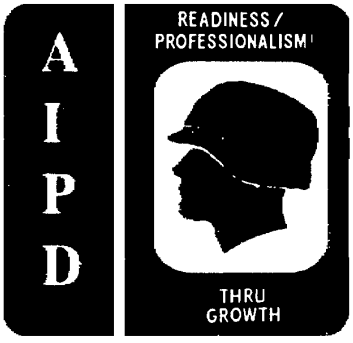
SUBCOURSE
SS0572

EDITION
A

PRINTING COLOR NEGATIVES

THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM



US ARMY STILL PHOTOGRAPHIC SPECIALIST
MOS 84B SKILL LEVEL 1

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PRINTING COLOR NEGATIVES

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SUBCOURSE NO. SS 0572-A

US Army Signal Center and Fort Gordon
Fort Gordon, Georgia

One Credit Hour

GENERAL

Printing Color Negatives is designed to teach techniques of printing color negatives. It is specifically based on Eastman Kodak color negative film processed in C-41 chemistry. Prior to completing this subcourse, SS 0514, Basic Color Photography, must be completed.

This subcourse is presented in three lessons. Each lesson corresponds to a terminal objective as listed below.

Lesson 1: COLOR NEGATIVES

TASK: Prepare to print color negatives.

CONDITIONS: Given information and charts about color negative characteristics and printing equipment.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to 80 percent of the multiple-choice test covering characteristics of color negatives.

(This objective supports SM Task 113-478-3048, Print Color Negatives)

Lesson 2: COLOR PRINTING FILTERS

TASK: Select Color Print filters.

CONDITIONS: Given information and charts depicting color print filters.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to 80% of the multiple-choice test covering color print filters.

(This objective supports SM Task 113-578-3048, Print Color Negative)

Lesson 3: PRINTING THE NEGATIVE

TASK: Determine exposure requirements.

CONDITIONS: Given information and charts describing exposure.

STANDARDS: Demonstrate competency of the task skills and knowledge by correctly responding to 80% of the multiple-choice test covering exposure.

(This objective supports SM Task 113-578-3034, Expose Color RC Paper)

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ANSWERS TO PRACTICE EXERCISES

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

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INTRODUCTION TO PRINTING COLOR NEGATIVES

These three lessons on printing color negatives are designed to teach you the methods of color printing within your unit. Army Visual Information Units are becoming more tactically oriented and will require efficient and quick color printing. Much of this printing will be done in the field. Your ability to support Army Visual Information Combat Documentation Teams and your commander with fast, clear, color-balanced photographs may well spell the difference between mission failure and mission accomplishment.

LESSON 1
PREPARE TO PRINT COLOR NEGATIVES

TASK

Perform the techniques to prepare to print color negatives.

CONDITIONS:

Given procedural techniques, information and charts about color negative characteristics and printing equipment.

STANDARDS:

Demonstrate competency of the task skills and knowledge by correctly responding to 80% of multiple-choice test covering procedural techniques and characteristics of color negatives.

REFERENCES

STP 11-84B14-SM-TG

Learning Event 1:
VISUALLY IDENTIFY COLOR NEGATIVE EMULSION-SENSITIVE LAYERS AND THEIR DYE FORMATIONS

1. Color negative film. Color negative materials are highly versatile, having certain advantages over reversal color films. From a color negative, you can produce color transparencies directly without first producing an internegative.

a. Color negative materials have wider exposure latitude and are easier to correct for color balance and contrast variations. Their only real disadvantage is the fact that they don't lend themselves well to visual evaluation since their printing characteristics cannot be accurately determined just by viewing the negative.

b. There are many color films available, made by different companies. All have variable characteristics in relation in speed, grain, resolving power and color balance. Emulsion speed ranges from 30 seconds in internegative film up to ISO 1000 in Kodacolor.

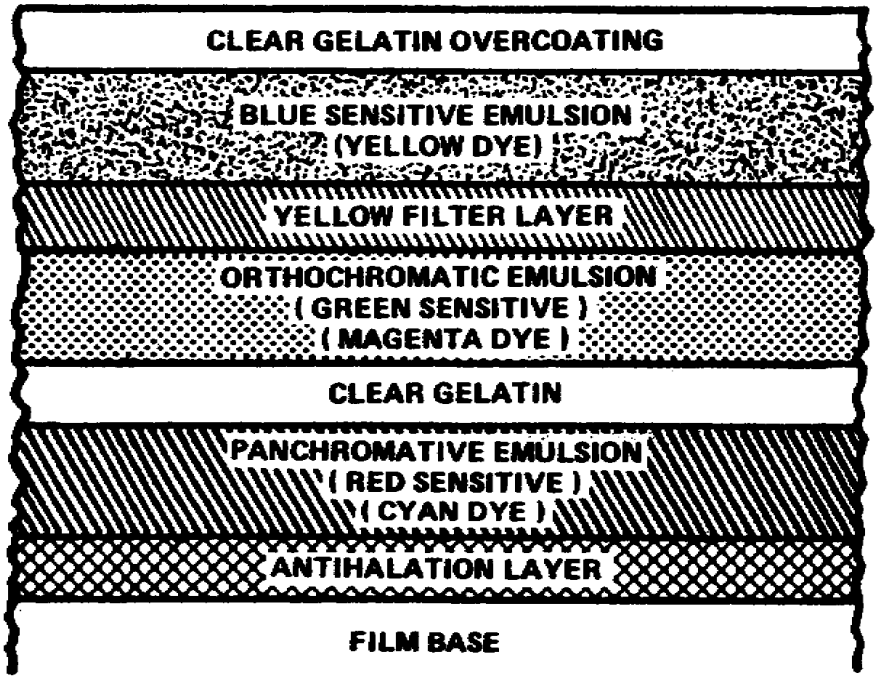

Figure 1-1. Cross section of negative film

2. Figure 1-1 shows a cross section of a typical color film. Starting at the top and working down the diagram, an antiabrasion overcoating protects the film from minor abrasions. Next is the blue-sensitive emulsion layer where the blue record is made and where yellow dye is formed during processing. The next layer consists of a colloidal silver. It acts as a yellow filter to absorb blue light so that only green is recorded in the orthochromatic layer. Magenta dye is formed during the process. Red is recorded in the next layer, which is a panchromatic emulsion. This emulsion is manufactured with a very low sensitivity to green light since the blue light is absorbed by the colloidal silver, only a red record is made. Cyan dye is formed in the panchromatic emulsion layer during processing.

3. In effect then, a sheet of color film is made up of three separate layers, each one sensitive to or able to record only one of the three additive primary colors of light. Subtractive colors, such as yellow, are recorded in the two layers which form to make up the color (green and red). Green and blue light make cyan, the complement of red. Blue and red light combine to form magenta, the complement of green. These three complementary colors-cyan, magenta, and yellow, known as the subtractive primaries, are the colors of the dye layers formed in an exposed and processed color negative (fig 1-2).

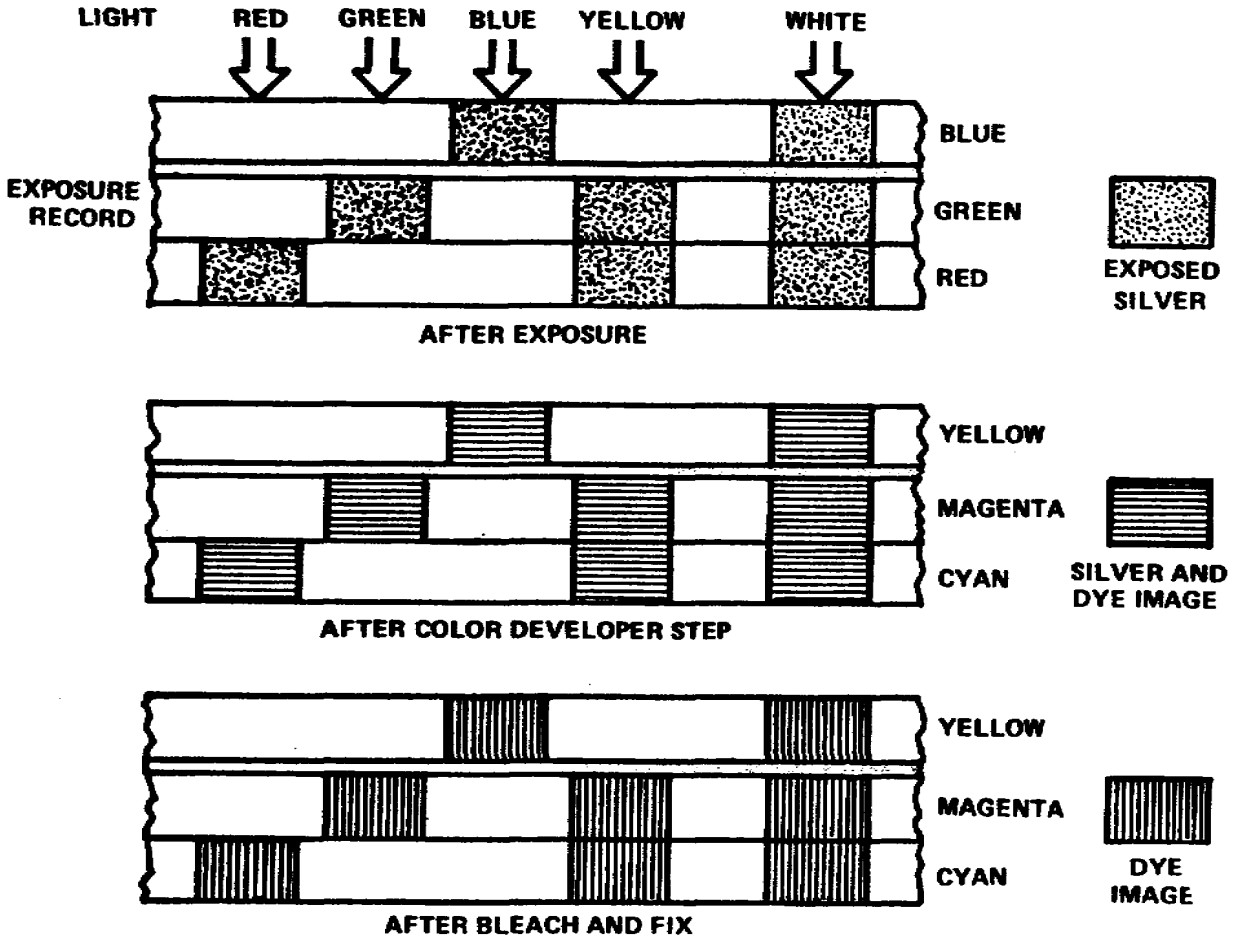

Figure 1-2. Color negative film, exposure and processing effects

Learning Event 2:
IDENTIFY COLOR NEGATIVE REQUIREMENTS

1. Obviously, you can make a better print from good negatives than you can from poor ones. Few characteristics are exactly the same in two color negatives. This is because there can be lighting condition changes just before exposure, different color quality, normal emulsion coating changes, adverse storage conditions between exposure and processing and nonstandard processing conditions. If you have more than one negative of a subject, you will want to select the best possible one available. As a general rule, select a negative with the following characteristics:

a. Select a negative that has proper density. This negative should also have a properly exposed gray card in the image area and with a full range of tones including a flesh tone.

b. Choose a negative that is free of defects such as scratches, stains, fingerprints, etc.

c. The negative should be of a typical subject with typical lighting as nearly as possible, typical of that to be printed in the future.

2. Keep in mind that a typical negative shot indoors under lights, is not the same typical negative of an outdoor scene. Each typical negative must be of the same subject, under the same lighting conditions.

Learning Event 3:
IDENTIFY PRINTING EQUIPMENT

1. To make color prints, you need certain items of equipment. Most any photography equipment used for black and white printing and processing can be used. However, specifically designed equipment makes your job easier.

a. Enlarger. Any enlarger that is equipped with a tungsten lamp, heat-absorbing glass, ultraviolet absorption filter (CP2B), and a means to hold printing filters is acceptable for making color prints. The enlarger should have a means of holding the filters between the lamp and the negative. Color printing (CP) filters are designed to be used in this position. If you use filters between the lens and the printing paper, you must use color-compensating (CC) filters. Since the projected image is passing through the filter, the highest quality filter must be used; CC filters are very high quality.

b. Enlargers designed specifically for color printing have two distinct advantages, a diffused light source, and dial-in filters. A diffused light source enlarger will minimize negative defects such as dust and scratches. Dial-in filters make it much easier to alter the filter pack than trying to work with separate sheets of filter material. Figure 1-3 shows a typical enlarger setup.

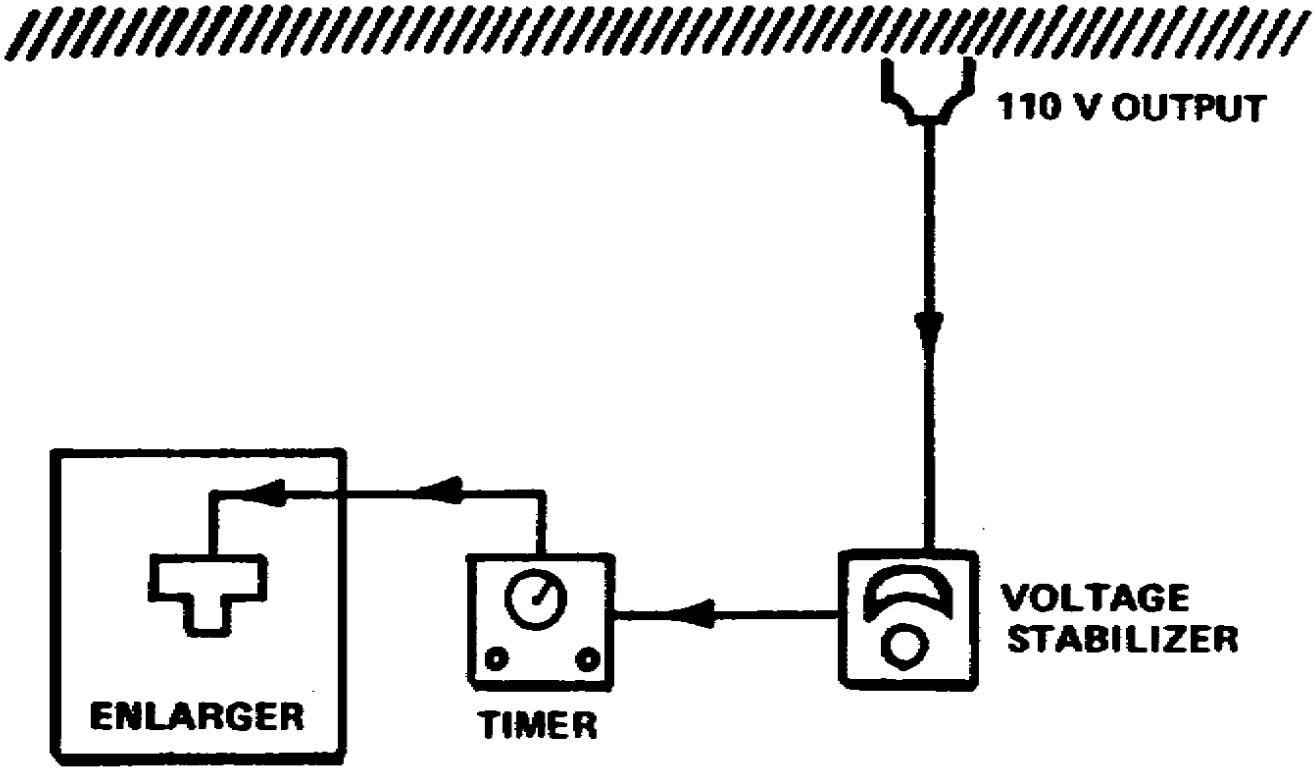

Figure 1-3. Typical enlarger setup

c. You should also have an assortment of lenses to cover different size negatives. The lens focal length should be roughly equal to the diagonal measurement of the negative. No matter what lens you use, be sure it is clean.

d. Voltage regulator. Stable, unfluctuating voltage is a must. Any fluctuations in the line voltage to a tungsten lamp changes the output and color quality of the lamp. This in turn causes a color shift in the print. The best type is the constant voltage transformer in the power line.

e. Safelight. Kodak Safelight Filter No. 13 (amber) with a 7 1/2-watt bulb, or Kodak Safelight Filter No. 10 (dark amber) with a 15-watt bulb, should be placed at least 4 feet from the paper.

2. Light leakage. Because of the high sensitivity of the color printing materials, extraneous light fogs the materials and degrades the product. Before you begin any color printing with existing equipment, you may find it necessary to block minor light leaks even though they produce no significant problems when you work with black and white materials. This can be done by:

a. Placing opaque tape over leaks.

b. Replacing or tighten molding around doors and windows.

c. Painting over windows, moldings, etc.

Learning Event 4:
PERFORM DARKROOM INSPECTION PROCEDURES

1. Safety, cleanliness, heat, and humidity control are among the most important considerations in a darkroom. Printing and processing operations in color photographic laboratories must contend with dust, chemical fumes, humidity, and heat from processing solutions.

a. Dust can cause spots on final prints that will render the product unusable. Dust has ruined more photographic projects than any other cause. Proper housekeeping, including periodic vacuuming of equipment and furnishings, along with weekly wet mopping of the floors, are essential. No smoking signs should be posted in all laboratories and finishing rooms. Smoke can coat negatives with a film that causes imperfections on the print. Tobacco ashes can cause spots on the final print. Clean up all chemical spills before they evaporate. Chemicals left to dry will leave a residue that can settle on equipment causing damage. Change all filters in air conditioners and furnaces on a regular basis.

b. Humidity and heat must be controlled. Set air conditioners to maintain temperatures between 70 and 75 degrees Fahrenheit. Humidity should be maintained between 45 and 55 percent.

c. Chemical fumes can be held down or eliminated by circulating the air through high efficiency filters that control airflow from one direction to the other at a uniform rate of flow. Inexpensive, portable airflow units can be used in small darkrooms. Darkroom ventilation is essential to the safety and comfort of personnel working in the laboratory.

d. Before using a laboratory it is necessary to observe all mechanical, electrical, and chemical safety precautions.

(1) Mechanical safety: Avoid loose clothing, such as neckties, unbuttoned lab coats, remove wrist watches, and rings. Also, secure long hair. These items can become entangled in drives and other moving parts of equipment in a laboratory. Print trimmers and scissors, used to cut film and paper, can cut fingers if not used properly. When not in use, always put cutting tools away and lower and lock the blade of a trimmer.

CAUTION: The blade of a trimmer must NEVER be left in the UP position.

(2) Electrical safety: Check power cords for worn or frayed insulation, loose connections and broken parts to minimize accidents. Use circuit breakers or other approved means to prevent accidental overloading. See that electrical equipment is properly grounded, and all power cords have polarized, three-prong plugs attached.

CAUTION: Secure all electrical items such as timers, clocks, lamps, or any other electrical item, near sinks, washers and other water or chemical containers.

An electrical item falling into a wash tank or other liquid container could cause electrocution.

(3) Chemical safety: Observing posted warning signs and complying with directed procedures helps establish safe working habits. Make sure that your laboratory has adequate ventilation. Never sniff a container or opened bottle to determine its contents. When necessary, proper protective equipment and clothing should be worn. Working with caustic chemicals or acids requires that you use a rubber apron, rubber gloves, and goggles.

CAUTION: Always add acid to water. Adding water to concentrated acid can cause it to boil and splatter.

2. Make sure that cleaning material and chemicals are not allowed to mix with photographic chemistry. After cleaning, remove all cleaning material residue from tanks, trays, sinks, and shelves.

Lesson 1
PRACTICE EXERCISE

1. What are the real disadvantages of color negative material?

   a. There are no disadvantages
   b. You can never make black and white prints
   c. Visual evaluation is not accurate
   d. You cannot produce gray in the prints

2. In color negative emulsions, what color is the second emulsion layer sensitive to?

   a. Red
   b. Blue
   c. White
   d. Green

3. You are selecting a negative from a group of two or more. What characteristics should you look for?

   a. Color balance, gray card, and filter pack
   b. Filter pack, proper density, and color balance
   c. Proper density, gray card, and free of defects
   d. Color balance, filter pack, and instructor's recommendation

4. You have photographed a red original. In what layer or layers will the dyes be formed in the color negative?

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

5. You must block out ultraviolet radiation emitted by the light source. Which filter should you use?

   a. CP2B
   b. CC2Y
   c. CP10B
   d. CC10Y

6. What will minimize negative defects?

   a. Condensed light source
   b. Diffused light source
   c. CP2B filter
   d. Filter pack

7. You are preparing a darkroom for printing. What should be the temperature of the darkroom?

   a. Between 50 - 75
   b. Between 70 - 75
   c. Between 50 - 100
   d. Between 75 - 100

8. How can you control dust in the darkroom?

   a. Nothing, dust will always be there
   b. Periodic vacuuming of equipment and weekly wet mopping of the floors
   c. Daily vacuuming of the studio and weekly dusting of the entrance way
   d. Yearly painting of the entire lab and rotating the equipment from one lab to another

9. You are ready to mix some caustic chemicals. What three protective equipment and clothing items should you wear?

   a. Rubber apron, rubber gloves, and goggles
   b. Respirator, surgical gloves, and lab coat
   c. Rubber gloves, respirator, and hospital gown
   d. Surgical gloves, hospital gown, and hospital cap

10. You are ready to use the photographic darkroom. What three main safety procedures should you observe?

    a. Gas, electrical, and heat safety
    b. Chemical, gas, and corrosion safety
    c. Mechanical, chemical, and electrical safety
    d. Electrical, biological, and chemical safety

LESSON 2
COLOR PRINTING FILTERS

TASK

Select color print filters.

CONDITIONS

Given information and charts depicting color print filters.

STANDARDS

Demonstrate competency of the task skills and knowledge by correctly responding to 80% of the multiple-choice test covering color print filters.

REFERENCES

SS 0514

Learning Event 1:
DESCRIBE COLOR PAPER AND ITS CHARACTERISTICS

1. Ektacolor RC paper is a waterproof, multilayer paper designed for the production of high quality color prints from Kodacolor, Vericolor or Internegative Films. Either contact or projection printing methods may be used. It is designed to be processed in Kodak Ektaprint 2 (EP-2) chemicals. There are various methods used for processing Ektacolor paper. All produce satisfactory color prints.

a. Ektacolor RC (resin coated) paper is an integral tripack emulsion. It has three light-sensitive emulsion layers. Each emulsion layer is sensitive to one of the primary colors of light. The order of emulsion layers is red-sensitive on top, followed by green-sensitive, and blue-sensitive on the bottom. This is reversed from that of the negative.

b. Ektacolor 74 RC paper is available in only one grade of contrast. This is all that is needed because the paper is matched to the normal characteristic of the color negative.

c. Color printing paper also exhibits reciprocity failure very similar to film materials when varying exposure times are used. Reciprocity failure differs in degree between the three-print emulsion layers and will cause serious differences in color balance. It is, therefore, recommended that exposure times shorter than 5 seconds and longer than 45 seconds be avoided.

This is why it is generally advisable to rely on the diaphragm (f/stop) when adjusting for print density while keeping the exposure time constant.

d. Reciprocity failure. The law of reciprocity is the law of exposure, i.e., Exposure = Intensity x Time (E = I x T). In theory, any combination of light intensity and exposure can be used as long as it produces a good exposure. This theory is true in most cases. However, exposures of extremely long or short duration sometimes cause a shift in the emulsion layers. This is especially true when working with color materials, both film and paper. Since you are working with three emulsion layers, you must be very careful with your exposures. In effect, if you encounter reciprocity failure, you have an apparent loss of film speed, and the colors in the emulsion layers will shift, meaning the colors are not rendered in their true colors.

2. Manufacturers recommend that for short term storage, (3 months or less), color papers should be kept at a temperature of 50 degrees Fahrenheit or lower. For long term storage, (4 months or more), color paper should be kept at 10 degrees Fahrenheit or lower. In either case, paper should be removed from storage the day before you intend to use it. For best results, process the exposed color paper as soon as possible.

Learning Event 2:
EXPLAIN THE USES OF COLOR PRINTING FILTERS

1. The major difference between black and white and color printing is that black and white negatives and printing paper have only one emulsion layer. Therefore, there is only one image. Color negatives and color printing papers have three emulsion layers and, therefore, produce three images. The three emulsions are converted to colored dyes after processing as explained in Lesson 1. The three dye images in color paper are controlled by the exposure time in the printer and the color of the light that is transmitted. In other words, the image is controlled by exposure and filtration.

a. A combination of dye images in the negative plus any filters you use in the printer combine forces to control the final dye image in the color print.

b. There are two methods of exposing Ektacolor paper using the color printer. They are tricolor or additive printing and white light or subtractive printing. The tricolor method is very time consuming but is still a valid method of making prints. In the military, we normally use the white light method of making color prints.

2. The tricolor or additive color process. Exposure of color film, and to a more limited degree color printing paper, applies the principles of the additive color process. The additive process uses the primary colors of blue, green, and red.

a. When equal parts of blue, green, and red light are projected from separate projectors and are partially superimposed on a screen, you see in the area of overlap of all three colors, white, as shown in Figure 2-1.

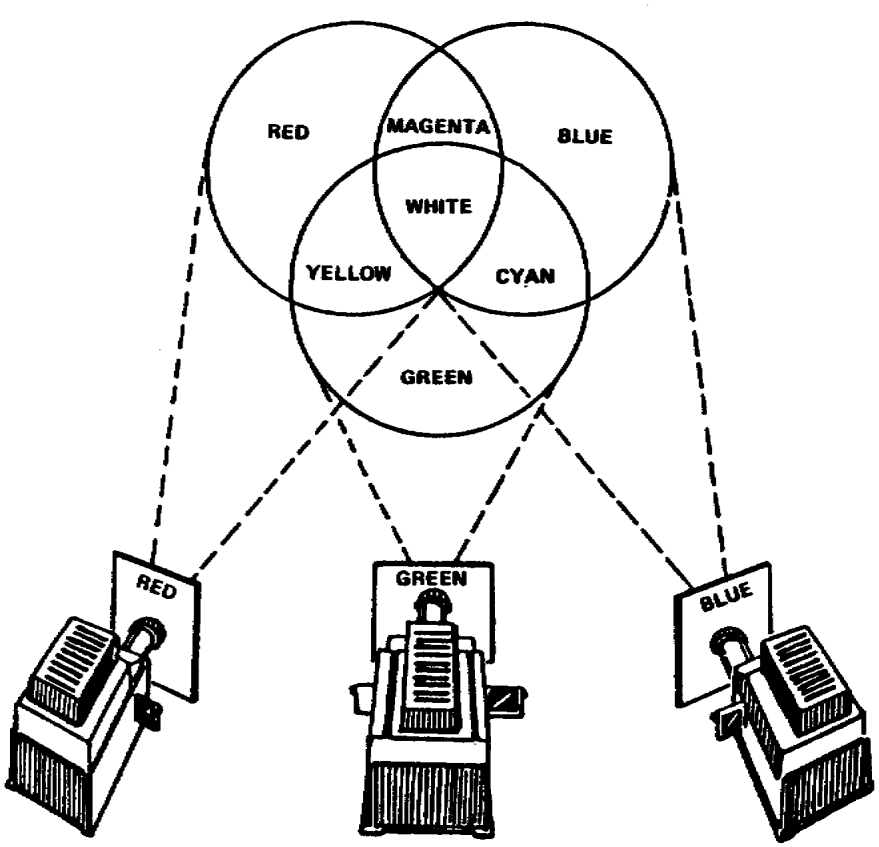

Figure 2-1. Additive color system

(1) The area of overlap between the blue and green light produces cyan (blue green). The area of overlap of the red and blue light produces magenta, and the overlap of the red and green light produces yellow. Almost any desired color match can be produced by varying the amount of one of the two colors used for producing that color.

(2) If you have equal proportions of red and green, the result is yellow. By increasing the amount of red, the result is orange. Since matching a wide range of colors with red, green, and blue light involves addition of the colored light, the primary colors are often identified further as the additive primaries.

b. In color photography, the three colors produced by mixtures of additive primaries in pairs are of particular importance. These colors, cyan, magenta, and yellow, are known as the subtractive primaries. Since each represents white light minus one of the additive primaries, the subtractive primaries are the complements of the additive primaries. For example, cyan and red light blend together to give white light. Similarly, magenta is complementary to green, and yellow is complementary to blue.

c. At this point, refer to Figure 2-2 and study the color star. Remember which colors are the additive primaries (blue, green, and red) and notice that the subtractive primary colors between any two of the additive primaries are mixtures of these two primary colors. Also, notice the colors that are directly opposite to each other in this star; these colors are complementary to each other.

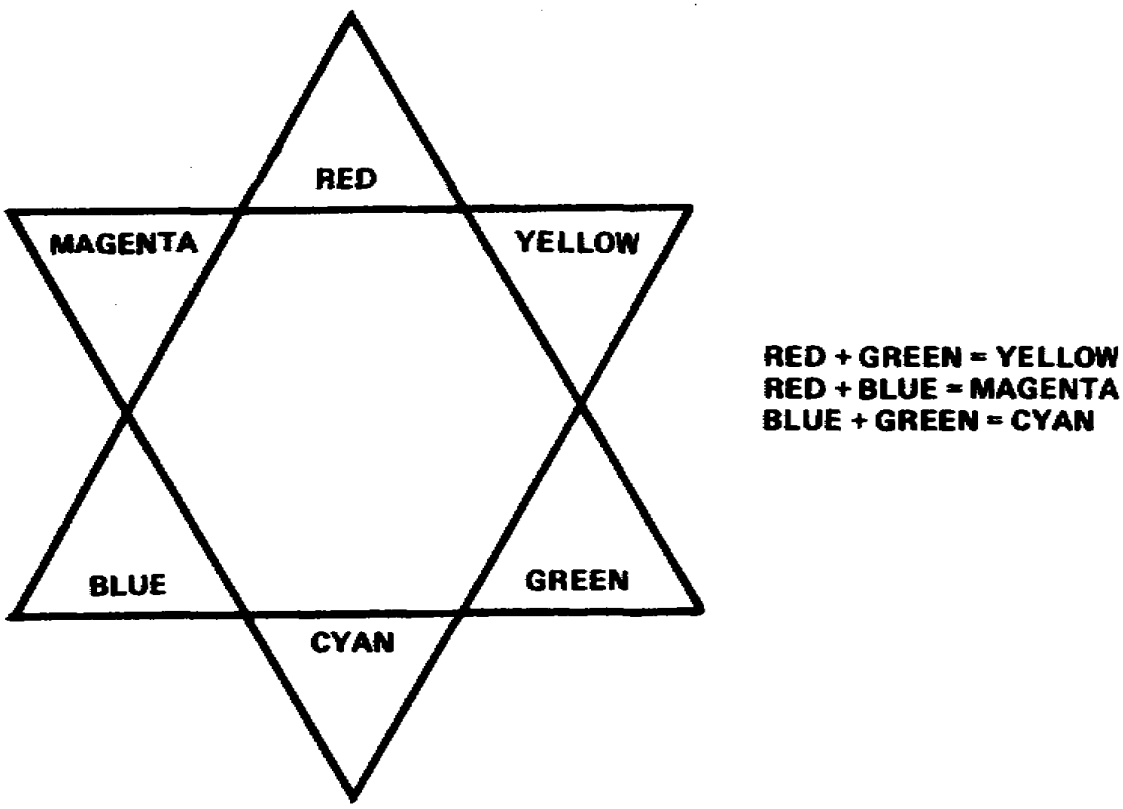

Figure 2-2. Color star

d. Although the original photographic record on color film uses the additive primary colors, these are not suitable for the final color product. This is because any combination or primary colors over one light source results in neutral density. A transparency, for example, must be viewed when you use only one white light source. It is the subtractive process that makes the "final product" possible.

3. White light or subtractive color process.

a. The white light method of exposing color paper requires only a single exposure. This requires using the appropriate color printing (CP) or Color Compensation (CC) filters. CP filters are acetate sheets and are placed between the light source and the negative. CC filters are gelatin and are placed below the lens. Both filters have the same density characteristics and transmit the same amount of light for a given factor. That is, a CC 20 Y will transmit the same amount of light as a CP 20 Y filter. Some color enlargers are equipped with "dial-in filters." That is, the filter packs are enclosed in the printer head. You dial the appropriate filter combination required.

Newer model color printers have "Dichroic Glass filters." These filters are more accurate and produce better color images than CP or CC filters.

b. In the additive color process, where three projectors were used, (one lens was covered with a red filter, one with a green filter, and one with a blue filter), we were able to produce any desired color. Theoretically, any filter transmits light of its own color and absorbs all other colors. The amount of absorption depends upon the density of the filter. Therefore, we could not place all three filters over a single light source. To a certain extent, the filters are mutually exclusive. That is, none of them transmits light passed by either one of the other two. Consequently, any two of the filters used in combination in front of a single light source will absorb all of the light.

c. Since a filter of any of the additive primary colors transmits only that one primary color, the subtractive primary colors are used as filters in the structure of color materials. This makes it possible to transmit any two of the additive primary colors and subtract the third.

d. The term subtractive primary color has the same meaning as secondary color as used when discussing filters. The colors yellow, cyan, and magenta can be called either secondary colors or subtractive primaries.

e. A cyan filter transmits blue and green light, but absorbs red light. In other words, it subtracts red from white light. Similarly, a magenta filter (which transmits red and blue) functions by subtracting green from white light. A yellow filter will transmit green and red and subtract blue. These are the same colors used as filters on enlargers.

f. Since each of the subtractive primary filters transmits approximately two-thirds of the visible spectrum, we can superimpose any two of them over a single light source to produce other colors. Refer to Figure 2-3 for an illustration of the principle of the subtractive color process. Notice

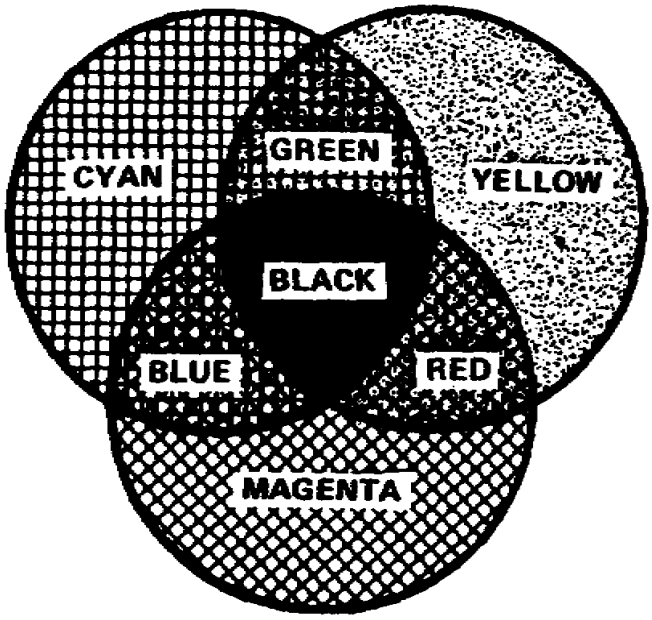

Figure 2-3. Subtractive color system

that the combination of any pair of the subtractive primary colors in equal densities produces one of the additive primary colors.

(1) A yellow filter transmits red and green and absorbs blue, and a magenta filter transmits red and blue and subtracts green from the light source. When these two filters are used over a single light source, the one color that is transmitted by both magenta and yellow is red. Therefore, yellow plus magenta produces red.

(2) In the same manner, when yellow and cyan are used in combination, the one color that is transmitted by both filters is green; since yellow transmits red and green, and cyan transmits blue and green.

(3) Cyan plus magenta produces blue, because blue is transmitted by both filters. Where all three filters overlap in the center, all of the light is absorbed, and the result is black.

(4) By varying the density of any one of the filters, any desired change in the color produced can be brought about. For example, to change the appearance of red to make it an orange red, increase the amount of yellow; in other words, decrease the amount of magenta.

4. The principal theory of filters is that a filter transmits its own color and absorbs all others (table 2-1). A red filter will transmit red and absorb blue and green and the color they have in common is cyan. A cyan filter will transmit blue and green but will absorb red which is its compliment. When a CP 30C filter (fig 2-4) is placed over a white light source in subtractive color printing, it will transmit almost all the green and blue and subtract part of the red. In this case it will be 0.30 log exposure unit.

NOTE: "CP" stands for color printing, "30" for a density of 0.30, and "C" for cyan.

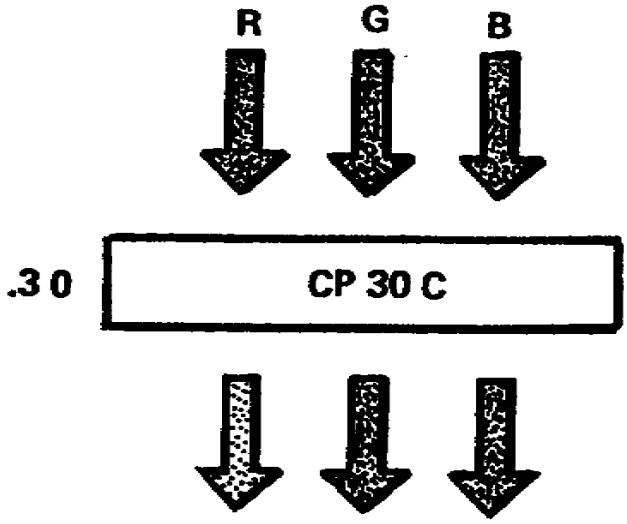

Figure 2-4. Color printing filter

TYPICAL COLOR PRINTING (CP) FILTERS

FILTER	COLOR	DENSITY (LOG EXPOSURE UNITS)	COLOR PASSED USING WHITE LIGHT AND SUBTRACTIVE COLOR PRINTING
CP 025 R		0.025	
CP 05 R		0.05	
CP 10 R	RED	0.10	YELLOW AND MAGENTA
CP 20 R		0.20	
CP 025 G		0.025	
CP 05 G		0.05	
CP 10 G	GREEN	0.10	CYAN AND YELLOW
CP 20 G		0.20	
CP 025 B		0.025	
CP 05 B		0.05	
CP 10 B	BLUE	0.10	CYAN AND MAGENTA
CP 20 B		0.20	
CP 025 Y		0.025	
CP 05 Y		0.05	
CP 10 Y	YELLOW	0.10	GREEN AND RED
CP 20 Y		0.20	
CP 025 C		0.025	
CP 05 C		0.05	
CP 10 C	CYAN	0.10	BLUE AND GREEN
CP 20 C		0.20	
CP 025 M		0.025	
CP 05 M		0.05	
CP 10 M	MAGENTA	0.10	BLUE AND RED
CP 20 M		0.20	

NOTE: Each of the filters sets above come in densities of 0.30, 0.40 and 0.50.

Table 2-1. Typical color printing (CP) filters

5. It is helpful for you to think of color paper in terms of its three separate emulsion layers. Each of the layers is sensitive to light of a particular color (blue, green, or red). Each of the layers must receive the correct exposure in order to produce a print of satisfactory density and color balance. A change in the overall exposure time affects all three of the dye images, while a change in filters and its strength will affect the exposure of one or two emulsion layers. By manipulating these variables, you can control the density and the overall color balance of the print.

Lesson 2
PRACTICE EXERCISE

1. The top layer of the Ektacolor RC paper is sensitive to which color of light?

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

2. You are concerned about reciprocity failure. What should be the recommended exposure time for Ektacolor paper to minimize this failure?

   a. 5 to 45 seconds
   b. 5 to 100 seconds
   c. 10 to 45 seconds
   d. 10 to 120 seconds

3. You most store color paper for a short time. What should be the storage temperature in degrees fahrenheit?

   a. 10 degrees or lower
   b. 50 degrees or lower
   c. 10 degrees or higher
   d. 50 degrees or higher

4. What is the major difference between black and white and color printing?

   a. Color has two emulsion layers
   b. Color has three emulsion layers
   c. Black and white has two emulsion layers
   d. Black and white has three emulsion layers

5. What are the two methods of color printing?

   a. Tricolor, additive
   b. Additive, monocolor
   c. Monocolor, tricolor
   d. Tricolor, subtractive

6. Is the following true or false: A filter absorbs its own color and transmits all other colors.

   a. True
   b. False

7. In order to produce white light using the additive process, which filters must you use?

   a. Cyan, red, white
   b. Red, blue, green
   c. Red, white, blue
   d. Yellow, magenta, cyan

8. You want to produce a perfect print. Which filters must you use?

   a. Contrast
   b. Dichroic
   c. Conversion
   d. Complementary

9. The subtractive filters, yellow and magenta, will produce the color they have in common. What color will that be?

   a. Red
   b. Blue
   c. Green
   d. White

10. You add a yellow filter over a white light source. Which color or colors of the spectrum will it transmit?

    a. Blue
    b. Green
    c. Green and red
    d. Cyan and yellow

LESSON 3
PRINTING COLOR NEGATIVES

TASK

Describe and determine exposure requirements and chemistry.

CONDITIONS

Given procedural techniques information and charts for determining and describing exposure and starting filter pack.

STANDARDS

Demonstrate competency of the task skills and knowledge by correctly responding to 80% of the multiple-choice test covering exposure and starting filter pack.

REFERENCES

STP 11-84B14-SM-TG
SS 0514

Learning Event 1:
PROCEDURES FOR MAKING THE FIRST TEST PRINT

1. Two main factors that determine how your print will appear are exposure and filtration. Enlargers differ from each other in both light intensity and filtration. Therefore, it is difficult to say a certain filter pack and exposure will produce a perfect print. You must make a test print. Kodak does recommend a starting filter pack for different types of enlargers and negatives (Table 3-1).

Negatives	Dichroic Filters and Tungsten Halogen Lamps	CC or CP Filters and Tungsten Halogen Lamps
Ektacolor S	35M + 85Y	55M + 75Y
Kodacolor X	35M + 65Y	55M + 55Y
Kodacolor II	65M + 125Y	85M + 115Y
Varicolor II, Type S	65M + 105Y	85M + 95Y

Table 3-1. Starting filter packs for RC 74 paper

a. Test exposures (and subsequent trials) are essential. You should write down the magnification, exposure time, f/stop, filtration, and anything else that is changed from one test to another. It really doesn't matter what exposure and filtration you use for your test as long as you know what it was and can relate to it for subsequent test comparisons. Kodak does recommend a starting exposure for a 35mm to 8- by 10-inch print of about 10 seconds f/8.

b. As we stated before, select a negative that is properly exposed and processed. The negative should have gray card in the image area. The negative should be of a typical subject with typical lighting. Finally choose a negative that is free of defects such as scratches, stain, fingerprints, etc.

2. Place your negative, emulsion side down, into the negative carrier of your printer. Make sure your negative is free from dust. Dial in your starting filter pack, make a test-strip series of four exposures at the same magnification that is to be used for the final print. Expose one strip for 5 seconds at f/5.6, another for 5 seconds at f/8, and one at 5 seconds at f/11. By keeping the time consistent, you have little problem with reciprocity failure.

3. Elimination of stray light around the edges of the negative image is absolutely essential. Masks of black paper or black masking tape in the negative carrier will prevent stray light from fogging the paper.

Learning Event 2:
JUDGING AND MODIFYING THE TEST PRINT

1. Study the color balance and density level of the test print. Look at the gray tones area and see if there are any variations from neutral color balance. If any variation is recognized, think of it as an overexposure or underexposure of one or more of the paper emulsion layers.

a. For example, if the grays appear bluish and light, the yellow dye has been underexposed. On the next test print, more light of the color to which this layer is sensitive (i.e., blue light) must be allowed to strike the paper. You can accomplish this by subtracting the yellow filter from your filter pack.

b. If the print appears yellow and dark, hold back the blue light by adding yellow filtration to the pack. If the print appears red, subtract cyan from the filter pack, but if there is no cyan or cyan is not used in the filter pack, then you have to add yellow and magenta, which is the equivalent of a red filter. Most manufacturers balance their paper so the use of a combination of magenta and yellow filters in the printer light source is usually required to make a balanced print.

c. After you have determined what color is in excess, you then have to determine how much change is desired to alter the color of the exposing light reaching the three emulsion sensitive layers of the paper. You determine the "how much" by three categories. Table 3-2 will assist you to select what filter adjustment should be made.

1.	Slight	10 density filter changes
2.	Considerable	20 density filter changes
3.	Great	30 Density filter changers

Table 3-2. Suggested density changes

2. Viewing the test print. There are a number of variables that must be controlled to produce an acceptable color print. It is highly unlikely that you will make a perfect print on your first attempt. The first test print must be considered and evaluated for density and color balance.

a. Use of a ring-around. Compare your test print to the Kodak ring-around chart. It is a series of prints that vary in known amounts for standard prints of acceptable balance. Match the test print as closely as possible to the prints in the ring around.

b. Use of viewing filters. If a test print is reasonably close to the desirable range of color balance, use the Kodak color print viewing filter kit, a suitable tool to evaluate color balance.

c. Viewing condition. The light you use for viewing should be of the same quality as the light under which the final print is to be displayed. From a practical standpoint, some average conditions must be selected.

d. To modify the printing filter pack, refer to Table 3-3. It can be used as a guide in determining what adjustments should be made.

If the color balance is:	If possible subtract these filters:	or add these filters
Yellow	Magenta and cyan (or blue)	Yellow
Magenta	Cyan and yellow (or green)	Magenta
Cyan	Yellow and magenta (or red)	Cyan
Blue	Yellow	Magenta and cyan (or blue)
Green	Magenta	Cyan and yellow (or green)
Red	Cyan	Yellow and magenta (or red)

Table 3-3. Modifying the filter pack

e. After you select the filter adjustment, you must decide how much of a change is required. Refer to Table 3-4 as a guide to the degree of adjustment.

If the color balance is too	Slight change	Considerable	Great change
Red	Add 10M + 10Y	Add 20M + 20Y	Add 30M + 30Y
Green	Subtract 10M	Subtract 20M	Subtract 30M
Blue	Subtract 10Y	Subtract 20Y	Subtract 30M
Cyan	Subtract 10M + 10Y	Subtract 20 + 20Y	Subtract 30M + 30Y
Magenta	Add 10M	Add 20M	Add 30M
Yellow	Add 10Y	Add 20Y	Add 30Y

Table 3-4. Amount of change required

Learning Event 3:
DETERMINE THE TYPE OF EVALUATION METHOD

1. There are various methods utilized in making color prints; all producing satisfactory results. The printing steps for color are essentially the same as in black and white printing. The main additional factor that must be considered in color negative printing is the required use of filters. Once the use of filters is understood, color printing can be relatively simple. Once the use of filters is understood, color printing can be relatively simple. There are two evaluation methods, visual and densitometric.

2. The different evaluation techniques provide a method of reading the blue, green, and red densities of the negative and print. These values provide the data you need to adjust the densities of the CP, CC, or dichroic filters. When the print material is exposed, the blue-, green-, and red-sensitive layers of printing material receive the proper exposure.

a. The visual method of evaluation is also called the trial and error method and uses various filters. This method of evaluation is not the most accurate and requires guesswork in determining print filter packs and exposure. However, to understand the theory in making color prints, the visual (trial and error) method will help you to understand what is taking place when color densitometers, color analyzers, and color video analyzers are used for mass production. This is the method usually used in a small lab.

(1) After print is made, you view the print through a series of filters (fig 3-1). These filters alter the color of the print. The print should be viewed under daylight fluorescent lighting. Warm, soft, fluorescents or regular tungsten household lamps will give a wrong color balance.

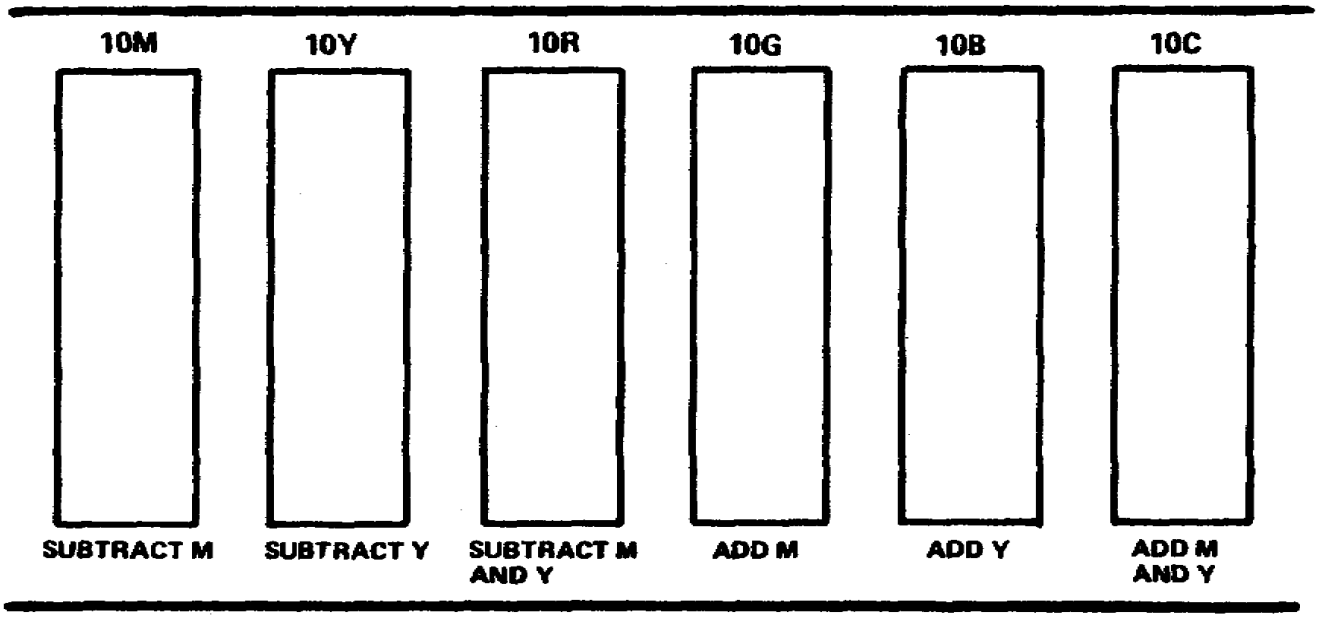

Figure 3-1. Typical color print viewer

(2) By viewing the print through the various filters, you can see what adjustments to the filter pack are required.

b. The densitometric method of evaluation can be performed either on or off the enlarger. It removes all the guesswork in determining printing filter packs and exposure. Such evaluation can usually produce satisfactory prints on the first try.

(1) Off-easel reflectance densitometer evaluation is based on reading the dye density of cyan, magenta, and yellow in the print. This is done by reading the neutral area with the densitometer through the red, green, and blue filters. It will speed up your evaluation and make your color identification easier. This method can be set up on a production basis outside the darkroom. In such cases a densitometer operator can furnish filter-pack information to all the darkroom technicians.

(2) On-easel evaluation requires an electronic analyzer for each printer. This proves economical only if the time and accuracy can outweigh the initial cost of the analyzers. There are several types of on-easel analyzers available. They vary in design, simplicity, and accuracy. The on-easel electronic analyzer is a light meter with filters. With on-easel evaluation, you are making the comparisons through the printing filters in the darkroom, with the lens, light source, and negative in place. This makes it far more accurate than of-easel evaluation. This method of evaluation is the most accurate and consistent, compared to the off-easel evaluation.

3. Regardless of which method is used, some form of evaluation must be made on all color prints. Many times what looks like a good print turns out to be an off-color print. This can occur when viewed under a different light source. Make sure the print has been evaluated before sending it to the customer.

Lesson 3
PRACTICE EXERCISE

1. What information should you write down for your test exposures?

   a. Magnification, exposure time, f/stop, filtration
   b. Exposure time, f/stop, developer type, date of printing
   c. Magnification, f/stop, date of printing, developer type
   d. Developer type, date of printing, magnification, filtration

2. You are using Kodacolor II with dichroic filter and tungsten halogen lamps. What are the recommended filter packs?

   a. 65M + 125Y
   b. 95M + 100Y
   c. 75C + 125Y
   d. 10C + 200M

3. You are selecting a negative for a test print. What should you look for in this negative?

   a. Gray card shot in shadows, good color balance, good exposure
   b. Good color balance, good density, good exposure, free of dust
   c. Outdoor shot gray card, free of dust, instructor's recommendation
   d. Free of defects, outdoor shot gray card, proper exposure and density

4. What will you recommend test exposure be when making an 8- by 10-inch color print from a 35mm negative?

   a. 5 seconds at f/16
   b. 5 seconds at f/11
   c. 10 seconds at f/8
   d. 10 seconds at f/4

5. Which methods of evaluation can be set up on a production basis outside the darkroom?

   a. On-easel densitometric
   b. Off-easel densitometric
   c. Trial and error
   d. None of the above

6. If the print looks too blue, what color should be subtracted from the filter pack?

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

7. When the predominate color is yellow, what color filtration should be added to the pack?

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

8. What color will be formed if you combine a yellow and magenta filter?

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

9. If your test print appears to be red, what adjustment should you make to your filter pack?

   a. Add yellow and magenta
   b. Add magenta and cyan
   c. Add cyan and yellow
   d. Add yellow only

10. You are checking a test print, and have studied color balance and density level. Where do you check for over or underexposure?

    a. Dark shadows
    b. Gray tone areas
    c. White highlights
    d. Both shadows and highlights

ANSWERS TO PRACTICE EXERCISES

Lesson 1

1. c. Visual evaluation is not accurate
2. d. Green
3. c. Proper density, gray card, and free of defects
4. a. Red
5. a. CP2B
6. b. Diffused light source
7. b. Between 70 and 75
8. b. Periodic vacuuming equipment and weekly wet mopping of the floors
9. a. Rubber apron, rubber gloves and goggles
10. c. Mechanical, electrical, and chemical safety

Lesson 2

1. a. Red
2. a. 5 to 45 seconds
3. b. 50 degrees or lower
4. b. Color has three emulsion layers
5. d. Tricolor and subtractive
6. b. False
7. b. Red, green, and blue
8. b. Dichroic
9. a. Red
10. c. Green and red

Lesson 3

1. a. Magnification, exposure time, f/stop, filtration
2. a. 65M + 125Y
3. d. Free of defects, outdoor shot gray card, proper exposure and density
4. c. 10 seconds at f/8
5. b. Off-easel densitometric
6. c. Yellow
7. c. Yellow
8. a. Red
9. a. Add yellow and magenta
10. b. Gray tone areas