplishes two things:

- It tends to tame highlights that are too hot, reducing the need for burning in.
- It helps to control graininess. Grain in a black-and-white print is most noticeable at densities slightly less than an 18-percent gray card. Grain at any density is also directly proportional to paper contrast at that density. Because POLYMAX II RC Paper has slightly less contrast throughout the highlights and lighter tones, it tends to subdue the graininess you would otherwise see at these critical densities.

ANY LAST THOUGHTS ON PUSH PROCESSING?

Only one: Have fun with it! You may well have photo opportunities or assignments that require push processing to get the job done. But beyond these, watch for—or create—opportunities. Pushing can lend a special aura to an otherwise ordinary image.

One good way to explore such opportunities is to load your camera with T-MAX P3200 Professional Film, set the film speed at 6400 (or even higher), and do some candid late-night street photography. This film lets you capture images with a handheld camera without a flash that you never could obtain otherwise. The extra push in processing will yield substantial grain, especially in big enlargements. This is “good grain.” It’s sometimes described as “grain that looks like you could catch your fingernail on it” compared to the oatmeal-like grain older films produced.

Also explore offbeat printing techniques. One frequently successful technique involves printing grainy negatives on KODAK P-MAX Art RC Paper. This paper has a very “toothy” surface that adds to the image’s gritty look, and it is very receptive to hand-coloring. An underexposed and pushed image made with this very fast film, enlarged onto P-MAX Art Paper, and spot-colored to highlight portions of the scene can be a very powerful and satisfying image.

FILM-HANDLING TIPS

FILM KINK MARKS

Physical deformation, buckling, or kinking can produce localized differences in film density. These usually appear as crescent-shaped marks that are lighter or darker than the surrounding area. Kink marks show up in prints as patterns of the opposite density—light marks (minus density) in the negative will be dark (plus density) in the print.

How Do Kink Marks Affect Different Film Types?

The specific appearance of kink marks depends on the type of film, when the kinking occurs (before or after exposure), the exposure level of the film where kinking occurs, and similar factors. Also, in color films, the color of the mark may vary with the product, the severity of kinking, etc.

Product	Kinking Before Exposure	Kinking After Exposure
Black-and-White Films		
Negative	Light Marks (Minus Density)	Dark Marks(Plus Density)
Positive	Dark Marks (Plus Density)	Light Marks (Minus-Density)
Color Films		
Negative	Light-Brown Marks	Dark-Brown Marks
Positive	Dark-Colored Marks	Light-Colored Marks

What Causes Them?

Bending film during handling can exert pressure on the silver halide grains and affect sensitization of the emulsion. Pressure before exposure may desensitize the silver grains. This desensitization later produces minus-density marks in exposed areas of the processed film or plus-density marks in unexposed areas. Pressure after exposure may sensitize the silver grains.

Usually kinking or bending occurs during handling. For example, film may be bent sharply during loading of film holders and processing equipment, or it may be kinked by pressure from fingernails. Mechanical problems in mechanized processing equipment may also kink film.

Lower-than-normal temperatures may make film stiffer and more susceptible to kink marks.

What Can I Do to Avoid Kink Marks?

The best prevention is to handle film with care, especially under cold conditions.

After processing, you can't correct kink marks. However, you can use negative- and print-retouching techniques to correct less severe marks.

How Can I Tell If Kinking Is Really the Problem?

Light leaks, x-ray exposure, and other types of fog may produce similar patterns. If you notice random plus-density marks—especially crescent-shaped marks—consider film kinking as a potential cause.

LIP FOG

Lip fog is a patterned exposure sometimes found on 35 mm films. It usually appears as streaks running completely across the film, starting near frame No. 1 and repeating at decreasing intervals.

Black-and-white negatives will show dark streaks.

Color negatives will show dark-colored streaks.

Color reversal films will show white, yellow, orange, or light-colored streaks.

Black-and-white infrared films will show dark streaks.

Color infrared film will usually exhibit reddish streaks, but the color may vary.

Note: Infrared films are especially vulnerable because they are sensitive to light over a wider range of the spectrum.

What Causes Lip Fog?

Lip fog forms when film is exposed through the lips of the 35 mm magazine, where the leader protrudes. Exposure can take place when you load a magazine into a camera or leave unprotected magazines in direct sunlight. Infrared film may be fogged even when loaded into a camera in very dim light.

The following conditions contribute to lip fog:

- loading film in overused reloadable magazines with wider-than-normal lips
- bright light angled toward the lips of the magazine
- for infrared films, radiation high in the infrared region of the spectrum or loading in darkrooms with safelights

Also, if film is incompletely rewound into a magazine after exposure, light can leak into the magazine and fog the film.

How Do You Prevent Lip Fog?

Although lip-fog streaks are developable and form a permanent part of the image, you can take a number of steps to avoid them:

- Replace reloadable magazines regularly with new ones.
- Examine magazines frequently. (Comparing them to a factory-loaded magazine is a good check.)
- Keep magazines out of bright light. Keep film in lighttight plastic containers whenever possible.
- If you use infrared film, don't subject unprotected magazines to any light at all.

Do Any Other Conditions Look Like Lip Fog?

It's possible to confuse lip fog with—

- fog caused by light leaks from a camera back or camera body latch
- fog caused by light leaks in the darkroom
- safelight fog that occurs during loading film onto reels for processing

WHITE-LIGHT FOG

Fog caused by exposure to white light usually appears as an area of maximum density on negative films and minimum density on reversal films. When fogging is complete, no image or edgeprint will be visible on the film. When the film is partially protected or the light leaks are small, the fog can appear in a wide variety of patterns and densities.

Black-and-white negatives will show plus-density or maximum-density areas, which produce white or light areas on prints.

Color negatives will show neutral to blue plus-density areas, which produce white, yellow, or orange areas on prints.

Color reversal films will show neutral minus-density or minimum-density areas, usually with yellow or orange patches.

What Causes White-Light Fog?

As the name indicates, the cause is unwanted exposure of the film to light. The fog may produce overall exposure or various patterns and densities, depending on the intensity and duration of the exposing light, the presence of objects between the film and the light source, and the way in which the film was fogged. For example:

- A frame-by-frame repeat pattern on the film indicates a camera problem such as a slightly open camera back. The frames are formed in the camera and the fog repeats when the film is advanced.
- Usually fog confined to the image area indicates a light leak in the front of the camera. Only the area that is exposed by the shutter is affected by the fog.

How Do I Know When Fogging Occurred?

Shadow patterns of equipment may indicate how the fog occurred. Images of camera parts on the film indicate a camera problem. The images may be highly distorted, depending on the direction of the light and the shadows cast by the camera parts. Shadows of dust and dirt on the film may indicate the direction of the light.

If shadow patterns appear on the film where film clips held the film during processing, fogging probably occurred during darkroom handling.

Light leaks in the **camera** may come from—

- worn locks or seals
- dirt in camera locks or seals
- missing screws, broken or cracked parts, loose lens mounts, improperly seated lenses, or improperly seated interchangeable camera backs
- film-transport failure that requires opening the camera back
- accidental opening of the camera back

Fogging that occurs in the **lab** or **darkroom** may come from—

- light leaks in the darkroom or processing equipment (White-light leaks produce yellow marks or areas on color print paper.)
- processor breakdowns or accidents that require using a light in the darkroom
- opening a darkroom door that's not equipped with a light trap
- safelights that are poorly sealed or cracked

Do Any Other Conditions Look Like White-Light Fog?

Exposing film to high temperatures and relative humidity may produce an increased fog level. This type of fog is usually uniform and isn't so severe as white-light fog.

Chemical fogging during processing may increase the fog level. Chemical fogging looks more like heat damage because it produces less severe fogging than white-light fog.

X-RAY FOG

Until recently, x-ray inspection units used for airport security have been relatively safe for films. However, as airports step up their security measures, some have introduced a new type of inspection unit that has a greater potential to fog film. To date, these units are not widespread, but we expect them to become increasingly common.

This new equipment is intended for *checked* luggage, although it is possible that boarding-gate security checkpoints will use it in the future. Because your checked luggage may be subjected to these new units, we suggest that you hand-carry your film and request visual inspection.

Historically, fog caused by x-ray radiation has appeared as lines or patterns across the width of roll film. The patterns are usually widely spaced lines followed by many more closely spaced lines. This happens because the image of the plastic core at the center of the roll and the individual laps of the film are projected onto the other laps of film in the roll. Undulating or wavy patterns may also occur throughout the length of the roll; this happens when the film is x-rayed at an angle and the shadow from the end of the film spool and magazine alters the exposure. Shadow images from other objects may also be evident. For example, film x-rayed inside a camera may show images of camera mechanisms.

The fog caused by the new airport inspection units is usually more pronounced. It typically appears as soft-edged bands ¼ to ⅜ inch (1 to 1.5 cm) wide. Because the new equipment uses a higher and more focused x-ray beam, the banding will be very dark on negative films and very light on reversal films. Depending on the orientation of the film to the x-ray beam, the banding may be linear or wavy, and can run lengthwise or crosswise on the film. It can also undulate, depending on the combination of the angle of exposure and the multiple laps of film on the roll. However, the fog will usually lack the more subtle patterns produced by traditional types of x-ray equipment.

Black-and-white films will show a plus-density area with patterns as described above.

Color negative films will show a plus-density area with neutral or brown patterns.

Color reversal films will show a minus-density area with patterns as described above.

How Does X-Ray Fog Occur?

X-ray fog can result from exposure to x-rays from medical equipment, airport inspection equipment, industrial x-ray sources, and other sources of x-rays, as well as from gamma rays from radioactive materials.

Airport x-ray inspection equipment is the most common source encountered by most photographers. Except for the new types of inspection units described earlier, most inspection units in use today are relatively safe for films with an ISO speed or Exposure Index (EI) of 400 or lower. However, multiple exposures without reorientation of the film, cumulative doses of more than five exposures, and malfunctioning inspection units can cause fog. Films with an ISO speed or EI higher than 400 require added precautions because they are much more sensitive to x-ray exposure. Even with "film-safe" x-ray units, you should limit exposure to one inspection. For films with a speed of 1000 or higher, request *visual* inspection if allowed by local regulations or law.

Other factors can affect the severity of x-ray exposures on photographic films. Film that is—or will be—underexposed and film that you intend to push-process may be particularly vulnerable to x-ray exposure.

Underexposure. X-ray fog occurs in the lower exposure range of the film. Film that is underexposed has more of the image recorded in this range. Therefore, the effects of x-ray exposure may further reduce the quality of underexposed images.

Push Processing. Push processing involves overdevelopment of film to increase the effective speed and increase the density of underexposed images. Just as overdevelopment increases image density, it will also increase the density of any fog, including x-ray fog.

Limiting x-ray exposure is increasingly important for film that may be subject to underexposure or push processing.

What Precautions Can You Take?

At airport inspection stations, be sure to look for posted advisories on potential effects on film. Requesting visual inspection of photographic materials is still the best preventive measure, when it's allowed. For easy inspection, carry the film in a clear plastic bag.

If you choose to place your film in luggage that you will check, ask if the luggage will be x-rayed. Be aware that security procedures in some locations may prohibit informing passengers whether or not their checked luggage will be x-rayed. Because of random x-ray examination of checked luggage and differences in procedures worldwide, we suggest that you *not* carry film in checked luggage. By hand-carrying your film, you will know if it is subjected to x-ray inspection.

If possible, you may want to have your exposed film processed locally before passing through airport security. X-ray exposure has no effect on processed film.

Any Other Conditions that Look Like X-Ray Problems?

- As noted earlier, exposure to the new airport security equipment produces a pronounced band of plus density or minus density that lacks the subtle patterns associated with x-ray exposure by other equipment. The fog pattern can resemble typical white-light fogging that occurs in a defined path—for example, from pinhole light leaks in equipment. The most defining characteristics of fog caused by the new equipment are the well-defined width of the bands and a fairly uniform density within the band. The banding will typically run through the whole roll (continuously or broken by patterns from the laps of film in the roll).
- On 135-size film, reverse-wind streaks are often mistaken for x-ray fog. However, these streaks are more evenly spaced and prominent, and tend to bow outward from the film perforations.
- Certain keeping conditions can produce effects that are confused with x-ray fog. However, you can usually distinguish x-ray fog by its distinct patterns.
- With focal-plane shutters, using shutter speeds higher than 1/60 second under fluorescent lights or higher than 1/125 second under high-intensity discharge lamps can produce crossbanding that may be mistaken for x-ray fog. However, these crossbanding patterns are usually widely spaced and diffuse.

STATIC MARKS

Especially during the winter, static can become a problem as you handle your equipment and films. Most photographic materials are susceptible to exposure by static electricity. Several different kinds of static marks have names such as branch marks, blotch static, bar static, starfish, and distorted starfish.

What Causes Static on Film and Cameras?

When you subject a camera or film to friction, it can become positively or negatively charged with static electricity. The film or camera then tries to return to a neutral state by transferring electrons to or from other objects.

Sometimes this transfer occurs slowly, without any adverse effects. But sometimes the charge builds up faster than it can safely dissipate. Then a sudden discharge produces heat, light, and ultraviolet radiation. The ultraviolet radiation forms a latent image on the film in the shape of the static discharge. You'll notice these images on processed negatives and transparencies.

Although friction is the chief culprit in causing static charges, the separation of film surfaces during rapid unwinding of roll film can also cause static.

As a rule, static is most troublesome when the relative humidity is low. Using 35 mm camera motor drives in very dry air can cause static marks.

How Does Static Affect Different Types of Materials?

Black-and-white negatives will show dark areas, which produce light areas on prints.

Color negatives will show yellow areas, which produce blue areas on prints.

Color reversal films will show blue areas.

The yellow/blue coloration of static marks on color films rarely varies unless exposure occurs through the back of the film. This is because the light from a static spark is predominantly blue or ultraviolet. When the light strikes the film, it first affects the blue-sensitive (top) layer. A yellow filter layer under the blue-sensitive layer prevents the blue light from reaching the other layers. Static exposure through the **back** of the film will appear as cyan areas on color negatives (red in prints) and red areas on color reversal films.

What Do Static Marks Look Like?

Positive polarities of charge produce spots. Lines, bars, and blotches usually consist of many closely spaced—or even overlapping—spots. Negative polarities produce branches. The branches may look like trees, rivers, lighting bolts, or starfish.

The branch-like markings you see occasionally on sheet-film negatives are the typical result of a negative charge that is discharged to a small point or object.

Diffuse spots with dark centers can occur when a charge builds up on the camera and then discharges to the film. A similar marking, called bar static, looks like a row of spots (often surrounded by fogged areas) that extend across the width of roll films. This type of marking can occur when you unwind a roll of film that has been tightly wound.

Unrolling the backing paper from roll film and passing the film rapidly between your fingers can produce a line of closely spaced bead-like spots down the center of the roll.

Surprisingly, *high* relative humidity can also cause static. It softens the emulsion of a film, so layers of tightly wound film make better contact with each other. You may cause an irregular blotchy pattern if you unwind a roll of slightly damp or tacky film. This blotchy pattern is typical of moisture static or "tacky static."

What Can You Do to Prevent Static Marks?

During manufacturing and packaging, Kodak takes every possible precaution to avoid the buildup of static charges on sensitized products. Taking the following precautions will help you avoid problems caused by static:

- Avoid handling film with sudden movements that might cause friction.
- If possible, keep the relative humidity at 40 to 60 percent in areas where you load and unload film.
- Don't advance or rewind roll films rapidly; don't wind rolls too tightly.
- Move plastic dark slides in sheet-film holders slowly. Don't withdraw or replace the slides quickly. When you remove the slide, don't place it under your arm and then withdraw it quickly to reinsert it into the film holder. This can cause a static charge on the slide that may discharge to the film.
- Remove the backing paper from roll film carefully. Don't pass the film between your fingers to unroll it.

FILM-PROCESSING TIPS

AIR BELLS

When air bells or bubbles of air form on film surfaces during processing, they produce circular spots on the film. These spots may have distinct edges or relatively diffuse edges. They may be higher or lower in density than the surrounding areas. Patterns vary from isolated spots to clusters where a heavy concentration of air bells or foam formed.

How Do Air Bells Affect Photographic Materials?

Air bubbles adhering to film surfaces prevent processing solutions from penetrating the emulsion. If this occurs in the developer, the result will be a circular spot that shows lack of development. Air bells in other solutions may produce spots of overdevelopment where the developer continued to act on the emulsion, or spots may form where incomplete bleaching, fixing, or washing has occurred.

With color materials, the color of the marks depends on the process and at what step in the process the air bells formed.

Why Do Air Bells Form?

Air bubbles may simply cling to film surfaces when you first immerse the film in a processing solution. That's why initial agitation to dislodge bubbles is so important.

Also, any condition that causes bubbles or foam in a processing solution can help to form air bells. All of the following factors can contribute to air-bell problems:

- overagitation
- equipment that draws air into solutions
- use of solutions too soon after mixing
- temperature changes in solutions
- insufficient filling of closed processing tanks
- incorrect filling of rotary-tube processors
- improper distribution or leaks in gaseous-burst agitation systems
- freeing up of dissolved air when cold incoming water warms to room temperature or is heated to provide hot water

How Do You Prevent Air Bells?

The most important factor is proper initial agitation. In batch systems, rap the reels or racks against the side of the tank to dislodge air bells carried in on the film. Agitating too vigorously causes bubbles to form. Agitating for too long a time can produce mottling.

In automatic processing systems, properly maintain the agitation system. In closed tanks and rotary-tube processors, be sure to observe proper filling procedures.

Treat dissolved air in a water supply by installing an aerator on the faucet. An aerator produces large bubbles, which rise to the surface and don't adhere to the film. Allow cold tempered water to stand before using it; this will allow dissolved air to dissipate.

When the water supply is cold, you can minimize air bells by connecting 100 feet of coiled hose between the water supply and the chemical-mixing area or processor. The water will warm up gradually and the freed air will collect at the top of the coils, producing larger bubbles that won't present air-bell problems.

Allow freshly mixed chemicals or chemicals diluted before use to stand for a time so that dissolved air can dissipate.

What About Films Already Affected?

Air bells that are present in the developer produce spots that are a permanent part of the image.

When spots have formed in other solutions or washes, you can reduce or sometimes eliminate them by reprocessing, starting with the solution in which the spots formed.

Air Bells? Or Something Else?

Sometimes chemical splashes can make spots that look like spots from air bells. Air bells are usually round, so irregularities in the shapes of the spots indicate splatter may be the source.

Air bells may be more irregular when they are caused by heavy foam concentrations. However, you can usually see a foam pattern.

Effects of differential drying can also resemble air-bell patterns. Differential-drying spots occur when small drops of water cause areas of film to dry at different rates. This produces a physical deformation of the surface. In this case, wash films immediately to help reduce the effect.

DIFFERENTIAL DRYING MARKS

Differential drying marks appear as a deformation in the gelatin surface; they range from highly irregular and elongated marks to pits, craters, or rows of small circular spots.

Most drying concerns occur when the weather changes—from fall to winter, when humidity gets quite low, and in the spring or summer, when humidity starts to rise.

How Does Differential Drying Affect Film?

Differential drying marks on film will print as plus-density marks. When you examine the film closely, the surface will appear deformed. The deformations may also appear as slight minus-density areas when you view them by transmitted light.

These marks are caused by differences in the rate of drying in localized areas on the film surface. The more slowly the gelatin dries, the more it will contract. If water is unevenly dispersed on the film surface during drying, the areas underneath the surface solution will dry more slowly, forming a crater, pit, or other deformation in the emulsion surface.

What Conditions Cause Differential Drying?

Quite a variety of conditions can cause differential drying:

- drying differences caused by changes in drying temperature or humidity
- excess solution on the film surface because of poor squeegeeing
- solution splatters striking the film after drying has begun
- dirt particles on the film (These can hold droplets of water and cause a drying problem. Be sure that the drying area is clean and that processing solutions do not contain particles that can stick to the film.)
- poorly aligned rollers in roller-transport processors that allow too much water to be carried into the dryer
- excessive hardener or stabilizer carryover that causes dirt in film dryers

Can You Correct the Problem?

To remove differential drying marks, rewet and redry the film. In most cases, the sooner you do this, the more success you are likely to have. You can repeat the treatment twice. When gelatin swelling occurs in an alkaline solution, completely reprocessing the film may be more effective. Be sure to wash the film adequately before reprocessing so that you won't contaminate the developer.

What Can You Do to Prevent It?

Any change in drying conditions can either cause or eliminate differential drying problems.

Check the following:

- Dryer temperature—Lowering the temperature to slow drying (particularly in the initial stages) usually will help. This allows time for uniform drying. In some cases, increasing the temperature during the later stages of drying may also help.
- Solution splashes—Check for solution splashing into the dryer area.
- Squeegees—In continuous processors, check the condition and operation of squeegees.
- Solution carryover—In rack-and-tank processors, solution carried over in film clips can splash on the film.
- Delay in drying—In rotary-tube and sink-line processing, problems may occur if there is a delay between removing the film from the last solution and hanging it in the dryer. Splattering may also occur when you hang other rolls in the dryer.
- Roller alignment—In roller-transport processors, check the alignment of the rollers. These rollers provide the only squeegeeing. If roller clearance is too great, too much solution will carry over into the dryer.

Bathing the film in KODAK PHOTO-FLO Solution promotes better drying. It contains a wetting agent to promote water shedding from the film surface. Be sure to dilute the solution with water in the correct proportions.

Do Any Other Conditions Look Like Differential Drying?

- Foam or air bells on the film surface during development can limit the initial swelling of the emulsion and produce an effect similar to differential drying.
- Uneven roller surfaces in roller-transport processors can emboss a texture into the film surface that resembles differential drying.
- Films with backing paper are subject to a texturing condition known as "orange peel." This texturing can occur when heat or high relative humidity softens the film surface so that the texture of the backing paper is embossed onto the film. (This effect may not show in prints.)

WATER SPOTS

These spots are usually round, but can occur in a variety of shapes.

What Causes Them?

They are formed from water droplets or "bubbles" on film surfaces that dry more slowly than the rest of the film, or by chemical deposits in the water. They may also result from air bells on film during washing. Water spots can occur on film during manual or machine processing.

Differential drying of the water drop and the area surrounding it causes the edges to dry first while the thicker center of the drop is still liquid. This slightly alters the thickness or hardness of the gelatin, causing a printable image of a crater. If the water contains residual processing chemicals or other chemicals, the residue left after drying will magnify the problem.

How Can You Prevent Them?

Very rapid drying, lack of a wetting agent, splashed water or chemicals in manual or machine processing, low relative humidity, and hard water can all contribute to this condition.

The following may help prevent water spots:

- Filter the wash water.
- Dry films at 20-percent relative humidity.
- Eliminate splashing through techniques such as fabricating baffles for machine processors.
- Use an adequate dryer temperature–neither too high nor too low.
- Avoid air bubbles.
- Check cleanliness.
- Use a water softener in extreme cases.

In less severe cases, you can minimize spots by washing and redrying the film several times. Be sure to watch out for bubbles and air bells. Use KODAK PHOTO-FLO 200 Solution after the final wash.

KODAK BLACK-AND-WHITE PAPERS

KODAK Paper	Description	Surface,* Paper Weight,† Contrast Grades‡	Paper Base	Base Tint	Tray Processing§			Image Tone
					KODAK Developer	Recommended Development Time (minutes)	Development Range (minutes)	
Enlarging Paper								
Selective Contrast—Use KODAK OC Safelight Filter ¶								
POLYCONTRAST III RC	Fast, general-purpose enlarging paper. Incorporated developing agent for rapid development. Designed for machine and tray processing.	F–MW N–MW E–MW	RC	White	DEKTOL; POLYMAX T	1	¾ to 2	Neutral black
					EKTONOL	1½	1 to 3	
POLYMAX II RC	Fast, general-purpose enlarging paper with outstanding highlight detail. Wide contrast range, rich blacks, and excellent process latitude.	F–MW N–MW E–MW	RC	White	DEKTOL; POLYMAX T	1	¾ to 3	Neutral black
					EKTONOL	1½	1 to 3	
POLYMAX Fine-Art	Double-weight, selective-contrast enlarging paper that accommodates an extended range of negative contrasts, and exhibits excellent tone reproduction.	C–DW F–DW N–DW	Fiber	Creamy (C) or White (F, N)	DEKTOL, POLYMAX T	2 to 3	2 to 3	Neutral black
POLYMAX Fiber	Single-weight, selective-contrast enlarging paper that accommodates an extended range of negative contrasts, and exhibits excellent tone reproduction.	F–SW N–SW	Fiber	White	DEKTOL; POLYMAX T	1½	1 to 3	Neutral black
EKTAMATIC SC	For use in applications that require fast processing. Intended for machine stabilization processing, but can be tray-processed.	F–SW	Fiber	White	DEKTOL; POLYMAX T	1	¾ to 2	Neutral black (warm black with stabilization processing)
Graded Contrast—Use KODAK OC Safelight Filter¶								
ELITE Fine-Art**	Medium-speed enlarging paper with excellent tonal range—deep, detail-rich blacks and brilliant whites. Designed for tray processing.	S–PW 2–3	Fiber	White	DEKTOL; POLYMAX T	2	1 to 4	Neutral black
P-MAX Art RC	High-speed enlarging paper designed for hand-coloring with oils, dyes, pastels, and pencils. Double-matt surface provides excellent "tooth." Incorporated developing agent for rapid development. Designed for machine and tray processing.	V–HW 2–3	RC	White	DEKTOL; POLYMAX T	1	¾ to 2	Neutral to warm black
					EKTONOL	1½	¾ to 3	
KODABROME II RC	Fast, graded paper for general use. Designed for machine and tray processing.	F–MW 1–5 N–MW 1–5 E–MW 2–3	RC	White	DEKTOL; POLYMAX T	1	¾ to 2	Neutral black
					EKTONOL	1½	¾ to 3	

KODAK Paper	Description	Surface,* Paper Weight,† Contrast Grades‡	Paper Base	Base Tint	Tray Processing§			Image Tone
					KODAK Developer	Recommended Development Time (minutes)	Development Range (minutes)	
KODABROMIDE**	Fast, graded enlarging paper with wide exposure latitude. Short exposure times. Good range of tones.	F–SW 2–5	Fiber	White	DEKTOL; POLYMAX T	1½	1 to 3	Neutral black
EKTALURE**	Medium-speed, single-contrast, warm-tone paper for making enlargements and contact prints from well-exposed and developed negatives.	G–DW	Fiber	Cream	DEKTOL; EKTONOL; EKTAFLO, Type 2; SELECTOL-SOFT††	2	1½ to 3	Warm black
Panchromatic—Use KODAK 13 Safelight Filter¶								
PANALURE SELECT RC	Panchromatic, projection-speed paper designed for making black-and-white enlargements (or contact prints with reduced illumination) from color negatives. Accommodates a wide range of scene contrast and negative quality. Incorporated developing agent for rapid development. Designed for machine and tray processing.	FL FM FH	RC	White	DEKTOL; POLYMAX T	1	¾ to 2	Warm black
					EKTONOL	1½	¾ to 3	
EKTAMAX RA Professional‡‡	Fast, panchromatic paper for making black-and-white prints from color or black-and-white negatives. For intermediate applications where long-term display or keeping is not required. Use with Process RA-4.	FL FM NM	RC	White	EKTACOLOR RA Chemicals for Process RA-4	—	—	Neutral black
Contact Paper								
Graded Contrast—Use KODAK OC Safelight Filter ¶								
AZO	Blue-sensitive, contact-speed paper suitable for negatives of widely different contrast ranges.	F–SW 1–3	Fiber	White	DEKTOL; POLYMAX T	1	¾ to 2	Neutral black
					EKTAFLO, Type 2; EKTONOL; SELECTOL-SOFT ††	2	1½ to 4	Warm black

* Surface (texture and sheen)
C—Creamy, lustre
E, G—Fine-grained, lustre
F—Smooth, glossy
N—Smooth, semi-matt
S—Ultra-smooth, high-lustre
V—Suede, double-matt

† Base Weight
SW—Single Weight
MW—Medium Weight
DW—Double Weight
HW—Heavy Weight
PW—Premium Weight (extra heavy)

‡ For graded papers only. Indicated by numbers after the base weight.

§ At 68°F (20°C) with continuous agitation.

¶ For direct lighting, use a 15-watt bulb and keep the safelight at least 4 feet (1.2 metres) from the paper. For indirect lighting (safelight illumination bounced off ceiling), use a 25-watt bulb.

** To be discontinued by year end 1999.

†† For lower contrast.

‡‡ Using a safelight will affect your results. *If absolutely necessary,* you can use a safelight equipped with a KODAK 13 Safelight Filter (amber) with a 7½-watt bulb. Keep the safelight at least 4 feet (1.2 meters) from the paper.

Note: Do not ferrotype F-surface RC papers. They dry to a natural gloss without ferrotyping.

Note: For more information, see KODAK Publication No. E103BP, *KODAK PROFESSIONAL Black-and-White Papers,* available from dealers who sell Kodak products, or you can contact Kodak in your country for more information.

WHY USE VARIABLE-CONTRAST PAPERS?

Kodak offers an impressive selection of resin-coated (RC) and fiber-base variable-contrast papers to suit just about any application. Why choose a variable-contrast paper?

ONE BOX DOES IT ALL

With graded papers, lab operators must decide which grades to have on hand to meet their customers' printing needs. Usually, labs use grades 2 and 3 as their standards, keeping a box of grade 1 for those contrasty and extra-dense problem negatives. They may also keep a box of grade 5 for making high-contrast prints and prints that include phototypesetting, to bring out the blacks of the type while producing clean white backgrounds.

Often operators will find that the contrast and speed characteristics of their grade 1 and 5 papers have changed somewhat over time because they are used less frequently.

In addition to keeping different grades of paper, labs keep a variety of paper sizes and surfaces. It's difficult to predict which sizes and surfaces customer negatives will require, and therefore, waste seems inevitable.

This is no longer true with KODAK POLYMAX II RC and POLYCONTRAST III RC Papers! One box of paper for each size and surface is all labs need to meet all contrast situations. These Kodak papers can simplify and economize the stocking procedure for any darkroom.

THE LATEST TECHNOLOGY

With variable-contrast papers such as KODAK POLYMAX II RC and POLYCONTRAST III RC Papers, all the contrast grades are in the same box. You don't need to worry about differential aging characteristics from one grade of paper to another, and all the "grades" in the box are on exactly the same emulsion. With today's technology, we can produce much more consistent and accurate papers than ever before.

We can say with confidence that KODAK POLYMAX II RC and POLYCONTRAST III RC Papers are the most consistent papers in the world. When these papers are manufactured, on average, they do not vary from their aim speed and contrast points by more than ⅙ stop. This is a level that many manufacturers have not been able to obtain with their *films*! Our "buy-back" program, in which we purchase and test papers from around the world, confirms these statements.

Speed and contrast characteristics are maintained over time—in some cases for more than three years. This holds true no matter where you buy the paper. These papers will be consistent from the top of the box to the bottom of the box, and from box to box—especially important for big print runs when print contrast and density must match from print to print over hundreds or even thousands of prints. Consistency also helps master printers, because they don't have to waste paper on making tests when they change boxes or paper emulsions.

EXTREMELY WIDE CONTRAST RANGE

Besides greater consistency, these papers have an extremely wide contrast range. Typically, graded papers range in contrast from grade 1 (or possibly 0) to grade 5. POLYMAX II RC Paper, with proper filtration, can produce paper grades equivalent to grade -1 through grade 5 (with POLYCONTRAST III RC Paper, grade 0 through 6). The grade range is so extreme that Kodak needed to make new grade designations. Of course, achieving these grade numbers depends on the spectral quality of the imaging light source.

This expanded contrast capability gives labs a powerful advantage. There's virtually no negative they can't print. For example, we've made excellent prints from thick, contrasty, hand-coated glass-plate emulsions, and from negatives on KODAK T-MAX 400 Professional Film processed in the range of 60-percent underdevelopment to 240-percent overdevelopment.

SMALLER CONTRAST INCREMENTS

In addition to having greater contrast ranges, KODAK POLYMAX II RC and POLYCONTRAST III RC Papers also provide contrast in smaller increments than graded papers.

Because Kodak's variable-contrast papers are manufactured with a blue/green-sensitive emulsion, it's possible to change the contrast of these papers with magenta and yellow filters. KODAK POLYMAX Filters are composed of varying amounts of magenta and yellow dyes to provide contrast grades in increments of one-half grade. This lets you obtain a much closer contrast match to the negative than is possible with graded papers.

POLYMAX Filters are speed-matched in two groups: grades -1 through 3½ and grades 4 through 5+. This facilitates a filter change without making a difficult exposure adjustment. Additional finer values of magenta or yellow CC filters or dichroic color-head filtration can provide very subtle gradations of contrast.

For the ultimate in control, you can vary the paper contrast within the same print—something that is impossible to do with graded papers! For example, in a problem situation, you could print a landscape with a –1 filter to bring out the detail in the clouds and add density to the sky.

CURVE SHAPE DESIGNED FOR *KODAK T-MAX* PROFESSIONAL FILMS

As more photographers adopt T-MAX Professional Films as their standard, it is especially important that labs use POLYMAX II RC Paper, which was designed to bring out the best qualities of these films. And the characteristics that make it especially suitable for T-MAX Films also make it useful with more conventional films.

The curve of POLYMAX II RC Paper was enhanced to provide an extended toe to increase rendition of highlight detail. This lower-contrast slope of the highlight portion of the curve produces a much finer gradation of tones and *less grain*! (This is not a subtle difference; make the tests and see for yourself.)

Our surveys show that many negatives are overexposed or overdeveloped (or both). The increased lower-contrast range of POLYMAX II RC Paper is particularly useful with contrasty or overdeveloped negatives, and lets you print negatives that were impossible to print before.

In addition, the shoulder contrast of the paper curve was increased to produce greater separation of shadow tones. This higher-contrast shoulder produces blacker blacks sooner, permitting darker blacks than papers with inherently greater D-max.

POLYMAX II RC Paper is especially useful for the "matched-highlight" method of printing. To use this method, make the best print of the *detailed* highlights that you can, and then examine the shadows. If the shadows are too weak, try a higher-contrast filter; if the shadows are too dense, try a lower-contrast filter.

KODAK POLYCONTRAST III RC Paper has inherently higher contrast in the highlights and lower contrast in the shadows than POLYMAX II RC Paper. These characteristics benefit those who want crisp, clean, sharply defined highlights coupled with more gradual contrast in the shadows.

SIMILAR HANDLING CHARACTERISTICS

KODAK POLYCONTRAST III RC Paper has developer incorporated into the emulsion just like KODABROME II RC Paper. Therefore, you can expect similar development characteristics, and fast processing through a KODAK ROYALPRINT Processor. POLYMAX II RC Paper is not intended for use in a ROYALPRINT Processor. Other characteristics such as type of developer used, safelights required, drying, etc., are similar to those of other RC papers.

ARCHIVAL ASPECTS OF RESIN-COATED PAPERS

Some photographers—and photography instructors—still hold outdated prejudices toward resin-coated (RC) papers. They have serious doubts about the longevity of RC papers—even to the point of not using them for contact sheets and work prints.

Now the photo industry has had decades of experience in manufacturing RC supports. In fact, no fiber-base color papers have been on the market for quite some time. Today Kodak offers an extensive family of RC papers—with characteristics that suit just about any application you can name. In view of the advances in RC papers, let's take a look at their "archival" aspects.

HOW DO RC PAPERS DIFFER FROM FIBER-BASE PAPERS?

In the late 1960s, photographic manufacturers began to produce papers with a new type of support. They coated both sides of the paper support (the fibrous cellulose part) with a layer of extruded polyethylene resin. Then they applied the emulsion over the polyethylene.

The chief advantages of RC papers are faster processing and significantly reduced curl compared to older fiber-base (baryta-coated) supports. Because the processing solutions don't soak into the paper support (the resin keeps them out), the processing and wash times can be much shorter. These advantages are significant in both tray and machine processing.

In spite of the long-held view that fiber-base papers have superior archival characteristics, fiber-base papers may more often show problems with fading. When photographers are in a rush to get the job done, the fiber-base print may fade rather quickly because it is loaded with retained fixer (hypo). Most of the hypo in a print is trapped in the nooks and crannies between cellulose fibers in the paper support, not in the gelatin emulsion.

It is much easier to wash hypo out of RC prints than fiber-base prints. In an RC print, only the cut edges of the paper support are exposed to the processing solutions, and edge penetration of hypo is negligible. The tiny amounts of hypo absorbed through the cut edges would have to diffuse through the resin layer to get at the image. Even if that did occur, the level of hypo would not be enough to discolor the image. The old fears of "edge penetration" are unfounded.

WHAT HAPPENED WITH THE EARLY RC PAPERS?

Very early RC papers did have two big archival keeping problems that no one suspected, but they had nothing to do with hypo. They both had the same root cause. Before manufacturers discovered the cause and brought it under control, some photographers had decided that RC papers couldn't be trusted to last out the year. Today, the perception lingers, but the problems have been solved.

Put yourself in the place of the photographic engineers who needed to explain and solve the two-part mystery:

1. Reports came back from the field during the early and mid-1970s that the emulsion layer of framed and displayed RC prints (black-and-white and color) cracked in a random mosaic pattern. Similar prints that were kept in the dark, or displayed under identical circumstances without framing, were unaffected.
2. Other field reports indicated that resin-coated black-and-white prints (not color) showed unnatural fading, orange-red discoloration of the image, and a mirror-like metallic sheen in parts of the silver image. (Cracking often accompanied this black-and-white image discoloration.) This problem also occurred only in framed and displayed prints.

What was going on? Intensive research finally pointed to the culprit: the white pigment titanium dioxide (TiO_2) that was added to the polyethylene resin layer on the face side of the print to make it white and reflective. While the prints were on display, the TiO_2 pigment absorbed light energy and generated a very active form of oxygen that attacked the resin layer and caused the cracking.

Also, the oxidizing agent formed by the irradiated TiO_2 is a very small molecule. It diffused through the resin to the gelatin emulsion, where it could oxidize and fade the metallic silver image of black-and-white prints. The metallic sheen and orange-red discoloration were the result of this oxidant breaking down the silver image particles. The dye image of color papers had more resistance, so fading was insignificant. In unframed prints, the active oxidizing agent could diffuse through the resin and the emulsion to escape into the air. It was only when the oxidizing agent was trapped by a frame that the cracking and fading occurred.

When these problems became common knowledge, they supported the natural skepticism of many photographers. The conviction grew that RC papers were definitely not "archival."

Once the manufacturers understood the problem, they had to decide what to do about the generation of oxidants by TiO_2 embedded in the polyethylene resin. The usual answer was to include antioxidant compounds in the paper support and resin layers of the print.

By the late 1970s, "stabilized" RC supports eliminated the problem. Very sophisticated testing and accelerated aging procedures indicated that decades of normal display wouldn't cause resin cracking or silver-image oxidation in stabilized papers.

One unfortunate side effect of some antioxidants was a tendency to turn yellow themselves, causing a yellowish stain around the borders on both sides of the prints. Manufacturers also corrected this problem by altering the antioxidant additives.

WHAT ABOUT TODAY'S RC PAPERS?

Current Kodak products benefit from this long technical evolution, and are far superior to their predecessors.

The American National Standards Institute (ANSI) has been preparing a new American National Standard on the permanence characteristics of black-and-white photographic papers. This document includes test methods for resin cracking and print yellowing. It will form the basis for consumers to assure themselves that current RC papers are indeed safe from the earlier problems of cracking and fading on display, and yellowing with time.

The best scientific estimates of the comparative life expectancy of RC and fiber-base prints show little practical difference. Both will last for a very long time under reasonable storage and display conditions.

Believing that all RC prints are greatly inferior to fiber-base prints in terms of archival keeping has no technical basis. Specific problems such as resin cracking have been eliminated, and accelerated aging does not reveal any other inferiority.

For true long-term keeping of both RC and fiber-base black-and-white prints, we recommend treatment with a selenium, sulfide, or gold toner. This will protect the silver image from atmospheric contaminants. But today's technology ensures that with proper processing and storage, your RC prints will have a very long life.

TEST-EXPOSURE PRINTS AND STRIPS

Test-exposure prints and strips serve the same function, but are different in size. A test print is a sheet of photographic paper exposed and processed to find out if your exposure and contrast estimates are correct. (Although your first test print may look good enough to be the final print, don't be disappointed if it doesn't.)

A test-exposure strip is a 1- or 2-inch-wide strip of enlarging paper cut from a larger sheet. Because it's more economical to expose test strips than full test prints, we'll focus on test-exposure strips here.

With your negative in the negative carrier of the enlarger, focus the image and adjust the enlarger lens to a "best-guess" aperture. Turn off the enlarger. Open the easel and insert the test strip emulsion side up. Be careful to place the strip so that it records a representative sampling of important image tones in the negative. Close the easel or use masking tape to hold the strip flat, and make a series of test exposures.

Make a 5-second exposure of the entire strip. Then cover one fifth of the strip with an opaque object such as a sheet of heavy cardboard, and expose for 2 seconds. Cover an additional fifth of the strip, and expose for 3 seconds. Cover another fifth, and expose for 4 seconds. Cover another fifth, and expose for 6 seconds. This will provide a series of five exposures ranging over two stops in approximately 1/2-stop increments, as shown:

20 sec	14 sec	10 sec	7 sec	5 sec

Process your test strip, and evaluate it after it dries. If the entire strip is under- or overexposed, open or close the lens aperture two stops and repeat the test.

Judge which portion of the strip has the best overall exposure. If it looks flat or muddy, use paper of a higher contrast grade or use a higher-numbered filter with a variable-contrast paper. If it has a very harsh, contrasty appearance, use a lower contrast grade or lower-numbered filter.

Now that you know the approximate exposure and best contrast, you may want to make one final test strip, with very small differences in exposure time between steps, to determine the very best overall exposure time before making a full print.

KODAK CHEMICALS FOR PROCESSING *KODAK* BLACK-AND-WHITE PAPERS

DEVELOPERS AND ACTIVATORS

For developing the latent image on black-and-white papers. With some papers, developer choice helps to control print tone and contrast.

KODAK DEKTOL Developer. Our standard developer for tray processing—a must for every darkroom. Produces neutral or cold tones with cold-tone papers and warm tones with warm-tone papers. Offers high capacity and uniform development rate. Supplied in powder form.

KODAK EKTAFLO Developer, Type 2. Produces warm tones with warm-tone papers. Supplied as a concentrated liquid that dilutes one part concentrate with nine parts water. Results are similar to those produced by EKTONOL Developer. Designed for tray processing.

KODAK EKTONOL Developer. For tray processing of warm-tone or neutral-tone papers. Supplied in powder form.

KODAK POLYMAX T Developer. Produces neutral or cold tones with cold-tone papers. Supplied as an easy-to-use liquid that dilutes one part concentrate with nine parts water. Results are similar to those produced by DEKTOL Developer, but with the convenience of a liquid. Designed for tray processing.

KODAK SELECTOL-SOFT Developer. Provides softer contrast and increased shadow detail. Designed for tray processing. Supplied in powder form.

KODAK POLYMAX RT Developer and Replenisher. Liquid concentrate for machine processing of black-and-white papers. Compatible with fiber-base and RC papers. No starter required.

KODAK SELECTOMAT Developer Replenisher. For processing of warm-tone papers in automated processors. Supplied as a two-part powder to make 25 gallons. Can also be used in trays.

Use **KODAK Developer Starting Solution** to make a fresh working developer solution from KODAK SELECTOMAT Developer Replenisher.

KODAK ROYALPRINT Activator. For use in the KODAK ROYALPRINT Processor, Model 417, for processing water-resistant, developer-incorporated papers. Supplied as a liquid.

KODAK SII Activator. For processing Kodak stabilization-type papers. Supplied as a liquid.

STOP BATHS

Used to stop development rapidly and uniformly, and to extend the life of the fixer.

KODAK EKTAFLO Stop Bath. A liquid concentrate with built-in color indicator to signal exhaustion. Dilute one part concentrate with 31 parts water. Also for use with film.

KODAK Indicator Stop Bath. Concentrated liquid stop bath that turns purplish blue to signal exhaustion. Dilute one part concentrate with 64 parts water.

KODAK ROYALPRINT Stop Bath. For use in the KODAK ROYALPRINT Processor, Model 417. Supplied as a liquid.

STABILIZER

KODAK EKTAMATIC S30 Stabilizer. For processing KODAK EKTAMATIC SC Paper in stabilization processors.

FIXERS

For removing undeveloped silver halide.

KODAFIX Solution. General-purpose, single-solution, hardening fixer for papers (1:7) and films (1:3). Supplied as a liquid concentrate.

KODAK Fixer. A general-purpose hardening fixer for films and papers. Available in powder form.

KODAK POLYMAX T Fixer. A single-solution, liquid-concentrate, hardening fixer. For use with KODAK POLYMAX T Developer and other developers. Dilute one part concentrate to seven parts water for paper; one part concentrate to three parts water for film.

KODAK Rapid Fixer. A fast-acting hardening fixer for machine or tray processing. Consists of two liquid concentrates: Solution A (the fixer concentrate) and Solution B (the hardener concentrate). Also for use with film.

KODAK POLYMAX RT Fixer and Replenisher. Liquid non-hardening fixer for processing of resin-coated papers in continuous or roller-transport processors.

KODAK ROYALPRINT Fixer and Replenisher. For use with the KODAK ROYALPRINT Processor, Model 417. Supplied as a liquid.

PROCESSING AIDS

KODAK Farmer's Reducer. For general or selective bleaching of black-and-white prints, negatives, and transparencies. Available as a two-part powder. When bleaching prints, use a weaker dilution than for negatives and transparencies. Start with one part Solution A (potassium ferricyanide) to seven parts Solution B (hypo).

KODAK Hypo Clearing Agent. Ideal when water or time is at a premium. Use to facilitate the removal of hypo (fixer) from black-and-white fiber-base papers, films, and plates. Available as a powder.

KODAK Liquid Hardener. For preparing an acid hardening fixing bath. Also for use after toning.

KODAK Chemicals for Processing KODAK Black-and-White Papers

KODAK Chemicals	*KODAK* RESIN-COATED PAPERS				
	POLYCONTRAST II RC	POLYMAX II RC	PANALURE SELECT RC	KODABROME II RC	P-MAX Art RC
Developers–Tray Processing					
DEKTOL	✓	✓	✓	✓	✓
EKTAFLO, Type 2	✓	✓	✓	✓	✓
EKTONOL	✓	✓	✓	✓	✓
POLYMAX T	✓	✓	✓	✓	✓
SELECTOL-SOFT	✓	✓	✓	✓	✓
Developers and Activators–Machine Processing					
POLYMAX RT Developer and Replenisher	✓	✓	✓	✓	✓
ROYALPRINT Activator	✓		✓	✓	✓
Stop Baths					
EKTAFLO	✓	✓	✓	✓	✓
Indicator	✓	✓	✓	✓	✓
ROYALPRINT	✓		✓	✓	✓
Fixers–Tray Processing					
Fixer	✓	✓	✓	✓	✓
KODAFIX Solution	✓	✓	✓	✓	✓
POLYMAX T	✓	✓	✓	✓	✓
Rapid	✓	✓	✓	✓	✓
Fixers and Stabilizers–Machine Processing					
POLYMAX RT Fixer and Replenisher	✓	✓	✓	✓	✓
ROYALPRINT	✓		✓	✓	✓
Washing Aid					
Not necessary for resin-coated papers					

Note: Some developers may be better suited for enhancing paper characteristics. Refer to the individual product descriptions.

KODAK Chemicals	*KODAK* FIBER-BASE Papers						
	POLYMAX Fine-Art	POLYMAX Fiber	EKTAMATIC SC	EKTALURE*	AZO	KODABROMIDE*	ELITE Fine-Art*
Developers–Tray Processing							
DEKTOL	✓	✓	✓	✓	✓	✓	✓
EKTAFLO, Type 2	✓	✓	✓	✓	✓	✓	✓
EKTONOL	✓	✓	✓	✓	✓	✓	✓
POLYMAX T	✓	✓	✓	✓	✓	✓	✓
SELECTOL-SOFT	✓	✓	✓	✓	✓	✓	✓
Developers and Activators–Machine Processing							
POLYMAX RT Developer and Replenisher	✓	✓				✓	
SELECTOMAT	✓		✓	✓		✓	
SII Activator			✓				
Stop Baths							
EKTAFLO	✓	✓	✓	✓	✓	✓	✓
Indicator	✓	✓	✓†	✓	✓	✓	✓
Fixers–Tray Processing							
Fixer	✓	✓	✓†	✓	✓	✓	✓
KODAFIX Solution	✓	✓	✓†	✓	✓	✓	✓
POLYMAX T	✓	✓	✓†	✓	✓	✓	✓
Rapid	✓	✓	✓†	✓	✓	✓	✓
Fixers and Stabilizers–Machine Processing							
POLYMAX RT Fixer and Replenisher	✓	✓	✓†	✓		✓	
EKTAMATIC S30 Stabilizer			✓				
Washing Aid							
Hypo Clearing Agent	✓	✓	✓†	✓	✓	✓	✓

* To be discontinued by year end 1999.
† Not used when an activator is used.

Note: Some developers may be better suited for enhancing paper characteristics. Refer to the individual product descriptions.

TONERS

The color of a toned print depends on the formula and dilution of the toner; the paper type, surface, and stock tint; and the processing. Toners extend the life of prints that may be exposed to oxidizing gases or subjected to adverse storage or display conditions.

KODAK POLY-TONER. Produces hues from reddish-brown to a very warm brown with warm-tone papers, and a purplish-brown tone with some neutral- or cold-tone papers.

KODAK Brown Toner. Produces a variety of brown tones on neutral- and warm-tone papers.

KODAK Sepia Toner. Produces warm brown tones on cold-tone papers or yellowish-brown tones on warm-tone papers. Includes bleach and redeveloper.

KODAK Rapid Selenium Toner. Produces several cold-brown hues with warm-tone papers. Higher dilutions (1:20 and 1:40) provide slightly cooler tones and enhanced maximum density.

Toning Produced with KODAK Papers and Toners

KODAK Paper	KODAK Developer* or Developer and Processor	KODAK POLY-TONER			KODAK Brown Toner	KODAK Sepia Toner	KODAK Rapid Seleium Toner		
		1:4	1:24	1:50			1:3	1:9	1:20
Resin-Coated									
POLYCONTRAST III RC	POLYMAX RT, POLYMAX T, DEKTOL	S	M	M	F	F	S	S	N
	ROYALPRINT, Model 417	N	N	S	M	F	N	N	N
POLYMAX II RC	DEKTOL, POLYMAX RT, POLYMAX T	M	M	M	F	F	S	S	S
PANALURE SELECT RC	POLYMAX RT, POLYMAX T, DEKTOL	S	M	M	M	F	S	S	N
	ROYALPRINT, Model 417	S	S	S	M	F	N	N	N
KODABROME II RC	POLYMAX RT, POLYMAX T, DEKTOL	S	M	M	F	F	N	N	N
	ROYALPRINT, Model 417	N	S	S	M	F	N	N	N
P-MAX Art RC	DEKTOL	S	M	M	F	F	S	S	N
Fiber Base									
POLYMAX Fine-Art	DEKTOL	S	S	S	S	M	N	N	N
POLYMAX Fiber	DEKTOL	S	S	S	S	M	N	N	N
EKTAMATIC SC	DEKTOL	N	S	S	M	F	N	N	N
	EKTAMATIC, Model 214	S	S	S	S	F	N	N	N
EKTALURE†	EKTAFLO, Type 2; DEKTOL; EKTONOL	M	F	F	F	F	M	VS	N
AZO	DEKTOL	M	M	M	F	F	M	S	S
KODABROMIDE†	DEKTOL	N	S	S	S	F	N	N	N
ELITE Fine-Art†	POLYMAX T, DEKTOL	M	M	M	F	F	S	S	VS

* Developer used for tray processing.
† To be discontinued by year end 1999.

N = No tone change, but provides print protection
VS = Very slight tone difference
S = Slight tone change
M = Moderate tone change
F = Full tone change

Note: Follow the instructions supplied with KODAK Toners to produce the tones listed in the table. N, VS, S, M, and F indicate the degree of color change under most conditions. Toning is not as predictable as most other photographic processes; at times, prints may tone more or less easily than the information in the table indicates.

TEST SOLUTIONS FOR PRINT STOP BATHS AND FIXING BATHS

Proper processing is your first step toward assuring that your black-and-white prints will enjoy a long life. Proper processing includes use of a fresh stop bath and fixing bath.

An exhausted stop bath will cause stains on prints, neutralize the acid in the fixer, and reduce the hardening properties of the fixer. An exhausted fixer, or one that contains an excess of dissolved silver halide, won't remove all of the unexposed silver halide from the paper. As a result, prints will fade or turn yellow after a time.

To avoid problems caused by exhausted solutions, you need a simple way of determining the condition of these baths. Some stop baths, such as KODAK Indicator Stop Bath, contain an indicator that changes color when you should replace the solution. However, the appearance of most fixing baths and acid stop baths changes very little during their useful life. By preparing test solutions from the following formulas and using them according to the directions, you can check the acidity of your stop bath and the silver content of your fixing bath quickly and easily.

CAUTION: The Stop Bath Test Solution contains chemicals that can be hazardous.

Sodium hydroxide is caustic and can cause severe burns in all tissues. Take special care to prevent contact with skin or eyes. Use a face shield or goggles when handling the solid compound.

Phosphoric acid is a strong, non-volatile inorganic acid. It is corrosive to tissue and can cause severe skin or eye burns. Wear impervious gloves and goggles when handling the concentrated solution.

In case of contact with either of these chemicals, immediately flush the involved areas with plenty of water; for eyes, get prompt medical attention.

STOP BATH TEST SOLUTION, SBT-1

Preparing the Solution

Use a clean, dry mixing vessel to prepare the solution.

1. Start with 750 mL of distilled or demineralized water at 78°F (26°C).
2. Add 6.0 g of sodium hydroxide.
3. With stirring, add 4.0 g of bromocresol purple.
4. Mix for 15 to 20 minutes. Then add 3.0 mL of phosphoric acid (80 percent).
5. Add water to make 1.0 litre.

Testing the Stop Bath

Fill a clean, dry 50 mL test tube about three-quarters full with the acid stop bath. Add two drops of Stop Bath Test Solution, SBT-1. An acid stop bath that is still useful will remain yellow. If the acid has been neutralized, the bath will turn purple. Discard it and replace it with fresh solution.

Under a safelight equipped with a KODAK OC Safelight Filter (light amber), the yellow color is not noticeable, but the purple color appears dark.

You can also add Stop Bath Test Solution, SBT-1, directly to the tray containing the stop bath. While stirring, add the appropriate volume of test solution according to the table:

Solution	Volume		
Acid Stop Bath	1 L	2 L	3 L
SBT-1	1 mL	2 mL	4 mL

Again, if the liquid darkens under safelight illumination or turns a light purple in room light, the bath is exhausted; discard it. Do not allow prints to remain in the stop bath containing the test solution longer than 2 minutes; slight yellow stains may result.

FIXER TEST SOLUTION, FT-1

Preparing the Solution

Use a clean, dry mixing vessel to prepare the solution.

1. Start with 750 mL of water at 78°F (26°C).
2. Add 190 g of potassium iodide.
3. Add water to make 1.0 litre.

Testing the Fixing Bath Single-Bath Fixer

To 5 drops of Fixer Test Solution, FT-1, add five drops of the fixing bath and five drops of water. If a yellow-white precipitate forms instantly, discard the fixer. Disregard any slight milkiness.

Two-Bath Fixer. Test the baths separately as follows: *First Bath*: Test as described above for a single-bath fixer. *Second Bath*: To five drops of Fixer Test Solution, FT-1, add five drops of the fixing bath and 15 drops of water. If both tests produce a yellow-white precipitate, replace both baths with fresh solution. If only the first bath forms a precipitate, replace the first bath with the second, and replace the second bath with a fresh bath.

STORING THE TEST SOLUTIONS

You can store mixed solutions in tightly stoppered brown glass bottles for one year.

HAND-COLORING PRINTS ON *KODAK P-MAX* ART RC PAPER

Hand-coloring offers a creative option that combines photography and fine art. This technique can give new life to antique black-and-white photographs or add a unique touch to modern portraits, commercial photographs, and fine-art prints.

For best results, use P-MAX Art RC Paper to make prints that you plan to hand-color. The heavy weight, double-matt surface, neutral-black to warm-black image tone, and excellent "tooth" of this paper make it an ideal choice for hand-coloring.

BEFORE YOU BEGIN

- Work with prints that are at least 15 percent lighter than normal.
- Natural-looking skin tones are easier to reproduce if prints are toned with KODAK Sepia Toner (CAT 169 1757) or KODAK Brown Toner (CAT 146 4452).
- Color lighter tones first (e.g., fair skin) as a guide for darker tones.

MATERIALS YOU'LL NEED

- Color media
- White non-porous palette with wells for holding liquid dyes
- Applicators—sable brushes, cotton swabs, loose natural cotton, toothpicks, wooden skewers, paper towels
- Removers—kneaded rubber eraser, 5-percent clear, pure household ammonia
- Spray lacquer
- Steam source (for setting dry dyes)

USING TRANSPARENT OILS

Transparent oils such as Marshall's Photo Oils can help you achieve a broad range of results. They are easy to apply and remove, allow print details to show through, and are made specifically for use on photographs. Follow this procedure:

1. Wipe the print with a cotton tuft moistened with Marshall's P.M. Solution (or equivalent). Then dry it with a clean cotton tuft.
2. Apply small amounts of color with a cotton tuft or swab, using a circular motion. Rub the color to a thin, even layer with clean cotton.
3. Remove stray color with Marshall's P.M. Solution or a kneaded rubber eraser.
4. Clean out highlights with a dry cotton swab to give colored areas more definition. Buff highlight edges with cotton.
5. When the print is completely dry, spray several light, even coats of lacquer over the finished print.

USING LIQUID RETOUCHING DYES

Liquid retouching dyes, such as the KODAK Liquid Retouching Color Set (CAT 190 1743), are useful for creating brilliant hues in small areas or subtler effects in large areas.

For small areas, apply the dye with controlled brush strokes or a stippling action. Use distilled water to pre-moisten large areas that you plan to color. Then dilute the dyes with distilled water, and use a "wash" or watercolor technique.

You can remove liquid dye by wiping it with 5-percent clear ammonia, followed by distilled water.

USING DRY DYES

Dry dyes, such as KODAK Retouching Colors (CAT 189 0888), are well suited for coloring large areas and achieving subtle pastel tones. Follow these steps:

1. Dry the print thoroughly with a hair dryer to remove residual moisture.
2. Soften the dye cake by breathing on it. *Do not use water to soften the cake.*
3. Pick up the dye from the cake and apply it with a cotton tuft, working in a circular motion, and covering the area completely.
4. Buff the colored area with clean cotton until the color is smooth and even.
5. For more definition, remove color from the highlights by using cotton and Remover for KODAK Retouching Colors (CAT 194 6730).
6. Buff to blend the edges.
7. To set the color, hold the print 6 to 8 inches from a steam source for about 10 seconds.
8. Remove unwanted dye before steaming with remover. After steaming, you can remove color with a 5-percent clear ammonia solution.

OTHER COLORING OPTIONS

Many color media are available, each with different levels of color-fastness and ease of use. The following are just a few suggestions:

- pastels for soft-looking, large-area applications
- opaque oils and acrylics for a brush-painted look
- pencils for small details
- felt-tipped markers for selective bold colors
- oil stick for the combined qualities of opaque oils and pastels
- airbrush for even color with good control
- watercolors for delicate, luminous color
- food dyes and natural plant dyes for effective, inexpensive color
- artist's inks for a wide range of strong colors

MORE INFORMATION

Kodak has many publications to assist you with information on Kodak products, equipment, and materials.

Additional information is available on the Kodak website and through the U.S.A./Canada faxback system.

The following publications are available from Kodak Customer Service or dealers who sell Kodak products, or you can contact Kodak in your country for more information.

Black-and-White Films

E103BF	*KODAK PROFESSIONAL Black-and-White Films Matrix*
F-7	*KODAK VERICHROME Pan Film*
F-8	*KODAK PLUS-X Pan and KODAK PLUS-X Pan Professional Films*
F-9	*KODAK TRI-X Pan and KODAK TRI-X Pan Professional Films*
F-10	*KODAK EKTAPAN Film*
F-11	*KODAK PROFESSIONAL B/W Duplicating Film SO-132*
F-12	*KODAK EKTAGRAPHIC HC Slide Film*
F-13	*KODAK High Speed Infrared Film*
F-16	*KODAK Commercial Film*
F-17	*KODAK Professional Copy Film*
F-32	*KODAK T-MAX Professional Films*
G-72	*KODAK PRECISION LINE Film*
P-255	*KODAK Technical Pan Films*

Black-and-White Papers

E103BP	*KODAK PROFESSIONAL Black-and-White Papers Matrix*
G-7	*KODAK POLYMAX Fiber Paper*
G-8	*KODABROMIDE Paper*
G-9	*KODAK EKTALURE Paper*
G-10	*KODAK AZO Paper*
G-16	*KODABROME II RC Paper*
G-19	*KODAK ELITE Fine-Art Paper*
G-21	*KODAK POLYCONTRAST III RC Paper*
G-22	*KODAK EKTAMAX RA Professional Papers*
G-23	*Toning KODAK Black-and-White Materials*
G-24	*KODAK POLYMAX Fine-Art Paper*
G-26	*KODAK POLYMAX II RC Paper*
G-27	*KODAK PANALURE SELECT RC Paper*
G-28	*KODAK P-MAX Art RC Paper*

Chemicals for Processing Black-and-White Films and Papers

E103CF	*Chemicals for KODAK PROFESSIONAL Black-and-White Films*
E103CP	*Chemicals for KODAK PROFESSIONAL Black-and-White Papers*
J-5	*KODAK POLYMAX T Developer and KODAK POLYMAX T Fixer*
J-24	*KODAK HC-110 Developer*
J-78	*KODAK Developer D-76*
J-85	*KODAK POLYMAX RT Chemicals*
J-86	*KODAK T-MAX Developers*
J-87	*KODAK T-MAX 100 Direct Positive Film Developing Outfit*
J-109	*KODAK XTOL Developer*

Reference and Techniques

E-30	*Storage and Care of KODAK Photographic Materials—Before and After Processing*
F-2	*Pathways to Black and White*
F-3	*Code Notches for KODAK Sheet Films*
J-2A	*Health, Safety, and Environmental Emergency Card*
J-4	*Safe Handling of Photographic Chemicals*
J-4S	*The Prevention of Contact Dermatitis in Photographic Work*
K-4	*How Safe Is Your Safelight?*
L-9	*KODAK Professional Photographic Catalog*

Process Monitoring

Z-133E	*Monitoring and Troubleshooting KODAK Black-and White Film Processes*

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Note: The Kodak materials described in this publication are available from dealers who supply KODAK PROFESSIONAL Products. You can use other materials, but you may not obtain similar results.

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