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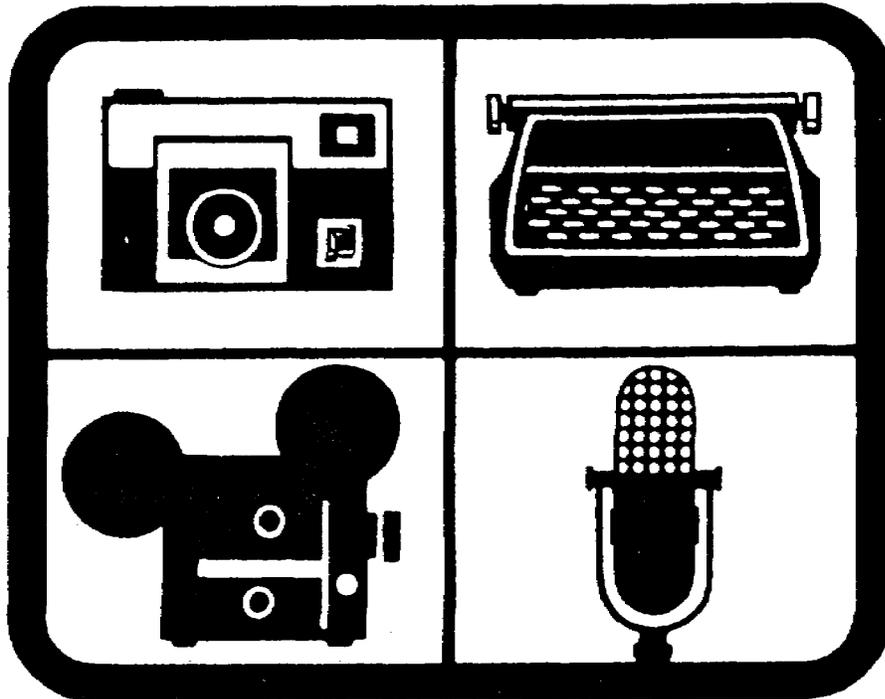
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STILL PHOTOGRAPHY  
FOR JOURNALISTS

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THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT  
ARMY CORRESPONDENCE COURSE PROGRAM

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READINESS/  
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THRU  
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STILL PHOTOGRAPHY  
FOR  
JOURNALISTS

Subcourse Number DI0250

Army Public Affairs Center  
Fort George G. Meade, Maryland

10 Credit hours

Edition Date: June 1989

SUBCOURSE OVERVIEW

This subcourse contains 5 lessons, giving the journalist the tools necessary to perform as a photojournalist. These lessons will provide a general knowledge and understanding of using a 35mm camera, film and exposure, controlling light, film development and making prints.

There are no prerequisites for this subcourse.

This subcourse reflects the doctrine which was current at the time the subcourse was prepared. In your own work situation, always refer to the latest publications.

The words "he," "him," "his," and "men," when use in this publication, represent both the masculine and feminine genders unless otherwise stated.

TERMINAL LEARNING OBJECTIVE

**Task:** In this subcourse you will learn the principles and methods used in photography.

**Conditions:** You are given the material presented in this lesson.

**Standards:** You will demonstrate a basic understanding of the principles and methods used in photography.

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# LESSON ONE

## OPERATE A 35mm CAMERA

46Q Soldier's Manual Task: 214-176-1315

### OVERVIEW

#### **TASK DESCRIPTION:**

In this lesson you will learn how to operate a 35mm camera.

#### **LEARNING OBJECTIVE:**

**ACTIONS:** Describe the procedures used in taking a picture with a 35mm camera.

**CONDITIONS:** You are given the material presented in this lesson.

**STANDARDS:** You will know the methods and procedures used to operate a 35mm camera.

**REFERENCES:** The material contained in this lesson was derived from the following publications:

Soldier's Manual and Trainer's Guide for  
Journalists  
Applied Journalism Handbook  
DINFOS Public Affairs Handbook  
ACCP SS0193  
ACCP SS0516

# OPERATE A 35mm CAMERA

## INTRODUCTION

In the past, the term "press photographer" was used to describe a person who worked as a photographer within the press media. Today, the term "photojournalist" is used to describe a journalist who uses a camera as a tool to tell a story. For this reason it is important for the journalist to have an understanding of the basics of photography.

Most photographs that fail to come out as they were planned are not due to the camera not working, bad film, or a processing error. It is the photographer's lack of knowledge of the camera. You should become as familiar as possible with your camera, know what the camera can do, then know what you want it to do.

Today's cameras use 35mm film, and were designed as lightweight instruments for difficult forms of pictorial coverage. The Army issues the KS-99 camera kit, which consists of a Canon F-1 35mm single-lens reflex (SLR) camera, a 50mm lens, a 35mm lens, a 135mm lens and a Vivitar flash unit. NOTE: See Appendix A for definition of terms.

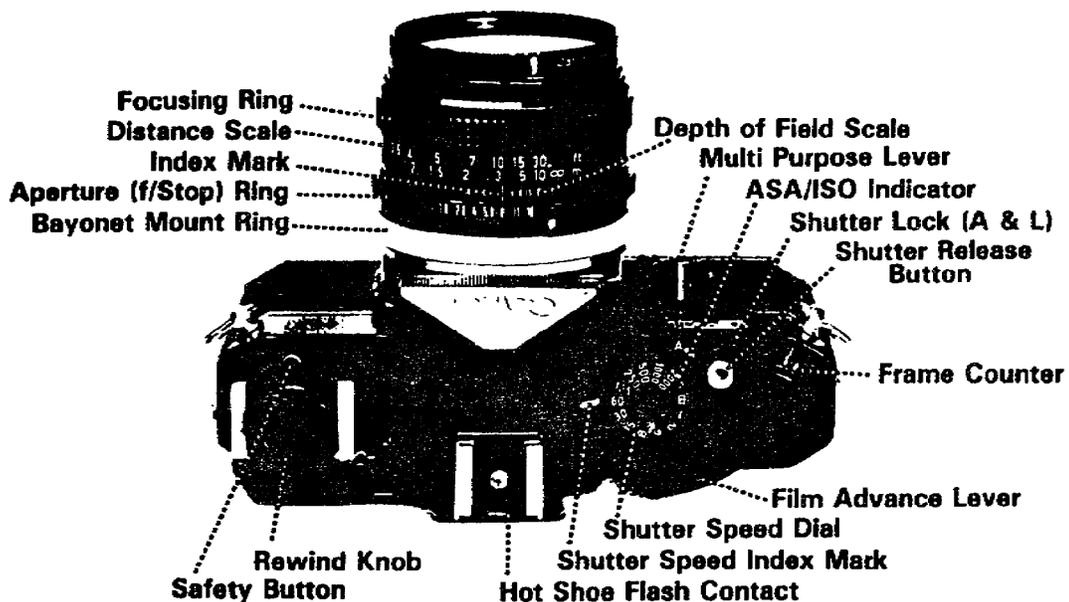


FIGURE 1-1. 35mm CAMERA

### Familiarize Yourself with the Camera

You should inspect the camera and familiarize yourself with its controls. Learn how they operate. Figure 1-1 shows the location of camera controls and indicators.

- o Film advance lever. Advances film one frame at a time, cocks the shutter, prepares aperture and mirror for exposure and advances the frame counter one number.

- o Shutter release button. Releases the shutter, initiating the exposure.

- o Shutter speed dial. Indicates optional shutter speeds and sets the length of time the shutter remains open during an exposure. Shutter speeds are indicated in fractions of a second (60 = 1/60th of a second). The higher the number on the dial, the faster the shutter speed (and the shorter the exposure).

- o ASA/ISO setting. Some films are more light-sensitive than others. This dial adjusts the light meter accordingly.

- o Aperture ring. A ring around the lens with a scale listing aperture numbers (i.e. 2.8, 3.5, 4, 5.6 etc.). These numbers are also known as "f/stops." The ring sets the f/stop on the lens to control the amount of light entering the lens.

- o Rewind knob. Used to rewind film into the cassette (film canister), to tighten slack in loaded film, and to open the camera back. Turn in the direction of the arrow to rewind film. Lift to open the camera back.

### **Lenses and Apertures**

Most 35mm SLRs have interchangeable lenses. The "focal length" of a lens is the distance from the optical center of the lens to the focal plane (film plane), when the camera is focused upon an object at infinity. A 50mm focal length lens is considered the "normal" lens because when you look through the viewfinder objects appear at their approximate normal size. A smaller than normal focal length (like 28mm) means a wider angle of view. A longer than normal focal length (135mm) is a telephoto lens. Focal length affects film image size.

The lens of a 35mm SLR has "f/stops" or aperture settings (see figure 1-1) which includes the numbers 3.5, 4, 5.6, etc. These control the amount of light passing through the lens and striking the film. The higher the f/stop number, the smaller the amount of light allowed to enter the camera lens. Aperture f/5.6 lets twice the amount of light strike the film as aperture f/8. Another way of saying it is that f/5.6 is "one stop larger" than f/8. Click stops between the apertures are "half stops." F/stops can range from f/1.4 to f/22; the larger the number, the smaller the aperture. This f/stop system (factorial system) is always read as a whole number, not as a fraction or ratio. The meaning of "f/8"

is that the diameter of the opening in the diaphragm is one-eighth of the lens" focal length (Figure 1-2).

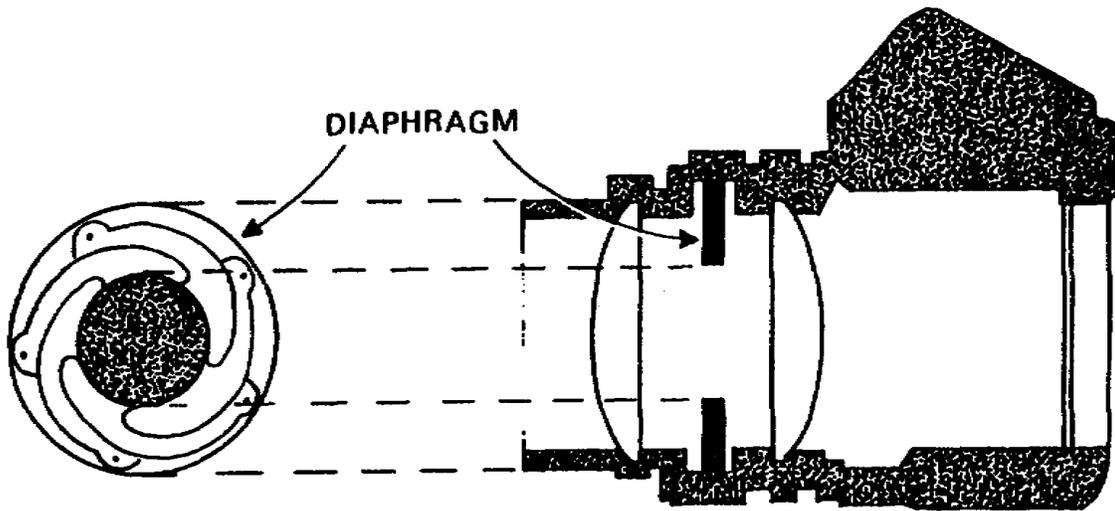


FIGURE 1-2. DIAPHRAGM

### Shutter Speed

The shutter speed control on the 35mm SLR (see Figure 1-1) is usually a dial with a scale that includes the numbers 500, 250, 125, 60 etc. Shutter speeds control the duration of time that light is allowed to pass through the lens aperture to reach the film. The shutter speeds usually range from one second to 1/1000 of a second or more. Unlike aperture settings that can be set between the marked f/stops, there are no intermediate shutter speed settings on a manual camera.

The camera shutter is an adjustable mechanism that can be opened and closed for predetermined lengths of time to regulate the amount of light permitted to pass through the lens.

Each marked shutter speed admits one-half or two times the light of the adjacent speed. 1/125 second lets in half the light that 1/60th second lets in. 1/125 second lets in twice the light that 1/250 second lets in. A lot of light will get to the film when the shutter speed is slow. Shooting without a flash, handheld photography of stationary objects requires a minimum shutter speed in order to prevent camera shake." "Camera shake" is especially noticeable in photographs taken with telephoto lenses (ever try to look through a powerful telescope without a tripod?). To prevent it you should choose a shutter speed close to the focal length of your lens. Example: a 50mm lens could be handheld at 1/60 second...a 135mm lens could be handheld at 1/125 second. If the camera is mounted on a tripod or a steady support, speeds of less than the recommended speed can be used.

## Film Speed

The camera has an ASA/ISO setting (usually a small ring located around the shutter speed dial as in Figure 1-1). The setting should match the ASA/ISO of the film you will use. Film speed is the relative sensitivity of film to light. This is indicated by its "ASA/ISO rating number." A film with an ASA/ISO rating of 400 is more sensitive to light than a film with an ASA/ISO rating of 100. "ASA rating" is the numerical system devised by the now-defunct American Standards Association. The ISO number is a rating of film speed devised by the International Standards Organization.

## Exposure

The term "exposure" is used with a variety of meanings at different times. Photographers often use the term "exposure" to indicate combinations of shutter speed and lens aperture (f/stops). This is more properly called camera exposure.

Various combinations of f/stops and shutter speeds can give the same camera exposure. This is called "equivalent exposure." Example: A starting exposure combination of 1/250 second at f/4 can be changed to an equivalent exposure of 1/30 at f/11 (see Figure 1-3). This can then be changed to an equivalent exposure of 1/125 at f/5.6. Each time you increase the shutter speed by one setting (allowing less light in) you must open up the aperture by one stop.

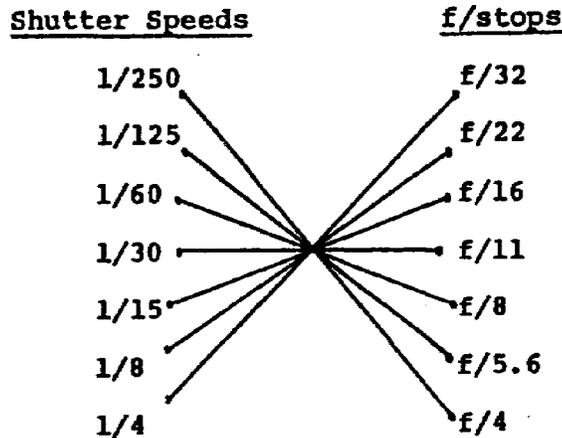


FIGURE 1-3. EQUIVALENT EXPOSURE

Again, various combinations of lens aperture and shutter speed can give the same camera exposure. The key is that these combinations allow

the same total amount of light to pass through the lens, and onto the film.

Any given subject will reflect a variety of light. By this we mean various object brightness will reflect varying amounts of light. Without these various reflectances, we would not have an image on the film. All we would have is an even tone or shade of gray. Thus, the camera settings must be adjusted so as to produce the correct range of camera exposure on the film for your particular subject (Figure 1-4).

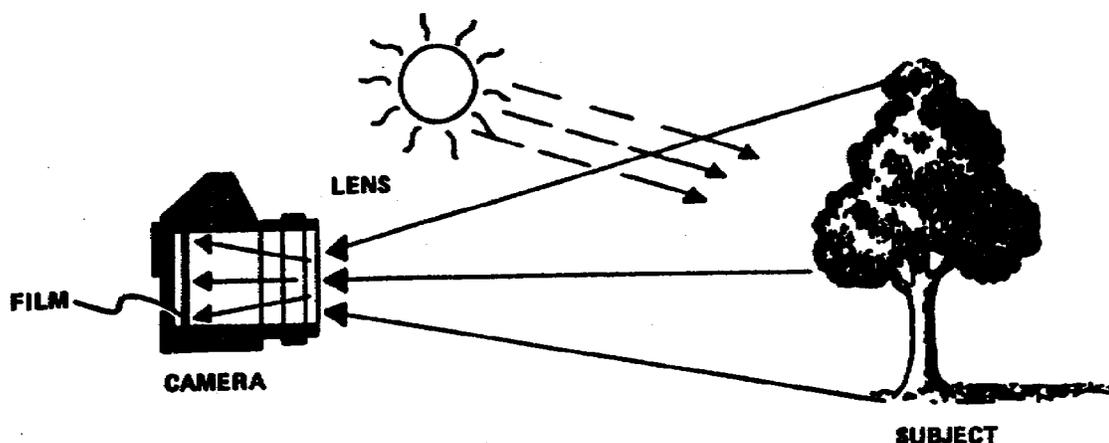


FIGURE 1-4. EXPOSURE

Another meaning of "exposure" is "film exposure." This refers to how the film has been exposed. Did it come out too light or too dark? There are four variable, and interrelating, factors in getting the correct film exposure:

- o The speed or sensitivity of the film (ASA/ISO).
- o The intensity and nature of the light.
- o The lens aperture setting.
- o The shutter speed setting. Each factor affects the other three. Each factor is dependent on the other three for good exposure.

Modern 35mm single-lens reflex cameras have built-in exposure meters. Before the exposure meter can give out accurate information, it must be programmed by 'dialing in' the ASA/ISO of the specific film being used. This is sometimes done with a small ring (the ASA/ISO setting) located around the shutter speed dial. You are not "changing" the ASA/ISO of the film. You are telling the exposure meter what the ASA/ISO of the film is.

## OPERATING THE CAMERA

### Loading the Camera

Load the camera with film (see Figure 1-5). This should be done in subdued light (not direct sunlight). Follow the steps listed below:

- o Place the film in the chamber, grasp the beginning of the film (called the leader) and feed it onto the sprockets of the take-up spool.
- o Move the film-advance lever forward, depress the shutter-release button, and again advance the film one frame.
- o Carefully close the back of the camera and depress the shutter-release button.
- o Advance the film another frame and watch the rewind knob to make sure it moves.

If it does not move, either the film has been loaded incorrectly or there is still some slack in the film cassette. The latter situation can be checked by gently and slowly rewinding the rewind knob (without depressing the rewind button on the bottom of the camera, as is usually done when rewinding). If there is tension, the slack has been corrected. Perhaps the most common mistake made by users of 35mm cameras is failing to make sure that the film is advancing in the camera.

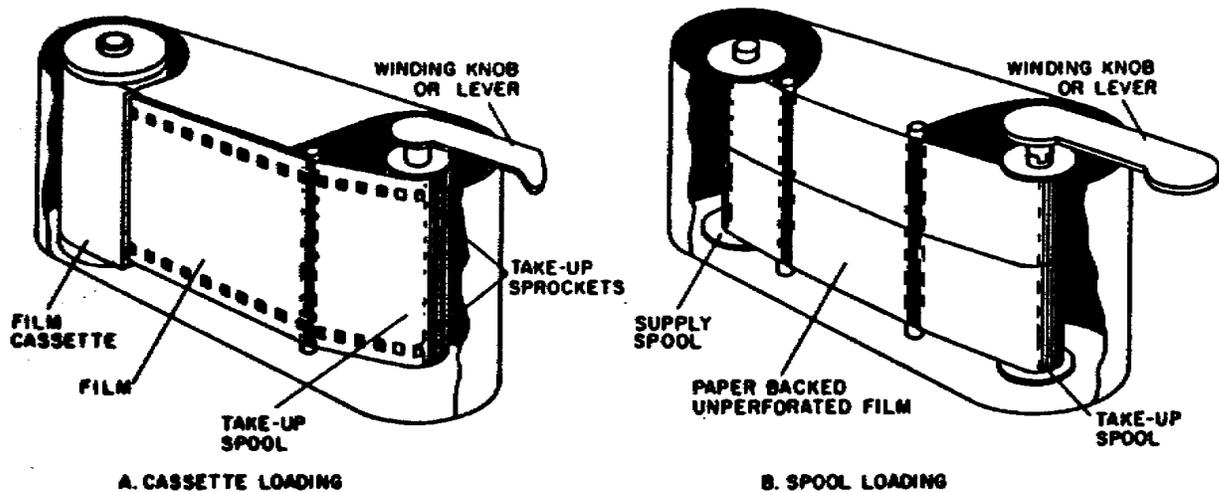


FIGURE 1-5. CASSETTE LOADING AND SPOOL LOADING

## **Freezing the Action**

Why would you want to increase the shutter speed? One reason would be that you have too much light -- even though your aperture is on the smallest setting. Shooting photos at a beach or on a snow-covered mountain would call for a high shutter speed.

Another advantage of high shutter speeds is that they tend to freeze the subject. Your pictures can suffer from camera shake" if you are not using a tripod to hold the camera still. One way to get around this problem is with a high shutter speed. Besides camera movement, you may have the problem of subject movement. Sports pictures often call for a higher shutter speed to freeze the subject in mid-action. To photograph moving objects, a shutter speed in excess of 1/125 second is ordinarily required. Direction of moving action is also a factor in determining correct shutter speeds. An object moving toward you would not be blurred as easily as an object moving from left to right.

Another reason for using a high shutter speed might be to allow for a large aperture (f/1.8, f/2 or f/2.8). Large apertures lessen the "depth of field," causing the background to soften or blur. This is called "selective focus" and is useful in eliminating background distractions (see Figure 1-7).

## **Getting it in Focus**

A camera is focused by moving the lens closer or farther from the film (or focal) plane. On the 35mm cameras used today the lenses are mounted on a threaded mount that permits precision movement of the lens by rotating a ring or some similar device.

There are three aids that are used to help obtain correct focusing:

- o Ground Glass. One method is to simply turn the focus ring (located on the front of the lens barrel) until you see a sharp image in the viewfinder. What you are looking at in the viewfinder is the image being formed on a groundglass (see Figure 1-6).
- o Viewfinder Focusing Aid. Most modern 35mm SLRs have focusing aids in the middle of the ground glass. These might be "micro prisms," "split image" aids, or some combination of both (see Figure 1-10). These can be useful under most conditions. But they do have limitations when used with wide-angle lenses and telephoto lenses.
- o Distance Scales. The distance scale, located on the camera's lens

barrel, is often ignored. But it can be very useful. It is the most accurate method of focusing.

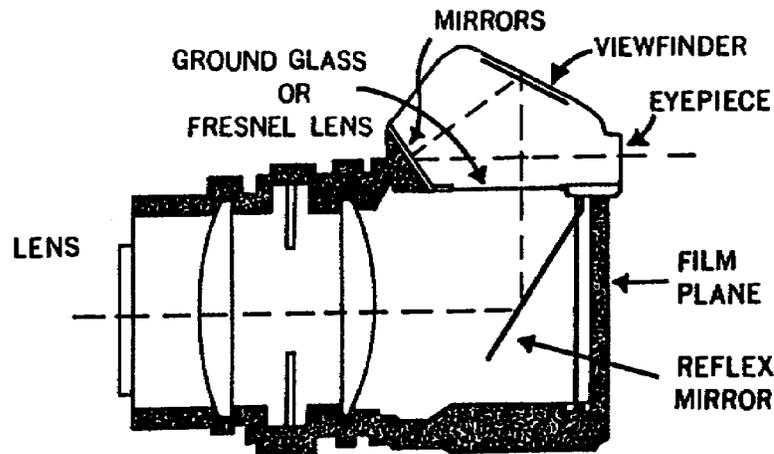


FIGURE 1-6. VIEWFINDER OPTICAL SYSTEM

### Depth of field

Because of the laws of optics, a smaller aperture means that more things will be in focus in a photograph. In the example of  $f/16$  at the beach, not only would the horizon of the ocean be in focus, but so would the sand bucket sitting three feet in front of the camera. The distance between the closest object in focus and the farthest object in focus for a given lens focal length and  $f$ /stop is called the "depth of field" (see Figure 1-7). Most 35mm SLRs have a depth-of-field scale incorporated in the distance scale. By using it properly you can set the camera to best advantage. (Example --You are shooting at  $f/22$  with a 55mm lens. The depth-of-field scale shows you that you can get everything in focus from five feet to infinity.)

Because of the laws of optics, shorter focal length lenses (wide angle -i.e. 28mm) have greater depth of field than long focal length (telephoto -i.e. 135mm) lenses. A short focal length lens with a small aperture gives maximum depth of field.

When you don't have as much light to work with you may have to open your aperture (a larger  $f$ /stop -i.e.  $f/2.8$ ). On a dark, stormy day at the beach you would be lucky to get the shore and the horizon both in focus, because instead of  $f/16$  you **might** be using  $f/3.5$ .

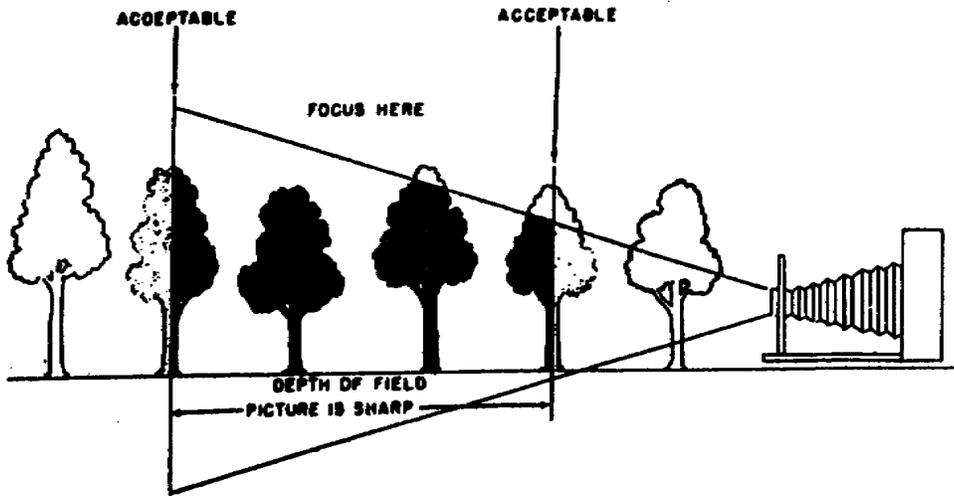


FIGURE 1-7. DEPTH OF FIELD

Trade offs

In photography there are trade-offs. If the aperture is decreased to increase the depth of field then the shutter speed must be decreased or a faster film must be used (see Figure 1-8).

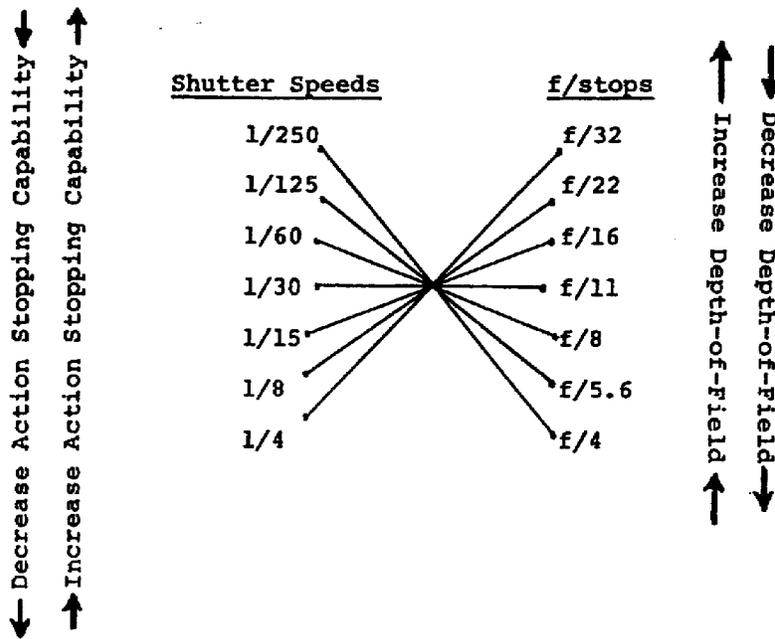


FIGURE 1-8. DEPTH OF FIELD vs ACTION STOPPING CAPABILITY

On a stormy day at the beach you could still have a large depth-of-field if you used a slow shutter speed like one second. But a moving boat would be nothing but a blur because of the slow shutter speed. One way to solve this problem would be to use a film that is more sensitive to light. High-speed films (usually classified as ASA/ISO 400 and up) can be used to solve the problem of low light levels. A high-speed film doesn't need as much light for a proper exposure. Here, too, there is a trade-off. Higher-speed films are "grainier" than lower-speed films. Through a magnifying glass every photograph can be seen to have a granular pattern. In high-speed films this grain pattern is more pronounced. Another quality of film called "sharpness" (not to be confused with focus) can also be related to film speed. Generally speaking, the slower films will give more accurate reproduction of a subject. In military newspaper and magazine work the high-speed films are usually O.K.

## PICTURE TAKING

### Holding the Camera



Hold the camera whatever way works best for you. But there is a preferred way to hold a 35mm camera. It allows the manipulation of controls and provides a steady platform for the camera, thereby reducing camera movement. The method can be used for both horizontal and vertical format photography and is the same for right- or left-handed people. Grasp the camera, lens facing forward, by the right side of the camera with the right hand (see Figure 1-9). The index finger of the right hand depresses the shutter-release button. The thumb of the right hand advances the film. The index finger and thumb of the right hand adjust the shutter speed control. The left hand cradles the camera.

FIGURE 1-9. HOLDING CAMERA

The index finger and thumb of the left hand adjust aperture settings and focus. On horizontal shots, both elbows should be placed against the body for support. On vertical shots, the left elbow should be placed

against the body for support. For very long (telephoto) lenses, cradle the lens in the left hand.

### **Focus**

Focus the camera on your subject. Look through the viewfinder. With the thumb and index finger of your left hand, rotate the focus ring until you obtain a sharp focus on your subject (see Figure 1-10).

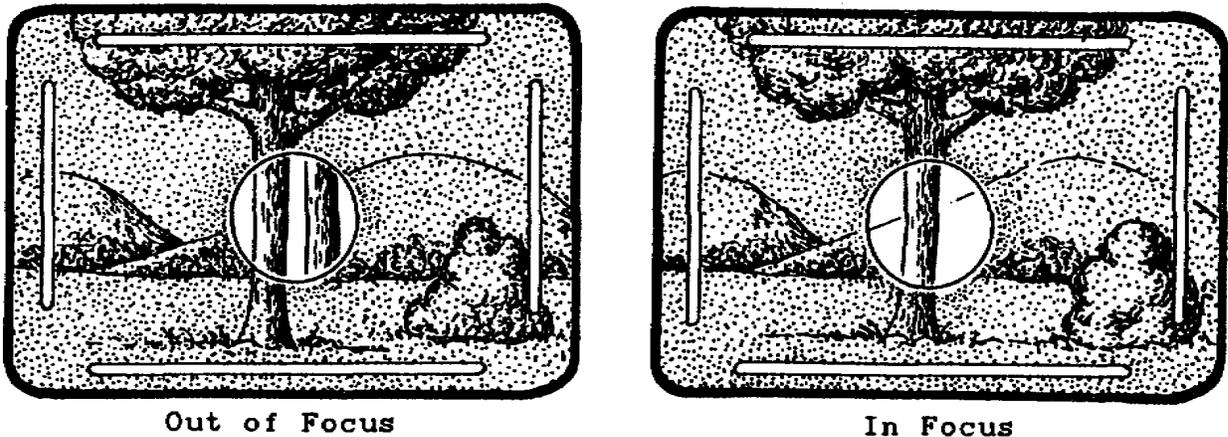


FIGURE 1-10. FOCUSING AID

### **Set the Film Speed**

No matter how experienced you are, you should continue to make this vital check. The film speed dial is incorporated into the shutter speed dial of most 35mm SLRs (like the Canon F-1). Set the ASA/ISO dial to match the film's rating; e.g., for Kodak Tri-X you would set it at 400.

### **Activate the Light Meter**

The light meter can be left on throughout the shooting assignment. The meter on-off switch is located on the back of the Canon F-1. Refer to the owner's manual for other cameras. A light-sensitive photocell moves a meter needle inside the viewfinder. When it's in line with the aperture needle then the Canon F-1 is set for a proper exposure (see Figure 1-11).

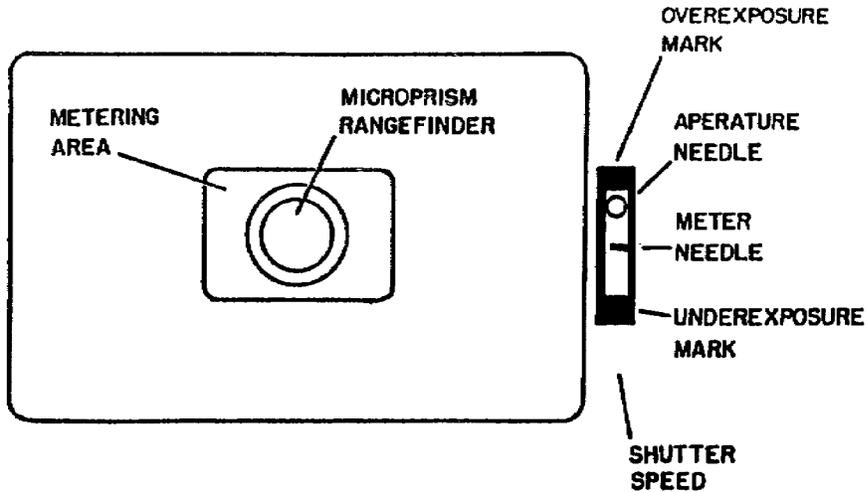


FIGURE 1-11. LIGHT METER

**Set the Shutter Speed**

The film manufacturer's instructions provide time-tested shutter speeds for varying light conditions, e.g., sunny, overcast and cloudy. However, photographers often prefer to freeze action or blur motion, and in doing so must manipulate the shutter speed in concert with the aperture control ring. To capture a runner, the photographer may set his camera at 1/60th" of a second to illustrate the speed; the runner's legs and arms are a blur of motion on the finished photograph. If the photographer wants to freeze the action, he sets his camera at 1/250th or higher; the legs, arms and victory expression are "frozen." For handheld shots, choose a shutter speed no slower than the speed closest to the focal length of the lens. Examples: 50mm lens --1/60th of a second; 200mm lens --1/250th of a second.

**Set the Aperture Control**

Adjust the f/stop on the aperture control ring to match the light meter requirement. The aperture control can be used to increase or decrease the depth of field. Increased depth of field is achieved with higher f/stop settings (f/11, f/16, f/22). A narrow depth of field is achieved with lower f/stop settings (f/4, f/2.8, f/1.4).

In a situation where you are assigned to shoot a photograph with two subjects in the field of view, one in the foreground, the other to the rear, the following would apply:

- o At an aperture setting of f/4 and a shutter speed of 1/250th, only the subject in the foreground is in focus. You adjust the aperture to f/8, and now both subjects are in focus. The depth of field was increased by "stopping down" two f/stops.

- o The shutter speed was changed to 1/60th in order to get an equivalent exposure.

Shutter speed and aperture control are correlated. To maintain a correct exposure, increasing the shutter speed by one setting must be answered by lowering (or opening up) the f/stop one setting. Likewise, decreasing the shutter speed by one setting must be answered by closing (or stopping down) the f/stop one setting. Example: A correct exposure of 1/250th at f/8 is obtained by an initial light meter reading. The following adjustments can be made in shutter speed and aperture settings without affecting the exposure:

SHUTTER SPEED	APERTURE
1/30	f/22
1/60	f/16
1/125	f/11
1/250	f/8
1/500	f/5.6
1/1000	f/4
1/2000	f/2.8

### **Steady the Camera**

Avoid camera movement unless you are intentionally using a creative technique, such as panning (following a moving subject). The best way to steady the camera is with a tripod, but they are not usually used by reporters in a hurry to meet deadlines. Wrapping the neck strap tightly around your right wrist and tucking your elbows into your waist will help to steady the camera. Pressing your shoulder or back against a wall, a tree or some other stationary object will also help steady you. Using the camera's self-timer to release the shutter instead of depressing the shutter-release button with your finger is also helpful in some situations.

### **Composition**

Your job as a photographer is to take pictures that best serve the purpose of your assignment. How well you do depends on how you use the necessary technical controls.

The most basic control is composition. Crop (cut out unwanted parts of the picture) within the camera's viewfinder while taking each frame.

Employ the elements of photographic composition, including the "rule of thirds."

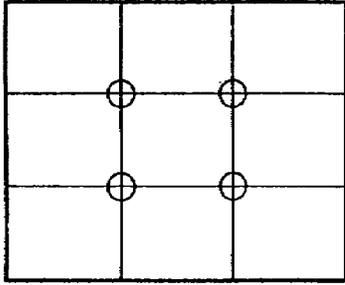


FIGURE 1-12.  
RULE OF THIRDS

The rule of thirds uses two vertical and two horizontal lines to divide the viewfinder into nine equal parts (see Figure 1-12). The subject should be positioned at or near one of the four intersections, depending on the direction the subject is moving or looking. Subjects centered in the viewfinder create a dull, static photo.

When photographing a runner or other moving subject, allow him space to run into. Examples of this can be seen in most any newspaper or magazine photograph.

The same is true of a simple portrait; allow space for an individual facing left or right to look into. Crop as much as possible within the camera, eliminating any distractions. Obtain a variety of horizontal and vertical shots from a variety of angles to give the editor more flexibility when laying out the story and photograph(s).

#### **Shoot the Picture**

Much like pulling the trigger on a rifle, lightly depress the shutter-release button until the camera clicks.

Advance the film to the next frame, and you are set for the next exposure.

Record the data for each frame or series of frames using either an Audiovisual Caption Book (DA Form 3315), a locally designed form or a reporter's notepad. Note each frame and the names of individuals, the action taking place (the five W's and H) and the nomenclature of any unusual equipment. If possible, record each frame as you shoot it. If more than one roll of film has been shot, number the rolls and note such in the caption log or notepad.

#### **Unload the Film**

Besides failing to load the film in the camera properly, one of the most common mistakes photographers make is failing to wind the 35mm film back into the cartridge **before opening the back of the camera.**

After all frames have been taken, depress the rewind button, normally at the bottom of the camera, and slowly rewind the film. Rewinding too quickly, especially in cold weather, could crack the film or cause static electricity that will damage the film. When the film has been rewound, you will no longer feel tension on the rewind knob.

Store the film in a dry, dark container (photo bag) or in its original canister until it is ready for developing. If your assignment requires that you shoot more than one roll of film, number the rolls with a grease pencil, laundry marking pen or on masking tape on the film canister.

## **INSPECTING THE CAMERA**

Besides knowing how to operate a 35mm SLR, it is important that you know how to take care of the camera. Before going on an assignment you should thoroughly check your camera.

### **The Lens**

Remove the lens from the camera in accordance with the manufacturer's instructions and inspect it. Check the glass for dirt, smudges, fingerprints and scratches. Dirt can be removed from the lens by carefully using a blower brush. Dirt, smudges and fingerprints can and should be removed from the glass as soon as noticed by gently wiping the glass with lens-cleaning tissue moistened with a couple of drops of lens-cleaning fluid (don't use more than that). Minor scratches may not alter lens performance so as to deem it unusable, but, nonetheless, scratches should be duly noted and brought to the attention of your supervisor. Deep scratches probably will affect lens performance. In this case, notify your supervisor and seek a replacement lens. If in doubt, attach the lens to the camera body, look through the viewfinder and focus on a subject. If any part of the field of view appears blurred or obscured, the lens should be replaced. Next, check the lens aperture control ring, or the f/stop ring. The f/stop ring should firmly click into each position. Check the focus ring. It should move smoothly, without interruption. Check the lens exterior for dents and other damage. Lastly, make sure the lens is mounted with either a UV (ultraviolet), haze or skylight filter to protect the front glass surface and its delicate coating (this ultra-thin coating on each glass surface reduces reflections).

### **The Camera Body**

Inspect the camera body for dirt and defects. Dirt should be removed from the camera body with a blower brush. Hard to remove dirt can be

removed with a silicon cloth or a soft chamois. **Do not use liquids to clean the camera body.** Liquid cleaners, including water, can damage the camera. Check the back of the camera body. The camera must be light tight. While the back of the camera is open, conduct a shutter speed test to determine whether the camera has maintained its calibration. This is done by opening the shutter at the varying speeds from one second to 1/1000 (or faster). There should be noticeable differences at the slower speeds, 1/1, 1/2, 1/4, 1/8, 1/15, 1/30, and 1/60th seconds. Inspect the back of the camera's outer film carriage for nicks and warps. Check the door hinge for looseness. Camera body damage should be reported to your supervisor. If the camera is no longer light tight get it repaired or seek a replacement body.

### **Inspect the Camera Optics**

Look through the camera's viewfinder. Focus on an object. If the field of view is blurred or obscured, you may have a damaged lens, or perhaps the viewfinder is dirty.

If the mirror is dirty, very carefully clean it using the blower brush. Do not use lens-cleaning tissue or fluids on the mirror. If smudges remain on the mirror, consult with your supervisor prior to taking the camera body to an authorized dealer or repairman for professional cleaning.

Check the camera battery/internal light meter. Consult your manufacturer's instructions for the proper method of conducting this very important systems check. A weak battery can affect your light meter readings and, ultimately, your exposures.

Open the camera back and inspect the film chamber, rails, pressure plates, shutter curtain and take-up spool for dirt, film debris and other foreign matter. Debris can scratch the film. A blower brush should be used to clean this area. Be careful not to press on the shutter curtain.

Inspect the neckstrap for cracks and wear, especially at the pressure points --the clips which attach it to the camera. In wet and humid climates, leather neckstraps have a tendency to rot and should be checked daily. Adjust the neckstrap to your needs. Always use the neckstrap as a safeguard against dropping the camera. (**Caution: You can be held liable for any damage to the camera.**)

You should clean the camera equipment as required. Always store the camera in its case with the lens cap over the protective filter.

# PRACTICE EXERCISE

LESSON 1

SUBCOURSE NO.

INTRODUCTION TO PHOTOGRAPHY

## INSTRUCTIONS:

Review the material in this lesson. Answer the questions below by circling the "T" or "F" next to each question. Compare your answers with the answer key on the next page.

- T F 1. The camera's aperture controls the amount of light passing through the lens and striking the film.
- T F 2. The "focal length" of a lens is the distance from the optical center of the lens to the focal plane.
- T F 3. The mirror in an SLR should be cleaned with lens-cleaning tissue and fluid.
- T F 4. The shutter speed controls the duration of time that light is allowed to pass through the lens aperture to reach the film.
- T F 5. An advantage of high shutter speeds is that they tend to freeze the subject.
- T F 6. In aperture readings lower numbers means less light is admitted through the lens.

# ANSWER KEY

LESSON 1

SUBCOURSE NO.

INTRODUCTION TO PHOTOGRAPHY

1. True (Page 3)
2. True (Page 3)
3. False (Page 17)
4. True (Page 4)
5. True (Page 8)
6. False (Page 3)

# LESSON TWO

## FILM AND EXPOSURE

46Q Soldier's Manual Task: 214-176-1315

### OVERVIEW

#### **TASK DESCRIPTION:**

In this lesson you will learn about film and exposure.

#### **LEARNING OBJECTIVE:**

**ACTIONS:** Describe what film is and the proper way to expose it.

**CONDITIONS:** You are given the material presented in this lesson.

**STANDARDS:** You will describe what film is and the proper way to expose it.

**REFERENCES:** The material contained in this lesson was derived from the following publications:

Soldier's Manual and Trainer's Guide for  
Journalists  
Applied Journalism Handbook  
DINFOS Public Affairs Handbook

# FILM AND EXPOSURE

The three basic steps in making a photograph are exposure, developing and printing. This chapter deals with black and white film and exposure.

## CHARACTERISTICS OF FILM EMULSIONS

Each emulsion reacts to light in a different way, and it determines the characteristics of the different types of films. As a photographer you should be familiar with these characteristics.

### Color Sensitivity

Because silver halides are sensitive to blue, violet and ultraviolet light, all photographic emulsions are sensitive to these colors. Sensitivity to other colors is obtained by adding various types of dyes to the emulsion during manufacture. Negative emulsions are divided into four general classes according to the way they reproduce color differences (in shades of gray). These classifications are:

- o Blue Sensitive. These are sensitive to blue and ultraviolet light.
- o Orthochromatic Emulsions. These are sensitive to all visible colors except red.
- o Infrared Emulsions. These are sensitive to infrared light.
- o Panchromatic Emulsions. These are sensitive to all visible colors, and is the most commonly used film.

### Film Speed

The "speed" of a film is determined by how fast the film reacts to light. The more responsive an emulsion is to light, the faster it is said to be. This means that less exposure to light is required to produce an image.

The silver halide grains determine how fast the film reacts to light. Some of these grains are highly sensitive to light while others are less sensitive. Varying the proportion of highly sensitive grains will affect the speed of the film.

Several systems have been developed to accurately compare the light sensitivity of different films. One of the most commonly used

systems was developed by the American National Standards Institute (ANSI), which was previously called the American Standards Association (ASA). This same system is used by the International Standards Organization (ISO). This system uses a speed rating in which numbers are assigned to emulsions to indicate their relative speeds. Doubling of speed is denoted by doubling of the numbers. For example, a film with a speed of 250 is twice as fast as one with 125; therefore, it takes half the amount of exposure to produce an image.

These rating numbers can be seen on boxes of film with the letters ASA/ISO beside them. T-Max film, for example, would have ASA/ISO 400 on the box and Plus X Pan has ASA/ISO 125. Relatively speaking, films are termed either slow, medium or fast. An ASA/ISO of 40 would be a slow film, and ASA/ISO 125 would be medium. An ASA/ISO of 400 would be fast. Some films are extremely fast --with speeds of ASA/ISO 3,200. The speed of the film you select is determined by the photographic assignment.

### **Grain**

During manufacturing, the halide grains clump together. This determines the size of the grain in any film, and is called "inherent grain size."

Films can be broadly classified into low, medium, and coarse-grained emulsions. High-speed emulsions generally have larger grains than slow-speed emulsions. Large grain size is undesirable except to achieve a special effect. However, they usually will not become apparent until you begin to make enlargements from your negative. You should use the slowest film possible under the exposure conditions for optimum results.

### **Contrast**

Contrast is the term used to describe how film will record the difference in tones between the lightest and darkest areas in the negative. This capability, which is also determined by the size of the grain, is incorporated into the film at the time of manufacture and is described as low, normal and high contrast. Normal contrast materials have the ability to form a wide range of grays and are used for a majority of general-purpose photography.

The shades of gray as they are reproduced in the negative and its subsequent print can be changed by factors other than the inherent contrast of the film. Such things as lighting, exposure, development and the developer can produce a negative that may be flat (lacking contrast)

or hard (too contrasty). You can see an example of hard and flat contrast by adjusting the contrast dial of a T.V.

## **CHOOSING AN APPROPRIATE FILM**

In the previous section we have discussed the characteristics of film emulsions. These characteristics can be of great value and some consideration should be given them on any photographic assignment.

You must first consider the mission requirements. For each mission there is one or more factors that must be considered. Sometimes one factor offsets the other, or one may have an opposite effect on the other.

You should choose film that will take the desired picture. The slower-speed film will give you comparatively better grain and resolving power. Range of f/stops and shutter speeds available under the lighting conditions also dictate your film-speed choice. For example, a portrait is normally shot with a wide aperture to reduce depth of field. Choosing a fast film for an outdoor portrait on a sunny day would limit you to fast shutter speeds and small apertures. Conversely, in low-light situations where wide exposure latitude is needed or on an airborne mission where fast shutter speeds and small apertures are desired, a high-speed film is ideal.

Let's take a look at some examples and discuss how one would consider emulsions for different situations. Remember that these are hypothetical situations and are not meant to be exact solutions for that example.

Example #1: If the subject being photographed is in the area of poor illumination, a high-speed film is desirable. A high-speed film, however, has low resolution.

Example #2: Assume your assignment calls for photographing a subject having little difference in the shades of gray. In this case you need a film that can produce fairly high contrast. That will probably be a high-speed film. Again, high-speed film has low resolution. Proper lighting also can increase contrast.

Example #3: Suppose you are asked to take a photograph of an object, and the negative will be enlarged considerably. The proper film would be one having very fine grain and high resolution. However, such a film may be extremely slow and may have low contrast. You will have to compensate by changing developer or using different lighting. Another possibility is to sacrifice resolution for contrast.

For newspaper and magazine work, the best choice is a high-speed film

like Tri-X or T-Max. In this situation, grain is not as important a factor since there will be a loss of print sharpness when it is reproduced in the newspaper or magazine.

## **EXPOSURE**

### **Exposure and Film**

A negative is said to be correctly exposed when it gives good reproduction of detail in both the deepest shadows and brightest highlights of the scene or subject. Fortunately, in many cases there is more than a single exposure that will produce such a result --there is a wide range of possible exposures within which satisfactory tone separation is possible. The "minimum" satisfactory exposure is one in which good tone separation is just attained in the deepest shadow areas. The "maximum" satisfactory exposure is one in which detail is just retained in the brightest highlights.

Any additional exposure will cause this highlight detail to become flattened out or "blocked up." Exposure is the term used to define the lens aperture and shutter speed used to allow light to pass into the camera and form a latent image on the film. **Exposure** is the total amount of light reaching the film; **Correct Exposure** is the exact amount of light required to record maximum detail.

### **Exposure Considerations**

The exposure of the film is governed by the intensity of light on the film. Assuming proper development, a good separation between the light, dark and middle tones of a picture depends almost entirely on the exposure.

Underexposure, or too little light, results in a loss of tone separation, contrast and detail in the darker parts of a picture. Underexposed negatives are difficult to print, or may be unprintable, because they are too transparent.

Overexposure, or too much light, produces a very dense negative with poor tone separation in the lighter parts of the picture. It occurs either when the aperture is too large or when the shutter speed is too low. Overexposed negatives are difficult to print because the density of the negative requires extensive exposure in printing. With modern black and white materials, however, negatives can be very dense and still yield prints of usable quality.

Most films come with a daylight exposure table which you can use to get good exposures. In Figure 2-2 the table shows that when shooting a

picture of an average subject (such as a fair-skinned person) in hazy sun you would set the aperture at f/11. Note that you should "use shutter speed which is reciprocal of film speed (with ASA/ISO 400 you would use 1/500th shutter speed, with ASA/ISO 125 you would use 1/125th shutter speed, etc.)

DAYLIGHT EXPOSURE TABLE <span style="float: right;">231-294</span>					
USE SHUTTER SPEED WHICH IS RECIPROCAL OF FILM SPEED					
BRIGHT SUN ON LIGHT SAND OR SNOW	BRIGHT SUN SUBJECT IN DIRECT SUNLIGHT	HAZY SUN SOFT SHADOWS	CLOUDY BRIGHT WITH NO SHADOWS	OPEN SHADE WITH CLEAR BLUE SKY	DEEP SHADE
					
BRILLIANT SUBJECT f/32	BETWEEN f/22 - f/32	f/22	f/16	f/11	f/8
BRIGHT SUBJECT f/22	BETWEEN f/16 - f/22	f/16	f/11	f/8	f/5.6
AVERAGE SUBJECT f/16	BETWEEN f/11 - f/16	f/11	f/8	f/5.6	f/4
DARK SUBJECT f/11	BETWEEN f/8 - f/11	f/8	f/5.6	f/4	f/2.8

FIGURE 2-2. EXPOSURE TABLE

### Exposure Meters

The photographer may also use photoelectric light meters to measure the intensity of light. These light meters have photosensitive cells that control the current as light strikes them. This current is measured by a microammeter, and the calibrations of the meter can be interpreted to give the photographer the required camera shutter speed and the lens aperture setting with a given film speed.

### Reflected light meter

In this type of photoelectric light meter, the ammeter is calibrated to permit measurement of the amount of light reflected back into the meter by a particular subject. It

should be aimed at the subject when used, because it will measure all of the light that it is aimed at (including backlight). This is the type of light meter built into most 35mm cameras today.

### **Incident light meter**

In this type of photoelectric light meter, the ammeter is similar to the one used in reflected light meters. In this meter, however, a diffusing device is placed over the meter light window to permit measurement of the amount of light falling on a particular subject. It should be held in the hand next to the subject and aimed at the light source when used.

### **Through-the-lens meter**

Almost all modern 35mm single-lens reflex cameras have a built-in, through-the-lens meter. It is a reflected light meter that reads the light being reflected from the subject.

Some advantages of the built-in meter are that it is always available, compensating for filters (filter factor) is unnecessary and the meter reads only the picture area (if you change lenses the meter's angle of view changes too).

Used correctly, through-the-lens meters are accurate. But you will still need a handheld meter in situations that call for an incident light meter.

Be especially careful when shooting a subject that has backlighting. Don't hesitate to move in close to take the meter reading to eliminate the backlight from the camera's field of view, then move back for the shot.

Most through-the-lens meters are "center-weighted." That means they will give more attention to the level of light in the center of the viewfinder than the edges of the viewfinder. You should keep that fact in mind when using them.

### **Application of Photoelectric Exposure Meter**

Photoelectric meters are valuable tools when used with common sense. Since every subject reflects various intensities of light with some shadow areas, one general reading does not give a correct measurement of existing light values.

Before measuring light values, determine the type of photograph needed. If shadow detail is important, measure the shadow area carefully. If the highlight area is to be emphasized, base exposure on the measurement of the highlight areas alone. To record both shadow and highlight

areas in equal detail, measure both areas and use a compromise setting.

Do not make your light reading at a considerable distance from your subject, because this reading will include distracting areas that are not usually a part of the photograph. When taking specific readings, hold the meter close enough to the subject to indicate the average reflected light. The distance recommended is equal to the width of the subject.

If a strong backlight is likely to throw your meter reading off, then you should move in close enough so that the backlight is not visible to the meter. With a through-the-lens meter you can also do this by changing to a telephoto lens to get a reading on just the main subject.

Before using an exposure meter, make sure that the light value indicator points to zero while the photo cell unit is covered. If it does not, turn it in for repair.

Shield exposure meters from shock, strong magnetic influence, dampness, and extreme heat. Never point a reflection-type meter at the sun.

Check the calibration of a meter periodically against the quality of resulting photographs.

### **Substitution**

The substitution method of determining exposure is simply the process of substituting an object from which to take a reflected-light reading when a reading cannot be taken in the usual manner. This method is useful when it is difficult to approach the subject close enough. It can be applied to small areas within a scene, either light or dark objects, or to an entire scene. In normal use, a meter should be held close enough to the principle object or scene to exclude all light except that which is reflected from the area to be included in the picture. Many times it is impractical to do this. In such instances, an object which has approximately the same brightness can be substituted. The back of the hand can be substituted when determining the light value of flesh tones, assuming the lighting where you are is similar to that of your subject.

### **Bracketing**

If you have any doubts about the proper exposure for a particular scene then you should shoot additional exposures at two f/stops larger and two f/stops smaller than the exposure indicate by the built-in meter.

## **STORING AND HANDLING SENSITIZED MATERIALS**

Both the emulsion and the base of film are designed to be stored and used under specified conditions and within certain tolerances. Because of this, proper handling and storage conditions must be maintained if you expect good photographic results. Let's discuss problems arising from poor storage and use of film.

### **Effects of Low Temperature**

At low temperature, film becomes somewhat brittle and stiff. Emulsion cracks occur. This is especially true when film is wound onto a takeup spool. Normal moisture content in the film helps reduce problems. With care, film used at temperatures as low as minus 60 degrees F has produced acceptable results. Shrinkage and excessive curl may cause some problems, depending on the particular equipment used. Cold also increases the danger of abrasions and static electricity markings. But low temperatures are excellent for long-term storage if it is sealed against humidity loss.

If you have taken high school chemistry, you may remember that cold slows down chemical processes. The reaction of film to the exposing (and developing) process is no exception. Film speed is reduced.

### **Effects of High Temperature**

Extended storage of film and photographic paper at high temperatures causes an overall fogging of the materials. Storage conditions to be avoided for even short periods of time include hot, unventilated storage rooms or lockers, automobile glove compartments or trunks, and any other abnormally hot areas. Direct rays of the sun or high intensity lamps must also be avoided. It is only too easy to lay film cassettes on top of a camera case, window ledge, or similar surface exposed to direct sunlight. They can reach extreme temperatures, especially if they are black.

### **Humidity**

The moisture content of the air is very closely related to temperature. If humidity and temperature are both improper, even a short storage period can cause pronounced image degradation. High temperature and excessive humidity in combination is common and may cause fog, provide an opportunity for growing fungus, produce transparent spots, etc. Excessive humidity plus temperature fluctuation causes condensation of moisture. It is usually recommended that film be used and stored at

no more than 60-percent relative humidity. On the other hand, very low humidity and low temperature causes film to become dry and brittle and curl up. Most film is packaged by the manufacturer at 50-percent relative humidity. In general, humidity during storage is not a problem as long as the package seal is unbroken.

### **Static Electricity**

When one material, either positively or negatively charged, comes close to, or contacts, another material having an opposite charge, there is a spark. This is static electricity, and it is especially bad under low-humidity conditions. Such a spark close to a spool of undeveloped film can expose the film. The exposure looks much like lightning.

Static electricity is caused by friction or by contact and rapid separation of materials. The best protection against it is to handle the film properly under conditions that minimize static electricity. All equipment should be grounded and any film movement (rewinding into the cassette, etc.) should be slowed down to minimize static electricity.

# PRACTICE EXERCISE

## LESSON 2

### SUBCOURSE NO.

### FILM AND EXPOSURE

#### INSTRUCTIONS:

Review the material in this lesson. Answer the questions below by circling the "T" or "F" next to each question. Compare your answers with the answer key on the next page.

- T F 1. Overexposure, or too much light, produces a very dense negative with poor tone separation.
- T F 2. The "speed" of a film is determined by how fast it can be developed.
- T F 3. Large "grain" size is normally a desirable characteristic of film.
- T F 4. The most commonly used black and white film is panchromatic.
- T F 5. Lighting, exposure and development can affect contrast.
- T F 6. A light meter that is built into a camera would be an "incident light" meter.

# ANSWER KEY

LESSON 2

SUBCOURSE NO.

FILM AND EXPOSURE

1. True (Page 25)
2. False (Page 22)
3. False (Page 23)
4. True (Page 22)
5. True (Page 23)
6. False (Page 27)

# LESSON THREE

## CONTROLLING LIGHT

46Q Soldier's Manual Task: 214-176-1316

### OVERVIEW

#### **TASK DESCRIPTION:**

In this lesson you will learn how to control and use light.

#### **LEARNING OBJECTIVES:**

**ACTIONS:** Describe the procedure in using electronic flash and available light.

**CONDITIONS:** You are given the material presented in this lesson.

**STANDARDS:** You will know the methods and procedure for using electronic flash and available light.

**REFERENCES:** The material contained in this lesson was derived from the following publications:

Soldier's Manual and Trainer's Guide for  
Journalists  
Applied Journalism Handbook  
DINFOS Public Affairs Handbook

# CONTROLLING LIGHT

## INTRODUCTION

Light makes photography possible. It is reflected from the subject, then it enters the camera and exposes the film.

Scientists tell us that light is produced in waves. In many respects the waves of light can be compared to sound waves. Sound waves vary in length, and they register as different pitches. Light waves register as different colors.

In photography, light is the most important basic ingredient. The intensity of light determines the brightness of the subject. The formula that describes this is the inverse-square law (Figure 3-1). It states that light decreases as the square of the distance increases. Being familiar with this principle will enable you to use light more effectively when photographing.

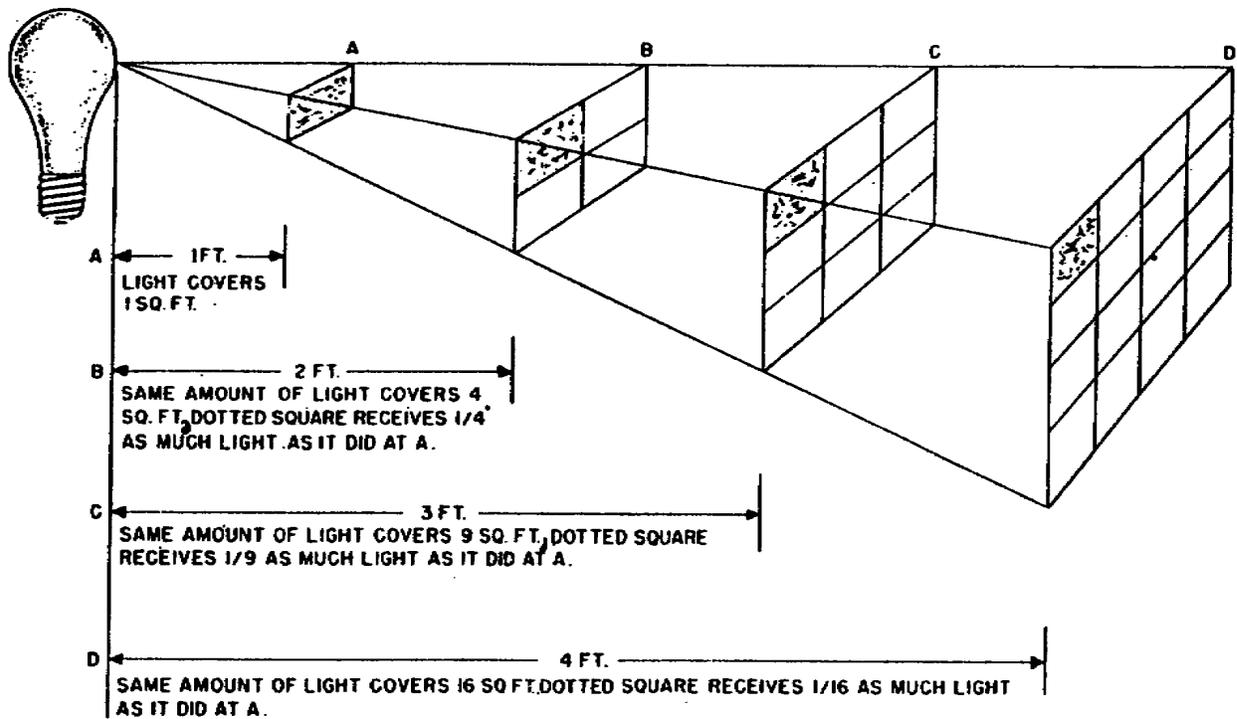


FIGURE 3-1. INVERSE-SQUARE LAW

The light falling upon a subject from a source is called incident light. When incident light strikes a surface, it will change direction; this change is called reflection. If the surface is smooth the reflected light is said to be specular; however, if the surface is rough, the reflected light is diffused. Most objects reflect back both types of light.

Reflection is an important characteristic of light. It is how our eyes can see objects and how a film acquires a latent image.

In this lesson you will learn about shooting photographs using available light, electronic flash and filters.

## **AVAILABLE-LIGHT PHOTOGRAPHY**

Available-light photography opens new doors to your creative talents. Mastering the technique takes only a few rolls of film and careful attention to detail. You will find that photography under available or existing light will be more realistic and preserve the mood just as you saw it. Also, you can enhance the technical aspect by selecting the camera angle, auxiliary lighting and type of camera support. From the technical side to the creative, it still remains the cameraman's responsibility to get the picture.

### **Types of Available Light**

There are five different kinds of available light: fluorescent, window, window light with fill, single-point incandescent and single-point incandescent with fill.

#### **Fluorescent light**

Fluorescent light is normally found in offices, schools and public buildings. It is characterized by high overhead lighting that produces dark shadows under the eyes and other facial features. You will want to take a meter reading to include some shadow reading. Move in close and take your meter reading from a mid-tone skin area, such as a forearm or cheek.

#### **Window lighting**

Window lighting is normally one of the most pleasing and more beautiful types of lighting, when handled properly. It is a strong creative light, characterized by harsh shadows and brilliant highlights across the facial features when in direct window light. If you are lucky enough to have an overcast day, the effect is slightly different because the shadows soften much the same as in open shade. Since the sky is overcast, most of the light falling on the subject is diffused. Make your meter reading to

include the shadow side of the face. This will ensure proper shadow exposure and detail. Be very careful about shooting into the window. Two things can happen:

- o You may get a silhouette. Normally this will not flatter your subject.
- o You could come up with flare, which is also unflattering.

You should try to make the most natural and pleasant photograph possible. This type of lighting will help.

#### **Window light with fill**

This is just one step better than normal window light. Your fill illuminator, whether a white card reflector or some nearby object reflecting light, will lighten the shadow areas and soften the harshness. This produces a most pleasing effect as well as improving your photographic technique. You will want to make a meter reading to include the shadow illuminator. A large white card works well for illuminating; however, remember that any book or newspaper held in close proximity to the face will work.

#### **Single-point incandescent**

This is a familiar type of light found in household lamps and overhead ceiling lamps, characterized by very directional shadows with little or no shadow detail. You will want to take your meter reading to include some shadow exposure. Since this light is very directional, it also is highly moody. If you find yourself shooting in a room where the light level is very low, you may wish to increase it by replacing the regular household bulb with a #2 photoflood (do this only when there is no danger of burning a lampshade). **Note: Most household fuse boxes will only take two or three of these 500-watt bulbs before blowing a fuse.**

#### **Single-point incandescent with fill**

When you use fill light with incandescent light, you have a choice of using a white card reflector or another incandescent lamp (electronic flash would give a different, unnatural quality of light). When using a bare bulb lamp, keep it at a distance so that it just adds some sparkle to the eyes and lightens the shadows. In some cases, you will use a bulb in a reflector. Do not aim the reflector directly at your subject. Secondary shadows and overpowering of your main light will result. Bounce the light off some nearby surface --a wall, a ceiling, or white card.

Good lighting is important to obtain pleasing and lifelike results. Informal available light photography carries with it all the technical aspects of formal studio portraits.

The application and desired result is sometimes slightly different.

## **SHOOTING A PHOTOGRAPH WITH AN ELECTRONIC FLASH**

With its short duration, electronic flash (also known as a strobe) is an excellent source of artificial light for exposing both black-and-white and daylight color films.

The burst of light is so brief it is easier on the eyes than bulb flash. All electronic flash units operate on the same principle: electric energy is built up within a capacitor (condenser) and suddenly discharged through a gas-filled glass tube, thereby creating the flash. Most units will recycle for another flash in a matter of seconds, as long as the batteries are fresh.

### **Using Electronic Flash**

Load the camera with film and set the ASA/ISO dial to match the film's rating.

Attach the electronic flash unit to the camera. This can be done by sliding the flash into a "hot shoe" or plugging a "PC" cord from the flash into the camera's "PC" plug. Since different cameras have different arrangements for hot shoes and PC plugs, you should refer to the camera's instructions.

Check the flash unit batteries. (Normally, camera manufacturer instructions list procedures for checking the batteries. In normal use, as the batteries lose strength, the recycle time between flashes greatly increases.) Set the flash to the proper film speed setting. Set the flash in either automatic or manual mode. Since every manufacturer's flash unit is different, read the instructions for your particular flash.

Set the shutter speed in accordance with flash synchronization guidance in the operator's instructions (normally 1/60th or 1/125th for a 35mm SLR). It is usually indicated by a different colored number or a "lightning bolt" indicator. Failing to set the correct camera shutter speed can result in loss of the picture. Generally speaking, leaf shutters will synchronize at higher shutter speeds than focal plane shutters.

Set the aperture control to the automatic mode or the setting established by the flash-to-subject distance in feet or meters, e.g., f/11 for 0-15 feet.

Turn on the flash. Employ direct, diffused, fill or bounce-flash techniques to achieve optimum effects.

Using one of these flash techniques, you advance your film one frame, focus on the subject and depress the shutter-release button.

Check the flash's pilot lamp to check the battery charge. (Some flash units also indicate whether the exposure and lighting was sufficient. If the unit you are using indicates such, check this device with each exposure.)

Keep an Audiovisual Caption Book (DA Form 3315) or notepad list of caption information for each frame. (NOTE: As a learning tool, note flash and exposure information with each frame, if possible.)

Be sure to turn the flash unit off when not in use to conserve batteries.

### **Synchronizing Camera with Electronic Flash**

The camera shutter must be synchronized with the flash unit to ensure that the shutter is wide open at the instant the camera triggers the flash to fire. Otherwise, only partially exposed film would result.

On most 35mm cameras a shutter speed of 1/60 second is set on the camera to synchronize the camera shutter with electronic flash.

When electronic flash is used, there is usually no need for a fast shutter speed. The exposure speed is governed by the extremely short duration of the intense light -- not the shutter.

But a phenomenon known as a "ghost image" can result under certain circumstances. If your subject is moving quickly while you take the picture and the available light is sufficient to make an exposure on the film, then you might get a flash shot which freezes the subject -- while at the same time getting an available light shot showing a much-dimmer subject in motion. This usually happens when the available light is also relatively bright and movement is occurring.

### **Setting the Aperture**

When shooting a flash photograph using a non-automatic camera, you cannot rely on the camera's meter to guide you in setting the proper aperture for the camera.

A numerical rating, or guide number, is given to a manual flash unit by its manufacturer. This number indicates its strength and aids in determining exposure. Once the guide number has been established, it will always be valid for a particular combination of camera, flash unit, and film speed.

Determining exposure with guide numbers can slow down most journalists who are trying to do other things, too (like getting the story).

Most flash units have a calculator dial which tells you at a glance what aperture to use for a given flash-to-subject distance.

But you should know how to figure guide numbers if you are using older equipment.

To set the lens aperture for a given combination, you simply divide the flash-to-subject distance in feet into the guide number (there are also metric system guide numbers).

Example: A flash-to-subject distance of 10 feet divided into an ASA/ISO 25 guide number of 56 (for a particular flash unit) would result in an f/5.6 lens aperture.

Guide numbers are used as guides only. They can be changed to fit individual conditions of use. If your color slides are too light, use a higher guide number. If your negatives are not dense enough (too light) use a lower guide number.

Manufacturers often claim guide numbers for their flash units that are overly optimistic.

An even easier-to-use flash unit is the "automatic flash. This has built-in photoelectric eyes. When the burst of light from the flash unit reflects off of the subject and returns to this photoelectric eye, it shuts the flash unit off. In effect, it "knows" when the subject has been exposed properly. So once the proper aperture has been set (different for each type of flash unit) the photographer need only focus and shoot. The photojournalist must know the flash unit he is using. Read the instruction booklet thoroughly.

Automatic flash units do have disadvantages. The photoelectric eye really can't distinguish between the subject and any other object which happens to be in the picture. This can be a problem if there are any objects in the foreground and the subject is farther away. In addition, some subjects reflect light better than others. That could throw your exposure off.

When you have the time it's best to use the flash on the manual setting. But automatic can be useful when things are happening quickly.

## **Flash Techniques**

Using flash techniques properly compensates for low existing light intensity. Below are several techniques you can use.

### **Direct flash**

When the unit is in this position, light is flashed directly to the subject. The flash head is aimed directly at the subject. Direct flash often results in harsh shadows, bleached-out whites and lost details. The subject's shadow normally cannot be eliminated using this technique. The shadow can actually detract from the subject, so be careful when using direct flash. Direct flash can make a person appear mean and cold. In addition, a phenomenon called "pink eye" can result when your subject looks straight into your direct flash. The subject's eyes will look pink in a color photograph. This can be avoided by keeping the flash at least a foot or two to one side of the camera.

### **Diffused flash**

With the flash in a direct flash mode, open up one f/stop setting. The flash is diffused by placing a specially made filter in front of the flash head. Diffusion also can be achieved by using one or two layers of lens-cleaning tissue or a white handkerchief over the flash face. As in direct flash, the subject's shadow normally cannot be eliminated. Again, the harsh shadow tends to detract from the subject.

### **Fill flash**

This technique balances sunlight (or brilliant light) and shadows by illuminating the shadow areas, thus bringing out details. This technique is used frequently, for example, to illuminate the eyes of a subject wearing a baseball cap. Fill flash is used with another light source to eliminate or soften harsh shadows caused by intense directional light. The guide number of a flash could come in handy when using fill flash. A flash that is too strong or too weak might make fill flash difficult. Refer to the flash operator instructions for specific fill flash guidance, as directions vary from one maker to the next. With thyristor (special energy saving) technology, many manufacturers make units capable of limiting output power to one-half, one-quarter, one-eighth, and even one-sixteenth, with the flick of a dial. This is useful with fill flash.

### **Bounce flash**

This technique uses the ceiling or walls to bounce light and cover a wide field of view. It works best with flashes that feature tilting flash

heads. The head is rotatable from the direct-flash position (9 o'clock) to the straight-up (12 o'clock) position. Bounce flash often requires that the photographer open up two or more f/stops to make up for light absorbed by the ceiling or walls. You can determine the f/stop setting by determining the distance from the flash to the ceiling or wall, and then from that point to the subject. Add the two distances for your total distance. Then you must consider the color and texture of the surfaces used in bouncing; darker ceilings and walls may require another f/stop. Many flash units feature a sensor device which, in automatic mode, compensates for bounce flash by increasing the light output until the scene receives enough illumination. The sensor measures the amount of light reflecting off the subject and adjusts the time the flash is exposed to the subject accordingly. When using this method with a subject who has deep-set eyes, affix a plastic picnic-type spoon (concave side toward subject) to the back of the flash head with a rubber band. This will redirect some of the flash directly to the shadow areas. The end result will be more balanced lighting of the subject.

### **Split-beam flash**

This method combines bounce and fill flash techniques. A specially made bounce card is attached to the head of the flash in its bounce flash setting. Light is directed off the card and also off the ceiling or wall and to the subject. This technique produces an evenly illuminated background and subject, as well as soft shadows. It is widely used by modern photojournalists.

### **Open flash**

Open flash is used to evenly light large dark areas. At night, or anywhere there is little ambient light, you can open a camera shutter (with the camera on a tripod) and leave it open while you fire the flash several times to cover the entire area. The shutter is set to "B" and the f/stop according to the guide number (the flash is not attached to the camera body).

## **FILTERS**

The principles behind using filters are the same for color and black and white film.

### **Function**

A filter is primarily a device to modify the character of the light passing through the lens to the sensitive film. These changes may be desired for artistic effect, to increase or decrease contrast, or for photographing certain colors at the exclusion of other colors. Its

effectiveness depends upon three factors: color of light reflected from the object, color transmission of the filter (absorption), and color sensitivity of the negative emulsion. The use of the filter therefore alters the gray values of the image in relation to the colors of the subject. It also increases or decreases the "contrast" in the image and increases or diminishes atmospheric-haze effects.

The most important fact to remember about a filter is that it is exactly what its name indicates: a screen. It sifts light rays. This means that a filter adds nothing to a picture. As strange as it sounds, the only positive thing about filters is that the function of every filter is negative; it subtracts a part of the light, holding back certain of the rays in the rainbow of colors. This is done selectively, which is why filters are so useful (see Figure 3-2).

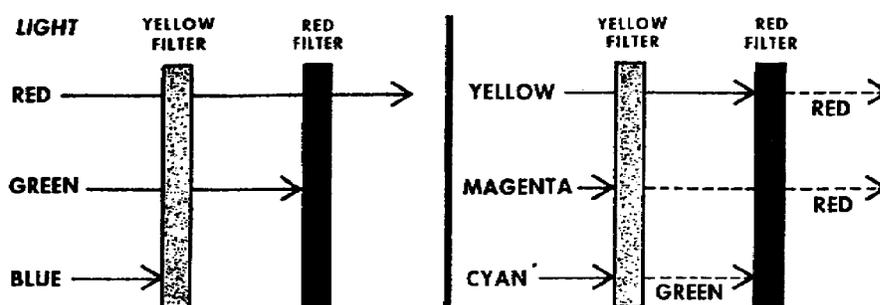


FIGURE 3-2. FILTERS

The intelligent use of filters improves a large percentage of photographs. However, the lack of a thorough understanding of the effects of filters (on the response of the film emulsion) is the reason so many photographers don't use them.

Human eyes and photographic film do not respond equally to all colors. The eyes sense the brightness or dullness of colors; but black and white film records colors as a range of grays, and these grays may not indicate how bright or dull these colors appear to the eye. When film is exposed to unfiltered light, a bright yellow may reproduce as a dark gray and a medium blue may be depicted as a very light gray in the print. The eyes are most sensitive to yellow and green, whereas most films are most sensitive to blue, violet and ultraviolet, which the eyes do not see at all. Consequently, the photographic reproduction in a black and white print may be unsatisfactory in some cases --blue skies too light, green grass too dark. It is often necessary to use filters designed to render

a scene or subject in tones that will appear natural in a black and white print. Filters may be regarded as special glasses that enable the film to see better, or to render various colors as a range of grays. A filter differentiates colors in the black and white film so they may be faithfully reproduced as different grays in the print. For example, objects in distant scenes on hazy days appear partly hidden by a blue veil and photograph as gray upon gray. This haze is composed of air, water vapor, and dust particles that scatter more blue, violet and ultraviolet light than green and red light. A yellow or a red filter -- depending upon the amount of haze -- can penetrate the haze because they absorb blue, violet, and ultraviolet light. Then the veil is eliminated, since the distant objects can be clearly photographed by either green and red light, or by red light.

### Using Filters

The basic principle of filtering is simple. To brighten a color (make it a lighter shade of gray), you use a filter of the same color as the object. To darken a color, use a filter of a complementary color.

An object can be seen because it reflects light to your eye. You can photograph this object because of the reflected light. If the object is colored, you see the color it reflects. An object looks red because it reflects red light and absorbs blue and green light. When the three primary colors (red, green and blue) are combined in equal quantities, white light is produced. If an object is colored in any one of the three colors, it reflects that color and absorbs the other two. All other colors are a mixture of the above three primary colors (see Figure 3-3).

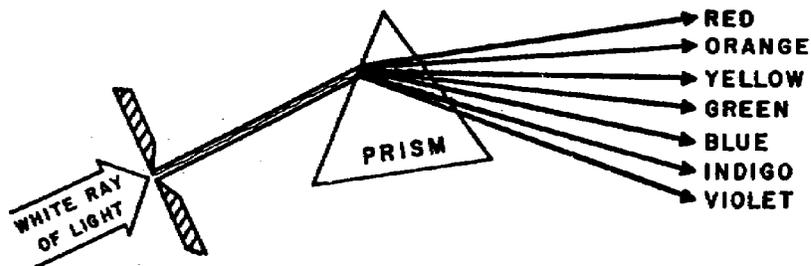


FIGURE 3-3. PRISM

If blue and green light are combined in equal quantities, they form the color cyan (blue-green). A combination of blue and red produces magenta

(blue-red), and green and red combined produces yellow (green-red). Cyan, magenta and yellow are called secondary colors.

The color triangle below shows the three primary colors and the secondary colors --each one created by two primaries on either side. The colors on opposite sides are called complementary colors. When these are mixed in the proper proportion, they produce white light (see Figure 3-4).

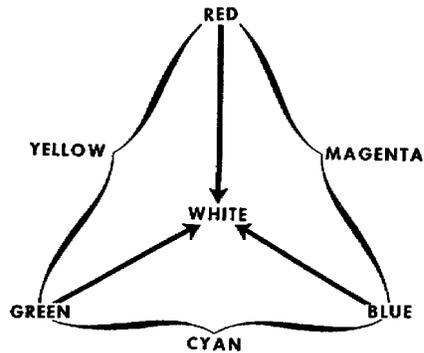


FIGURE 3-4. COLOR TRIANGLE

Filters censor or destroy their complementaries. This action leaves blank patches on the negative, which produces dark patches on the print.

To photograph a color as black, use a contrasting (complementary) filter. For example, a green or blue filter will make red go black.

To photograph a color as white, use a matching (similar) filter. For example, a red or orange filter will make red go white.

As you are beginning to see, a color filter is simply a color screen. It is placed (usually) in front of the lens to withhold from the negative a part of the spectrum of the light reflected from the subject. The amount and color of the light withheld depends upon the characteristics of the filter.

## Types

The filters most useful to photographers are usually supplied with the camera equipment available to Army journalists. Filters fall into two categories:

- o Correction filters. Correction filters equalize the color sensitiveness of film emulsions to make them nearly coincide with that of the eyes. These filters are designed to reduce the intensity of all color wavelengths in a pleasing proportion according to the emulsion sensitivity of a certain type of film. No color is removed completely, but one or two colors may be reduced in strength more than others. The problem is to select the filter that passes the colors in the proper proportion for the film and light source being used, and for the needs of the finished picture.
- o Contrast filters. Many subjects should not be reproduced in the photograph as the eyes see them. Often in the case of drawings and paintings, some objects in them are distinguished by a difference in color only; therefore, it is necessary for the photographic reproduction to render some contrast between the colors; otherwise, they may appear the same shade of gray in the print. For instance, very light yellow and comparatively dark blue usually photograph the same shade.

Most picture-taking situations can be handled with three filters -- a yellow-green, an orange and a red. There are occasions when other filters are called for. Here is a description of what the basic filters can do and how to use them.

- o Yellow. The only kind of filter to use with orthochromatic film, which it corrects completely. Though it can also be used with panchromatic film (like Tri X or Plus X), it is not so effective. This filter lightens reds and pinks too much and is therefore not suitable for portraits; good for landscapes and snow scenes and for cloud photography.
- o Yellow-Green. This filter can be used for both orthochromatic film and panchromatic film. It corrects Type B panchromatic film (balanced for tungsten light) completely in daylight. It is useful in darkening skies, emphasizing clouds, reducing haze, and increasing contrast. Yellow-green is also good for outdoor portraits, landscapes, distant views, water scenes, snow scenes, mountain scenes, sunsets, and for photography of architecture. It can also add brilliance to a scene of normal color distribution.

- Green. This filter is designed for Type B panchromatic film. It corrects Type B in tungsten light. Though it tends to soften light contrast, it increases color contrast. It is good for pictures against the light, snow scenes, and portraits outdoors.
- Blue. Used for color separation with tungsten light. It makes an emulsion color blind and increases the effect of haze outdoors. Indoors, the effect of this filter can be produced by using blue photo floods. Blue is good for copying, especially where yellows or reds have to be separated, and for photographing white objects against snow.
- Orange. It is excellent for increasing contrast between colors. It can also lighten flesh tones, make blue sky quite dark, and improve the rendition of texture under the blue sky. Many photographers use it for contrast emphasis in studio work.
- Red. Used with panchromatic films, it darkens blue skies producing spectacular cloud effects. It is ideal for photographing light-colored buildings, statues, shiny metallic structures, and faces against a dark sky. This filter creates exquisite landscapes, and increases over-all contrast considerably. This is not good for shots of green vegetation, dark buildings, portraits and artificial light.
- UV Ultraviolet (haze). Ultraviolet rays do not focus on the same plane as other rays and therefore blur the image. 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. You can filter out haze because it is blue and ultraviolet light. For filtering purposes we can consider ultraviolet light as blue light. This filter is often kept on the lens all the time to protect the lens from being scratched.

### **Polarizing**

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. When the light vibrates in one direction, it is polarized (see Figure 3-5).

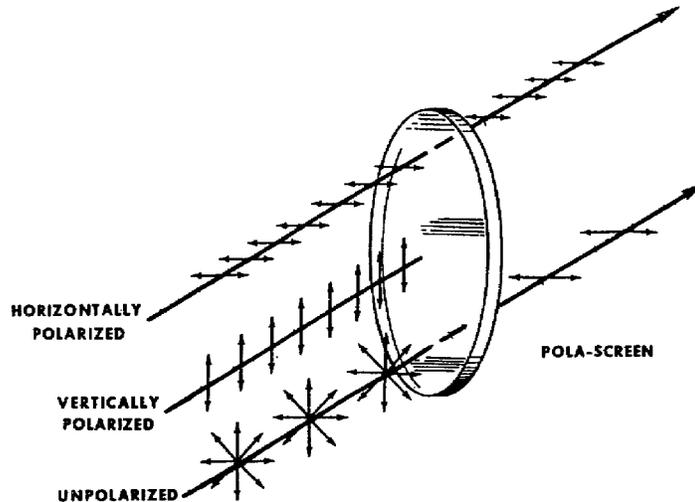


FIGURE 3-5. POLARIZING

Polarizers are transparent (pass light) to light polarized in one direction and opaque (filter out) when the direction of polarization is rotated 90 degrees.

This filter reacts the same with all colors of light as long as the polarization is the same. It is good for darkening blue skies without distorting color rendering of foreground objects. It is the only filter that can be so used in color photography. The greatest effect occurs when you're photographing almost at right angles to the sun. When photographing through glass or water at an angle, surface reflections interfere with the visibility of detail below the surface; the polarizing screen subdues the reflections and shows the detail. It can also be used the same way to bring out texture in such non-metallic objects as grained wood, linoleum, tile, lacquered or varnished objects, glass, leather, etc.

The most spectacular use of the polarizing filter is in color photography. It darkens the sky to an intense, vibrant blue --if you are at a right angle to the sun. It brings out the green of the sea. It makes reds redder and yellows purer. It also eliminates reflections that dilute color. The polarizing screen is especially effective in photographing sunsets.

In general, the polarizer gives color film a saturation and richness that is unmatched. The polarizer has been called 'the filter that drives color wild.'

#### **Effect of polarizer on the sky**

As light from the blue sky is polarized, the polarizer will give an increased depth of tone at the optimum angle from the sun

(90 degrees). This deepening of the sky becomes less as the angle from the sun increases or decreases. Therefore, the use of a wide-angle lens on subjects containing much sky area will produce a definite change of sky value across the image. It will be deepest at the optimum angle to the sun, and lighter on either side of this limited sky area.

The most consistent effect is obtained with lenses of long focal length. When the blue sky is polarized, clouds and haze are exaggerated in contrast against the sky. The sky itself is given more 'shape" and total intensity.

#### **Effect of polarizer on distant haze**

The sky and atmospheric haze are subject to control by the polarizer. The greater the distance, the more obvious the effect. This can be adjusted and controlled by visual examination through the polarizer.

#### **Effect of polarizer on water**

Unless the surfaces of distant bodies of water are very smooth, the reflections of the sky will be broken and diffuse. The polarizing effect in this case will only be partial. If the surfaces are smooth and unruffled the polarizer will lower the values to a striking degree. Bands of color, cloud reflections, and the sheen of the sun itself can be modified.

Still water at closer distances may have sky and environmental reflections almost entirely removed. The filter can reveal details at the bottom of pools and streams that would otherwise be impossible to photograph. The degree of polarization can be visually adjusted to avoid losing the "substance" of the subject (pool, water, etc.).

#### **Other effects**

Glare can also be removed from glass and other glossy surfaces. It will not work on bare metal, however. Since each situation is different, the only way to know what a polarizer will do is to look through the SLR viewfinder to see the result.

From this discussion we can thoroughly understand the wisdom behind this basic polarizing rule: Reduce or eliminate surface reflections only when it is of greater esthetic and practical importance to reveal what the reflections obscure.

#### **Filter Factors**

Since every filter cuts out part of the available light, we necessarily have to increase the exposure to compensate for this loss. If using a 35mm SLR camera that incorporates through-the-lens light metering, this

is not a problem. The meter will automatically compensate for most filters (read your camera's instructions for exceptions).

When using a camera that does not incorporate through-the-lens metering, it then becomes a problem to determine how much to compensate for the filter's absorption of light.

The amount of overall light a filter absorbs is indicated by a number called the filter factor. The filter factor is designated by a numeral followed by an "x," such as 1x, 1.5x, etc. These numbers are usually given on the filter itself. However, they are not totally helpful unless you apply all the conditions under which you will be working. Example: Adding a 2x polarizer means that a setting of f/8 must be changed to f/5.6

Filters cannot eliminate 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 block the haze light, but they do not increase the light coming from the subject.

There are many other filters available for special effects and unusual applications. Manufacturer catalogs explain their uses.

# PRACTICE EXERCISE

LESSON 3

SUBCOURSE NO.

CONTROLLING LIGHT

## INSTRUCTIONS:

Review the material in this lesson. Answer the questions below by circling the "T" or "F" next to each question. Compare your answers with the answer key on page 9.

- T      F    1.      Direct flash will usually give the most pleasing portrait results.
- T    F    2.    When you use the bounce flash technique, you must open up your aperture to compensate for less light reaching the subject.
- T    F    3.    A red filter will block red light but allow other colors to pass.
- T    F    4.    A polarizer filter cannot eliminate solid particles in the air such as dust and smoke from your picture.
- T    F    5.    Still water at close distances may have sky reflections almost entirely removed by polarizing filters.

# **ANSWER KEY**

LESSON 3

SUBCOURSE NO.

CONTROLLING LIGHT

1. False (Page 40)
2. True (Page 41)
3. False (Page 42)
4. True (Page 49)
5. True (Page 48)

# LESSON FOUR

## FILM DEVELOPMENT

46Q Soldier's Manual Task: 214-176-1325

### OVERVIEW

#### **TASK DESCRIPTION:**

In this lesson you will learn how to develop film.

#### **LEARNING OBJECTIVES:**

**ACTIONS:** Describe the procedure used in developing film.

**CONDITIONS:** You are given the material presented in this lesson.

**STANDARDS:** You will know the methods and procedure used to develop film.

**REFERENCES:** The material contained in this lesson was derived from the following publications:

Soldier's Manual and Trainer's Guide for  
Journalists  
Applied Journalism Handbook  
DINFOS Public Affairs Handbook

# FILM DEVELOPMENT

## INTRODUCTION

The objective of the film development process is to make the latent image on the exposed film both visible and permanent. It is this process that results in a permanent negative image of the photographed scene. This negative is in turn used to make a photographic print.

The lesson will be presented in three parts: A quick overview of the process, then a typical procedure from beginning to end, and finally an in-depth look at what happens during the film development process.

The objective of the film development process is to make the latent image of the exposed film both visible and permanent. There are nine primary steps in the process. They are:

1. Gather materials. The materials needed for the process are gathered together. The chemicals are mixed into working solutions and their temperature stabilized.
2. Load film. The film is removed from the film cassette in total darkness. It is wound onto film developing reels, which are put into a light-tight film developing tank.
3. Develop film. The film is covered with film developer for a specific amount of time with the developer at a specific temperature.
4. Stop development. When the time/temperature development step is completed the film is put into another chemical called a stop bath. The stop bath step does just that --it stops the development process by neutralizing the developing chemicals.
5. Fix. Next, the film is covered with a fixer. The fixer makes the developed image permanent and removes unexposed portions of the film emulsion. After this step the rest of the processing can be done with the lid off the tank.
6. Hypo-clearing agent. Following the fixing step a bath of hypo-clearing agent may be used to remove most of the fixer and thus reduce the amount of time the film must be washed. This step is optional.
7. Wash. The next step in the process is the wash. The wash removes the chemicals that are on the film. If the chemicals are not removed by the wash, they will begin to attack the permanent image and will eventually destroy it.

8. Wetting agent. Following the wash, it is recommended that the film be put into a wetting agent solution. This step prevents water spots from forming on the surface of the film.

9. Dry film. The negatives are then dried. The most common method of doing this is hanging the film from a string with a weight attached to the bottom to prevent the film from curling. The location where the negatives are hung to dry should be entirely dust free.

10. Store negatives. The last step in the process is cutting the negatives into strips of five or six, and storing them in a clear negative protector. The negative protector is then labeled and filed into a loose-leaf binder.

These steps have briefly described the entire film development process. It should be noted that each of the steps must be performed in the order stated. Further, the film must be handled with a great deal of care in each step of the process in order to prevent flaws in the negatives.

## **THE FILM DEVELOPMENT PROCESS**

How a photojournalist prepares the photographic chemicals and gathers and arranges the equipment necessary for film development is an important part of the process. Accomplishing these steps accurately and efficiently reduces the possibility of error and saves time.

### **Prepare Chemicals**

Most photographic chemicals are normally mixed from a powder with water. They are stored after mixing in a more concentrated form until they are used for film processing. This concentrated form is called the "stock solution." Write the date that the stock solution was made so you'll know when unused chemicals are old and due for replacement.

It is necessary for the stock solution to be diluted with water for use in the film development process. The reason for this is that chemicals will retain their strength longer when they remain in a more concentrated form. It also reduces storage space needed. So 16 ounces of stock solution would make 32 ounces of working solution when diluted 1: 1 (assuming the instructions call for a 1: 1 dilution).

Liquid chemicals off the shelf will probably be about room temperature when mixed with tap water. Dry chemicals often require mixing at higher temperatures than liquid chemicals. That means that you will need to allow for the stock solution to cool off before you use it.

It is necessary for the chemicals to be at the desired processing temperature. This is not normally a problem when the chemicals are stored under usual office or lab conditions. If the chemicals are freshly mixed or if the storage area is not air conditioned, however, it may be necessary to adjust the temperature. This is normally accomplished by putting each of the chemicals in a separate container, and setting them in a tray of water. Water from a faucet is directed into the tray and the temperature of the water flowing into the tray is adjusted to the desired film processing temperature. Gradually the temperature of the chemicals rises or lowers to the temperature of the water in the tray. One way to speed things up is to check the temperature of the stock solution. If it is too warm, then add cooler water to make the working solution. The desired film processing temperature is between 65 and 75 degrees F. The temperature of the working solution is taken using a darkroom thermometer.

In most cases the mixing of a working solution is done by pouring the stock solution into a graduated beaker, much like a measuring cup used in cooking. Then water is added to achieve the working solution. You may want to have a separate beaker for each of the chemicals used in the film development process, labeled with the name of the chemical. Otherwise, you must wash the beakers between uses to avoid contamination.

### **Film developer**

The film developer is mixed to a working dilution from the stock dilution at which it is stored. The temperature of the working dilution of the film developer is then taken using a typical darkroom thermometer. Then the graduate, containing the working developer dilution is set in a tray of water on the extreme left hand side. The temperature of the water flowing into the tray is adjusted to the desired film processing temperature. Gradually the temperature of the developer inside the graduate rises or lowers to the same temperature of the water.

### **Stop bath**

The stop bath is mixed next. (See container label for mixing instructions.)

### **Fixing bath**

Next the fixer is mixed. (See container label for mixing instructions.) Normally, fixer is stored at the same

strength for which it is used to fix film, so there are no special mixing instructions.

### Hypo-clearing agent

If the optional hypo-clearing agent is used, it too is mixed according to the manufacturer's instructions. The clearing agent is then also placed in the tray of water, to the right of the fixer.

### Arrangement of chemicals

Each of the chemicals are placed in the tray to the right of the previous chemical. This is done because each of the steps must be performed in a specific order. That is, the developer is first, stop bath second, fixer third, etc. Therefore, they are placed in the tray of water in the order in which they will be used. The first used is placed on the extreme left and the last to be used is placed on the extreme right (see Figure 4-1).

BATH FOR FILM DEVELOPMENT CHEMICALS

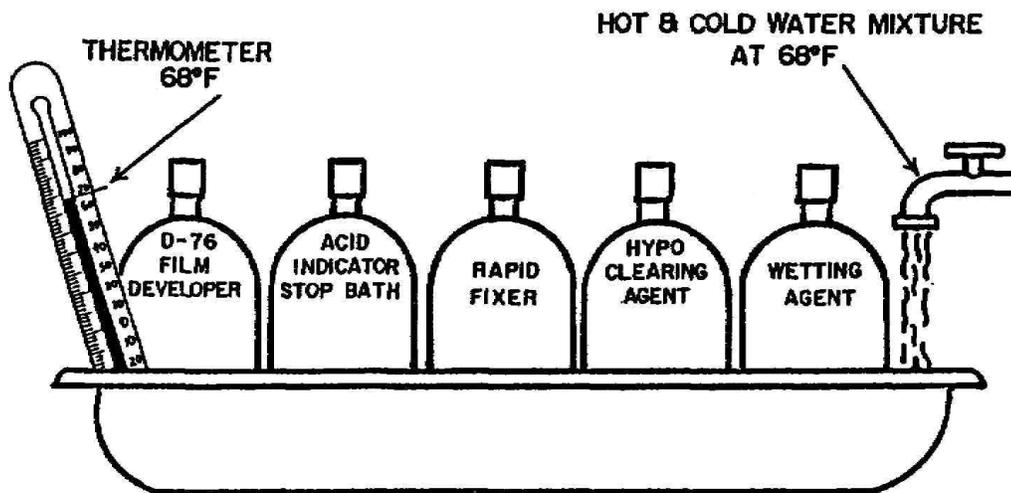


FIGURE 4-1. CHEMICAL ARRANGEMENT

### **Assemble Equipment**

The equipment used in the film development process is gathered together while the chemicals in the water bath are achieving the desired film development temperature. The rolls of film to be developed are gathered together and placed on a dry counter in a light-tight room. (Lights are on at this time.) Next come a pair of scissors, the film development tank with cover removed and placed next to the tank, film development reels laid side-by-side, and a bottle top opener --all lined up on the same counter. It is important to line everything up in such a way that you will know where each item is when the lights are turned off. The presence and location of each item should be double-checked prior to turning out the lights (see Figure 4-2).

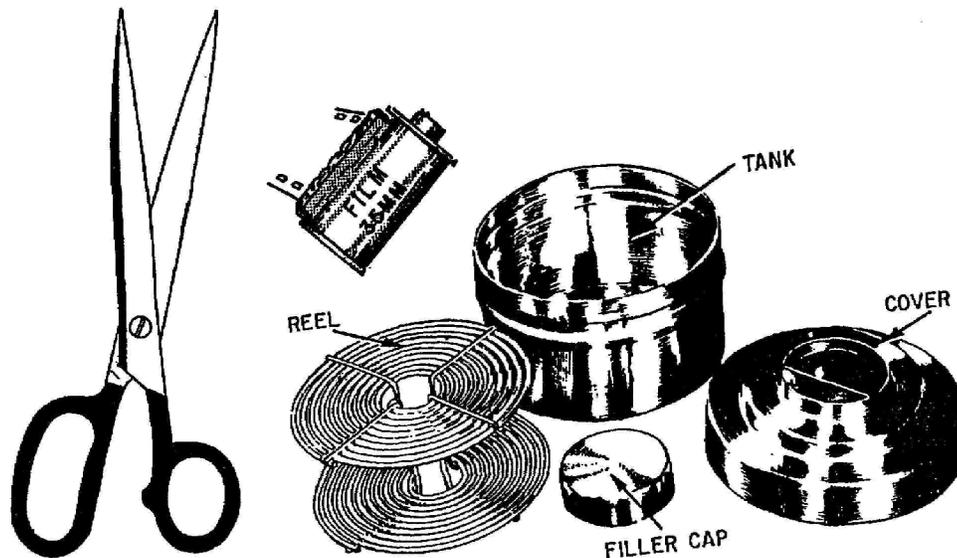


FIGURE 4-2. DEVELOPING EQUIPMENT

#### Turn off lights

Once all of the items listed above are lined up, the lights in the darkroom should be turned off. The room must be totally without light. Small sources of light entering the room can ruin the film. Before continuing, the person processing the film should make sure that there is no light at all entering the room. If you cannot see a white piece of paper on the table in front of you after 30 seconds in the dark, then the room is dark enough.

#### Preparing the Film for Development

With lights off, take the first film canister and remove the flat bottom of it with the bottle opener. Next remove the film from the canister and cut the leader (see Figure 4-3) off of the film. It is extremely important to remember that anytime a negative or film is handled it should ONLY be handled by the edges. A single fingerprint on a negative can have a severe adverse effect on the quality of the photographic print made from the negative.

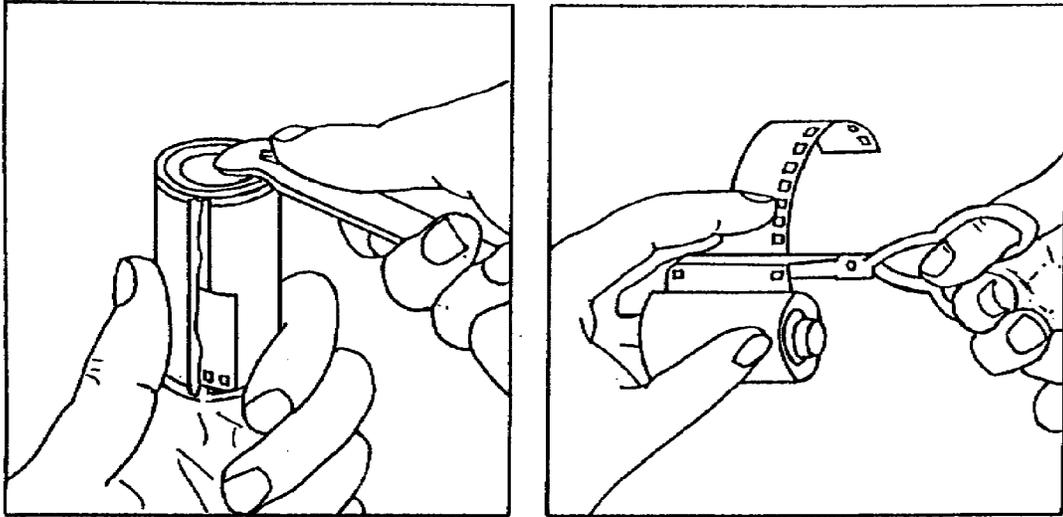


FIGURE 4-3. UNLOADING CASSETTE

**Wind film on reel**

The next step in the process is that of winding the film onto the spiral development reel or apron. All of the film processing steps before drying will be done with the film wound onto these reels, and care should be taken to wind the film properly. "Properly" means that the film is wound onto the spiral reel or apron so that one part of the film does not come into contact with any other part of the film (see Figure 4-4). This is necessary so the chemicals used in the development process touch all areas of the film. If the developer or fixer is prevented from touching

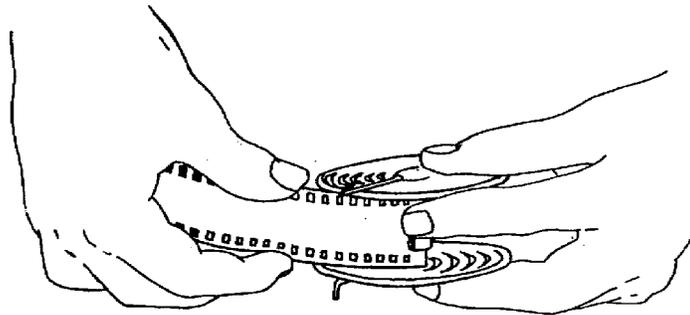


FIGURE 4-4. WINDING ONTO REEL

any area of a negative, that area will not be developed or fixed. When film is improperly wound onto the reel it may touch another part of the film. The result will be that the parts of the film that touch will

not be developed or fixed rendering those parts useless. This can be tragic if the negative affected is "the" shot you need for the newspaper. It is therefore imperative for the photojournalist to learn how to wind film onto film development reels or into film development aprons properly.

Some beginning photojournalists seem to have difficulty with this step. While there is less initial difficulty using the apron type of film development reel or the plastic self loading types, they are inferior to the stainless steel reels in many ways. Additionally, the stainless steel film development reels and tanks are "the" accepted darkroom standard.

However, stainless steel reels are more difficult to learn to wind properly in total darkness. The problem is normally solved with a little practice in the daylight with eyes open and using some old film. You may want an experienced co-worker to assist you. Once the process is mastered with the eyes open the next step is to practice it with the eyes closed. When the process is mastered with the eyes closed, the beginning photojournalist is ready to try it for real with a roll of film that has been shot as a test. The photojournalist should not use important film the first few times the development procedure is attempted.

The reel and your hands must be clean and dry before beginning. Feed the beginning of the film into the reel axle, holding the film so that it is slightly bent concave to clear the edge of the spiral grooves. Slowly wind the film onto the reel, turning the reel with one hand, allowing the film to fill the grooves from inside to outside. Handle the film by the edges only, loading the emulsion side of the film so that it faces the center of the reel (the film will naturally curl this way). The tension on the film should be firm enough to fill the groove of the reel, but not so firm as to cause it to overlap or to fall into the same groove twice. Wind the film onto the reel until you reach the spool. Cut the film from its spool with scissors.

#### **Place reel in tank**

The reel is placed into the film development tank after the film is loaded onto the reel. Film development tanks are normally made of stainless steel or plastic. They come in various sizes that allow development of up to eight rolls of 35mm film at one time. The tanks are normally cylindrical. The lids of the tanks have a second, smaller lid in the center of the first. This second lid, when opened, allows the development chemicals to be poured into and out of the tank, but does not allow light to enter the tank. If the tank is capable of holding four film reels and only two rolls of film are being developed, two empty reels should also be placed in the tank. The loaded rolls should always

be placed in the tank first (on the bottom) and the empty ones placed on top of them. The empty reels prevent the loaded reels from sliding back and forth in the tank. If the reels are permitted to slide back and fourth during the development process, the sliding action will cause developer to flow through the sprocket holes of the film. This action will in turn cause streaks on the negative and result in useless negatives.

Next the development tank lid is placed on the top of the tank.

### **Turn lights on**

Room lights may now be turned back on.

### **The Development Process**

The film has been loaded onto the reels and placed in the light-tight development tank. We are now ready to begin the actual chemical process of film development.

It was previously mentioned that film development is a time/temperature process. Specifically, this means that the higher the temperature of the developing chemical, the shorter the amount of time needed to complete the development process. For example: A certain film requires development in a certain developer for 12 minutes when that developer is at 68 degrees Fahrenheit (NOTE: All temperatures will be given in Fahrenheit). The same film however, developed in the same developer when that developer is at 75 degrees requires only 8.5 minutes development.

### **Acceptable chemical and wash temperature**

Acceptable film development temperature is any temperature between 65 degrees to 75 degrees. However, the preferred film development temperature is 68 degrees. The developer is only one of the liquids the film must come in contact with during the entire development process. The temperature of the other chemicals and the wash water must also be regulated. The purpose of regulating the temperature of the other chemicals is not so much the time/temperature consideration already discussed, but more a consideration of the stability of the photographic emulsion of the film.

Perhaps a simple way to illustrate what can happen to film when it is subjected to wide temperature fluctuations is to compare it to a hot glass that is submerged into cold water. The glass cracks and breaks. The same thing will happen if the glass is cold and is put into hot water. Film reacts much the same way. It doesn't break, but the emulsion does crack or reticulate. Therefore, the temperature of all the chemicals and the wash water should be stabilized (preferably at 68 degrees).

The best way to do this is to put the chemical containers in a tray of and allow water to run into the tray at the desired (68 degree) temperature. After a period of time the chemicals in this water bath will increase or decrease to the same temperature as the water. It should be noted that this may take some time to happen. Consequently, the person processing the film should take steps to stabilize the chemicals at the desired temperature when first arriving at the darkroom.

The last point in this area is that the chemicals should remain at the stabilized temperature through out the entire film development procedure. Therefore, the film development tank should be kept in the water bath and removed only to agitate or pour chemicals in or out.

Assuming the chemicals have been stabilized at 68 degrees, and double-checked, we are now almost ready to begin the development process.

### **What film developer does**

Before moving on to the development procedure, a little background on what the film developer does will prove helpful.

When photographic film is exposed to light, the light-sensitive silver halide crystals embedded in the emulsion of the film react and form a latent or invisible image. The degree of reaction depends on both the intensity and the length of time the silver halides are exposed to light. When the photographic film or paper comes in contact with a developing, chemical a reaction takes place. The reaction causes the exposed silver halides to blacken, turning the latent image to a visible one. Again the degree to which the silver halides blacken during the development process is dependent on the amount of light to which they have been exposed.

It should also be noted that the developing chemical reacts with all the silver halides in the emulsion and not just the ones that have been exposed to light. However, the developer reacts to the silver halides that have been exposed to light much faster than those that have not been exposed. Therefore, the purpose of the development step is to develop the photographic material long enough to blacken all of the silver halides in the emulsion that have reacted to the exposure, but not so long as to blacken the halides that have not reacted to the exposure.

### **Determining development time**

Consequently, before we begin we must know the length of time for which we are going to develop the film. This information is normally supplied with the film and developer by the manufacturer. As of this writing

the most complete information concerning recommended guidelines for film development normally comes with the film developer. Limited information is provided with the film.

A development time of 10 minutes is recommended by the information provided with the Eastman Kodak Company's D-76 film developer, when the stock developing solution is mixed with one part water (1: 1), and when that developer is at 68 degrees for the development of the same company's Tri-X film (see Figure 4-5).

If you know the time-temperature for a given film developer combination, processing becomes relatively simple.

There is a definite correlation between time and temperature as shown on the sample time-temperature graph below.

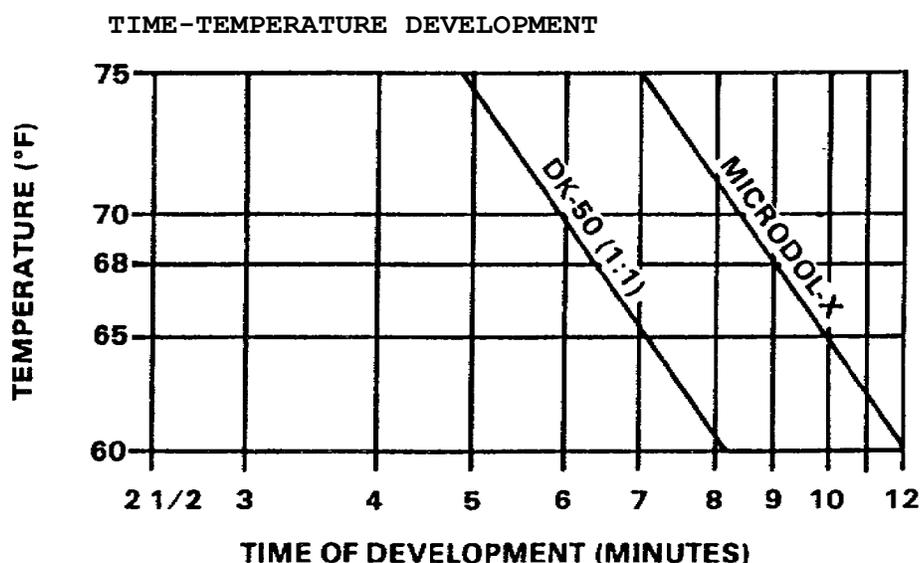


FIGURE 4-5. TIME-TEMPERATURE DEVELOPMENT

(The term "stock solution" means the amount of water the manufacturer recommends the dry chemical developer is mixed with initially. For example, one manufacturer sells film developer in dry powder form that will make one gallon of working developer. When preparing the developer you would start with a less than one gallon of water and add the dry developing chemical to the water. After the developer has been added to the water and mixed thoroughly, then more water is added to make one full gallon of working developer solution. So when it is said to mix the stock solution with one part of water this means, if 32 ounces of working developer are needed, 16 ounces of stock solution would be mixed with

16 ounces of water to give 32 ounces of working developer. Another common "photographic" way of saying the same thing is a "1: 1 dilution of developer.") The development time recommended by Kodak and other manufacturers is based on water of normal alkalinity. If your water is particularly hard, you may need to increase development time by as much as 20 percent.

### **Set timer**

Now that a time has been established the timer or clock that displays both minutes and seconds should be set.

Next remove the center part of the cover of the development tank. This is the cap that allows the chemicals to be poured in and out of the tank while preventing light from hitting the film. This particular part of the development tank cover is called the filler cap. A sufficient amount of film developer is poured into the tank, through the filler cap, to completely cover the film.

When this has been done, four additional steps must be taken immediately:

- o The timer or clock must be started.
- o The filler cap must be put back on the cover of the development tank.
- o The bottom edge of the development tank must be rapped firmly against a solid surface. This is necessary to dislodge air bubbles that form on the surface of the film when the developer is poured into the tank. If such bubbles are not dislodged immediately, film developer will not reach the surface of the film under the bubbles. This will result in the area under the bubble not being developed or, at best, the bubble will dislodge sometime later in the development step and the area where the bubble was will be developed less than the surrounding area. In the photographic print this will show up as dark spots on the print.
- o The tank must be agitated for 15 seconds. The purpose of initial agitation is to ensure that any small pockets of trapped air are dislodged.

When those four steps have been taken, the developing tank should be set in a water bath that is the same temperature as the developing solution.

### **Agitation intervals**

After the molecules of developer touching the film react with the film for a period of time, they become exhausted. It is therefore necessary to replace these molecules with fresh ones. This is accomplished by agitating the development tank after regular intervals while the film is in the developing solution. Agitation should occur for five seconds every 30 seconds throughout the time the film is in the developing solution.

The method used for agitation is also important. If the developer flows over the film the same way every time the tank is agitated there is a distinct possibility of streaks being formed on the film emulsion. Therefore, when the tank is agitated, it should be done at regular intervals but with irregular movement. Care should also be exercised when lifting the tank and agitating it, because many developing tanks have lids that do not screw on but rather just slip on. If the lid slips off while the tank is being agitated it could ruin the negatives and make a real mess in the darkroom. Some photographers make a habit of keeping their index finger over the cap while they agitate the tank.

Another item to consider while agitating the film is the temperature of the developer in the tank. The effects of handling and the ambient temperature of the room may cause the developing solution inside the tank to rise. Such a rise will cause the development process to speed up unpredictably. To avoid this, the development tank is kept in a water bath along with the containers of the other processing chemicals. The tank is removed from the water bath only to agitate or pour chemicals in or out.

Begin pouring the developer out of the development tank, through the filler cap, about 10 to 15 seconds prior to the end of the film development step.

NOTE: The developer as well as all other chemicals must be disposed of in accordance with local SOPs. Check the manufacturer's instructions. Some chemicals (stop bath, fixer, hypo-clearing agent and wetting agent) are normally reusable.

### **Stop bath**

When the developer has been poured out of the development tank, a small amount of developer remains both on the surface and in the emulsion of the film. Therefore, the next step in the process is to slow down or stop the development process. This may be done in a couple of different ways, and each has its advantages and disadvantages.

- o Water rinse bath. To slow down the action of the development

process, water (at the same temperature as the developer) is poured into the development tank and agitated continuously for 30 seconds. Following the water rinse bath the film must be treated with an acid fix bath to stop development.

- o Acid stop bath. Although a plain water rinse bath is commonly used between development and fixation, a better procedure is to use an acid stop bath. An acid stop bath effectively stops the development process not only on the surface of the film but also within the emulsion of the film. Using an acid stop bath also prevents developer being carried over to the next step in the film development process--the fixing bath. The primary chemical used in acid stop bath is acetic acid, which is readily available in the Army supply system. Several commercially available acid stop baths available. One that is available in the Army supply system is Kodak's Indicator Stop Bath. This acid stop bath has an additive that turns the chemical a dark purple under safelights when the chemical is exhausted. The procedure for using an acid stop bath is about the same as that of the water rinse bath. In a properly mixed acid stop bath, if the film is covered with the solution and agitated continuously for 30 seconds, it should entirely stop the action of the developer on the surface of and within the emulsion of the film.

### **Fixing bath**

When photographic film has been developed, it contains a visible silver image, but it is not yet ready to be brought out into the light or to be used to make photographic prints. This is because the halides that haven't been reduced to silver by the development process are still on the film and are still sensitive to light. If they remain on the film they will stain it and render the negatives useless. The fixing bath removes these halides. Therefore, to make an image permanent, it is necessary to "fix" the film before exposing it to light.

Fixer is a solvent also known a "hypo. This name comes from the chemical most commonly used for this purpose --sodium hyposulfite. Since fixer is a solvent, care must be exercised when using it. That is, if film or paper is left in the fixing bath too long it will begin attacking the image put there by the developer. It is therefore necessary to determine how long to keep the film in the fixer before fixation is complete. As with the other steps involved in the development process, follow the manufacturer's instructions (normally five to 10 minutes).

### **Chemical quality**

If there is doubt about the quality of any chemical used in the processing of photographic film or paper, don't use it. Put another way --when in doubt, throw it out.

### **Washing**

After the fixing process is complete, all of the fixer must be washed from the film. Otherwise, the negative will stain, crystallize and fade. The film may be exposed to light at this point, since it is no longer sensitive to light.

At this point the film reels are removed from the cylindrical development tank and put in a rapid roll film washer. A rapid roll film washer is an excellent device for washing hand-processed 35mm film. This type of washer is a cylindrical tank normally constructed from a clear plastic material. It is large enough to hold two, four or eight reels of 35mm film. Water enters the washer via a hose connected to the bottom of the tank and flows rapidly up through the tank and over the surface of the film on the reels. The water is discharged from the top of the tank carrying more hypo than would be removed if water both entered and was discharged from the top of the tank. Assuming there is a rapid flow of water over the film using this type of film washer, and assuming that the temperature of the water is 68 degrees, a wash time of 15 minutes should remove the remaining hypo on the film.

In the absence of a rapid roll film washer, the tank in which the film was developed may be used to wash the film. After the fixer has been poured out of the tank, the cover of the tank is removed and the tank is placed so that a stream of water flows rapidly into the center of the tank. The water and the flow created will carry the remaining hypo on the film up and out over the top of the tank. Making the same assumptions as previously mentioned, the washing time using this method should be 30 minutes.

**NOTE:** Wash time may be reduced considerably by using a hypo-clearing agent after the fixing step in the film processing procedure. Follow the manufacturer's directions for mixing and using this product.

### **Wetting agent**

Many areas where photojournalists are required to work have hard water. When film is washed in hard water, droplets of water form on the film. When these droplets dry they cause circular spots of minerals in the water to be deposited on the negatives. These spots, when the negative is printed, cause marks on the print. The best way to avoid spots is to bathe the negatives in a wetting agent solution prior to drying. A wetting agent is an emulsifier usually in liquid form, that lowers the surface tension of a liquid. The result is that the surface of the film

is quickly and evenly wetted, and droplets of water do not form on the surface of the film.

### **Drying the film**

When the film is removed from the wash or wetting agent bath, it must be dried. As with all other steps of the film development process, the film must be handled carefully to prevent damage. It should be noted that many of the problems visible in finished prints can be attributed to improper drying or negative- handling.

During the drying process the primary problems that must be guarded against are uneven drying, dust, scratches, and damage to the emulsion of the film caused by overheating.

A variety of methods are used to dry film. The most common of these is to hang the film vertically on a line with a weight attached to the bottom. The weight is used to prevent vertical curling of the film. If weights are unavailable, clothespins or spring paper fasteners are a common substitute. This method is used for roll film regardless of whether the film is hung up on a string in an open room or in a film-drying cabinet. Either way, the film should be dried in an area as free of dust as possible.

**NOTE:** Roll film [35mm] should not be dried on the reel in which it was processed, since uneven drying will result.

Some photographers wipe excess liquid off the film prior to hanging it up in order to prevent water spots from forming on the film. This action is the foremost cause of scratches on the negatives. If a wetting agent has been used, there is no need to wipe excess fluid from the negatives before drying. The wetting agent will have reduced the cohesion of the remaining liquid to the extent that water spots will not form on the film. Therefore, wiping the film is not recommended.

### **Negative storage**

After the film is processed and dried, the problem of negative storage presents itself. Some of the questions that must be answered are how to keep the negatives dust free, and how to store them in a manner that will allow them to be found again for reprinting if necessary. In this lesson methods that answer these questions will be discussed.

### **Cutting the film**

When the 35mm film is dry, it is cut into strips of five or six negatives each. This is done so that the negative will be easier to handle during the contact and projection printing processes, and to facilitate negative storage.

If the film is a 20-exposure roll, cut the negatives into strips of five. If the roll of film is a 36-exposure roll, cut the film into strips of six. The reason for this is simple. If a 20 exposure roll is cut into strips of six, the result is three strips of six and one strip of two negatives. Handling a strip of two negatives during the projection printing process is, at best, difficult. Therefore, a 20-exposure roll of film is cut into four strips of five.

The next step is to place the negatives in negative protectors for storage. A variety of these are available. What the photojournalist should look for in a commercial negative protector is that it should not allow dirt to enter the area where the negatives are kept. It should allow all negatives to be viewed without removing them from the protector, and it should allow up to 36 negatives to be stored in one protector.

The advantage of clear negative protectors over opaque protectors is that all the negatives on a particular roll of film may be viewed without removing the negatives from the protector. Another advantage of this type of protector is that adequate contact prints may be made without removing the negatives from the protector. Most of the current variety of this type of protector are made from a clear celluloid material that has a paper strip along the left side with holes punched in for storage in a loose-leaf binder.

#### **Marking the protectors**

After the negatives are in the negative protector, the negative protector should be labeled. Labeling that works best for newspapers or public affairs offices is a date and name label. Write the date the photographs were taken and the name of the particular assignment on the white paper area. The negatives are then stored in a loose-leaf binder with subsequent assignments placed on top.

This method of storing negatives works particularly well in public affairs offices because if a negative must be reprinted the approximate date of the event can normally be determined by consulting the morgue file. Loose-leaf binders should be properly labeled as well. The date of the first and last set of negatives stored within the binder should be shown on the outside.

# PRACTICE EXERCISE

## LESSON 4

### SUBCOURSE NO.

### FILM DEVELOPMENT

#### INSTRUCTIONS:

Review the material in this lesson. Answer the questions below by circling the "T" or "F" next to each question. Compare your answers with the answer key on Page 9.

- T      F      1.    The objective of the film development process is to make the latent image of the exposed film both visible and permanent.
- T      F      2.    Photographic chemicals normally come in liquid form and should not be diluted.
- T      F      3.    The purpose of wetting agents is to prevent drying spots.
- T      F      4.    Putting just one reel in a developing tank that will hold more than one reel could cause streaking.
- T      F      5.    Hard water is one reason that manufacturers' recommended film developing times are often too short.
- T      F      6.    "Hypo" is another term for "fixer."
- T      F      7.    The best way to store negatives is by putting the developed negative back into the plastic film canister.

# ANSWER KEY

LESSON 4

SUBCOURSE NO.

FILM DEVELOPMENT

1. True (Page 54)
2. False (Page 55)
3. True (Page 67)
4. True (Page 61)
5. True (Page 64)
6. True (Page 66)
7. False (Page 69)

# LESSON FIVE

## MAKING PRINTS

46Q Soldier's Manual Task: 214-176-1325

### OVERVIEW

#### **TASK DESCRIPTION:**

In this lesson you will learn how to make prints.

#### **LEARNING OBJECTIVES:**

**ACTIONS:** Describe the procedure used in making prints.

**CONDITIONS:** You are given the material presented in this lesson.

**STANDARDS:** You will know the methods and procedure used to make prints.

**REFERENCES:** The material contained in this lesson was derived from the following publications:

Soldier's Manual and Trainer's Guide for  
Journalists  
Applied Journalism Handbook  
DINFOS Public Affairs Handbook  
ACCP SS0193  
ACCP SS0516

# MAKING PRINTS

## INTRODUCTION

The object of the printing process is to make contact prints or projection prints. There are nine primary steps in the process. They are:

1. The materials needed for the process are gathered together, and the chemicals are mixed into working solutions. The temperature of the chemicals are stabilized.
2. The negative is put into the projection printer or the contact printer. It is focused on the easel (or centered under the projector light for contact prints).
3. The photo paper is exposed to the light, which is projected through the negative.
4. The paper is put into the developer tray for a specific amount of time with the developer at about room temperature.
5. When the print is developed it is then put into another chemical called a stop bath. The stop bath does just that --it stops the development process by neutralizing the developing chemicals.
6. Next the paper (or image) is covered with a fixer. The fixer makes the developed image permanent.
7. Following the fixing step, hypo-clearing agent may be used to remove the fixer and thus reduce washing time.
8. The next step is the wash. The wash removes the chemicals that are on the film. If these chemicals are not removed by the wash they will eventually destroy the print.
9. The last step is drying the print. The most common method of doing this is using a drying machine especially designed for this purpose. However, a print can also be air-dried in a few hours. (NOTE: In this lesson, we will assume resin-coated (RC) paper is used. RC paper requires less washing time and can be air dried.)

These steps describe the entire print-making process. It should be noted that each of the steps must be performed in the order stated. Further, the prints must be handled with care in each step of the process in order to prevent scratches.

## **MAKING A CONTACT SHEET**

### **Overview**

Contact printing is a step done between developing the negatives and making prints. Contact prints are made by placing a sheet of photographic paper in direct contact with a negative. When white light is directed toward the negative, the negative image controls the amount of light striking the paper. The dense areas of the negative bar the passage of light, while the clear, or low-density areas, permit light to pass freely. The image formed on the sensitized coating of the paper is, therefore, a reverse of the negative. In reality this makes it a positive that approximates the true black and white relationship of the subject.

Contact prints are usually made for two different reasons. One, to be used as the final product (for negatives 2 1/4" square and larger), and two, to be used to select which negatives will be projection printed.

Contacts used to select which negatives will be projection printed, are commonly called proof sheets, and are convenient for viewing negatives available for printing from any particular job or event that was photographed. This type of contact sheet is more commonly produced in the photographic facilities throughout the Army.

The basic requirement for photographic contact printing is to hold the emulsion side of the negative (dull side) and the emulsion side of the paper (shiny side) together during exposure to the printing light. Contact prints can be made with a printing frame, with a piece of glass, or with a contact printer to keep the film and paper in contact.

Some contact printers used by the Army are quite elaborate. Some have a platen with a pneumatic (air filled) bag, and others use a vacuum platen to assure contact between the negative and the sensitized material. A handle-operated switch automatically turns on the exposing lights when the platen is brought into position and locked.

### **Prepare for contact printing**

Contact printing is a simple step, but it can fast become a time-consuming step if you are not prepared. Clean the enlarger by wiping it with a moist cloth followed by a dry cloth. Clean the enlarger lens as you would a camera lens. Dust the enlarger baseboard and easel. Also ensure the contact printer (a sheet of glass will do) is clean and free of dust or lint.

### **Mix the chemicals**

Most darkrooms mix bulk chemicals, especially if they do a lot of printing. Check the expiration or mixing dates and replace outdated chemicals.

### **Lay out development trays**

Lay out the trays from left to right: developer, stop bath, and fixer. (If using other than RC paper, a fixer eliminator tray, also known as a "hypo-clearing agent," would be established after the fixer). If required, dilute the chemical as directed by the manufacturer. Lastly, a wash tray should be under a spigot with running water. Keep the water temperature at 65 to 75 degrees Fahrenheit. You also need one or more tongs, and you may want to wear an apron.

### **Turn on safelights**

Turn off the room lights and turn on the safelights (lights that won't fog the paper). Check the paper safe (a lighttight container for photographic paper) to ensure it is adequately stocked with 8" x 10" paper. The darkroom may have a safe for 5" x 7" and 8" x 10" paper.

### **Adjust the enlarger**

Turn on the enlarger by turning the timer switch to "focus." Open the aperture as wide as possible, normally f/3.5. Look up through the lens toward the light source to check for lint, fingerprints and grime. Again, if it is not clean, clean it with a blower brush or lens-cleaning tissue moistened with lens-cleaning fluid.

Rotate the vertical adjustment lever to raise or lower the enlarger head to about half its maximum height.

A printing frame is a simple device with a wooden or plastic frame, a clear glass face, and a padded spring clamp back. The negative and the paper are held, emulsion to emulsion, between the glass and the back. The negative is placed on the glass side. For the exposure, the frame is placed with its glass face toward a light, usually a projection printer, for a few seconds.

Place the contact printer, printing frame or glass in the center of the enlarger baseboard. Adjust the focus lever so that the light completely covers the contact printer or the glass, an area of approximately 10" x 12". The lens is still at f/3.5.

Rotate the aperture control ring from its lowest to highest setting. There should be noticeable differences of light output with each aperture setting. Set the aperture control ring to f/8.

Set the timer switch to the 'time" position. Set the timer dial for three seconds. Turn off the timer.

### **Make a test print**

Make the contact print by positioning an 8" x 10" sheet of photographic paper (emulsion [shiny] side up) on the contact printer or under the glass. Align the negative strips emulsion (dull) side down on top of the photographic paper and secure the glass over the negatives.

If the negatives are stored in clear plastic folders where the film slips into a sleeve, you can lay the entire folder down on the photo paper.

Using a piece of cardboard, uncover the first negative strip. Push the timer button for a three-second exposure.

Uncover the second negative strip. Again push the timer button. Do the same with the third, fourth and fifth negative strips. The first strip will have been exposed for 15 seconds, the second strip for 12 seconds, the third strip for nine seconds, the fourth for six seconds and the fifth for three seconds.

### **Develop the Contact Test Print**

#### **Developer**

Slide the photographic paper, emulsion side down, into the developer, covering the paper entirely in the chemical. Agitate it constantly for one minute and 45 seconds by either rocking the tray or gently rocking the print with the tongs.

Using the tongs, grasp the paper by one corner and remove it from the developer, allowing it to drain over the developer tray for a few seconds.

#### **Stopbath**

Slide the contact test print face down into the stop bath and agitate it for 15 seconds.

Using the tongs, grasp the print by the corner and remove it from the stop bath, allowing it to drip over the stop bath tray.

### **Fixer**

Slide the print into the fixer, and agitate it for half of the required fixing time. The fixing time is established in the manufacturer's data sheets for both fixer and the paper.

### **Wash**

After the print has been fixed, slide it into the wash, face up.

### **Inspect the test print**

Turn on the darkroom lights and inspect the test print. Select the best of the five exposures. If the best is the third test, set the timer for nine seconds (three times the three-second exposure).

One of the five tests should be close to the correct exposure. If none is, determine whether the negatives are too thin or too dense (perhaps over- or underdeveloped). Or perhaps there is a contrast problem, too much or not enough. If the contacts are too dark, set the aperture to f/11, the timer to three seconds and repeat the contact printing process. If the negatives are too light, open up to f/5.6 and repeat the contact printing process. If it's a problem of contrast, it can be corrected in the print phase.

When you select the proper contact exposure, again place the negatives (emulsion side down) on the paper (emulsion side up), and with the glass over the negatives expose the paper to light to the desired time. Process the paper as before.

### **Finished print wash**

Wash the finished print for five minutes. Squeegee the print. Dry the print in a forced-air dryer or by hang-drying in a dust-free area.

## **PROJECTION PRINTING**

Projection printing differs from contact printing in that the negative is separated from the photo paper --the image on the negative is projected by means of incandescent light and a lens onto the photo paper (much like a slide projector). By changing the lens-to-paper distance and the negative-to-lens distance, it is possible to reduce, maintain, or enlarge the image size. Because most projection prints are made at an enlarged scale, it has become common to refer to projection prints as "enlargements" and to call a projection printer an "enlarger." But the "enlarger" has the capability of reducing prints as well.

Enlargers offer advantages over contact printing. The main advantage is that the size of the print can be regulated regardless of the size of the negative. Other advantages are the ability to correct image distortion,

cropping, the ease of dodging and burning in, and the many special effects that can be obtained.

In general, all enlargers are similar in design and operation. They consist of an enclosed light source, some method of obtaining an even distribution of light over the negative, a negative carrier, a lens, a means of adjusting lens-to-negative and lens-to-paper distances, and an easel for holding the photo paper. By changing the lens-to-easel distance it is possible to provide for different degrees of enlargement or reduction. By changing the lens-to-negative distance it is possible to focus.

### Types of Enlargers

There are two types of enlargers, the condenser type and the diffusion type (see Figure 5-1).

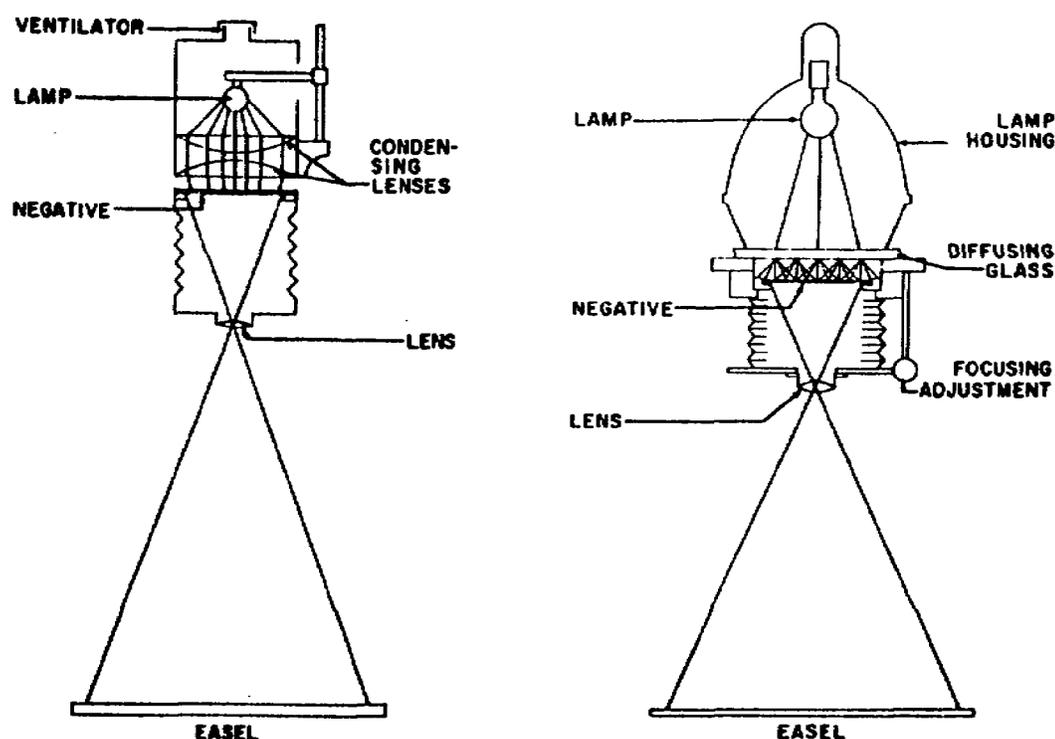


FIGURE 5-1. TYPES OF ENLARGERS

The condenser type enlarger (the most commonly used type) has a set of condensing lenses between the printing light and the negative. These

condensing lenses align and project the light rays evenly through the negative. Since all features of the negative are being enlarged, you can easily see that the flaws will also be enlarged. The condenser type printer produces more contrast in the print image from a given negative than the diffusion type printer.

Condenser lenses are designed to provide maximum image sharpness when used with a given focal length lens. Therefore, if you change projector lenses, you must also change the position of the condensing lens. The proper position for use with the different lenses is indicated on the inside flap of the variable-condenser housing.

The diffusion type enlarger has a diffusing medium (usually a ground glass) between the light source and the negative to spread the light evenly over the entire surface of the negative. Light emitted from the lamp, as well as that reflected from the parabolic reflector, strikes the diffuser, which in turn, scatters it in all directions. Thus, when the light reaches the negative, the light is traveling in a non-directional pattern.

The effect of using diffused illumination is that minor negative defects are not clearly recorded on the print.

There is a general softening of the image sharpness and this is accompanied by a reduction in image contrast.

The major components of an enlarger are:

- o A tungsten lamp as a light source. The lamp is enclosed in a light-tight housing, which is ventilated to prevent excessive heat from damaging the negative.
- o A negative carrier. The negative carrier consists of two metal plates with an opening in the center large enough to accommodate the negative. The negative is placed between these plates and is held in position by its edges.
- o A bellows. The bellows should be capable of extending to at least twice the focal length of the lens. This amount of bellows extension is necessary for the production of 1: 1 (same size) reproductions.
- o A lens. The lens used should be large enough to cover the negative being printed. 35mm negatives use a 50mm lens, 2 1/4 x 2 3/4 negatives use a 90mm lens and 4 x 5 negatives use a 135mm lens.
- o An easel. There are many types of easels, each serving the same basic purpose: holding the printing paper in a flat plane.

- o Adjusting knobs. To focus, enlarge or reduce you turn the knobs to change the lens-to-negative distance and the lens-to-easel distance.

## **Printing**

### **Clean enlarger**

Ensure the enlarger and the lens are free of dust, grime and fingerprints. Ensure the contrast filters are cleaned and numerically organized. Ensure the grain analyzer or other focusing device is clean. Ensure that dodging and burning tools are near the enlarger baseboard. Lastly, ensure that the photographic paper safe is near the enlarger baseboard.

### **Mix chemicals**

Ensure the chemicals are fresh; dilute according to local policy or manufacturers' instructions. The sink must contain developer, stop bath, fixer and wash trays.

### **Position negative**

Position the first negative, emulsion side down, in the negative carrier, frame numbers facing away from you. (When the image is projected onto the easel it will face you.) Use a professional static brush to remove any lint from the negative. Water spots can be removed only by rewashing the negative --do not wipe the negative on either side, since negatives scratch easily, especially on the emulsion side.

### **Turn on the safelights**

Turn on the darkroom safelights and turn off the room lights.

### **Compose the image**

Position the easel under the enlarger. Set the timer switch to focus, and adjust the focus.

It is necessary before printing to compose your image on the easel frame you are going to use.

Rotate the enlarger's vertical adjustment knob until the image covers the easel. At this point, if you have not already done so on the contact print, study the image of the photo. Determine how the finished picture would look best in print. Eliminate excess detail on both sides, and at the top and bottom, of the image cropping. Now raise or lower the enlarger until the exact picture you've envisioned fills the easel. Remember the rule of thumb: "Crop ruthlessly; enlarge generously." Consider the rule of thirds when composing and cropping the print.

Fine-focus the negative using a grain analyzer or other focusing device.

Focusing and arranging the composition of the projected image should be accomplished with the lens wide open for two reasons. First, the brighter the image, the easier it is to see for accurate focusing. Second, stopping down the lens after focusing causes a greater depth of field and this provides a margin of safety for any slight error in focusing.

To bring the image to the desired size, the printer head is raised or lowered until the approximate size is reached. The image is then brought into sharp focus. At this point you are faced with several minor problems. Take a moment and study the image carefully. The picture is easier to compose if the scene is right side up. If it is upside down, remove the carrier and reposition the negative. Most printing papers are rectangular; therefore, the next problem is to determine whether to use a vertical or a horizontal format. In many cases, the manner in which the scene is composed on the negative is the controlling factor. However, many photographs can be improved in printing by suitable cropping, straightening, tilting, or by some adjustment of the balance of tones. If the cameraman made no attempt to compose the picture on the negative, you can often enlarge a part of the negative that contains a good picture. In a newspaper shop, an editor may already have indicated his idea of how the print should look by cropping the contact sheets you provided him earlier.

Turn off the timer's focus switch. Set the enlarger aperture control ring at f/8. Set the timer dial to three seconds.

Put a sheet of photographic paper in the easel.

### **Make a test print**

This is the same process you've used to make contacts. Using cardboard, uncover one-fifth of the vertical or horizontal space and depress the timer button, giving the paper a three-second exposure. Uncover another fifth of the photograph and again expose for three-seconds. Do this three more times until the entire paper is exposed. The first part will have been exposed for a total of 15 seconds. The last part will have been exposed for only three seconds (see Figure 5-2)

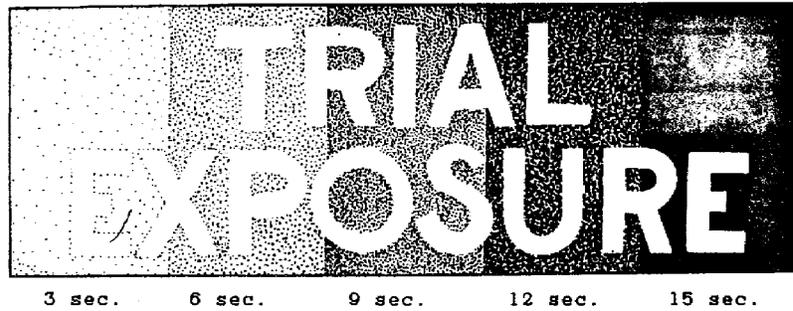


FIGURE 5-2. TRIAL EXPOSURE

### **Develop the Test Print**

#### **Developer**

Slide the test print, emulsion (shiny) side down, into the developer, immersing the print. Agitate it constantly for 15 seconds. After one minute and 45 seconds, remove the print from the developer, letting it drip over the tray for 15 seconds.

#### **Stopbath**

Slide the print into the stop bath, immersing it. Agitate it for 30 seconds. Remove the print from the stop bath and let it drip over the stop bath.

#### **Fixer**

Slide the print into the fixer, immersing it. Agitate for half of the fixing time as established by the paper and fixer manufacturers. After the fixing time has expired, remove the print from the fixer.

#### **Wash**

Slide the print into the wash, immersing it. If needed, turn on the room lights and inspect the print. The print will have five exposures from which you can determine the correct exposure. From light to dark, the exposures are 3, 6, 9, 12 and 15 seconds. Select the best exposure setting.

If all exposures are too light or too dark, set the aperture control ring to a higher or lower f/stop setting, and make another test print.

Caution: When using only one set of tongs for agitating prints, be sure to keep them on the white edges of the exposed print. Otherwise you might have chemical reactions in print areas where you don't want them.

### **Make a Print**

Set the timer for the best exposure time as established by the test print. If you determined that a correct exposure is between six and nine seconds, set the timer for seven or eight seconds (see Figure 5-3).

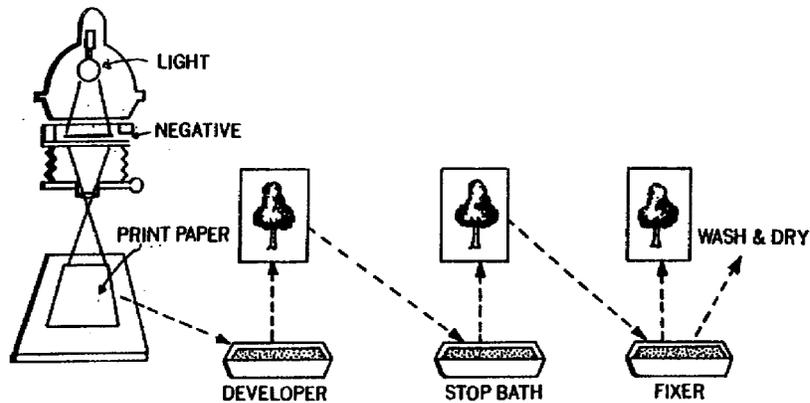


FIGURE 5-3. MAKING A PRINT

### **Contrast filters**

Select a contrast filter that either "hardens" or "softens" the print -- gives it more or less contrast -- as established by careful study of the test print. The Kodak Polycontrast Filter Kit consists of seven filters in half-step increments from 1 to 4. The #2 filter is normal contrast. Any filter lower than #2 tones down the print -- lowering the contrast. A filter higher than #2 increases contrast. Ideally, a print that exhibits the full scale of tones from white to black is best suited for newspaper production. The whites should be bright, the blacks should be deep, and the full scale of grays in-between should be captured. Many editors prefer photographs produced with higher contrast, in the #3 range, because newspaper reproduction tends to dull tones. In that case, the test prints should also use a #3 filter. **The exposure time may have to be decreased or increased depending on the filter used.** A higher filter may require you to increase the exposure time. A #1 filter may require you to shorten the exposure time. More than one print is normally required to fine tune the exposure time, aperture setting and filter selection. With each test, analyze the print in an attempt to save both time and photographic paper.

### **Dodging**

In some instances, the brightness range of a subject may be too great to be reproduced in a straight print. However, adequate compensation is usually possible by shading the area which prints too dark. For example, detail in shadow areas can be preserved by dodging (holding back the light) during part of the exposure (see Figure 5-4).

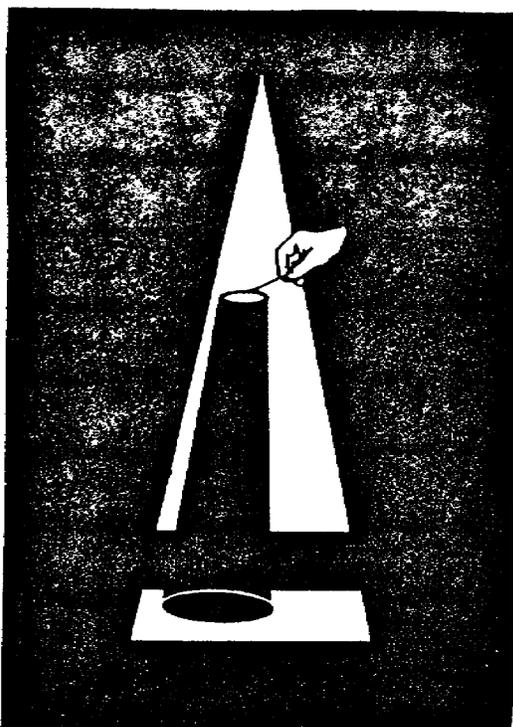


FIGURE 5-4. DODGING

Sometimes it is necessary to dodge or lighten some parts of the projection print to produce a correctly exposed image. Since the dodging material is held and manipulated in the beam of light from the lens, its location and coverage can be seen and controlled during the printing exposure.

Dodging is usually accomplished either using hands or a specially made stick with a piece of cardboard affixed to the end. It is surprising how many shapes you can form with your hands. A dodging tool can be made in any shape (see Figure 5-5). The area that is overexposed is shadowed while the rest of the photograph is exposed as normal. This is frequently required in photographs exposed under bright lighting, in which eyes are lost in shadows.

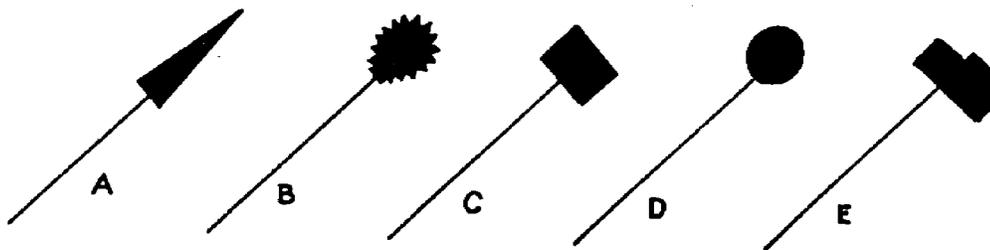


FIGURE 5-5. DODGING TOOLS

Overdodged areas appear noticeably and unnaturally light. If dodging is noticeable in the print, it has been overdone or poorly done. Also,

keep the dodging implement in constant motion, vertically and/or laterally, to avoid any sharp lines of demarcation.

Properly done, the area should be lightened without any distinguishing marks.

### **Burning**

In some light conditions, highlights often are "blocked-up" and no detail can be seen. "Burning in" or "burning" is used to make an area darker, one which would otherwise print too light. Burning is usually accomplished using the hands or a specially made piece of cardboard with a hole in it. The hole should be cut in the center of the cardboard, and it should be smaller, but the same shape, as the area to be burned in. Only the area to be "burned in" is exposed.

The devices must be moved at all times during the exposure to avoid observable dodge and burn marks --a noticeable line between the area dodged and the other parts of the image. This movement can be a slow up-and-down motion. Some situations where burning might be used are listed below:

- o Darken sky areas of landscapes or seascapes. Skies should be darkened at least to the extent that the 1/4-inch white margin is discernable all around the print.
- o Specular highlights (glare light) should be darkened to bring out subject detail and/or to render such areas less distracting.
- o Any area that prints too light, particularly flesh tones, should be darkened to the point that normal detail and/or naturalness are obtained.
- o In portraiture, corners of the print are sometimes darkened progressively so that the edges are darkest and the areas closest to the subject are lightest. This dramatizes the subject and prevents the eye from straying out of the subject area.

Distracting areas in the foreground or background can be made less objectionable if darkened somewhat. A negative that requires extensive burning-in usually indicates that the subject was poorly lighted when the photograph was made. Single flash shots as a class give the printer the most trouble because of the rapid fall-off of illumination. The flash burns up (overexposes) near objects, whereas more distant objects may be normal or underexposed. Such a negative may require both burning-in and dodging to hold satisfactory detail throughout the print (see Figure 5-6).

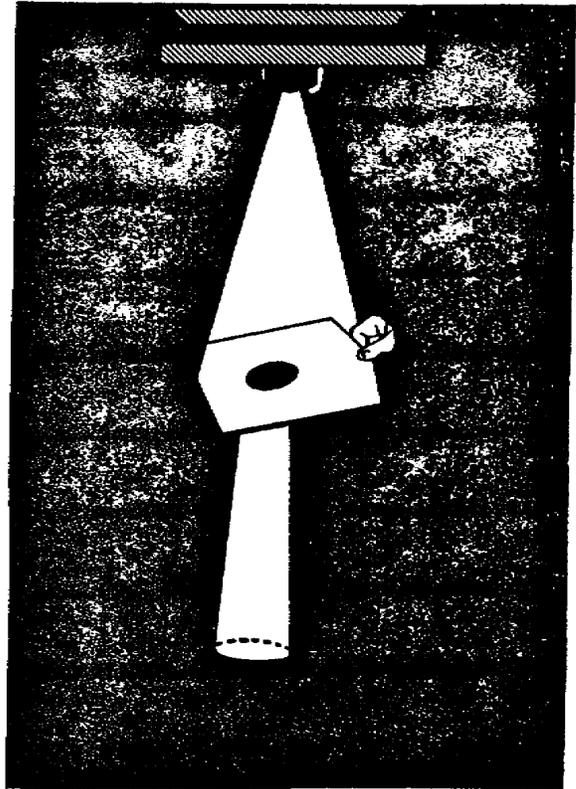
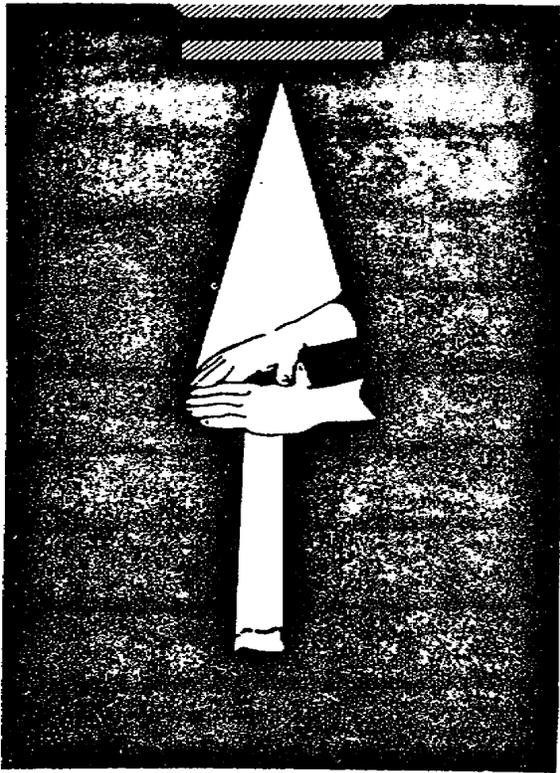


FIGURE 5-6. BURNING-IN

Almost any opaque material can be used for burning-in. The hands are especially useful because an opening of almost any shape can be obtained by cupping the hands together in different ways." A large area, such as the sky, is best burnt-in by giving the entire print the proper exposure time for the foreground area, then giving the sky area additional printing time while covering the foreground area with a large straight piece of cardboard. A small area within the print is best burnt-in through a properly shaped "cutout" in cardboard.

Only a minimum of opening shapes need be prepared, since the shape of an opening can be varied with a finger or masking tape, whereas its size is controlled by proximity to the lens.

### **Diffusion**

Sometimes because of extreme contrast or detail, a subject requires diffusion. A crunched-up cigarette cellophane wrapper is a good diffuser, as is a woman's nylon stocking. Depending on the negative, it can be diffused from 10 to 100 percent of the exposure time. Diffuse the print by moving the cigarette wrapper or stocking in the path of light

back and forth under the enlarger lens. This "softens" the image, removing harsh shadows, lines and facial blemishes.

### **Practice**

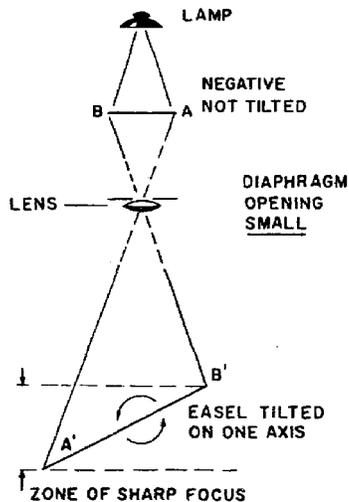
You should practice dodging and burning before attempting to expose the print. Remember the amounts of time that you used for each step in the printing exposure. That is the only way in which the procedure can be controlled well enough to be duplicated for additional prints. Write the exposure on the back of the negative jacket. For example, 10 seconds overall exposure, 3 seconds dodge facial area, and 8 seconds burn in the sky.

While you gain experience in all of the dodging techniques, you will also develop your ability to "read" a negative. That is, by observing the negative, you can judge the amount of dodging that is necessary without having to make a test exposure. Before you develop the ability to "read" negatives, you should use test strips. You can use a small test strip, approximately one inch wide, to determine the printing time for the area to be dodged or burned in. To do this you simply place the test strips over the desired area on the easel and make the test exposure. This will aid you in determining the exposure time for that particular area of the negative. Use of test strips saves photo paper and money.

### **Distortion Control**

Many cameras have no means of correcting the alignment of the film and the subject. As a result of these limitations, many negatives are made which show buildings tilted backwards or sideways. This places the burden of correcting perspective upon you and your darkroom lab knowledge.

Certain kinds of perspective can be corrected when using an enlarger. This perspective control is based on the fact that the farther the easel is from the lens --the larger the image will be. Thus, if the image is projected upon a tilted plane, that portion of the image farthest from the negative will have the largest image size. If the negative consisting of parallel lines were to be projected onto a tilted plane, all portions of the negative would not be the same distance from the paper, and the lines would converge, or not be recorded as parallel (see Figure 5-7).



By the same token, a negative that has lines which are not parallel (within limits) could be projected so that the print will show them as parallel.

As an example, suppose you must print a photograph of a tall building and, because of a lack of controls on the camera, it was necessary for the photographer to point the camera upward. This will cause the building to appear wider at the bottom than at the top, or make the building look as though it was leaning backward.

FIGURE 5-7. DISTORTION CONTROL

This can be corrected in projection printing by tilting the easel so that the image of the top part of the building is farther from the enlarger lens --thus restoring the vertical lines to their correct position. This technique requires a small f/stop setting on the enlarger (f/11 --f16) in order to achieve enough depth of field to keep the tilted easel in focus.

### **Develop the Print**

Follow the same instructions used for making the test print. Wash the print according to manufacturer's specifications. Dry the print in a professional-style dryer or by hang drying in a dust-free area.

### **File the prints**

Place the prints made from the negatives with the contact sheet in a large envelope marked with an internal control number, subject and date, and file.

### **Clean the lab**

Empty the trays, disposing of the chemicals as prescribed by the manufacturers or by local standard operating procedures. Rinse the trays with water, ensuring there is no chemical residue. Cover the enlarger and put away the tools used for print making.

## PRINT COMPOSITION

A well-composed negative leaves little for the lab worker to do in the way of composition. However, a 2-1/4" x 2-1/4" or a 35mm negative usually requires some cropping to fit standard paper sizes. Cropping is the term used to indicate that only a portion of the negative image is used in the print.

In practice, the photographer rarely produces a negative that cannot be improved to some extent by additional cropping, even when great care was taken in composing the negative. Cropping is the lab worker's means of recomposing the picture. A well-cropped print should result in a picture that is the best possible compromise between the picture the photographer had in mind, and the subject matter he gives the printer to work with.

Producing the best possible print from a negative is possible only when the lab worker has a real feel for composition, and at the same time, is proficient at print manipulation, which includes the ability to control tonal values, and to a lesser extent, perspective on the print. The photojournalist who does not develop his own film must communicate his composition requirements to the lab worker. This is usually done by marking the contact sheet to show how to crop the photograph. Since photographs have infinite variety, and personal likes and dislikes differ there are no hard and fast rules in composition. However, here are some suggestions for producing compositions that are pleasing to most people:

- o Mask off unneeded detail at the edges of the picture. Many times the foreground is fuzzy and is cluttered with objects that distract attention from the center of interest.
- o Never place the center of interest in the middle of the format, but a little to the left or to the right of the center, and a little above or below the center line.
- o Horizontal, vertical, or diagonal lines should never be allowed to cut the picture into equal parts. For example, the horizon should be below or above the center of the picture.
- o The horizon should be truly horizontal.
- o Live subjects should be looking into the picture, not out of it. In other words, there should be more space in front of the figure than behind it. This also applies to action photographs. Your composition will

be strengthened if the action leads into the photograph and weakened if it leads out of it.

- Good composition is defined as a pleasing arrangement of subject matter within the picture; consequently, if the subject matter of the entire negative is pleasing and well-balanced, it should be printed full. If the composition leaves something to be desired, however, the projected image should be studied closely to determine if a well-composed picture is hidden within the poorly composed one.
- Consideration should be given in any photograph to the "SAPP rule" (security, accuracy, policy and propriety).
- Before mercilessly cropping a negative, however, consider first of all the intent or purpose of the photograph. Indiscriminate cropping could defeat the purpose for which the exposure was made. For example, Figure 5-8 shows a sketch of a photograph to be used in a story about activities in the building. So the building cannot be cropped out. In Figure 5-9 the picture could be cropped as indicated if the story is about the girl. But if the story is about fun at the beach, then it should show some of the beach.



FIGURE 5-8.

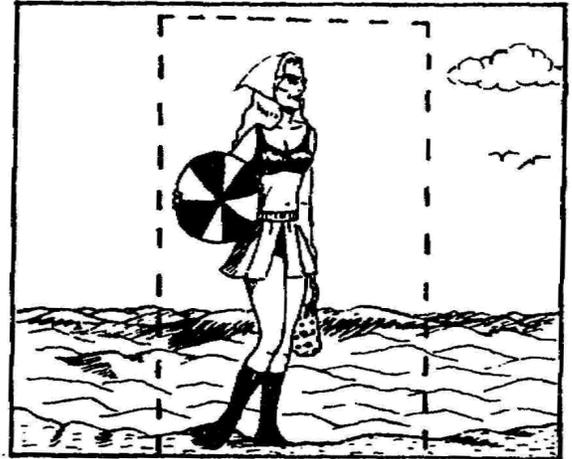


FIGURE 5-9.

o Cropping is certainly indicated in Figures 5-10 and 5-11. The dotted lines suggest the cropping that would improve the pictures.

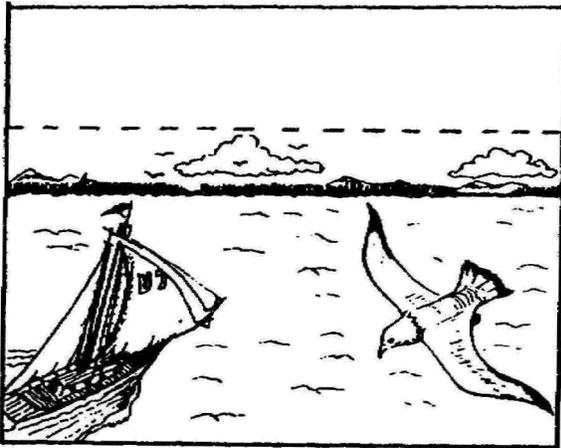


FIGURE 5-10.

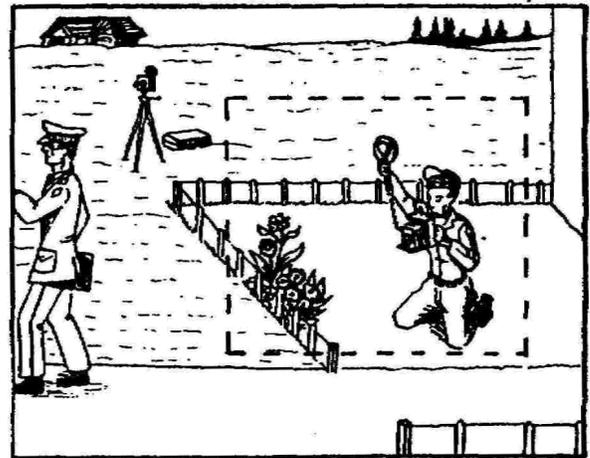


FIGURE 5-11.

There four basic arrangements of subject matter within the borders of a print.

- o Horizontal. Suggests peace, quiet, rest.
- o Vertical. Gives feeling of height, power, wisdom.
- o Diagonal. Creates feeling of motion, force, action.
- o Curved lines. Implies grace, charm, beauty.

Each of these compositional arrangements creates a mood or feeling that can sometimes be strengthened by creative cropping (see Figure 5-12).

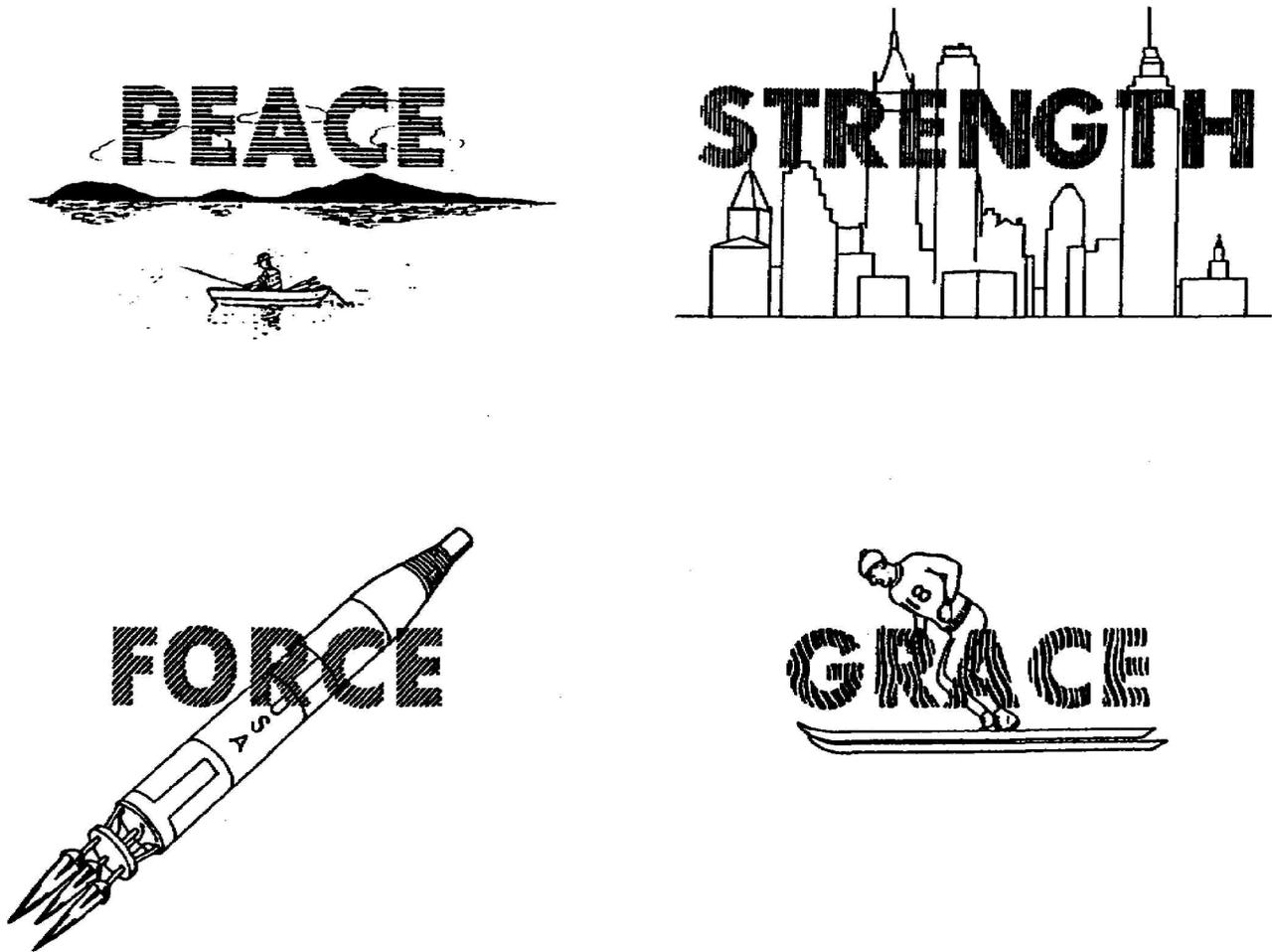


FIGURE 5-12. ARRANGEMENTS OF SUBJECT MATTER

# PRACTICE EXERCISE

LESSON 5

SUBCOURSE NO.

MAKING PRINTS

## INSTRUCTIONS:

Review the material in this lesson. Answer the questions below by circling the "T" or "F" next to each question. Compare your answers with the answer key on page 9.

- T     F     1.    There are two types of enlargers --the condenser type and the diffusion type.
- T     F     2.    Water spots should be removed from a negative by wiping with a soft cloth.
- T     F     3.    In print composition, horizontal lines should never be allowed to cut the picture into equal parts.
- T     F     4.    The main advantage of enlargers over contact printing is that they reduce dust problems.
- T     F     5.    Contact printing is a step done between developing a negative and making prints.
- T     T     6.    The rule of thumb "Crop generously; enlarge ruthlessly" applies.

ANSWER KEY

LESSON

SUBCOURSE NO.

MAKING PRINTS

1. True (Page 79)
2. False (Page 81)
3. True (Page 90)
4. False (Page 78)
5. True (Page 75)
6. False (Page 81)

# APPENDIX A

## GLOSSARY OF STILL PHOTOGRAPHY TERMS

### GLOSSARY OF STILL PHOTOGRAPHY TERMS

Absorption: A taking in, or soaking up, of light by a medium or subject akin to the learning process in a classroom. A term used in a classroom. A term used in optics, especially in filter work.

Acceptance angle: The angle of the cone of light ray which enters through the light entrance window of an exposure meter. This angle controls the distance the meter should be held from the subject for proper reading. Ordinarily, a meter should be held a distance no farther away than the shortest dimension of the subject.

Acetate base: A transparent material on which film emulsions are coated. Composed of cellulose acetate, it is almost noninflammable.

Acetic acid; short stop; stop bath: An acid diluted with water and used in processing between the developer and hypo to stop development of film or printing paper. Don't spill concentrated acid on your hands. It may burn your skin.

Agitation: The movement of film, paper, or developer during the developing process to cause even development through continual change of solution at the face of the sensitized material. It is controlled, and is done either continuously or intermittently; if done incorrectly, it will cause spots on negatives.

Air bells: Undeveloped spots on negatives or prints, due to air bubbles, are caused by lack of proper agitation.

Alkali: The opposite of acid; developers are alkaline.

Anastigmat: A lens corrected for astigmatism; one which brings both vertical and horizontal lines to a focus in the same plane.

Angle of field: The angle formed by imaginary lines drawn from the center of the lens to the diagonally opposite corners of the film. It determines the coverage of a lens with a particular film size.

Antihalation backing: A color dye coating on the side of the film opposite to the emulsion. It prevents halation, or the halo-type effect around a subject due to reflection of light rays from the film base back through the emulsion.

Aperture; diaphragm stop; f/stop; lens opening; stop: The opening of a lens, as controlled by an iris diaphragm, through which the light passes before striking the film. It controls the brightness of the image, that is, the amount of light entering the camera.

Artificial light; Tungsten light: Any light supplied primarily by a means other than daylight. Most common in photography is flash and photoflood.

Background light: A light projected on the background behind the subject, generally used in portrait photography.

Back light; hair light; edge light; rim light: Any light which shines from behind the subject toward the camera. It separates the subject from the background and causes a third dimensional effect because it forms a partial or complete rim of light on the subject. (See also key and fill light.) There is danger in the use of this light, however; it can emphasize large or unshapely ears and create harsh shadows across the cheek and nose. Look at its effect without the other lights before you snap that shutter.

Barn doors: Accessory flaps fitted to photoflood reflectors in a manner of a swinging door. They are used to block out or diminish light from lamps on parts of a subject, especially in portrait photography.

Basic exposure: The amount of light needed by the film for proper exposure. The term is usually used in connection with a chart or guide. It implies that the combination of f/stop and shutter speed (for depth of field or action purposes) which gives an equivalent exposure. Example: basic exposure for bright sun, front lighting, average subject, ASA 100 film is 1/100 second at f/16. This can be changed to 1/200 at f/11 or 1/50 at f/22 or some other combination for an equivalent exposure.

Bellows extension: The distance between the center of a lens and the film in a camera. In ordinary usage, it refers to situations in which pictures are taken at distances closer than infinity.

Bellows draw; draw: The most the bellows can be extended on a given camera.

Bellows extension compensation; bellows extension factor: When taking close-ups, the bellows extension may be so great that the light which enters the camera can no longer be measured reliably by means of the conventional f/stop markings (because f/stops are mathematically dependent on the original focal length -- see f/stop). The exposure must then be increased by an amount equal to the use of formula:

$$\frac{\text{bellows extension squared}}{\text{focal length squared}} = \text{bellows extension factor}$$

Between-the-lens: Usually used in references to a type of shutter which is set between the elements of a lens as against the focal-plane or back shutter. Sometimes used in connection with the iris diaphragm whose blades operate between lens elements.

Blank: A transparent negative caused by extreme underexposure or no exposure as from forgetting to pull out the slide or loading cut film holders backwards. A common fault of beginners, sometimes called a "windowpane."

Blocked; blocked-up; turned out: Refers to extremely dark or "heavy" highlight portions of negatives. It implies that the negative is so dark in those regions that a good print, which should show good detail in the light portions of the subject, cannot be made from it. Caused by overexposure and/or overdevelopment of the film.

Blow-up: A photographic enlargement or projection print.

**Blurred:** Indistinct or not in sharp focus. Due to a variety of causes; dirty, wet, moist or imperfect lens, improper focusing, improper cut film loading, improper setting of front standard against infinity marks, subject or camera movement, or faulty printing techniques. It is one of the greatest causes of rejected pictures.

**Bounce light:** A type of lighting technique, usually used in flash work, in which the light source is not aimed directly at the subject but is directed at the ceiling or wall and bounced back to the subject for an indirect type of light with indistinct shadows and is preferred when a more natural look is desired in the subject. In computing exposure, care must be taken to consider distance from camera to ceiling and ceiling to subject and also to compensate for loss of light due to absorption.

**Brightness range:** Variation of light intensities on the subject from minimum to maximum. A brightness range of 16:1, for instance, means that the brightest highlights of the scene reflect sixteen times as much light as the darkest shadows. Also refers to a method of exposure meter calculation which is based on this principle.

**Broad lighting:** Illuminating fully the side of the face turned towards the camera. It results in a broad expanse of highlight on the face as against the narrow amount of highlight which is the consequence of short lighting (see latter).

**Camera angle:** The point of view from which a subject is photographed usually implying the angle used, such as high and low.

**Camera axis:** An imaginary line drawn through the center of the film and lens and outward to the subject. It is considered when planning the placement of lights when photographing with artificial light and in the posing of the subject in portrait photography.

**Circle of permissible blurring; (circle of confusion):** A mathematical standard of sharpness used to determine the permissible deviation from true sharpness. It refers to the size of the circle formed when a point is depicted as a circle on the focal plane instead of a point. For example, a circle of 1/100 inch means that a point which is 1/100 inch in diameter could be formed on the film and still be seen as an acceptably sharp image. Knowledge of this expression has no appreciable effect on the quality of your picture taking.

**Clear:** The length of time it takes to remove the unexposed and undeveloped silver salts from a negative in the fixing bath. Visually, it refers to the time it takes to get rid of the milky appearance of the film.

**Close-up:** A photograph taken close to the subject or which includes only a small portion of a large object. A technique not used as often by photographers as it should be either because of shyness (rare), fear of parallax problems (more common), or a reluctance to face the challenge of a more difficult shot (most common).

**Color:** A visual sensation produced by light of different wavelengths either separately or in combination.

**Color balance:** A general term used in color photography when referring to the matching of light source and film for proper and "natural" reproduction of colors.

Color blind: See non-color sensitized.

Color negative: A negative rendition of color values of the subject in color photography. Both the light values (highlights and shadows) and the actual colors of the subject are recorded opposite to what they are in nature. A light green, for instance, shows up as a dark magenta color.

Color temperature: A scale used in color photography to describe the apparent color of a light source in terms of its relative blue or red content. Expressed in degrees Kelvin (K), high temperatures of light sources look bluish and low temperatures look either reddish or yellowish.

Color triangle: A graphic representation of the relationship of colors to each other. Primaries, (blue, green, red) are placed at the three points of the triangle and secondaries (cyan, yellow, magenta) are placed in between.

Complementary colors: Colors of pigment which when mixed produce a grey; colors of light which produce white when mixed. Opposite colors on a color triangle, blue and yellow for instance, are complementary to each other.

Continuous tone: Photographs in which the tone values of the subject are reproduced by a gradual gradation of grey densities from black to white. In copy work, it is one of two types of reproduction, the other being line copy.

Contrast: A general term referring to differences between extremes of tone values in negatives, prints, and subject or lighting. When the difference is great, the contrast is called high, hard, or contrasty; when the difference is slight, the contrast is soft, flat, or low. Contrast in the final photograph may be the result of many contributing factors: lighting of the subject, the subject itself, type of film and developing used, and the kind of control exercised in printing.

Covering power: The ability of a lens to form a satisfactory image of a given size. Commonly expressed as the diameter of the maximum usable image formed by the lens, it is important to consider before using a lens for swing and tilt adjustments in view camera work. The five-inch lens on the Graphic, for instance, does not have enough covering power to use the rising or shifting front without loss of image clarity on the edges.

Crop: To trim or block out parts of the photograph either by cutting the print or in enlarging or contact printing. Aim is to improve composition or remove unwanted portions in the print. Sometimes it is loosely used to describe the act of moving in closer with the camera when photographing a subject. It is more desirable to compose well in the camera than to resort to cropping while printing.

Curtain aperture: The slit in a focal plane shutter which permits light to reach the film. It changes in size with different shutter speeds.

Out (engraving, halftone): Name for the metal plate on which a picture is reproduced for a newspaper or periodical.

Cyan: Blue-green secondary color resembling the turquoise blue of artists' pigments.

Data sheet: A direction and information sheet packed with film.

Daylight: Used in photography, the combination of sunlight and skylight; more loosely, any outdoor lighting from natural sources.

Daylight loading: Any arrangement on a camera, a film magazine or a developing tank permitting insertion of film in light without the use of a darkroom or a changing bag. Examples: film pack, cassettes, roll film.

Definition: The clarity, sharpness, resolution and brilliancy of an image formed by a lens.

Delay time: The time from releasing the shutter to fully open position in between-lens shutter operation. Also, in flash work, the time it takes a flashbulb to build up to highest or peak intensity.

Dense: A dark or "heavy" negative, usually caused by overexposure and/or overdevelopment. Also is used to refer to specific dark portions of negatives. Opposite to thin.

Density: The relative darkness or lightness of a negative or portions of it, according to the amount of silver present. The contrast of a negative, for example, is determined by differences of densities between highlights and shadows.

Depth of field: When a camera is focused on an object, a certain amount of distance in front of and back of the subject will appear acceptably sharp. This total distance is the depth of field. Knowledge and use of it enables a photographer to control the relative sharpness and blurriness of different parts of the picture to achieve desired effects.

Detail: The clarity of the registration of objects in negative or print. Akin to definition.

Developer: A chemical solution which makes the exposed (latent) image visible by changing silver halides to black metallic silver. There are many developers available according to use, but they are first classified broadly into two types: film and paper.

Diaphragm: See aperture.

Distortion: An unnatural rendering of the shape or size of a subject in a photograph. It is not necessarily a bad practice to cause distortion. For dramatization of the subject, in news photography and for special effects, it is very effective. On the other hand, in technical or legal type of photography it is generally undesirable.

Dodging: The operation of permitting light from parts of a negative to fall on the paper for varying amounts of time when exposing the print so that final results are modified.

Double exposure: Two exposures on a single negative. When done by a professional it is sometimes justifiably claimed to have been intended for artistic effect; when done by a beginner it is always a mistake.

Double extension: A camera bellows which may be extended up to twice the focal length of its lens. At this distance, the camera will yield a 1:1, or actual sized, subject image. It is useful in copy and close-up work.

Draw: See bellows draw.

Esaki: A device used to keep sensitive paper flat while enlarging, forms white borders on a print.

Edge light: See back light.

Electromagnetic spectrum: The radiant energy band which includes X-rays, ultra-violet, radio and light, among others.

Electronic flash; strobe light: A high intensity, short duration flash used as a source of illumination. Its light is usually softer than flash which necessitates development of film to a higher contrast.

Emulsion: In film or paper, a gelatin layer containing the silver salts which are sensitive to light.

Enlarging; projection printing: The making of large prints by means of a projected image.

Exhaustion: The aging or depleting of processing solutions so that they no longer produce satisfactory results.

Exploded view: A photograph showing objects disassembled but in proper order of assembly. Used for training engineering and maintenance purposes.

Exposure: The length of time that light has been allowed to act on a sensitive emulsion. It is controlled by a combination of f/stops and shutter speeds. Many factors affect the amount of exposure needed in a given situation among which are the kind and amount of illumination used, type of subject, and film speed.

Exposure index: See ASA ratings.

Exposure meter: A hand operated, photoelectric celled instrument used to measure the amount of light falling upon or being reflected from a subject with the object of calculating exposure. There are two types, incident and reflected light. The first measures the strength of the light which shines on the subject, the second measure light reflected from the subject.

f/ (as f/4.5, f/11, f/32): The number of the opening through which light enters the camera to strike the film. F/numbers are usually calibrated to change the amount of light entering by a factor of two times with each succeeding number -- f/22 allows twice as much light to enter as f/32 while f/8 lets in only one-half the light of f/5.6. A given f/number is mathematically derived by dividing the focal length of a lens by the diameter of the lens diaphragm in question.

Factor; multiplying factor: An amount of compensation or increase of exposure due to various causes as in filter factor and bellows extension factor.

Falling front: See rising front.

Far point: The farthest object from the camera which is still acceptably sharp when the camera is focused for a given distance. Near and far points are used to describe the extent of depth of field.

**Fast:** Used in photography, a term meaning generally accelerated or efficient. For instance, a fast film is one which is highly sensitive to light, a fast lens transmits relatively more light than a "slow" one and a fast developer is one which acts more quickly on a film causing more rapid development. "Fast" does not always imply a gain in exposure as in the above examples; a fast shutter speed is one which is of shorter duration and which stops action but which causes less exposure if not compensated for.

**Feather; feathering:** Lighting by means of the peripheral area or edges of the normal light spread of the beam of a lamp. The purpose of feathering varies; it can help make lighting more even over a given area, as when a flashgun is feathered by aiming it over the heads of a deep group; it can enhance highlight brilliance and redistribute light on a subject when a key light is feathered in portrait lighting; or it can be used to reduce the intensity of a light.

**Feature picture:** One that is planned, aimed to tell a particular story, and not dependent on timeliness to any great degree.

**Field:** The area covered by a lens or a view finder.

**Fill; fill-in light:** Secondary illumination to lighten the shadows which are caused by a main or key light in basic lighting. It should be weaker than the main source and be placed close to the camera axis to avoid cross shadows. (See key and back light).

**Film base:** A cellulose acetate or plastic support for the emulsion layer in film.

**Film pack:** A daylight loading unit containing twelve or sixteen sheets of film attached to paper tabs so that the films can be successively exposed in the camera and then withdrawn to the rear of the pack without withdrawing it from the camera.

**Film pack adapter:** A device that holds the film pack when the pack is to be used in the camera.

**Film speed:** See ASA rating.

**Filter:** A piece of colored glass or gelatin used to selectively pass (transmit) or block (absorb) certain colors of light to alter the film's usual grey scale rendition of the subject. Filters can be used in a variety of situations to meet specific needs; for color correction, haze penetration and contrast control.

**Filter factor:** The number of times the exposure must be increased to compensate for the light which is absorbed by the filter.

**Fixer; fixing bath; hypo:** A chemical solution which dissolves or removes the unexposed and undeveloped silver halides from the developed film or paper. Its purpose is to make the negative or print permanent.

**Flare:** Excess light reaching film and causing fog, resulting from internal reflections within the lens. You can most easily get it when the camera is pointed towards the light source.

**Flat:** Lacking in contrast; opposite to "contrasty".

**Flood; flood lamp; photoflood lamp:** A high intensity bulb used to light indoor pictures, especially portraits and studio-type photographs.

**Focal length:** The distance from the optical center of the lens to the film plane when focused on infinity. It determines the image size which can be gotten with a given lens as well as controls its *f/stop*, depth of field and other lens attributes.

**Focal plane shutter:** A shutter consisting of a curtain with slits of various sizes, traveling as close to the film as possible. It generally includes higher shutter speeds than between-the-lens shutters. A camera having a focal plane shutter can be used with interchangeable lenses which do not have shutters of their own.

**Focal point:** A point on the focal plane at which converging rays of light from a lens meet. More simply, the photographic image of a point.

**Focus:** To adjust the distance between the lens and the film for greatest image sharpness, most commonly by moving the lens assembly forwards or backwards.

**Fog:** Non-image density on prints or negatives. This defect can be caused chemically in storage or in outdated film, it can be the result of stray light entering the lens when taking the picture or it may be due to a darkroom which is not absolutely light tight.

**Forcing:** Overdevelopment of an exposed film or paper, usually to try to compensate for underexposure. Largely an unsuccessful photographic practice, it is not recommended for students.

**Foreshortening:** Distortion because of too close a distance between subject and camera.

**Framing:** The practice of adjusting the camera to place the image within the picture frame, or borders, as seen in a viewfinder or ground glass.

**Fuzzy:** Out of focus; not sharp.

**Grain:** The individual particles of image silver in emulsions. According to their size and/or amount of "clumping" together, they give an impression either of coarse grain or fine grain. The former condition, also referred to as grainy or graininess, may be due to improper processing technique, type of film used or overexposure and/or overdevelopment. On the other hand, fine grain is usually the result of slower films, proper exposure, and careful processing. Fine grain is generally more desirable, but some small camera enthusiasts and experimentalist argue that coarse grain can give visual impact to the finished picture. Unfortunately, many unskilled amateurs, weak in basic technique and unwilling or unable to learn, use this argument as an excuse for poor craftsmanship.

Ground glass: A sheet of glass with a grained surface, attached to the back of the camera at the focal plane and used to aid in focusing and composition.

Guide number: A numerical rating given to a flashlamp to indicate its strength and to aid in determining exposure. It is not a fixed value and may be adjusted to suit specific conditions of equipment, processing, and the photographer's exposure preference.

Hair light: See back light.

Halation: A fog or halo around light objects in a photograph, due to reflection of light from the film base back up through the emulsion. Most modern films contain antihalation dyes which absorb light and prevent halation in all but the most brilliantly lit subjects.

Halftones: Middle grey tones between highlights and shadows.

Halides; silver halides; silver salts: The individual particles of light sensitive material which are suspended in the gelatin emulsion. Specifically, they are chemical compounds of silver bromides, iodides or chlorides, the amount and ratio of each depending on whether paper or film and on the purpose.

Hard: Having excess contrast as in a hard print or hard lighting.

Hardener: A chemical which makes the gelatin of the film emulsion physically tough and hard, making it more resistant to scratches and softening due to heat. It is used in the fixing bath.

Heavy: Large deposits of metallic silver on the negative, hence dark or dense.

High angle: Placement of camera above the action at a downward angle, it emphasizes pattern in the subject.

High key: A scene, subject, or print in which the majority of tones are light greys and white. Good for women, children, and light, airy effects. (See low key).

Highlights: The parts of a picture having the greatest amount of light; the blackest portions of a negative. Term is used in opposition to "shadows".

Haze penetration: The use of filters to discount or diminish the effect of ultra-violet radiation in distant scenes. (See ultra-violet).

Hot spot: A reflection on glass or highly reflective object causing a dark, blocked-up area on the negative or a central area of the scene having a markedly higher intensity than the edges. It should be avoided in artificial lighting by moving lights to another position. This is difficult in flash work; one device you can use is to light a match where the flash is to be positioned and watch for reflections from the camera position.

Hyperfocal distance: The distance from the camera to the nearest point of acceptable sharpness when the lens is focused at infinity. By focusing at

the hyperfocal distance for a given f/stop, the photographer gains the total sharpness possible because the picture is then sharp from half the hyperfocal distance to infinity.

Hypo: See fixer.

Image: The representation of a subject formed by optical (as on ground glass) and/or chemical means (as in developing).

Impact: The eye-stopping ability of a photograph. High impact photos are the result of an imaginative approach to photography -- of dramatic composition, unusual viewpoints or angles, and action and emotion in the subject matter. Ability to make photos with impact is a highly creative part of picture taking.

Incident light: Any great distance from the camera lens beyond which light rays to the lens are regarded as parallel. With the five inch f/4.5 lens any distance beyond 150 feet can be considered at infinity.

Infrared: Those electromagnetic rays which lie just beyond the visible light spectrum above 700 millimicrons. Although invisible to the human eye, they are used in photography with infrared sensitive film for special effects, camouflage detection, and in legal work.

Inverse square law: The intensity of light received at a point varies inversely as the square of the distance from the source. Example: light from a bulb at five feet is four times stronger on a subject than light from a bulb that is 10 feet away ( $5 \times 5 \times 25$  divided into  $10 \times 10 = 100$  is four times). Use of this principle is useful in exposure calculation with flash and flood lights and in compensating for bellows extension in copy and close-up work.

Kelvin ( $K^{\circ}$ ): See color temperature.

Key light; main light: The main source of illumination when lighting with two or more light sources. It should be stronger in effect on the subject than the fill light, with which it is used, and should be placed higher than and to the side of the camera. By such placement, it causes shadows which "key" or set the mood of the picture. (See fill light and back light.)

Key shot: The one picture in a picture story that can tell the whole story fairly well by itself.

Kill: To stop, or order stopped, the publication of a picture.

Latent image: The image recorded by light on the sensitive emulsion, remaining invisible until developed.

Latitude; exposure latitude: The amount by which a negative may be overexposed or underexposed without appreciable loss of image quality. The latitude of a film is not a fixed quality but depends on the brightness range of the scene and the amount of tones in the subject that the photographer wishes to reproduce well. For example, since most films will reproduce a range of 128 tones from white to black, there is theoretically only one "correct" exposure which can be used for a scene, which has 128:1 brightness range. Any other exposure will either overexpose the near-whites or underexpose near-blacks. On the other hand, a flat scene which has a 2:1 brightness range has a

latitude of six stops; that is, it can be overexposed three stops or underexposed three stops from "normal" exposure as indicated on chart or by meter, and still retain details in highlights and shadows. The best bet for beginners is to aim at the middle or "correct" exposure as calculated by use of a dependable chart or correct use of an exposure meter.

Lens louse: Newspaper slang for a person who wants to get in a picture whether he belongs in it or not.

Line copy: Original material to be copied containing only black and white areas or lines, without halftones. Also, the results of copying such material to a high contrast.

Low angle: Where the camera is placed low and the scene is photographed at an upward angle.

Low key: Applied to a picture in which the majority of tones range from dark grey to black. Good for moody or dramatic effects. (See high key.)

Magenta: A secondary color, the result of a combination of blue and red. It resembles the artist's pigment, fuchsia.

Matte surface: Applied to dull surfaced prints to distinguish them from glossy surface ones.

Middle tones: The values or tones in a photograph, subject, or negative between highlights and shadows.

Miniature camera: Any camera taking pictures approximately 2 1/4 x 2 1/4 inches or smaller.

Modeling: The illusion of three dimensional form and shape given to the photographed subject through effective lighting. The term is used especially in portraiture. A sense of modeling is lost or made weak when lighting is frontal (as in single flash on camera) or flat (as in two lights in a 2:1 ratio). Good modeling is gained by providing a higher contrast of key and fill lights and by the effective placement of the key light which causes shadows to fall across the planes of the subject's face.

Multilayer: Used to describe an emulsion with two or more separate photosensitive layers of emulsion with differing characteristics, such as positive color film.

Narrow lighting: See short lighting.

Near point: The nearest object to the camera which is still acceptably sharp when the camera is focused for a given distance. Near and far points are used to describe the extent of depth of field.

Negative: A photographic image, on film usually, in which the tones appear reversed.

Neutral: Without color, grey. Chemically, a solution which is neither acid or alkaline.

Non-color sensitized; NC emulsion; color blind: A photographic emulsion sensitive only to blue, violet, and near ultra-violet light. NC film is used in copy work and enlarging paper is generally color blind. The blue recording layer of color film is also an NC emulsion. (See also orthochromatic and panchromatic.)

Optics; optical: Pertaining to vision and the mechanics and characteristics of light bending by means of lenses, such as in the eye or camera.

Original: Material from which copies are made such as typing, printed matter, drawings, and photographs. Originals can be line, continuous tone or a combination of the two. They are also either in color or in black and white.

Orthochromatic film: A type of film which is sensitive to ultra-violet, blue, green, and some yellow light but not to red. It can be used in ordinary photography where the reproduction of red is unimportant or undesirable or where better tonal rendition in the greens is wanted. It is also quite useful in copying when a photographer wants to reproduce red as black. (See also panchromatic and noncolor sensitized.)

Overexposure: The result of too much light being permitted to reach the film during exposure in the camera. It is caused by too large an aperture or too slow a shutter speed or both. Overexposure for a given scene and film is relative to the latitude of the film. (See latitude.)

Oxidation: Chemical combination of oxygen with other substances. In practical terms, the loss of strength and activity of a developer because of its contact with air and/or its continued use. A developer turns brown as it oxidizes.

- Pan:
1. To swing the camera around horizontally as when following action or in movie work.
  2. An abbreviation for panchromatic film.

Panchromatic: A black and white emulsion which is sensitive to all visible light. It is the most widely used film emulsion since it most nearly approximates the sensitivity of the human eye and because it generally has the highest film speed. (See also orthochromatic film and non-color sensitized.)

Parallax: The viewing difference of an object as seen through the viewfinder and as actually photographed by the taking lens. This fault will result in improper framing (heads chopped off, objects not in center of the photograph) if not compensated for with a parallax footage adjustment. Parallax is not encountered when the scene is viewed by means of an image which is formed by the taking lens, as in ground glass or single lens reflex camera viewing.

Photojournalism: A means of communication where the main emphasis is predominately achieved through pictures.

Photomicrography: Photography of extremely small objects through a microscope.

Photomontage: A photographic print made from several different negatives on one sheet of paper.

Photomural: A photograph of a very large size mounted on a wall or panel usually for decorative or display purposes.

Photosensitive: Material which is chemically or physically changed by the action of light. Most commonly in photography silver halides are exposed to controlled amounts of light to form a latent image of the subject. (See halides and latent image.)

Picture plane: See focal plane.

Picture story: A planned, organized series of related pictures that tell a story.

Pictorialist: A non-commercial photographer who takes pictures for the sake of esthetics alone, rather than for a functional use. The title is sometimes applied more narrowly to a member of the Photographic Society of America (PSA); this international non-profit club holds regular exhibitions in the tradition of the "salon".

Pinhole camera: A camera having a tiny aperture instead of a lens. It has no practical significance in picture taking and is used for the most part as a training device or a novelty.

Pinholes: Tiny clear spots on negatives generally caused by dust on the film during exposure, sometimes the result of air bells during development. In both cases, they emphasize the need of cleanliness and control during the photographic process.

Pix; pics: Slang term for pictures.

Positive: A photographic reproduction in which tone values correspond to the original scene; it is opposite to negative.

Primary colors: Blue, green, and red.

Print: (noun) -- A picture that has been made photographically.  
(verb) -- To make a picture from a negative.

Processing: The chemical treatment of exposed emulsion to make a permanent visible image; besides developing and fixing, the term is usually used also to refer to such operations as washing and drying.

- Ratio:
1. Lighting ratio is the relationship of strengths of lights, one to another, and is expressed numerically as 2:1, 3:1, etc. It is commonly used in portraiture and multiple flash work.
  2. In copying, it refers to the degree of enlargement or reduction of the copy with respect to the original, such as 1:1 copy.

Reading: The process of measuring light with an exposure meter and calculating proper exposure.

Reciprocity law: Exposure is equal to the intensity of the light times the time during which it acts, or  $E = I \times T$ . If an exposure like 1/100 at f/16 is recombined into 1/50 at f/22, the exposure effect on the film should be exactly the same according to this law. The law is only approximately true, however, because photographic materials react differently to light

under different intensity and time conditions, especially at the extremes. The result is a "failure of the law of reciprocity" under which condition exposure times have to be readjusted. For example, a long exposure of 10 seconds or more in color photography does not result in an equivalent exposure to a short one -- a 16 second time at f/32 is not the same as 1/2 second at f/5.6 as it would be mathematically; it needs 1/2 stop more exposure because of a reciprocity law failure.

**Reducer:** A solution used for decreasing contrast or density in overexposed or overdeveloped negative.

**Reflector:** A curved bowl used to increase the efficiency of a light source by concentrating the light into a direction or beam. Used especially under artificial light conditions such as studio floodlighting and flash. Outdoors, flat cardboard or tinfoil reflectors are sometimes used.

**Refraction:** The bending of a ray of light in its passage between optical glass of different densities.

**Resolving power; resolution:** The relative ability of a lens or an emulsion to record fine detail, usually expressed as the maximum number of black lines, with equal white spaces, which can be distinguished per millimeter. Results for a given lens or emulsion will vary with contrast and with type and time of development.

**Reticulation:** The wrinkling or puckering of the emulsion surface of a film, due to sudden changes of temperature during processing. Even if reticulation does not occur, a change of temperature of more than five degrees during any part of processing is a poor practice since increased graininess of the negative is a result. (See grain)

**Retouching:** Alteration of a photographic image by making portions of it darker, lighter, or by removing it. Done by pencil, dye, etching knife (for removal of silver) or chemical means.

**Reversal film:** A film which after exposure is processed to produce a positive image instead of a negative. It can be either color or black and white.

**Rim light:** See back light.

**Rising front:** An adjustment on most press cameras and all view cameras which permits the lens board to be raised higher than normal. In this position the camera "sees" the subject higher without perspective distortion as would happen if the whole camera were tilted up. It cannot be used, however, unless the camera lens has enough covering power. (See latter) The adjustment which permits the lens board to drop lower than normal is called falling front. It can be used when shooting down from high places. The same adjustment in back is called rising back.

**Safety shot:** An extra negative exposed as insurance against loss of the first negative.

**Saturation:** Degree of purity of color or freedom from dilution by white, black, or grey.

**Secondary colors:** Cyan, yellow, and magenta.

Selective focus: Bringing the background, or the foreground either into or out of focus by means of variations in the depth of field in order to emphasize the main subject.

Sensitivity: 1. The degree to which an emulsion reacts to light. A film with a high sensitivity needs less exposure than one with low sensitivity, and vice versa.

2. The degree to which a photographer reacts to a subject or photographic situation. A photographer with a highly developed sense of visual and emotional sensitivity needs less luck and will have better pictures than one with a routine approach to his picture taking.

Shadows: The darker portions of a picture or subject or the thinner portions of a negative.

Sharpness: The sense of distinctness and precision of detail in the reproduction of a subject in a picture. In focus; opposite to out of focus or blurriness.

Shifting front; shifting back: The same adjustment as the rising and falling fronts and backs except on a left and right basis instead of up and down. (See rising front)

Shoot; shot: To take a picture; a picture.

Shooting script: A written plan for a picture story.

Short stop: See acetic acid.

Short lighting; narrow lighting: Illuminating fully the side of the face turned away from the camera. It is called narrow lighting because it results in more shadow area on the face while keeping the highlight side more narrow than in broad lighting. (See latter)

Silver halides; silver salts: See halides.

Slide: A photographic transparency bound for viewing by projection on a screen.

Slow: Opposite to fast. (See latter).

Snap; snappy: Having brilliance or contrast.

Soft: 1. Relatively low contrast in negative or print, or in lighting as in a low ratio.

2. Unsharp or diffused image overall caused by accident (oil, water, or dirt on lens, or improper focus) or by intention by means of a special lens as in portrait photography. Soft focus photography was in vogue two generations ago, went out of fashion for a time and has made a revival recently in advertising photographs of women's personal property and of cigarettes. It is not taught in this school.

Soup: Developer.

Speed: A general term referring to the relative efficiency of emulsions, lenses or shutters. The expression is usually preceded by "slow," "medium," or "flat."

Spill: Stray light from a light source as in floodlighting, caused by light rays from the front of the lamp which do not reach the reflector to form the main beam.

- Spot:
1. Contraction for spotlight, a lamp which projects a strong, narrow beam of light.
  2. To remove white spots from photographic prints with pencil or brush and water color.

Spot news picture: A picture that has an immediacy in usage, and that cannot be planned, as a rule: fires, catastrophes, events of interest happening now.

Squeegee: A strip of flat rubber in a handle used in removing excess moisture from prints or film by stroking. Don't press too hard or you may scratch the picture.

Stain: Local or general discoloration of negatives and prints due to many varied causes but all stemming from either unclean or uncontrolled practices in processing.

Static marks: Branching, treelike marks produced on sensitive materials by discharges of static electricity during handling or winding under very dry atmospheric conditions. Quite unusual but sometimes happens when inserting or taking out a dark slide rapidly from a holder, for example.

Stills: Photographs as distinguished from motion pictures.

Stock solution: A concentrated solution of a processing chemical, usually a developer, which has to be diluted with water for use.

- Stop:
1. An aperture or f/stop, as used in "What stop are you using?"
  2. Loosely, a reference to a two times multiple of light, as in "Give a backlighted subject two stops more exposure, say from 1/100 at f/16 to 1/100 at f/8." In this instance, the photographer means to give four times more exposure which, of course, is accomplished by opening up the diaphragm by two f/stops; it can also suggest changing the exposure by means of the shutter speeds. In the above example, the photographer could have increased the exposure by using a slower shutter speed (1/25 at f/16) which would have given four times the light. Or he could have increased the exposure one stop's worth (2x) through f/stop change and one stop's worth by means of shutter speed and used 1/50 at f/11. The exposures, 1/100 at f/8, 1/25 at f/16 and 1/50 at f/11, are equivalent; they are all the result of opening-up or increasing the exposure by two "stops".

Stop bath: See acetic acid.

Stop down: To use a small aperture.

- Straight:
1. Not retouched, used in reference to negative or prints.
  2. Processing solutions which are not diluted.

Strobe light: See electronic flash.

Subject reflectivity: A photographic subject is capable of reflecting a certain percentage of the light which shines on it. According to how much it reflects, it is classified as dark (it reflects approximately 9% of the light which falls on it), average (reflects 18%), light (reflects 36%) or brilliant (reflects 72%). Subjects are broadly classified into these types when calculating exposure from a daylight exposure chart or when determining flash exposure.

Swings: A function of a view camera in which the lens aboard and/or back can be revolved horizontally around the optical axis. Used together with tilts it provides shape and sharpness (through depth of field) control of the image.

Synchronizer: A device which trips the camera shutter simultaneously with the firing of a flashbulb so that the shutter is fully open at the instant that the flash has reached its highest intensity.

Telephoto lens: A lens of long focal length used to obtain enlarged images of distant objects.

Test strip: A piece of contact or projection paper exposed in such a way that it contains several different exposures; from it, the best printing time is determined.

Text: The written matter on a page as distinguished from photographs, drawings, etc.

Thin: A light or "weak" negative lacking density, usually caused by underexposure and/or underdevelopment. Also is used to refer to specific light portions within negatives. Opposite to "dense".

Three-quarter: 1. In portraiture, a standing or seated pose which includes the subject from about the knees up.  
2. In general photography, it refers to an angle or view which shows three sides of a subject, for example the front, side, and some of the top of a car.

Tilts: Companion term to swings in which, however, the front or back revolve around a horizontal axis. A good way to remember the difference is that "swing" acts like a gate while "tilt" is like a man walking against the wind.

Time-temperature: A system or procedure in photographic processing in which developing is done in the dark using a predetermined time based on the temperature of the developer. The system is consistent and dependable because there is a direct and predictable connection between these two factors so that as temperature goes up, time is decreased and vice versa.

Tonal range: Relative ability of a light sensitive material to reproduce accurately the varying tones between black and white. Film has a greater tonal range than printing paper; most films will reproduce about 130 tones between black and white while paper reproduces from about 15 to 60 tones depending on its contrast. In practical terms, this means that tone brilliancy and/or fidelity is always lost between negative and print.

**Translucent:** Permitting the passage of light but scattering light sufficiently so that no image can be seen through the material. A ground glass is translucent.

**Transmit:** To allow to pass through as red light is transmitted through a red filter. If a color is not transmitted by a filter, then it is either reflected from it or absorbed by it.

**Transparency:** A positive, color, or black and white picture on a transparent base which is viewed by transmitted light. A 35mm slide is a transparency.

**Tungsten:** Artificial light as contrasted with daylight. A differentiation between the two is useful in many areas in photography; for instance, black and white film speeds are different for each kind of light and the color temperature of tungsten is lower than that of daylight. (See latter.)

**Ultra-violet:** The invisible region of the electromagnetic spectrum ranging from about 300 to 400 millimicrons. Even if invisible to the eye it affects all photographic emulsions and causes additional, unexpected exposure in film. For instance, distant scenes contain much ultra-violet, even though they appear clear to the eye, and photos of them appear as if taken in a fog or haze. To correct this condition, a filter (usually of a red or yellow color type) which absorbs ultra-violet radiation is used.

**View camera:** A camera which controls the shape, placement and sharpness of an image through adjustments and realignments of lens and film planes. (See tilts, swings, shifting and rising fronts). Besides front and back controls, it has a long bellows draw for close-up work. Because of its adjustments it is generally used on a tripod with ground glass viewing. It is not convenient for news work and is chiefly a studio or architectural camera.

**Viewpoint:** The place from which the picture is taken or viewed. Often used interchangeably with "angle" although the latter usually implies a higher or lower than normal viewpoint.

**Washed-out:** Term applied to a print or portions of a print with too white or light highlight details.

**Water spots:** Defects on negative due to drops of water being allowed to stand on the negative during drying. They are formed when the gelatin layer dries at a different rate around the drop, and they are impossible to correct once they form. To help prevent them, use wetting solutions before drying and/or squeegee negatives carefully so as not to leave sizeable drops.

**Weak:** Light or thin negatives or parts of negatives.

**Wetting agent:** A chemical added to water to reduce surface tension and make it "wetter." It helps reduce the formation of water spots in drying negatives.

**Whites:** The highlights of a print.

**Wide angle lens:** A lens of a shorter focal length than the standard lens, used to get more area into the picture.

## APPENDIX B

### FILTER CHARACTERISTICS

Type of filter	Filter factor	Performance characteristics
Aero 1, K1, light yellow.....	1.5	Slight color correction for all types of panchromatic films. Produces slight contrast. Penetrates light haze. Improves facial details with little added exposure.
Aero 2, K2, K3, yellow.....	2.0	Normal color correction for all types of panchromatic films. Produces medium contrast. Darkens blue sky. Brings out clouds. Greater haze penetration than Aero 1. The most popular filter for general outdoor photography. Absorbs ultraviolet, violet, and some blue.
12 minus blue yellow.....	2.0	Slightly stronger effect than Aero 2. Useful in eliminating haze in air motion picture photography. Color correction between Aero 2 and 15G.
15G deep yellow.....	2.0	Full color correction for all types of panchromatic film. Produces greater contrast than 12 and Aero 2. Used more for open landscape. Darkens blue sky, bringing out clouds. Penetrates distant haze. For use with long focal length lenses. Lightens all yellows, reds, and oranges.
No. 21 orange.....	2.0	Slight overcorrection for all types of panchromatic film. Produces more contrast than G filter. Strong cloud effects. Good for mountain and air photography. Penetrates distant haze with long focal length lenses.
23A orange red.....	4.0	Medium overcorrection for all types of panchromatic film. Darkens blue sky and water for light night effect in sunlight. Produces more contrast than No. 21 filter. Darkens greens slightly. Lightens all yellow, orange, and red colors.
25A red.....	8.0	Considerable overcorrection on panchromatic film. Action same as 23A but more pronounced. Produces very strong contrast. Penetrates aerial haze. Creates dramatic and spectacular night effects. Standard tricolor red filter for three-color separation negatives. Normally used with infrared films.
29F deep red.....	16.0	Extreme overcorrection and contrast. Full night effects in strong sunlight. Turns blue sky and water to strong black. Turns all yellow, orange, and red colors into white. Used with infrared films. This filter is also useful with C4 and N-67 in making separation negatives from original color transparencies.
35D 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.
47 C5 blue.....	6.0	Generally used with orthochromatic films to increase blue contrast. Makes blue sky lighter and any emulsion colorblind. Also used as tricolor blue for color separation negatives from color transparencies.
49 C4 dark blue.....	14.0	Experimental tricolor filter. 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.
X1 light green.....	4.0	Slight softening effect and good correction for all types of panchromatic film. Can also be used with orthochromatic films. Renders green and yellow slightly lighter, red and blue slightly darker.
X2 green.....	6.0	Medium softening effect and good correction with all types of panchromatic film. Slightly stronger green contrast than X1. Darkens reds and blues.
56 B3 green.....	4.0	Strong softening effect with all types of panchromatic film. Produces green and yellow contrast. Same action as X1 and X2 but with much stronger effect. Used with 23A for soft night effect in sunlight.
48 B2 dark green.....	12.0	Slightly stronger than 56 B3. Used for greater contrast. Records green and yellow very light, other colors dark. Also used as tricolor green for three-color separation work.
3 N5 yellow green.....	4.0	Combination of Aero 1 and 50% ND. Slight color correction. General use, open landscape, street, desert, and snow scenes.
5 N5 yellow green.....	6.0	Combination of Aero 2 and 50% ND. Normal color correction. Used for snow scenes and strong contrast. Gives pleasing value to open water photographs.
70 deep red.....	32.0	Extreme overcorrection and extreme contrast in all blue and green colors. Used generally for haze cutting in air photography and heavy night effects in strong sunlight. Also used with infrared film.
72 brown red.....	80.0	Extreme overcorrection and contrast in all blue values. Turns blue sky and water into jet black. Can be used for long distance haze cutting in air photography and for extreme night effects in sunlight.

Type of filter	Filter factor	Performance characteristics
90 deep yellow		A monochromatic viewing filter showing relative color values and their photographic densities. Designed primarily for visual use to reduce color differences to a monotone. Also used as a guide to determine relative density of tungsten illumination on subject.
25% ND neutral	1.8	Slight contrast neutralizer. Softens light glare and contrast and functions as light exposure compensator. Has no corrective color value.
50% ND neutral	3.0	Medium contrast neutralizer. Used for medium softening of glare and contrast. Medium exposure compensator. May be used with all types of film and with any filter.
100% ND neutral	10.0	Extreme contrast neutralizer. Same action as 50% ND but with greater degree of softening effect.
200% ND neutral	20.0	Extreme contrast neutralizer. Same action as 100% ND but with greater degree of softening effect. Used with very strong sunlight.
Pola-screen	2.5	For controlling strong glare and brightness of sky and water and harshly lit and contrasty subjects. Dissolves reflections through glass and water without changing the color density. Darkens blue sky to about the same extent as an A filter. May be used with any filter. The maximum results are obtained with the sun's rays at 90-degree angle to the camera. Two pola-screens together form a variable neutral density filter with a range up to 32% transmission.
47B blue violet	5.0	Used for three-color separation.
N-61 green	10.0	Used for three-color separation.

*Filter Selection*

Subject	Desired effect	Filter selection																									
Architecture, light colored buildings against blue sky.	Separate building and sky	K2																									
	Greater building-sky contrast	G																									
	Dark sky	A																									
Red brick	Show texture	G																									
Furniture (reddish woods)	Show grain	A																									
Leather, wallpaper	Natural condition	Correction filter as indicated below.																									
		<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Film</th> <th style="text-align: left;">Daylight</th> <th style="text-align: left;">Tungsten</th> </tr> </thead> <tbody> <tr> <td>Ortho</td> <td>K2</td> <td></td> </tr> <tr> <td>Pan B</td> <td>K2</td> <td>X1</td> </tr> <tr> <td>Pan C</td> <td>X1</td> <td>X2</td> </tr> </tbody> </table>	Film	Daylight	Tungsten	Ortho	K2		Pan B	K2	X1	Pan C	X1	X2													
Film	Daylight	Tungsten																									
Ortho	K2																										
Pan B	K2	X1																									
Pan C	X1	X2																									
Colored objects	Increase contrast	Contrast filter as indicated below. (Filters listed in order of decreasing effect.)																									
		<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Color of subject</th> <th style="text-align: left;">To lighten use—</th> <th style="text-align: left;">To darken use—</th> </tr> </thead> <tbody> <tr> <td>Red</td> <td>A, F, G</td> <td>C5, B</td> </tr> <tr> <td>Green</td> <td>B, X1, X2</td> <td>C5, A</td> </tr> <tr> <td>Blue</td> <td>C5</td> <td>F, A, G, B</td> </tr> <tr> <td>Cyan</td> <td>C5, B</td> <td>F, A</td> </tr> <tr> <td>Magenta</td> <td>F, A</td> <td>B</td> </tr> <tr> <td>Purple</td> <td>C5</td> <td>B</td> </tr> <tr> <td>Yellow</td> <td>K2, G, A</td> <td>C5</td> </tr> <tr> <td>Orange</td> <td>G, A</td> <td>C5</td> </tr> </tbody> </table>	Color of subject	To lighten use—	To darken use—	Red	A, F, G	C5, B	Green	B, X1, X2	C5, A	Blue	C5	F, A, G, B	Cyan	C5, B	F, A	Magenta	F, A	B	Purple	C5	B	Yellow	K2, G, A	C5	Orange
Color of subject	To lighten use—	To darken use—																									
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Cyan	C5, B	F, A																									
Magenta	F, A	B																									
Purple	C5	B																									
Yellow	K2, G, A	C5																									
Orange	G, A	C5																									
Lettering	Increase legibility	Contrast filter to darken (see above).																									
Mountain views, ice, snow, and water.	Reduce haze	Haze filter (any blue-absorbing). The following are listed in order of increasing effectiveness. K2, G, X1, A																									
Glass, bright sky, water, and wet pavement.	Reduce reflection	Pola-screen																									

## APPENDIX C

### NEGATIVE DEFECTS, THEIR APPEARANCE, CAUSE, AND REMEDY

Defect	Appearance	Cause	Remedy
Abrasion marks or streaks.	Fine black lines usually resembling pencil scratches running in same direction.	Friction on emulsion caused by improper handling or storage sometime between manufacture and development.	Great care should be taken in storage of film. Boxes containing film should be stored on end so that no pressure is exerted on surface of emulsion. Care should also be taken not to rub or drag sensitized material over a rough surface, before or after development.
Air bells.	An air bell occurring during development shows as a small transparent spot. Sometimes minute, dark streaks lead from spot. When negative is rocked in tray, streak projects from each side of spot in direction tray is rocked. If tray is rocked in two directions, streaks form cross with transparent spot in center. In tank development, dark streak usually forms at lower edge of transparent spot. In fixing bath they show as small, round, dark spots.	Transparent spots occurring in developer are caused by bubbles of air on surface of emulsion. These prevent developer coming into contact with emulsion. Darkened streaks are result of excess oxidation of developer, caused by air in bubble. Dark spots which occur in fixing bath, caused by pocket of air holding fixer away from emulsion allowing a slight continuation of development.	Immerse film carefully and thoroughly in developing and fixing solutions; Move film during development and fixation to break up and prevent air bells. Water always contains some air and when there is a rise in temperature, air is expelled and gathers in form of small bubbles on inside of tank and also on surface of film during preliminary stages of development. Allow water needed for development, to stand for several hours at temperature required for use, before beginning developing operations.
Blisters.	Resemble familiar ones which arise on human skin from slight burns.	Liquid or gas, formed between emulsion and film support when solution has become too warm and has loosened gelatin from its support; also produced by developer and fixer too strongly concentrated; changing film from one bath to next may cause formulation of gas between emulsion and support; frequently caused by insufficient rinse after development and placing	Description of causes of blisters indicates manner in which defects may be avoided.

Defect	Appearance	Cause	Remedy
		<p>directly into fixer having strong acid content. Another common cause is allowing water from faucet to flow directly on emulsion of negative.</p>	
<p><b>Blurred negative.</b></p>	<p>Indistinctness or lack of definition in negative image.</p>	<p>Subject not properly focused on the film; movement of camera or subject; or, lack of proper camera adjustment; film was not flat in focal plane when exposure was made. Sometimes produced by moisture or haze on lens or dirty lens.</p>	<p>Care in focusing and holding camera, keeping camera in proper adjustment and lens free of moisture or dirt.</p>
<p><b>Brown spots.</b></p>	<p>Brown or sepia-colored small areas or spots on negative.</p>	<p>Produced by oxidized developer or by fine particles of chemicals settling on film prior to development. May also occur during washing, from rust or other impurities in water.</p>	<p>Avoid exhausted or oxidized developer. Do not use developing room for mixing chemicals. Filter wash water.</p>
<p><b>Crystalline surface.</b></p>	<p>Surface of negative emulsion possesses a crystalline appearance suggesting frost on a window pane.</p>	<p>Insufficient washing after fixing. Hypo remains in film and crystallizes.</p>	<p>Use sufficient final washings.</p>
<p><b>Dark lines.</b></p>	<p>These lines must be divided into two distinct classes--those which run from dark areas to more transparent areas of the negative, and those from more transparent areas to darker areas. In both cases lines are wider, not as clean cut, and not nearly as parallel as abrasion marks.</p>	<p>First class is caused by insufficient agitation of negative in tank development. Cause of second class is thought to be of an electrolytic origin.</p>	<p>For first class, more frequent agitation during development. Remedy for this class aggravates defect in second class. Only known remedy is to remove all film hangers from tank 4 or 5 times during developing period, holding hangers in a bunch, and allowing corners of hangers to rest on edge of developing tank for 10 to 15 seconds.</p>

Defect	Appearance	Cause	Remedy
Fading tendency	Sepia or yellow-colored stains or areas in negative.	Incomplete fixation, or insufficient washing will cause fading. Remnants of fixing bath left in emulsion continue their action and in time this defect appears.	Properly fix and wash negatives completely. Final washing is as important as any operation in negative processing.
Fingermarks.	Imprint of fingers shows up on negative.	Impressing wet or greasy fingers on emulsion of film before or during development and fixation. If mark is merely an outline of finger, it was caused by water or grease on finger; if dark it was caused by developer; and if transparent or light, it was caused by fixing bath.	Keep hands clean and dry when handling film. Sometimes natural oil on fingertips causes grease marks referred to above. Handle film by edges. When fingers become wet with water or solutions, wash and <b>DRY THOROUGHLY</b> before attempting to handle film.
Fog (Aerial).	A slight veiling of negative or parts of negative.	Negative exposed to air during development, especially when hydroquinone is used as a developing agent. Occurs most frequently in freshly mixed developers, particularly those containing excessive amounts of alkali or hydroquinone.	Add potassium bromide to developer or add used developer to fresh developer.
Fog (Dichroic).	Usually a fog of little density, consisting of finely divided particles of silver. When viewed by transmitted light it is pinkish; viewed by reflected light, it appears reddish-green.	Using ammonia as an accelerator. Hypo or excessive amount of sulfite in developer.	Easily removed by treating negative in weak solution of potassium permanganate. Prevention is obvious from list of causes. Further prevention is assured by using clean tanks for developer and fixer solutions.
Frilling.	Edges of gelatin become detached from base. Detached edge of emulsion may either break off or fold over. When latter happens, it is sometimes possible to partially remedy damage by smoothing out emulsion when negative is	Careless handling; using solutions that are too warm; insufficient hardening of emulsion due to insufficient fixation; exhausted fixing bath or one containing insufficient amount of hardener; and/or excessive	Handle film carefully and sparingly; use working solutions that are mixed correctly and are at proper temperature. Wash film sufficiently, but never excessively.

Defect	Appearance	Cause	Remedy
	placed to dry.	washing. Frilling is usually caused by a combination of careless handling and any other mistake that will render the emulsion of film soft.	
Gas bells.	Minute pimples or blisters.	Develop by transferring negative from strongly concentrated developer to strongly acid fixing bath without thoroughly rinsing, after removing from developer and before immersing in fixing bath. In warm weather, gas bells may appear even when using solutions of normal strength, if rinsing between development and fixation has been insufficient.	Use an intermediate hardener/rinse bath.
Halation.	A dark band or area extending from intensely bright objects, suggesting a double image, and appearing in print as a halo or band of light around object.	Photographing an intensely bright object surrounded by dark objects. Intense light penetrates emulsion and is reflected back by negative support.	Use antihalation film and avoid pointing camera at bright sources of light.
Pit marks.	Fine holes or pits in emulsion.	Excessive alum in fixing bath; sulfurous precipitation from fixing bath when negatives are fixed in tray; and too rapid drying of film.	Proper fixing and drying.
Pinholes.	Minute transparent spots.	Dust on film before exposure.	Proper handling of film.
Reticulation.	Leatherlike graininess or wrinkling of emulsion.	Too great a difference in temperature of baths or between final wash water and air in which negative is dried. Gelatin of emulsion may become badly swollen due to temperature of a solution or wash water, and upon shrinking contracts irregularly due to	Keep all solutions cool and at uniform temperature. Under tropical conditions use a concentrated developer and short development. Reticulation effect may sometimes be removed by placing negative in a 10 percent solution of formaldehyde for a few minutes and drying

Defect	Appearance	Cause	Remedy
		<p>metallic silver incorporated in emulsion. Excessive softening of emulsion followed by a strong hardening bath or a highly alkaline treatment followed by strong acid.</p>	<p>rapidly with heat. Use ample ventilation in drying negatives treated in formaldehyde.</p>
Streaks.	<p>Streaks and patches, as in case of spots, may be dark, white, or transparent.</p>	<p>May be due to uneven development, by developer not flowing evenly over film, by not rocking tray, or not moving film in developer. May also be due to developer splashed on film before development, dirty tray or tank, fixer tray or tank used for developing, or light fog. If edges of film are clear, trouble is in camera; if edges are fogged, it is due to manipulation in darkroom. Certain kinds of resinous woods and varnishes cause dark fog patches. White or transparent patches may be due to obstructions in camera, which prevented light from acting on film; a "resist" in the form of oil or grease, which prevented action of developer; a splash of hypo, or film touched with hypo-soaked fingers before development. Hypo dissolves away some of the emulsion so that, on development, portion touched appears lighter than rest. Drying marks in form of teardrops or white patches are caused by splashes of water on a dry negative or by leaving spots of water on film before drying, especially if film is dried in warm air.</p>	<p>Precautions to avoid streaks suggest themselves when cause is traced. In many cases, they can be avoided by care in operation and maintenance of equipment. When placing negative to dry, blot excess moisture from both sides or use suitable wetting agent.</p>

# APPENDIX D

## COLOR TEMPERATURE SCALE

OUTDOOR	KELVIN	FILM	DECAMIRED	INDOOR			
EXTREMELY BLUE CLEAR NORTH- WEST SKY	26000						
	25000						
	24000				4.0		
	23000						
	22000						
CLEAR BLUE SKY	21000						
	20000				5.0		
	19000						
	18000						
	17000				6.0		
BLUE SKY WITH VERY THIN CLOUDS	16000						
	15000						
	14000				7.0		
	13000				8.0		
	12000						
BLUE SKY	11000				9.0		
	10000				10.0		
	9000				11.0		
	8000				12.0		
	8000				13.0		
UNIFORM OVERCAST	7000				14.0		
	7000				15.0		
	7000				16.0		
AVERAGE NOON SUN	6000				Daylight	17.0	ELECTRONIC FLASH
	6000					18.0	DAYLIGHT FLUORESCENTS
	6000					19.0	BLUE FLASHBULBS
	6000					20.0	
	6000					22.0	DAYLIGHT PHOTOFLOODS
	6000					22.0	
	4000					25.0	
	4000					25.0	CLEAR FLASHBULBS
	3500					30.0	PHOTOFLOODS
	3500					30.0	STUDIO FLOODS
Tung- sten	3000				35.0	HOUSEHOLD TUNGSTEN	
	3000				35.0	FILAMENT LAMPS	
	2500				40.0		
	2500				45.0		
	2000				50.0	CANDLE FLAME	