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To the Girls

Chiara Lue and India Simone

Preface

Though it seems as if the world of photography is constantly changing, in fact, very little of the basic process is different from the one invented by Henry Fox Talbot in the nineteenth century. This is especially true for darkrooms. (See the illustrations, on the next few pages, of the darkroom of the 1880s—look familiar?) Yes, there are different kinds of materials and new, fancier equipment used in making images, but mostly things have remained the same—negative, paper, three chemicals. However, there is now the beginning of a revolution in photography—the digital photographic revolution. Even though this revolution has not impacted most amateur photographers it will not be long before its effects will be felt by all of us. In recognition of this, and in an effort to keep up with some of the new types of materials—especially the Kodak RA color system—and to eliminate some outdated equipment, the authors have decided to issue an updated version of this book. To address heightened concerns about the environment, the new version also contains a section on the environmental impact of the darkroom.

A positive side effect of the digital revolution in general has been the ability for people all around the world to communicate quickly and inexpensively through the Internet. Images, as well as ideas, can now be swapped across continents without the need for packaging, mailing, or even leaving your home. In an effort to take advantage of these new possibilities, we've replaced the chapter on "Darkrooms of the Professionals" with "Darkrooms Around the World." Many of the images in this section were transmitted to the authors from across the planet via the Internet. They were then converted to B/W and enhanced using Adobe Photoshop (See Chapter 11, "The Digital Darkroom") where necessary.

As with previous editions, this book is still for those who wish to resist the temptation to let the camera and the photofinisher do all the work in making photographs. It is for those who want to experience the full range of the photographic process.

The professional, the advanced amateur, or the merely curious realize that the only way to make a photograph look the way they want it to look is by making it themselves. Negatives or slides are only the starting point in producing an image that conveys a desired feeling or idea. The machine processing available from commercial sources, while sometimes remarkably good, is always set to a mechanical standard. Custom processing, even if you could convey exactly what you want the print to look like, is generally too expensive. The best solution is to build your own darkroom, ensuring that, with some practice, the print you obtain is the one you want.

Building a darkroom can be an intimidating thought. The information on how to do it well is scattered throughout photographic literature. The vast majority of this information has traditionally been transmitted verbally from one photographer to another. The Darkroom Handbook was the first serious attempt to gather together in one source the ideas and techniques that have been developed over the years by trial and error. It was the result of the efforts of many photographers who have overcome the difficulties of locating a darkroom in a bathroom, kitchen, bedroom, or basement of a house or apartment. Almost any problem you might encounter in building a darkroom has been encountered by others and successful solutions have been devised. This book is a compilation of those successful solutions from which you can benefit.

Those interested in building a darkroom are confronted with many problems, such as: where it should be located; installing partitions, plumbing, and electricity; and choosing appropriate darkroom equipment. This book is a comprehensive treatment of darkroom design, construction, and equipment. It is the end result of the trials and tribulations of many people who discovered solutions after long hours and many mistakes, and who have also been willing to share this information freely with others. New products have been included and products no longer available have been dropped. The primary criterion for a product's inclusion rests with its proven acceptance and reliability. It would not be possible to include all of the products that are available today, but you can be assured that those featured here are produced by reputable manufacturers. The introduction of Kodak's RA color-processing system has further simplified and improved the technique of color printing and is treated herein for that reason.

A new section has been added to cover some of the possibilities allowed by the greatest change to photographic processing that has occurred since the last edition of this book—the ability to digitize a photograph and manipulate it with a desktop computer. It is no longer necessary to have the resources of a major film studio or printing company to be able to afford a machine that will allow you to have a new and almost unlimited type of control over an image. This change brings with it new equipment requirements for processing images. Inputting images into a computer and outputting them (the counterpart to traditional printing) are handled by equipment that works without the necessity of a dark space. There are no real chemicals, but now we must deal with inks. What will the new "darkroom" be called? Only time and the imagination of its users will tell.

Introduction

Throughout the history of photography, the process of producing a photographic image has been split into two parts—one done in the camera and the other in the darkroom. It is not always easy to decide which has more effect on the final "look" of the photograph. With the camera, one makes an initial decision that has a profound effect on the image—choice of subject, composition, and so on. The options for altering the image, and thus how it is perceived, that are provided by the darkroom (tone, contrast, density, cropping, etc.) can have an equally profound effect. In this age of the digital manipulation of images, the actual photograph may only be the raw material in the production of a much more complicated image.

Both cameras and darkrooms can be extremely crude and still produce fine images. Many of the great images throughout the history of photography have been produced in odd darkrooms under the most trying circumstances. Some have even been scary. Imagine using a darkroom wagon pulled up to the battlefield during the Civil War. While shells burst outside, you are desperately trying to coat a glass plate to be used in the camera, or developing one just exposed! All the while, you are making sure the entire plate is still wet! However, a good camera and a good darkroom allow the photographer to concentrate on what is really important—the process of producing an image. While it would be difficult for most of us to build a camera (barring those enduring pin-hole cameras), the building of a darkroom can be both easy and satisfying. It separates the total amateur from the serious photographer. Building your own darkroom is a rite of passage to a new world of possibilities.

It is the purpose of this book to make that passage as simple and satisfying as possible. This book uses ideas that have been tried and used successfully by other photographers to produce darkrooms that are functional, personal, efficient, and inexpensive. It shows how to tailor your darkroom to your space, wherever that might be.

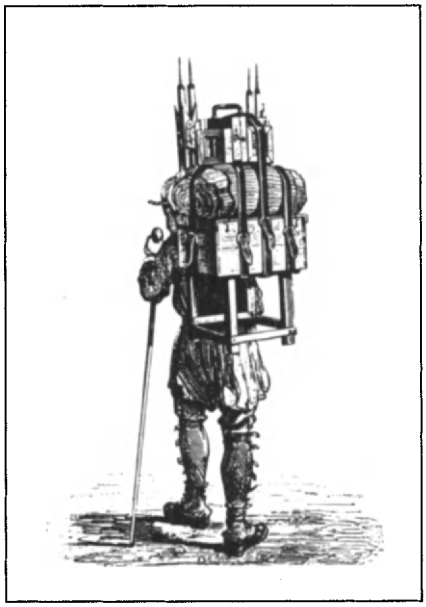
Because a significant part of the time in producing an image is spent in the darkroom—the time in the camera may only be 1/125th of a second!—all obstacles to the pleasant and efficient workings of that space should be removed. Planning and forethought are the essential ingredients to the successful completion of any project, and it is no less true of darkroom construction. The time spent before any physical work is done is often the time best spent. This book gives guidelines and many useful hints for planning a darkroom, and for how the resulting plan can be brought to fruition.

You should start by brainstorming and daydreaming about your ideal darkroom. Then slowly whittle it down based on the realities of space, time, and finances. The dreaming phase should not be neglected, because you may surprise yourself with what you can actually have. It often takes only a simple solution to allow yourself a luxury you once thought impossible to obtain. A darkroom does not have to be all stainless steel and fancy electronics. There is no real correlation between money spent and quality of image produced. Darkrooms have existed in all places and with all degrees of sophistication. It's not the money that makes your darkroom a great place to work, it's the planning and personal touches that make a space truly your own. Your darkroom represents your tastes and personal feelings as much as your photographs do.

In the final chapter on digital darkrooms, we will see how you may create a "darkroom" that is nothing more than a table top with a few pieces of electronic equipment on it. Under this system, there is no need to isolate yourself in a dark space, surrounded by large and sometimes noisy pieces of equipment that are based on concepts more than 100 years old. Here there are no chemicals, no odors, no skin irritations. And yet, perhaps the feeling of actually making something by hand is lost. Is the manipulation of a mouse and the insertion of a piece of paper in a machine as satisfying as working on an image under the light and time constraints of a traditional exposure? Is there more satisfaction in sloshing a piece of paper around in a series of trays? Each photographer must decide for him or herself, but there seems to be nothing quite so satisfying to human beings as actually touching things with their hands.

So, roll up your sleeves, dig in, and build yourself a darkroom.

It's easy to forget that photography today, where the taking of the picture and the development of the negative are two distinct acts, is quite different from what it used to be. During the wet-plate era of photography (c.1853-1890) the characteristics of the glass plate negatives were such that the negative glass had to be coated with the emulsion, the exposure made, and then the development completed while the plate was still wet. Since the negatives could not be taken back to a darkroom for development, the only solution was to take a darkroom along. Early photographers must have looked strange to passersby, but they did come up with creative solutions to problems that make ours pale by comparison.



A photographer of the wet-plate period loaded with camera and darkroom equipment.

Gernsheim Collection, Humanities Research Center, The University of Texas at Austin

An engraving showing a portable darkroom set up close to the camera so the plate can be coated, loaded in the camera, and then returned to the darkroom for development after the exposure and before the emulsion dried (c. 1865).

Photo, Science Museum, London

View showing William Henry Jackson's darkroom set up amongst the rocks.

R. A. Ronzio Collection

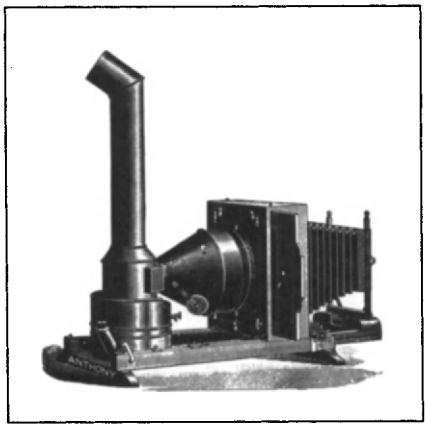
A mobile darkroom that was a step up in class from the tent; it gave slightly more comfort to the photographer.

Courtesy Colorado Historical Society

Safelights

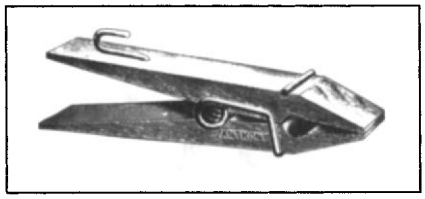
Safelights. 1880s safelights came in kerosene and candle versions.

Enlarger



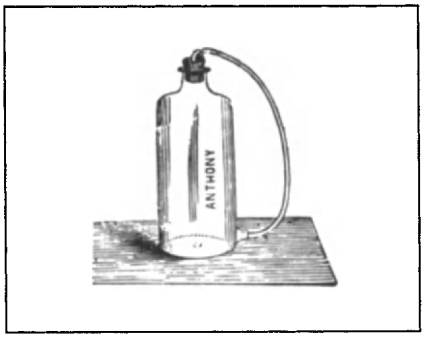
Enlarger. Since electricity was not yet widely available, even the enlarger had to be operated with kerosene.

U.S. Photo Clip



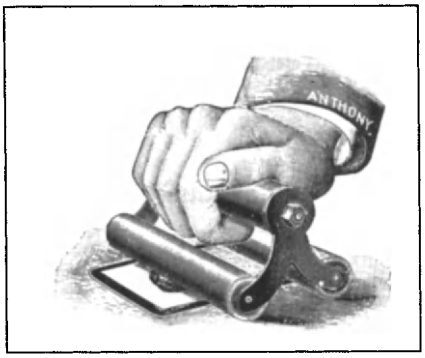
U.S. Photo Clip. Not at all unlike the venerable old clothespin still used to hang negatives and prints to dry.

Chemical Storage



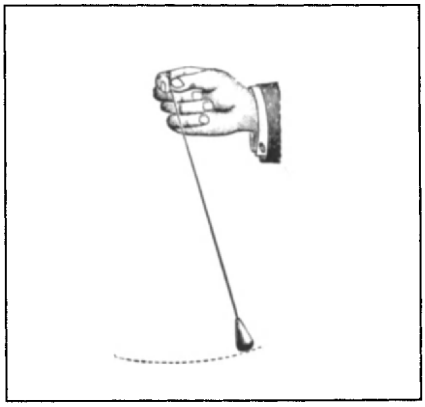
Chemical Storage. This innovative developer bottle had a tube to draw the fluid from the bottom of the bottle and a thin layer of oil on top to keep the air and developer from making contact. This enabled the developer to last longer.

Print Mounter



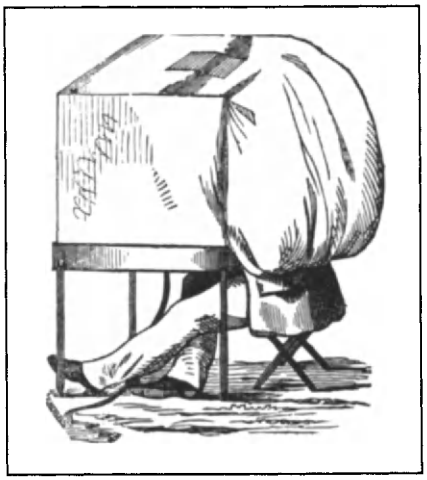
Print Mounter. This is basically the same design still used today.

Timing Plummet



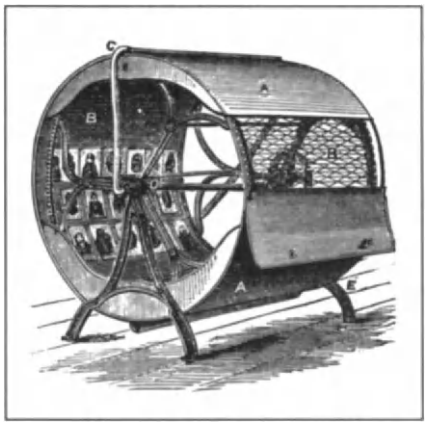
Timing Plummet. It must have been difficult to swing, count, dodge, and burn at the same time.

A Portable Darkroom Tent



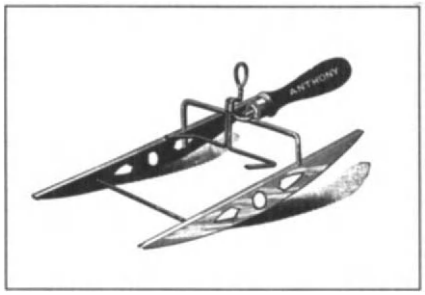
A Portable Darkroom Tent. Similar units are in use today, especially for color photography where the print is exposed, put in a light-tight drum, and then processed in daylight.

Print Dryer



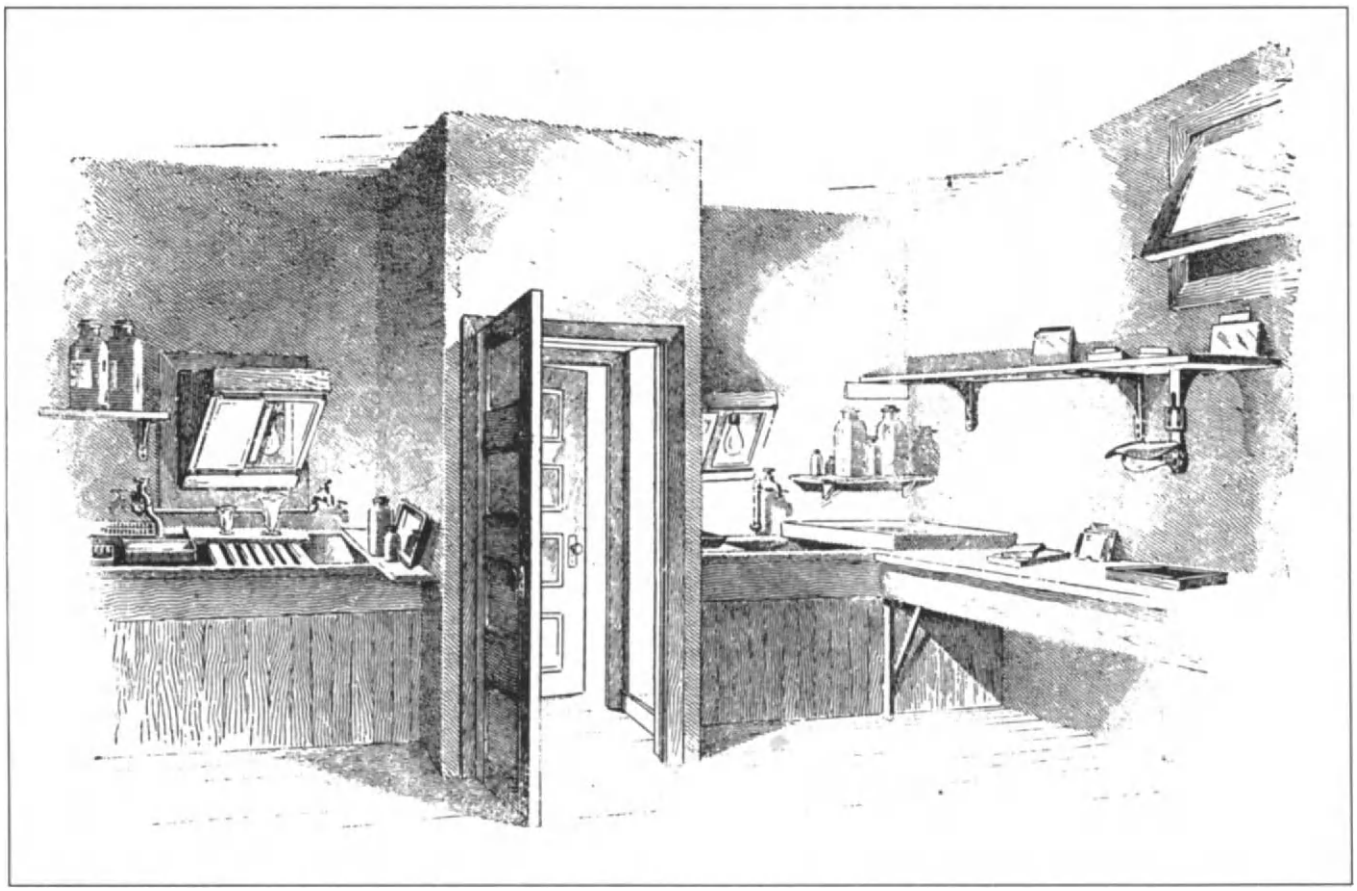
Print Dryer. This print dryer revolved increasing the air flow over the print surface to speed drying.

Allderige's Developing Rocker



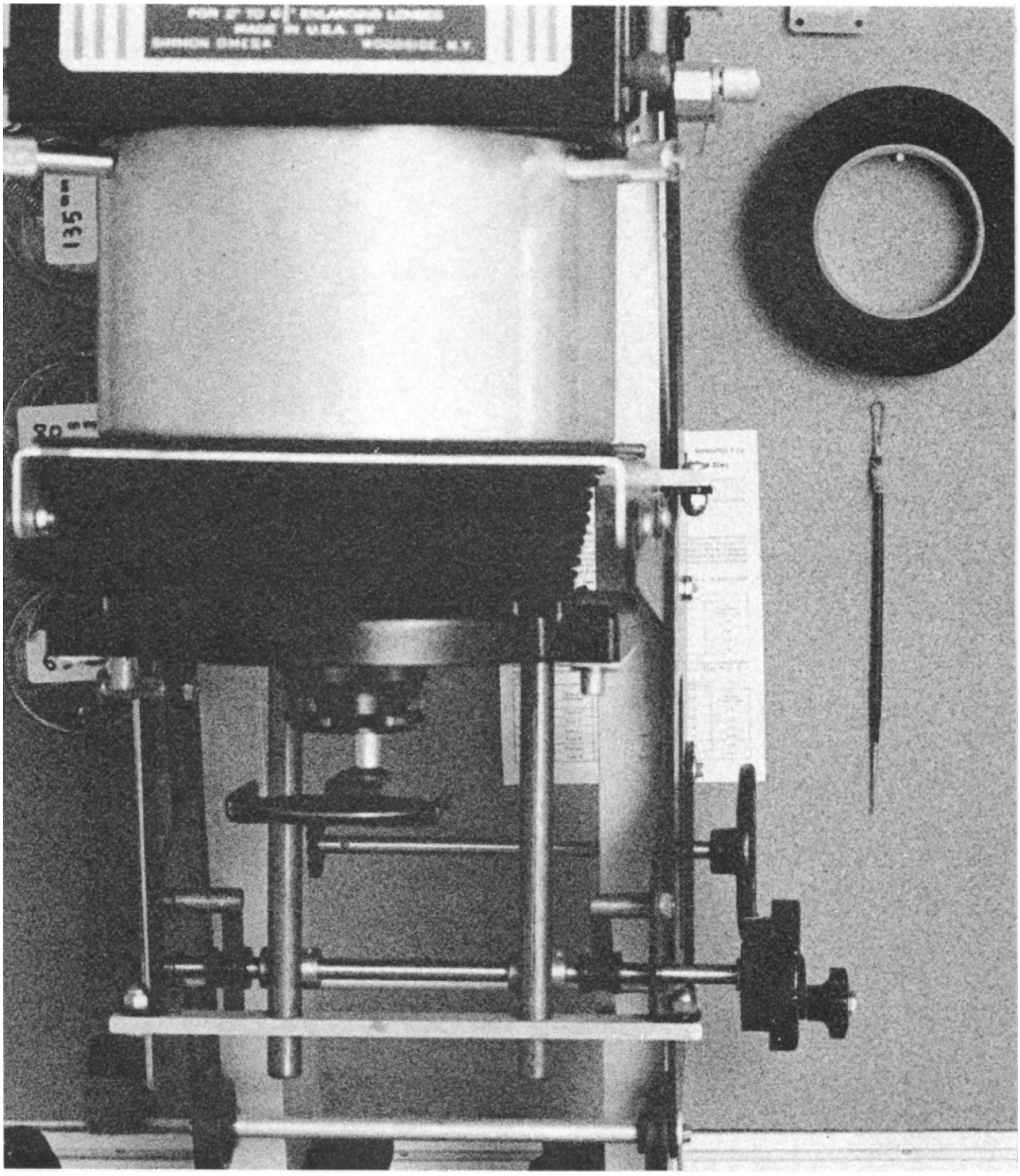
Allderige's Developing Rocker. Agitation during development was as important in the 1880s as it is today. This is the forerunner of Amblico wave trays and drum processors.

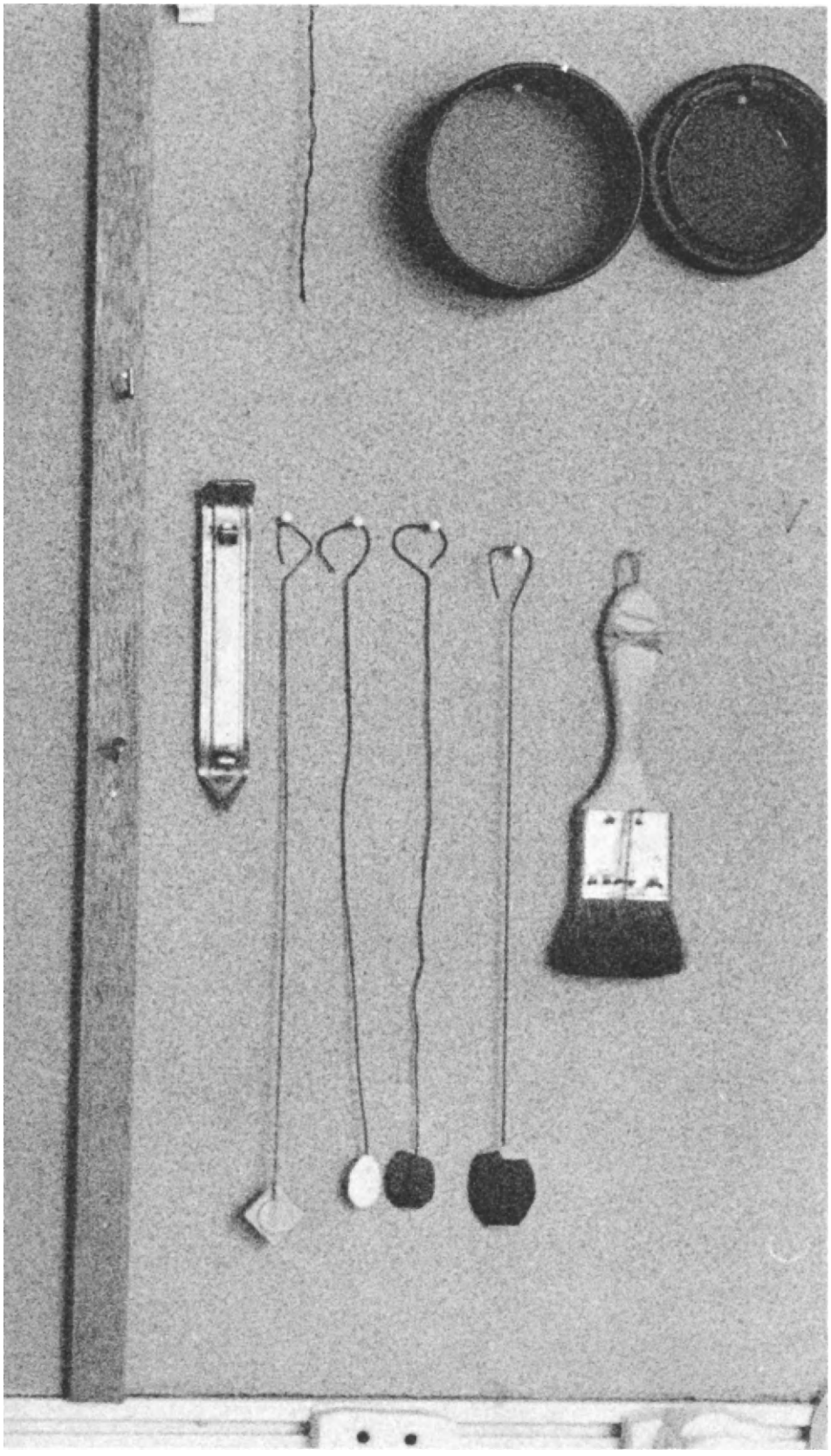
A Typical Darkroom of the 1880s



A Typical Darkroom of the 1880s. Papers were contact-printed and produced the same sized print as the negative. They were exposed in the frames mounted to the wall on either side of the door.

1 Darkrooms of the Famous





Contents

During the writing of the original *Darkroom Handbook*, the authors interviewed the photographers in this section (except Eugene Smith who had recently passed away) in person. The photographs, comments, and observations, though recorded in the present tense, are no longer current. However, the authors feel that the information contained herein is an historial document and have decided to leave it untouched.

Harry Callahan

To get to Harry Callahan's darkroom you walk up three flights of a wide-pine spiral staircase to the top of a house on a historic street in Providence, Rhode Island. Just across the hall from the darkroom is his workroom, a spacious oak-floored room with a view across Providence to the Capitol building and the hills beyond.

Callahan moved to this house in 1964. He made the down payment with money earned from selling prints. He was delighted with his darkroom, because it was the first darkroom he had with a sink in it. He had been printing for almost twenty-five years without a sink—bringing water into a room, carrying it out to dump it, washing prints in the bathroom. "I had always had just makeshift things. To have a sink was remarkable." But when he finally had a real darkroom, he laughs, "I felt I was more on the spot. I really had to produce."

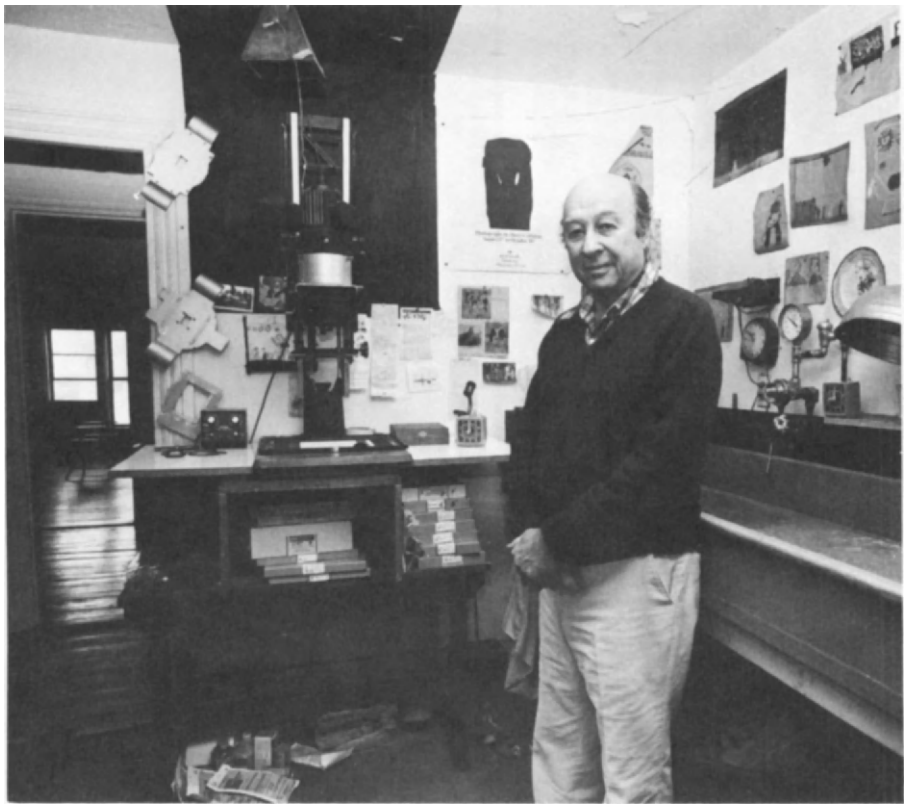
He is spending more time in his darkroom these days. The good news is that he is selling prints; the bad news is that he has to spend time in the darkroom that he would rather spend photographing. "I don't mind printing, though I've gotten tired of it lately because I've been doing so much of it. I think I like just about everything about photography. I don't even mind mixing chemicals."

He has a new washer to help cut down on the drudgery: a Zone VI workshop washer that will take about thirty 8 x 10 prints, and one that is much more efficient than his old one, which took six hours to wash twelve prints.

Other equipment that makes his darkroom work easier is a water temperature regulator (to set washing temperatures), a sodium safelight (he likes the brightness of it compared to regular safelights), and air conditioning (because the top floor of the house gets very hot in the summer). One amenity is the view from his workroom; he likes to make a print, then be able to take a little break by walking out of the darkroom to look out the window.

In retrospect, Callahan might have built a bigger sink. An 8' sink seems very big when you've never had a sink before, but in recent years the need for archival processing (which, among other things, requires two trays of fixer and a large washer) has made his sink seem too small.

Callahan never really designed his darkrooms, but just used whatever space was available. He says he knows the present darkroom could be reorganized more efficiently, especially with more shelves and better storage, but "you get used to something, you reach, and you can find it in the dark. I think I have a very dumb darkroom, but I like it."



Callahan in His Darkroom. Harry Callahan's darkroom is as warm and friendly as Harry himself is. There are no elaborate arrangements, and the equipment is as straightforward as his prints. It is clearly a room for a photographer whose ultimate concern is the print and not the hardware necessary to produce it.

The Dry Side. Harry has placed his enlarger adjacent to the sink, only a few feet from the developer tray, minimizing steps from one to the other. The enlarger is set on a sturdy table, and paper and chemicals are within easy reach.

The Too-Short Sink. The wooden sink built for Harry by a boat-builder is used to hold processing trays and a Zone VI workshop print washer. The narrowness of the sink requires that prints be processed in two cycles with a change in solutions in between.

Time and Temperature. The artwork by Harry's child when she was younger almost hides the temperature regulating valve, which Harry thinks is a great convenience, an old wall clock used to check processing times, and a somewhat battered print-viewing light.

A Gallery in the Darkroom. The wall covered with posters and announcements provides a backdrop for a stool on rollers for those long sessions at the sink, a wall-mounted air conditioner, and a wire strung across the room with film clips and clothespins used to hang negatives and prints to dry.

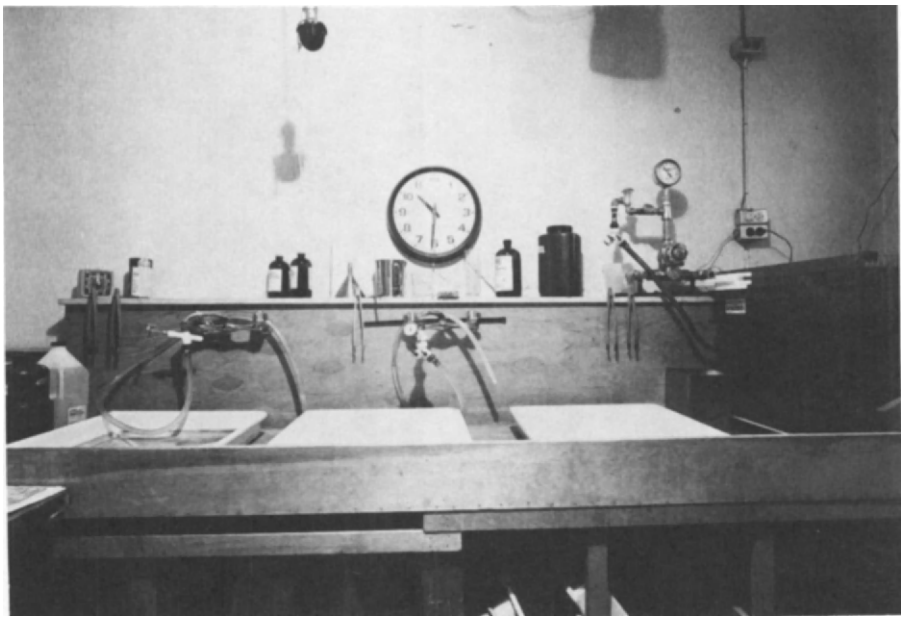
Aaron Siskind

Aaron Siskind lives on a quiet residential street in Providence, Rhode Island, a long stone's throw from Harry Callahan. Like Callahan, Siskind came to Providence to teach at the Rhode Island School of Design. Siskind is much more proficient with a camera than he is with a hammer, so much of the actual construction of the darkroom was done by his students.

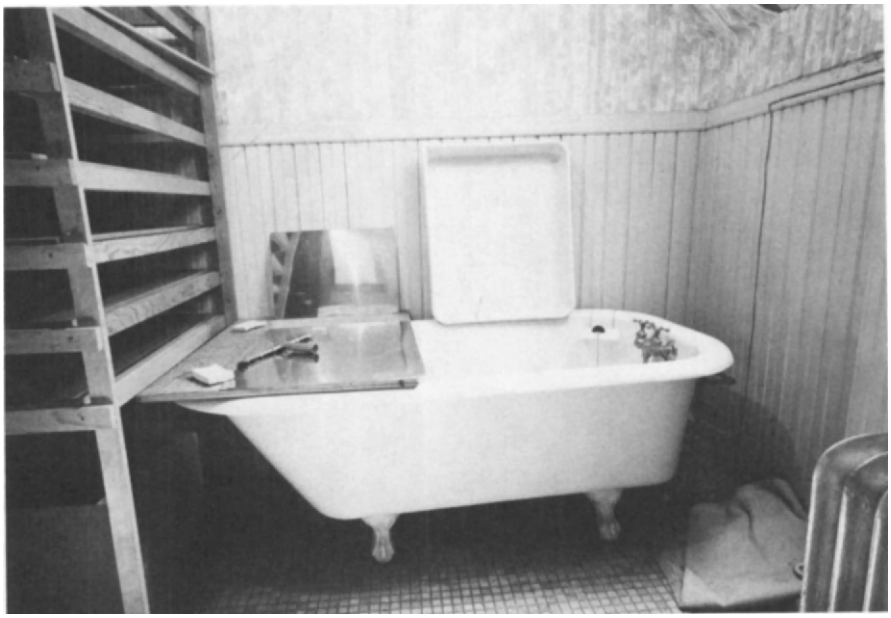
Like many well-known photographers, Siskind did not have a complete darkroom for most of his career, and within the past few years he has had both the time and inclination to construct one. The increasing sale of his prints led to long hours in the darkroom to meet the demand, and making things comfortable and efficient became of prime importance. Siskind made the entire darkroom one that could be worked comfortably from a sitting position. Both the enlarger baseboard and the sink are set lower than would be required for a standing position. In addition, the enlarger has a focus attachment that allows the machine to be focused without having to reach way up for the knob. This also allows for easy focusing when very large enlargements are being made and the knob is raised high above the baseboard.

Siskind spends a great deal of time making prints and rewashing and reprocessing older vintage prints that were made in the days before archival processing. In tune with modern theories, he no longer dry mounts; he uses his dry-mount press only to flatten prints. As he says about the new archival processing theories, "They really have us running scared."

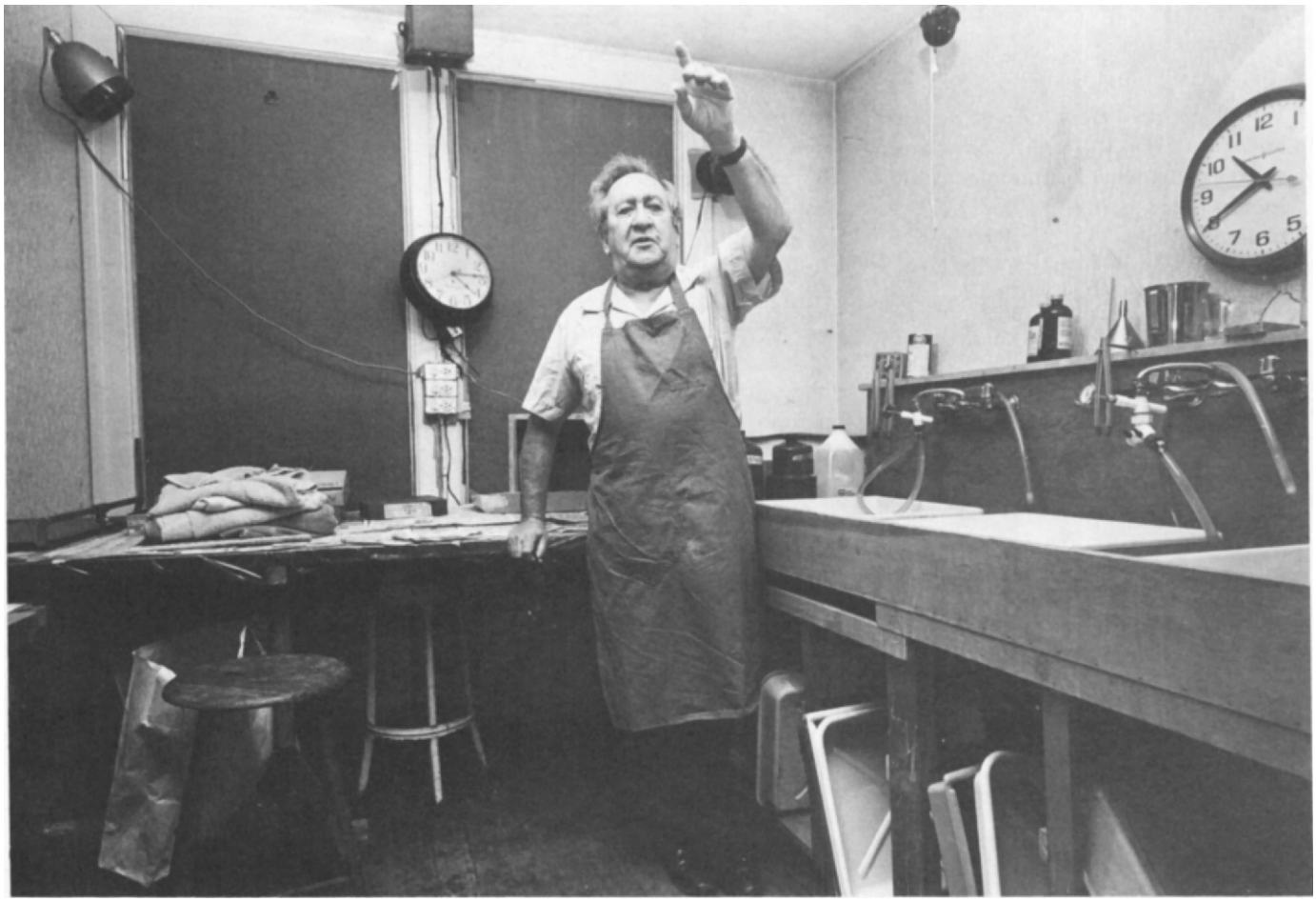
One of the unexpected fringe benefits of buying an older home was the walk-in cedar closet in which he now stores many of his own prints and prints from his collection.



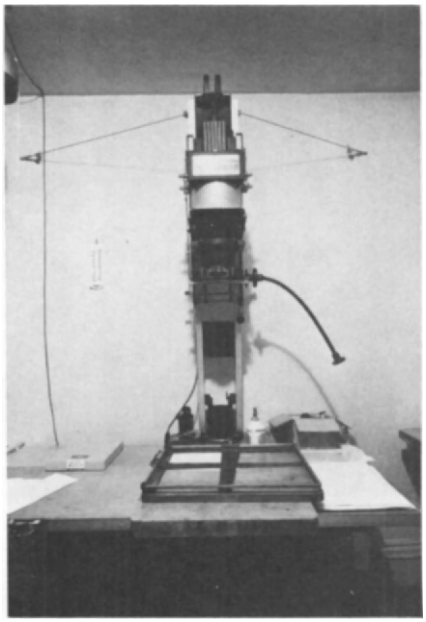
The Wet Side. The sink has several water outlets so that print washing and other processing steps can be handled simultaneously. The Zone V washer is connected to the temperature-regulating valve so that washing temperatures do not have to be continually monitored. Rubber hoses are used to connect all of the outlets and are more than long enough to reach to the floor of the sink. This arrangement allows water to be used anywhere in the sink without moving trays around and also prevents splashing. A shelf over the sink provides convenient storage of frequently used chemicals and print tongs.



Print Drying. One of the several bathrooms in the house serves the dual function of print-drying room and bathroom. Siskind denies that he dries prints while sitting in the tub, but in any event, the ferrotype plate used as a squeegee board allows the runoff water to drain directly into the tub and down the drain. The print-drying rack made from aluminum frames and fiberglass screens is conveniently located next to the squeegee area. The line above the tub can be used for drying film, and the excess water that runs off takes the same exit into the drain system.



Aaron Siskind in the Darkroom. When one is concentrating on making fine prints, everything is relative—even the time of day. If that were not so Siskind would set the clocks to read the same time. Here he stands next to the sink at which he can sit while working. "I had a student build it. I paid him well . . . but it works." The trays are stored under the sink and the room has a number of stools conveniently located. The windows have been light-proofed by nailing masonite panels over them.



The Dry Side. This view shows the Omega enlarger with a focusing extension that makes focusing easy. Siskind also uses a Micromega focusing magnifier but feels that its high degree of magnification makes it difficult to interpret. The enlarger is supported at the top of the column with picture-framing wire connected to eyebolts in the wall. This reduces the possibility of column vibration that makes prints less than sharp. The enlarger timer is mounted to the front of the counter within easy reach while sitting at the baseboard.

Berenice Abbott

When the snow is melting in Boston and spring is in the air, the lakes and rivers of Blanchard, Maine, are still locked in ice. Backed against the Piscataquis River, in a small hollow in the hills, stands an old frame farmhouse that is now the home and workspace for Berenice Abbott. A magnificent back room hangs over the banks of the river, and the sound of water rushing over the rocky river bed can be heard throughout the house. Berenice Abbott has integrated photography into her daily life as can be seen by the way workspaces are located in central parts of the house.

Abbott first became involved with photography as an assistant to Man Ray in Paris in the 1920s, and her involvement and contributions still continue. She became well known in the 1920s for her portraits in Paris, and in the 1930s she produced a large series documenting New York. She also has devoted a large portion of her career to scientific photography using strobe and multiple exposures to illustrate the laws of physics. She discovered the photography of Eugene Atget, whom she met in Paris, and later brought his work to the attention of the photographic world. Atget is now considered to be one of the leading photographers in the history of photography, and his images have been a major influence on many contemporary photographers.

Abbot's home in Maine is isolated from the hectic pace of Paris and New York, but it provides the quiet needed to concentrate on her photography. The entire top floor is devoted to the office, workspace, and darkroom. An old wood-burning stove heats the floor, and the atmosphere is warm and relaxed. Prints by Abbott and Atget are piled on the desk and nearby work surfaces. The darkroom, dominated by a Durst 8 x 10 enlarger, is connected to the office area by a light trap.

The Enlarger. The huge Durst 8 x 10 enlarger rises through a hole cut in the ceiling. Without the added height, the maximum size of prints would be substantially reduced. The large baseboard built into the enlarger eliminates the need for a nearby counter, because focusing magnifiers, timers, and other pieces of equipment can fit in the space not occupied by the easel.

Print Drying. Abbott uses fiberglass screens and frames for print drying. However, she has eliminated the need for a rack to hold the screens by gluing small spacers on the bottom four corners of each frame, so that when they are set on top of each other, the frames are separated by a few inches to allow for air to circulate.

Duckboards. The bottom of the sink is lined with duckboards, which reduce wear and tear on the waterproof sink coating. They also raise the trays so that water flowing from the washer through the sink does not float the trays. These duckboards are made in sections so they can be easily removed and stored. A stool is on the left, used to sit on when it is not holding extra print-processing trays.

The Wet Side. This view, with the enlarger baseboard on the right, shows the sink and the light-trap entrance to the darkroom. The space directly under the sink is used for tray and chemical storage. Floor mats are located in front of all work areas to make standing at the sink and enlarger more comfortable. Aprons and gloves hang on the wall to the right.

The sink has several outlets for water, and pegs mounted into the wall provide a convenient place to store mixing graduates, funnels, and other wet-side paraphernalia. The line suspended over the sink is used to dry film so that the runoff water drains directly into the sink. A bright bulb on the left is used for print viewing when prints come out of the fixer.

The Office and Darkroom. The top floor, containing an office and darkroom, is heated by a large wood-burning stove, and the entire area, except the darkroom, is flooded with natural light. This view shows the stairs leading down to the main part of the house. The desk used for paperwork is on the right, as is a storage closet.

W. Eugene Smith

W. Eugene Smith had a reputation as one of the leading American photojournalists from before World War II until his untimely death in 1978. His involvement with photography began when, as a young man, he was interested in becoming an aircraft designer. In the course of taking photographs of airplanes, his goals changed and he became committed to photography as a form of visual communication. He was best known for his photo-essays for *Life Magazine* ("Spanish Village," "Country Doctor," etc.), and he also produced extensive photo-essays, such as "Minamata," which were published in book form.

Smith disliked making prints but never backed off from the work involved. It was only through total control of the entire process that he could be assured his images would convey the meaning he intended. One of the ways he relieved the monotony he found in the work was to listen to music while printing, and it was said he had a collection of over 25,000 records to choose from. He also occasionally watched television; as shown in the accompanying photographs, he covered the screen with a safelight filter to protect his unfixed images from unwanted exposure.

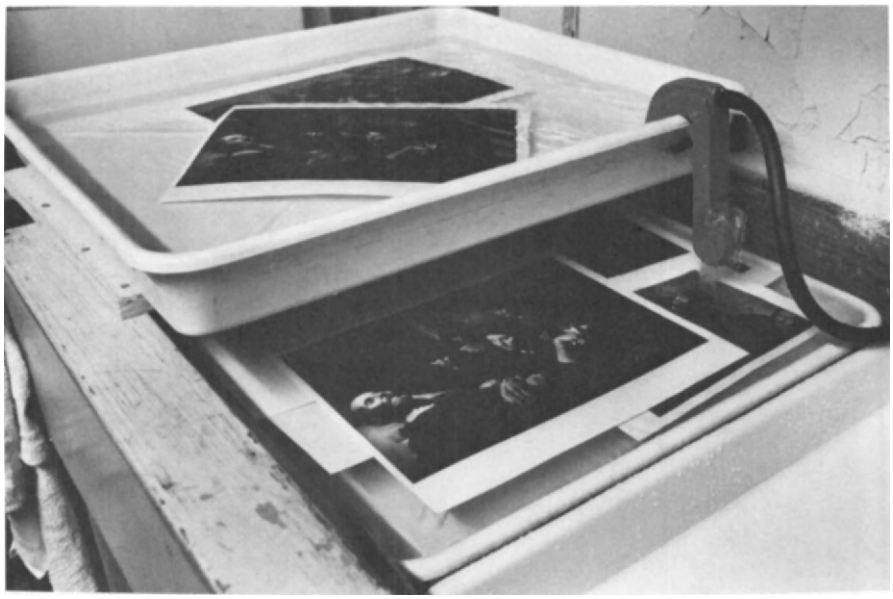
Over the years Smith developed his printing techniques to match his vision. He made extensive use of ferricyanide to bleach out his highlights and open up shadow areas. He also used diffusion screens of either wire mesh or black stockings, moved rapidly back and forth between the lens and easel during the exposure, to soften and break up the image grain.

Because he did considerable print dodging and burning, he equipped the darkroom with a foot switch that controlled the enlarger and left his hands free to dodge and burn. As a final step, he toned most of his prints in selenium toner to enrich the midtones and blacks.

Bleaching prints with ferricyanide takes time; the print is repeatedly bleached, then placed in the hypo to stop the bleaching action. One print from the famous series on Albert Schweitzer required over five days to produce to Smith's satisfaction. The stool and sink rail are wide enough to lean on, making things more comfortable for extended printing sessions.

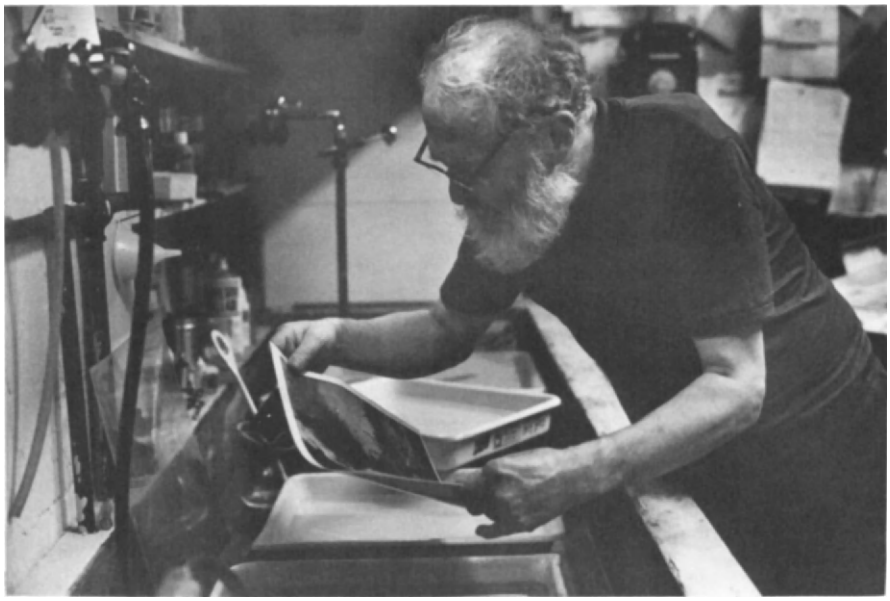
This view gives a good indication of the overall size of the darkroom. Smith liked the darkroom to be large and comfortable, with plenty of room to move about. A towel rack was mounted conveniently over the sink and safelights abound. A string running the length of the room overhead controlled the white lights so they could be turned on from almost any location in the darkroom.

Smith used two trays, one above the other, as a print washer. Freshly fixed prints are placed in the bottom tray, which rinses with overflow from the top tray. After partial washing, the final wash was given in the top tray. The water entered and left the top tray by way of the Kodak siphon attached. The lower tray overflowed into the sink.

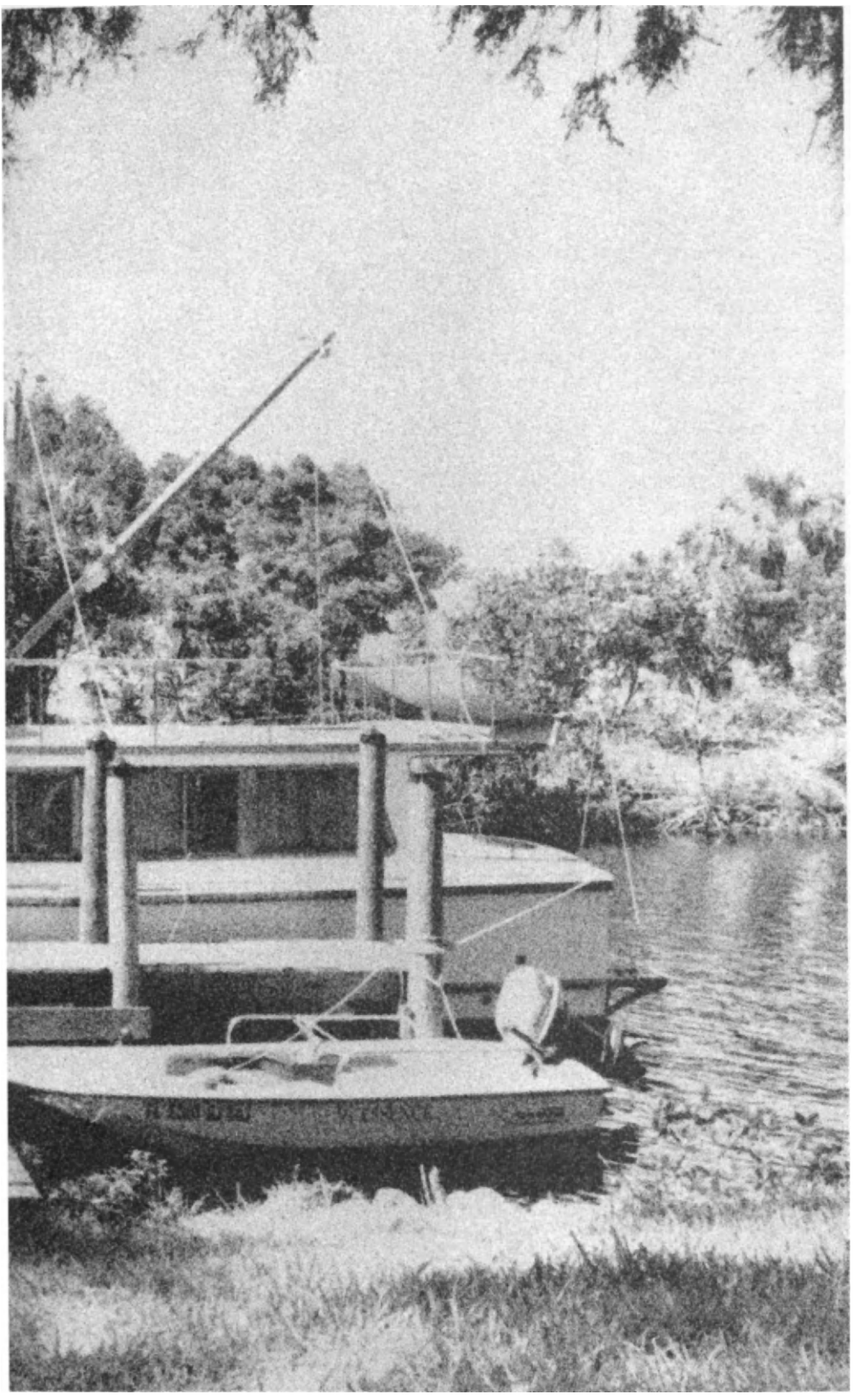


The dry side was a place to enlarge and finish prints, and also doubled as an office. The multiple use sometimes led to confusion, but everything was there . . . somewhere. Numerous focusing devices are in evidence. Smith's favorite enlarger was an old Leitz Valloy, which is no longer made, equipped with a Minolta color-corrected lens designed for color printing.

Here Smith examines a print during processing. The glass panel immediately behind the developing trays is used to hold the print while applying ferricyanide. A thermometer used to monitor the temperature of water coming from an outlet can been seen in the background. All water outlets are attached to rubber hoses, which rest in the sink bottom when not in use.



2 Darkrooms Around the World



Contents

Philippe Moroux

Born in Le Havre, France, Philippe Moroux now lives in the Netherlands with his Dutch wife. Philippe teaches photography and is the head of the photography department at St. Joost Art School in Breda, Netherlands. You can visit his home page at: http://www.knoware.nl/users/philippe/

Philippe is a photographer who wants to be as intimately involved in the creation of a photograph as he can be. He also wants the place in which he photographs to take as active a part as possible. In his own words, "the concentration of the photographer, between the exposure and the final result, should not relax. A complete cycle of image creation would have to happen at the same place without discontinuity. The photographic image would then be able to become impregnated with the location, and the confrontation of the photographer with his subject would last more than 1/125th of a second."

To affect this deeper involvement with the process, Philippe has returned to the days when a photographer carried a darkroom with him, performing the entire process from exposure to print at one place. He uses alternative processes such as the Kallitype, a method of creating images using iron-sensitive salts that break down during development and leave behind a lovely warm brown image. Any type of paper can be impregnated with the sensitive emulsion, contact printed with the negative in the sun, and then developed under a dark cloth. Philippe will travel to an isolated spot, create an image, and then mail the image to a friend on his way home.

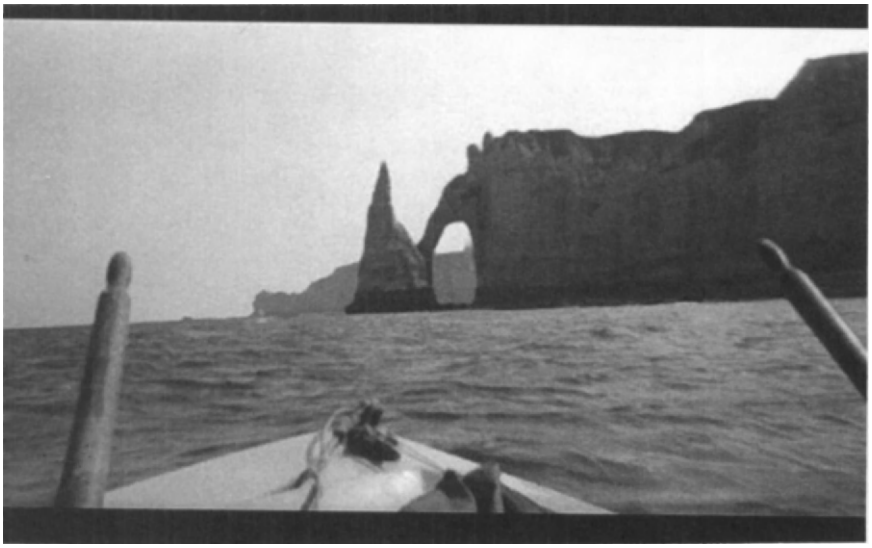
Philippe uses a 4 x 5 pinhole camera and, in his only concession to modernity, 4 x 5 Polaroid negative film. He has also used a 2m x 2m x 3m pinhole camera in which RC photographic paper is used as the negative, and development takes place inside the camera with a sponge.

Here is a paraphrase of Philippe's description of how an image came to be made in Etretat, on the coast of France:

> I photographed with a 4 x 5 pinhole camera on Polaroid Type 55 film. I developed the Polaroid and washed the negative with sea water. I dried it in the open air in a metallic frame. I contacted this film on previously kallitype-coated watercolor paper with a contact frame and sunlight. In my own shadow, and under a one-square-meter darkcloth, I washed the exposed kallitype with fresh water (the cliff in Normandy provides a lot of sources) and fixed it with a very poor concentration of sodium thiosulfate. A ten minute wash in sea water (sea water is a very good hypo-clearing agent) and a final fresh water wash before drying in the sun completes the process. On my way home, the print was directly stamped, addressed, and sent to a friend.

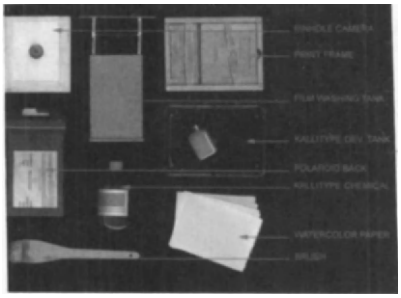
How would you like to find one of Philippe Moroux's warm and exotic prints in your mailbox!

Philippe and Anne. Philippe Moroux with his young daughter Anne. Note the old typewriter! In the color version of this photograph, Anne is wearing yellow shoes.



Rowing to the Location. An image Philippe made while rowing to the remote location where he has chosen to work.

Developing the Kallitype. Philippe develops a kallitype inside a wooden box. © Philippe Moroux



The Equipment. The complete kit necessary for exposing and printing a kallitype on location. Except for the pinhole camera, which appears to be homemade, all the rest is simple, readily available darkroom equipment.

© Philippe Moroux

Large Pinhole Camera. A sequence of shots taken on video of Philippe and a group using the large pinhole camera. The fact that it is homemade is readily apparent. © Philippe Moroux

Preparing to Develop. Philippe on the seacoast preparing to develop a negative and make a kallitype print. Notice how little equipment it takes, and the wonderful windblown feeling of working outdoors.

© Philippe Moroux

Sample of Work. A sample of what one of Philippe's friends might find in the mail! The B/W reproduction does not do justice to the warmth of the brown tone of the image. © Philippe Moroux

Famiglia Trentotto

Famiglia Trentotto is an images studio, originally set up in Milan, Italy in 1989. Mimo Visconti, Paolo Mazzo, and Francesco (Chicco) Di Loreto work together to produce photography based on the manipulation of any kind of visual surface. They take images and enliven them using darkroom manipulations. To see some of their very exciting work dial up their home page at: http://www.photographers.com/famiglia trentotto/

The darkroom is situated within a 200 square meter photography studio. Its position at the center of the studio (occupying about 10 square meters, or 2m x 5m) is symbolic of the central position of darkroom work for Famiglia Trentotto's imagery. It is a B/W darkroom that is used for a wide variety of techniques, ranging from traditional printing, to antique processes, to more improvised experimentations. The term they use for their creative work is "research."

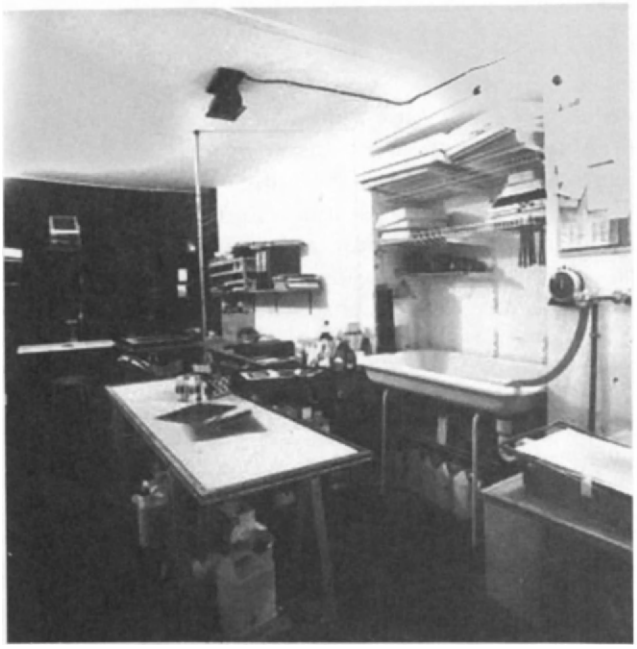
For enlargers they use the Durst Laborator 138 S and the Durst M 805, both of which are set up with condenser heads. The maximum size print that can be accommodated in the darkroom is 50 x 60 cm, or about 20 x 24 inches. That's a substantial size print for such a small darkroom! They use variable contrast paper, which they control with Ilford filters. Discarded chemicals are not simply washed down the drain but are stored in sealed drums and hauled away by specialized contractors. All the electrical, plumbing, and ventilation systems were installed by the photographers at Famiglia Trentotto themselves to meet their specific needs. As can be seen from the accompanying photographs, Famiglia Trentotto considers all the structures that make up the darkroom to be temporary and subject to changes of use and position according to need. For instance, the table where they place the chemical trays also often becomes the surface used for the retouching and "elaboration" of the images. As with all practical solutions to space problems, it does violate some of the rules of placement, but it works for them.

Here is what the members of Famiglia Trentotto have to say about what the darkroom means to them: "We consider the darkroom to be the space in which the idea of the image is revealed, and this possibility is enriched if our other photographer friends, whom we allow to use our equipment, participate in our space. Often the darkroom represents for us the point of departure of the final image, which we arrive at via post-production procedures that are not necessarily tied to traditional photographic techniques, such as the use of a photocopier, hand coloring, and the general 'mistreatment' of good B/W prints."

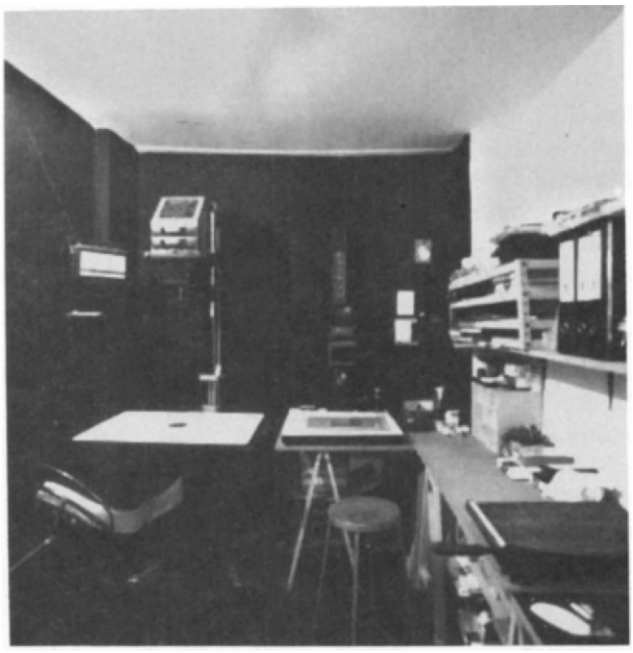
This interesting and free philosophy is clearly the reason why Famiglia Trentotto produces such exciting images.

Sample of Work. A sample of the type of work that Famiglia Trentotto produces. As can be seen, it is highly abstracted but still recognizable. It retains the look of a traditional photograph while giving the viewer a totally different feeling.

Famiglia Trentotto. The three photographers who comprise Famiglia Trentotto: Mimo Visconti, Paolo Mazzo, Francesco (Chicco) Di Loreto. The self-portrait gives some idea of the type of photographs that Famiglia Trentotto makes.



Overall View. An overall view of the darkroom. The somewhat temporary nature of the room is clearly visable. The lack of a clearly defined wet/dry side arrangement is also indicative of the free style of Famiglia Trentotto.



Enlargers. The two enlargers that are used by Famiglia Trentotto are seen here with the Laborator on the left and the M 805 on the right.

Processing/Work Area. A view back towards the area that is used for both processing and photographic manipulation. Storage beneath the table gives convenient access to both the processing and the enlarger area.

Work Area. The area that Famiglia Trentotto uses for both processing and manipulations. They defy the rule of separating dry- and wet-side activities with the same casual ease that they defy the common rules of photographic convention.

Ron Harrod

Ron Harrod got his start in photography by taking an adult education course in 1975. Since then he has had seven or eight darkrooms, ranging in size from 42 sq. ft. to 120 sq. ft. Ron is extremely inventive and very handy. He always comes up with the simplest and least expensive solution to any problem. Ron is responsible for the darkroom-in-a-closet photographs in Chapter 3. In 1981, Ron moved his entire life aboard a 31-foot sailboat. The boat proved to be workable for a darkroom, which Ron says is, "though not the smallest perhaps the oddest. Developer and stop were in the main cabin, fix and wash were outside in the cockpit."

Ron presently lives on a 36-foot pilothouse trawler named "Essence." Since space is at a premium on any boat, the darkroom is set up as needed in the main salon, the largest room on the boat. Since light-proofing is impractical, Ron does his darkroom work at night. Film loading is done in a changing bag. Occasionally, it is necessary to drape a window to block direct light from other boats or nearby docks. The "dry side" is the main salon table and allows negative selection and enlarging while sitting down. The galley serves as the "wet side" and is compact but very efficient.

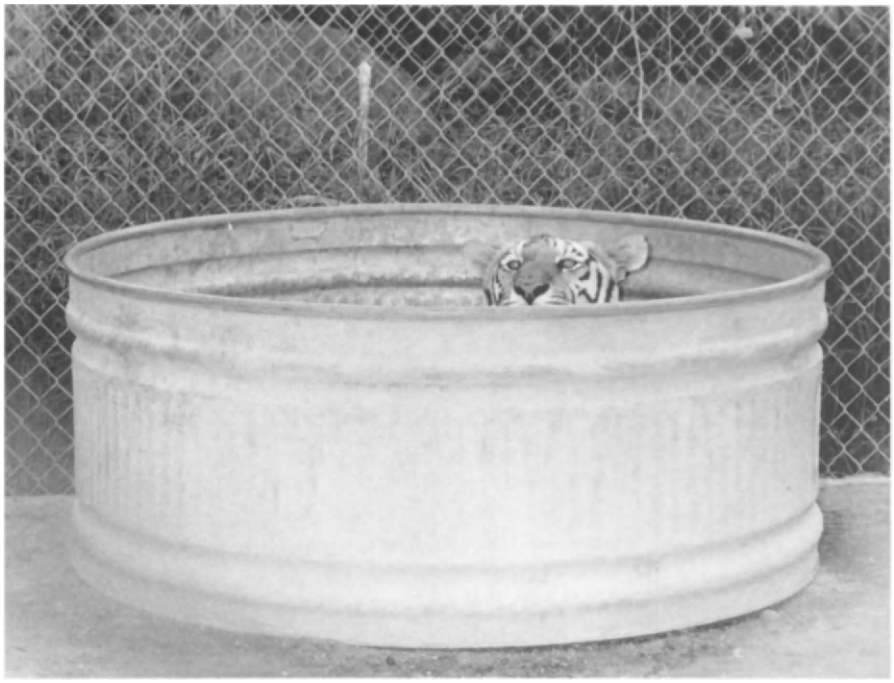
Boats present some problems not shared by land-based darkrooms. For instance, water supply is limited and boats have expensive pumps that are not meant to run continuously. For print and film washing Ron brings a hose aboard. He spends most of his time in Florida, so temperature control is an issue. Using a cold water tray under the developer tray keeps the solution at the right temperature. Ice is added as needed. Ron finds that on the hottest nights he can print for four hours with a ten-pound bag of ice. He uses several layers of mosquito netting on a pull-out berth for print drying.

Ron tries to keep things as simple and inexpensive as possible. "Photography equipment, as well as boating equipment, is usually way overpriced. Kitty-litter trays are fine for developing. My light table is fashioned from a loaf pan. For timers, I use a digital dashboard clock set to count seconds. Safelights are simply red light bulbs."

Although Ron is primarily a B/W photographer, he will do color on occasion. Most of his work has been for conservation causes—the Florida Panther, the Florida Key Deer, the International Iguana Society, the Octagon Wildlife Refuge, and Bahamas National Trust.

Ron Harrod with his boat "Essence" docked on a river in Florida.

Ron Harrod relaxing with his ever present cup of Chinese tea behind the "dry side" of his darkroom set up and ready to go.



Ron's photograph of a tiger.

Ron Harrod's Darkroom. The "dry side" showing Rons' c.1935 Leitz Foco-mat enlarger (purchased for $65 in a junk shop!) fitted with a dichroic head. Note the loaf pan light box.

Ron Harrod's Darkroom. The "wet-side" setup in the boat's galley. Kitty-litter trays are used for developing chemicals.

Robert Mann

Robert Mann is an American living and doing his art in Paris, in the tradition of such luminaries as Ernest Hemingway, Gertrude Stein, and Ezra Pound. Since Robert is a professional printer for the likes of Herb Ritts, Helmut Newton, Pamela Hanson, and a whole bevy of fashion photographers worldwide, he is an expert on both darkroom technique and darkrooms themselves. Over the years, he has built six darkrooms in such cities as New York, Los Angeles, and Paris.

The Paris darkroom itself is in what must have been a maid's quarters, which was complete with a shower and hot-water heater. It seems that in classic French apartments, the maid's quarters are typically adjacent to the kitchen. This facilitated plumbing the darkroom, since all the basic requirements—hot and cold water and drain—were right where they needed to be. The French use the English system of plumbing. Robert brought over his own filters and lime magnets from the States. Robert is quite tall, so all work surfaces are at 42 inches. He had his sinks custom-made in England and brought them to Paris himself. Robert broke down the shower wall and extended the sink into it. Before doing anything else, he tiled the floor in basic, clean white. As Robert puts it, "I find that a darkroom should be painted stark white on as many surfaces as possible with more than adequate lighting. Flat black is only localized around the enlarger. There is no need for all surfaces to be black, as long as the room is light tight. If the lights are off, it should be darker than dark. With all the white surfaces, just a couple safelights are needed, because the light will bounce around nicely."

The layout is in classic workflow order in a clockwise direction around the darkroom. As with many photographers, Robert wishes for more table space. That would enable him to make mural-sized prints without the present difficulty that his limited space causes.

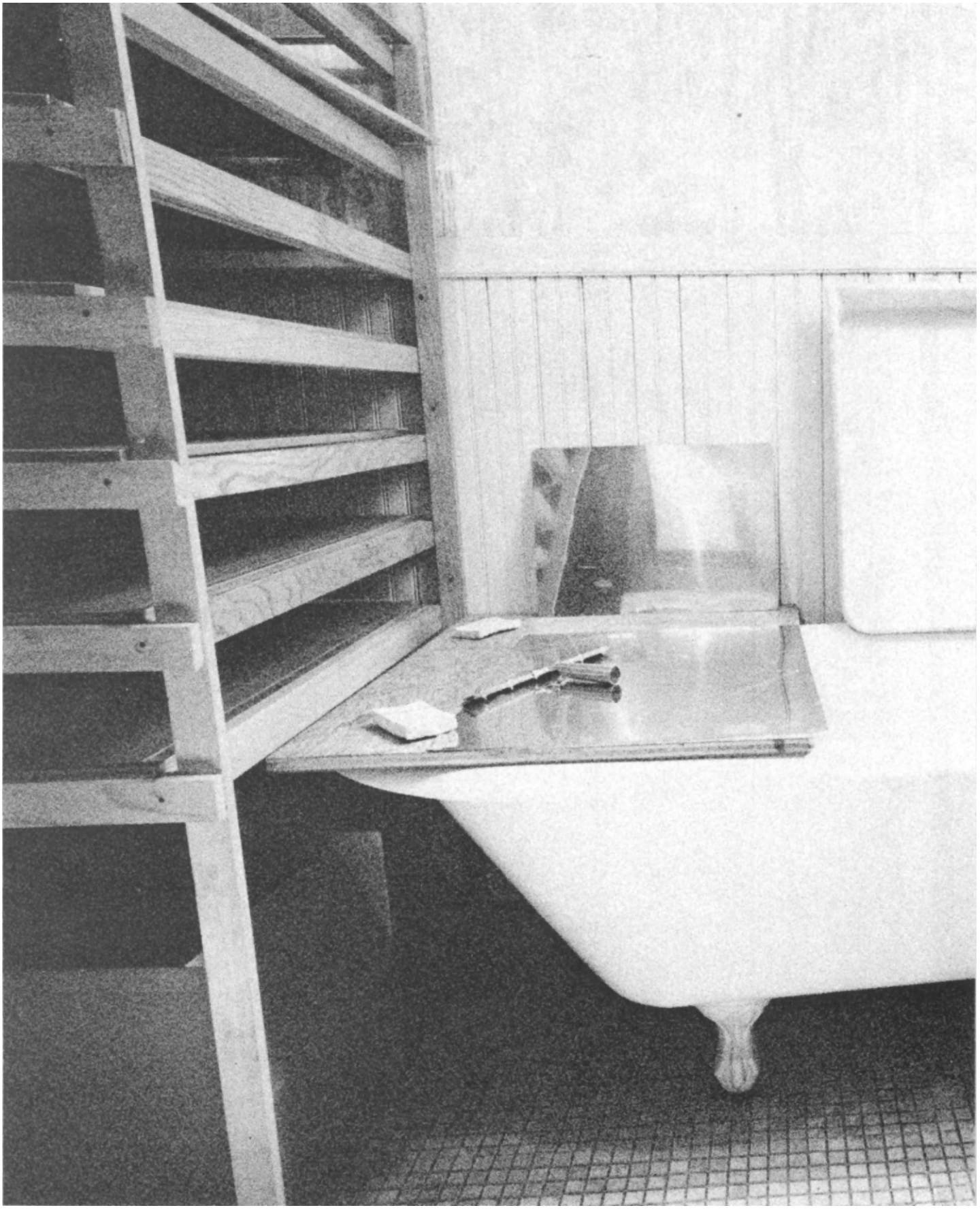
Robert uses an old Omega D2V enlarger that he found in Los Angeles. It had been sitting in a box for fifteen years without ever being used. As Robert says, "It's impeccable, and I maintain a very special relationship with it." Robert has replaced the enlarger's condenser light source with a cold light source that has an internal stabilizer. However, he is ready to upgrade to one of the new multigrade cold-light heads. He is beginning to accept that there are exquisite multigrade printing papers available and to enjoy the flexibility of splitgrade burning and dodging.

The darkroom is equipped with a JOBO CPP2 processor that Robert uses to develop 4 x 5 and 8 x 10 film. His personal work is done with 4 x 5 and 8 x 10 precision pinhole cameras that he built himself. Robert has started to experiment with color, but is still working on platinum-palladium, Kallitype, bromoil, and monochrome carbon processes.

Robert Mann's Darkroom: Dry Side. This is the "dry side" of Robert's darkroom. Notice that as many pieces of equipment as possible are wall mounted—the enlarger, timer, telephone—to save precious counter space. Since the counter tops are 42" to accommodate Robert's height, there is plenty of storage space underneath. Note the many types of paper available. The enlarger area is painted black to minimize light scattering. The key to this working darkroom is neatness.

Robert Mann's Darkroom: Wet Side. The "wet-side" sink of the darkroom is placed at the point where the shower was in order to make plumbing easier. Note the soil pipe right at the point where a drain is necessary. There are light-tight ventilation baffles in the walls and chemical storage under the high sink. Again, the feeling of efficiency and organization lets you know that this is a working darkroom.

3 Ideas for Placement



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Darkrooms in Closets

Most closets hardly have sufficient space for clothes and other items needing storage space. Occasionally, however, you may be lucky enough to have a very large walk-in closet, or a long closet with sliding or folding doors that can be spared for a darkroom or a portion of a darkroom. In most cases (but not all), working in a closet means you will have a "dry darkroom." Prints will be stored in a water tray after fixing, then carried in batches to another room for washing. If you are printing in color, all you have to do in the closet is make the exposure and insert the print into a light-tight drum (see Chapter 9, "The Color Darkroom"). All other processing can be done where there is more room. Closets are generally so small that careful planning is required to make one acceptable for use as a darkroom.

Enlarger

Where possible, the enlarger should be wall-mounted, because it can be difficult to find a small table that is steady enough for it. Or you can build a sturdy counter on which to set the enlarger and its baseboard. As closet space is at a premium, an adjustable enlarger base is not practical, since 11 x 14 prints can normally be made on the baseboard, and there probably will not be space to process larger prints.

Counter Tops

Shelves to hold the processing trays should be built at a convenient height, often counter-top height. You will require a minimum of four trays (developer, stop bath, fixer, and water-holding trays).

Storage

If the enlarger and processing trays fit, you could store everything else outside of the darkroom. If you have a tendency, however, to see how many people will fit in a phone booth, you can build storage shelves over cabinets in whatever space is available.

Ventilation

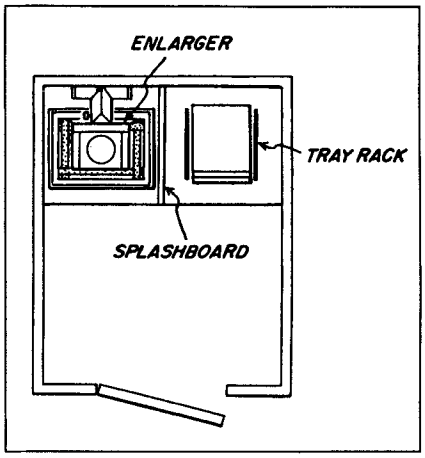
Working in a small space increases the problems of fumes and vapors. Good ventilation is almost a necessity for closet work, so plan on installing a fan and air vents in the closet.

Lights

The white light in the closet could be string-operated if the switch is outside the room. You can pick up a screw-in, string-operated adaptor at any hardware store if one is not already in the socket.

An extension cord can be run into the room to provide electricity for the enlarger, timer, and safelights. Be sure it has sufficient space so the door does not crush it when closed. If the cord is slammed by the door a few times, it could create a short circuit and possibly be a fire hazard.

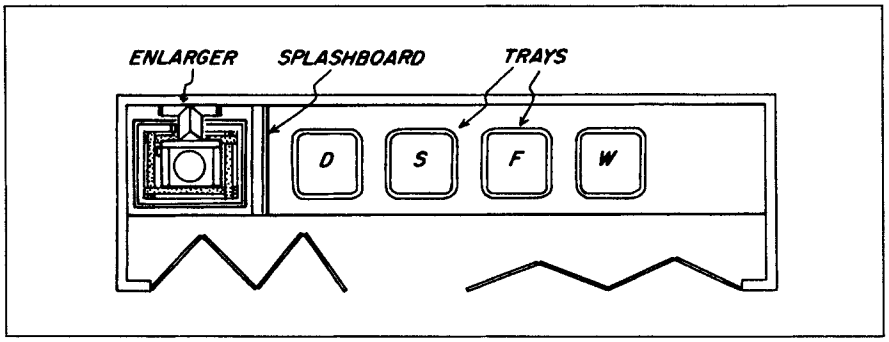
Very Small Closet



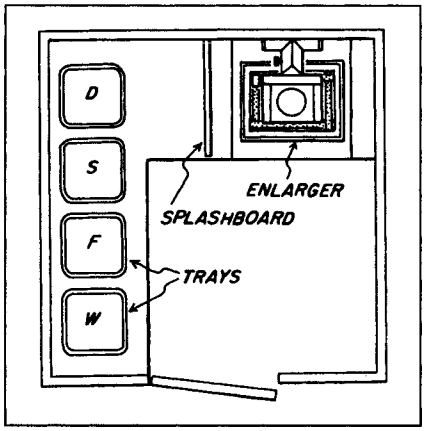
Very Small Closet. The most space-saving design consists of an enlarger and a tray rack that permits trays to be stacked on top of each other, which reduces the amount of counter space required. Timers and safelights should be wall-mounted, so they don't use the scarce counter space. As you can see from the elevation, storage of paper and chemicals can be arranged on shelves under the enlarger. A splashboard made of plywood or masonite should be installed between the enlarger and the processing trays to reduce the risk of contamination.

Long Closet. These are ideal, but generally require that the entire room in which it is located be light-proofed. The closet can have wet and dry sides facing each other with one or the other permanently installed in the closet. If the wet side is built in, plumbing can be added. The enlarger can be mounted to an old (solid) desk and pushed into place when needed. The desk can also be used for storage.

Long Closet



Walk-in Closet

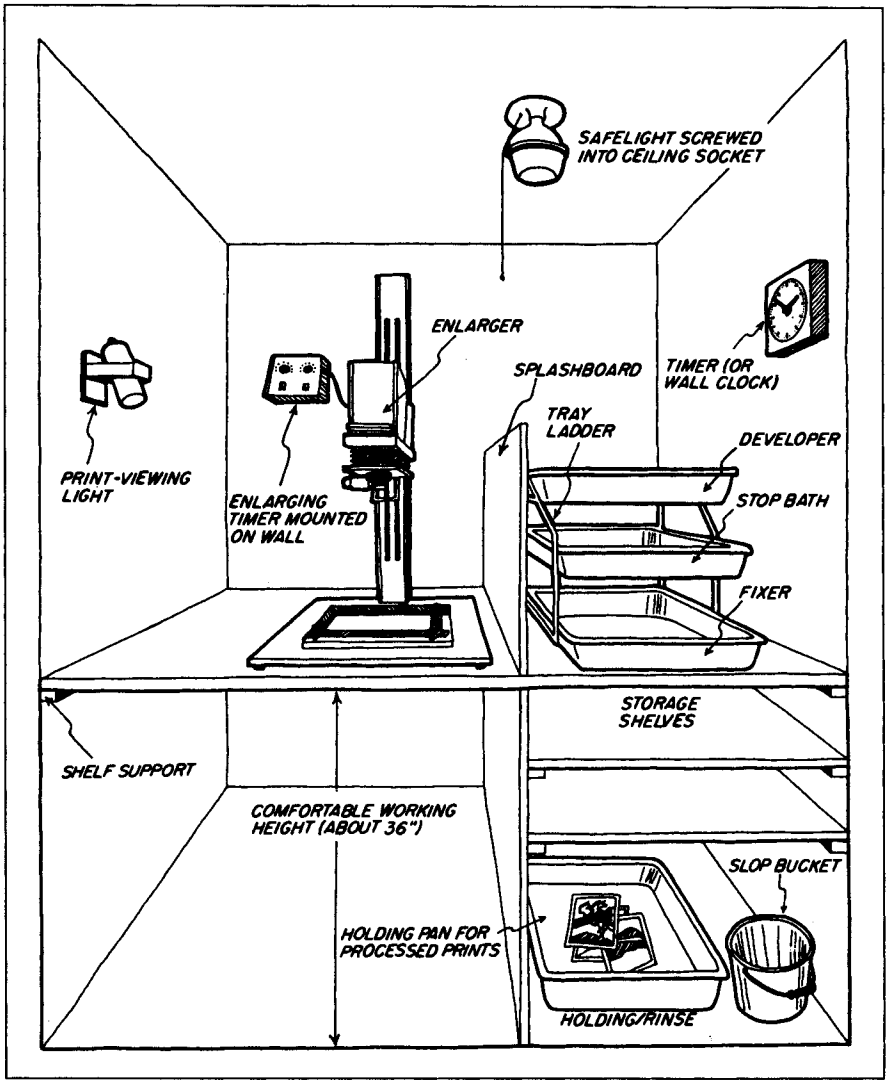


Walk-in Closet. These are generally larger-sized closets that permit slightly more flexibility than a small closet does. An L-shaped darkroom layout is most common, unless the closet is large enough to have a wet side and a dry side separated by an aisle. Storage and splashboard would be the same as for a very small closet.

Before and After. These before and after photographs show how Ron Harrod installed his darkroom in a small closet. The sliding doors were removed (folding doors would not have to be) and the entire room was light-proofed. Plumbing was hooked up to nearby pipes and a sink constructed out of a plastic sign. The plumbing system connects and disconnects with threaded fittings, so if the darkroom has to move, the plumbing can go with it.

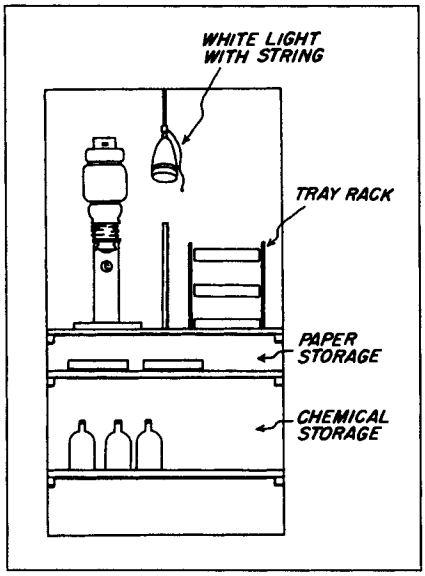
Photographs, Ron Harrod

A Closet Darkroom



A Closet Darkroom. A few innovations make even a small closet darkroom a feasible option. Wall-mount your timer and safelight or screw a safelight into the ceiling fixture. Use a tray rack to stack your three trays. Keep a bucket nearby for fixed prints that will be washed elsewhere. Construct a splashboard to protect your dry side. Store your chemicals below the counter. When set up, run an extension cord under the door to plug in your electrical equipment.

Closet Elevation



Closet Elevation. If you build a permanent darkroom in a closet, the space below the enlarger makes an ideal place to store chemicals and trays. The tray ladder used to hold the trays vertically is described in Chapter 6. A piece of paneling between the enlarger (dry side) and the processing trays (wet side) prevents splashes.

Darkrooms in Kitchens

Using a kitchen for a darkroom is only slightly more desirable than using the only bathroom in your house or apartment. Kitchens can be difficult to light-proof, must serve a second use on a daily basis, tend to have heavy traffic, and are more difficult to keep clean. You also have to worry about contaminating not only your developer but also your yogurt. Photographic chemicals are hazardous to your health, and when you work in the kitchen, all food items should be stored away.

Yet it is still possible to work in the kitchen and do it well. Thousands of photographers do it every day—several of them known by the authors—so there is no reason why you cannot.

Evening is the best time to work in the kitchen, because meals are over and after dark the light-proofing is simplified. A safelight can be screwed into the existing ceiling fixture, the windows and doors draped with light-proof cloth, and you're in business until dawn.

Finding a stable base for the enlarger can be a problem. If it will not fit onto one of the counters, it might be a good investment to buy a small sturdy table or old desk on which to keep it. Some kitchen tables tend to be unstable and this will definitely show in your prints.

An alternative is to wall-mount the enlarger (see "Mounting the Enlarger" in Chapter 6) in a place where it will be out of the way. If no such place exists, the enlarger can be attached to a wall mount with bolts and wing nuts so it is easy to remove.

The Work Triangle

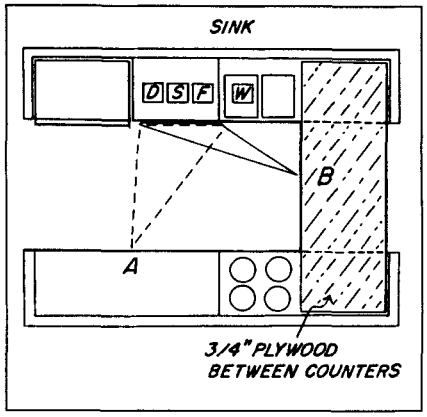
The efficiency of any kitchen is based on a "work triangle," the distances between the three key units of refrigerator, stove, and sink. The efficiency of a darkroom superimposed over this initial design is based on a work triangle between the enlarger, developer tray, and fixer tray.

The wet side is determined to a large extent by the position of the sink, and the processing trays should be arranged as close to it as possible. The placement of the enlarger should then be as close to the wet side as possible.

Kitchens are generally designed in one of four patterns. The following illustrations suggest ways of superimposing a darkroom over these existing designs. As you can see from the work triangles indicated on the drawings, the placement of the enlarger has a tremendous influence on the length of the walk required to expose and process a print.

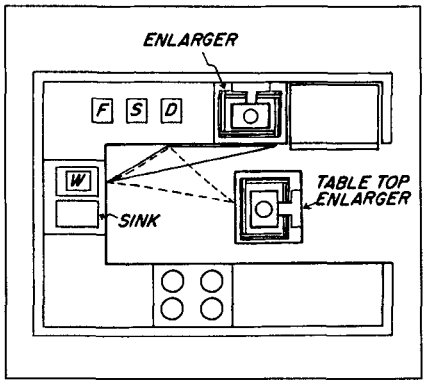
If need be, work surfaces can be expanded by using plywood to cover the range (be sure pilot lights on the gas range are out), or to bridge other work surfaces, such as between two facing counters.

Corridor Kitchen



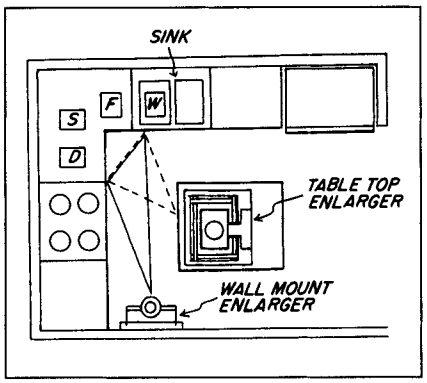
Corridor Kitchen. A piece of plywood can be placed as a bridge between counters. You should reinforce it with a wooden frame if you are going to place the enlarger on it. The enlarger would best be placed on the counter at the location indicated by A, since this is both sturdy and convenient to the developer tray on the sink side of the kitchen.

U-Shaped Kitchen



U-Shaped Kitchen. In a U-shaped kitchen, the enlarger can be placed on the counter next to the developing tray, on a table in the middle of the kitchen, or on a facing counter.

L-Shaped Kitchen

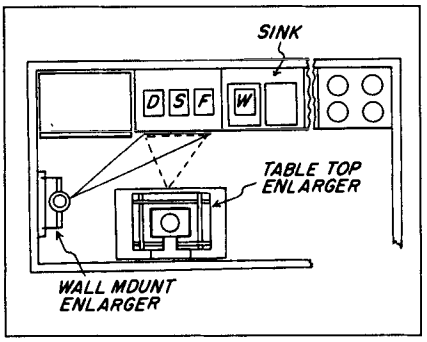


L-Shaped Kitchen. In a kitchen such as this, the ideal place for the enlarger is on the counter between the wall and the stove. Barring that, a wall mount is possible, or the enlarger can be placed on a sturdy table in the center of the room, convenient to the developer tray.

Desk-Mounted Enlarger. An old-style oak desk, commonly found in secondhand stores or flea markets, makes an outstanding enlarger stand. This one, in the R&D darkroom of Saunders Photo/Graphic, was painted mat black, but the desk can be used in its natural finish as well. The drawers provide handy, dust-free storage for lenses and accessories. The enlarger should be securely bolted to the top. Do not use wood screws. A sheet of pegboard on the wall behind the enlarger, as shown, provides a handy place for negative carriers.

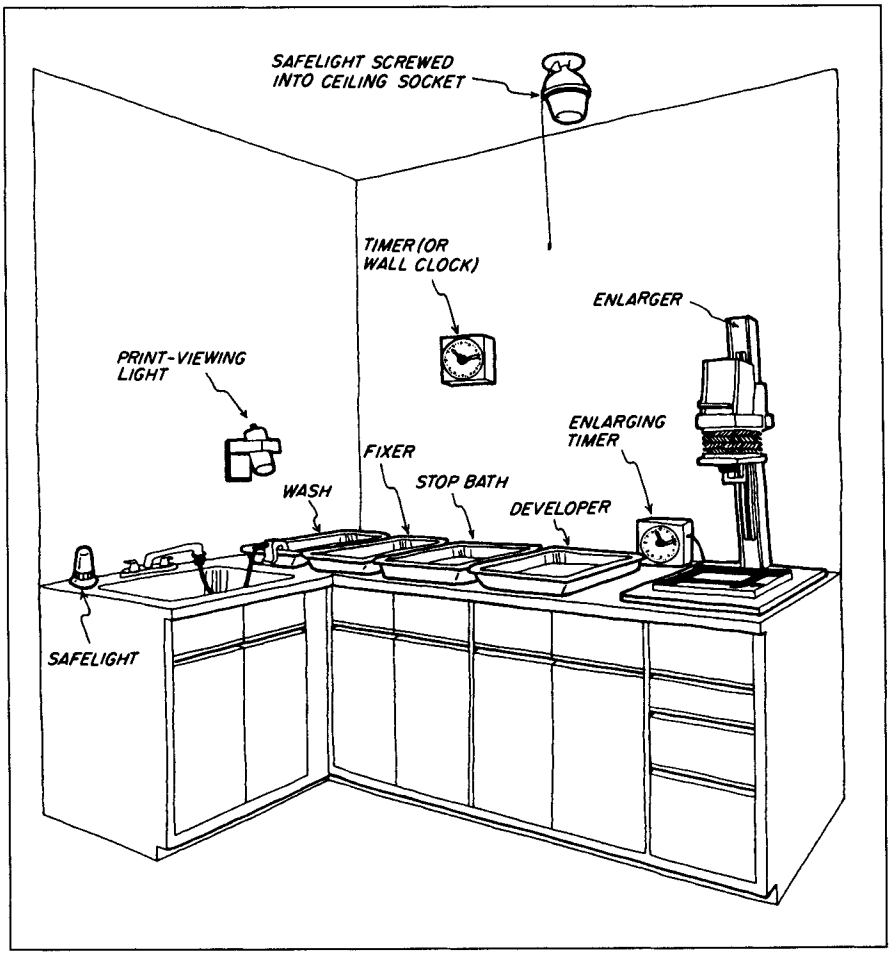
Photo by Metzger Studios, Rochester, New York

Single-Wall Kitchen



Single-Wall Kitchen. In many small apartments, the kitchen occupies a single stretch of wall. In this case, the only place for the enlarger is on a facing table or on a wall mount.

A Kitchen Darkroom



A Kitchen Darkroom. A kitchen may seem to be the ideal location for a darkroom, but it is often time-consuming to light-proof. If you do use your kitchen, avoid chemical contamination of surfaces and utensils used in preparing food. No matter what shape your kitchen is, a sturdy sheet of plywood is often handy to use as extra counter space on top of the stove (but turn off pilot lights on a gas range) or as a bridge to span the gap in a corridor-type kitchen.

Darkrooms in Bathrooms

Many photographers at one time or another have used a bathroom for either a temporary or permanent darkroom. It has the advantage of having running water and is usually easy to light-proof. A bathroom can function well if its double use is taken into account. Its major drawback is, of course, that its use cannot be as carefully scheduled as a kitchen's can.

Layout

Some bathrooms lend themselves to using the bathtub side as the wet side and the sink and toilet side as the dry side.

Sink

In the beginning it may be acceptable to kneel alongside the tub while processing prints, but you will probably soon tire of this. For a more permanent arrangement, it is usually possible to build rails above the tub on which a wooden sink can be placed. When the sink is removed for storage, the rails stay permanently attached. If good molding is used, and it is painted, the rails will not detract from the bathroom. The sink can drain, through a rubber hose, into the bathtub below without additional plumbing. A water supply can also be connected to the sink by connecting the shower head to a faucet mounted on the sink. It may be difficult to adjust the water temperature if the handles are near the tub (and under the darkroom sink) but it is possible to live with this.

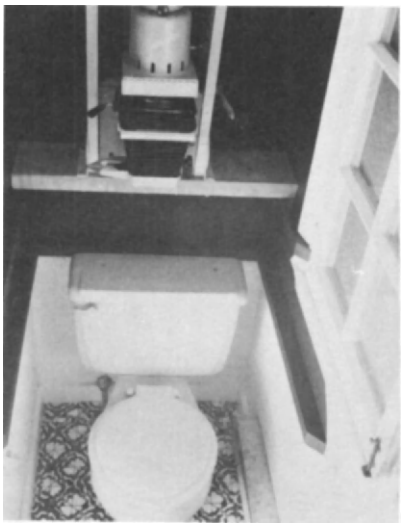
If the tub is installed along a single wall, rather than in a corner, a large box may have to be built around it to accommodate the sink and sink rails.

Enlarger

The toilet can be boxed in, providing room for both an adjustable enlarger baseboard and an enlarger mount. By removing the easel board, the toilet is accessible, especially when the enlarger head is raised to the top of the column. The instructions in Chapter 6 for building an adjustable enlarger base can be followed to build this unit.

Working Space

Additional working space can be obtained by using two or three enlarger bases at one time. The top one holds the easel, and the lower two hold unexposed and exposed paper. A piece of plywood can be cut to cover the sink if additional space is needed.

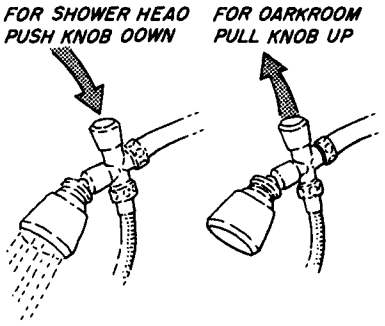


Wall Mount Over Toilet. The space over the toilet is usually wasted, although it makes a possible place to permanently wall-mount the enlarger. The shelf rails can be designed to permit lowering the shelf for greater enlargements. The shelves are removable, so the room can be converted to its original purpose.

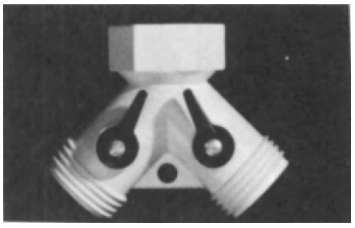
Bathroom Plumbing

When converting a bathroom to serve a dual function as a darkroom, it helps to adapt the faucets to accept the fittings of the darkroom equipment. Pfefer Products makes a complete line of adaptors to be used for this purpose. Other units are also available at your local hardware store. Some of the major ones are:

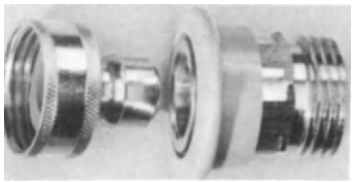
Shower Diverter. This unit can be permanently installed on the shower head. When adjusted, it allows the water to flow out of either the shower head or a fitting to which a print washer can be connected.



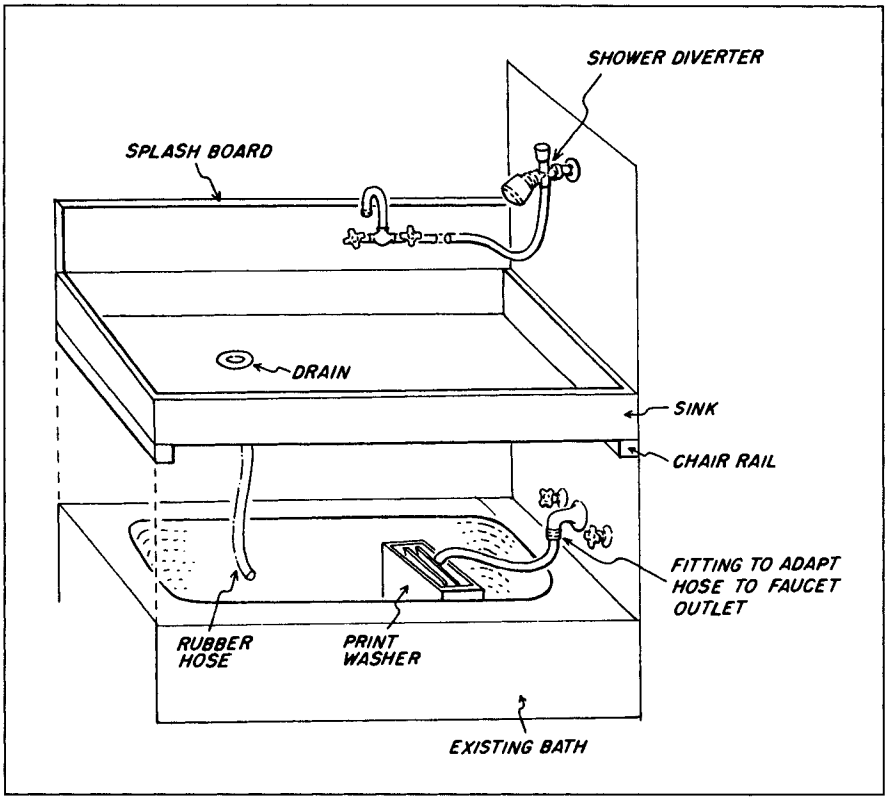
Y-Adaptor. This unit allows two hoses to be fed from one faucet.



Standard Adaptor. This unit is designed to fit most kitchen and bathroom male- or female-threaded faucets. It will convert a faucet to accept male garden hose fittings.

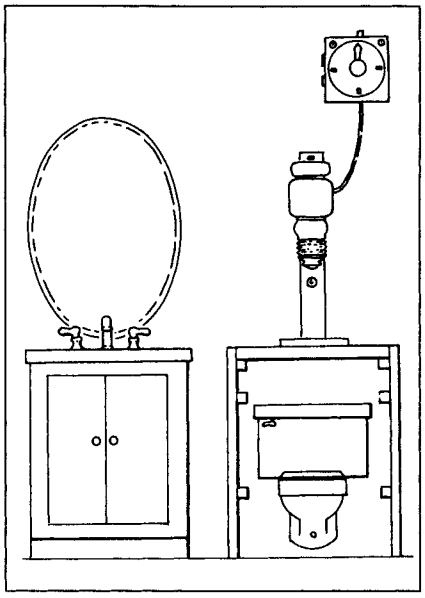


Sink Over Bathtub



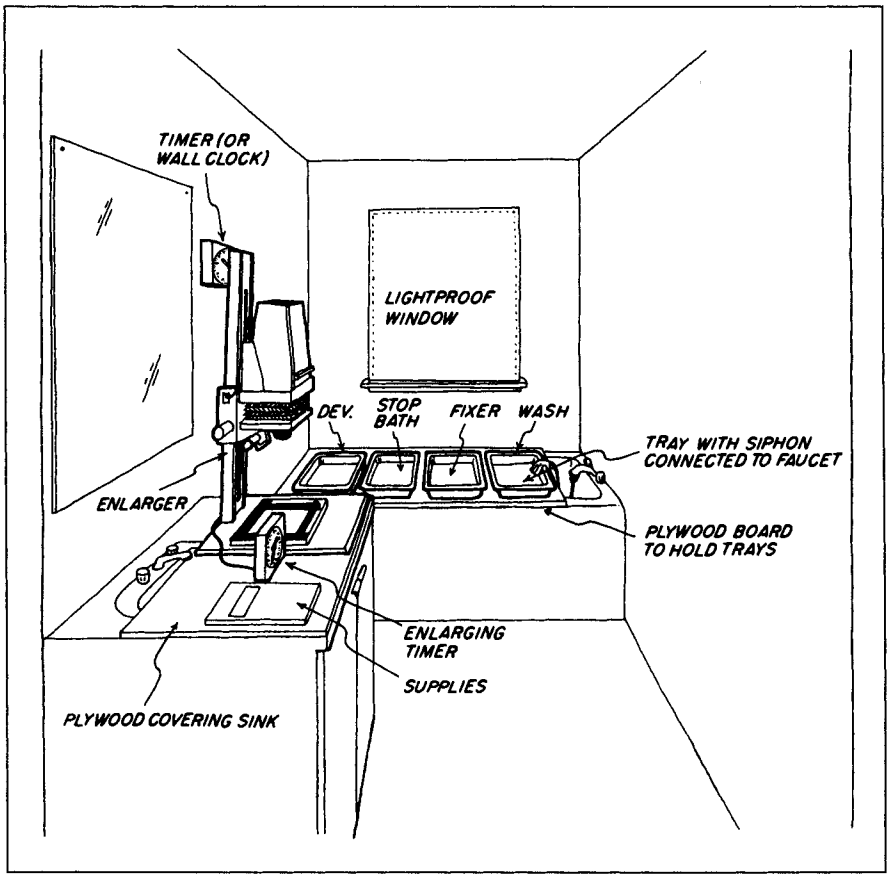
Sink Over Bathtub. A rail installed around the bathtub can be used to support a removable wooden darkroom sink. The sink can drain directly into the tub below, which eliminates any plumbing problems. Water can be obtained from the bathtub outlet or the shower head. The shower head might not have its own mixing valves, so temperature regulation can be difficult. The print washer can be located either in the sink or in the tub below.

Bathroom Dry Side



Bathroom Dry Side. This elevation shows how the toilet can be enclosed in a cabinet for an adjustable enlarger baseboard. Instructions on how to build one of these units are given in Chapter 6. The sink can be covered with a piece of plywood to increase the amount of dry-side shelf space.

A Bathroom Darkroom



A Bathroom Darkroom. A bathroom is often the best location for a darkroom. It has the necessary plumbing, waterproof surfaces, and can easily be made light-proof. A bathtub makes a good wet side: it's waterproof, and has running water and a drain. You can lay your trays out in the tub, or you can save your back by placing them on a sheet of plywood covering the tub, for the dry side. You can place your enlarger directly on top of your sink space, or you can first cover the sink with a sheet of plywood. It's important that the enlarger be very stable; any vibration will mean unsharp, blurred prints.

Darkrooms in Spare Rooms

In most apartments and many homes, it is inconvenient to convert a closet, kitchen, or bathroom into a darkroom. Therefore, one of the rooms that is normally used as a bedroom or spare room can be the location for the darkroom.

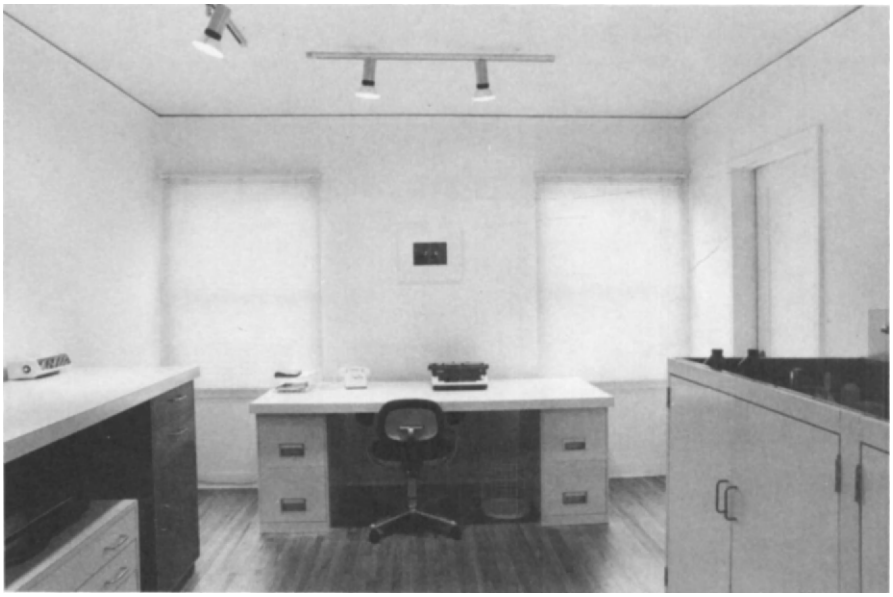
Unlike bathroom and kitchen locations, a spare room generally does not have a water source. This means that either the darkroom must be dry and the prints washed in another room, or a water source must be brought into the room.

Another problem with converting spare rooms is minimizing the damage caused to the room so it can be reconverted back to its original purpose should the darkroom be moved. Or perhaps the spare room must serve a number of functions simultaneously. At the very least, it may have to be both darkroom and workroom.

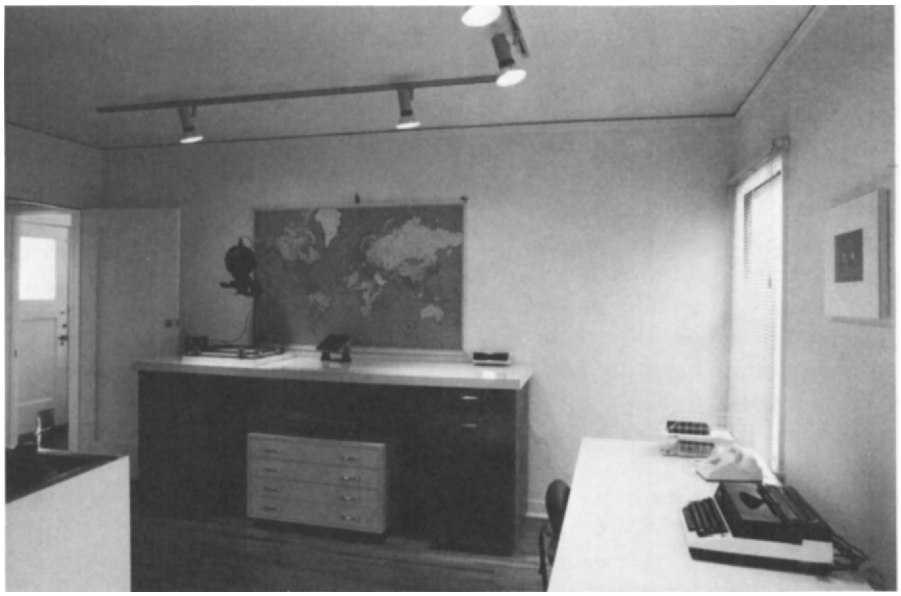
Anthony Hernandez, a Los Angeles photographer, was confronted with this problem when moving into an apartment. His solution was to convert a bedroom into a combination office, workroom, and darkroom. The room functions as an office and general working space during the day and is converted to a darkroom at night by putting down the window shades.

The room is one of the major spaces in the apartment and was designed to be an elegant addition to the living space, with utilitarian features concealed in the overall design.

The Entrance. The entrance to the darkroom does not give a feeling that you have stepped into a different world. The room still seems to be part of the apartment and functions as a living space as well as a darkroom.

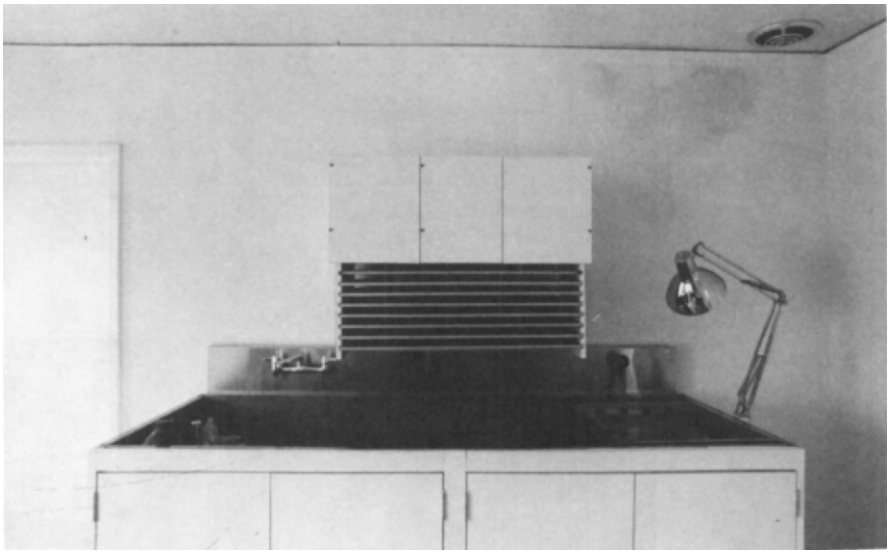


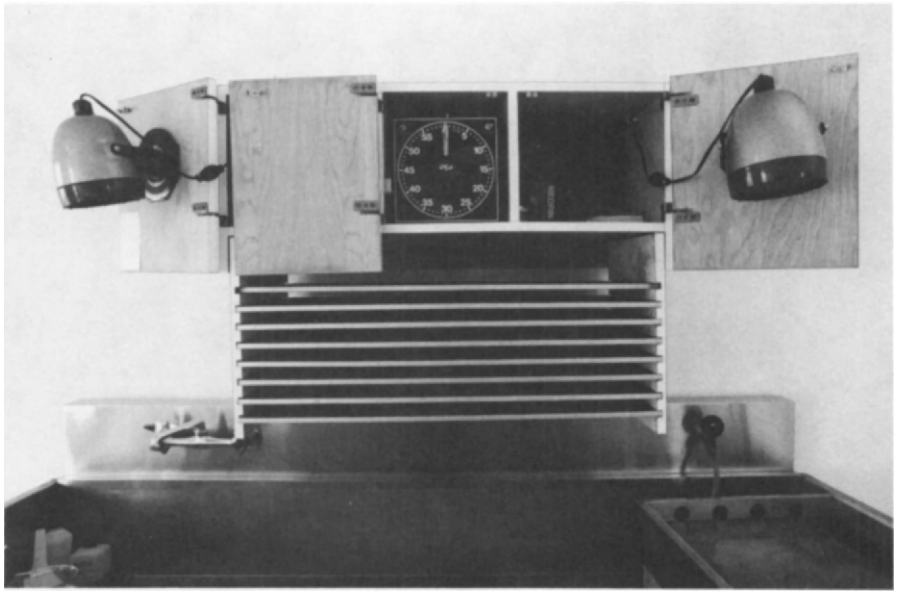
Organization. The darkroom is designed with the dry side on the left, the wet side on the right, and the office/workspace at the other end of the room. The blinds are pulled at night to convert the room into a darkroom. Because they are not totally light-proof, it is not possible to print during daylight hours.



The Dry Side. The dry side of the room consists of storage cabinets and a large formica-covered counter. The cabinets supporting the counter and the separate cabinet underneath are used to store equipment and prints. The track lights on the ceiling are used when the room functions as an office, and the dry-side safelight rests on the counter along with the enlarger and timer.

The Wet Side. The wet side of a darkroom is the place where, in most darkrooms, the greatest disorder appears. The photographer solved the problem by designing the wet side so that the majority of the equipment is hidden from view when the darkroom is not in use. The exhaust fan is located in the ceiling over the sink, the print-viewing light on the right end of the sink complements the overall style of the room, and even the print drying screens directly over the sink do not detract from the room's clean appearance.





The Wet-Side Equipment. Opening the doors over the print-drying rack reveals the wet-side timer, safelights, and equipment storage. When closed, the equipment is again concealed from view.

Workrooms

Generally, all stages after print washing can be completed in an adjoining workroom. Print drying, spotting, matting, and mounting are some of the activities that can and should be done outside of the darkroom. Each photographer's situation is slightly different, and many, where space is tight, will build their print-drying rack in the darkroom itself but complete all other steps in a separate room. Many home darkrooms utilize whatever available space there is; to free up additional space for a workroom is a real luxury.

Given space limitations, a good alternative is to use a room such as a bedroom for print finishing and storage. The main space requirements are for matting and mounting equipment. Many photographers work on the kitchen or dining-room table.

Counter or Table Space

Counter or table space is needed for cutting mats and holding a dry-mount press. If you do not have a press, you might still need space to mount the prints with an iron or cold mounting tissue. Because of the cleanliness required, it's best to have a permanent space set aside, but if need be, the table can be cleaned after dinner and the equipment set up. After all of the hard work it took to get the print to this stage, it is a heartbreaker to find that you have set it in a puddle of giblet gravy.

Storage Space

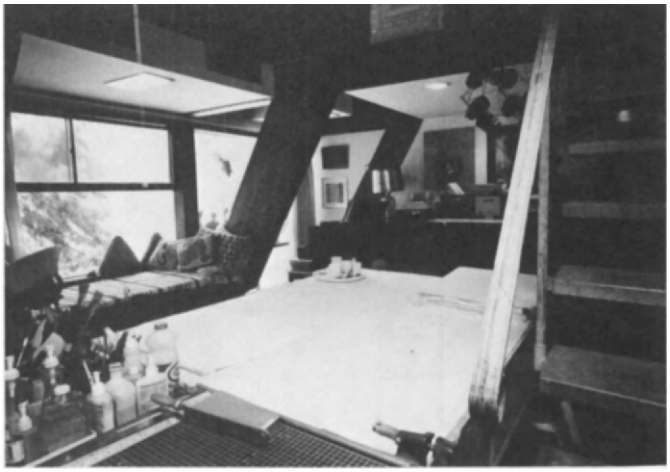
For most photographers, what begins as a "little" darkroom starts to expand and consume incredible amounts of space. Very few photographers can bring themselves to throw out extra prints. Negatives and other supplies such as paper and mount board need a home. Because many of these materials are to some extent affected by humidity, they cannot be tucked away in the basement or stored in a hot, humid attic. This means that a space in the house must be found where shelves can be built or cabinets installed.

Light

An absolute necessity for a workroom is good light. This can be natural light from numerous windows or bright artificial lights. Natural light is excellent, especially when spotting prints or evaluating color proofs. Matting and framing under glass can be done in strong artificial or natural light.

Harry Callahan's workroom, which is a combination office and print-finishing room, occupies the top floor of his Providence townhouse adjacent to his darkroom. This photograph was taken from the immediate vicinity of his desk and shows the side of the room where the dry-mount press and print-finishing equipment are stored and used. The light in the room is natural and bright, good for making those last final adjustments to a final print.

This photograph taken from George Tice's office shows the rest of Tice's print-finishing area. On the left are the print-drying screens in an open frame. Paper is stored at the far end of the room and the right side is devoted to paper trimmers and the dry storage area.

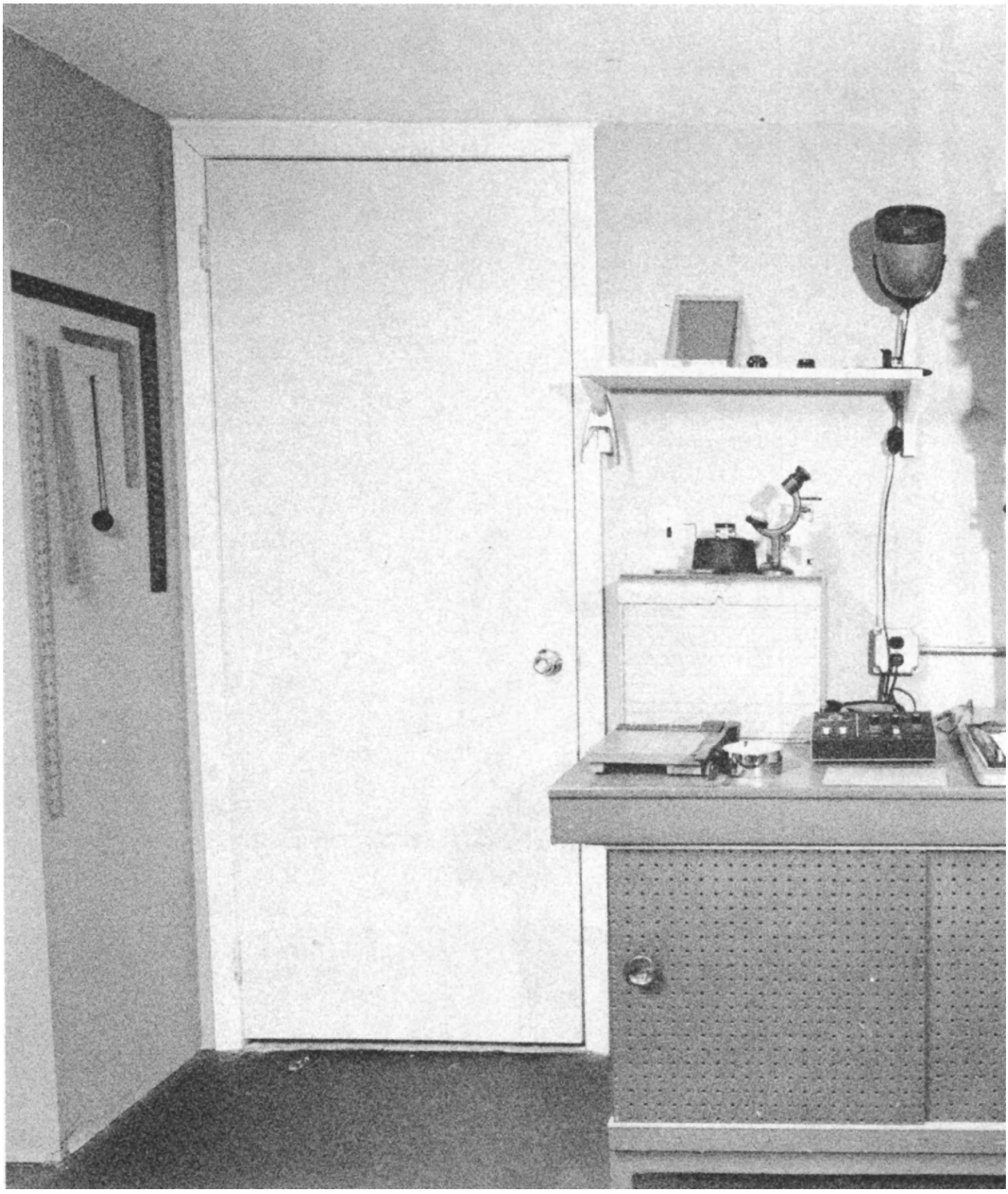


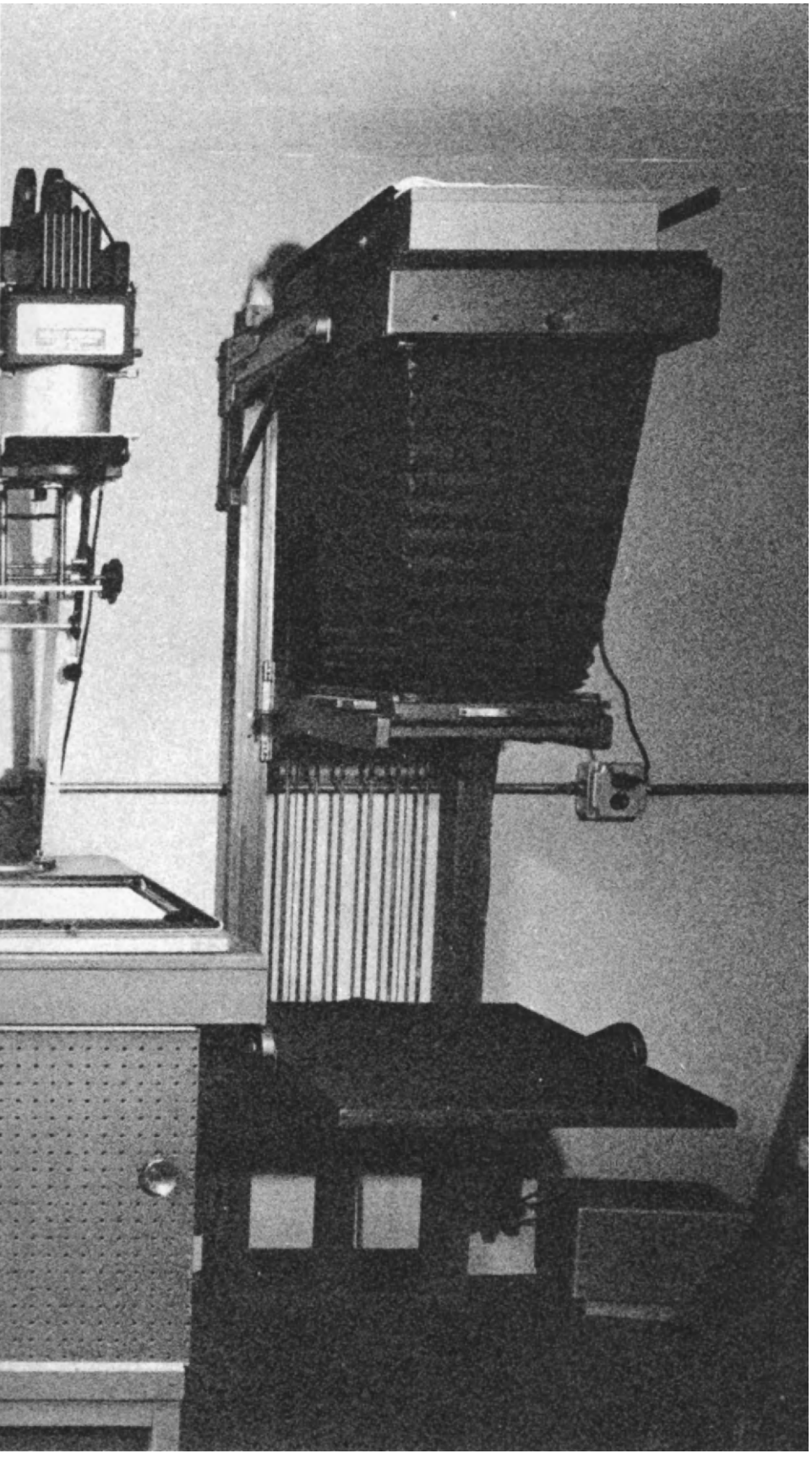
Naomi Savage's workroom is on the ground level and looks out on a landscape that includes her husband's welded stainless steel sculptures. The room is bright and full of light. This view shows a paper trimmer in the foreground and a large expanse of open counter space used for print finishing. The stairway rises to a storage area.

Neal Slavin's prints are given their final wash in the print-finishing area. The window has sliding red plexiglass panels that are used as a "pass through" for prints from the darkroom to the washer. The red plexiglass acts as a safelight, so the lights in the print-finishing room do not affect the sensitive materials in the darkroom (color material excepted). The light entering the darkroom through the panels gives the room a pleasant open feeling. The cabinet on the lower left contains print-drying racks concealed behind the swinging door.

Mike Shaw and Peter Rayment handle the print finishing at the Sutcliffe Galleries in Whitby, England in a well laid-out workroom. Spotting and print finishing are done on a sloped drafting table with strong natural light entering from a nearby window. Shaw is shown framing prints on a large work table. Supplies are stored close by on the racks behind him.

4 Designing the Room





Contents

What Are Layouts and Elevations?

Designing a Darkroom

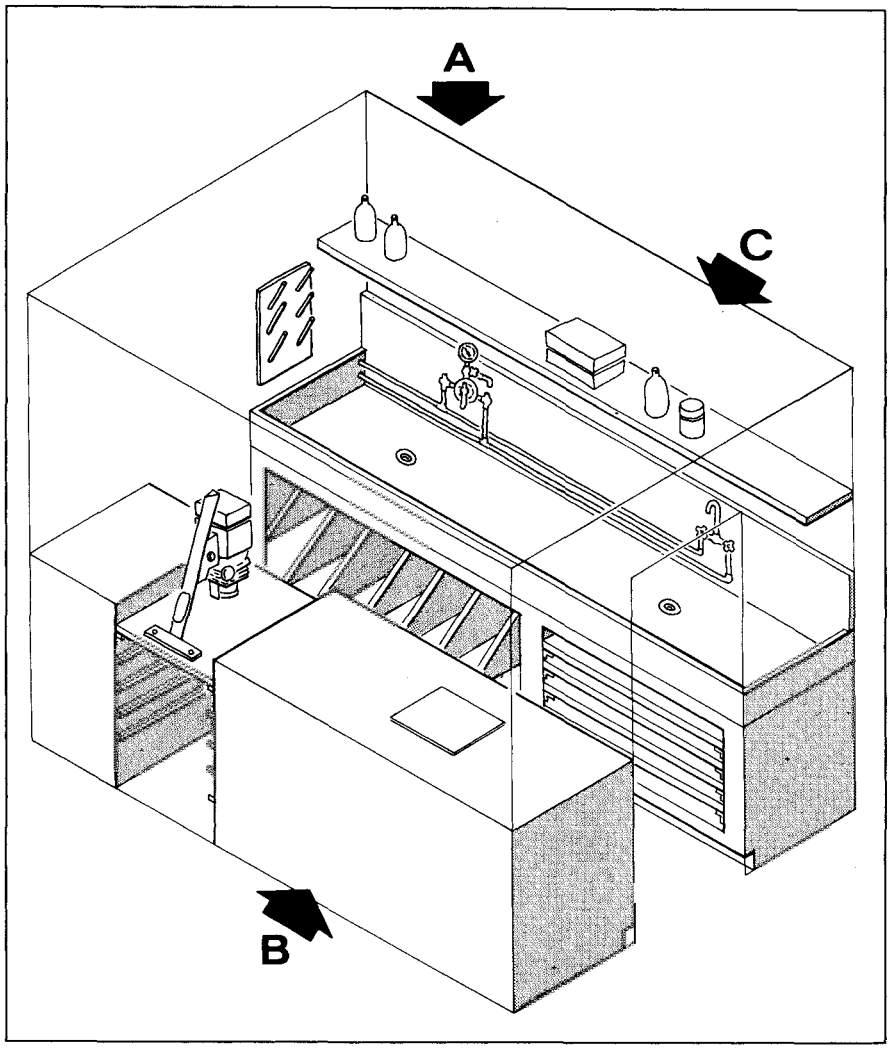
A well-designed darkroom requires the completion of a number of planning steps to ensure that the darkroom will function as well after it is built as you had hoped when you first conceived it. The major steps and the order in which they should be completed are:

- Determine the size and type of equipment to be used in the darkroom and the size of prints that will be made.
- Prepare a layout (floor plan), making provisions for all of the items to be used in the room and the print sizes that must be accommodated.
- Prepare elevations to show how storage shelves and cabinets are to be built and at what height the work surfaces are to be located.
- Prepare working drawings for those items that you plan to build yourself or have someone else build for you.

This section will help you follow these steps and ease the burden of making all of your drawings to scale. Before you begin, it might help to explain the terms *layout, floor plan, working drawing,* and *elevations.*

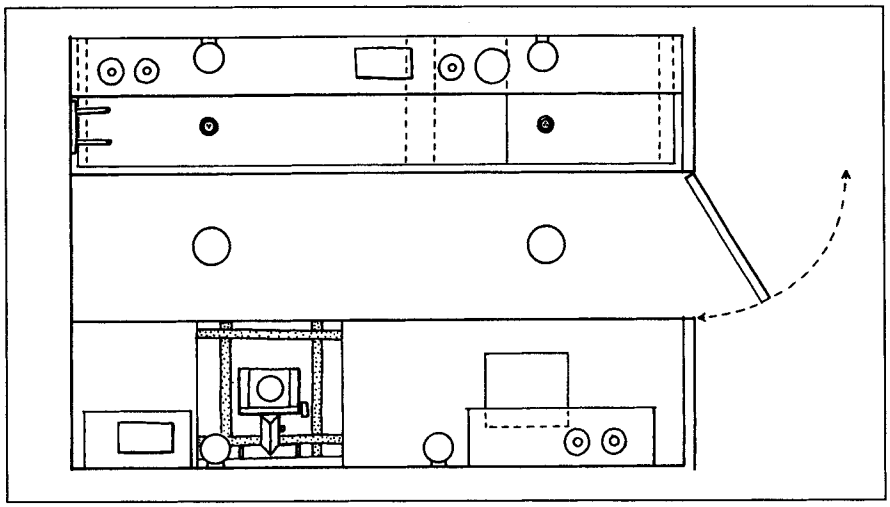
Working Drawings

Layouts and elevations indicate the placement of items in a room and the outside dimensions of those items. However, they are not detailed enough to actually build from, unless you are a very experienced carpenter or are willing to make do as you go along. To make the job progress more smoothly, the best course is to prepare working drawings that show the pieces that make up a major unit. Working drawings are shown throughout this book for such items as print-drying racks, sinks, light tables, and so on. If you plan on building something that is not detailed in this book, the drawings we have shown will give you a good idea of how to do your own.



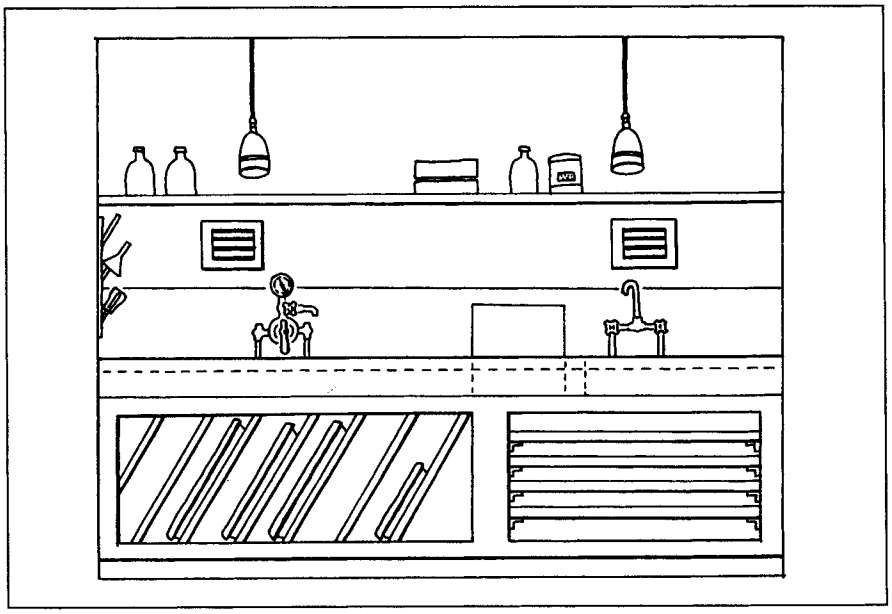
General View. This general view of a typical darkroom gives an idea of what the room would look like if the walls were transparent. The drawing clearly shows the placement of the wet side, the dry side, and other major elements of the darkroom. Although it is very easy to understand, it is difficult to draw, so a more simplified method has been developed to represent the major elements in a room. This simpler method consists of drawing separate sketches to represent the arrangement of items on the floor of the room (the layouts), and on each of the walls (the elevations).

Layouts



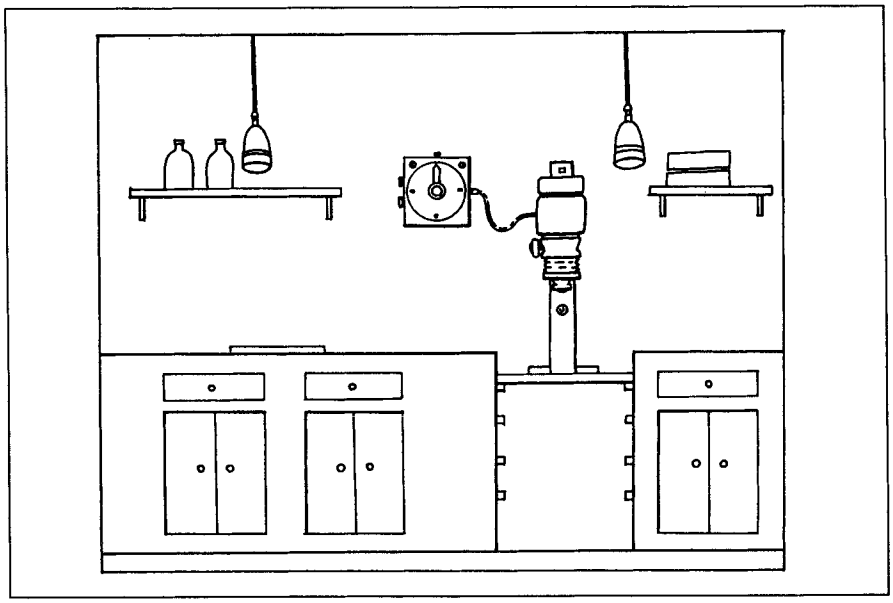
Layouts. If you were directly above the room and peering down through the ceiling from point A in the figure on the opposite page, you would see how items were arranged on the floor of the room. This view is what is called a *layout* or *floor plan*, and its preparation is the first step in the design of any living or working space. At this stage, the physical placement of equipment is determined to allow for working comfort by eliminating unnecessary steps.

Wet-Side Elevation



Wet-Side Elevation. If you were to stand outside of the darkroom and look through the transparent wall from point B in the illustration, you would see the wall against which the wet side of the darkroom is built. This view is called an *elevation* and shows only the fronts of sinks, shelves, and other items on the wall. It is used to plan the placement of equipment and cabinets and should be based on the previously prepared layout.

Dry-Side Elevation



Dry-Side Elevation. Standing outside of the darkroom and looking in from point C would show the dry-side elevation. This elevation will contain the enlarger, dry-side counters, enlarger base, and under-counter storage.

How to Do Layouts

The preparation of a layout is the first step in building any darkroom. This section has been designed to make this preparation as fast and easy as possible. It consists of grids and cutout parts drawn to the approximate scale they will occupy in the actual darkroom. Both the grids and the cutout parts are drawn to a scale of 1/2" to 1' in the actual darkroom. You might want to make a photocopy of both the grids and cutouts rather than cut up the book.

You can begin your layout in one of two ways. You can either draw the size of the room you plan to use on the grid, or you can assemble all of the elements you plan to use and then draw a room sufficiently large to hold them. The first approach is used when you have a room to convert in which you do not want to change any of the partitions. The second is used when you plan to partition the darkroom off from a larger area such as a basement, and therefore the actual size and proportions of the room are initially unimportant.

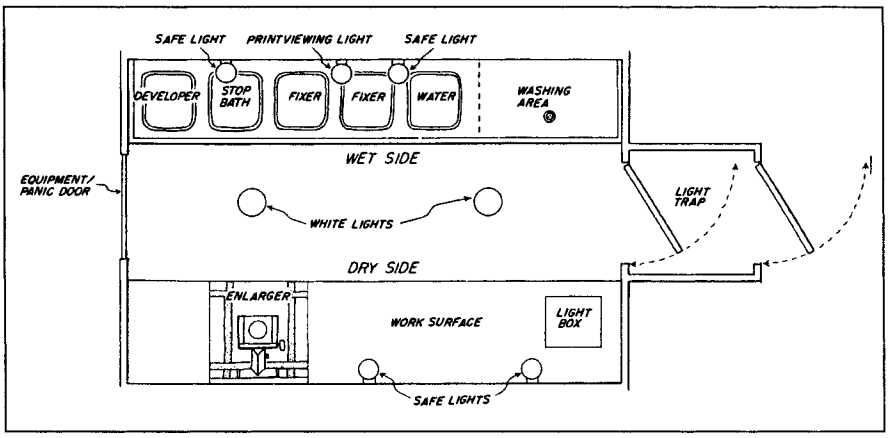
If you plan to convert an existing room, start the layout by drawing the outline of the room on the grid. Measure the length of all four walls, then freehand sketch the room outline using one square on the grid to represent one square foot in the room. Next, indicate all existing doors, windows, and other major features in the room, locating them on the drawing in the same scale they represent in the room.

After the room outline is drawn, use the equipment checklist on the facing page to inventory the equipment you have, or plan to have in the future. The amount of material to be accommodated and the size of the prints you plan to make are the key ingredients in planning a workable room. Some of the pieces of equipment directly affect the amount of either counter space or storage space needed in the darkroom, so be sure to make provisions for these items.

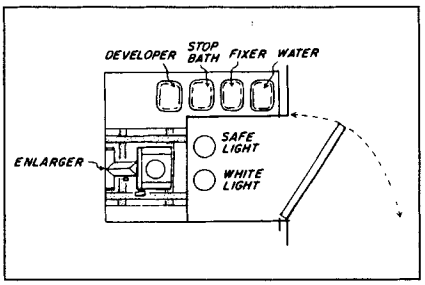
All of the major darkroom elements can now be cut out and placed on the grid. The ability to shift and move them about will speed the time it takes to arrive at a final floorplan.

If you plan to include any equipment not provided in cutout form, or if your equipment is to be a different size, you can make your own cutouts by drawing them to the same scale of 1/2" to 1'.

Large Darkroom Layout



Small Darkroom Layout



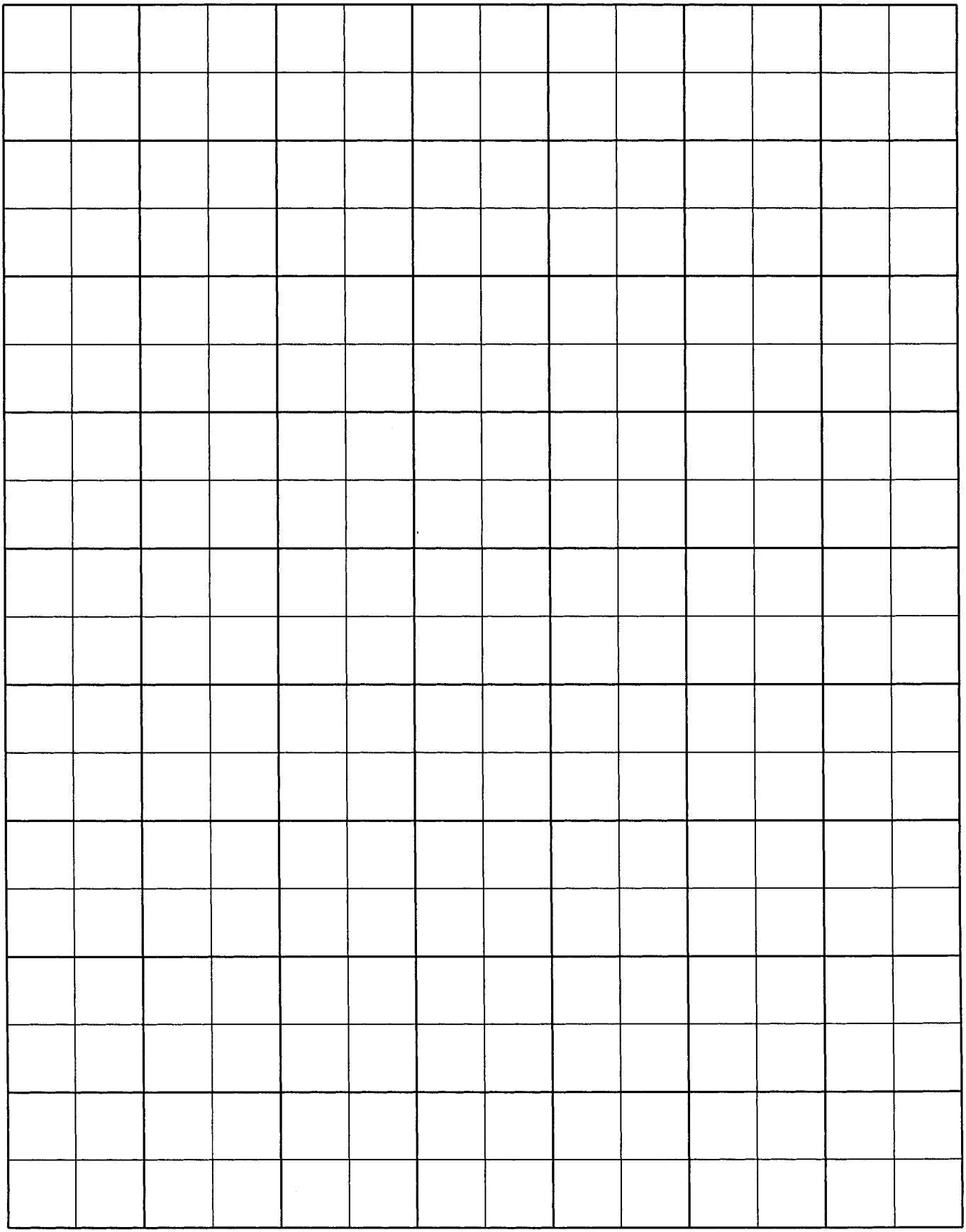
Typical Darkroom Layouts. These two darkroom layouts illustrate the extremes that you are likely to encounter. The smaller the space available, the more creative you will have to be. Fitting everything in a large room is relatively easy compared to fitting it into a 3' x 4' closet. Both, however, can be done and done well.

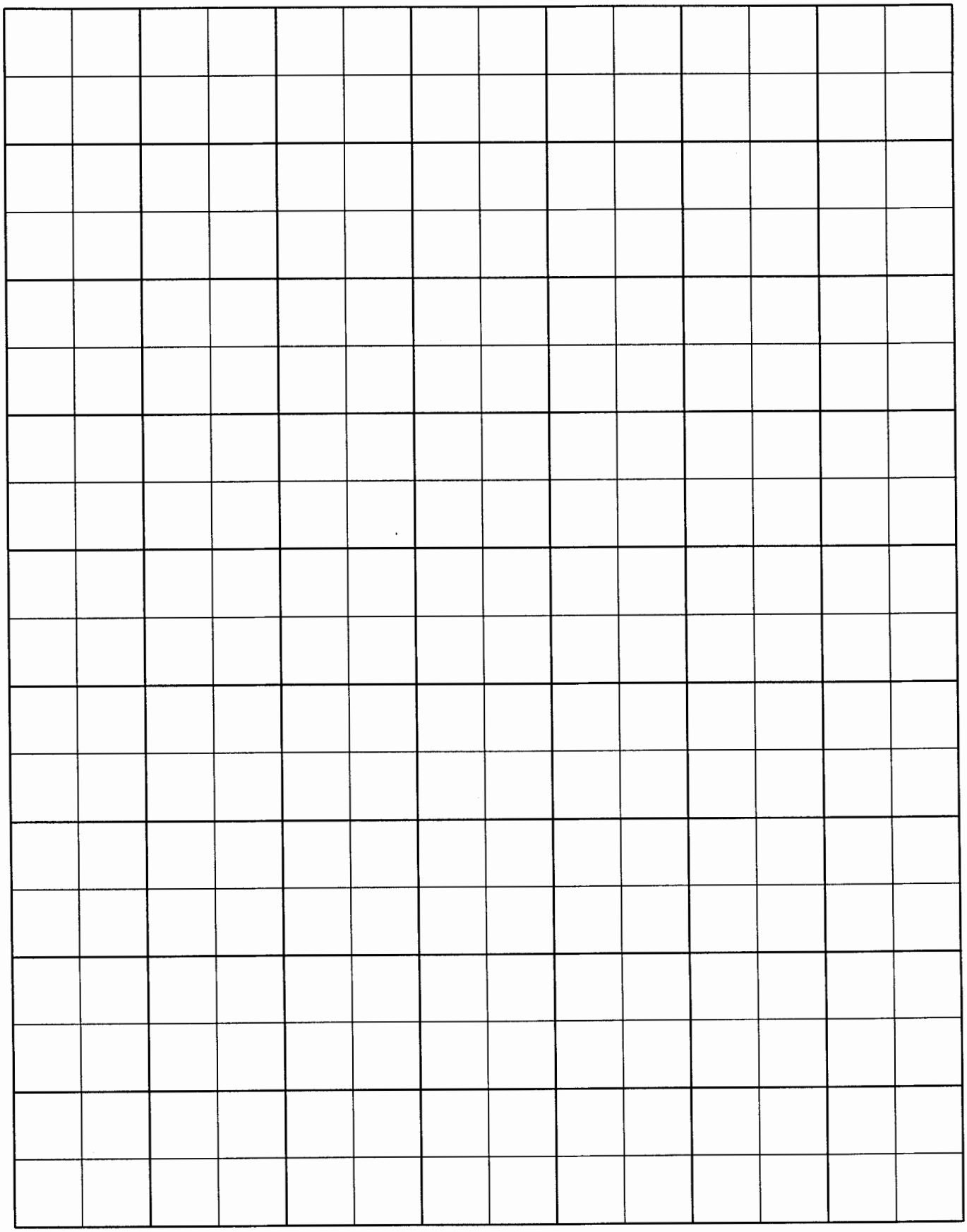
Darkroom Planning Checklist

Before beginning the preparation of the layouts and elevations, it is helpful to make a complete inventory of the materials and equipment that you have or might eventually want to accommodate in the darkroom. It makes good sense to plan ahead and provide space for equipment that will be added during the life of the darkroom. This information is also helpful in planning the type of storage space, sink size, and other elements of the darkroom based on the actual equipment to be used.

Equipment	*Model*	*Already Have*	*Will Build*	*May Add Later*
Dry Side				
Enlarger, 35mm				
Enlarger, 4 x 5				
Enlarger, other				
Enlarger lenses				
Enlarger coldlight head				
Enlarger color head				
Polycontrast filters				
Color correcting filters				
Exposure meter				
Color analyzer				
Voltage regulator				
Easel, 11 x 14				
Easel, 16 x 20				
Easel 20 x 24				
Easel, other				
Focusing magnifier				
Negative proof printer				
Contact printer				
Paper safe				
Enlarging timer				
Footswitch				
Scale/balance				
Printing control devices				
Dust sprays/brushes				
Paper trimmer				
Scissors/film cutter				
Densitometer				
Film cassette opener				
Wet Side				
35mm/2 ¼ developing tanks				
Roll film washer				
Sheet film tanks				
Sheet film hangers				
Film squeegee				
Processing trays				
Mural processing tray/drum				
Color processing drum				
Color drum agitator				
Print tongs				
Immersion heaters				
Water chiller				
Recirculating heater				
Stabilization processor				
Thermometer				
Gloves				
Stirring rods				
Graduates				
Funnels				
Aprons				
Towels				
Timer				
Chemical storage containers				
Squeegee board				
Print squeegee				
Print washer				
Negative drying cabinet				
Workroom				
Film				
Paper				
Print dryer, electric				
Print dryer, screens				
Dry mounting press				
Tacking iron				
Mat board				
Mat cutters				
Spotting brushes				
Spotting dyes				
Negative storage system				
Print storage containers				
Safelight filters				
Unmixed chemicals				
Negative clips				
Copystand				
Built-in Equipment				
Counters				
Sink				
Enlarger base, adjustable				
Light box				
Towel rack				
Shelf over sink				
Shelf over enlarger				
Ventilator fan				
Air conditioner				
Light-proof louvers				
Dehumidifier				
Light-proof door				
Safelights				
Water temperature regulator				
Valve				
Water filters				
Footswitch for enlarger				
Supply cabinets				
Electrostatic air cleaner				
Print viewing light				

Planning Grids





Dry-Side Cutouts

Preparing Layouts: Things to Remember

When working on your layout, there are certain things to keep in mind:

Enlarger. If you plan to make very large prints, the enlarger should be placed where it can be tilted horizontally to project the image on a facing wall. Enlargements of up to 20" x 24" can usually be made by making an adjustable enlarger base (see Chapter 6) or by using a wide-angle enlarging lens.

Aisles. There should always be sufficient room in the aisle to allow for free movement but not so much that additional steps are necessary to move from the enlarger to the sink. Aisle width for a one-person darkroom is whatever is comfortable, usually between 30" and 36".

Doors and Drawers. Be sure to allow for door and drawer openings. If an aisle is too narrow, cabinet doors and drawers may not open completely without hitting the opposite side. Be sure also to allow for print-drying racks to pull out fully.

Wet and Dry Sides. Where space allows, the dry and wet sides of the darkroom could be on opposite sides of the room, separated by a center aisle. This reduces the possibility of contamination.

Ideally, the developer tray should be located directly opposite the enlarger to reduce the number of steps needed to go from one to the other. If space is not sufficient to separate them with an aisle, a partition of wood can be installed between them to eliminate any possibility of splashing.

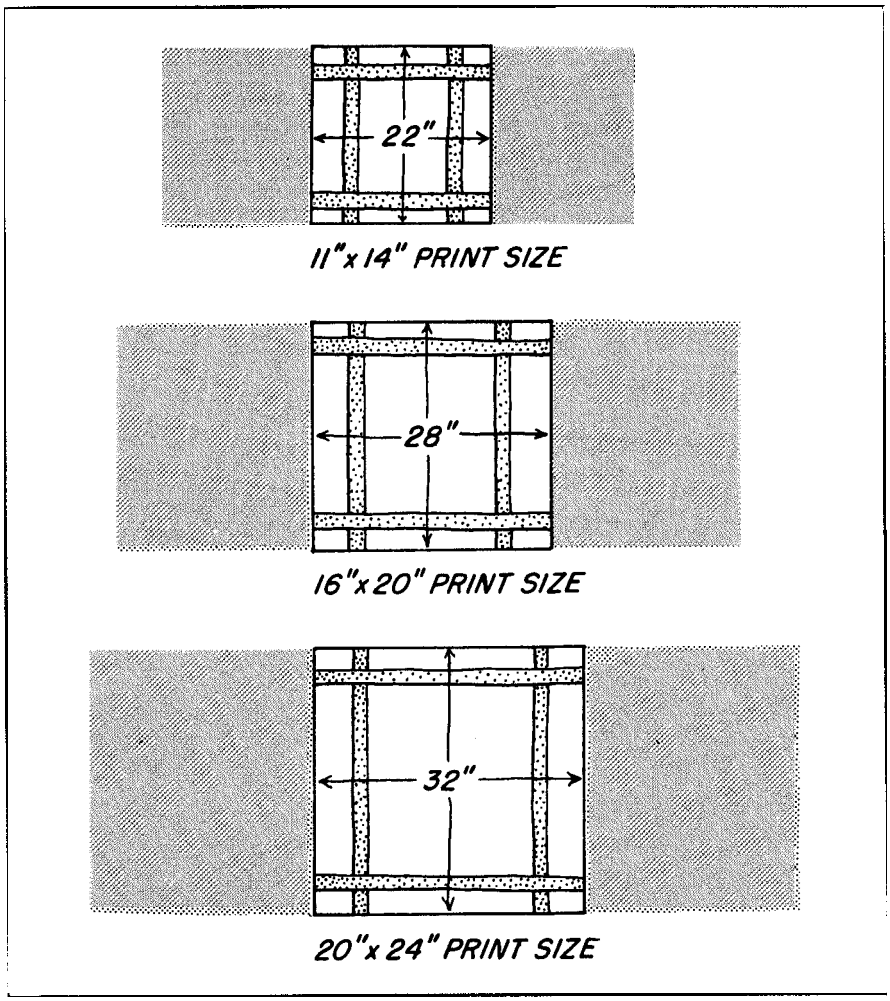
Left-Handed? It is recommended that if you are right-handed the room be laid out so that work proceeds from the left to the right (clockwise on the layout sheet), and if you are left-handed it could flow in the opposite direction (counter-clockwise).

Exits. All exits should open outward so in case of emergency you can leave the room with the least resistance. Exits should also be sufficiently large to allow for the movement of equipment into and out of the room without tearing down walls.

Size. The size of the darkroom depends, to a large extent, on the size of the prints you plan on making. If you are working primarily with 8" x 10" prints there is a strong likelihood that you will someday want to make larger prints, so accommodate that possibility when planning the room. It's easier to do it now than to have to rebuild the darkroom later. Darkrooms should not, however, be larger than necessary. A large room only makes you walk farther. The average darkroom will fit well into a space ranging from 6' x 7' to 10' x 12', regardless of the print sizes being made.

Working Space. Always remember that most equipment also requires working space. For instance, a dry-mount press without a place to have mat board, prints, and dry-mount tissue nearby will be a constant irritation.

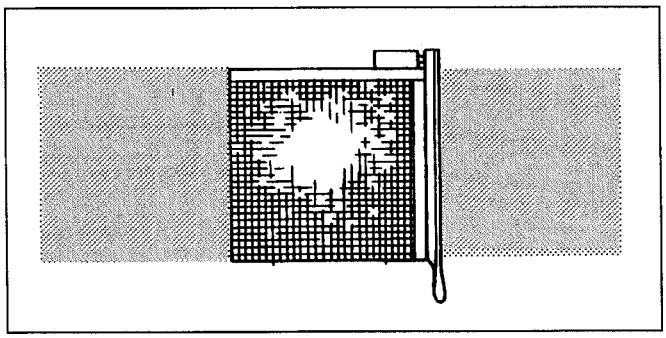
Enlargers



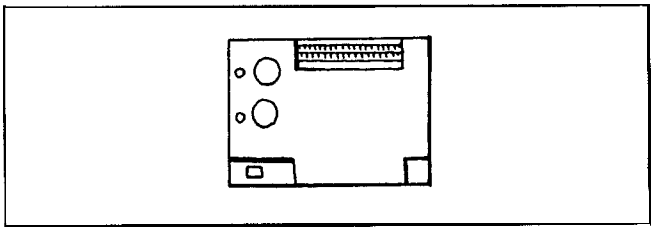
Enlargers. These enlarger cutouts are based on the maximum size of the prints to be made. Enlargers are relatively small compared to the size of the easel, plus the handling room required to make prints of a given size. The enlarger cutouts are also based on the longest dimension of the paper to be used so that both vertical and horizontal prints can be made. If you normally plan on making prints up to 11 x 14 but occasionally make larger ones, you can allow for the larger space with an adjustable easel base (see Chapter 6).

When making an allowance for the enlarger, you should also be generous with the working space on either side. There should be sufficient room for the maximum-sized paper you plan to use, with unexposed paper kept on one side and exposed on the other. The space required can be reduced by installing a light-proof drawer under the enlarger base, thereby eliminating the requirement for counter space to handle it. However, the light-proof drawer will conflict with the adjustable enlarger base unless it is offset to one side.

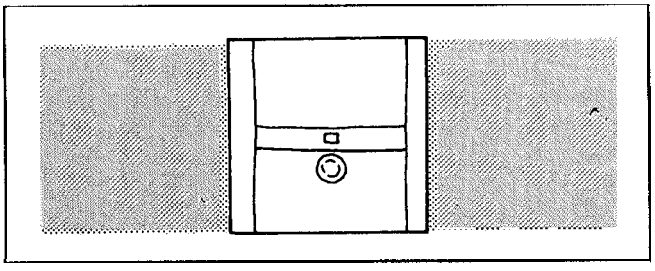
Paper Cutter



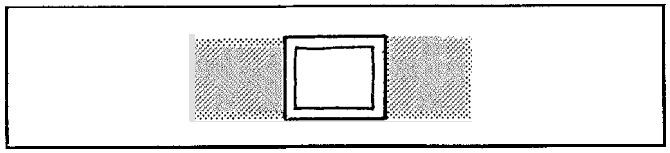
Color Processor



Dry-Mount Press



Light Table

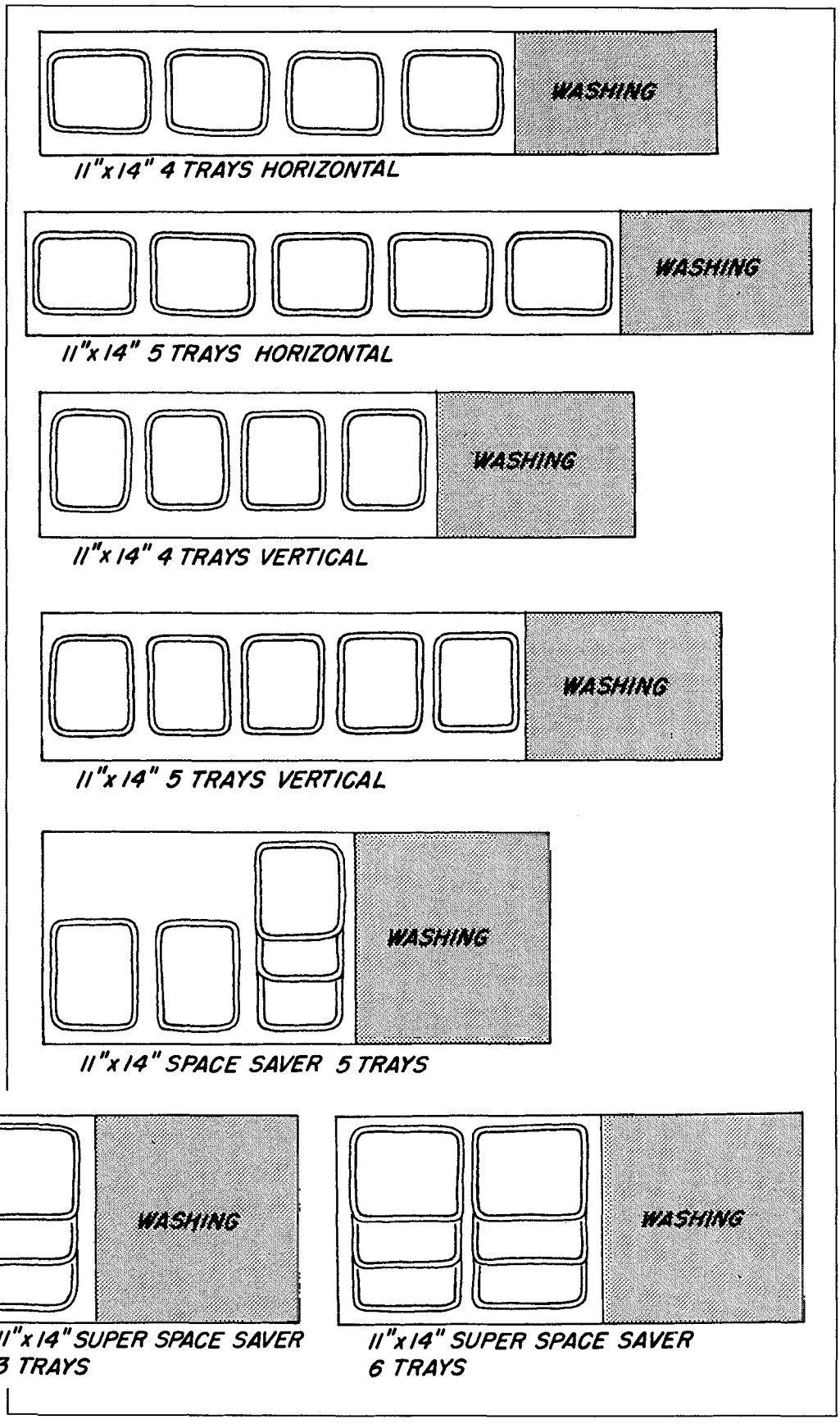


Wet-Side Cutouts

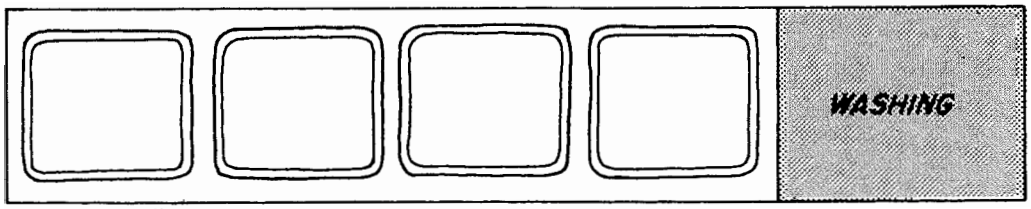
Sinks

Processing prints requires a minimum of three trays: for developer, stop bath, and fixer. There should also be a fourth tray to be used as a holding-water bath for prints prior to placing them in the washer. Ideally, the sink should allow for a fifth tray to hold fixer, because two-bath fixing is more effective and more economical. The sinks shown here are designed to accommodate anywhere from three trays to six, with an additional 30" space left for washing. If you plan on washing with an East Street Gallery washer or some other such space-saving equipment, the 30" space allowed can be greatly reduced. The sinks vary in size, depending on whether you plan to align your trays in a horizontal or vertical position in the sink, and on the size and number of trays you plan to use. If you plan on building your own sink, and if space allows, you should build the largest size possible to accommodate expansion of your activities. The actual cost of the additional materials and the additional labor required are minimal. If space in your darkroom is at a premium, you can save sink space by using tray racks to hold the trays one over the other.

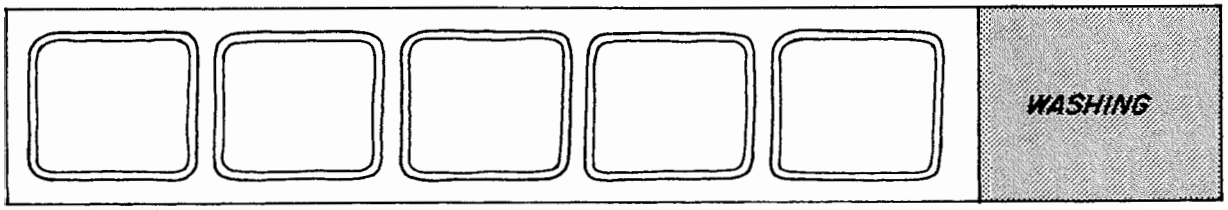
Sinks for Processing Prints up to 11" x 14"



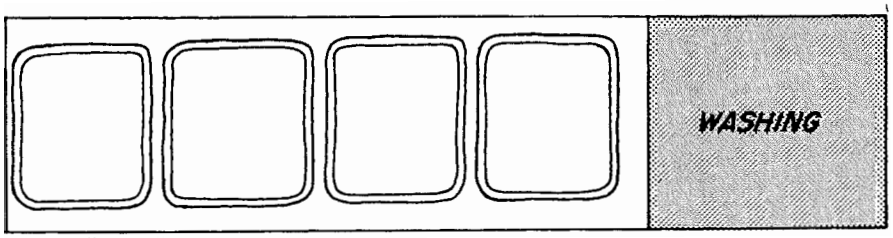
Sinks for Processing Prints up to 16" x 20"



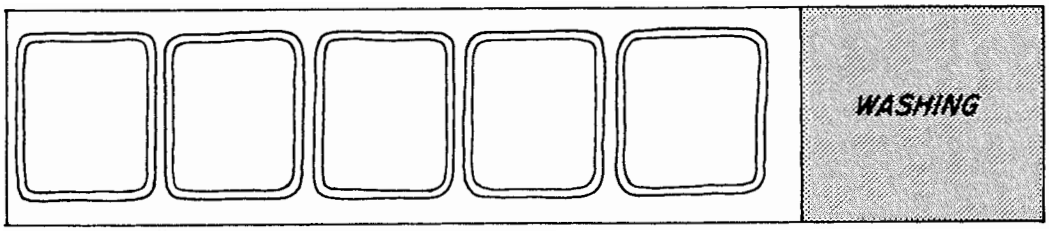
16"x 20" 4 TRAYS HORIZONTAL



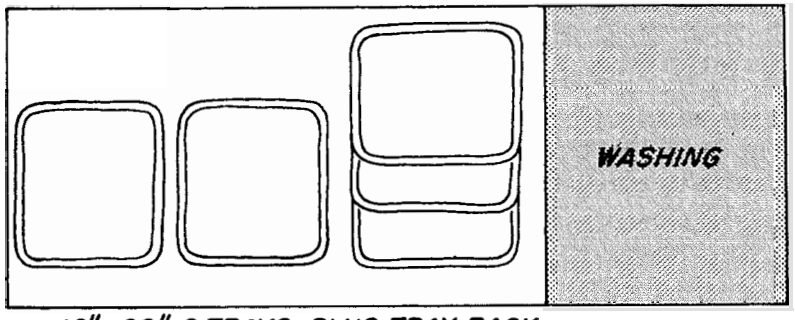
16"x 20" 5 TRAYS HORIZONTAL



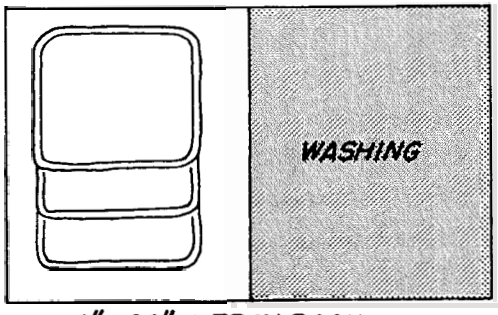
16"x 20" 4 TRAYS VERTICAL



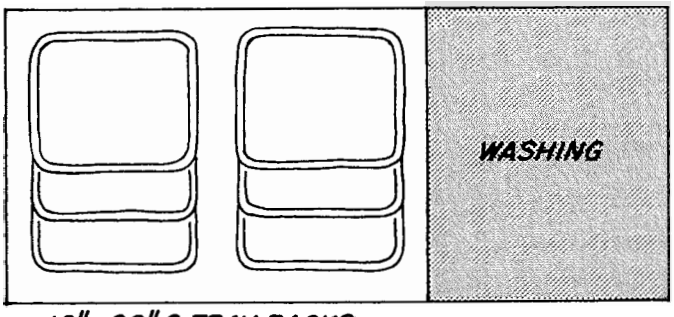
16"x 20" 5 TRAYS VERTICAL



16"x 20" 2 TRAYS PLUS TRAY RACK



16"x 20" 1 TRAY RACK



16"x 20" 2 TRAY RACKS

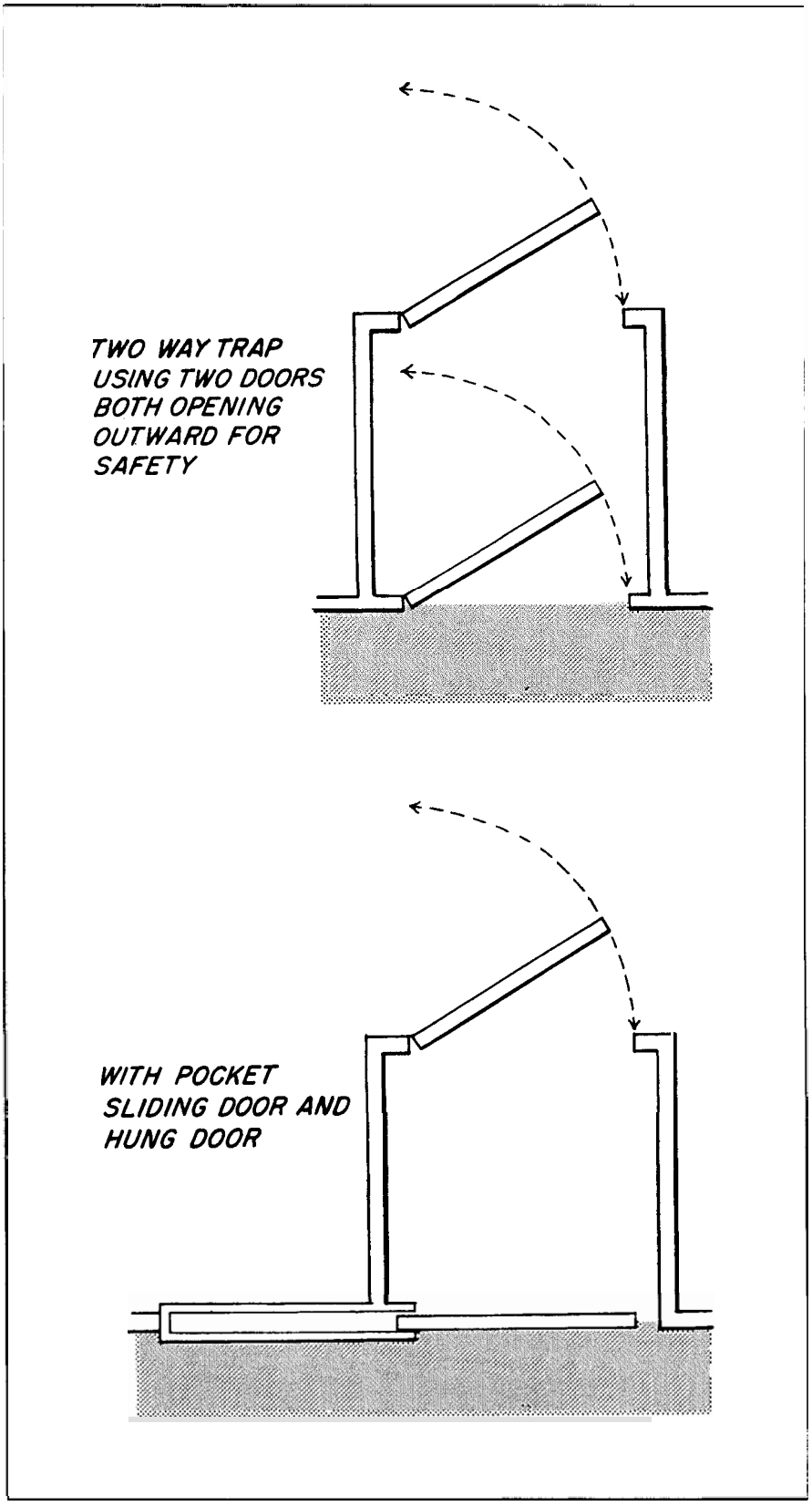
Light-Trap Cutouts

Light-traps allow free access even when light-sensitive materials are exposed. Light-traps are generally a combination of doors and curtains, or mazes that require no doors; the configuration of the walls is enough to prevent light from entering the room.

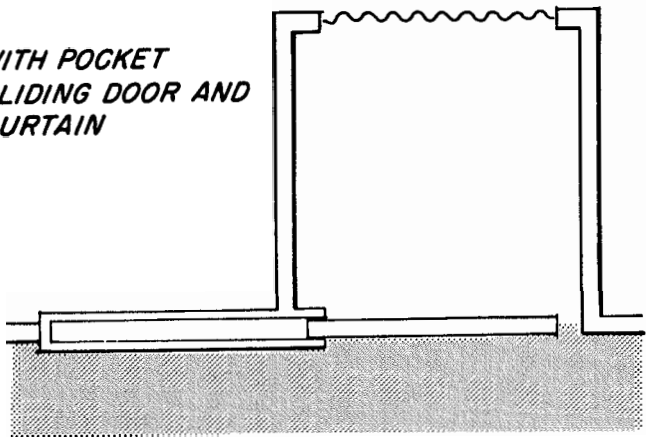
The inside of a maze or trap should always be painted a flat black to reduce reflections, and tests should be made to ensure that they are light-proof. Film is especially sensitive to light, even minor reflections, and mazes in particular should be watched so that no reflections enter the room to fog the film.

A white line can be painted on the inside walls of any light trap as a guide. All door handles should also be marked with phosphorescent paint. Entering a maze directly out of the bright sun can cause you to be quite blind until your eyes adjust. The white line will enable you to enter without waiting for a complete adjustment. In a short time, you will be able to move around in the dark.

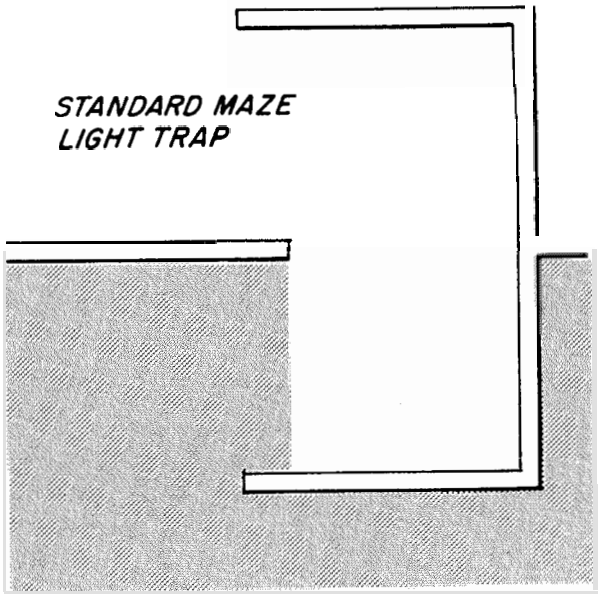
The accompanying mazes have been drawn to scale providing for 30" of shoulder room. The minimum would be about 28", so slightly smaller designs are possible. A separate equipment door can be constructed in the maze to allow the entry of larger equipment than the light-trap will allow, and it can also double as a panic door. As this door will not be opened regularly, it need not be hinged. A panel attached loosely with small screws is quite effective and can be pushed out if a fast exit is required. Make sure all doors, including the equipment door, open outward for safety.



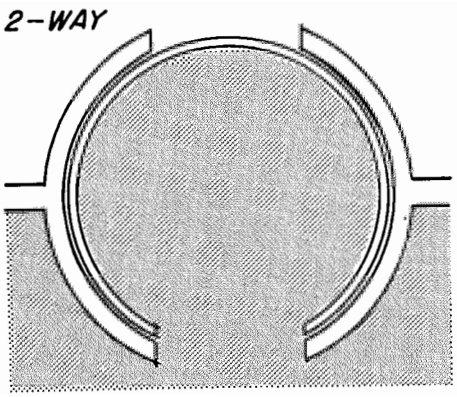
WITH POCKET SLIDING DOOR AND CURTAIN



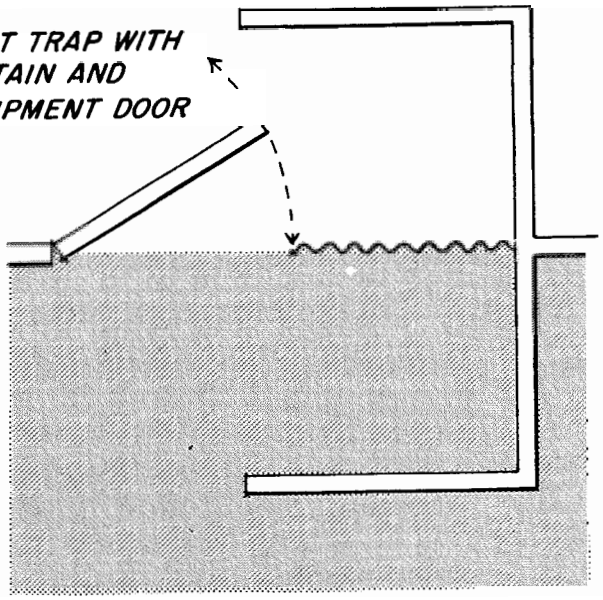
STANDARD MAZE LIGHT TRAP



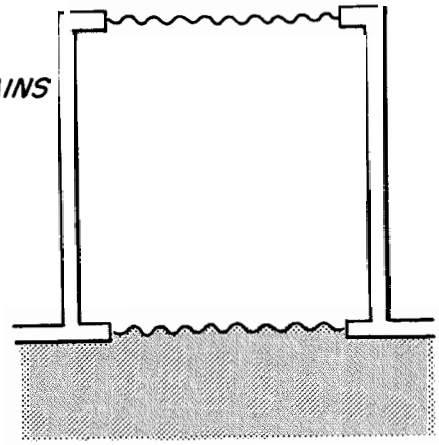
REVOLVING 2-WAY DOOR



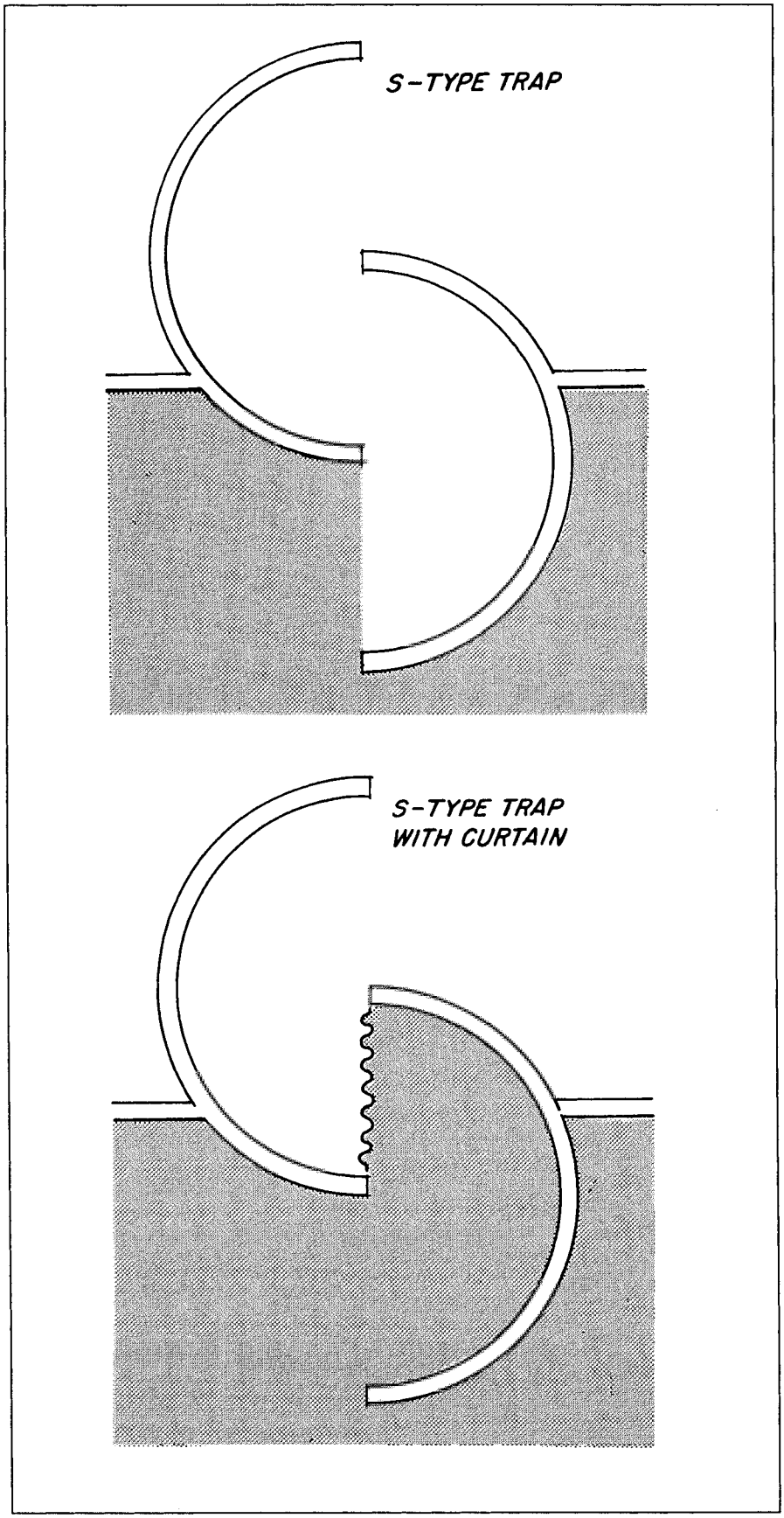
LIGHT TRAP WITH CURTAIN AND EQUIPMENT DOOR

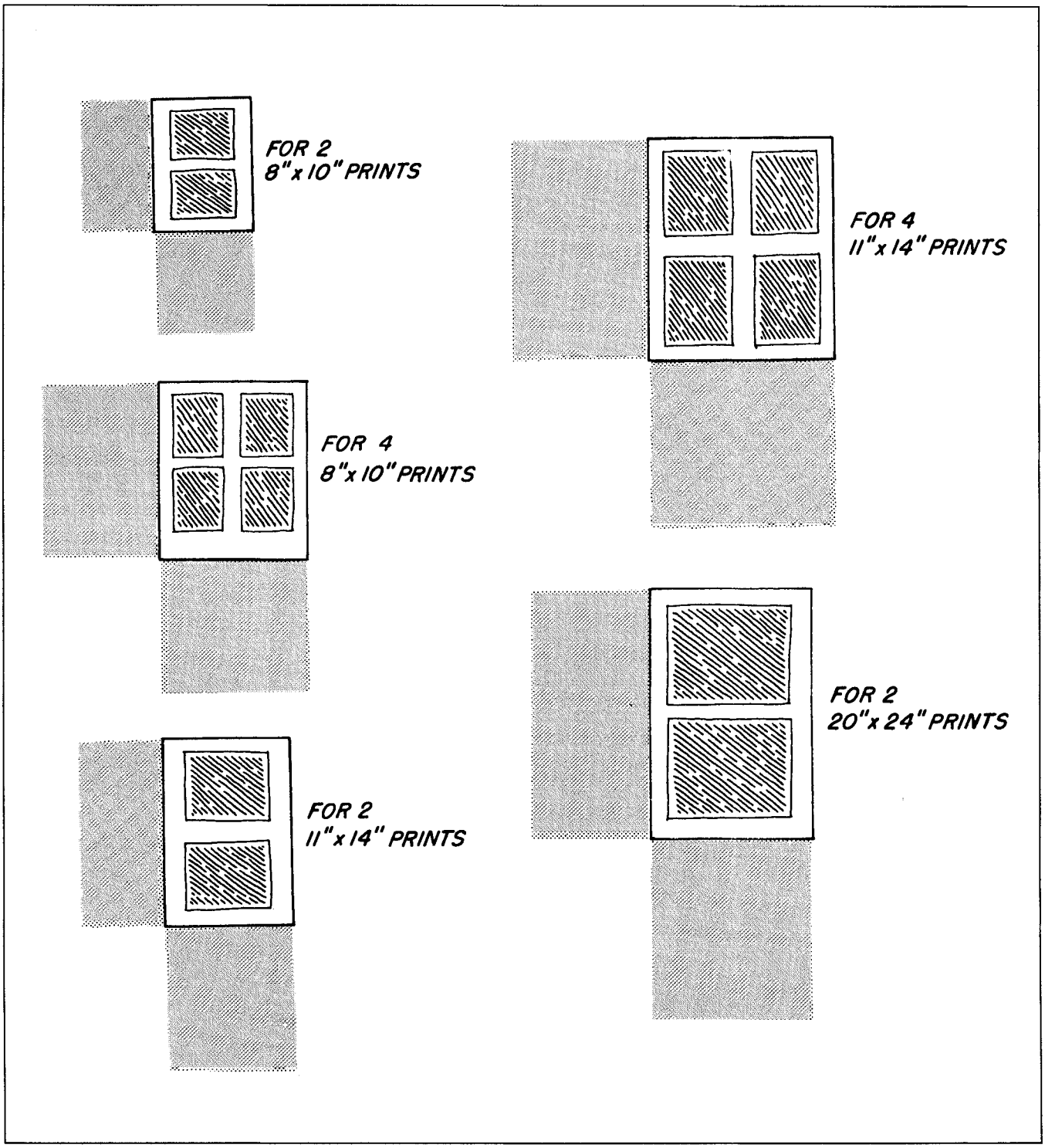


TWO WAY TRAP USING TWO CURTAINS



Light-Trap and Drying-Rack Cutouts





Drying Racks. The drying racks shown here are made with fiberglass screens and wood or metal frames (see Chapter 6). Their capacity should be sufficient to hold prints from a normal printing session. The capacity of the drying rack depends on the horizontal dimensions shown, as well as on the number of shelves allowed by the vertical height available to you. If you normally work in more than one size print, you should build for the larger size. The shaded areas indicate the space needed to pull the rack out either horizontally or vertically. Once you have determined how a given rack will be positioned in your darkroom, you can trim off the shaded area that will not be used.

Preparing Elevations

After the layouts for the darkroom have been completed, work can begin on the elevations for the dry and wet sides of the room. Elevations are similar to floorplans except they show the vertical surfaces of the room rather than the floor. To prepare elevations the first step is to measure each wall's length and height, then outline them on a section of the grid paper using the scale of 1/2" to 1'. When this is completed you will have four rectangles (or squares), each of which represents a wall in the darkroom. Label one of them wet side and one dry side, depending on how they relate to the floorplan. Now draw in all of the existing features of the room that affect the darkroom design, such as door openings, window openings, plumbing outlets, sinks, and so on. These items should be drawn to scale and in their proper location in the room. Measure their size and placement and use the 1/2" to 1' scale to locate them on the drawings properly.

When the walls have been drawn to scale on the grid, you can begin to plan what the counters and sinks will look like after they are installed. The next step in preparing elevations is to determine the height of the work surfaces in the room. The height of counters, sinks, and enlarger baseboards determines to a large extent how comfortable the darkroom will be to work in. If they are too high or too low, great strain can be put on the back and legs and cut your visit to the darkroom short. Because this decision is so critical it pays to make it wisely. The normal height for work surfaces is 36" above the floor, but this is only a starting point. Comfort while working depends not only on your height but also on the length of your arms and legs. Until all photographers are standardized, darkrooms cannot be.

Begin with the 36" indicated height and make a temporary surface at this suggested height. You can do this by supporting a board with books. Now try to lean on it and move things about. See how comfortable the height is. Strain will show only after a number of minutes have passed, so spend some time to see what your reaction is. If your back is straight and your arms are comfortable, the height will be right for you. If not, raise or lower the board until a more comfortable height is found.

Transfer the ideal working height to the elevations by drawing a line on all wall surfaces to represent that height. Draw another line about 6" above the floor line to indicate the lowest level for the fronts of counters, sinks, drying racks, and so forth. If they go all the way to the floor, there will not be room for your feet as you stand at the counter, and cleaning the room will be much more difficult, because you will not be able to reach under the sink to clean up spilled chemicals.

The Wet Side

The wet-side elevation should show the placement of the sink, shelves, water outlets, safelights, under-sink storage, and, if there is no other space available, the print-drying racks.

The sink bottom should be located at a distance slightly below the ideal working height. The side walls rise about 6" above the bottom, and if the sink is too high it is difficult to reach over the side walls to reach the trays in the bottom of the sink.

Water outlets: Ideally, there will be a regulated outlet at one end of the sink and an unregulated one at the other. Both outlets should be at least 12" above the sink bottom (or above the duckboards, if you plan to use them) so that large graduates can be placed under them to be filled. Even better is to have rubber hoses attached to faucets. When not being used, they lie on the bottom of the sink. In use, they can fill graduates as high as the hose is long.

Storage under the sink can be used to hold processing trays, which can be separated by thin sheets of masonite or plywood. The bottom of this tray-storage rack should slope toward the front to allow for drainage when wet trays are stored. Preferably, trays should be

(continued on next page)

The Dry Side

The dry-side elevation will show the counter, dry-side storage, and the enlarger mount and baseboard. If you plan on using kitchen-type cabinets, they can be drawn in so that their counters are at the height of the line drawn on the elevation to indicate working height. Check to be sure the enlarger head can be raised to its full limit, and use the chart on "Negative-to-Easel Distance" in Chapter 6 to determine if you can make the size prints you normally make at the counter-top height. Perhaps your enlarger head will hit the ceiling before the negative-to-easel distance is sufficient to give you the size prints you normally make. If this happens, you have three alternatives:

(continued on next page)

left tilted on end in the sink to drain completely prior to being stored.

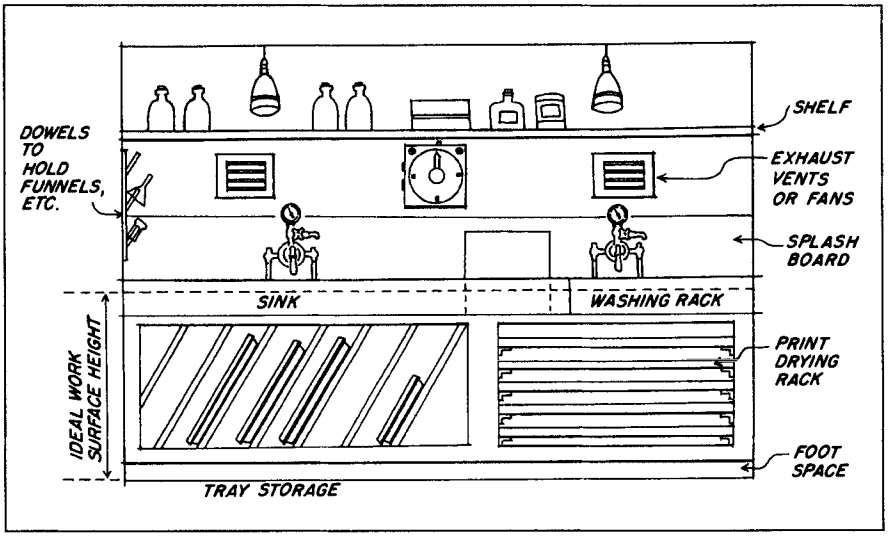
Print-drying racks can be located under the sink if there is no room for them outside of the darkroom (building instructions are shown in Chapter 6).

Dowels can be mounted into the walls on the sides or back of the sink to provide a convenient place to hang graduates, funnels, tongs, and other small items for draining and storage. Be sure to place them where the dripping water will not contaminate processing trays. A small trough can be fashioned under the trays to funnel the water into the sink.

Exhaust vents or fans can be located over the sink to eliminate fumes and water vapor. Never locate a fan that blows air into the room over the sink, since that will just distribute the dust and vapor more widely. The wet side should always be used to exhaust the air out of the darkroom.

Safelights should be indicated on the elevation and should be no closer than 4' from processing trays or the enlarger baseboard.

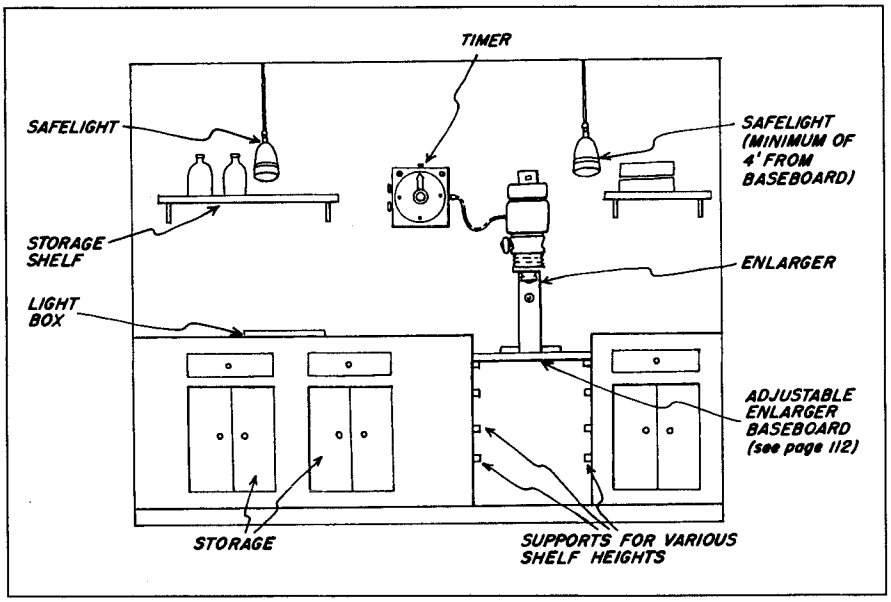
The shelves over the sink should be high enough so that when trays are stood on end to drain in the sink, they will not hit them.



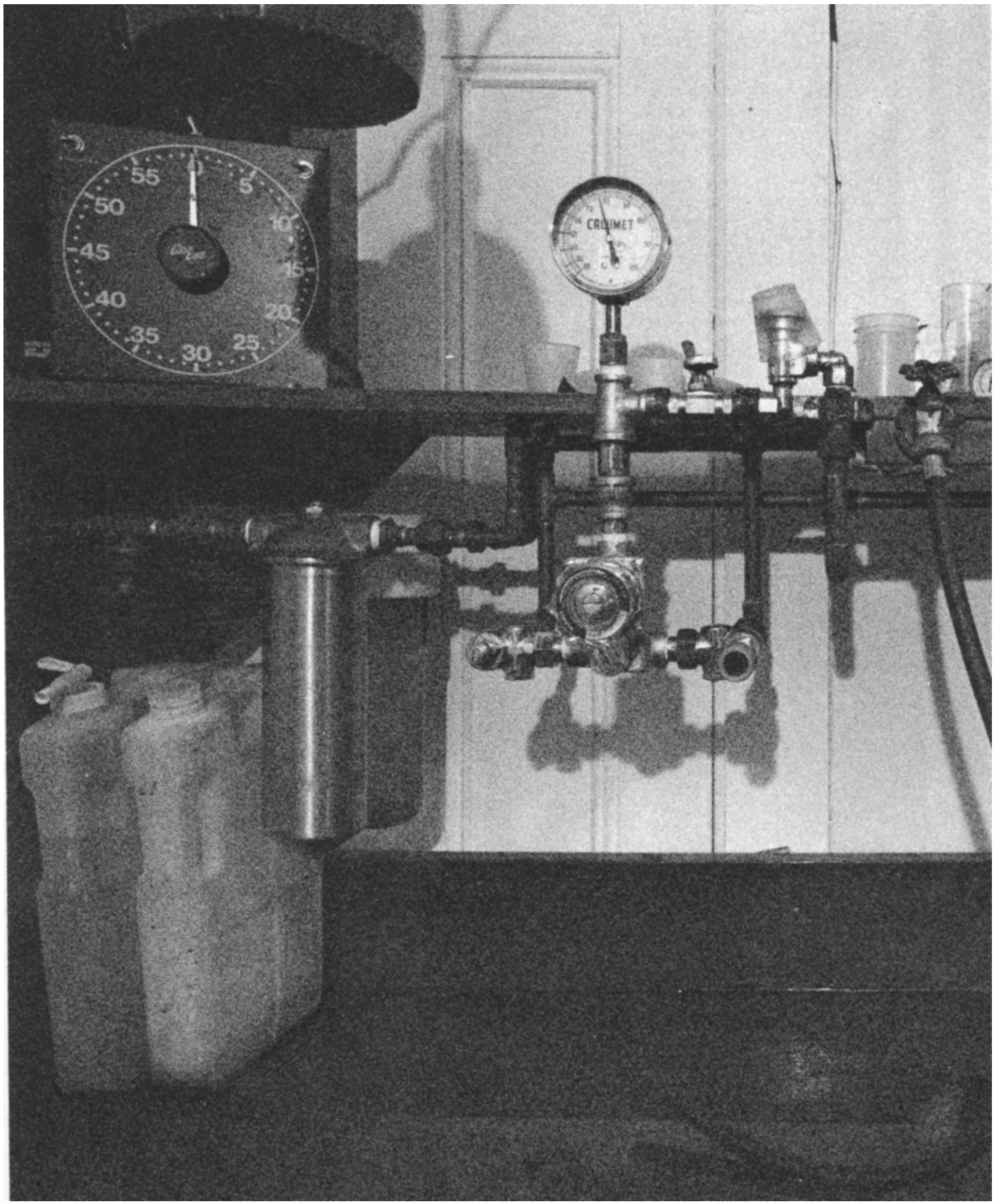
1. Cut a hole in the ceiling to allow the enlarger head to rise higher.
2. Lower the enlarger baseboard to increase the negative-to-easel distance.
3. Use a wide-angle enlarging lens.

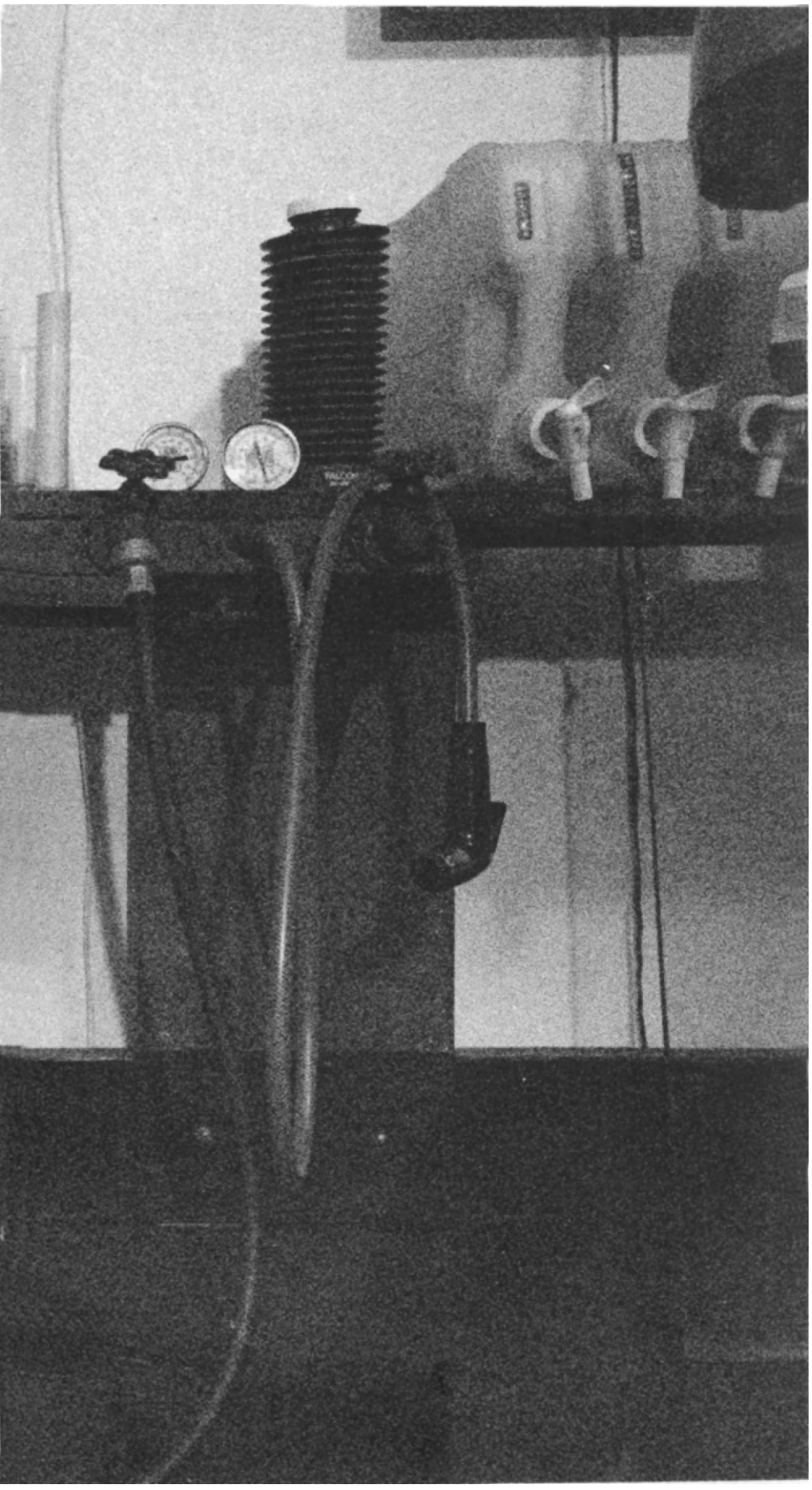
Normally the enlarger can be mounted on the wall just above the counter top, or it can be set directly on the counter. You may want to build an adjustable enlarger base to provide for larger prints (see Chapter 6).

Determine the width of the enlarger area based on the maximum-sized easel you plan to use. Locate this area near the developing end of the sink, allowing for room on either side of it for unexposed and exposed paper.



5 Building the Room





Contents

Most communities require a permit to do plumbing or electrical work and in many cases require that the work be performed or supervised by a licensed electrician or plumber. These legal requirements are designed to ensure that the work is done properly and safely. Failure to comply with local laws is not recommended and can have a significant impact on your legal liabilities should any personal or property damage result.

Tools

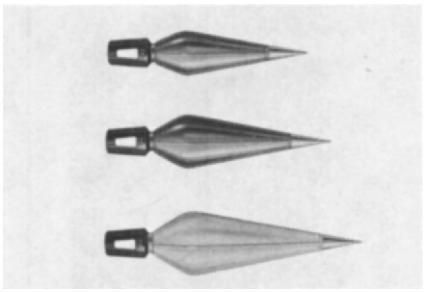
The tools required to build a darkroom are common ones that you may already own. If you had to buy all of the best available tools, the total expenditure would be less than $300, which is reasonable considering how much you would have to pay to have the room built for you. If you are converting an existing room and plan on adding only wiring or plumbing, the cost will be even less.

Take it from someone who has learned the hard way: buy only the best tools. With reasonable care they will last a lifetime, whereas cheap tools probably won't last through the first job. The tools shown on these pages are the standard ones required to do carpentry, plumbing, and electrical work.

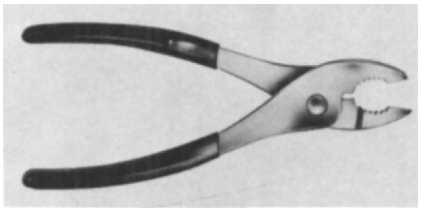
Tools are generally classed as hand tools (powered only by the human hand), power hand tools (operated by hand but powered by a motor), and power tools (bench-mounted and powered by a motor). The tools demonstrated in this book are from the first two categories; large power tools are not necessary.

Hand Tools

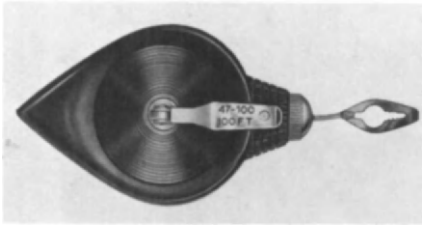
Hand Saw. These come in two kinds: crosscut (used to cut across the grain of the wood) or rip (used to cut along the grain).



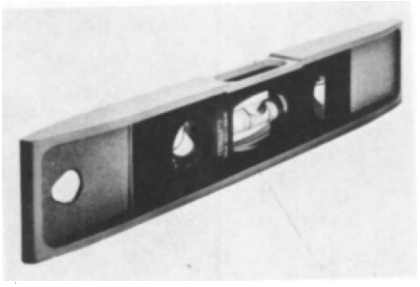
Plumb Bob. Suspended on a string, these are used to determine a perfect vertical line. When installing framing, paneling, and so forth, they will ensure that the verticals are accurate.



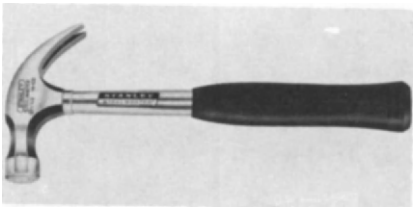
Pliers. Pliers can be used for holding, turning, bending, or crushing. The best kind are slip-joint pliers that adjust to handle either larger or smaller pieces.



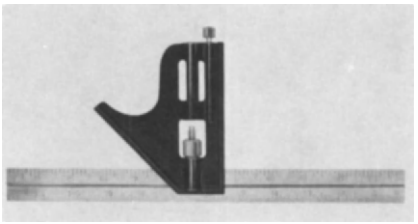
Chalk Line. When the string is pulled out of the holder it is covered with chalk dust. If you hold both ends down and snap the taut string, it will snap against the floor or wall and leave a line of chalk. This is a simple way to lay out the floorplan on the basement floor, or to indicate where pipes or counters are to be run along a wall. You can also use a piece of string and chalk, snapping it against the floor in the same manner, which works just as well (although a bit messier).



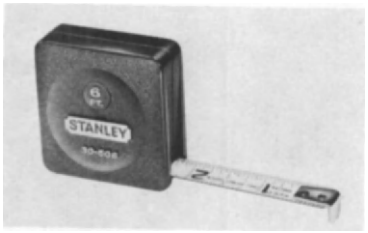
Level. These are used to determine if something is level in either the vertical or horizontal directions. A curved fluid-filled tube with an air bubble in it indicates when the level (and whatever it happens to be held against) is level and, if not, what direction it is tilted.



Hammers. The best hammer for carpentry work is the curved claw model that enables you to drive a nail and then pull it out using the other end.

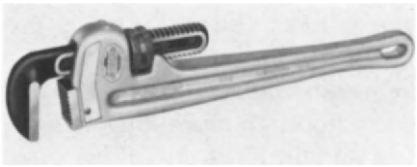


Combination Square. Combines the functions of a ruler, square, and level in one unit. Ideal for general purpose work, and its small size makes it easy to work with.

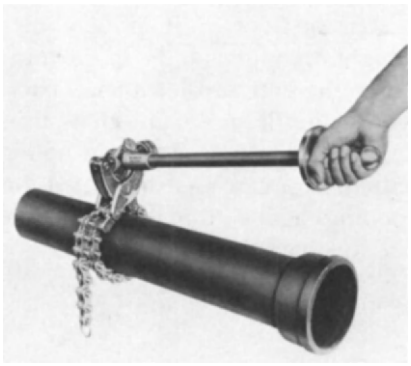


Tape Measure. You can buy several different types of rulers, including the folding zig-zag ruler or the tape ruler shown here. Most types will suffice for general construction work, but this one is slightly more convenient, since it is small and comes in lengths ranging from 6' to many hundreds of feet.

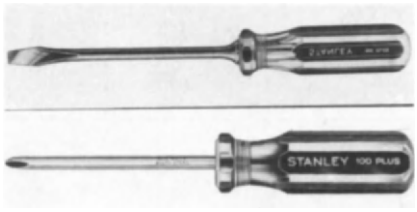
Adjustable Wrench. Rather than buy a whole set of open-end wrenches, buy one of these. They come in various sizes, and the one you select should be based on the maximum size of nut you expect to encounter. Because the largest nut is most likely to be in the plumbing, a wrench for working on plumbing fittings should have jaws that open at least 1 1/2".



Pipe Wrench. Used primarily to fasten and unfasten threaded steel pipe.

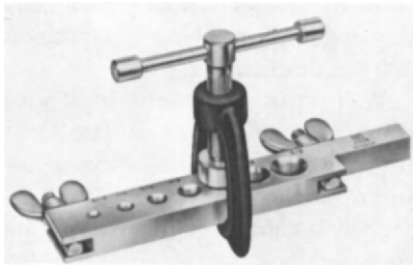


Chain Wench. Used to twist large drain, waste, or vent pipes in sewer systems.

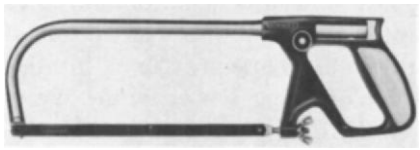


Screwdrivers. These come in two types, slot-headed and Phillips, for two different kinds of screw heads. They are easy to tell apart: the Phillips screw has crossed slots, and the other has a single straight slot running across the screw head. You should have a variety of sizes of screwdrivers. The head should fit snugly into the slot of the screw or you will damage the screw, making it difficult to remove.

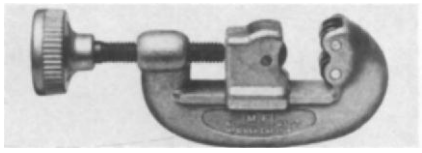
Tubing Bender. Used to bend copper tubing so that the walls do not collapse and restrict the flow.



Flaring Tool. Used in flaring the ends of copper tubing to be used in plumbing and incoming water lines; simplifies the installation and eliminates the need for using a torch and solder.

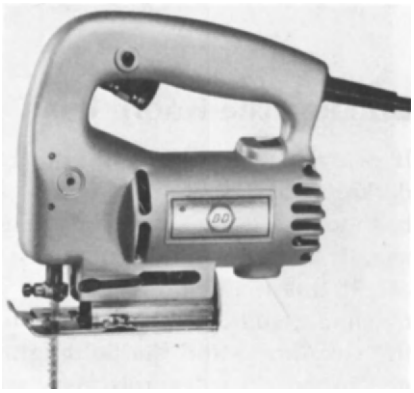


Hacksaw. This tool is very handy for cutting copper or plastic plumbing pipe. It can also be used to cut cast-iron pipe or ventilating duct.



Tubing Cutter. Designed to make even, smooth cuts in copper pipe or tubing. Makes working with pipe easy. As the tool is revolved around the tube, the blade gradually cuts deeper and deeper until the piece you want drops off.

Propane Torch. If you choose to use soldered joints in your plumbing system, you will need a torch to solder the joints.



Sabre/Bayonet Saw. If you plan on buying only one power tool, this should be it. It is by far the most versatile tool available for cutting wood, plastics, and metal. Many styles of blades are available, ranging from fine wood scroll blades, to blades that cut cardboard, to blades that cut sheet steel. The narrow blades allow you to drill a starter hole in a wall and then cut out an opening without using additional tools.

Drill. The power drill is usually a standard tool in the home workshop. Its basic function is to drill holes, but special attachments can be added to grind, polish, and sand. Slightly more expensive models have reversing motors and variable speed controls, which are especially useful because they allow you to start a hole with a low speed thus giving you more control. For darkroom building, a hand brace and bit will suffice if you don't already have a power drill.

Sander. The power sander can save you hours of work and is certainly a good investment.

Installing Partitions

Building the Room Itself

If you are planning to install the darkroom in a large space, such as a basement or garage, the first step is usually to partition the darkroom off. If this is not done, it will be much more difficult to control both the cleanliness and the light-tightness of the space. It is relatively easy to make partitions; building door frames and hanging doors can be greatly simplified by buying set-up units.

There are two kinds of partitions, load-bearing and nonbearing. If you have to move an existing partition to accommodate the new ones for your darkroom, you should know which kind it is. A load-bearing wall supports part of the weight of the house, and its removal can cause serious problems in upstairs floors and ceilings. A nonbearing wall can be removed without replacing the support, as you would have to do with a bearing wall; however, even nonbearing walls may contain pipes or electrical wiring that must be rerouted. Study the wall carefully before deciding to move it. Wiring is fairly easy to reroute; plumbing is much more difficult. The detailed plans in this section deal with only the installation of new partitions that are nonbearing.

Wall partitions can be built with either 2 x 4 studs or 2 x 3s. The 2 x 4s are not significantly more expensive and do make a more stable wall, especially if cabinets and sinks will be mounted to it.

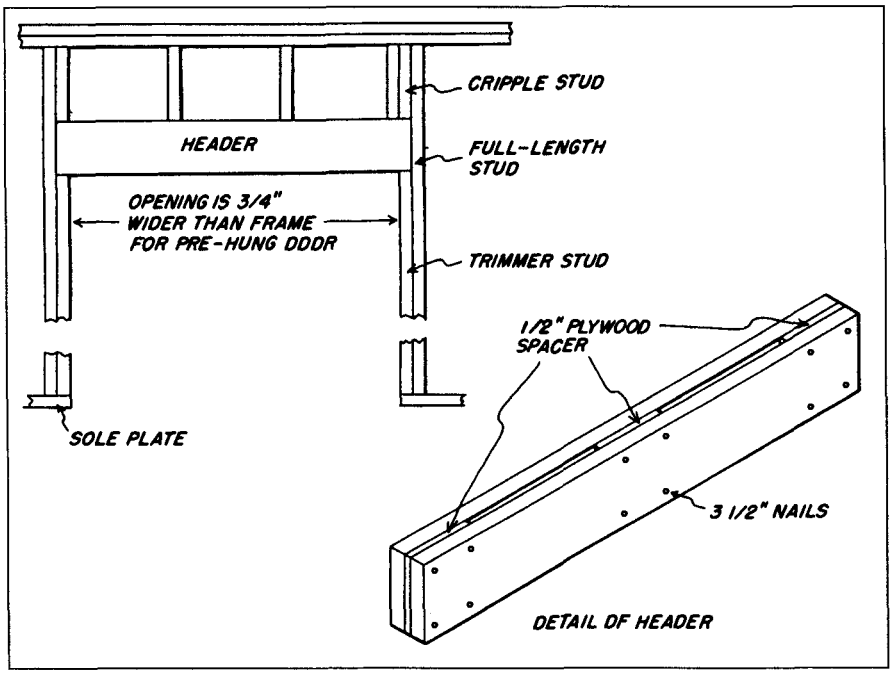
Always be sure to use well-seasoned lumber. If you use inexpensive green or wet lumber it will tend to twist and bend as it dries within the wall. This will crack the wall board and also make door frames and enlarger mounts move out of alignment. Specify "dry" lumber when ordering. For economy, always use the lowest grade of lumber suitable for your project. For wall studs, this would be "construction," "standard," or "utility" grades if your partitions are nonbearing, and "stud" grade if they are either load-bearing or nonbearing.

When preparing plans, remember that the measurements of lumber refer to the lumber before final cutting by the lumber yard. Therefore, a 2 x 4 is actually 1 1/2 x 3 1/2, and a 2 x 6 is actually 1 1/2 x 5 1/2.

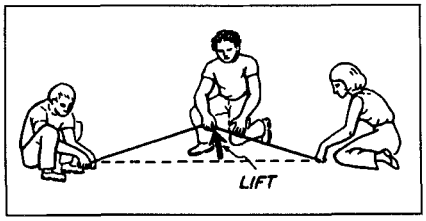
Marking the Layout on the Floor

The first step in building the room is to mark the floor to show where the various walls and doors are to be placed. Using a chalk line, transfer the measurements from your layout to the floor. To make long straight lines with the chalk line, either drive nails at both ends so that the string can be stretched between them, or ask two friends to hold the ends down. With the string held tautly against the floor, lift it an inch or so straight up by grasping it in the middle of the run and let it snap back against the floor. A faint chalk line shows where the wall should be installed. You can measure off door openings against this line and indicate the markings on the floor.

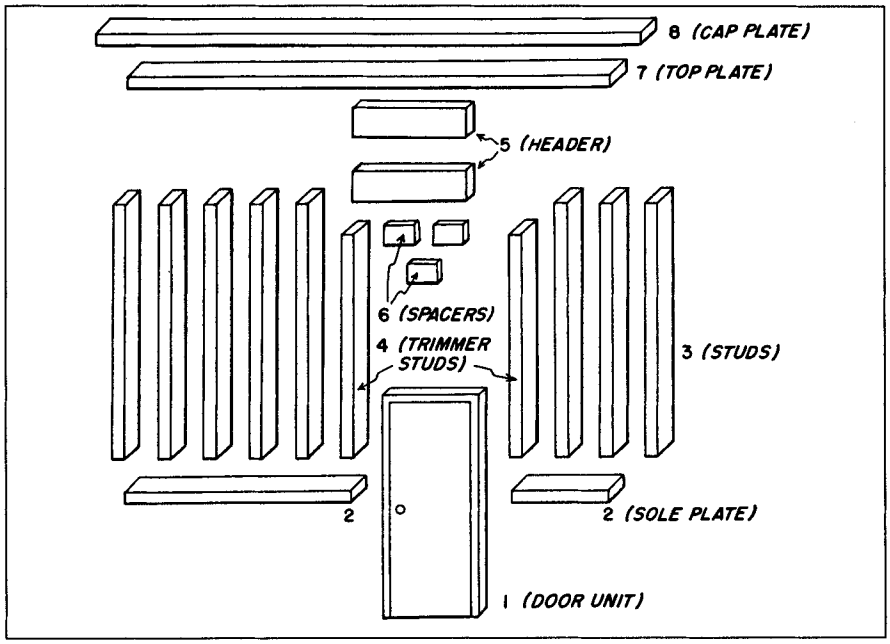
Door and Header Details



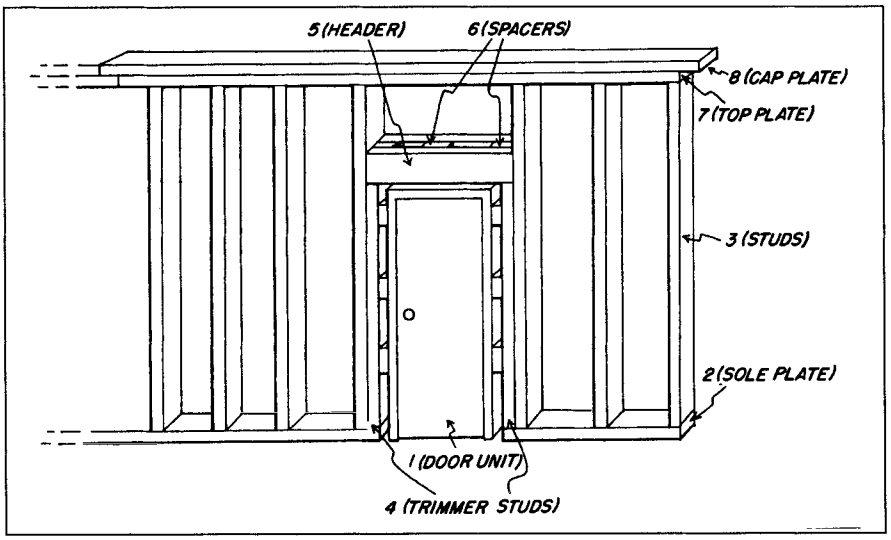
Marking a Chalk Line



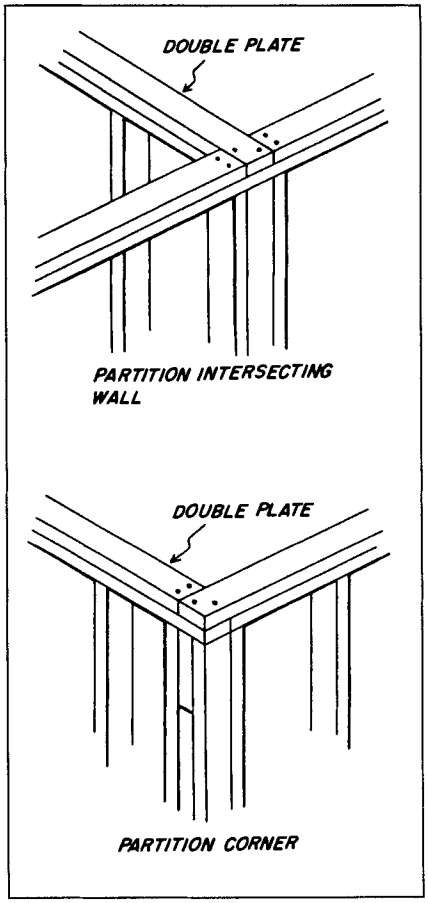
Partition Parts



Assembled Partition



Joining Partitions



Partition Assembly. This two-part drawing shows a typical partition in both its assembled and unassembled state. If you are planning to build a light-trap, the construction would be identical, except the door and door frame would not be used. Instead, additional partitions would be built in the pattern selected for the light trap.

Begin the cutting and assembling by measuring off the sole plate (#2), cutting it to allow for a door opening if one is to be in that partition. The opening should be the width of the door frame, plus an additional 3/4" clearance needed for making adjustments when the frame is mounted into the wall.

Next cut the studs (#3) so that there are enough to be spaced every 16" along the sole plate. Cut a top plate (#7) to the same length as the sole plate (including the door opening).

Cut trimmer studs (#4) used to support the header over the door frame opening. These should be cut long enough to go from the top of the sole plate to 3/4" above the door frame.

Now cut two pieces of 2 x 6 (#5) for use as the header. Since they will be turned sideways to the other studs, their width will be too narrow unless spacing (#6) is used. If the wall is being constructed of 2 x 4s, an ideal "spacer" would be a piece of 1/2" plywood cut to size. Two pieces of 2 x 4 used sideways with a piece of this spacer in between equals the width of the 2 x 4 studs it will come in contact with. If your wall is being built of 2 x 6s to accommodate a sliding door, the header should be constructed of two pieces of 2 x 4 with spacers cut from another piece of 2 x 4 so that they are 2 1/4" wide.

After you cut and lay out all of the pieces on the floor, you can begin assembling the wall. Start by connecting the top and sole plates at either end to the full-length studs. Now put the door frame in place and nail in the trimmers and full-length studs, remembering to leave 3/4" clearance on top and sides. Now nail the header into place over the trimmers. Install the remaining studs, raise into place, and nail into the adjoining wall. Assemble the second and third walls in the same manner. Once they are raised into place, all of the walls should be connected with a cap plate (#8) as detailed in the figure.

Hanging Doors

Installing Prehung Door Frame

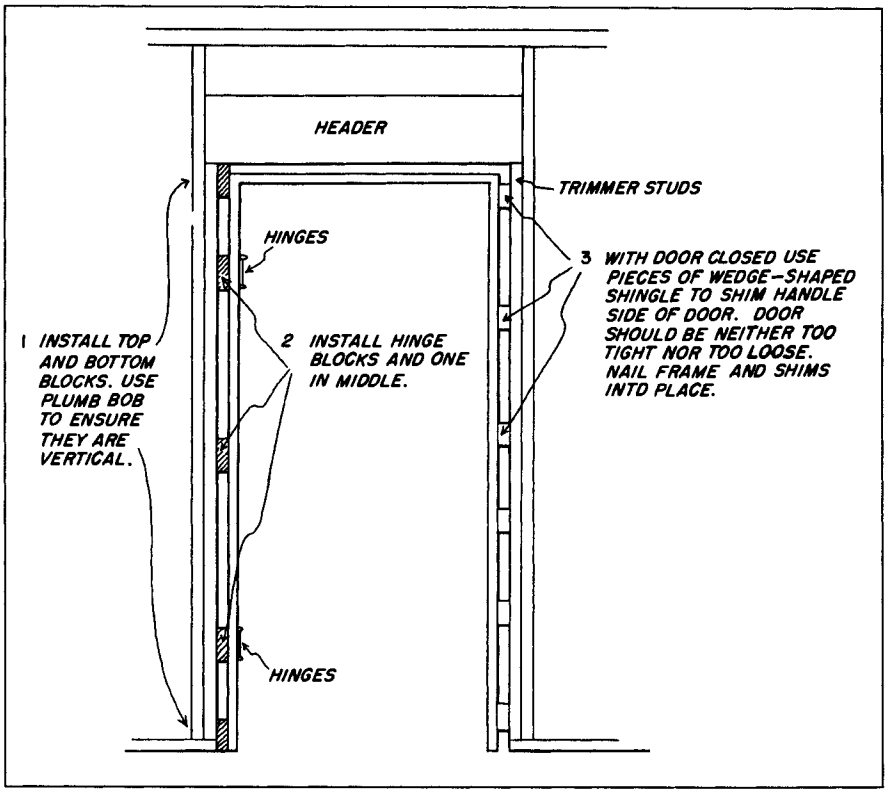
When the walls have been raised into position and plumbed to ensure they are vertical, the door frame can be installed. Prehung (set-up) doors are available from most lumber yards, and since the door is already mounted to a frame, you do not have to install hinges, handles, lock sets, and so on. It is by far the easiest unit to use.

The first step is to cut five blocks half the width of the clearance left when the rough frame was assembled (3/8"). Nail one block to the top and one to the bottom of the rough opening on the side where the hinges are to be placed. Using a level, make sure they are exactly vertical. If they are not, you will have to plane the top or bottom one to make them so. Now install two blocks at the exact height of the door hinges to provide them with support, and place the remaining block halfway between them. Using the plumb bob, make sure that they are in line with the first two installed.

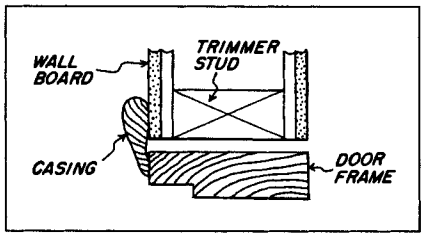
Install the door frame and nail it to these blocks using 3" nails. Once the hinge side of the door is nailed into place, the door can be closed and the other side of the frame shimmed into place, using old shingles that are wedge-shaped between the door frame and trimmer stud. Lightly tap them into place so the frame comes within 1/8" to 1/4" of the door itself. Be sure not to use too much pressure when inserting the shingles; that can cause the door frame to bow out, making the door stick. Use a level to ensure that the door frame is level on all sides. Open and close the door to make sure it is properly installed.

After the wall board has been installed, the door frame and the gap between it and the trimmer studs can be covered by casing, as shown in the figure.

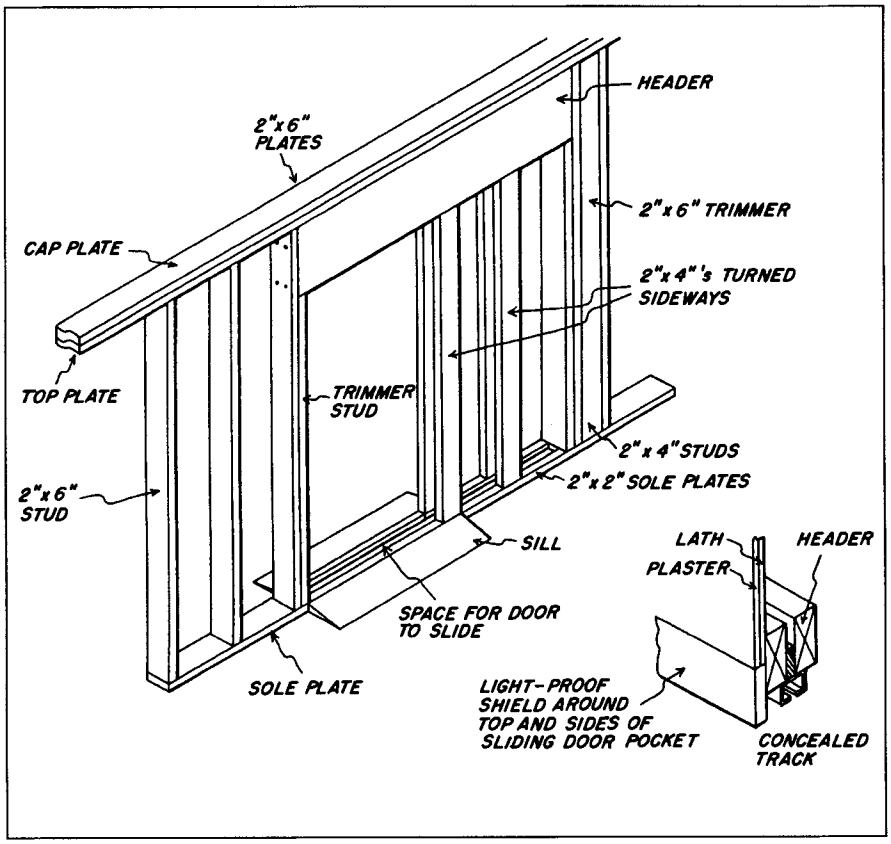
Door Frame in Place



Casing



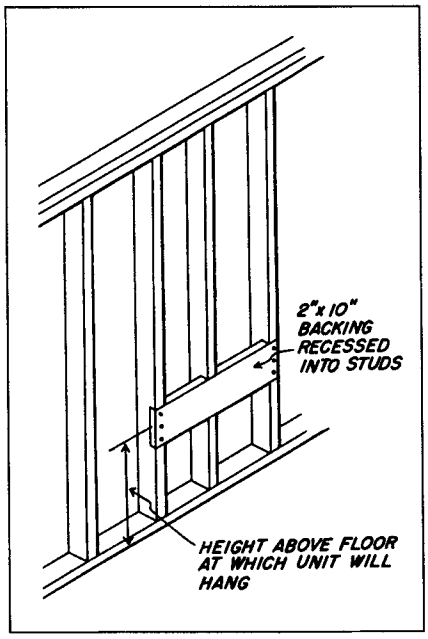
Sliding Door



Pocket Sliding Door. If you are going to install a sliding door, the construction details are slightly different from those of a regular hung door. The wall must be thick enough to accommodate the door and its track within the partition itself, and there must be a space left in the door frame for the door to enter the partition when it is opened. The figure shows how the track and wall should be constructed. All steps are the same as for the regular wall, except the header is twice the width of the door and the space between the 2 x 2 sole plates must be wide enough to accommodate the door track. The door and track should be bought before assembling the wall, because track widths vary and you should be sure the opening you leave is wide enough.

In light-proofing the door, it is necessary to bring the 2 x 2 sole plates across the opening, which can create a hazard when entering or leaving the room. This hazard can be eliminated by cutting two wedge-shaped sills to be placed on either side of the sole plate.

Installing Backing



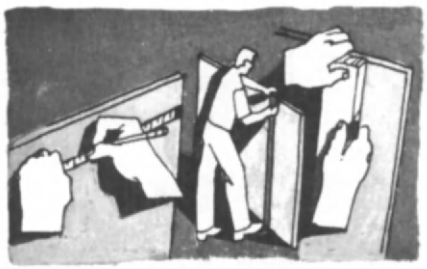
Backing. In some places, you will need support for heavy objects such as sinks, enlarger mounts, cabinets, and phones. Special reinforcement, called backing, should be installed at these locations. Use 2" x 10" board and notch the studs to accommodate it. The backing should be securely nailed to the studs and can span any distance, ranging from the distance between two studs to an entire length of wall. Its location should be indicated on your elevations, because it will be covered by wall board before the sinks and other pieces of equipment are attached to it. If you don't remember where the backing is, you could have a problem locating it.

Installing Sheetrock®

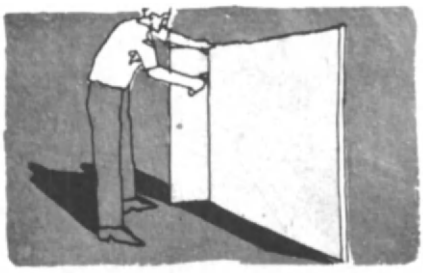
Finishing and Painting

This step takes place after the plumbing and wiring have been installed. It is the final step in finishing the room and helps to make it more attractive and easy to keep clean. The materials used help to determine the quietness of the room, the ability to maintain a stable temperature inside it, and its degree of light-proofness and light-reflecting qualities.

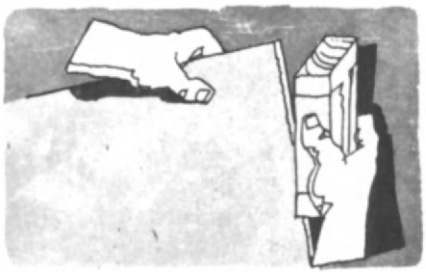
Most rooms today are finished in drywall, which is a gypsum board consisting of a noncombustible core with a paper surface on front, back, and edges. It is easy to cut and install. Panels come in standard 4' widths, and if you put your studs on 16" centers, one panel will cover four studs, from the middle of the first stud to the fourth. Some boards have beveled edges where sheets meet each other, allowing for easy filling of the cracks. If your panels have these bevels, they should be facing out. It is recommended that you use panels of either 1/2" or 5/8" thickness. The floor-to-ceiling height should be measured and the panels cut to fit and installed with nails made specifically for wallboard installation.



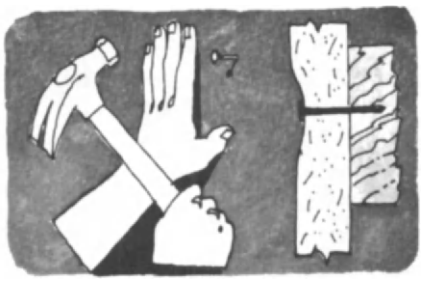
1. Scoring. Place panel with ivory-colored side face up. Measure and mark panel size at opposite edges of panel. Line up straightedge with the marks. Hold straightedge firmly against the panel while scoring down through paper and part of panel core. Hold knife at slight angle away from straightedge to prevent cutting into straightedge.



2. Cutting. Break core of Sheetrock panel by snapping away from the scored face paper. Complete cutting by running knife through back paper.

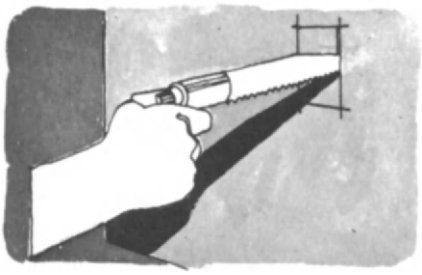


3. Sanding Edges. Smooth all cut edges of panels with coarse sandpaper wrapped around a hand-size block of wood. Keep panel edges as square as possible.



4. Nail Attachment. For 1/4", 3/8", and 1/2" thick panels use 1 1/4" GWB-54 annular-ring nails. For 5/8" panels, use 1 3/8" annular-ring nails. Space nails a maximum of 7" apart on ceilings, 8" on walls, and at least 3/8" from ends and edges of panels. Hold panel tight against framing and nail center of panel first, perimeter last. Leave a small dimple at the nailhead for filling with joint compound. Do not overdrive or countersink nails. This results in breaking the face paper or fracturing the core of the panel.

5. Ceilings. Apply ceilings first, with two people handling panels if possible. If you're doing the job alone, make simple T-braces consisting of 2' lengths of 1 x 4s nailed to 2 x 4 uprights that are 1/2" longer than the floor-to-ceiling height. Wedge T-braces between the floor and panel to support panel while nailing and assure firm contact with joists.

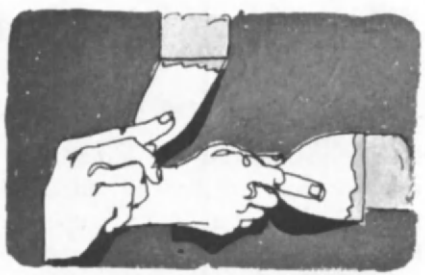


6. Walls. Carefully measure the locations and sizes of all openings in panels for fixtures. Cut with a keyhole saw. Fixture plates must cover cutouts completely. For horizontal application, apply the top panel first, tight against the ceiling panels. Stagger end-joints in adjacent rows. Use vertical application when ceiling height is over 8' 2", or if this results in fewer joints and less waste. Cut panels accurately so that they do not have to be forced into place.

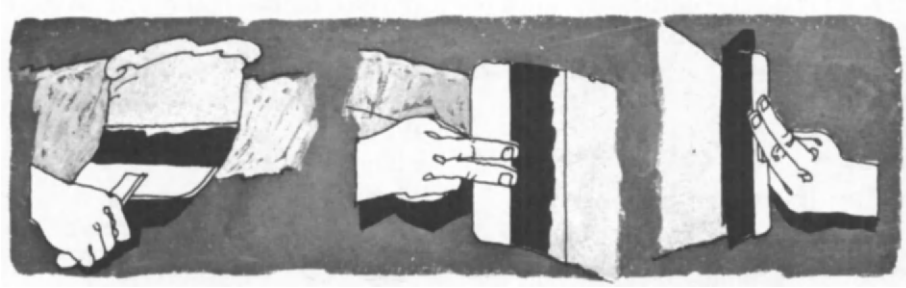
Courtesy United States Gypsum Company

7. Taping. Apply a large daub of joint compound across joint. Level with the surface of the channel formed by the tapered (or wrapped) edges of the board by drawing knife in direction of joint. Do not leave bare spots. Immediately apply reinforcing tape. Center tape over depression and firmly press into compound with joint-finishing knife. Remove excess compound, but leave sufficient amount under tape for strong bond. Embed tape with thin layer of compound to fill taper flush with panel surface. Allow to dry.

To finish end joints (not paper wrapped), apply compound and center tape directly over joint. Do not overlap tape applied at tapered joints.

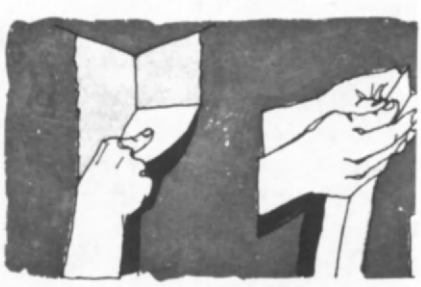


8. First Coat, Nails. Draw bare joint-finishing knife over nails. If metallic ring occurs, drive nail below surface. Fill all depressions with compound, level with surface. Apply compound with sweep of knife in one direction: wipe off excess compound in opposite direction, level with panel surface.



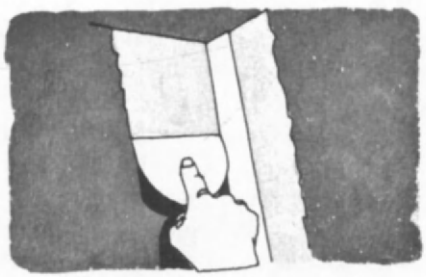
9. Second Coat. After taping coat has dried (at least 24 hours), smooth lightly with sandpaper to level surface. Apply compound, using larger knife, with compound extending 2" beyond taping coat. Feather both edges of compound, flush with face of panel, by applying pressure to the edge of the knife riding the panel. Allow to dry. Finishing the end (butt) joints is the same as for tapered-edge joints, except that the compound should cover a width of about 7".

Apply second coat to nailheads.

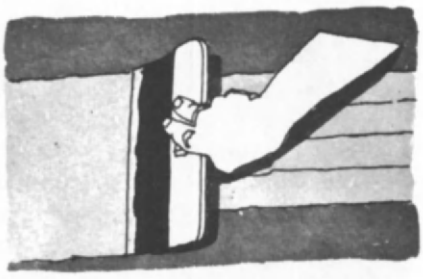


10. Inside Corners. Use a joint-finishing knife to "butter" joint compound on both sides of the corner. Extend the compound slightly beyond the area to be covered by tape.

11. Inside Corners, Continued. Fold tape along center crease and lightly press into position. Firmly press both edges of tape into compound with finishing knife, removing excess compound. Leave enough compound under tape for strong bond.



12. Inside Corners, Second Coat. After joint compound has dried (at least 24 hours), apply second coat. Cover one side at a time, allowing first side to dry before applying compound to second side. Feather out onto face of panels beyond first coat.



13. Third Coat. Same procedure as No. 9 but feather about 2" beyond second coat. Apply third coat to nailheads. Allow to dry and sand lightly. Remove sanding dust from surface by wiping with a damp cloth.

14. Sanding Joints. Use a fine-grade, open-coat sandpaper wrapped around a sanding block. After drying, lightly sand imperfections in finished joints, corners, and over nailheads. Do not rough up face paper. Do not use power sander. Remove sanding dust.

For Painting. After drywall surfaces have thoroughly dried, seal with a good commercial sealer and paint.

Getting to Know Your Plumbing

Nothing is quite so intimidating to the prospective darkroom builder as the thought of installing new plumbing. There is something awesome about cutting into the pipes of one's home when you are not totally confident that the job can actually be successfully completed. It is this fear of the unknown that makes plumbing a forbidding prospect. This fear can be overcome so you don't have to give up in advance and pay a plumber to do the entire job. Perhaps the job required is relatively simple and requires no major work at all. If not, you can study the basic theory of plumbing. This section will be a good start, but other references should be searched out in the local library, especially if your home is plumbed in materials not covered in this book.

You should tackle difficult jobs only if the water system can be shut off for a day or so in case something serious does happen and you cannot get professional help to correct it or complete the job yourself. The recommended method is to find a plumber who will do the planning and guide you through the intricacies of the job, but allow you to do all of the routine work. This results in a lower cost to you, and it also ensures that the job will meet the local building codes and pass inspection. Also, if something does go wrong, there is someone to call on for help. There are four major steps involved in installing a plumbing system:

1. Locate and identify the existing plumbing and select a point at which the new system can tap into the old.
2. Draw plans for how the lines will run and where the connections will be made to the hot and cold supply lines, the drain, and the vent system.
3. Measure the runs and draw up the specifications for the materials needed, including pipe or tubing, fittings, pipe hangers or supports, and tools.
4. Install the system and check it out to see that it works properly. Invite the building inspector from your local office over to inspect it and give it a passing or failing grade. It usually helps to have touched base with the building inspector first. You'd be surprised at the kind of free advice you can receive before the job is begun.

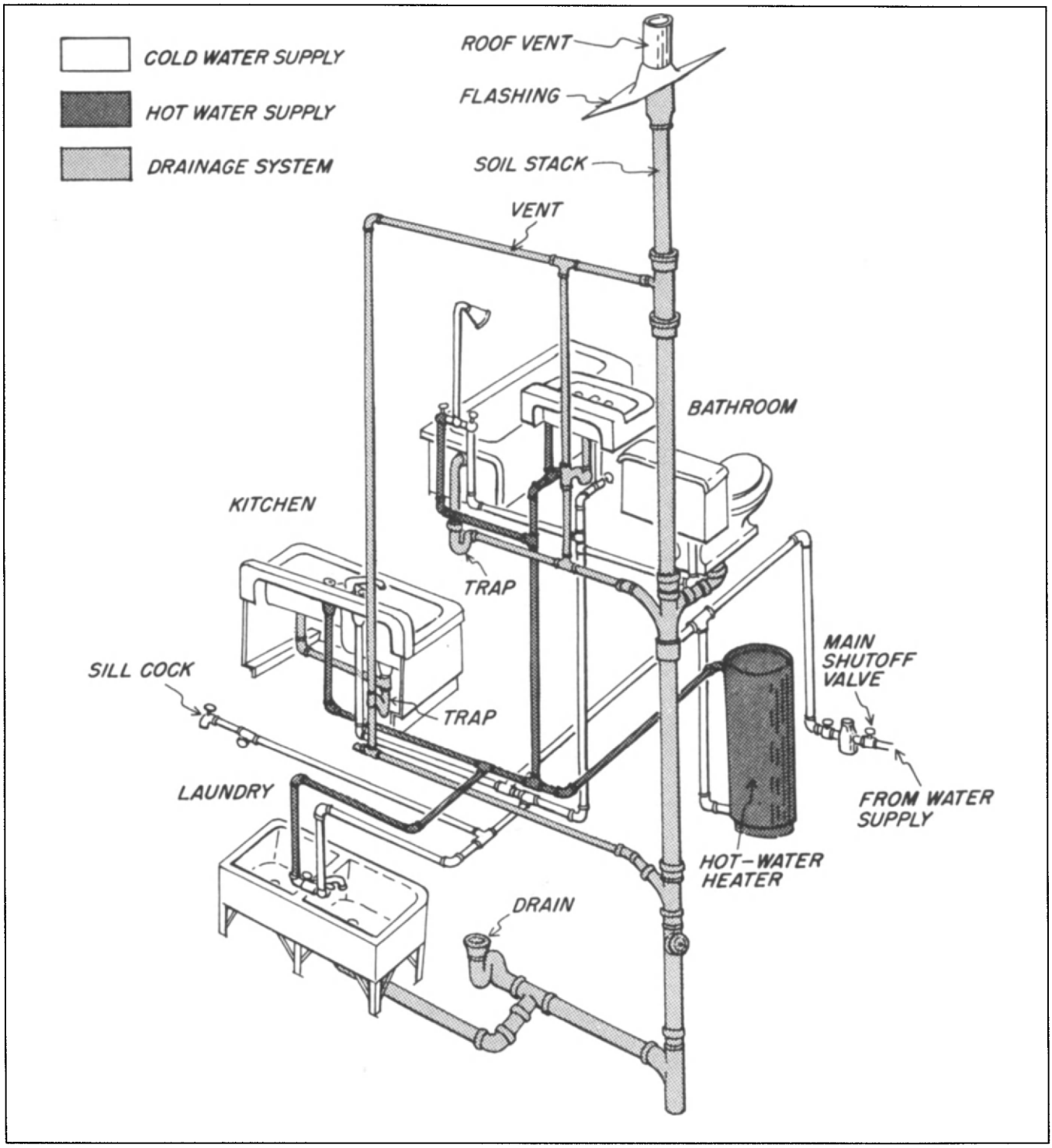
How to Locate a Place to Tap into the System

When deciding where to put a darkroom in a house or apartment, you must consider the ready availability of hot and cold water and access to a drainage system. Before making the final decision on the darkroom placement, you should find the possible points to tie into the plumbing system.

Plumbing will be either exposed or concealed. If it is exposed, you should have no problem identifying the various elements by tracing the supply lines from the meter and the drain lines from the sewer connection. If the plumbing is concealed, however, as it will be in most houses and apartments, you will have to involve yourself in some sleuthing. Here are clues that you should look for:

1. In bathrooms, kitchens, or utility rooms, the plumbing will usually be exposed under a sink. That will make a natural tie-in point for both the supply and the drain, and connecting at this point will eliminate any worries about having to install a venting system since one already exists for the sink.
2. If you are converting a spare room, the wall it shares with either a kitchen or bathroom (provided that the wall in the other room has the sink or toilet against it) is the one most likely to have plumbing. If you have to break through a wall to find the plumbing, first remove any molding and see if the plumbing can be located through the exposed opening. Otherwise, careful measurements in one room can be transferred into the other to give an accurate location. It is also sometimes possible to hear the water in the pipes, especially if someone turns the water on and off in a nearby sink while you listen.
3. If you are converting a spare room that is either over or under an existing system, it is relatively easy to tap into it vertically by running pipes between the wall studs. This will allow you at least to utilize the existing drain and venting system.
4. If you are converting an attic, garage, or loft, there may be no existing plumbing readily available and a major installation could be required.

Typical Plumbing System



Typical Plumbing System. The plumbing system in a typical home or apartment will look something like the figure shown here. It is composed of three main subsystems:

Supply. Both the cold water (coming directly from the meter) and the hot water (coming from the meter through the hot-water heater) that feed the faucets throughout the house.

Drain. The system that removes the waste water from the home. Since this system is not under pressure, all drain pipes must be sloped toward their eventual outlet.

Vent. This system equalizes the pressure in the drain system so that a quick rush of water does not create a vacuum that will empty the traps and allow gases from the city sewer lines or septic systems to enter the home.

More About Your Plumbing

Analyzing the Plumbing

After locating the pipes and deciding where to tap into the existing lines, you should identify exactly the materials and the sizes of the pipes so you can properly join the existing system to any new plumbing. The sections in this book dealing with the installation of the supply lines and drain systems will assume that the new supply lines will be run in copper and the new drain lines in plastic.

Identifying the Pipes

Hot Water Supply Lines. Both the hot and cold supply lines will usually be the smaller pipes in the system. In very few cases will they be more than 1" in diameter. To be sure of which is which, turn on the hot water faucet in the nearest sink or tub and let it run for a few minutes. The hot water running through the pipes will gradually make one warmer than the other. If neither gets hot, you either have the wrong pipes or the wrong sink, so try another sink before looking for more pipes. If the line is very hot (or if the furnace is not on and the pipe isn't hot even with a faucet running) it may be a line for hot water to radiators, which you should not cut into.

Cold Water Supply Lines. These will usually look identical to the hot water supply in material and size and will normally run parallel to it.

Drain. This will usually be larger than the supply lines, with a diameter of 1 1/2" to 2" (the main stack will run straight up and down and is 6" to 8" in diameter). Because the drain pipe is not under pressure, it must slope downward from the sink or tub outlet. Use a level to see that it is sloping down. The slope should average about 1/4" per horizontal foot.

Vent. This line will normally tap into a drain line downstream from a trap. It will tend to run upwards because it acts as a gas outlet.

Determining the Materials

Once you know which pipes are which, the next step is to determine what they are made of. There are generally four kinds:

Copper. This comes in rigid and flexible kinds. You can tell one from the other by the number of bends in it. Because flexible copper tubing is normally sold in rolls, it will have small bends and bumps after it has been unrolled and installed. Rigid piping, however, runs straight.

Galvanized Steel Pipe. This is hard and straight pipe. If you scratch it you will see the shine of steel. It often has a dark color from tarnish and a galvanized surface pattern you probably have seen on galvanized garbage cans.

Plastic. A good way to identify plastic is to shave it slightly with a knife. The plastic can be shaved away whereas any other material will just be scratched.

Hubless Cast Iron. If you find this material, you have probably encountered a drain or vent. It will usually be larger than supply pipe and is joined with either leaded joints or special connections.

Darkroom Planning and Shopping

Before buying the materials you need, you should first think through the basic requirements of your darkroom. What is the quality of the incoming water? Is it too hard? Is it full of suspended particles that will end up as white spots on good prints, requiring more time spotting and less time taking pictures? Is there sufficient hot water in the water tank to meet your needs as you foresee them? Is the temperature of the incoming water such that it would be convenient to have a water temperature regulator?

Water Too Hard. Hard water can make chemical mixing more difficult. The problem can be alleviated with a water softener or chemical additives.

Suspended Particles in Water. Often, an accumulation of particles, either in the city pipes leading to your house or in the house plumbing itself, becomes dislodged and comes out of the water faucet, whereupon the particles attach themselves to the finest negative you ever made. One way to prevent this is to use water filters (see Chapter 7 for examples of available equipment).

Temperature Regulation. If you have done much darkroom work, you will have discovered long ago that there are two main problems with temperature regulation, either when mixing chemicals or when washing prints and negatives. The first is caused by your sink having two separate nozzles rather than one, with hot water coming out of one and cold out of the other. The only solution is to make connections to each faucet with a threaded coupling and have the two streams merge through an attachment. However, you will still be left with the second problem that is intrinsic to all systems: keeping the water temperature steady at the temperature you require. To make sure that the water flows evenly at 68°F (20°C), buy a water temperature regulator (see Chapter 7 for available units). The installation of this device ensures that once the temperature is set the water will remain at that temperature plus or minus the manufacturer's specifications (usually 1/2°F).

Number of Faucets. In addition to the water quality, you should also consider the number and types of outlets available on the sink. The major types are:

Regulated Output. This type is connected through the temperature regulator and used primarily for mixing chemicals, washing prints and negatives, and providing a water bath for development.

An Unregulated but Mixed Hot and Cold Outlet. This unit can be used separately to clean equipment or as a unit to mix chemicals when the other outlet is being used to wash prints.

A Spray Nozzle. Normally found on kitchen sinks. Attached to a long hose, it can be used for such jobs as cleaning of equipment and the sink itself. This nozzle should always be connected to the system with a high-pressure rubber hose and a shut-off valve. Both devices will prevent the hose from breaking while you are away from home.

It is helpful if all outlet faucets swivel and are high enough in their clearance to allow placing tall mixing graduates under them. Normally, there should be a minimum of 15" clearance from the bottom of the sink (or the top of the duckboards, if you use them) to the bottom of the faucet.

Later in this section, we will describe how to build a modular unit containing all of these devices. The unit is designed to be detachable and can move with you from darkroom to darkroom.

Required Materials and Tools

To install a plumbing system, special tools are required, as are certain materials such as pipes and fittings. This section will discuss the most commonly available.

Materials. Household plumbing comes in a wide variety of materials, with the most commonly used being copper, galvanized steel, cast iron, and plastic. Copper is frequently used for supply lines because it satisfies the widest number of municipal codes. Drain lines are often installed in plastic because it is acceptable in a wide variety of locations and is much easier to work with than other materials.

Supply Lines. Copper supply lines come in two major kinds, rigid and flexible. Both have their advantages and disadvantages, and you should make your selection based on your particular needs. Rigid pipe is easier to connect to fittings because its rigidity makes it easier to cut evenly and keep straight. Flexible pipe or tubing is easier to install on long runs, especially those that have occasional obstacles preventing running it in a straight line. Each time the rigid variety turns a corner even slightly, a fitting is required; the flexible kind can be bent as required and less joining is needed.

Copper pipe and tubing comes in three main types based on the thickness of its walls. This thickness determines the amount of pressure the line can safely handle:

Type K—Thick Walled
Type L—Medium Walled
Type M—Thin Walled

Flexible tubing comes in only Type K and Type L. Type L, either in rigid or flexible varieties, is the most commonly used interior pipe and is suitable for the darkroom. In most cases, you will require adaptors to tap into the existing lines in your house. You will normally tap into either a 3/8", 1/2", or 3/4" supply line. The size of the line to be tapped can be determined by referring to the earlier section on "Getting to Know Your Plumbing." The reduction from a larger pipe to the 3/8" or 1/2" pipe you will be using for the new plumbing is done with a reducing T. The kind of T you require is determined by the kind of pipe you are tapping into. The fitting required to tap into a galvanized pipe is different from that required to tap into a copper pipe.

Drain Lines. Plastic pipe is a relative newcomer in the plumbing world, and as a result, its ability to satisfy building codes is not yet uniformly established across the country. You should check with your building department to see if this material will meet the local requirements. The big advantage of plastic, and the reason it is being recommended in this book, is that it is by far the easiest material to work with. Drain pipe made of galvanized steel or cast iron in the large sizes needed can be very heavy when installed in long runs and is therefore very difficult to work with. Plastic pipe, on the other hand, is no more difficult to use than the parts in building a model airplane, and the only tools required are a saw and glue. An additional advantage is that it is not corroded by darkroom chemicals and will last indefinitely without any problems. To install the drain, you will need selected fittings and an adaptor to the existing drain in addition to the pipe itself.

Three main types of plastic pipe are on the market, and their intended uses are somewhat different. The major types are:

PVC—Polyvinyl chloride
CPVC—Chlorinated polyvinyl chloride
ABS—Acrylonitrile butadiene styrene

All three can be used in cold water supply lines, but only CPVC can be used in hot water lines or a drain system. CPVC has been designed to withstand higher temperature without failure.

Typical Darkroom Plumbing

The typical darkroom plumbing requirements are relatively simple. This section shows most of the elements that will be encountered in the existing system and illustrates most of the materials needed for the new plumbing. It is an idealized plan, but by using it as a guide, you should be able to design and specify the materials you need for your own system.

Shopping List

General Plumbing—Supply

7. Copper pipe (rigid)
7. Copper tubing (flexible)
11. Saddle T adaptors
11. T adaptors
17. 90° elbows
12. Hose bibs
11. Reducing Ts Caps
18. Adaptors to existing pipes
14. Couplings

Faucets if not using filters and temperature regulators

8. Long-necked swivel mixing faucet

Spray hose attachment

Plumbers putty

Materials needed to build modular plumbing unit with both filtration and temperature regulation (described on pages 76–77)

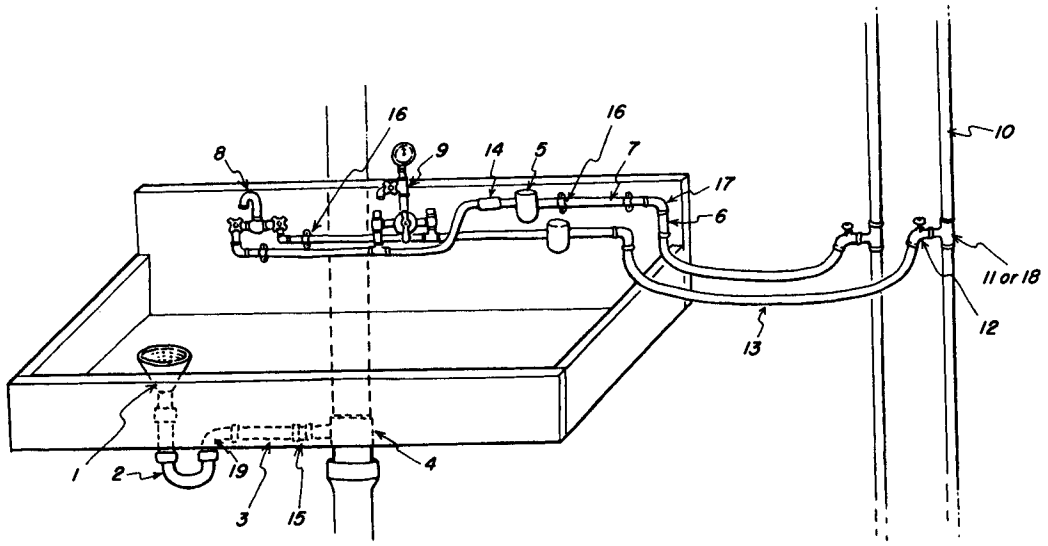
5. Hot line filter
5. Cold line filter
9. Temperature regulator
17. Elbows
11. Ts
7. Pipe
9. Faucet
8. Long-necked swivel mixing faucet (for unregulated outlet)
13. Hose
6. Hose connection

Drain

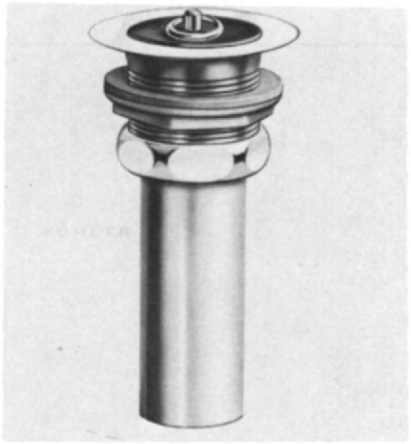
3. Plastic drain pipe
4. Adaptor
19. Elbows
2. Trap
1. Sink strainer/drain

Shopping List for Plumbing Installation.

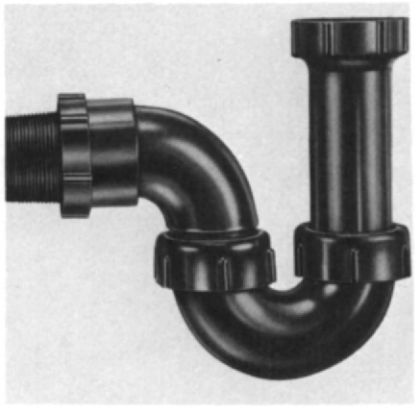
This general plan for darkroom plumbing illustrates and identifies all of the parts required. The numbers are keyed to the shopping list and to the photographs on the opposite page.



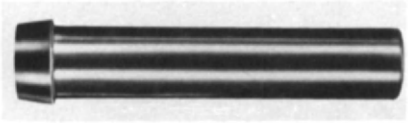
1 SINK DRAIN UNIT
2 P-TRAP (PVC)
3 PVC PIPE
4 ADAPTOR TO SOIL STACK
5 WATER FILTERS
6 HOSE CONNECTIONS
7 COPPER PIPE
8 UNREGULATED WATER MIXING VALVE
9 TEMPERATURE REGULATED WATER MIXING VALVE
10 EXISTING SUPPLY LINES (HOT AND COLD)
11 T's TO ADAPT FROM OLD SYSTEM TO NEW
12 HOSE BIB WITH SHUT OFF VALVE
13 HIGH PRESSURE WASHING MACHINE HOSE
14 COUPLINGS
15 PVC COUPLINGS
16 PIPE HANGERS
17 ELBOWS
18 ADAPTOR FROM THREADED PIPE
19 PVC ELBOW



1. Sink Strainer/Drain

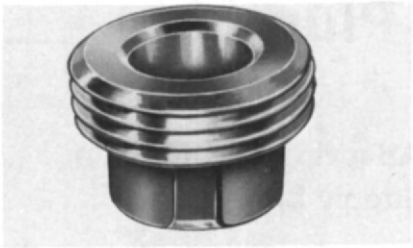


2. Trap

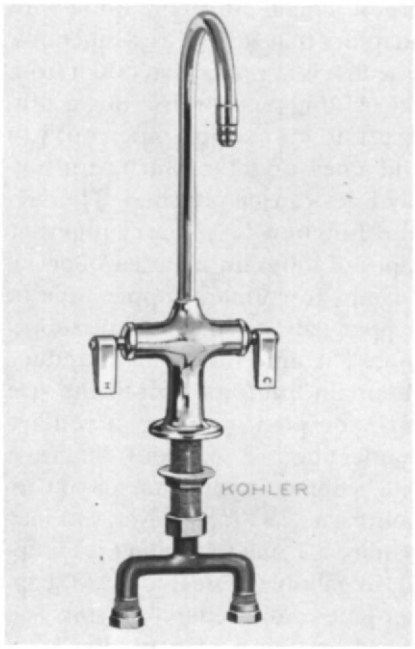


3. Plastic Drain Pipe

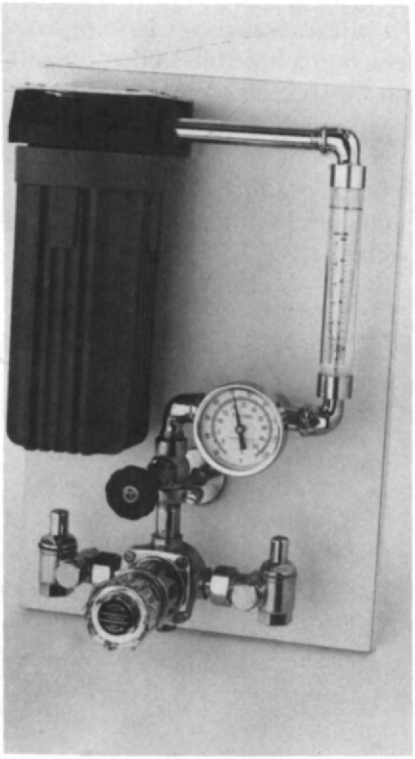
5. Hot and Cold Line Filters



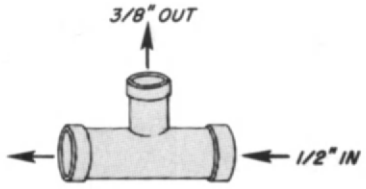
6. Hose Connection



8. Long-Necked Swivel Mixing Faucet



9. Temperature Regulator

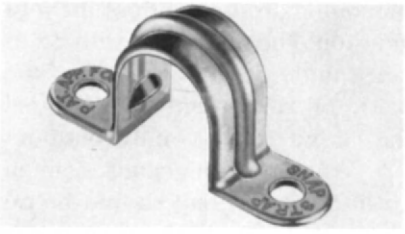


11. Reducing T

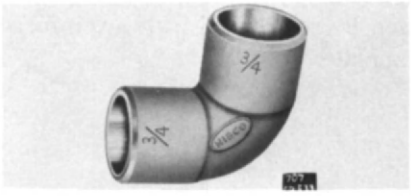
12. Hose Bib

14. Coupling

15. Pipe Coupling



16. Pipe Hanger



17. Elbow

18. Adaptor

Roughing in the Plumbing

Installation

If you have to do major work to install the system, begin by roughing in the plumbing. Plumbing is installed in new construction after the room has been framed but before the finishing wallboard has been put up. If you are not doing new construction, the plumbing can be hidden behind cabinets, covered by a false wall, or left exposed—although that can become a dust collector.

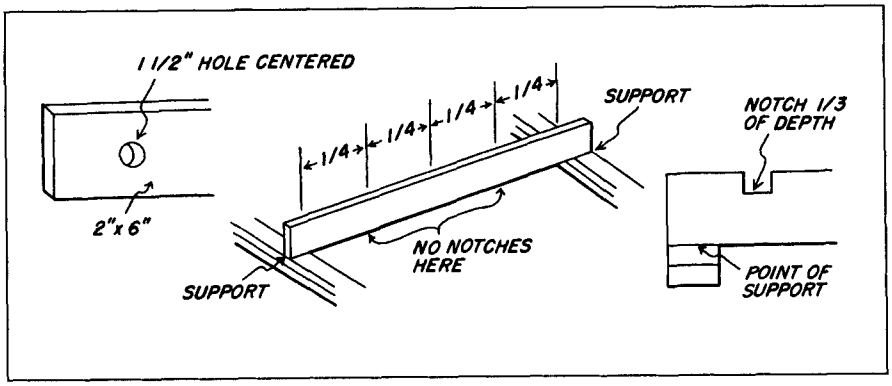
If you are installing the plumbing in a newly framed (or exposed) wall, you should consider recessing the pipes into either the studs (the 2 x 4s holding up the walls) or the joists (the beams holding up the ceiling). When doing this, there are a few things to remember:

1. All holes in joists should be centered in the vertical direction, and the hole diameters should be no greater than one-quarter of the depth of the joist.
2. A notch can be cut in a joist as long as it does not fall in the middle and is as close to a support as possible. The notch should be no more than one-sixth the depth of the joist and should be reinforced with 2 x 4s nailed under it (if it's on top of the joist), or reinforced with a steel brace if the notch is on the bottom.
3. When notching studs, a notch cut into the top half should be no deeper than two-thirds of the stud's depth, but on the bottom no deeper than one-third. The notch should then be reinforced with a reinforcing plate.

Adapting off the Main Supply Lines

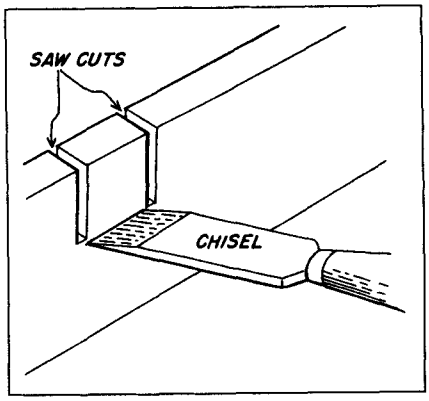
The next step after roughing in the plumbing is to make the connection between the new system and existing pipes. This is normally done with adaptors that serve three functions. The first is to provide an outlet from the existing pipe; by inserting a T-fitting into an existing pipe run, you add a new outlet to which your supply lines can be attached. The second function is to marry together pipes of different materials. Special Ts exist to connect copper pipe to copper, galvanized, or plastic supply pipe. The third function is to reduce the main line pipe size to the size pipe you plan on using. If you are connecting 3/8" copper tubing to a 3/8" copper supply line, all you require is a 3/8" T. However, you may require a T that will reduce a 1" supply in galvanized steel to a 3/8" copper pipe connected to your sink. See the description of a saddle T on page 66 before committing yourself to any more complex method of tapping your existing system. Although the illustration shows it being connected to a hose bib so that the sink can be connected through rubber hoses, saddle Ts can be used to connect galvanized pipe to copper and so on. It is a time-saving device that eliminates having to cut and thread steel pipe.

How to Support the Pipes



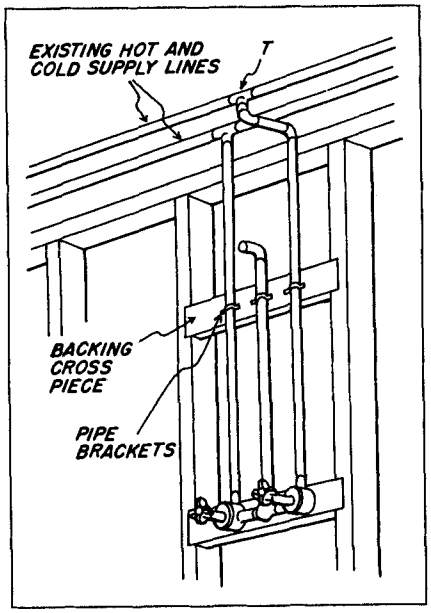
How to Support the Pipes. All pipes should be supported with brackets or hangers at regular intervals. With plastic pipe or long runs of copper, leave the hangers loose enough to allow for expansion and contraction of the pipes.

How to Make a Notch



How to Make a Notch. Using a crosscut saw, make two parallel cuts into the stud or joist as far apart as the pipe to be inserted is wide. Cut them to the necessary depth, and then, using a wood chisel, knock out the piece of wood between the cuts.

Cross Pieces



Cross Pieces. In those cases where the plumbing is running parallel to the existing supports, cross pieces can be inserted against which the plumbing can be attached. Be sure the plumbing is recessed sufficiently so that the pipes are hidden, but the fixtures will protrude the correct distance after the finish wallboard or paneling has been installed.

Installing Supply Lines

The advantages of using copper for supply lines are its quality, its ease of installation, and its ability to meet most codes.

Measuring Pipe and Tubing

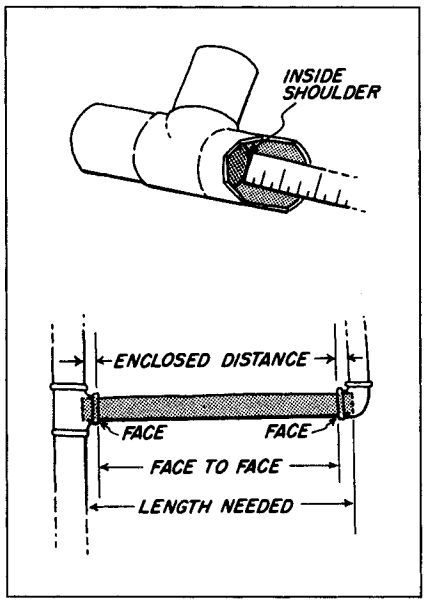
How to Determine the Diameter Needed. Most of the plumbing you install for the darkroom will be 3/8" or 1/2" in diameter on the supply side and 1 ¼" or 2" on the drain side. It is important to determine the size of the existing system into which you will tap to know what size adaptors to buy. The outside diameter is not a completely accurate guide, because the diameter in which pipe is sold is determined by the size of the hole running through it. The pipe you normally encounter in the wall has all its holes covered (otherwise it leaks), so you have to make a determination based on the kind of material and the outside circumference. The table below will give a good indication of the size of the existing pipe. Run a string around the pipe and mark where it crosses. The distance between the two points is the circumference of the pipe.

If the length of the string is:	2¾"	3¼"	3½"	4"	4¼"	5"
	The size of the pipe is:					
and the pipe is galvanized:		¾"		1"		1¼"
or copper:	¾"		1"		1¼"	

Measuring the Length of Pipe Needed

When measuring the length of pipe required, take into account the fittings into which the pipe is eventually going to be inserted. The easiest way to do this is first to measure the distance from the end of the fitting to where the pipe will be stopped when inserted. Now place the fittings exactly where they will be installed in the system and measure the distance from one face of the fitting (the end) to the other. Add this measurement to the distance determined above (add it twice, for there are usually two fittings, one at each end) for the total length of pipe required.

Measuring Pipe



If you plan to work with threaded pipe, you can use the following table to indicate how far you can expect the threaded pipe to go into the fitting. Again, remember that there will be two fittings, so the distance that the pipe goes into the fitting should be doubled before adding it to the face-to-face measurement.

Distance Threaded Pipe Extends into a Fitting

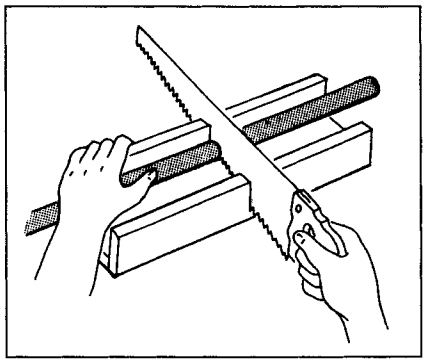
Size of pipe	*Distance into fitting*
1/2"	1/2"
3/4"	1/2"
1"	9/16"
1-1/4"	5/8"
1-1/2"	5/8"
2"	1-1/16"

Working with Copper Pipe

Cutting. There are two ways to cut copper pipe. The first is to use a hacksaw to make the cut and a file to smooth off the burrs. An easier method is to use a tube-cutter, ensuring a square and smooth cut in the pipe or tubing.

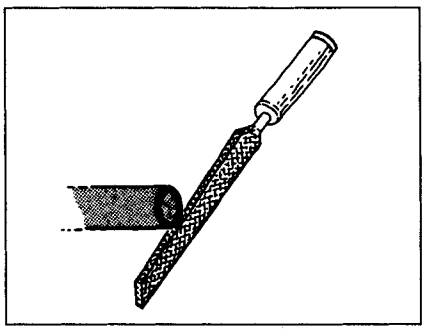
Connecting Copper Pipe or Tube to Its Fittings. There are four types of connections that can be made with copper tubing or pipe: soldered (used for either rigid or flexible pipe); threaded (rigid only); flared (flexible only); and compression (flexible only). Compression fittings are the easiest to use and require no tools other than a pair of wrenches.

Using a Mitre Box



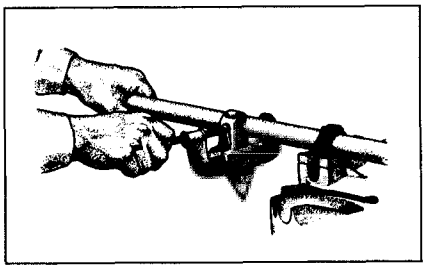
When cutting with a hacksaw, it helps to use a mitre box to ensure a square cut in the pipe.

Filing Off Burrs



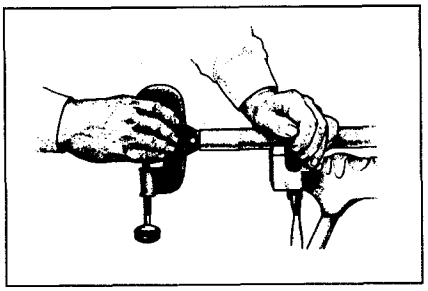
After cutting the pipe, be sure to file off the burrs left by the saw blade.

Cutting Pipe



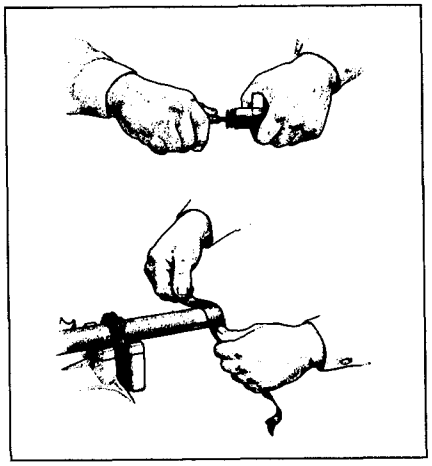
The tube-cutter works by revolving it around the tube and gradually tightening the screw handle so the rotary blade cuts deeper and deeper into the wall of the pipe. If you turn the handle too fast, it can flatten the pipe and make a connection difficult when it comes time to connect it to a fitting.

Using a Reamer



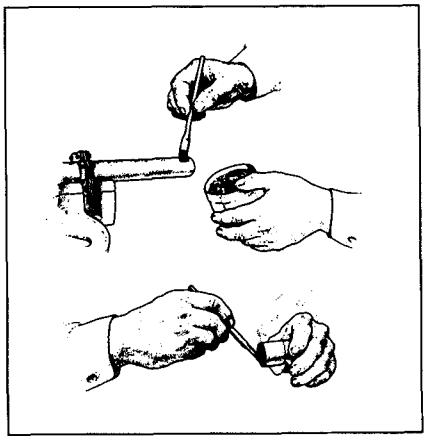
All you have to do after cutting with the tube-cutter is to rotate the reamer in the opening until the sharp edge is removed and a smooth end is made.

Cleaning End of Pipe



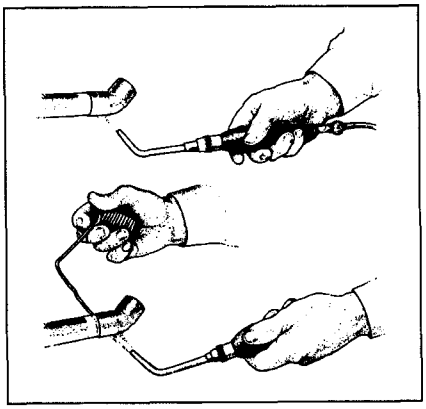
All surfaces should be cleaned and free of grease or dirt to ensure a strong joint. Use steel wool, emery cloth, or a wire brush.

Applying Flux



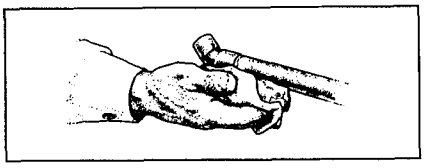
Flux keeps the tube from oxidizing when you apply the torch, making the solder stick better to the tube and fitting. Coat both the outside of the pipe and the inside of the fitting.

Applying Solder



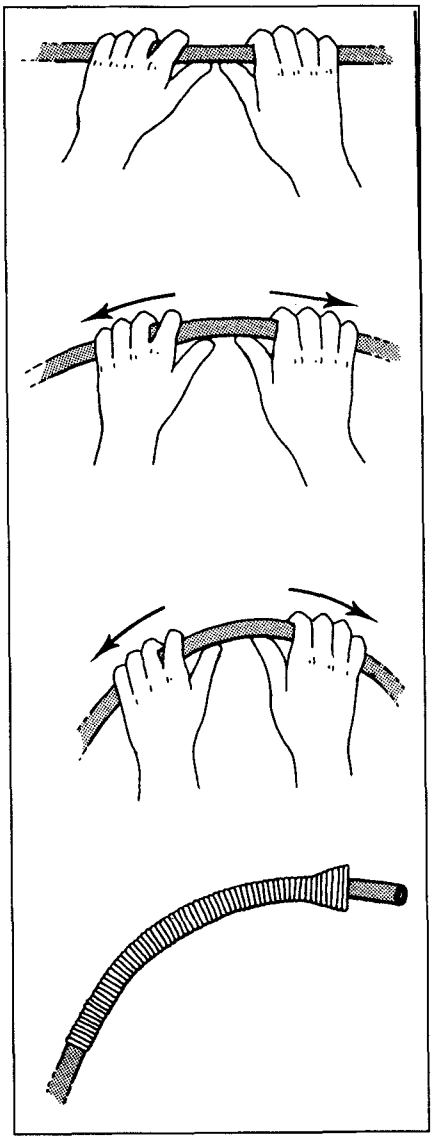
The hottest part of the torch flame is where the blue flame meets at a point. Apply this portion of the flame to the fitting (not the pipe). Keep touching the solder to the pipe and fitting where they come together. When the solder begins to melt, fill the joint evenly (the solder will automatically be pulled into the joint by capillary action) until it is full. Do not move the fitting or the pipe until the solder has hardened; otherwise, you may eventually have leaks.

Wiping Joint



Before it hardens, remove excess solder with a small brush or wiping cloth.

Bending Pipe



Bending. Copper pipe should not be bent, because it is too rigid. Bending copper tube can be a problem, because if the tube is bent too fast or too sharply the walls can collapse. This is fine when you're trying to impress someone by bending a Coors can in one hand, but the plumbing inspector frowns on it in your plumbing system. There are two ways to prevent this. The first is simple: bend it slowly from the center of the bend outward while supporting the side toward which it's being bent with the thumbs of each hand. Gradually work your hands out as you continue the bending action. Make a few passes along the pipe to complete the bend rather than doing it all at once.

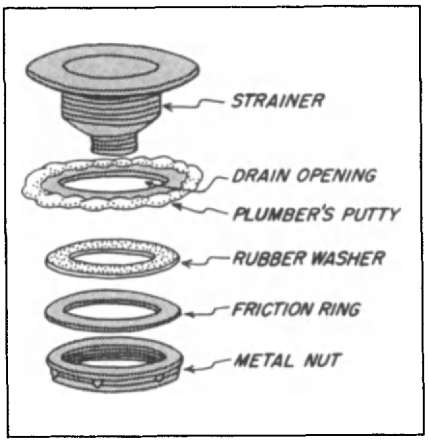
The second and simpler method is to use a bending spring that distributes the force of the bending evenly along the tube and supports the tube so the walls do not collapse.

Installing the Drain

If your building code permits the use of PVC plastic pipe for drains, you are in good shape. To install this material you basically need only a saw and some glue. Additional tools may be required where you tie into the existing system. The installation of a drain pipe encompasses three steps:

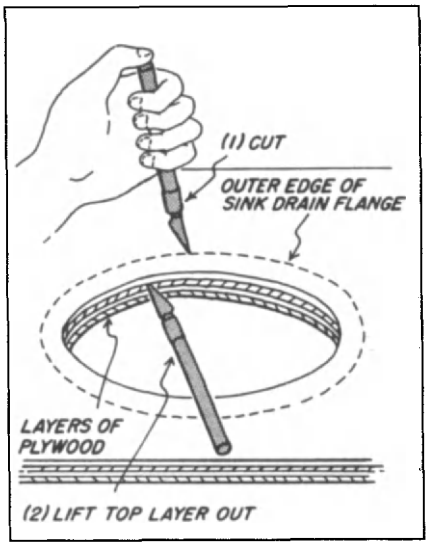
1. Installing the drain outlet in the sink.
2. Connecting a trap to the sink.
3. Running the drain pipe and connecting it to the existing DWV (drain-waste-vent) system.

Drain Assembly



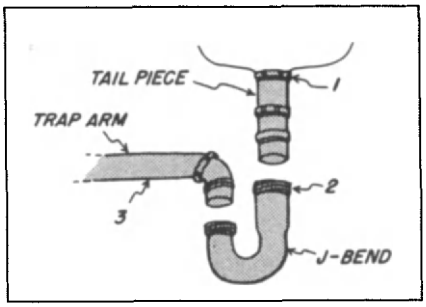
Drain Assembly. Buy a sink outlet unit that matches the drain pipe you intend to install (usually 1 1/2"). Drill a hole in the bottom of the sink at its lowest point, and install the unit following the instructions that came with it. Or use the illustration above as a guide.

Fitting Drain in a Wooden Sink



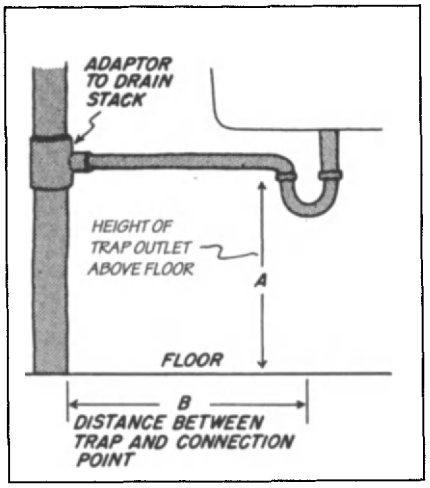
Fitting Drain in a Wooden Sink. If your sink drain is being installed in a wooden sink, you should first drill or saw the hole to hold the unit. The next step is to recess the flange that keeps the drain from falling through the hole. If it is not recessed, water will build up in the sink to the top of the flange. The best way to do this is to insert the unit in the drain, draw a circle around the outer part of the flange, and remove the unit. At this point, carefully cut the circle out to the depth of the flange. If the sink bottom is made of plywood, one of the levels of laminate will be approximately the same height as the flange. After the circle is cut, use the knife to separate the top layer of plywood and remove it.

Assembling the Trap



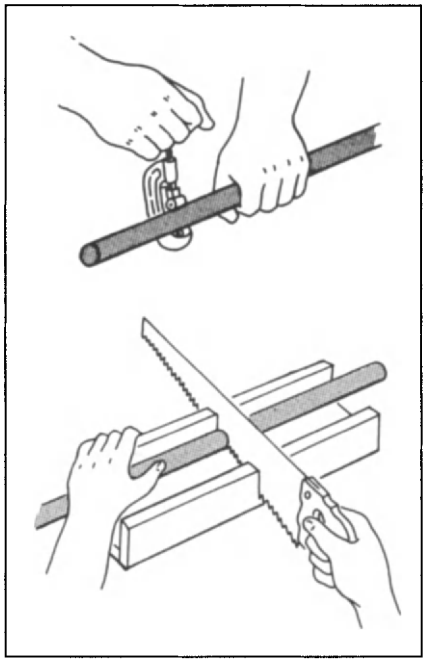
Assembling the Trap. Install a P-trap consisting of three parts (usually available as a unit): (1) a tail piece coming from the sink drain; (2) a J-bend; and (3) a trap arm.

Installing the Run to Existing Drain Pipe



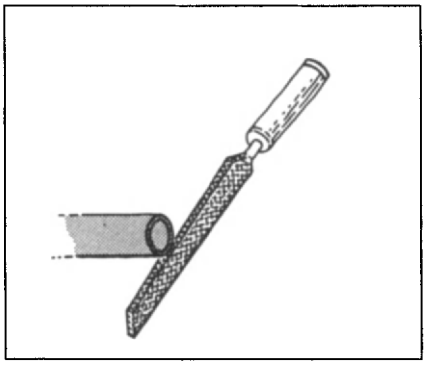
Installing the Run to Existing Drain Pipe. The P-trap should now be connected to the existing drain system. All drain pipe must slope toward its outlet at the rate of 1/4" per linear foot. To determine this, measure the height of the bottom of the trap outlet you have installed and the horizontal distance between it and the pipe to which you will connect the drain. Multiply the 1/4" drop times the number of horizontal feet and that will tell you how far to drop the pipe over the entire run. Subtract that number from the distance between the bottom of the trap outlet and the floor; this determines how far up the existing drain you should make your connection. Most building codes require, and common sense dictates, that no part of the drain pipe can be below the top part of the U-bend in the trap. This is to prevent the pipe from acting as a siphon and emptying the trap, which would allow sewer gas to enter the darkroom. This requirement, when related to the need for the pipe to drop 1/4" for each foot that it runs, means that a sink outlet can be no farther than 4 1/4' from the stack if the drain pipe you are using is 1 1/4" in diameter, or 5' if the pipe is 3". This measurement can influence the location of the darkroom, as well as the sink and the sink's drain. Everything should be done to ensure that the outlet meets these requirements, because installing a new DWV stack can be very expensive.

Cutting the Drain Pipe



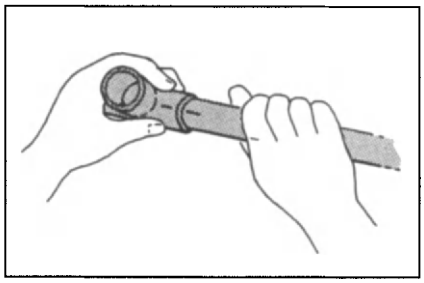
Cutting the Drain Pipe. Working with plastic pipe is easy. First measure the pipe run needed, as demonstrated earlier in this section. Then, make the necessary cuts, using either a hacksaw or special plastic pipe cutter similar to the one illustrated. When cutting with a hacksaw, use a mitre box to ensure straight, square cuts.

Removing Burrs



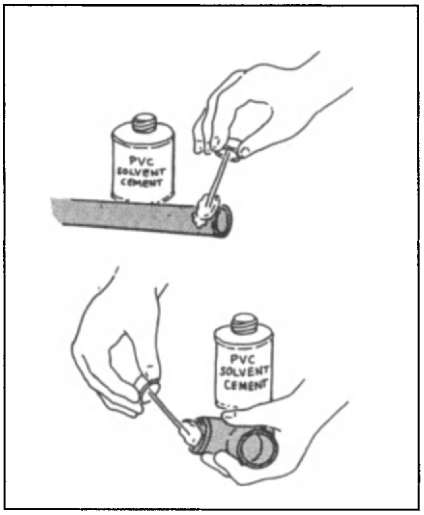
After cutting, all burrs should be removed with a burring tool, and the end of the pipe cleaned of all dirt and grease.

Aligning the Joint



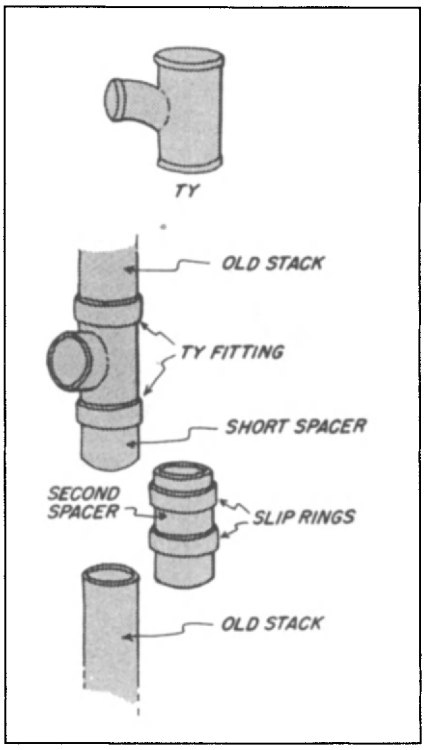
Working with the Pipe. Insert the pipe into the fitting to make sure it fits. Align the fitting on the pipe in the direction it will actually point. Mark the location with a pencil.

Applying Solvent Cement



Remove the fitting and apply PVC solvent cement to the outside of the pipe up to the point where it will extend out of the fitting. Also coat the outside of the fittings. Quickly place the fitting over the pipe and align the pencil marks. Because of the speed with which the cement dries, this should be done within one minute.

Adapting to the Stack



Connecting to the DWV Stack. Connecting the sink to the existing stack requires that the stack be cut and a TY fitting inserted. Hold the TY against the stack with the outlet centered where you have marked the center of the drain to be. Mark the stack to indicate where the top and bottom of the TY are to be.

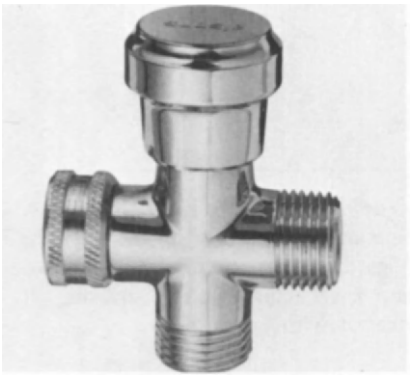
If the Stack is Hubless Cast Iron. If the stack is hubless cast iron, the stack should be cut with a pipe cutter (which can usually be rented). The TY is then inserted in the line and connected with rubber sleeves and clamps (available at your plumbing supply store).

If the Stack is Copper or Plastic. If the stack is copper or plastic, the lower cut into the existing stack should be about 8" below the center line of the TY inlet. This allows room for a spacer to be inserted in the line to adapt the TY to the existing stack. First, make the connection to the top cut with either solder or cement (for plastic), and then cement or solder a short spacer into the bottom of the inserted TY. Then cut a spacer to fill the remaining gap and seal it to the spacer above and the existing drain below with slip fittings at both ends. These fittings should also be soldered or cemented in place.

The Easy Way Out and Unique Solutions

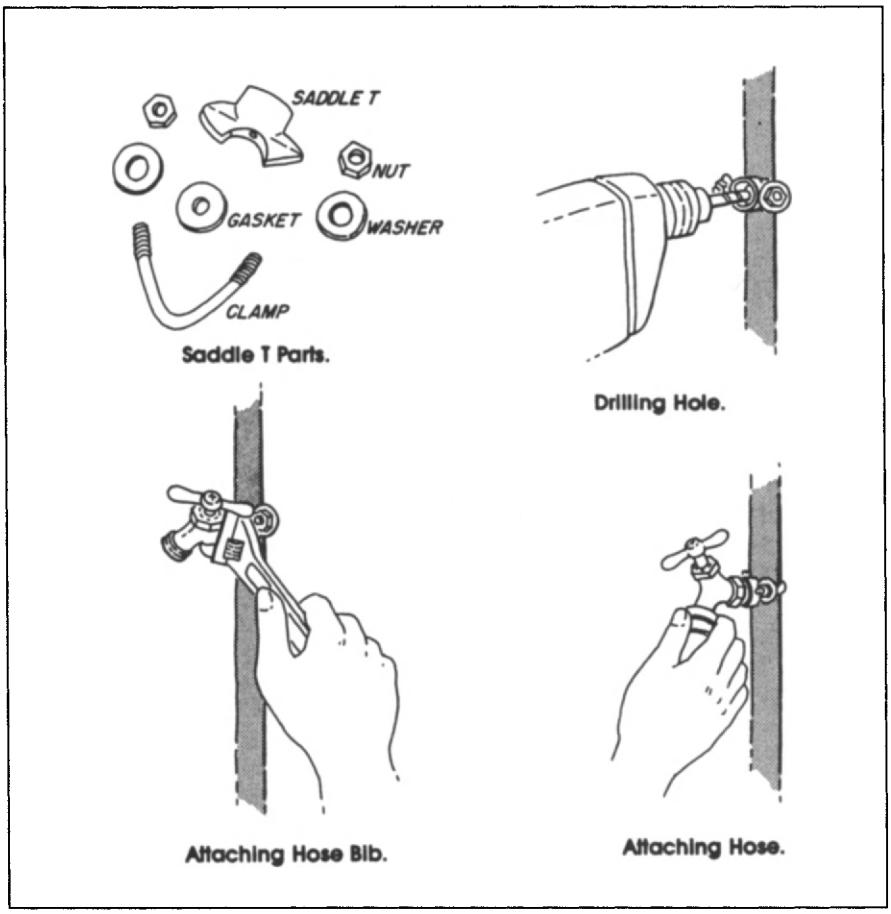
A Unique Solution

If you are lucky, your entire plumbing connection can be made between the sink assembly and the existing water supply in a matter of minutes. All you need is a "saddle T." You can bolt this device onto the existing pipe and then drill through to tap the water line (the water should be turned off and the drill grounded). Screw a hose bib into the saddle-T fitting and connect the sink to the water supply with the high-pressure water hose used for washing machines. Either tap the drain into the existing drain, or run a rubber hose from the sink drain into the existing sink, bath, or shower to provide drainage.

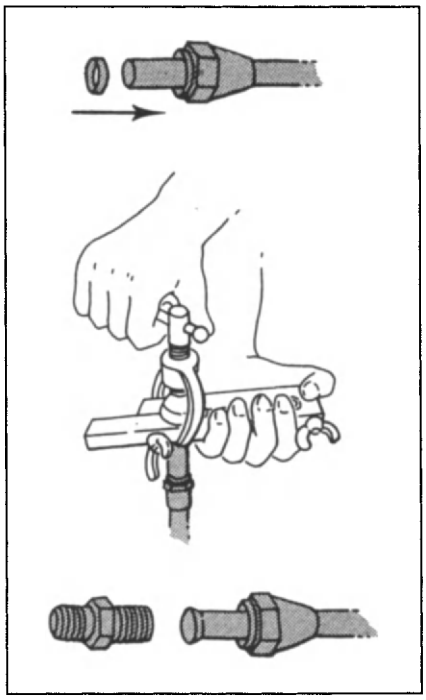


Shower Diverter. If you build your darkroom in a bathroom, you can purchase a shower diverter that allows you to use the shower and, at the same time, provide a convenient connection for a hose that can run to the print washer or to the sink. The diverter is easy to install; remove the shower head, screw on the diverter, replace the shower head, and connect the darkroom hose. These diverters by Alsons are available in most hardware stores.

Saddle-T Assembly



Making Flared Joints

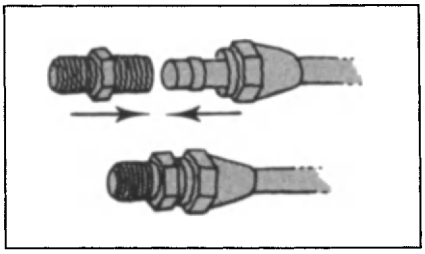


Making Flared Joints. Fit the threaded portion of the fitting onto the tube before beginning the flaring operation. Then slide on the metal gasket.

Insert the tube into the flaring block so its end protrudes just slightly. Screw the tapered head of the flaring tool into the tube, making it flare into a funnel shape.

Screw the male-threaded fitting into the fitting that was first put on the tube. Tighten it down with reasonable pressure.

Making Compression Joints



Making Compression Joints. Slip the female fitting over the tube, followed by the metal gasket.

Insert the male fitting and, using wrenches, tighten the joint.

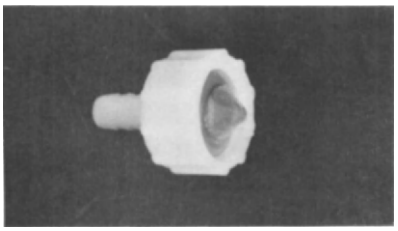
Draining Uphill

You may find that your darkroom does not have a drain to connect with that is lower than the sink outlet you plan to install. To get the waste water out of the sink and up to the drain, you will have to install a pumping system. First, determine the rate of flow of your pump. Your plumbing store or plumber can help you with this. Usually, installation instructions will be included with the pump. If they are not, you can follow the basic instructions covered in the section "Installing the Drain" above.

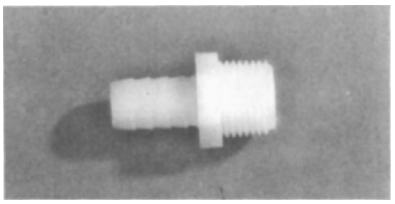
Pumping water uphill to an existing drain line was the least expensive solution when Rick Ashley installed his darkroom in the basement of an older Marblehead, Mass. home. The unit consists of a holding tank with float valve, a pump, and a check valve. The water from the sink flows into the tank, and its level is measured by the float, which automatically turns the pump on and off as needed. The check valve prevents water from flowing backward in the system.

Pfefer Phittings.

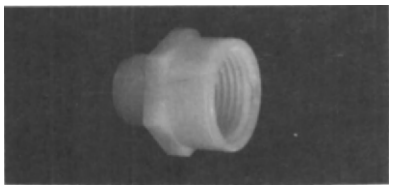
The Pfefer Company distributes a complete line of plumbing connecters for darkroom use. The ones shown below are typical of the wide range available.



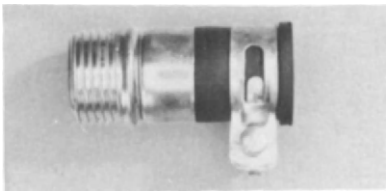
Swivel Hose Connecter. Has female garden hose swivel. Models are available to connect to 1/4", 3/8", and 1/2" ID (inner diameter) tubing.



Barbed Hose Connecter. Designed for use when connecting a hose to any tank or tray. Models are available to connect to 1/4", 3/8", and 1/2" ID hose or tubing.

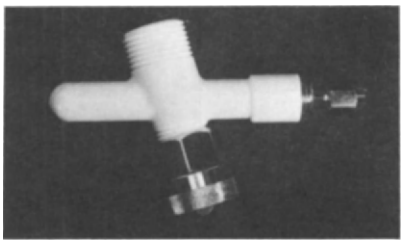


Adaptor. Models are available to connect garden hose to 1/2" or 3/4" male pipe threads.

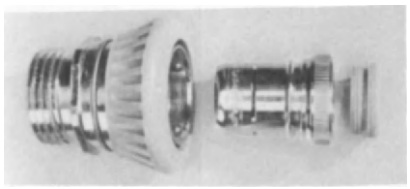


Clamp-on Hose Adaptor. Connects garden hose to threadless faucets. Similar model has snap fitting to connect to snap nipple.

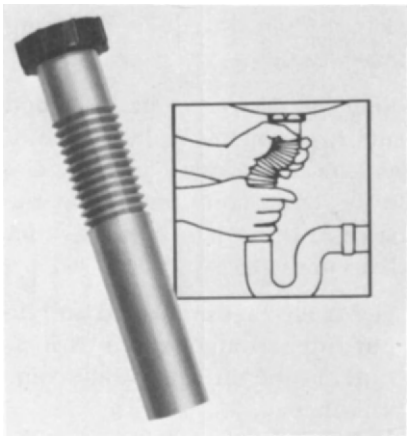
Y-Adaptor. Designed to give two outlets from one water source, each with separate shut-off valve. All fittings connect with garden-hose threads.



Thermometer Well. Can be inserted in line to hold thermometer in water flow. Allows constant monitoring of the incoming water temperature.

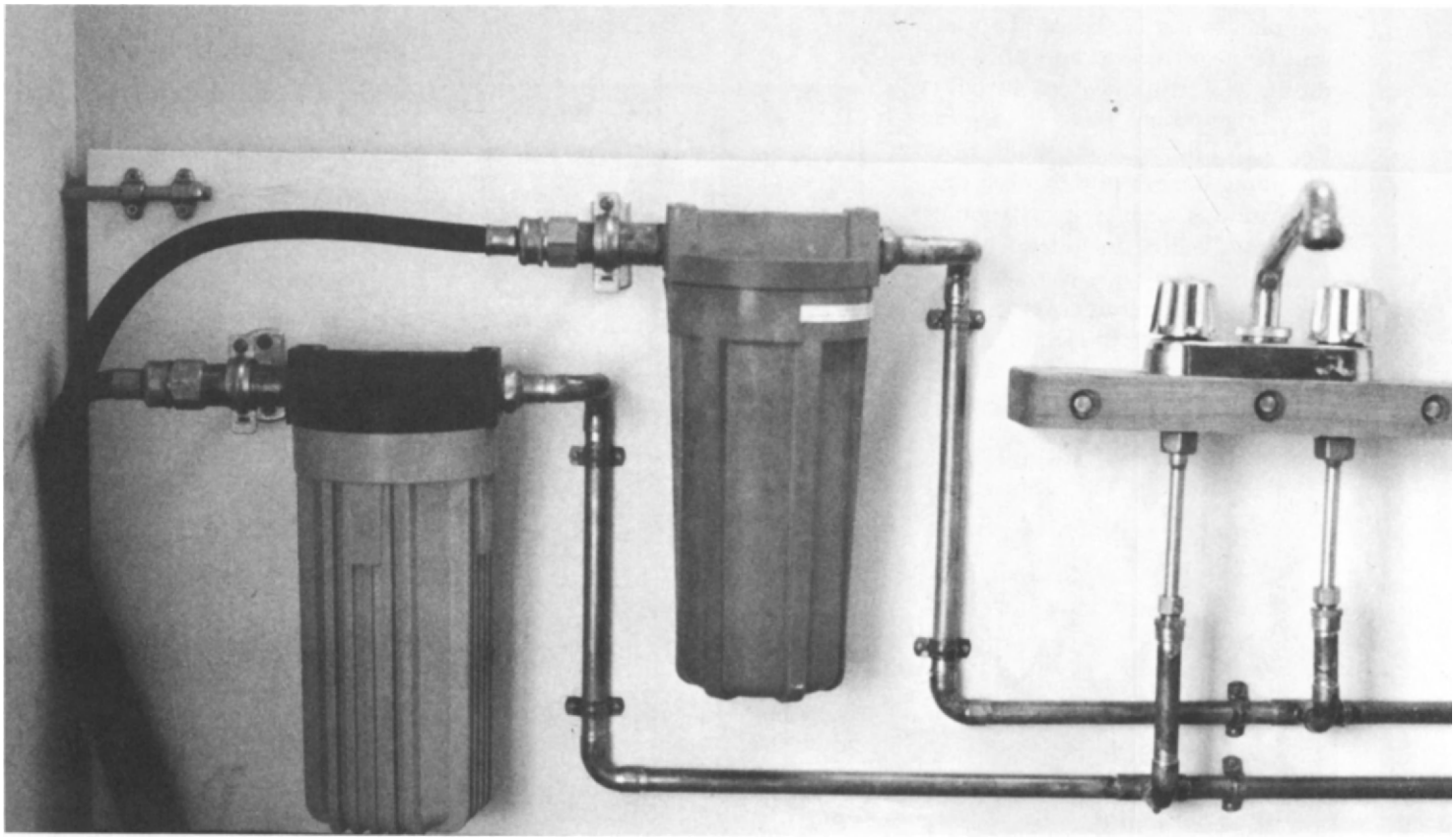


Snap Coupler. With all hoses and fittings connected with snap couplers, lines can be changed around quickly without having to unscrew threaded fittings. Makes connections quick and easy.



Drain Alignment Mistakes. Installing a drain can be like digging a tunnel from two sides of a mountain: if they don't meet in the middle, they don't do much good. If you find that your drain and sink don't meet where you had planned, this flexible connecter by Webstone can be used to cover this mistake.

A Modular Plumbing System



The Components

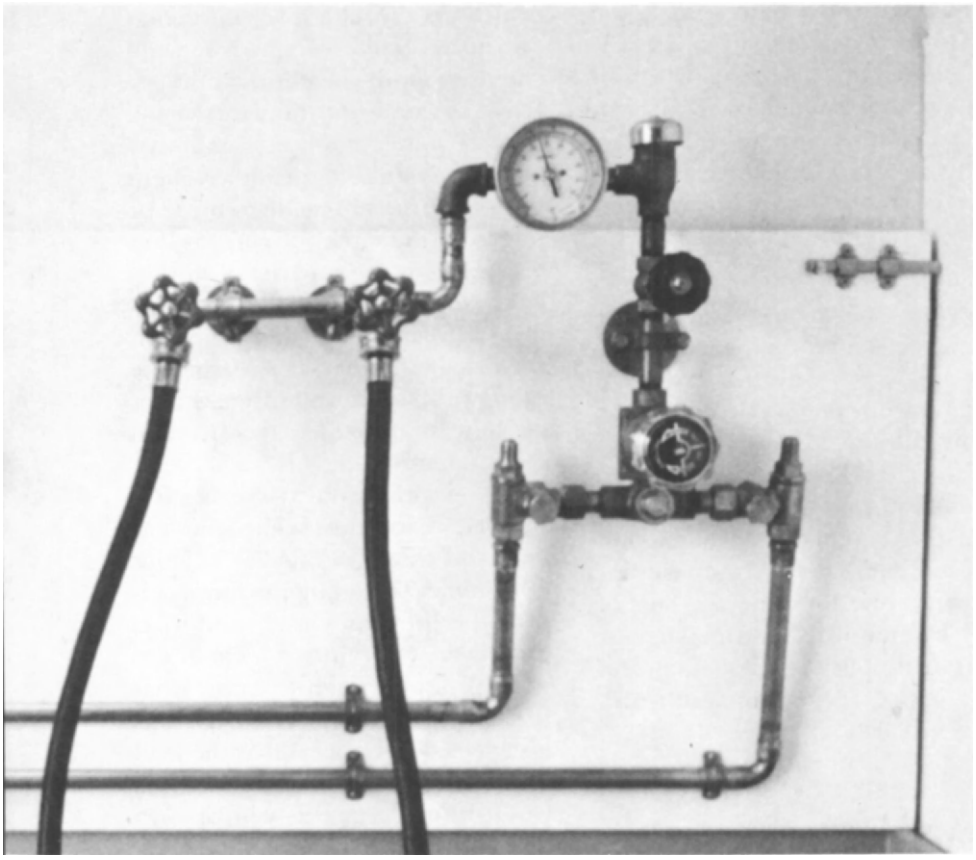
This modular unit consists of a temperature-regulating valve by Meynall, two in-line water filters by Arkay, and an unregulated mixing valve.

Laying Out the Units. Cut a plywood panel (5/8" or 3/4") the length of your sink and at least 2' high. Assemble the basic components on the boards in the rough positions they will occupy.

- Filters have an input and an output side, so align them as indicated in the directions that come with them.
- Determine the correct mount for the unregulated outlet. Since most faucets are designed to be connected from either the rear of the unit or from the bottom, your mount may vary somewhat from the one illustrated. If possible, use the type that is plumbed from the bottom and cut a 2"-thick piece of wood large enough to hold it. This can later be mounted to the plywood panel with long bolts.
- Mount the regulator valve on the back panel.
- Using a black pencil, draw lines connecting the cold water lines from the outlet side of the filter to both the regulated and unregulated valves. Make sure that they are fed on the correct side. Both units will be marked as to which side is hot and which is cold.
- Using a red pencil, trace the hot water supply lines from the outlet on the hot water filter to the regulated and unregulated valves.

Assembling the Unit. The unit should be assembled using 1/2" copper pipe with soldered joints.

- Determine the exact fittings required for the assembly. Each right-angle turn will require an elbow; each fitting will require a matching fitting that fits into or on it; each connection from the main line to a branching line will require a T.
- With this list of components in hand, visit your local plumbing supply store. A plumbing supply store will probably be more useful than a hardware store: the line of parts is usually larger, and the people are more knowledgeable about your needs.
- If you are unsure about fittings for certain parts, take the parts with



The plumbing system shown here is mounted on a large panel over the darkroom sink. It is connected to the house plumbing supply with high-pressure rubber washing-machine hoses. This modular design allows the sink and plumbing system to be moved into a new darkroom. You can assemble the unit at a workbench, which is usually easier than assembling a unit permanently on the wall.

you so that the salesperson can determine the right fittings.

- Begin the assembly by laying the fittings on the board in the places indicated by the sketch you drew earlier while doing the layout.
- Measure the lengths of pipe needed to connect these fittings. Be sure to include the portion of the pipe that will fit into the fitting.
- Cut the lengths of pipe needed, and assemble the entire unit to be sure that everything lines up and fits correctly.
- Remove the copper pipe and fitting and solder all of the joints. Where fittings are to be set at various angles, be sure to mark the proper alignment (scratch the pipe and fitting with a knife) so that they can be reassembled in the correct alignment.
- Reassemble the soldered units on the panel and connect the fittings to the filters, and the faucets with the threaded fittings. Be sure that all threaded fittings are tightened securely and sealed with pipe-joint cement.
- Connect the unit to its supply by attaching the high-pressure washing machine hoses (regular hose will break and flood your darkroom). They can be connected to the existing supply lines with a saddle-T adaptor.
- Turn on the water and check for leaks.

Introduction to Electricity

If plumbing is intimidating to the average person, electrical wiring can be downright terrifying. Very few photographers have drowned while installing plumbing, but you can bet there have been a few shocks for those installing their own wiring. Electricity can be fatal, and this is especially true in a darkroom where the presence of moisture contributes to electrical conductivity. Wiring should be attempted only by knowledgeable people, and even then it should be inspected by a licensed electrician to be sure there are no hidden flaws. Wiring over sinks, faulty grounding, or cables in moisture-laden places all contribute to serious problems. If you are not experienced enough to take on this job yourself and yet don't want to spend a great deal of money, find an electrician who will do the heavy wiring (service entrance wiring, fuse panels, etc.) but will allow you to do the installation of cable runs, light switches, power outlets, and so forth, and inspect the job upon completion. This method will save money but also guarantee that the job has been done correctly.

In this section it is assumed that you are confronted with one of two common situations.

Utilizing an Existing Outlet. If your darkroom has walls that have been finished and you don't want to get involved in any heavy construction work, you can build an electrical control panel that plugs into an existing outlet. The only requirement is that the circuit into which you are plugging can carry the expected load. To make these calculations use the information in the next section, "Electricity in the Darkroom." This method has several advantages. Primarily, it requires no damage to the existing room, so it can be reconverted to its original purpose without any extensive work. It's easier and less expensive than redoing the entire room wiring and is equally functional and effective. The unit can be constructed on a kitchen table and, when you move, it can go with you and be plugged into the next darkroom. Instructions on how to build this unit follow later in this section.

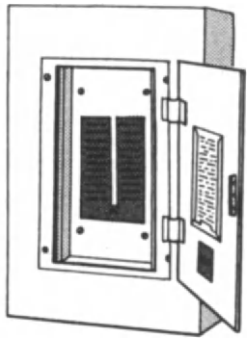
Rewiring from the Service Entrance. When you want a permanent installation, you can wire the darkroom circuits from the service entrance (fuse panel) to the darkroom outlets and switches. Before beginning this installation, you should check with your local building department and become familiar with the relevant codes. Failure to follow the laws of your community could make your insurance policy invalid should injury or fire occur as a result of a faulty installation.

How Your Electrical Circuits Work

The electric current for your residence enters from the street through heavy-duty cables. The first connection after they enter the house is to a fuse panel. This panel (called a service entrance) performs two functions. The first function is to take the incoming current and distribute it to a number of smaller circuits. This allows the house wiring and equipment to be of a smaller size than it would be if all of the house current went through one large circuit. In this respect it's like an eight-lane expressway coming into the panel with a large number of one-lane exits leaving to various parts of the house. The second function of the fuse panel is to prevent the wiring from catching fire or melting should it become overloaded. This is accomplished with fuses or circuit breakers. When current flows through a wire it generates heat. If there were no fuses, and you drew more current than the system was rated for, the wires would become hotter and hotter until they or the surrounding material caught fire. The fuses are made to break or interrupt the circuit if current flow ever exceeds the capacity of the circuit. Never try to increase the capacity of a circuit by inserting pennies in the fuse holder or by increasing the rating of the fuse you install. Either of these solutions creates fire and safety hazards.

When wiring your darkroom it is important to know what your circuits and fuses are rated at in amps (the higher the rating the more current the line can carry) and what outlets are currently on which circuits. You also need to know what the darkroom load on your circuits is expected to be, as well as the load on other outlets that may already be wired into the circuit you plan to use. If you calculate that your darkroom will require 12 amps and your circuits are rated to carry 15 amps, you can wire off an existing circuit—provided other outlets already wired into the circuit are using no more than 3 amps. If they are using more, or if your circuits are rated at less than you need, you will either have to install an entirely new circuit or split your darkroom load between two existing circuits.

Fuse Panel



How to Tell What Outlets Are on What Circuits

If you plan to run the wiring off of an existing circuit, you should first figure out what outlets and current demands are already on that circuit. These other outlets and their loads must be taken into consideration when determining if the circuit can handle the load your darkroom will add to it.

The wall outlets and the lighting fixtures in a home or apartment are generally installed and wired before the final wall panels are installed. This means that the initial wiring is located for reasons of convenience and economics. All outlets in all rooms are usually not on the same circuit. So be sure to check the entire house when trying to decide what outlets are on which circuits.

1. Draw the fuse panel (or circuit breakers) showing their arrangement in the box.
2. Turn off the master power switch or pull the master fuse. This will kill all of the electricity in the house and make it safe to pull one of the circuit fuses. If your house is on circuit breakers, they are safe to switch without turning off the master switch.
3. Remove one fuse or turn one circuit breaker off.
4. Turn the main power switch back on. This will restore all electrical power, with the exception of the circuit from which you removed the fuse or turned off the circuit breaker.
5. Using a voltage tester (see "Tools and Materials for Electrical Work" below), or by plugging in a small lamp, check all of the outlets in the house to see which ones don't work. These are all on the circuit from which you removed the fuse. Also check all light switches to see which lights are on the circuit; don't forget to check such heavy appliances as the refrigerator, washing machine, and so on. Any appliance outlet or switch on each circuit should be noted on your drawing.
6. Turn the master switch off; turn the circuit breaker back on or replace the fuse. Take out another fuse and repeat the same process. If working with a fuse panel, always turn off the main power before removing or installing a fuse just to be safe.

When you have completed this chart, you should know what is already on the circuit to which you want to make your connection. If any heavy appliances such as washing machines or space heaters are on the same circuit, you should change your plans because their load is guaranteed to be too high. It may also be against your building codes to connect into those circuits. In any event, whatever is already on the circuit should be used in making the power calculations in the next section.

Electricity in the Darkroom

How to Calculate Power Requirements

When you are working in your darkroom, you are drawing current from the house electrical system. Because house wiring is designed to carry a specific load and no more, it is important to be sure you will be within those limits. If you are not, you will be cursed with blown fuses or tripped circuit breakers. The easiest solution is to prevent problems initially. This section will help you calculate the expected load so that corrective action can be taken before you have problems.

Computing the energy requirements in your darkroom, and then comparing those with what the wiring will allow, is really very easy. There are three units of measurement involved:

Volt. A unit of measurement of the electrical pressure in a circuit. It is similar in this respect to measuring air pressure in pounds.

Amp. A unit of measurement for flow in the circuit. Similar to measuring water flow in gallons per minute.

Watt. A unit of measurement representing power consumption.

Most of the appliances you deal with consume a fixed amount of power when they are operating. This amount is almost always expressed in watts. Unfortunately, your house circuits are rated in amps. To find out what power you need (in amps), you must add all of the devices expected to be on the circuit you plan to use so you know the total number of watts. Then convert this figure to amps to see if your circuit can accommodate the load. To do this, you can use the following table:

Calculating Power Requirements

A. Equipment	*B. Watts*	*C. Number in Use*	*D. Total Watts*
Enlarger			
Printing Safelights			
Red Safelights			
Timers			
White Lights			
Light Table			
Exhaust Fan			
Air Conditioner			
Dehumidifier			
Radio			
Exposure Analyzers			
Print Dryers*			
Dry-Mount Press*			
Space Heaters*			
Other (including other outlets on the same circuit)			
Other**			
Other			
Other			
Other			
Other			
Other			
E. Total Darkroom Requirements in Watts			

* These items are unusually large users of power and should be placed on separate circuits if at all possible, or not used at the same time as the darkroom if they have to be on the same circuit.

**Under "Other" you should also refer to the chart showing what other outlets are on this same circuit and add those in this space.

How to Use This Table

A. Column A lists the most commonly used darkroom equipment. It is essentially a checklist of what you have now or might have in the future. Under "Other," list anything additional you plan on having.

B. In this space list the power requirements for the equipment in watts. If you already have the equipment, you can usually find its rating in watts on a plate that also lists additional information, such as manufacturer's name, serial number, and so forth. If you do not have the equipment, use the following table of normal (or average) ratings:

Safelights	15–40
Enlargers	75
White lights	40–100
Timers	25
Exhaust fans	75
Air conditioner	800–3000
Dehumidifier	550
Radio (solid state)	25
White light (fluorescent)	100

C. In this column, list the number of similar pieces of equipment you will have. For instance, you will probably have more than one incandescent light bulb in the room.

D. Multiply the number in Column B times the number of units in Column C and enter the figure here, in Column D.

E. Add all of the numbers in Column D to give you a grand total for the darkroom. You now know what your energy requirements are; now convert the watts to amps to see if your circuit will carry the load.

Converting from Watts to Amps

To convert from watts to amps, use the formula:

$$\text{AMPS} = \frac{\text{WATTS}}{\text{VOLTS}}$$

If you live in the United States, divide the results from Row E of the previous table by 115 (the standard American voltage) and you will know how many amps are required. In England or Europe, you would divide by 220 for the same result.

You can also use the following table:

If you are using wattage between	*and you live in the U.S. (115 volts) your circuit must be capable of carrying*	*Europe 220 volts*
0–100	0.9 amps	0.5
100–200	1.8 amps	0.9
200–300	2.6 amps	1.4
300–400	3.5 amps	1.8
400–500	4.4 amps	2.3
500–600	5.2 amps	2.7
600–700	6.1 amps	3.2
700–800	7.0 amps	3.6
800–900	8.0 amps	4.1
900–1000	9.0 amps	4.6
1000–1100	10.0 amps	5.0
1100–1200	10.5 amps	5.5
1200–1300	11.5 amps	5.9
1300–1400	12.5 amps	6.4

Do You Have Enough Amps in Your Circuit?

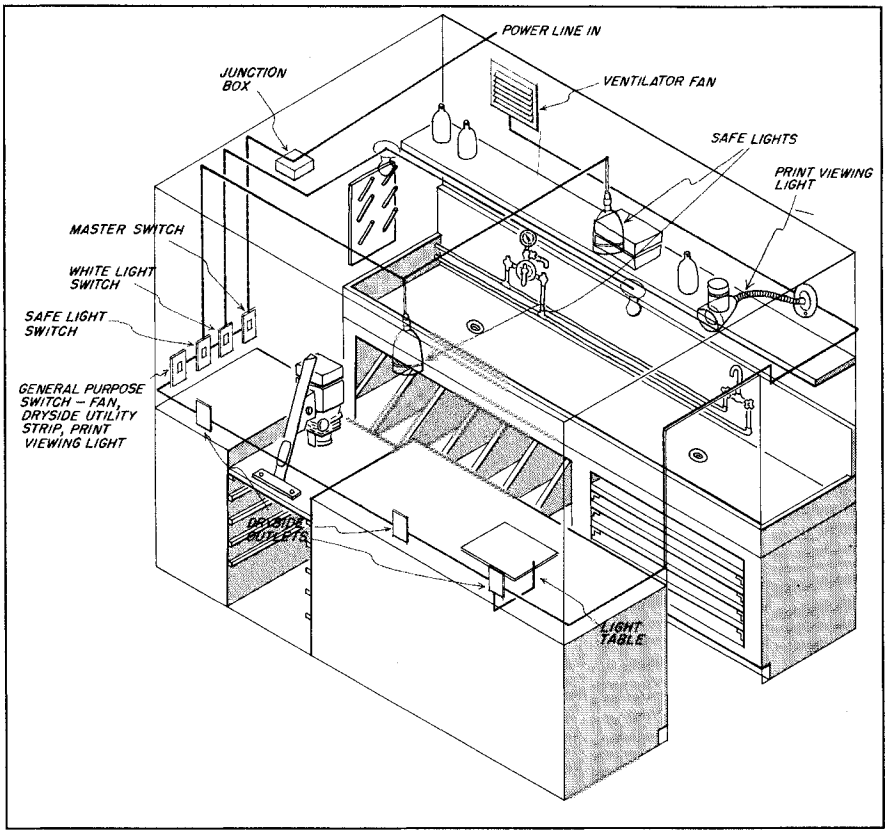
In most modern American homes, the circuits are wired up to handle a load of 15 amps. Older homes vary, and you should check carefully to determine what their rated capacity is. If your answer to the previous calculation is less than the rated capacity of your house, you will have no problem using the circuit you planned. If your answer was more, there are a few solutions:

1. Eliminate some of the equipment.
2. Put some of the equipment on a separate circuit. Use your drawing to determine the closest convenient one that is truly a separate circuit and not just a different outlet on the same circuit.
3. Do not use all of the equipment at the same time. You can easily change your work habits so that you are not drying prints when the enlarger is on, or vice versa.
4. Add a new circuit coming from the fuse panel rated at the capacity you need.

Solutions NOT to use:

1. NEVER put pennies in fuse boxes.
2. NEVER put higher-rated fuses in the box. You cannot do this safely without changing the wiring.

Typical Darkroom Circuits



Placement of Electrical Circuits in the Darkroom. This illustration shows the typical arrangement of required electrical fixtures, outlets, and switches. The drawing shows three separate circuits for white lights, safelights, and outlets. There is also a master switch controlling all power to the darkroom.

- All switches should be located near the enlarger as a matter of convenience.
- All safelights should be located at least 4' from where light-sensitive materials will be used, that is, the enlarger easel and processing trays.
- The switch controlling the white-light circuit should be separated from the other switches to prevent accidentally turning the lights on when materials are exposed.
- All electrical outlets should be mounted at least 3' above the floor to eliminate the hazard of walking on wires plugged into them.

Tools and Materials for Electrical Work

All of the materials needed to wire darkroom circuits are available at local hardware stores. Make a list of all the parts you need before you go, because once you are working on electricity in the house, it will be difficult to safely turn it back on until the job is completed.

Tools

Voltage Tester (1). This device is used to determine if a circuit is live. It will light up if there is voltage in the circuit. It is also used to determine what outlets are on which circuits and to make sure that the circuit is not live before working on it.

Pliers (2). These are used to twist together the ground wires, which are usually too heavy to twist by hand.

Wire Strippers (3). Wire can be stripped with a knife but wire strippers are better. The surface of the wire should not be damaged when stripping; such damage could cause a short circuit.

Equipment

Fuse Panel (4). A modern fuse panel with circuit breakers will be located near the source of the incoming electrical lines.

Fuses (5 and 8). Fuses in older panels will look like the illustrations shown here. One screws into place, and the other snaps into holding clips.

Wall Switch (6). Used to control power to circuits and outlets in the darkroom.

Outlets (7). Used to plug in darkroom equipment. Always buy the type that accepts grounded plugs.

Switch with Pilot Light (9). This switch can be used to control all outlets in the darkroom. The light will indicate if the circuits are on or off.

Switch Outlet (10). You can use these outlets in place of regular outlets if you want to be able to turn individual outlets on or off at the outlet itself.

Cable (11). Most wiring today is done with what is called NM (nonmetallic) cable, which replaces armor cable found in older homes. Be sure to buy it with two wires and ground. Also be sure to buy it with large enough wires to carry your load. In most cases, you can use a #12 wire, but after determining the load you expect to put on the darkroom, check your building code to see if this is sufficient.

Junction Boxes (12). These are used as a point to connect two or more cables: they are the only place where cables should be spliced or connected to each other.

Switch Boxes (13). These are similar to junction boxes, but somewhat smaller in size, and are used wherever a switch or outlet is to be connected. They are mounted to a stud so that the front of the box will be flush with the eventual wall surface. The switch or outlet is wired into them and then covered with a face plate.

Light Fixture (14). These are inexpensive ceramic fixtures that attach to switch boxes recessed in the wall. They are ideal to use to screw in bulbs or safelights and are a great deal cheaper than more elaborate fixtures.

Grounded Plug (15). All cords in the darkroom should have grounded plugs similar to the one shown. This ensures that the equipment ground will connect with the grounded circuits in the house wiring.

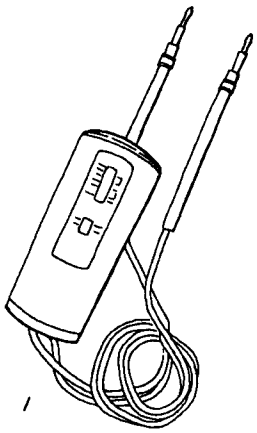
Wire Nuts (16). When connecting cable, the wires are stripped about 3/8" back from the end and then two or more can be held together by one of these "nuts." The nuts eliminate the need for soldering and are available in different sizes, depending on size or number of wires to be connected.

Junction Box Cover (17). Once the wires have been installed in a junction box (12), a protecting cover should be screwed in place to close the box.

Wall Plates (18 and 19). After switches or outlets are installed, they are finished off by installing a plate over the box in which they are mounted.

Connecter (20). These are used to attach the cable when it enters the junction box or switch. They should always be used, because they protect the cable from stress and abrasion.

Fasteners (21 and 22). When installing equipment against wallboard, these fasteners can be used to mount in places where there is no backing into which screws can be fastened.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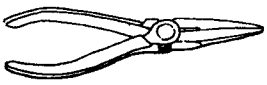
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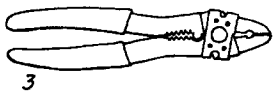
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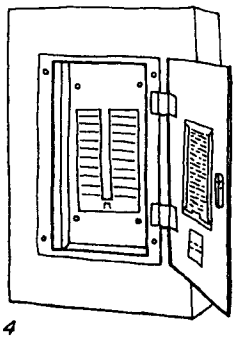
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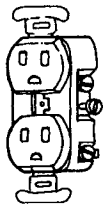
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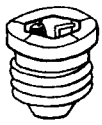
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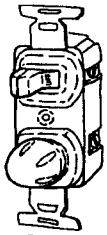
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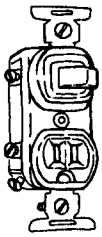
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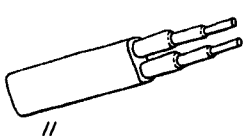
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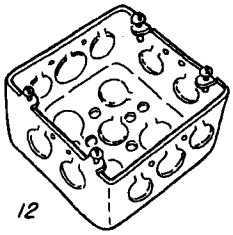
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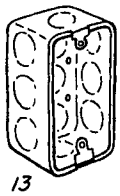
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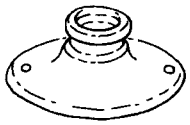
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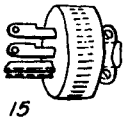
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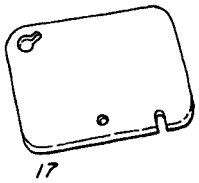
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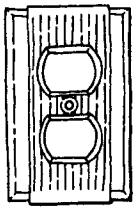
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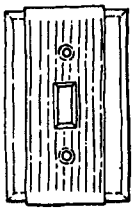
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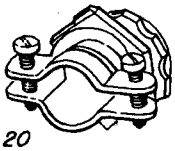
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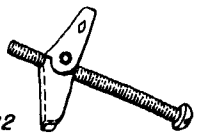
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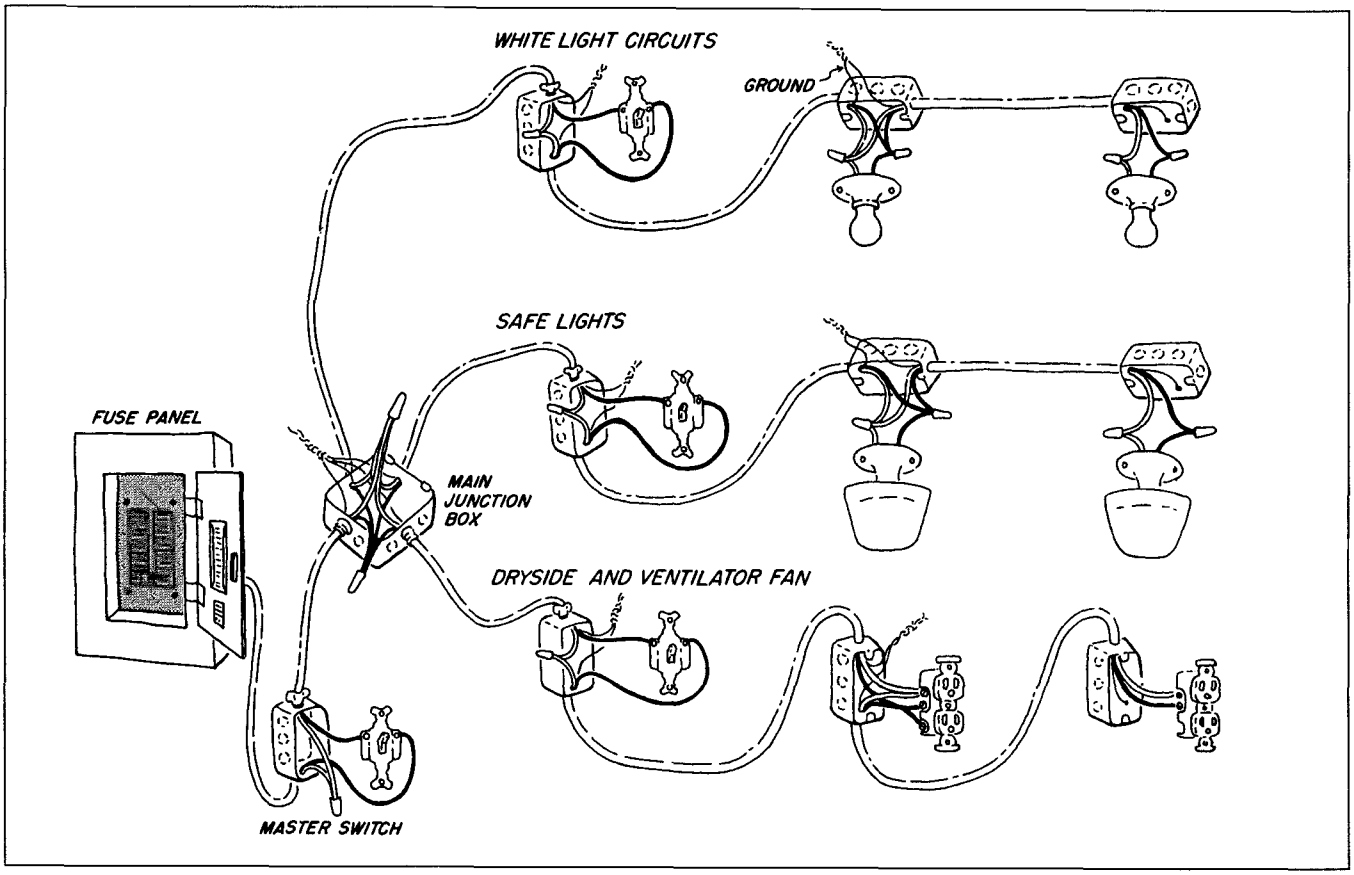
Wiring the Circuits

How to Wire the Circuits



How to Wire the Circuits. This drawing shows a typical darkroom circuit with a master switch controlling separate circuits for white lights, safelights, and a general circuit for the dry side. Wiring can be run directly from the fuse box, or it can begin from an available junction box—provided the load is within the limits of the circuit being tapped.

Things to Remember

1. Before working on any circuit, be sure you pull the fuse or interrupt the circuit breaker in the service panel. To be safe, shut down the master power switch and ALSO remove the fuse for the circuit you are working on. Use a voltage tester or plug in a lamp to be sure the circuit is not hot. Do not be careless, since you can be fatally injured by failing to follow this step.

2. Always use grounded cable for all circuits. Grounded cable consists of a white wire, a black wire, and a bare copper wire. The bare copper wire is the ground and should always be twisted together with all other ground wires in the same box and then fastened to the box itself. This will ensure that all circuits and boxes are at the same electrical potential as the earth, and if there is a short, the current will go through the ground wire and not you.

3. Always buy outlets that will accept the 3-pronged grounded plugs. If you don't, then the equipment itself will not be grounded, even though the circuit is, and you will be in danger and have wasted your time grounding the circuits.

4. The white wire in the cable is the neutral wire (this does not mean you can touch it with the power on) and should always be connected to the silver terminal in outlets. When wiring a switch, the white wire is connected straight through to the other white wires and should never be connected to the switch terminals.

5. The black wire is the hot wire and should always be connected to the brass terminals on switches and outlets. When wiring switches, it is the black wire that is connected to the switch.

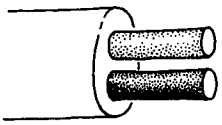
6. Always use connectors when running cable into a junction or switch box. These connectors protect the cable from being cut by the rough edges of the box and also from being pulled loose.

DANGER! No wiring should be attempted without having it inspected. Failure to do so can be extremely dangerous and in violation of local laws. The material in this section is for descriptive purposes so you can discuss it with a licensed expert. Do not use these drawings and captions as a guide to wiring.

Wiring In a Junction Box

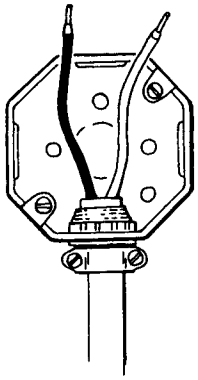
Wiring In a Junction Box. Run the cable into the junction box leaving 6" of cable past the point where the connector will fasten it to the box. Mark the point where the cable is flush with the inside of the connector.

Remove the outer sheath of the cable at the place marked, being sure not to cut into the insulation of the wires inside. A small knife blade can be used to cut outward through the plastic sheath, ensuring that the wires are not cut.

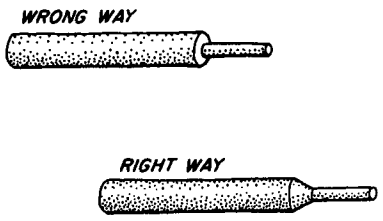


Attach the connector to the box, using the nut that comes with it.

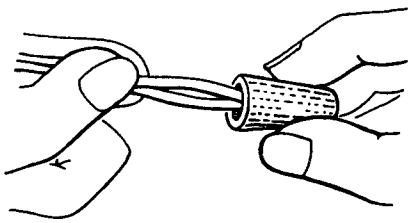
Run the cable through the connector so that the end of the sheath comes flush with the inside of the connector.

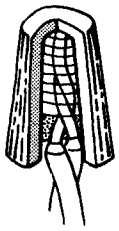


Carefully remove the insulation from the last 3/8" or so of the wires.

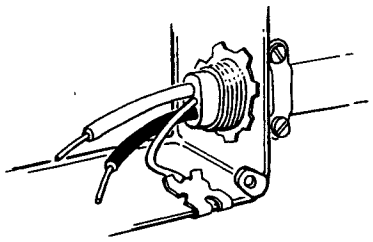


Hold the exposed wires together and screw the correct-sized wire nut over the ends to hold them together. If too much insulation has been removed, you will see bare wire when the nut is screwed tightly into place. This should be corrected by removing the wire nut and trimming the end off the wire, so that when it is rescrewed into place no bare wire is exposed.

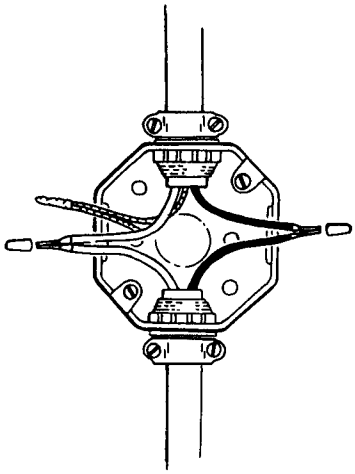




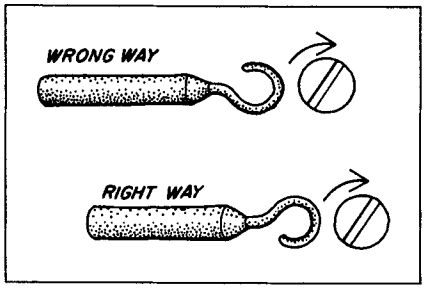
Twist the ground wires together tightly. In some junction boxes, the ground wire can be attached with a clip to the side of the box.



The completed wiring in the junction box will look like the one in this illustration, with all of the wires tightly connected by wire nuts. Now, carefully fold up the wires and place them in the junction box and screw the cover into place.

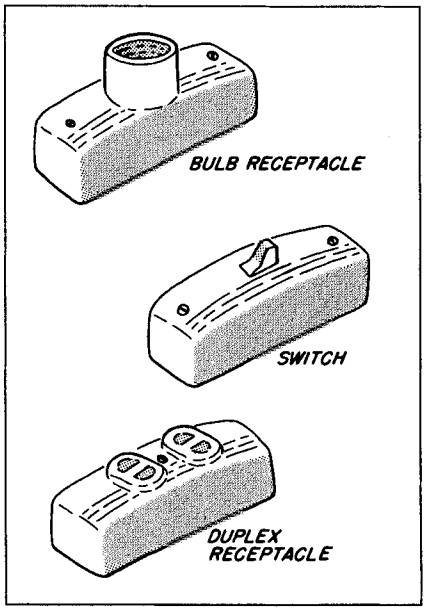


Connecting Wires to Switches



Connecting Wires to Switches. Those wires that are to be connected to terminal screws on switches or outlets should be twisted together and bent to fit around the screw head on the switch. They should be installed with the wires pointed in the same direction that the screw will be turned to tighten it, that is, clockwise, so that they will not be pushed out by the screw as it is tightened.

Wiring on the Surface



Wiring on the Surface. If you are converting a room that is already panelled, or made of some material such as concrete block that you cannot run wires through, you can choose to run all of the darkroom wiring on the surface rather than behind the wall. To do this, you will need special fixtures made especially for this purpose. Junction boxes can be surface mounted, then the three items illustrated replace the usual bulb receptacles, outlets, and switches. The cable can be stapled into place or hidden inside conduit.

Modular Control Panel

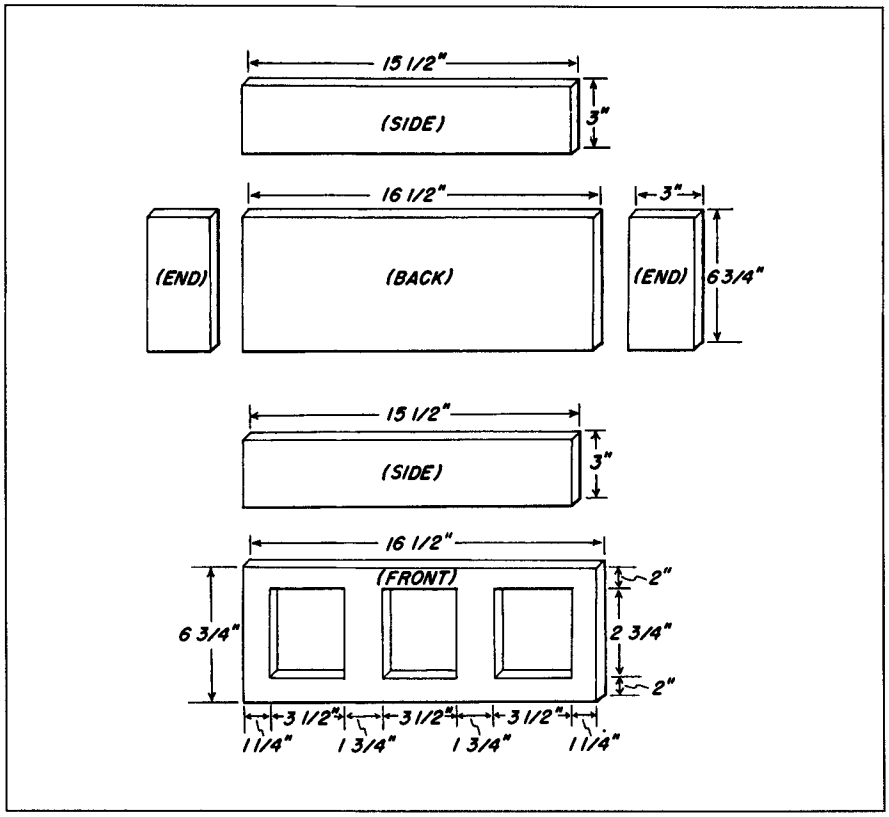
Building a Master Electric Control Unit

When installing a darkroom in an apartment, or in a finished room that may eventually be converted back to its original use, it is wise to do as little interior conversion as possible. This section shows you how to build an electric control panel that will put all of the electrical controls at your fingertips. All that's required, once it's built, is to plug it in. It has the following advantages over rewiring the room:

1. It can be built in your shop, on your kitchen table, or by a friend, and then installed in the room just by plugging it in.
2. It can be taken with you if you move. All you have to do is plug it in the next apartment or house.
3. It has two outlets for safelights, each on separate switches.
4. It can be adapted to allow the unit to be plugged into two separate outlets (provided they are on separate circuits; see "How Your Electrical Circuits Work" earlier in this chapter), thereby dividing the darkroom load so it does not exceed the limits of a single circuit.
5. It can be used to feed a remote power strip installed elsewhere in the room as a power supply. If the control unit is mounted on the dry side near the enlarger, the remote strip would be near the wet side (never close enough to the sink to get wet), or vice versa.

This unit is based on the actual switches listed. If you use different switches, the wiring will be different. Wiring diagrams usually accompany electrical parts and can be used as a guide.

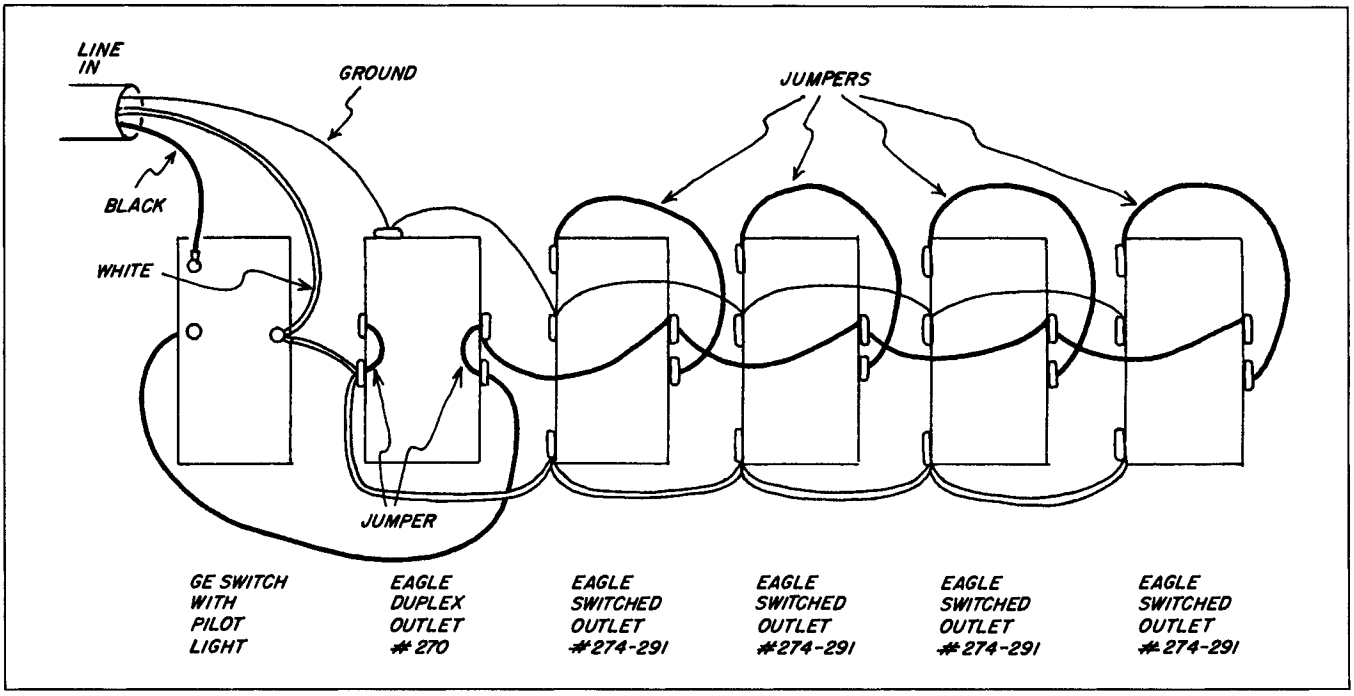
Building the Case



Building the Case. The first step in assembling the control panel is to build a case to hold the switches and outlets. This case can be cut, to the dimensions indicated, from 1/2" plywood. The back sides and ends are glued, then nailed together. The front panel is attached to the case with wood screws, so that it can be removed if necessary to repair wiring.

DANGER! No wiring should be attempted without having it inspected. Failure to do so can be extremely dangerous and in violation of local laws. The material in this section is for descriptive purposes so you can discuss it with a licensed expert. Do not use these drawings and captions as a guide to wiring.

Wiring Diagram

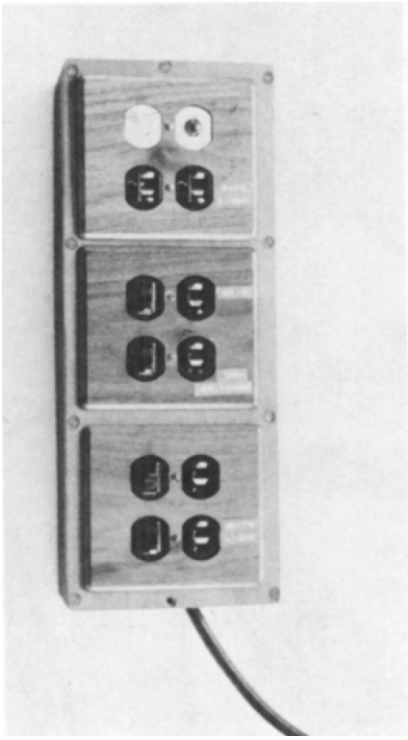


Wiring Diagram. This wiring diagram is for a series of switches and outlets identical to the ones listed. As all switches vary in their design, switches other than those indicated will require slightly different wiring.

This view is from the back of the switches. The best approach is to mount the switches to the front panel of the case before attempting to wire them. This will keep them from shifting about and lessens the chance of an inadvertent short circuit.

Never work on the panel with power supplied to the circuits. Also, have the wiring checked by a licensed electrician prior to using it. All wiring is potentially dangerous, and it pays to be sure that it has been done correctly.

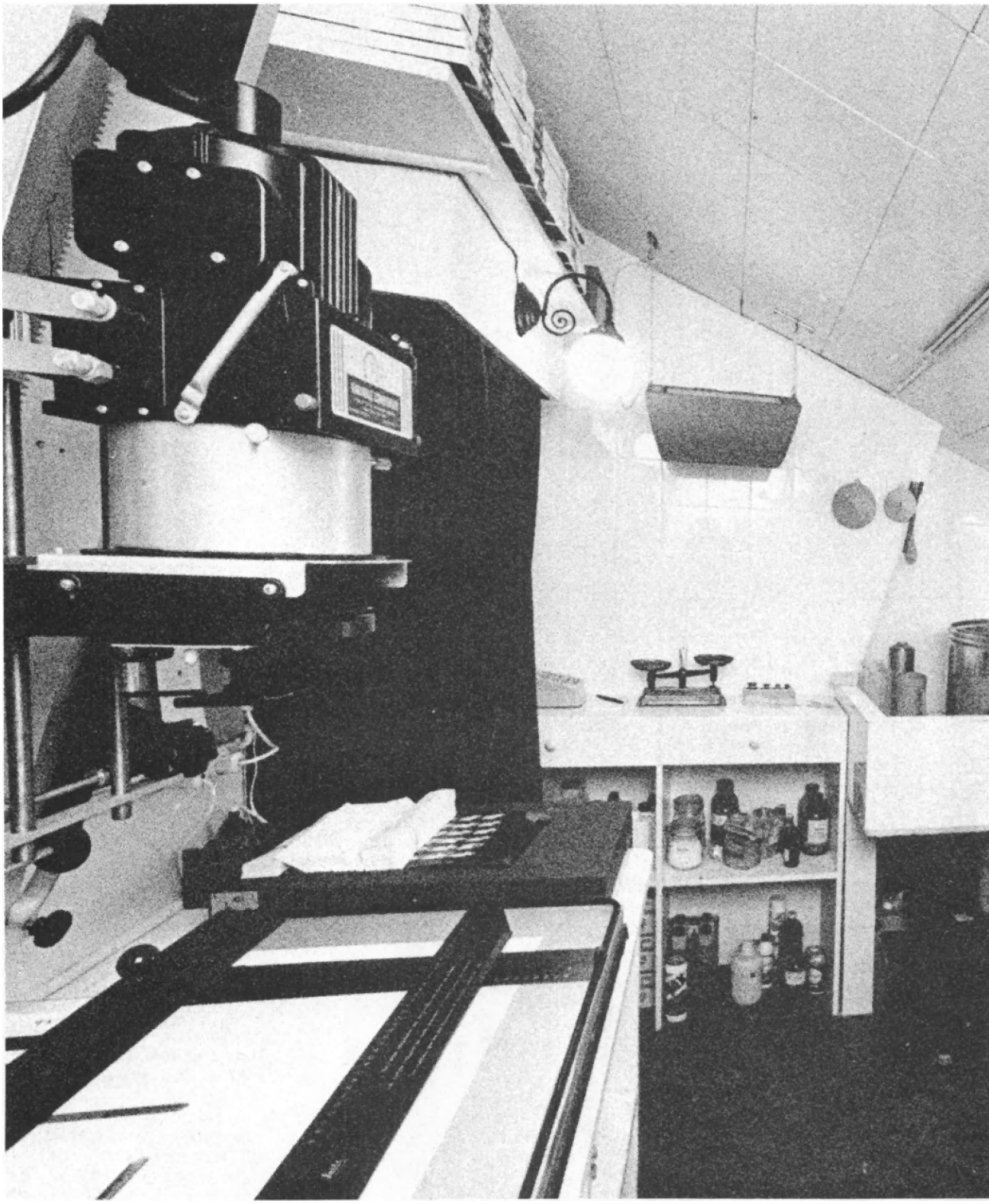
This switch panel should be kept well away from sources of water, and all switches should be grounded to ensure that shorts will not be dangerous.

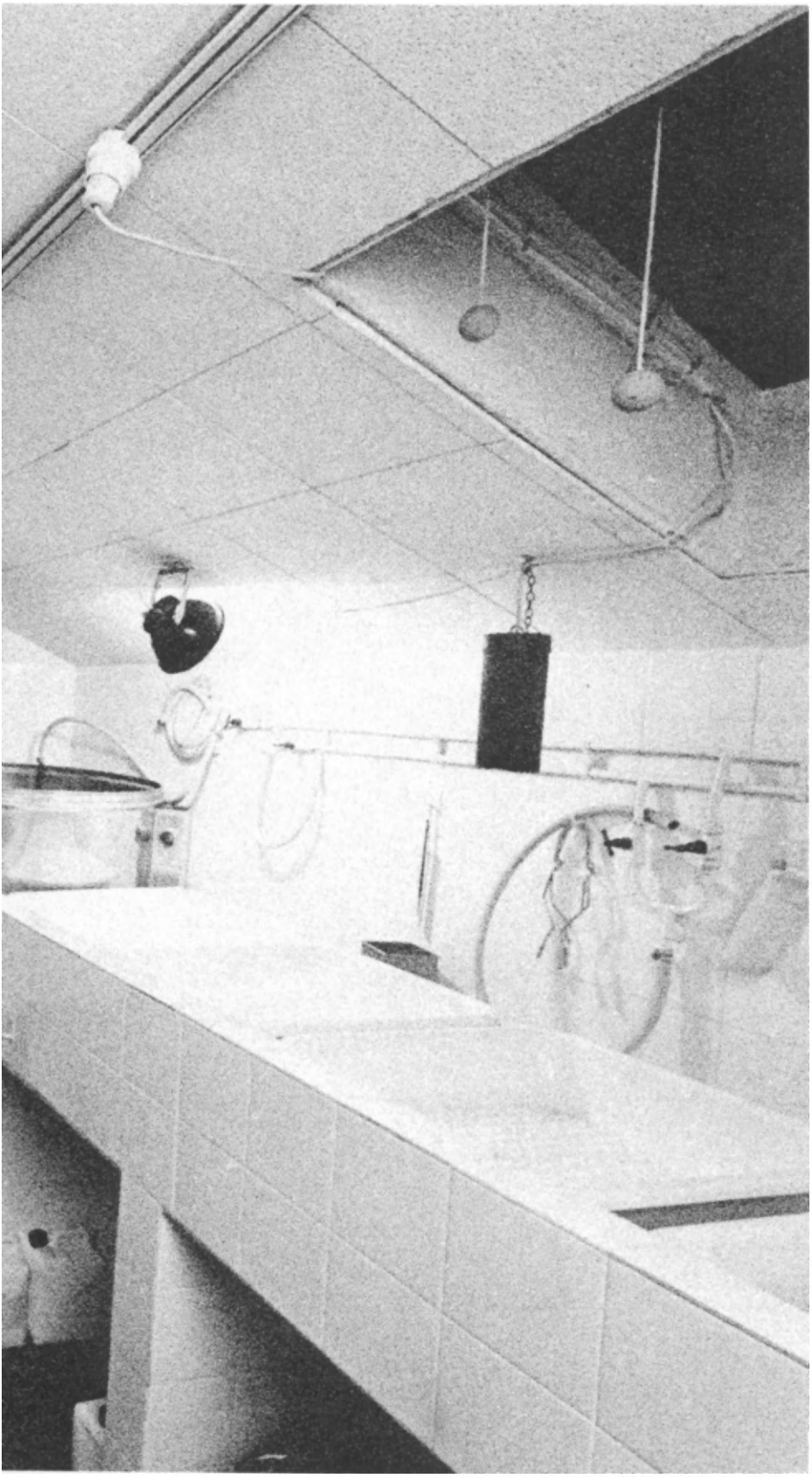


The Assembled Unit. This photograph shows a completely assembled unit built from the plans given on these pages. The top switch (white) is the master power switch that controls all other circuits. At the end of the session in the darkroom, turning off the master switch shuts down all darkroom circuits.

There are two outlets controlled only by the master switch, and four outlets controlled both by the master switch and by their own switches.

6 Building the Inside





Contents

The Lighting Circuits

Lighting the Darkroom

Lighting a darkroom has similar considerations to taking pictures: eliminating unwanted light and controlling the light you do want. Later we will discuss making the room dark by eliminating unwanted light. This section deals with controlling the light you do want.

General Lighting. There should be sufficient illumination when the main lights are on to clean the room and to do general work that is not involved with light-sensitive materials. For this purpose, regular incandescent or fluorescent fixtures are normally used. The switch for the lights on this circuit should be separated from the other darkroom lights or should have a switch guard to prevent it from being turned on by mistake. The number of lights depends to a large degree on the size of the darkroom or workroom. Generally, two 100-watt fixtures are sufficient.

Safelighting. Safelighting provides filtered light that will not affect light-sensitive materials. Each type of material has a specified filter. Using the wrong filter can reduce the safety factor or offers no protection at all. The intensity of the safelight desired varies from photographer to photographer. Some like a darkroom that is as bright as possible, and others a more moody room with cones of safelight only at key spots near the enlarger and print-developing trays. Use your own judgment in selecting the type of lighting for the room you plan.

Print-Viewing Lights. When the print comes out of the fixer, it's usually evaluated to determine what should be modified to make the next print better. To make an accurate evaluation you need proper lighting. Too little light or too much of the wrong kind can seriously affect your decision. Light that is too bright will make prints look weak and washed out, whereas light that is too weak will make them appear to be too dark. The solution is to have a viewing light in the darkroom that best represents the light in which the print will eventually be viewed.

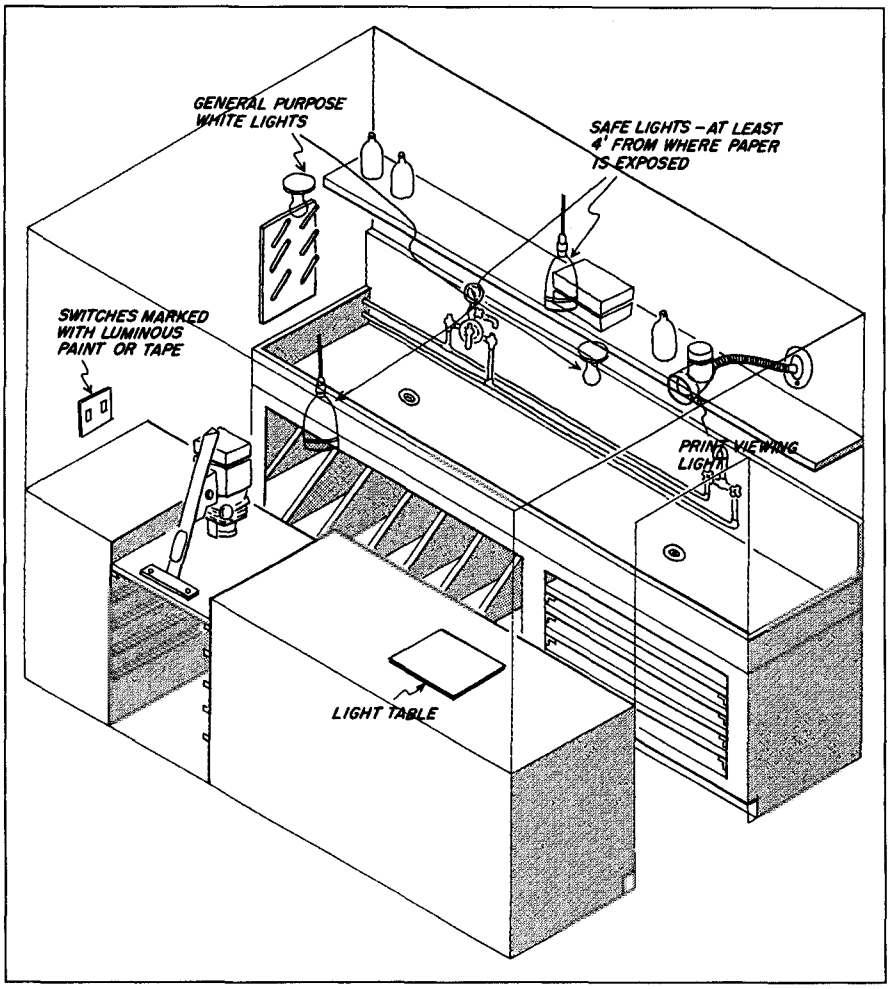
With black and white prints, all you need worry about is light intensity. If you are printing for gallery display, remember that the gallery lights are much brighter than in the average living room or bedroom. Most galleries will have lighting of 80 to 100 foot candles, and that intensity should be matched by the print-viewing light. A dimmer switch, available in hardware stores, can be used on the print-viewing light and calibrated to various viewing environments.

With color prints, the light in the darkroom ideally should also be the same color balance as the light by which the prints will be finally viewed—often, though not always, daylight. For convenience, many photographers simply match their darkroom light to a daylight balance. Kodak recommends for viewing color prints a light of 50 foot candles or more, a color temperature of approximately 4,000° K, and a color-rendering index of 85-100. Deluxe cool-white fluorescent lights come close to these requirements. They should not be used for viewing in conjunction with ordinary incandescent lights, which are of a different color balance.

Light Table. It is generally helpful to have a light table built into or sitting on the dry-side counter. A light table is the ideal way to view negatives while making selections for enlargements. The light table can be covered with a large safelight filter so that it can be left on while printing (this will work only if you are printing in black and white), or it can be controlled with a dimmer switch.

Luminous Tape or Paint. You should consider the use of phosphorescent tape or paint to identify key items in the room that you might need to find in the dark, such as focusing magnifier, print tongs, and drawer handles. It's also helpful to indicate any sharp corners so they can be avoided in the dark. Even with good safelighting, the room will be dark when working with film and color materials.

Lighting Circuits



General Lights. These are standard ceiling fixtures giving sufficient light to work and clean the room when light-sensitive materials are not being used.

Safelights. The number of safelights is determined by the size of the room and the intensity of the light desired. Safelights should be no closer than 4' from enlarger baseboard or processing trays, otherwise fogging of paper is possible.

Print-Viewing Light. Most photographers like to check their prints after they have been in the fixer for a few minutes. It's convenient to have a light nearby, because prints cannot be evaluated accurately under safelighting regardless of how bright it is.

Light Table. A small light table built into the counter is handy to use in selecting negatives.

Calibrated Print-Viewing Light

If you want to make prints that are adjusted for the brightness of light available where your photographs will be viewed, you can calibrate your darkroom print-viewing light using a regular light meter, a standard photographic gray card, and a dimmer switch installed on the print-viewing light. First determine where the prints will be viewed, either in the home or in a gallery. Place the gray card in the position the print will occupy and illuminate it with the lights that will be used to illuminate the print. Take a reading from the gray card with the light meter.

Now place the gray card under the darkroom print-viewing light in the position where prints will normally be set for evaluation. Install the dimmer switch according to the instructions. While watching the light meter, gradually increase the light intensity until the reading matches that obtained at the position the print will eventually occupy. Mark the dimmer switch to indicate its position so you can repeat the setting without additional measurements. If you print for a number of viewing conditions, you will eventually have a dimmer switch with various settings indicated. Experiment with a trial print on the particular printing paper you are using, because some papers dry down to a tone that is darker than when they are wet.

Lighting Equipment

Choosing a Safelight

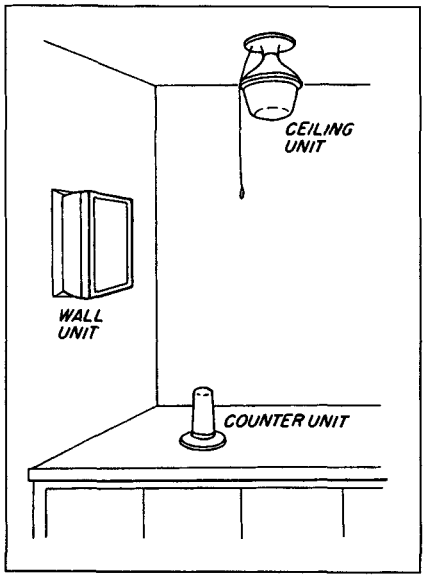
Safelights contain a bulb and a colored filter. As the light from the bulb passes through the filter, portions of it are blocked and only light of a certain color is allowed to pass: this light will not expose your enlarging paper (it will affect film, however). Although the light from a safelight is dim, it does allow you to see in the darkroom while making proofsheets and enlargements. Two considerations when buying a safelight are where to put it and what kind of filter to use.

Kodak Safelight Filters

Kodak Safelight Filters are scientifically designed for safelight lamps to provide maximum safe illumination plus protection from white light when using sensitized materials:

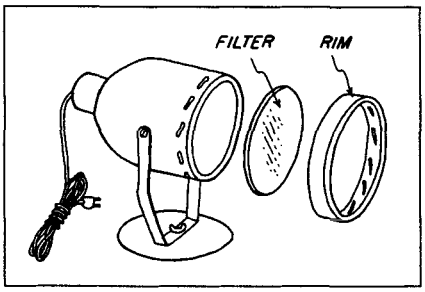
- OA (greenish yellow)—for black-and-white contact and duplicating materials, and projection films
- OC (light amber)—for contact and enlarging papers
- OO (light yellow)—for flash exposure technique with Kodak Contact Screens (available only in 5 1/2" diameter)
- No. 1 (red)—for blue-sensitive materials, most photo-typesetting materials, Kodagraph Projection, and some Linagraph Papers
- No. 1A (light red)—for slow orthochromatic materials, Kodalith and Kodagraph orthochromatic materials, and high-resolution plates
- No. 2 (dark red)—for fast orthochromatic materials, some green-sensitive x-ray films, Ektaline Papers, and Orthochromatic Linagraph Papers
- No 3 (dark green)—for some panchromatic materials
- No. 6B (brown)—for blue-sensitive x-ray films
- No. 8 (dark yellow)—for some Eastman Color Print and Intermediate Films
- No. 10 (dark amber)—for Vericolor slide film 5072, Vericolor print film 4111, and Panalure papers
- No. 11 (appears opaque, transmits infrared radiation)—for use with infrared scope and similar inspection devices (available only in 5 1/2" diameter)
- No. 13 (amber)—for all Ektacolor, Panalure, Panalure and Resisto Rapid Pan Papers
- GBX-2—for all blue- and most green-sensitive medical and dental x-ray films

Safelight Location

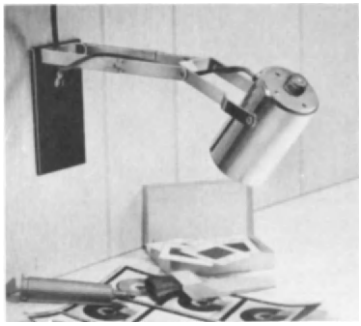


Where to Put It. Safelights can be screwed into existing ceiling or lamp fixtures, mounted on the wall, or placed directly on your counter. To reduce the chance of fogging (an overall graying of your paper), keep in mind that the safelight (with a 15w bulb) should be located at least 4' (1 1/4 m) from where your paper is exposed and processed.

What Kind of Filter



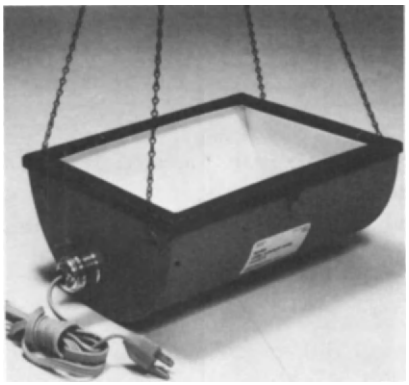
What Kind of Filter. The instruction sheet packed with your paper (open the package only in the dark to remove it) specifies a particular type of filter. Most enlarging papers require a light amber filter, such as a Kodak Wratten OC. Safelight filters are usually purchased separately from the safelight itself and come in a variety of shapes and sizes.



Print-Viewing Light. A small wall-mounted light to use in evaluating prints is very useful. This model from Edmund Scientific has important features, such as a shielded light for increased brightness, and a swivel bracket that allows it to be positioned as needed. The arm also slides into a closed position only 3" long and extends out to 11".

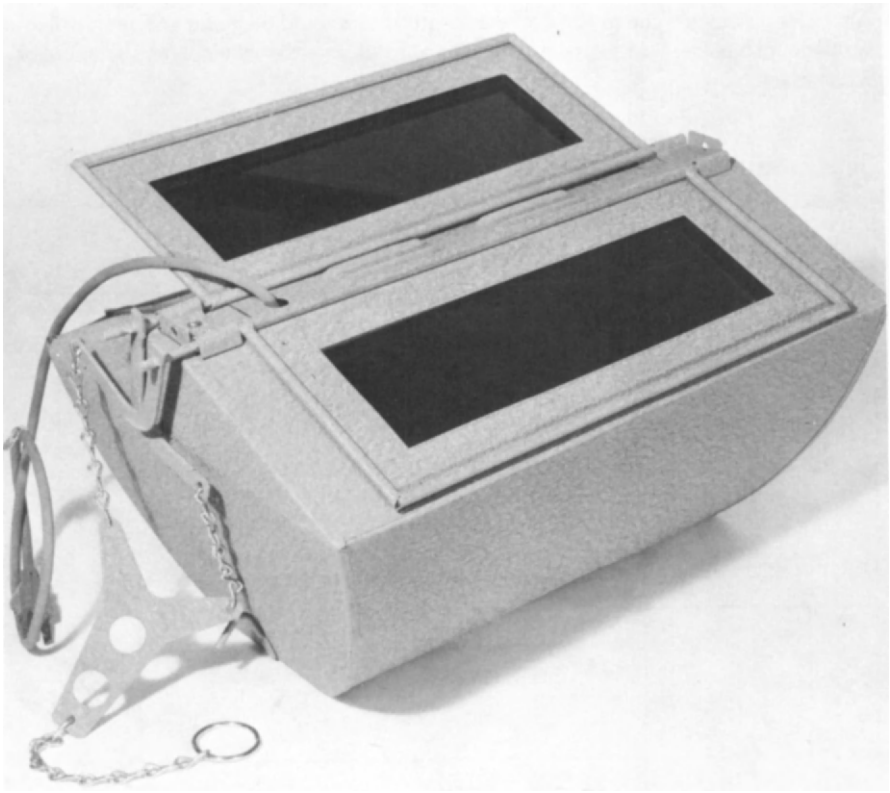
Kodak Two-Way Safelight. This Kodak two-way safelight is a popular model. It is inexpensive and effective. The light is directed in two directions for even illumination. To install, screw it into an existing socket and you're ready to print.

Courtesy Eastman Kodak Company



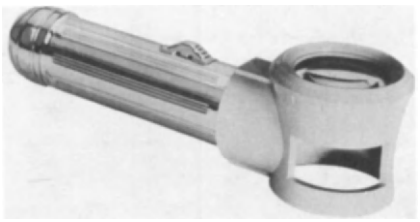
Utility Safelight. The Kodak utility safelight model D is a good example of a safelight that can be suspended from the ceiling. The light is then reflected downward from the ceiling for even illumination throughout the room.

Courtesy Eastman Kodak Company



Thomas Sodium-Vapor Safelight. This sodium-vapor safelight puts out light from a very narrow part of the spectrum, one which has the least effect on photographic papers, but to which the human eye is most sensitive. The result is a light bright enough to read the fine print in the next contract for your photographic services. This is an excellent choice if you want a bright darkroom in which to work.

5 1/2" Round Safelights. This 5 1/2" safelight system consists of a housing, filters, and a universal base. It uses standard 5 1/2" filters available from Kodak and others. The universal base can be mounted on a wall or ceiling or stood on a counter top. An alternative socket base allows the safelight to be screwed into an existing light socket.



Illuminated Magnifier. A combination magnifying glass and flashlight that is useful for examining 35mm contact proof sheets.

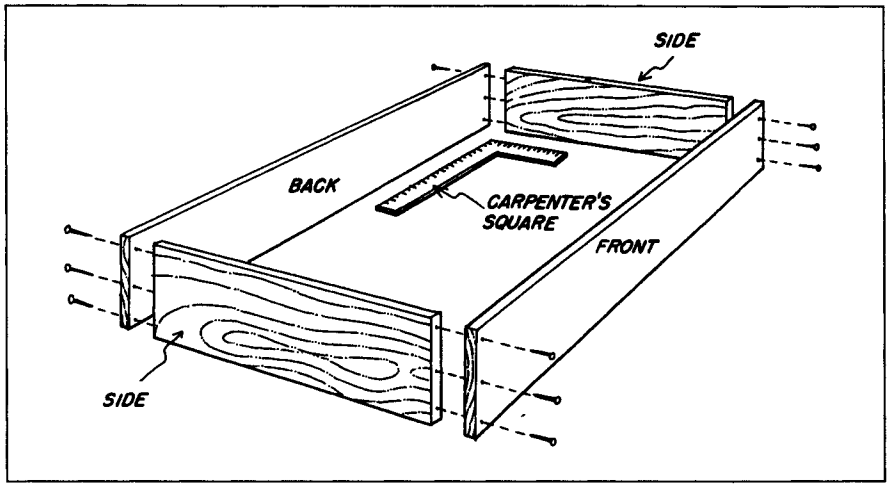
Building a Darkroom Sink

A sink is a basic piece of darkroom equipment. A long sink made out of wood, plastic, fiberglass, or stainless steel will hold print-processing trays plus the print washer.

Darkroom sinks make it easier to keep the darkroom clean by containing spills that, at the end of a session, can be flushed out with a hose. Because many chemicals dry to a powdered state that can be carried by air currents onto sensitive materials, it is essential that they be removed, and the sink provides the most efficient way of doing so. In addition to improving cleanliness, a darkroom sink allows all of the processing trays to be immersed in a water bath to help maintain their correct temperature.

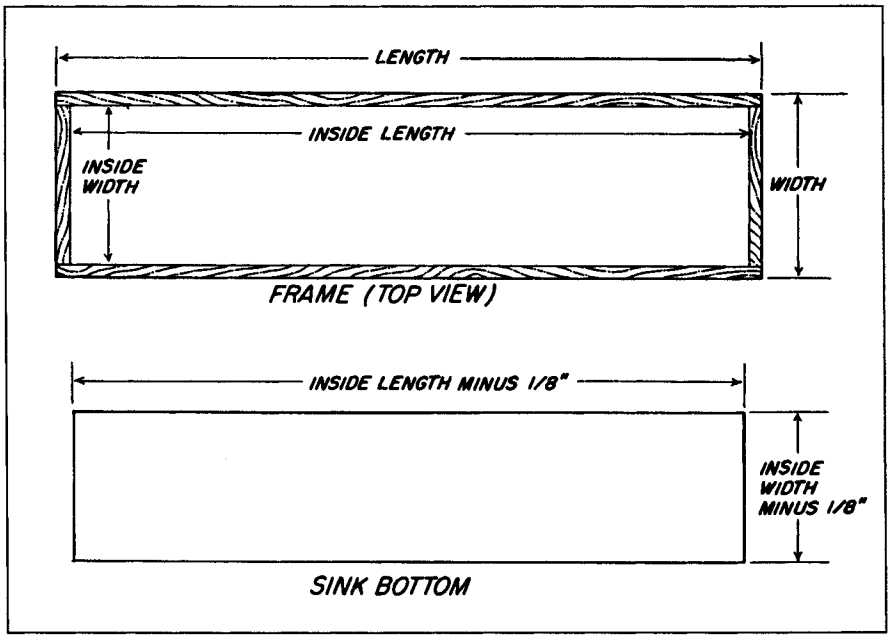
You can buy a sink, but the vast majority of photographers build their own sinks out of plywood, which is then caulked and sealed with epoxy or other waterproofing material.

Making the Sink Sidewall Frame



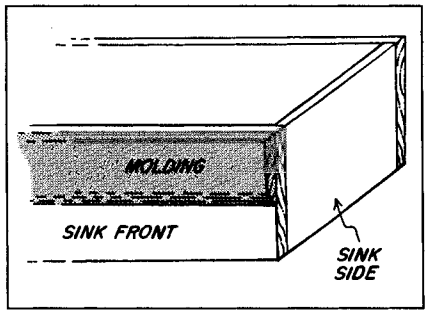
Making the Sink Sidewall Frame. The sink frame can be made out of a variety of materials but the most popular is 1/2" or 3/4" plywood. Because the sink will be painted, a lower grade of plywood called "plug and touch," which is finished on one side, is suitable for its construction. The sides should be approximately 8" deep and long enough and wide enough to hold the number of processing trays you plan on using (see the section on "Wet-Side Cutouts" in Chapter 4 for various sink sizes). After the pieces are cut to the correct length they should be glued and then nailed or screwed into place. Use a carpenter's square to ensure that the corners are square when assembling.

Sink Frame



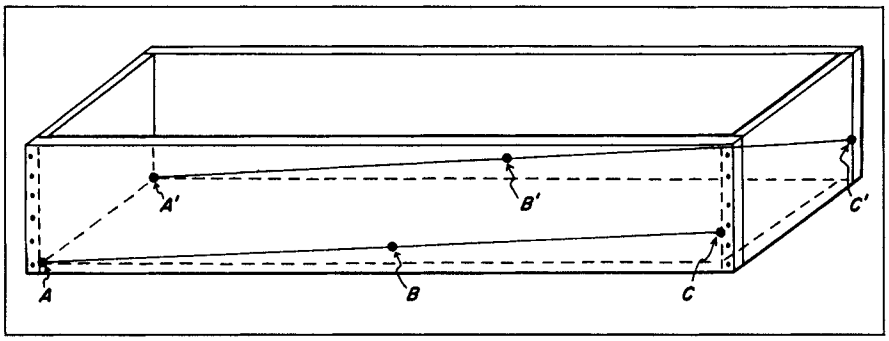
Building and Installing the Sink Bottom. After you have finished the frame, measure the inside dimensions. Cut a piece of 1/2" plywood so that it fits into the sink side-wall frame with as little clearance on all sides as possible. As a starting point, the plywood should be cut 1/8" shorter and narrower than the inside dimensions of the sink frame. If it does not fit, sand off the excess wood until it fits snugly into the frame.

Rail to Lean On



Rail to Lean On. Neither 1/2" nor 3/4" plywood provides much of an edge to lean on. Since you will want to lean on the sink while rocking trays, it helps to install a piece of 1/2"-wide casing (or molding) along the front sink frame to widen the top edge. This will make the sink front much more comfortable to work on.

Measuring for Bottom Slope

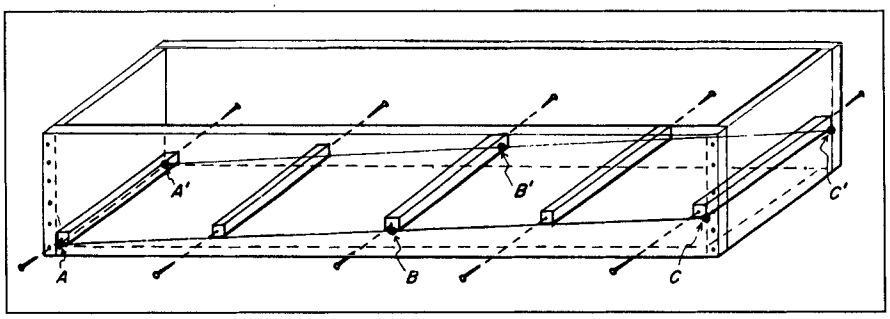


Measuring for Bottom Slope. After the sink bottom has been cut to size, it must be installed in the sink so that it tilts enough to drain toward one end or the other. Do this by installing the bottom supports at gradually increasing heights along the length of the sink. Cut these supports out of 1 x 1" or 1 x 2" lumber to a length equal to that of the sink end pieces.

To build in the slope at the bottom, draw a sloping line down both long sides of the inside of the sink frame as a guide line for nailing in the cross pieces. Make one mark at point A and A' flush with the bottom of the sink frame. Halfway down the sink, make a mark at B and B' 1/8" above the sink frame bottom, and at the other end of the sink (C and C'), place a mark indicating a point 1/4" above the sink bottom. Connect these three points with a straightedge and you will have a sloping line as a guide for where to nail the bottom edge of each support piece.

If your drain will be in a far corner and you decide that you also need a front-to-back slope, you can raise the A, B, and C, or A', B', and C' measurements an additional 1/8" above the measurements on the other part of the frame.

Installing Bottom Supports



Installing Bottom Supports. Hold each support cross piece in position and drive a long nail through the front of the sink and into the support. Since you will be nailing blind, it may help to first measure where the support is to be located inside the sink and then transfer this measurement to the outside. Nail the support on the other side (back) of the sink, and continue with each of the subsequent cross pieces. Make sure that the bottom of each cross piece is aligned with the guide line that indicates the tilt of the sink bottom.

When all of the supports are nailed in place, insert the sink bottom and nail it into place.

Waterproofing the Sink

The assembled sink must be made waterproof before it is used. The first step is to caulk all of the seams on the inside of the sink using an acrylic caulking compound, which comes in tubes and is available at most hardware stores or lumber supply houses. Run a bead around the bottom of the sink and up the four corners. To make it form a smooth surface use a large 3/4" to 1" wooden dowel to make a curve in the caulk. This is done by running a bead of caulk the length of the seam and then running the dowel along the bead, smoothing it as it is pulled along.

The sink can now be painted with a waterproofing material. Epoxy paint can be used, or you can fiberglass the inside. The demands put on the typical sink do not require the use of fiberglass cloth but it is commonly used. (Strips of fiberglass cloth can be used in conjunction with epoxy resin to seal the seams if you choose not to use acrylic caulk.) Epoxy by itself will tend to crack if the sink is moved or pushed out of alignment. We can recommend the following sink coatings:

Sherwin-Williams Tile Clad II comes in two parts and, when mixed and applied, dries to a hard surface finish.

Epoxy Resin is the most commonly used coating. It can be applied like paint directly on the wooden sink and will provide sufficient waterproofing. Seams can be sealed by embedding cloth tape in the wet epoxy and then repainting the top surface with more epoxy.

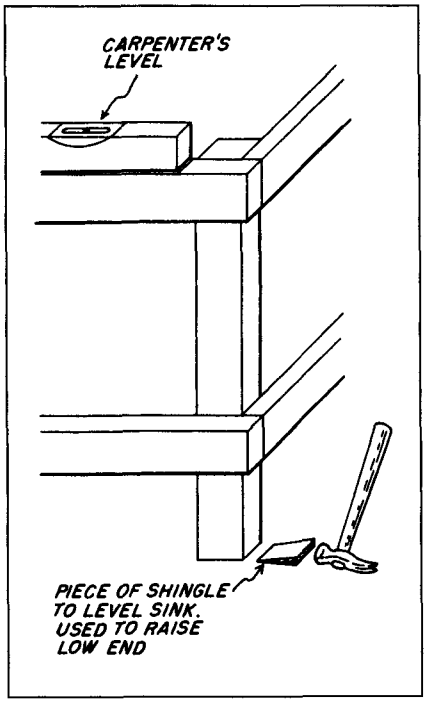
One of the best places to find good sink-waterproofing materials is a marine supply store. Anything used to keep water out of a boat can also be used to keep water in your sink. New waterproofing products come on the market frequently, so you should visit a good store if you want to know what the latest products are.

Building a Sink Stand

After the sink itself has been completed, it is necessary to find a place to put it other than flat on the floor. If the darkroom is in a bathroom or other room that is used for more than one purpose, the sink can be mounted on chair rails (1 1/2" x 1 1/2" molding) along three walls of the room. This allows the sink to be removed easily and the chair rails do not detract from the room.

However, you may want to build a permanent sink stand that is sturdy enough to hold the sink and can also provide additional storage space. This section covers both of these possibilities.

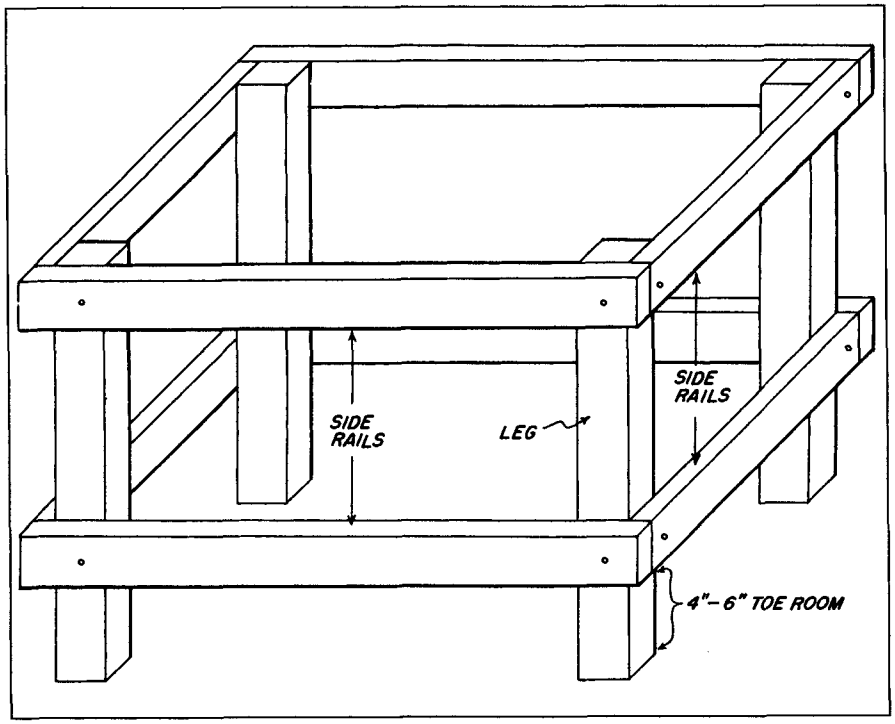
Leveling the Sink



Leveling the Sink. Once the sink stand has been finished, it should be installed in the darkroom and leveled. Use a carpenter's level and small pieces of wood such as shingle. Put the level on the top rail and level the sink lengthwise using the wood pieces to raise the low end. After you level the sink in the long direction, follow the same procedure to level it front to back.

Now place the sink itself on top of the sink stand. The sink bottom's built-in tilt should now be at the correct angle for proper drainage.

Building the Sink Stand



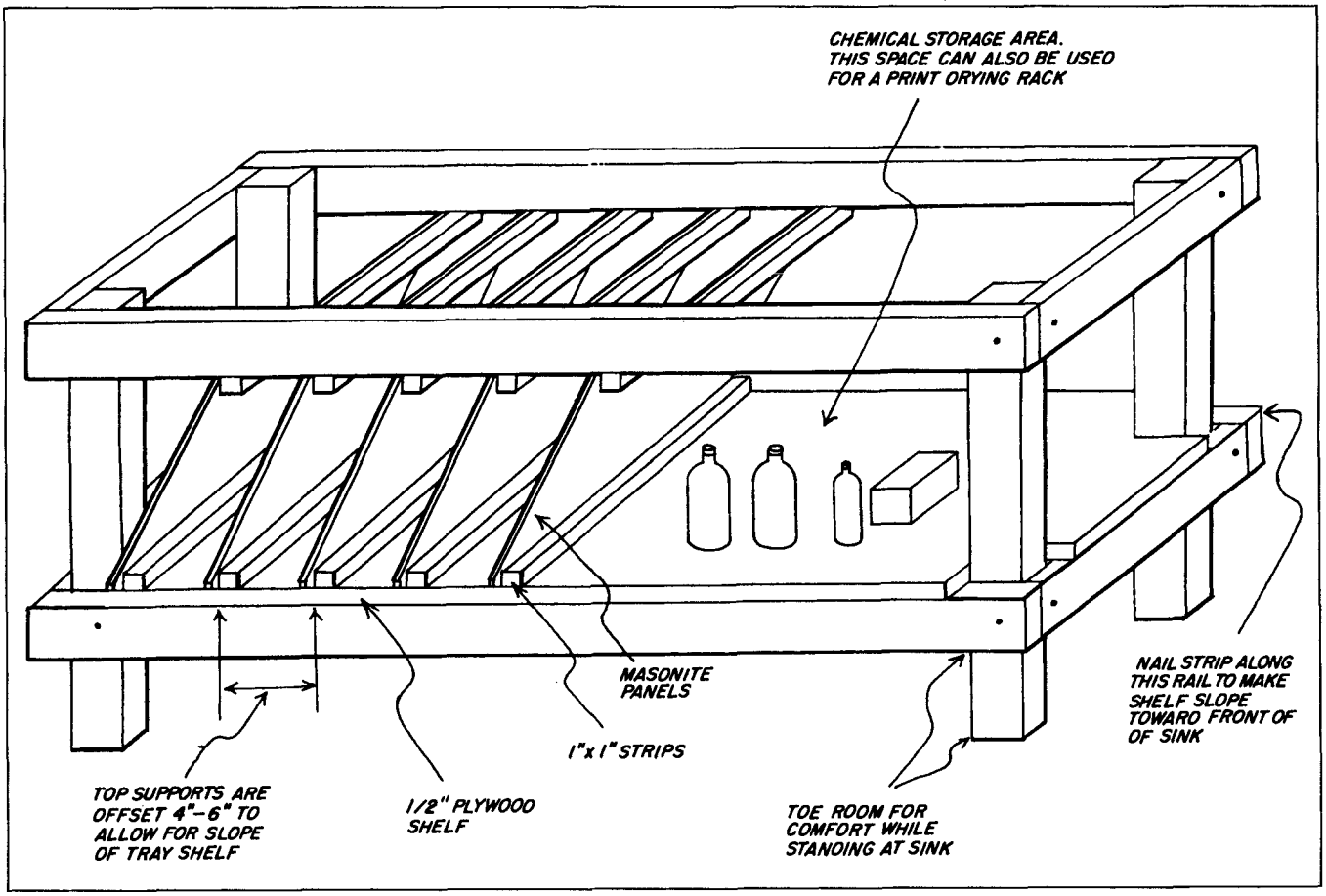
Building the Sink Stand. The sink stand should be constructed with 2 x 4s nailed or bolted together. The outside dimensions should be the same as the outside dimensions of the sink itself.

Begin by cutting the base rails to the same lengths as the sink side walls. Make two sets to provide support at both the top and bottom of the sink stand.

Now cut the four legs to the height you want the sink bottom above the floor. Because the sink bottom is actually a few inches above the bottom of the sink side-wall frame, cut the legs a few inches shorter than the ideal height to allow for the difference.

Assemble the two sets of side-rail frames for the stand, and then belt or nail the legs in place as shown in the illustration.

Building Undersink Storage



Building Undersink Storage. The space under the sink can be utilized for storage of trays and chemicals, or even for a permanently installed print-drying rack.

The simplest method is to cut a piece of plywood to fit on the lower side rails providing one large expanse of shelf. This would be fine for chemical storage.

One-half of this shelf can be converted to a tray storage area by mounting small wood strips across its width with additional strips, offset a few inches, nailed across the bottom of the top side rails. Pieces of masonite can be cut so that when installed they divide the space into a series of sloping compartments wide enough to hold the trays.

The bottom shelf can be tilted toward the front of the sink to ensure drainage should you ever store wet trays. Nail a thin strip of wood no thicker than 1/4" along the back rail before nailing in the plywood shelf. When the plywood is nailed on top of this piece it will slope toward the front of the sink stand.

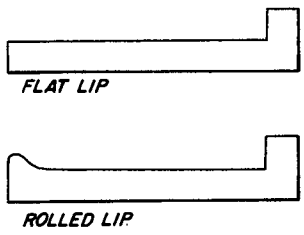
Installing Counters

Installing Dry-Side Counters and Storage

Counters and storage cabinets can be custom-made for a darkroom, but they can be very expensive. The know-how required to build them yourself is also extensive. The ideal solution is to use kitchen cabinets and post-formed (seamless) counter tops. Cabinets can usually be picked up quite cheaply at sales or in used condition. Since visual appeal is not as important in the darkroom as it is in the kitchen, damaged units, poor sellers, and inexpensive units all become candidates for your Darkroom.

Base Units. Counter base units come in standard widths from 9" to 42" in increments of 3". They are standardized at a 24" depth.

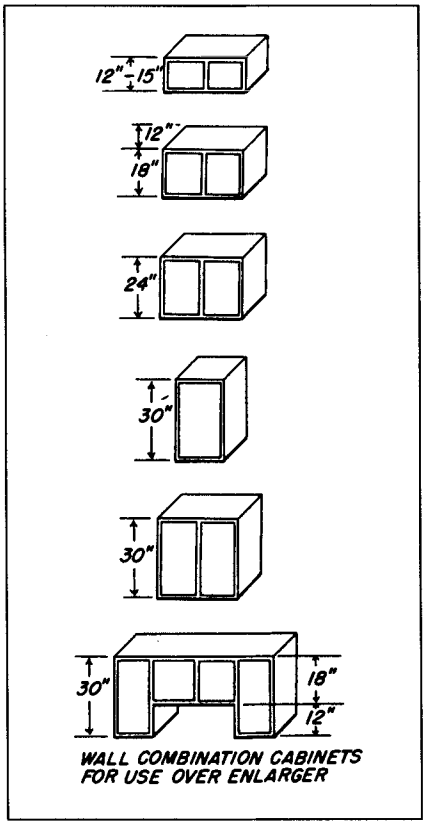
Counter Tops. Pre-made counter tops are available in long strips 25" wide; the building supply company can cut them to the length you need. There are two styles available, one with a flat lip on the front edge and one with a rolled lip. Avoid the rolled lip since large items such as a paper trimmer will not rest flat on the counter.



Currently, pre-formed counter tops cost less than $15 per running foot. A counter top for a large darkroom with a 10' dry side (minus 30" for the enlarger base) would cost approximately $115. It would be difficult to custom-build one for less, especially if tools had to be purchased.

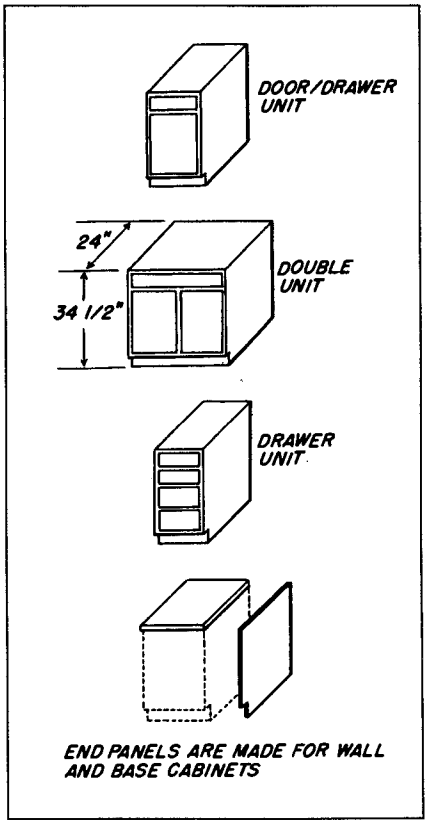
Wall Cabinets. Wall cabinets are also available from building supply companies and can be installed above the dry-side base cabinets for additional storage. They come in the same standard widths as the base cabinets, but are only 12" deep.

Dry-Side Wall Cabinets



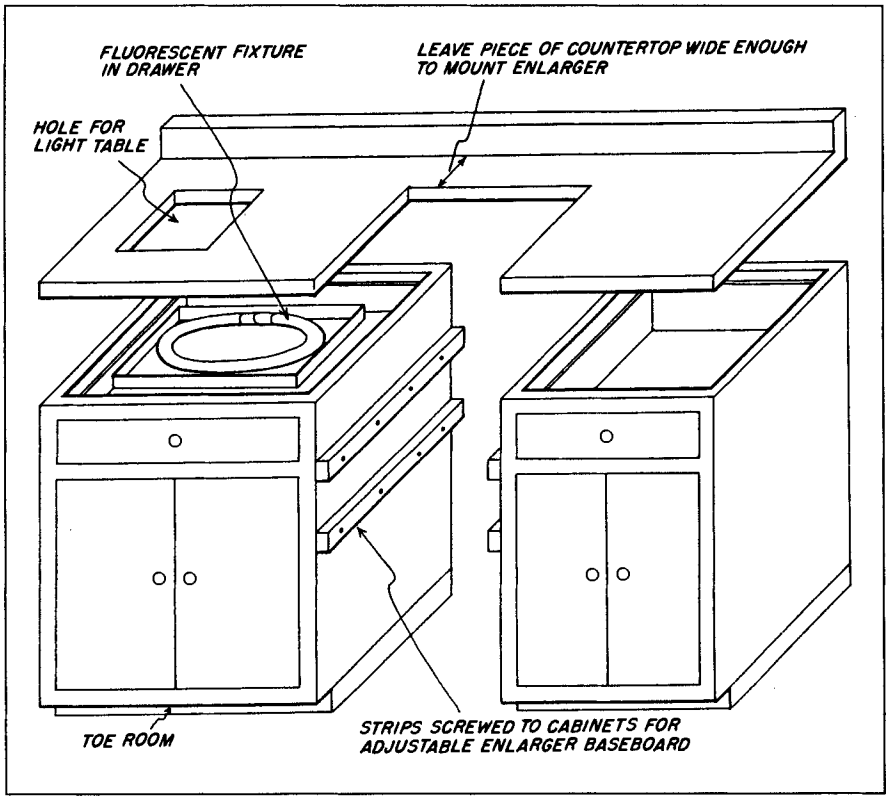
Dry-Side Wall Cabinets. Wall cabinets come in lengths of 24" to 48" in increments of 3". They range in height from 12" to 30".

Dry-Side Base Cabinets



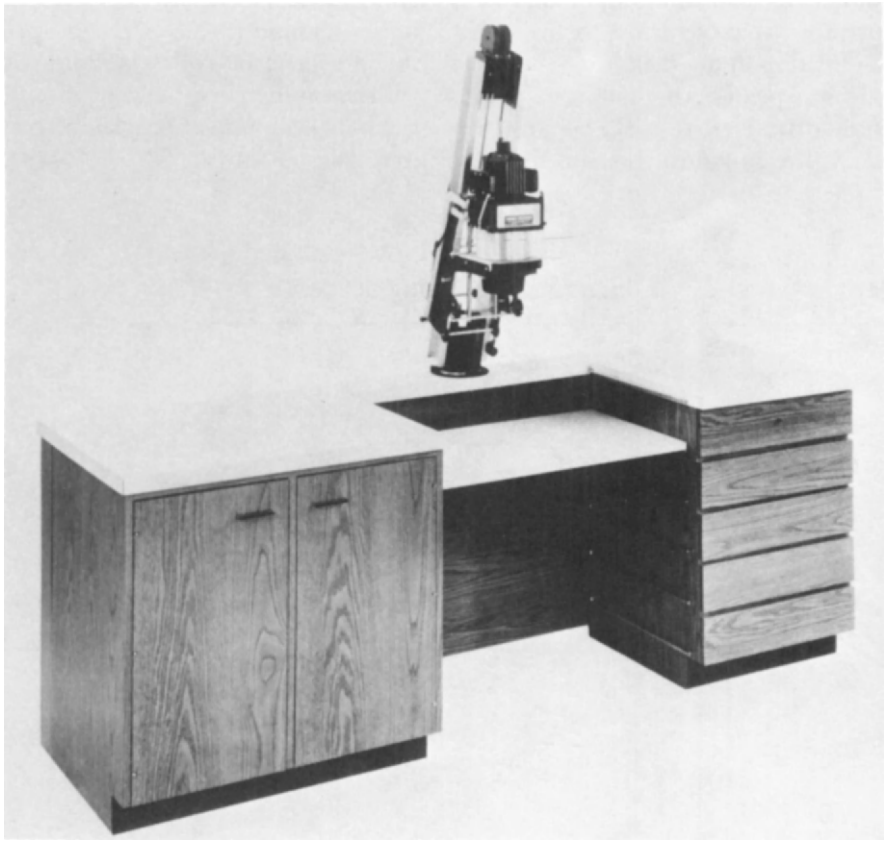
Dry-Side Base Cabinets. Base cabinets are available in sizes ranging from 9" to 48" in increments of 3". They come with doors, drawers, or a combination of both. Although their standard height is 34 1/2" (36" once the counter top is installed), they can be raised by building a base under them.

Dry-Side Assembly



Dry-Side Assembly. This view shows how the dry-side cabinets can be assembled to accommodate the enlarger mount, adjustable easel baseboard, and light table.

When ordering pre-formed counter tops, you can have them custom-cut and finished for both the enlarger and the built-in light table.



Professional Cabinets. This dry-side cabinet is a good example of a professionally designed and manufactured unit. Such units are extremely well-made, but the high quality comes with a relatively high price tag.

Building a Print-Drying Rack

A homemade print-drying rack utilizing fiberglass screens is easy to build and can either be made to stand alone or built-in. The rack consists of two major elements:

1. Frames with fiberglass screen stretched over them. The frames provide the rigidity required to keep the fiberglass flat and tight. The fiberglass screen supports the print, but at the same time allows air to circulate freely on all sides of the print, contributing to even, fast drying. Fiberglass screen should be used because it is impervious to darkroom chemicals and will not rust. It is also nonabsorbent, so if a poorly washed print does come in contact with it, the screen can be washed clean to protect subsequent prints.

The frames on which the fiberglass screens are stretched can be made out of 1" x 1" wood cut at a 45° angle to make corner joints similar to a picture frame. For this you need a mitre box and saw. Frames can also be constructed out of aluminum window screen frames. Aluminum framing members can be bought either in long lengths or precut to the size you desire. Wooden canvas stretchers available in artists' supply stores also work quite well and are already pre-cut, making tools unnecessary.

If you choose to make the racks out of aluminum framing, you will also need what is called "Spline," the rubber gasket that locks the screen into the frame, and an installation tool.

2. Rails on which the frames will slide in and out and a cabinet to hold them. The rail can be either aluminum angle iron, wooden rails made out of 1" x 1", or wood molding that is L-shaped. Regardless of which is chosen, they should be installed level and parallel so the frames slide in and out easily. They should be spaced approximately 3" or more apart to allow for free air circulation in the rack.

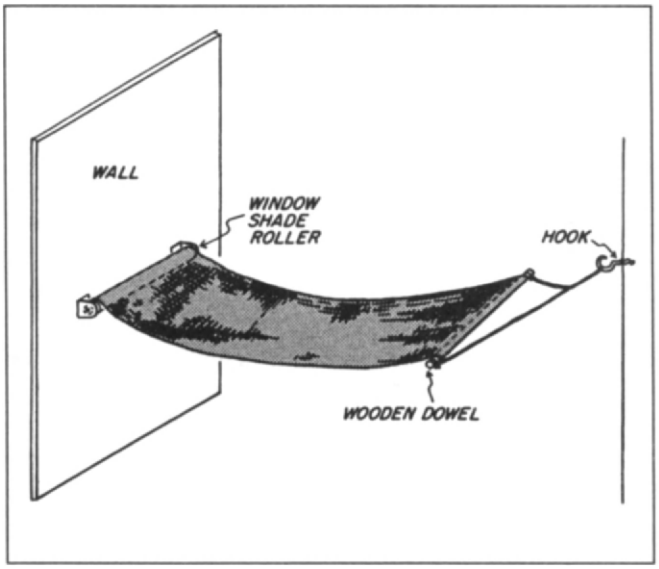
If the print-drying rack is to be installed under the sink, be sure to build the sink and its stand first so that exact measurements for the print-drying rack can be taken from the actual unit (see "Building a Sink Stand" above). This will ensure that the rack fits into the existing space.

The Easy Way Out

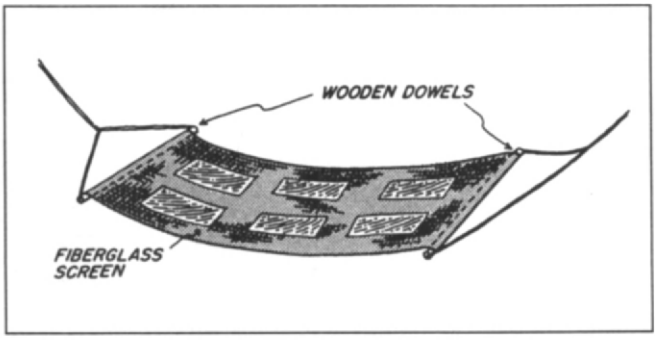
A simple print-drying rack can be made with a long piece of fiberglass screen, two wooden dowels, and some string. The dowels are stapled to each end of the screen and the unit is suspended like a hammock. When not in use, it can be rolled up and stored. It's also easy to keep clean because it can be washed in the sink.

If you use an old (or new) window shade roller in place of one dowel and attach it permanently to a wall you can pull the screen out when needed. Just attach it to a hook on an opposite wall. When finished, you unhook it and it rolls back up by itself. Be sure the roller is mounted with enough space between it and the wall to allow the fiberglass screen to roll all the way up.

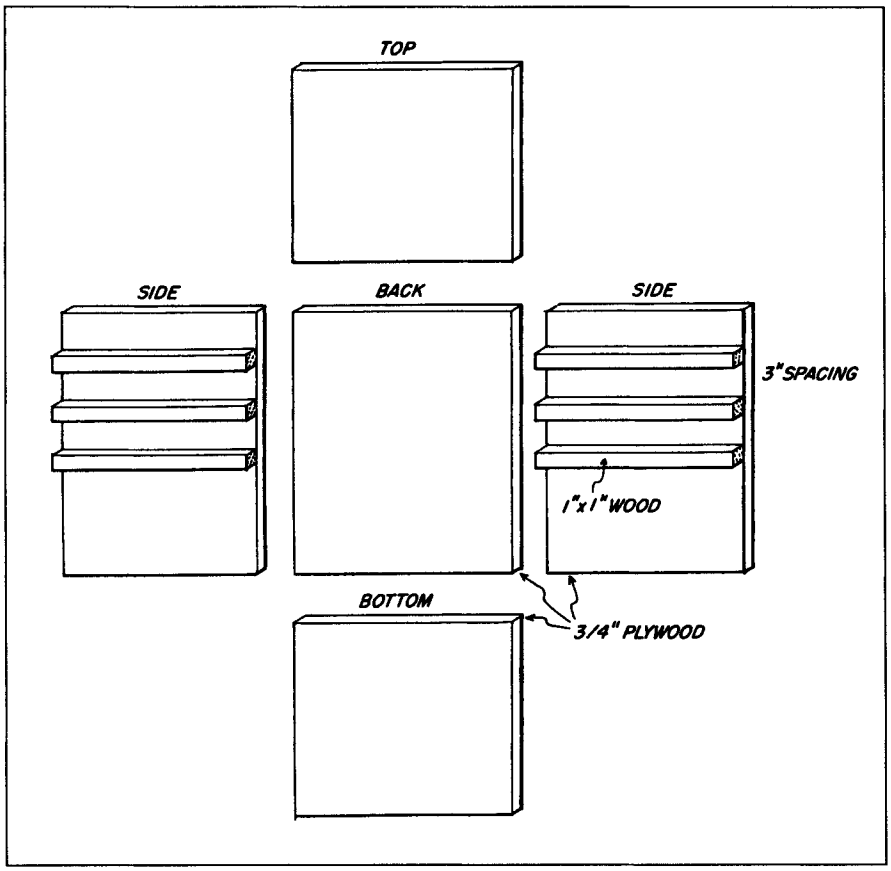
"Hammock" on Window-Shade Roller



"Hammock" Drying Screen



Print-Drying Rack



Building the Print-Drying Rack. The cabinet needed to hold the fiberglass frames can be made out of either 1/2" or 3/4" plywood. The thicker material will give a more stable cabinet. Begin by determining the size frame you need to hold your prints, and then calculate the size cabinet you will require to hold frames of the chosen size.

Measure the two side pieces so they are the exact length of one of the dimensions of your frames. The back piece should then be measured off so it is as wide as the other dimension of the frame, plus an additional amount at each end (either 1/2" or 3/8" where it will overlap the side pieces).

The back and side panels should be the same height. The height depends on where you plan on putting the cabinet and the number of drying frames you want it to hold.

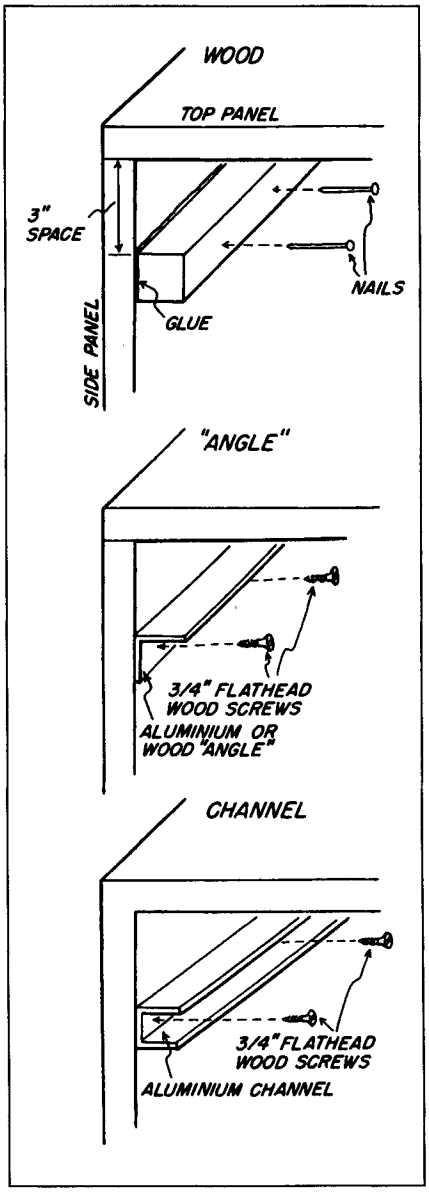
Measure the top and bottom panels of the cabinet. They should be the same width as the back panel and the same length as the sides, plus an additional 1/2" or 3/4" where they will overlap the back panel.

Now measure where the rails on which the frames will rest will be placed. They should be 3" apart. Begin by measuring down from the top of the side panels 3" and draw a line across each panel.

Measure off another 3" and do the same. Continue doing this for the entire length of both panels. Now cut 1" x 2" lengths of wood as long as the panel is wide. Cut as many as you have marked on the side panels. Nail and glue them into place using the lines drawn to ensure that they are level and parallel.

Nail and glue the side panels to the back panel, and then do the same with both the top and bottom panels. The cabinet is now complete with the frame guides in place.

Details of the Frame Supports



Details of the Frame Supports. These drawings show how various types of frame supports can be attached to the side panels of the print-drying rack.

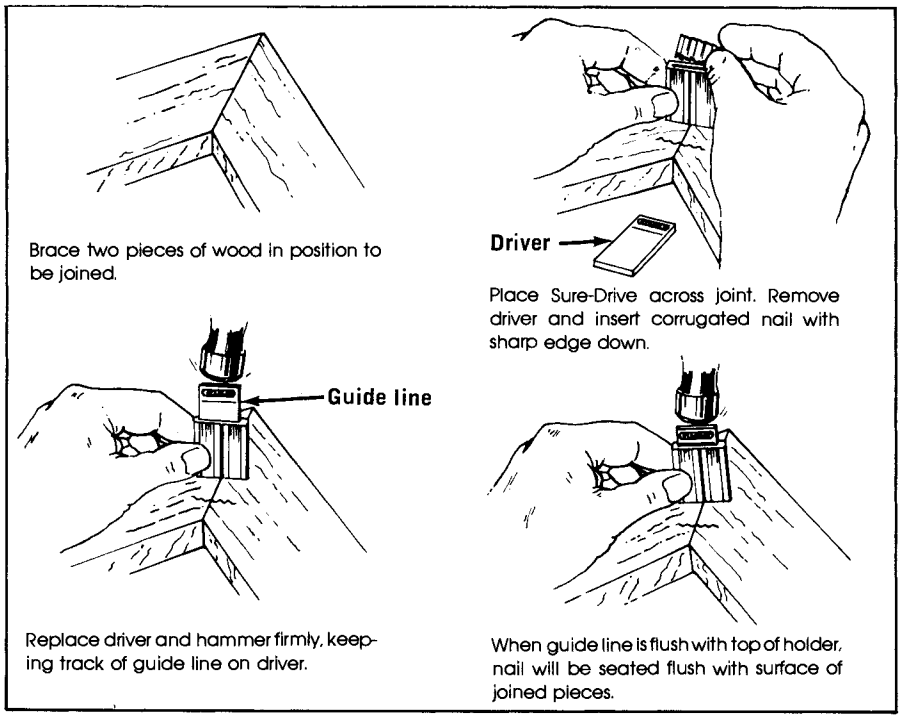
Making the Drying Frames

After the cabinet has been completed, the next step is to build the frames to hold the fiberglass screen. There are three principal ways to make these screen frames: wooden frames, canvas stretchers, and aluminum frames.

Wooden Frames

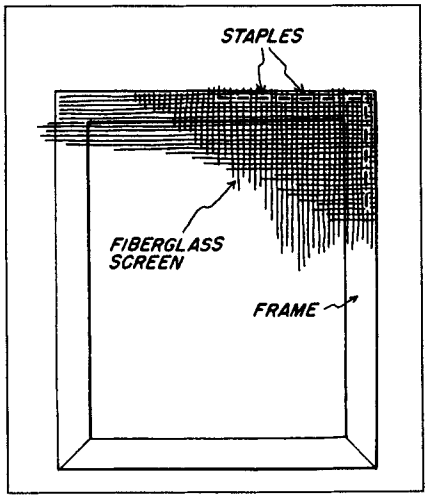
Wooden frames can be made out of any lumber from 1" x 1" up to 1" x 3". Begin by measuring the inside of the print-drying cabinet. Make the frames about 1/8" to 1/4" smaller to allow them to slide in and out easily. The frames can be mitred or square cut at the corner joints. Because there is very little weight on the screens, the joints do not have to be extremely strong. The corners of the frames can be joined with screws, nails, angle irons, or corrugated nails. A Stanley "Sure-Drive" set can save you a great deal of time. This makes firm joints and is both easier and faster than using either nails or screws. Wooden frames should always be painted to keep them from absorbing chemicals.

Frame Assembled with Stanley "Sure-Drive"



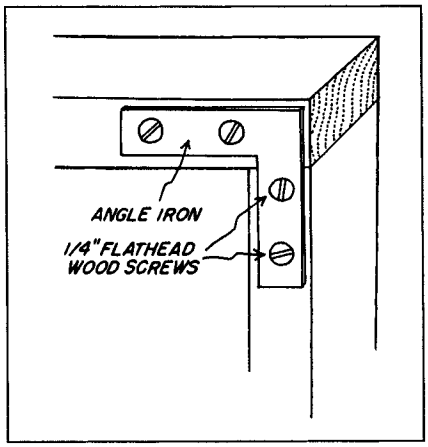
Frame Assembled with Stanley "Sure-Drive." This fastening device and tool is ideal for making a large number of joints in a very short time. Be sure to buy corrugated nails no deeper than one-half the thickness of your frame.

Attaching the Screen to Wooden Frames

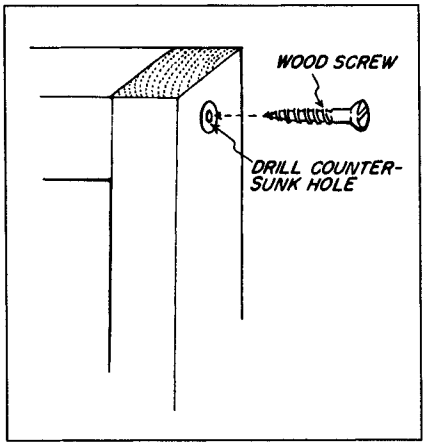


Attaching the Screen to Wooden Frames. After the wooden frame is assembled, staple the fiberglass screen to it so that the screen is tight and free of wrinkles. The easiest way is to use a staple gun to staple the screen in place. Because galvanized staples are almost impossible to buy, the heads should be touched up with varnish to prevent them from rusting. It is also advisable to paint or varnish the wooden frames before attaching the screening. This will keep them from absorbing chemicals that can contaminate subsequent prints.

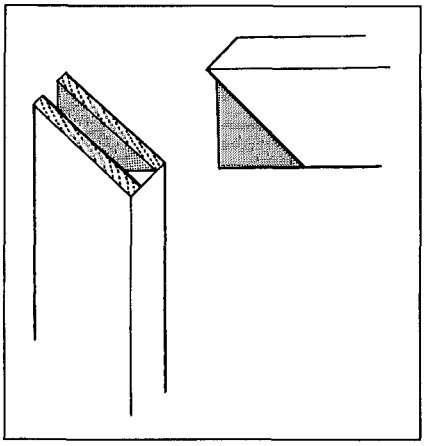
Frame Assembled with Angle Irons



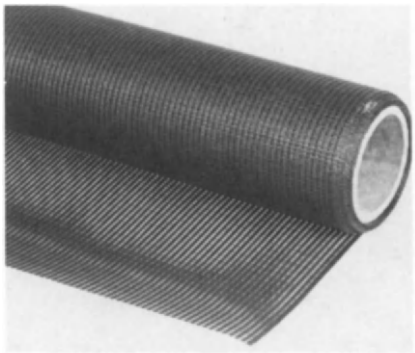
Frame Assembled with Screws

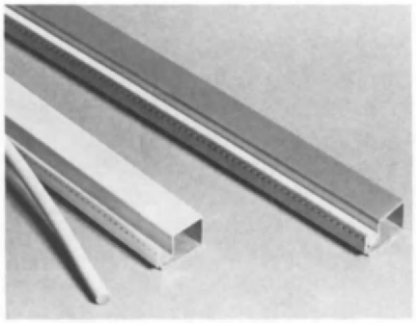


Canvas Stretchers



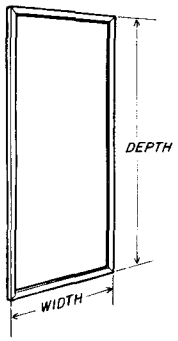
Canvas Stretchers. Wooden canvas stretchers are available from most art supply stores. They come pre-cut in different sizes and can be easily assembled in a variety of combinations. The joints are pre-cut to slip together, and they can be glued or nailed to give the joint greater strength.



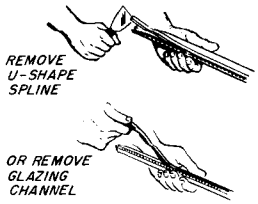


Aluminum Frame Members and Fiberglass Screen. These photographs show what the aluminum frame members look like. The round material is the "spline" and is used to hold the fiberglass screen in place once the frames have been assembled. Fiberglass screen comes in rolls of different widths. Buy the size closest to the width of your frames.

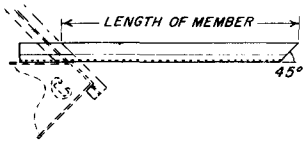
Aluminum Frames



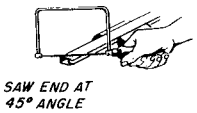
1. Measure the width and depth of the inside of your print drying rack. Mark two lengths (depth minus ⅛") of screen section for the side frame pieces and two widths (width minus ⅛") for the top and bottom of frame pieces.



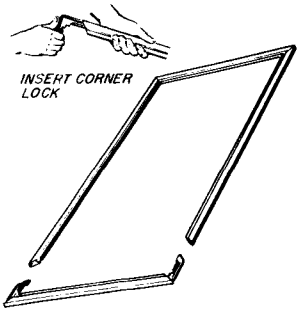
2. Remove the U-shaped splines or glazing channels from all the frame members.



3. Mark 45-degree angles at the measured points.

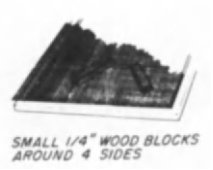


4. Saw off the ends, using a fine-toothed coping or hack saw. Smooth cut ends with file or sandpaper.



5. Insert corner locks into the two short frame pieces. Slip the two long frame pieces onto one of the end pieces. Finally, add the other end as shown to complete the frame.

6. Cut screening to outside dimensions of frame. Cut carefully between two screen wires to keep screening square. Place frame on table and scatter scraps of frame section in the center area to hold screening level with top of frame. On large frames you may want to nail small ¼"-thick blocks around frame to maintain squareness as shown in illustration 2.



7. Line up screening with the outside edge of the screen groove at the side and end of the frame shown. Bend the screening into the side and end grooves. When using fiberglass screen it should fit down, across, and up inside of grooves.

8. After completing operation along one side (as in step above), cut off excess screen cloth along line even with outside edge of groove in other adjacent leg.

9. Cut U-shaped splines 1/16" less than length of spline groove; make butt joints at the corners. Next, tap spline into groove using block of wood with rounded front corner (on one long frame piece) to hold screening securely. In the same manner, form screen cloth on the two short sides, cut off excess screen cloth, and insert spline. Then, complete fourth side.

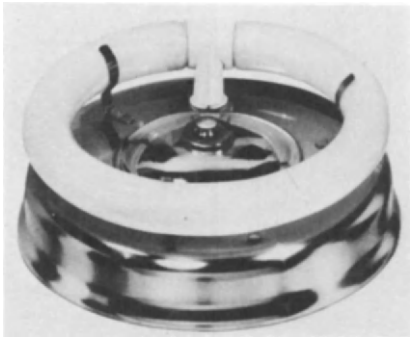
Aluminum Frames. You can either buy pre-assembled aluminum frames from a window supply house, or you can assemble them yourself. To do a complete job, you will need frame members, a mitre saw, a "spline" tool, and fiberglass screen.

Building a Light Box

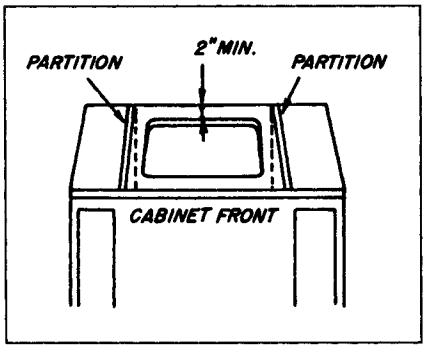
A light table built into the dry-side counter makes it much easier to evaluate and select negatives for printing. This is especially true if you use medium or large film formats. Holding a 4" x 5" negative up to a bare ceiling bulb gives a very unevenly illuminated image. With a light table, you can also evaluate an entire roll of 35mm film.

To build a light box, select a space separated from the enlarger by a short distance (leave working room on both sides of each) and located directly over a drawer or other unobstructed counter surface.

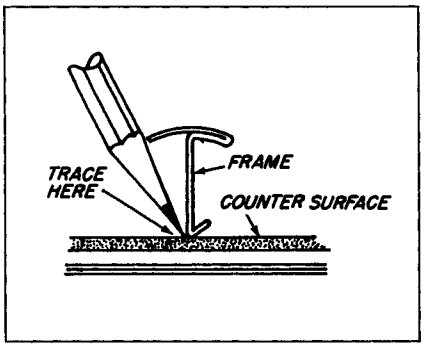
Purchase a metal rim frame, such as what is used to mount a sink on a ceramic working surface into a kitchen counter. It requires only a saw to cut a hole in the counter and the rest of the assembly is easy. Buy a piece of white acrylic cut to fit the frame; small pieces of acrylic are usually available at low cost from the scrap bin in supply stores.



Round Fluorescent Fixture. This round fluorescent fixture by Sterling Lighting is ideal for illumination of a light table installed in the counter top.



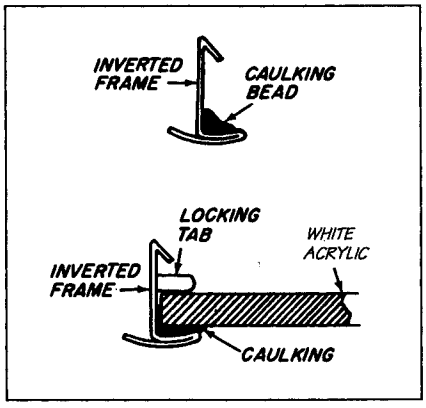
Locate the desired position of your light-table insert on the counter top, usually close to the enlarger for convenience, and check for proper clearance. Be sure that the compartment under the location is at least 2" wider and deeper than the overall size being used. This will assure sufficient room to fasten the holding lugs. Be careful not to cut the supports on the underside of the counter top.



Position the frame assembly, right side up, on top of the counter in the location desired (step #1 above) and trace around the frame as shown.

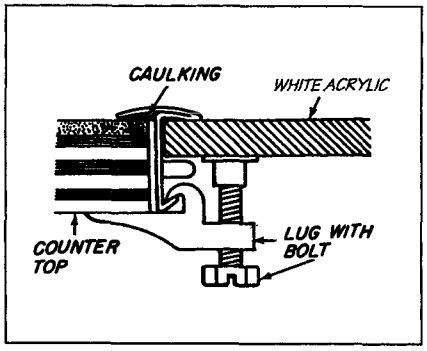
Cut along the traced line carefully. This can be easily accomplished by drilling a 3/8" starter hole just inside the traced line and cutting along the line with a medium or fine-tooth electric saber saw. Be sure to keep edge of saw vertical. A manual key-hole saw may also be used to make the cutout. Use only a fine-tooth saw for manual cutting, and cut only on the down stroke to avoid splitting and delaminating the counter top surface.

(NOTE: When using an electric saber saw, it is advisable to cover the counter top surface on the outside of the traced line with masking tape to protect the surface from being scratched by the vibrating base, or foot of the saw.)



Assemble your light table insert by placing the frame upside down on a flat surface and applying an adequate bead of caulking (such as clear silicone bathtub seal) around the under-inside top edge of the frame-top flange.

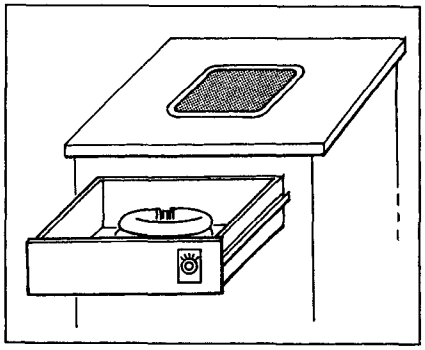
After caulking the inside of the frame, insert the piece of white acrylic. With the insert positioned in the frame, bend one of the perforated press-out locking tabs in the frame, on each side of the assembly, inward to hold the insert in the frame for installation. This need not be a tight fit, as the installation lugs will secure the assembly firmly when installed.



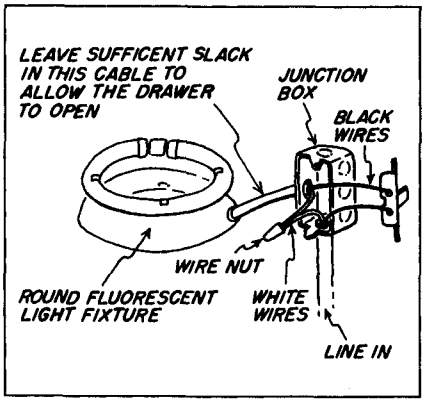
Seal the frame on the outside by applying a uniform bead of caulking to the under-outside edge of the frame-top flange.

Install the light table assembly into the counter top cutout. From the underside of the counter top, attach the lugs onto the hook of the frame leg. Always place two lugs as close as possible to each side of the corner bends. Space and tighten lug bolts evenly and firmly until top flanges of the frame are clamped tightly to both the counter top and the insert. Caution: Do not overtighten lugs. Additional unnecessary pressure may distort the frame causing gaps.

Courtesy Hudee Manufacturing Co.



Use the drawer under the counter, or build in a box to hold the fluorescent light fixture. The inside should be painted white to give an even distribution of light.



Wire the light using either a regular on-off switch, or a dimmer switch made for fluorescent lights. Mount the switch on the front of the drawer where it will be within easy reach. The junction box for the connection should be under the counter and out of the way. Be sure the line running to the drawer has sufficient slack in the wire to allow you to open the drawer to change the tube when necessary.

Mounting the Enlarger

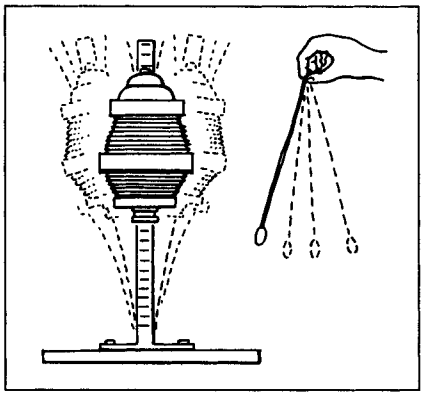
Normally when you purchase an enlarger, it comes mounted to a wooden or composition baseboard. With minimal effort, you can make improvements in two significant areas: reducing vibrations and increasing the size of prints that can be made.

Reducing Vibration

The sharpness of an enlarged print depends on the sharpness of the camera and enlarging lenses, the type of film used, and the shutter speed or firmness of support used at the time the picture was taken. A factor quite often overlooked is the steadiness of the enlarger at the time the enlargement is made. There is vibration in every enlarger column. This vibration is either picked up from the surrounding environment (such as passing trucks, trains, or kids running in the apartment above the darkroom), or it is induced when you make adjustments to the enlarger while preparing to make a print. Because the enlarger acts as an upside-down pendulum, the vibrations picked up by the base are magnified by the time they reach the enlarger head perched on top of the column.

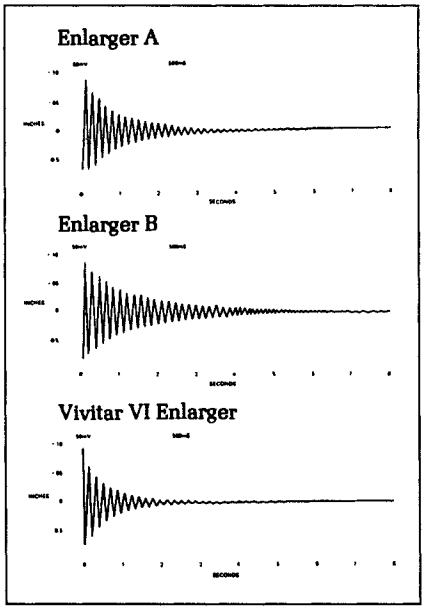
Since all enlargers, regardless of manufacturers' claims, are subject to vibrations, the true science should be applied to reducing vibrations or damping them out of the system as far as possible. As long as the column is not oscillating at the time the print is made, the image will be sharp. Part of the damping of the vibrations will be a result of good design on the part of the enlarger manufacturer. The rest depends on where you use the enlarger and how you mount it. The best design in the world will not make an enlarger steady if it is used on an unstable base.

The Pendulum Effect



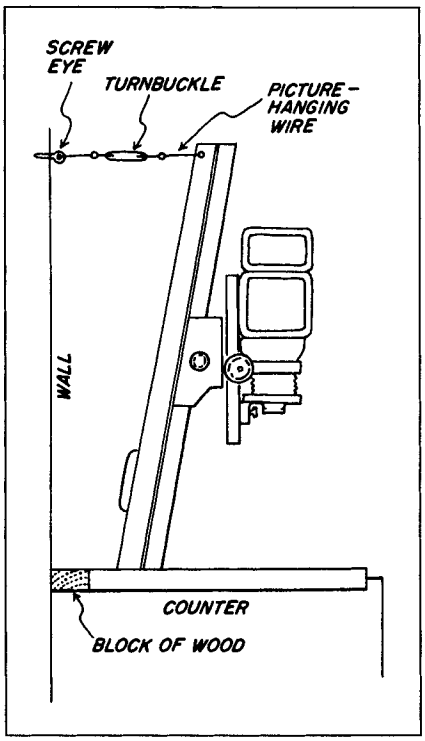
The Pendulum Effect. The enlarger column acts as an inverted pendulum. The vibrations that are picked up by the baseboard are magnified as they go higher up the column. The column will no longer act as a pendulum if the top of the column is supported. This would be the same as holding the bottom of a pendulum and preventing it from swinging.

Damping Vibrations



Damping Vibrations. Contrary to what you might think, making an enlarger column more rigid (or stiff) will not help to dampen out the vibrations faster. In fact, a stiff column will only vibrate at a higher frequency, which makes vibrations last longer. These graphs show how the Vivitar IV enlarger, by using a more flexible column, actually dampens vibrations faster than a more rigid enlarger would.

Eliminating Vibrations



Eliminating Vibrations. The enlarger can be made more steady, giving sharper prints, by attaching the top of the column to a wall or other very solid surface. Be careful, however, since this will not help, and in fact can make things worse, if the wall is not solid and stable. Buy some picture hanging wire, a screw eye, and a small turnbuckle in the hardware store. Cut the wire into two lengths and attach to either end of the turnbuckle. Now screw the screw eye in the wall directly behind the enlarger and fasten one of the wires to it. Fasten the other to the enlarger (you may have to drill a hole for it). Now tighten the turnbuckle just enough to put pressure on the enlarger column. Too much pressure will distort the column, so be gentle.

If you want the enlarger farther out from the wall, insert a block of wood of the necessary length behind it. This will keep the enlarger from moving backward as the turnbuckles are tightened.

Increasing Print Size

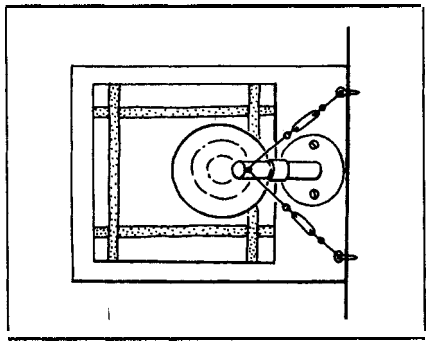
The major factor that determines how large a print you can make with a given lens/film format combination is the distance between the negative and the paper on which the print is being projected.

Most enlargers are capable of making prints up to 11" x 14" on the baseboard, and longer columns are also available with options allowing prints as large as 16" x 20" to be made. In either case, larger print sizes can be made by wall-mounting the enlarger.

Wall-mounting the enlarger is usually done in conjunction with building an adjustable enlarger baseboard. This increases the range of print sizes that can be made conveniently. The following pages illustrate how to build one of these units.

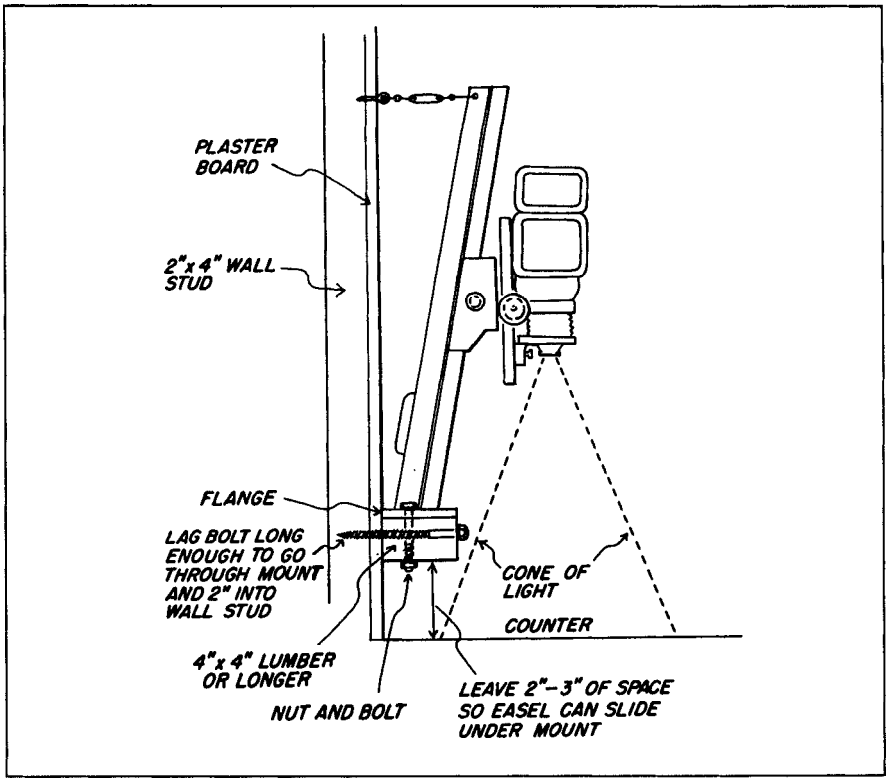
Most enlarger manufacturers make wall-mount units for their enlargers that are relatively inexpensive. You can also build your own, provided you are handy with tools. Before doing so, it is wise to check how steady the wall in the room is. Exterior walls are generally well-made since they are designed to carry the weight of the house. Interior walls are either load-bearing or not; the ones that are not load-bearing are usually less steady. If possible, use an exterior wall or an interior load-bearing wall to mount the enlarger. Generally, shorter walls will be more stable than taller walls, because their supports are closer together.

Using Two Turnbuckles



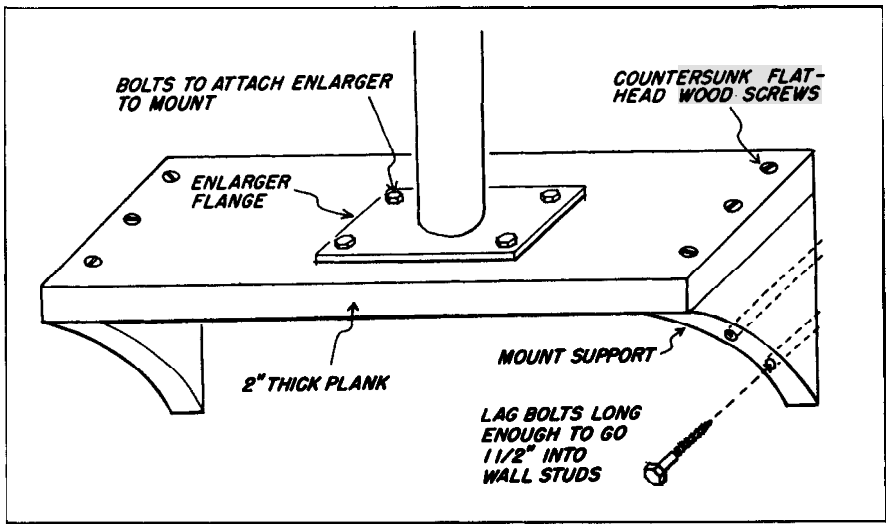
Using Two Turnbuckles. A single column enlarger can be made even steadier by using two sets of turnbuckles.

Wall-Mounting the Enlarger



Wall-Mounting the Enlarger. The first step in mounting the enlarger is to devise a support to which it can be fastened. The type of support will vary, depending on the type of flange used to bolt the enlarger to its base. The easiest support can be made from a few feet of 4" x 4" lumber from a local lumber supply store. If the flange on the enlarger is larger than 4" buy a 6" x 6" or larger piece of wood. This can be bolted to the wall studs (not to the plaster or plaster board) with long "lag bolts," and then the enlarger can be mounted to it. The top of the column should then be supported with turnbuckles and picture-hanging wire to eliminate any vibrations in the column.

Another Wall Mount



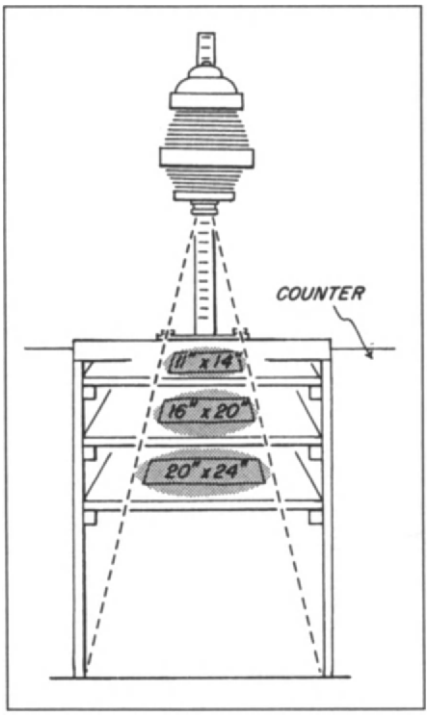
Another Wall Mount. In some cases it may be necessary to build a more complicated support on which to mount the enlarger. If the flange on the enlarger is wider than 6", it is generally better to use a 2"-thick plank, wide enough to accommodate the enlarger-mounting flange. This plank can then be mounted horizontally to the wall by cuffing supports for both ends out of the same plank.

Building an Adjustable Enlarger Baseboard

With a given film format/lens combination, the sole determining factor as to what size prints can be made is the distance between the negative and the paper surface. This can be increased by raising the enlarger head up the column, but at some point it can go no farther. In addition, problems with vibration are increased as the head is raised higher.

An adjustable baseboard can be built to allow for greater print sizes. It is essentially a unit that decreases or increases the negative-to-easel distance by raising or lowering the shelf on which the easel rests. The lower the shelf, the greater the size of the enlargement.

Print Sizes



Print Sizes. The enlarger projects a cone-shaped image that grows in size the farther it gets from the enlarger lens. To obtain a larger image, the easel must be placed farther from the lens in a wider section of the cone.

Determinng Shelf Heights

When making an adjustable enlarger baseboard, you should take into account the size of the prints you make most often. The shelf for this print size should be placed at countertop height for maximum comfort. Very much larger print sizes will be lower and very much smaller print sizes higher, but because they are made less frequently, the resulting discomfort is minimized.

Most enlargers will print up to 11" x 14" on the baseboard, and some will go as high as 16" x 20". Therefore, it is likely that one of these sizes will be the one placed on the shelf at counter-top height.

Keep in mind that if you crop your prints considerably, you may actually be enlarging to 16" x 20" size to obtain the 11" x 14" print you want.

Selecting the Easel Shelf Size

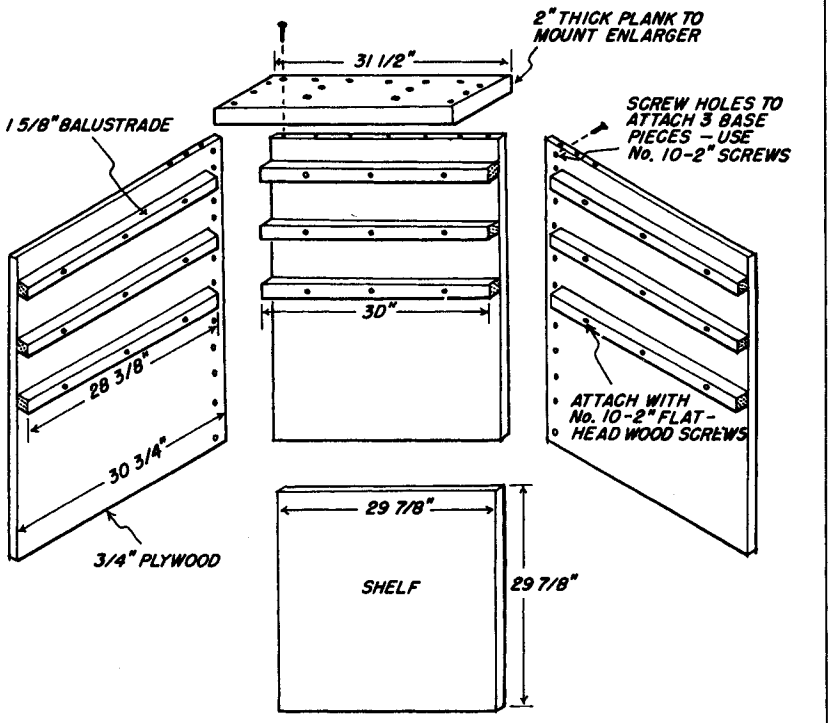
The size of the enlarger baseboard you need is based on the size of the largest easel you plan on using. If you normally print 8" x 10" but occasionally want to print up to 20" x 24", the baseboard should be designed to handle the easel for a 20" x 24" print in either a horizontal or vertical alignment. This will require a shelf size of at least 28" x 28"; the shelf, side, and back panels, plus the shelf supports, should be cut accordingly. Be sure to allow for the size of the easel, not the print, plus handling room on either side of the easel.

The shelf can have handles attached to the top side on both sides to make it easier to lift in and out when it's being raised or lowered.

Negative-to-Easel Distance

Negative-to-Easel Distances. When making an enlargement from a given negative size, the significant factor determining the size of enlargement that is possible is the distance between the negative and the paper on which the image is projected. Secondary factors that influence maximum print size include increased exposure times, reciprocity failure, loss of contrast, and vibration, but for the moment these will be discounted. This table is designed to give you the approximate distance your negative must be from the paper (easel surface) to obtain a specific print size from the most common film format/enlarger lens focal-length combinations. Decide first what print sizes you want to make. Once that size is established, you can determine what range of distances has to be obtained for the minimum and maximum sizes you want to print. If, for instance, you want to make both 5" x 7" and 20" x 24" prints using a 50mm lens and 35mm film, you must be able to increase the distance between the negative and the easel from a minimum distance of approximately 11" to a maximum distance of 36", or a total range of 25". Some enlargers can accommodate this range on the baseboard that comes with the enlarger, but on most, you will either have to project the image on the floor, tilt the head to project on a facing wall, or build an adjustable enlarger baseboard.

	If Your Film Format Enlarging Lens Combination Is:			
Print size desired	*35mm film 50mm enlarging lens*	*2¼ x 2¼ film 75mm lens*	*2¼ x 3¼ film 100mm lens*	*4 x 5 film 150mm lens*
8 x 10	18"	15"	17"	18"
11 x 14	26"	20"	22"	23"
16 x 20	34"	27"	30"	30"
20 x 24	37"	33"	36"	36"



MATERIALS NEEDED FOR 30"x 30"ADJUSTABLE ENLARGER BASE BOARD.

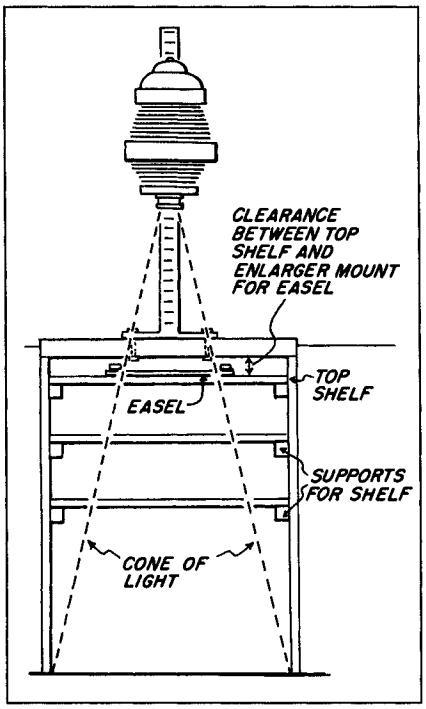
3	1 5/8"x 1 5/8" BALUSTRADE 30" LONG (BACK RAILS)
6	1 5/8"x 1 5/8" BALUSTRADE 28 3/8" LONG (SIDE RAILS)
60	No. 10-2" FLATHEAD WOOD SCREWS
1	3/4" PLYWOOD PANEL 30"x 40" (BACK PANEL) (THE 40" HEIGHT CAN BE ADJUSTED TO YOUR INDIVIDUAL WORK SURFACE HEIGHT)
2	3/4" PLYWOOD PANEL 30 3/4"x 40" (SIDE PANEL)
1	3/4" PLYWOOD PANEL 29 7/8"x 29 7/8" (BASEBOARD SHELF)
1	2"x 8" PLANK 31 1/2" LONG (ENLARGER MOUNT)

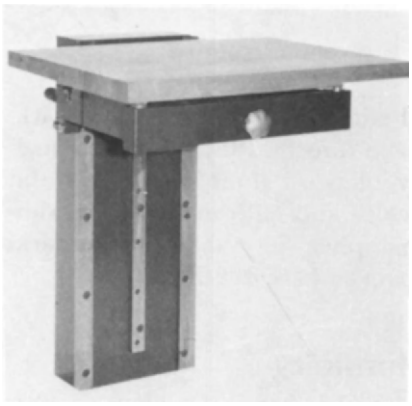
How to Build It. Cut the shelf and three side panels from a sheet of 3/4" plywood. The back panel should be cut the same width as the frames, plus 1/8" for ease in getting the frames in and out. The side panels should be cut to the same length plus an additional 3/4", because they will be screwed into the 3/4"-thick back panel. The back rails should be the same width as the back panel. The side rails should be only long enough to be flush with the front of the unit and with the back rails.

Assemble the three large plywood panels, and then measure and install the back and side shelf supports.

Mount a plank at least 2" thick to the top back of the unit as a support on which to mount the enlarger. The first (top) shelf support should be low enough to provide clearance for the easel to fit between the top shelf and the board on which the enlarger is mounted, otherwise you may not be able to center the image on the easel.

Assembled Unit





Fotar Enlarging Table. This enlarging table from Colenta America is extremely sturdy. It's expensive, but a butcher-block baseboard and ease of operation would make it worthwhile for someone making a great many prints and changing print sizes frequently.

Special Lenses. There are also special enlarging lenses that can be used to increase the size of the prints you make with a given negative-to-easel distance. Wide-angle and zoom enlarging lenses are available, although those of high quality are very expensive. For more on enlarging lenses see Chapter 8.

Air Quality

The quality of the air in the darkroom directly affects both the quality of work done there and the health and enjoyment of the photographer. Several aspects of darkroom air have to be considered.

Humidity

The ideal darkroom humidity is between 45 and 50 percent. In some parts of the country, this is easy to maintain without controls, but sometimes control is an absolute necessity. Air that is too damp will rust equipment and make it perform inaccurately; air that is too dry will create static electricity problems and increase problems with dust. A dehumidifier can help a damp room (a side benefit is that the water run off from the dehumidifier can be bottled and used as distilled water for negative processing). A room that is too dry can be corrected with the addition of a humidifier.

Temperature

The ideal darkroom temperature is approximately 68°F, the temperature at which most photographic chemicals are used. If temperatures vary considerably, time is spent worrying about water baths, comfort, and the timing of the various developmental processes. To control the temperature, you can install heaters or air conditioners. Air conditioners are especially useful because they will also filter and dehumidify the air as they are cooling it. If you use an air conditioner, try to have the air flow from the dry side to the wet side, so that steam and vapors rising from the sink are not carried over to the dry side. Be sure to buy an air conditioner that can operate on fan only, so that the room can be ventilated without being cooled.

Ventilation

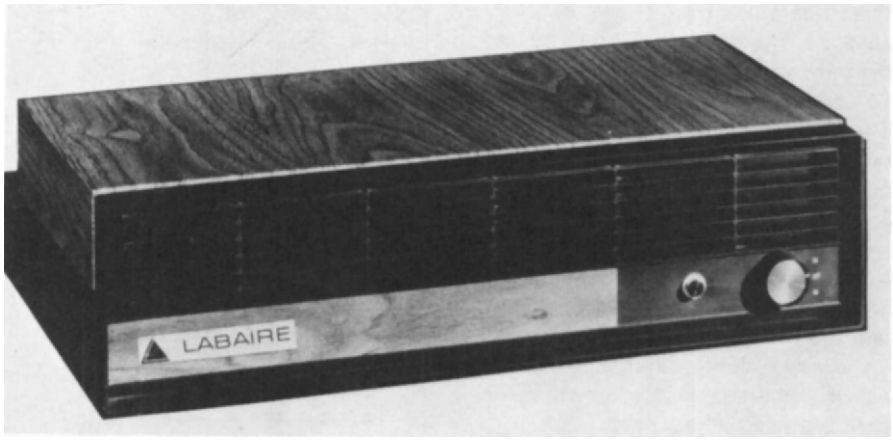
The minimal controls required in a darkroom concern air flow and turnover. The air in the darkroom must be changed every six to eight minutes for comfort. To make this possible a fan and vents must be installed. The fan should always be filtered, and the air stream should enter the darkroom from the dry side. Outlet vents should be over the sink on the wet side. This arrangement increases the pressure in the room, so that unfiltered air from outside does not carry dust into the darkroom. The flow from the dry to the wet side keeps the vapors from the sink contained, and the outlets over the sink provide a way for the air to be carried from the room. All vents and fans should be light-proof.

Dust

Dust must be kept out of the room, or removed if any dust seeps in. The best device is an electrostatic air cleaner to filter particles out of the air.

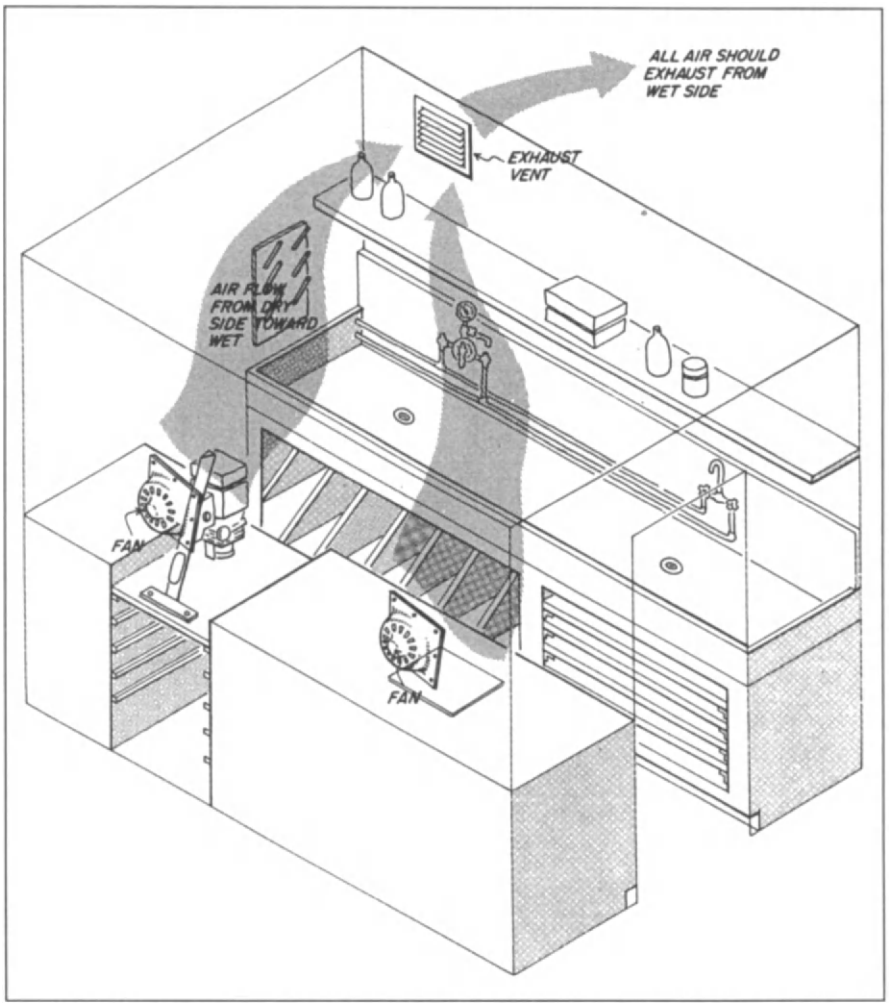
How to Find the Size Fan You Need

Air in the darkroom should be changed every six to eight minutes. To determine the size fan needed you have to know the number of cubic feet in the room. Fan capacities are rated in cfm (cubic feet per minute). To determine the cubic feet in your darkroom, measure the room's width, length, and height. Multiply these dimensions to give you the total cubic feet in the room. Divide that figure by 6 to determine how many cubic feet per minute the fan must move if it is to change the entire room every six minutes. Example: if the room is 8' wide, 10' long, and 7' high: 8 x 10 = 80; 80 x 7 = 560 cubic feet. 560 divided by 6 = 93 cubic feet per minute. The fan should be approximately 100 cfm rated.



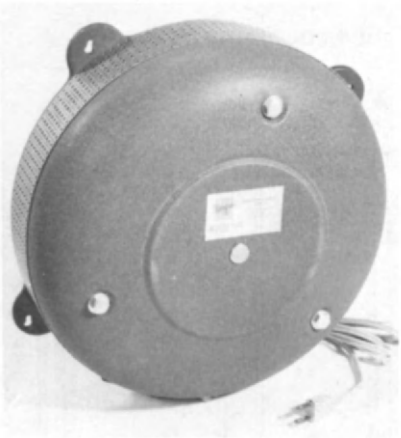
Electrostatic Air Cleaner. Eliminating dust from the darkroom can be a full-time job. If you don't get it out of the air, you have to get it off of the negatives. If you don't get it off of the negatives, you have to spot the prints. If dust is a problem, you can install either a wall-mounted or tabletop electrostatic air cleaner. It works by charging dust particles so that they will adhere to a collector with an opposite charge. Because the dust builds up on these collectors, you should also consider their ease of cleaning. This model collects particles down to .01 microns. The collecting screen is washable.

Darkroom Air Flow

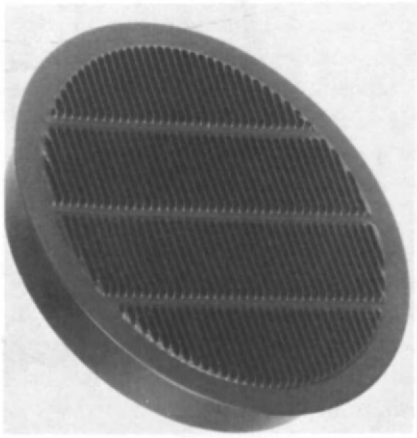


Darkroom Air Flow. If the fan is mounted to blow into the room, the fan should be installed on the dry side of the darkroom with the vents on the wet side. The air entering the room will keep it at a positive pressure, and air will flow out of the cracks in the room, which keeps the dust out.

Should you decide to use the fan as an exhaust fan blowing air out of the room, it should be mounted on the wet side, so that the moist air from the sink and chemicals exit immediately without being distributed throughout the room.



Ventilator Fan. Special light-proof fans are baffled to prevent light from leaking through the fan opening. They are often hard to find, so most photographers just use a regular bathroom fan and build a light-proof baffle around it themselves. In some cases, you may be able to vent the fan into a dark attic or basement and avoid the need for a baffle entirely.



Exhaust Vents. Darkroom vents should be light-proof. Spiratone supplies these 4"-diameter "Darkroom Breather" vents.

Humidity and Temperature Indicator. This combination humidity and temperature indicator is a good item for the darkroom. Then again, perhaps ignorance is bliss.

Light-Proofing

Light-proofing is essential to prevent light-sensitive film and paper from fogging. Many prints lack contrast between shadow and highlight areas because the paper or film was exposed to non-imaging light that made the contrast muddy. This effect is sometimes so slight that it can be discovered only by running a proper test, but once comparison prints are made, the loss of quality will become immediately apparent.

Film, with its higher speed, is much more susceptible to light than is enlarging paper; therefore, a room in which printing is done need not be as light-proof as a room in which film is handled. A kitchen or other temporary darkroom can usually be light-proofed sufficiently to make prints (or you could print only at night), and film can be loaded into reels and placed in daylight tanks inside a changing bag. To be sure a room is light-proof enough to print, first stand in it with the lights out for at least five minutes so your eyes have a chance to adjust completely. If you then cannot see a plain white paper held against a dark background the room should be safe. A few small leaks around doors and windows are safe if they are not near the enlarger or processing trays or paper cutter. Such leaks can be eliminated, however, with aluminum foil crumpled and stuck into holes or taped in sheets over larger openings. Larger areas can be covered with light-proof cloth or black garden plastic and tape.

Windows

Windows can be light-proofed using special shades made specifically for the purpose. These shades are relatively expensive but are convenient if the darkroom must be used for other purposes. A somewhat less expensive method is to use light-proof cloth fastened to the wall or window frame with velcro tape, which is available in sewing supply stores. One part of the tape can be permanently mounted to the window frame and the other sewn to the cloth. The two can then be stuck together and pulled apart as need be. When the cloth is not being used, it is easy to fold and store.

A third method is to use masonite paneling and either velcro tape or screws to hold it in place. These panels can be made cheaply and are totally light-proof.

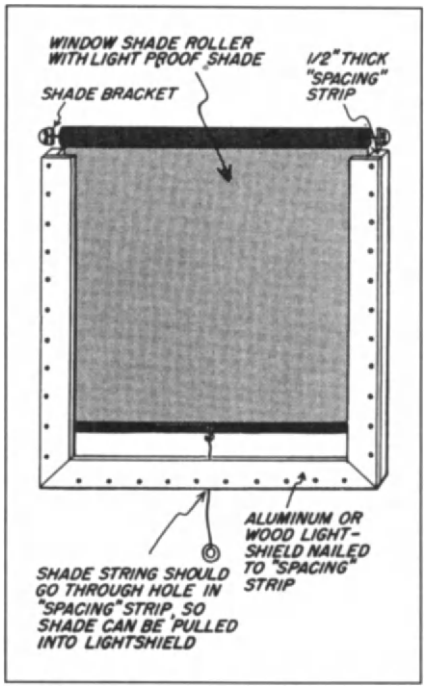
Windows facing sources of subdued light can be covered with red plexiglass to act as a safelight. Always run a safelight test after doing this. If paper fogs, use a double thickness of plexiglass.

The cheapest and easiest method of all is to paint the windows black, but this works only if you never want light through them.

Doors

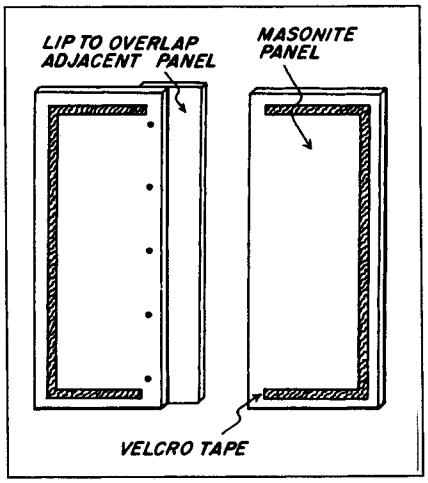
The ultimate door is a revolving one, but most people cannot afford the expense. An alternate solution is a light trap, which is inexpensive but does require a lot of floor space. Several possible designs are shown in Chapter 4. These entryways are ideal, because they allow people and air to circulate freely without light entering the darkroom. Light traps should not face a bright light source because reflections can work their way into the darkroom. If this is impossible to avoid, the entrance can be covered with a hanging cloth with a chain or weights sewn in the bottom to hold it down.

Light-Proofing a Shade



Light-Proof Shade. These are perfect for the room that must serve more than one purpose. Release the latch and ZAP . . . the light is back in the room and the shade has disappeared. Reasonably priced, custom-made models are available from Draper Shade Co.

Light-Proofing with Panels



Light-Proofing with Panels. Use either one large panel or a series of smaller panels fastened to the wall or window frame with velcro tape. This will allow for easy installation and removal. Handles on the top and bottom of each panel make the chore even easier.

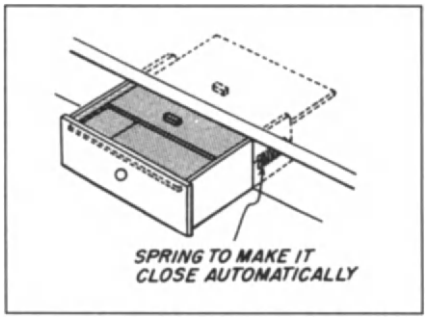
Light-Tight Drawer or Paper Safes

A place to store paper when the lights are on is a real convenience. It is time-consuming and bothersome to work directly from the paper box, especially when large numbers of prints are being made. Better to build a light-proof drawer or buy a paper safe.

Vents, Fans, and Heaters

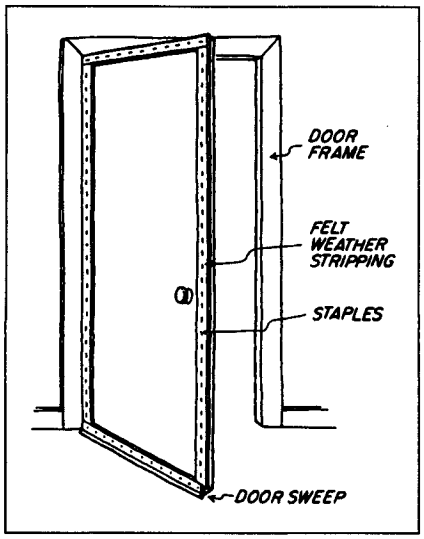
All equipment installed in the walls of a darkroom should be light-tight. Some vents and fans are made specifically for darkroom use. If you choose to use a regular fan, a louvered box can be made to cover it making it light-safe. You should also remember that some space heaters have radiating coils that can emit sufficient light to fog paper. If you plan to use one that emits a glow, be sure to run the safelight test given on page 112. If the darkroom is located near the furnace or hot water heater, make sure that, if they suddenly turn on, the light emitted won't fog your prints.

Light-Proof Drawer



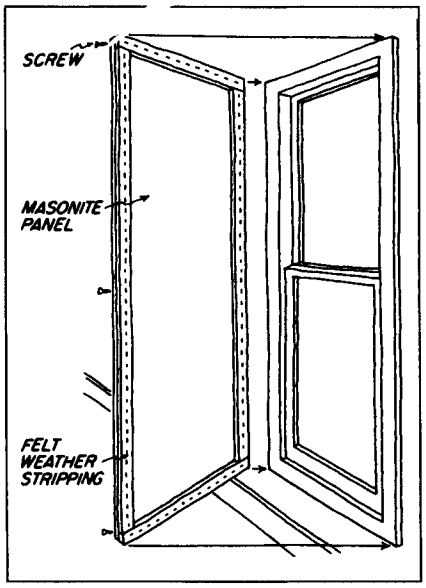
Light-Proof Drawer. A light-proof drawer makes the printing process a great deal easier. The one illustrated here has a top, sliding in grooves, that closes automatically when the drawer is closed. The piece of wood on the top slide hits the piece of wood on the bottom of the counter top and closes the interior lid. The springs attached between the drawer and the wall ensure that the drawer closes automatically. All of the interior surfaces of the drawer should be painted a flat black to reduce reflections.

Light-Proofing a Door



Light-Proofing a Door. A light-proof door still has to open and close. You can light-proof the door, and still allow it to be usable, with inexpensive weather stripping and a rubber door-sweep available at any hardware store.

Light-Proofing a Window



Light-Proofing a Window. The techniques used to light-proof a window range from painting it black (which is hard to remove the next day), to just lowering the shades and printing at night. A more flexible method is to cover the entire window with a sheet of masonite (or plywood) edged with felt weather stripping (or foam tape); your room is light-proofed, but you can easily remove the masonite whenever you want.

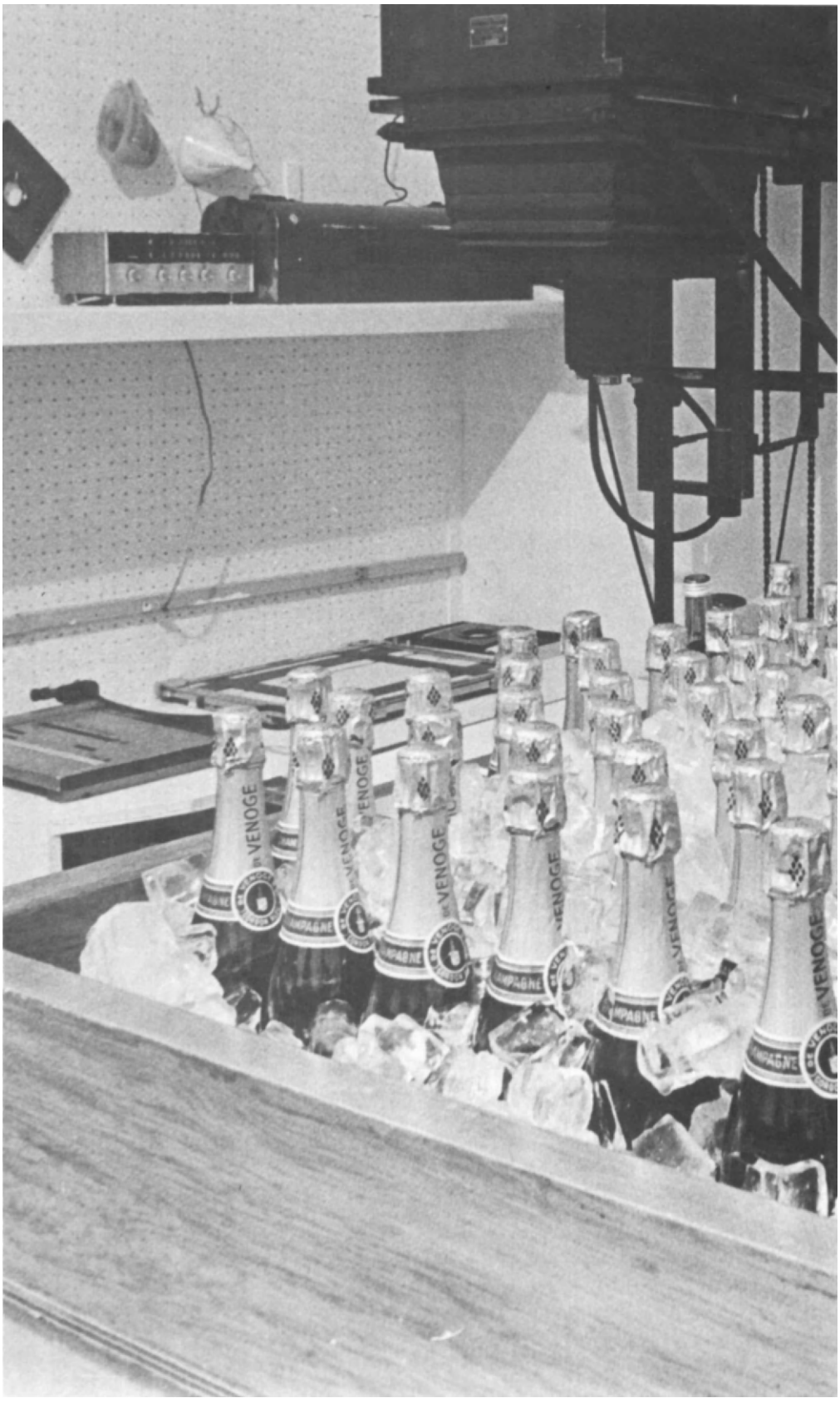
Changing Bag. Many darkrooms are safe to print in but have too much light to load and unload film safely. The solution is to use a changing bag that is completely light-proof. Film can be loaded onto developing reels and placed in a daylight tank.

Unique Solution

Because of the high cost of energy, a variety of ingenious energy-saving interior storm windows are on the market. Many use plastic channels that attach to the window frame and hold a rigid or flexible vinyl storm window. In order to light-proof using these products, you will have to locate a light-proof, rigid or flexible vinyl to fit the channels. Masonite will usually fit the rigid models, and two layers of 4 mil. garden plastic should work with the flexible models. These units are easy to use and have the added benefit of conserving energy. Most of them are made by small companies and a variety of types are manufactured, so visit a few different building supply stores to find out what is available.

Those Added Comforts

It's rare that you will have a reason to fill your sink with champagne bottles as Gil Amiaga did for the opening of his new studio. There are, however, small things that can be added to a darkroom to make it a more pleasant place to be when all of your listless friends are lying on the beach.

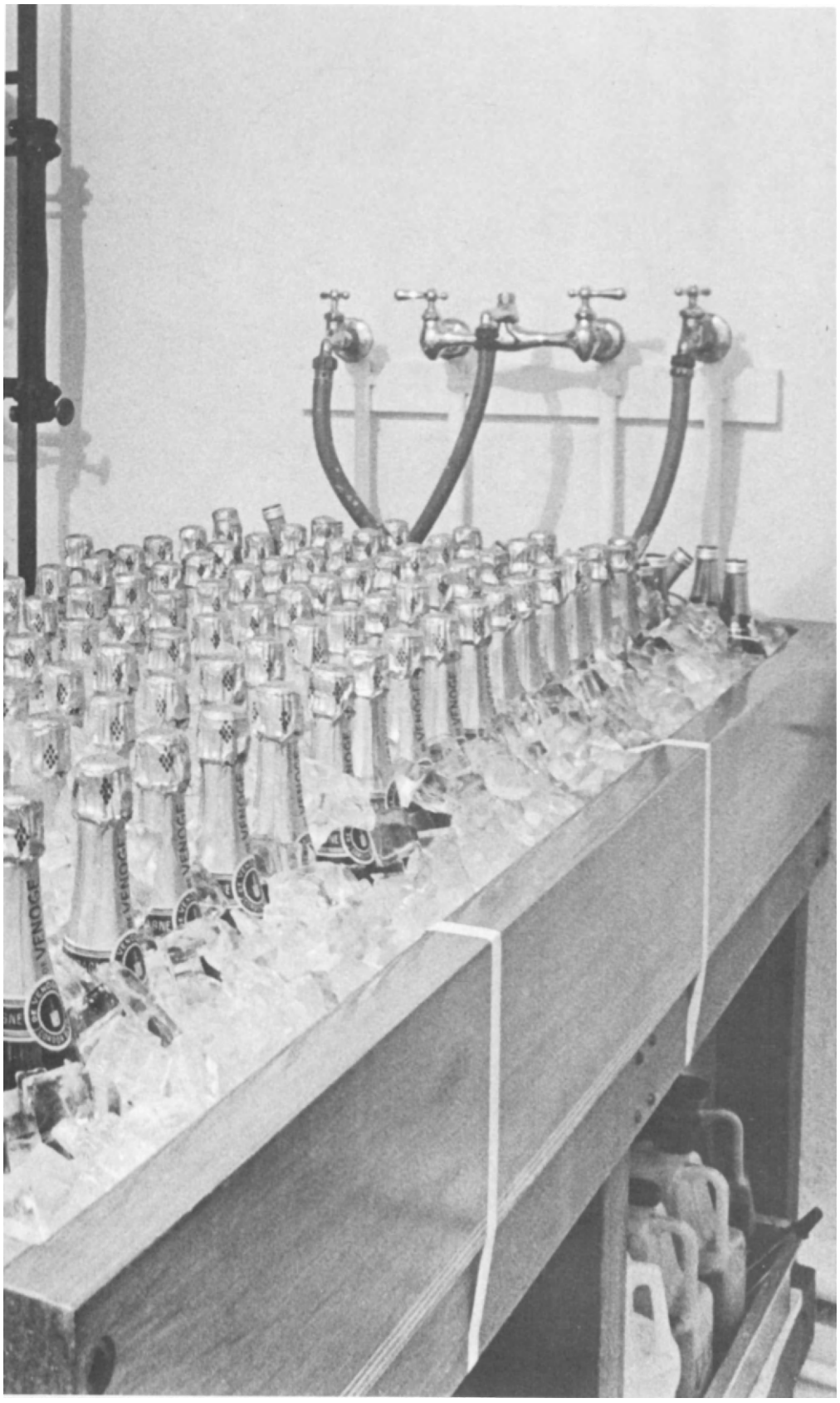


Phone

To avoid the dilemma of having to hurry up with a print or miss a call from your editor, an extension phone permanently installed in the darkroom can save time and pictures. It's also a good way to keep in touch with the outside world when performing some of the more boring aspects of your work.

Heaters

Adequate heat in the darkroom isn't only for your comfort, but also helps keep chemicals at the proper temperatures when processing. If you can keep the darkroom temperature at 68°F (20°C), it greatly simplifies temperature regulation. You need a heater that doesn't emit any light that could fog your film and paper. Radiant heaters with quartz or electric coils are out, because they light up when in use. A large variety of models at discount stores have concealed heating elements that don't emit light. A built-in thermostat is also useful, because it will help keep the room consistently at the right temperature. Be sure your heater has a special mercury switch that automatically turns the unit off if it's tipped over and a three-prong grounded plug for additional safety.



Floor Mats

Standing on a hard floor all day was fine in a nineteenth-century sweatshop, but in a comfortable darkroom it is definitely out. There are commercial floor coverings, such as Ace Core-Lite and Leedal floor mats, made especially for the darkroom. A piece near the enlarger and a strip along the front of the sink will usually suffice if you don't want to do the entire floor.

Stereo

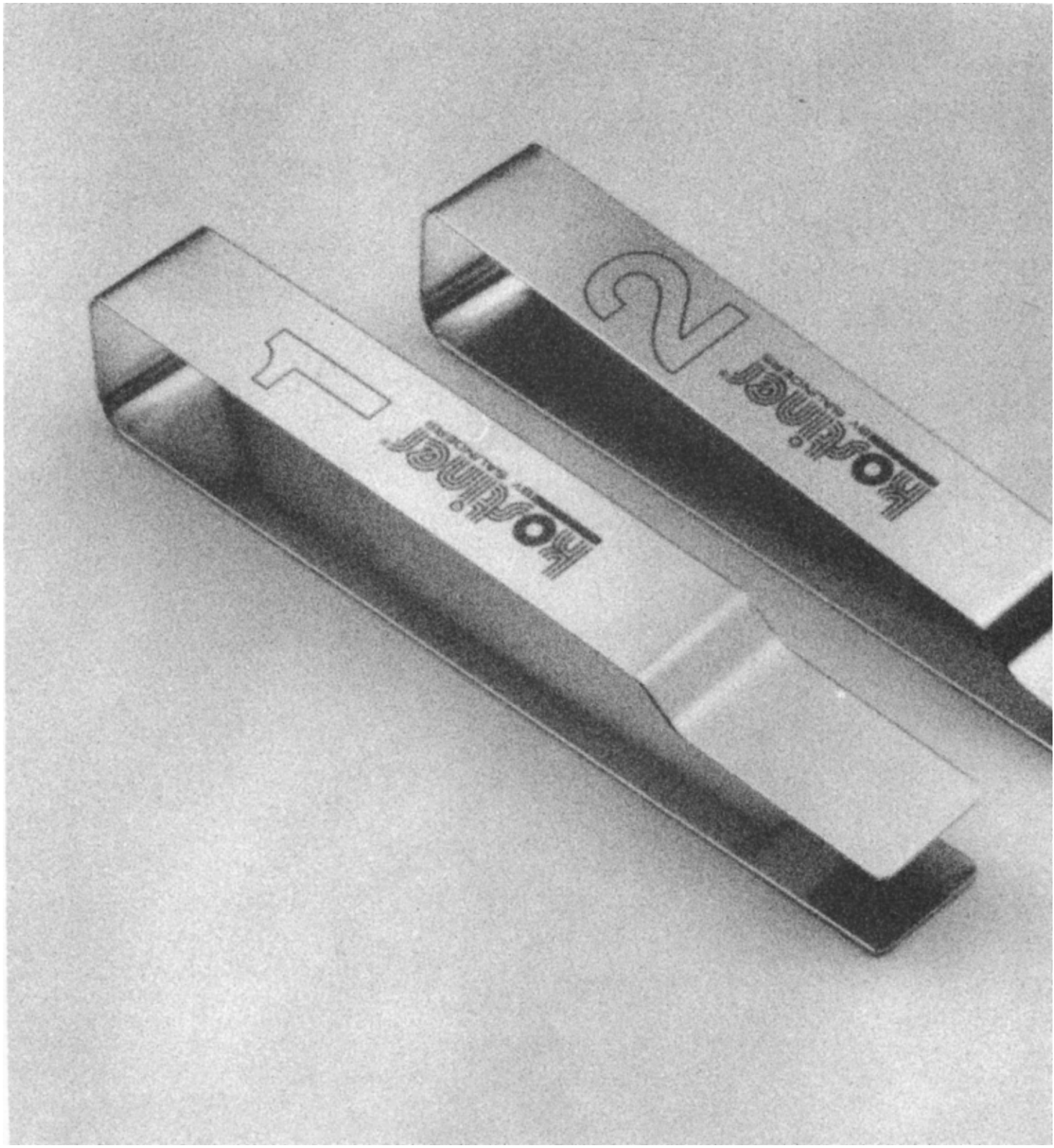
A radio or extension speakers from a good stereo will add a lot to the enjoyment of printing.

Television

Believe it or not, there are photographers who have filters taped over their television sets so they can watch the football game while printing. They have a tendency to get their zone systems confused with zone defenses, but that's one of the hazards of doing two things at the same time.

Photograph by Gil Amiaga.

7 Processing Equipment

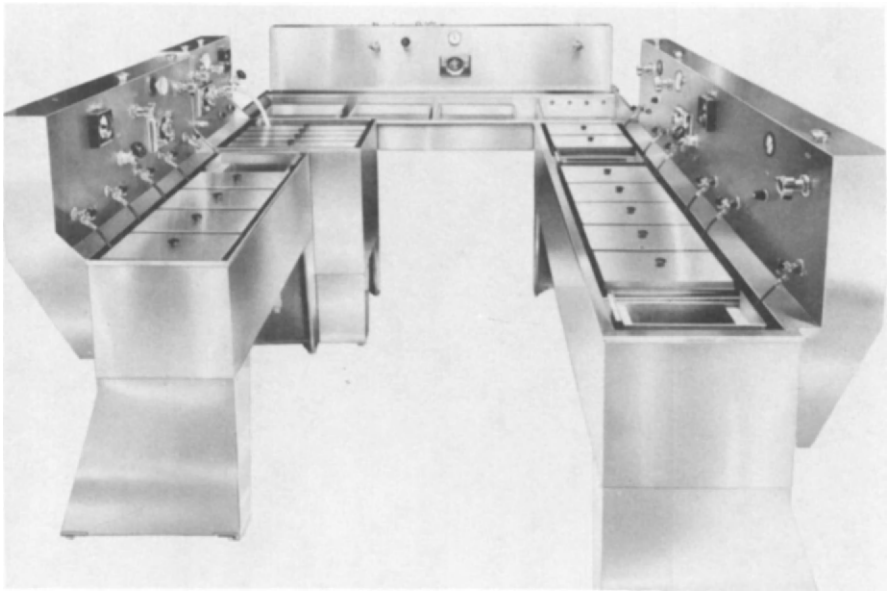


Contents

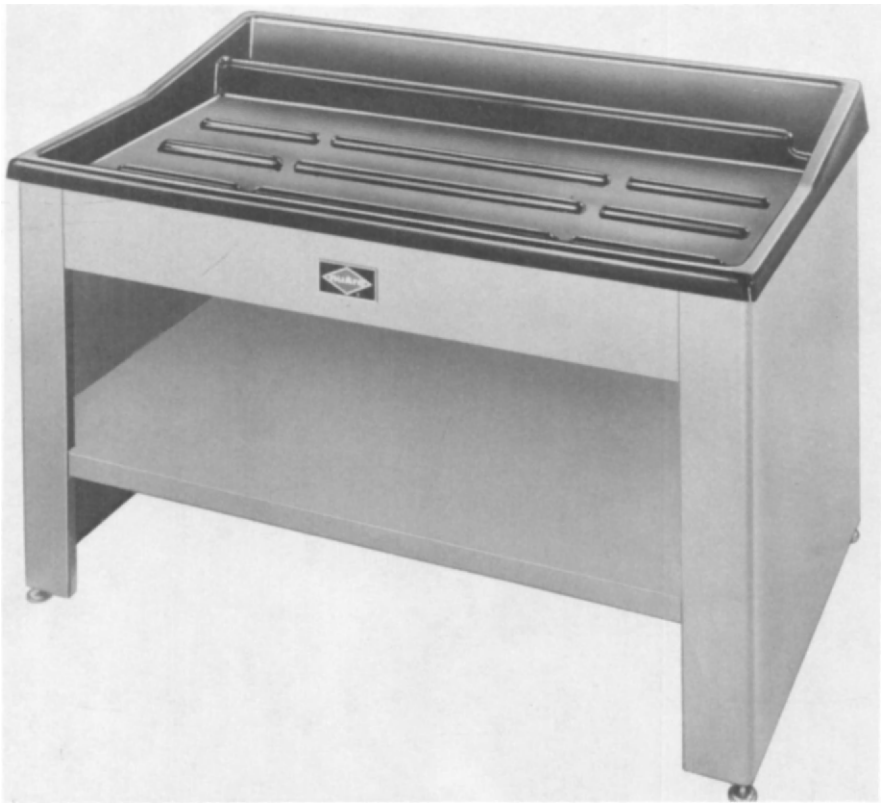
Sinks

Most beginning photographers start by putting trays of chemicals on the kitchen table or counters. They soon learn that spills are impossible to avoid and temperatures in the trays difficult to hold at a constant level. In addition, the cleanup time is longer than need be because of the care with which the counters and tables have to be cleaned. The solution is a sink large enough to hold all of the processing trays. Photographic sinks should have a large area and a shallow depth. They can be equipped with temperature control faucets, standpipes, and duckboards to make them even more efficient. You can build your own of wood, as shown in Chapter 6, but commercial models are available that are perfect for the home darkroom.

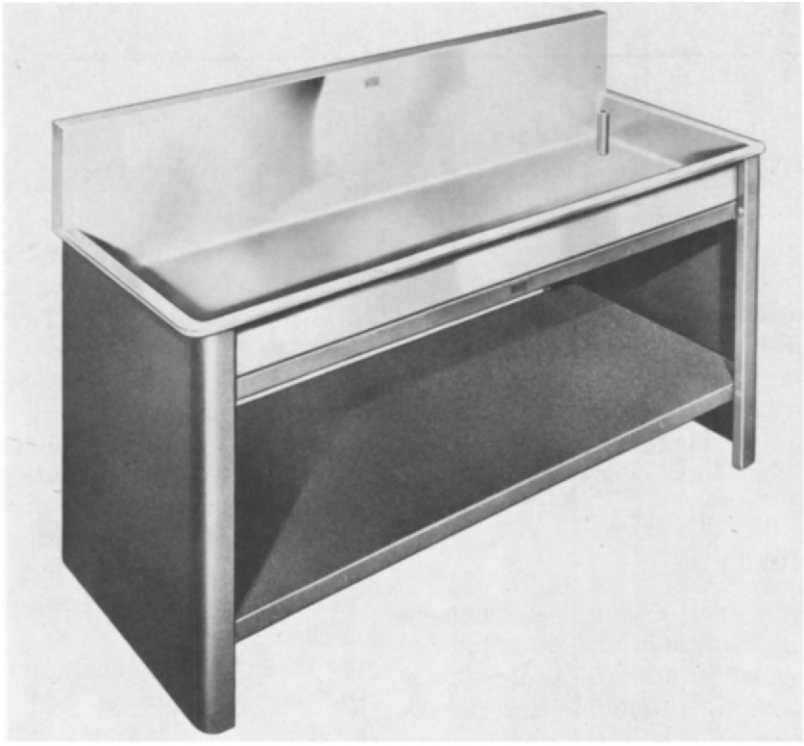
Commercial sinks come in either plastic or stainless steel models. Stainless is extremely long-lasting but much more expensive. Stainless sinks also tend to be a little noisy with trays and tongs banging against them, but their durability and ease of cleaning make them a dream to use. Plastic sinks are equally efficient at keeping the spills contained, are easy to clean, and, given reasonable care, should outlast even the youngest photographer. Sinks can be ordered from suppliers either with or without stands. The stands make them portable if you are moving. They can also be built in without using the stand, but in doing so you are making it much more difficult to remove and install in another location. Be sure the stand is made of a corrosion-proof material or is well painted; the chemicals used in photography will badly corrode most steel stands, and rust scaling will detract from the cleanliness and appearance of the room.

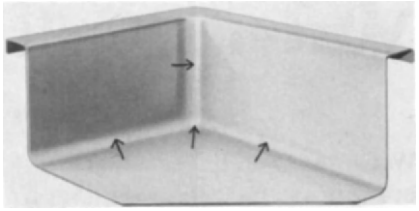


Stainless Steel Darkroom. This Calumet darkroom setup illustrates equipment for a high-volume operation. The sinks provide for bulk-processing of film and prints and have all of the best possible features, including temperature regulation, gaseous burst agitation, stainless steel construction, and daylight tanks.

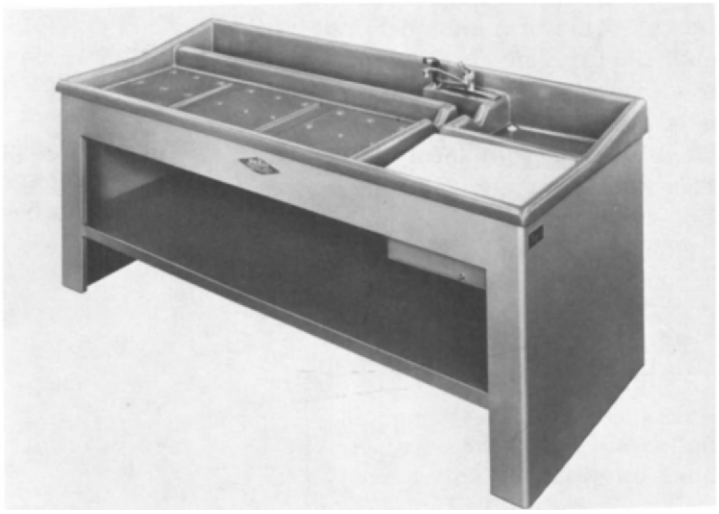


Sink with Ribbed Bottom. This NuArc plastic sink features the dump trough in the back and a ribbed bottom making duckboards unnecessary. A simple straightforward design.



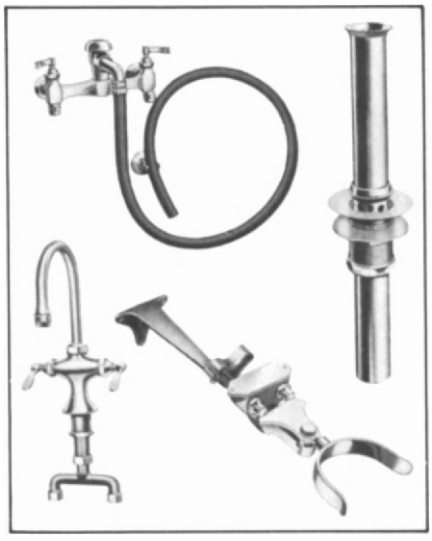


Arkay Sink. This Arkay sink is representative of the many well-designed stainless steel sinks available commercially. The key features are the high splashboard and the rounded corners in the sink that make for fast and easy cleaning. This illustration also shows a standpipe inserted. When the sink is filled, the water rises only to the top of the standpipe and then overflows into it and down the drain. A number of standpipes of different heights allow you to fill the sink to different levels, depending on what is in the water bath. Trays would need a low level of water to keep them regulated, but developing tanks could use a higher level.



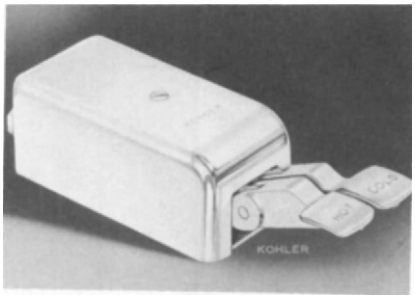
Plastic Sinks. This ABS plastic sink by NuArc has a unique design that allows you to dump chemicals without affecting the temperature bath for processing trays. The trough running along the back of the sink is connected to a fast-emptying drain. The sink also features a ribbed bottom that allows water to circulate freely under the tray for more efficient temperature control. It comes equipped with a built-in viewing area that doubles as a light table and squeegee board—ideal for those working with large negatives or graphic arts materials.

Note the sink sprayer that makes cleaning up easy. This device can be installed on any sink, including one you build yourself.



Sink Accessories. When building or buying a sink, there are several accessory items that can be considered. The illustration here shows a knee-operated mixing valve from Eljer that allows you to mix the water at any temperature you desire using your knee, which leaves your hands free to hold the processing trays, film, or whatever. The high faucet is ideal, because it allows for the placement of large graduates and bottles under it for filling. The faucet with the rubber hose attached does the same thing and also eliminates noisy drips, since it lies on the bottom of the sink when not in use, and any water coming out slips quietly onto the sink bottom. The illustration of the drain and standpipe shows how it is assembled.

Courtesy Eljer Plumbingware



Foot-Operated Valve. Kohler makes a foot-operated control valve that allows you to vary the temperature of the water flow while keeping your hands free. Designed for hospital work, it can also be used in the darkroom.

Water Quality

Water quality in this section refers to everything but its temperature, which is discussed in the next section on temperature regulation. There are several basic components that affect the quality of water used in photography.

Suspended Solids

These small, solid particles exist in all water systems. They originate at the source, or enter into the water at some point in the distribution system, and can be removed by using water filters. Their removal becomes increasingly important if you are using a temperature-regulating valve that can be damaged by solid particles in the water.

Although these particles have relatively little effect on prints, they have a tendency to adhere to negatives, and once they have dried to the surface, it is impossible to remove them.

Hard and Soft Water

Hard water can make chemical mixing difficult, and soft water can soften the gelatin on film and paper after long washing cycles. The range of allowable hardness of water is from 40 to 150 parts of calcium carbonate ($CaCO_3$) per million. To find out the range of your own supply, call the local water authority.

Purity

Only a very expensive filtration system can remove anything but suspended particles. For badly polluted sources, one solution is to use distilled water, at least for washing the negatives. You can store water that runs off of the air conditioner or dehumidifier cooling coils. Because of concern with water quality, it is possible to buy very inexpensive distilled water at your local market. This water is sometimes labeled infant or baby water. However, if there is plain distilled water, it is the same thing and a bit less expensive.

Air in the Water

Air in water and solutions causes bubbles to build up on film and paper surfaces, preventing developers and other chemicals from coming in contact. This should be prevented if uniform development, fixing, toning, and washing is to be achieved. Either boil the water to drive off the air, or add an aerator to the incoming line. The aerator forces large bubbles into the water, and these combine with and remove the smaller ones before rising to the surface.

When stirring chemicals, it also helps to use a stirring paddle with a wide blade and narrow handle. The narrow handle disturbs the surface of the solution less than a larger object would and prevents additional air from entering. Some chemical mixers are designed to go one step further and are magnetically operated paddles without handles so very little surface disturbance occurs.

Water Impurities

If you are using water from a source other than a municipal water supply, you should have it analyzed by a lab to determine its contents. The following table gives some of the maximum allowable limits for commonly encountered chemicals.

Practical Limits for Common Impurities in Water Used for Photographic Processing

Impurity	*Maximum or Range or Content (ppm*)*
Color and suspended matter	None
Dissolved solids	250
Silica	20
pH	7.0 to 8.5
Hardness, as calcium carbonate	40 (preferable) to 150
Copper, iron, manganese (each)	0.1
Chlorine, as free hypochlorous acid	2
Chloride (for black-and-white reversal)	25
Chloride (for color processing)	100
Bicarbonate	150
Sulfate	200
Sulfide	0.1

*parts per million

Water Filter. Filters are rated by the size of the particles that they remove from the water. The largest filter you should use for photographic processing is 50 micrometers. A smaller filter will make the water cleaner and the filter dirtier, requiring more filter changes without noticeable effect on your negatives or prints.

Water filters come in cold or hot models. The basic difference is their respective ability to resist temperature damage. The hot-line filter is usually designed to withstand high temperature and pressure over a sustained period of time. The cold filters are not subjected to this stress, so their quality (and price) is not as high.

This illustration shows a Leedal model and the filter element inside.

Temperature Regulation

The more heat you have in photographic processes, the faster things happen. It is easy to understand the importance of temperature regulation in controlling the rates of chemical reactions found in developing, fixing, toning, and washing. As a rule of thumb, a 10°F change in temperature will double or halve the rate of a chemical reaction. Solution temperatures can be regulated in several ways to ensure that processes occur at expected rates and can be repeated.

Controlling Ambient Conditions

Having the room temperature close to the temperature at which chemicals are used helps reduce the need for more exotic controls. It is not necessary to make conditions perfect, but perfect conditions can save a great deal of time, because if stored chemicals are at the correct temperature, they can then be used without additional heating or cooling.

Controlling the Temperature of Incoming Water

When mixing chemicals, washing prints, or trying to maintain a constant temperature in a water bath, it helps to have a thermostatically controlled water valve. These can be preset to maintain a temperature within a given design range (usually 1/2°), despite changes in line temperature or pressure. They are a good investment and significantly reduce the problems involved with working in a darkroom.

Controlling the Temperature of Water Baths

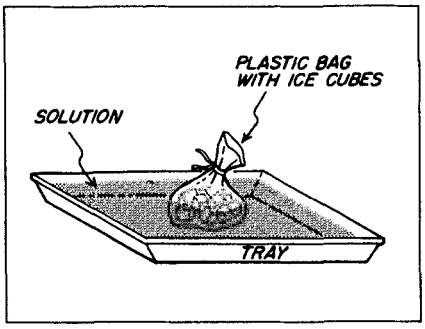
Chemicals can be maintained at the proper working temperature by immersing the container in which they are held in a water bath that is maintained at the correct temperature. The larger volume of the water bath makes the temperature more stable and will keep the smaller volume of chemical solutions from changing temperature. A water bath can be made by immersing a tray or tank in a larger one into which water at the correct temperature has been poured. The larger the amount of water in the bath, the easier it is to obtain and control a stable temperature. If you have a sink, it can be plugged with a standpipe that you can buy or make out of a plastic graduate. The standpipe will allow the water in the sink to rise only to the top of the pipe, at which point it overflows into it and down the drain. The large volume of water in the sink will maintain a stable temperature for a longer period of time.

In the absence of a temperature-regulating valve and standpipe, the water bath temperature can be maintained with either an immersion heater or recirculating unit. The temperature can also be controlled by adding hot or cold water occasionally to raise or lower the temperature.

It helps to have a stainless steel graduate to use for changing the temperature of small volumes of chemicals. Stainless steel is an excellent conductor of heat, and immersing it, full of the chemical, into a hot or cold bath will quickly change the temperature of the solution it contains. The same effect can be obtained with a plastic graduate, but it takes much longer to obtain the same degree of change.

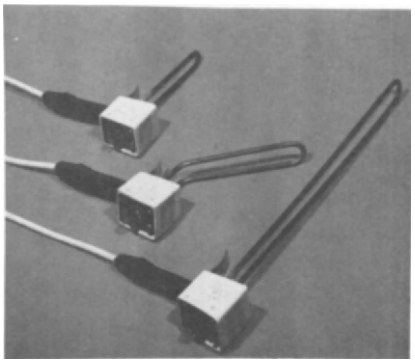
Temperature regulation of the water in most darkrooms will depend to a large degree on the amount of hot water available to your house or apartment. You may well find after spending $300 on a temperature-regulating valve that your hot water capacity is sufficient for only half an hour or so of water at the desired temperature. It's better to know beforehand what the capacity of your heater is, what your consumption is expected to be, and how the two relate. If you have to install a larger hot water heater for the darkroom, you can derive a side benefit (the whole family can take long, hot baths one after the other).

Ice Cubes in a Plastic Bag



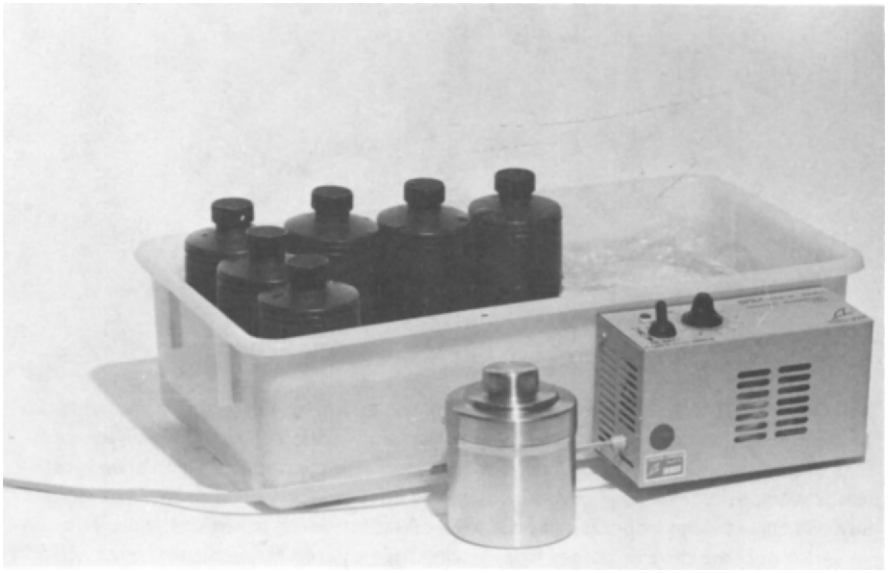
Ice Cubes in a Plastic Bag. If you overshoot and your temperature climbs too high, it can be lowered without diluting the mixture by placing ice cubes in a plastic bag into the solution. The melted water is retained in the bag.

Recirculating Heater. The basic application of a recirculator is to keep the water at a constant temperature without adding any new water to the system. This conserves water (however, it consumes electricity), because the temperature of the water in a water bath can be raised without adding new hot water. The recirculator pumps the water out of the sink or bath, heats it, and then returns it at the preselected temperature. Look for the rated capacity of the recirculator in terms of both flow rate (gallons per minute) and temperature range. It's also helpful to know what its range is in relation to the ambient temperature of the room. Can it hold 68° on a minus 32° day in your northern Maine darkroom?



Immersion Heaters. The least expensive way to control temperature in a fixed body of solution is with an immersion heater. They work on the same principle as electric probes used to heat a cup of coffee. The electricity raises the temperature of the heating element and that heats the water. Some immersion heaters are quite sophisticated, with thermostatic controls and circulating pumps, so the temperature is maintained uniformly throughout the solution. Without adequate circulation, the temperature would be uneven.

Stainless Steel Graduates. Stainless steel graduates are great conductors of heat and can be used for raising or lowering the temperature of solutions placed in them. Immerse the graduate in a water bath at the desired temperature, or do what Neal Slavin does and use a hot plate to bring the temperature up quickly.



Water Bath. One way to maintain a water bath requires a heating element, a temperature-control device, and a circulating pump. The pump is necessary to ensure evenness of temperature throughout the solution. This model has all of these elements combined into one and can maintain the water within one-tenth of a degree of the preset temperature.

Thermometer in Fitting. If you don't go all the way with temperature regulation, it's at least helpful not to have to hold the thermometer in the stream of water with one hand while trying to adjust two faucets with the other. The solution is a fitting into which a thermometer is permanently mounted. You still have to regulate the temperature manually, but at least you can check the temperature without standing there holding the thermometer. This model is by Pfefer.

Automatic Temperature Regulation

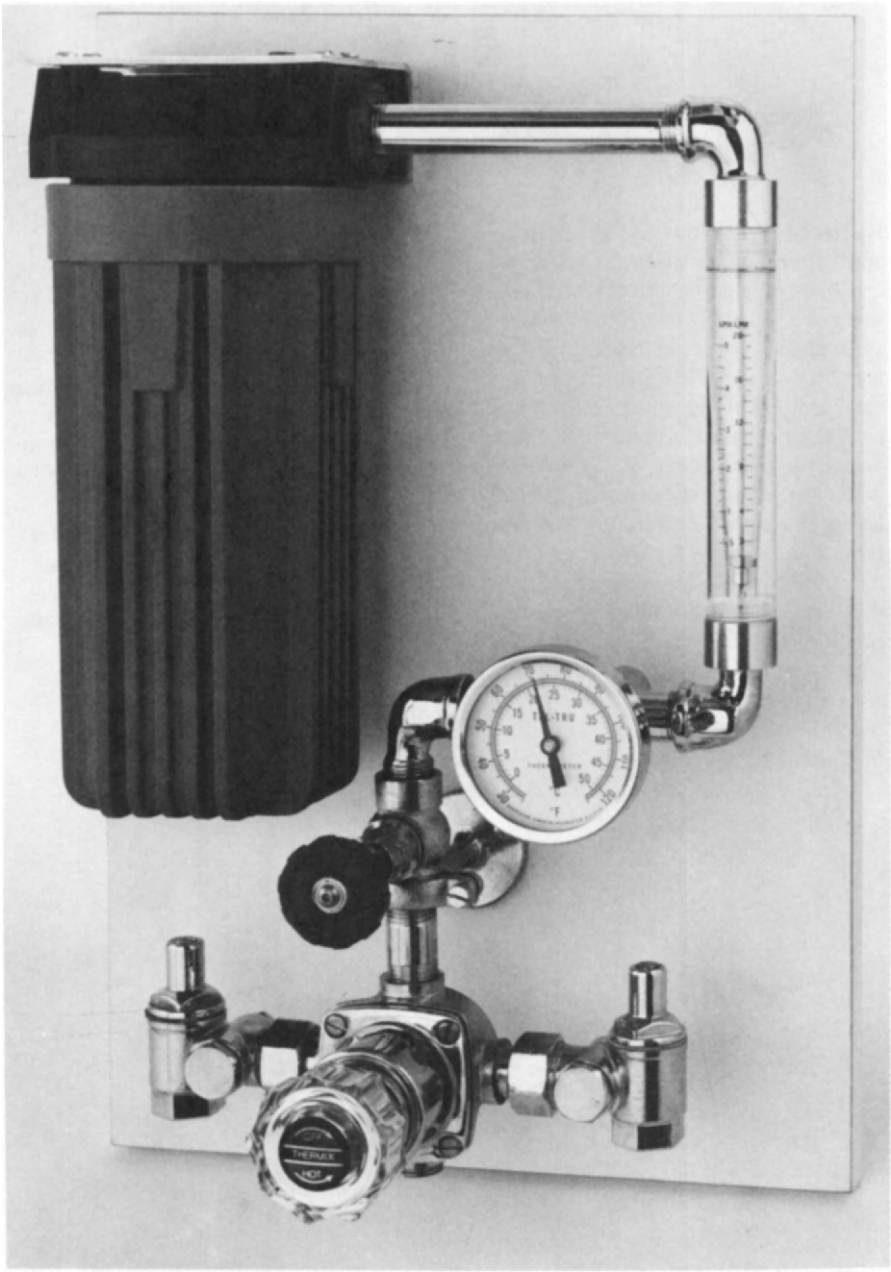
For photographers who spend a great deal of time in the darkroom, one of the main problems is regulating the temperature of the water flow into water baths and print and negative washers. It is a great luxury to be able to avoid constantly monitoring and adjusting the temperature of the incoming water. Manufacturers have developed a number of units that reduce or remove this onerous chore; this section illustrates and describes some of the most popular ones.

Measuring Your Outlet's Flow Rate

When it comes time to order the temperature regulator for your sink you will have to specify the flow rate at which the temperature-regulating valve will normally operate. This allows the supplier to install a collar that will allow you to use the temperature-regulating valve without having the water on full force. Measuring the flow rate is a simple matter.

Find a five-gallon can and connect it to a sink outlet with a rubber hose. Turn the water on at the flow rate you intend to use. Time how long it takes for the five-gallon can to fill. Divide that time by 5 and you will have the gallons-per-minute flow rate you will be using.

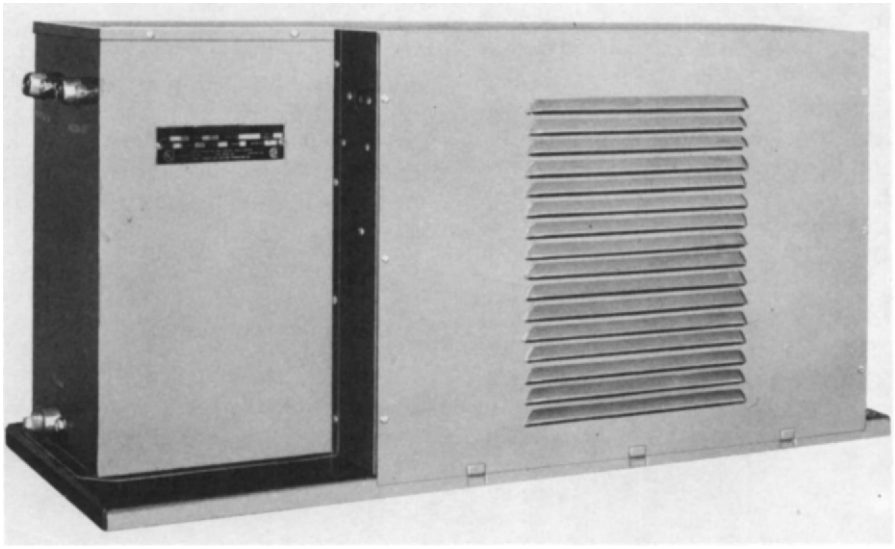
The flow rate will vary seasonally, with the lowest rate likely to occur in the hot summer months when neighbors are watering their lawns and filling their pools. This should be taken into consideration when measuring the rate of flow.



Thermostatic Valve. Thermostatic mixing valves work by the same basic principle on which the thermostat in a home heating system works. When the water temperature in the outflow drops, the supply of hot water is increased and vice versa. Most valves work best at or near their highest rated flow capacity. Be sure that you do not buy one that is always operating at the lower limit for which it was designed. The convenience of these devices comes from setting the required temperature only once and then having the valve hold it automatically, freeing your hands and mind for other things.

Most well-made units have a vacuum breaker that prevents the siphonage of water back into the water supply system. In many areas this is required by building codes.

Because most units operate best at their maximum rated capacity, it's important that you determine the flow rates you will be dealing with and notify the company from which you are buying what range you expect from their valve. For most home darkrooms, a flow rate from 1/2 to 2 gallons per minute will suffice for all operations, including washing.



Water Chiller. In some areas of the country, at certain times of the year, the incoming cold water is at a higher temperature than the darkroom requires. Most photographers grin and bear it, but the more affluent consider the installation of a water-chilling unit.

A thermostatic mixing valve requires a sufficient difference between hot and cold supply lines to operate accurately. So if you are considering installing one of these valves in areas of the country where the cold water is above 60°, you may find that the mixing valve will not work without the installation of a water chiller. Check this with both your water department (they can tell you the highest temperature to expect) and the manufacturer of the valve and chilling unit. This unit is from California Stainless.

Processing Trays and Tongs

Trays

It's been said that all Edward Weston had in his darkroom were a lightbulb, a printing frame, and three wooden developing trays. This indicates either the importance of trays or the lack of importance of everything else. The primary function of trays is to hold chemicals, but variations in design, materials, and purpose do affect, slightly, the usefulness of the various models.

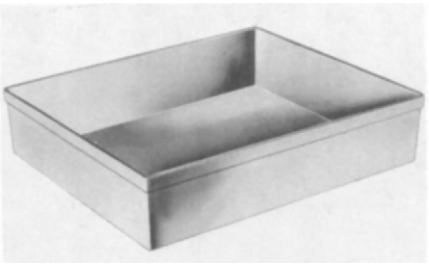
The trays should be deep enough to prevent unwanted overflow when agitating the tray full of chemicals. And they should be large enough to handle a print easily, either by hand or by tongs, without trapping the print between sides that are too close together. Ribs on the bottom reinforce the tray and also make picking up prints easier.

Inexpensive trays can be too small to hold the sized prints for which they are marked. Rather than buy a more expensive tray, however, you can buy the larger size of the less expensive one and save some money.

A tray should be rigid enough so that you can lift it when full of chemicals without it bending under the weight and spilling chemicals. Try flexing the tray by holding the corners and twisting. If there is too much flex, buy another model.

To reduce the possibility of tray contamination, label the trays for developer, stop bath, and fixer and then use the same tray for each chemical every time. Use entirely separate trays for such things as toning solutions.

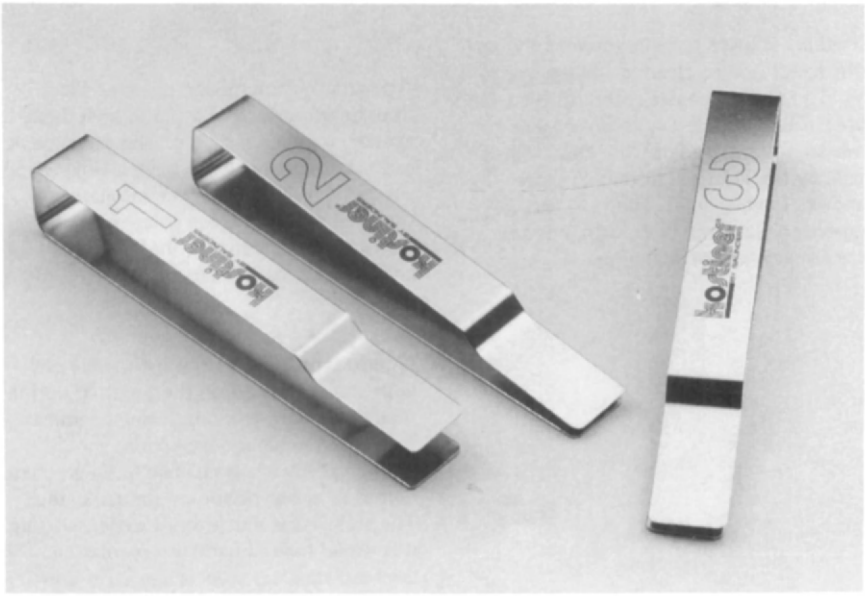
Leedal Tray Rack. A great deal of space can be saved by using a tray rack that holds trays one on top of the other. If you are concerned about possible contamination from chemicals splashing from one tray to another as a result of this arrangement, use the tray rack to hold two fixing trays and the water holding tray. This way contamination, should it occur, will have no effect on the prints. The prints should always progress from the top down to reduce the danger of contamination. If you have to use developer, stop bath, and fixer in the rack, put the developer on top, then stop bath, with the fixer on the bottom level. This Leedal model is made of stainless steel. A somewhat less expensive, but well designed, model is available from Richard.



Deep Hypo Tray. There is a tendency for prints to back up in the hypo tray, and the added agitation required makes it desirable to have a deeper tray than is needed for development or stopping. This problem has been solved by trays such as the Arkay deep hypo tray.

Plastic Print Trays. These Paterson trays are typical of high-quality plastic trays that are perfectly suitable for darkroom purposes. The pouring lip makes pouring the chemicals back into the bottle or down the sink much easier.

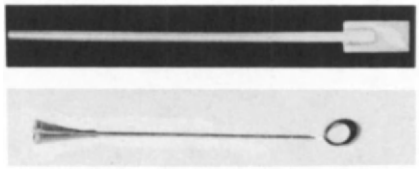
Print Drums. Print drums were initially designed to allow development of color prints in a well-lit room. They also have the advantage of requiring a smaller quantity of chemicals to get the job done. Drum agitators are available to keep the solutions moving, making the entire development process easier. These drums are also available in larger sizes for mural processing. They are often used for color printing, because safelights generally cannot be used and it's easier to develop the print in a drum than in the dark. With black and white printing, however, drums remove the excitement of seeing the print emerging from the white paper.



Print Tongs. Print tongs are giant tweezers that allow you to agitate and remove prints from processing trays without using your fingers. They reduce contamination and keep your fingers clean, so that the next time you change a negative in the enlarger you don't ruin it with fixer. A good print tong should hold the print securely but not at the expense of damaging the emulsion. Plastic tongs are usually the best: they combine cleanability and holding power. If you buy tongs with rubber tips that are subject to contamination, mark them to indicate which is for developer, stop bath, and fixer.

Wet-Side Accessories

Just as the kitchen of a good French chef is made more enjoyable and more productive as a result of high-quality and useful accessories, so is the darkroom. Not having a graduate large enough to mix a solution, or a stirring rod long enough to keep your hands out of the solution when mixing, are frustrations that can and should be avoided. These pages describe some of the accessories that are available and what questions to consider when buying them.



Stirring Rods. Stirring rods are useful when mixing powdered or liquid chemicals. They are usually designed with narrow handles and larger blades on the bottom. The narrow handles reduce the amount of disturbance at the surface, preventing air from entering the solution. The blades increase the agitation below the surface and are available in a wide range of styles, including ones with holes and others with heads that can be used for crushing powdered chemicals.

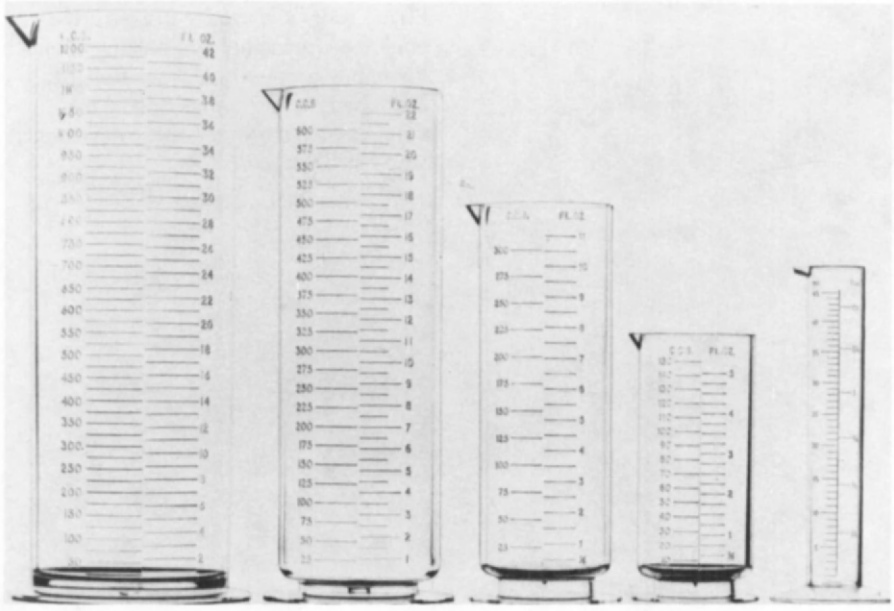
When buying a paddle, make sure that the handle is long enough to provide you with a grip when fully immersed in the largest mixing container you use.

Funnel. A funnel is almost a necessity if you want to pour chemicals from a large graduate into a bottle with a narrow neck. Two funnels are handy to have because you can mix your chemicals right in the storage bottle using one funnel to pour in the dry powder and the other to pour in the water. Funnels are usually cheaper in the hardware store than in the camera store and serve the same function.

Illustration courtesy of Nalge Company, Division of Sybron Corporation

Towels. It helps to have towels to wipe your hands and to clean up spilled chemicals. The least expensive method is to use paper towels, but occasionally it helps to have some that are lint-free. Photowipes, made by the Photo Materials Co., are handy to have around. They are too expensive to clean the floor with, but are very convenient for equipment.

Aprons. When mixing chemicals it doesn't take much of a slip to spill them on your clothes. To be on the safe side, it might be worthwhile to have a vinyl apron handy. They only cost a few dollars and can save their purchase price in ruined clothes. This apron is from BelArt; EPOI and Kodak have similar models.



Graduates. Graduates are containers with scales marked on their side, used for mixing, holding, and measuring chemicals. Every well-equipped darkroom should have a variety available. The basic graduate comes in either plastic or stainless steel. The stainless is much more expensive, but it is useful for temperature regulation. Because stainless steel is a greater conductor of heat, you can raise or lower the temperature of chemicals quickly by pouring them into the graduate and immersing the graduate in either hot or cold water as the situation requires. The same effect can be achieved with a plastic graduate, although it takes longer.

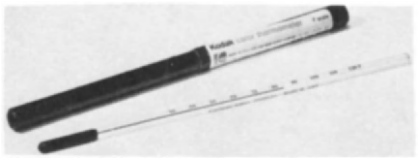
A tall, thin graduate is also useful for measuring small quantities of chemicals. Trying to measure 1 ounce of stop bath concentrate to mix with 1 gallon of water is very difficult with a large, wide graduate.

Thermometers

Thermometers can be divided into classes based on the principles by which they operate. Your selection should be based on accuracy, cost, and durability.

Liquid in Glass. This type is identical in principle to the thermometers that we take our own temperatures with. It consists of a bulb full of a fluid, usually alcohol, and a long narrow tube marked in degrees. As the fluid heats or cools, it either expands or contracts.

These thermometers are extremely accurate, relatively fast-acting and long-lasting—if you don't break them. If the thermometer overheats, you may break the tube. To work accurately, the entire column of liquid that indicates the temperature should be immersed in the liquid you are measuring.



Glass Thermometer. This glass tube Kodak thermometer is fast-acting and reliable. It is a little slippery to grip with wet hands, so handle it carefully. As a safety precaution, wrap a rubber band around the end to provide you with a better grip. It will also help prevent it from rolling off the counter. If you jar a glass thermometer, you will sometimes find that an air bubble has entered the column of alcohol. If this happens, you can heat the thermometer gradually until the column is filled entirely with alcohol. When it cools, the column will usually be rejoined. Overheating, even a little, will pop the top off the glass tube. This model has a range from 30° to 120°F.

Courtesy Eastman Kodak Company

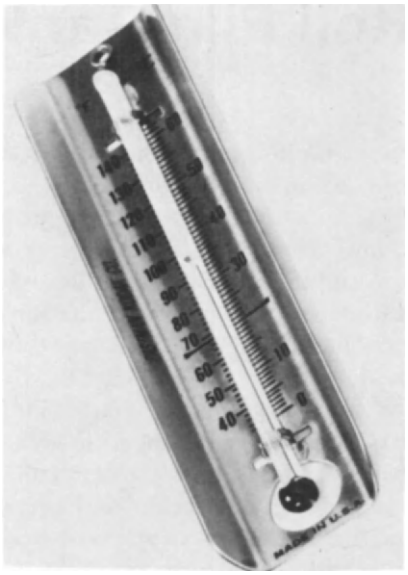
Liquid in Glass with Metal Backing. Some thermometers are reinforced with a metal backing to prevent them from rolling or breaking as easily. These are ideal for tray thermometers, but if the scale is on the backing and not on the tube itself, the thermometer can get out of register and indicate the incorrect temperature.

Dial Thermometer. These thermometers have large dial faces that are very easy to read. The needle moves because of the expansion or contraction of a bi-metallic strip. These thermometers are also quite accurate and durable but, because of their mechanical nature, are more sensitive to physical abuse. If a glass thermometer breaks you will know it, but if one of these does you may not. The dial face is also prone to leaking, because the seal between the glass and metal case will not last forever. Occasionally calibrate them by comparing with a thermometer that is known to be accurate.

Electronic Thermometers. These thermometers are available with digital readouts and even audible ones. It is sometimes difficult to read the temperature on a glass or dial thermometer because of parallax and the small numbering on the thermometer itself. This problem is eliminated with the digital thermometer that gives you a direct numerical readout of the temperature. However, they are sensitive to mechanical damage and moisture because of their electronic nature.

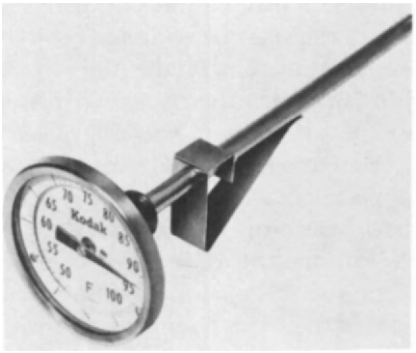
Kodak Glass with Metal Backing Thermometer. This glass thermometer is longer lasting because it is attached to a metal backing that provides support for the glass tube.

Courtesy Eastman Kodak Company



Tray Thermometer. This Kodak tray thermometer is typical of those made to be left immersed in developer trays for quick and easy monitoring of the solution's temperature. Be gentle with thermometers such as this, because the scale is not on the glass tube itself. If the tube is slid up or down in the metal case, it will read an incorrect temperature.

Courtesy Eastman Kodak Company



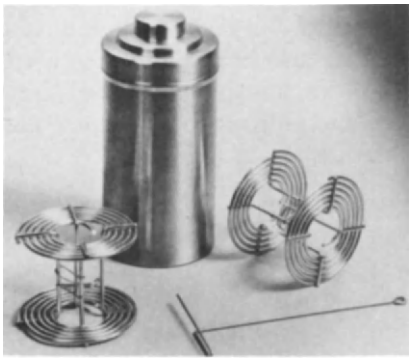
Dial Thermometer. The advantage of a dial thermometer such as this Kodak model is that it is extremely easy to read. The light will not be defracted, as it can be with a glass thermometer. In some models a mirror is used to reflect the needle, and when the needle and its image are seen in perfect alignment, viewing parallax has been eliminated. This ensures that you read the correct temperature by showing you the correct viewing angle.

Courtesy Eastman Kodak Company

Roll Film Tanks and Reels

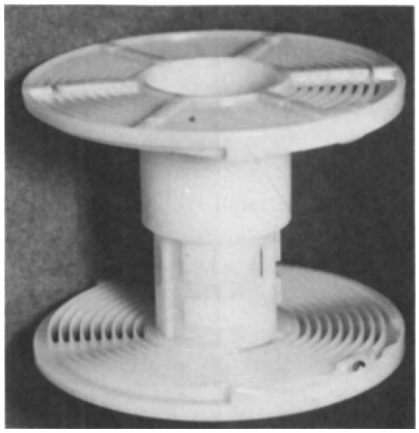
Photographers using 35mm or 2 1/4 format film are confronted with the difficulties of developing a long strip of film. The most common solution is to coil it on a reel so that there is sufficient space between the surfaces to allow for the circulation of chemicals, but not so much that the coil occupies a large space. This basic principle is packaged today in three variations: stainless steel tanks and reels, plastic tanks and reels, and a combination of stainless steel tanks with plastic tops. Traditionally, most pros have used the all-stainless-steel tanks and reels because they perform extremely well and last almost forever. However, one problem is that they may leak around the top if the tank is inverted during agitation. This difficulty has been solved by marrying a plastic top to the stainless steel tank. The seal is tighter and less susceptible to leaks. Many photographers use the all-plastic tank and reel, which has the advantage of a reel that can be widened or narrowed depending on the film format you happen to be using. With the stainless steel reels, you will need a set for each format you shoot.

Stainless steel tanks will lose or gain heat more quickly because of the conductivity of stainless steel, so if the room is a good deal hotter or colder than the chemical solution, use either a water bath or change to plastic tanks that will act as an insulator.



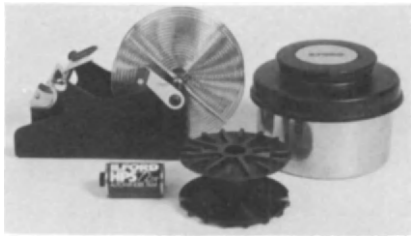
Stainless Steel Tanks. These stainless steel tanks from Burleigh Brooks are representative of what most photographers tend to use. They are well-made and durable. Some reels by other manufacturers have different catches for the end of the film, and some of these designs work better than others. It's best to take a piece of film with you when you buy to see how easy it is to insert and how well it is held.

The long rod is used to raise and lower the reels. Always buy enough reels to fill the tank and use them all if you are developing one roll of film and you agitate by inverting the tank. If one reel slides up and down the tank, development will be affected because of the increased agitation.

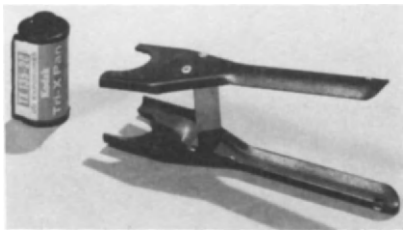


Plastic Reels. This Paterson plastic reel shows the mechanism by which it can be widened or narrowed to accommodate different film formats. The small bearing on the right is part of the self-loading device that makes these reels extremely easy to load just by turning the sides back and forth.

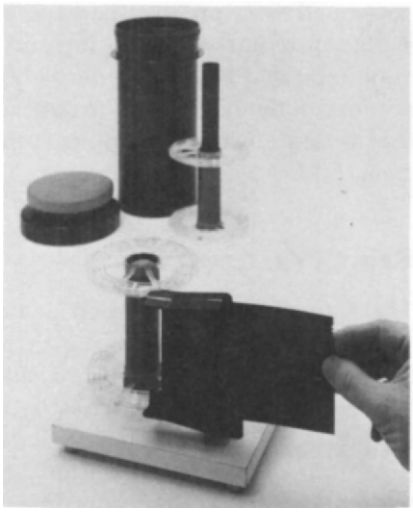
Film-Developing Tanks. Paterson Super System 4 is representative of the many film-developing tanks on the market. It is unbreakable, fast-filling, and comes in a variety of sizes.



72-Exposure Reels. The introduction of 72-exposure film cassettes has led to the manufacture of developing reels capable of handling these longer lengths of film. Ilford makes a reel for these film lengths that fits into a standard development tank.



Film Cartridge Openers. If you have a 1954 Ford convertible, you might be able to find a "church key" in the trunk or under the back seat. It will work fine for opening 35mm cassettes. If you want to step up, you can buy something like this Nikor cassette opener. Kodak also supplies openers for 110 and 126 cartridges.

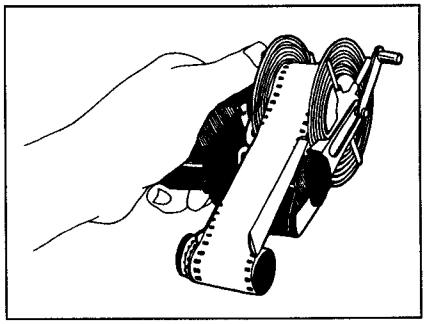


Daylight Tank for Sheet Film. Jobo sheet film reels and film loaders provide a daylight tank system for large format work. The film loader holds the sheet film reel on a flat base. The film guide permits easy insertion of each sheet into a separate groove—without crimping, binding, or scratching. As the reel rotates, each groove clicks into position for positive film loading.

Each reel holds 6 sheets of 4 x 5 film. Two reels can be used with the tank to make roomlight processing of up to 12 sheets of film as convenient as processing roll film. Also, this economical daylight system uses only half of the chemistry required for processing in hard-rubber tanks.

Daylight Developing Tank. There's nothing new about using a daylight developing tank. Any tank, once loaded, can be used in normal room lighting. But the Jobo #2400 tank does more. It allows you not only to develop your film in daylight, but to load it in daylight, too. You can also load and develop partly exposed film in this tank; you simply load and develop the exposed part in full daylight, then cut the film and put the unexposed portion back into the camera.

Automatic Film Loader



Automatic Film Loader. Loading stainless steel reels requires the development of a "feel" for when the film is reeled up correctly. This takes practice, and you cannot let the first few attempts discourage you. If you want to try a more mechanical (but not necessarily more effective) method, you can buy automatic film loaders.

Washers

The washing of prints and negatives is absolutely essential if they are expected to last. Many photographers are careless with this step, not fully realizing that the effects of poor washing may arise days or years after the processing. Prints and negatives that are not fully washed of chemicals deteriorate and, unfortunately, contaminate other prints and negatives with which they come into contact. If a poorly washed print is placed on a drying screen or run through an electric dryer, that screen or dryer is contaminated and will affect the prints that follow. There is no excuse for not washing well—it is the one unforgivable sin of photography.

The quality of the washing depends on the number of complete water changes in a water cycle.

To be effective, wash water must circulate on all sides of a negative or print. Its failure to do so will leave spots that continue to be contaminated even when the rest of the print or negative is safe. Just laying prints in a tray with a hose circulating water over them is not enough. The flow must be enough to change all of the water in the washer at least five times.

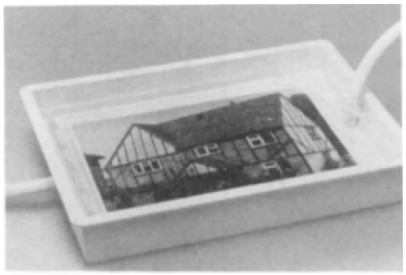
Negative Washers

Leaving the reels in the developing tank and running water in the top does not provide for even washing of the negatives. The water tends to wash those at the top faster than it washes the ones at the bottom, and because the film is in a coil, the water flow will not be evenly distributed along the film but will tend to wash better in the direct stream from the faucet. To compensate for this, several new washers have been developed to ensure that the water is evenly distributed throughout the tank, and that heavy chemicals do not rest on the bottom of the tank as they would if water were poured in from the top.

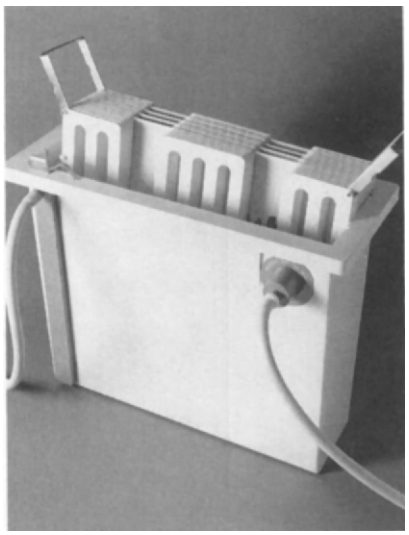
Print Washers

The key ingredients in good print washing are to keep the prints separated so that wash water can freely circulate around them, and to follow the paper manufacturer's directions regarding the time they should be washed. To shorten washing times, you can use Hypo Clearing Agent made by Kodak or PermaWash manufactured by Heico.

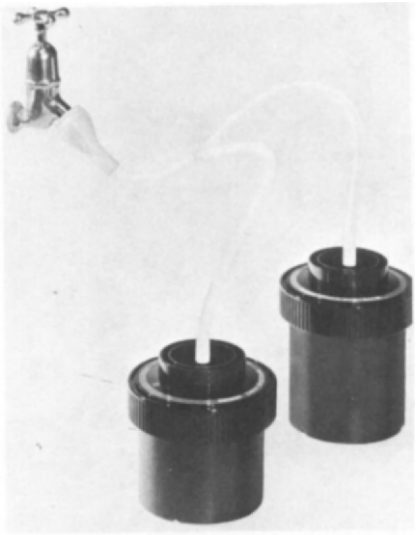
Washing prints for archival purposes is not an easy task. Maintaining an adequate rate of flow and keeping the photographs separated are not enough to ensure complete washing. The dynamics of fluid flow (that is, the wash water) depend on several factors; the placement and orientation of prints in a washer can affect the flow. If all of the prints are horizontal, they can have air pockets or pockets of low water flow regardless of how high the water flow is elsewhere in the washer. To be absolutely safe, buy a washer designed for archival purposes and follow instructions.



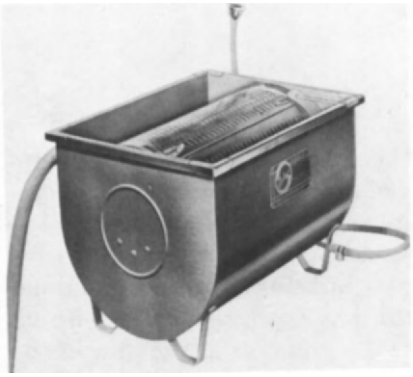
High-Speed Print Washer.



Auto Print Washer. Paterson Auto Print Washers for RC, fiber-based prints.



Built-in Washer. The Paterson film developing tanks are designed with a built-in washer. The hose is connected at one end to the top of the washer and at the other to the faucet. The water enters from the bottom of the tank and leaves from the top, taking the chemicals with it.



Revolving Drum. This Arkay Loadmaster washer is typical of washers using a revolving drum. A gate in the drum is opened and the prints are placed inside. The jet of water entering the washer acts like a millrace and the drum revolves like a water wheel. The level of water never completely covers the drum, so as the drum revolves, the prints tend to become dislodged when they reach the surface of the water, ensuring that they do not stick to the drum and wash unevenly. These washers are effective but can cause mechanical damage to prints, such as bent corners, and so on. A similar design is available from Pako.

Tray Siphon. Kodak makes a very efficient tray washer that also contains a siphon. The design assures that the heavier chemicals that tend to accumulate on the bottom of the tray are removed by the siphoning effect. If you were to place a hose in a tray and expect the water flow to lift the chemicals over the rim, the washing times should be greatly increased. This siphon lifts the water from the bottom of the tray, reducing the time needed for washing well.

To be washed effectively, prints should be placed in a tray twice their size. This allows the water coming from the siphon to spin the prints and gives them much needed agitation.

Courtesy Eastman Kodak Company

Timing Systems

Electronic sophistication is affecting traditional darkroom equipment primarily in the design of exposure meters and timers. In most cases, the absolute accuracy of many of the newer units is not necessary; what is necessary is that your timer repeat each timing cycle exactly the same as every other. If the timer takes 65 seconds to indicate a minute, that's okay, as long as it does it every time. The only exception to this rule is when you are working with color materials that are much more sensitive to the absolute timing of processes.

Timers can be broken down into two main classes, mechanical and electric. Mechanical timers are operated by winding a spring; electrical timers require a source of energy from either a wall outlet or a battery. Electric timers can use either motors or transistors. Electronic timers will often have a digital readout.

The old standby in most darkrooms is the Gralab timer, which is used for timing everything from development, to printing, to making coffee. Its timing range from 1 second to 1 hour makes it useful for timing many activities. Many of the newer timers now on the market are designed for specific purposes and should be used only for those for which they are designed.

General Timers

For a timer to be useful for all darkroom activities, it must accurately measure short intervals in printing exposures and longer intervals in film development. It is also helpful if the dial is large and glows in the dark. If it is to be used as a general timer, it should also have some of the best features of enlarging timers, such as electrical switching capability and repeatability.

Enlarging Timers

When making enlargements, you need a timer that is extremely accurate in the range of approximately 5 seconds to 1 minute (or longer for color printing). The timer should also have the capability of turning off the enlarger at the end of the preselected timing cycle. It is also convenient to have a reset device that allows you to repeat a preset period of time. This is especially helpful when making a large number of identical exposures, such as proofsheets. A luxury is to have the timer programmable so that it stops and starts at different intervals during its cycle, allowing you to time a variety of continuous activities without having to reset the clock for each step

Gralab Timer. For practical timing of both development and enlarging, there isn't anything quite like the Gralab timer. This timer is probably the most used timer in the field, and although it isn't digital or electronic, it's proven and it works well.

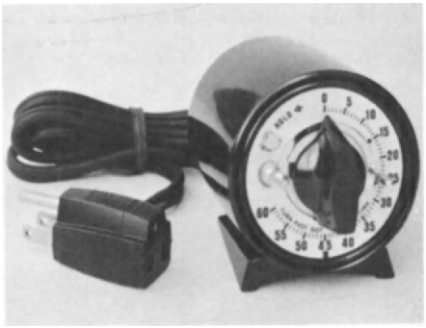
It has a large dial, it glows in the dark, and it has a timing range from 1 second to 60 minutes. It also has a circuit to turn off the enlarger at the end of the preset cycle.

Mechanical Timer. Humble? Yes, but you can still develop your film when the electricity is out. Kodak still makes this versatile mechanical clock with a timing range of 1 second to 60 minutes. It has both minute and second hands and a switch allows you to stop the timer and reset without resetting the hands.

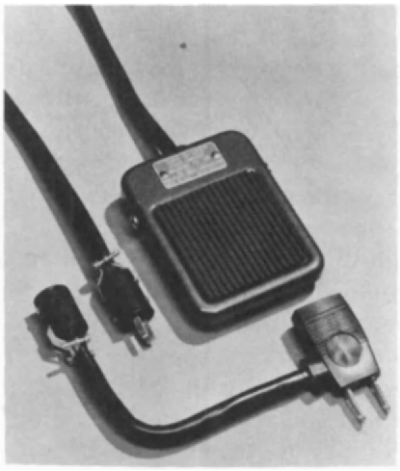
Courtesy Eastman Kodak Company

Multi Timer. This unit allows the timing of several operations at once—ideal for those who need to keep track of more than one thing at a time. The memory feature allows you to store times that are used repeatedly.

Digital Timer. The advantage of a digital timer is the ability to have short enlarger times that are accurate and repeatable. This timer shows the amount of time that has elapsed, a feature that is handy when burning or dodging.



Mechanical Enlarging Timer. This Omega 60-second timer is an excellent example of a relatively inexpensive mechanical timer. The electric cord provides power to the enlarger when the clock is switched into its timing interval.



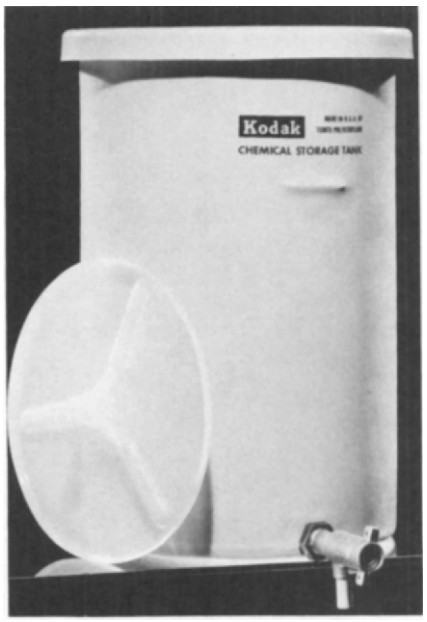
Footswitch. A footswitch to turn the enlarger on and off is handy when, for example, you're confronted with a 10-second exposure in which you have to dodge or burn for 8 seconds. By pressing the switch with your foot, it will turn on the enlarger and leave your hands free to do other things.

Chemical Storage and Waste Disposal

Chemical Storage

Storing chemicals is really a two-part problem. The simpler problem is where to store unmixed chemicals such as developer or fixer. An easy solution is to keep them in a storage cabinet somewhere outside of the darkroom, which will protect boxed or half-used containers from the high humidity. The more difficult problem involves storing mixed chemicals. If you are a prodigious photographer and process through developer, stop bath, fixer #1, fixer #2, hypo-clearing agent, and toning, as well as negative developers, wetting agents, and possibly color-photography chemicals, storage of mixed chemicals can be a troublesome matter. The basic rules that should be considered when planning for mixed chemical storage are:

1. The chemicals should be stored in containers that do not react with their contents.
2. The chemicals should be stored conveniently near where they are used, such as a shelf over the sink.
3. They should be accessible. If you mix in large quantities for economy or because you use a lot, it's easier to plan on containers with spigots than it is to lift 5-gallon containers every half hour.
4. Containers should be airtight and preferably have a system to keep all air away from the surface of the chemicals. When air interacts with chemicals, it oxidizes them—an undesirable effect—so the less surface exposed to the air the longer your chemicals will last. The two best techniques for accomplishing this are containers that collapse as solution is removed, which keeps the air out, or floating lids for rigid storage containers.
5. The bottles for the chemicals should be opaque or amber colored, because light speeds the degradation of the chemicals.



Bulk Storage. Large quantities of mixed chemicals can be stored in plastic storage tanks. To make sure they are stored properly, use a tank with a floating lid. This lid prevents air from coming in contact with the stored chemical and weakening it. If the tank is more than 1 gallon, it is almost a necessity to have a spigot with which to draw off chemicals. These tanks are good examples of bulk chemical storage tanks. Kodak makes bulk storage tanks with floating lids in 7-, 14-, 30-, and 55-gallon sizes.

Courtesy Eastman Kodak Company

Storage Containers. These Falcon chemical containers have become the standard in the field. They are well made, durable, and have a convenient labeling system that allows you to identity the chemical, the date it was mixed, and any other pertinent information.

Air Evacuation Bottle. Falcon has also developed a way to keep chemicals at top form longer. These bottles allow you to squeeze the air out, thus prolonging the life of the chemicals by keeping air from contacting the surface.

Waste Disposal

Because darkroom work by its very nature produces waste products, the photographer should be aware of the nature of these products and what can be done to minimize their impact on the environment.

The factors affecting waste management are volume of effluent (the waste flowing out of the darkroom), temperature of effluent, types of chemicals used, and the ratio of chemical waste to wash water. The effluent from personal darkrooms is within most established sewer codes. The pH (measure of relative acidity or alkalinity of a liquid) is between 6.5 and 9, the temperature is less than 90°, and there are very few suspended solids. Most commercially available processing solutions contain no grease or oils, nothing flammable or explosive, and they do not have much color or odor. Photographic chemicals are generally biodegradable and will not harm municipally run biological treatment systems. It is not advisable to discharge photographic wastes directly into a septic tank and/or leach field, unless the amount is small in comparison to domestic discharge volumes or has been greatly diluted.

Many states require the installation of a back-flow prevention valve in the inlet water supply of the darkroom. The valve prevents chemicals from being sucked back into the domestic water supply if a vacuum is accidentally created in the municipal system.

The silver in the waste water is in the form of soluble silver thiosulfate from the fixing bath. It is not in the form of toxic, free-ion silver. The thiosulfate is converted by municipal processing plants into insoluble silver sulfide and some metallic silver. These are removed with other solids during clarification.

Recycling

Since the earth and its resources are finite, photographic chemicals should be conserved whenever possible. The use of replenishers instead of one-shot chemistry is advised where feasible. The main darkroom chemical that is recycled is silver. It can be removed from fixing baths by several methods—metallic replacement, electrolytic recovery, and ion exchange. For larger, commercial darkrooms with high flow rates, electrolytic or ion exchange are economically reasonable. For personal darkrooms with much lower flow rates, metallic exchange makes the most sense.

Metallic exchange is a very simple process in which a more active metal than silver (usually iron) replaces the silver and goes into solution. The insoluble silver metal settles out as a solid. There are several commercially available systems on the market. Photographers can make their own by placing steel wool in a drum and pouring the fixing bath into it. The silver will form a sludge in the bottom. This sludge is sold or given to a recycling company that recovers the silver. The silver content of the sludge is hard to determine, so most companies will not pay for it. They pick it up for free and make what profit they can. Even though the photographer receives no monetary compensation, the feeling of having made an effort to help the environment is payment enough.

8 Enlarging Equipment

Contents

Enlargers

The wide array of enlargers on the market is confusing to the prospective buyer because the criteria for selection are somewhat obscure. What separates a $150 enlarger from one that costs $2,000? Is the additional expenditure worthwhile and, most importantly, will it show in the prints themselves?

The most important elements in a black-and-white enlarger are that it be steady, optically aligned, and have a first-rate enlarging lens. The next most important criteria are the characteristics of the light source. This is secondary only because its choice is as much aesthetic as practical. Almost all other criteria for enlarger selection fall outside of the area of necessity into the area of convenience and comfort. Let's take a look at these criteria.

Steadiness. If an enlarger moves in any direction while an exposure is being made, the movement will decrease the quality of the print. The edges will lose definition and the overall sharpness of the image will be degraded. In many cases, the effects are wrongly attributed to the film, camera, or enlarger lens. Enlarger design certainly affects how steady the system is at the time of the exposure, but any enlarger, even a heavy-duty one already securely attached to a sturdy stand, can be made more solid by providing additional support for the top of the column. The steadiness of some enlargers is improved by wall mounting (see page 107).

Alignment. It is essential that the lens, negative, and printing surface be in perfect alignment to avoid image distortion, unevenness of illumination, and variations in focus from corner to corner.

Quality of Lens. This is probably the single most important element in any enlarging system, and is covered in detail in the section called "Enlarging Lenses" (see pages 144-145). With enough time and patience, almost every other enlarger shortcoming can be overcome, but there is nothing you can do about this element except make sure you have the best or buy another lens. In many cases, the lenses that come with an enlarger are inexpensive and are thrown in as part of a package deal. With camera optics being what they are today, almost any camera will outperform a cheap enlarger lens. This means that what you are getting on the negative is not what you are getting on the print. If possible, always buy the enlarger without the lens, or try to get a package price with a good lens substituted for the one that comes with the enlarger.

Light Source. The type of bulb used in an enlarger is relatively unimportant in black-and-white printing, but it becomes critical for color work. There are three major types of bulbs in use today:

1. *Tungsten.* These bulbs have been around for a long time and are perfectly suitable for black-and-white printing. They are less suitable for color work because they tend to degrade in intensity over their life span and change color balance.
2. *Quartz-halogen.* These bulbs are used in color enlargers because they have a steady output throughout their life cycle and do not develop a build-up of emissions on the glass envelope—which on tungsten bulbs changes the color characteristics of the transmitted light.
3. *Fluorescent tubes.* Some enlargers will use a series of fluorescent tubes as the light source. This is referred to as a cold light head and is discussed in more detail later.

Light Quality. The quality of light used in an enlarger varies from a highly diffused light to one where the light rays are as nearly parallel as possible. Generally, the more nearly parallel the light rays (called collimation), the sharper and more detailed the print will be. Sharpness isn't everything, however, so other characteristics have to be taken into account. The major types of light available are:

1. *Point source.* This is a light source emitting rays that are almost parallel and give an extremely sharp print. With 35mm film excessive sharpness can be a problem, because small imperfections such as dust or scratches will be magnified in proportion to the size enlargement being made. The sharper the image and the greater the enlargement, the more these imperfections become apparent. Point source illumination is rarely used because of its ability to highlight these imperfections. Its major application is in the making of large-scale photo murals.
2. *Condenser heads.* The condenser enlarger uses a lens to focus the light from the source onto the negative plane. Because the light is focused, the image is sharp and imperfections in the negative are obvious on the print. Its quality of magnifying imperfections is overridden by its advantages in terms of sharp images and fast printing times. For these reasons, it is the major form of black-and-white enlarger design.
3. *Diffusion heads.* The light from a diffusion enlarger source is unlike a condenser system in that the light is highly diffused (less collimated). This diffusion is achieved in several ways: opalescent glass can be inserted in the light path to mix the light; the light can be bounced back and forth in a mixing chamber to scramble it; in the old Vivitar VI, the light was diffused by bouncing against the walls of a light pipe. In all cases, the goal is to have the light scrambled at the point where it reaches the negative plane. This scrambled light results in a softer image on the printing plane and imperfections in the negative are less obvious on the prints.

4. *Cold-light heads.* These are the ultimate in diffused light. The high level of scrambling is achieved by having a very diffused source, which is usually a series of fluorescent bulbs in the shape of a grid to cover a wide area of space. Because the source itself is large in relation to the negative area, and because it is not focused through a lens system like the condenser system, it reaches the negative plane with the light rays heading in many directions.

Format. Enlargers work best in a relatively narrow range of film formats. If you plan on printing both 35mm and 8 x 10 negatives, it is not a good idea to buy an 8 x 10 enlarger and use it in both formats. Generally, enlarger design is good enough to encompass a small range of film formats and can do equally well with 35mm and 2 1/4 square, for instance. An enlarger to handle both 5 x 7 and 8 x 10 negatives also makes sense.

Quality of Construction. The quality of construction is a main criterion for choosing an enlarger. This quality will become apparent if you take the time to work with a few enlargers before making a buying decision. The ease and smoothness of operation, the positive control of locking and focusing mechanisms, the quality of materials, and the detailing on the enlarger itself should all be considered. It is definitely worth it to buy a quality enlarger.

Modular Design. A fully equipped enlarger is expensive and long-lasting. A modular design allows you to buy a basic black-and-white enlarger now and add equipment to it as your interests change or you shift into color printing. Regardless of what you think you may be doing five years from now, it is still wise to buy a modular enlarger. People's minds change, and since modular design costs little extra, you might as well make provision in case yours changes too.

Negative Flatness. If the image is to be undistorted and in focus at all points, it must be held flat in the negative carrier. In 35mm this is normally accomplished by sandwiching the negative between two sheets of material that hold it flat but that have an opening over the image area. If the carrier is well designed, this should be sufficient to keep the negative from buckling. Some enlargers in 35mm—and many in larger formats—use carriers with glass plates to hold the negative. These plates are made from special glass that does not make Newton rings where it comes in contact with the negative. These glass carriers hold the negative flat but provide additional surfaces for the light to refract off of, which lessens sharpness. They are also notorious collectors of dust and fingerprints.

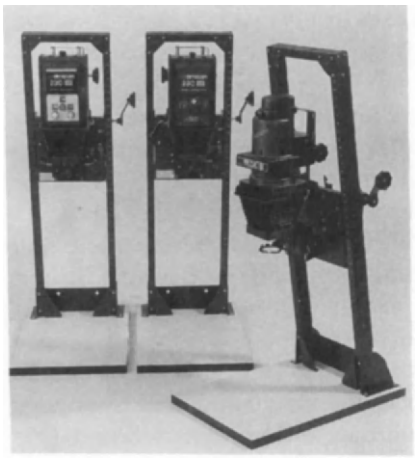
Tilting Lensboard. Some enlargers have a provision for tilting the board on which the lens is mounted. This allows for the correction of distortion known as "convergence of parallels." If you have ever taken a photograph of a tall building from close up and had to tilt the camera to get the whole building in, you may have been surprised at what you saw when the print came back. The parallel lines of the vertical walls of the building will not be parallel in the photograph but will converge as they move farther from the camera position. This effect is not unlike the apparent convergence of railroad tracks as they recede into the distance. A tilting lensboard will help correct this distortion by tilting the image the other way when printing and thereby reversing the effect. The end result is a print with parallel lines.

Size of Enlargements. The height of the enlarger column determines the size of prints that can be made with a given lens/film format, because the main determinant for image size is the negative-to-easel distance. Most enlargers have a column long enough to print up to 11 x 14 on the baseboard, which is the size range that most photographers use. If you want to make larger prints, buy an enlarger that accommodates them on the baseboard, provides a capability to tilt the enlarger head to focus the image on a nearby wall, or build an adjustable baseboard (see Chapter 6). One shortcoming of tall columns is that they have a tendency to be unstable and cause vibrations that result in unsharp images. For economy and convenience, the adjustable baseboard is the best answer.

Keep in mind that the size of enlargement you want may be understated. For example, if you print 11 x 14 and buy an enlarger that accommodates that size you may be disappointed. If you decide to crop an image heavily you may discover that to make an 11 x 14 print of the section you want you must enlarge the total projected image to 16 x 20—beyond the capacity of your enlarger.

Filter Drawers. If you plan on using variable contrast papers or experimenting with color printing, you will need a place to put the filters between the light source and the negative plane. A good enlarger will have a drawer into which they can be placed. If the enlarger does not have such a drawer, you will have to buy much more expensive filters that can be placed between the lens and the easel.

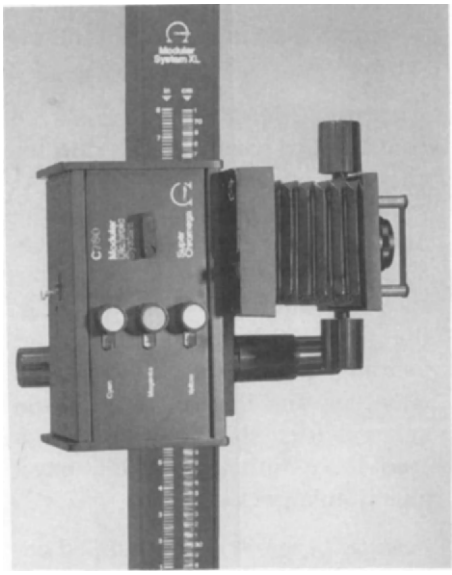
Enlargers, continued



Modular Design. Although many photographers start by making black-and-white prints, Kodak's RA print system makes color so easy that many would like to switch. Enlargers now come in modular designs that allow the replacement of the condenser head with a dichroic head. The head makes changing variable contrast filtration much easier as well as providing the necessary filters for color work.

Perspective Correction. This enlarger head twists to allow you to correct perspective problems with an image.

Level. Saunders supplies a level designed specifically to be used to align on an enlarger. Its small size allows it to be used to level the negative stage and ensure that it and the baseboard are in perfect alignment.



Large Prints. This enlarger allows you to make mural-size prints by easily turning the head assembly and projecting the image onto a wall.

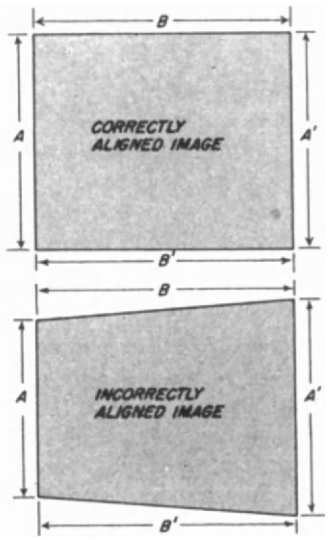
How Do You Know the Lens, Negative, and Easel Are Parallel?

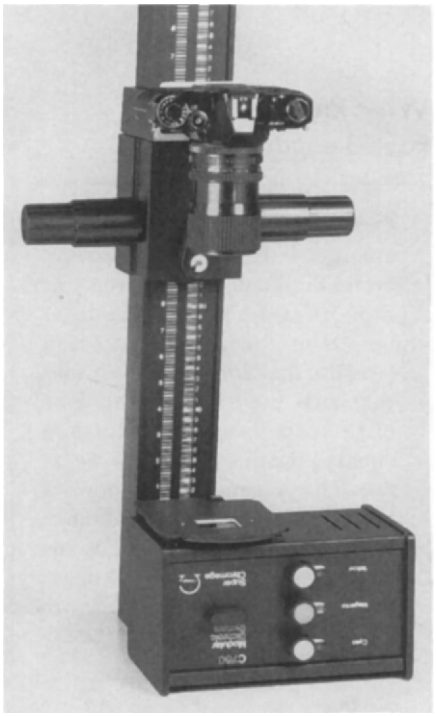
Having all the elements in the enlarger light path parallel is important if the image is to be sharp from corner to corner and undistorted. Project the image and focus as you would if you were making the final print.

Gradually move the enlarger or its lensboard to correct the image area to make the parallel sides equal in length.

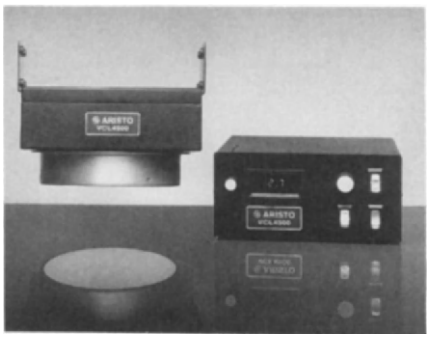
Correctly Aligned Image. If the projected image is perfectly parallel to the negative plane, as it should be, the parallel sides of the image area will be equal in length. In this diagram, the parallel sides A and A' are of equal length to sides B and B'.

Incorrectly Aligned Image. Measurements of the image area in the improperly aligned image reveal that although the parallel sides B and B' are of equal length, those of A and A' are not. This indicates that either the easel surface, lens, or negative—or all three—are out of alignment.



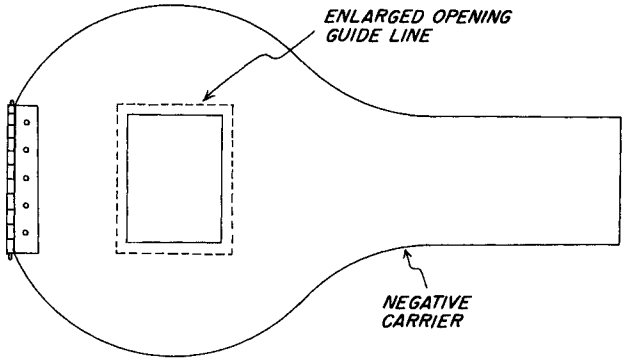


Slide Copier. The dichroic head is turning upside down to provide a light source that is cool and even. Using the built-in filters allows color correction of the slide.

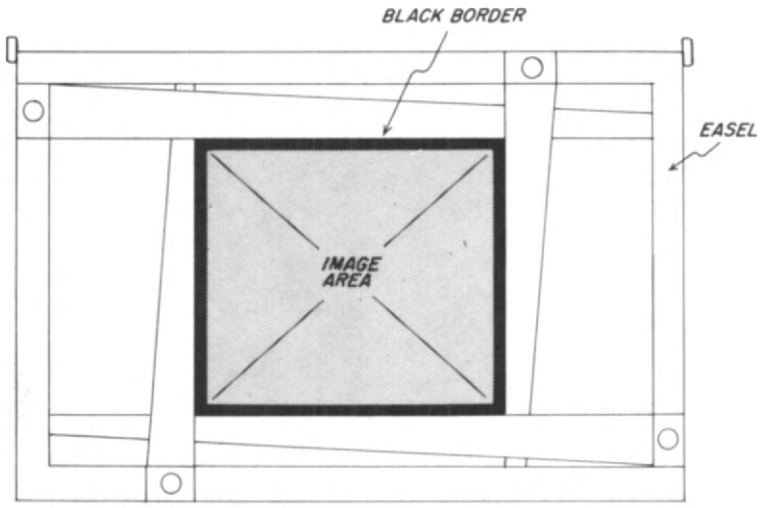


Aristo Cold-Light Head. Aristo manufactures cold-light diffusion heads for many of the major models of enlargers. Because of the type of light source, there is no heat on the negative plane and the highly actinic (photographically active) rays produce extremely fast printing speeds. The VCL 4500 is a variable contrast head that fits enlargers from 35mm to 5 x 7.

Photography is like all other art forms in that it is periodically swept with waves of fashion. One of the recent waves is that what you shoot is what you print. That is, some photographers prefer to do all cropping in camera at the time the picture is taken, then print the entire image plus a narrow border of the surrounding unexposed film (clear on the film, black on the print). The black border has the added benefit of holding together what might otherwise be a loosely organized image. Here's how it can be done: The edges of the window in the negative carrier are filed down to increase the opening to a size slightly larger than the image area of the negative. Draw guide lines on the carrier and file both halves at the same time. Some carriers will already be slightly bigger than the image area and others will be slightly smaller so the amount of filing necessary varies. File only a small amount, insert the negative and hold it up to the light. If a narrow area shows around the negative image area it will print black because the light coming through it will be unrestricted by negative density. If the border around the negative area does not show, file in gradual steps until it does. File corners carefully—either rounded or squared, but all four the same.



The filing should be done as evenly as possible but mistakes can be evened out in the print by adjusting the blades of the printing easel. With the negative in the carrier focus the enlarger on the easel surface with the image enlarged to the size you want. Now, instead of using the easel blades to make sharp edges on the sides of the image area they should be backed off slightly to leave room for the black border. The distance the easel blades are backed off from the image area makes any fine adjustments of the width of the black border.



Enlarging Lenses

A chain is only as strong as its weakest link, and the chances are that in most darkrooms the weakest optical link is the enlarging lens. Most of us are quite willing to spend a great deal for a new wide-angle or telephoto lens, but are happy to accept a lens that came as part of the "package" when the enlarger was purchased. A top camera lens will not overcome the deficiencies of a cheap enlarger lens, so it's worth the extra money to upgrade your enlarger lens if need be. You may discover after printing with a better enlarger lens that your camera lens is better than you thought.

When purchasing an enlarger lens there are several factors to consider.

Optical Quality. Enlarging lenses differ from camera lenses: they are designed to project a flat image (the negative) onto a flat plane (the easel). When first buying a lens, you may have to rely on brand names to determine quality, but if you can test the lens before buying it, there are ways to check its quality.

Evenness of Illumination from Corner to Corner. For each lens aperture setting, expose a sheet of the paper size you normally use sufficiently to give you a middle gray tone. Try to obtain the same tone on each sheet (the Kodak enlarging calculator in the "Kodak Darkroom Guide" can be used to adjust times as apertures change). Compare the prints to see if any show the image tone becoming lighter toward the edges and corners. If so, those apertures should be avoided or the lens returned.

Resolution. Using a Kodak test negative and a low paper grade to reduce contrast, make a print at each of the lens's aperture settings. Compare them to see if they are sharp across the entire image area. If not, select the one that is sharpest, and you have at least determined your lens's optimal setting.

What Enlarger Lens Focal Length?

Ordinarily, the focal length of the enlarger lens needed to provide even illumination for a given size negative is the same as the focal length of the taking (camera) lens for that format. Going one step back, the normal taking lens of the camera is approximately equal to the diagonal of the negative. This means that the normal lens for a 35mm negative is 50mm for both the camera and enlarger. For a 2 1/4 x 2 1/4 negative it would be 75mm.

Focal Lengths

Negative size	*Enlarger lens focal length*
35mm	50mm
2 1/4 x 2 1/4	75mm-105mm
2 1/4 x 3 1/4	100mm
6cm x 7cm	100mm
4 x 5	135mm-150mm

Beseler HD Series Enlarging Lenses. Beseler lenses are high-quality lenses that meet the most critical demands of the amateur photographer.

Schneider Componon Lenses. Schneider Componon lenses have an excellent reputation. They perform extremely well through their entire range of apertures. They are expensive but worth every penny if you care about obtaining the sharpest possible images.

Wide-Angle Lenses. Bogen was one of the first to introduce the concept of wide-angle enlarging lenses. These lenses reduce the negative-to-easel distance required for a given enlargement. They also reduce the vibration problem caused by raising the enlarger head on the column, because they reduce the height to which it must be raised for a given image size.

Lens-Cleaning Cloth. Much handier than old lens-cleaning solutions (especially when on location) that required the moistening of a lens surface, then using a special tissue to wipe it off—which was almost impossible to do outside. If kept clean and used with care, it will last a long time and give excellent results.

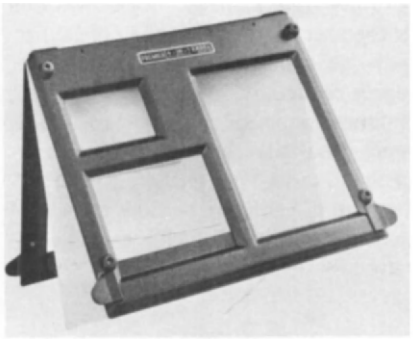
Easels

A seeming misnomer, enlarging easels are so named because early photographic enlargers were horizontal devices, and upright artists' easels were used to hold the print material in front of the lens. The steady evolution of these paper holders now offers the darkroom enthusiast a wide choice of easel types, styles, and, of course, sizes.

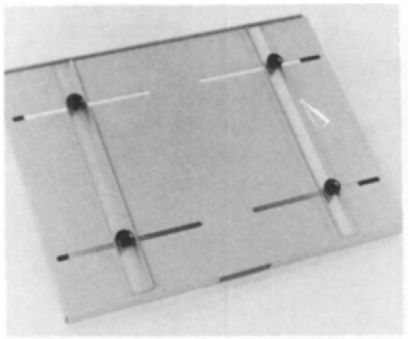
To the beginner, an easel is often an afterthought, selected on the basis of lowest cost to complete the enlarger outfit. Even limited darkroom experience, however, will show that the proper choice of easels will pay dividends in printing speed, convenience, and accuracy. Moreover, like the enlarger, the easel, if properly selected, is usually a one-time purchase whose useful life is usually measured in decades. The all-purpose easel is a bladed type, which permits adjustable border sizes. Most low-cost easels are two-bladed styles that are satisfactory for the beginner, although they have two limitations. First, paper is always registered into the upper left-hand corner and to position the paper under the enlarger lens, the easel is moved down and to the right of the baseboard. When making small prints, the easel can hang over the edges of the baseboard, which can be awkward. Second, the range of border treatments and sizes is limited. Most professionals prefer a high-quality four-bladed easel that always stays centered on the baseboard and that permits making borders up to 2" or more. However, if price is crucial, you are better off with a good-quality two-bladed easel than with an inexpensive four-bladed one. There are also available a large number of special purpose easels, ranging from ones that make test strips to ones that hold the paper flat with either static electricity or a vacuum.

How to Select an Enlarging Easel

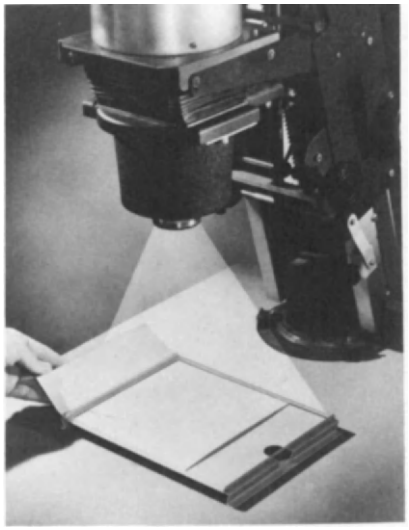
1. Determine the largest paper size you commonly print (for very large prints, you will want to bench-mount or wall-mount your enlarger).
2. Decide what type of easel is best suited to your requirements—bladed, borderless, single-size (speed easel), or multi-print.
3. When going to a camera store to look at easels, take along a fresh sheet of unprocessed paper of the maximum size you'll be printing (don't roll it and don't take a processed print, since paper often stretches after processing).
4. Examine the easel you are considering on a solid table at a normal working height. After reviewing the instructions, operate the easel a few times to get used to it and then try loading and unloading it with your eyes closed. You will be surprised at the difference in registration and handling characteristics between different easels.
5. Check for border accuracy by tracing the blades with a sharp pencil. (Be sure your test paper is, in fact, square.)
6. Hold the easel at eye level and sight across the face, checking for flatness,
7. Look for good finish, a skid-resistant bottom, smooth edges, good fit in hinges and working parts, accurate scales, adjustments that stay put, and blades that are absolutely flat and square.



4-in-1 Easels. This Premier 4-in-1 easel is typical of models that allow you to make more than one image size on a single easel. This model has three sizes on the front and a border for 8 x 10 printing on the back side.

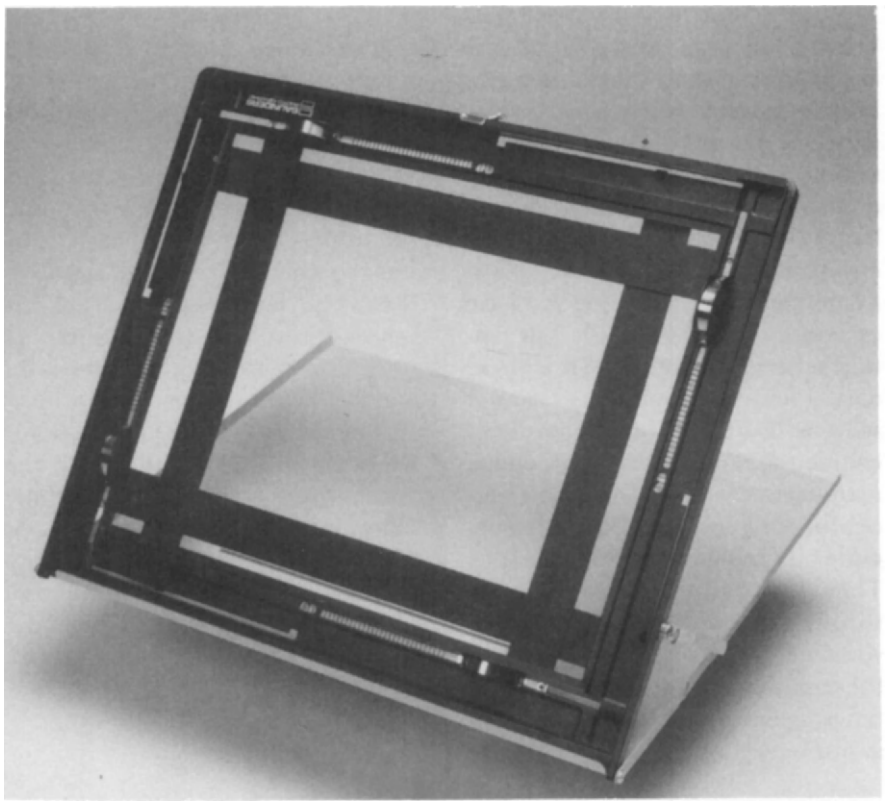


Borderless Easels. Borderless prints in the past were made under glass, until Saunders introduced their unique borderless easel with angled paper retainers. This easel is now widely imitated, but quality among other brands varies. These easels work on the "cone of light" principle, permitting the projected light from the enlarger to expose the very edges of the paper, even while the print is securely held by retainers whose front edges match the projection angle. In judging these easels, look for smooth and straight paper retainers that are usually extruded aluminum. Check for perfect base flatness and smooth finish. The non-skid material on the bottom of the base is most important, and the best borderless types use long cork strips along all sides.

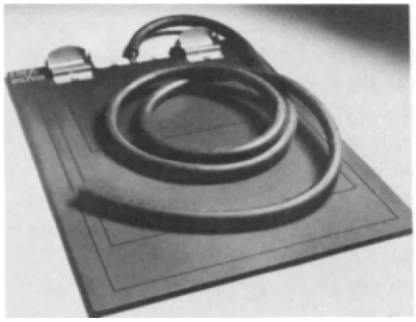


Single-Size Easels. When making quantity prints, or for sheer speed and convenience, single-size easels are the logical choice. Ganz makes a full selection of easels of this type that are loaded by sliding the paper into a channel. These easels are lightweight and can be taped to the baseboard to prevent their being pushed out of position.

All single-size easels have fixed borders, usually 3/16" or 1/4" all around. This is fine for publicity prints, catalog shots, or commercial shots that are to be placed in frames or folders.



Four-Bladed Easel. The Saunders Omega easel is the standard in the industry when it comes to four-bladed easels. The four blades allow you to center the image on the paper, leaving a white border on all sides. This makes the prints more attractive if you do not want to trim and dry mount them.



Vacuum Easels. Rather than use blades to hold paper flat for printing, it is also possible to use a vacuum. This Kodak vacuum register pumps the air out from behind the paper so air pressure holds it flat against the easel surface.

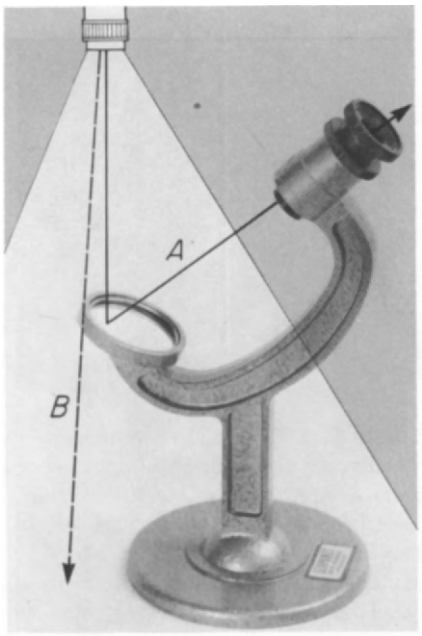
Courtesy Eastman Kodak Company

Focusing Magnifiers

When making an enlargement, it is always desirable to have the image projected onto the paper plane as sharply as possible. If it is not, the resulting image will be blurry and the quality of both the taking and enlarging lenses will be undercut. Focusing with the naked eye is extremely accurate, assuming you have extremely accurate vision, but natural selection being what it is these days, a lot of photographers cannot see as well as they should. In order to compensate and make us all equal, manufacturers have developed various focusing devices, all of which operate on the same general principle. They focus the projected image through an eyepiece so that what you see is the image as it appears on the easel surface but enlarged many times, making a small part of it very easy to see.

This allows you to watch the magnified grain go from fuzzy to sharp to fuzzy again as you adjust the focus. You can then select the point at which the image is the sharpest. Since focusing on the film grain itself rather than on a part of the image (which might have been deliberately left out of focus) is the best way to ensure a sharp image, one of these devices can be a real time saver and can help to make better prints.

The main features to look for when buying a magnifier are the amount of magnification, the durability, and the lens construction. As with everything else in photography, price is usually a general indicator of quality, but you must determine what price meets your own needs adequately.



Focusing Magnifiers. A focusing magnifier works by reflecting some of the light from the enlarger up into an eyepiece that magnifies the reflected image. The unit is designed so that the distance of the light path from the enlarging lens to the focus magnifier's mirror, and then to its eyepiece (A), is identical to the distance of the light path from the enlarging lens to the baseboard on which the magnifier rests (B). This design allows you to see the small image grains in the negative exactly the way they appear on the baseboard. This allows you to focus the image very finely and also explains why the magnifier needs to be resting on the same surface that you print on, since it's designed to bring that point into focus. Place a piece of the paper you are printing on under the magnifier when focusing.

How to Get the Sharpest Print

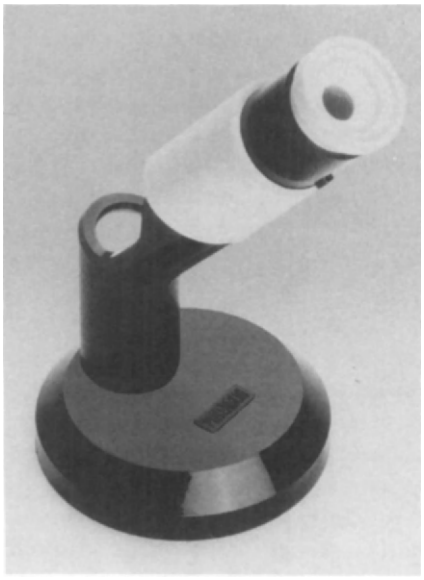
All focusing magnifiers are designed to focus on the same plane upon which their base rests. Therefore, if you focus with the grain magnifier on the easel surface and then use a piece of double-weight paper on which to make a print, you have not focused and printed on exactly the same plane. To eliminate this problem, you can put a piece of paper similar to the one on which you print under the base of the magnifier. If you use the same paper regularly you can glue a piece to the base of the magnifier, which eliminates the need to think about it every time you want to focus.

When focusing, the best way to find the sharpest image is the same way you would with a microscope or a ground glass on a view camera. You focus until the image comes into focus then goes slightly out. You then back up to the sharpest image and go slightly past it, repeating this back and forth while gradually narrowing the range of movement until you have the image focused without doubt.

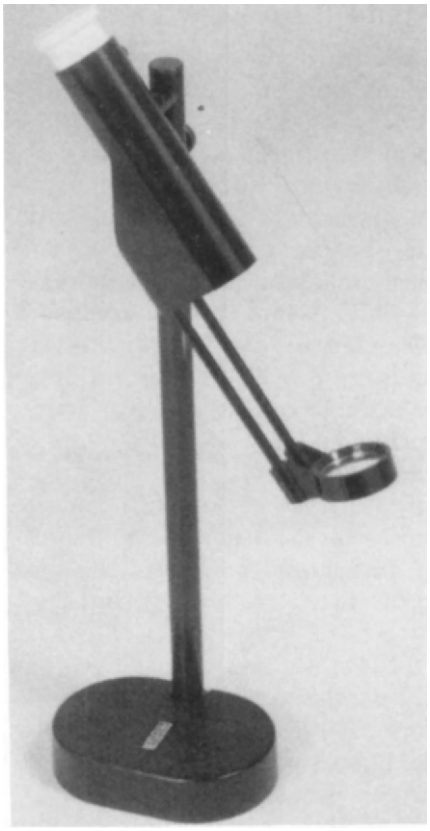
Each f-stop of the enlarging lens will have a slightly different focus, so either focus using the f-stop at which you plan to print, or at least print at a smaller f-stop (which has more depth of field).

Omega Micromega Critical Enlarging Focuser. This focuser is the ultimate focusing device, with several unique features:

- It can focus almost everywhere in the projected image, giving you a chance to compare the focus of the lens at the center of the image and at the edges. The focus will normally be better at the specific aperture for which the lens was designed, and the point of focus at the center and edges will generally get farther from each other as you move the f-stop farther from the best one for your particular lens. If you can't bring them together by focusing, perhaps you need a new lens (test a new one before you buy it).
- The mirror surface is deposited on the front of the glass surface rather than behind it. This lessens the distortion brought about by light passing through a surface.
- It has a blue filter to help compensate for chromatic aberration in the enlarging lens. Visual focusing is done at 4800 to 5600 angstroms in wavelength, and black-and-white printing paper is most sensitive to light from 3800 to 4300 angstroms. The blue filter eliminates some of the higher wavelengths in the tungsten light source, which allows you to focus on the shorter ones that are closer to what the paper will actually record.



Paterson Micro-Focus Finder. This modern focus finder has a very bright image and an adjustable eyepiece to customize it to your eye.



Paterson Major Focus Finder. This tall focus finder is convenient for focusing large prints since the head of the enlarger will be high above the easel.

Negative Cleaning and Dusting

Negative Dusting

Dust on negatives leaves enlarged white spots on prints because the dust enlarges at the same rate as the projected image. This can be especially serious with 35mm photography because of the high magnification required to go from a small negative to a large print. It is usually easier to ensure that the negative is clean before printing it than it is to spot the print later. Dust on negatives can be caused by several factors, including the general cleanliness of the darkroom, the protective measures that have been taken, and the storage of the negatives themselves.

Techniques to reduce the dust problem to a minimum include:

1. Do not mix dry chemicals in the darkroom. Fixer is especially injurious to negatives, but any chemical powder will hang in the air to settle somewhere eventually. Mix these chemicals in another room separate from the darkroom and your stored negatives. (If you use a bathroom for a darkroom, don't use talcum powder.)

2. Store negatives in envelopes or pages as recommended in the last section of this chapter.

3. Install a doormat at the outside of the entrance to the darkroom to reduce the amount of new dust brought in.

4. Install filters over all vents and fans through which air enters the darkroom.

5. Install an electrostatic air cleaner to circulate the darkroom air and remove dust from it.

6. Keep the humidity between 45 and 50 percent to eliminate as much static electricity as possible. You might remember childhood days that were extremely dry when you could rub your feet across the living room carpet and zap your sister or brother with a jolt of static electricity. This same effect is encountered in the darkroom, and static electricity attracts dust and holds it to negatives. Moderate humidity lessens this occurrence.

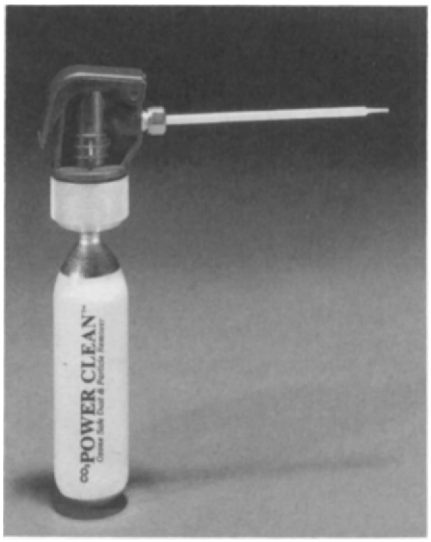
Even if you take these precautions, there will still be dust on your negatives, but by then the problems should be minor and controllable. At the time of printing this remaining dust can be removed with an aerosol can of compressed air or an antistatic dusting brush.

Negative Cleaning

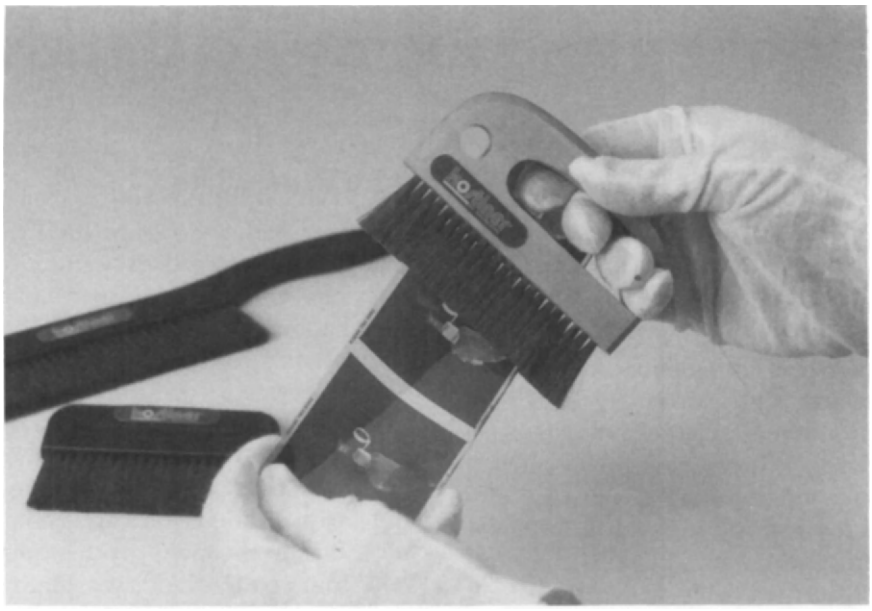
In addition to dust, negatives are sometimes marked with chemicals or fingerprints. The best solution to this problem is prevention, but if something does happen to one of your negatives, you should clean it. The acid in skin oils is especially harmful and if left on the negative can eventually etch itself permanently into the emulsion. You can remove fingerprints with Kodak film cleaner or by careful rubbing with a very clean antistatic cloth. Should chemicals of any kind come in contact with your negatives, rewash them immediately.

Falcon Dust-Off. When it comes to making dust-free prints, there may be a conflict between your concern for the prints and your concern over the ozone layer. Many photographers have chosen to sacrifice the ozone layer, because its remoteness and size make it harder to comprehend. Aerosol cans containing compressed air, such as this product by Falcon, are effective for blowing dust off of your negatives.

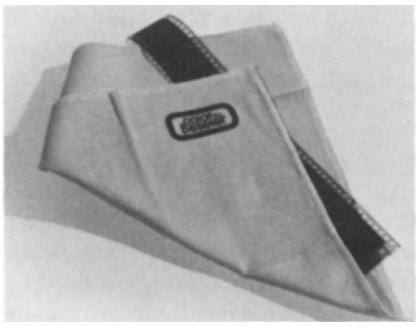
When using an aerosol can, remember that you should never shake it before using. Shaking makes the propellant mix with the chemical and escape through the valve. The sudden decompression can dramatically lower the temperature of the propellant and can actually freeze your negatives, causing serious damage.



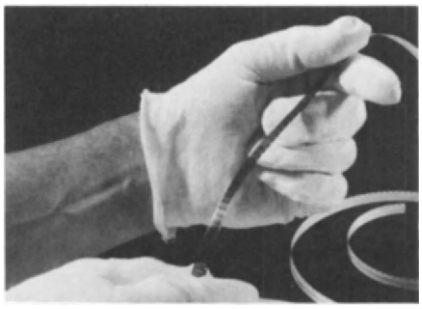
Leland Power Clean I. The Leland Power Clean I is an environmentally safe (and very stylish) addition to the area of compressed gases that photographers use to remove dust from their negatives or any type of equipment. The problem with it is that it has a rounded bottom and will not stand up, taking up more counter space than necessary.



Kostiner Anti-Static Brush. Special synthetic brush fibers use resistance flow to eliminate dust and static electricity. There are no radioactive elements, and no chemicals.



Antistatic Cloth. If you are very careful, you can use a cloth such as this Beseler antistatic cloth for negative cleaning. To be effective, it must be perfectly clean; any dirt on it can scratch a negative.



Cotton Gloves. When doing extensive handling of negatives (or prints), an ounce of prevention is worth a pound of cure. The best insurance against fingerprints is to wear a pair of clean, lint-free cotton gloves like these from Porters Camera Store. They are inexpensive and reduce the worry of damaging the negatives as a result of a mistake.

Compressed Air. Compressed air, although somewhat luxurious for most darkrooms, is invaluable for chasing dust from negatives and equipment. If you have access to a small electric compressor, make sure the air is made dry and oil-free by proper filtration.

Photo by Metzger Studio, Rochester, New York

Printing and Exposure Controls

Beginning photographers often experience difficulties when making their first prints. The density of their negatives tends to vary from greatly underexposed to greatly overexposed. Each print becomes an exploration in patience when you try to find the proper exposure. The problem is compounded because densities vary within the negative itself, and therefore there may not be a perfect printing exposure for the entire negative. Luckily, there are devices available and certain techniques that can be learned to make it easy to find the correct exposure for the print as a whole and also to modify the exposure of various portions within the print.

The Correct Exposure

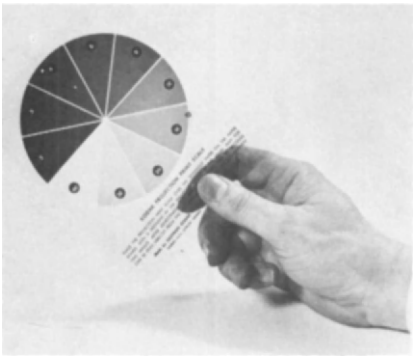
Expensive electronic exposure meters are not necessary for making high-quality prints. They are used by labs making large quantities of prints, but most photographers prefer the quite accurate method of making a test strip, which is a piece of printing paper on which a series of exposures are made at progressively longer times. By reviewing the test strip after it has been developed and fixed, it is easy to pick out the part of the strip that looks best.

The Work Print

The time on the part of the test strip that looked right is then used to expose the entire image on what is called a work print. This print is developed and fixed and then evaluated in terms of the tonal values. Some areas may be too dark and others too light. At this point a decision must be made as to how to change the various tones. You can accomplish this by changing paper grades (the higher the grade, the higher the contrast) or by local burning and dodging. Burning means increasing the exposure time for various parts of the print to make them darker; dodging is holding back light from sections to make them lighter.

The Final Print

The final print can be the same as the work print if everything is satisfactory. Normally, however, the final print will have to be manipulated to some extent to make it a more interesting or effective image. The tools needed to control the values in the print are simple and can be made out of cardboard. Some are also available commercially and are described in this section.



Kodak Projection Print Scale. This projection print scale consists of a plastic sheet with each pie-shaped slice having a different density. When placed over the printing paper so light passes through it during the exposure, the finished print will show wedges of varying darkness. By comparing the one that seems right with the print scale, you can determine the correct exposure time for the work print.

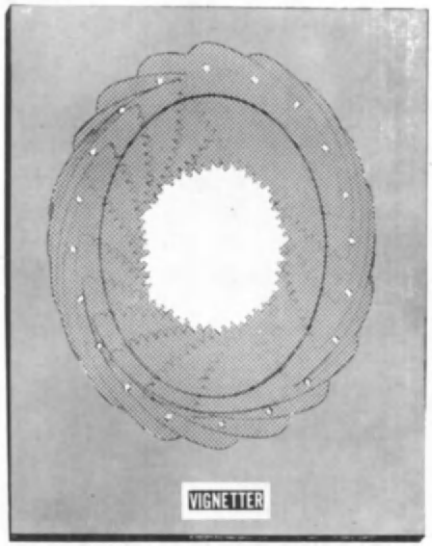
Courtesy Eastman Kodak Company

Enlarging Exposure Meter. This Paterson meter is typical of exposure meters used in making enlargements. If you work with widely varying negative densities, they can help you save paper by reducing the number of test strips you will need to make.

Dodging and Burning

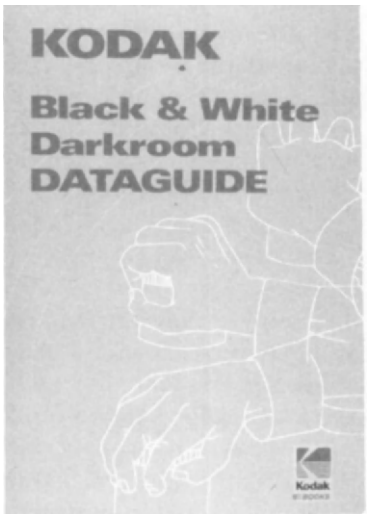
You can make dodging tools at home out of pieces of black cardboard cut from empty printing paper containers and taped to a piece of wire coat hanger. Circles or other shapes of various sizes can be made to hold back light from larger or smaller areas.

Burning tools do the opposite of dodging tools: they hold back the light from the majority of the print while increasing the exposure of a relatively small portion of it. Several pieces of cardboard, each with a different size hole, will be useful. The holes can be circular or cut to the general shape of the area you want darkened. Vignetting tools are similar to those used in burning, but they generally have a larger opening, often with a serrated edge, so that when the tool is moved about in the beam of light from the lens, it will leave a smooth and gradual line between the dark and light areas.



Vignetter. This Testrite vignetter can be varied in size to fit the size area you wish to vignette. It can also be used as a burning tool by changing the size to fit the area you want burned. Oscillate it smoothly and continuously in the light beam while making the exposure.

Test Strip. This test strip is typical of how they can be made. Each successive strip has an increased exposure over the previous strip. By looking at the strip, you can tell what the correct printing time should be. One of the key points to remember is to place a part of the print that shows all of the tonal values to be considered in each segment of the test strip. If this is not done, it will be impossible to judge the correct exposure as it relates to both highlights and shadows.



Kodak produces many sources of technical information. The reader may want to avail themselves of this extensive body of information by obtaining a list of these publications from their local camera store. This one is a must for the darkroom beginner, but also is a good reference guide for the experienced printer.

Negative Storage and Proof Printers

After the camera has been unloaded and the film developed, it's important that the negatives be stored carefully and that you can see what is on them. A negative is an irreplaceable record and should be treated with the care that all such items deserve. The history of photography is replete with stories of valuable negatives being destroyed. Many Civil War negatives on glass plates, including some Brady negatives of Lincoln, were recycled into such useful items as greenhouses. You may not want to preserve your negatives for posterity, but you may want to make prints from them in the future, so they should be maintained in as good a condition as possible.

Contact-printed proofsheets can be made to show you what the negatives contain. They are made by laying the negatives, emulsion side down, on a sheet of printing paper, holding them flat with a piece of glass, and exposing them with the enlarger light. The resulting images are the same size as the negative image. Making proofsheets serves several purposes:

1. It lets you more easily find a given negative by allowing you to look at positive images rather than holding negative strips up to the light.

2. If contact sheets are made correctly, the proof will tell you not only the subject matter of the negative, but also its quality in terms of exposure, density, sharpness, and so forth. To determine the density of a given negative it is important to print all of your proofsheets to the same standard. In this way you can tell by looking if the negative is under- or overexposed or is satisfactory.

How to Standardize Proofsheets

Many photographers try to make their proofsheets look like a series of little gallery prints. The problem with that approach is that it makes it difficult to evaluate negatives that are selected for enlargement. It makes a great deal of sense to standardize the exposure given to all proofsheets so you can tell immediately by looking at them if a given negative is well-exposed or is under- or overexposed. You will also be able to tell if you are consistently underexposing or overexposing the film.

To standardize the printing of proofsheets you must determine the exact exposure time required to print pure black in the areas of the negative lacking in detail (very dense shadow areas). This is accomplished by testing to determine how much exposure is necessary to obtain pure blacks in the unexposed edges of the film.

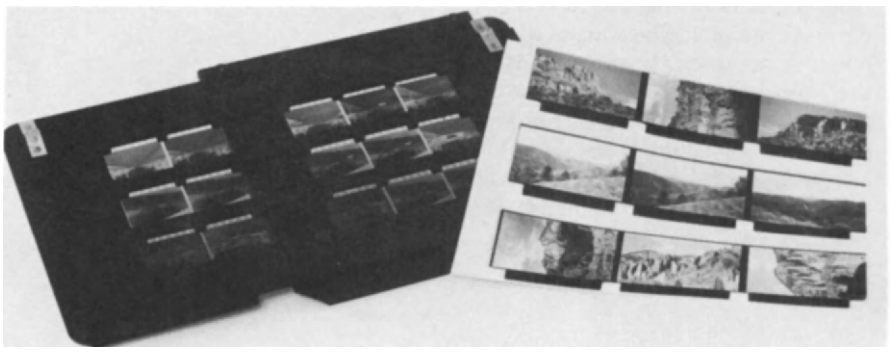
The edge of 35mm film has a series of sprocket holes used to transport the film when it is advanced in the camera. These holes are completely transparent because the film has been removed from them. The area around the holes appears to be transparent, but it actually has some density (called film base plus fog). To determine the correct exposure you have to determine at what point the area around the sprocket holes turns just as black as they are. Here's how:

1. With a negative in the enlarger, focus it as if you were planning to print a full-frame 11 x 14 enlargement. Remove the negative.

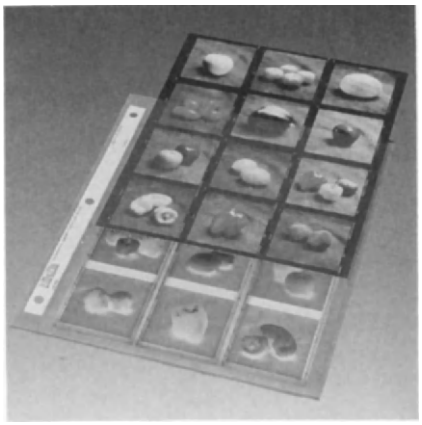
2. Make a test strip using the negatives and proof printer, giving increasingly longer exposures to each successive strip, that is, 5, 10, 15, 20 seconds.

3. Process the print sheet and examine it under good lighting. You will notice that the area under the sprocket holes turns pure black much earlier than does the area surrounding them. At some point on the test strip, the holes should no longer be distinguishable from the surrounding area because both the holes and the surrounding area are pure black. The time of exposure needed to make this happen is the correct exposure to make all subsequent proofsheets.

If as a result of standardizing you find that all of your proofsheets are too light or too dark, you will know that you have a tendency to over- or underexpose. You should make the correction at the time the picture is taken (or later, when the print is made), and not tinker with the proofsheets.



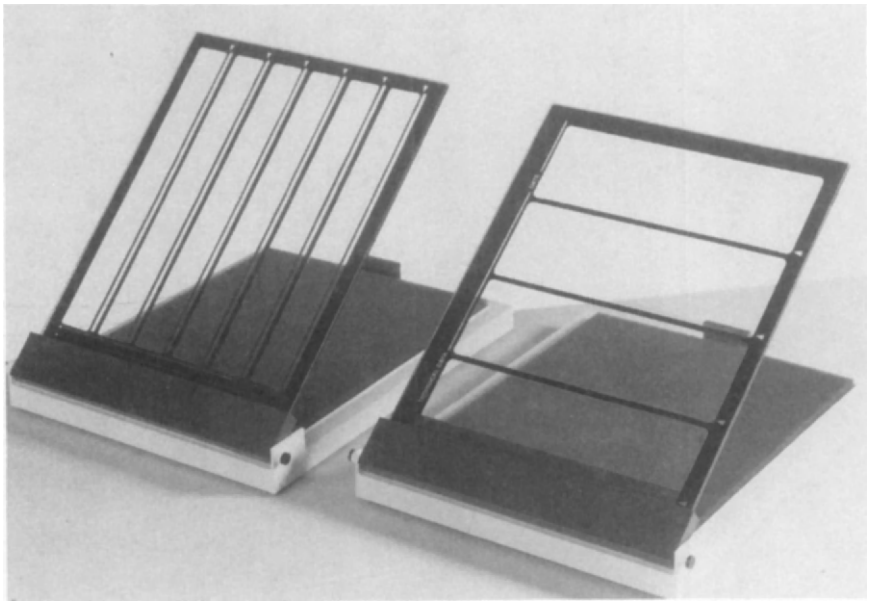
Negative Carrier. Saunders has developed a negative carrier that can be used in a 4 x 5 enlarger to make enlarged proofsheets. The problem with standard 35mm proofs is that it is very difficult to evaluate accurately the image because of its very small size. With this unit, the proofsheets have enlarged images that are easier to evaluate.



Print File. Although some negative storage envelopes on the market require you to remove the negatives from the sheet to make a proof sheet, this step has been eliminated by some of the newer envelopes that allow you to print through the sheet holding the negatives. In addition to being a great time-saver this also subjects the negatives to less handling and therefore reduces the possibility that they will incur any damage. Print File makes a complete line of these negative storage envelopes for different film formats. They are also designed to fit any 3-hole binder which eliminates the additional expense of having to pay a higher price to fit a nonstandard storage binder.

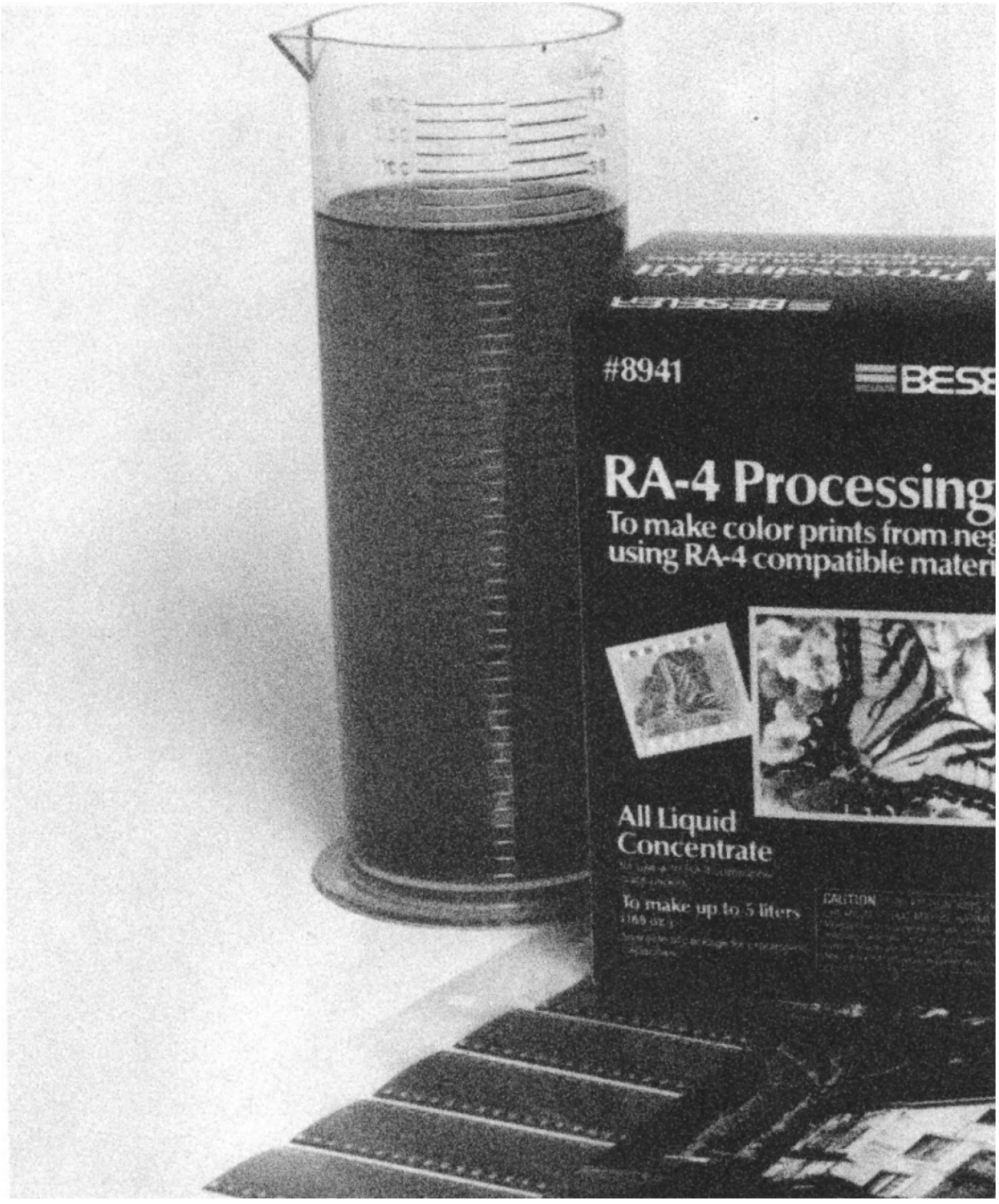
Large Print Files. Used for storing large size prints.

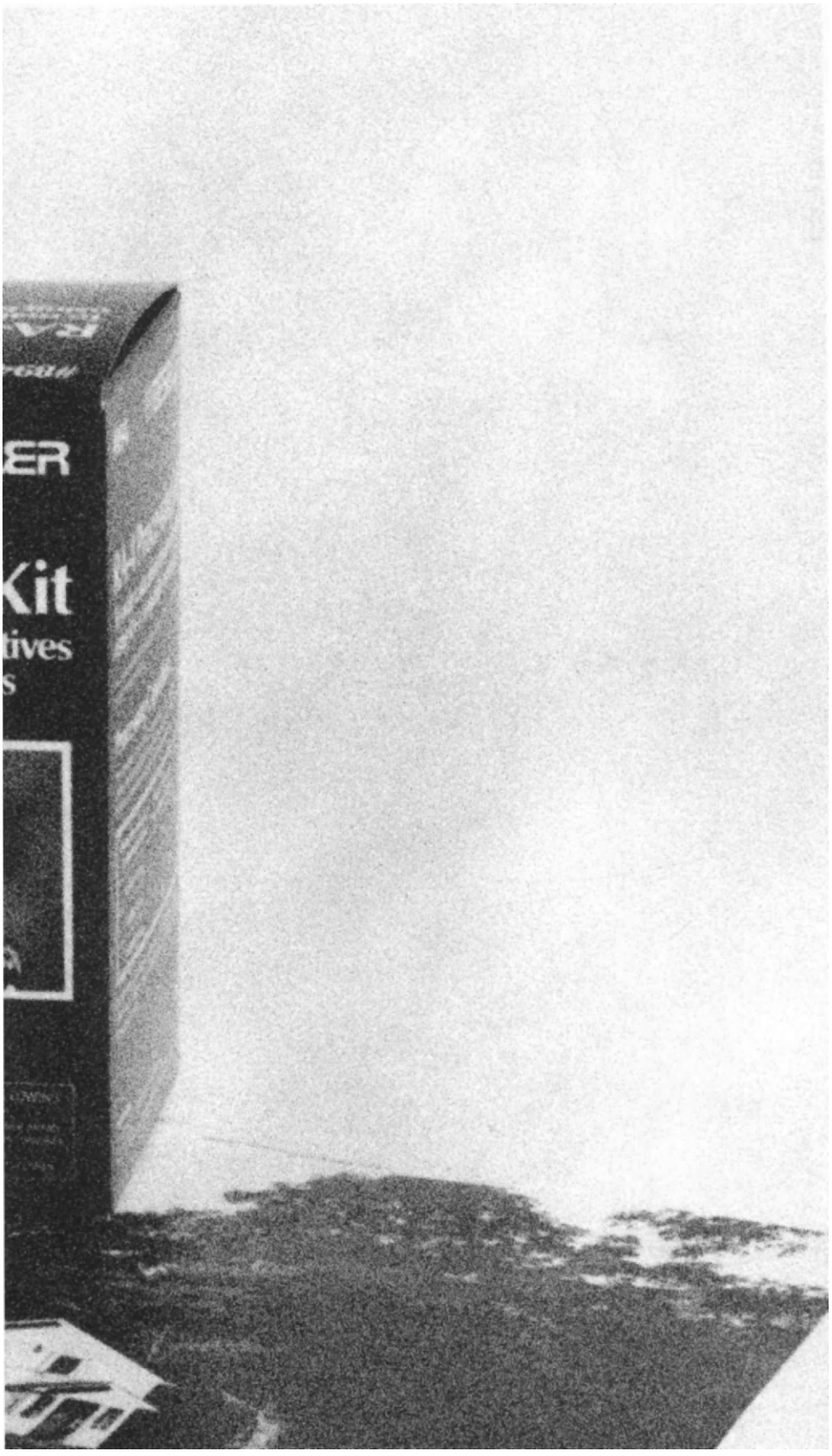
Proof Printer. Print File and others also make proof printers that hold the negatives flat against the printing paper, which is absolutely necessary if your proof sheets are to have accurate, sharp images. This can be done with a piece of clear glass but if you print a number of rolls at one time the hinged proof printer makes it much easier and faster.



Print File Hangers. These plastic inserts allow Print Files to be used in a standard Pendaflex filing system.

9 The Color Darkroom





Contents

Introduction to Color

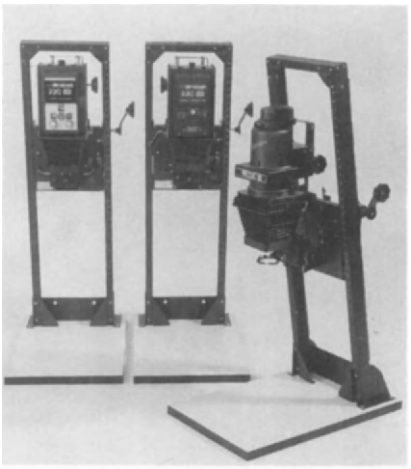
With the introduction during the past few years of greatly simplified color-print chemistry and affordable processing equipment, there has been a phenomenal increase in interest in color printing. More and more home darkroom photographers and professionals are making their own color prints. Until a few years ago, the time, effort, and expense involved made it impractical for anyone but a technical expert to do what anyone can do today.

The Starter Darkroom

One of the first questions a teacher of color photography is usually asked is, "What kind of darkroom do I need?" The assumption is that something very elaborate is required. However, a color darkroom can be even simpler than one designed for black-and-white processing. One of the main differences pertains to safelight illumination. Color printing paper is sensitive to light of all colors, so it cannot be exposed to bright safelight illumination. (Some papers allow the use of dim safelights, but the illumination is so weak it provides little help.) This shortcoming is easily overcome; once the paper is exposed under the enlarger it is placed into a light-tight drum or tabletop printmaker for processing.

This section is a general overview; additional information can be found in the following sections of this chapter. As a primer, however, here are the basic materials needed to set up a color darkroom or to convert a black-and-white darkroom to color.

Equipment Common to All Color Processes



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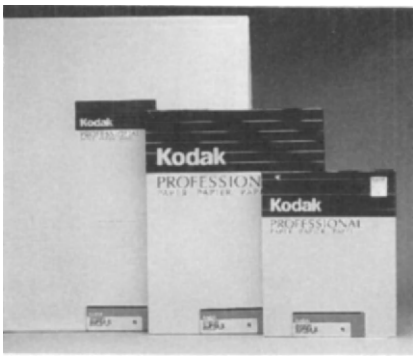
Safelights (page 93)

Print-Viewing Filters (page 165)

Plastic Print Trays (page 126)



One of the many types of enlarging paper for making prints from negatives.

Kodak's RA Chemistry in the 10-Litre Size. It may seem like a lot, but it lasts a long time if the developer is not mixed with the activator (not shown) until just before use.

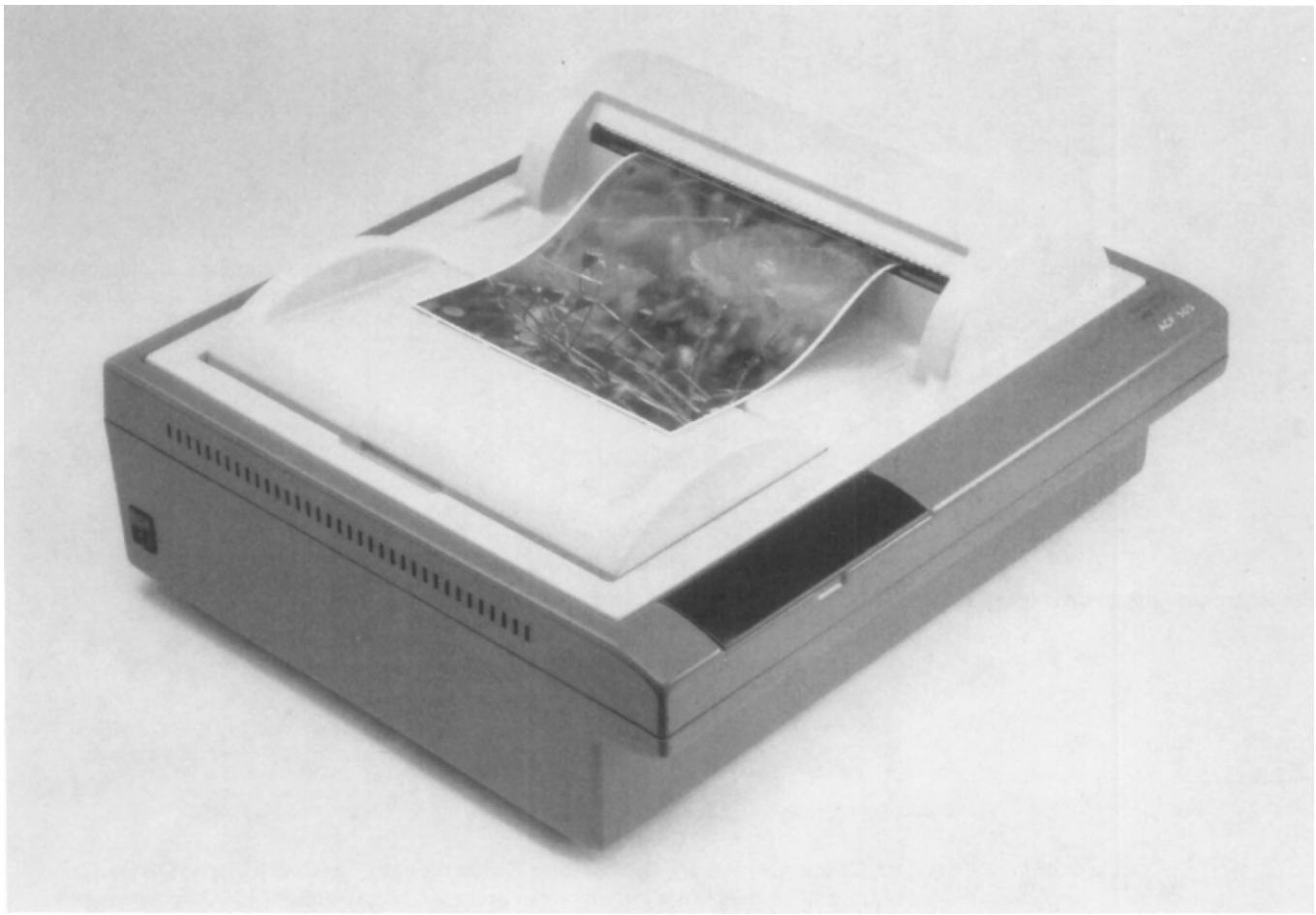
Print Processing Drums (page 167)

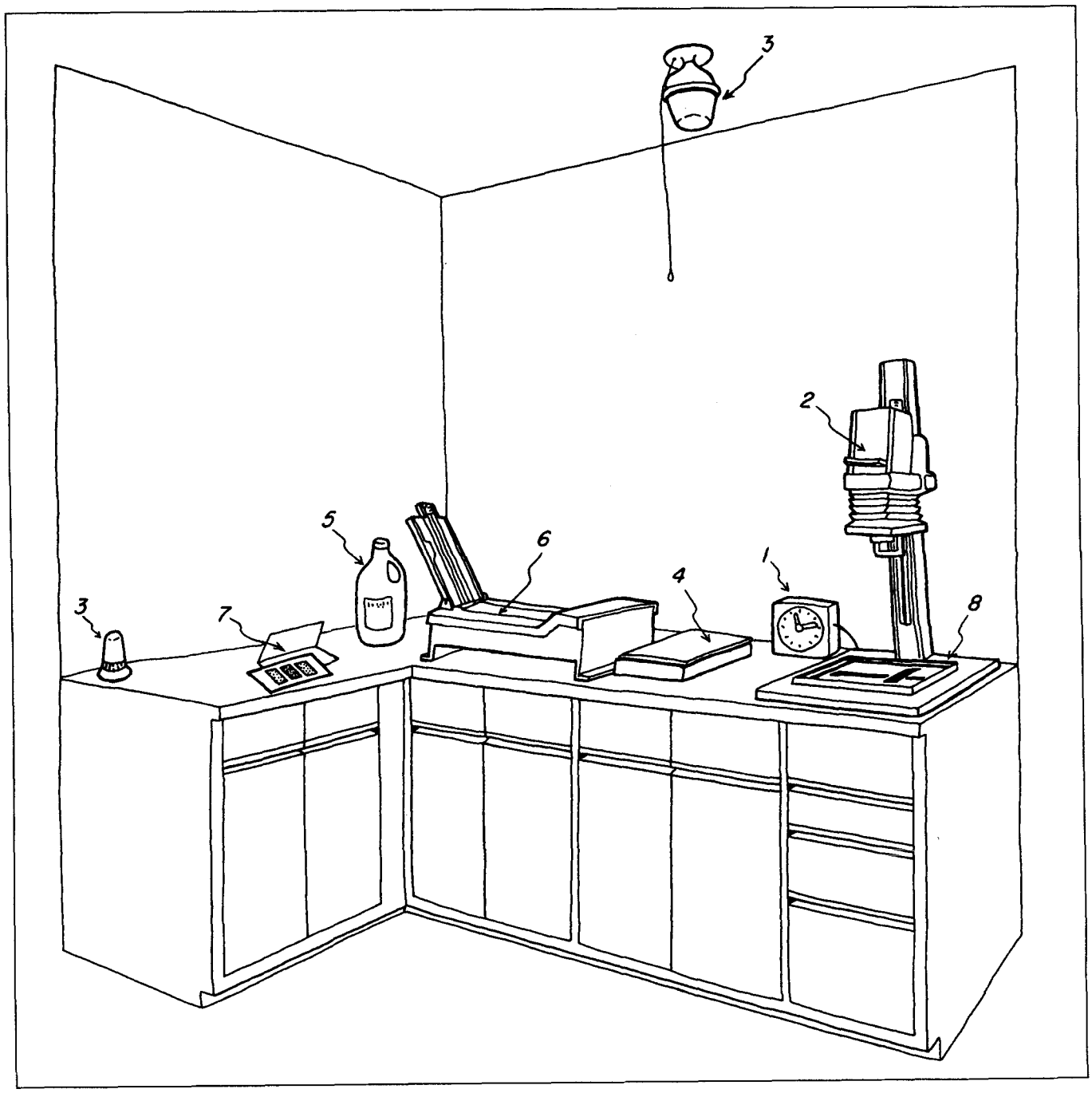
Chemistry Kit for Developing Color Negatives (C-41) from JOBO. Makes 1 litre of working solution, which can process 12 to 16 rolls of 135/36 color negative film or the equivalent area of other sizes.

The RA Color System

Several years ago Kodak introduced its RA color system for printing color negatives. It is a simple two-step process using only a developer and bleach/fix with a very short processing time. Colors prints are now processed, depending on temperature, for as little as four minutes. The paper chemistry combination has very consistent color balance from one batch to another. The low tar buildup makes it ideal for color-processing machines.

Beseler ACP Table Top Color Processor





The RA Color Darkroom. The simplicity of the RA process reduces the amount of processing equipment needed to make color prints. The basic requirement is a light-proof room with sufficient counter space to set up the enlarger and printmaker. In addition to the enlarger and printmaker, you will also need the following items:

1. Timer. To time the exposure and the processing of the print a standard darkroom timer with a range from 1 second to 60 minutes should be sufficient (see "Timing Systems" in Chapter 7).

2. Color Printing Filters or a Color Head on the Enlarger. Needed to control color balance in the print.

3. Safelight. Most people do not use a safelight when printing color. Kodak advises that a No. 13 will be safe, but it is too dim to be useful.

4. RA Paper. Comes in glossy and smooth-lustre surfaces.

5. RA Developer.

6. Beseler ACP 505 Table-Top Processor.

7. The Kodak Color Print Viewing Filter Kit. To help guide you in evaluating your prints and obtaining the correct color balance (see "Color Analyers and Calculators" later in this chapter).

8. Easel. An easel holds the paper flat and positions it under the enlarger. Easels are available with moveable blades that adjust the size of the image on the paper. (See "Easels" in Chapter 8.)

Color Enlargers

Color printing has several problems that are not encountered in black and white work. These problems have influenced enlarger design, and to a large extent the difficulties have been overcome by modern equipment.

Filtration

Because of the complexities involved in their manufacture, color negatives, or slides that are used to make color prints, are not in perfect color balance. Even if they are, the enlarger light source will not be color balanced, or the print emulsion will react differently from what is expected. Any of these variables can throw a print out of balance. To remedy this, color filters are inserted somewhere between the light source and the print to correct the light. There are three possibilities:

1. *CC (color-compensating) filters.* These are very expensive because they are gelatin filters used between the lens and the paper. The image passes through them, so they must be optically pure. Because of their high cost and their delicate, easily-scratched surface, they are not often used in the average darkroom.
2. *CP (color-printing) filters.* These are used between the light source and the negative. Because the image does not pass through them, they can be made of a less expensive material. Most enlargers have a filter drawer that can be used to hold these filters. They do have the advantage of being inexpensive, but at the same time, since they are made of a dyed acetate-polyester, they tend to fade with age and lose their color-correcting ability.
3. *Dichroic filtration.* These filters are made of glass. They are not used in the same way as acetate filters; they are built into the enlarger head itself. Filtration is varied by moving the filters partially into or out of the beam of light from the enlarger head. The farther the filters are placed into the light beam, the more filtration they provide. Because only part of the light goes through the filter, the total amount of light reaching the negative is higher for the same degree of filtration than with acetate filters. They are also much more permanent than other types of filters and can therefore be counted on to give consistent results over a long period of time. They also allow finer filtration steps. They can be varied in steps of .01, whereas acetate filters come in steps of .025

Voltage Variations

The color balance of an enlarger bulb depends to a large degree on the voltage that is used to light it. Variations in the voltage will cause variations in the color of the light coming from the bulb. The same effect is at work in black-and-white printing, but the slight variations are not sufficient to be noticeable in the print. Because successful printing is based on eliminating as many variables as possible, manufacturers have produced devices called voltage regulators to use with color enlargers. These regulators give the same output voltage to the enlarger bulb, regardless of voltage variations in the incoming line.

Consistent Light Source

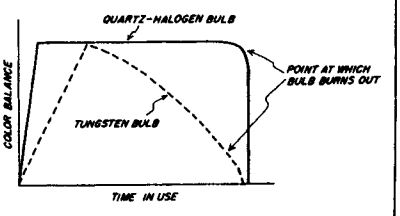
Tungsten light sources, which have been used for years in black-and-white enlargers, have problems when used for color printing. They tend to change their color balance over their life cycle, because of aging of the filament and the build-up of emissions on the inside of the glass envelope in which they are encased. This continuous change in color balance makes it difficult to obtain consistent results over a long period of time. If you print a negative one week and then use the same negative and set of filters (a filter pack) a month from then, the filtration will be off because of a change in the light bulb. To overcome this problem modern enlargers use a quartz-halogen lamp that does not have a build-up of emissions on the inside of the envelope and maintains a constant color balance throughout its life cycle.

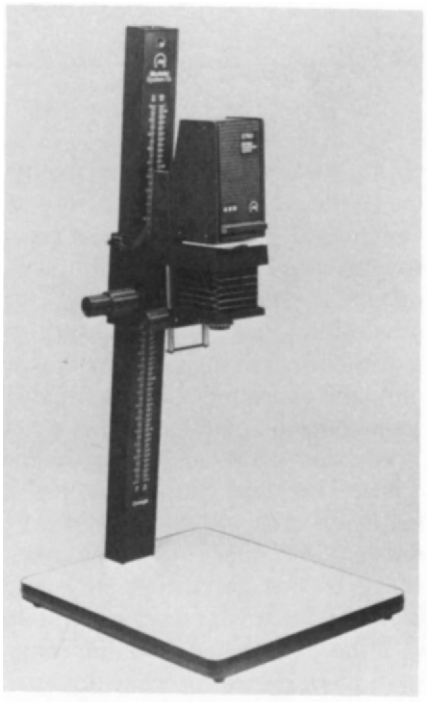
Heat on the Negative Plane

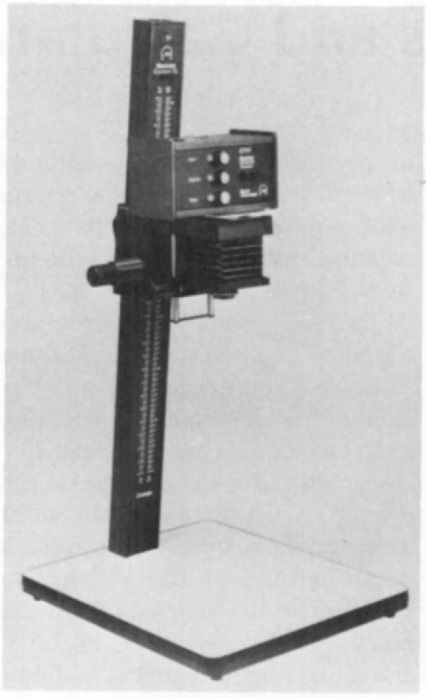
Heat on the negative plane is caused by the infrared part of the light spectrum and can cause buckling of the negative, especially during long exposures. To overcome this problem the designers have developed several techniques, including the use of filters and light pipes. Some use a combination of fiber optics and an infrared reflector that passes the visible light but reflects the heat-producing light out of the optical path. Another solution has been to install a cooling fan in the enlarger head, but this can cause vibration problems.

Enlarger Bulbs

This graph shows the relative behavior of both tungsten and quartz-halogen bulbs. The quartz bulb tends to maintain a consistent color balance over its life compared to the gradual decay of the tungsten bulb. If your enlarger is already equipped with a tungsten bulb the best solution is to reserve a special bulb for color printing only. This way, if you print color only occasionally between long sessions of black and white printing, the bulb will not change as drastically as it would if you were using it for both kinds of printing.







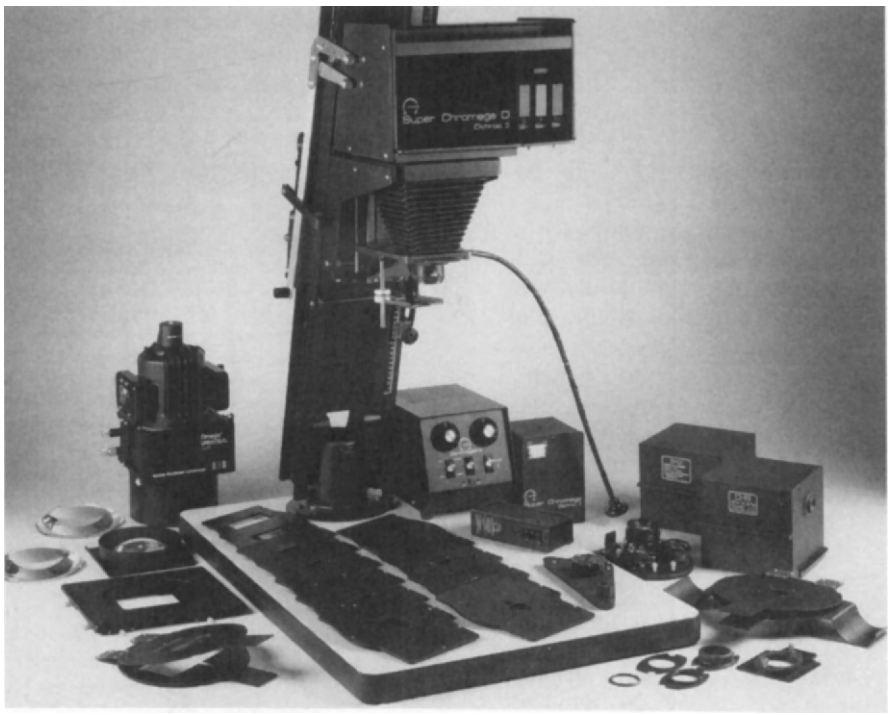
Color Heads. Most major brands of enlargers can be purchased with a black-and-white condenser head and later be converted to color. These two pictures of the Omega enlarger show it with and without the color head. In many enlargers the addition of the color head changes the enlarger from a condenser to a diffusion light source. The enlarger can be used for color printing without the color head by inserting filters in the filter drawer just below the top unit.

Dichroic Head. Changing the condenser head on your enlarger to a dichroic head improves the ability to print variable contrast B/W as well as color. Most dichroic heads change your enlarger from a condenser light source to a diffusion light source.

Voltage Regulators. Here is the entire Super Chromega color enlarging system including a voltage regulator. Voltage regulators will keep the voltage supplied to the enlarger lamp at an even 115 volts, despite any variations in the input from the electrical company. This ensures that every print you make will have the same enlarger light brilliance, and this consistency eliminates one of the major sources of different print densities and color balances.

A 5-volt change will affect the color balance about as much as a CC10 filter, with the effect most noticeable at the blue end of the spectrum.

Some color enlargers use step-down transformers to reduce the voltage to the lamp (quartz-halogen) and act as voltage regulators. The control they give is sufficient and makes a separate voltage-regulator unnecessary.



Color Analyzers and Calculators

When printing in black and white, the photographer is primarily concerned with determining the correct density and contrast range of the print. In color printing, these basic concerns are only part of the problem. The major difficulty for beginning color printers is determining a color balance, so that the colors in the print appear the way you want them to. Manufacturers have developed a number of products to assist in determining what the correct color filtration should be to give you a print that you like.

Electronic Color Analyzers

Electronic color analyzers are devices designed to give you the correct printing time and color filtration required to make a high-quality color print. Unfortunately, to use one you first have to make a print with a color balance you like. You then use that print to calibrate the analyzer. Once the calibration is made, the analyzer will automatically compare any subsequent negatives or slides with the color balance of the "ideal one" used to calibrate it. It will then indicate the filtration pack required to duplicate the color balance and exposure time of the "ideal" print.

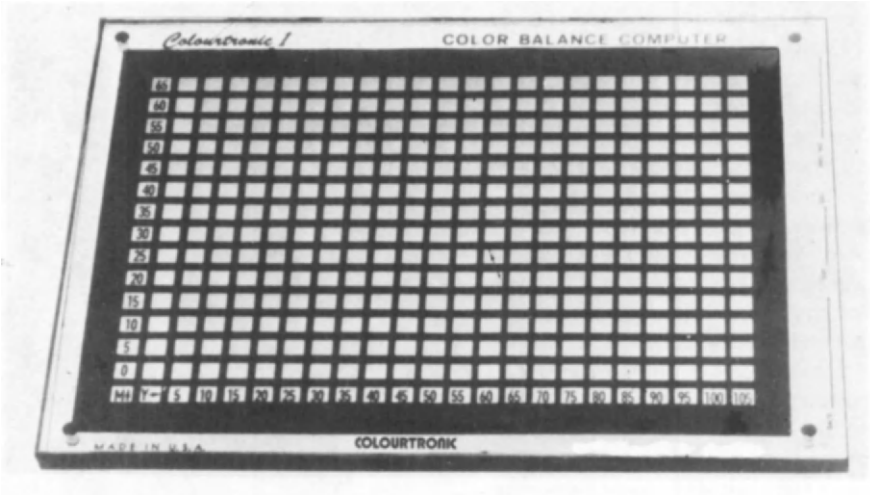
There are two difficulties that you can expect when using one of these analyzers. The first is that you may have a problem making the first print needed to calibrate the machine. Since it does not come precalibrated, you will have to make at least one good print by more traditional methods so that you have a standard to use in calibrating the machine. The second problem arises from the fact that it is almost impossible to use one "ideal" print to judge a large number of subsequent photographs. Sunsets are quite a bit different from snow-covered scenes, and the analyzer cannot make judgments about how you want to interpret them. All it can do is try to make each print look like the last, but that is not the goal of most color printers. Some analyzers are being designed to allow for programming with any number of "ideal" prints. Each time the machine is calibrated to a particular image the information can be stored and reused. After a period of time you can assemble a library of "ideal" images covering a broad range of possibilities. You can then use the "snow-covered" program to determine the exposure of all subsequent snow-covered scenes, and so on.

Another problem with analyzers is that when you change the paper emulsion you will have to recalibrate. If you want, buy an analyzer when you first start to print in color, but do it with your eyes open and with the expectation of doing some hard work on top of what the analyzer will do for you. A well-balanced and exposed color print will still be the result of experience, which an analyzer cannot yet duplicate. Unless you are making large numbers of prints based on the same emulsion, a color analyzer is not of much use to you. You will be surprised at how quickly you become adept at finding the right filters for the print you want using some of the less expensive alternatives illustrated on this and the next page.

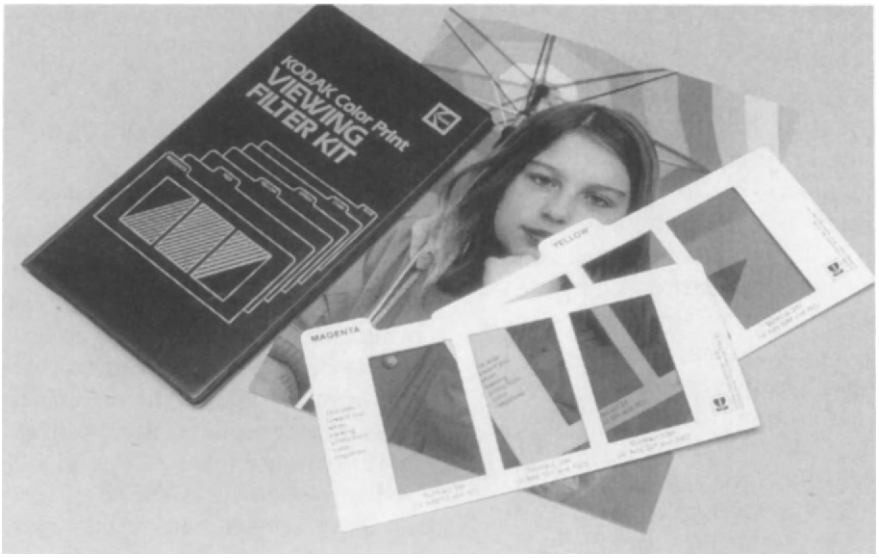
Light Required to View Color Prints

The quality of the light used to evaluate color prints is extremely important. The light should be as close as possible in its color makeup to the light that will eventually be used to view the print. Most prints are viewed in light close to daylight in color balance, so you should use a light source of the same quality. A fluorescent bulb such as the Norelco Color Match 5000 will provide illumination with the same color balance as daylight.

Color balance cannot be accurately checked unless the print is dry, so be sure you have the right light source and a dry print or you may be disappointed in the morning.



Calculator Grids. These are ingenious devices that help you select both exposure and filtration. The grid is placed over the print before it is exposed. A diffuser is placed over the lens of the enlarger to scramble the colors and give an even illumination of the print. The print is exposed, processed, and dried. The portion of the print that is exposed to the value of 18 percent gray is the correct exposure. By reading the scales on the sides of the grid, you can easily figure out the filtration required to achieve that exposure and color balance.



Print-Viewing Filters. Print-viewing filters shift the apparent color balance according to the density and combination of filters used. With this device you can try a number of combinations to see which makes the print take on the color balance you would like it to have. Once you have located the right filter combination, use the recommended filter pack and make another print. You can then do the same thing all over again to refine the balance even further.

Courtesy Eastman Kodak Company

Kodak Color Dataguide. This is another of Kodak's many helpful sources of information. It contains innumerable facts, hints, tables, and so forth. Especially for the beginning color printer, it is a necessity. Experienced printers will also benefit from the large amounts of technical information it contains.

The Kodak Ektacolor FilterFinder Kit. Printing from negatives is more difficult than printing from transparencies, because the negative projected on the paper surface is not as familiar in its color balance (it's reversed) as a color transparency is. The Kodak Ektacolor FilterFinder kit (publication R-30) helps take some of the guesswork out of filter selection and exposure calculations when making prints from color negatives. The kit consists of a filterfinder matrix, locator, Kodak neutral test card (gray card), calculator dial, and simple, step-by-step instructions. It can be a great help in learning how to make those first color-balanced prints without wasting valuable photographic paper.

Courtesy Eastman Kodak Company

Color Analyzers. With so many photographers switching to color, there is clearly a need for some well-developed aids. Many photographers have spent years developing a visual memory of what various tones will look like when translated into a black-and-white print, but doing that, and at the same time worrying about color balance and saturation, is too much to handle. The color analyzer is a help, but certainly not the complete answer to all problems in producing color prints.

Drum and Tank Color Processors

Color-print processors all perform the same function: to move the print through the chemistry, or move the chemistry over the print. Four basic designs are used today that vary depending on the type of darkroom and the quantity of prints being processed. Theoretically, it is possible not to use a processor at all. But you would need sufficient patience and a high enough threshold of claustrophobia to stand in a totally dark room while processing the prints in a tray just like black-and-white prints. Putting your hands into color developer and breathing the fumes from open trays do not contribute to a very healthy way to work. Few of us have the sort of patience required and therefore choose to work with a processor.

The Four Main Types of Color Processors

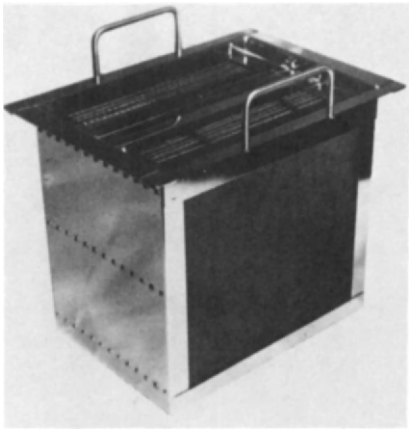
Drum with Roller. This is simply a light-tight drum very much like a film developing can, into which the exposed print is placed. It is then closed with caps at either end. Chemistry can be poured in and emptied through light-traps in the end caps. The roller base agitates the drum after the chemistry has been poured in. Roller bases can be operated by hand or can be motorized. In some cases, the roller is just a rim around the drum that allows the drum to be easily rolled back and forth on the counter or in the sink to provide agitation.

Because of their simplicity, these drum processors are used by almost everyone making color prints, unless their budget and/or volume requires or allows a machine processor.

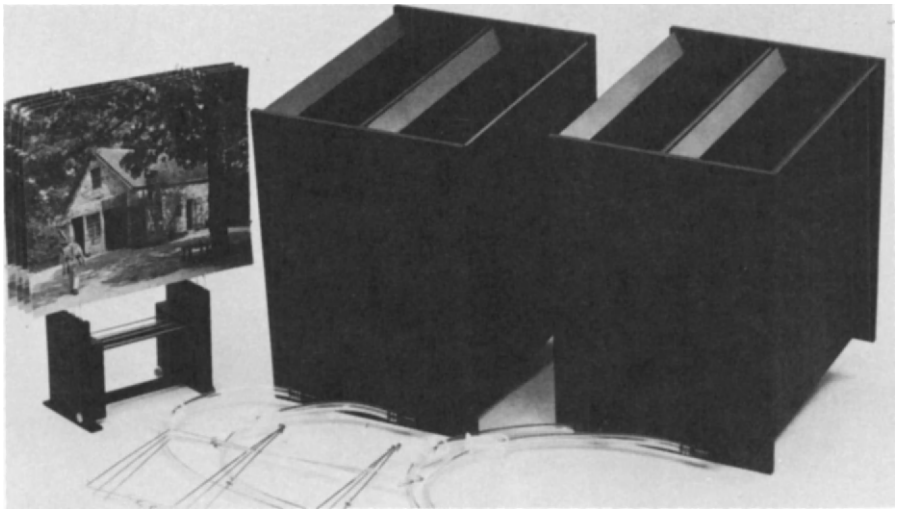
Kodak Processors. Unlike drum processors, these are stand-up units into which the chemistry is poured. The print is then transported through the machine and the various chemicals by a roller transport mechanism. These processors must be used in total darkness, because they are not light-proof and also are designed to use chemical replenishment rather than one-shot chemistry. They are also quite expensive.

Basket Processing. Basket processing allows you to process more than one print at the same time. A series of prints can be stored in a light-tight drawer and then placed in the basket for immersion in the chemicals. Most photographers rarely process more than one print at a time, and basket processing is therefore primarily a tool of commercial printers.

Daylight Processors. Some manufacturers have recently introduced relatively inexpensive, self-contained, light-tight processors that sit on a counter. These also hold the chemistry in temperature-regulated tanks and either pass the print through it by means of rollers, or pump the chemistry across the surface of the print. With the stability of the RA chemistry system, the processor can be left filled for more than a week and prints can be made at your leisure.



Processor Basket. This Leedal processor basket is typical of those used commercially. The cost and capacity of this kind of unit restricts it to the high-volume operator.

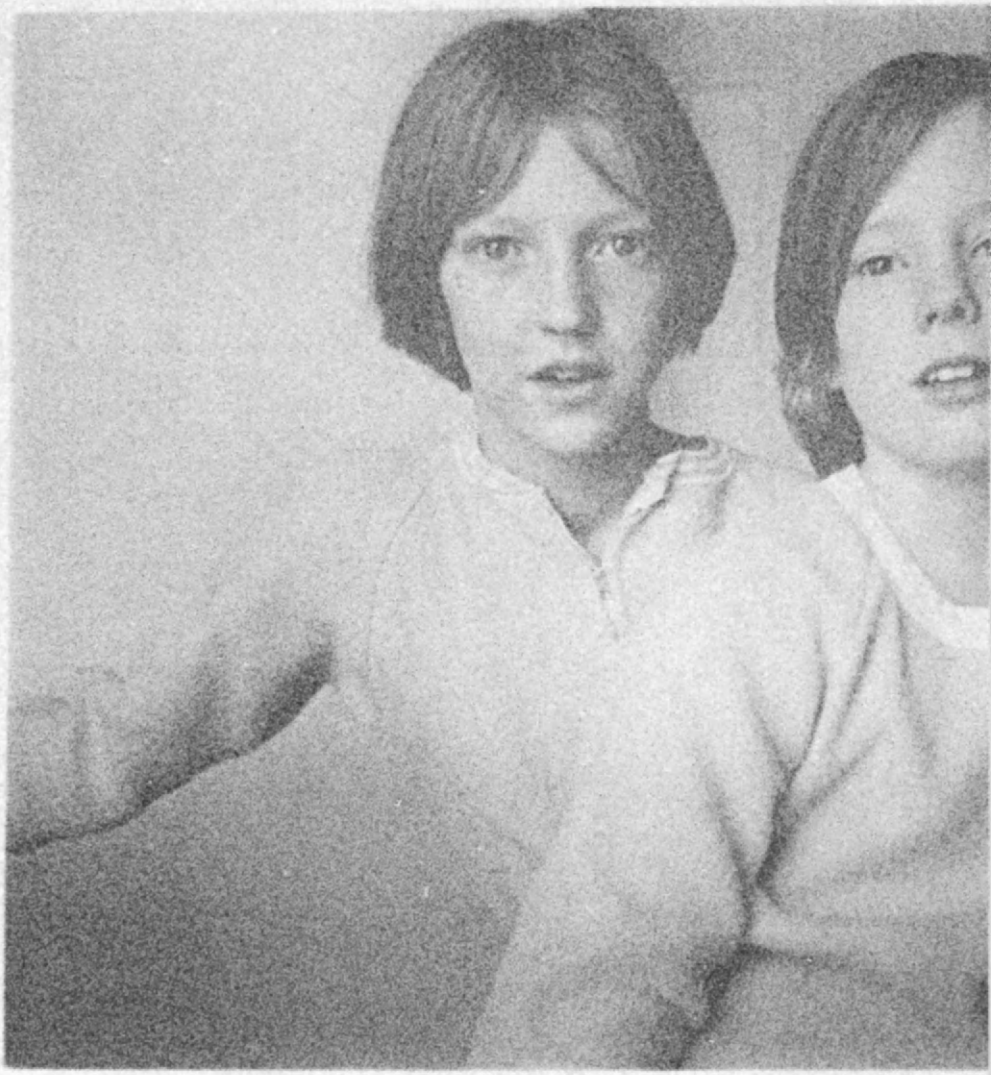


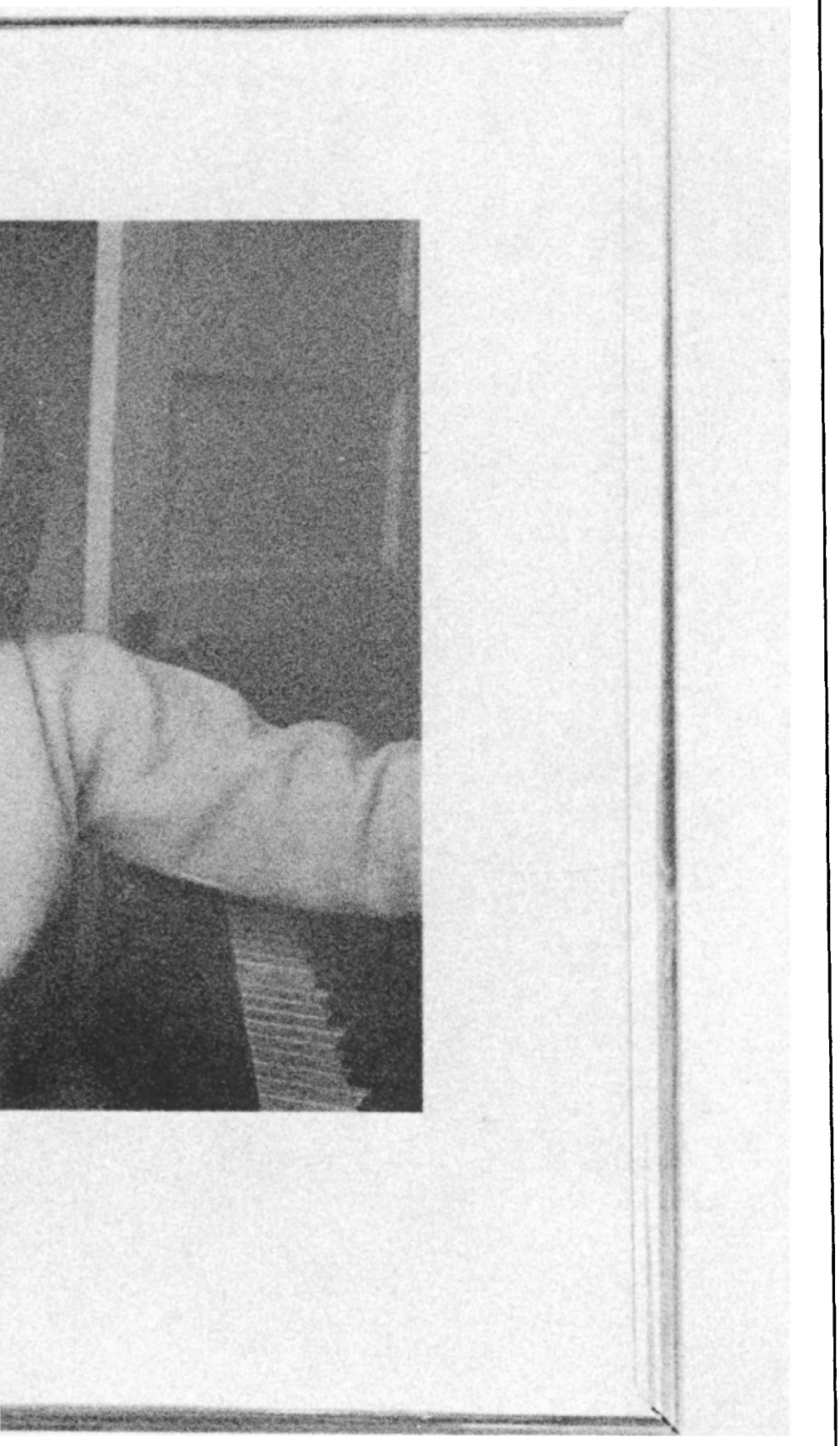
Medium-Volume Basket Processor. This Unicolor unit is a basket processor for those photographers whose capacity has increased over what a drum system can handle but who cannot afford the cost of a continuous-processing machine. It comes equipped with an intank heater and can be equipped with a Unicolor temperature controller to maintain a consistent temperature. The unit's capacity is ten 8 x 10 prints at one time. It can also be used to process black-and-white prints or sheet film.

Daylight Drum Processor. The Beseler is one of the most advanced drum processors on the market today.

Drums for this and other units come in a variety of sizes and should match the print sizes you plan on making. If you print in more than one size, it is cheaper to buy different drums, because a small print in a large drum will waste expensive chemistry.

10 Print Finishing





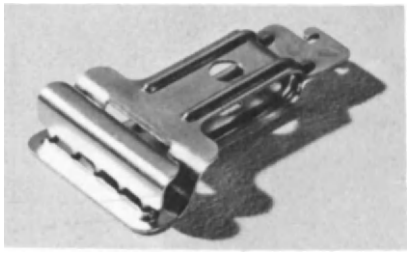
Contents

Dryers

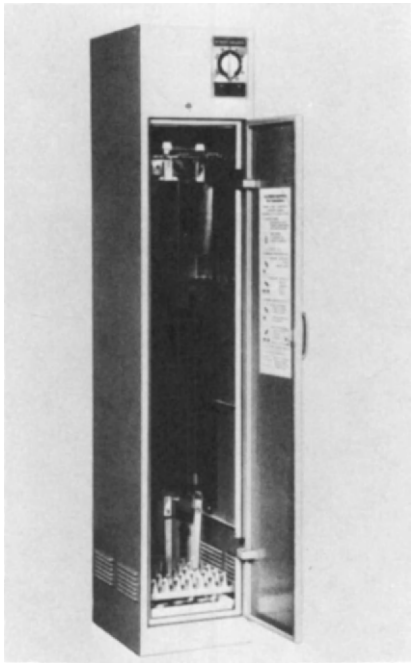
There is something terrifying about the irreversibility of processing negatives. Most photographers don't mind ruining a print because it's done all the time and it's relatively easy to make another, but a ruined negative is gone forever. This mortality tends to keep experimentation to a minimum. Drying is the stage where negatives are most susceptible to damage, especially from streaking, dust, and scratching. Because of the softness of the negative emulsion at this stage, there is a great deal of controversy over how to dry them without damage. Many photographers use a wetting agent to assist the water to run off so it will not build up in drops that leave a residue when dried. After using the wetting agent, some photographers squeegee their negatives with a small viscous sponge specially manufactured for photo use (kitchen sponges scratch).

The negatives should always be hung in a dust-free area to dry. The ideal place is either an unused shower (run the shower for a few minutes first to settle any dust), or a sealed negative drying cabinet. Never use unfiltered hot air to speed drying, because there is a good chance that all you will do is imbed dust in the negative emulsion. All negatives, when hung to dry, should be weighted at the bottom to eliminate curling.

Clothespins. There is no substitute for the humble clothespin as a negative dryer. You can clip one to the top of the film to hold it to a string strung across your shower, drying cabinet, or the darkroom. At the bottom of the film, clip another clothespin to keep the film strip taut, otherwise it will curl as it dries and stick to itself where it curls. A hook can be attached to one end of the clothespin to make it easier to hang on the string. Be sure to buy the spring-loaded clothespins, and not the ones that are a simple notch in a piece of wood.



Stainless Steel Film Clips. If you think clothespins make your darkroom look tacky, buy yourself a complete set of stainless steel clips such as these made by the Photo Materials Co. They come in two versions. The one illustrated is to attach the film to the string from which it hangs. The other version is weighted and when attached to the bottom of the film holds it straight while drying.



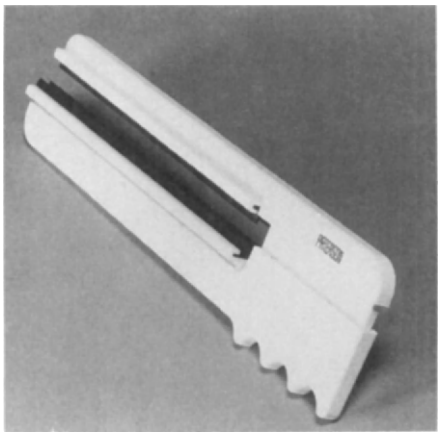
Drying Cabinet. Kindermann makes a series of negative drying cabinets similar to the one illustrated. They all feature filtered, forced air ventilation for drying almost any size of roll or sheet film. The temperature of the warm air can be adjusted, and the fan and heater are connected to a timer that will shut the unit off at the end of a preselected period. Kindermann also makes a "Porta-Dri" model that has flexible plastic sides so the entire unit can be easily stored in a small space when not in use. The combination of rapid drying and a dust-proof environment for the film makes these units extremely useful.

Print Dryers

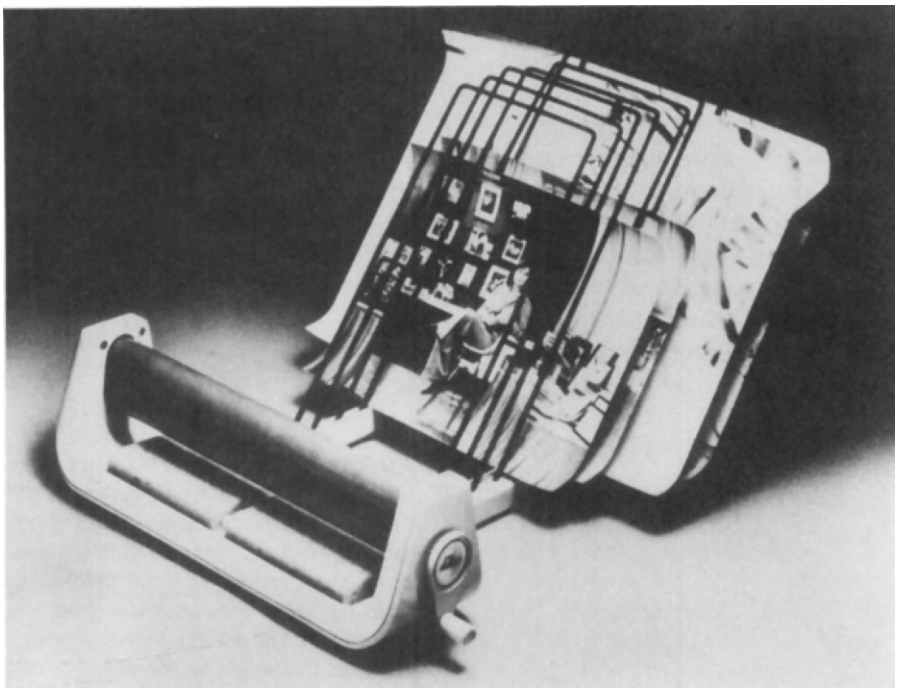
Drying prints can be accomplished naturally, or it can be accelerated through the use of either increased heat or increased air flow. The concerns in drying prints are their tendency to curl when drying, the archival quality of the print, the protection of the print surface, and the effect of heat or other drying methods on the image.

The safest way to dry prints is to squeegee the excess water from the surface using a smooth squeegee so the surface of the print is not scratched. Lay the squeegeed print on a fiberglass screen to have it dry evenly and with minimal damage (see "Building a Print-Drying Rack" in Chapter 6).

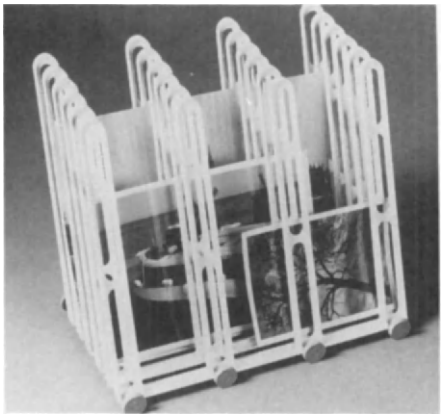
If you have a high output that would overload a natural drying system, consider a dryer that uses air flow, temperature, or a combination of both to accelerate the drying process. RC papers are very sensitive to heat, as are color prints, and air impingement dryers are best for those materials. RC papers dry flat. The curl in regular papers can be minimized by using an electric or double-screen dryer that holds the print flat while drying. Curl can be removed, when it does occur, by heating the print briefly in a dry-mount press, or by stacking prints in piles under a weight of books.



Squeegee. Squeegeeing excess water off of the print prevents it from gathering in pools or drops and leaving spots on the print when it dries. Get a well-made squeegee and keep it clean; it can easily scratch the surface of the print if mistreated. This Paterson model is well-designed, with a handle large enough to give good leverage.



Roller Squeege and Drying Rack. A handy, compact table-top unit that removes excess water from a print with a roller system and has a built-in rack for drying the prints.

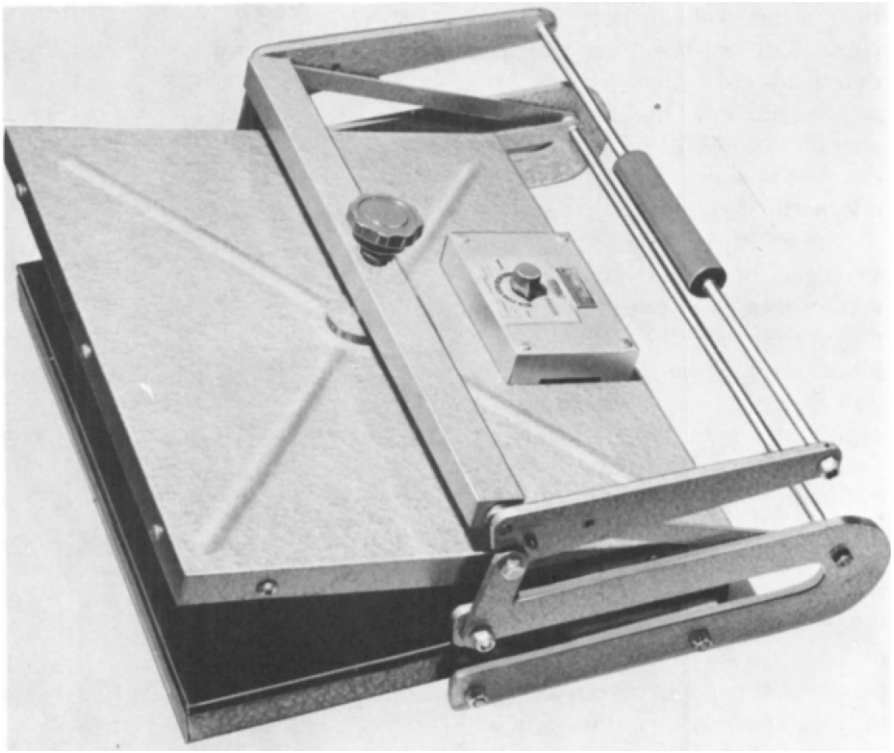


Print-Drying Rack. This RC print-drying rack dries up to 20 prints of varying sizes. It is efficient and compact and prevents the prints from sticking together.

Mounting

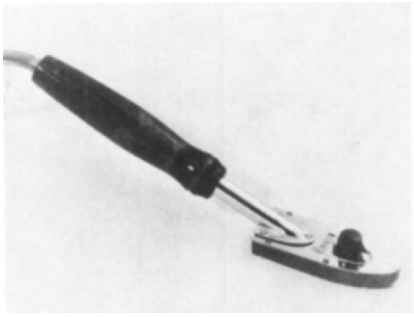
Many photographers mount their work to keep it flat for viewing. However, chemicals or impurities in adhesives can damage photographs, and once mounted, the photographs are very difficult to remove from the backing. So mounting is recommended only for photographs that do not need to be preserved for a number of years. Valuable artwork should be flattened and attached to a mat with acid-free hinges instead.

Several mounting processes are described below. From a conservator's point of view, dry mounting is the preferred process, because the pH of the adhesive is within the accepted range. Whichever method you use, it is important to mount on 100 percent rag, acid-free board; chemicals in other boards will affect both the photograph and the board.



Dry-Mount Press. The binding agent in dry-mounting is a tissue that, with heat and evenly applied pressure, permanently adheres the print to the backing.

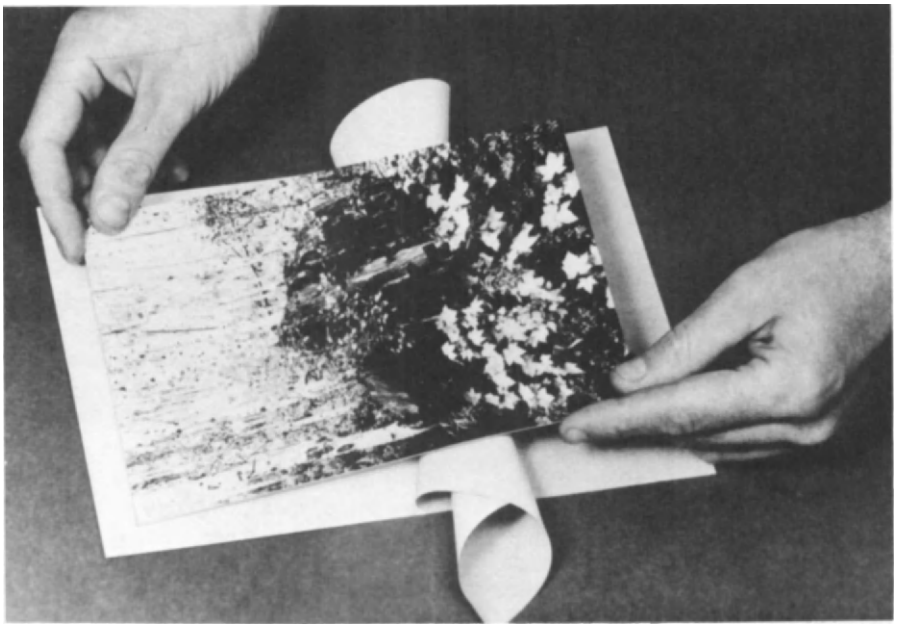
Dry-mounting requires the use of a dry-mount press like the one shown here made by Technal. Presses come in several sizes, from 8 x 10 to 40 x 60. You will need a press at least as big as the board on which you are mounting the print. You will also need dry-mount tissue (there are different kinds for black and white, color, and resin-coated prints). Dry-mounting is a quick process and doesn't involve messy adhesives that might accidentally get on the face of the print. However, it is not foolproof. It is possible to ruin a print by trapping a bubble of air under it or by setting the temperature too high.



Tacking Iron. The tacking iron is an auxiliary dry-mounting tool. It is used to mount the photograph to the backing in one spot so it won't slip out of place when you put it in the press.

Spray Adhesive. 3M's Photo-Mount forms a permanent bond after pressure is applied with a rubber roller.

Print Positioner. The print-mounting positioner made by Falcon is a timesaving device that helps you position the print in the optical center of the board without measuring or drawing lines.



Perma/Mount. Perma/Mount is a sheet with adhesive on both sides. The process is simple: stick the print to one side of the card; trim off the extra card; peel off the protective covering on the back of the card exposing the adhesive; and apply pressure to mount the print to the backing. It is available for 8 x 10, 11 x 14, and 16 x 20 prints.

Matting and Storing Prints

Because the surface of a photographic print is so easily damaged by fingerprints, dirt, or scratches, a good storage system for finished prints is an essential part of preserving them. The major considerations when you're choosing a system should be whether you need to transport your prints, or simply keep them in your studio; whether you will be matting them to make them presentable for viewing, or storing them without mats; and whether you want to use archival methods to preserve them.

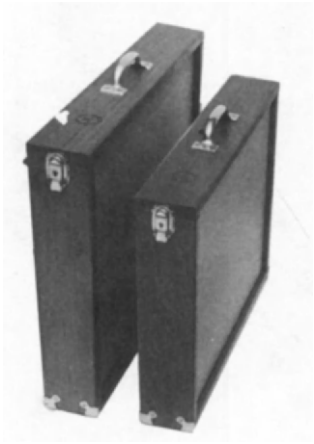
For storage in the darkroom, the best idea is to put each print in an envelope to protect the surface, and then place them all in a storage box for further protection.

The most common envelopes made for storing prints are glassine envelopes. These protect the surface of the print from damage, and they're fine for prints that aren't valuable. However, they are not archival, because the acidic content of both the paper and the glue can damage the print over a long period of time.

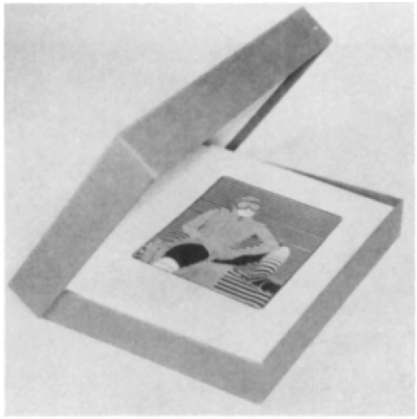
For archival protection, Light Impressions supplies white storage envelopes of Perma-Life paper in two sizes, 8 1/2 x 10 1/2 and 11 1/2 x 14 1/2.

If you will be showing your prints to people from time to time, you will probably want to place each print in a mat and backing, protecting the print surface with a sheet of tissue that can be lifted for viewing.

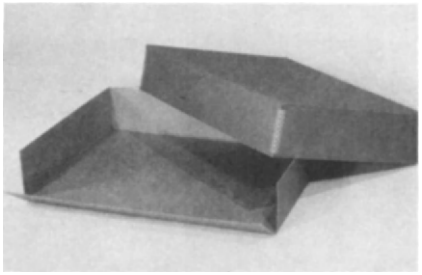
Interleaving tissue is an acid-free tissue used for this purpose. It is placed under the mat and over the surface of the print. It can also be used instead of envelopes between unmatted prints in a storage box. Light Impressions supplies it in sizes from 11 x 14 to 16 x 20.



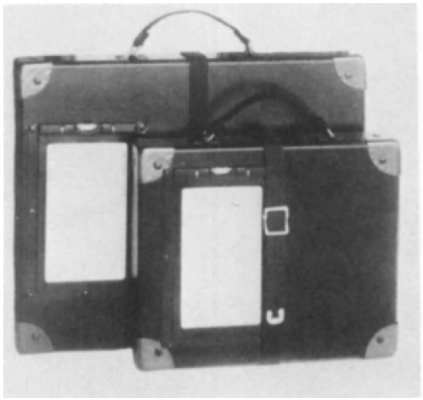
Wooden Boxes. The redwood and brass portfolio box shown here is designed for transporting and viewing mounted work. The top and one side detach for viewing prints, and the inside is sealed against wood vapors, which are harmful to photographs. The strong construction, attractive materials, and easy conversion from carrying case to display box are the important features of this storage system available from Depth of Field. All boxes are custom-made in any size you want.



Portfolio Box. The portfolio box shown here folds together in a clamshell design. Made of high-quality neutral pH materials, it is excellent for archival storage and display of matted or unmatted prints. It is deep enough for eighteen matted prints and comes in three sizes to accommodate 11 x 14, 14 x 18, and 16 x 20 prints or mats. The advantage of this kind of box is its flexibility for carrying or folding out to provide a very attractive display. Available from Light Impressions.



Drop-Front Storage Box. The drop-front storage box is made of archival-quality materials with metal corners to strengthen the construction and eliminate the need for adhesives, which might damage the paper. Light Impressions has them in two sizes: 15 x 11 x 3 and 16 1/2 x 20 1/2 x 3. The larger can be divided into four 8 x 10 sections for storing large numbers of unmatted prints. This box is the least expensive of those illustrated here and is used more often for utility storage than for display.

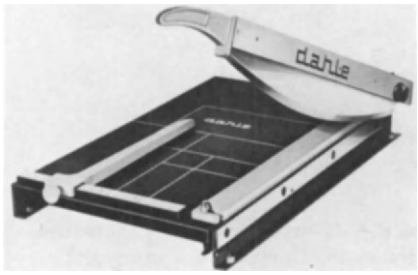


Shipping Case. This one is not just a storage box, but a shipping case. It's made of tough Vulcan fiber with heavy-gauge steel corners and a cardholder for addressing the unit in transit. It comes in three sizes—11 x 14, 14 x 17, 16 x 20, all 3 inches deep—from Light Impressions.

Mat Boards

There are two kinds of mat board, wood-pulp board and museum-quality board. Wood-pulp board comes in a variety of colors, but it is highly acidic. The acid content will, over a period of years, cause both the print and the mat board itself to discolor and become brittle. The alternative is non-acidic museum board, usually of 100 percent rag content. Because it contains no acid, it will not have any adverse effects on the print. However, it is more expensive than ordinary wood pulp board, and it comes in a very limited selection of whites, neutral colors, and black. If you want archival protection for your prints, you must use acid-free board for the overmat as well as for the backing immediately behind the print. Many photographers use 4-ply board for the overmat and 2-ply board for the backing. In a frame, an additional backing, such as corrugated cardboard or Fome-Cor, is needed for stiffness.

Mat Knife. A mat knife is the most basic mat-cutting tool. It's a good idea to get one with a retractable blade for safety's sake. You can also purchase a metal straight edge with a no-slip rubber backing from Light Impressions.



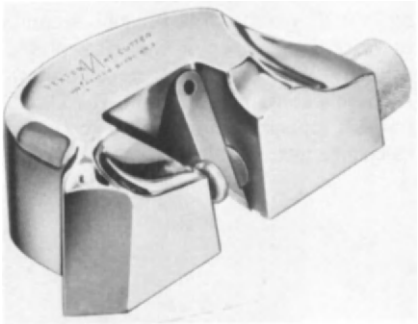
Paper Cutter. The guillotine-type cutter shown here is one of several models designed to cut mat board as well as paper. It's also available with a safety guard.

Mat-Cutting Tools

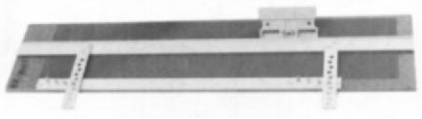
Cutting the outside of a mat is not difficult. You can use a simple mat knife and straight edge, or a paper cutter designed to take mat board, or the mat and glass cutter described in the framing section of this book.

Cutting mat window openings is a little more tricky, and because a poorly cut mat will detract from the overall effect of the picture, it is important to find a mat-cutting tool with which you are comfortable. Tools range from the inexpensive Dexter cutter to the rather expensive, but much more efficient, Keeton Kutter.

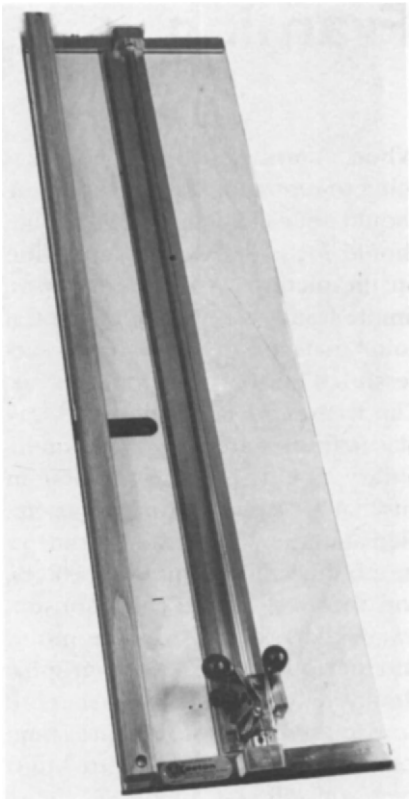
It's very difficult to cut professional looking circular or elliptical mat openings with a simple hand cutter. A sophisticated machine such as the Keeton Oval Kutter is generally required.



Dexter Mat Cutter. Of the simple hand-cutters, the Dexter is the least expensive and the most widely used. Use a straight edge with a no-slip backing as a cutting guide. The blade can be clamped in place at any angle to allow straight or bevelled cuts. Available from Brookstone.



Mat Cutter. The cutter shown here operates on the same principle as the Dexter, but it comes with its own straight edge, mat guide, and measuring system. You can order it from Saunders.



Keeton Kutter. The most efficient and most accurate machine for cutting mats is the Keeton Kutter. The bar clamps the mat board tightly in place while you cut, and the cutting blade is actually mounted on the straight edge to ensure a straight cut. It's quite expensive, but probably worth the investment if you cut a lot of mats.

Attaching the Photograph

Photographs may be held in place in the mat with archival-quality photo corners, or with an archival-quality tape—never with masking tape or cellophane tape. The most suitable mounting tape is white linen tape, a cloth tape with a water-activated acid-free adhesive on one side. You can get the photo corners or rolls of tape from Light Impressions.

When using tape, attach the photograph to the backing with only two small squares of tape placed along the top edge of the photo near the corners. If it is taped along the sides and bottom as well, it will buckle with changes in humidity.

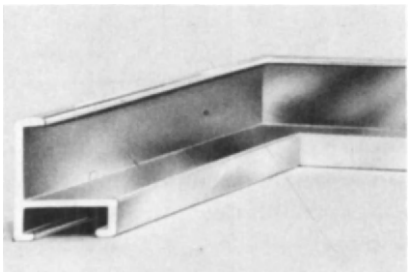
Framing

When choosing a frame, the first thing to remember is that the frame should not call attention to itself but should focus the viewers' attention on the picture. With photographs, simple frames with white or neutral color mats are generally most successful. There are several choices. Clip frames, metal frames, and Dax plastic frames are all quite contemporary looking and are available in kits that are easily and quickly assembled at home. Wood frames come in an infinite variety of profiles, colors, and finishes, so you can choose a frame that exactly suits the mood and period of your photographs. However, wood frames do take more time to assemble, and require some special tools if you plan to build them yourself.

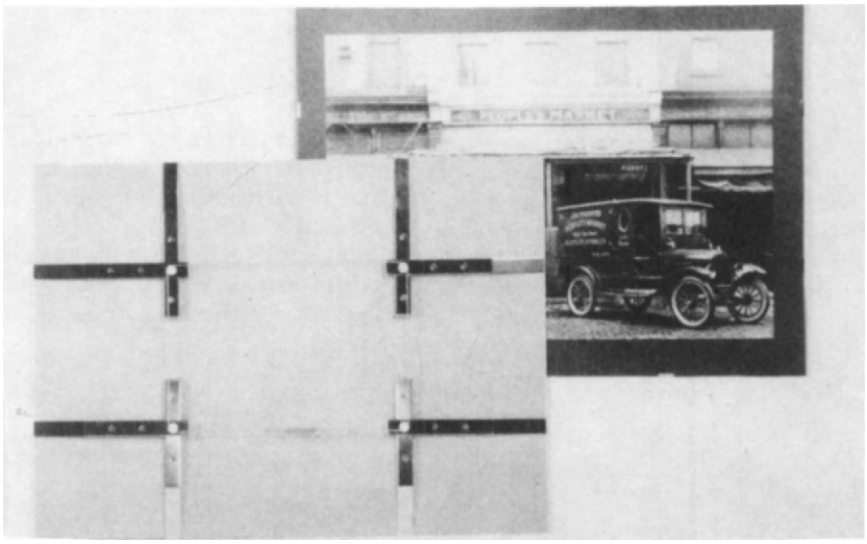
Whenever you are putting a photograph in a frame with glass, you should also use a mat. Moisture can condense easily on the inside of a sheet of glass, and if the photograph is in contact with the glass when this happens, it can be ruined. The mat provides a space between the surface of the glass and the surface of the photograph so that the photo won't be affected. Acrylic is less likely to condense moisture, and therefore is often used instead of glass when framing unmatted pictures, but this is not considered archival framing.

If you must frame without a mat to get the visual effect you want, the only archival solution is to use spacers between the glass and the photograph. A spacer is a thin strip of wood or mat board attached to the inside surface of the frame after the glass is in place. The edges of the photograph then rest against the spacers instead of the glass. Nielsen makes a metal frame with a spacer to separate the glass from the photograph.

Dax Frame. Of the ready-made frames, the Dax frame is the simplest and quickest to use. It is a clear acrylic box with an open back and a slightly smaller cardboard box that slips in to hold the picture in place. All you have to do is mat your photograph, or attach it to the inner cardboard box. If you choose not to mat it, then slip it into the frame. Dax frames come in several standard sizes, from 5 x 7 to 24 x 30, which can be hung horizontally or vertically. They come with clear plastic sides and an assortment of color finishes. All have a contemporary look. The Dax frame is especially convenient if you want to change pictures often.



Metal Frames. Metal frames are quite contemporary and easy to assemble. The only tool you need is a screwdriver. The Nielsen frame, shown here, is held together by metal angles that slip into the slot at the back of the frame. Glass, mat, and backing are held securely against the lip of the frame by metal springs inserted after the frame is assembled. Pre-cut lengths are sold, two to a package, along with instructions and assembly hardware, and you buy two packages to make a frame the size you want. Only a few styles and colors are available in kit form; however, you will find a much wider selection if you go to a store that carries the complete line, and you can have them cut to exactly the size you need.



Eubank Frame. Clip frames are another simple, easy-to-assemble framing alternative. The Eubank frame shown here, and the plastic version, the Uniframe, are sturdy and quite attractive. Clips hold the glass and backing together in eight places, and a string or wire on the back holds the clips securely in place and provides a means for hanging the completed frame. Kits that clip the glass to the backing in two or four places, such as Braquettes, Fast Frame, and Gallery Clips, are suitable for small pictures. But since the glass and backing tend to separate over long, unsupported distances, larger pictures need to be clipped in eight places. Clip frames are adjustable and can be re-used on pictures of different sizes and shapes.

Do-It-Yourself Framing

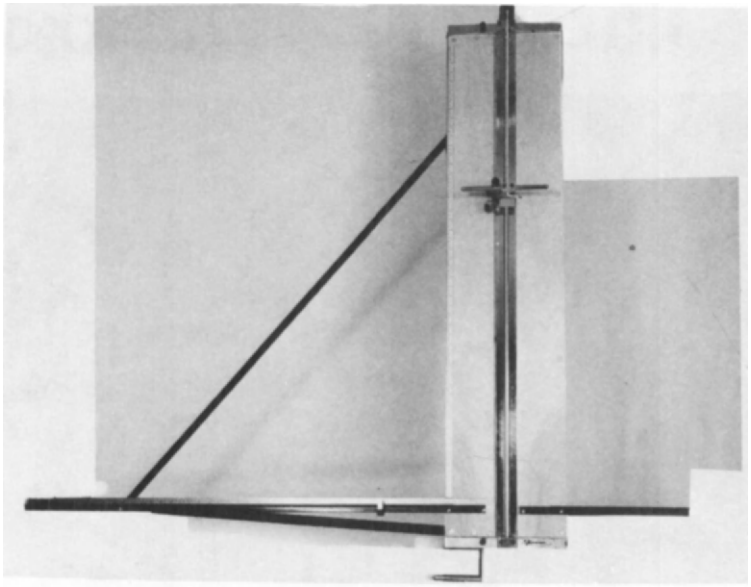
Custom framing can be quite expensive, but there are cheaper alternatives for anyone who is willing to spend some time framing. Do-it-yourself frame shops will cut materials to size for you and show you how to assemble them yourself. If you've never built a frame before, this is the best way to begin, because you'll have professional help. Or you can invest in a few tools and set up your own work space for cutting and assembling frames.

You can cut framing materials with fancy equipment or relatively inexpensive tools and get good results either way. The main difference with the more specialized tools is that they make the job easier and save you a lot of time.

The simplest and least expensive tool to use for cutting wood molding is a miter box. Because the angle of the cut is crucial when you're building a frame, it's best to purchase one with some kind of clamping device for holding the saw. Some miter boxes cut only 45° or 90° angles. So if you might at some point want to make six- or eight-sided frames, buy one that will adjust to the appropriate angles. You'll also need a good sharp back saw, fourteen teeth per inch or finer.

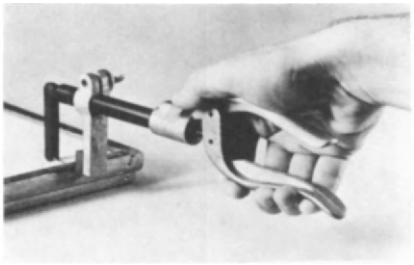
Most professional framers use choppers instead of miter boxes, because the chopper is quicker and more accurate and makes a smoother cut than does a back saw. However, the chopper cuts only wood, so many people who deal in metal or plastic frames do all their cutting with a power saw such as the Keeton Kut-All Saw.

Frame assembly requires several tools and supplies that you can pick up in a hardware store if you don't already have them: tack hammer, nail set, wood glue, wire brads, hand drill, and pliers. The only special tool you need is a corner clamp. A fitting tool, while not absolutely necessary, will make the job easier.

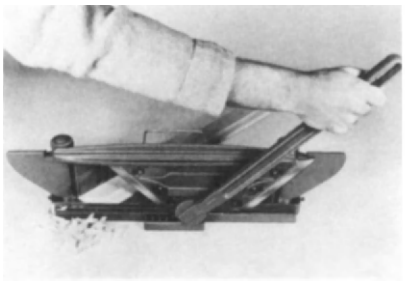


Keeton Kutter. The ultimate device for cutting glass, mat board, and backings is the Keeton Cardboard and Glass Kutter. The piece to be cut sits on the horizontal bar at the bottom, which also has a measuring guide on it. The blade or glass cutter moves along a vertical track. A straight cut is guaranteed, and the time taken to measure is practically eliminated. It's expensive but worth it if you do a lot of framing.

Square-Head Hammer. Wire brads are used in the back of frames to hold the contents in place. The framing hammer shown here is designed specifically for tapping those brads gently into place. Available from Brookstone.

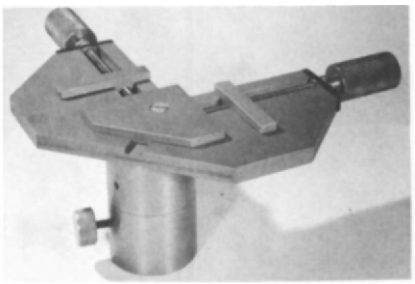


Fitting Tool. The fitting tool, also available from Brookstone, is used to squeeze brads into the back of the frame. Because it doesn't jostle the frame, you don't run the risk of breaking the glass or weakening the glued corners.



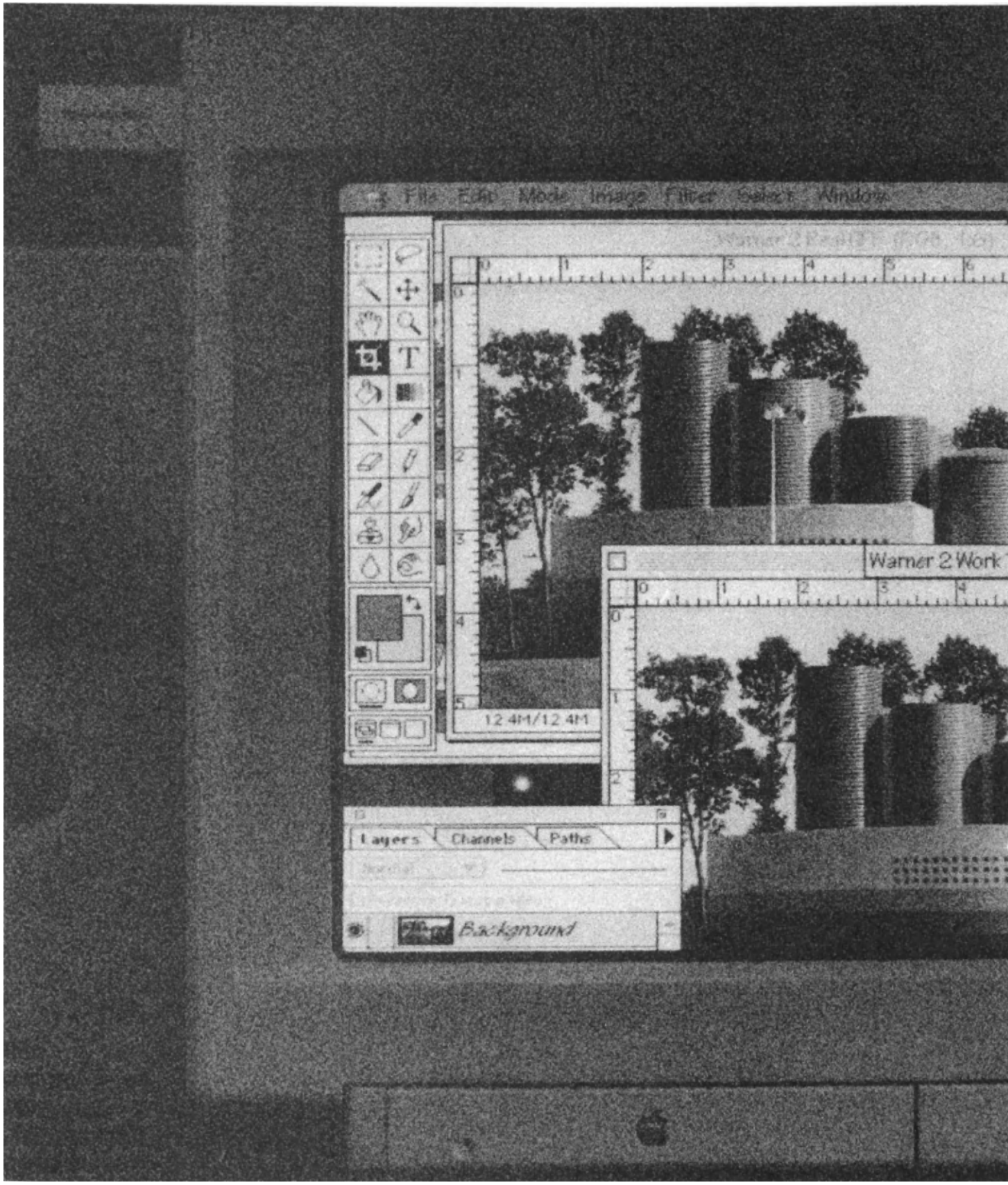
Miter Trimmer. This miter trimmer, available from Brookstone, is one of the simplest choppers available. You must first rough-cut the molding a little longer than you want it, then trim it exactly to size with the trimmer. It cuts any angle, from 45° to 90°.

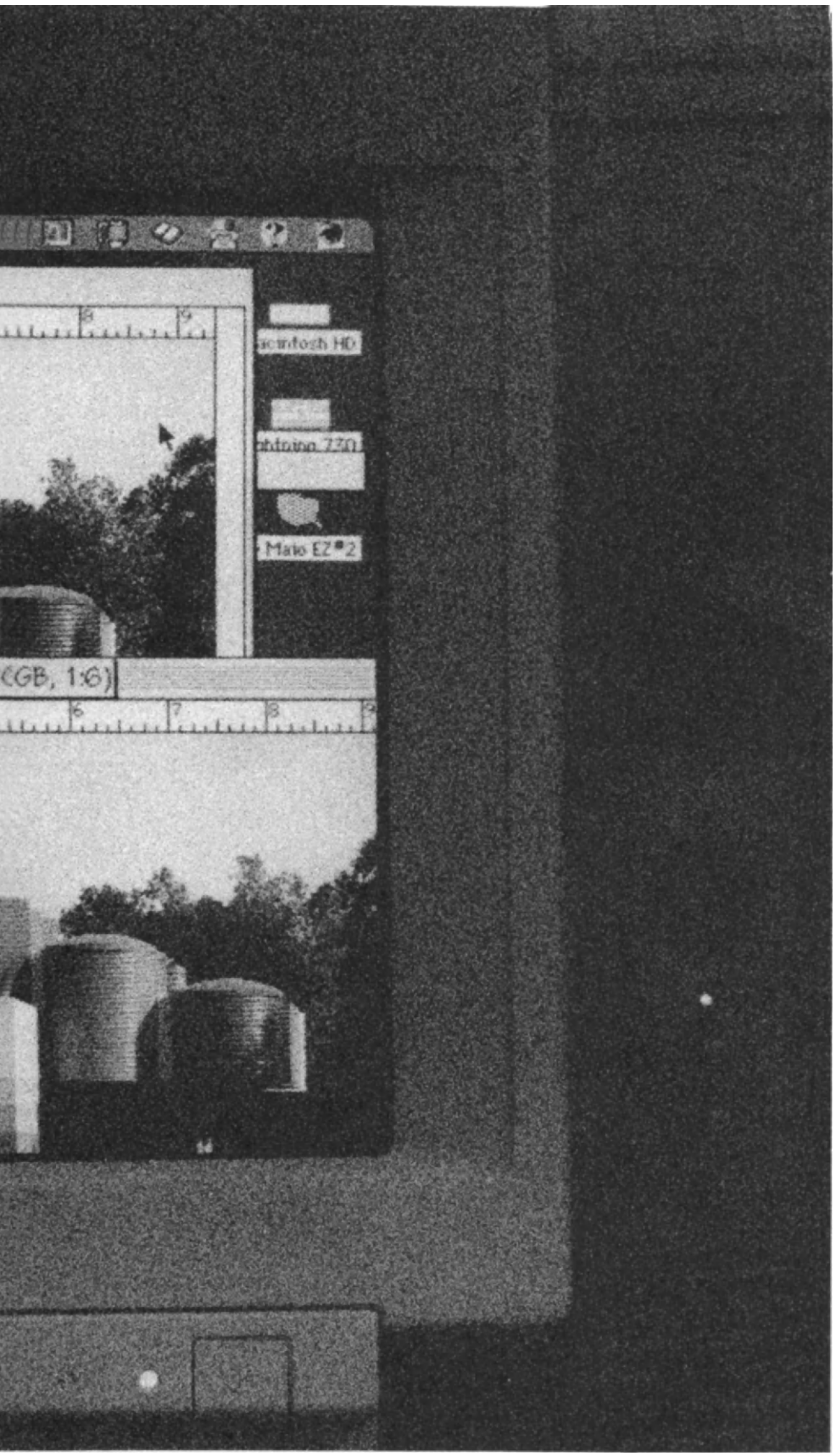
Keeton makes a larger chopper that is similar to this one and quite a bit more expensive.



Corner Clamp. A corner clamp is essential for holding the corners of the frame tightly in place while the glue sets up. The simple, inexpensive corner clamps available in most hardware stores are fine for most frames but are limited in the size of the moldings they can accept.

11 The Digital Darkroom





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Introduction to the Digital World

The digital revolution has descended on photography with all the speed we've become used to in computer-related progress. Remember records? Those big disks of vinyl covered in grooves that could produce the scratchiest sound ever heard? It's possible that you've still got a bunch of them and the turntable to play them on, but now you just slip a CD into your player and listen to the clear, clean sound of digital music. The ability to choose a song at random, skip through it, fast forward or back, program the sequence—what luxury! And you have to go a long way to damage them. Well, that same sort of convenience, clarity, and stability is now available to any photographer who owns a computer.

I'm sure that most people have become familiar with the phrase "to digitize" thanks to the music industry. Simply put, there are two ways to store and display information: one is "analog" or continuous, the other is "digital" or discreet bits. An analog is a continuous, unbroken stream of information as in a curve on a graph. There is an infinite amount of information in the curve, since you can extract that information at infinitely small divisions. It gives, by far, the greatest amount of information. Digital information comes in discreet amounts or levels as opposed to the continuously variable analog information. There is a finite amount of data, and that's what makes it possible to store and manipulate it on a small personal computer.

Digital creates the illusion of a continuously variable analog in much the same way that movies create the illusion of motion with discreet still images. It's a matter of spacing. If the digital information is made up of steps that are sufficiently close together, then the difference is so small as to become unnoticeable. Or at least that's the theory. There are musicians who claim they can hear the difference between a digital and an analog recording. If the steps are not close enough together, it is quite easy to tell a digital image from a standard photographic image. (The standard photograph is, to be sure, a digital image, made up of discreet clumps of silver. There are just so many of them—more than any but the very largest computers could store and manipulate.) So you can see where this is leading. The problem for digital photography, especially for the amateur, is how many digits the image can be broken down into and still be manageable. In the computer world, the question is always "how big a 'file' can you deal with?"

Image-file size, or the "resolution" of the image, is a function of something called dpi or dots per inch. This term reflects an effort to retain some of the familiar terminology used in the printing industry. There, dots refer to the dots on a printing screen that make up the image: the more dots, the finer the image. In mechanical printing, the size of the dots as well as their density make up the variations of the image. In digital imagery, it is the height of the step, its value, and the density of steps that make up the variations of the image. The dots are recorded by individual sensors called charge couple devices, with one sensor for each dot. One reason digital recording devices are so expensive is because of the large number of these sensors required to get a high-resolution image—lots of dpi's. Each machine has an upper limit to the amount of resolution it can record or output. The higher the resolution, the better the image quality.

Adobe Photoshop. This computer screen displays an image being altered using Adobe Photoshop. The background image is unmanipulated; the foreground shows the image after it has been altered. Note that the large lamppost has been removed.

Digital Equipment

How do you digitize an image? How do you get digital information into your computer? You can do it directly by using a digital camera. These cameras, which are becoming more common and less expensive by the day, allow you to take and store in the camera a number of photographs. This number depends on the storage capacity of the camera and the resolution of the image. Many of the digital cameras allow you to choose the resolution or dpi of the image, and thereby the number of images you can store in the camera. The higher the resolution, for instance 600 x 600 dpi, the bigger the image file and the fewer the images that can be stored. Some cameras have removable storage cartridges that give you the ability to take a virtually unlimited number of photographs. You might even want to take along a laptop and input, or "download," the photographs directly into the computer. The current problem with affordable digital cameras is the amount of resolution they can provide. This level of resolution is usually not enough to produce a high-quality image, especially when reproduced in a large size.

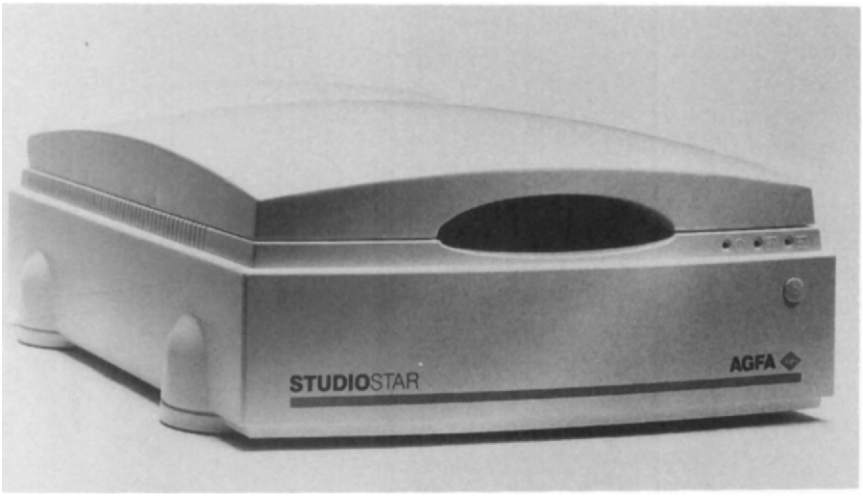
The method most people use to have their photographs digitized is to have them "scanned." Traditional formats, produced with a photographer's old tried-and-true camera are then subjected to the scanning process. Transparencies, negatives, or prints can all be scanned. A scanner is a device that records your photograph in digital form. There are two kinds of scanners: drum and flat bed. Drum scanners are complex and extremely expensive. They are used mainly by service bureaus, businesses that provide digital input and output. The photograph is attached to a rotating drum and then scanned as it spins under the sensors. Flat-bed scanners are much less expensive and well within the range of most commercial photographers. The photograph is placed on the bed of the scanner and is scanned by a moving bar much like that in a photocopy machine. Many scanners allow you to preview the digitized photograph, called the "scan," before you enter it into the computer. Then you can use the scanner's software for an initial manipulation of the image for contrast, color, density, and so forth.

Another way of obtaining digital scans of your photographs is to send the film to a developing house that will develop your film, scan the negatives and send you back a CD full of your pictures. You then put the CD into your computer and access or open any image directly into your image manipulation software. Once you have a digital image in your computer, you can do virtually anything with or to it. After all, you're just changing a number associated with a dot.

When it comes to image-manipulation software, there is really only one: the great, the wondrous, the ever-changing Adobe Photoshop. This program will allow you to play with your image in standard ways (contrast, color, density, cropping). In addition, it will give you an almost unlimited freedom to add, subtract, twist, turn, and otherwise play with your photographs.

Photoshop is quite expensive and requires a computer with sizable memory, both internal and external, but there are a number of far less expensive programs that give you quite a variety of things to do to your photographs. Some page-layout programs have image manipulation capabilities. Once you have a digital image, you can import it into almost any document in your computer. Page-layout programs allow you to make documents combining photographs, illustrations, and text. They are used extensively in the design industry, but they can also be a lot of fun at home.

Digital Camera. The Epson Photo PC 500 is a 640 x 480 dpi camera that stores up to 30 images at maximum resolution.



Digital Scanner. The Agfa Studio Star is a 600 x 1200 dpi, moderately-priced scanner. Adapter for scanning transparencies is optional.

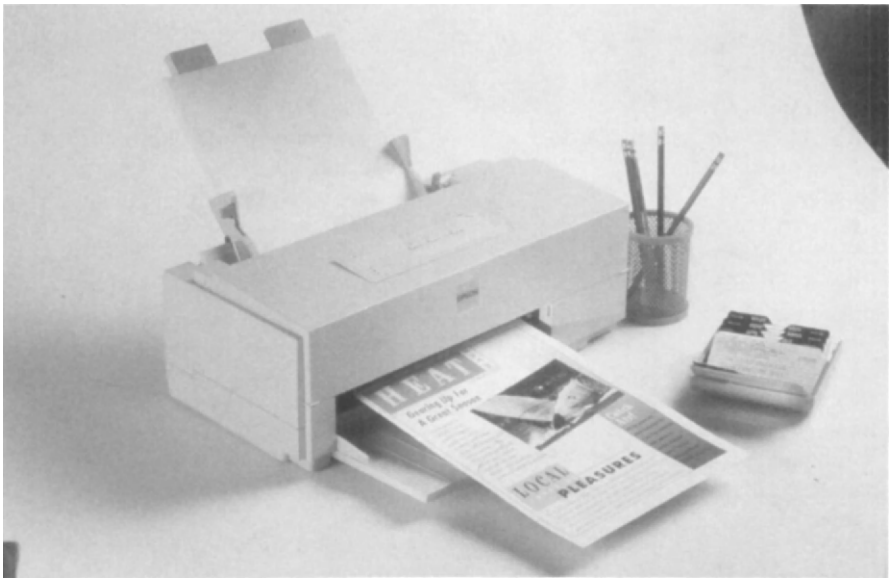
Printing the Digital Image

Once you've altered or enhanced your digital image, you will want to show it to the world. You can have people look at it on your computer screen, but that's not very convenient. Instead, you'll want to avail yourself of one of the many output options. There are printers that work with your computer to produce a very credible image without spending a lot of money. Ink-jet and bubble-jet printers are the most popular. They allow you to use many kinds of plain paper stock, such as watercolor paper, to change the look of your photograph. You can even put your photograph on a transferable medium and make t-shirts! A much higher-quality image can be achieved by using a laser printer. Naturally, this higher quality is reflected in the printer's price tag.

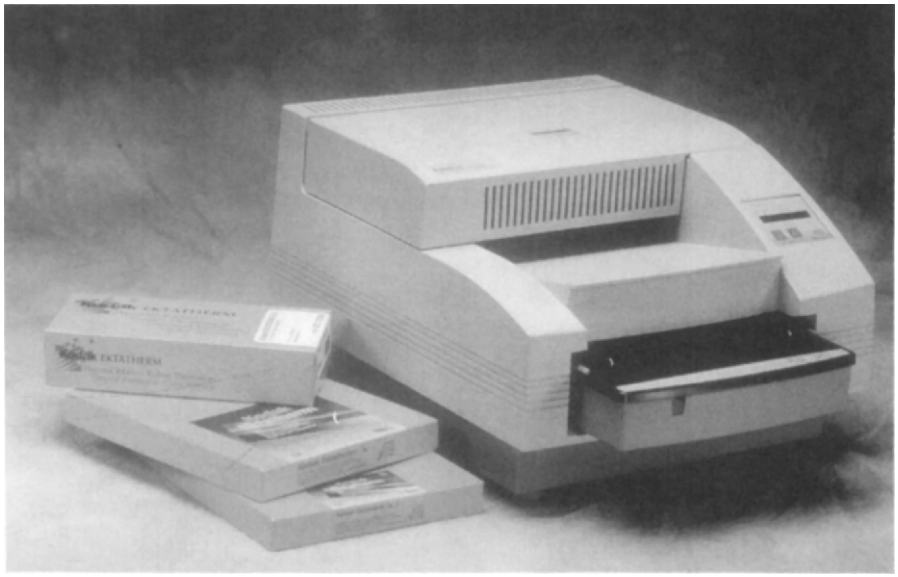
The closest thing to a true photographic output is the dye-sublimate printer. It is quite expensive, but it gives a beautiful photographic print on special paper. Again, no chemicals are used, not even the inks of the jet printers. Dye sublimate printers use a film roll that must be replaced after a certain number of prints have been "processed."

If you want to make your own prints, a machine called an imagesetter will make a continuous-tone negative. Imagesetters are very expensive and are usually found only in service bureaus. These machines will also make slides, if you prefer to view your photographs by projection.

In the context of digital imagery, the entire concept of the traditional darkroom has now been replaced. No dark room, no chemicals, no handling negatives, no touching at all, except for keyboarding. A very large change has been effected in a very short period of time. But get used to it—the digital world is here to stay.



Ink Jet Printer. The Epson Stylist Color 500 is a 720 x 720 dpi plain-paper printer.



Dye Sublimate Printer. One of Kodak's dye sublimate printers and the special paper and thermal ribbon needed to print with it. An expensive unit, but imagine the luxury of adjusting an image with your computer and then making a print by just pressing a button! This type of equipment is being constantly updated, and you may be able to purchase a used one at a reasonable price.

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