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Special Bulletin #11: Guide to Copy Photography for Visual Resources Professionals

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Abstract
It is not uncommon for visual resources management to involve some photographic production. If these production needs are substantial, the services of a professional photographer may be required. However, where needs are modest, photography may be done by anyone prepared to carry out the task. It is intended that this publication be a guide for equipment and supply purchases, and production procedures for visual resources professionals who do not have access to the services of a professional photographer, or who are themselves not trained photographers. This manual is designed to provide all the information a visual resources professional needs to set up and operate a copystand, and to make photo-reproductions from two- and three-dimensional originals. Not intended as a technical or darkroom manual, this guide emphasizes bare-bones, simple how-to skills.

Keywords
copy photography, how-to, photographs, copywork, imaging, photographing

Author Bio & Acknowledgements
Jenni Rodda - New York University

Photographer: Christa Blackwood - New York University

Illustrators:

Gordon Arkenberg - New York University

Jason Varone - New York University

Margaret Webster - Cornell University

Special Bulletin Editor: Wendy E. Holden - University of Michigan

GUIDE TO COPY PHOTOGRAPHY

for Visual Resources Professionals

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GUIDE *to* COPY PHOTOGRAPHY *for* VISUAL RESOURCES PROFESSIONALS

Jenni Rodda, Curator, Visual Resources Collections,
New York University, Institute of Fine Arts, and
Christa Blackwood, Photographer.

Illustrated by Gordon Arkenberg
and Jason Varone
New York University, Institute of Fine Arts

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Foreword

It is not uncommon for visual resources management to involve some photographic production. If these production needs are substantial, the services of a professional photographer may be required. However, where needs are modest, photography may be done by anyone prepared to carry out the task. It is intended that this publication be a guide for equipment and supply purchases, and production procedures for visual resources professionals who do not have access to the services of a professional photographer, or who are themselves not trained photographers.

What makes copy photography relatively easy is the level of control that you have, as photographer-by-profession or photographer-for-a-day. By becoming thoroughly familiar with the elements of copy photography—stand, table, lights, camera, lens, and film—you can achieve consistent results.

This manual is designed to provide all the information a visual resources professional needs to set up and operate a copystand, and to make photo-reproductions from two-and three-dimensional originals. It is assumed that the reader knows nothing more about photography than which way to point a camera. Not intended as a technical or darkroom manual, this guide emphasizes bare-bones, simple how-to skills. A basic set-up is described and all component parts are clearly explained. Throughout the text, important words are highlighted. There is a problem-solving section at the conclusion.

The issue of copyright is not addressed here; that should be

done at the local level with appropriate administrative and legal counsel. Nor are true technical comparisons of various films included here, as the purpose of this manual is instruction and simplicity of approach. Once a reader has the basics well in hand, he or she may experiment with a variety of set-ups, or find more detailed information through the sources suggested in the bibliography and appendices.

Many collections are exploring the uses of digital imaging as a supplement to or substitute for copy photography. Digital imaging is not explained here; this text deals only with traditional analog imaging. The 35mm transparency is still, and will remain for the near future, a necessary medium in most visual resources collections.

There have been many changes in the photography industry since this text was first published in 1996. The section dealing with film types has been completely revised, based on informal film tests conducted at the Institute of Fine Arts in the summer of 2001. The analysis of the results of those tests is written by Gordon Arkenberg. Appendix C, Equipment and Technical Information Sources, has been revised to include current addresses, telephone numbers, and web site addresses. All URLs are accurate as of February 2002.

The revised edition is dedicated to Jason Varone, Gordon Arkenberg, Michael Konrad, and Yonatan Radzin, the dedicated IFA staff members who created all-new illustrations and assisted with scanning and production. They are all artists, and went out of their way to make me (and this text) look good—for which I am grateful. Lastly, without the constant support of my husband, Adam Loory, this text would never have been completed.

Jenni Rodda, Curator
Visual Resources Collections, Institute of Fine Arts, NYU
New York, February 2002.

CHAPTER 1

THE COPYSTAND AND RELATED EQUIPMENT

A copystand is an apparatus used for the purpose of making photographic reproductions of static, usually two-dimensional originals (see Figure 1). It consists of four major parts: 1) an armature, camera stand, or tripod, which holds the camera still and parallel to the flat original; 2) a table or other level, stable support, used to hold the material being photographed parallel to the camera; 3) a symmetric set of lights of known color temperature, either attached to the copystand or freestanding; 4) a camera with close-up capabilities (although any camera with close-up capabilities may be used with a copystand, a 35mm camera is typically used for this purpose). Many combinations of these elements are possible, each of which necessitates different combinations of lens aperture (f-stop), shutter speed, and film speed to achieve the best results. The table size, camera stand height, light source, and lenses will dictate the size of the originals that can be photographed. The first three elements are discussed below (Sections 1.1, 1.2, 1.3). Cameras, lenses, and related equipment will be described in Chapter 2.

1.1 Camera Stand

To produce an image from a two-dimensional original, the film must be held parallel to the original, and brought as close as is optically possible to insure a full-frame reproduction. A camera stand is any device which will hold the camera back (which in turn holds the film) parallel to the original, and allows you to focus closely. A camera stand consists of a column or post with a vertically movable armature which holds the camera. A good camera stand armature should also move horizontally a bit, to make it easier to center the film over whatever is being photographed. The armature has a standard-sized wing nut (like the screw on a tripod) which attaches to the bottom of the camera and holds it securely in place.

A tripod—the height-adjustable three-legged camera stand normally associated with time exposures or large-format portrait photography—can be used in place of a column-and-armature support. Tripods used for copy photography should be of substantial weight to ensure stability of frame and focus. The legs should spread apart far enough to accommodate large originals, and the camera table (the flat surface to which the camera is attached) should swivel sufficiently to allow the camera back to be held parallel to the original. A tripod used for copy photography should also have a camera support post that permits the camera to be moved horizontally. This allows the camera to be centered over the original being photographed.

Using a tripod causes some special problems: If the original is laid flat on a table, the tripod, holding the camera above the original, may cast shadows which will then be visible in the finished copy photograph. Shifting the legs to minimize the shadows may increase the tripod's instability; moving the lights to achieve the same end may be impractical. If the tripod table does not swivel sufficiently, it will be difficult to center the camera over the original. If the original and the camera are held vertically (as would be the case in order to shoot a hanging object, such as a tapestry or a painting), the weight and size of the original that can be photographed is severely limited. For example, it would not be feasible to photograph a book held vertically without specialized support equipment.

For the purposes of this guide, a horizontal copy stand set-up will be described. Vertical copy photography, e.g., taking photo-

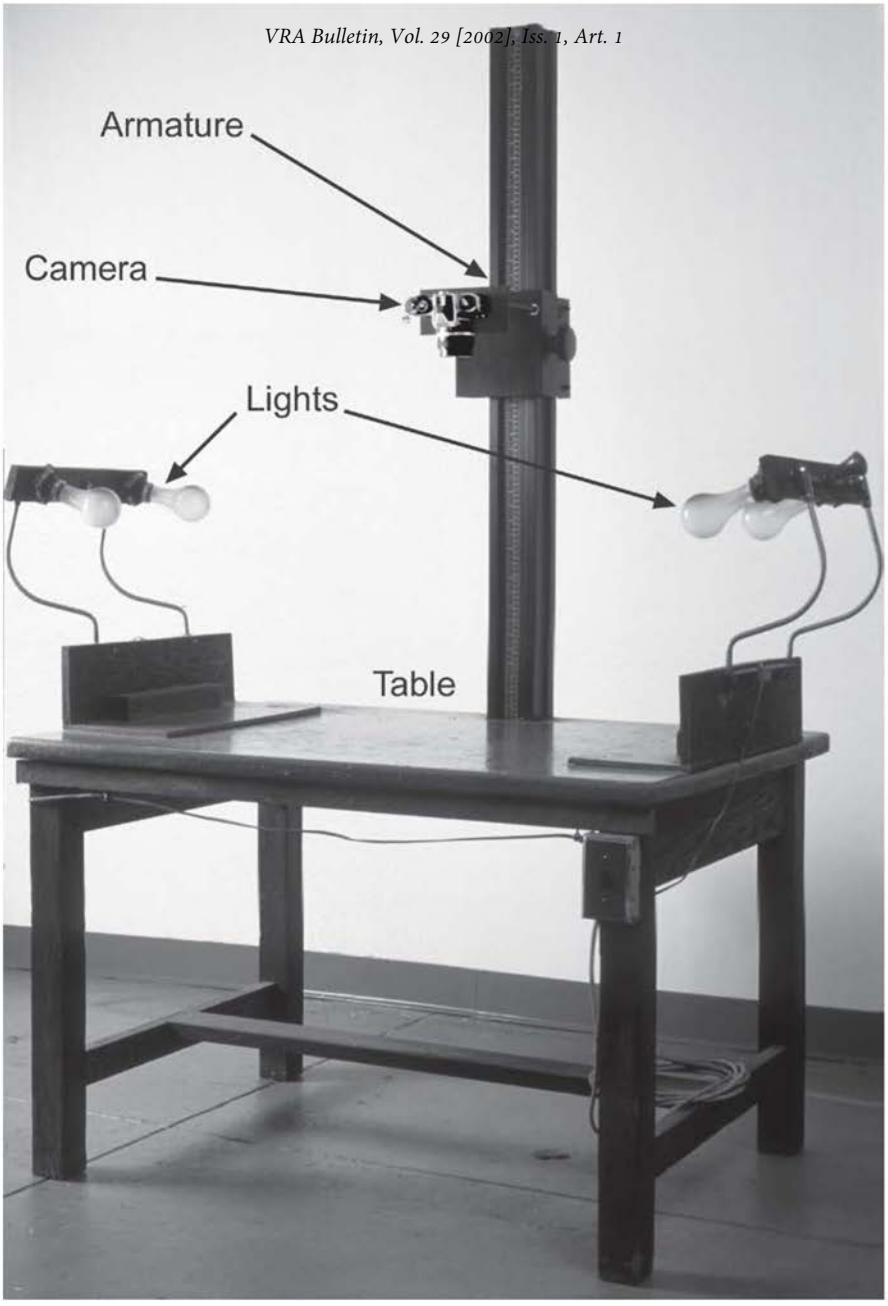

Figure 1: Basic Copystand.

graphs of paintings on the walls of museums, requires different procedures which will not be described in any detail here.

1.2 Table or Other Support

The table used for copy photography must be large enough to accommodate the camera armature, lights, and the original to be photographed. It must also be high enough that it is comfortable for the photographer, but not so high that it is difficult to look through the viewfinder of the camera. The table should not be so wide that the lights are set too far from the original. All of these dimensions are relative, however: the table can be as large or as small as is comfortable for a particular person to work with, and the camera stand may be either short or tall. The size of the set-up, as mentioned above, will dictate the relative size of the originals that can be photographed, as well as the camera settings needed to achieve the desired results. As an example: a well-sized table for a 36-inch camera support column, to be used by a person of average height (about 5 feet 5 inches to 5 feet 10 inches), is 44 inches wide by 30 inches deep, 30 inches up from the floor (see Figure 2).

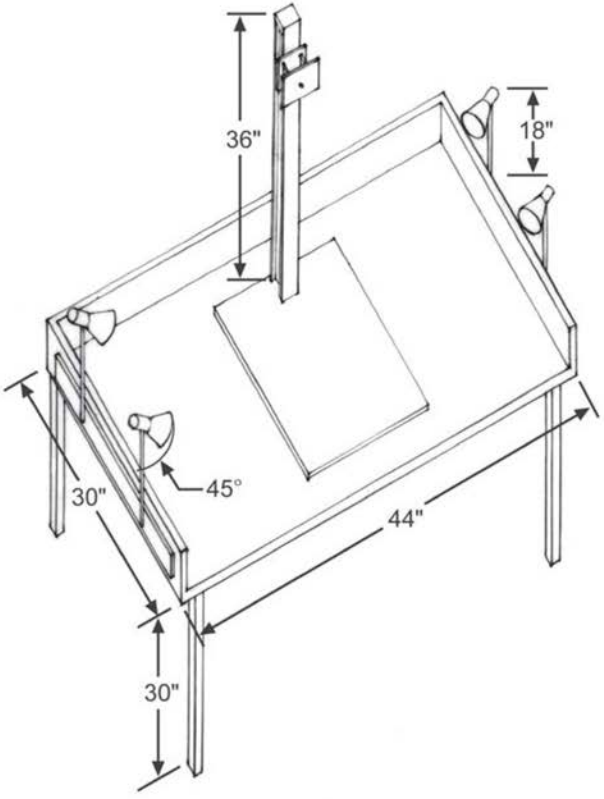

Figure 2: Custom copystand. Andrew K.Y. Leung drawing

1.3 Lights: Attached and Separate

Figure 3: Floodlamp (left) and halogen lamp (right).

The lighting source selected for the camera stand (hereafter referred to as the copystand) directly affects which kinds of film can be used. Every light source has a characteristic color output called its color temperature, for which the unit of measure is degrees Kelvin (K), which reacts with the film's emulsions to produce an image. Color temperature differs from lamp type to lamp type and even within each type individually, from bulb to bulb. This difference is most apparent if you compare an incandescent bulb with a fluorescent one: incandescent lamps give off a warm, near-white light; fluorescent lamps give off a cool, slightly greenish light. Two different kinds of copystand lamps are illustrated in Figure 3.

As a bulb is used, its filament or gaseous filling ages, causing the bulb to emit light of different quality, of different color temperature. As a copy photographer you need only be concerned with a bulb's age if you choose fluorescent bulbs for your copystand set-up, since fluorescent bulbs change considerably with use. Most tungsten-filament photo flood lights, however, change so little as they age that it does not need to be a concern.

Regular photo flood bulbs will darken with age as the tungsten from the filament deposits on the inside of the bulb (see Figure 4). This can change the bulbs' light output considerably (and therefore the time needed for a proper exposure) by the end of their life. Remember to change bulbs in pairs when one goes out to avoid the uneven lighting that can result from using an old bulb and a new bulb simultaneously. Tungsten-halogen bulbs, although more expensive, avoid this problem because the tungsten burned while the bulb is lit is deposited on the filament, not on the inside surface of the glass.

Film type and light source must "agree," that is, the film must be sensitive to the light being used to achieve the best results (see Table 3.1). Color films, either print or transparency, fall into essentially two light-sensitive categories: daylight, or blue-light sensitive; and tungsten, or yellowish-light sensitive. Daylight- and tungsten-balanced films are chemically corrected to give the appearance that they were exposed under white light. Each film requires different lights for best results.

A simple copystand set-up might have four lights, two on either side of the camera support column (as mentioned above, lights should always be used in symmetric pairs to ensure even illumination of the original). The lights should be held by stable supports, either attached to the copy stand base or positioned at the sides of the table, that are half the total height of the camera support column, and at a 45-degree angle to the surface on which your originals will rest. In other words, if you have a 36-inch high camera support column, your lights should be set 18 inches up from the table surface. Four 250-watt, 150-volt, 3200-degree Kelvin bulbs (assigned the standard call letters ECA) provide enough light for Ektachrome 160T (a Kodak brand tungsten-balanced slide film) to be exposed properly without using color filters. Figures 1 and 2 show standard, straightforward copystand set-ups. Standard light sockets, which will accommodate many different kinds of bulbs, are used for added convenience.

Some bulbs, such as the ECA bulbs described above, remain lighted during the entire process of photography. ECA bulbs are tungsten-filament bulbs, which emit the slightly greenish light to which tungsten-balanced films are calibrated. ECA bulbs are easy to find and relatively inexpensive (about $3.00 each when purchased by the case of 24). Since they remain lighted during the entire photography process, any shutter speed may be used. However, ECA bulbs generate quite a bit of heat, which can make the photographer uncomfortable over time.

Strobe lights also may be used with a copystand. A strobe light is a lamp that emits a short burst of very bright, white light, synchronized to a camera's flash timer. This white light is best for use with daylight films. Strobe lights are much cooler than lamps which remain lighted during the entire photography process, but care must be taken to connect the strobes to the camera's flash function, and to use only the flash shutter speed proper for your camera. Any discomfort to the photographer arises from the brightness of the flash of light, rather than from heat generated by the bulbs.

Strobe lights are "chained" together in what is called a "master/slave" configuration: one "master" light is connected directly to the camera; all other strobes (the "slaves") are linked to the "master." This linkage ensures that all the strobe lamps will flash at the same time.

Strobe lamps are initially expensive (about $50 each), but very economical in the long run. One set will illuminate thousands of exposures when properly connected and maintained. Six Morris brand master/slave strobe lamps provide sufficient light for a variety of daylight-balanced 35mm slide films ranging in speed from ASA 50 to ASA 100, regardless of manufacturer, and last for up to 50,000 flashes (see Chapter 3 for more about film speeds).

Copystand lights may be either attached to the main apparatus, or separate from it. There are advantages to both set-ups. Attached lights are pre-built to be of the proper height and angle for copy photography, although they may be so close together at the base that the size of originals that can be photographed is limited. Separate lights can be attached to the table or moved at will, accommodating both large and small originals. Separate lights also can be used if large flat-work must be tacked to a wall to be photographed. However, the photographer must then take into consideration the height and distance of the lights relative to the camera armature, and the angle

relative to the original, in order to make a good exposure.

When building a copystand, rather than purchasing it from a commercial source, it is useful to connect all the lighting fixtures to a single on-off switch, especially if you will be using a light source that will be illuminated for the entire photography process. The lights then can be turned off between exposures, preventing heat damage to either the original or the photographer. See Section 3.2 for more about choosing lights.

A note about lights, heat, UV, and the potential for damage to your originals: if you are photographing rare or brittle originals, be sure to consult with a knowledgeable librarian or curator concerning the conditions under which the works will be photographed. Exposure to intense heat and bright light may damage fragile originals, and should be limited or avoided completely.

CHAPTER 2

CAMERAS AND OTHER EQUIPMENT

2.1 Cameras

Any brand and format camera, new or used, may be used for copy photography, providing it has manual shutter, f-stop, and focus controls. Most commonly used is a 35mm camera that can, of course, accommodate both slide and negative film. A single lens reflex camera (abbreviated SLR; that is, one which permits the photographer to look directly through the lens by way of a single mirror refraction) is the easiest to use for copy photography. A Nikon FM-2 or a Pentax P-3 are examples of cameras suitable for copy photography.

Do not use a completely automatic camera, or a camera set to expose film automatically, for copy photography. Most automatic light meter readings and lens settings are unreliable for copy photography, and can result in dark or otherwise poorly exposed images.

A cable release is a device that allows the camera's shutter to be opened remotely. This minimizes moving the camera on the armature, and helps ensure that the camera back remains parallel to the original being photographed. A cable release is a flexible metal chord about 8 inches long, with a plunger at one end and a screw attach-

ment at the other. Attach the screw end to the center of the shutter release button; pressing the plunger at the other end releases the shutter, without the camera being touched or jiggled (see Figure 6).

2.2 Lenses

A macro (close-up) lens is mandatory for copy photography. This lens is fairly inexpensive and can be used as a general, all-purpose lens as well as for close-up work. A good basic lens for copy photography is a standard 50mm lens with macro capabilities. The cost of such a lens ranges from $100 to $500, depending upon the power (that is, the lens's enlarging capabilities) and the brand name. A basic 50mm macro lens that can focus on images as small as two inches square should not cost more than $150 or $200. With a Nikon FM-2, a Sigma Macro 128 (50mm) lens may be used; with a Pentax P-3, a Pentax-M Macro (50mm) lens may be used. These are certainly not the only possible combinations of camera and lens; the key criteria are manual camera operation and macro lens capability.

When choosing a lens, look for one that is lightweight and compact. The lens should be tested with the camera body to be used to determine that it will focus easily, and that the diaphragm opens smoothly to each f-stop (see Section 4.1.2 for more on f-stops) over the entire range of settings (especially necessary if you buy a second-hand lens). Check the outer lens surfaces for scratches. A lens with as close as possible to a 1:1 ratio is best. (With a 1:1 focusing ratio, what you see through the viewfinder is what is actually exposed on the film.)

An alternative to a macro lens is a set of close-up rings (extension rings or tubes) coupled with another lens, and providing magnification similar to a macro. The quality of the final image produced with close-up rings, however, may be less sharp than that of an image made with a macro lens. Close-up rings are inexpensive, but attaching and removing them when photographing originals of different sizes can be inconvenient and time-consuming. The chance of getting dust and fingerprints on the lens when using close-up rings is also great.

Close-up rings are available in sets, of 1x, 2x, and 4x enlarging powers. They can be attached to a camera lens individually or in combination to provide the needed magnification. The addition of

each close-up ring changes the amount of light reaching the film, and each frame must be metered closely to ensure a proper exposure (see below, Section 2.3). When purchasing close-up rings, make certain that their diameter is the same as the diameter of the lens to which they will be attached.

See Appendix A for more about lenses and their uses.

2.3 Light Metering

Most 35mm cameras now have built-in light meters that enable you to set the camera for the best film exposures based on the lighting source and film in use. Through the lens (abbreviated as TTL) light meters read the light available directly through the lens, and make calculations about how much light needs to reach the film for a proper exposure. These calculations are often summarized by a needle, visible on one side of the viewfinder, which moves between a "+" and "-" sign. When the needle falls halfway between the two, neutral density (and a proper exposure) is achieved. Other TTL light meters indicate exposure with a number, visible along one side of the viewfinder, which shows at what shutter speed the camera should be set for a proper exposure at a given f-stop.

Hand-held light meters also may be used for copy photography. These measure light independently of the camera, and are held between the camera and the original being photographed. Hand-held meters, while more sensitive and flexible than TTL meters, are more cumbersome and difficult to use. Be sure to use a gray card (see Section 2.4 below) to get an accurate light meter reading, whichever meter is used.

See Chapter 4 for more about light metering.

2.4 Gray Cards

A gray card is just that—an 18% neutral density measurement aid in the form of a gray cardboard rectangle. This is used to calculate exposures while using a light meter; the gray card gives the light meter a "known" tonal density from which to calculate shutter speed and aperture settings. Gray cards are available in most photo stores, and come in the same sizes as standard photo enlargements—4 x 5 inches, 8 x 10 inches, and so on. Select a gray card that is about the

same size as most of the originals you will be shooting. Gray cards are relatively inexpensive, usually costing between $4 and $15, depending upon size.

The use of a gray card or some other neutral-density source during copy photography is very important to ensure proper exposure settings. An evenly-toned black-and-white photograph, one with a good spectrum of grays, neither too dark nor too light, can be substituted for a gray card if one is not available. The palm of your hand can also be used, but average Caucasian skin color is lighter than a gray card. (You must compensate for this by about one stop; for example, if the light meter reading from your hand indicates that 1/30 of a second at f11 will provide an accurate exposure, then change the shutter speed to 1/15, or change the f-stop to f8.) Neither the black-and-white photograph, nor your hand will provide a completely accurate light-meter reading.

Gray cards can become soiled with use (as can your palm), and they may fade with continual exposure to the bright lights of a copystand. Gray cards should be replaced as soon as exposures made with their aid appear consistently incorrect.

The column base of the Bencher Copymate copystand is the correct shade of gray for light meter readings, thereby eliminating the need for a separate gray card; it is also possible to paint the table surface of a copystand the correct shade of gray. To use a gray base for this purpose, first adjust the armature height and focus the camera on the original, then remove the original from the base and take a light meter reading. Replace the original, check the focus, and release the shutter. This process is more time-consuming than using a gray card, but will save the purchase price of that extra accessory.

2.5 Clips, Weights, Foam Wedges, and Paper Clamps

In order to make a rectangular photograph from a rectangular original, the original must be held flat and parallel to the camera back containing the film. That is sometimes easier said than done, especially when photographing books. Books with stiff bindings often will not lie flat under the camera, causing illustrations to disappear into the binding gutter.

Although not all problems associated with tightly bound books can be solved, many can be minimized by using clips, weights, foam

wedges, or paper clamps to hold the book open, flat, and parallel to the film in the camera. Foam wedges, about 6 inches long and 2 inches tall, cut from any slightly stiff foam material, can help to keep a thick-spined book level with the camera. Weights take many forms, but all should be padded to prevent damage to the originals. Paper weights, hand exercise weights, even a fragment of brick wrapped with something soft such as a sock will suffice to hold the corners of a page being photographed. Clips, such as 1-inch "bully" clips or banker's money clips, are also useful for smoothing the pages of books being photographed.

Four weights, four clips, and four foam wedges should not cost more than a few dollars to assemble, and will provide you with great flexibility in the sizes of books that can be held flat and photographed. Commercially available book cradles or book presses, while useful, can be expensive, and should be used only with great caution; any time a book is flattened to be photographed, no matter what devices are used, its spine or binding may break or be damaged.

2.6 Backing Papers

Occasionally when photographing an original with something printed on the back (newsprint, for example, or a line drawing in an old periodical), the copy on the back will show through to the side being photographed. Backing papers or thin-gauge cardboard, usually 8 x 10 inches and of a solid color, can alleviate this problem.

When copying a building plan drawn on tracing paper with notations on the reverse, for example, it is possible to minimize the bleed-through in the final photograph by placing black backing paper beneath the image before photographing it. Multi-color bleed-through can be minimized using white backing paper, or even a gray card. For most effective results, use a backing paper that is the same color as that which needs to be blocked out.

2.7 Glass or Plastic Plates

Sometimes no amount of weight nor number of clips will sufficiently flatten the original to be photographed. A glass or clear plastic plate placed over the original may do a better job of flattening than simply weighting the edges. Glass plates should be no more

than 1/4 inch thick and clear ("water" glass, with no color tint), with beveled edges to make handling safer. The glass should be bigger than the original to be photographed; a good all-purpose size is 12 x 18 inches. If the glass alone isn't heavy enough, weights and clips can be added at the edges to help flatten the original.

Remember to clean the glass carefully before using it. The edges can be covered with photographic masking tape or heavy box tape to prevent chipping and to make handling safer. A camera mask must be used (see Section 2.8 below) when a reflective glass or plastic plate is used for flattening purposes.

A good substitute for a weighted glass or plastic plate, at least for unbound paper originals, is a combination of a thin metal plate and a set of strip magnets, the same set-up that many needle workers use to hold their work in place. The metal plate is placed underneath the original to be photographed, then the strip magnets are placed along the edges. The magnets hold the original in place and smooth it at the edges.

2.8 Camera Mask

Glass or plastic plates have one major drawback: a reflection of the light source on the shiny surface of the plate may show on the processed film. To prevent this, use a camera mask. Commercially available camera masks, which are soft black cones made of rubber or plastic, are easy to find and simple to use. However, it is possible to make a mask that works just as well with a piece of black cardboard. Cut a hole which fits snugly over the camera lens (but does not block it!) in the center of a piece of black cardboard 8 to 10 inches square. Fit this cardboard over the lens whenever using glass or plastic and errant reflections should be minimized.

CHAPTER 3

FILMS, LIGHTS, AND PROCESSING

3.1 Choosing a Film

Film is rated by its speed (a measurement calibrated by the American Statistical Association or the International Standards Organization, and consequently referred to as the ASA or ISO number), that is, how quickly a given film emulsion will react to light and produce an image. The ASA/ISO number reflects the relative speed of the film: high ASA/ISO numbers are assigned to fast films, low numbers are assigned to slow ones. The "faster" the film (and the higher its ASA/ISO number), the less light is needed to produce an image. Speed, then, refers to the time it takes a film's emulsions to react to light, which is why fast films can be used in low light conditions. Fast film emulsions are made up of larger light-sensitive molecules than are slow film emulsions; they therefore produce grainier (and often less sharp) images. These larger molecules do retain an image more quickly, making fast film true to its description. For a sharp, crisp image, however, it is best to use film of the slowest speed (the lowest ASA/ISO number) that conditions will permit.

3.1.1 Color Films Color films are made to respond to different light color balances (see Section 1.3 for a discussion of the differences between lights). Light color balance, as noted above, is measured in degrees Kelvin. There are two basic types of color film: daylight film, which is balanced to 5500-degrees Kelvin; and indoor (tungsten) film, which is balanced to 3200- to 3400-degrees Kelvin. Daylight film is balanced for sunlight and electronic flash. This film is normally used outdoors and gives good results with strobe lights or flash attachments. Indoor (tungsten) film is balanced for photo flood lamps and tungsten or tungsten-halogen bulbs. Indoors, these films also produce fairly acceptable results with regular household light bulbs (incandescent lamps, not fluorescent ones).

All color films produce inaccurate results if they are not exposed in the light for which they are balanced. For example, Kodak Ektachrome Type B and Fujichrome RT films have a decidedly cool, blue cast when exposed in daylight; Kodachrome, Kodak's Ektachrome daylight films, and Fujichrome RD films have a warm yellowish cast when exposed in most indoor light. Color film should always be selected to match the light source. Table 3.1 will help you to match film to light source.

TABLE 3.1: FILMS AND LIGHT SOURCES

Daylight Films (these need around 5500-degree Kelvin light sources)

Temperature	Source
6000-degrees K	strobe lamps
5500-degrees K	sunlight (at high noon)
4800-degrees K	fluorescent lamps
4000-degrees K	flash bulbs or flash attachments

Tungsten Films (these need 3200- to 3400-degrees Kelvin light

Temperature	Source
3200-3400-degrees K	photo flood lamps
3200-degrees K	halogen lamps
2800-degrees K	household incandescent lamps
1900-degrees K	candlelight

3.1.2 Black-and-White Negative Films Black-and-white negative films, like color films, have an ASA/ISO number which indicates how much light is needed to produce an accurate exposure. Like color films, the faster the film, the more quickly the emulsion reacts to light, and the larger the grains of light-sensitive material that make up the emulsion. Again, use the slowest film possible for the lights on the copystand to ensure a sharp exposure.

Any black-and-white film will work on a copystand—although very few black-and-white films produce direct positive images (slides). Make sure you are using the proper film, either for negatives or slides. The color balance of the lights on the copystand is not an issue when using black-and-white films, but the intensity of the lights is. Use gray card and light meter to ensure proper exposures.

3.2 Choosing Lights

It is important that the light source on the copy stand "agrees" with the film to be used. For tungsten-balanced films, photo lamps rated at 3200-degrees Kelvin are sufficient. Many kinds of lamps may be used; the intensity (accumulated wattage) of the lamps determines how many are needed. Four lamps rated at 3200- to 3400-degrees Kelvin will provide sufficient illumination for tungsten-balanced films with an ASA/ISO of 160 to be properly exposed, without special color-correcting filters.

For daylight films, photo strobe lights may be used. As noted in Section 1.3, strobe lights give off a short, bright burst of light synchronized with the camera's flash function. Typically, six master/slave strobe lights are needed for daylight film with ASA/ISO rating of 25 to be properly exposed without filtering. Strobe lights need to be connected directly to the camera, and to one another, to synchronize properly with the camera's flash function. Both strobe and photo flood lamps that fit into standard light sockets are available.

To repeat, for black-and-white films, the color of the light is less important than its intensity. To ensure a proper exposure, remember to use gray card and light meter for each frame, and set the shutter speed and f-stop carefully.

Which film and which lights to use are determined at least in part by what the finished slides or photographs will be used for. Some films have a longer dark-storage life; others have a longer

projection life (see Section 3.6 for more on dark storage life). Whether the final slides will be used on a light table or projected on a screen may determine which slide film to use. If a black-and-white photograph is needed for publication purposes, it should be made with the slowest (and therefore finest-grained) film possible. Black-and-white prints intended only for study purposes, however, may be shot with faster films. The result, of course, will be grainier, less sharp, reproductions, but exposure times will be shorter.

3.3 Filters

Filters—transparent, colored lens attachments purchased in the same diameter as the camera lens—may be used to correct for film that is not suitable for the existing light source. Ideally, color film used should always be compatible with the light sources under which it is exposed, but it is not unusual to encounter light conditions that do not match the color balance of the film you have in hand. Filters are used to correct these discrepancies. When using filters for color correction the light meter reading or exposure must be made with the filter on the camera lens. A filter not only changes the color of light coming into the camera, it also reduces the amount of light which reaches the film. It may be necessary to change the shutter speed, the f-stop, or both, to compensate. Table 3.2 illustrates filters that are appropriate for various light sources.

TABLE 3.2: BASIC COLOR FILTRATION CHART

Please note: Because each film type has different color sensitivities, the exposure compensation for various filters will vary with each kind of film. The variations for common filter types should be included with the specification sheet enclosed with the film.

Each of these filters will diminish the amount of light your film receives, which will change the exposure needed. Most of the light changes are relatively small (about 1/3 of an f-stop), and you need not worry about the shift. However, 80A and 80B filters diminish the light reaching the film by a factor of 2 to 2 1/3 f-stops, which means the film receives 400 to 500% less light than it would without the filter. Under such conditions, you might consider using a film with a higher ASA/ISO rating to help compensate for the loss of light. Fluorescent filters (FL-B and FL-D) will decrease the exposure by one f-stop.

Filter Numbers	Filter Colors	Film Types	Filter Functions
81A	yellow	daylight	Corrects color balance when tungsten film is used with 3400-degree Kelvin light sources.
82A	light blue	type A	Corrects color balance when type A film is used with 3200-degree Kelvin light sources.
80	blue	daylight	Corrects color balance when daylight film is used with tungsten light: 80A for 3200-degree Kelvin light sources; 80B for 3400-degree Kelvin.
85	amber	type A or tungsten	Corrects color balance when indoor films are used outdoors: 85 for type A film; 85B for tungsten.
FL		daylight or tungsten	Approximate correction for excessive blue-green cast of fluorescent lights: FL-D for daylight film, FL-B for tungsten.
CC		any	Used for color balancing. These filters come in various densities in each of 6 colors (red, green, blue, yellow, magenta, cyan). Density is indicated by a number, the higher the number, the more intense the color: a CC10R is a less-dense red filter than a CC20R.

3.4 Films and Processing

Different films require different chemical processing (just as they require different light sources). All film should be processed properly and promptly, based on the kind of film used and the speed at which it was exposed; color print film, color transparency film, and black-and-white film each require different processing chemistry and techniques. Whether Agfa, Fuji, Ilford, Kodak, or Konica is used; self-bulk-loaded or commercially prepared; daylight- or tungsten-balanced; is less important than that consistent results are achieved with

a local copystand set-up. Do not be afraid to experiment with different kinds of film to determine which is best for your intended purposes and available equipment.

With so many different brands and speeds of film available, choosing the film that is right for your needs can be a daunting prospect. A recent (June 2001) blind test undertaken to find a new daylight-balanced copy photography film to use at the Institute of Fine Arts (now that Kodachrome 25 and its companion K-14 process films are being slowly discontinued), revealed a full spectrum of strong opinions, and some rather partisan feelings for particular film brands.

What follows is a summary of the results of the 2001 IFA film test, as compiled by Gordon Arkenberg. Films are listed in the order ranked, from "best" to "worst.," in Sections 3.4.1 to 3.4.9. Only daylight balanced, ASA/ISO 100 or slower, E-6 developing process films were considered. Films were rated by four judges on ten different criteria, including color saturation, granularity, color accuracy, bracketing performance, and projection performance. Although each film described below has particular strengths, each performed nearly identically when scanned--and it should be noted that all of the films considered performed consistently and well. A full description of this test, including methodology and judging criteria and a list of participants, can be found on IFA's web site, www.ifa.nyu.edu.

Black and white transparency films and Polaroid "instant" transparency films are considered separately, in sections 3.4.10 and 3.4.11 respectively.

3.4.1 Agfachrome RSKII 50. This film has normal but strong color saturation, high color accuracy, and exceptional color response. It performs particularly well while projected. While all Agfa transparency films tested showed exceptional dimensionality, this film was the highest-ranked for overall performance.

3.4.2 Ektachrome EPP 100. This is one of the oldest transparency films on the market. This film is comparable to Agfachrome, with the exception that it seems not to bracket well. EPP is advertised as having higher color saturation than Ektachrome EPN, but EPP's color rendering is more erratic—good in cyan, fair in magenta (where the film is most saturated), extremely good in yellow.

3.4.3 Ektachrome EPN 100. In terms of color saturation and accuracy, this film performs quite similarly to Kodachrome 25. The film's strength is its ability to distinctly separate red and magenta, and its subdued greens. However, its ability to render shadow detail and its dimensionality are both poor. It has average bracketing performance.

3.4.4 Agfachrome RSXII 100. This film performed at what would probably be considered the average mark for all the films tested. This is a very consistent film, rating well on color saturation, granularity, and rendering of whites. Its advanced grain technology seems to make images "jump" off the frame.

3.4.5 Agfa CT Precisa 100. While tying its professional counterpart (RSXII 100), Precisa's performance was a little more erratic. The film scored consistently in its rendition of color, but Precisa was not well liked for its bracketing performance. This film is unique in that it had the lowest contrast of all the films tested. Its shadow detail and dimensionality are admirably high.

3.4.6 Fuji Velvia 50 RVP. The well-respected Velvia fell low in the ranking largely because of its unique response to color. It was rated as average in color saturation because of its absolutely vivid response to reds and greens. Yellows were found to be far off the mark, probably because of the way they "popped" and didn't retain any detail. The film performed admirably in shadow detail, dimensionality and bracketing, but did poorly in projection where its bright colors were only further skewed from the standard color bar. Velvia is a gorgeous film, but it seems better suited for outdoor photography than it is for copystand work.

3.4.7 Fuji Astia 100 RAP. Astia responded consistently throughout the test. This film is designed to have less green saturation than other Fuji slide films, and it looks very similar to Ektachrome EPN.

3.4.8 Fuji Provia F 100 RDPIII. Provia F ranked similarly to Astia, but it garnered criticism for poor projection quality and yellow accuracy. The film's greatest strength is its ability to render neutral color saturation and tonality. This is the recently reformulated Provia that has finer grain, and, as with most changes in film grain structure, changes in color accuracy seem to have resulted.

3.4.9 Ektachrome 64 EPR. This film ranked last of the 9 tested. It performed best in color accuracy, with normal saturation and neutral color rendition. However, when it comes to matters of tonality this film appears to fall flat. EPR's bracketing performance was ranked the lowest of all films tested because each change of 1/2 f-stop would bring about strong differences in color and tonality. The film's granularity seems extremely poor and the film seems to lack dimensionality. Even though its color rendering was considered fairly consistent, the film's quality was still average and presented nothing exceptional.

3.4.10 Black-and-White Transparency Films No color transparency film gives absolutely accurate reproduction of black-and-white originals. White areas of the original tend to take on the general color tone of the film, lending a yellow (Astia, Provia, Velvia), blue-green (Ektachrome), or magenta cast (Kodachrome) to the copy slide; while black areas tend to appear a similar deeply-colored gray. Black-and-white transparency films give the best results from black-and-white originals, but they must be shot and processed separately from color films; many commercial photo labs are not equipped to handle them.

One of the most-recommended black-and-white transparency films is Kodak Precision Line film (LPD4). This is a very slow, very high contrast film, suitable for line drawings and other high-contrast originals. For continuous-tone black-and-white originals, Kodak MP 5360 reportedly gives good results, as does Agfa Scala (B8PRK), a relatively new film with reputedly very rich tonal ranges.

A note on black-and-white processing: many art departments and slide libraries do black-and-white processing in-house. It is beyond the scope of this text to discuss black-and-white processing in any detail. When sending black-and-white film to a commercial source to be processed, make sure that the processor knows at what speed the film was exposed. This allows the processor to adjust developing times as needed. Also make sure that your processor does not batch-develop black and white film with color chemistry.

3.4.11 Polaroid 35mm Transparency Films Polaroid has a full line of 35mm "instant" slide films, including color (PolaChrome CS), black-and-white (PolaPan CT for continuous tone originals,

PolaGraph HC for high-contrast ones), high-contrast color (High Contrast PolaChrome CS), and blue-line reversal (PolaBlue BN) films. Opinions vary as to how useful and stable these films are, but there is no doubt that shooting and developing times are very fast, which makes them ideal when working on short deadlines. In general, Polaroid instant slide films are somewhat finicky, needing very specific ranges of exposure in which to give accurate results. Read the package insert carefully, and use a gray card.

Figure 5: Polaroid hand processor and film.

Polaroid films come in a kit, with a roll of film and a small chemical tank included in each one. Developing is done in a cranked box, called the processor, purchased separately and either hand- or motor-operated, which draws the exposed film through the chemical tank (see Figure 5). Developing times vary with each kind of film; read the film package insert carefully, and follow the directions.

Processed Polaroid film emulsions are quite soft, and must be handled carefully. Any contact with another surface will scratch the emulsion layer of the film, and fingerprints are virtually impossible to remove. Unlike other films, the emulsion layer of Polaroid films is on the front surface. This must be noted when mounting and orienting finished transparencies. It is advisable to remove what remains of the unexposed emulsion layer from the edges of the film. This can be done by laying a narrow strip of photo masking tape over the sprocketed edge, then lifting the tape away. The unexposed emulsion will stick to the tape, and can thus be removed and discarded.

3.5 Film Storage and Handling

Film is affected by changes in temperature and humidity, and by time. These elements may cause color shifts or clouding of the film, if not prevented by proper storage and handling.

High temperatures are bad for all films. Do not leave film in a precarious situation, such as next to a radiator, in a hot car, or near running electronic equipment. Most film keeps better in the refrigerator or freezer (indeed, for professional-grade films the manufacturers assume that the film will be refrigerated, and the emulsions are formulated accordingly), but cooled film must be allowed to return to room temperature before being exposed. Once at room temperature, film should be exposed and processed as soon as possible. This extra time constraint can be inconvenient, if not planned for in advance.

Like fine wines, film emulsions are formulated in batches, each of which is assigned a number, similar to a wine's vintage year. Sometimes the balance of the emulsion will vary from one batch to the next, and it is always a good idea to run a test roll to determine if any filtering adjustments are needed to give the best possible results from particular equipment set-ups.

Unlike fine wines, films do not improve with age. Film boxes are stamped with an expiration date: always check the expiration date of any film you purchase. There is a steady and marked decline in quality after that expiration date has passed. Beware of bargain films; some unscrupulous vendors will sell film beyond its expiration date for a lower price. You buy such "gray market" films at the risk of poor results.

Film needs careful handling when you are travelling. Keep film away from heat and direct sunlight, preferably in a cool, clean place (the beach is a terrible place for film canisters and cameras, even if it's a good place for a vacation). Film processing is available worldwide, of course, but many photographers believe that the processing available "at home" is the most consistent. Have your film processed by a lab you trust, regardless of its location. Some, but not all, airport security x-ray machines (particularly older machines, such as those found in third-world countries) can fog film. Exposed but undeveloped film is the most susceptible to fogging, and the more times unexposed films are put through airport x-ray machines, the more likely they are to fog. Very fast films fog more readily in airport x-ray

machines than do slow films. Ask to have film checked manually if there is any concern.

Processed film is also affected by changes in temperature and humidity, by time, and by exposure to light (projection light, overhead light, sunlight, and so on). Processed Polaroid transparency films seem to react most quickly to unstable storage environments and light exposure. In the absence of archival-level climate control (which is impractical in most academic environments), the storage acronym "CDCD" is a good rule of thumb: all processed films will last longer in clean, dry, cool, dark storage.

3.6 Dark Storage Life

Dark storage life refers to the length of time a processed film maintains good color verity (a loss of no more than 20% verity in any emulsion layer) when kept from exposure to light of any kind. Photographs, unfortunately, last longest when kept in ways that make them least useful: in the dark, in a climate-controlled (inhospitably cold and dry) environment. All films fade; they fade more quickly when projected, left standing on a light box, or exposed to sunlight. They also fade more quickly when stored in an unstable environment, even if it is dark.

When used to build a collection of copy photographs for academic use, a film's dark storage life should be a general consideration, as only a small percentage of most teaching slide collections is in use at any given time. Getting accurate information from the manufacturers about the dark storage capabilities of the films discussed in this chapter proved to be nearly impossible; what information is made public is based on tests done under ideal (and therefore unrealistic for the purposes of this text) conditions. In general, E-6 processed films do not have the superior dark storage reputation that K-14 processed films earned. However, Ektachrome films reportedly have a dark storage life of about 75 years; Fuji gives a very optimistic figure of more than 100 years for its E-6 films. As film emulsions are reformulated or their grain structures are altered, figures for their dark storage life are likely to change. Ensuring that your films are properly processed; keeping finished film clean and dry; and storing films in a stable environment will give them the longest useful life, regardless of film brand used.

CHAPTER 4

HOW TO MAKE COPY PHOTOGRAPHS

4.1 Basic Exposure Settings: All Films

The camera should be set to manual, as opposed to automatic, when being used for copy photography. Non-adjustable, automatic cameras typically do not produce satisfactory results in copy photography.

Set the film speed dial on the camera to correspond to the ASA/ISO number of the film being used. This allows the camera's light meter to calculate the appropriate amount of light required to expose the film correctly. Place the camera on the copy stand armature, being careful to screw the wing nut or other attaching screw to the camera, but not the camera to the screw. Overtightening the wing nut can result in bowing or puncturing the base of the camera, which will cause light to streak the lower edges of the film. Make sure the camera back is level with and parallel to the originals. Look through the viewfinder, and focus the image by rotating the barrel of the lens.

With the copy lights on and any overhead lights off, take a light meter reading, using the gray card. If using a built-in light meter,

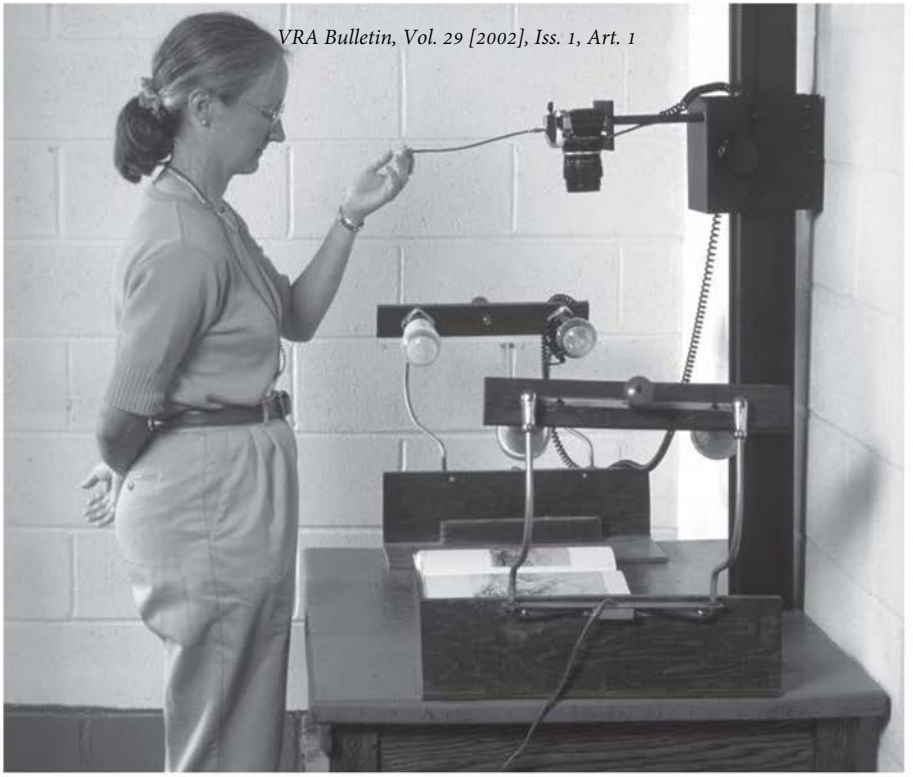

Figure 6: Shooting copy photographs. Notice the use of a cable release to press the shutter, and the strobe lights connected directly to the camera.

look through the camera's view finder and manipulate two of its dials to set the shutter speed and aperture, until the meter indicates a correct exposure setting. Both the shutter speed and aperture allow control of the amount of light which reaches the film to expose the image, as described below.

4.1.1 Shutter Speed The shutter controls the amount of light that reaches the film by controlling the amount of time the film is exposed to light. The shutter speed dial is usually located on the top of the camera, next to the shutter release button (the button pressed to actually take a picture; see Figures 7 and 8). Each shutter setting is half or double that of the next. This relationship is expressed with a series of numbers that represent fractions of a second, from 1 (1/1 or one second), through 2 and 4 (1/2 and 1/4 second respectively), sometimes all the way to 2000 (1/2000 of a second). "B" or "bulb"

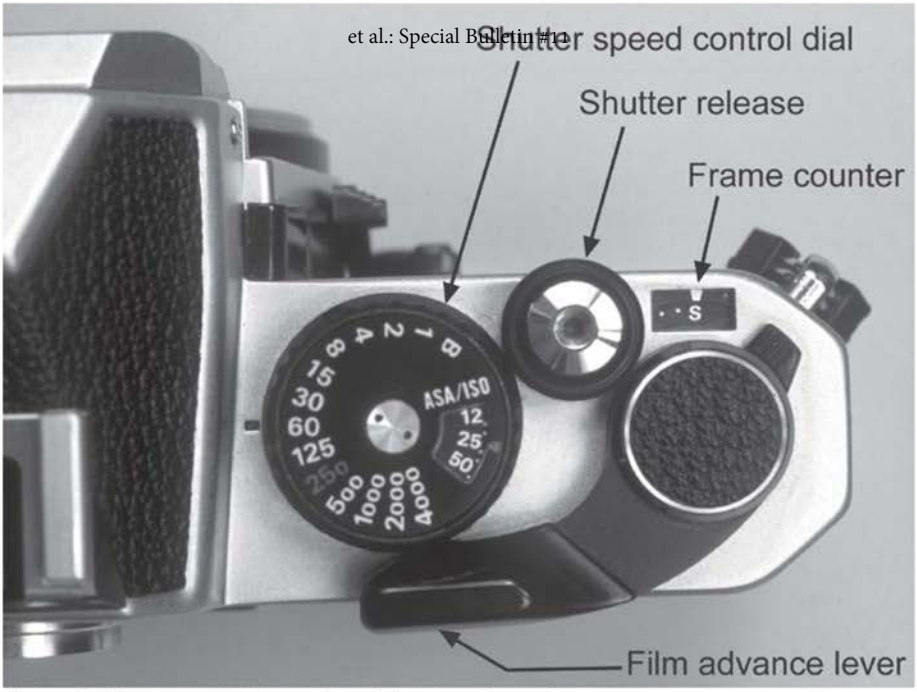

Figure 7: Shutter speed control and shutter release button.

setting keeps the shutter open as long as the shutter release is depressed. "T" or "time" setting opens the shutter with one press of the release and closes it with another press. Think of the camera lens as the window to your film, and the shutter as the window's shade. The shutter speed controls the amount of time the shade is up, allowing light through the window and onto the film.

4.1.2 Aperture or F-stop The aperture is the opening of the camera through which light enters. The aperture controls the amount of light coming in to the camera by changing the physical size of the opening through which the light must pass. The aperture may be opened up so that most of the light reaching the surface of the lens passes through, or closed down so that the opening becomes very small and allows very little light to pass through. To continue the analogy of the window: the aperture represents the size of the window covered by the shade. A small aperture may be compared to a peephole; a large aperture may be compared to a picture window.

The aperture dial is located on the camera's lens, and has a

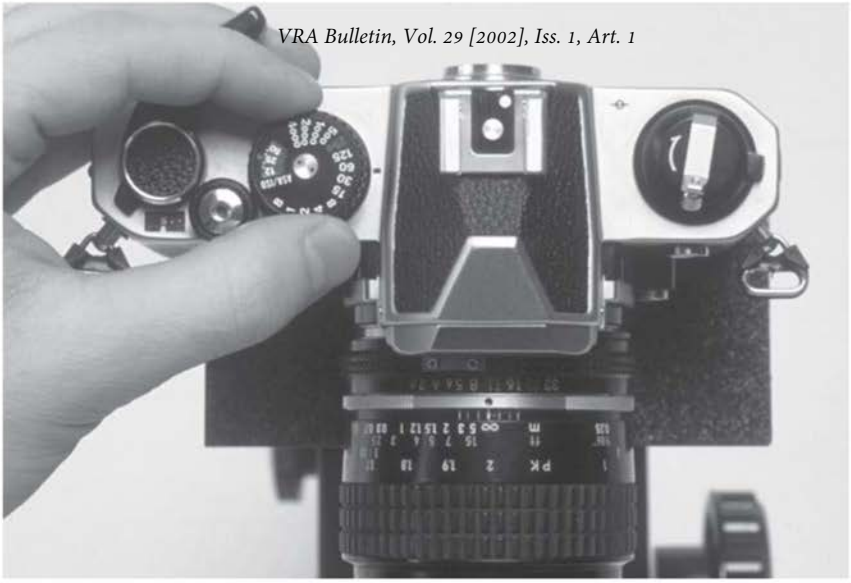

Figure 8: Setting the shutter speed.

series of numbers (called f-stops) that indicate the size of the opening. The numbers commonly used are f2.8, f4, f5.6, f8, f11, f16, f22, and f32. These numbers are inversely proportional to the diameter of the opening: 2.8 corresponds to the largest opening, 32 to the smallest. Each f-stop in between admits half the light of the previous one: f4 will admit half as much light as f2.8; f5.6 lets in only a quarter of the light that f2.8 does; and so on (see Figures 9 and 10).

A change in aperture size affects the sharpness of the photograph as well as the amount of light entering the camera. As the aperture gets smaller, more of the background and foreground becomes sharp. The range of distances from the lens that can be photographed with acceptable sharpness is known as depth of field. The smaller the aperture (that is, the higher the f-stop), the greater the sharpness or depth of field (this is analogous to squinting your eyes in order to sharpen a small portion of your overall field of vision). Depth of field is an important consideration when photographing landscapes or three-dimensional objects. Since most copy photography is done from two-dimensional objects, a small aperture giving great depth of field is usually unnecessary, unless the surface is bowed or wavy. Then a small aperture will help to preserve clear focus across the whole image.

By changing these two settings—shutter speed and f-stop—the amount of light which reaches the film is controlled. This is what is meant by proper exposure: coordinated setting of the shutter speed and aperture opening to ensure an image that is neither too light nor too dark, with an appropriate depth of field for the subject. Film that has had too much light strike it is overexposed; film that has had too little light strike it is underexposed. Taking a meter reading from a gray card determines the proper shutter and aperture settings for that particular original, so your finished photograph will be properly exposed.

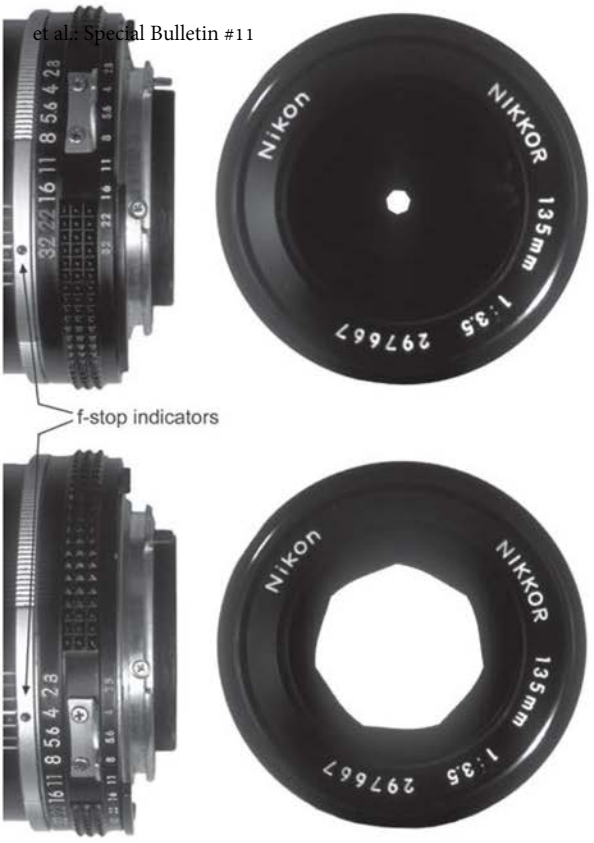

Figure 9: The top lens is set to f32; the bottom lens is set to f4

4.1.3 Camera Stand or Tripod Exposures Since the camera is completely stabilized during copy photography it is possible to use any shutter speed needed, even comparatively long ones (see also Section 4.5 for a discussion of reciprocity and the effect of longer exposure times on aperture settings, and Table 4.1 for exposures over 1/4 of a second). For copy photography done with four 3200-degree Kelvin lamps and tungsten-balanced film with an ASA/ISO rating of 160, the exposure time may be 1/30 to 1/60 of a second. For copy photography done with strobe lights and daylight film, the exposure time should be synchronized with the camera's flash function (check

Figure 10: Setting the f-stop

the camera's manual for the appropriate flash setting). For copy photography done with black-and-white negative film, the exposure time may be anywhere from 1/2 to 1/60 of a second, depending on the lights used and the speed of the film. Black-and-white high contrast direct positive film may need exposure times of more than a second.

4.1.4 Hand-Held Exposures Without access to a stand or tripod for copy photography, it should be kept in mind that, as a rule, no hand-held exposure should be longer than 1/30 of a second. Longer exposure times will reveal the smallest movement of the photographer's hand or arm. Another good rule of thumb is to use an exposure that corresponds to the length of the lens, or higher. For example, with a 120mm lens exposures should be set for 1/120 of a second or shorter (1/250 or 1/500 of a second would be better still).

Because the length of the lens makes the camera's weight distribution uneven, it also becomes more difficult to hold the camera steady. The longer the lens, the greater the need for a tripod or camera stand, even for relatively short exposure times. A camera with a short lens—28 mm or so—can be comfortably hand-held at exposure times of 1/30 of a second or shorter (1/60 to 1/120 are best; see Appendix A for more about lens lengths).

4.2 Placement of Two-Dimensional Originals: All Films

In copy photography, the object to be photographed should be placed so that it fills the frame, i.e., if the subject is horizontal, it should be placed parallel to the camera back so as to correspond to the frame of the film. With most lenses, what is included in the viewfinder is slightly more than what is exposed on the film. Test your camera and lens to determine if you are working with less than a 1:1 ratio between the image and its representation in the viewfinder; you may need to allow a small amount of space around the subject to show through the viewfinder when framing and focusing to prevent unexpected cropping of the edges of the finished image.

The camera back, and thus the film inside it, should be level and parallel to the original. With practice, it becomes possible to tell by sight whether or not the camera back and original are roughly parallel to one another; however, a small hand level is always a useful accessory (see Figure 11). Frame the image, and bring it into focus by rotating the barrel of the lens until the image visible through the viewfinder is as large and as clear as possible. Move the camera support on the copystand up or down to frame as much of the image as required. Once the image is in focus, use a gray card, placed right on top of the original being copied, to take a light meter reading. When the light meter needle is centered (or the shutter speed number turns green or stops flashing, depending on the kind of meter), re-

Figure 11: Leveling the camera body

move the gray card, check the focus once more, and take the picture by pressing the shutter release button. Advance the film, and you are ready to go on to the next original.

4.2.1 Problems in Two-Dimensional Copy Photography Two of the most critical factors in successful copy photography are getting the original flat without damaging it, and keeping it that way long enough to make a proper exposure. Here are some common difficulties in photographing two-dimensional originals:

Wrinkled Originals

To make photographs or slides from newspaper clippings, old photographs, maps, or any two-dimensional original that has been folded and unfolded, it is helpful to use a glass or plastic plate, with weights or clips at the corners to flatten the original, or the metal plate/strip magnet arrangement described in Section 2.7. If the original is severely wrinkled (perhaps it has been crumpled, and then smoothed), and no amount of weight will flatten it sufficiently, the shadows which will show up in the final photograph are inevitable. Remember to use a camera mask to prevent glare every time a glass or plastic plate comes between the lens and the original, and the smallest aperture setting possible, to take advantage of an increase in the depth of field. Both will help to minimize wrinkles.

Thick-Spined Books

Books with very thick spines or those in which the plates are bound into the gutter present two problems, the first being leveling the image. If the image to be photographed is on the side of the book with fewer pages (and thus thinner), use foam wedges, magazines, or thinner books under the outside edge to raise the page and level the image. If necessary, flatten the page with a glass plate, or weight the edges of the page, to hold the image firmly in place. Handle with great care so as not to break the book's spine or tear pages from the binding.

The second problem of thick-spined books is that illustrations may disappear into the gutter of the binding. A glass plate, weighted, if necessary, can be used to flatten the book as much as possible, again taking care not to damage the binding. Sometimes, however, no

amount of flattening reveals the whole image. In such a case, a highlight along the length of the gutter will appear in the final photograph. The highlight can be masked out while mounting the slide, but the image will, of necessity, be cropped. If the original is small enough (and closer to square), rotate it 90 degrees, so that the gutter falls perpendicular to the light source, rather than parallel to it; this allows light to shine through the gutter rather than across it. The highlight may thus be minimized, although the final image may be quite small within the film frame. A useful accessory is Stroboframe's "Vertaflip PHD," a device which allows the photographer to rotate the camera up to 90 degrees. The original will thus remain focussed in full-frame, while minimizing the gutter highlight (see Figure 12).

Figure 12: Vertaflip bracket, top view

Semi-Transparent Originals

As described in Section 2.6, solid-colored backing papers, placed underneath the original, may alleviate the largest problem encountered when photographing semi-transparent originals.

Very Small Originals

The size of originals that can be photographed is determined by the size of the copystand set-up and the capabilities of the lens used. With an image that is too small for the lens to focus on clearly, close-up rings (see above, Section 2.1) may be used on any lens, even on a macro, to enhance enlarging capabilities. Remember to take a light

meter reading with a gray card before releasing the shutter—close-up rings, like filters, cut down on the amount of light reaching the film. Close-up rings should be of the same diameter as the lens. See Appendix A for more information about lens diameters.

Very Large Originals

For images that are too large for the copystand, a wide-angle lens, or a hand-held exposure from a ladder (really!) may provide a solution (see Figure 13). Again, remember to take a light meter reading with a gray card (or a series of gray cards laid over this larger surface) and make needed exposure adjustments before releasing the shutter. Another consideration is to shoot two or even three images of sequential sections of the object, rather than one of the whole thing. Be objective; sometimes reducing a very large original (maps and line drawings in particular) onto a single 35mm frame gives unsatisfactory results, as so much detail is lost between the original and the copy photograph.

Figure 13: Using a ladder for focusing on large originals.

Poorly Printed Originals

A copy photographer can improve poor quality originals to a certain extent. However, there really is no substitute for a clear original. Bad photocopies, pencil drawings, newspaper and magazine illustrations, and early four-color process book plates look the worst when copy photographed. It is best to make copy photographs from the best originals available. A good rule of thumb: a copy photograph will probably emphasize whatever is wrong with the original.

4.3 Placement of Three-Dimensional Originals: All Films

Three-dimensional originals are not usually considered part of the copy photographer's domain. However, photographs of small sculpture or works of decorative art are not beyond the copy photographer's abilities or equipment; three-dimensional objects up to about 18 inches are easily photographed.

The set-up for photography of three-dimensional originals is the same as that for two-dimensional ones. The exposure is determined by the distance of the camera from the original; remember to use a gray card to determine the appropriate aperture and shutter speed. Since most copystand lights are fixed in place at a 45-degree angle to the support table, changes in raking light (used to highlight low relief, for example) simply are not possible. For most small objects, however, the copy photographer's set-up is perfectly adequate.

Place the object to be photographed on its side, supported with small pads of fabric or even cotton balls to prevent rolling. Focus, meter, and shoot as you would for a two-dimensional original. When working with three-dimensional originals, depth of field is more important; adjust the f-stop and shutter speed for the smallest f-stop (and thus the greatest depth of field) possible.

4.3.1 Lighting of Three-Dimensional Originals

Lighting is the most severe problem when using a copystand to photograph three-dimensional originals. The lighting fixtures on copystands are often stationary: light angles cannot easily be changed. If you are not satisfied with the quality of lighting of a three-dimensional original, try changing the bulbs to a lower wattage, or using a tripod and a backdrop instead of a copystand.

Bracketing

When in doubt, make more than one exposure of the same object, changing the f-stop or shutter speed one full unit at a time. This process is called bracketing, and will help obtain the best exposure for any object being photographed. It is also helpful, when bracketing, to record the f-stop and shutter speed used to make a particular exposure. This helps the photographer remember what

settings provided the best exposure for a given original. (When making photographs while travelling, bracket everything. Film is cheaper than airline tickets.)

4.4 Problems in On-Site Copy Photography: Low Light

Should you find yourself in a situation where there is very little light, such as a dark museum or an older library, and there is no hope of being able to adjust your light source (flash is not permitted, for example), here is a good rule of thumb: If there is enough light to see by, there is probably enough light to make a photograph, even if the light level is so low your camera's meter doesn't seem to be working.

To help your light meter determine the proper exposure, place a white sheet of paper, a handkerchief, or the back of a gray card (rather than the gray card itself) in front of what you wish to photograph, then take a meter reading. Open the aperture two more stops than the light meter indicates is correct: that is, if the light meter indicates that an aperture of f8 and a shutter speed of 1/60 of a second is correct, open up the aperture two stops to f4. If a tripod is permitted, you can also change the shutter speed two stops to 1/15 of a second, while leaving the aperture setting at f8. In low light settings it is always advisable to bracket both up and down from what your light meter indicates is the correct exposure. This ensures good results, even in precarious circumstances.

4.5 Reciprocity

Reciprocity is the relationship between the length of exposure and the intensity of light, meaning that the increase in one will be balanced by a decrease in the other. For example, doubling light intensity should cut the exposure time in half. This holds true except for very long exposures (see Section 4.4 above, and Table 4.1 below) and very short (1/1000 of a second or less) exposures. Reciprocity failure causes underexposure (dark images) unless your exposure time or f-stop is increased. It also causes color shifts in color films.

Various films react differently to very long and very short exposures. Most film manufacturers includes instructions for recommended exposure changes as an insert in every film box. The general rule is to increase exposure time geometrically (see Table 4.1):

TABLE 4.1: CORRECTIONS FOR LONG EXPOSURES

Indicated Exposure	Open Aperture	OR	Increase Exposure Time
1 second	1 stop more		2 seconds
10 seconds	2 stops more		50 seconds
100 seconds	3 stops more		120 seconds

4.6 Copying Transparencies as Color Slides

It is quite easy to duplicate transparencies and slides of a quality acceptable for research and study purposes on your own, provided that your camera lens is capable of very close work, and that you can back-light the original sufficiently for an accurate exposure.

There are several ways to back-light transparencies, the easiest being to use a light box. Since most light boxes are lit with fluorescent bulbs (4500-5000-degrees Kelvin), you should use daylight film for such color copy work. Shoot a test roll to determine proper exposures and color balance, remembering that filtering may be needed. Meter the original carefully and take several exposures, bracketing one to two stops up and down from the light meter's original suggested exposure. Process the film and check the results; make adjustments to exposure or filter as needed.

As noted above, some filtration will probably be needed to correct for color variation. Typically, fluorescent bulbs balanced for daylight film photography give light of a slightly greenish cast. A pale magenta filter of relatively low density (CC10M to CC30M) will usually provide sufficient correction. If the originals have a red cast, use a pale blue filter (which absorbs excessive red), so the final image is closer to correct.

It is difficult to give exact filter recommendations for fluorescent lights, since their color balance varies depending on the type of lamp, its manufacturer, and its age. If uncertain which filter to use for color correction, consult your processor, or call one of the film manufacturer technical services numbers (see Appendix C) and ask for suggested color filter combinations for the conditions which you are working.

If exhibition or publication quality reproductions are needed, it is best to take the original color transparencies to a commercial lab. If such high-quality results are not necessary, money can be saved by making duplicates in-house.

APPENDIX A

LENSES AND THEIR USES

Lenses are defined by their focal length, which is given as a number expressed in millimeters (mm). The focal length is the distance between the rear element of the lens and the plane of the film being exposed. The higher the number, the longer and heavier the lens. Longer lenses, with multiple optical elements, need more light for proper exposures. Different kinds of cameras have different lens mounts, or require lenses of different diameters; be careful when purchasing a lens to buy one of the proper diameter and mount for the camera being used.

Filters and close-up rings should correspond to the size of the diameter of the lens. Filters and close-up rings are sized in millimeters; the size given refers to the diameter of the lens, not to its focal length.

28mm This, one of the so-called wide-angle lenses, is a relatively short focal-length lens. It is used primarily in landscape photography to bring more of the scene into view.

35mm This is also a wide-angle lens, good for architectural interiors and most exteriors. It is also used by newspaper and street photogra-

phers, because it is good for crowd scenes: it brings random elements in from the sides of the scene, and helps develop visual relationships between normally unrelated objects within a single frame. Some photographers prefer using a 35mm to a macro lens when doing copy work, insisting that it gives a sharper exposure.

50 or 55mm A "normal" lens, which comes as standard equipment with most cameras. This is the lens to be used unless the photographer is absolutely sure that a lens of another barrel length is called for. The 50mm lens with macro, i.e., close-up, capabilities, is what is used most often on a copystand.

85—105mm These are portrait-length lenses. These lenses allow the photographer to get close to a human subject without distorting facial features. These lenses are also good for photographing flowers or focusing on a subject against a busy backdrop.

The most popular additional lenses are the 28—70mm and 70—200mm zoom lenses, which give a wide range of focal length for normal use. Because they are multiple-element lenses, which break down the light as it travels through the lens barrel, zoom lenses tend to produce photographs that are less sharp. Some photographers use telephoto lenses for copy photography. Telephoto lenses are designed to provide enlargements of distant objects; they can eliminate the need for close-up rings. These are multiple-element lenses that require careful metering to achieve proper exposures; they may also distort images made from very small originals.

Figure 14: Zoom, 105 mm, and 55 mm lenses

APPENDIX B

PHOTOGRAPHY FOR ART HISTORIANS

This workshop has been taught with great success at the Institute of Fine Arts, New York University, since 1993. Co-sponsored by the Institute's Graduate Student Association and the Visual Resources Collections, the class covers the basics of camera selection and use; object, architectural, and copy photography; and preservation and organization of finished images. A section on scanning was added in 2000. The syllabus used in the 2002 class is included here as a guide for those visual resources professionals who may also wish to instruct students in the basic uses of cameras and film. The goal of this workshop is to introduce and reinforce in a limited time the basic camera skills that art history students need to produce photographs suitable for research, publication, and teaching.

Topics to be covered

Camera and film: the basics.
Copystand photography (from books and works on paper; small objects).

Photographing objects in situ.
Photographing architecture.
Scanning images for various purposes.
Mounting, labeling, storing, and sorting slides and photos.

Schedule

9:00—10:30 a.m. Introduction to equipment, including a discussion of cameras, films, lights, and lenses; full class.
10:45—noon Session I: The class will be broken down into 4 smaller groups of equal size. Each of the following topics will be covered at each of the sessions held during the day, so all participants will receive instruction in all areas:

Architectural photography
Copy photography
Object photography
Basic scanning

Noon—1:00 p.m. Lunch.
1:00—2:15 p.m. Session II. Groups rotate.
2:15—3:30 p.m. Session III. Groups rotate.
3:30—4:45 p.m. Session IV. Groups rotate.
4:45—5:30 p.m. Preservation and organization of photographic materials; final questions; full class.

To make most effective use of the teaching resources, enrollment is limited to 24, with no more than 6 students in any one of the topical sessions; there is a separate instructor for each topic. Students are expected to bring their own cameras, but not to buy one especially for the class. Film is provided (one roll each of tungsten and daylight slide film), but students must pay for the cost of developing. Supplies for mounting up to five slides are also provided, as are a copy of this text and a variety of handouts prepared by the instructors.

APPENDIX C

EQUIPMENT AND TECHNICAL INFORMATION SOURCES

Archival storage and display materials

Conservation Resources International, Inc.
8000-H Forbes Place
Springfield, VA 22151
800-634-6932 (in Virginia 703-321-7730)
www.conservationresources.com

Gaylord Bros.
P.O. Box 4901
Syracuse, NY 13221-4901
800-634-6307
www.gaylord.com

Light Impressions Corp.
P.O. Box 787
Brea, CA 92822-0787
800-828-6216, fax 800-828-5539
technical assistance 800-828-6216
www.lightimpressionsdirect.com

University Products, Inc.
517 Main Street, P.O. Box 101
Holyoke, MA 01041-0101
800-336-4847
www.universityproducts.com

Equipment

Bencher, Inc.
831 North Central Avenue
Woodale, IL 60191
630-238-1183
www.bencher.com

Beseler
1600 Lower Road
Linden, NJ 07036
800-BESELER
www.beseler-photo.com

Bogen Photo Corp.
565 East Crescent Avenue,
P.O. Box 506
Ramsey, NJ 07446-0506
201-818-9500 9:00 a.m. to
5:30 p.m. EST
www.bogenphoto.com

Calumet Photographic, Inc.
890 Supreme Drive
Bensonville, IL 60106
630-860-7447; 800-453-2550
www.calumetphoto.com

Canon U.S.A., (Camera Division)
1 Canon Plaza
Lake Success, NY 11042
516-488-6700, fax 516-828-4040
www.usa.canon.com

Edmund Scientific Company
60 Pearce Avenue
Tonawanda, NY 14150-6711
800-728-6999, 8:00 a.m. to 8:00 p.m.
Monday through Friday
716-874-9091
www.scientificsonline.com

Leica Camera, Inc.
156 Ludlow Avenue
Northvale, NJ 07647
201-767-7500, fax 201-767-8666
www.leica-camera.com

Nikon Inc.
1300 Walt Whitman Road
Melville, NY 11747
800-NIKON-US
www.nikonusa.com

Pentax Corp.
35 Inverness Drive East
Englewood, CO 80112
800-877-0155, fax 303-799-9213
www.pentax.com

Professional Photographic Products, Inc.
1117 Vine Street
Hammonton, NJ 08037
800-257-8541
www.hubphoto.com

Sigma Corporation of America
15 Fleetwood Court
Ronkonkoma, NY 11779
631-585-1144, fax 631-585-1895
www.sigmaphoto.com

Stroboframe Division
Saunders/Tiffen Company
21 Jet View Drive
Rochester, NY 14624-4996
716-328-7800
www.saundersphoto.com

Testrite Instrument Company
135 Monroe Street
Newark, NJ 07105
973-589-6767, 888-873-2735, fax 973-589-4196
www.testrite.com

Vivitar USA
1280 Rancho Conejo Boulevard
Newbury Park, CA 91320
805-498-7008, fax 805-498-5086
www.vivitar.com

This is by no means a comprehensive list; it is intended as a useful place to start your search for more information. Online, one of the best sources for technical information is Resource Advantage's web site, at www.rasource.com/photomfgdarkroomequip.htm

Publishers

Aperture
20 East 23rd Street
New York, NY 10010
212-505-5555

Eastman Kodak Company
Dept. 412-L, 343 State Street
Rochester, NY 14650-0532
(send $1.00 for publication L-1, "KODAK Index to Photographic Information")

Preservation Publishing Co.
P.O. Box 567
Grinnell, IA 50112

Technical information

Agfa Film Corp.
100 Challenger Road
Ridgefield Park, NJ 07660
800-926-AGFA, 201-440-2500
www.agfaus.com

Eastman Kodak Company
product information: 800-242-2424
www.kodak.com

Fuji Photo Film USA, Inc.
1100 King George Post Road
Edison, NJ 08818
732-857-3000, fax 732-857-3492
home.fujifilm.com

Ilford Corp.
West 70 Century Road
Paramus, NJ 07653
201-265-6000
www.ilford.com

Polaroid Corp.
201 Burlington Road
Medford, MA 01730
781-386-2000
www.polaroid.com

APPENDIX D

WHAT WORKS IN VISUAL RESOURCES COLLECTIONS

Below is a sampling of specific copystand equipment combinations that visual resources professionals have found work well. These are set-ups that are actually in use; they are not product advertisements. There are many variations possible in all cases. Many thanks to everyone who contributed to this appendix, the information for which was solicited in February 2002 via the listservs of the Visual Resources Association's Greater New York and Greater Philadelphia Chapters:

Donald Beetham at Rutgers University uses a Nikon F3 with a flat field macro lens on a Technal copy stand. He uses two inexpensive tungsten light stands on each side of the copy stand; both sit on little pieces of tape to mark where everything should be to keep it aligned. He uses Fujichrome 50 tungsten because of its overall performance. You can see pictures of Don's set-up at www-rci.rutgers.edu/~bbetham/vrstaff.htm.

Mary Brower at the Rhode Island School of Design uses a

Bencher copy stand with 2 halogen lights and a Nikon FM2 with a macro lens, adding a filter "sandwich" of a skylight 1B plus a very pale orange filter to help correct the color cast from the lights. Mary uses metal copy boards with magnetic strips for flatter and squarer shots. Kodak 64 EPY tungsten film is her film of choice.

Lynn Cunningham at Bard College uses a Bencher Copymate II with 3200 degree Kelvin halogen lamps to shoot Fujichrome 64T tungsten film. She uses a Nikon FM2 camera with a 60mm lens and a polarizing filter.

Jorge Loynaz Garcia, School of Architecture, University of Miami, uses a fixed camera setting of 1/30 of a second at f4.8, with 2 3200-degree Kelvin halogen lamps to shoot Kodak Ektachrome 64T professional grade film. With this set-up, he gets "perfect" results.

Lorraine Gerety at the School of Visual Arts in New York uses a Bencher M2 copystand with 2 quartz halogen bulbs. She uses a Nikon FE with a Nikkor micro 55mm lens to shoot Kodak Ektachrome 64T film. She keeps the shutter speed set at 1/8 of a second and the aperture at f 5.6.

Louise Kulp, Franklin & Marshall College, uses a model 45MCRX Beseler copystand, GE 3200 degree Kelvin photo flood lamps, and Kodak 64T film. She uses a Nikon F2 camera with a Micro-Nikkor P lens.

Kathleen MacQueen at NYU uses a Bencher VP310 system with a 20 x 20 inch steel baseboard with light control and side-arms with quartz halogen lights to shoot Fujichrome Professional 64T Type II film with a typical exposure of 1/8 of a second at f16. She uses a Nikon FM2 with a Micro Nikkor 60mm lens. This set-up "works exceptionally well for basic copywork but does not accommodate oversize books or maps."

Constance Mood, Fisher Fine Arts Library, University of Pennsylvania, uses a Nikon DW-3 with a Micro-Nikkor f 2.8 lens on a Bencher M3 model 430-06 copystand to shoot Kodak Ektachrome 64 (EPY 404). She uses Lowel Tota Lights with tungsten halogen bulbs on pole stands.

Nita Roberts, photographer at the Institute of Fine Arts, uses a Bencher copystand equipped with a custom-built table, six Morris master/slave strobes, a Kinex viewfinder illuminator, and a cable release. Most exposures made with Kodachrome 25 require an exposure time of 1/100 of a second, usually at f8. In 2002, the transition

from Kodachrome 25 to Agfachrome RXSII will be undertaken. Further information about the services provided by the Institute of Fine Arts can be found on their web site, www.ifa.nyu.edu; click on "visual resources."

In July 2001, the readers of VRA-L, the Visual Resources Association's main on-line discussion forum, were asked what kind of film they used for copy photography. Of the 14 institutions responding, the most popular films were rated as follows:

Ektachrome 64T (tungsten), either bulk- or pre-loaded; 6 institutions.
Fuji Velvia 50, 2 institutions.
Fuji Provia 100, 2 institutions.
Ektachrome 160T, 1 institution.
Fuji 64T, 1 institution.
Fuji Sensia, 1 institution.
Elite Chrome 100, 1 institution.

BIBLIOGRAPHY

Butterfield, Moira, and Susan Peach: Photography. London: Usborne Publishing Ltd., 1987.

Collins, Sheldon: How to Photograph Works of Art. Nashville, TN: AASLH Press, c. 1986.

Cooper, Joseph David, and Joseph C. Abbott: Close-up Photography and Copying. Garden City, NY: Amphoto, c. 1979.

Croy, Otto R.: Camera Copying and Reproduction. Trans. L. A. Mannheim. London: Focal Press, [1964].

Eastman Kodak Company, technical publication M-1: "Copying and Duplicating in Black-and-White and Color."

Fittipaldi, Richard A.: A Basic Manual for Library Media Specialists in the Use of the 35mm Camera, Slide Copier, and Copy Stand. Glassboro, NJ: Glassboro State College, 1978.

Hart, Russell: Photographing Your Artwork, 1st edition. Cincinnati, OH: North Light Books, c. 1987, rev. upd. c. 1992.

Horenstein, Henry: Black and White Photography: A Basic Manual, 1st edition. Boston, MA: Little, Brown, 1971.

Horenstein, Henry: Beyond Basic Photography: A Technical Manual, 1st edition. Boston, MA: Little, Brown, c1977.

Horenstein, Henry, with Russell Hart: Color Photography: A Working Manual, 1st edition. Boston, MA: Little, Brown, c1995.

Kuehn, Rosemary, and Arlene Zelda Richardson, eds.: Guide to Copy Photography for Visual Resource Collections. Mid-America College Art Association Visual Resources Committee, 1980.

Kushel, Dan: Photodocumentation for Conservation: Procedural Guidelines and Photographic Concepts and Techniques. Cooperstown, NY: D. Kushel, c1980.

Lewis, John Noel Claude, and Edwin Smith: Reproducing Art; the Photography, Graphic Reproduction and Printing of Works of Art. New York: Praeger, [1969].

Maclean, Hector, F.R.P.S.: Photography for Artists. New York: Arno Press, 1973.

Mates, Robert E.: Photographing Art. New York: Amphoto [1966].

Matthews, Sydney Kent: Photography in Archaeology and Art. London: Baker, 1968.

Parks, Janet: "AVIADOR Photography." Visual Resources: An International Journal of Documentation, vol. X, no. 4, 1995, pp. 317-332.

Royal Photographic Society of Great Britain: The Conservation of Color Photographic Records. Proceedings of a symposium organized by the Colour Group of the Society. London: RPS Publications, 1974.

Schmid, Claus Peter: Photography for Artists and Craftsmen. New York: Van Nostrand Reinhold Co., [1975].

Schwalberg, Bob; Henry Wilhelm, and Carol Brower: "Going! Going! Gone! Which color films and papers last longest? How do the ones you use stack up?" Popular Photography, June 1990, pp. 37-49 and ff.

Shafran, Alexander: Restoration and Photographic Copying: The Techniques of Copying and Restoring Old and Damaged Photographs. New York: American Photographic Book Publishing Co., [1967].

Shaw, Susan, ed. David Featherstone: Overexposure: Health Hazards in Photography. Carmel, CA: Friends of Photography, c. 1983.

Shulman, Julius: The Photography of Architecture and Design: Photographing Buildings, Interiors, and the Visual Arts. New York: Whitney Library of Design, 1977.

Sundt, Christine L.: Conservation Practices for Slide and Photograph Collections. Visual Resources Association Special Bulletin No. 3.

Titus, William H.: Photographing Works of Art: Techniques for Photographing Your Paintings, Drawings, Sculpture, and Crafts. New York: Watson-Guptill, 1981.

Wilhelm, Henry: The Permanence and Care of Color Photographs: Traditional and Digital Color Prints, Color Negatives, Slides, and Motion Pictures. Grinnell, IA: Preservation Publishing, Co., 1993.