SILVER IMAGING

PREFACE

The purpose of this text is to provide the reader with a working knowledge of film-based black and white photography in a fine art environment. Within that context, the compositional principles of fine art photography in the following chapters will include a limited discussion on the technical (and important) aspects of film and paper production, camera operation, and film exposure. This approach is not meant to lessen the need or importance of fully understanding the "how and what" of photography. Instead it encourages the reader to continue researching information and acquiring knowledge as it applies to the specific type of photography the individual chooses to pursue.

The text is arranged to first provide an introduction into the technical basics of photography before engaging in a discussion of composition and image management as it applies to fine art photography. The technical information has been arranged to include camera types, lens operation and types, and basic film and paper exposure and processing principles. Of those categories, the reader is encouraged to research the various methods and techniques of film exposure and processing which are beyond the scope this text. Understanding how variations in film and paper processing can add to the visual impact of black and white photography can greatly expand the artist's ability to interpret and explore photography.

The discussion of composition and image management which follows the technical dialogue is designed to provide the reader with a basic understanding of how photographs work to convey information in the strongest way possible. Although words cannot fully describe the mechanics of photography, it is possible to weave some of the basic principles of composition into a tapestry that can be discussed and shared as "Image Elements." Throughout the text this term is used in to describe the techniques and components which can result in improving the visual impact of photographs.

The remaining portion of the text is devoted to describing photographs as they exist in a fine art environment, and applying that knowledge to our own skills and abilities. Based on a practical application of what is learned by describing photographs, the text creates a methodology for exploring the world through the eyes of the camera in what is termed Personal Photography, or in other words a "visual diary". Although a very modern form of visual art, photography relies somewhat on the techniques of the past in terms of composition and visual impact. From there, it ascends to a new role that was best explained by John Szarkowski, the former director of the photography department at the Museum of Modern Art, as he describes the two basic types of photographs:

> "The romantic view is that the meanings of the world are dependent on our own understandings. The field mouse, the skylark, the sky itself do not earn their meanings out of their own evolutionary history, but are meaningful in terms of the anthropocentric metaphors we assign to them. It is the realist view that the world exists independent of human attention, that it contains discoverable patterns of intrinsic meaning, and that by discerning these patterns, and forming models or symbols of them with the materials of his art, the artist is joined to a larger intelligence." [1]

Mr. Szarkowski goes on to label the romantic and realist notions as "mirrors" and "windows" respectively. This text should help the individual create either mirrors or windows as each might choose.

R. Tonder - September 2005

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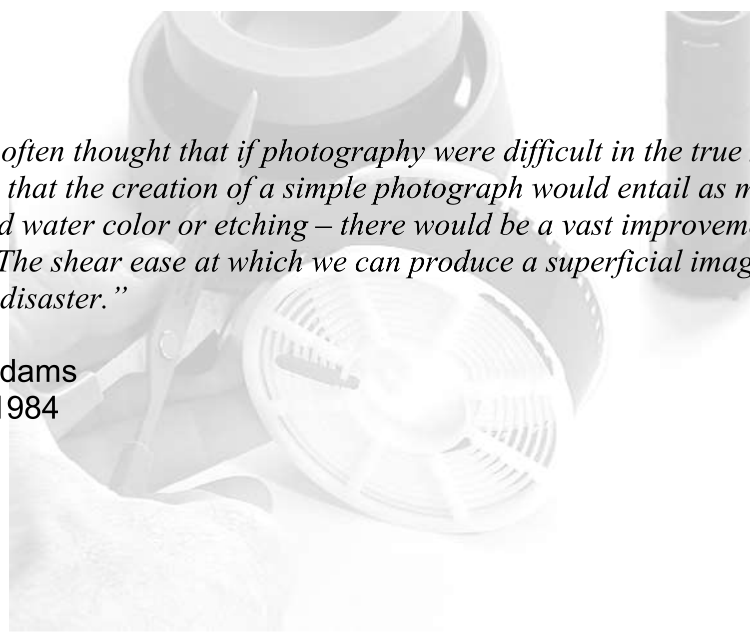
ISBN 978-0-9793719-1-2
Grand Forks, North Dakota

BLACK AND WHITE PHOTOGRAPHY

PART ONE: PHOTOGRAPHIC FUNDAMENTALS



"I Have often thought that if photography were difficult in the true sense of the term – meaning that the creation of a simple photograph would entail as much time and effort as a good water color or etching – there would be a vast improvement in the total output. The shear ease at which we can produce a superficial image often leads to creative disaster."

Ansel Adams
1902 - 1984

Part One – Chapter One: Camera Basics

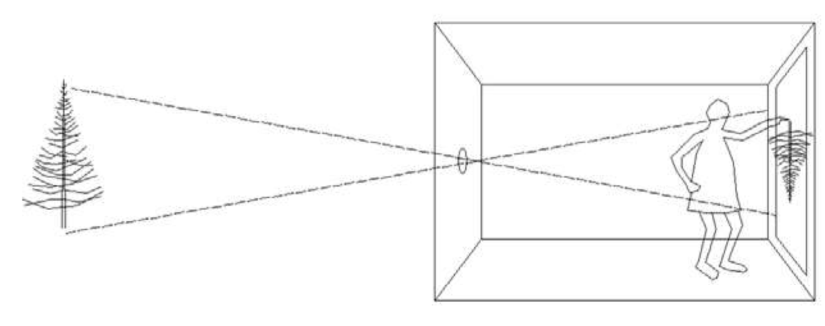
Introduction

This chapter illustrates and identifies basic camera operations and types. Because the camera is the gateway or tool for forming images on film, understanding how the camera works is essential to controlling "Image Elements," the building blocks of photographic composition.

The First Camera

Since the word "photography" means "writing with light," it follows that the camera is a tool which regulates or controls light. To do so, the most primitive camera requires a light proof container to protect the unexposed film from unwanted light, and a portal or opening to allow light to enter the container forming the image. In addition, the portal must accommodate a way to open and close, thereby regulating the amount of light reaching the film. This basic form of camera dates back thousands of years prior to the invention of film and is referred to as the *camera obscura* (Latin for *Dark Chamber.*)

Basically a darkened room, the camera obscura forms an image by projection onto an interior wall. The source of the image is whatever scene is present outside the darkened room. A small opening in the exterior wall acts like a lens, creating a reproduction of the exterior view on the interior of the camera obscura. The artist traced the image formed by the light onto a sheet of paper or canvas hung from the ceiling. It works because light rays travel in a straight line, with the size of the wall opening determining the diameter of the light ray. The light ray originates as a dark or light object (or point) in the scene, then travels in a straight line to form a dark or light object on the wall. The image is made up as a collection of the light and dark points



Camera Obscura

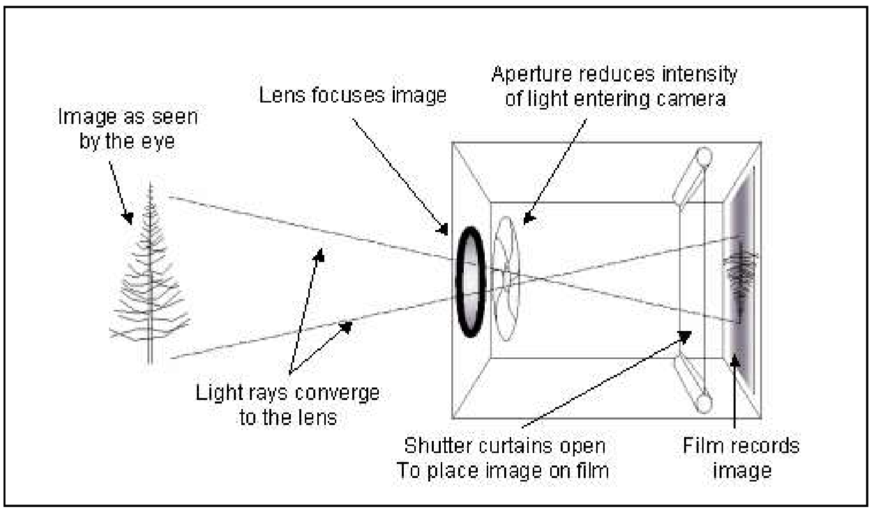
Some type of Camera Obscura was used by both the ancient Greeks and Chinese, suggesting that the discovery of the circumstance giving rise to this process may have been accidental. In a similar fashion, it was determined that the daily exposure of the same image on the wall soon left a permanent impression. Most likely this was the result of the sun's ability to fade paints and dyes, resulting in detail more accurate than what was traced by hand in a darkened room. The search was soon on for a *photosensitive* material, i.e., a substance able to record the image more quickly than paint or dyes. This journey eventually lead to metallic silver, which today remains the primary ingredient for creating film emulsions (chapter 3.) Film replaced the artist within the camera, and as a result it grew smaller and more portable. Although the basic principles of the camera obscura have been retained, numerous improvements have resulted in better control of exposure and image quality.

How the Camera Works

Soon after the invention of silver based film, the camera began a slow evolution of technological improvements that responded to similar improvements in film emulsions. Sharper lenses, a means to control the intensity of light entering the camera, and a requirement to make relatively short exposures were developed in response to better films. The basic camera components have remained unchanged for the past 75 years, and include the following:

- Camera Body
- Lens
- Diaphragm - Aperture
- Shutter
- Film Transport

The Camera Body functions to support the other components which make up the camera and provides a light proof container for the unexposed film. The camera body is unique in its function in that it must seal out the brightest light yet allow easy access for replacing film.



The Lens functions to collect light rays reflected from the subject and direct them onto the film. The distance between the lens and the film when focused on infinity is referred to as the focal length of the lens. The diameter of the lens determines the amount of light it is capable of gathering into the camera, and is typically referred to as the "speed" of a lens. Fast lenses are large in diameter and collect a greater amount of light rays than do slow lenses which are smaller in diameter.

The Diaphragm is a mechanical device that functions to control the intensity or brightness of the light entering the camera. It accomplishes this with a series of metal blades arranged in a circle which can close progressively. The opening created by the metal blades is termed the "aperture." The diaphragm effectively changes the overall diameter of the lens and controls the intensity of light allowed to pass through it. Controlling the intensity is one of two ways the camera regulates the amount of light reaching the film.

The Shutter is a mechanical device which covers the film inside the camera and protects it from light. As the name suggests, shutter curtains are drawn across the film and opened for a specific amount of time when an exposure is made. The amount of time that the shutter curtains are opened and exposing the film is referred to as the "shutter speed." The shutter speed and aperture opening control the total amount of light reaching the film and are the primary camera exposure controls.

The Film Transport is a mechanical device which removes the exposed film from behind the shutter and replaces it with unexposed film. Cameras which use roll film have a series of gears and rollers that carefully move the film from side to side. Large cameras which use sheets of film have a “film holder” that is inserted in the back of the camera for each exposure. Once inserted, a “dark slide” is removed from the holder, revealing the sheet film below. After the exposure is made, the dark slide is re-inserted and the film holder is removed from the camera back.

Although there are many camera styles which use a variety of film formats, the basic operation described above applies to all. Variations include viewfinders which assist in focusing, interchangeable lens and film backs, specialized attachments, and digital controls for exposure and focusing. Today there exist three basic film formats, with several styles of cameras using each format.

Camera Format Types

Camera design has evolved over the last 100 years in response to marketplace demand. Domestic, industrial, and commercial production of photographs resulted in a wide variety of camera styles which satisfied a somewhat narrow application or use. Improvements in lens technology, automatic focus & exposure, and more efficient film emulsions have made a smaller variety of cameras more capable of a larger number of tasks. In general, camera types can be broken down into categories based on three film formats: **35mm (small)**, **120/220 (medium)**, and **large format or sheet film cameras**.

Leica Rangefinder Camera

35mm cameras include Rangefinder and Single Lens Reflex (SLR) designs. Rangefinder cameras are typically compact, and include the popular “point-and-shoot” models as well as the more sophisticated (and costly) Leica and Contax designs. Rangefinder cameras acquired the name from the method used to focus the image, where the camera uses an optical mechanism that measures the distance between the camera and subject (range = distance) and indicates when the image is in focus by imposing a double image within the viewfinder.

The Leica rangefinder camera became famous at the hands of the French photographer Henry Cartier-Bresson who gained fame using the camera to capture Paris street scenes and other situations where the camera’s quick handling and superior image quality proved invaluable.[2] This style of camera remains in widespread use by photojournalists who specialize in documentaries and essays that don’t require the immediate image delivery of daily newspaper production now dominated by digital cameras. More recently, the Paris based and Brazilian born photo-essayist Sebastio Salgado has used the Leica rangefinder to document the life of working men and women around the world in numerous exhibitions and books, including ***An Uncertain Grace,***[3] ***Working,***[4] ***and Migrations: Humanity in Transition.***[5]

35mm SLR Camera

The 35mm SLR camera remains the most popular film camera design in history. Unlike the rangefinder camera, the SLR uses a mirror (hence "reflex") and a complex optical system that allows the user to view the scene through the same lens that makes the image. Viewing through the camera lens allows the use of interchangeable lenses of various focal lengths and styles.

Being able to preview the scene exactly as it will be created on film is particularly important if the photographer is carefully editing the image content. The relationship between near and far image elements, the effects created by wide angle and telephoto lenses, and the critical placement of subject matter are the hallmark abilities of the SLR camera.

In addition to the critical editing capabilities of the SLR, it also lends itself to convenient use and portability. Fast lenses and film make the need for a tripod or electronic flash unnecessary in most situations, allowing the photographer to explore the world in a most unobtrusive way. This type of use is the obvious strength of the SLR camera and lends itself to what we will later define as "personal photography," a visual diary of our lives and the events, people, and places which shape it.

Medium Format Camera

120/220 film sizes are often referred to as **Medium Format.** More than twice the width of 35mm, medium format film allows for the capture of greater detail on a scene-by-scene basis due to its larger size. The improved image quality comes at the expense of size and convenience since the larger film requires a larger camera to contain it. Medium format cameras find extensive use in the fashion and portrait industry, where image quality is important to customers.

Because of the increased size and weight, medium format cameras are typically used on a tripod or other support for natural light photography. When used with electronic flash, the cameras can be hand-held since the short duration of the burst will "freeze" the image even if the camera is shaking. When used on a tripod, care must be taken to reduce any possible vibration created by the camera mechanism.

Graflex Press Camera

Medium format cameras come in a variety of configurations, including SLR and rangefinder models. They are ideal cameras for the fine art photographer seeking a portable camera that will produce large prints of exceptional quality. Standard accessories should include a strong tripod and shutter release cable. A powerful electronic flash is a must should the camera be used for hand-held portrait or fashion work.

Large Format cameras are defined by the use of **sheet film**, with the most common sizes (in inches) being 4x5 and 8x10, but are available up to 20x24. Large format cameras come in three basic styles: **Press, Field,** and **Studio**. As the name suggests, **Press** cameras were once the mainstay of the newspaper industry, where a large negative could be developed in a short time and the image placed into print without enlargement. This type of camera used interchangeable lenses, and was very light for its size. Made famous by "Weegee," (Aurthur Fellig)[6] a New York press photographer, the Graflex camera is often seen today in movies and television commercials where the look of a press camera remains unchanged over time.

Field Cameras are similar in design to Press Cameras, but because the photographer may require special camera controls that can be used to adjust the "perspective" of the scene by shifting or turning the lens in relationship to the film, the Field camera typically is more complex in design and construction. It must also remain very light for transport within a backpack or field case, a typical means of transport for fine art landscape photographers. Press cameras are also used in a similar role when the range of movement for perspective control is limited. Because of its lack of demand, the typical Press camera can be found at bargain prices but remains fully capable of producing images of the highest quality.

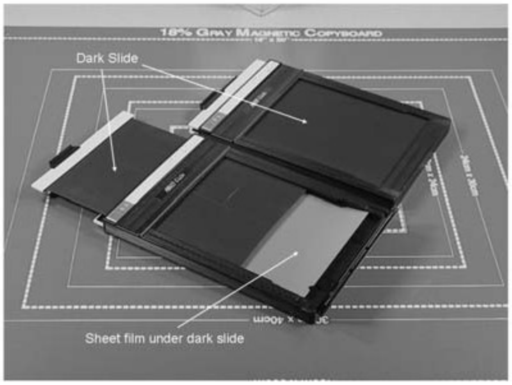
16 x 20 Field Camera

Studio cameras are large, heavy units which are limited to use on a tripod or studio stand. They feature an even greater range of perspective control movements than the field camera, and find the greatest amount of use within the controlled environment of a studio. Typical fine art studio work includes the still life and human form, with the camera creating large detail-rich negatives that will produce prints of 48 inches by 60 inches and larger. Because of the extensive movements and range of motion, studio cameras require a substantial framework in order to keep the lens and film in the proper relationship. This structure comes with a significant weight, and therefore does not lend itself to travel. When combined with the necessary lighting units, tables, back-drops and other support, it's understandable that studios are built around the camera.

Studio Camera

The term **"View Camera"** refers to the means used to compose the subject and focus the image. In large format cameras, this is accomplished by using a view screen which allows the image to be seen or "viewed" as it is projected by the lens inside the camera. The view screen is a thin sheet of glass that has been made slightly opaque by a grinding process. As the image is projected on to the screen, it can be viewed from behind through an opening in the camera. Because the image is typically somewhat dim due to the aperture reduction by the lens, photographers will cloak themselves around the camera with a dark cloth that blocks out the sunlight and allows the image to be seen more easily.

Press, Field, and Studio cameras all qualify as view cameras, and all use the same type of film transport mechanism. Because the view-screen is used to compose and focus the image, it must be replaced by



Sheet Film Holders

the film in order to create the image. To do so, a **Film Holder** is inserted into the camera, displacing the view screen and placing the film in the exact position of the focused image. A dark slide covers the film while it is being handled outside the camera, but once in place it is removed to make the exposure. After the shot, the dark slide is returned to the holder and the film holder is removed from the camera.

The above steps may seem cumbersome and time consuming, but typically are accomplished quite readily as the photographer becomes experienced with the camera.

Review Questions

Answer the following questions to help you better understand this chapter.

1. How does the Camera Obscura produce an image?
2. Which camera is easiest to carry: The 35mm SLR or Camera Obscura? Which would best serve as a tent?
3. What five components do all film cameras share?
4. What characteristic gives the view camera its name?
5. What photographer made the Press camera famous?
6. What is the difference between roll film and sheet film?

Photographic Assignment

Becoming familiar with operating your camera and understanding the various controls is essential for producing quality images. Because the various brands and models of cameras differ greatly in the location of the controls, consult your owner's manual to find the following on your 35mm camera:

- ❖ Shutter release
- ❖ Aperture control
- ❖ Shutter speed control
- ❖ Focus and Zoom (if applicable) controls
- ❖ Film back release
- ❖ Mirror and Pentaprism

Dust and dirt within the camera or on the lens will greatly reduce the image quality. Fingerprints on the lens surfaces can result in lack of sharp detail on the image. Dust within the camera can lodge on the film and create spots on the final print. Once you've identified all the important camera controls above, give the camera a thorough cleaning with the following recommendations:

- ❖ Remove the lens from the camera, then using a "blower brush" or a can of compressed air, dislodge any dust or small specks from the glass surfaces. If you notice any finger prints or smudges, breathe on the lens to leave a fog, and then carefully wipe the surface with a soft cotton cloth. If this does not remove the smudge, use a small amount of lens cleaner on the cloth to dissolve the spot. **DO NOT** use window cleaner or any other type of household cleanser as it can damage the coatings which are placed on the lens to improve image quality.

- Using a blower brush, dust out the inside of camera where the lens attaches. Do not use canned air unless you are very careful! The mirror and shutter assembly within the camera can be damaged by a direct blast of compressed air focused on the fragile surfaces.
- Using a "Q-Tip" cleaner, gently wipe the viewfinder window to remove any smudges. Before replacing the lens, look through the viewfinder while the camera is pointed at a light source to determine if any dust has settled on the focusing screen within the camera. A few camera models have removable screens that can be cleaned. Note that dust specks on the focusing screen are a nuisance only. They do not affect the image.
- Open the camera back and once again dust out the compartment with a blower brush. Be extremely careful of the shutter curtain. When complete, close the camera back and replace the lens.
- Prior to loading the camera with film, check the battery to make sure it retains enough power to operate the camera. Older cameras typically have small batteries that are required to operate only the meter and electronic shutter controls. Newer cameras may use several batteries to operate the various autofocus and film advance motors in addition to the meter and shutter controls. Weak batteries can fail at any time and leave you stranded mid-roll without a functional camera. Replace them if in doubt and keep an extra set on hand in your gadget bag.

Once cleaned and fully operational, load the camera with film and set the film speed (if necessary) on the film speed dial. Henri Cartier Bresson referred to his camera as a "sketch pad" that he used to record life as it happened. Do the same by keeping your camera with you whenever possible so that you can capture the events, people, and places which describe your life. Take the following precautions when using your camera to maintain it in good operating condition.

1. **Never leave your camera in the sun. The lens may focus the sun on to the shutter curtain and permanently damage it.**
2. **Never leave your camera in the cold for extended periods of time. Cold will drain the batteries and break down the lubricating oils should moisture condense on the camera when brought into a warm, humid space.**
3. **If you must use your camera in the cold, place it in a large "zip-lock" bag before returning indoors. Moisture will collect on the zip-lock bag and not the camera.**
4. **Don't drop your camera. Although rugged, the lens is made from a number of carefully positioned glass elements that if dislodged from impact will render the lens useless.**
5. **Keep your camera in a small gadget bag with the lens caps in place. The bag will help protect the outer surfaces, and the lens caps will ensure no sharp object damages the lens surface.**

Part One - Chapter Two: Lenses

Introduction

Camera lenses are available for a wide variety of uses, with a corresponding variety of size and shape. The purpose of this chapter is to explain basic lens functions, identify the various types of lenses (specifically those used for 35mm photography,) and to illustrate the result each type brings to the photograph.

The Basic Lens

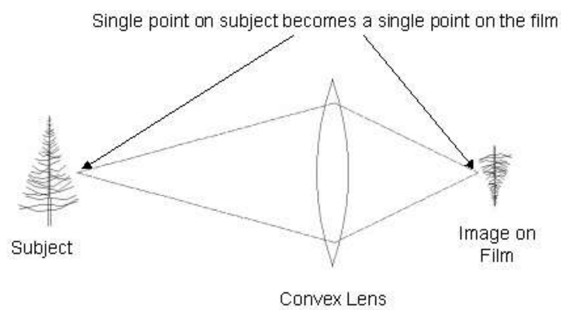


Figure 1

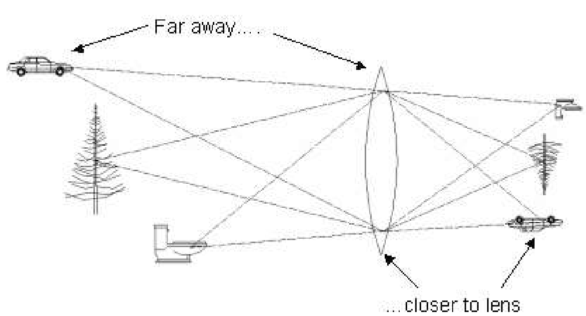


Figure 2

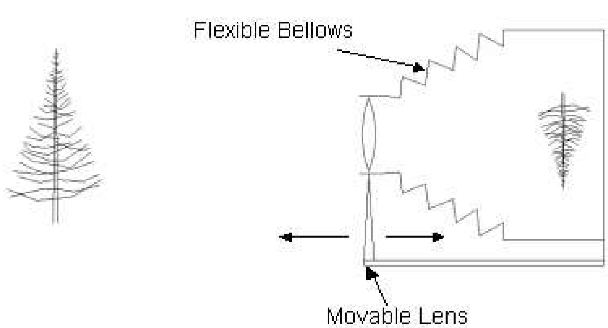


Figure 3

The primary function of the lens is to act as the “hole-in-the-wall” found in the Camera Obscura, and place an image on the film plane. Unlike the Camera Obscura, the lens does not send a single point of light from the subject to a single point on the film, but instead does it countless times for each individual point (Figure 1). As a result, the lens is capable of collecting more light rays than a simple opening, producing a brighter image on the film.

The distance between the subject, lens, and image on film is fixed by the shape of the lens. If the subject moves closer to the lens, the image on film moves farther away, and vice-versa (Figure 2).

To accommodate focusing on a subject at different distances from the camera, it is necessary to move the lens in relationship to the film. This simple function was made possible by the bellows, a flexible light-tight bag that connected the lens to the film transport and allows the photographer to focus the image (Figure 3).

The modern 35mm camera lens manages the task of the bellows by housing the lens in a round cylinder which can extend and retract as the cylinder is rotated. As the cylinder is rotated to focus on near objects, the lens extends away from the camera body. As it rotates to focus on far objects, it retracts closer to the camera body and the enclosed film. But what if both need to be in focus?

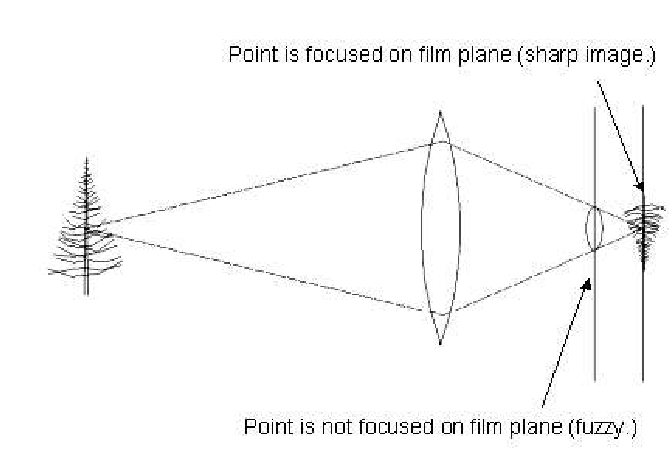


Figure 4

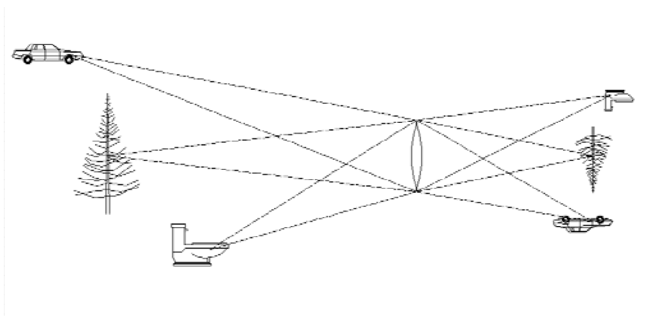


Figure 5

As the previous diagrams illustrate, the lens takes any point on the subject and places it on the film in a similar specific location. If the lens places the point either in front of or behind the film plane, then the point will be out of focus or fuzzy. This effect is illustrated in Figure 4 which shows how the light rays approach the point.

Notice how the angle of the light rays as they approach the lens is very great. It follows that the lens must be focused very carefully if the image is to be in focus, since the point rapidly becomes a circle if the distance is changed only slightly. Would there be any change in this effect if the lens was smaller in diameter?

Compare Figure 5 to Figure 2. Notice how the angle of the rays of light are not as great when the lens itself is smaller in diameter. If the lens became small enough, the rays of light would be almost parallel to each other, and the effect noted in Figure 4 would become negligible. If the lens continues to shrink in size, the need for focusing is almost eliminated because everything within the view of the lens will be in focus. But what are the drawbacks to having such a small lens? Consider the following characteristics and how they affect the image:

- Large Diameter Lens = More light (brighter image) + limited range of sharp focus
- Small Diameter Lens = Less light (dim image) + greater range of sharp focus

The term used to define the range or distance between the near and far subjects which are in acceptable focus is "Depth of Field." The corresponding term (which is seldom used [7]) that defines the distance between sharp objects on the film plane is "Depth of Focus" as illustrated in Figure 6. Having the ability to control the diameter of the lens is accomplished through the diaphragm, which forms the aperture or lens opening. The following series of photographs show how the diaphragm reduces the size of the lens by closing the metal blades which form the aperture opening.

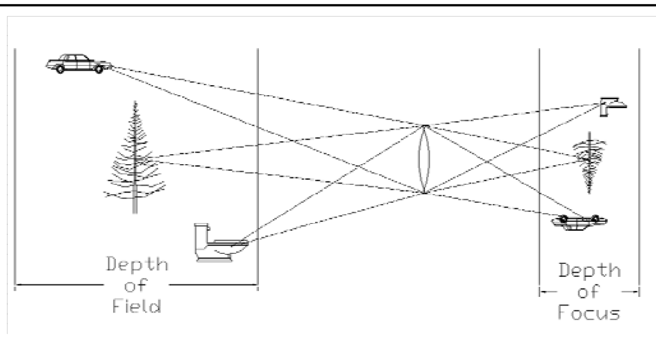


Figure 6

Figure 7

Figure 7: Diaphragm blades are only slightly closed, reducing the amount of light by approximately one half. The additional depth of field created is relatively small.

Figure 8

Figure 8: Diaphragm blades are closed approximately half way, and have reduced the amount (intensity) of light when fully open to approximately one eighth. The depth of field is substantially greater.

Figure 9

Figure 9: Diaphragm blades are closed to the minimum position, and have reduced the amount of light available from fully open to one sixty-fourth (1/64). Depth of field is now at a maximum for this lens.

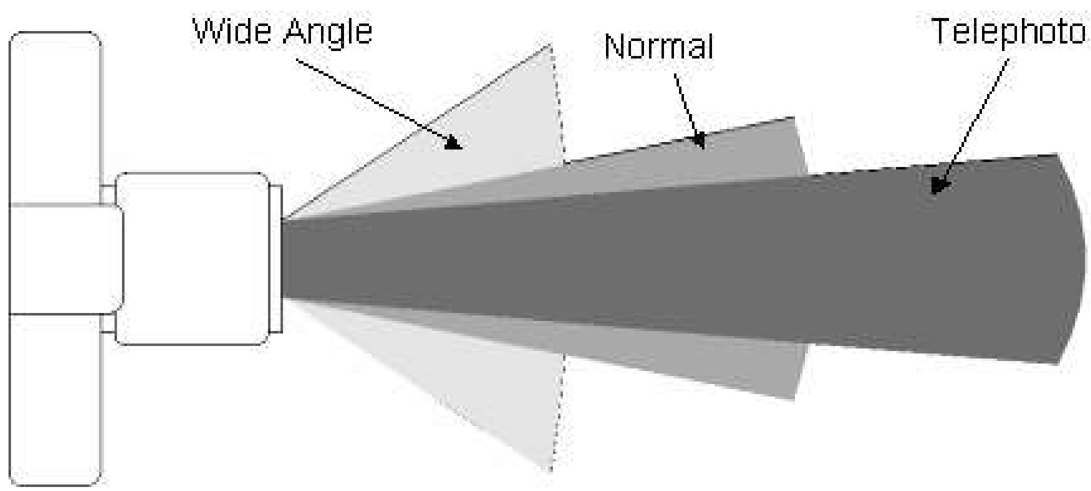
Selective Focus is one of the principles of composition explored in a later chapter that stems from controlling depth of field. As the diagram on page 14 illustrates, Selective Focus allows the photographer to emphasize the subject by making unwanted subject matter out of focus. Depending on the type of lens, the depth of field at maximum aperture can be as short as a few inches to virtually everything in front of the camera.

Lens Types

Although there exists hundreds of specialty lenses that are used for limited (usually scientific or industrial) purposes, most photographers will use four general lens types:

- Wide Angle
- Normal
- Telephoto
- Zoom

The lens types are defined by the relative angles of view each is able to cover. Wide angle lenses, as the term suggests, see a broad view typical of landscapes and other vistas. Normal lenses tend to see a range that is similar to our own vision. Telephoto lenses see a somewhat narrow slice of the world, and are often used in sports and nature photography. Zoom lenses are capable of covering at least two if not all three of the various angles of view.



Lens Angle of View

For 35mm cameras, we can define the lens types by focal length.

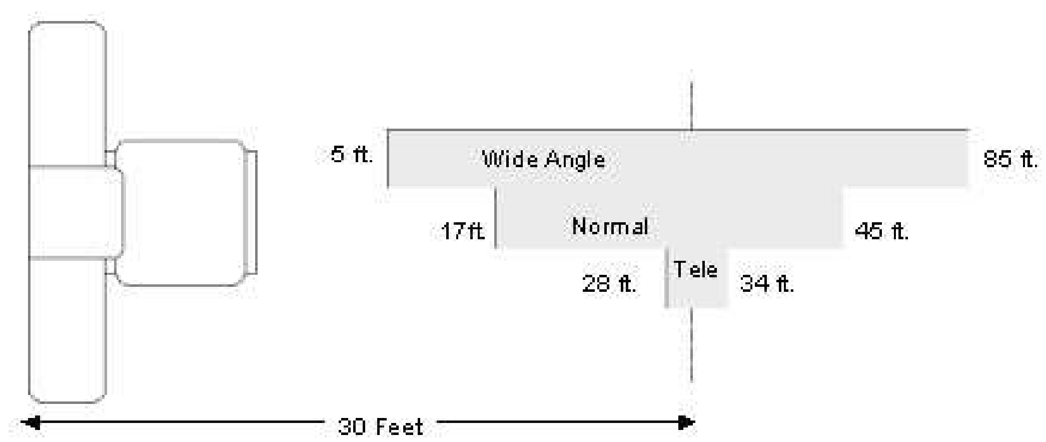
- Wide angle = 30mm focal length and less
- Normal = 35mm to 75mm focal length
- Telephoto = 80mm and over
- Zoom =A combination of the above

In addition to the differences in the angle of view, each lens type has other characteristics that make it suitable for a specific need. Wide angle lenses tend to exaggerate the apparent distance between near and far objects, especially so when the near objects are relatively close to the camera. This can be very effective in emphasizing smaller subjects that can appear much larger using a wide angle lens. Telephoto lenses have the opposite effect on apparent distance. They tend to compress objects together that may be quite far apart, and can serve to create a relationship between two objects by proximity. Normal lenses tend to represent distance the way our own vision does, and is the characteristic which gives it the tern "normal" since most of us see a field of view that is somewhat wider than the average normal lens.

Wide angle, normal, and telephoto lenses are often referred to as "fixed focal length" lenses since they have only one focal length. Zoom lenses have variable focal lengths, and do so as a result of complex lens formulas and multiple lens elements that made older zoom lenses somewhat less than ideal for sharpness and contrast.. In addition, due to the complex lens design, older zooms were relatively "slow" in that the maximum aperture size or "f stop" was too small to use for fast action shooting. As a result, many photographers shunned using zoom lenses in favor of fixed focal length, but typically carried as many as five different lenses to cover what a single zoom lens could accomplish. Thanks to modern technology and computer aided design, today's zoom lenses are typically as sharp and fast as any fixed focal length of comparable size.

Zoom lens construction

Lens type also affects the depth of field. Wide angle lenses are known for having a deep depth of field, to the point where focusing is not necessary if the lens is stopped down (smallest aperture.) Conversely, long telephoto lenses (400mm and greater) have a very shallow depth of field, especially when used at the maximum aperture. The following chart compares each in relative depth of field when focused on an object 30 feet in the distance.



For purposes of composition, telephoto lenses can be very effective for applying Selective Focus as a compositional element. When focused on the eyes of a person standing twenty feet away, the tip of the nose will be out of focus when using a 400mm lens at maximum aperture. A great tool to fix noses. In the same context, wide angle lenses are incapable of effective selective focus, but can bring a huge expanse into sharp focus without difficulty. As a result it is the lens of choice for landscapes and scenic views where any apparent soft focus would be distracting and objectionable.

"f-stop" is a common term you will encounter often in photography. It refers to the aperture setting within the camera lens, and typically will be a numerical amount between 1 and 64. The number is derived from the relationship in size between the aperture opening and the focal length of the lens, and is more fully reviewed in Chapter Four. In general, when the term "f-stop" is used within this text, it is a direct reference to the aperture opening.

Modern lens technology also has automated focusing, where special sensors within the camera can operate motors either within the lens or inside the camera that focus the subject with pinpoint precision. "Autofocus" lenses have been extremely popular in sports photography, where telephoto lenses having shallow depth of field can now capture the fast action with razor sharpness. Autofocus technology works by having a sensor within the camera that detects the relative contrast within a scene, and adjusts the focus until the contrast is at its greatest. Although the sensors can be deceived by panes of glass or low light subjects having little if any contrast, the majority of situations allow modern autofocus cameras to focus as accurately (and significantly faster) than the human eye-hand combination.

Review Questions

Answer the following questions to help you better understand this chapter.

1. What is the most notable difference between the lens and the hole in the wall of a camera obscura?
2. What is depth of field? Depth of Focus?
3. What lens type has the least depth of field? Greatest?
4. What type of lens is best suited for landscape photography?
5. How does the aperture control depth of field?
6. What is a zoom lens?

Photographic Assignment

Identify the following on your 35mm camera lens

1. Focal length
2. Aperture control (if present)
3. Zoom ring (if present)
4. Filter size
5. Extra clean lens surfaces (hint-hint)
6. Depth of field scale (May not be present on some autofocus lenses)

Part One - Chapter Three: Film and Paper

Introduction

Having a basic understanding of how black and white film and paper are made provides a foundation for understanding the medium. It also provides the photographer with a basis for choosing from the various types available. Although the market for traditional film based photographic products is shrinking due to the advent of digital imaging, a variety of both film and paper will be available well into the future.[8]

Photosensitivity

Photographic film and paper produce images by being exposed to light. The light sensitive material is created by coating the clear film and translucent paper bases with a thin layer of gelatin that contains metallic silver combined with another element to produce what is referred to as "silver salts." Like table salt, or sodium chloride, silver is attached to one of the "halogen" elements such as chlorine, bromine, or iodine. Some texts refer to the salts as "silver halogens", but regardless of the term each refers to the metallic silver as the principle component of the emulsion.[9]

Light breaks down silver halogens into black metallic silver over time. To hasten the process, chemical "developers" act as catalysts to speed up the process. This allows for the film to have a minimal exposure to light, which would have no visible results, to become a fully detailed negative. Chemists alter the properties of the silver halides to control the amount of light necessary to start the reaction. In addition, the paper and film emulsions must be treated to allow liquid chemicals to quickly enter the coating and begin the process of development, be rugged enough to endure handling by both hands and machines, and be relatively fault free to produce enlargements free of blemishes or stains.

Film and paper manufacturing are very similar, and include the following steps which must be completed in an environment completely void of light:

Step 1. Silver halide crystals are mixed together in a soup of warm gelatin.

Step 2. The resulting emulsion is heated for a several hours according to the degree of sensitivity required in the film or paper. This heating process also controls the relative contrast of the paper or film.

Step 3. The warm gelatin is chilled to where it solidifies, then shredded and washed in cold water.

Step 4. Once dry, the gelatin is once again heated to a liquid state, where it is treated with special dies or pigments that make it less sensitive to infrared and ultraviolet lights.

Step 5. Using special equipment, the liquid emulsion is applied to large sheets of the paper or clear acetate film base. After the paper or film is dried and cured, it is cut into the required sizes and stored in light proof containers.

Black and white film and paper are both NEGATIVE processes, where WHITE light reduces the metallic silver to BLACK. Film emulsions are coated on a clear acetate base which allows light to pass through in order to project the image onto the paper. During the exposure of the film, objects in the scene which are light in color or bright in value turn the corresponding area of the film black. Dark objects in the scene do not reduce the silver, and those areas remain transparent. During exposure of the paper, the process repeats and the values reverse again, this time clear areas on the film transmit more light and turn the corresponding area of the paper black, whereas dark or dense areas on the negative transmit little light, and as a result the corresponding areas of the paper receive little if any exposure and retain the basic tone of the paper base itself.

Types of Paper

Fiber Based and Resin Coated

Black and white photographic paper comes in two basic forms: fiber based and resin coated. The two forms differ mainly in the type of paper base the emulsion is applied to. Resin coated papers have a coating of clear plastic or resin applied to the paper before the emulsion is attached. As a result, the paper base does not absorb the water or chemicals used to process the emulsion. Because the residual chemicals must be removed to prevent image staining, resin coated papers can be processed in a relatively short amount of time as the chemicals were prevented from entering the paper itself.

Fiber based papers have the emulsion applied directly to the paper base, which is essentially cotton fiber paper with a coating of barium hydroxide (baryta) which gives the paper its bright white base. The paper soaks up all the processing solutions, and must be carefully washed for at least one hour before the print is free of damaging chemicals. Processing times for fiber based papers are typically one or two hours compared to the five or six minutes of resin coated papers.

Although both types of paper can produce brilliant, exquisite prints, fiber based paper has a unique look and feel due to its construction. Because the emulsion is applied directly to the paper, the fine texture and luminosity is difficult to recreate with resin coated products. Fiber based papers remain the mainstay of fine art work due to this characteristic. In addition, fiber based papers, when processed correctly, have an almost limitless life span. Resin coated papers have been tested to similar extents, but questions concerning the stability of the resin coating over hundreds of years have been presented.[10]

Warm or Cold Tone

Black and white photographic papers are not black and white. In practice, the papers vary having blacks that range from blue to green, and whites which range from cream to blue-white. A combination of paper bases and emulsion types give each paper a unique color that can be defined as being either **cool** or **warm**.

Warm tone papers typically have a creamy white base and a greenish brown emulsion. These papers are often used for portraiture and romantic images. They are somewhat slower in speed than cool tone papers due to the use of silver chloride in the emulsion. Cool tone papers have a pure white base and a blue-black emulsion that comes from using silver bromide as the silver salt. Although cool tone papers are widely used for general photography, they are prized for use as fiber based fine art prints.

Surface Texture

Resin coated papers come in a variety of surface finishes, including glossy, semi gloss, matte, semi matte, and specialty finishes. The texture is embossed directly onto the resin coating where it carries through to the emulsion. Glossy finishes have a mirror like surface that captures great detail but is susceptible to glare when displayed on a wall. Semi gloss and matte surfaces capture less detail but are more appropriate for display since the textured surface reduces reflections.

Fiber based papers are available in only a limited number of surfaces, usually referred to as a “natural” or “machine glossy.” When processed normally and dried in the open air, the prints finish with a very light texture that has a slight sheen. If required, the papers can be dried in contact with a smooth metal surface having a mirror finish that creates a glossy surface. This drying process is called **ferrotyping**, and is seldom used for fine art prints.

Contrast Grades

Both fiber based and resin coated papers are manufactured with emulsions that are either high or low in contrast. "Contrast" refers to the relative difference between black and white in any scene, and is graded according to the amount of contrast it will deliver based on a standard negative. Using a scale of 0 to 5, low contrast paper is rated at 0, and high contrast paper is rated a 5. Standard contrast is considered to be 2 or 3 based on individual preference and usually reflects the photographer's method of processing film.

Certain papers are also manufactured to deliver a variety of contrast grades by changing the color of the light used for exposure. This is accomplished with either a specialized light source that has adjustable filters which alters the color, or by using a single colored gelatin filter produced for a specific contrast grade that can be inserted between the light source and paper. During exposure the paper responds to the specific color by changing the level of contrast. Such papers are called variable contrast, with trade names such as Polycontrast and Multigrade.

Low Contrast

High Contrast

Selecting a graded paper or level of contrast in a variable contrast paper is based on both the photographer's intent and the relative level of contrast available in the negative. Film exposures made on overcast days tend to result in low contrast negatives, and print to a flat and lifeless gray. Film exposures made on bright, sunny days tend to result in high contrast negatives, which can print with a distracting "soot and chalk" effect. Selecting a high contrast paper for low contrast negatives, and low contrast paper for high contrast negatives can result in a more acceptable print.

Types of Film

Black and white films are similar in the clear acetate base used to support the emulsion, but films vary greatly in terms of sensitivity to light and the type of silver halide grains or crystals used to produce the emulsion. Because the silver halide crystals respond in a "chain reaction" when developed, larger crystals reduce to silver with less exposure to light than smaller crystals. This effect is used to produce films with various levels of sensitivity or speed. Sensitive or high speed films have larger crystals and produce photographs with noticeable grain that are slightly higher in contrast. Low speed films have smaller crystals and produce photographs with more subtle variations in tone and lack noticeable grain.

In recent years film manufacturers have produced new emulsions which use a grain that is longer and flatter in size than the traditional crystal structure. Referred to as "tabular grain" films, the emulsions are more sensitive to light than comparable-sized traditional crystals, and as a result produce images having finer grain while retaining the same film speed.[11] With trade names such as "T-Max"© and "Delta"©, tabular grain films exhibit other characteristics which photographers may dislike. They include a tendency to "block up" high values as the tabular crystals block out light transmissions, resulting in a loss of detail and separation in clouds and other white or near white objects.

Slow Film

Fast Film

A number of specialized black and white films and emulsions continue to be produced for special effects and scientific purposes:

- Infrared film, which is sensitive to the infrared portion of the light spectrum and produces negatives that create a "dream-like" effect.
- Ultra "fast" films used for surveillance and police work.
- X-ray films that are sensitive to radiation which can pass through solid mass.

In addition to the different types of films noted above, film is also manufactured with variations in its sensitivity to light. This is accomplished in part by the size of the silver grains placed within the emulsion, and is categorized by assigning a numerical value to the film. The value is based on an international standard which determines how much light is required to expose the film and darken the emulsion sufficiently to produce a "middle gray" value. The system of grading the film for speed is established by the International Standards Organization, or ISO. The relative sensitivity of the film or "film speed" is defined by its ISO grading or "ISO Speed" which is printed on the exterior of the film package and coded into 35mm film cassettes by a series of metallic squares arranged in a way that can communicate this information to the camera by a series of electrical contacts within the camera itself. More information on film speed is presented in the following chapter.

Due to onset of digital imaging, film manufacturers have cut back dramatically on the types of black and white films available. Although the total demand for black and white film has remained steady, the loss of color film demand has reduced the incentives for manufacturers to offer a variety of films in order to retain customer loyalties. Many of the specialty films that were produced in order to offer a broad selection were manufactured at a loss in profit, but supported sales of the more common products. As the common products give way to digital imaging, specialty films will be dropped from the product line in order to maintain viability.

Review Questions

Answer the following questions to help you better understand this chapter.

1. What metal is basic to film and paper emulsions?
2. What is a silver salt?
3. What is meant by a "negative" process?
4. What is a contrast grade?

5. What characteristic of the film emulsion regulates film speed?
6. How does film speed affect the image quality or characteristics?

Photographic Assignment

As the text indicates, black and white silver-based paper and film come in a wide variety of surfaces and sensitivities. Although the reader is encouraged to experiment with as many types sizes as possible, it is recommended that variable contrast resin coated papers and medium speed films be used initially as they produce excellent results while being very forgiving of processing and exposure errors. Below is a partial listing of paper types that will produce excellent results for the beginning photographer, most of which are readily available from the larger photographic supply companies.

- ❖ Ilford Multigrade IV RC Deluxe©. Available in glossy, pearl, and satin surfaces.
- ❖ Ilford Multigrade IV Portfolio©. Same as above, but in a heavier paper base.
- ❖ Ilford RC Cooltone©. Available in pearl and glossy. A somewhat unusual paper that has a colder image tone than most other resin coated papers.
- ❖ Forte Polywarmtone©. Available in glossy and semi-matte. This paper has a warm image tone.
- ❖ Forte Polygrade V©. Available in glossy and semi-matte. Very similar to Ilford Multigrade IV RC Deluxe.

Medium speed films are generally rated at ISO 400. They have moderate grain and are suitable for general photography that may include both indoor and outdoor settings. Films typically have a specific "look" and "feel" that varies between manufacturers and gives the film an identity based on those characteristics. Below is a listing of medium speed, 35mm films that produce excellent results.

- ❖ Kodak T-Max 400©. A tabular grain film available in 24 and 36 exposure rolls.
- ❖ Kodak Tri-X© (highly recommended). A very forgiving film available in 24 and 36 exposure rolls.
- ❖ Ilford HP5©. Similar to Tri-X, but with slightly larger grain.
- ❖ Ilford Delta 400©. A tabular grain film available in 24 and 36 exposure rolls.
- ❖ Fujifilm Neopan 400©. Similar to Tri-X, but a smoother grain structure.

Important Note: Most film manufacturers now produce a black and white film that is developed using color film chemicals. This film type uses a processing method called "C-41" which is usually indicated on the film packaging. C-41 films <u>cannot</u> be developed in the black and white film chemicals described in this text.

In preparation for the first image-making assignment, obtain several rolls of the film of your choice and a package of black and white RC paper. DO NOT open the paper to examine the surface unless you are in a darkroom with the correct type of safelights as described in Chapter Five. Examine the film and paper packaging to determine the following

1. Type of process used to develop the film. (Does it indicate C-41?)
2. Film speed or ISO rating.
3. Paper or contrast grade.
4. Paper surface type.
5. Paper tone (cold or warm?)
6. Film development recommendations (usually found on the inside of the paper packaging.)
7. Number of exposures available on the film (usually 24 or 36.)

Part One – Chapter Four: Film Exposure Fundamentals

Introduction

The modern camera is a carefully crafted instrument which is able to expose film with great precision. Understanding the basic principles of film exposure and processing is necessary for understanding the cause and effect relationships between camera settings, film processing, and final printing. A working knowledge of this process is the foundation for "pre-visualization", a process of imagining the appearance of the finished photographic print while viewing the scene through the camera.

The Quantity of Light

In the previous chapter we learned that film emulsions are made by mixing silver salts with a gelatin in total darkness, and that silver salts break down into silver when exposed to light. This fundamental process of exposing film is the basis of all modern film photography, and can be expanded to include the understanding that as you increase the amount of light which exposes the film, you will increase the amount of silver salts that break down into silver. Measuring the amount of light necessary to break down the silver salts to an extent they become a specific shade of gray is the key element in correctly exposing film.

Measuring light is more than measuring its intensity, although that may seem the most logical method of evaluating a light source. Because light is a flowing medium not unlike water, it must be measured in terms of a quantity. Like water, the brightness of light can be compared to the pressure of water which flows from a faucet. To understand this relationship, imagine filling a pail with water from two sources: a kitchen faucet and a fire hose. The fire hose represents a bright light source, and the kitchen faucet represents a dim light source. Both can fill the pail to the rim, resulting in the same quantity of water. But which one fills the pail faster?

Understanding how light is a quantity also indicates it is measured by both time and intensity. Because our human eyes never stop recording the amount of light present, time can be a somewhat abstract term when measuring light. But film "sees" light as a quantity which is combined with intensity to render it into that specific shade of gray. The camera "captures" a quantity of light by measuring the time and intensity, then "pours" it on the film to obtain the correct exposure.

The Correct Shade of Gray

Our world, when viewed in black and white, is filled with objects that vary in tone from the deepest black to the brightest white, with an infinite number of gray shades in between. All of what we see is reflected light unless we gaze at the sun or other light source. In terms of black and white film, black objects reflect so little light that they do not record on film, where as white objects reflect enough light that they turn the film black. When the camera measures the correct amount of light to expose the film, it "pours" enough light on the film to turn it **Middle Gray**.

Middle Gray represents a point halfway between the amount of light necessary to expose the film to a maximum usable white and the threshold of no exposure or black. The amount of exposure to achieve Middle Gray for any particular film is determined by the **Film Speed**, or film sensitivity. It is important to remember that the camera does not care if it measures the reflected light from a black, white, or gray object when it is setting the exposure as that amount of light varies with the light source. As an example, consider the amount of light reflected from a gray house at mid-day, and the amount reflected from the same house illuminated by a street light at night. The house remains gray, but the amount of light reflected has been reduced dramatically because the sources vary greatly in intensity.

To compensate for such changes in intensity, the camera assumes the user is pointing it at an object you wish to record as middle gray. It accommodates that decision by suggesting shutter speed and aperture or **"f-stop"** settings which will expose the type of film loaded in the camera to middle gray. The settings will vary between day light and street light exposures, but the final result will remain middle gray.

The Range of Values

Our eyes have the ability to record a brightness range of almost 1 to 10,000. We can see detail in the darkest shadows and brightest reflections as they adjust to the changing conditions. Black and white film is less capable, but will record a brightness range of 1 to 1000 or more. Black and white photographic paper is the least capable, and struggles to record a brightness range of 1 to 250. As we compare all three, our eyes see a range of values that the film cannot record, and the film sees a range of values the print cannot record. Because the print is the final product, we have to adjust our eyes and expose the film to accommodate it.

The "effective range" of paper can be described as the deepest black which retains the slightest detail to the brightest white which retains subtle variation in shade. The deepest paper black with detail corresponds to an almost transparent area on the film which contains the slightest amount of subject information.

Print Value Zones

The brightest white on the paper corresponds to a dark area on the film which records on the print as white with just the slightest amount of tonal variation indicating it has been exposed. We can establish the distance between the two points as our **Range of Values**, measured by steps or "**Zones**", with each step or zone representing twice the exposure (twice the quantity of light) of the previous. Black and white paper, with its available brightness range of 1 to 250, would have the following steps or Zones:

Zone	Brightness Range	Print Value
1	1	Maximum Black
2	2	Black
3	4	Near Black
4	8	Dark Gray
5	16	Middle Gray
6	32	Light Gray
7	64	Near White
8	128	White
9	256	Brightest White

Understanding Zones of value puts film exposure into a context of camera controls which are based on doubling or halving exposures. The next section explains how to set the camera controls for exposure and what effect the settings will have on the image.

Camera Controls

The device within the camera which measures the light and indicates the correct exposure setting is the **Exposure Meter**. The exposure meter is an electronic device which is coupled to the three camera settings that control exposure:

1: The Film Speed Setting. Film speed is the relative sensitivity of the film to light. **Fast Films** are very sensitive to light and require less exposure than **Slow Films**. The method used to rate films is a numeric scale standard set by the International Standards Organization or ISO. Film speeds range from ISO 12 to ISO 12,000 but the most common speeds for black and white film range from ISO 25 to ISO 800. Film speeds can be broken down into the following categories:

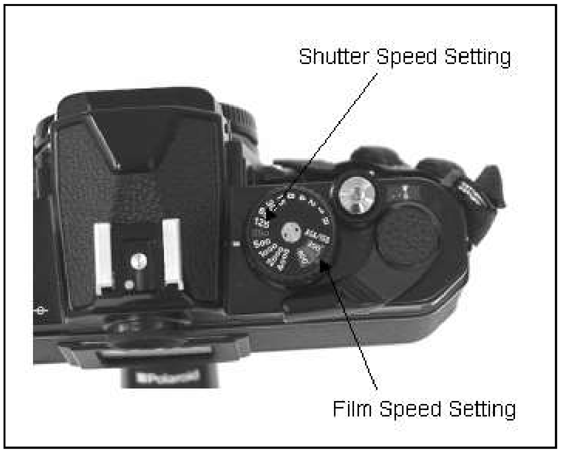
- ISO 25 through ISO 125 are considered "slow" speed films and should produce fine-grained images with smooth tonality.
- ISO 200 through ISO 800 are considered "medium" speed or "general purpose" films that have moderate grain and can be used in a wide variety of lighting conditions.
- ISO 1000 and higher are considered "fast" films and typically have noticeable grain and a staccato like tonality which tends to compliment the grain.

Film speeds are set on the camera by using a dial with the speeds engraved on the top bezel, or in the case of modern cameras the film speed is set automatically by the camera. The latter is accomplished by having a series of electronic contacts in the camera body which "read" the film speed from the metallic coding strip on the outside of the cassette.

2: The Shutter Speed Setting. Shutter speed refers to the amount of time that the shutter curtains or blades remain open, exposing the film to light. The speeds are a range of fractions of a second, from one full second to 1/1000 second with the following progression:

1 - 2 - 4 - 8 - 15 - 30 - 60 - 125 - 250 - 500 - 1000

The numbers represent the lower number of the fraction, i.e. 2 = ½ second, 4 = ¼ second, etc. Each number reflects a shutter speed that is one-half the time of the previous number as you read from left to right. This "step" of either halving or doubling the exposure with each setting is elemental to photography, and coincides with similar settings on the aperture scale.

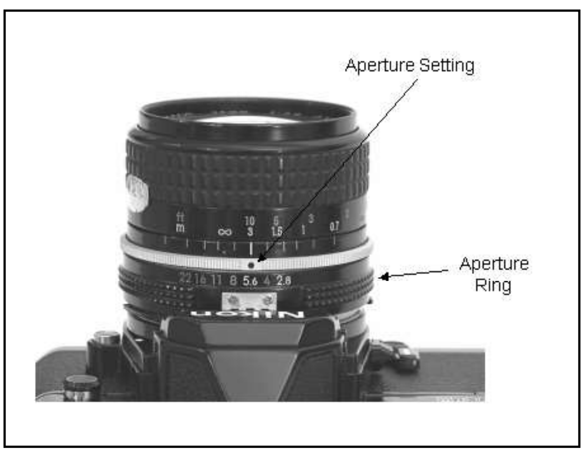


Setting the shutter speed on older cameras as shown on the left is accomplished by rotating the dial and aligning the shutter speed with the adjacent marking. Modern cameras typically set the film and shutter speed using a thumbwheel, with the selection indicated on a LCD or other display on the top of the camera or within the viewfinder.

3: The Aperture Setting. The aperture opening is indicated by a progression of numbers which reflect the relationship between the diameter of the opening and the focal length of the lens (setting = focal length / aperture opening.) As an example, if a lens with a focal length of 50mm had an aperture opening of 18mm, the resulting setting for that particular combination would be f 2.8 where "f" refers to the aperture opening ratio or "**f-Stop**." The progression for f-stops is as follows:

f 1 - f 1.4 - f 2 - f 2.8 - f 4 - f 5.6 - f 8 - f 11 - f 16 - f 22 - f 32

As with the shutter speed, each number represents one half the amount of light of the previous setting as read from left to right. Not all lenses have this range of aperture openings, and most have only 6 or 7. The **Base Speed** of the lens is the aperture setting available when the lens is "wide open" or at it's maximum aperture setting. The base speed setting is always the smallest aperture number indicated on the aperture control. On the illustration to the left, the lens Base Speed is F 2.8.



The aperture is controlled either with an engraved ring which fits around the most rearward portion of the lens, or a thumbwheel located on the camera and connected electronically to the lens itself. The engraved ring typically is adjusted manually by looking down at the aperture scale prior to focusing the lens. Notice in the illustration above, the focusing ring is immediately above the aperture ring. There are two scales on the focusing ring, one for feet (upper) and one for meters (lower.) A vertical white line above the black aperture setting "dot" indicates what distance the lens is focused on. In the illustration, the lens is focused on 3 meters or 10 feet.

On each side of the white line are a series of additional marks that reference a particular f stop. Although this black and white illustration doesn't reveal the color coding, the additional marks are colored to correspond to a particular f stop, and indicate what the depth of field is for this lens when focused as shown using a particular aperture setting. In this case, the lens is focused on 10 feet, with the aperture set at f 5.6. The additional marks corresponding to f 5.6 are located two over from the center mark, and indicate a depth of field from just over ∞ to just under 5 feet. ∞ is the symbol for "infinity," meaning the lens is focused at a distance that is infinite.

The light meter uses information from all three camera settings above to indicate the correct exposure. The method of indicating is a varied as the number of cameras, and can be a simple moving needle to a series of LEDs (Light Emitting Diode or "tiny little light") within the viewfinder. Consult your camera owner's manual to determine how the camera meter operates.

Exposure Tips

As previously noted, the camera meter suggests a combination of aperture and shutter speed settings which will expose the film to a middle gray based on whatever is in the viewfinder. A black cat, a white shoe, a green tree: all are rendered to a middle gray by the camera. The Print Value Zones illustration on page 21 demonstrates how a typical scene has a wide range of values. By exposing to middle gray (Zone 5), the film has the capacity to record Zone 1 and Zone 9. If the camera were to expose Zone 7 as middle gray, Zones 1 and 2 would fall off the scale and record as an empty black.

In general, most camera light meters read a large amount of the scene and offer an "average" reading that is very accurate. Should there exist within the frame a very bright source of light or a exceptionally large light or dark area, the camera meter would provide an incorrect reading since the "average" range of values within the scene has been compromised. You can compensate for these conditions by pointing the camera to an area which is more balanced in tone, but shares the same source of lighting. Once set, return to the original scene and make the exposure.

Using the above tips will help you produce consistent negatives that are easier to print and include the entire range of print values.

Equivalent Exposures

Setting the shutter speed and aperture for the correct exposure involves choosing a setting for a particular effect. A fast shutter speed (large number) can freeze motion, while a slow shutter speed (small number) can create a blur that suggests motion is present. A wide open aperture (small number) can create a very shallow depth of field that isolates the subject, where as a small aperture opening (large number) will create a deep depth of field that keeps everything in focus. The following rule **ALWAYS** applies to setting the camera controls:

- **If you select the shutter speed, the camera meter indicates the aperture setting.**
- **If you select the aperture setting, the camera meter indicates the shutter speed.**

Because both the aperture setting and shutter speed setting operate in steps that either halve or double the exposure, you have a wide variety of combinations to use for any exposure setting. The following table lists a series of equivalent exposures and the affect of each on the image for a scene that was originally metered and set with an aperture setting of 5.6 and a shutter speed of 125.

Aperture Setting (f-stop)	Shutter Speed Setting	Image Effect
2.8	500	Very shallow depth of field will isolate the subject from the foreground and background. Fast shutter speed can freeze motion. This setting would be good for hand held shots, but focusing on the subject is critical.
4	250	Moderate depth of field, with a shutter speed that will freeze motion on subjects such as passing cars.
5.6	125	Moderate depth of field, with a shutter speed that will show some blurring in fast moving objects. Lens is at optimum performance at this aperture.
8	60	Slow shutter speed may be difficult to hand hold for longer lenses. Depth of field is increasing to where it would be very deep on a wide angle lens. Good setting for hand held landscapes and scenic views with a wide angle lens.
11	30	Shutter speed may be too slow for anything but a wide angle lens. Camera support such as a tripod is required to avoid camera shake. Depth of field is at a maximum for most lenses.
16	15	Shutter speed requires camera support. Aperture opening is so small it can cause a reduction in image quality (pin hole effect) and should only be used if the shutter speed and available light require it.

Review Questions

Answer the following questions to help you better understand this chapter.

1. When we measure light, what two components must be considered?
2. What is meant by "reflected light?"
3. The camera meter exposes the scene for what shade of gray?
4. What shade of gray would a black cat be exposed for if you metered on the cat?
5. How many steps or zones are available within the average photographic print?
6. Why does the camera set the aperture if you set the shutter speed?

Photographic Assignment

Locate and Identify the following on your camera:

1. Film speed setting.
2. Shutter speed dial and / or indicator.
3. Aperture control.
4. Depth of field preview button (if present.)
5. Depth of field scale (if present.)

Part One – Chapter Five: Film and Paper Processing

Introduction

Possibly one of the greatest attractions of film based black and white photography is the hands-on craftsmanship that includes processing the film and making your own black and white prints. This chapter discusses the steps involved with processing and some of the tools available to the beginning photographer for controlling the results of both film and paper development. Because of its long history, black and white silver-based photography has produced a very broad number of processing methods that produce a similar variety of results. Evaluating even a small portion of the various methods would be beyond the scope of this text, but the reader is encouraged to research those processes if interested in fine print making.

The Basic Steps

Both film and paper share the same basic steps for processing. Once exposed in the camera or under the enlarger, the following steps are used to process the image:

1. **Development.** After exposure, silver halide crystals in either the film or paper are in a "latent" condition. The image is there, but it must be brought out through the application of a catalyst. Developers act on the silver crystals with a chain reaction that reduces the silver halide to silver in proportion to the amount of exposure received by the latent image. Like any chemical process, development is sensitive to both time and temperature.
2. **Stop Bath**. Once developed, this brief process uses a weak acid to render the residual developer ineffective, stopping the development process in seconds. This step is important for film, where even a few extra seconds of development can affect the image quality, but is also important in paper processing to keep the developer from "poisoning" the fixer, the next step that is also slightly acidic.
3. **Fixer**. Once developed, the image continues to retain unexposed silver salts that would turn black if exposed to a source of light (other than a safe light for paper only.) To make the image safe for viewing, the unexposed silver salts must be removed by "fixing" the print with a fixing bath. Fixers are compounds which dissolve the silver halides and remove them from the emulsion. It has no effect on silver, so the developed image is unharmed.
4. **Washing**. Because the processing chemicals can be harmful to the film and paper if not removed, a thorough washing is required. In general, both film and **R**esin **C**oated or **RC** paper can be washed in a short time due to the plastic coatings and support. Fiber based papers must wash for hours in order to remove the chemicals. Failure to do so with either film or paper will result in staining that cannot be removed.

Film Processing

Film differs from paper in that it must be processed in total darkness. This stems from how film must be responsive to all colors of light in order to faithfully record the scene. In contrast, paper is exposed only to the single color of light from the enlarger, and therefore the emulsions can be prepared so as to be insensitive to certain colors of light in the darkroom. The amber "safe lights" in the darkroom are of a color that black and white paper cannot "see", but is completely visible to human eyes and allows us to work in the darkroom safely without exposing the paper.

To process film without exposing it to any light (including safe lights), it must be completed within a closed container that allows the photographer to add and remove the processing chemicals without allowing light to enter. This is accomplished using a **daylight developing tank** with the following step by step methods:

Step One. Processing film requires it be loaded into a daylight processing tank. To do so requires a tank, can opener, scissors, and a light proof room.

Step Two: Remove the lid from the tank, and place the lid, center spool, and film reel on the table next to the tank. Lay out the components in such a way that you can find them in complete darkness.

Step Three: If your camera rewinds the film manually, you may be able to stop the process before the leader is retracted into the cassette. If so, pull out a short section of the leader (no more than two inches.) <u>If your camera rewinds the film completely into the cassette, go to Step Nine.</u>

Step Four: Using the scissors, trim the narrow portion of the leader away, and leaving only the full width film in place. Try to trim the leader between the sprocket holes with a curve in the leading edge to help insert the film into the reel.

Step Five: Locate on the inside of the film reel the entrance to the spiral ramps. This is where the film enters the reel and wraps itself around to the center.

Step Six: Insert the film into the entrance ramp and stop. **This is as far as you can go with the lights on!** The next step is to enter a light-proof room and finish pushing the film onto the reel.

Step Seven: Once inside the light-proof room, rock the reel back and forth while holding the film against the reel with your thumb. Rock one side ahead, release your thumb, then rock the other side ahead. Repeat until the entire strip of film is loaded into the reel.

Step Eight: Once fully loaded, trim the empty cassette from the film strip with a scissors and proceed to step13.

Step Nine: If your camera retracts the film entirely inside the cassette, or you were unfortunate enough to do it yourself, you must open the cassette with a can opener to load the film. ALL of the steps in this case must be carried out inside a light-proof room. **DO NOT OPEN THE CASSETTE UNLESS YOU ARE IN COMPLETE DARKNESS.**

Step Ten: Once in complete darkness, open the cassette and remove the inner spool and film. Locate the leader, and trim away the narrow portion with a scissors as in Step Four. Check the end near the outside edges of the film to make sure no remnants of the sprocket holes remain. If you feel a small fragment, trim it away with the scissors.

Step Eleven: Load the film onto the reel as in Step seven. If you have trouble, it may be that a small fragment of film on the leading edge was not trimmed away. Try rocking the cassette back and forth, but if the film will not progress, remove it and check for problems.

Step Twelve: Once the film is fully loaded into the reel, trim off the spool as closely as possible. Some cameras make the last exposure within an inch of the cassette.

Step Thirteen: Once the film is loaded on the reel, insert the center tube into the reel. The wide end of the center tube goes to the bottom of the tank.

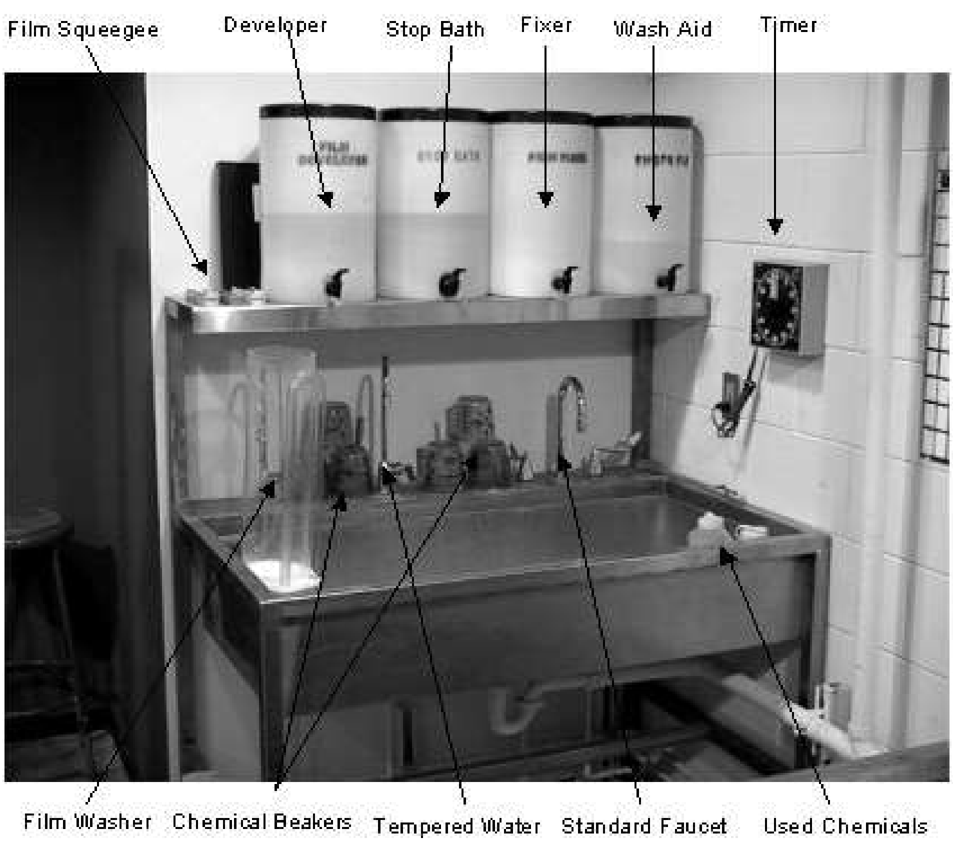
Step Fourteen: Place the reel and center tube within the tank.

Step Fifteen: Place the lid on the tank, sealing it in place by pushing the outer ring down. The ring seals with an audible "snap." Verify the ring is in place by feeling along its upper edge – it should be flush with the top of the tank lid.

Once loaded, the film is ready to be processed by pouring the developer, stop bath, and fixer into the tank. Do so by removing the rubber cap, and pour in the liquid as quickly as possible without flowing over. Replace the lid to invert the tank for agitation during processing.

The "wet" process for developing film may be considered by many as somewhat time consuming. On average, film development from "dry to dry" takes about 40 minutes based on the following processing times:

Step	Time	Notes
Pre-Soak	1 min.	Fill the film tank with tempered water and tap lightly on edge of sink. While soaking, fill the three chemical beakers with Developer, Stop Bath, and Fixer to the indicator lines. Pour out the water after at least one minute (longer doesn't affect film.)
Developer	10 min.	Set timer on wall to 10 minutes. Pour in developer, tap lightly on edge of sink to dislodge air bubbles. Start the timer, then agitate the film by tipping and rotating the tank to a count of 1001, 1002, etc. for the first 30 seconds of development. Thereafter, agitate for five seconds every 30 seconds until cycle is complete. Pour developer back in beaker.
Stop Bath	1 min.	Set timer for 1 minute. Pour in stop bath. Agitate continuously for entire cycle. Pour stop bath back in beaker.
Fixer	10 min.	Set timer for 10 minutes. Pour in fixer. Agitate continuously for first minute. Thereafter, agitate for 5 seconds every minute until cycle is complete. Pour fixer back in beaker.
Wash	10 min	Open film tank, remove film reel. Start film washer, and place reel on wire support. Wash film for at least 10 minutes. While film is washing, pour the developer down the drain, pour the stop and fixer into the waste containers for used chemicals.
Wash Aid	30 sec	Remove the reel from the washer, then remove film from reel. Slide the film through the tray with washing aid for 30 seconds. Squeegee the film.
Dry	5 min	Hang the film in the film drying cabinet. Hang a weight on the end of the film, then turn on the dryer. Check the film after five minutes. If it has fully curled over to the emulsion side, it is dry. Remove and cut into frames of 4 or 5 and place in sleeves.



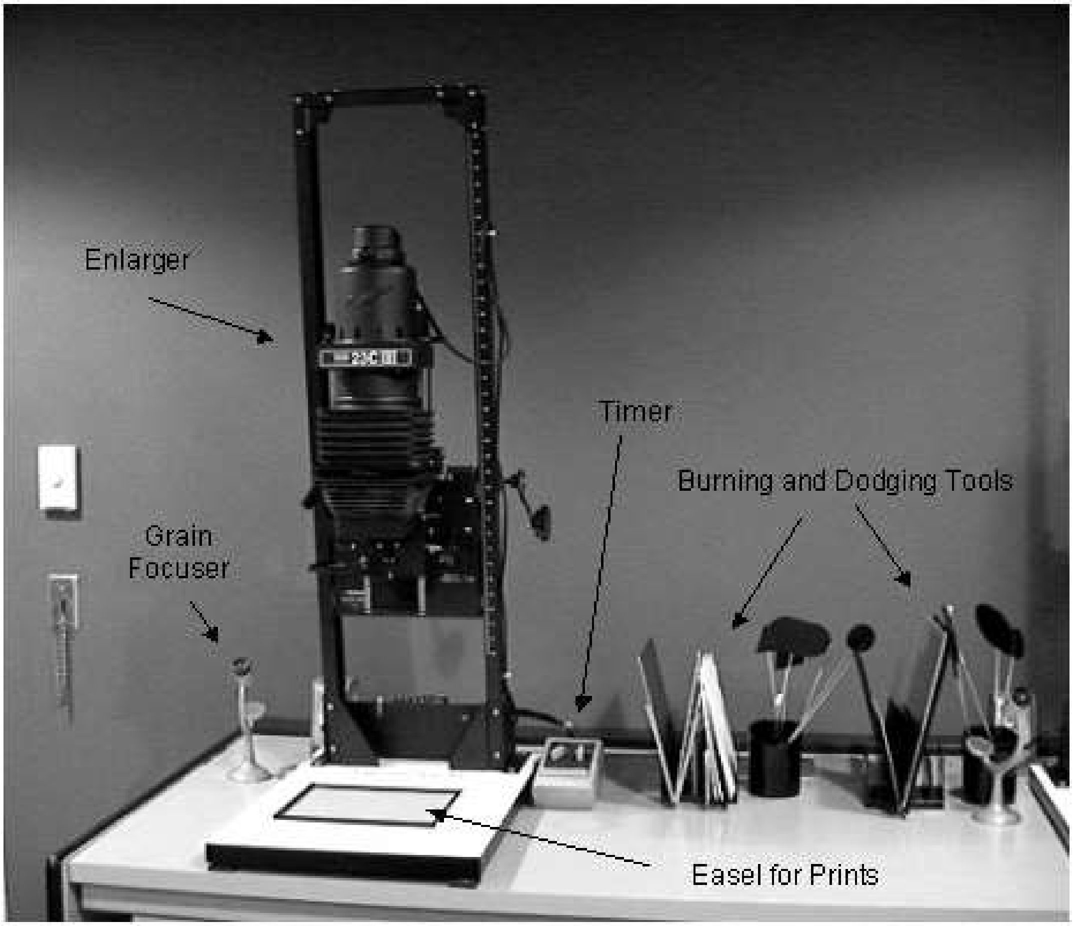
Printing and Print Processing

Print making involves the projection of the developed negative onto a sheet of black and white paper. The following "photo-tour" is meant to make the reader familiar with the darkroom, enlarger, and print processing.

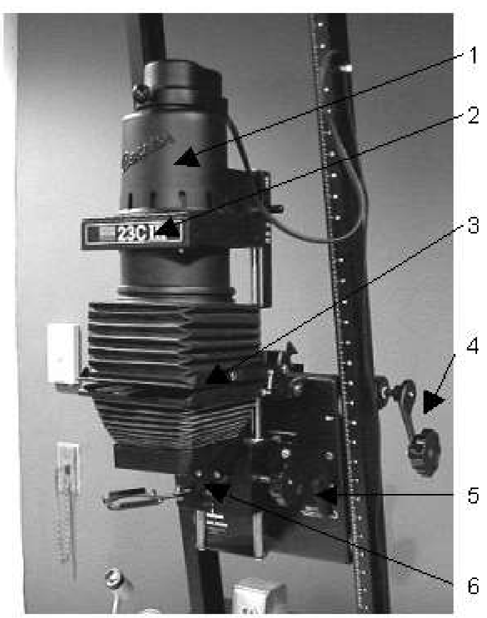
The darkroom is organized with a **wet** and **dry** side. The enlargers are placed on the dry side to avoid any contamination from processing chemicals. The three enlargers shown function in the same way, but have different capacities. The two enlargers on the left will enlarge negatives up to 120 size. The enlarger on the right will enlarge sheet film up to 4 inches by 5 inches.

The wet side of the darkroom is where paper processing takes place. The large sink in the foreground contains the trays used for processing paper. The very right hand side of the sink has a print washer and squeegee board. On the far wall from left to right is the film dryer, print chemicals, film drums, and a print dryer. Below the print chemicals are tray decanters and an air hose for cleaning film.

Inside the paper sink are the three processing trays. Developer is in Tray No. 1. Stop bath is in Tray No. 2. Fixer is in Tray No. 3, and closest to you is the print washer (No. 4).



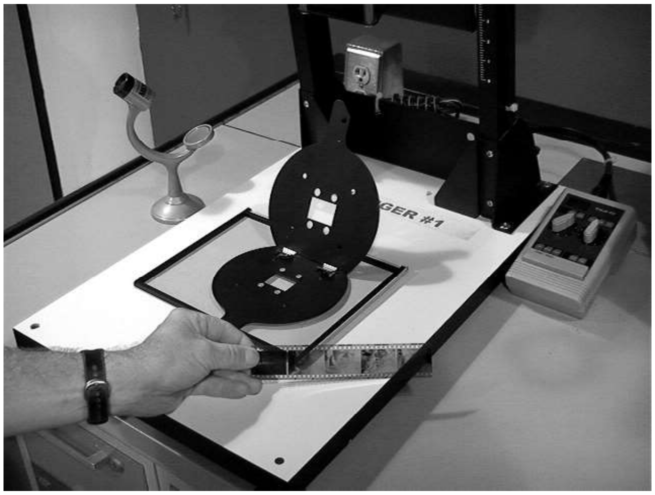
The enlarging station contains all the tools necessary for making prints. Dodging and burning tools are for increasing or decreasing the exposure on certain areas of the print to improve the contrast or detail. The easel holds the paper in place under the enlarger. The timer is the equivalent of the shutter on the camera, where it sets the amount of time the paper is exposed to light. The grain focusing tool is a focusing aid that magnifies the projected image to a point you can see the actual silver grains. Once the grains are clearly visible, the negative must be in focus.



The enlarger itself has the following key components:

1. The **lamp house** which has special condensing lenses to make the image as sharp as possible.
2. The **filter drawer** where contrast control filters can be inserted to increase or decrease the print's contrast.
3. The **negative stage**, where the negative is held in place by a **Negative Carrier**.
4. The **elevation control**, which raises and lowers the enlarger head in order to increase or decrease the size of the projected image.
5. The **focus control** which moves the lens in relationship to the negative stage for focusing the image on the baseboard and easel.
6. **The lens**, which contains a diaphragm like the camera lens to control light intensity.

Making a print begins with the following steps that project the image on to the paper.

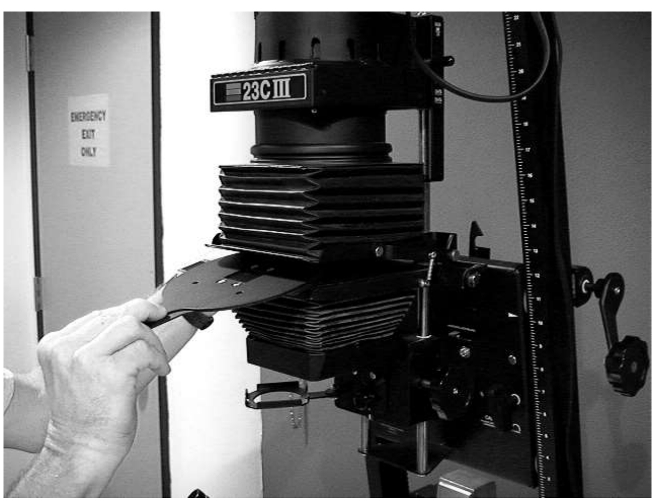


Step 1: A negative is selected for focus, contrast, and exposure. To determine if the negative is properly exposed, place it on top of newspaper print in room light. You should be able to just read the text.

Make sure the negative is clean and free of finger prints. Cleaning tools are located under the film drums and in the drawer under the print dryer.

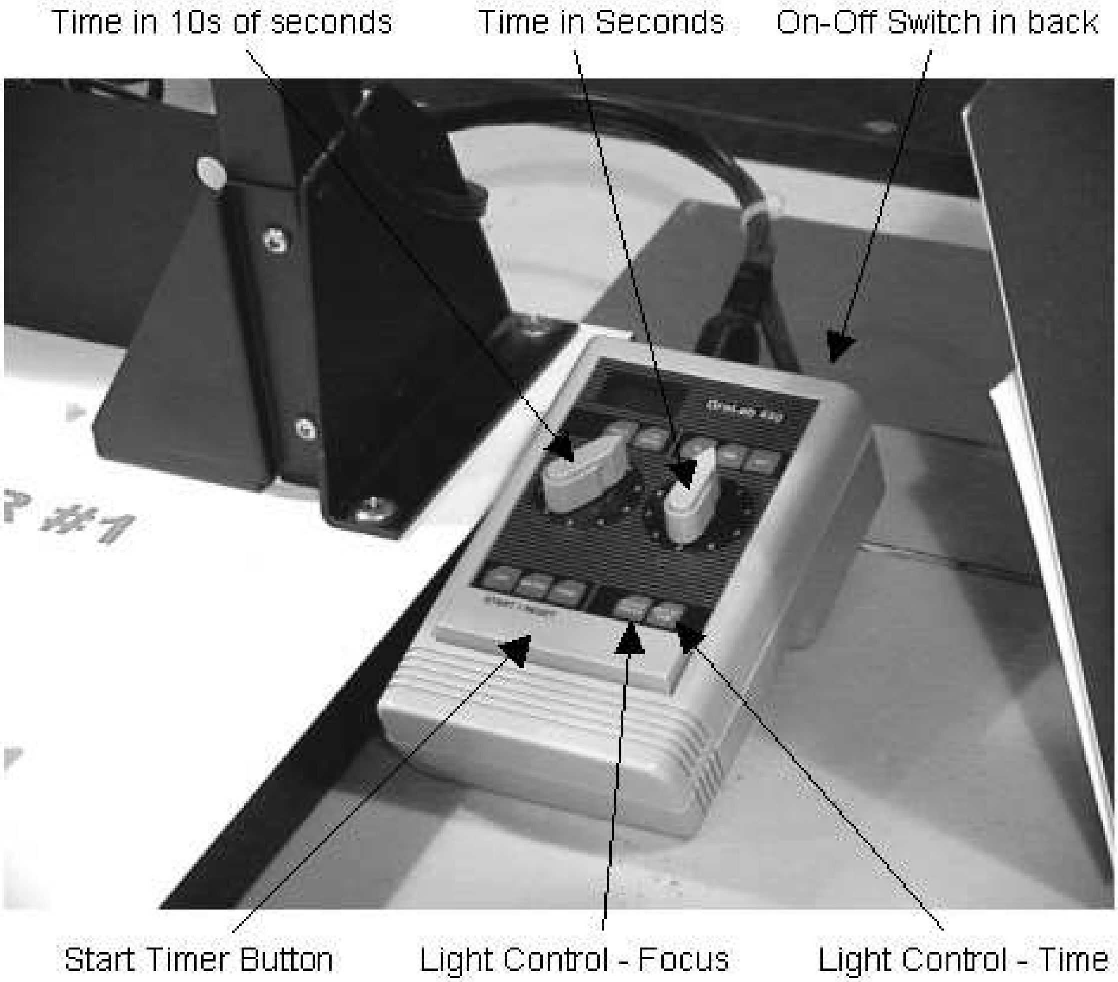
Step Two: Place the negative emulsion side down within the rectangular opening in the negative carrier. The emulsion side of the film has a matte finish, whereas the side opposite the emulsion is glossy.

Close the negative carrier carefully when you have the negative placed correctly. You must hold the carrier closed at all times until it is placed back in the enlarger.

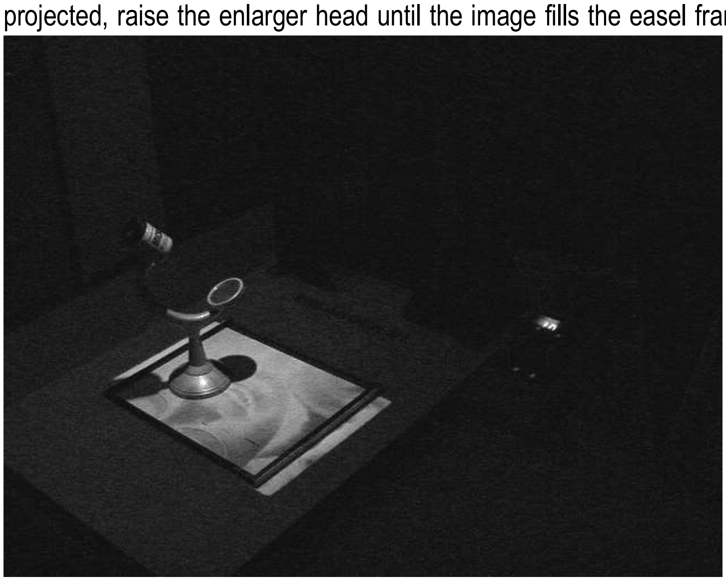


Step Three: Insert the carrier back into the enlarger. Once in place, close the negative stage by rotating the lever on the left side of the enlarger. The spring loaded arms will hold the negative carrier closed at which point you can release it.

Note: In lieu of placing a negative in the negative carrier for projection, the negative may also be placed directly in contact with the paper and covered with glass. The exposure is made by turning on the enlarger and exposing the entire strip (or several strips) of the negative. This is referred to as a **Contact Sheet**.



The timer controls the enlarger light for both exposure and focusing. Once the negative is loaded, turn the timer on with the switch in back. To focus and compose the image, press the touch pad "Light Control – Focus." It will turn on the enlarger lamp and project the image to the baseboard. Once the image is projected, raise the enlarger head until the image fills the easel frames on all four sides. Focus the image using the focus control on the side of the lens. Do so with the lens aperture wide open in order to see the image most clearly. Place the grain focuser on the easel, and fine-focus the image. Once in proper focus, press the touch pad for "Light Control – Time," and set the Time in Seconds to 5 seconds. Insert a sheet of paper into the easel, then stop the lens down two stops from wide open (f-8). Press the Start Timer Button.



The print is now exposed and ready to be processed.

Processing the exposed print follows the same basic steps as the film but with much shorter times. Remember the following tips when processing the prints:

1. Start the timer above the print sink and let it run. Check the position of the sweep hand when you insert the print in the solutions to keep track of the time.
2. Always use the print tongs when processing prints. A very few individuals may be allergic to the black and white chemicals (1 in 1000). If you should notice a slight reddening of the skin when if developer splashes on you, wear a pair of latex gloves in the darkroom.
3. Switch tongs between trays to avoid contamination.
4. Don't leave prints in the trays if you don't want to finish them. The trashcan is your friend.
5. Keep track of the number of prints you make on the board. When the developer or fixer is exhausted, replace it using the decanters under the print chemicals with the dilutions noted on the containers. Dump the old chemicals down the drain.
6. Replace the stop bath when it turns dark.

Resin Coated Paper Processing Times and Notes

Step	Time	Notes
Developer	1-1/2 min	Insert the print using the tongs. The image should begin to form in approximately 10 seconds. Agitate the print continuously during development by either rocking the tray or swishing the print tongs. Pick up the print at the end of the time and let it drip for a few seconds before dropping it into the stop bath tray.
Stop Bath	30 sec	Push the print down carefully using the print tongs. Agitate continuously by rocking the tray or swishing with the tongs. "Pick up and Drip" for a few seconds, then drop print into the fixer tray.
Fixer	2 min	Push the print down carefully using the print tongs. Agitate continuously as before. Once completed, "Pick and Drip" for a few seconds and then slip the print into the washer.
Wash	5 min max	Don't over wash the prints. They will curl up when dried.
Squeegee	As Required	Take the print out of the washer and place it face up on the squeegee board. Leave a corner hanging over the side to help peel it off. Squeegee as required.
Dry	2 min	Turn the dryer on by rotating the timer switch on the wall ¼ turn. Insert the print in the slot facing the film dryer, and let the machine pull the print in. It should be done in about two minutes. DON'T increase the heat beyond the midpoint settings. It can scorch the print and ruin the emulsion.

Final Processing

Resin coated prints are ready to display once out of the dryer. No special care is needed, but do be careful not to fold or bend the prints. As you gain experience in the darkroom, you will develop your own work habits that make print making all the more enjoyable. Remember the following safety and housekeeping rules:

- Keep the darkroom clean. A dirty darkroom is reflected in every print.
- No food in the darkroom. Setting it down is a problem, plus it makes a mess.
- Be considerate. If you're all alone, keep the music down. If someone else is working at the same time, wear headphones.
- Watch your belongings. Don't leave them in the hallway, bring them into the darkroom.
- If you happen to spill the chemicals, don't panic. Locate a custodian, or other capable person, and help clean up the spill.

- ❖ Wash your hands if you've placed them in the chemicals. Again, black and white chemicals should not be ingested, so wash and dry your hands if you've spilled anything on them.
- ❖ Keep the dry side dry. Don't bring wet prints back to the enlarging stations.
- ❖ Have fun. This is your darkroom, so take care of it and enjoy it as much as possible.

Review Questions

Answer the following questions to help you better understand this chapter.

1. What are the steps for processing film?
2. What is the purpose of the fixer?
3. What does stop bath stop?
4. What device holds the negative?
5. What is the equivalent of the shutter on the enlarger?
6. What are the safety and housekeeping procedures that must be followed in the darkroom?

Photographic Assignment

Practice loading film onto the film reels with scrap rolls of film found in the darkroom. Practice first in room light with your eyes open, then practice with them closed. Do it once more inside the light-proof room before you try your own film.