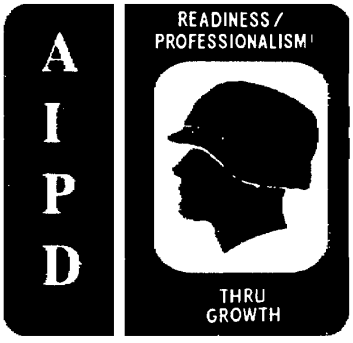
SUBCOURSE
SS0512

EDITION
7

COPY PHOTOGRAPHY II

THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM



US ARMY STILL PHOTOGRAPHIC SPECIALIST
MOS 84B SKILL LEVEL 1

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COPY PHOTOGRAPHY II

SUBCOURSE NO. SS 0512-7
(Developmental Date: 30 June 1987)

US Army Signal Center and Fort Gordon
Fort Gordon, Georgia

Two Credit Hours

GENERAL

Copy Photography II subcourse is designed to teach tasks related to copy photography. Information is provided on filters; function, selection, and filter factors; copy film; and procedures for making a photographic copy. This subcourse is presented in three lessons. Each lesson corresponds to a terminal learning objective as listed below.

Lesson 1: USE AND PURPOSE OF FILTERS IN COPY WORK

TASK: Determine filter functions, selection of filters, and determine filter factors.

CONDITIONS: Given information and diagrams about filters, selection of filters, filter factors, and types of filters.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to 80 percent of the multiple-choice test covering filter functions, selection of filters, and filter factors.

(This objective supports SM Task 113-578-1014, Alter the Rendition of Colors Recorded on Black and White Film)

Lesson 2: COPY FILMS

TASK: Determine the types of copy film and their uses.

CONDITIONS: Given information and diagrams about copy films and their uses.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to 80 percent of the multiple-choice test covering types of copy film and their uses.

(This objective supports SM Task 113-578-1012, Perform Copy Photography Using Camera Set KS-7A)

Lesson 3: PERFORM COPY PHOTOGRAPHY

TASK: Describe procedures for making a photographic copy.

CONDITIONS: Given information and diagrams on how to mount an original, placing the lights, focusing the camera, and determining and making exposures.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to 80 percent of the multiple-choice test covering procedures for making a photographic copy.

(This task supports SM Task 113-578-1010, Operate a View Camera; 113-578-1012, Perform Copy Photography Using a Camera Set KS-7A; and 113-578-1007, Obtain Light Readings Using a Photoelectric Light Meter)

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***** IMPORTANT NOTICE *****

THE PASSING SCORE FOR ALL ACCP MATERIAL IS NOW 70%.

PLEASE DISREGARD ALL REFERENCES TO THE 75% REQUIREMENT.

Whenever pronouns or other references denoting gender appear in this document, they are written to refer to either male or female unless otherwise indicated.

Two credit hours will be awarded for successful completion of this subcourse.

INTRODUCTION TO COPY PHOTOGRAPHY II

These three lessons on copy photography are designed to teach you the methods of performing copy photography within your unit. Army Visual Information units are becoming more tactically oriented and will require efficient copy photography. Most of this photography will be performed in the field. Your ability to support the Army with usable copy materials may well spell the difference between mission failure and mission accomplishment.

The term "visual information" has replaced "audiovisual" in the Army of Excellence.

LESSON 1
USE AND PURPOSE OF FILTERS IN COPY WORK

TASK

Determine filter functions, selection of filters, and determine filter factors.

CONDITIONS

Given information and diagrams about filters, selection of filters, filter factors, and types of filters.

STANDARDS

Demonstrate competency of the task skills and knowledge by correctly responding to 80 percent of the multiple-choice test covering filter functions, selection of filters, and filter factors.

REFERENCES

TM 11-401 and TM 11-401-2

Learning Event 1:
USE OF FILTERS

1. Introduction. Copy photography requires special techniques not always used in other types of photography. Besides a well-supported camera and flat field lens, you will require special film and a complete understanding of black and white light filter functions. This subcourse will cover these areas.

a. A photographic filter is a piece of transparent-colored material. They are made in three forms: glass, gelatin, or gelatin sandwiched between two pieces of glass covers. The color of a filter determines the color of light permitted to pass through the filter to the film. There are also apparently colorless filters which correct for ultraviolet light, and neutral density filters which regulate the intensity of light. Every filter holds some unwanted light and allows a portion of light to pass through to the film.

b. To use filters effectively, a photographer must be familiar with the theory of filter operation. Important aspects include the effect of filters in relation to the color of the objects being photographed, the color of the light source, and the color sensitivity of photographic emulsions used.

2. Filters improve tone.

a. Filters are used to control the amount and type of light that reaches the film. Some filters hold back a particular color of light, others block light reflected from smooth objects, and others simply reduce brightness. You can stress any feature on a picture or de-emphasize that feature depending on the filter.

b. Filters that prevent certain colors of light from reaching the film are used with black and white film because even black and white film is sensitive in varying degrees to the color of light. Film sensitivity to color is discussed later in this lesson. In this section we'll just say that two different colors may or may not produce the same shade of gray on black and white film, depending on the type of film and the colors.

c. If a filter completely absorbs a color, the light of that color does not reach the film and the film sees darkness (dark gray on print). For instance, where a red shirt photographs as light gray without a filter, the red shirt will be black when photographed through a filter that completely absorbs red. Normally, the filter does not completely absorb the color so the red shirt would show up as a darker gray.

d. When the colors that the filter absorbs appear darker on the print, the colors that the filter passes appear lighter.

e. When dealing with colors and filters, keep in mind that we are dealing with exposures onto a negative which then must be printed onto paper. When photographing with transparencies we are dealing with a reversal process. When the filter passes a color, that portion of the negative is dark. When we print the negative, the dark portion of the negative holds back light and that portion of the print is light in color (shade of gray). Conversely, if a filter absorbs a color, that portion of the negative is light or transparent. When a print is made, the light passes through and is dark on the print.

3. Filters pass their own color. To select the proper filter, you must know a few simple facts about color.

a. Out of the vast number of colors, there are three primary colors -- red, green, and blue. They are called primary colors because any other color can be formed from a combination of the three. The picture you see on a color television set is actually three pictures, one red, one green, and one blue. All the other colors you see are actually mixtures of these three colors of light. A similar process is used to produce color photographs.

b. A filter passes its own color and absorbs other colors. For instance, a red filter looks red because of the red light coming through the filter. Green and blue objects look black through a red filter because green light and blue light do not pass through a red filter.

c. Equal amounts of all three primary colors produce white, so white light is said to contain all colors. Snow looks red when seen through a red filter because only the red portion of the white light comes through the filter. The result of combining the primary colors in equal amounts is shown in Figure 1-1.

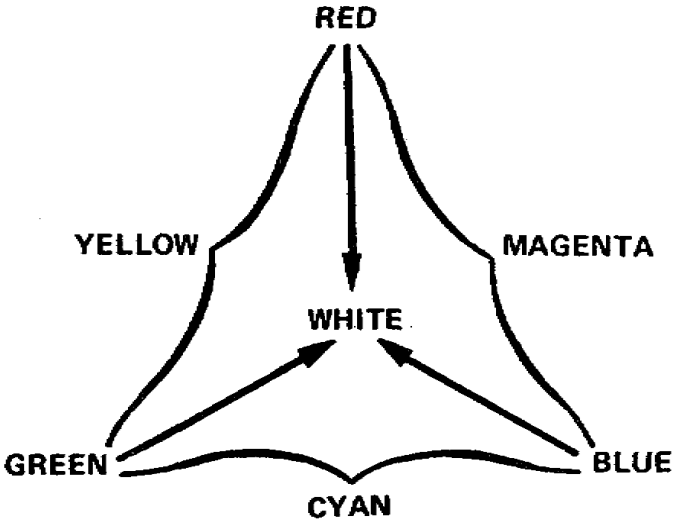

Figure 1-1. Combination of primary colors

d. Combining two primary colors in equal amounts produces a secondary color. Red and green produce yellow, red and blue produce magenta (a reddish purple), and green and blue produce cyan (a light greenish blue).

e. A filter of a secondary color will pass both the primary colors that make up the secondary color and combine to produce the secondary color. For example, a yellow filter will pass red, green, and yellow but will not pass blue (fig 1-2).

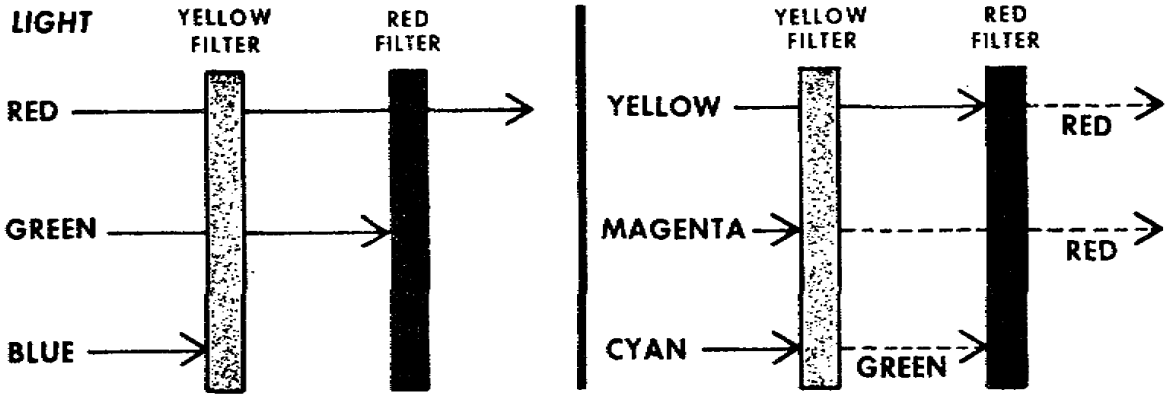

Figure 1-2. Effect of filter on color

4. Complementary colors.

a. Certain additive primary and subtractive primary colors are called "complementary colors." Complementary colors is a term used to describe two colors that can be combined to produce white light. Since all three of the primary colors must be present to produce white light, it is reasonable to assume that we must combine the additive and subtractive colors that will provide the required amounts of these wavelengths. For this reason, red and cyan (blue-green) are said to be complementary. Blue and yellow (red-green) are complementary. Green and magenta (red-blue) are also complementary to each other. The additive will transmit one-third of the wavelengths necessary, and the complementary will transmit the remaining two-thirds of the wavelengths necessary to produce white light.

b. A filter passes its own color or colors that make up its own color but it does not pass the complement of its own color. The exact effect of the filter is more clearly indicated by its number identification and absorption curves than the color of the filter. Wratten numbers form the most common numbering system for filters. The ability of a filter to absorb or pass certain colors gives you a control to compensate for film limitations to emphasize one color, and to eliminate defects.

5. Filter compensation for film, limitations.

a. Correction filters adjust the color sensitivity of the film so that the picture will look more natural. For instance, black and white film does not have the same sensitivity to all colors nor does it respond in the same manner as your eye. If you use correction filters, your photograph will have a more natural appearance.

b. To make panchromatic (pan) or orthochromatic (ortho) film respond in daylight more like the eye, use a yellow (No. 8) filter. No. 8 is the Wratten number. All film is generally sensitive to blue, and daylight contains more blue than other colors. Thus, the reason for a filter is to reduce the amount of blue that reaches the film in order to make the photograph appear more natural. A yellow filter is used because it is the complement of blue and therefore absorbs the blue color. Table 1-1 is a list of the more common filters used in black and white photography. At one time a combination of letters and numbers was used to designate filters. Now most filters have only a number. The table shows the obsolete designation and the new filter designations along with the colors.

Obsolete Designation	New Designation	Color
K-1	6	Light Yellow
K-2	8	Yellow
X-1	11	Yellow-green
X-2	13	Dark Yellow-green
G	15	Deep Yellow
E	23A	Light Red
A	25	Red
F	29	Deep Red
C4	49	Blue
B	58	Green

Table 1-1. Wratten filter designations

c. To make pan film exposed to tungsten light respond like your eye, you must reduce the blue which the pan film is sensitive to and reduce the red of the tungsten light. So you should use a light green (No. 11) filter (Table 1-2).

Light Source	Film type		
	Ortho	Pan B	Pan C
Daylight.....	No. 8	No. 8	No. 11
Tungsten.....		No. 11	No. 13

Table 1-2. Tone-correcting filters

6. Filters emphasize one color.

a. It is possible that two different colors reproduce the same shade of gray in a black and white photograph. If your subject and background normally reproduce similar shades of gray, even though the colors are different, you can make the subject stand out by using the proper contrast filter to lighten or darken a particular color.

b. Use a filter the same color as the subject you wish to lighten.

c. Use a filter the complementary color of the subject you wish to darken.

d. As an example, suppose you have red letters on a green background, but there is a very little contrast on the black and white print. A cyan or green filter will darken the letters and lighten the background; a red filter will lighten the letters and darken the background.

e. You can reduce as well as increase contrast by using color filters. One place this is effective is in black and white copying when the original has a stain. In this case use a filter the same color but slightly darker than the stain. The filter will pass only the color of the stain so the white or gray portions of the original will appear similar in color to the stain, thus hiding the stain. It is important to remember that the stain must be transparent. This technique cannot be used if the stain is opaque.

7. Filters penetrate haze.

a. Haze filters eliminate or reduce atmospheric haze on the negative. Haze is the blue of the sky resulting from light reflected off the moisture in the air. At short distances the amount of haze is too small to have any effect on a photograph. At long distances the haze may be too heavy to photograph hills or buildings clearly.

b. You can filter out haze because it is blue and ultraviolet light. Ultraviolet is invisible to the eye but not to the film; all films record ultraviolet light. For filtering purposes we can consider ultraviolet light as blue light.

c. Use yellow (No. 8), light green (No. 11), dark yellow (No. 15), and red (No. 25) filters as haze filters. These are listed in order of increasing effectiveness. The No. 8 gives the least penetration and the red No. 25 gives the most penetration.

d. Filters cannot penetrate solid particles in the air such as dust or smoke. Anything that blocks the light of the subject will prevent the camera from seeing the subject. Haze filters reduce haze but they do not increase the light coming from the subject.

8. Polarized light. A bright spot or ghostly image caused by light reflected from a mirror-like surface such as water, glass, or glossy painted surfaces is usually undesirable in your photograph. A reflected image such as trees on a quiet lake often lends atmosphere to the picture but at other times the reflected image is a distraction, particularly when it is the reflection of a lamp you are using to light the scene. Some light sources can cause a very bright spot or reflection in a window that masks a window display. In the case of copy photography, if you have a glossy photograph that is not flat, bright spots can reflect back into your lens. Fortunately, a characteristic of reflected light polarization makes it possible to filter out the reflection.

a. Besides traveling in a straight line, light vibrates from side to side, up and down, and in all directions perpendicular to its direction of travel (fig 1-4a).

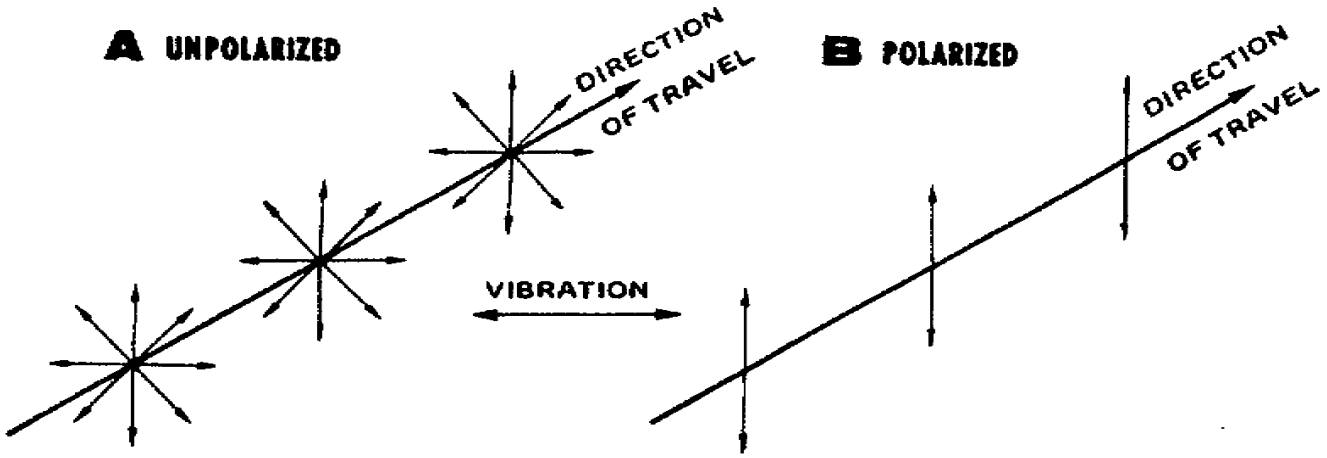

Figure 1-4. Unpolarized and polarized light

When light vibrates in only one direction (fig 1-4b), it is said to be polarized.

b. Unpolarized light shining on a smooth surface is reflected as polarized light. One part of the unpolarized light vibrating in a particular direction strikes the surface at an angle that causes the reflection. The light reflected back from the surface vibrates in only one direction and is therefore polarized.

c. Polarized light is reflected from glass, water, highly polished surfaces, and even a clear blue sky. Because the light is polarized it can be controlled by a device called a polarizing screen.

9. Polarizing screens filter polarized light.

a. Polarizing screens, or polarizing filters, are transparent to light polarized in one direction and opaque when the direction of polarization is rotated 90 degrees. Thus, if you rotated the polarizing screen to the proper position, you can either pass or filter out polarized light. Because normal light is unpolarized, a polarizing screen will only reduce the amount of normal light.

b. Polarizing screens have a neutral density, that is, they have the same effect on all colors of light. Blue light passes through just as well as red or any other color as long as the polarization is the same. For this reason polarizing can be used with black and white or color film.

c. A polarizing screen is made of rodlike crystals lined up and embedded in plastic. The light gets through only when the vibration (polarization) is in line with the crystals. Although the actual physics are a little more complex than this, you can think of the light as a coin going into a narrow slot. The coin fits through the slot only when the coin and the slot are in line. To get them in line you can either rotate the coin or the slot.

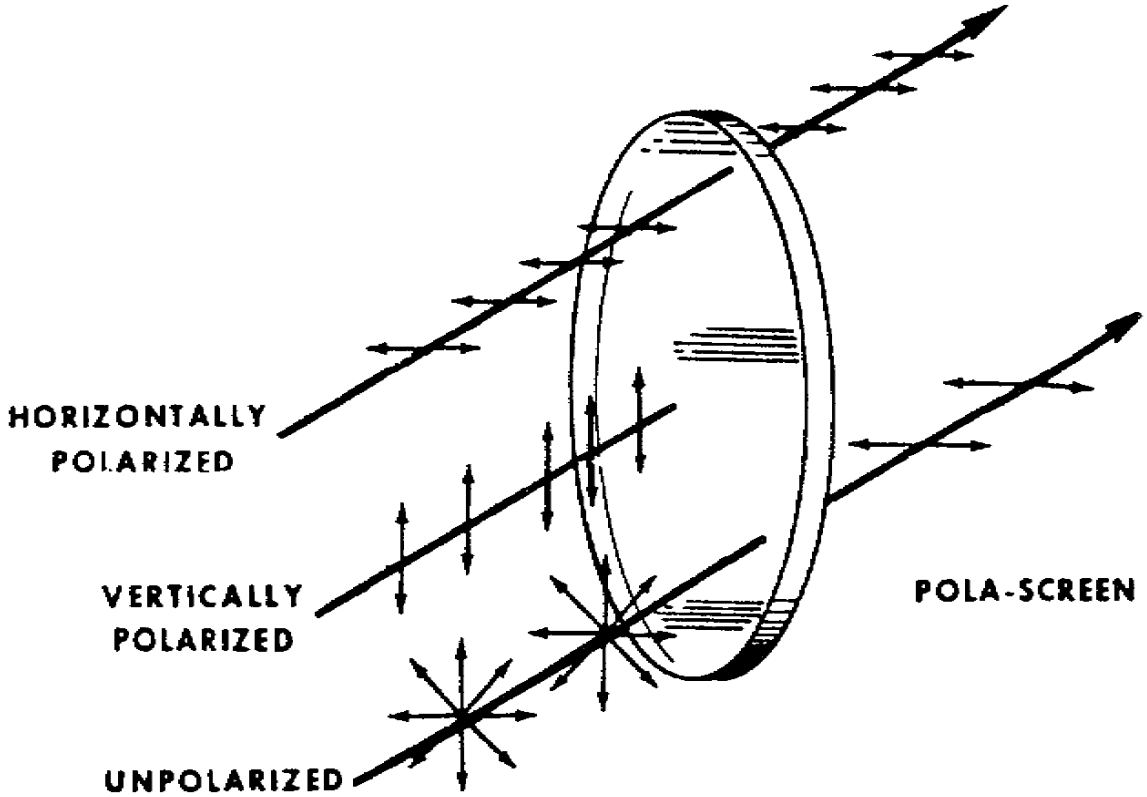

Figure 1-5. Effect of polarizing screen

10. How to use polarizing screens.

a. Polarizing filters are often used to control sky brightness because they reduce the polarized light reflected from the sky. Polarizing filters are most effective for controlling sky brightness when the sun is at a right angle to the optical axis and least effective when the camera is looking into or away from the sun.

b. When you photograph through water, acetate, or glass, use a polarizing screen. Place the illumination at an angle of 30 degrees off the surface of the water, acetate, or glass.

c. Just as you turn the coin until it fits into the slot, you must rotate the polarizing screen until it blocks the polarized light. If you use polarizing material over your light source or if you use a filter over your lens, look at the scene as the camera will see it while you rotate the filter for the desired effect.

11. Polarizing screens decrease exposure.

a. A polarizing screen decreases the amount of light that gets to the film; it not only blocks polarized light but also reduces the intensity of unpolarized light.

b. Polarizing filters reduce light about 2.5 times, however, a definite factor cannot be applied. It is best to experiment with the filter you are using in order to estimate the filter factor.

12. Absorption curves show filter effect.

a. No light filter will absorb one specific color, but rather it operates over a range of colors. Even within the range of colors, the effect of the filter may vary. Charts called absorption curves show the effect of filters. Figure 1-6 shows absorption curves for some of the most common filters.

b. Since the color of light depends on its wavelength, the illustration shows the effect of the filter on each wavelength. The relationship of color to wavelength is as follows:

Ultraviolet	Below 400 nanometers (nm)
Blue	400 to 500 nm
Green	500 to 600 nm
Red	600 to 700 nm
Infrared	Over 700 nm

NOTE: A nanometer is one billionth of a millimeter

c. The white part of each illustration indicates the light that passes through the filter, and the gray part shows what is absorbed. Note in the illustration that the red (No. 25) filter passes almost 80 percent of the wavelength (600 to 700 nm), but almost none of the lower wavelength. The green (No. 11) filter passes 70 percent of the green (520nm), 40 percent of the red (650nm), and a small amount of blue.

d. As you can see in the illustration, all filters reduce the intensity of the light that reaches the film. The amount of overall light a filter absorbs is indicated by a number called the filter factor.

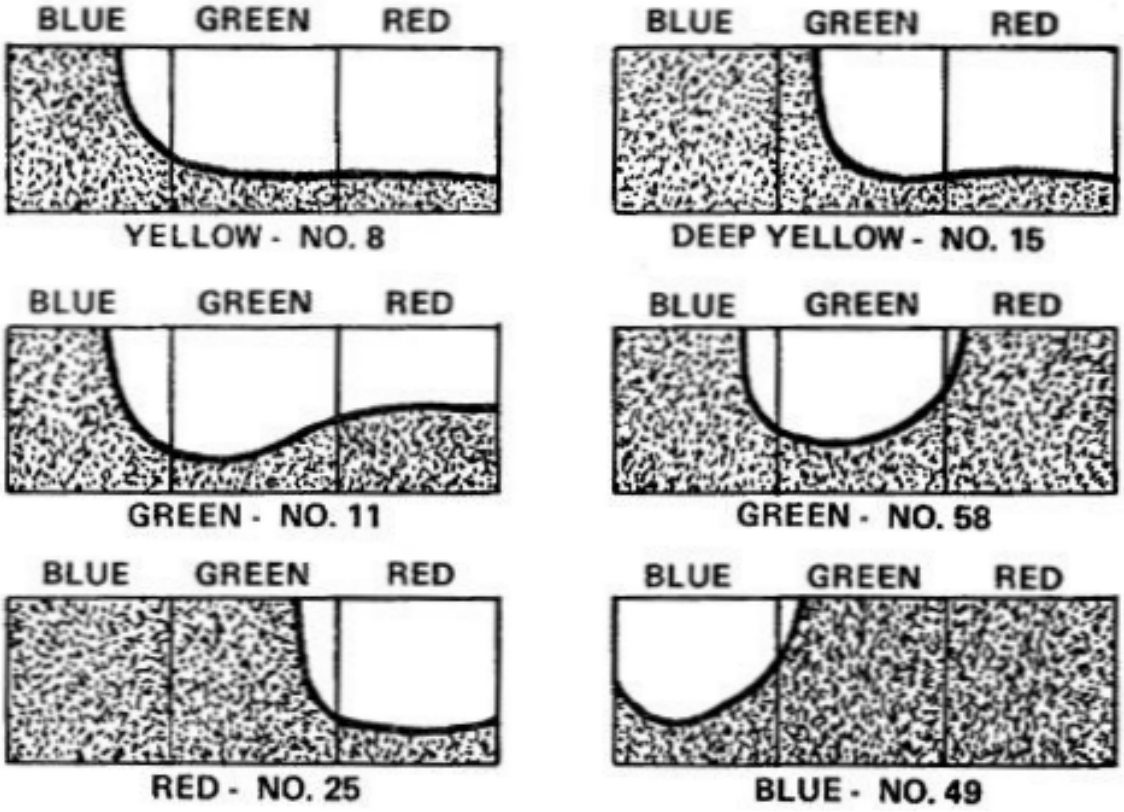

Figure 1-6. Absorption curves

Learning Event 2:
FILTER FACTORS AND TYPES OF FILTERS

1. Filter factor determines exposure increases.

a. The filter factor compensates for less light reaching the film. Exposures must be increased when using filters. The factor depends on the color sensitivity of the film, the color of the illumination, and the density of the filter. Panchromatic (pan) film is sensitive to blue, green, and red light radiations. Orthochromatic (ortho) film is sensitive to blue and green light radiations.

b. The more dense the filter, the larger the filter factor. Less light striking the film requires a longer exposure.

c. The less sensitive the film is to the color of the filter, the higher the filter factor. Let us see why. The color of the filter is the color that reaches the film. If the film is not very sensitive to that color, you'll need a very long exposure. An extreme example would be to use a red filter with ortho film. Ortho film is not sensitive to red light and a red filter passes only red light. So when red light reaches the film it does not record. So do not use a red filter with ortho film.

d. Although you do not always notice, there is a color difference between daylight and tungsten or artificial light. Daylight contains more blue, and most electric lights contain more red. A blue-absorbing filter such as No. 8, therefore, has a higher filter factor when used outdoors, and a red-absorbing filter such as No. 47 has a higher filter factor when used indoors with artificial light.

e. The following table, (Table 1-3) shows how the filter factor varies with filter, film, and illumination. A polarizing screen has a filter factor of about 2.5 for all film under any light because of its neutral density. The following are general filter factors and may be different for a specific film. Check the data sheet packaged with the film.

Filter	Filter Factor			
	Panchromatic		Orthochromatic	
No.	Daylight	Tungsten	Daylight	Tungsten
8	2	1.5	2.5	2
11	4	3	*	*
13	5	4	*	*
15	3	2	5	3
23A	7	3	*	*
25	8	5	*	*
47	5	10	3	4
49	12	25	7	15
58	8	8	8	5

* This filter is not recommended for ortho film except under special circumstances such as male portraits.

Table 1-3. Film data

f. According to the table, the filter factor for a No. 15 filter used with ortho film and tungsten light is 3. The table is general and not specific for each of the many varieties of pan and ortho films. However, filter factor data for a specific type of film is packaged with the film.

2. Multiple exposure by filter factor.

a. Filter factor compensates for light the filter absorbs. This absorbed light does not reach the film. This requires that you allow more light to pass through the lens. There are two ways to adjust exposure for the filter factor. Adjust your f/stop or adjust your shutter speeds by multiplying the factor.

(1) You can increase the exposure by using a wider aperture; opening one f/stop doubles the exposure. All f/stop numbers get smaller as the aperture gets larger. If the basic exposure is f/5.6 and the filter factor is 2, you must multiply by 2 or double the exposure by opening up one f/stop to f/4. If the factor is 4, you must multiply the exposure by 4 or open up two f/stops. The term open up means to enlarge the size of an aperture. A basic exposure using f/16 and a filter factor of 4 requires opening the aperture to f/8 or two f/stops. If the factor is 8 you must open the aperture by 3 f/stops.

(2) Remember, the larger the f/number the smaller the aperture and the smaller the f/number, the larger the aperture (fig 1-6a). Also remember that each f/stop allows 2x or 1/2 as much light to pass through to the film as the next aperture; the same holds true with the shutter speeds. That means that f/11 will pass 1/2 less light as f/8 and f/4 allows 4x more light to pass than f/8. Table 1-4 shows the proper f/stops to use for various basic exposures and filter factors.

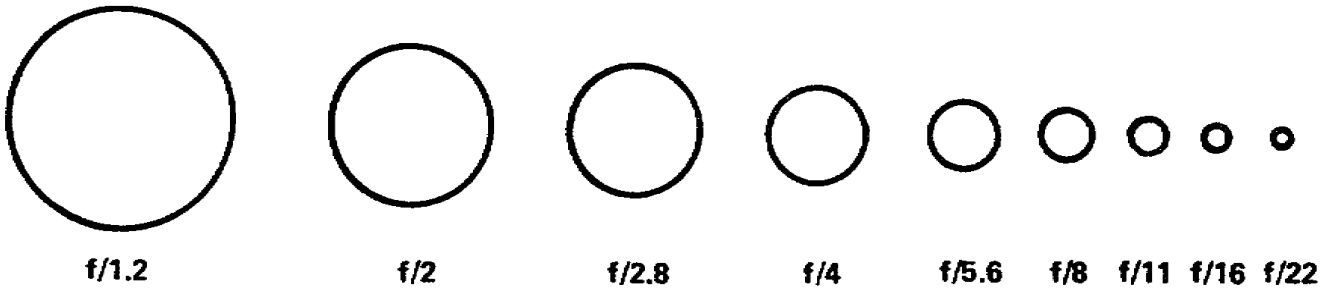

Figure 1-6a. F/stop relationship

1.0 OR NO FILTER	1.5	2	2.5	FILTER FACTORS 3	4	5	6	8	10	12	14
2	1.6										
2.8	2.3	2									
4	3.2	2.8	2.5	2.3	2						
5.6	4.5	4	3.6	3.2	2.8	2.5	2.3	2			
8	6.3	5.6	4.5	4.3	4	3.6	3.2	2.8	2.5	2.3	2.2
11	9	8	7.2	6.3	5.6	5.1	4.5	4	3.6	3.2	3
16	12.5	11	10.1	9.1	8	7.2	6.3	5.6	5.1	4.5	4.3
22	18	16	14	12.5	11	10.1	9.1	8	7.2	6.3	5.9
32	25	22	20	18	16	14	12.5	11	10.1	9.1	8.5

Table 1-4. F/stops for filter factors

b. Either method of adjusting exposure for filter factor is acceptable. Under some circumstances you may want to change the shutter speed in order to maintain the same aperture for depth of field purposes. At other times you may want to change the aperture to maintain a fast shutter speed. You as a photographer must choose the method most suitable for the job at hand.

3. Types of filters.

a. Filters are constructed in three ways. These three types of filters are gelatin, cemented, and glass. Dyed gelatin sheets come in a wide range of colors and density and can be cut to any desired shape. However, they are very thin, unstable, and easily damaged. Cemented filters are sheets of gelatin glued between two pieces of clear glass. This gives the filter some strength and stability, but the cement, which must be optically pure, is sensitive to heat. Dyed glass filters are constructed in one piece; they are not sensitive to heat as with cemented filters. There are fewer varieties of dyed glass filters than the others mentioned. Both cemented and dyed glass filters affect the focusing slightly by displacing the focusing plane, due to their thinner construction. However, dyed glass filters affect focusing to a lesser degree.

b. Dirt, moisture, and fingerprints reduce the usefulness of all filters, so treat filters carefully. Table 1-5 describes the characteristics of various filters, and Table 1-6 tells which filter to select for a given situation.

Wratten Filter No.	Tungsten Filter Factor	Performance Characteristics
No. 6 light yellow	1.5	Slight color correction for all types of panchromatic films. Produces slight contrast.
No 8 yellow	2.0	Normal color correction for all types of panchromatic films. Produces medium contrast.
No. 15 deep yellow	2.0	Full color correction for all types of panchromatic film. Lightens all yellows, reds and oranges.
No. 21 orange	2.0	Slight overcorrection for all types of panchromatic film. Produces more contrast than No. 15 filter.
No. 23A orange	4.0	Medium overcorrection for all types of panchromatic film. Darkens blue. Produces more contrast than No. 21 filter. Darkens green slightly. Lightens all yellow, orange and red colors.
No. 25 red	5.0	Considerable overcorrection on panchromatic film. Action same as No. 23A but more pronounced. Produces very strong contrast. Standard tricolor red filter for three-color separation negatives. Can be used with infrared films.
No. 29 deep red	16.0	Extreme overcorrection and contrast. Turns blue to strong black. Turns all yellow, orange, and red colors into white. Used with infrared films. This filter is also useful with No. 49 and N-67 in making separation negatives from original color transparencies.

Table 1-5. Filter characteristics

Wratten Filter No.	Tungsten Filter Factor	Performance Characteristics
No. 35 magenta	...	Moderately stable contrast filter. Transmits both red and blue. Darkens green and orange and lightens violet and red. Used singly or in pairs for scientific research and for photomicrography.
No. 47 blue	6.0	Generally used with orthochromatic films to increase blue contrast. Makes blue lighter and any emulsion colorblind. Also used as tricolor blue for color separation negatives from color transparencies.
No.49 dark blue	14.0	Generally used as a viewing filter for arc and daylight illumination. Increases blue contrast on all orthochromatic films. Also used for separation negatives from color transparencies.
No. 11 yellowish green	4.0	Correction for type B panchromatic film. Can be used with orthochromatic films for male portraits. Renders green and yellow slightly lighter, red and blue slightly darker.
No. 13 dark yellow green	6.0	Good correction with all types of panchromatic film. Is also used with orthochromatic film for male portraits. Slightly stronger green contrast than No. 11. Darkens reds and blues, lightens greens.
No. 56	4.0	Strong effect with all types of panchromatic film. Produces green and yellow contrast. Same action as No. 11 and No. 13 but much stronger.
Polarizing screen	2.5	For controlling strong glare and brightness of harshly lit and contrasting subjects. May be used with any filter. Two polarizing screens together form a variable neutral density filter.

Table 1-5. Filter characteristics (cont'd)

<table>
<tr><th>Subject</th><th>Desired Effect</th><th>Filter Selection</th></tr>
<tr><td>Red brick</td><td>Show texture</td><td>No. 15</td></tr>
<tr><td>Furniture (reddish woods)</td><td>Show grain</td><td>No. 25</td></tr>
<tr><td>Leather, wallpaper</td><td>Natural condition</td><td>Correction filter as indicated below.
Film | Tungsten
Ortho.....No. 8
Pan B.....No. 11
Pan C.....No. 13</td></tr>
<tr><td>Colored objects</td><td>Increase contrast</td><td>Contrast filter as indicated below. (Filters listed in order of decreasing effect.)
<table><tr><th>Color of Subject</th><th>To lighten use-</th><th>To darken use-</th></tr><tr><td>Red</td><td>25, 29, 15</td><td>47, 58</td></tr><tr><td>Green</td><td>58, 11, 13</td><td>47, 25</td></tr><tr><td>Blue</td><td>47</td><td>29, 25, 15, 58</td></tr><tr><td>Cyan</td><td>47, 58</td><td>29, 25</td></tr><tr><td>Magenta</td><td>29, 25</td><td>58</td></tr><tr><td>Purple</td><td>47</td><td>58</td></tr><tr><td>Yellow</td><td>8, 15, 25</td><td>47</td></tr><tr><td>Orange</td><td>15, 25</td><td>47</td></tr></table></td></tr>
<tr><td>Lettering</td><td>Increase legibility</td><td>Contrast filter to darken (see above).</td></tr>
<tr><td>Glass, water</td><td>Reduce reflection</td><td>Pola-screen</td></tr>
</table>

Table 1-6. Filter selection

Lesson 1
PRACTICE EXERCISE

1. You are photographing a multicolored subject with black and white film and place a green filter over the lens. How will the subject appear on the print?

   a. Green
   b. Magenta
   c. Lighter
   d. Darker

2. What is one of the simplest methods of de-emphasizing or stressing a point in photography?

   a. Using the correct f/stop
   b. Choosing the right film
   c. Selecting the right camera
   d. Selecting the right filter

3. If a beam of white light is directed at a red filter, what primary color will pass through?

   a. Cyan
   b. Red
   c. Blue
   d. Yellow

4. If a beam of white light is directed at a cyan filter, what primary colors will pass through?

   a. Blue and green
   b. Yellow and green
   c. Blue and magenta
   d. Cyan and red

5. What color is a No. 8 filter?

   a. Light yellow
   b. Yellow
   c. Green
   d. Orange

6. To eliminate a transparent yellow stain, what filter should you use?

   a. 8
   b. 13
   c. 23A
   d. 58

7. To eliminate the reflection of light from glass, water, and smooth surfaces, which filter should you use?

   a. Contrast filter
   b. Neutral density filter
   c. Deep yellow filter
   d. Polarizing filter

8. What does the color of a filter determine?

   a. Color of subject
   b. Color of film
   c. The light that passes
   d. Type of chemistry

9. You photographed a subject with a red shirt on with a cyan filter. How will the shirt appear on the print?

   a. Dark
   b. White
   c. Cyan
   d. Red

10. You have a subject and background that reproduce in the same shade of gray. What type of filter could you use to separate the colors?

    a. Correction
    b. Contrast
    c. Haze
    d. Neutral density

11. How much do polarizing filters reduce light?

    a. 1.0
    b. 1.5
    c. 2.5
    d. 3.0

12. Orthochromatic film is sensitive to what colors of light?

    a. Yellow and red
    b. Blue and red
    c. Blue and green
    d. Yellow and green

13. What are the two ways to adjust your exposure for the filter factor?

    a. Adjust f/stop or shutter speed
    b. Adjust shutter speed or film
    c. Adjust film speed or filters
    d. Change camera or filters

14. You are making a copy and your exposure is 1/125 at f/16. You place a filter over the lens with a factor of 4. What is your adjusted f/stop?

a. f/4
b. f/8
c. f/11
d. f/32

15. Using the information in Question 14, you find that you do not want to change your f/stop, what would be your adjusted shutter speed?

a. 1/30
b. 1/60
c. 1/250
d. 1/500

16. Filters are constructed in what three ways?

a. Gelatin, glass, paper
b. Glass, water, cemented
c. Cemented, paper, dichroic
d. Gelatin, cemented, glass

17. What filter is generally used for arc and daylight illumination?

a. 8
b. 15
c. 23A
d. 49

18. Refer to Table 1-6. You are shooting a red brick building. Which filter would you select to show texture?

a. 11
b. 15
c. 25
d. 56

LESSON 2
COPY FILMS

TASK

Determine the types of copy films and their uses.

CONDITIONS

Given information and diagrams about copy films and their uses.

STANDARDS

Demonstrate competency of the task skills and knowledge by correctly responding to 80 percent of the multiple-choice test covering types of copy film and their uses.

REFERENCES

TM 11-401 and TM 11-401-2

Learning Event 1:
DESCRIBE THE TYPES OF COPY FILMS

1. Film controls picture quality. To produce high quality pictures, you must select the proper film for the job. In selecting the proper film consider color sensitivity, film speed, and contrast. We will discuss only black and white film in this section.

2. Film type and color sensitivity.

a. The many different varieties of film can be reduced to five basic types by their color sensitivity. The types are nonchromatic, orthochromatic, panchromatic B, panchromatic C, and infrared. The color sensitivity of each of these types, and of the human eye is shown in Figure 2-1.

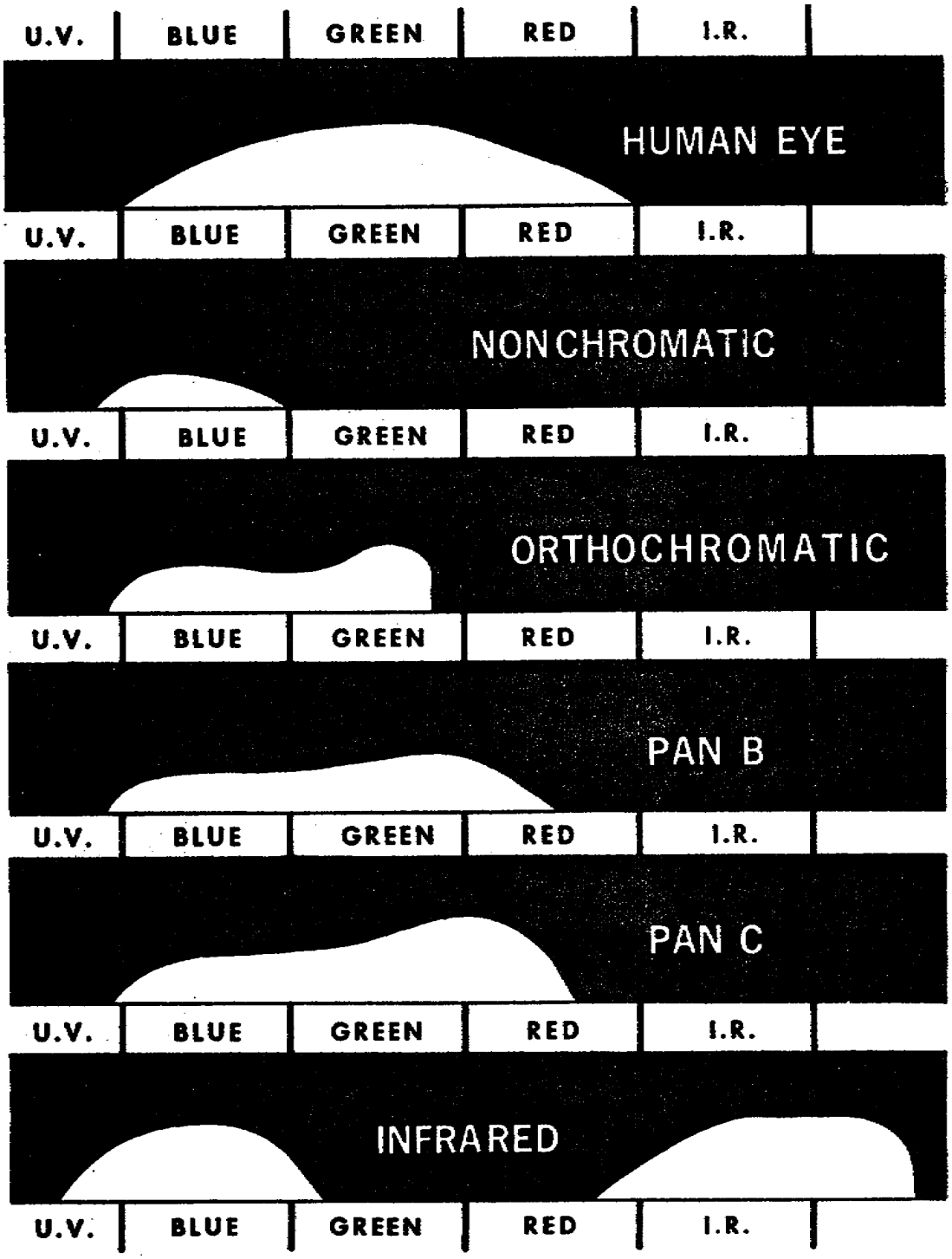

Figure 2-1. Film color sensitivity

b. Nonchromatic (blue-sensitive) film records only ultraviolet and blue light. All film is sensitive to these colors. Nonchromatic film generally has high contrast and is used mainly for copying black and white originals or other work where color is unimportant.

c. Orthochromatic film records green, blue, and ultraviolet light but not red. Therefore, reds appear dark on the prints.

d. Panchromatic B film records some red as well as green, blue and ultraviolet light. It is fairly close to the eye in color sensitivity. The natural color rendition makes it useful in close portraits and copy work involving multicolors.

e. Panchromatic C film records more red than panchromatic B, making the reds print a lighter shade of gray. The greater contrast between clouds and sky makes panchromatic C useful for scenery.

f. Infrared film is sensitive to ultraviolet and blue light, as are all films. It is also sensitive to the wavelengths longer than those visible to the eye, called infrared. Since infrared films are sensitive to light beyond the visible light, the film is used to see what cannot be seen by the human eye. For example, artificial trees used as camouflage appear darker than live trees when photographed with infrared film. It is also used for investigative types of work.

Learning Event 2:
FILM SPEEDS AND CONTRAST

1. Selecting film speeds.

a. Film speed is given as an International Standards Organization (ISO) rating. In the past it was known as American Standards Association (ASA) rating. This rating, much like the octane rating of gasoline, determines how much light is required to obtain an acceptable exposure. Normal film speed is about ISO 100.

b. Fast films have ASA/ISO ratings well above 100, even up into the thousands. The fast films allow you to use very fast shutter speeds to stop the action and photograph moving objects. Also, since less light is required for fast films, a slow shutter speed used with the fast film permits photographing under poor lighting conditions. Fast films are not normally required for copy work.

c. Slow films under ASA/ISO 100 should be used for copying. They usually have a finer grain and produce enlargements with excellent detail and little grain.

2. Contrast is the range of tones.

a. Normal contrast film is most commonly used because it reproduces white, black, and all shades of gray.

b. When the material to be copied has a constant tone, that is, very little contrast, with little difference in color, then use a high contrast film to make the light colors lighter and the dark areas darker.

c. Low contrast film shows mostly middle gray and lacks black and white. Use this film to reduce differences in high contrast scenes, such as a dark subject against a very bright background.

d. When copying documents such as typewritten pages where only black and white appear (line copy), use a high contrast ortho film.

Learning Event 3:
FILM SELECTION AND CHARACTERISTICS OF VARIOUS FILMS

1. Film selection. Table 2-1 gives general procedures for selecting film. Table 2-2 gives you film types and the characteristics of various films.

Condition	Film
Copying, black and white..... (line copy)	High contrast orthochromatic
Copying, with gray tones..... (continuous tone)	Medium contrast panchromatic
Enlargements	Slow (low ISO)
Open, bright, sharp contrast....	Low contrast
Scientific, technical, and tactical detection of heat and light.....	Infrared
Shade, dark, dull contrast.....	High contrast

Table 2-1. Film selection

Film Name	Type	Roll Film-RF Filmpack-FP Cut Film-CF 35mm Film-35	Characteristics	Speed Rating	
				(ASA) Day	(ISO) Tung.
Contrast Process Ortho	Ortho	CF	High contrast, medium speed film for copying line originals in monochrome as well as certain types of colored originals where red sensitivity is not necessary.	-	50
Kodalith Ortho	Ortho	CF-35mm	Extremely long rolls high contrast film copy and half tone negatives and positives.	-	8
High Speed Infrared (with No. 25 filter).	Infrared	CF, 35	Sensitive to infrared radiation in addition to the normal blue violet sensitivity. Used for medical, other technical and scientific fields of photography.	-	125*
Contrast Process Pan	Pan	CF	High contrast fine grain pan film for copying colored lines or printed matter on white or colored paper.	-	80

Table 2-2. Characteristics of various films

Film Name	Type	Roll Film-RF Filmpack-FP Cut Film-CF 35mm Film-35	Characteristics	Speed Rating	
				(ASA) Day	(ISO) Tung.
Commercial	Ortho	CF	Medium speed, moderately high contrast, for for continuous tone B&W originals. Also used for positive transparencies.	50	8
The following films may be used for copy photography but should be used only as an alternative to the films previously listed.					
Panatomic X	Pan	35, RF	Extremely fine grain and excellent definition. Can be processed by reversal for B&W slides.	32	32
Plus X Pan	Pan	35, RF	Fine grain, wide latitude film for general use.	125	125
Royal Pan	Pan	CF	Extremely high speed film for a great variety of photographic work. Good tonal rendition.	400	400
Tri-X Ortho	Ortho	CF	Fast film with fine grain and moderate contrast lighting. Good contrast control. Retouching surface on both sides of film.	320	320

* Estimated Rating

Table 2-2. Characteristics of various films (continued)

2. Recap. In this lesson we have talked about the numerous types of film. We have recommended which type of film to use and we talked about color sensitivity of film, film speed, and contrast. We don't expect you to become an expert today, but with the help of this information you should be able to detect a general improvement in your picture quality within a short period of time.

Lesson 2
PRACTICE EXERCISE

1. What controls picture quality?

   a. Developer
   b. Filters
   c. Proper film
   d. Camera

2. What type of film would you select for copy work where color is unimportant?

   a. Nonchromatic
   b. Panchromatic C
   c. Infrared
   d. Orthochromatic

3. (Refer to Figure 2-1). What type of film has the least sensitivity to colors?

   a. Panchromatic B
   b. Nonchromatic
   c. Infrared
   d. Panchromatic C

4. What speed film would you usually use for copy work?

   a. 500 ASA/ISO
   b. 400 ASA/ISO
   c. 200 ASA/ISO
   d. 100 or less ASA/ISO

Refer to Table 2-1 for Questions 5 and 6.

5. You are copying material that has a constant tone and very dull contrast. What type of contrast film should you use?

   a. Low contrast
   b. Average contrast
   c. High contrast
   d. Use filters

6. You are copying documents where only black and white are present. What type of film should you select?

   a. High contrast orthochromatic
   b. Low contrast orthochromatic
   c. Panchromatic ortho
   d. Infrared chromatic

Refer to Table 2-1 and 2-2 for Questions 7, 8, 9, 10.

7. You want to select a film with wide latitude and fine grain. What film should you select?

   a. Plus-X pan
   b. Tri-X ortho
   c. Kodalith ortho
   d. Royal pan

8. You are copying documents with colored lines. What would be the best type of film to use?

   a. Contrast process ortho
   b. Contrast process pan
   c. Panatomic X
   d. Commercial ortho

9. You want to take photographs that show tactical detection of heat and light. What type of film should you select?

   a. Panatomic
   b. Panchromatic
   c. Orthochromatic
   d. Infrared

10. You are copying documents where red sensitivity is not necessary. What type of film should you select?

    a. Contract process pan
    b. Tri-X ortho
    c. Contrast process ortho
    d. Panatomic-X

LESSON 3
PERFORM COPY PHOTOGRAPHY

TASK

Describe procedures for making a photographic copy.

CONDITIONS

Given information and diagrams on how to mount an original, place the lights, focus the camera, and determine and make exposures.

STANDARDS

Demonstrate competency of the task skill and knowledge by correctly responding to 80 percent of the multiple-choice test covering procedures for making a photographic copy.

REFERENCES

TM 11-401, TM 11-401-2

Learning Event 1:
MOUNTING ORIGINAL FOR EXPOSURE

1. Selecting correct backing. Translucent originals, material that passes diffused light, should be backed with white paper when there is print on only one side of the original and with black paper when there is print on both sides. Much of the light shining on translucent originals is reflected to the camera. Some of the light that goes through the original, is reflected off the white paper backing, and is sent back through the original to the camera. This makes the whites whiter and the blacks blacker. If the original has print on both sides, then the light reflected off a white backing would be blocked by the printing on the back of the original and an image of this printing would appear on the film. So you should use a black backing to absorb all the light that passes through an original that has printing on both sides.

2. Placing the copy original. Mount the original and backing upside down and flat on a copy board or easel parallel to the film plane. It should be centered with the optical axis of the lens (fig 3-1). Place the original parallel with the film to prevent distortion due to perspective. Centering the original with the optical axis of the lens aids in framing and minimizes

distortion caused by the lens. The reason you place the original upside down on the copy board is so it will appear right side up on the ground glass of the camera; this makes focusing the camera easier for you. Holding the original flat is most important; any bumps, wrinkles, or other displacement will distort the image, create shadows and produce hot spots, just as the curved mirrors do in a fun house at an amusement park.

3. Choosing copy position. Your choice of copying in the vertical or horizontal position depends on your camera, size or weight of copy, or your preference. Most small copy cameras mounted on stands are vertical; that is, they expose copy from above. Most heavy 8- by 10-inch and larger cameras are horizontal but some such as the KS-7A are adjustable to both styles. Any hand-held camera and the 4- by 5-inch view camera can be used in either way (figs 3-1 and 3-2).

Learning Event 2:
PLACING THE LIGHTS

1. Light is needed. When making a photographic exposure on a piece of film there must be some type of light, whether it is daylight, studio lights or moonlight. This holds especially true in copy photography. Most copy photography is done indoors. There are a few things you have to know about lighting techniques to ensure top-quality copy work.

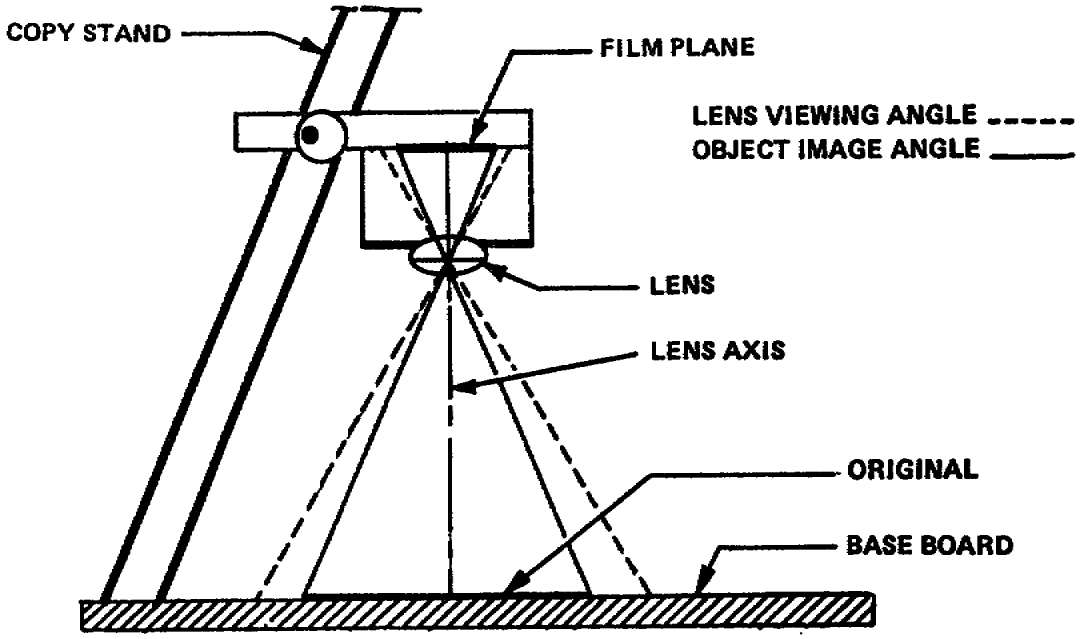

Figure 3-1. Vertical copying

a. Sheets of plastic are excellent for protecting an original from physical damage and for keeping the original flat during handling. However, do not use plastic coverings on originals when copying because they:

(1) are seldom optically pure

(2) are hard to hold flat

(3) distort the copy

(4) reflect light, causing hot spots

(5) reflect images of other objects in the room

b. If possible, a piece of optically pure flat glass should be used to flatten your original when copying. Window glass is not optically flat.

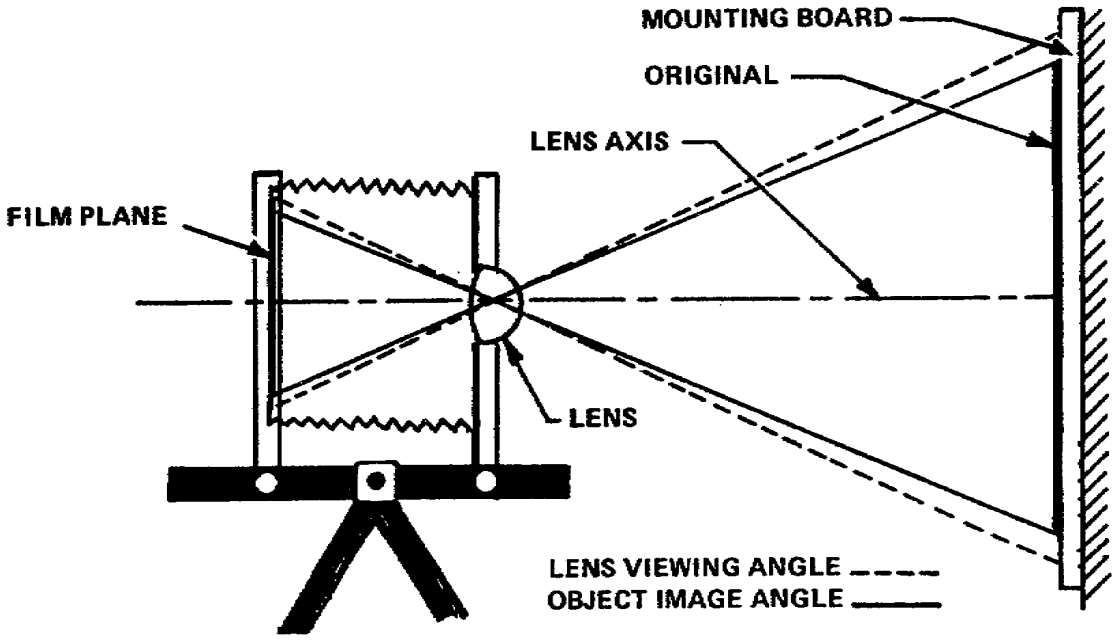

Figure 3-2. Horizontal copying

c. Be sure to mount the original so it can be uniformly illuminated.

2. How to place the lights.

a. Natural light (sunlight) is excellent for copying. House lamps, however, are poor for copy work because the light is seldom uniform. If you are working outdoors, find an open shade area to work in. The shade side of a building is best. When using tungsten light, place the original so that it gets light from both sides, or use reflectors so the original is illuminated as uniformly as possible.

b. There are two ways to check the uniformity of illumination on the original. You can use an exposure meter, or a pencil, or other long thin object.

(1) When checking with a meter, you are not interested in exposure at this time, only even lighting. Take a reading of the center of the copy, then read the four corners of the copy. All readings should be the same. If not, adjust the lights until all areas receive the same amount of light. Do not read the shadows of your hand or the meter.

(2) When using a pencil or similar object, place the pencil perpendicular and centered on the copy. Make sure you place the blunt end and not the sharp end against the copy. The shadows cast by the pencil should be of equal darkness, if not, move the lights until all shadows are equal. Remember that this method is only used to check for uniformity. An exposure must still be taken.

c. To obtain uniform lighting, use at least two lights. Locate one on either side of the camera. Place the lights so there is a 45-degree angle between the light and the original, and between the light and the camera (fig 3-3).

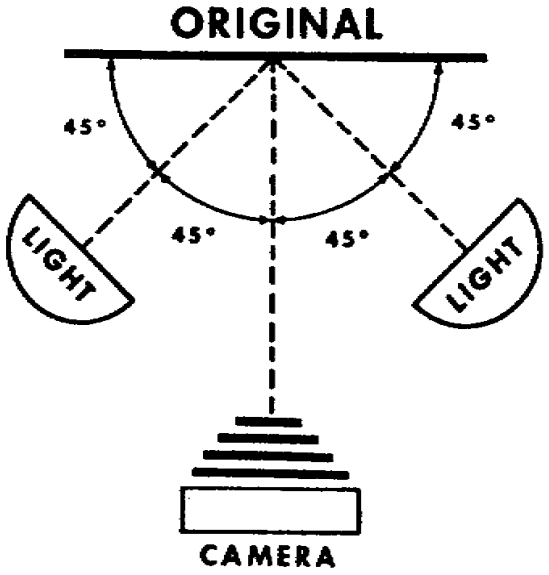

Figure 3-3. Uniform lighting

d. As shown in Figure 3-4, the angle between the light and the camera should be reduced for original with textured surfaces. Textured surfaces diffuse the light so you need a more direct light to prevent shadows and to reflect more light to the lens.

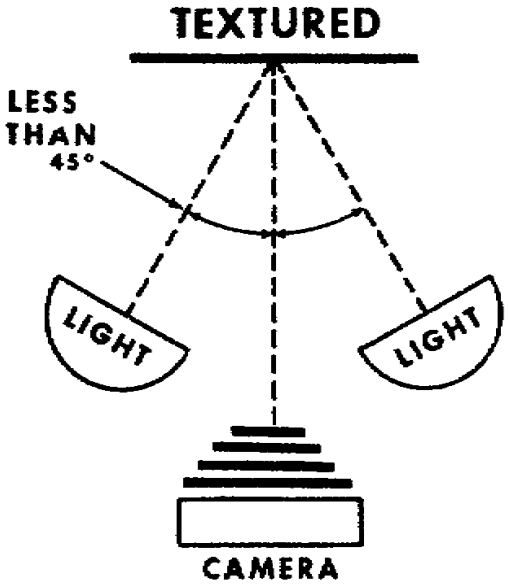

Figure 3-4. Lighting textured surfaces

e. The angle should be increased when the surface of the original is very smooth (fig 3-5). Smooth surfaces reflect light, so you should use a more oblique light to prevent surface reflection from spoiling the copy.

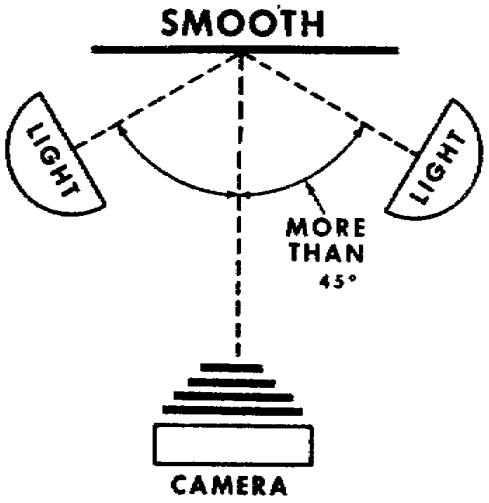

Figure 3-5. Lighting smooth surface

f. Place lights equal distances from the original if they are of equal intensity (fig 3-6). When the intensity is not equal, place the brighter light farther away so the illumination of the original from each light is the same (fig 3-7). Illumination decreases with the square of the distance, thus you can obtain the same illumination of the original by placing a light that is four times brighter, twice the distance away.

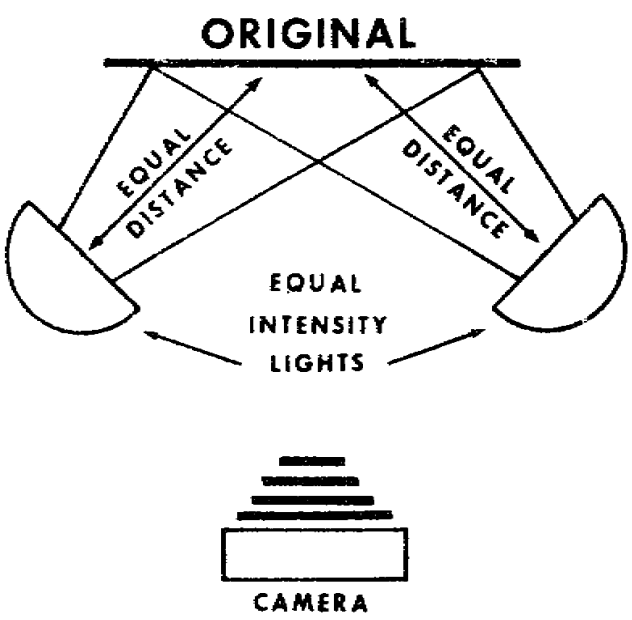

Figure 3-6. Equal intensity lights

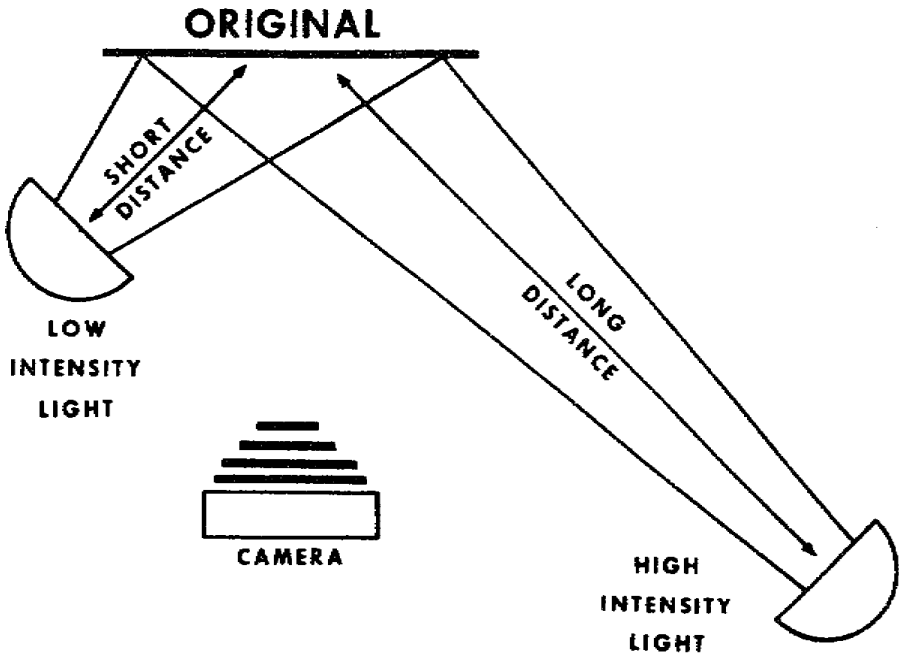

Figure 3-7. Unequal intensity lights

g. To achieve uniform lighting, it is better to set the lights away from the original. The center of the beam of light is generally brighter than the outside, so if lights are brought in too close, the center of the original (fig 3-8) may be brighter than the edge or corners. Distance does reduce the overall brightness but it makes the illumination more uniform (fig 2-9). You can also increase uniformity by placing white tissue paper over the light, thereby diffusing the light.

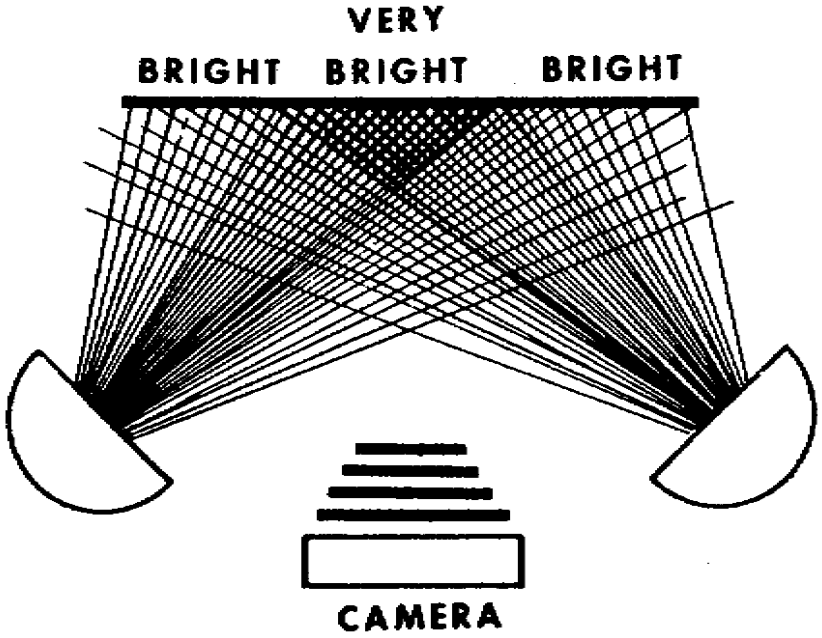

Figure 3-8. Uneven lighting

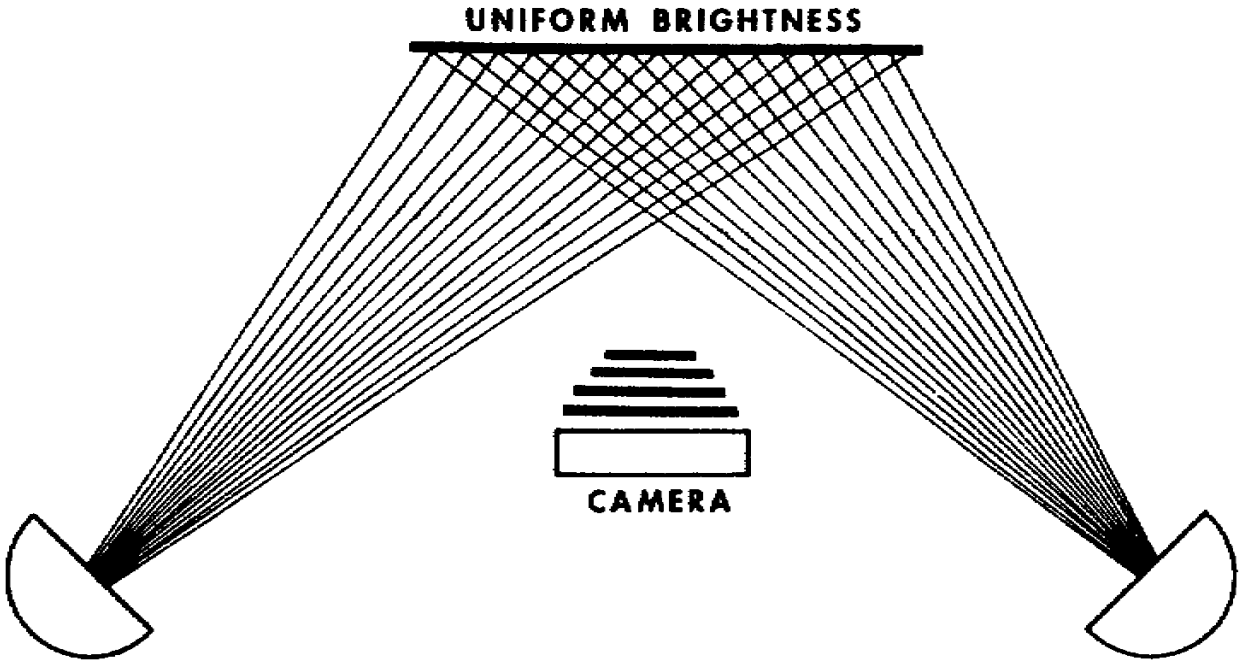

Figure 3-9. More distant uniform lighting

h. Placing the lights farther from the original than the camera also prevents the light from shining directly into the lens and causing hot or bright spots. There are also other ways bright spots occur. Light on any smooth surface causes a shiny reflection. Do NOT allow this reflection to be picked up by the lens. You can keep the shiny reflection out of the lens by moving the light, moving the reflecting surface, polarizing the light or by using shields (barn doors).

Learning Event 3:
EXPOSING AND PROCESSING THE FILM

1. Focus the camera.

a. Now that all the equipment and materials are in place, focus the camera by observing the image on the ground glass back. Besides focusing for a sharp image, also look for possible defects in the setup such as:

(1) perspective distortion caused by the original not being parallel to the film plane

(2) distortion caused by an original that is not flat

(3) hot spots caused by shiny reflections

(4) improper framing caused by poor alignment of original

(5) reflection of camera from glass-covered easel

b. After focusing, determine the exposure.

2. How to determine the exposure.

a. First determine the basic exposure. Multiply the exposure meter by reading five for line copy, or use the gray card reading, or you can use the middle tones directly for continuous-tone copy.

b. Then multiply the basic exposure by the filter factor.

c. When the original-to-lens is less than ten times the focal length of the lens, as it will be most of the time, you must multiply the exposure by the bellows extension factor (BEF). There are two methods of calculating the BEF.

(1) The first method is to measure the bellows extension (BE), (distance from lens to focal plane), divide by the focal length of the lens (FL), and square the result. To square a number, you multiply it by itself. Stated as a formula this is:

$$BEF = \left(\frac{BE}{FL}\right)^2 = \frac{BE}{FL} \times \frac{BE}{FL}$$

For example, if the bellows extension is 18 inches and the focal length is 12 inches then:

$$\text{BEF} = \left(\frac{18}{12}\right)^2 = \frac{324}{144} = 2.25$$

or

$$= (1.5)^2 = 2.25$$

that is: 18 x 18 = 324, 12 x 12 = 144, 324 divided by 144 = 2.25, or to keep the numbers smaller: 18 divided by 12 = 1.5. 1.5 x 1.5 = 2.25. Your bellows extension is 2.25.

(2) The second method. Divide the image size by the original size, add one, and then square the result as shown by the following formula:

$$\text{BEF} = \left(\frac{\text{IMAGE SIZE}}{\text{ORIGINAL SIZE}} + 1\right)^2$$

For example, if the image on your glass is 8 inches high and the original is 12 inches high, then the BEF equals:

$$\left(\frac{8}{12} + 1\right)2 = (.67 + 1)^2 = (1.67) = 2.78 \text{ or } 2.8$$

Your bellows extension factor is 2.8.

(3) If you are working with millimeters (mm) the equation is the same. Remember that 1 inch equals 25.4mm. For practical purposes, we round that off to 1 inch equals 25mm. This is close enough for normal copy work. If you are doing very critical scientific copy work then the 25.4 figure should be used.

(a) Using the same lens and bellow extension as in (1) above we find that 18 inches equals 450mm and 12 inches equals 300mm. The equation then reads:

$$\text{BEF} = \left(\frac{450}{300}\right)^2 = 1.5 \qquad 1.5 \text{ x } 1.5 = 2.25$$

(b) Your bellows extension factor is 2.25. It makes no difference if you use inches or millimeters, just make sure all the numbers are the same, all inches or all millimeters.

(4) After completing one of the above steps, you now multiply your basic exposure by the bellows extension factor. If your BEF is 2.25 and your basic exposure was 8 seconds at f/16, then your new exposure would be 18 seconds at f/16:

8 x 2.25 = 18, or 18 seconds at f/16

3. Making more than one exposure.

a. You should make trial exposures, starting with one-quarter of the exposure time you expect you will need, an aperture of f/8 (lens setting). You then make five exposures on one sheet of film. You do this in the following manner: first you pull the dark slide out 1 inch, make an exposure for 2 seconds, pull the slide out 1 more inch, and make another exposure. Do this a total of five times at 2 seconds each. The result will be a single negative with five different exposures, as shown in Figure 3-10.

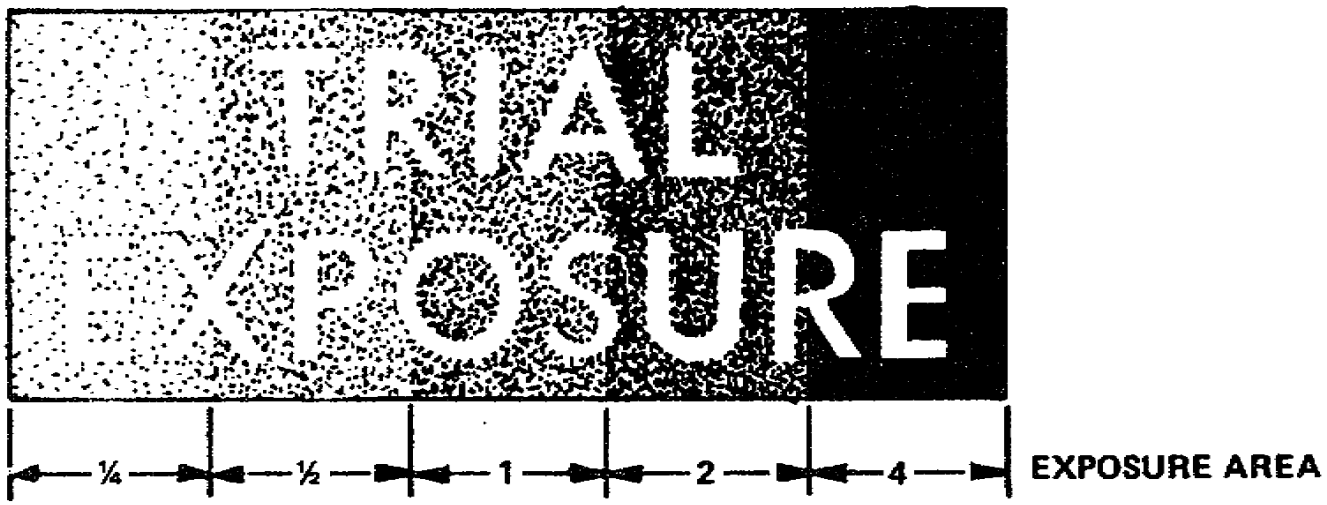

Figure 3-10. Trial exposure

b. If your negative does not have a desired shade of black and white, you must make another test negative. This time, instead of 2 seconds, double the exposure to 4 seconds and start over again. Let us say that exposure area 3 has the right amount of blacks and whites for your specific copy work. You then take the 3, multiply that by the seconds of exposure that you used for each exposure area. If it was 2 seconds, then it will be 3 times 2 seconds equals 6 seconds, which will then give the best negative for your specific copy job.

c. If time does not permit you to make and develop a trial negative, then make three separate exposures; one at the estimated exposure, one two stops underexposed, and one two stops overexposed. One of the three exposures should produce a good copy.

d. When using commercial film for line copy, underexpose two stops and overdevelop 50 percent to get high contrast and sharp deep blacks; also, use a high contrast developer.

4. Process the film.

a. You use the standard process for developing, fixing, washing and drying the film, with the following exceptions:

(1) develop line copy to the highest contrast.

(2) develop continuous-tone copy to slightly less than normal contrast.

b. If light areas of line copy show fog, they may be treated with R-4a, Farmer's Reducer.

Learning Event 4:
MAKING THE PRINT

1. Making the prints.

a. The principal difference in types of copy prints is that line copy has very high contrast and continuous-tone copy has a normal range of contrast.

b. As we mentioned before, some originals may contain both areas of line copy and areas of continuous-tone copy, such as a picture alongside printed text. These are best copied by making two exposures, one on line copy film, and the other on continuous-tone copy film. Then the two negatives are used to make one print by one of the following methods.

(1) Method one as shown in Figure 3-11. Mask the portion of each negative that will not be used, then expose the print twice, once with each negative. This is not a double exposure because the masked areas of the negatives keep light from striking the print. Carefully align the print paper and each negative in order to get the line copy and the continuous-tone copy into the proper position with respect to each other on the print. You can do this by hinging or taping the negative edges together.

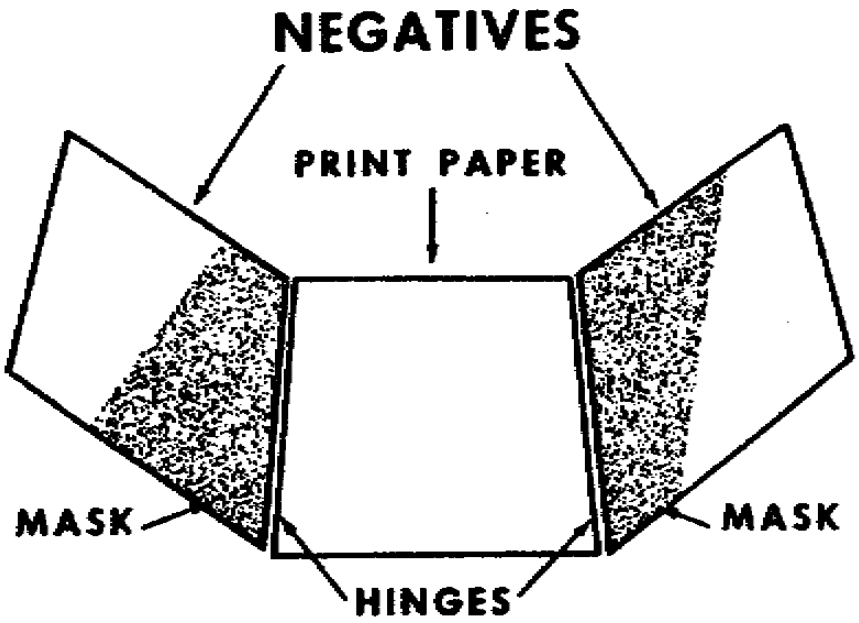

Figure 3-11. Masking

(2) Method two as shown in Figure 3-12. Cut away the unwanted parts of both negatives so the two negatives can be taped together to form one. This is called splicing or stripping. You may use red cellophane tape for opaque areas but you must use clear tape for transparent areas.

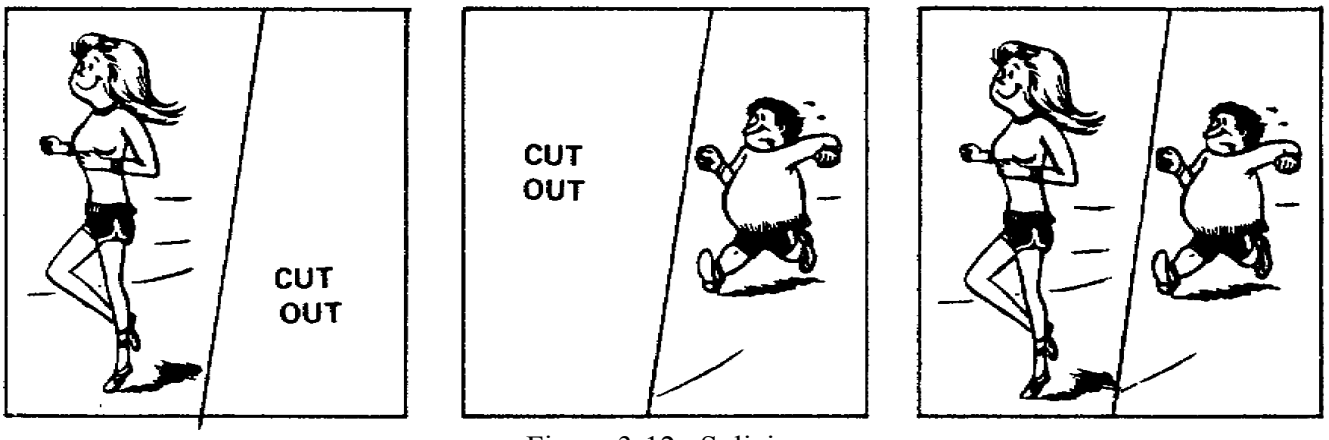

Figure 3-12. Splicing

2. Copying transparencies. There are two methods of copying transparencies, the indirect method and the direct method.

a. In the indirect method you use the transparency as you would use a negative to make a contact or an enlargement print. The print may be made on either film or print paper. In either case the result will be a negative of the transparency. If you use film, you need to repeat the process to get a negative of the negative or a copy of the transparency. Use a commercial or commercial matte film. If you use print paper, then you must photograph the print to get a negative that will be a copy of the transparency. The indirect method of copying transparencies uses a film with a solarized emulsion. A solarized emulsion produces the opposite result of a normal emulsion. That is, a solarized emulsion produces a clear or light area where the light strikes the emulsion. Thus, a positive or direct copy can be made with a normal printing process, using the transparency as you would use a negative and the solarized film as print paper.

b. Direct reflex copying.

(1) There are many ways you can make direct (scale 1:1) copies. A photographic method of direct copying is called reflex copying. The main advantages of reflex copying over other forms of direct copying are durability and sharpness of the image. Direct copy film, however, can produce as sharp or sharper results than reflex paper film. The scale in reflex copying is 1:1.

(2) When the original is translucent and printed on only one side, copy prints are made directly on flex copy paper by a contact printing process (fig 3-13). The original is placed face up on top of the reflex copy paper and exposure is made by shining light through the original.

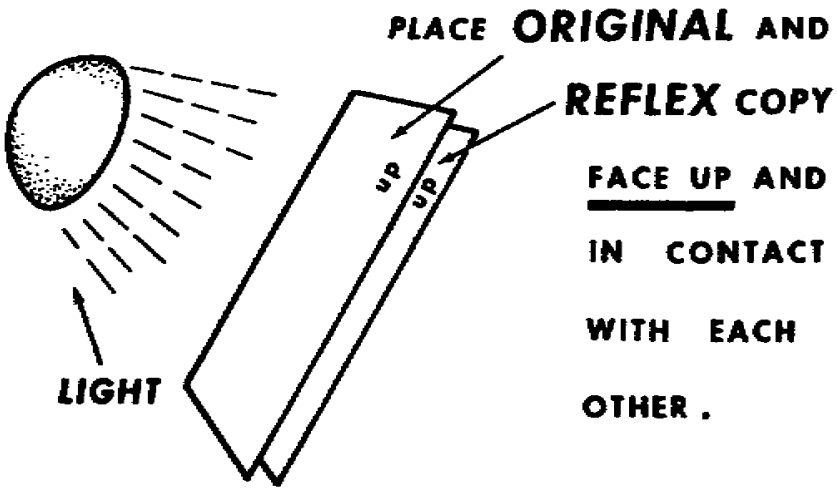

Figure 3-13. Direct copy

(3) When the original is either opaque or printed on both sides, an intermediate negative copy must be made. The original and the reflex copy paper are placed face-to-face and exposure is made by shining light through the reflex copy paper (fig 3-14). The result of the intermediate step is a mirror image in that words are printed backwards, laterally reversed. By using this mirror image copy after development as the original, and repeating the process mentioned before, you can produce a normal copy print.

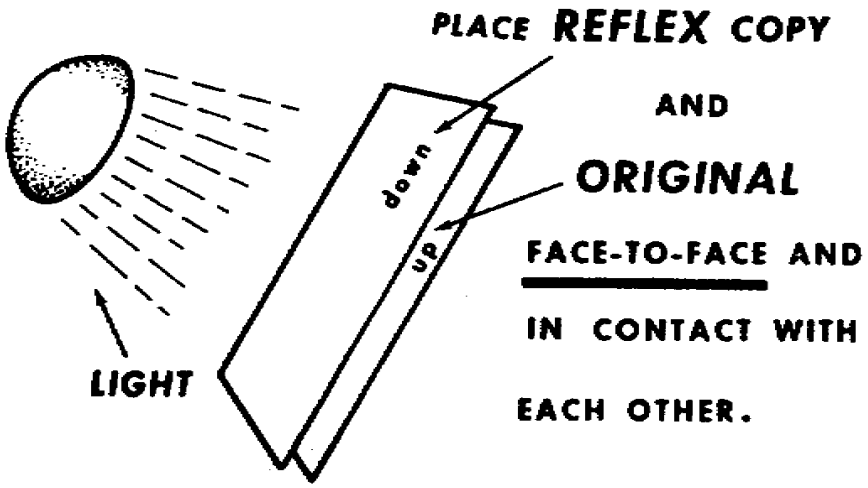

Figure 3-14. Image copy

(4) Reflex copy paper has an orthochromatic emulsion. The paper should be handled under a series of OA safelight, and is developed in about 60 seconds in D-72 (one part stock solution to two parts water) at 68 degrees Fahrenheit.

3. Recap. This lesson has explained how to place an original for copying, and how to select and place the proper lights or lighting equipment. You have been told how to measure and calculate the correct exposure to ensure a better negative, which will enable you to produce top quality reproduction work.

Lesson 3
PRACTICE EXERCISE

1. You are copying an original that has writing on both sides and is translucent. What should you place on the back of the original to prevent reflections?

   a. White paper
   b. Black paper
   c. Use a filter
   d. Use high contrast film

2. You want to minimize distortion caused by the lens. How should your original be placed for copying?

   a. Upside down
   b. Near the top
   c. Centered
   d. To the right of axis

3. What is the main reason for placing your original upside down?

   a. Makes focusing easier
   b. Improves picture quality
   c. Easier filtering
   d. Improve camera operation

4. What are two ways to check uniformity of illumination on your original?

   a. Bellows or pencil
   b. Exposure meter or estimate
   c. Estimate of long thin object
   d. Pencil or exposure meter

5. How many lights should you use to obtain uniform lighting?

   a. One
   b. Three
   c. At least two
   d. Depends on lighting

6. You are placing your lights. They should be placed at what angle between the light and the original?

   a. 30 degrees
   b. 45 degrees
   c. 60 degrees
   d. 180 degrees

7. When taking a meter reading to check your illumination level, how many areas should you check?

   a. 2
   b. 3
   c. 4
   d. 5

8. You are copying a textured, smooth surface original. How should you place your lights?

   a. More obliquely
   b. Center your lights
   c. Increase the angle
   d. Use more lighting

9. You have a bellows extension of 20 inches and the focal length is 12 inches. What is your bellows extension factor?

   a. 1.66
   b. 2.75
   c. 3.00
   d. 3.66

10. You have an image that is 10 inches high on the ground glass and your original is 13 inches, then your BEF equals what?

    a. 2.65
    b. 2.95
    c. 3.00
    d. 3.25

11. (Refer to the preceding question.) What would be your corrected exposure if your basic exposure was 9 seconds at f/22?

    a. 27 seconds at f/22
    b. 21 seconds at f/22
    c. 18 seconds at f/16
    d. 9 seconds at f/22

12. You want to increase contrast, and you are using a commercial film. What can you do?

    a. Underdevelop and underexpose
    b. Overexpose 2 stops and overdevelop
    c. Process at higher temperatures and overdevelop
    d. Under expose two stops and overdevelop 50 percent

13. When copying originals that contain both areas of lines and continuous tones, you should do what?

    a. Make two exposures
    b. Mask the unwanted areas
    c. Use different filters
    d. Use one type of film

14. You want to splice a transparent area of your negative. What type of tape must you use?

    a. Red cellophane tape
    b. Filters
    c. Clear tape
    d. Different film

15. You are copying transparencies. What are the two methods that you can select?

    a. Positive and negative
    b. Direct and indirect
    c. Image and direct
    d. Transparent and opaque

16. When working with orthochromatic film, you should use what series of safelight?

    a. 00
    b. OH
    c. OC
    d. OA

ANSWERS TO PRACTICE EXERCISES

Lesson 1

1.	c	LE 1	para 2d	pg	2
2.	d	LE 1	para 2a	pg	2
3.	b	LE 1	para 3c	pg	3
4.	a	LE 1	para 3e	pg	3
5.	b	LE 2	Table 1-5	pg	14
6.	a	LE 1	para 6e	pg	6
7.	d	LE 1	para 8c	pg	7
8.	c	LE 1	para 1a	pg	1
9.	a	LE 1	para 6d	pg	5
10.	b	LE 1	para 6a	pg	5
11.	b	LE 1	para 11b	pg	8
12.	c	LE 2	para 1a	pg	10
13.	a	LE 2	para 2a	pg	11
14.	b	LE 2	para 2a(1)	pg	12
15.	a	LE 2	para 2a(2)	pg	12
16.	d	LE 2	para 3a	pg	13
17.	d	LE 2	Table 1-5	pg	14
18.	b	LE 2	Table 1-6	pg	16

Lesson 2

1.	c	LE 1	para 1	pg	20
2.	d	LE 1	para 2b	pg	21
3.	b	LE 1	Figure 2-1	pg	21
4.	d	LE 2	para 1c	pg	22
5.	c	LE 2	para 2b	pg	22
6.	a	LE 2	para 2d	pg	23
7.	a	LE 3	Table 2-2	pg	24
8.	b	LE 3	Table 2-2	pg	24
9.	d	LE 3	Table 2-1	pg	23
10.	c	LE 3	Table 2-2	pg	24

ANSWERS TO PRACTICE EXERCISES (continued)

Lesson 3

1.	b	LE 1	para 1	pg 29
2.	c	LE 1	para 1	pg 29
3.	a	LE 1	para 1	pg 29
4.	d	LE 2	para 2b	pg 32
5.	c	LE 2	para 2c	pg 32
6.	b	LE 2	para 2c	pg 32
7.	d	LE 2	para 2b(1)	pg 32
8.	a	LE 2	para 2d	pg 32
9.	b	LE 3	para 2c(1)	pg 36
10.	c	LE 3	para 2c(2)	pg 37
11.	a	LE 3	para 2c(4)	pg 37
12.	d	LE 3	para 3d	pg 38
13.	a	LE 4	para 1b	pg 39
14.	c	LE 4	para 1b(2)	pg 39
15.	b	LE 4	para 2	pg 40
16.	d	LE 4	para 2b(4)	pg 41