Darkroom Techniques

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contents

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WHY A DARKROOM?

Doing your own developing and printing permits an additional creative control in photography. In the photo darkroom, you can change the final effect of the picture— either to correct for errors made in the camera or to make the picture match the effect you originally had in mind.

For camera repair, you don't need a fully equipped darkroom. But you'll want a means of quickly developing B&W film. You may need a photographic test on a questionable camera— perhaps a camera with a hard-to-detect malfunction such as a light leak. Having to rely on a processor for photo tests increases the time delay and the cost.

You should probably use B&W to learn darkroom techniques. Equipping a darkroom for color adds a lot of expense— both in the equipment you'll need and in the materials. Also, it's difficult for a home-darkroom enthusiast to maintain the same color quality that a fully equipped color lab can get. Yet in B&W, with a fairly modest investment, you can get quality that rivals or surpasses even custom-lab work.

HIGHLIGHTS, HALFTONES, AND SHADOWS

You've seen that the B&W negative interprets brightness values as varying shades of gray. The brightness values in the scene determine the density of silver deposits in each area of the negative. Areas of the negative that receive the most light during exposure have the most dense deposits, Fig. 1. Those areas that received little light have thin deposits.

The areas with heavy silver deposits represent the highlights. And the thin areas of the negative represent the shadows. In between the highlights and the shadows, the negative may have a wide range of densities — the halftones.

When you print the negative, you pass light through the silver deposits, Fig. 1. The heavy highlight areas in the negative allow little light to reach the printing paper. Thin shadow areas allow more light to pass.

The printing paper, like the negative, has a silver emulsion. Areas on the paper that receive large amounts of light then record as dark grays or blacks — the shadow areas. When you develop the paper, these areas have heavy silver deposits. Areas that receive little light record as light grays or white— the highlights.

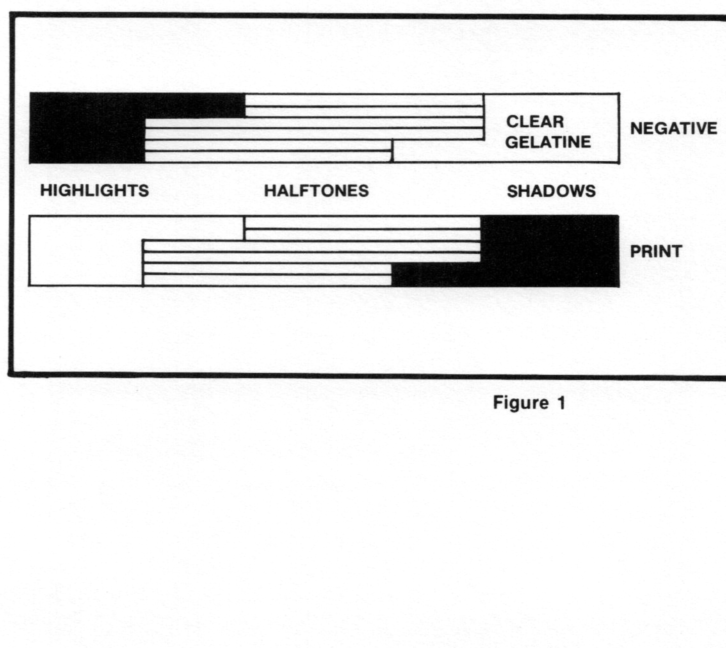


Figure 1

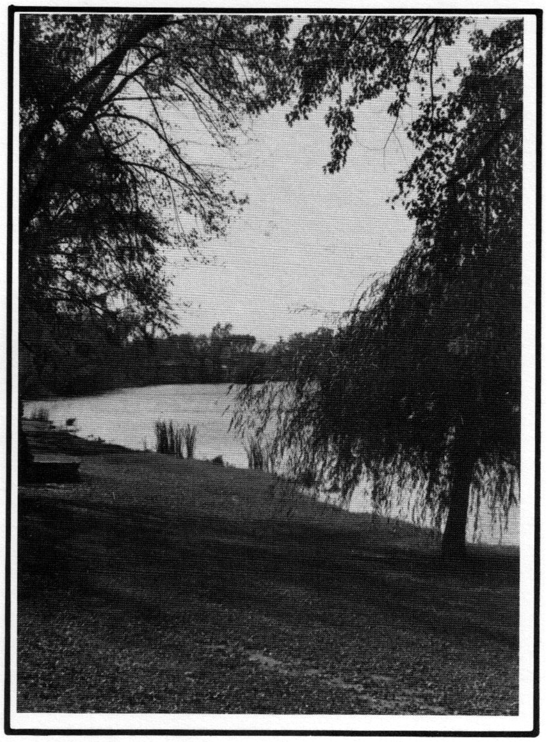


Figure 2

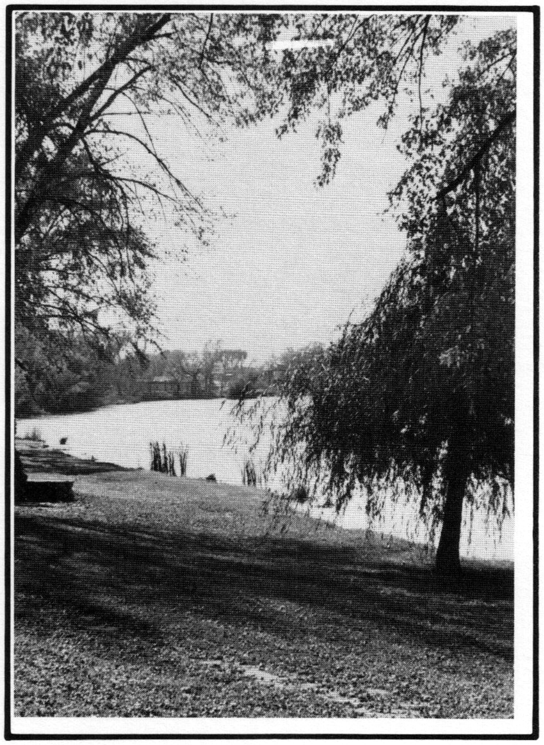


Figure 3

DENSITY AND CONTRAST

You'll learn to analyze negatives in order to select the proper printing paper and exposure time. Two of the characteristics you'll be concerned with are **density** and **contrast**. Many people confuse the two terms. Yet density and contrast have little to do with one another.

Density refers to the build-up of silver deposits. A dense (or "heavy") negative has heavy build-ups of silver — little light can pass through the negative. A "thin" negative has thin silver deposits which allow more light to pass.

The exposure in the camera provides your control of density— the longer the exposure, the heavier the negative. But a heavy negative isn't necessarily a contrasty negative. Nor does a thin negative necessarily lack contrast.

Contrast refers to the **difference in density** between highlights and shadows. The greater the density difference, the higher the contrast. If there's little difference in density between the highlights and shadows, you have a "flat" negative — a negative that lacks contrast.

Suppose, then, that you have a very dense negative. If both the highlight areas and the shadow areas have heavy silver deposits — close to the same density — the negative is flat. Similarly, an overall thin negative can be contrasty if there's a significant density difference between highlights and shadows.

The development time provides the main control over contrast. Development continues to build up highlight areas after the shadow areas have reached their maximum density. Increasing the development time then increases contrast.

You also have a printing control for contrast. Printing papers come in different grades of contrast. A soft paper has low contrast; a hard paper has high contrast. So, if your negative lacks contrast, you can print it on a hard paper. And, if your negative has too much contrast, you can print it on a soft paper.

Fig. 2 and Fig. 3 compare the effect of paper grade on contrast. With the soft paper, Fig. 2, the print appears flat — an overall "muddy" effect. Using a harder paper, Fig. 3, makes the print appear more crisp. But there's a loss of detail in the shadow and highlight areas.

You can then select a paper grade to compensate for imperfect negatives. Yet you get the best results when you're printing from a proper negative. Juggling paper grades offers only a compromise to top quality.

How can you determine the proper amount of contrast and density in a negative? Opinions differ as to how dense or contrasty a negative should be. Some photographers prefer a crisp, contrasty negative. A contrasty negative gives the appearance of greater sharpness. Other photographers prefer a slightly flat negative for a broader tonal range.

Opinions also differ as to the proper density. However, you can apply some general tests to evaluate your negatives. First, the highlights should not be "blocked up" — light should pass through even the most dense areas. On the print, the highlights should be light shades of gray rather than solid whites. One exception — actual light sources in the scene may appear solid black in the negative and solid white in the print.

Also, there should be some detail in the shadow areas — no completely transparent areas in the negative. Even the dark shadows should have some silver deposits. On the print, the shadow areas should appear dark gray rather than solid black.

One density test you can use is to place the negative on a printed page — perhaps a newspaper. You should be able to read the print on the page through the highlight areas. If you can't read the print, the highlights are "blocked up" — so dense that they won't show detail.

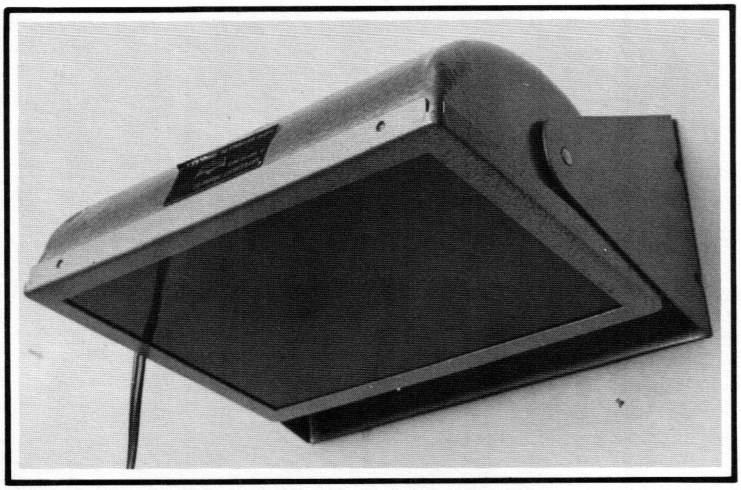


Figure 4 A safelight equipped with a light-amber filter is safe for most B&W papers.

THE DARKROOM

You must develop the film in total darkness. Printing, though, requires only a semidark area. Most B&W papers are insensitive to certain colors of light. You can then use a light of a safe color — a **safelight** — to see what you're doing, Fig. 4.

For most B&W papers, use the OC (light amber) safelight filter. Suspend one safelight above the area where you'll be processing the prints. You might want a second safelight over the area where you'll be exposing the printing paper. However, if the safelight is too close to the paper — or if you expose the paper to the safelight for a long period of time — even the OC filter won't provide complete protection.

Some fog may then result. You may not be able to detect the fog by looking at the print. But excessive safelight exposure may add density to the highlight areas, causing a reduction of brilliance. Keep the safelight around three feet away from the paper.

Ideally, you should have running water available inside your darkroom. You must wash the film and the paper between chemical treatments. You can get by without running water. But a faucet and sink make the process a lot easier.

The color of your darkroom walls makes no difference. After all, you'll be working in the dark or under a safelight. You can thus turn almost any room into a darkroom. How can you be sure your darkroom is dark enough? Try sitting in the darkroom for five minutes with the lights off. Keep a piece of white paper in front of you. If, after five minutes, you still can't see the white paper, your darkroom passes inspection.

DEVELOPING B&W FILM

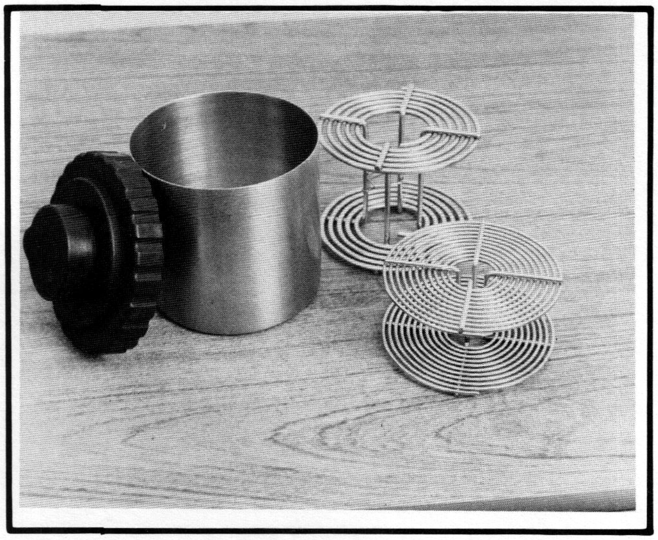


Figure 5 A stainless-steel tank with a 35mm film reel (foreground) and a 120 film reel.

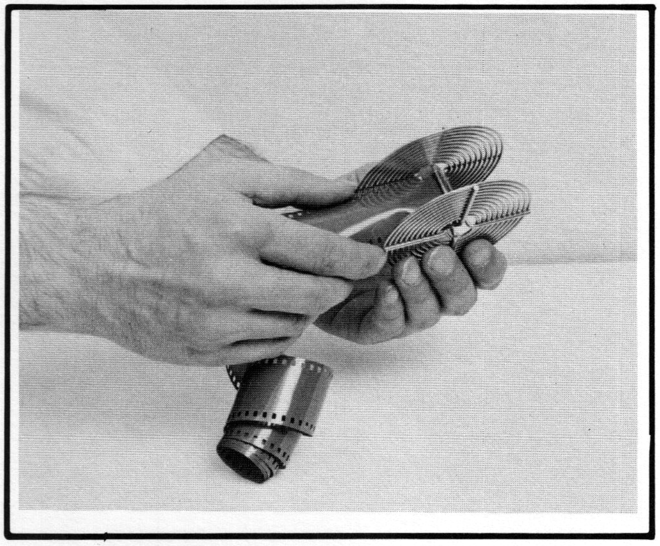


Figure 6

Developing the film requires at least two chemical treatments. First you develop the film. In the developer, the latent image turns into a visible image. Next you fix the film to dissolve unexposed silver halides and to make the image permanent.

Both treatments require total darkness. The film must remain in the fixing solution for a certain period of time before the image becomes permanent. However, by using a daylight-type film tank, you can perform most of the work with the room lights on. Just turn out the lights to load the film tank.

The film tank has a reel that goes inside a light-tight container, Fig. 5. All you do is load the film onto the reel in a completely dark area. Once you've sealed the reel inside the tank, you can turn on the room lights. Complete the development process by pouring the chemical solutions into the light-trap opening at the top of the tank.

Fig. 5 shows the stainless-steel tank and reels. Some stainless-steel reels have clips at the center to hold the film; other types just have openings in the center cage. If your reel has the clip, feed the film end under the clip, Fig. 6. You can now turn the reel to feed in the film a section at a time.

If your reel doesn't have the clip, start the film into the opening of the center cage. Then give the film a sharp bend to get it started on the reel.

It's important to constantly check the film as you're loading it — make sure the film feeds freely onto the reel. In the dark, you can check the loading by feel. Hold the reel steady after you've fed in a section of film. Then shift the film back and forth slightly, Fig. 7. The film should slide easily for a short distance.

If the film sticks, unwind it and start over. The film probably isn't feeding on properly. In that case, sections of the film might be touching and won't receive a proper bath in the solutions.

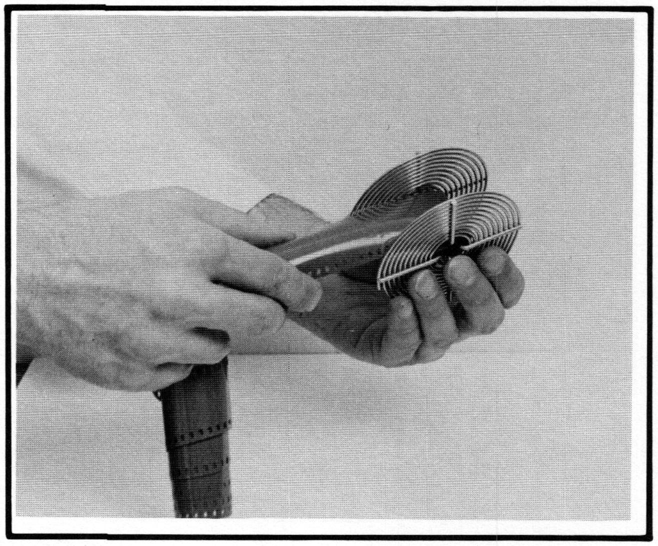


Figure 7

With practice, you'll find that you can load the stainless-steel reel quite quickly. But many people prefer the auto-loading reel, Fig. 8. The two sides of the auto-loading reel are separate sections. You load the reel by rocking one side back and forth.

Start the film into the slot at the outer edge, Fig. 8. Use your thumb to hold the film to the left-hand side of the reel. Now rotate the right-hand side of the reel toward you.

Next release the film from the left-hand side of the reel. And instead use your other thumb to clamp the film to the right-hand side. As you rotate the right-hand side in a clockwise direction, a section of film feeds onto the reel, Fig. 9. Continue the process until you've loaded the entire roll of film.

Some of the auto-loading reels have springlike grippers on the outer edges. Then you don't even have to alternate thumb pressure to load the film. The grippers automatically release the film as you rotate the side of the reel in one direction. When you rotate that side in the other direction, the grippers clamp the film and advance it onto the reel.

The plastic auto-loading reels offer another advantage over the stainless reels — most plastic reels will accept a variety of film sizes. With the plastic reel, you can change the distance between the two sides. The reel has detented stops for the standard film formats.

Plastic tanks often provide stir rods for agitating the film. During development, you must agitate the film at regular intervals. Each agitation brings fresh developer in contact with the film. The stir rod goes through the top of the tank and engages the reel. You rotate the stir rod like a swizzle stick to agitate the film.

There's no stir rod with a stainless tank. To agitate the film, turn the entire tank upside down and then right side up, Fig. 10. Or you can roll the tank on its side. Make sure the cap is on the lid to prevent loss of solution.

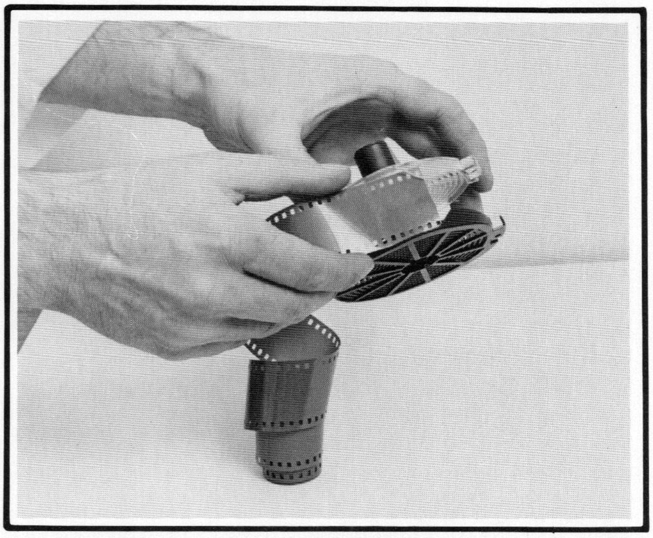


Figure 8

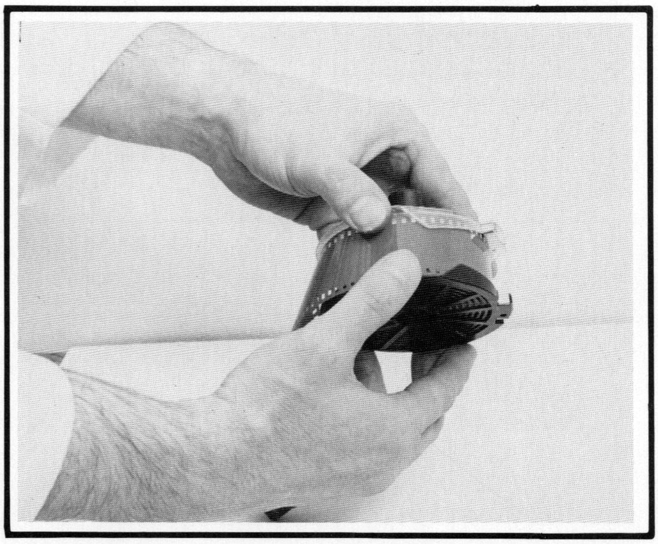


Figure 9

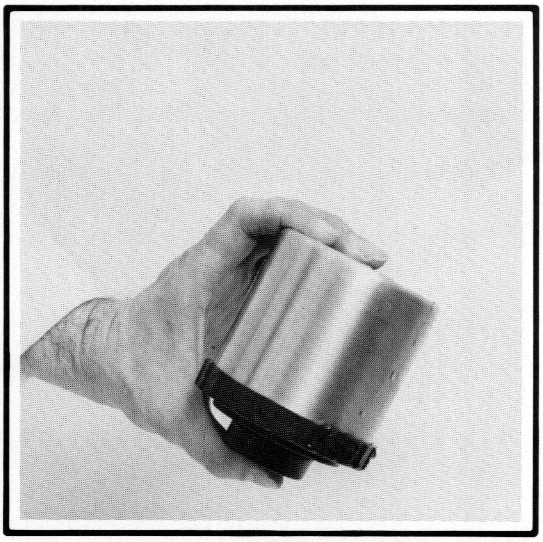


Figure 10

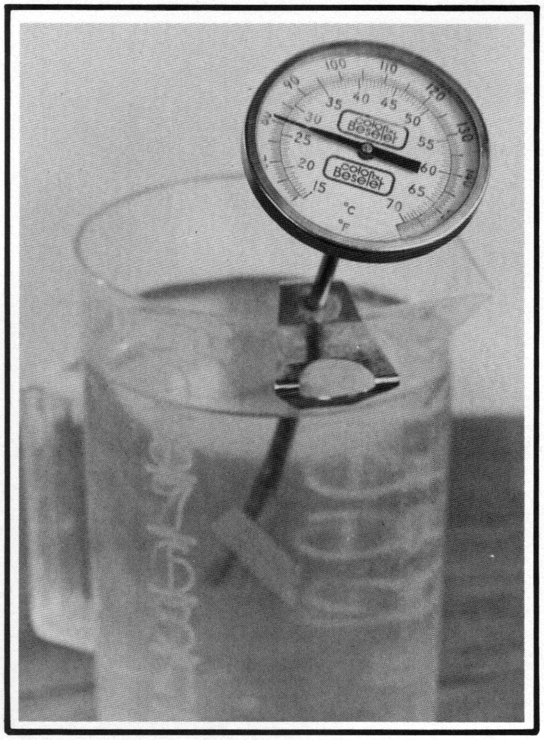


Figure 11

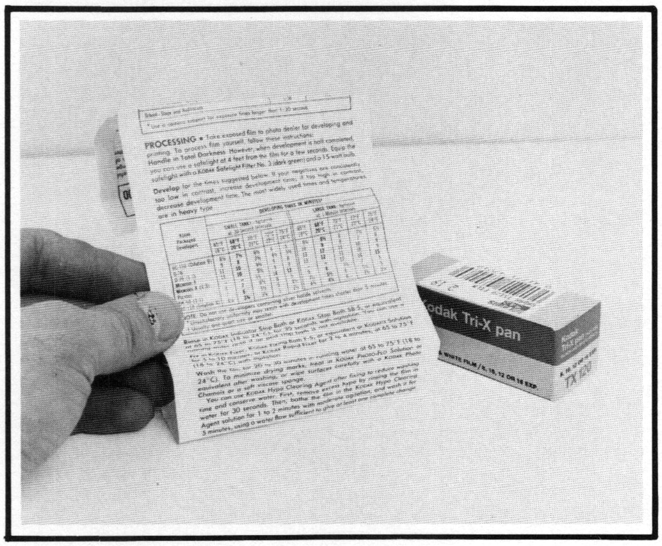


Figure 12

TEMPERATURE CONTROL

Temperature is critical during the development stage. Film develops faster in a warm solution, slower in a cool solution. In the fixing solution, the temperature isn't as critical. But the temperature of the fixing solution — and the temperature of the water washes — should be fairly close to the developer temperature.

The generally recommended temperature for most B&W developing is 68° F (20° C). Some photographic thermometers mark the 68° F calibration with a special indication. Photographic thermometers, like the dial thermometer shown in Fig. 11, react very quickly to temperature changes.

If you develop at 68° F, your water washes and your fixing solution should be somewhere between 68° and 75°. Going to temperature extremes between solutions can damage the negatives. Suppose, for example, that you've developed the film at 68° F. And you then wash out the developer with hot water. The sudden temperature change gives the film a shock that may cause **reticulation** — tiny cracks running through the emulsion.

TIME-AND-TEMPERATURE DEVELOPMENT

Temperature is just one of the factors that controls the density during development. Another is the length of time the film spends in the developing solution. Here are how time and temperature work together:

> Increasing the temperature speeds up the developer — makes it work faster. With a warmer solution, you then get darker negatives. Increasing the length of time gives the developer longer to work.

Since you're working in the dark, you can't see when the film has reached the desired density. Instead you must precisely control the time and the temperature. With a warmer developer, you can shorten the development time. For example, the recommended time and temperature for a certain film/developer combination might be seven minutes at 68° F. At 75° F, the proper time for the same combination might be five minutes.

Different films and developers have different recommended development times. You can find out the proper time and temperature by referring to a **time-and-temperature chart.** The time-and-temperature chart may be included with the film, Fig. 12, or printed inside the film box.

The time-and-temperature chart gives you some options. For one, you have a choice of temperatures. By increasing the temperature of the solution, you can decrease the necessary development time. Also, you have a choice as to the concentration of the developer. With the developer and film combination shown in Fig. 13, you can use an eight-minute development time by using the developer full strength at 68° F. But with a 1:1 solution (one part developer to one part water), develop the film for ten minutes.

Figure 13

	65°F	68°F	70°F	72°F	75°F
D76	9	8	7½	6½	5½
D76 (1:1)	11	10	9½	9	8

Figure 13 Time-and-temperature chart for Tri-X Pan with D76

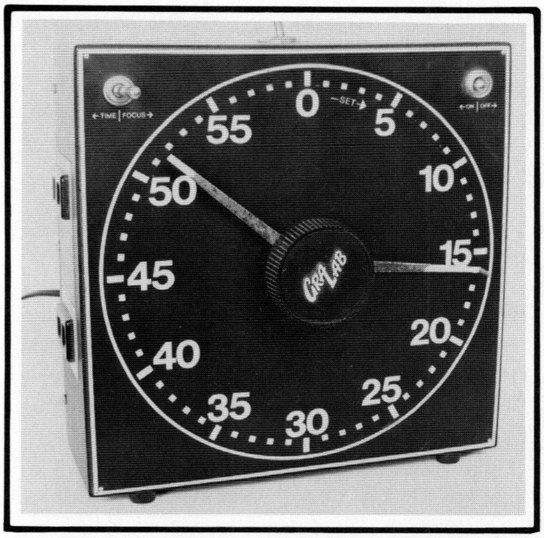


Figure 14 A darkroom timer.

THE DEVELOPER

The main component of the developer is the reducing agent. The reducing agent reduces the light-activated silver halides to pure silver. Another component, the alkali or accelerator, affects the rate of action. The more alkaline the solution, the faster the reducing agent operates.

Developers also use a preservative to prolong the life of the solution. Since the developing agent is a reducing agent, it has a tendency to absorb oxygen. The preservative, usually sodium sulfite, slows down the oxidation of the developing agent.

Another component, the restrainer, helps the developer distinguish between exposed and unexposed silver halides. Any developing agent has a tendency to reduce all silver halides — even those which weren't struck by light. A restrainer, such as potassium bromide, restrains the developer from reducing the unexposed silver halides.

The ingredients determine the type of developer. A fine-grain developer works gently to cause less-noticeable grain. Another type of developer, a high-energy developer, contains strong alkalies to work faster. But high-energy developers rarely produce fine grain.

Kodak's D-76, at first considered a fine-grain developer, now may be the most widely used all-purpose developer. D-76 produces a high emulsion speed. It also develops shadow areas to a maximum before the highlights become too dense. D-76 comes in powder form. You can get packages to mix working solutions of one quart, ½ gallon, or one gallon, Fig. 15.

Microdol-X, another all-purpose developer, also excels in the fine-grain department. You can get Microdol-X as a powder or as a liquid. For one-time use, Microdol-X comes in small foil packets of powder. A developer you use just once and then throw away is called a one-shot developer.

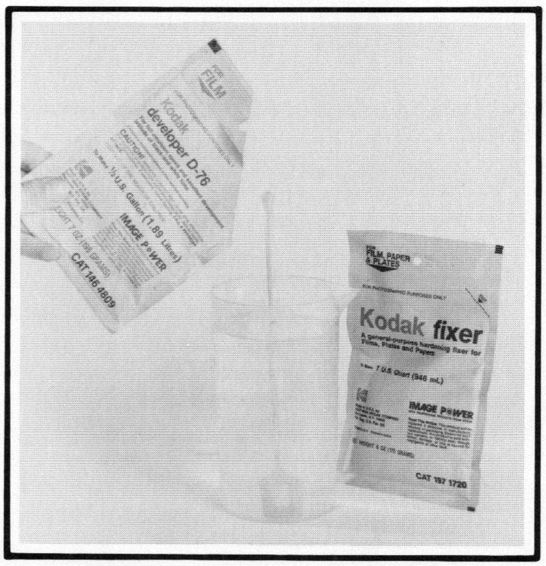


Figure 15 The two essential chemicals for film-processing — developer and fixer. Use the graduate and the stir rod to mix the powders with water.

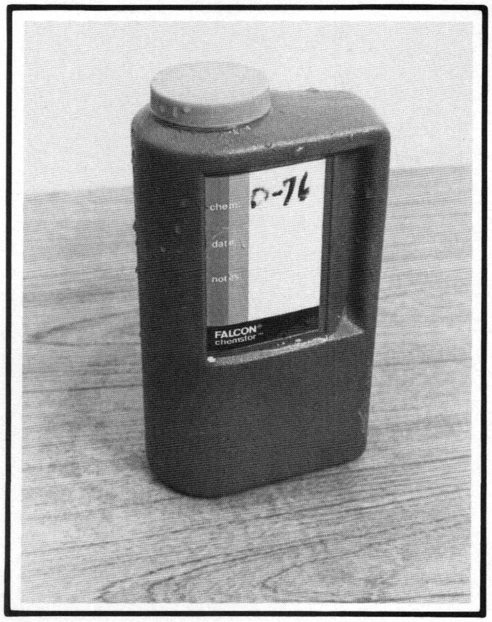


Figure 16

With a one-shot developer, the solution is ready to use once you mix it. But with other developers, you mix a stock solution. You can store the stock solution until you're ready to use it. Then, when you're ready to develop some film, you dilute the stock solution with water.

Storing the stock solution can present a problem. Stock solution has a limited shelf life — it can go sour just sitting on the shelf. To increase the shelf life, use containers that shut out both air and light. The brown, plastic bottles available at most photo-specialty stores make ideal containers for stock solutions, Fig. 16.

Although D-76 and Microdol-X are good all-purpose developers, some special film types may require special developers. For example, if you're processing Kodak's Technical Pan 2415, use Technidol LC developer. The combination of special film and special developer results in exceptionally fine grain. Technidol LC comes in envelopes of dry powder. A package contains three envelopes, enough developer for six rolls of Technical Pan 2415.

There's always a limit as to how many rolls of film you can run through a working solution (the stock solution mixed with water). Each time the developer does its job, it collects byproducts. Pretty soon the developer can't handle another roll of film.

Safety-first people may run no more than four rolls of 35mm film through a working solution. They then throw away that developer and mix a fresh solution. But budget-minded people often use replenishers. A replenisher is a kick-up solution. After you've processed several rolls, you just add the replenisher to the working solution. The replenisher then overcomes the restraining byproducts of development which have accumulated.

THE FIXING STAGE

The fixing solution is an acid solution — just opposite to the alkaline developer. Besides making the image permanent and clearing the unexposed silver halides, the fixer normally contains a hardening agent. The hardening agent hardens the emulsion to make it durable.

Most fixing solutions use sodium thiosulfate. Thus you can always recognize the fixer by the smell — the solution smells like the geysers at Yellowstone. The sodium thiosulfate dissolves the silver halides. But it doesn't dissolve the reduced silver.

However, if you leave the film in the fixer too long, the action isn't so selective. Given enough time, the fixer will even dissolve the silver reduced by the developer. Generally, you should limit the fixing time to around five minutes.

Since the developer and the fixer are chemical opposites, you should never move the film directly from one to the other. That's too sudden a change, and it gives the film a shock. Some people use a water bath between the two solutions. Others use a stop bath.

The stop bath is an acetic-acid solution that kills the effects of the developer — it stops development. So, by the time the film gets to the fixer, the developer has been neutralized. Your working solution of fixer then lasts longer because it doesn't have to work as hard.

STEPS IN FILM DEVELOPING

You mix the solutions at relatively high water temperatures — normally 80° F for the fixer and 125 ° F for the developer. After your stock solutions have cooled, you're ready to mix the working solution of developer. How much you need depends on the size of your film tank. The tank shown in Fig. 6 holds 16 ounces. So you can mix 8 ounces of stock developer with 8 ounces of water for a 1:1 working solution.

Now you're ready to load the film into the tank. With 35mm film, you need two more pieces of hardware — a pair of scissors and a bottle opener. Working in complete darkness, use the bottle opener to pry off the top of the film cassette, Fig. 17. Lift out the film spool and cut off the leader, Fig. 18. Then cut the other end of the film from the spool.

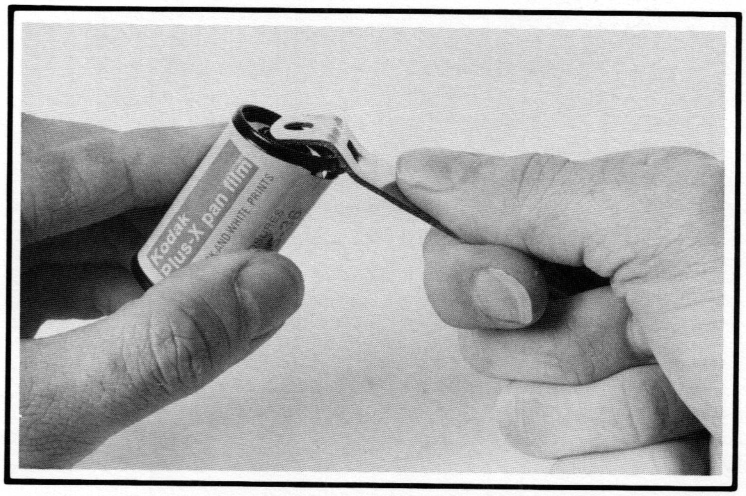


Figure 17

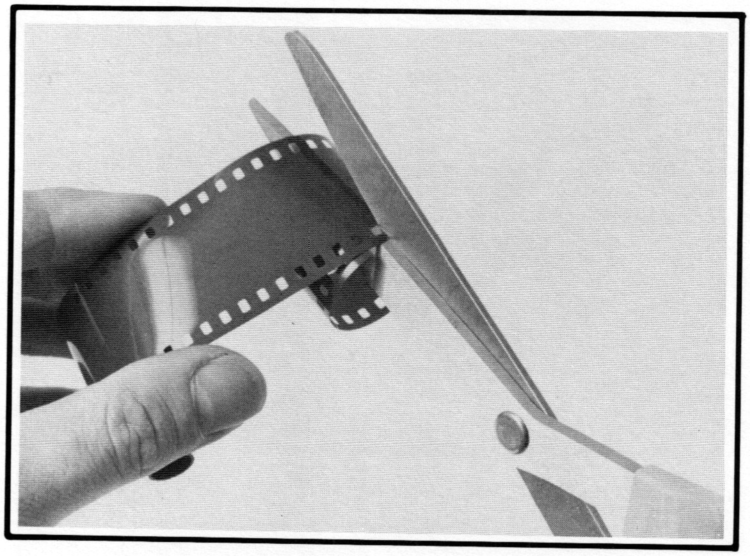


Figure 18

With 120 film, you don't need the scissors or the bottle opener. Just remove the tape that keeps the exposed film from unrolling. Then separate the paper backing from the film. Peel off the tape that holds the film to the spool.

Once you've loaded the tank, you can turn on the room lights. Make sure your developer is at the desired temperature. Then pour the developer into the top of the tank, Fig. 19. Start your timer as you pour in the solution.

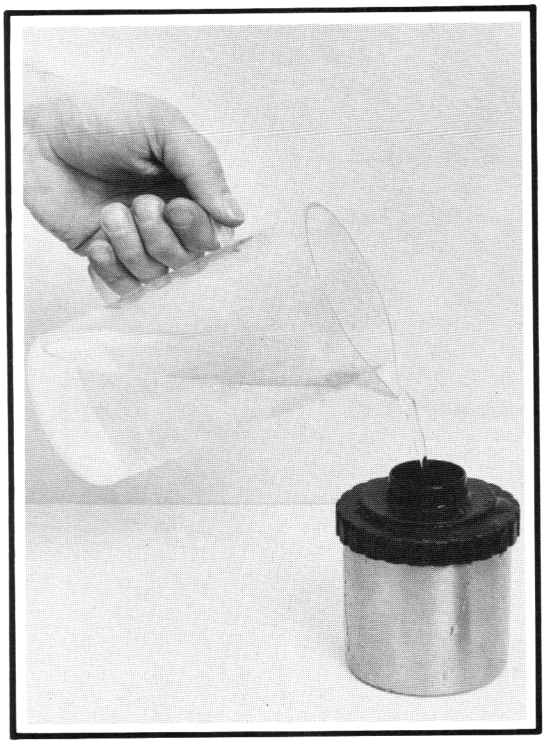


Figure 19

Pouring in the solution may allow air bubbles to cling to the surface of the film. If an air bubble clings to the film, there'll be a tiny spot that doesn't get developed. So, to free air bubbles, give the tank a sharp rap on the bottom of the sink or on the floor, Fig. 20.

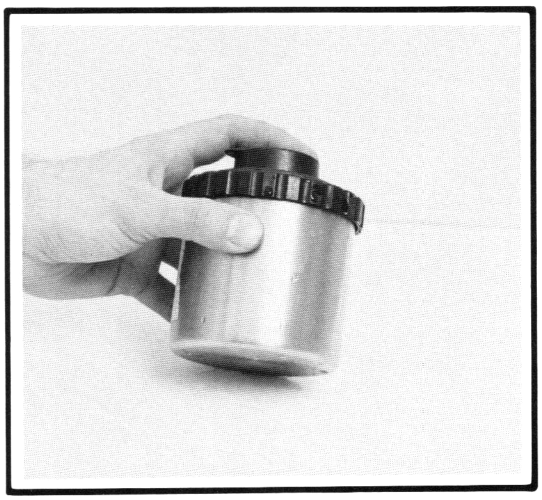


Figure 20

Now agitate the film for around 30 seconds. As a rule, you should agitate the film 30 seconds each time you pour in a fresh solution. Then give the tank one more sharp rap to dislodge air bubbles. And let the tank sit until the next agitation period.

The developer manufacturer may recommend that you agitate the film for five seconds every minute — or even every 30 seconds. Be sure you don't miss an agitation period — uniform, even agitation is one of the most critical of the development steps.

Continue the process until you have 10 seconds left on the total development time. Then pour out the developer. It normally takes around 10 seconds to completely drain the tank.

You can now wash the film or use a stop bath. If you're using a stop bath, pour in the solution. Give the tank another sharp rap to dislodge air bubbles and agitate the film for 30 seconds. Then pour out the stop bath.

However, you can simply use a water wash after the developer. Just fill the tank with fresh water close to the development temperature. As soon as the tank's full, dump out the water — that's called a "dump wash." Give the film three dump washes before pouring in the fixer.

Pour in the fixer and give the tank another sharp rap. Now agitate the film for 30 seconds. Regular agitation isn't as critical in the fixing stage. Here, agitation simply keeps fresh fixer in contact with the film. Some people like to agitate the film constantly for the full five minutes. Some simply invert the tank once every minute.

After four minutes in the fixer, you can open the tank to inspect the results. The film should be clear in unexposed areas. But if the film has a cloudy white appearance, the fixer hasn't finished its job — it hasn't cleared away the unexposed halides.

Let the film complete its five-minute bath in the fixer. Then pour out the fixer and wash the film. Washing the film takes at least 15 minutes. But you can speed up the washing process by using another solution — hypo-clearing agent. Hypo-clearing agent neutralizes the fixer (hypo).

Give the film a three-minute bath in the hypo-clearing agent. The hypo-clearing agent shortens the required washing time to around five minutes. Allow fresh water to run through the reel for the entire washing time.

Ideally, the fresh water should run into the bottom of the tank. The water then lifts the chemical to the top. As water runs out of the top of the tank, it carries the chemical with it. You can get special washing tanks that allow the water to run into the bottom and out the top, Fig. 21. Or you can simply run the water into the top of the film tank and dump the water periodically during the wash time.

The final step is to dry the negatives. Keep in mind that the film emulsion is still pretty soft — especially when it's wet. Handle the film carefully to avoid scratches.

If you simply hang up the film to dry, you'll get water spots. You can avoid water spots by giving the film a short bath in a wetting agent such as Photo-Flo, Fig. 22. Fix about ¼ capful of the Photo-Flo with a quart of water. The Photo-Flo makes a soapy-looking solution.

Take the film reel out of the water wash and agitate it in the Photo-Flo solution for around 30 seconds. Then hang up the film to dry. For a film-drying line, you can use something similar to a clothesline mounted in your darkroom. You can even use clothespins to hold the film. However, it's better to use the specially designed film hangers, Fig. 23. Hang the film from one hanger. Use another hanger as a weight at the other end of the film, Fig. 24. The weight prevents the film from curling during the drying process.

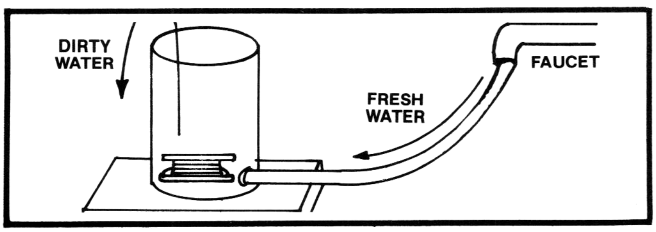


Figure 21

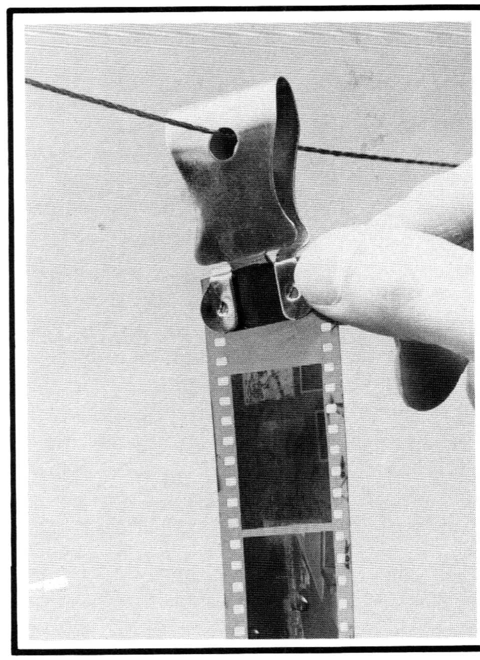


Figure 23

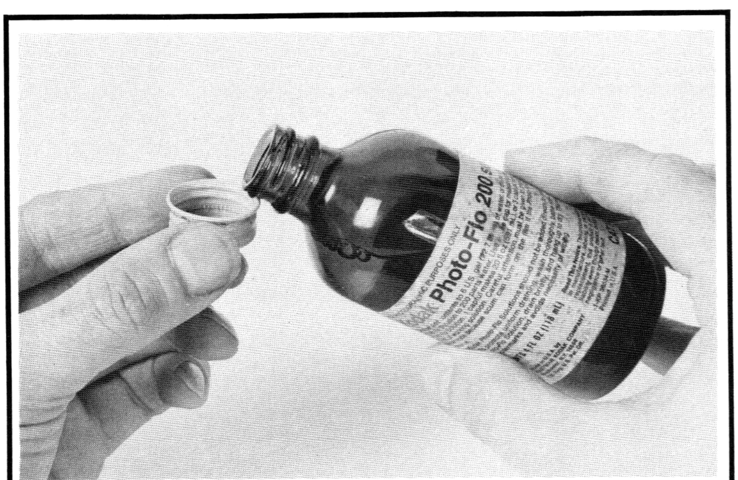


Figure 22

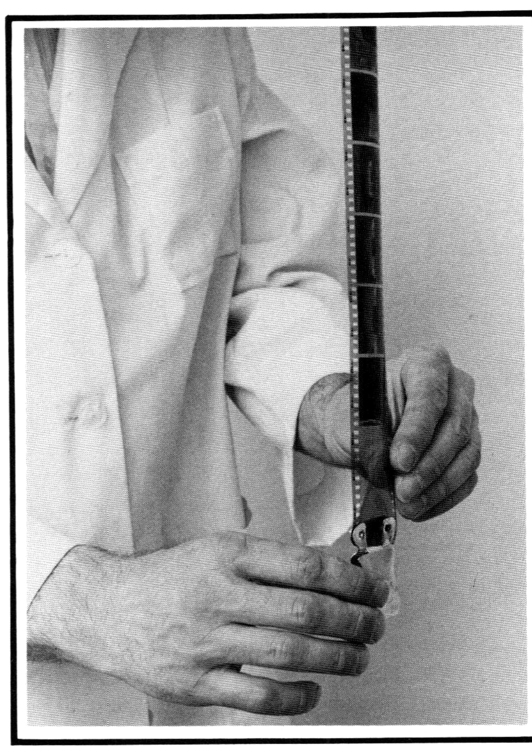


Figure 24

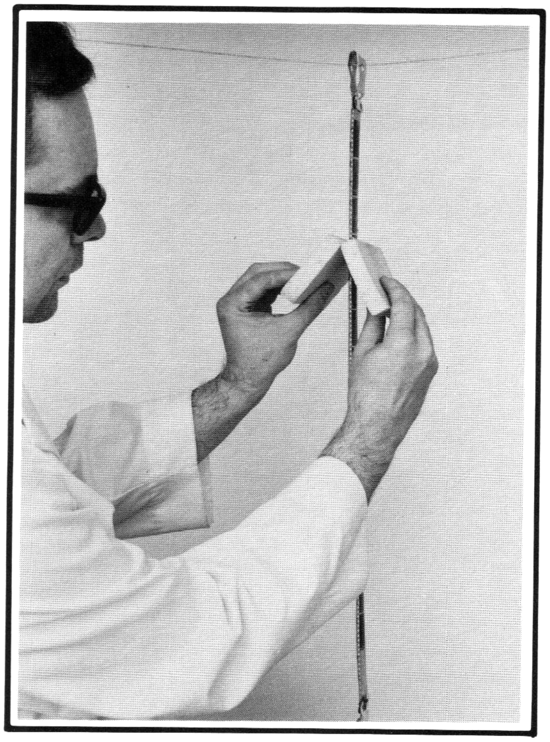


Figure 25

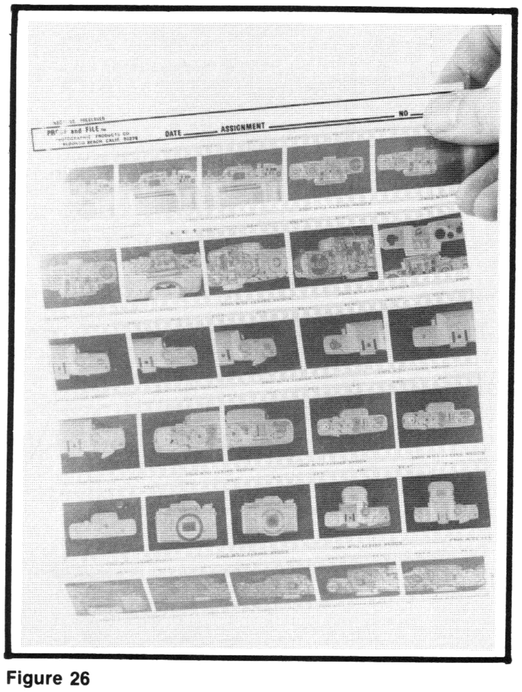


Figure 26

After hanging the film, use a pair of soft sponges to soak up the excess water. Soak the sponges first in the Photo-Flo solution. Then wring out the excess solution, leaving the sponges damp.

Starting at the top of the film, touch a corner of each sponge to the sides of the film, Fig. 25. Now draw the sponges to the bottom of the film. Keep the corners of the sponges in contact with the film to soak up water. But don't apply a lot of pressure — pressure could cause scratches along the film.

You might repeat the sponging procedure once more using different corners of the sponges. Then allow the negatives to hang until they're dry. Ideally, there should be no air blowing on the negatives. While the negatives are wet, they'll tend to collect bits of dust or lint that might be blowing through the air.

CARING FOR NEGATIVES

Never forget that your negatives are delicate — they require special care and storage. The archenemy of the darkroom worker is dirt. Any dirt or dust on the negtive shows up on the print. When you enlarge the print, you're also enlarging the dust and lint.

Fingerprints on the negtives will also show on the prints. The acids from your finger oils quickly etch the negatives. Always handle the negatives by the edges to avoid fingerprints.

To store your negatives, you can cut the film into strips. Then put the film strips into glassine negative sleeves — special envelopes designed for negatives. It's safest to use a separate sleeve for each strip. That way, the strips can't scratch one another. A 35mm glassine sleeve holds a strip of six frames, and a 120-size sleeve holds a strip of four frames.

The negative preserver, Fig. 26, provides another storage technique. Since the negative preserver is clear plastic, you can examine the negatives without removing them. One negative preserver holds a full roll of film — thirty-six 35mm negatives cut into strips of five frames each or twelve 120-size negatives cut into strips of three frames each.

DISTINGUISHING BETWEEN EXPOSURE AND DEVELOPMENT ERRORS

Exposure errors and development errors cause different symptoms. Here's a guideline:

1. An underexposed negative has a weak image with poor shadow detail.
2. An underdeveloped negative has a weak image. But you can see detail in the shadow areas.
3. An overexposed negative is very dense with blocked-up highlights.
4. An overdeveloped negative is dense overall. But it has detail in the highlight and shadow areas.
5. An underexposed and overdeveloped negative lacks shadow detail and has dense, blocked-up highlights. It's very contrasty with a short tonal range (few halftone values between the highlights and shadows).
6. An overexposed and underdeveloped negative has a lot of shadow detail. But the highlights aren't much darker than the shadows. The negative is very flat with little separation between dark and light tones.

PRINTING THE NEGATIVE

Printing the negative adds to the needed hardware. Tops on the cost list is the enlarger — a projection system for projecting the negative image onto the printing paper, Fig. 27. With the enlarger, you can enlarge the tiny negative image for a variety of print sizes.

It's possible to print without an enlarger. You can make a **contact print**, a print made with the negative in contact with the paper. A contact printer holds the negative flat against the paper while exposing the paper to a flash of light. When you develop the paper, you get a positive image the same size as the negative.

Contact prints make valuable previews — they help you decide which negative you want to print. But, unless you're shooting large negatives, the contact print is too small to be of much other value. With the enlarger, you can separate the negative from the paper and get prints almost any size you want.

The negative sits in the negative carrier of the enlarger, Fig. 27. A printing easel then holds the printing paper at the enlarger base. When you turn on the enlarger, a lamp shines light through the negative. The enlarger lens focuses the negative image onto the paper.

You have two controls for changing the size of the projected image. For one, you can change the distance between the enlarger head and the paper. Increasing the separation gives you a larger image. Also, you can change the focal length of the enlarger lens. Using a shorter focal length increases the image size for the same separation between the enlarger head and the paper.

Depending on quality and versatility, there's a wide price range for enlargers. Some enlargers will handle many negative sizes. But, if you only shoot one film size, you can save money by getting an enlarger for that particular format.

An enlarger that takes a variety of negative sizes must accept interchangeable lenses. For 35mm film, you'll need a 50mm enlarger lens. But for 120 film, the 50mm lens may not cover the entire negative area; it may vignette the corners. Also, the image will be too large — you may not be able to get the enlarger head close enough to the paper to project the entire negative image. Consequently, you need a longer focal length — around 80mm — for the medium formats.

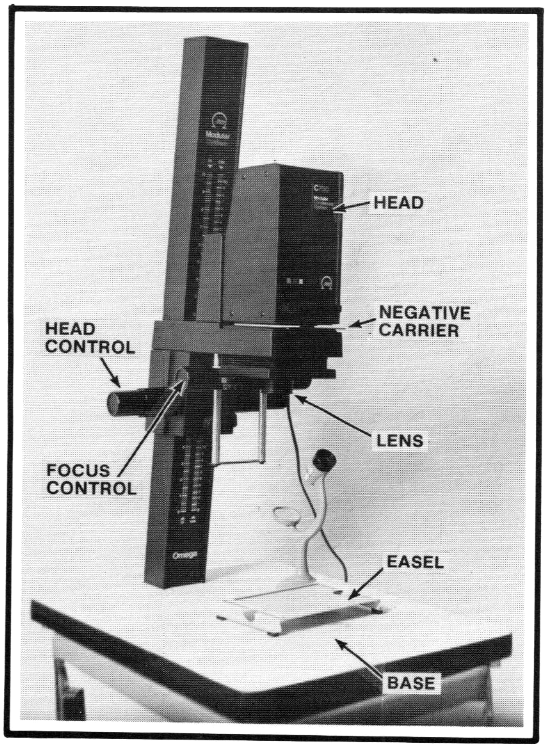


Figure 27

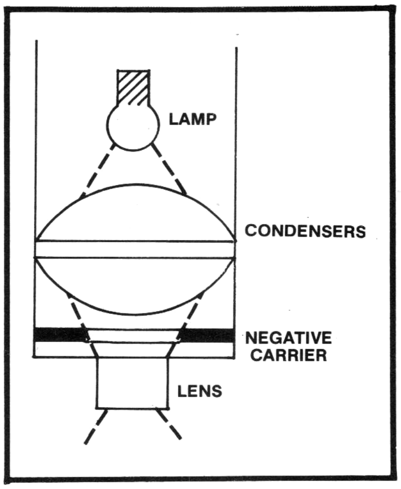


Figure 28 Condenser Head

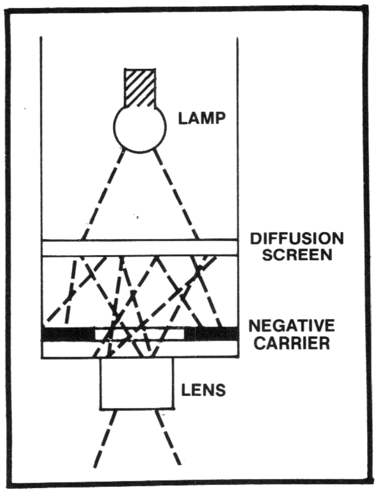


Figure 29 Diffusion Head

TYPES OF ENLARGERS

You also have a choice as to the type of enlarger lamp housing. There are two general types:

1. **condenser-type**
2. **diffusion-type.**

A condenser-type enlarger uses condenser lenses under the lamp, Fig. 28. The lenses concentrate the light onto the negative. With the condenser system, you get the maximum amount of detail and contrast.

A diffusion-type enlarger uses a diffusing glass in place of the condenser lenses, Fig. 29. The diffusing glass scatters and softens the light, providing even negative illumination.

With the diffusion-type enlarger, you generally need slightly longer exposure times. Also, since the diffused light softens contrast, your prints may not appear as crisp and sharp. But the diffusion-type enlarger can mask certain flaws, such as negative defects, as well as hide fine detail. And the effects of grain aren't as apparent.

For certain types of pictures, such as portraits, you probably don't want to show every detail. The diffusion-type enlarger then makes the better choice. But, to handle all types of B&W pictures, most people prefer the condenser-type enlarger. For color printing, the diffusion-type enlarger is the more popular.

Some enlargers accept both diffusion-type and condenser-type heads. With the enlarger shown in Fig. 30, you can remove the condenser lenses and insert a diffusion screen. Also, there are "hybrid" enlargers which combine the condenser lenses with a diffusing screen to gain the advantages of both types.

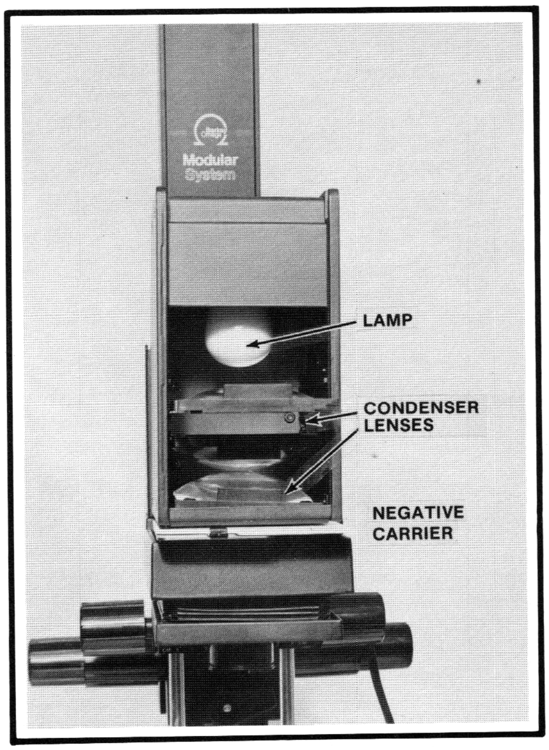


Figure 30

THE NEGATIVE CARRIER

The negative carrier holds the negative in position — securely and flat. If the negative buckles in the carrier, the focus won't be uniform from one side of the print to the other.

Some types of negative carriers sandwich the negative between two glass slides. The glass slides hold the negative flat. But there's a drawback — any dust on the slides shows up as a white spot on the print.

The glassless (or "dustless") negative carrier, Fig. 31, supports just the edges of the negative. Although the glassless carrier can't hold the negative perfectly flat, it does eliminate the dust problems of the glass slides. You can even clean the negative after you've mounted it in the carrier.

THE EASEL

It's also necessary to hold the paper flat. The easel, normally a separate accessory for the enlarger, holds the edges of the paper, Fig. 32. Fig. 32 shows an easel for 8 x 10″ paper. You can get similar easels in other standard sizes, such as 5 x 7″.

A multiple-format easel accepts several print sizes. Some have movable arms you can set according to the paper size. Others have several fixed formats — usually three sizes on one side of the easel and 8 x 10″ on the other side.

Another alternative — the speed easel, Fig. 33 — comes in a variety of sizes. Here, you just slide the paper into the slot at the top of the easel. Rules at the ends of the speed easel allow you to remove the paper without touching the emulsion side.

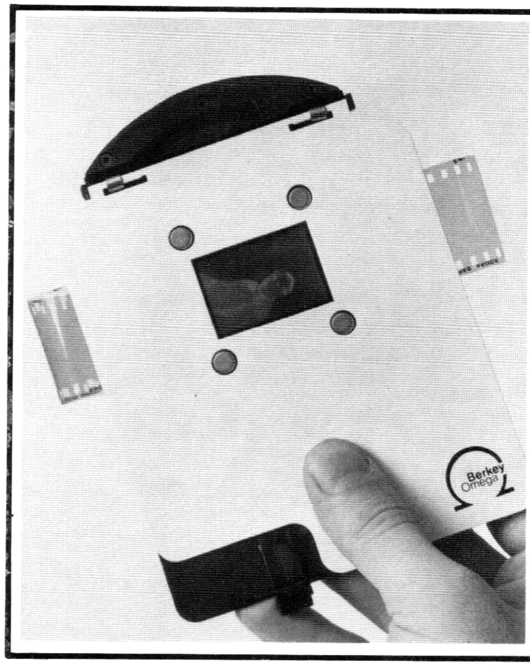


Figure 31

Figure 32

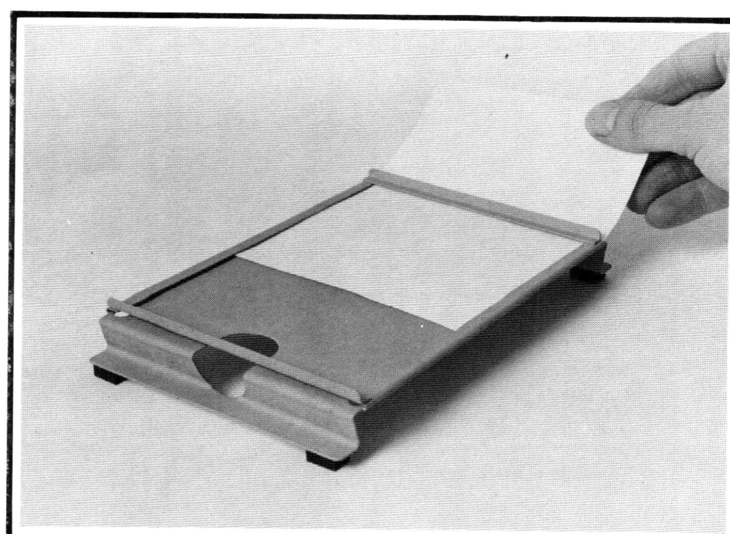


Figure 33

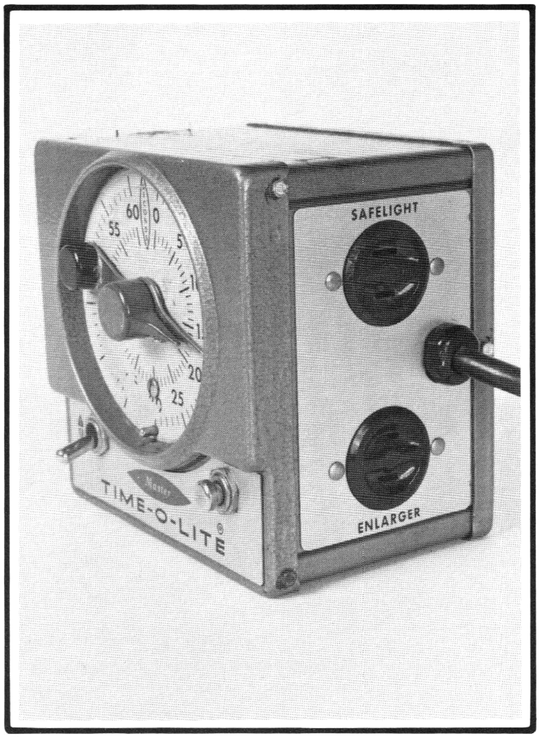


Figure 34

THE ENLARGER TIMER

The timer for printing turns on the enlarger for the precise length of time you select. Just plug the enlarger into the timer, Fig. 34. Plug the safelight into the second timer outlet.

Now the timer controls both the enlarger lamp and the safelight. The timer has two controls — a "focus" control that switches on the enlarger lamp for as long as you want and a "time" control that switches on the enlarger lamp for the length of time you've selected.

When the timer switches on the enlarger, it switches off the safelight. You can then more easily focus the enlarger. Even the relatively inexpensive mechanical timers, Fig. 35, control both the enlarger and the safelight. But the more sophisticated timers, Fig. 34, provide better accuracy and repeatability.

SELECTING THE PRINTING PAPER

The large choice of printing papers gives you further control in creativity. A glossy paper provides the widest tonal range. So, if the picture is going to be reproduced in a magazine or newspaper, choose a glossy paper. For portraits, though, you may want to subdue the total range with a matte or semimatte paper.

Most people now use the **RC (resin-coated) papers**. The RC paper has a plastic coating that air dries to a nearly perfect finish. You can get RC papers with different finish textures. With Kodak's Kodabrome RC papers, for example, the "F" finish indicates that the paper dries to a high gloss. The "E" finish has a fine surface texture that's ideal for display prints. Fingerprints won't show on the "E" surface.

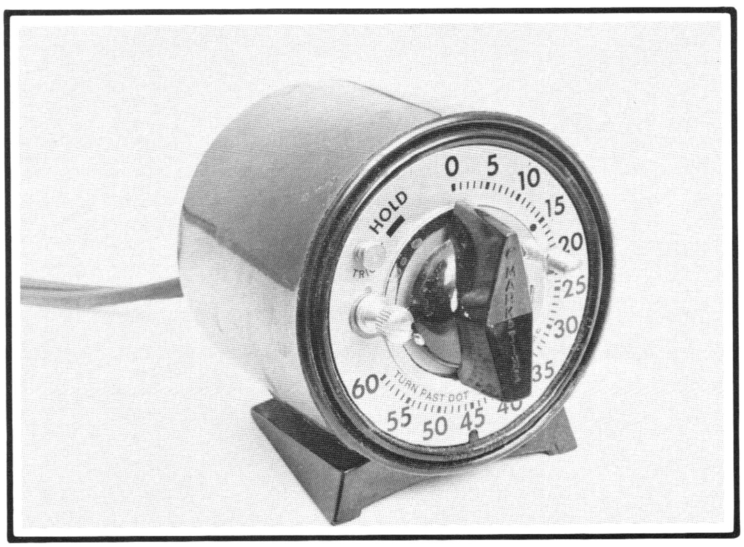


Figure 35

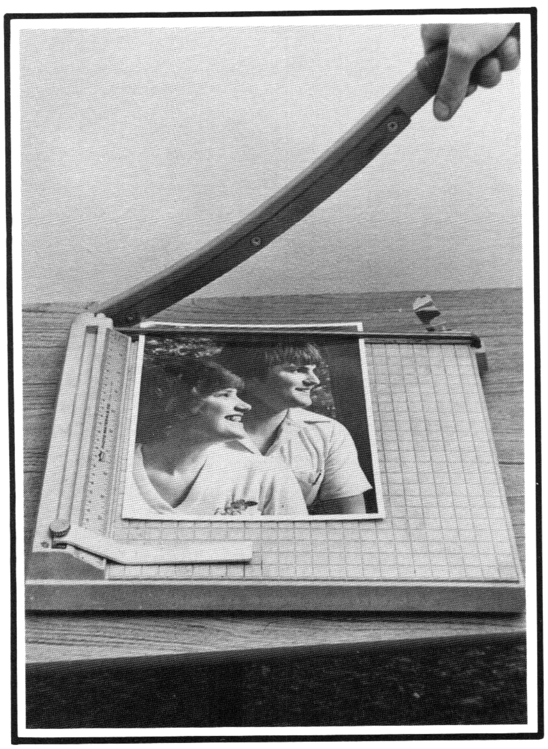
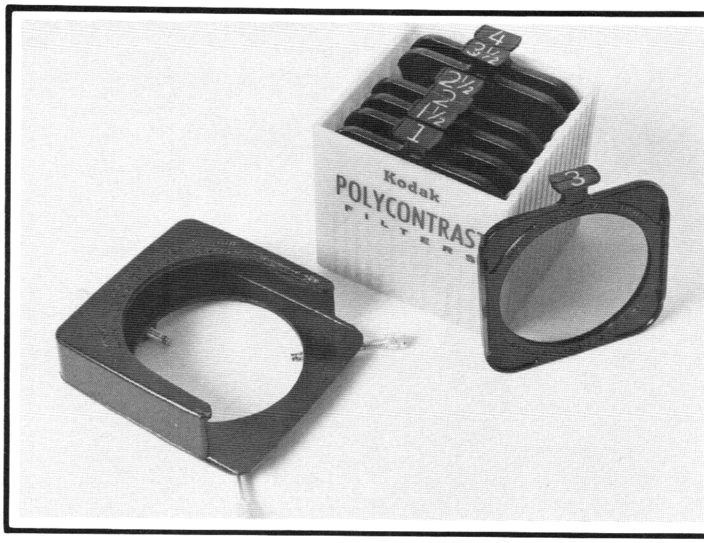


Figure 36 With a paper trimmer, you can cut standard paper formats to the size you want. Some people like to trim off the white borders as shown here. The white borders are lighter than the highlights in the print, making the highlights seem dull by comparison.

Figure 37 A set of variable-density filters. The filter-holder (foreground) mounts to the front of the enlarger lens.



The RC papers also come in a variety of contrast grades — soft, medium, hard, extra hard, and ultra hard. Other papers normally indicate the contrast grade with a number — 1 through 6. A grade 1 paper is very soft, while the grade 6 paper is very contrasty. For normal negatives, you'll probably want a grade 2 paper. Or, if you like slightly crisper prints, use a grade 3.

For a home darkroom, though, you may not want to stock a variety of paper grades. A **selective-contrast paper**, such as Kodak Polycontrast paper, offers a practical alternative. By using special filters to color the light during exposure, Fig. 37, you can print a wide range of contrast grades.

With no filter, a selective-contrast paper gives a very low contrast — approximately a grade 1 (depending on the color temperature of the enlarger lamp). You can then increase the contrast by inserting a filter in the light path. A Kodak Polycontrast filter #2 or #3 gives normal contrast. The filters with higher numbers provide higher-than-normal contrast.

The filters shown in Fig. 37 fit in a special filter holder (also shown) that mounts to the front of the lens. Just slip the appropriate filter into the filter holder. Since the filters go after the lens, they must be precisely made. The precision of the filters accounts for the cost.

However, if your enlarger has a filter drawer — a compartment in the head that's betwen the lamp and the lens — you can use less-expensive filters. A filter placed before the lens doesn't affect the image quality. Kodak also provides the Polycontrast filters designed for a filter drawer.

You can use your normal safelights with the selective-contrast papers. But, since the papers depend on blue and yellow light exposures for contrast control, keep your safelights to a minimum. Also, your enlarger should use a tungsten lamp. A different type of light source may affect the contrast.

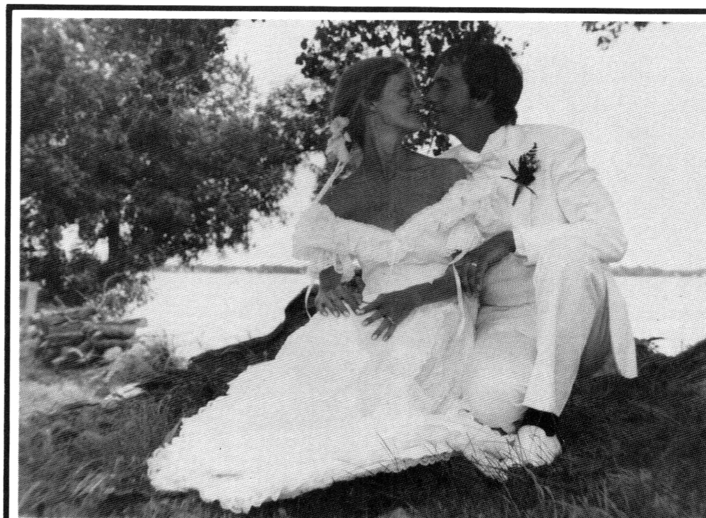


Figure 38A

The selective-contrast papers come both in RC and uncoated finishes. As with other papers, you have a choice of thicknesses — or weights. A single-weight paper is relatively thin and flimsy. But it's less expensive than the more durable medium-weight and double-weight papers.

If you're printing B&W prints from color negatives, you need a special paper — a paper that's sensitive to all colors. Ordinary papers are insensitive to the red end of the spectrum. So, if you print a color negative on ordinary B&W paper, you won't get the full tonal range. Fig. 38A shows the result.

Fig. 38B shows the same negative printed on Kodak Panalure. Panalure is sensitive to all colors. It therefore reproduces the different colors in the negative as corresponding gray tones. Since Panalure is sensitive to the red end of the spectrum, however, it can be fogged by your normal safelight. Work with Panalure in complete darkness. Or you can use Kodak's safelight filter #10 (dark amber).

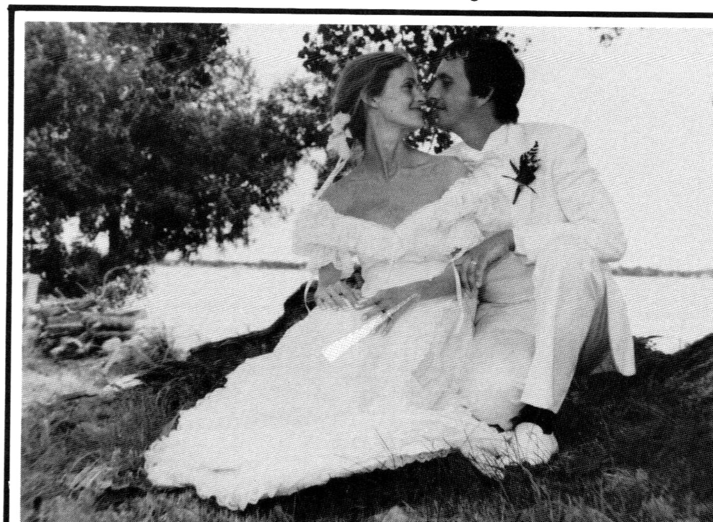


Figure 38B

Figure 39A

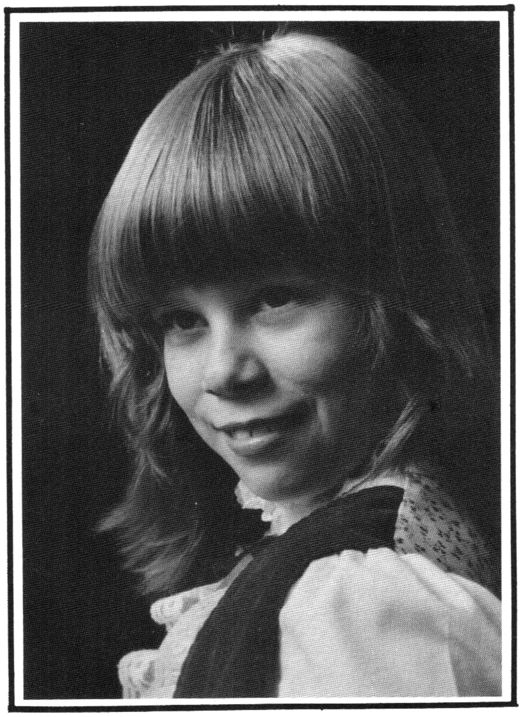


Figure 39B

USING THE ENLARGER

First mount the negative in the negative carrier. The emulsion side of the negative (dull side) goes down, facing the paper. There's one exception — you may wish to reverse the image from left to right, perhaps to improve the composition, Fig. 39. In that case, position the negative with the emulsion side facing the light source.

Now check the negative for dust spots. Remember, the enlarger will enlarge the dust spots along with the image. The larger the print you're making, the more evident the effects of dirt.

You can use a hand blower to remove dust. In dry areas, though, you may find that static electricity causes the dust to cling to the negative. Most photo-specialty stores carry the static-neutralizing brushes, Fig. 40. Dusting the negative with the brush simultaneously neutralizes static electricity. You can also get ionizing "guns" that neutralize static electricity on the negative.

Once you've cleaned the negative, mount the negative carrier in the enlarger. Use the focus control on the timer to turn on the enlarger lamp. Now focus the negative image onto the easel. Most enlargers have two controls — one to move the head up and down and the other to move the lens up and down. Moving the head provides your control for the image size; moving the lens provides your focus control.

Move the head up or down until the image appears as you want it on the easel. If you want to crop the negative — print just a portion of the image — move up the enlarger head until only the portion you want appears on the easel. Adjust the position of the easel to compose the image the way you want it.

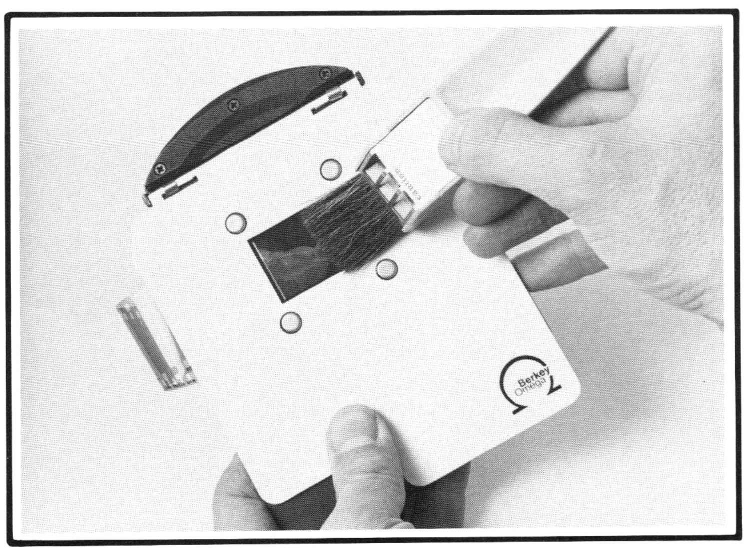


Figure 40

Then adjust the focus control, Fig. 41, for a sharp image. You'll probably have to work back and forth between the two enlarger controls to get both the size you want and the proper focus.

For critical focus, it helps to put a piece of enlarging paper in the easel — the same paper weight as you'll be using to make the print. Place the paper in the easel with the emulsion side down. With exposure to light, the emulsion side turns dark. But the back remains white, allowing a bright image.

There are several focusing aids you can use for critical focus. The grain focuser, Fig. 42, magnifies a small area of the negative. You can then focus on the grain for maximum sharpness.

Also, be sure to adjust the focus at the maximum lens aperture. At the largest f/stop, you get the brightest image and the least depth of field. Then, after you've adjusted the focus, stop down the lens to the aperture you want, Fig. 43. Stopping down the lens increases the depth of field, compensating for slight errors in focusing. Plus, with most lenses, you get the best results at the middle apertures — around f/5.6 or f/8.

Each time you change the image size, you must refocus the enlarger. The auto-focus enlarger offers a time-saving feature — a cam system corrects the focus as you move the enlarger head up or down. With an auto-focus enlarger, you need only adjust the focus once. The image then stays in focus as you position the enlarger head.

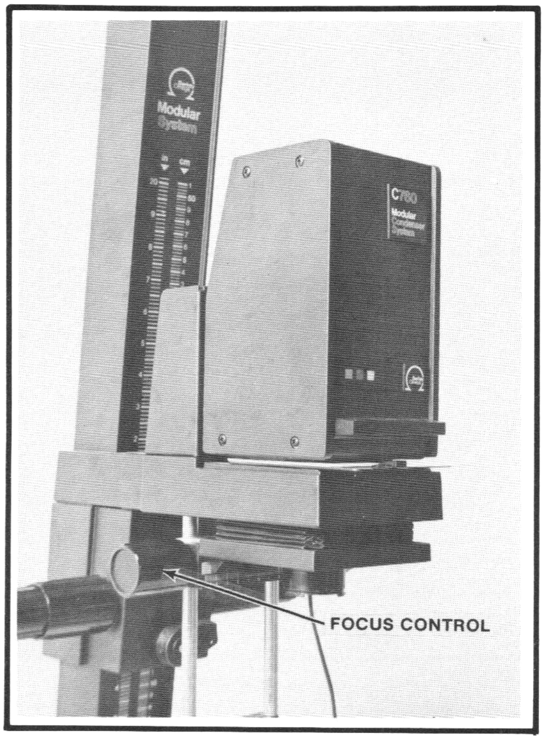


Figure 41

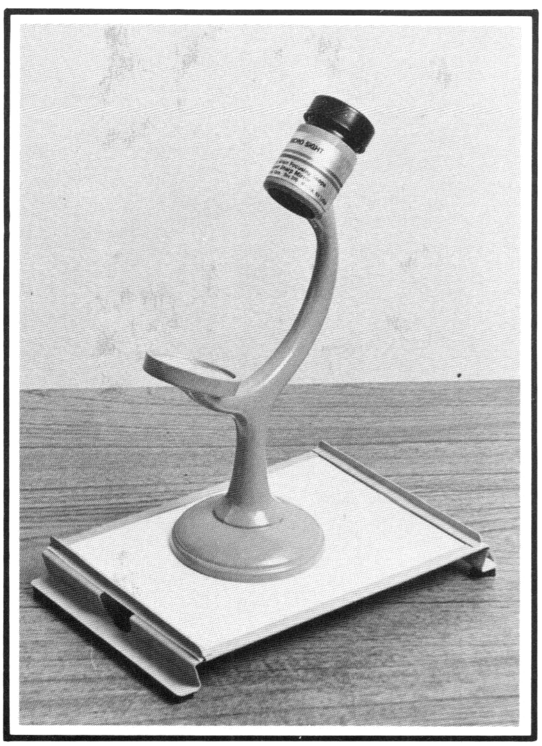


Figure 42

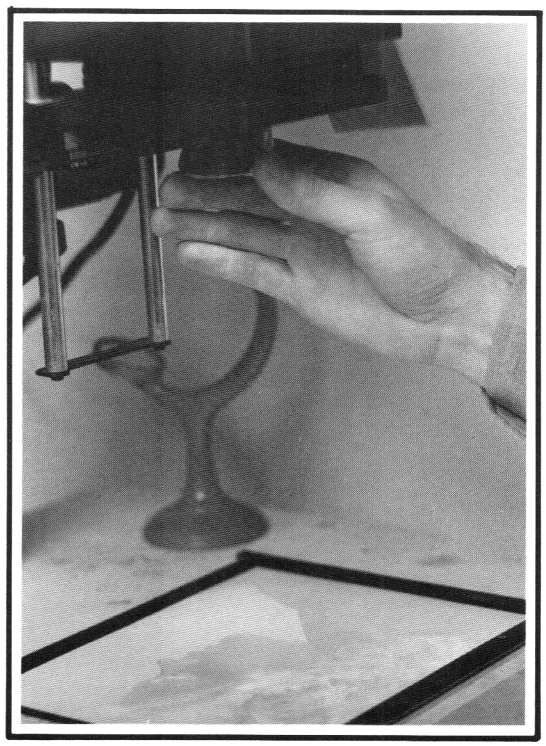


Figure 43

DETERMINING THE EXPOSURE TIME

By starting with a set aperture — perhaps f/5.6 — you have only one exposure variable to determine — the exposure time. Exposure times may vary from a couple of seconds to several minutes. If you decide to make a larger print, you need a longer exposure time. You also need a longer exposure time for a denser negative.

The shorter the exposure time, the more critical the accuracy. For example, suppose that you're using a 2-second exposure. A split-second error then throws off your results — a 1½ second exposure won't be enough, and a 2½ second exposure will be too much. Yet if you're making a 30-second exposure, that ½ second error won't make much of a difference.

To determine the proper exposure time, you can make a test strip. Here you print several exposures on one piece of enlarging paper. You then process the paper for the full development time. When you look at the processed test strip, Fig. 44, you can judge the best exposure.

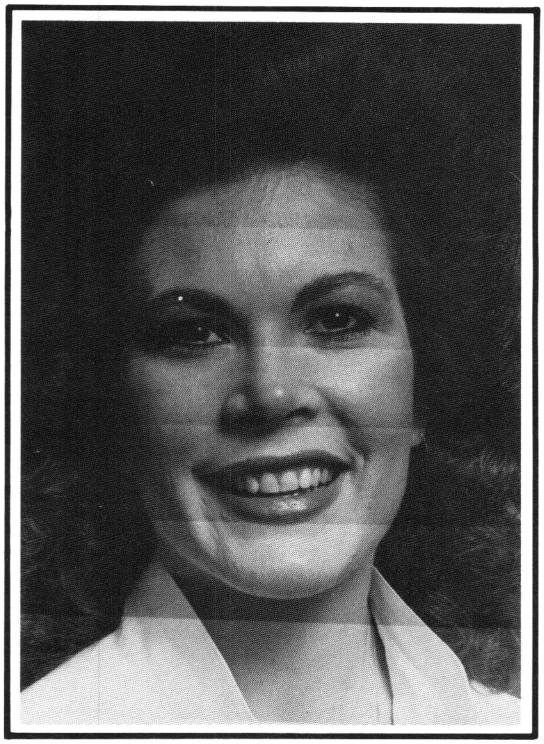


Figure 44

Some people cut up chunks of paper to make the test strips. But using a full-size piece of paper has advantages. Your finished test strip then tells you more than the correct exposure time — it also helps you judge the picture. Did you crop the picture the way you want it? Are there dust spots you didn't see when you cleaned the negative?

Let's say you're making a 5 x 7″ print from a 35mm negative. Turn off the enlarger lamp and take out your focusing paper. Now, working with only the safelight, place a fresh piece of 5 x 7″ paper in the easel. The emulsion side goes up, facing the emulsion side of the negative.

With a properly exposed negative, you might try 2 seconds on the timer (at f/8). Now use a piece of cardboard to cover all but one strip of the enlarging paper. Push the timer button to give that strip a 2-second exposure.

Next move your cardboard to uncover another strip. Push the timer button to get another 2-second exposure. Your previously exposed strip gets an additional exposure of 2 seconds — it now has a 4-second exposure. But your freshly uncovered strip gets only a 2-second exposure.

Continue the procedure until you've exposed the entire piece of paper in 2-second strips. Then process the paper. You can now determine the proper exposure time. Let's say you decide the 6-second exposure looks best. Set your timer for 6 seconds and expose a fresh piece of paper.

With a very thin negative — or with a very small print enlargement — you might have to use a smaller aperture. A dense negative or a very large print might require a larger aperture. You might also want to vary the aperture according to the desired exposure time. Generally, you should expose the paper for at least 1½ seconds. But you may want a longer exposure time to allow for creative controls as we'll discuss in a later topic.

CHEMICALS USED IN PRINTING

The development process for B&W prints is nearly the same as that for B&W negatives. You can use the same fixer. However, the paper exhausts the fixer a lot faster than does the film. After you fix a roll of film, you can save and reuse the fixer. But it's generally best to discard the fixer after you finish printing.

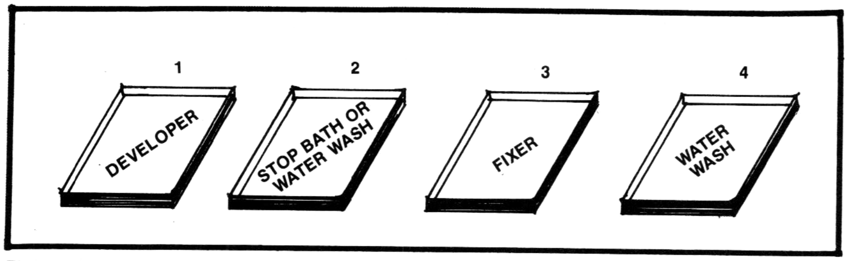


Figure 45 Tray Sequence

Printing paper, though, takes a different developer — a paper developer such as Kodak Dektol. Dektol comes in powder form. It's an all-purpose developer that you can use for many types of B&W paper.

Rather than using tanks, you develop the paper in trays. You should have four trays — one for developer, one for a water wash or stop bath, one for the fixer, and one for a final water wash, Fig. 45. The trays are available in different sizes. To avoid wasting solutions, it's desirable to use smaller trays for smaller prints.

An ideal darkroom sink is large enough to hold all four trays in sequence. You can purchase stainless-steel sinks designed specifically for printing. But many people save money by making their own sinks out of wood. They then apply a fibre-glass finish to the sinks.

You place the trays in sequence. The first tray has the working solution of developer. If you're using Dektol, mix a stock solution according to the directions on the package. Then dilute the stock solution in your first tray for a working solution. Most people dilute the Dektol 1:2 — one part Dektol to two parts water. Or, if you like your prints to start appearing a little faster, you might use a 1:1 solution — perhaps 20 ounces of Dektol with 20 ounces of water.

Temperature isn't as critical with the paper developer as it is with the film developer. With the paper, you can watch the image build up. But you should try to keep the developer within the 68-75° F range. If your developer gets too warm, the prints come up too fast and may appear brownish in tone. Or, with a cold developer, the prints may have chalky highlights and grayish shadows. The fixer and the water washes should be within the same range.

After exposing your first print, place it in the developer. The developer should cover the entire print quickly and evenly. With a small paper size, such as 5 x 7″, it's probably easiest to place the paper into the developer with the emulsion side down. But with larger sizes, such as 8 x 10″, another technique provides a more even start. Hold the paper with the emulsion side up. Then, starting at one-end of the tray, slide the paper into the developer, Fig. 46.

Start your developer timer as you slide in the print. If you're using RC paper, you should try for a development time of 1½ minutes using a 1:2 working solution. Develop for at least 1 minute with a 1:1 working solution. Most of the uncoated papers aren't as fast. Typically, you need around a 2-minute development time with an uncoated paper.

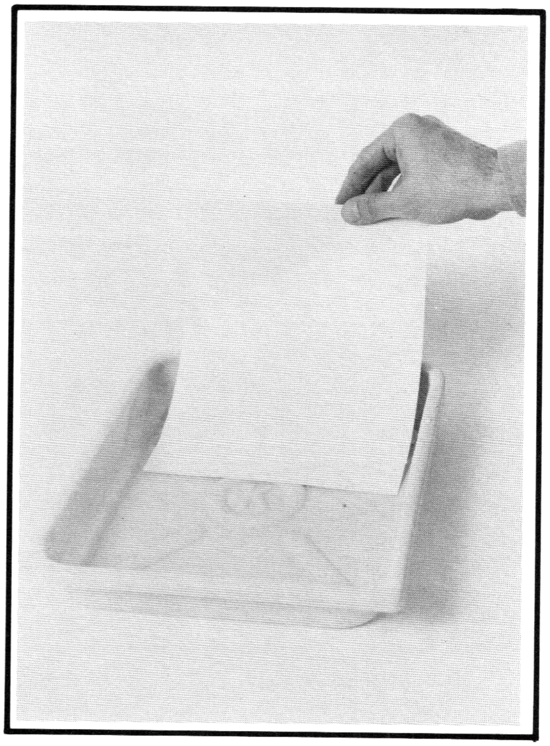


Figure 46

Figure 47

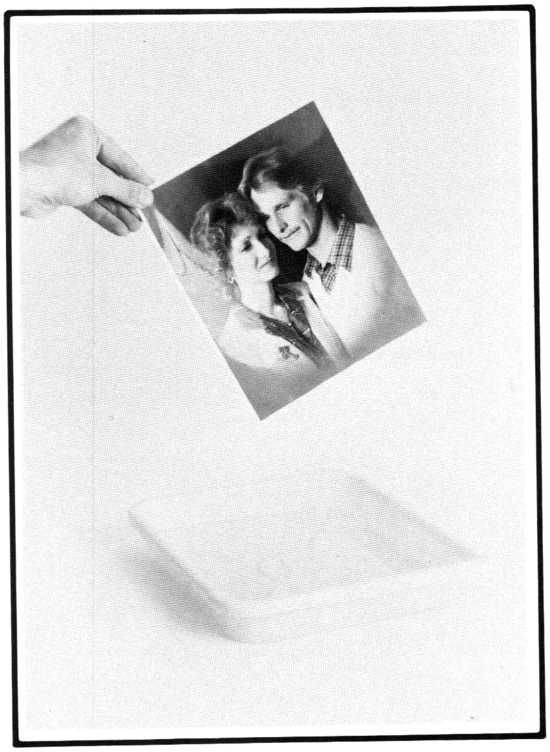


Figure 48

You'll find that the print at first tries to rise to the top of the developer solution. Keep poking down the corners until the print is thoroughly soaked with the solution and stays immersed, Fig. 47. For agitation, rock the tray during the entire development period.

Working under the safelight, you can watch the image form. How soon the image starts to appear depends on the developer dilution and the paper. With a 1:2 dilution, the image normally starts to appear in around 20-30 seconds. The image may start appearing in around 10 to 15 seconds with a 1:1 dilution.

You may find that the image starts appearing too quickly and builds up too fast. In that case, your exposure time was too long. You can pull the paper before the full development time. However, you should strive for at least one minute in the developer. Leaving the paper in the developer the full time allows proper build-up of all the tones.

An underdeveloped print then lacks contrast. Similarly, if the image has not come up enough in two minutes of development, you can leave the print in the developer a little longer. But the image soon reaches a point of maximum development — it can't build up any more regardless of how long you leave it in the developer. You then need a longer exposure time.

When there are around 10 seconds left on the development time, lift the paper as shown in Fig. 48. Hold the paper by one corner and allow the developer to drain off. By letting the solution drain for 10 seconds, you avoid carrying over excessive solution from one tray to the next.

Now move the paper to your second tray — either stop bath or a water wash. If you're using stop bath, leave the paper in the solution for 10 seconds. Rock the tray for the entire time. The stop bath kills the developer almost instantly. You'll even feel the difference. In the developer, the paper has a slick "soapy" feel. It loses that feel in the stop bath.

Using stop bath to kill the developer has an advantage — your fixer lasts longer because it doesn't have to work as hard. But there's also an advantage to using a water wash rather than a stop bath. The water wash doesn't instantly stop the developer — it just slows down the action. In the water wash, the image continues to build up slowly. You then have a touch more control over the image density. When the image looks right, transfer the print to the fixer.

Leave the print in the fixer for five minutes. After the first 30 seconds, though, you can turn on the room lights and examine the print more closely. Continue to rock the fixer tray every minute or so to keep fresh solution on the print.

Be sure to thoroughly wash the fixer from your hands before you develop another print. Otherwise, you'll contaminate your developer solution. Some people prefer to use print tongs, Fig. 49, rather than their hands for moving the prints. Using print tongs can save time — you don't have to wash your hands after every print. Be sure to use separate tongs for the developer tray and the fixer tray.

There'll be times, though, when your fingers have an advantage over the tongs. Remember that development with paper, as well as with film, depends on the agitation and the temperature. You can therefore use your fingers to speed up development in local areas.

Suppose that one area in your print — perhaps a burned-up highlight — isn't coming up fast enough. While the print is in the developer, lightly rub the burned-up area with your finger. You're now giving local agitation to the specific area, speeding up development. Also, you're warming the developer in the burned-up area with your finger temperature. The area that you're rubbing gets more agitation and a warmer developer than does the rest of the print.

FINISHING THE PRINTS

Each print should remain the full five minutes in the fixer. It doesn't hurt if the prints stay in the fixer a little longer. But, if the prints stay in too long, the fixer may start working on the exposed silver halides. After the fixing bath, move the prints to the final water wash.

Since the paper is more porous than the film, your prints require a longer wash period than do your negatives. Generally, you should wash prints for around an hour at a water temperature of 75° F. However, you can shorten the washing time by using hypo-clearing agent.

Wash the prints in running water for around two minutes. Then transfer the prints to the hypo-clearing agent. For single-weight paper, give the prints a three-minute hypo-clearing bath with constant agitation. Increase the time to five minutes with double-weight paper.

To agitate the prints, you can simply rock the tray. However, if you're doing a lot of prints, the paper tends to stick together. If the prints stick together, they won't all get a sufficient share of the hypo-clearing bath. You can get better agitation by shuffling the prints — take a print from the bottom of the stack and move it to the top. Continue shuffling the prints for the entire hypo-clearing time.

The hypo-clearing bath shortens the wash time to around 20 minutes. One way to wash the prints is to use a special washing tub — a tub with holes cut around the side. Run fresh water into the bottom of the tub. The water then runs from the bottom to the top, carrying out the chemical through the holes.

Another technique is to give the prints three fresh-water baths. Fill a clean tray with fresh water. Then transfer the prints, one at a time, to the clean water. As you lift a print from one tray, let it drain before you put it in the next tray. Leave the prints in each tray of clean water for around five minutes.

DRYING THE PRINTS

When drying the prints, you'll really appreciate the advantages of the RC papers. The RC papers air-dry to a perfect finish. Thanks to the resin coating, there's very little paper curl.

But uncoated papers curl toward the emulsion side as they dry. You can minimize the curl by giving the prints a final bath in print flat, Fig. 50. Print flat is a soapy-looking solution that cuts down on the curling tendencies. Leave single-weight papers in the print flat for at least five minutes — ten minutes for double-weight papers. Again, if you have a stack of prints, use the shuffling technique for agitation.

With the uncoated papers, the method of drying the prints affects the finish. A smooth glossy paper air-dries to a natural sheen — but not to a high gloss. To get the high gloss, the emulsion side must be in contact with a smooth, polished surface during the drying period. You then need a print dryer or a ferrotyping plate (a plate with a polished surface).

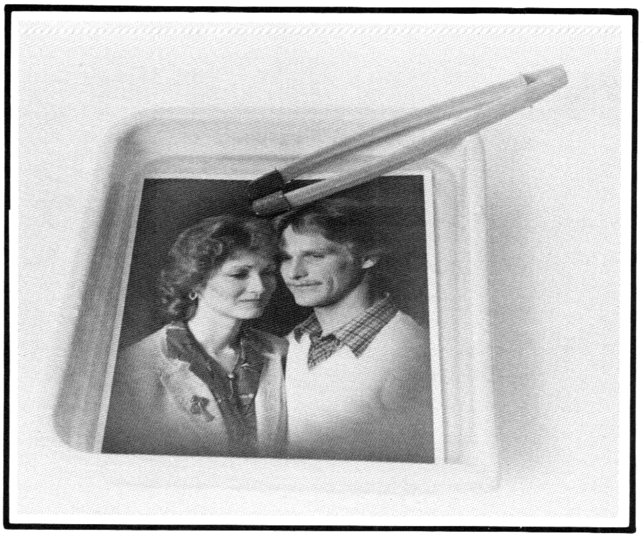


Figure 49

Figure 50

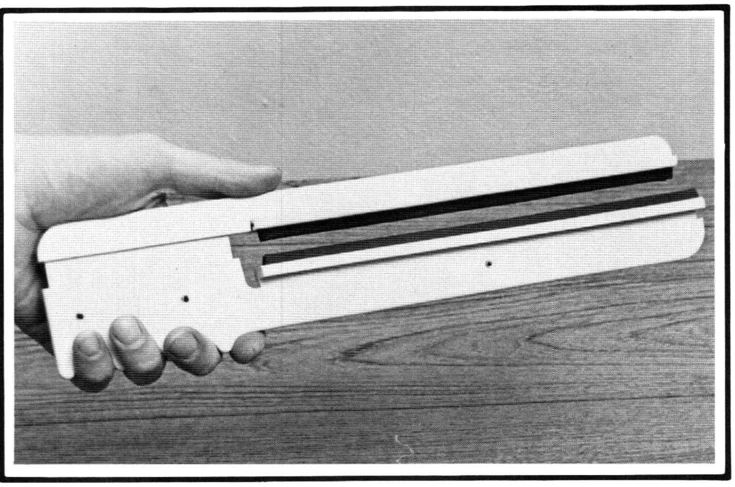


Figure 51

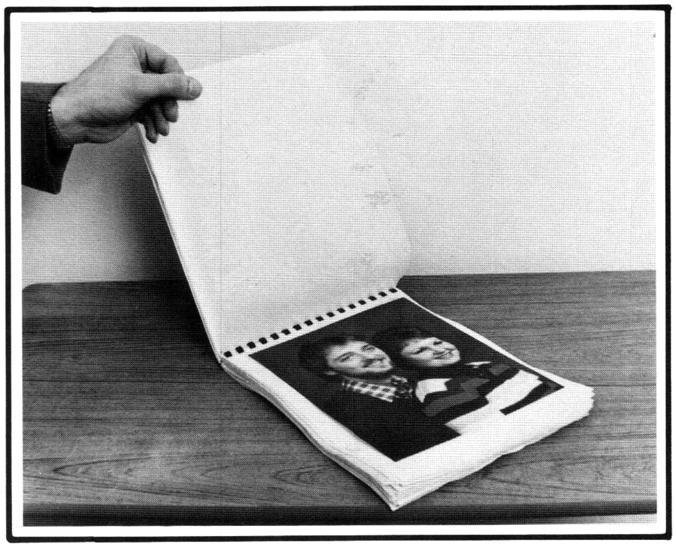


Figure 52

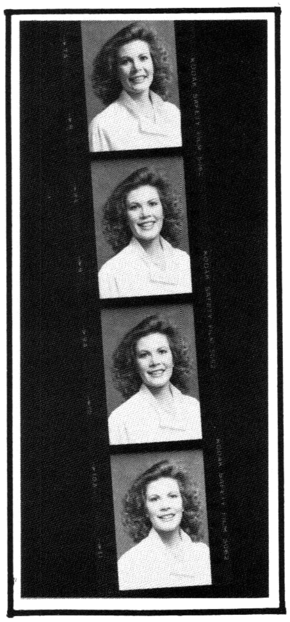


Figure 53

The RC papers have eliminated the need for print dryers. A print dryer applies heat to speed up the drying time. But you don't want to apply heat to the RC papers — heat can damage the plastic coating. The RC papers air-dry very quickly.

Regardless of the type of paper you're using, you should first remove excess water with a squeegee. You can use a regular window-cleaning squeegee along with a large, flat surface — a piece of plate glass or the back of a large print tray.

Lift a print from your water wash and allow it to drain. Then place the print emulsion-side down on the plate glass. Run the squeegee across the print from top to bottom.

Next lift the print and squeegee the glass to remove the water. Replace the print on the glass, emulsion-side up, and repeat the process. As you squeegee the emulsion side of the print, be careful that you don't accidentally put a crinkle in the paper.

Fig. 51 shows a squeegee designed especially for prints. The squeegee has two movable jaws with rubber blades. Clamp the jaws over one end of the print. Then draw the print through the jaws to squeegee off excess water.

With RC papers, you can now allow the prints to air-dry. There's just one precaution — make sure drops of water don't stand on the emulsion side. When the water drops dry, they'll cause "blisters" in the emulsion. You can use a soft sponge to soak up water drops. Or you can stand the prints on edge, allowing the water drops to drain off.

Another technique is to use lintless blotter, a porous paper that leaves no paper lint on the wet prints. After you squeegee the print, place the paper emulsion-side down on the blotter. The blotter soaks up water drops.

The blotter book, Fig. 52, contains several pages of lintless-blotter material. You can use the blotter book to dry several prints in a limited space. The blotter book can be especially handy when you're drying uncoated papers. First place the print emulsion-side down on the blotter page. Press down the print to soak up the moisture. Then turn over the print. Place the waxed-paper page on top of the print, Fig. 52, and close the blotter book. You can now place a heavy book on top of the blotter book, thereby preventing the prints from curling as they dry. However, the prints take several hours to dry inside the blotter book.

To speed up drying uncoated papers, you can let the prints air-dry until they start curling. Then place the prints inside a blotter book or even a telephone directory. The weight of the book holds the prints flat as they complete the drying time. If you're using a telephone book, make sure the prints are nearly dry before you allow the emulsion sides to contact a page. Wet prints will stick to the pages of the telephone book.

MAKING CONTACT PRINTS WITH THE ENLARGER

As mentioned earlier, contact prints can help in selecting the negative you want to print. Perhaps you have a series of shots of a person, and you want to select the best expression. With a contact sheet, Fig. 53, you can easily select the best negative.

You can get special contact-printing frames that hold the negatives in contact with the paper. Or you can simply use a piece of glass. First adjust the height of the enlarger head until the lamp covers the entire paper area. Then turn off the enlarger and place a piece of enlarging paper, emulsion side up, on the enlarger base.

Lay the negatives, emulsion side down, on the paper. And lay the glass plate on top of the negatives. Now turn on the enlarger to expose the paper. Making a contact print takes a relatively short exposure.

There's some danger in making contact prints — the delicate negatives may get scratched or dirty. To protect the negatives, you can use the type of negative-preserver shown in Fig. 26. Just lay the complete negative-preserver on top of the paper to make your contact sheet.

CREATIVE PRINTING CONTROLS

What's the biggest advantage in doing your own printing? It's probably the additional control you have over the final result. With creative printing controls, you can change the effect to more closely match what you want.

First you have the control in cropping. You may be able to improve the composition by printing just a portion of the negative. Fig. 54 shows an example. For Fig. 54A, we printed the full frame. But cropping more tightly, Fig. 54B, puts emphasis on the model's face. Cropping into the head calls attention to the eyes.

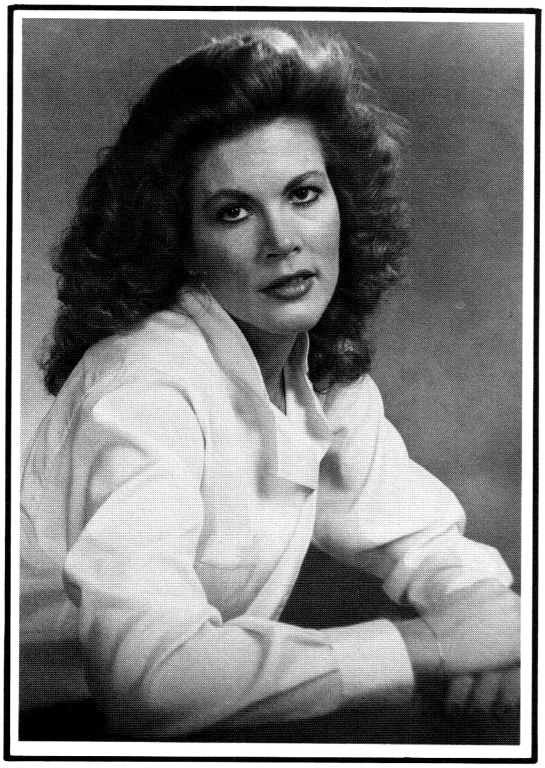


Figure 54A

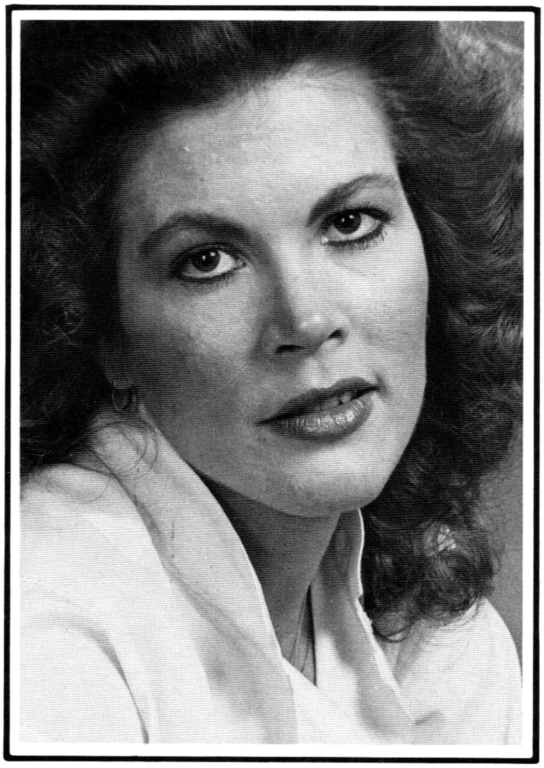


Figure 54B

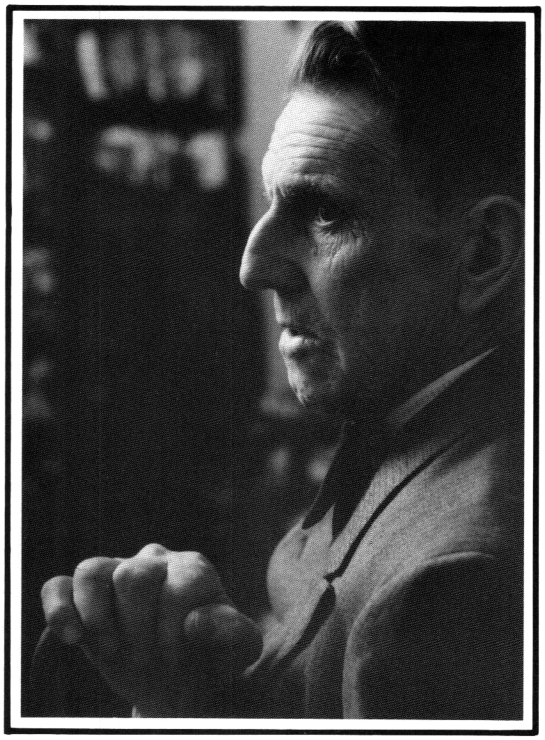


Figure 55A

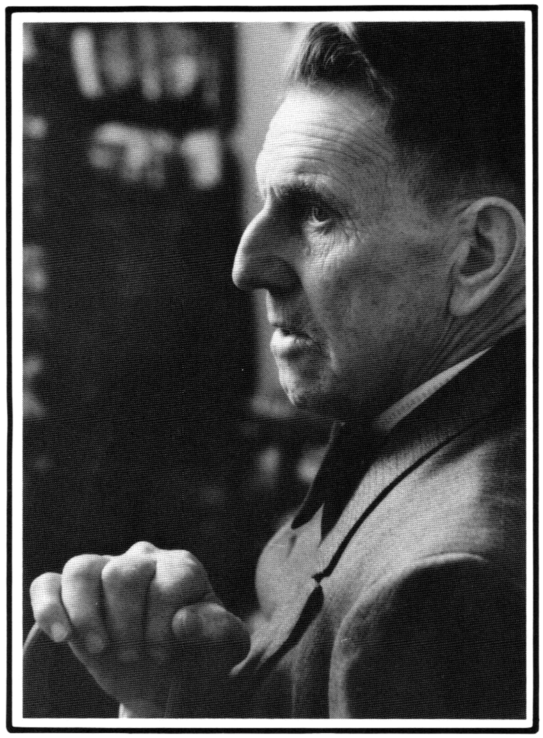


Figure 55B

Here are the other frequently used controls for custom printing:

Figure 56

Dodging

Dodging means holding back light from selected areas of the print. The brightness range of the subject may extend beyond the range of tones you can reproduce in the print. Shadow areas may then be too dark to show detail.

In Fig. 55A, the shadows hide detail in the subject's face and hand. You could lighten the shadow areas by reducing the overall exposure. But the highlights may then go too light. By dodging, you can reduce the exposure in the shadow areas, Fig. 55B, without affecting the other picture areas.

During the exposure, block off light from the area you want to lighten. You can simply insert your hand or finger into the light path, Fig. 56, for part of the exposure. That way you're holding back light from the shadow area.

It's important that you keep your hand in motion while you're dodging the print. Otherwise, you'll get a harsh separation between the dodged portion and the adjacent area. The dodged portion should have a soft edge — an edge that blends with the adjacent tones.

You can fairly easily dodge areas at the top, bottom, or sides of the print. Perhaps the shadow area appears at the bottom of the frame. During the exposure, just move your hand into the light path until a shadow falls across the shadow area. Then move your hand out of the light path. Continue moving your hand in and out of the light path during the exposure.

However, it's more difficult to dodge a small area within the picture. Your hand may not make the best dodging tool. To dodge small areas, you might want to make a dodging tool like the one shown in Fig. 57. Here, we've just taped a piece of black paper to a wire handle.

During the exposure, insert the dodging tool into the light path — until the shadow of the tool falls over the area you want to dodge. Be sure you keep the dodging tool in motion. If you don't move the dodging tool, you'll get a thin white line across the print — the shadow of the wire handle.

You can control the shadow by the position of the dodging tool relative to the enlarger lens. Holding the tool close to the lens results in a larger, soft shadow. As you move the tool closer to the paper, the shadow becomes smaller and harsher.

How long should you actually dodge an area? The longer you dodge with respect to the total exposure, the lighter the dodged area becomes. If your total exposure is only 5 seconds, very briefly dodging the print makes quite a difference. But if you're using a long exposure time, you'll have to increase the length of time you dodge. Getting the results you want may take several tries.

Burning-in

You dodge the print during the exposure. But you burn-in a print after the exposure. Burning-in adds light to select areas of the print. You can then give a longer exposure to that area.

For example, a burned-up highlight may show very little detail. Perhaps the sky in a scenic picture is too burned up to show cloud detail. Yet increasing the total exposure makes the foreground too dark. You can then burn-in the sky, giving the sky a longer exposure than you give the foreground.

Base your initial exposure on the rest of the picture — the areas you don't want to alter. After you've exposed the paper, cover the enlarger lens with your hand. Turn on the enlarger lamp using the focus control. Now move your hand until light spills onto the area you want to darken, Fig. 58.

By partially covering the lens, you can prevent light from reaching the remaining portions of the picture. Keep your hand in motion — in and out of the light path — to provide a blend of tones. With a short overall exposure, it may only take a brief flash of light to get the amount of darkening you want. But with a longer exposure, you may have to burn-in the area several times.

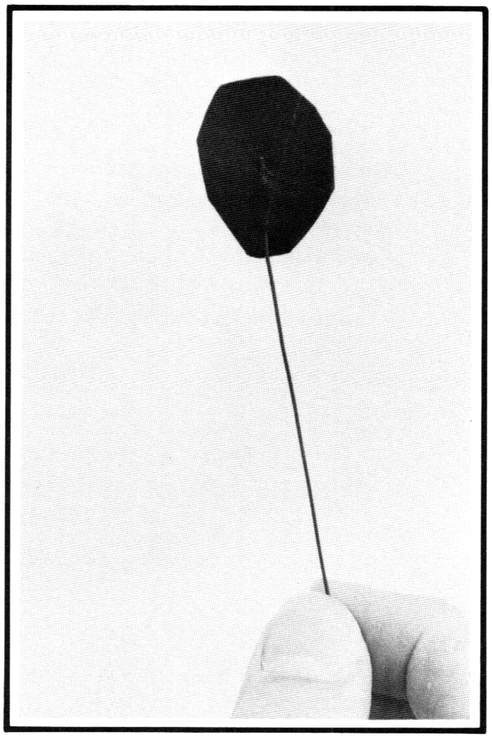


Figure 57

Figure 58

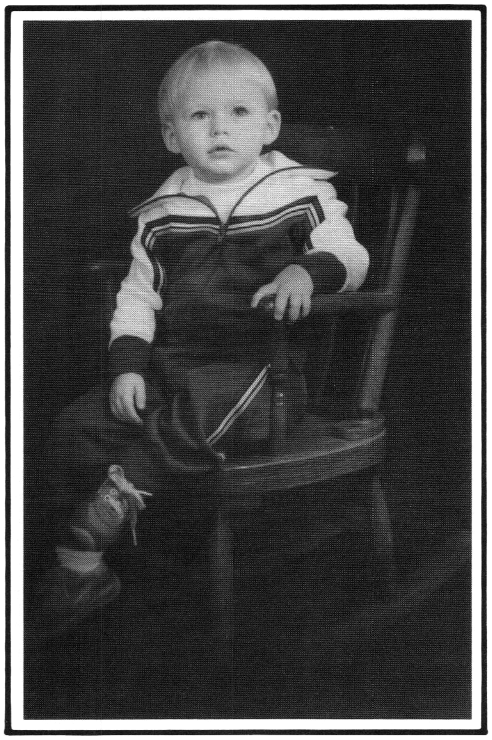


Figure 59

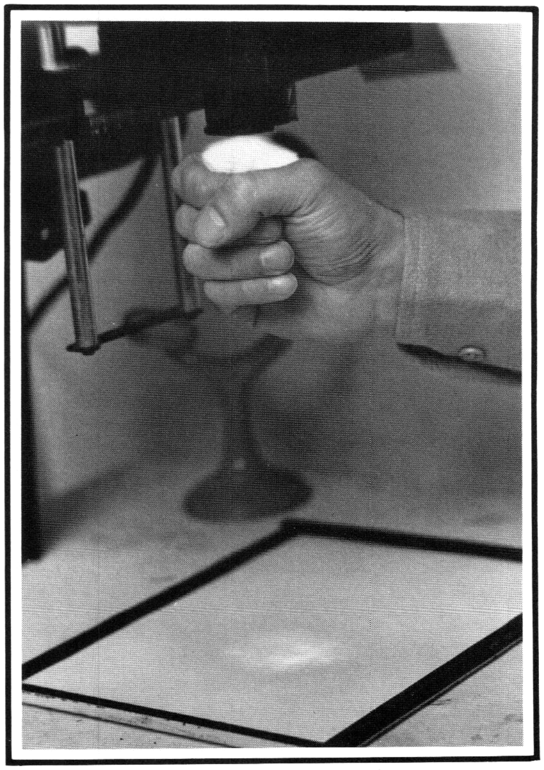


Figure 60

You can also use burning-in to produce a dark vignette. By burning-in the four corners of a portrait, you call attention to the subject's face. In Fig. 59, we burned-in the bottom of the print to produce a bottom vignette.

It's a little more difficult to burn-in areas within the picture. Perhaps there's a burned-up highlight toward the center of the frame. You can then form a funnel with your hand, Fig. 60. Use your cupped hand to direct the light beam to the specific area you want to darken. Alternately, you can use a piece of paper with a hole cut in the center.

Vignetting

A piece of paper with a hole in the center also makes a good tool for producing a white vignette. Expose the print through the hole, using the paper to hold back light from the rest of the picture. Since the edges then receive no light, they remain white after development — a white vignette, Fig. 61.

Continue moving the paper during the exposure. The vignette then fades gradually to white.

Soft Focus

There are several techniques that soften the focus during printing. Perhaps the best technique is to print two frames — a sharp image and an out-of-focus image — on the same piece of paper.

First print a sharp, slightly underexposed picture. Then, without moving the paper, turn the focus control of your enlarger. And print the second image — an out-of-focus image — on top of the sharp image.

You can control the amount of softening by the length of the second exposure. For a slight soft-focus effect, use a relatively short exposure time for the out-of-focus image (compared to the exposure time for the properly focused image). Increase the length of the second exposure for a softer image.

Another technique is to diffuse the light for part of the exposure. A piece of crumpled cellophane makes a good diffuser. During the exposure, move the cellophane into the light path. Keep the cellophane moving within the light path to diffuse the light.

If you expose through the cellophane for the entire exposure time, you get the maximum softening effect. You can vary the effect by the length of time you keep the cellophane in the light path. The longer you keep the cellophane in the light path (with respect to the total exposure time), the softer the image.

Texture Screens

A texture screen is a piece of transparent plastic with a dark pattern. Just place the texture screen on top of the easel before you make the exposure. You're then exposing the paper through the texture screen.

Since light doesn't pass through the dark areas of the pattern, the texture appears white on the print, Fig. 62. You can get texture screens with different patterns. However, using a texture screen does require a slight increase in the exposure time.

Figure 61

Solarization

Solarization refers to the complete reversal of negative tones due to extreme overexposure. It's almost impossible to demonstrate solarization. But you may have seen a touch of solarization in a negative that includes an image of the sun. If the sun appears as a white or gray dot (rather than a black dot), the negative tone has been reversed by solarization.

Although solarization exists mostly in theory, photographers often use partial reversal for special effect. The process, called the Sabattier effect, causes highlights and shadows to appear the same tone. Halftones, appearing in various shades of gray, form the image. The end result looks almost like a line drawing.

The partial reversal of tones is caused by re-exposing the film to white light during development. First you partially develop the film. During this first development stage, the highlights develop fully. However, you take the film out of the developer before the shadows are affected.

Next you rinse the film to remove the developer. Then you expose the film to white light. The highlights, already fully developed, aren't affected by the re-exposure. But the shadows are affected.

When you return the film to the developer, the shadows develop until they're just about as dense as the highlights. The halftones, affected in varying amounts by the re-exposure, are really unpredictable — you don't know what you're going to get until you fix the negatives.

The fixed negative now looks like a white line drawing on black. When you print the negative, the highlights and shadows both appear almost white. The darker halftones form the image — an almost surreal effect. But the whole process takes a lot of experimentation — the length of the first development time, the length and intensity of the re-exposure, the length of the second development time. If you have a lot of spare darkroom time, the experimenting may be of interest.

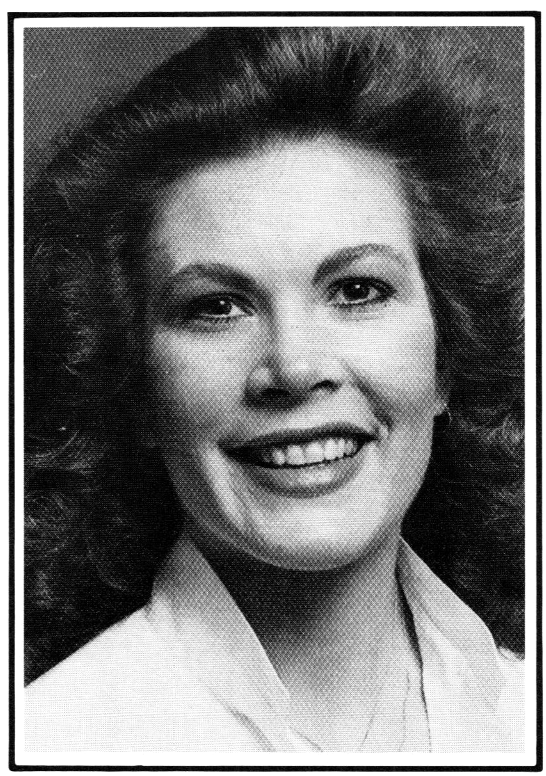


Figure 62

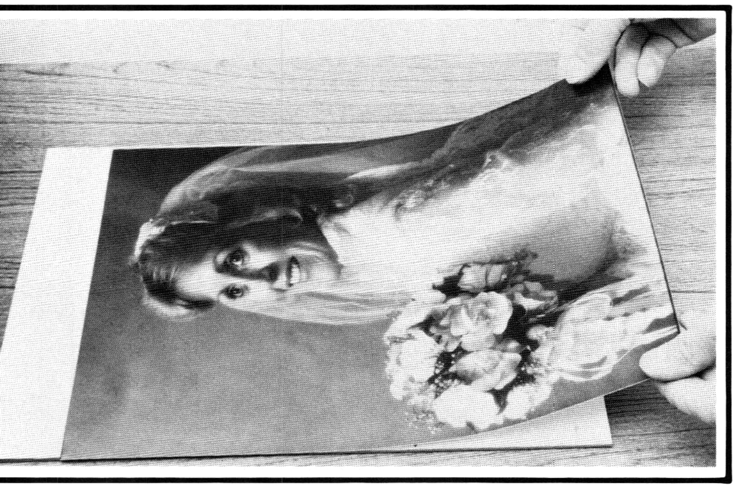


Figure 63

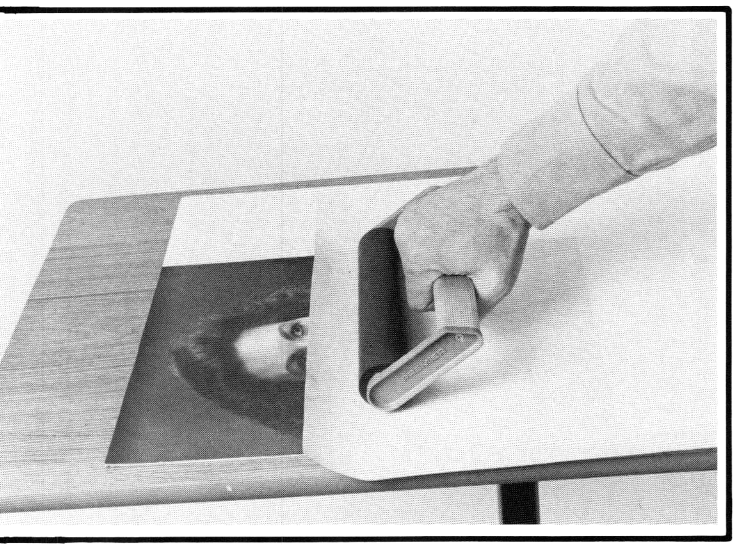


Figure 64

MOUNTING AND FINISHING THE PRINTS

For a display picture, you should mount the print on mounting board. Mounting board is a special cardboard stock, Fig. 63, that accepts the mounting adhesives. Even a print that's going to be framed should first be mounted.

There are two techniques generally used for mounting prints — dry-mounting and wet-mounting. Dry-mounting uses a heat-sensitive tissue between the print and the mounting board. When you apply heat, the dry-mounting tissue forms a bond.

With RC papers, excessive heat will damage the print. Wet-mounting then provides a safer technique. Wet-mounting uses an adhesive spray. Since the spray has an acetone base, be sure you use a well-ventilated area. Spray the back of the print and the front of the mounting board with the mounting spray.

Then carefully align the print with the mounting board. Once you touch the print to the mounting board, the adhesive makes an instant bond — you can't pull loose the print to correct the alignment. Since the initial alignment is so critical, you may wish to use oversize mounting boards. You can then trim the boards after mounting the prints.

Start by aligning and mounting the corners at one side of the print. Then lay the print over the rest of the mounting board. To assure that the entire surface makes good contact, use a rubber roller, Fig. 64. Place a piece of protective tissue on the front of the print. Then run the roller over the entire surface.

Besides being mounted, display prints should normally be lacquer-finished. The lacquer finish protects the print from fingerprints and other damage. It also reduces glare from room lights.

The lacquer finishes come in spray cans, Fig. 65. For portraits, you may prefer the matte spray which gives a matte (dull) finish to the print. Or, to retain maximum brilliance, you can use the lustre spray. Any of the lacquer finishes, however, will slightly reduce the print brilliance.

To apply the spray, position the print at an angle of approximately 30°, Fig. 65. Working from side to side, spray the print from top to bottom in overlapping strokes. Keep the spray fairly close to the print as shown. If the spray has to travel too far, it may dry before reaching the print. The finish then has a gritty appearance.

Make sure you use a well-ventilated area for spraying — the fumes can be harmful. Also, your area should be at room temperature. If the area is too cold or too humid, the finish may turn white.

After spraying the print, let the finish dry for a few minutes. Then repeat the process for a double coat. Your print now has a durable protective coating that'll endure most abuse.

SPOTTING PRINTS

Dust spots on the negative cause white spots on the print. A negative defect, such as a scratch in the emulsion, will cause black spots on the print. By spotting the print, you can remove these small imperfections.

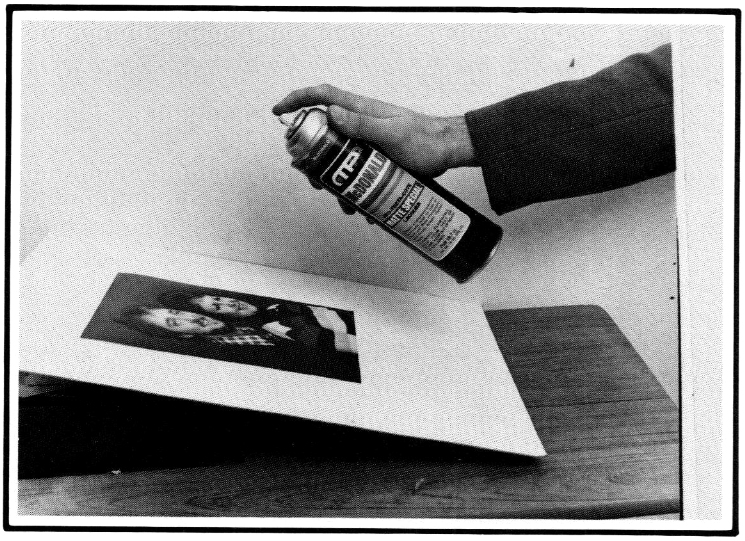


Figure 65

Figure 66 The retouching lacquer gives the print "teeth" to accept the retouching pencils.

To remove white spots from a B&W print, use spotting dye or a soft pencil. Apply the spotting dye with a fine camel-hair brush moistened with water. By mixing the spotting dye with water, you can control the dye's density — the greater the ratio of water to dye, the lighter the shade.

The trick in spotting is to build up the tones gradually. Don't try to simply paint over the white spot. Rather, build up the dye in gradual layers until the shade matches the surrounding area. Alternately, you can use the spotting pencils in the same manner.

To remove black spots, you can use an etching knife. Carefully scrape away the emulsion in gradual layers until the spot matches the surrounding area. Another technique is to use a special bleach such as Spot Off Bleacher.

Retouching pencils probably provide the easiest technique for spotting color prints. The pencils come in a variety of colors. To remove a white spot, select the color that matches the surrounding area in the print. Then gradually build up the color over the white spot. For a black spot, use the white pencil — make the black spot a white spot. Then use the colored pencils.

If your correction appears too harsh, lightly rub your finger over the retouched area to blend in the color. The pencils even allow room for error. If your correction doesn't match properly, simply erase the pencil and start over.

Most color papers, however, won't accept the pencil unless you first treat the print surface. A retouching fluid, Fig. 66, gives "teeth" to the print. The pencil then adheres to the surface.

Spray on the retouching fluid just as you would apply a lacquer finish. Allow the spray to dry and then make your pencil corrections. If you have to apply a lot of pencil, you may reach a point where the print will accept no more. You may then have to apply another coat of the retouching fluid.

You can also use the retouching pencils for larger corrections, such as reflections in eyeglasses. It's difficult to make a perfect correction unless you're an accomplished retoucher; with careful examination, you'll probably be able to see the correction. However, you can normally hide the pencil work by applying a lacquer spray.

With a little practice, most photographers can do their own pencil work on prints. Negative retouching is a different matter. Learning to retouch negatives requires a lot of practice and special training.

Most negative retouchers use a machine that holds the negative under magnification. The retoucher applies the negative dyes using a fine brush. But the brush hand rests on a vibrating platform. The machine then vibrates the retoucher's hand at a rate that causes the dyes to blend naturally with the surrounding emulsion.

COLOR PROCESSING

Equipping your darkroom for color processing can be a major investment. Even if you don't want to undertake color work, though, you should have an understanding of the processes.

In color processing, times and temperatures become more critical. It's therefore desirable to have a temperature-control unit attached to the darkroom sink. The temperature-control unit monitors and corrects the water temperature.

Agitation is also more critical with color film. When you pour solution into the light-trap top of the tank, the chemical doesn't reach all of the film area at precisely the same time. That's no problem in B&W work. But color film will show the effects of uneven agitation and chemical contamination much more noticeably.

A better technique is to use separate tanks for each solution. Working in complete darkness, plunge the loaded film reel into the first tank. The film then receives an even start in the developer. After the development time, move the reel to the next tank.

In other respects, the procedures for developing color film are very similar to those for B&W film. But more steps are involved. Different films require different "processes" — procedures and chemicals for development. You can get the processes in complete kits that include step-by-step instructions. For example, the C-41 process for Kodacolor II, Vericolor II, and Vericolor III has four chemicals and seven processing steps.

Besides the developer and the fixer, the steps include a bleach and stabilizer. The color-negative film has three layers, Fig. 67. In each layer, the silver salts are selectively sensitized to respond to different regions of the color spectrum. Dyes in each layer provide the selectivity — each layer sees its respective image with practically no response to the other layer sensitivities.

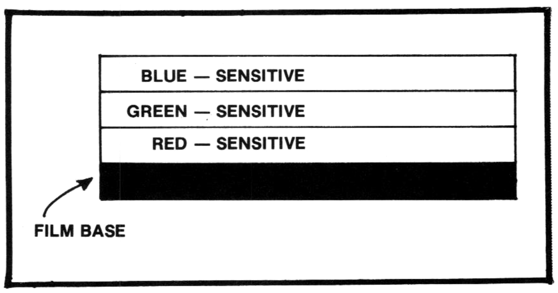


Figure 67

Fig. 67 shows the normal sequence of the three layers. The red-sensitive layer nearest the film base produces a cyan image, the complement of red. Green objects in the scene record in the green-sensitive second layer as a magenta image. And the blue-sensitive layer produces a yellow image of blue objects in the scene.

During processing, a bleach removes the dyes and the fixer removes the undeveloped silver salts. If you could strip the three layers apart, you'd have three separate images — a cyan image, a magenta image, and a yellow image. Working together, the three layers produce the full color spectrum.

Since the image appears in complementary colors, it's a little more difficult to "read" a color negative for proper contrast and exposure. Further, the color negative has an overall orange cast that comes from a built-in color-correction mask. Practically all color films have the dye-forming substances in the emulsion layers. With positive films, the dye-forming substances have to be colorless. But since color negatives aren't intended to be viewed, the dye-forming substances can have the orange cast.

COLOR PRINTING

There are many systems available for processing color prints. You can tray-develop the color paper just as you do with B&W prints. Or you can simplify the procedure by using a color processor, a machine that does practically all of the work for you. Kodak's Ektaflex system, for example, handles the print-processing with just one solution.

But even a color processor can't make color printing as easy as B&W printing. The reason is that your color negative won't exactly match the print material to give correct color balance. There are too many variations for an exact match — the various lighting conditions under which you shot the film, variations in film and print material, processing differences, etc. So, during printing, it's necessary to filter the light according to the individual negative.

The enlarger for color printing has a color head — a head that includes or accepts color filters. A dichroic head has built-in dichroic filters ("dichroic" refers to a type of filter that won't fade with age). But you can also use an enlarger that has a filter drawer — a drawer that holds color-correction filters between the light source and the lens.

There are two basic filter systems for color printing:

1. the additive system

2. the subtractive system.

An enlarger equipped for additive printing has three filters — a red filter, a green filter, and a blue filter. Mixed together in equal parts, the three colors produce white. You then expose the paper once through each filter. The length of each exposure determines how much of each color the paper sees. If the print appears too yellow, for example, you can increase the length of the blue-filter exposure.

But the additive-system enlarger may not require three separate exposures. The design shown in Fig. 68 has three separate lamps in the head — each lamp simultaneously projects a different color through the negative. An electronic control determines the length of the exposure for each lamp.

With the subtractive system, the enlarger has three filters in complementary colors — cyan, magenta, and yellow. These filters subtract colors from white light. If you use all three filters together in equal balance, you subtract all the colors and get black.

Besides the different colors, the filters come in different densities. You can thereby subtract the amount of each color you want. Suppose that the light passing through the negative is too blue. You might then increase the density of the yellow filter. The yellow filter subtracts its complementary color — blue — from the light.

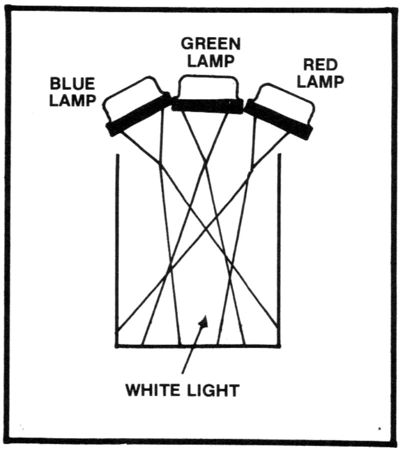


Figure 68 Additive Enlarger Head

An enlarger with built-in filters has three separate filter controls. You can then dial in the desired amount of filtration in each color. Or, if your enlarger has a filter drawer, you can use CP (color printing) filters. The CP filters range in density from 0.05 to 0.50 in different colors. A lower density means that the filter subtracts less light.

If your enlarger doesn't have a filter drawer, you can get a filter holder that attaches to the front of the lens. But now you need the CC (color correction) filters. Since the CC filter sits in the image path, it must be of higher quality than the CP filter. And that means the CC filters are more expensive.

CC and CP filters follow a uniform system for identification. Each filter has a number and a letter, like 40Y. The number tells you the density — in this case, 0.40. The letter indicates the color — Y for yellow, R for red, etc.

You can get by without cyan filters. But you will need magenta and yellow filters in densities of 05, 10, 20 and 40 each. You can then use filters in combination to get other densities. For example, adding the 5Y and 20Y filters results in a density of 25Y.

It's also helpful to have a couple of red filters like 20R and 50R. Why red? If you mix equal amounts of magenta and yellow, you get red. Suppose that you need a 20Y and a 20M (magenta) in the filtering system. Those two filters together have the same effect as a 20R filter. You can therefore use one red filter to replace the two complementary filters.

In addition, you should use the ultraviolet filter to absorb ultraviolet light. You might mount the CP 2B ultraviolet filter permanently above the negative carrier.

The problem now is determining what filter combination you need for a particular negative. A professional color lab normally uses a video analyzer. The video analyzer works like a color TV, providing a video picture from the negative. It's only necessary to adjust the analyzer controls until the colors look right. The control settings then show the color corrections needed.

A home-darkroom enthusiast probably can't justify the price of a video analyzer. Other types of analyzers work on a center-the-needle concept. A probe sits on the easel. When you then project the negative through the enlarger, you can adjust the individual filter controls. Zero the needle for each of the three filter colors. The filter controls then tell you what settings to use on the enlarger or what CP filters to use.

But even the color analyzer can't decide how the print should look. First you must program the analyzer — tell it what you're looking for. Programming the analyzer requires making test prints. Once you determine the filter combination that gives you the colors you want, you can program those settings into the color analyzer. Now the color analyzer can determine what correction is needed for other negatives you want to print.

A similar type of instrument — a densitometer — enables you to determine proper exposure. Changing the filtration changes the amount of light reaching the paper. Each filter change then requires exposure compensation. After you select the proper filtration, you can place the densitometer probe on the easel. Project the image and stop down the diaphragm until the densitometer needle centers. The diaphragm is now at the proper setting for the particular negative and filter combination.

Such sophisticated equipment doesn't always eliminate a test print. Chances are your first print will still need some correction. But the equipment does eliminate a lot of wasted paper from trial-and-error procedures.

To make a test print from scratch, you might use a standard starting pack — a filter combination of 50M plus 50Y. Focus the negative at the magnification you want for the final print. Then make an exposure-test strip as described in B&W printing.

Let's say you're making an 8 x 10″ print of a "normal" negative. You might use f/11. And make separate exposures for 5, 10, 15, 20 and 25 seconds on a piece of 8 x 10″ paper. After you process the test strip, you can judge the proper exposure time. Also, the color balance should be fairly close.

But you'll probably have to make some adjustments to the filtration for proper color balance. Changing the filters to correct the color balance requires a change of exposure. If you subtract filters, you need a shorter exposure. You need a longer exposure if you add filters.

Suppose that your best exposure strip is the 10-second one. However, that strip is slightly too red. For your next attempt, try adding 10M and 10Y. And increase the exposure time to 12 seconds.

Here's how you can correct the color balance by using yellow and magenta filters:

1. If the print's too yellow, add a yellow filter. If the print's too blue, subtract a yellow filter.
2. If the print's too red, increase the yellow and the magenta. Subtract yellow and magenta if the print's too cyan.
3. If the print's too green, subtract magenta. Add magenta if the print's too magenta.

The job of color-correcting becomes much easier with a set of viewing filters. It's pretty tough to look at a test print and determine that it needs 10 less yellow or 20 more magenta. The viewing filters help you decide how much correction you need.

Viewing filters come in different densities in cyan, magenta, yellow, blue, green, and red. Just look at the print through the viewing filter. Change and combine viewing filters until the colors appear the way you want.

The viewing filter that provides the proper correction tells you what colors to add or subtract. Subtract the color of the viewing filter. Or add its complementary color.

Suppose, for example, that the test print looks too blue. You know that you must subtract yellow from the enlarger's filter system. How much yellow? Try viewing the print through a yellow viewing filter.

It makes a difference if you hold the viewing filter in contact with the print or some distance from the print. When you hold the viewing filter against the print, the calibration on the viewing filter indicates the correction needed. Perhaps the print looks best when you're holding the 20Y viewing filter against the print. In that case, subtract 20Y from the enlarger's filter system.

If the colors look better when you hold the viewing filter away from the print, don't make the full correction. The separation between the print and the viewing filter makes a difference. Make your correction half the density of the viewing filter.

SUMMARY

A camera-repair shop doesn't need a fully equipped darkroom. But you should have some way of quickly developing B&W film for test purposes. Also you should have a good understanding of darkroom techniques to help in distinguishing between camera error and processing error.

You can get by without a darkroom. Load the film tank inside a changing bag, a lighttight bag with arm holes. Then do the processing in the light. But if your interests go beyond developing test film, you'll need the following equipment for your darkroom: a film tank and reel, a darkroom timer, a graduate and stir rod, a darkroom thermometer, film hangers, and soft sponges. In addition, you'll need the following chemicals: a film developer such as D-76, a fixer, and a wetting agent such as Photo-Flo.

To print in B&W, you need: an enlarger, negative carrier, four trays, an enlarger timer, an easel, a safelight, and the chemicals — a paper developer such as Dektol and a fixer.

If you gain some experience in processing, you'll find it easier to analyze customers' negatives. A very dense negative indicates overexposure — possibly a camera error. But a very contrasty negative indicates overdevelopment, a processing error. Similarly a thin negative indicates underexposure, while a flat negative indicates underdevelopment.

The developing time and developer temperature affect both density and contrast. At a higher temperature, the developer works harder. Time-and-temperature charts show you the proper combinations for a particular film. The ideal temperature for B&W processing is 68°. But you may wish to shorten the development time by using a higher temperature for test negatives.

Fix the film for five minutes. The fixer clears unexposed silver halides, hardens the emulsion, and makes the image permanent. For test film, you can shorten the fixer time to around four minutes. Your test negatives don't have to last forever; you'll probably just look at them once.

The advantage of doing your own printing is the control you have over the finished result. The most valuable custom-printing techniques are dodging and burning-in. To dodge a print, hold back light from select areas during the exposure. To burn-in a print, add light to select areas after the exposure. Remember to keep your hand in motion while dodging or burning-in. If you've done the job properly, nobody will be able to detect your handiwork.

Color processing adds to the needed hardware. To do color printing, you need a color enlarger and a color analyzer. If you enjoy darkroom work as a hobby, you'll probably want to advance from B&W to color.