

# How to Process and Print Black-and-White Film



Processing and printing your own films can be rewarding and fun. With a little practice, you'll find it's easy, too.

To process your film, you'll need the following equipment:

- Lighttight film-processing tank that accepts the size of film you plan to process
- Darkroom graduate or a 16-oz (473 mL) measuring cup
- Darkroom thermometer
- Several quart jars or bottles (glass, stainless steel, or plastic) for processing solutions
- Stirring paddle to mix solutions
- Soft viscose sponge
- Darkroom timer or a clock with a sweep-second hand
- Scissors
- Bottle or magazine opener if you are processing film in size 135 magazines
- Protective gloves to prevent skin contact with chemicals
- Spring-type clothespins for hanging processed film to dry

To make prints, you'll need this equipment:

- Safelight, such as a KODAK Darkroom Lamp with a KODAK OC Safelight Filter (light amber)
- Printing frame or enlarger
- 8 x 10-inch piece of heavy cardboard
- Four photographic processing trays a little larger than the largest prints you plan to make (or shallow pans or dishes made of glass, plastic, china, or stainless steel)
- Print squeegee or soft viscose sponge

To make prints the same size as your negatives, you need a printing frame or an enlarger and a piece of glass to hold the light-sensitive photographic paper in contact with your negatives during exposure. If you want to make enlargements, you need an enlarger with a negative holder that's the right size for your negatives. You also need an easel to hold the paper in position below the enlarger lens.

Your photo dealer will be glad to help you select your equipment, including darkroom kits of basic items. Some of this equipment is listed under "KODAK DARKROOM AIDS."

## WHERE TO WORK

Because photographic films and papers are sensitive to light, you must handle them in a darkroom. To process film, you'll need a darkroom only while you're loading the film into a lighttight film-developing tank. But during this time, the room must be *totally* dark.

If you convert a room or a closet into a temporary darkroom for loading film into the tank, check it by staying in the room or closet for about 5 minutes with the lights out. If you can't see a sheet of white paper placed against a dark background, your darkroom passes inspection. You can make areas around doors and windows lighttight by putting heavy cloth or black tape over the cracks.

For printing and enlarging, you do not need total darkness. Just be sure that the only light in the room is supplied by a suitable safelight lamp with an OC Safelight Filter, and keep the photographic paper at least 4 feet from the lamp.

Kitchens and bathrooms nearly always make the best places for temporary printing darkrooms because they provide three major essentials: running water, electrical outlets, and a good work surface. Use a sheet of plastic or a plastic tablecloth under the processing trays to protect the countertop from spills.

If possible, try to separate your darkroom into a wet area and a dry area. Use the dry area for enlarging and printing and for handling films, negatives, and photographic paper. Use the wet area for mixing chemicals and for all processing operations. Be sure to have a container of water for rinsing your hands to prevent contamination of your developer with other solutions. Use a clean towel to dry your hands thoroughly before handling films, negatives, and paper.

**Note:** For your safety, handle photographic chemicals and processing solutions with care, and keep them out of the reach of children. Some processing solutions can be stored and reused. Be sure to store them in a safe place. For safe-handling information for particular Kodak chemicals, see the product label or the Material Safety Data Sheet (MSDS). To obtain MSDSs, go to [www.kodak.com/go/MSDS](http://www.kodak.com/go/MSDS).

## PROCESSING YOUR FILM

To process black-and-white film, you'll need the following solutions:

- Film developer
- Stop bath or water
- Fixer
- KODAK Hypo Clearing Agent (optional)
- KODAK PHOTO-FLO 200 Solution (optional)

Kodak offers a number of black-and-white film developers as liquid concentrates or powders. For a list of developers, see "Chemicals." KODAK XTOL Developer is an excellent choice for all-around film developing. It is supplied as an easy-to-mix powder that you can mix and use at room temperature.

You'll need to use a stop bath (or water), such as KODAK Indicator Stop Bath or KODAK EKTAFLO Stop Bath, after the developer.

You can choose from several fixers supplied as liquids or powders, which you can also use when you process your prints (see "CHEMICALS"). If you plan to process KODAK T-MAX Professional Films, we recommend using KODAK Rapid Fixer.

Label three of the glass, plastic, or stainless-steel bottles "Film Developer," "Stop Bath," and "Fixer." Mix the three solutions according to the instructions packaged with the chemicals. The instructions give important information about proper mixing and handling, as well as the recommended development times, temperatures, and capacities.

You can also use KODAK Hypo Clearing Agent to shorten washing times, and KODAK PHOTO-FLO 200 Solution after washing to minimize water marks and streaks on film as it dries.

## Before Processing

Mix all solutions before loading your film into the film tank. The solutions should be at a temperature of 65 to 75°F (18 to 24°C) when you use them. You can cool or warm the solutions quickly by setting the bottles of solution in a pan of cold or warm water.

It's easy to become disoriented in the dark, so be sure you know how to load your film tank before turning out the

lights. (If necessary, practice with a roll of waste film with the lights on and then in total darkness until you can load the tank with confidence.)

Line up the equipment you will need so that you'll be able to locate each item quickly when the room is dark: film-processing tank, tank cover, film apron or reel, exposed film, scissors, and a bottle opener or 135 magazine opener if you are processing size 135 film.

Before you turn off the lights, pour the developer solution into the tank. Then turn off both the room lights and the safelights.

IN TOTAL DARKNESS, open your film as follows:

- *135 Film in Magazines:* Hold the magazine with the long spindle end down. Use a hook-type bottle opener to pry off the upper end cap. Rap the long end of the magazine sharply on a hard surface to release the film if it doesn't come out easily. Be careful of any sharp edges. (Leave the film attached to the spool until after you have loaded your tank apron or reel. Then cut the film off the spool with your scissors.)
- *Roll Film:* Tear off the "EXPOSED" sticker. Separate the backing paper from the film, and cut free the end that is attached to the paper.

Handling the film by the edges, load it onto the reel according to the instructions for your tank. Then follow the processing steps in the table below:

Processing Step	Time	Agitation and Notes
<b>1. Developer</b>	Use the development time for your film/developer/temperature combination given in the film or developer instructions.	Smoothly lower the loaded film reel into the developer solution in the tank, and attach the top to the tank. Turn on the lights. Firmly tap the tank on the top of the work surface to dislodge air bubbles. Provide initial agitation for 5 seconds, and then repeat the 5-second agitation at 30-second intervals for the remainder of the development time. (See the table below for agitation techniques for different types of tanks.) Drain the tank.
<b>2. Stop Bath</b>	30 seconds	Pour in the stop bath, and agitate continuously. Drain the tank.
<b>3. Fixer</b>	2 to 4* minutes with a liquid-concentrate fixer OR 5 to 10* minutes with a powder fixer	Pour in the fixer. Agitate continuously for the first 30 seconds, and then at 30-second intervals. Drain the tank.  <b>IMPORTANT:</b> With KODAK T-MAX Professional Films, fixer will be exhausted more rapidly than with other films. Fix for 3 to 5 minutes in KODAK Rapid Fixer or 5 to 10 minutes in KODAK Fixer, KODAFIX Solution, or POLYMAX T Fixer. If negatives show a pink stain after fixing, the fixer may be near exhaustion or the fixing time was too short.
<b>4. Rinse</b>	30 seconds	Rinse the film in the tank under running water.
<b>5. Hypo Clearing Agent</b>	1 to 2 minutes	Agitate continuously for the first 30 seconds and then at 30-second intervals.
<b>6. Water Wash</b>	5 minutes after Hypo Clearing Agent OR 20 to 30 minutes without Hypo Clearing Agent step	Remove the top from the tank. Run the wash water at least fast enough to provide a complete change of water in the tank in 5 minutes. For rapid washing in a small tank, fill the tank to overflowing with fresh water and then dump it all out. Repeat this cycle 10 times.
<b>7. Wetting Agent</b>	30 seconds	Provide gentle agitation for 5 seconds of the total time. To reduce drying scum, mix KODAK PHOTO-FLO Solution with distilled water in areas that have hard water.
<b>8. Dry</b>	As necessary	Remove the film from the reel, and hang it up to dry in a clean, dust-free place.

\* Times are approximate. See the film or developer instructions.

Agitation is very important for even development of the film. Follow the procedure below for the type of tank you are using:

Small-Tank Agitation Procedures		
Type of Agitation	Type of Tank	
	Invertible	Non-Invertible
Initial Agitation	Tap tank on work surface to dislodge air bubbles. Provide 5 to 7 inversion cycles in 5 seconds, i.e., extend your arm and twist your wrist 180°.	Tap tank on work surface to dislodge air bubbles. Rotate film reel 4 or 5 times during first 5 to 10 seconds.
Subsequent Agitation	At 30-second intervals, repeat 5 to 7 inversion cycles in 5 seconds.	At 30-second intervals, rotate film reel 4 or 5 times.

After processing, thoroughly wash and dry all equipment that came into contact with chemical solutions. When the film is thoroughly dry, cut it into shorter strips of negatives to make proof sheets.

Always store your negatives in sleeves or envelopes away from dust and extreme temperature and humidity.

## MAKING PRINTS

Kodak black-and-white photographic papers are available in a wide variety of sizes, speeds, contrasts, surface textures, image tones, stock tints, and weights.

To start, we suggest that you use KODAK POLYCONTRAST III RC Paper for both your contact prints and your enlargements. The resin coating on this paper permits short processing and drying times. When you expose it with KODAK POLYMAX Filters, you can produce different degrees of contrast in the prints you make from one package of paper.

When you become more proficient in printing and enlarging, you may want to try other papers. See “More Information” for publications on Kodak papers.

### Making a Proof Sheet

Proof sheets are photographic prints that include many images from strips of negatives. The print images are the same size as your negatives. They can help you choose the best negatives for enlarging, and they also make a good record of your prints to file with your negatives.

To make a proof sheet, you’ll need your strips of negatives and a printing frame with a 7-watt light bulb or an enlarger and a piece of glass.

You can make a printing frame by using a piece of window glass or clear Plexiglas and a piece of composition board. Both pieces should be the same size. Put one piece on top of the other and use wide adhesive tape to make a hinge connecting the two pieces. (If you use glass, it’s a good idea to tape the remaining edges so that you won’t cut yourself.)

Before exposing your proof sheet, prepare your paper-processing solutions. You’ll need the following chemicals:

- Paper developer
- Stop bath
- Fixer

Kodak has a variety of black-and-white paper developers to choose from. Some are designed to enhance paper characteristics, such as a warm image tone. A good all-around developer to start with is KODAK DEKTOL Developer, diluted 1:2 (1 part stock solution to 2 parts water).

You can use the same type of stop bath and fixer that you used to process your film, but be sure you mix it properly. Most fixers require a 1:3 dilution for use with film and a 1:7 dilution for paper. (See the fixer instructions.)

Mix the developer, stop bath, and fixer according to the instructions packaged with the chemicals, and store the solutions in labeled bottles.

When you are ready to make your proof sheets, arrange four trays on the work surface in your darkroom. Label them “Developer,” “Stop Bath,” “Fixer,” and “Wash.”

Working from left to right, pour the developer in the first tray, stop bath into the second tray, and fixer into the third tray. Fill these trays to a depth of about one-half inch of solution. Fill the fourth tray with water. Adjust the solutions to 65 to 70°F (18 to 21°C) by placing a small, deep bowl of either warm or cool water into the tray of solution. Be careful not to spill any water into the solutions.

Be sure your hands are clean and dry before handling your negatives and paper. Now you are ready to expose your proof sheet. Follow these steps:

1. Turn out all lights except the recommended safelight (see the label on the package for the recommended safelight illumination). The safelight should be at least 4 feet from the paper. Remove one sheet of paper from the package, and rewrap the remaining paper to protect it from the printing light.
2. Place your strips of negatives so that their emulsion side faces the emulsion side of the paper. Cover the paper and negatives with the glass. The negatives should face the light source.
3. Make the exposure:

*If you’re using a printing frame and a 7-watt bulb, hang the bare bulb 2 feet above the frame and turn it on for about 10 seconds. A 10-second exposure should be right, but you may have to experiment to get the correct exposure. If the processed print appears too light, make another proof sheet with double the exposure time; if it’s too dark, use half the time.*

*If you’re using an enlarger light source to make your proof sheet, place the empty negative carrier in the enlarger, and set the lens at f/11. Adjust the enlarger height so that the light covers an area just larger than the size of your paper. Expose for about 8 seconds. Again, you may have to experiment to get the correct time.*

## Processing Your Proof Sheet

1. Take the exposed paper from the printing frame or enlarger easel and slide it completely into the developer, emulsion side down. Then turn the paper over, and agitate by rocking the tray gently throughout the development time (1 minute for POLYCONTRAST III RC Paper in DEKTOL Developer). Tip up first one side, then the adjacent side.
2. Take the paper out of the developer and let it drain for 5 seconds. Then immerse it in the stop-bath solution for at least 10 seconds, agitating thoroughly as in Step 1.
3. Remove the paper from the stop bath, drain it for 2 seconds, and slip it into the fixer. Agitate frequently for 2 minutes. You can turn on the room lights after about 30 seconds. (If you have more than one print in the tray, keep them separated.) Do not overfix.
4. Transfer your print to the wash tray. Wash for 4 minutes in gently running water at a temperature between 50 and 85°F (10 and 30°C). Avoid overwashing.
5. Use a soft viscose sponge or a soft rubber squeegee to remove excess water from the print surfaces. Dry the print on a flat surface at room temperature with good air circulation. You can speed drying by blowing warm air from a portable hair dryer onto the print. Make sure that the temperature of the air is below 190°F (88°C).

## ENLARGING

Your proof sheet should serve as a good guide for selecting the negatives you want to enlarge. Study the images to find the ones with the best composition and exposure level (neither too dark nor too light). When you've selected a negative you want to enlarge, it's a good idea to make a test strip or print to determine the exposure you need to make a good enlargement. (After you've gained some experience, you won't need to make a test strip or print for every negative you print.)

### Making Test Exposure Strips and Prints

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 strips here.

1. Hold the negative gently by the edges and remove dust with a camel's-hair brush or by blowing compressed air across the surfaces. Small cans of compressed air appropriate for photographic uses are available from photo dealers. Place the negative in the correct negative carrier, emulsion side *down*. Slide a sheet of smooth white photo paper or a scrap sheet of photo paper under the guides of the easel to serve as a focusing aid.

2. Turn on the enlarger light and set the enlarger lens at its widest opening (the lowest *f*-number on the lens mount). Then raise or lower the enlarger head and adjust the easel guides to get the size and picture composition you want. For best viewing of the image on the easel, work with the safelight on and the room lights off.
3. Adjust the focus control on the enlarger lens to bring your picture into the sharpest focus possible. Then change the lens opening to *f*/8 and **turn off the enlarger light**.
4. Working only by safelight, open the easel and insert the paper test strip emulsion side up. Be careful to place the strip so that it records a good sampling of important image tones in the negative. Close the easel or use masking tape to hold the strip flat.
5. Make a 5-second exposure of the entire strip. Then cover one fifth of the strip with the 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. **Then turn off the enlarger light**. This will provide a series of five exposures ranging over 2 stops about 1/2 stop apart, as shown:

20 sec	14 sec	10 sec	7 sec	5 sec
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6. With only the safelight on, process the strip as described earlier under "Processing Your Proof Sheet." Then examine it under room lights to determine which portion of the strip has the best exposure. Note the exposure time for the portion you select. The 5-second exposure will be the lightest. If all the steps are too light, open up the lens (lower *f*-number) or increase the exposure time. If all the steps are too dark, close down the lens or decrease the exposure time.

If the strip looks flat or muddy, use a higher-numbered POLYMAX Filter in the enlarger to increase the contrast. If it has a very harsh, contrasty appearance, use a 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.

When you're satisfied with your exposure test, place a sheet of paper, emulsion side up, under the masking guides on the enlarger easel. Turn on the enlarger and expose for the time determined by your tests. Turn off the enlarger. Remove the sheet of paper, process it, and dry it.

**Safe Disposal of Used Chemicals.** Be sure to dispose of chemicals properly. To a large extent, exactly how you do that will depend on what the chemicals are, the volume of the solutions you discard, and whether you are discharging them into a sewer or into a septic system. Generally, you can pour small amounts of used photographic solutions down the drain without ill effect. Discard the solutions one at a time (to

avoid unwanted chemical reactions). Rinse the sink thoroughly and flush the drain with plenty of clean water after dumping each solution. Because the discharge or disposal of spent photographic solutions may be subject to local, state, or federal laws, contact the appropriate authorities to determine the requirements that apply to your area.

## CHEMICALS

You can purchase the following Kodak chemicals from dealers who sell Kodak Professional products.

### Film Developers

**KODAK XTOL Developer.** Provides excellent image quality with fine grain and high sharpness in both normally processed and push-processed films. It's supplied as a powder for easy, room-temperature mixing.

**KODAK T-MAX Developer.** Produces excellent image quality and improved tone reproduction (increased shadow detail) in both normally processed and push-processed films. It's supplied as a liquid concentrate.

**KODAK Developer D-76.** A general-purpose developer that produces moderately fine grain, full emulsion speed, and maximum shadow detail. It comes in powder form.

**KODAK HC-110 Developer.** A highly active developer supplied in liquid-concentrate form. It produces negatives of similar quality to those obtained with Developer D-76, but requires shorter development times.

**KODAK MICRODOL-X Developer.** An excellent fine-grain developer designed to produce low graininess and high sharpness of image detail. It's particularly good for developing small negatives from which you want to make big enlargements. MICRODOL-X Developer is available in both powder and liquid forms.

### Stop Baths

After development, you'll need a stop bath for rinsing your film and prints. You can use **KODAK Indicator Stop Bath (1:63)** or **KODAK EKTAFLO Stop Bath (1:31)**. Both are available as liquid concentrates, and both have built-in indicators to signal when the chemicals are exhausted and should be discarded.

### Fixing Baths

**KODAK Rapid Fixer.** An easy-to-use liquid concentrate for very rapid fixing of films and normal fixing of prints. It consists of two concentrates that you add to water to prepare the fixing bath. Dilute 1:3 for film and 1:7 for paper.

**KODAFIX Solution.** A general-purpose liquid-concentrate, single-solution fixer for both films and papers. Just mix with water for immediate use. Dilute 1:3 for film and 1:7 for paper.

**KODAK Fixer.** Recommended for general use with films and papers. It comes in powder form. Just mix with water for immediate use.

**KODAK POLYMAX T Fixer.** Single-solution hardening fixer for films and papers. Designed for use with KODAK POLYMAX T Developer. Dilute 1:3 for film and 1:7 for paper.

### Paper Developers

**KODAK DEKTOL Developer.** For neutral and cold-toned images on papers such as KODAK POLYCONTRAST III RC, POLYMAX II RC, KODABROME II RC, and KODAK POLYMAX Fine-Art Papers. It's supplied in powder form. Dilute 1:2 for use.

**KODAK POLYMAX T Developer.** For neutral or cold-toned images on papers such as POLYCONTRAST III RC, POLYMAX II RC, KODABROME II RC, and POLYMAX Fine-Art Papers. It's supplied as a liquid concentrate. Dilute 1:9 for use.

### Other Chemicals

**KODAK Hypo Clearing Agent.** Shortens washing times and makes possible more thorough washing of films and prints. It reduces the wash time to 5 minutes for films, 10 minutes for single-weight papers, and 20 minutes for double-weight papers. This water-saving chemical is *not* recommended for water-resistant, resin-coated (RC) papers, which already have a short wash time (4 minutes). Dilute 1:4 for use.

**KODAK PHOTO-FLO 200 Solution.** A liquid concentrate that minimizes water marks and drying streaks on film, and speeds drying. Dilute 1 part concentrate to 200 parts water for use.

**KODAK Toners.** For altering the image tone of black-and-white prints and prolonging print life. Several Kodak toners are available for producing various tones, depending on the toner/paper combination and the dilution of the toner.

### KODAK DARKROOM AIDS

**KODAK Darkroom Lamp.** For use in a wall socket or a drop-cord socket. Sturdy metal. Accepts circular 5½-inch safelight filters (not included).

**KODAK 2-Way Safelight.** For use in either a wall socket or a ceiling socket. Swivels to provide direct or indirect illumination. Holds a 3¼ x 4¾-inch safelight filter (not included).

**KODAK Safelight Filters.** Supplied in a variety of sizes and colors for use with papers and certain films.

# How to Process and Print Black-and-White Film

## 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 dealers who sell Kodak products, or you can contact Kodak in your country for more information.

F-2	<i>Pathways to Black and White</i>
F-32	<i>KODAK T-MAX Professional Films</i>
G-10	<i>KODAK AZO Paper</i>
G-16	<i>KODABROME II RC Paper</i>
G-21	<i>KODAK POLYCONTRAST III RC Paper</i>
G-23	<i>Toning KODAK Black-and-White Materials</i>
G-24	<i>KODAK POLYMAX Fine-Art Paper</i>
G-26	<i>KODAK POLYMAX II RC Paper</i>
G-27	<i>KODAK PANALURE SELECT RC Paper</i>
G-28	<i>KODAK P-MAX Art RC Paper</i>
J-24	<i>KODAK HC-110 Developer</i>
J-78	<i>KODAK Developer D-76</i>
J-86	<i>KODAK T-MAX Developers</i>
J-87	<i>KODAK T-MAX 100 Direct Positive Film Developing Outfit</i>
J-109	<i>KODAK XTOL Developer</i>
K-4	<i>How Safe Is Your Safelight?</i>

The following books are available from photo-specialty dealers who sell Kodak products:

F-5	<i>KODAK Professional Black-and-White Films</i>
R-20	<i>KODAK Black-and-White Darkroom DATAGUIDE</i>

For the latest version of technical support publications for KODAK PROFESSIONAL Products, visit Kodak on-line at:  
<http://www.kodak.com/go/professional>

Many technical support publications for KODAK PROFESSIONAL Products can be sent to your fax machine from the Kodak Information Center. Call:  
U.S. 1-800-242-2424, Ext. 33 / Canada 1-800-295-5531  
—Available 24 hours a day, 7 days a week—

If you have questions about KODAK PROFESSIONAL Products, call Kodak.

In the U.S.A.:

1-800-242-2424, Ext. 19, Monday–Friday  
9 a.m.–7 p.m. (Eastern time)

In Canada:

1-800-465-6325, Monday–Friday  
8 a.m.–5 p.m. (Eastern time)

**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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**Kodak Professional**