WESTON

Photographic Analyzer

Model 877

FW Wallace

Wallace

DENSITOMETER, ILLUMINATION METER, AND EXPOSURE GUIDE TO PROVIDE PRECISE INSTRUMENTATION WHEN MAKING PRINTS AND ENLARGEMENTS, OR COLOR PHOTOGRAPHS BY ANY PROCESS

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Foreword — The Weston Photographic Analyzer offers the professional and serious amateur photographer two basic tools by means of which the equipment and technique of producing either a black-and-white or color print can be checked by instrumentation.

Like the Weston Exposure Meter, the Analyzer will help the user by taking the guesswork out of many phases of photography, and, aside from materials saved, relieve the photographer of technical considerations so that more time may be devoted to esthetic phases.

Several of the original models were in use during World War II. Later models in field tests by professional and amateur photographers invariably proved indispensable after brief use. Still more recently, the Weston Laboratories carried on much additional research and development work. The present instrument is the culmination of these exhaustive endeavors and experience . . . a logical working companion to the Weston Exposure Meter.

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Description of the Analyzer

The Weston Photographic Analyzer consists essentially of a Densitometer, an Illumination Meter, an Exposure Guide, and a set of Instructional Data.

To the black-and-white photographer and especially the color photographer, it offers a scientific means of performing and checking each step leading to the finished product. It will enable the photographer to standardize his general photographic technique so that considerable savings in time and materials can be realized through the use of instrumentation in place of guesswork. The Analyzer is based on scientific principles and as such it will aid the photographer in standardizing his procedure, however, it is not intended to eliminate the personal artistic tendencies of the photographer but rather to aid him in expressing them.

By means of Analyzer measurements and the Exposure Guide, definite tones and tone ranges can be predicted with accuracy and therefore, print control, including dodging, can be done in a scientific manner.

As a densitometer, the Analyzer is capable of measuring the diffuse density of any portion of the negative. This method of measurement precludes the possibility of errors arising from the use of the human eye as the judging factor.

As an illumination meter, the Analyzer provides a means of determining the amount of light, in meter candles, available on the enlarger easel or contact printer platen.

Many of the variables encountered in the making of prints, such as enlarger specularity (condenser vs. opal type enlargers), lens flare, spectral quality of the light source and processing techniques are cancelled out or compensated for by using the Analyzer. Through its use the photographer can determine a working Analyzer Number for the particular printing paper he wishes to use, directly in terms of his equipment and processing technique. Different combinations of equipment and methods of processing may require different Analyzer Numbers for a given printing paper.

The Exposure Guide furnished with the Photographic Analyzer provides a simple and convenient means to convert negative density and illumination measurements into printing exposure values.

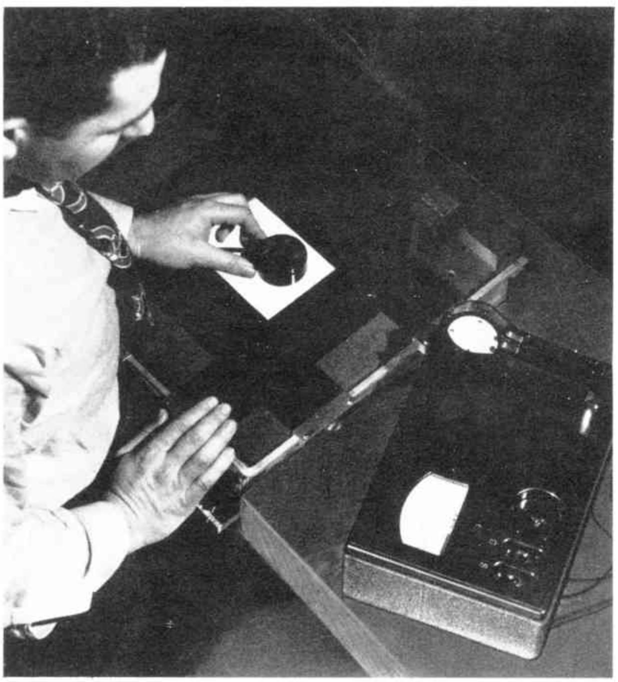
While the Analyzer is designed to help the photographer to produce good quality prints, it is unreasonable to assume that a perfect print will always result from the application of the instructions contained in this booklet. Obviously, an underexposed negative cannot yield a high quality print, and an overdeveloped negative may be too contrasty to print well even on the softest grade of paper. In fact, one of the most important functions of the Analyzer, is to reveal faults in negative exposure and development and to indicate what corrections or precautions should be taken in making future negatives.

Applications—

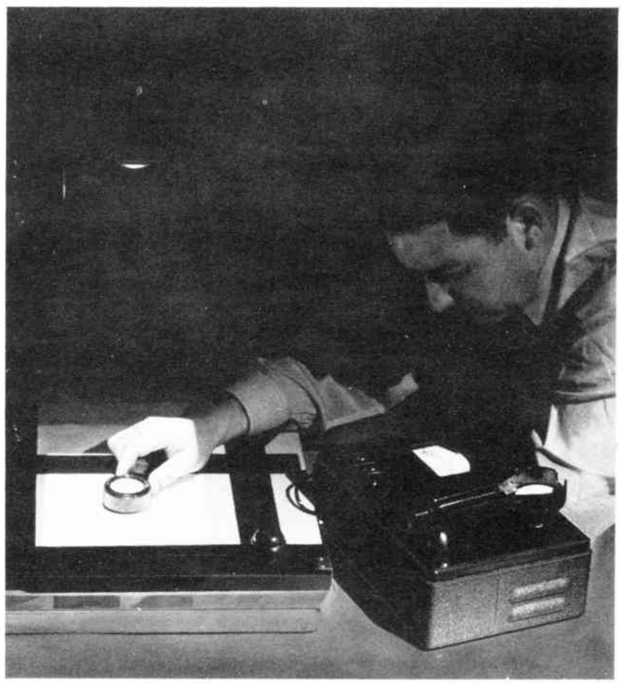
1. Measure maximum and minimum densities of negatives and determine the best grade of paper for each negative
2. Determine correct projection and contact printing times
3. Measure uniformity of light distribution
4. Measure contrast ranges of photographic papers
5. Measure relative speeds of printing papers
6. Check film speeds
7. Check filter factors
8. Construct time-gamma curves
9. Balance color-separation negatives
10. Mask transparencies to reduce their ranges
11. Control the various steps required in all of the color processes

Condensed Operation and Use of the WESTON Photographic Analyzer

The Weston Photographic Analyzer is both a Densitometer and Illumination Meter. Operating on 105-125 volts, alternating or direct current, it is easy to use and accurate in results. See pages 6 and 7.



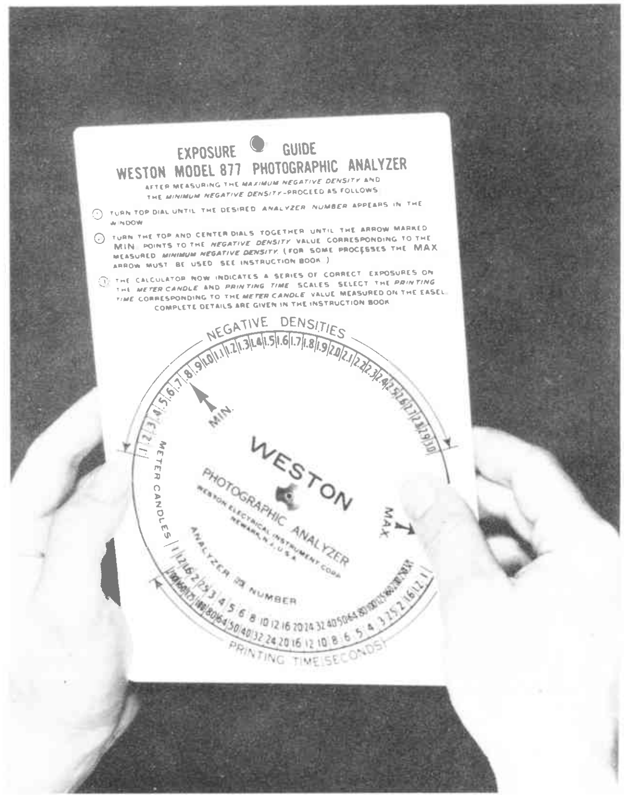
If you want to make contact prints, you measure the illumination by pressing a special disc over the *Photronic Photoelectric Cell, and placing the Cell face down on the printer platen. Then read the Meter-Candle value on the meter scale and multiply the reading by 10. See page 9.



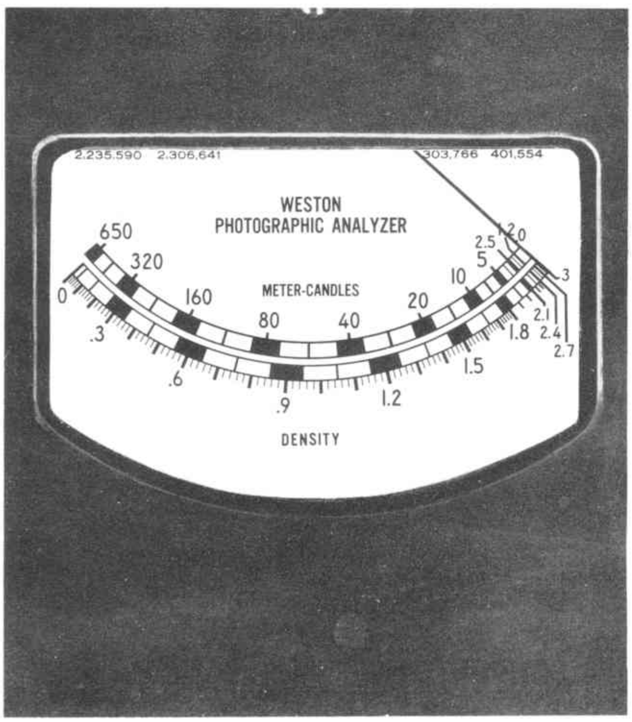
To use the Analyzer as an Illumination Meter, remove the *Photronic Photoelectric Cell from the movable arm, place it face up on the enlarger easel, and at any magnification and f:stop, read the illumination on the Meter-Candle scale of the Analyzer meter. See page 6.

***PHOTRONIC . . .** A copyrighted name designating the photoelectric cells and devices manufactured exclusively by the Weston Electrical Instrument Corporation.

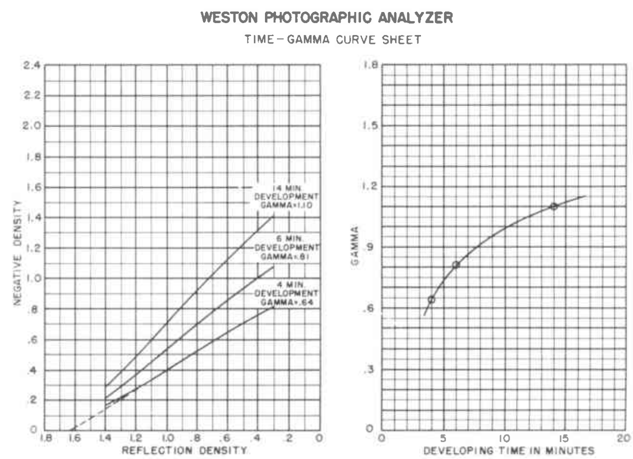
To use as a Densitometer, place negative on viewing plate, and press down the movable arm carrying the *Photronic Photo-electric Cell. Fully explained on page 6, and for color separation negatives on page 15.



Knowing the minimum negative density, the illumination value, and the Analyzer Number (paper speed) of the paper, a simple, quick adjustment of the rotating dials of the Exposure Guide gives the Printing Time in Seconds. Explained in detail on page 8.



On the built-in meter, the pointer will indicate the Negative Density. In this way, it is easy to find quickly the minimum and maximum densities of any negative and thus determine the density range. This meter also has a scale of Meter-Candle values for measuring illumination.



Time-Gamma Curves are easy to construct, by making step wedge negatives and then reading and recording the densities of the various steps and times of development. Complete instructions are given on page 12.

How it Operates—The positions of the various external features are shown in Figure 1. The optical system inside of the Analyzer is shown in Figure 2. Light from the lamp "D" passes upward through the heat-absorbing glass "K", the double condensers "L", diffusing glass "O", and emerges as a cone-shaped beam from aperture "E" in the viewing plate "I". When the outside arm "G" (Figure 1) is lowered to take a density reading, the diffusing glass "O" automatically slides out of place, and the light beam from aperture "E" passes through a corresponding aperture on cone "M" and impinges on the photo-electric cell "F". Obviously, this path of light must be kept in perfect alignment. If the elements are ever found to be out of adjustment, they can easily be realigned.

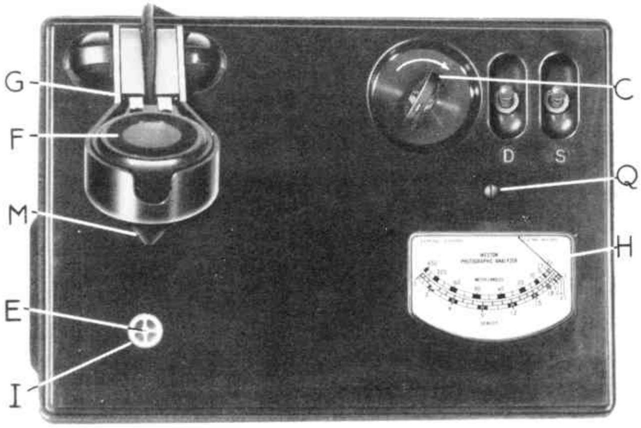


Fig. 1
Top View of Analyzer

The meter scale is illuminated through a red filter "U" by a 120 volt, 6 watt pilot lamp which may be replaced readily by swinging down the hinged socket.

As a Densitometer—

1. Light lamp "D" (Figure 2) by means of toggle switch "D" (Figure 1).

2. Changes in the line voltage will affect the density readings, and the brightness of lamp "D" should be checked before each reading.*

3. Place over aperture "E" the area of your negative whose density you want to measure.

4. Lower arm "G" carefully until the cone contacts the negative. Of course, the photo-electric cell must be in its place in the arm "G".

5. On meter "H" (Figure 1) read the density value indicated by the pointer, on the density scale.

6. The application of this density value will be shown in the following chapter on "Making the Print".

***NOTE:** *After lighting the lamp, and before putting negative in position, lower arm "G" over aperture and, if necessary, adjust rheostat "C" until pointer on meter "H" indicates zero density.*

If it is desired to measure densities greater than 2.4 the range of the Densitometer may be extended by placing a negative having a density of 0.4 or 0.5 over the aperture "E" and adjusting the rheostat "C" until the meter indicates zero density. Remove the negative and use densitometer in normal manner but add the value of the density used when working the above adjustment. For example if the density used was 0.4 and the meter reading obtained on the negative being measured is 2.3 then the correct density is 2.3 + 0.4 = 2.7.

As an Illumination Meter—

1. If room illumination is insufficient, turn on toggle switch "S" to light meter dial.

2. Remove photo-electric cell "F" from arm "G" and place it face up on the enlarger easel, or where the illumination to be measured falls directly on the cell.

3. Take the reading on the Meter-Candle scale of meter "H".

NOTE: *When measuring the illumination on the platen of a contact printer, it may be necessary to extend the range of the meter. This can be done by means of the multiplier disc, which can be mounted over the face of the photo-electric cell. Place the photo-electric cell, and multiplier disc if used, face down on the printer platen and read the Meter-Candle scale. If the multiplier is used, these values must be multiplied by 10.*

NOTE: *Before taking any readings, place cell face down on any flat surface to exclude the light, and adjust screw "Q" (Figure 1) until pointer indicates zero on Meter-Candle scale.*

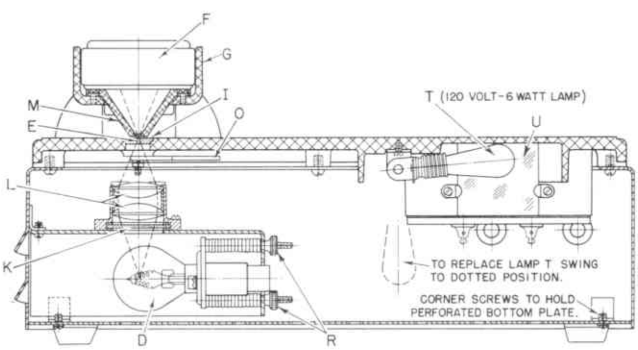


Fig. 2
Optical System inside Analyzer

Maintenance Adjustments—It is well to know how to keep the instrument at its peak of efficiency in the face of continued usage and varying individual conditions.

For example, in some localities the supply-line voltage may fluctuate so that occasional readjustments of the rheostat are necessary. If voltage variations are abnormal, we recommend using a 30 volt-ampere constant voltage transformer.

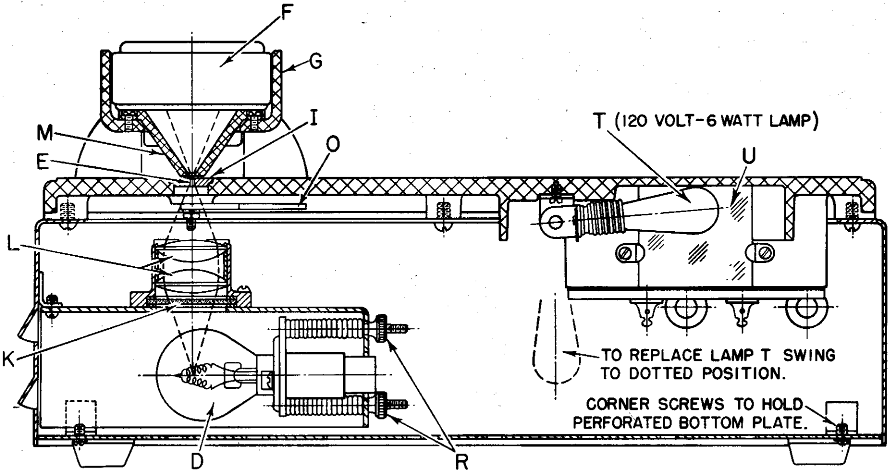


Fig. 2

Optical System inside Analyzer

The lamp "D" that illuminates the optical system of the Analyzer has been correctly positioned for optimum results. If a slight readjustment should become necessary, it is a simple operation.

1. Take off the perforated bottom of the Analyzer by removing the four corner screws.
2. Light the lamp by means of switch "D".
3. Push photocell arm "G" all the way down.
4. Turn rheostat knob "C" until meter indicates a density value between .4 and .5.
5. Turn any one of the three adjusting screws "R" (Figure 2) until the meter pointer on the density scale moves toward zero. When pointer starts to move away from zero end, turn screw back, until pointer is closest to zero end of density scale. Repeat with the other two screws "R".

The lamp "D" is a General Electric 50 watt, 105-120 volt toy projector lamp with CC2 filament.

The integrating cone "M" (Figure 1) on the photocell arm must coincide with aperture "E" in the viewing plate "I". This can be checked by merely removing the photocell from the arm "G" and noticing by inspection if the aperture "E" is in the center of the integrating cone "M". If not, loosen the four screws which hold the cone "M" in position, and re-center.

It is essential to clean the Analyzer periodically. Remove the perforated bottom by taking out the four corner screws. The lamp and optical system can now be easily reached and cleaned. Remove the top panel in the same way, and clean the rheostat and aperture "E". Before replacing the bottom, check the lamp position as previously described.

Material supplied with Analyzer—Various items are required for different applications of the Analyzer. These are supplied with the instrument, as follows:

1. Multiplier disc for contact printer measurements. D-92108 Weston Part no.
2. Negative step wedge (small) for enlarger. F-2219
3. Negative step wedge (large) for contact work. F-2220
4. Positive step wedge (gray scale) for color work. F-2221
5. Paper data sheet. F2217
6. Plotting paper for time-gamma curves. F-2216
7. Exposure Guide. D-94578

Making the Print

Calibrating Negative Step Wedges—The speed and contrast of photographic papers are influenced by the kind of enlarger you use—condenser or diffusion system, the nature of the light source in your contact printer, and the developer and operating technique you use. Since the Analyzer is designed to give readings in terms of your own equipment, it is first essential that you set up certain standards based on the characteristics of your particular conditions.

The first step is to calibrate the negative step wedges furnished with the Analyzer. Using the instrument as a densitometer, explained on page 6, find the density of each step of both wedges, and **record the results below.**

STEP WEDGE CALIBRATION TABLE

WEDGE #1 For Contact Printing		WEDGE #2 For Projection Printing	
Step	Density	Step	Density
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	
11		11	
12		12	
13		13	
14		14	
15		15	
16		16	
17		17	
18		18	
19		19	
20		20	

Checking Uniformity of Illumination—

ENLARGER EASEL

a. Adjust enlarger to illuminate area on easel you use most generally.

b. Remove photocell from Analyzer arm and place face up on easel.

c. Take successive Meter-Candle readings on meter as you move photocell from center to each corner of easel.

d. If there are differences in the readings of more than one block on the Meter-Candle scale, stopping down the enlarger lens will usually make the illumination more uniform.

CONTACT PRINTER PLATEN

To ascertain the illumination distribution of the contact printer, proceed in the same way, with the photocell face down. If necessary, however, mount the multiplier disc over the cell, and multiply the meter readings by 10.

Determining Projection Paper Speeds—

The Paper Data sheet supplied with the Analyzer gives a list of Analyzer (paper speed) Numbers. Since these numbers will be influenced by the type of enlarger being employed, they are intended to be used only as starting points. You must now establish Analyzer Numbers for each printing paper, that will be accurate for your own equipment and working conditions.

a. On the Paper Data Sheet, find the trial Analyzer Number for the paper you are going to use, and turn the top disc of the Exposure Guide until this number appears in the window marked Analyzer Number, as shown in Figure 3.

b. Consult the calibration table you have just made of the step wedge for the density reading of step 4. Turn both discs of the Exposure Guide together until the MIN arrow points to this density.

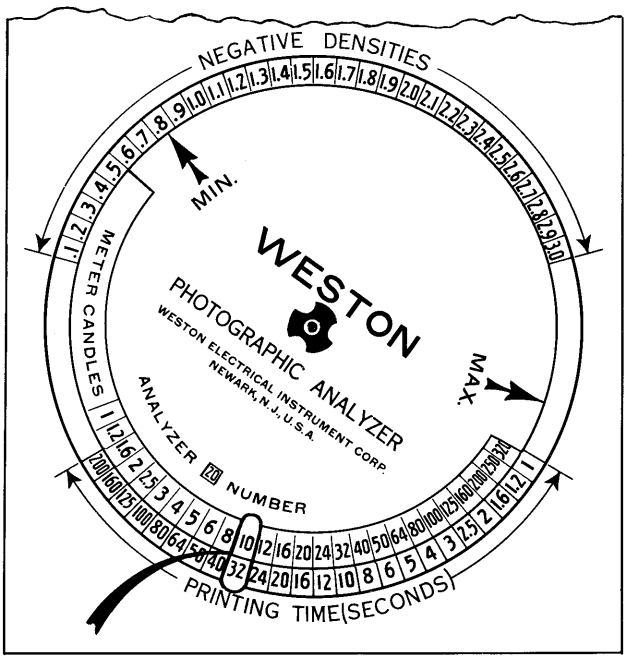


Fig. 3

The Exposure Guide is now set with a series of identical exposures consisting of combinations of Meter-Candles and Printing Times. Leave the Exposure Guide set until the easel illumination is measured, as explained in step "c".

c. Put step wedge in your enlarger, focus for any convenient magnification and with any f:stop. Remove step wedge and carrier, if used. Take photocell from Analyzer arm and measure the Meter-Candle value of the easel illumination as described in the previous section. Under this value on the Exposure Guide read the Printing Time in seconds.

EXAMPLE:

Paper-Kodabromide No. 2—Trial Speed No.	20
Density of 4th Step of wedge (assumed)	0.8
Enlarger Meter-Candle value	10
Printing time would be	32 seconds

d. Replace step wedge in enlarger, expose paper, develop, fix, and dry in usual manner. Then, under room illumination of not less than 100 Meter-Candles, examine the print you have just made. At the dense end of the print, it will be seen that the steps merge to form a solid block of black in which the individual steps are not readily apparent. (See Figure 6, page 9.) Select the first black step following the gray. Record the number of this step, and, by referring to your calibration of the wedge given on page 7, obtain the density value for this step, assume to be .7. In many cases, selection of the first black step can be made from a wet print, if the print is first wiped dry to remove the gloss produced by the water.

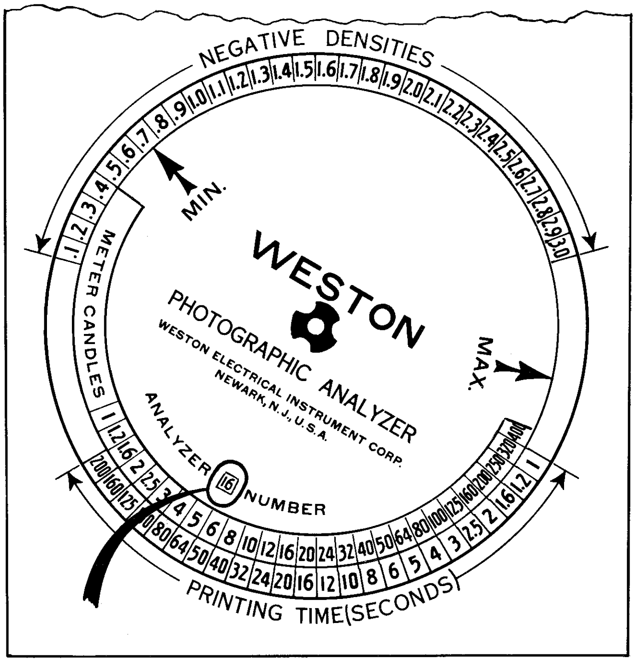


Fig. 4

e. With both dials of Exposure Guide still set as in step "b" above, turn top disc only until MIN arrow points to density you have selected in "d". The new figure in the Analyzer Number window is the true speed number for this printing paper in terms of your working conditions. See Figure 4.

f. Record this number (16) on back of Exposure Guide and on paper envelope or box.

g. Proceed as above for each different make and grade of paper you use. Repeat the test for each new batch of paper. These figures are comparable to and as important as the Film Speed Ratings on your Weston Exposure Meter.

h. If you use more than one enlarger, it will be necessary to obtain the separate Analyzer Numbers for each enlarger.

i. Keep a file of all of these step wedge prints, designating on each the name of the paper and its Analyzer Number . . . they will be used later for determining Paper Contrast Ranges.

NOTE: *Printing paper, similar to film, exhibits failure of the Reciprocity Law. Theoretically, the exposure given to the print should be the same as the exposure given to the wedge in calibrating the paper in order to eliminate the failure of the Recipocity Law. Obviously, this is impossible but by using a combination of "Meter-Candles" and "Printing Time" within reasonable limits, the failure due to reciprocity will be greatly minimized and except on abnormal negatives, the effects will be negligible.*

Determining Contact Paper Speeds—Proceed exactly as described above, except that before placing the photocell on the printer platen to read the illumination, the multiplier disc may be mounted over the photocell, and the Meter-Candle readings multiplied by 10. Naturally, you will use the larger negative step wedge for contact printing.

Now you are ready to print from your own negatives. For this you need to know only the negative density range, the paper with the nearest corresponding range, and the correct exposure. (See page 10 for an alternative method of calibrating the enlarger and contact printer.)

Negative Density Range—

a. Place negative on viewing plate of Analyzer with emulsion side up and measure the minimum and maximum density areas of the negative. (See Figure 5.) Check each reading on several similar portions; visual judgment is often unreliable. Properly exposed and developed negatives should have a minimum density about 0.2 to 0.3 greater than that of unexposed margin of negative.

b. Subtract minimum from maximum density value. The difference is the negative density range, and should be recorded in ink on margin of negative or on its envelope.

CAUTION: *Blue stained negatives usually cause no trouble, but yellow or brown stained negatives will give distorted readings.*

Paper Contrast Range—Using one of the step wedge prints you made to find the Analyzer Number, select the **third gray step above** solid white, and the first black step following the gray. From your Step Wedge Calibration Table (page 7) note the negative densities of these two steps

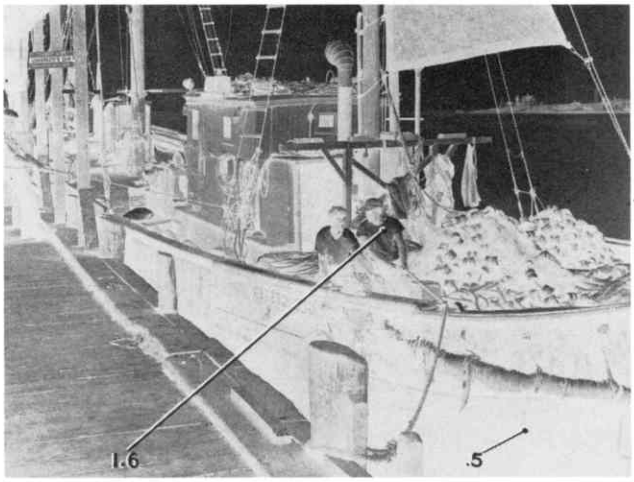


Fig. 5
Maximum and Minimum Density Areas

and subtract the smaller from the larger. This is the contrast range of the paper. The contrast range of each paper should be determined and recorded on the back of the Exposure Guide and on the paper box or envelope. Figure 6 shows a facsimile of two wedge prints, one on a soft paper, the other on a hard paper.

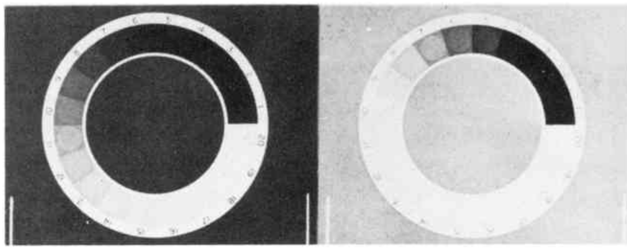


Fig. 6
Step Wedges printed on Soft and Hard Papers

Choosing the Best Paper—The paper required to make the best print should have as nearly as possible the same density range as the negative. Therefore, you will find it easier to make paper selections quickly if you tabulate the ranges of the papers you use.

However, it is neither possible nor necessary to have paper and negative density ranges **exactly** alike. The following method of classification has been proved entirely satisfactory:

Assume you have four grades of paper with these contrast ranges:

No. 1—1.64
No. 2—1.39
No. 3—1.09
No. 4—0.59

The mean value between papers 1 and 2 is 1.51
" " " " " 2 and 3 is 1.24
" " " " " 3 and 4 is 0.84

A chart of these values and mean values would be like figure 7.

The figures on this chart are only for illustrating the method. You should construct your own chart from the ranges of your papers, to which you can quickly refer to make a proper selection for each negative.

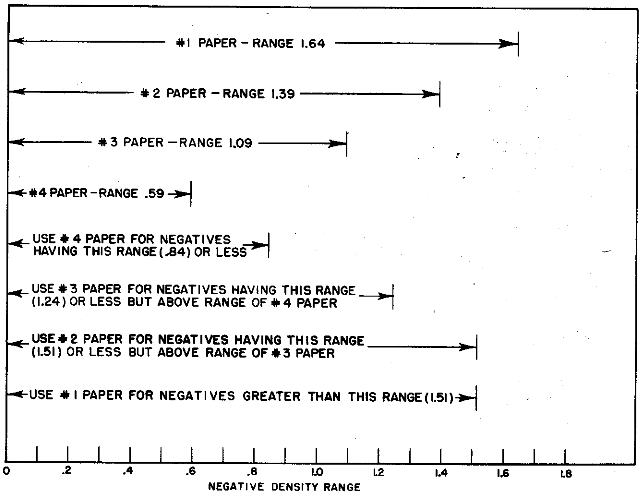


Fig. 7

Graphic Representation of Paper Characteristics

Filter-controlled Photographic Papers

Certain papers, such as DuPont Defender Varigam, utilize a set of filters by which the same paper can be made "hard", "soft", or any intermediate value. The contrast range and speed of these papers, are determined exactly as described for other papers, except that the filter should be used when printing the step wedge. However, the filter must not be used when taking readings of the illumination on the easel.

When the first series of tests are made, it is necessary to determine the contrast range and speed of the paper with each filter in your set. In subsequent tests (for new batches of paper), only the softest and hardest filters need be used; the ratio of intermediate filters will remain constant.

Calculating the Printing Time—

a. Locate Analyzer Number in window of Exposure Guide. (You have this recorded on paper envelope or box and back of Exposure Guide.)

b. Turn both dials together until MIN arrow points to minimum density value of your negative. (You recorded this on negative envelope.) Be sure this minimum density is included in the area you are enlarging.

c. Place negative in enlarger, adjust and focus to magnification desired, and set lens to desired f:number. Now remove negative and measure easel illumination.

d. Opposite this Meter-Candle value (easel illumination) on the Exposure Guide, read the required Printing Time. If this printing time is not convenient, change the f:setting of the lens until you get the Meter-Candle illumination required for the printing time you prefer.

NOTE: *The above refers to the use of the Analyzer for making enlargements. When making contact prints, the Exposure Guide is used in the same manner.*

Alternative Method of Calibrating Enlarger and Contact Printer — Where the power supply to the light source is reasonably free from voltage fluctuation, it would be a convenience to set up a permanent table of meter-candle values for the various magnifications and f:stops you may use. By referring to this, you can avoid removing the negative and reading the easel meter-candles each time after focusing the enlarger.

Calibrating the Enlarger—On the negative step wedge are two lines spaced exactly one inch apart. Put this in the enlarger and adjust the image of these lines on the easel to exactly 1". Mark this setting so you can find the same position without the wedge. Repeat the operation for each degree of magnification that may be used.

Remove the wedge from the carrier and re-adjust the enlarger to the first magnification. Open the lens to its largest stop. Place the photo-cell face up on the easel and note the meter-candle value. Repeat this operation for each f:stop, and record the readings beside this particular magnification.

Re-adjust the enlarger to the next magnification and find the readings for each f:stop. Do this for each magnification. The resulting table can then be referred to in order to determine the meter-candle value for any combination of magnification and f:stop.

Calibrating the Contact Printer—Place the photo-cell, with its multiplier disc in position, if necessary, face down on the platen. If you employ various combinations of lamps to produce different levels of illumination, take the reading for each combination, and make up a reference table.

Special Problems

The preceding instructions are to enable you to make technically good prints. Obviously, no instrument or scientific procedure can replace the human art and skill required for exceptional, or "salon", prints. Dodging and special processing can be handled by using instrumentation as a guide, then proceeding esthetically to produce the kind of print you desire.

Definition of a Good Negative—A good negative is one which renders correct tone details of the entire scene. The minimum density of such a negative should be 0.2 to 0.3 above that of the unexposed margin. A greater density in the thinnest shadows indicates over-exposure. The negative density range should be between 0.8 and 1.3, easily printable on No. 2 and No. 3 papers. A greater negative density range usually indicates over-development.

Extreme Range Negatives—You may have a negative with a density range too great for even the softest paper, and yet do not want to reduce the negative chemically or dodge the print. You can make the print in the normal manner, sacrificing some of the highlight details. Or if the details at one end of the scale are important, they may be preserved as follows:

> If shadow details are desired, set the MIN arrow of the Exposure Guide at the minimum density value of the negative. If highlight details are desired, subtract the density range of your softest paper from the maximum negative density and set the MIN arrow at the negative density value corresponding to this difference.

ILLUSTRATION:

a. Assume a negative with
   MAX density of 2.3
   MIN density of 0.4
   Range of 1.9

b. Assume the range of your softest paper is 1.6.

c. If shadow details are desired, set the MIN arrow at 0.4. If highlight details are desired, set the MIN arrow at 0.7, which is the difference between 2.3 and 1.6.

Dodging—In dodging a print, a tone, either lighter or darker than the tone normally rendered, is desired. To determine the proper "printing in" or "holding back" times, proceed as follows:

1. Make a normal print as described on page 9 under "Determining Contact Paper Speeds".

2. Examine the print and pick out a tone on the print to which you wish to dodge the desired area.

3. On the negative read the negative density of the tone desired.

4. Take the difference between these two negative density values by subtracting the smaller from the larger value. If the negative density of the desired tone area is less than the negative density of normal tone area, the difference is negative and should therefore have a minus (—) sign in front of it. If the negative density of the desired tone is greater than the negative density of the normal tone area, the difference is positive.

5. Refer to figure 8 and determine the factor by which the basic printing time must be multiplied to obtain the correct printing time for the desired area.

ILLUSTRATION: It is desired to darken the background of a print. The negative density of the background is 0.7. The negative density of the desired tone area is 0.4. The difference is 0.3 and since the desired tone value is less than the normal tone (in this case the background), the difference should be —0.3. In Fig. 8 the value of —.3 corresponds to a factor of 2. This means the background should receive twice normal printing time.

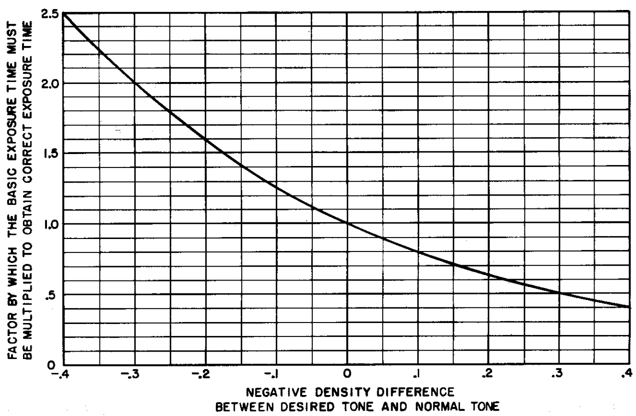


Fig. 8

Dodging Factor Curve

Checking Film Speed Settings—The Analyzer can be used as an overall check on your equipment and technique. If the densities of your negatives run consistently higher or lower than that which is most satisfactory for good prints, the indications are that the camera may be off calibration or that some particular phase of your method differs from what may be considered standard procedure. Such being the case, it may be well to alter the film speed setting on your exposure meter. If the negatives are too thin, decrease the value of the film speed, and, if the negatives are too dense, increase the value of the film speed.

This does not mean that the rated film speeds are incorrect. This method of correction is offered simply as a means of overcoming a particular difficulty.

Select a group of negatives and measure the minimum density of each one. Then measure the film base and fog on the edge of the negatives and subtract this figure from the minimum negative density values. For ordinary development and correct exposure, this difference should be in the order of 0.2 to 0.3. If such is the case, the film speed used is correct and should not be changed. If the net difference is lower, the film speed settings may be decreased one or two steps, until it approaches the proper value. On the other hand, if it is higher, the film speed should be increased to compensate for the variation. It is assumed that the brightness range of the scenes selected is average (approximately 1 to 30). If the range is less, the minimum density may be higher than normal, and, if greater, less than normal.

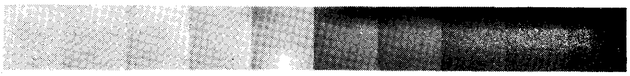


Fig. 9
Calibrated Gray Scale—Reflection Density Values

Checking Filter Factors

—Questions are frequently raised concerning filter factors in relationship to their application to different kinds of film. It is a known fact that filter factors are true only for films having a definite color sensitivity. Filter factors for other films can easily be determined through the use of the Analyzer, in the following manner:

a. **Without** a filter over the camera lens, photograph the paper gray scale (Figure 9) supplied with the Analyzer. To determine the exposure, cover the gray scale with a white card illuminated the same as the gray scale will be. Measure the brightness of the white card with an exposure meter. The exposure obtained should be increased five (5) times when photographing the gray scale. The simplest way to do this is to set your exposure meter film speed at one-fifth the rated value and then proceed in the normal manner.

b. **With** the filter over the lens, photograph the same gray scale. Increase the previous exposure by the filter factor given by the manufacturer.

c. Measure the negative densities of the steps on the two negatives where the density is about 1.0. If both negatives have the same density for the same step on the gray scale the filter factor is correct. If the densities differ, correct the filter factor by means of the following graph (Figure 10).

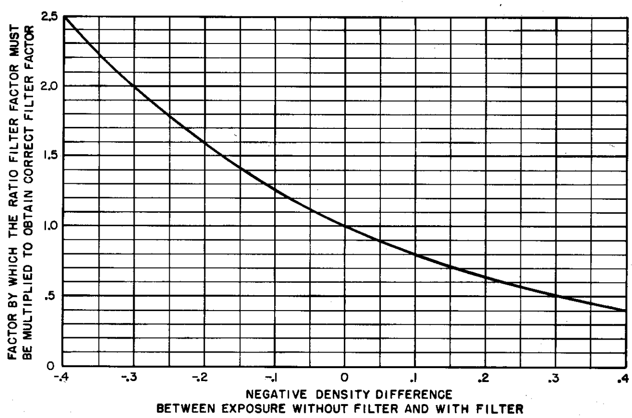


Fig. 10
Filter Factor Curve

ILLUSTRATION: Assume the first negative, exposed without a filter, has a density of 0.6. Assume the second negative, made with a rated 3X filter, has a density of 0.7. The difference is 0.1 higher, or plus 0.1, which cuts the curved line on the graph at 0.8. The correct filter factor is therefore $3 \times 0.8 = 2.4$.

NOTE: *Where negative densities differ more than 0.3, a more accurate method would be to take a number of exposures with the filter, using a series of filter factors. The factor used to make the negative that has the same density as the one made without the filter is the correct one.*

Simple Gamma Determination

—The Analyzer can also be used to determine the gamma of development of a film, within practical limits. Take two pictures of the same scene, one at normal exposure, the other at twice normal. Develop both simultaneously and measure the densities of the same area on both negatives at some point where density values are between 0.5 and 1.0. Gamma is then the difference between the two densities divided by 0.3.

$$\text{Gamma} = \frac{\text{Negative Density Difference}}{0.3}$$

NOTE: *This is an approximate method of determining gamma. For a more complete and exact method see "Time-Gamma Curves".*

Time-Gamma Curves

—Approximate Time-Gamma relationship is shown by curves furnished by the film manufacturers. But the rate of development of a film depends on the type of developer used and the rate of agitation given during development. You may wish to know the accurate Time-Gamma relationship in terms of your favorite developer and your own processing technique.

a. Make three identical exposures of the calibrated gray scale supplied with the Analyzer. (Daylight and Tungsten light will give slightly different curves.)

b. Develop one for the normal time, one for ¾ of normal, one for 1¼ normal.

c. Measure and record the densities of each wedge step of each negative.

d. A graph sheet supplied with the Analyzer is marked "Reflection Density" at the bottom and on the left "Negative Density". Place a dot where the reflection density of the gray scale and the transmission density of step 1 of one of the negatives intersect. Do the same for each step of each negative.

e. Draw a line through the series of dots representing each negative. The three lines resulting are the curves for the three development times. (A typical set of curves is shown in Figure 11.)

f. Inspection of Figure 11 will show that these three curves have different degrees of steepness, the degree of steepness usually being referred to as gamma. It will be noted that as the development time is increased gamma also increases. In order to express gamma as a number these curves are interpreted in terms of the average steepness. To do this extend the straight line portion of each curve until it meets the base line of the graph sheet as shown on the 4 min. development curve.

g. With the above construction the gamma values of the three curves can now be determined by means of the following formula.

$$\text{Gamma} = \frac{\text{Selected Negative Density Difference}}{\text{Selected Reflection Density Difference}}$$

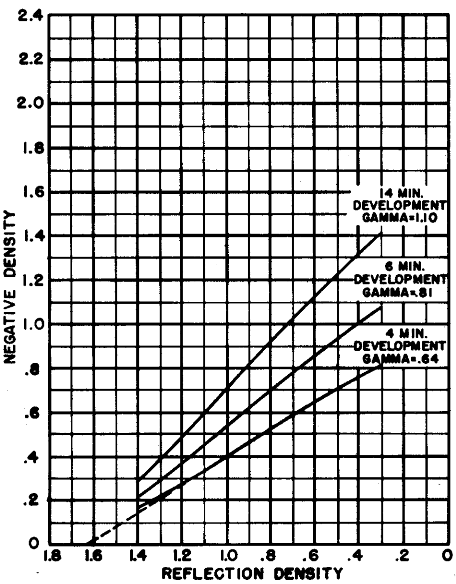


Fig. 11

H & D or D log e Curves for Various Development Times

h. Select two values of Reflection Density which lie on the straight portion of the curve and determine the difference.

i. Determine the negative density values corresponding to the Selected Reflection Density values and determine the difference.

j. Use these differences in the above formula and calculate gamma.

ILLUSTRATION: Referring to the 4 min. curve in Figure 11 let us assume reflection density values of 1.62 (the point where the extended straight line meets the base) and 1.0 which is still on the straight line portion of the curve and yet sufficiently large to obtain an appreciable difference. The negative density corresponding to the reflection density value of 1.62 is 0 and the negative density corresponding to the reflection density of 1.0 is .4.

Substituting the above values in the formula we obtain:

$$\text{Gamma} = \frac{.4 - 0}{1.62 - 1.0} = \frac{.4}{.62} = .64$$

k. By this formula, determine the gamma for each of the three negatives, according to its development time.

Preparing Final Time-Gamma Curves—

With the selected development times and resultant gamma values obtained the final time-gamma curve can now be prepared:

a. Plot the three corresponding values of gamma and development time in the space provided for the purpose as shown in Figure 12.

b. Draw a line through these three points.

This curve can now be used to determine the development time required to obtain any desired value of gamma.

NOTE: *Additional sheets of graph paper may be procured at stationery stores or wherever drafting supplies are sold. If an exact match is not obtainable, other paper may be used, but in all cases the same scale must be used for both Reflection Density and Negative Density.*

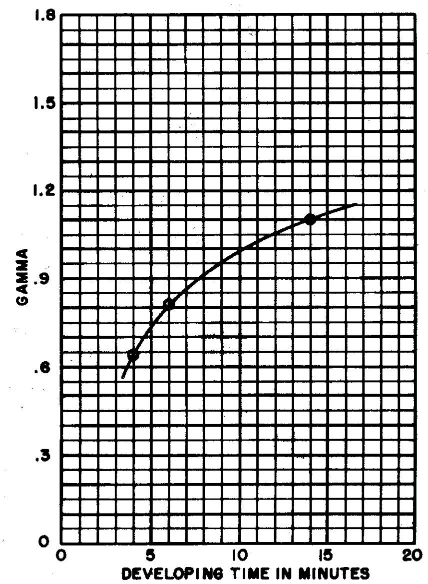


Fig. 12

Time-Gamma Curve

Use of the Analyzer in Color Photography

In color work, every step from exposure to washing the finished print must be exact. One error will upset the proper balance. The Weston Photographic Analyzer will enable you to avoid such an error. It makes possible that careful planning essential to a set of well-balanced separation negatives, as well as to compensate for differences that may occur in negative densities.

Color separation negatives can be made by:

1. Three separate exposures
2. Single or double mirror "one-shot" camera
3. Color transparencies, such as Kodachrome, Ansco Color, etc.

In most color processes, the best prints are made from negatives with a density range between 0.9 and 1.2. Much higher ranges may cause the loss of modeling in extreme highlights or shadows or both. Much lower ranges will sacrifice shadow details or give the print a flat appearance. Unbalanced negatives can be compensated for by different printing times, as determined by the Exposure Guide, or by masks to correct the density range of the separate negatives.

Balancing Three Separate Exposures—Before actually taking any color pictures, it is essential to determine the exact factors of the filters and the correct development time, so that all three separation negatives have the same gamma. Therefore, time-gamma curves are an absolute necessity when doing color work.

a. Pin up the **positive** step wedge (or gray scale) and illuminate by the same light that will be used later for taking pictures. The use of a color temperature meter is recommended when shooting both the step wedge and actual photographs.

b. Determine the basic exposure with an exposure meter, using the white card method as described on page 12. Use the filter factors recommended by the film manufacturer, and make three identical exposures through the red filter, three through the green, and three through the blue. Obviously, the filter factors of the red, green, and blue filters will be quite different and therefore the exposures will be different for each set.

c. Develop the nine negatives according to the following schedule of times:

   1. One red and one green negative—normal time
   2. One red and one green negative—¾ normal time
   3. One red and one green negative—1¼ normal time
   4. The three blue negatives 1¼, 1½, and 2 times normal.

d. When fixed, washed, and dried, measure and record the density of each step of the wedge on each negative.

e. Prepare three graphs for Red, Green, and Blue Records, as in Figure 11. Plot on the Red Record the H & D curve for each of the three Red Record negatives, as described on page 13. Do the same for the Green and Blue Record negatives.

f. Prepare a time-gamma curve for each color record, similar to Figure 12. These curves will enable you to obtain a set of separation negatives all having the same gamma, provided you follow the same technique. Films with different emulsion numbers, though of the same trade name, may have different characteristics. At least one exposure with each filter should be made and the gamma checked against your previous curves. If there is much change, complete new tests should be made; if only slight change, alter your curves to correspond.

Determining Filter Factors—In order to obtain correct exposures, it is very important to know the filter factor of each of the three filters. Changes in the color temperature of the lamp will affect the filter factors and for this reason, the use of a color temperature meter, or at least a voltmeter across the light source is recommended.

To obtain the filter factors proceed as follows:

1. In each set of the H & D curves just made for the Red, Blue, and Green Record Negatives, choose the curve having a gamma nearest to 0.8. (If the nearest curve does not have a gamma value between 0.75 and 0.85, a curve having a gamma of 0.8 can be drawn in by estimating its position with respect to the adjacent curves.)
2. Note the negative density, in each 0.8 gamma curve, which corresponds to the Reflection Density of the middle step in the gray scale.
3. Assume the negative density of one of the curves is correct so that the other two can be made to match it.
4. Calculate the density difference between the curve assumed to be correct and the other two at the same reflection density value.

5. Refer to the curve in Figure 10 and find the factor by which the assumed filter factor must be multiplied to obtain the correct filter factor.

ILLUSTRATION: Assume the reflection density of the middle step of the gray scale is .7 and that the corresponding negative density values, as obtained from the curves, are 0.75, 0.94, and 0.81 for the Red, Blue, and Green Record negatives respectively. Let us assume the Green Record negative density value of 0.81 is correct and on this basis the Red Record negative is .06 too low while the Blue Record negative is .13 too high. Since the Red Record negative is .06 too low it should be preceded by a minus sign, and referring to the curve (Fig. 10) the factor corresponding to —.06 is 1.14, hence the assumed filter factor for the red filter must be multiplied by 1.14. The Blue Record negative is .13 too high and the factor corresponding to .13 is .74, hence the assumed filter factor for the blue filter must be multiplied by .74. If the red filter factor you used was 4, this should be corrected to $4 \times 1.14 = 4.6$. Similarly, if you had used 10 for the blue filter, this must be corrected to $10 \times 0.74 = 7.4$.

Now expose one more set of films, using the correct filter factors and the development times derived from the time-gamma curves. From these three negatives plot the final set of working curves. The three curves should be made on a single graph, and if they are all parallel within plus or minus 0.05 in density, the speed numbers and processing technique are correct. With these data, the inclusion of a gray scale in the picture is unnecessary, though would be useful when balancing the final color print.

Balancing Negatives made in a "One-Shot" Camera—The single or double mirror "One Shot" Cameras are so constructed that with a single exposure, all three record negatives are exposed simultaneously through the proper filters. It is important when using this type of camera to adjust the light source to the proper color temperature or to use compensating filters to correct for an "off balance" light source. Since the exposure at the lens is a single exposure, there is no possibility of making filter factor adjustments. The proper color temperature of the light source is therefore essential to properly balance the filter factors. This, of course, is also dependent upon the negative material used.

When using the "One Shot" Camera, it is also advisable to purchase as large a quantity of the negative materials having the same emulsion number as is practical.

Pin up a step wedge as described on page 14 and make three exposures. Follow the same procedure of developing and make time-gamma charts from which the proper development times can easily be determined.

Separation Negatives from Transparencies—These can be made in three different ways: making contact negatives, photographing the transparency, or making enlarged negatives.

For contact negatives, the use of a Curtis Printer or some similar equipment will be found very convenient. First make a set of time-gamma curves and determine the correct filter factors, by using a negative step wedge. A slow panchromatic material will permit proper time control. To determine an Analyzer Number for this film, make an exposure of the step wedge without using filters, and develop normally. Select the step with a density of about 1.5. Measure the printing platen illumination without filters.

On the Exposure Guide, place the Meter-Candle reading of the platen opposite the exposure time you gave the negative, turn the top dial to place MIN arrow to the density of the step wedge that produced the negative density of 1.5, and read the correct speed number of the film in the Analyzer Number window.

Now, with this Analyzer Number, calculate the basic exposure without filters and multiply it by the filter factors.

For separations made by projection either by enlarging or photographing the transparency, follow a similar procedure, but take the Meter-Candle illumination reading on the easel at the magnification and f:stop used.

The step wedge can be eliminated from the negative, if the area to be photographed is too large to make its inclusion practical. There will be little difficulty in processing the negatives to the proper balance, if you made previous tests to determine proper developing times and filter factors.

Making Transparency Masks—These thin negative masks are required to reduce the contrasts which range beyond the capacity of the printing medium. A contrast range of 1.8, for example, cannot print satisfactorily, and must be reduced to about 1.2. A mask, then, must be made with a compensating range of 0.6.

a. Make test wedge exposures and construct a time-gamma curve.

b. Measure the densities of the neutral areas (whites, grays, and blacks) in the transparency and calculate the density range.

c. The mask should be made to reduce the total range of the transparency and mask to approximately 1.2. Its range should therefore equal the range of the transparency minus 1.2.

d. The range of the mask divided by that of the transparency is the gamma to which the negative must be developed. Determine the developing time for this from the time-gamma curve.

ILLUSTRATION: Assume the transparency has a density or contrast range of 1.8. The range of the mask should be 1.8 — 1.2, or 0.6. The gamma to which the film should be developed should equal 0.6 divided by 1.8, or 0.33. From the time-gamma curve, determine the developing time required to produce a gamma of 0.33 and develop accordingly.

Use of the Analyzer in Color Printing

Shadow detail usually determines the exposure in black-and-white photography. That is why we used the **minimum** density method in that type of work. In color photography, contrast is achieved by color differences, as the subjects generally have an even illumination.

When prints are made from separation negatives, the photographer always tries to have them veil over slightly in the white highlights. Therefore, the **maximum** density of the separation negatives must be the guide to exposures of the color prints.

It is essential that the illumination level and color temperature remain constant during all exposures in the color printing processes. Some means is necessary to keep a constant check and regulation of the line voltage on the enlarger lamp or contact printing lights. For some printing processes, the printing lamp must also be used at a specific voltage to achieve a certain color temperature. The lamp should be regulated to burn at the recommended voltages required for the various color printing methods.

Determining the Speed of Wash-Off Film

—Before a set of separation negatives can be exposed on the wash-off film, it is necessary to determine the speed of the film. This should be done as follows:

a. Place the calibrated step wedge in the enlarger and focus to fit a piece of wash-off film 4″ x 5″ or smaller.

b. Remove the negative carrier and measure the easel illumination. This should be reduced to 12 Meter-Candles or less, by stopping down the lens, to obtain an exposure time of 5 seconds or more.

c. Set the Exposure Guide to a trial Analyzer Number of 1, and turn both dials until the MAX arrow points to a density value about ¾ of the density of the darkest step. Assume this to be 1.7 and set the MAX arrow accordingly. Now the Printing Time appears under the meter-candle value. See Fig. 13.

d. Expose the wash-off film, and develop in the same developer and for the same time as you would for a matrix for color printing. Omit tanning, bleaching, and hot-water development; just fix, wash about 5 minutes, and dry.

e. Measure the density at several points on the unexposed border and strike an average. Measure the densities of the steps in the film until you reach one about 0.05 to 0.10 higher than the border average. Refer to the original step wedge to determine the density which produced this step.

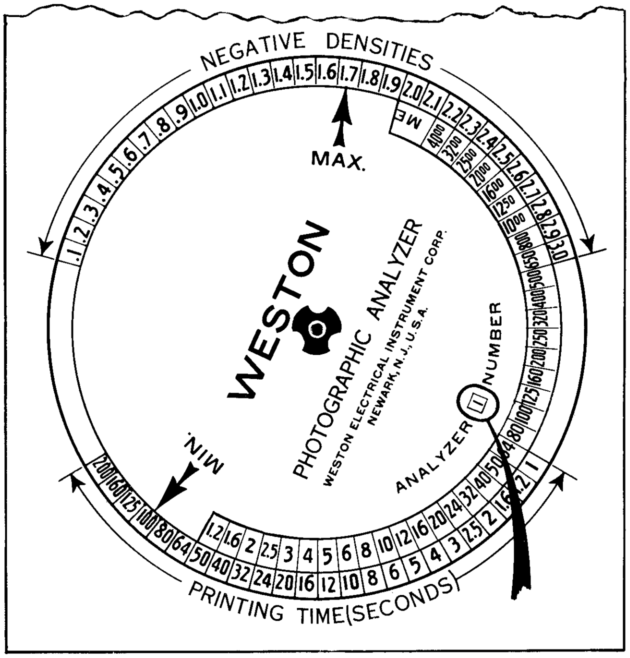


Fig. 13

So far you have used a trial Analyzer Number. To find the correct number, set the Exposure Guide to the Printing Time and Meter-Candle values you used in the test, rotate only the top dial until the MAX arrow points to the density value obtained in the step "e" above, and the correct Analyzer Number will show in the window.

ILLUSTRATION: Assume the average border density was 0.10, the fourth step on the wash-off film was 0.20 and the corresponding step on the negative step wedge was 1.5. Assume an easel illumination of 10 Meter-Candles and a Printing Time of 6 seconds. By setting the Exposure Guide to 10 Meter-Candles over 6 seconds and turning the MAX arrow to 1.5, you obtain in the window an Analyzer Number of 0.6. This is the correct number for all wash-off film having the same emulsion number when developed exactly as tested.

Determining the Exposure for Wash-Off Film

—Find the neutral white highlight of your scene. If you included a gray scale in the scene, the lightest step will be used as the highlight. If you are working from a color slide, having a separate step wedge beside it, use that step whose density is equal to the brightest object in the transparency. If you have no control wedge at all, use a neutral white highlight in the subject. This will be the "MAXimum density" in each separation negative. (Never use a colored object.)

This is the area which must be reproduced as a veiled highlight in the print and is the criterion used in determining the correct exposure which should be done as follows:

a. Read the density of the white or neutral highlight in each separation negative.

b. Place the Red Record negative in the enlarger and focus to desired size.

c. Remove negative and adjust the Meter-Candle Illumination on the easel to 6 Meter-Candles. Replace negative.

d. Set the Exposure Guide to the Analyzer Number found by test on this batch of film. Point the MAX arrow to the density of the highlight area in this negative, and read the printing time opposite the measured Meter-Candle value.

e. Expose the wash-off film, and place in light-tight box.

f. Repeat steps (d) and (e) for the Green Record and the Blue Record negatives.

g. Develop the three exposed films exactly as you did the trial piece, but continue standard processing to obtain the matrix or relief image.

ILLUSTRATION:

Analyzer Number for veiled highlight on Wash-Off	= 0.6
Illumination on easel without negative	= 6 Meter Candles
Density at HIGHLIGHT in Red Record	= 1.5 Time = 10 sec.
Density at HIGHLIGHT in Green Record	= 1.6 " = 12 sec.
Density at HIGHLIGHT in Blue Record	= 1.7 " = 16 sec.

Having made Balanced Reliefs, with equally veiled highlights, the usual procedure of dyeing the matrices and making the transfer print on paper will be quite easy, no washing out of dye being required unless for some exaggerated effect. Adjust acidity of dyes for balance and quality in the shadow, and your highlights will be correct if your exposures were exact.

Determining the Speed of Matrix Film used in the Kodak Dye Transfer Process—The Kodak Dye Transfer Process is the same as the Wash-Off Relief Process except for the processing technique. To determine the speed or Analyzer Number proceed as follows:

a. Place the calibrated step wedge in the enlarger and focus to fit a piece of matrix film 4″ x 5″ or smaller.

b. Remove the negative carrier and measure the easel illumination. This should be reduced to 12 Meter-Candles or less, by stopping down the lens, to obtain an exposure time of 5 seconds or more.

c. Set the Exposure Guide to a trial Analyzer Number of 1, and turn both dials until the MAX arrow points to a density value about ¾ of the density of the darkest step. Now the printing time appears under the easel Meter-Candle value.

d. Expose the matrix film and develop in the matrix developer omitting the contrast control solution. Process through to the blue-green or cyan dyed image.

e. Use the above matrix and transfer the dye image to the mordanted and conditioned paper.

f. From the blue-green or cyan image on paper determine which step has a faint tinge of this color.

g. Refer to the original step wedge data and determine the negative density of the step which produced the faint tinge of color referred to in "f."

h. Now set the Exposure Guide to the Printing Time and Meter Candle values used in the test. Now rotate the top dial only until the MAX arrow points to the density of the step wedge value determined in "g." The correct Analyzer Number will show in the window.

NOTE: *The Analyzer Number just determined is the basic speed of the film, as the test was made without the contrast control solution.*

If the Negative Density Ranges of the separation negatives require the use of the contrast control solution, exposure corrections may be necessary. These 'Exposure Factors' are furnished by the matrix film manufacturer. Either the Printing Time or the Meter Candles should be multiplied by the 'Exposure Factor'. Do not multiply the Analyzer Number by the 'Exposure Factor'.

Determining the Exposure for Kodak Matrix Film—Follow exactly the same procedure as outlined in the paragraph "Determining the Exposure for Wash-Off Film."

Tri-Color Carbro Printing—As with wash-off relief printing, a slight gray veil is desired in the highest highlight of the color print. The mechanics of carbro printing have been greatly simplified in recent years, but it is still necessary to be able to judge just the right amount of gray tone wanted in the highlight area.

In line with previous printing processes, it is also necessary to make a test with the gray step wedge to determine the speed of the bromide paper used in carbro printing.

a. Make a positive print of the gray wedge supplied with the Analyzer.

b. Note the Printing Time and Meter Candles used to make the print.

c. Develop the print, fix, wash, and dry. Note: It is essential that the developer and hypo formulas and temperatures used to make this test are exactly the same as those used to make the final print.

d. Determine the gray tone necessary for the carbro printing process, as explained below.

e. As described on page 16, calculate the proper Analyzer Number using the MAX arrow.

Since each carbro worker has his pet formulas as well as bromide paper, it is difficult to state to what exact depth the gray tone should be in the print highlight area. This is dependent upon the tissues, bromide paper, and carbro formula used.

If the reader has had experience with carbro printing, no difficulty will be experienced in picking out the proper step in the test wedge print. For the inexperienced, it would be advisable to choose the first perceptible step in the minimum density area of the positive wedge. A carbro print can be made using this criterion. If the color print is too dark or light, an adjustment can then be made in the Analyzer Number.

Balancing Bromide Prints for Carbro Printing—Measure the maximum density of the step wedge in each separation negative.

Adjust the enlarger to the magnification desired, remove the negative and measure the easel illumination. Since carbro printing is much more critical than black-and-white printing, a test strip from the blue printer negative must be made, placing it to record the highlight detail. When developed, this strip should show the correct veiling of gray in the whites. Once the correct Printing Time for the blue printer is known, those for the red and yellow may be easily calculated.

Measure the density of each negative (preferably the white of a step wedge). If the blue printer is 1.5, the red 1.39, and the yellow 1.57, the red will require less exposure than the blue, and the yellow more exposure.

Assume you found the correct Printing Time for the blue printer to be 12 seconds, and the easel illumination (without negative) is 6 Meter Candles. Set the Exposure Guide so that 12 seconds is under 6 Meter Candles, turn top dial until MAX arrow points to 1.5 (density of the blue negative), and the Analyzer Number will be 0.5. Refer to Figure 14.

Turn both dials together until MAX arrow indicates 1.4 (nearest to red printer density of 1.39), and the printing time for red printer is 10 seconds. Similarly, turn both dials to MAX 1.6 (nearest to yellow printer density of 1.57), and the printing time for yellow printer is 16 seconds.

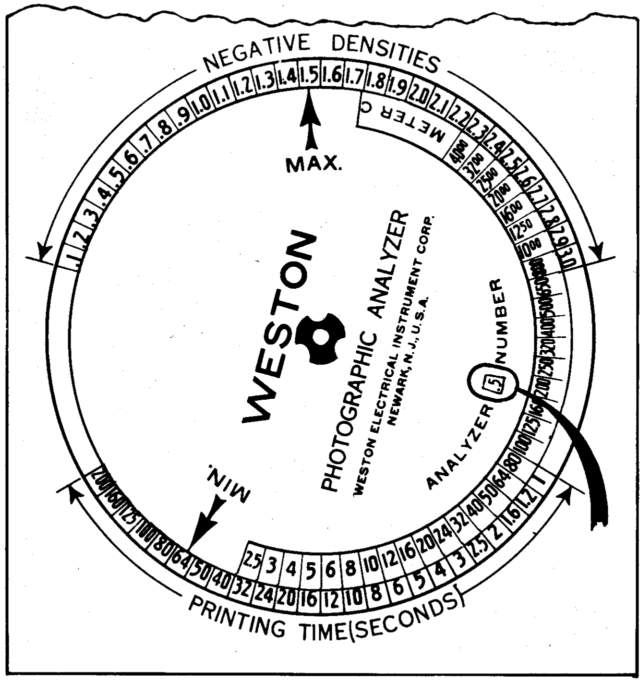


Fig. 14

With a constant easel illumination of 6 meter-candles, and the printing times thus ascertained, the resulting bromide prints will be correctly balanced. From this point on, the carbro process needs no further instrumentation.

Ansco Printon Printing—The making of a color print from a transparency with Ansco's Printon is nearly as simple and direct as making a black-and-white contact print or enlargement from a negative. Briefly, a single exposure is made through the color transparency to a sheet of Printon either by contact or by projection.

The procedure is as follows:

1. Measure and record minimum useful density in a color transparency of good overall color balance, including a person and possibly a gray scale or neutral gray object.

2. Make certain the enlarger to be used has in it the proper light source operating at the recommended voltage, also the Ansco Heat Absorbing glass and UV16P filter in the optical system.

3. Place transparency in enlarger, adjust magnification and focus, then remove the transparency.

4. Place in the optical system Ansco Color Compensating filters specified on the Printon package label. Adjust easel illumination by means of the diaphragm (a

range of 5 to 12 meter candles is usually satisfactory) with the CC filters in place.

Easel illumination should be adjusted so that when analyzer numbers suggested in in Step 5 are used the minimum exposure will not be less than 5 seconds or more than 50 seconds.

5. Set the exposure guide to tentative analyzer number 20; set minimum arrow to density determined in Step 1. Select the printing time corresponding to illumination determined in Step 4. Repeat for tentative analyzer numbers 32, 40 and 64.
6. Place transparency in enlarger and expose the Printon using values found in Step 5. Process exactly as specified by Ansco.
7. Select the properly exposed Printon print, continue using analyzer number which produced this exposure with the balance of the particular Printon emulsion used for the test. In the event that none of the above analyzer numbers produced a properly exposed print a further test should be made as follows:
   (1) If the prints are underexposed (dark) use the two analyzer numbers consecutively lower than 20.
   (2) If the prints are overexposed use the two analyzer numbers consecutively higher than 64.
8. If the normally exposed print produced in Step 6 appears incorrectly balanced, the necessary correction in filtration can be judged roughly by viewing the test exposure through various filters until one or more are found which will give the test print the proper color balance. Exposure compensation for this filter change can be be made by altering the minimum density reading obtained in Step 1 using the following tables:

± Filter change	± Minimum density change
3 series	0.05
4 series	0.10
5 series	0.20
6 series	0.30

NOTE:—*If a 33 filter is added to the filters already in use, add .05 to the minimum density reading obtained in Step 1.*

If a 33 filter is substracted from the filters subtract .05 from the minimum density reading obtained in Step 1.

Ansco Color Compensating Filter equivalents.

1—24 filter—2 23 filters
1—34 filter—2 33 filters
1—44 filter—2 43 filters
1—25 filter—2 24 filters (or 4 23 filters)
1—35 filter—2 34 filters (or 4 33 filters)
1—45 filter—2 44 filters (or 4 43 filters)
1—26 filter—2 25 filters (or 4 24 filters or 8 23 filters)
1—36 filter—2 35 filters (or 4 34 filters or 8 33 filters)

Kodak Flexichrome Process—In the Flexichrome Process, a normal black-and-white negative is used to make a relief print on Flexichrome Stripping Film which is stained in a black dye. This dye is then replaced by brushing on the desired dye or mixture thereof to produce a color print. Careful exposure of the stripping film is the most critical step and the Photographic Analyzer can be used to determine this exposure by first determining the Analyzer number of the film.

1. Calibrate one of the step wedges supplied with the analyzer (see page 7). Place the calibrated wedge in the enlarger and adjust focus and magnification to fit a piece of the Flexichrome Stripping Film about 4″ x 5″ in size.
2. Remove the negative carrier to measure the easel illumination, using the photocell face up on the easel. Stop down the lens to reduce this illumination to 12 meter-candles or less. Replace negative carrier.
3. Set the exposure guide dials so that a trial analyzer number of 1.2 appears in the window and the "MAX" arrow points to a density value about ¾ of the density of the darkest step in the wedge. The printing time in seconds now appears under the meter-candle figure of easel illumination.
4. Expose the piece of Flexichrome Stripping Film (through the film base as directed) for the time determined in Step 3.
5. Carry out the soaking, development, short stop, bleach, fix, dyeing and transfer exactly as specified by Kodak. Use developer proportions of 1 part A, 2 parts B. Omit use of part C (Contrast Control Solution), in the development step.
6. After transferring the film to the white paper support determine which step has a faint tinge or veiling of the modeling agent (black dye).
7. Refer to the original step wedge calibration and determine the density of the step which produced the faint tinge of gray selected in Step 6.
8. With the exposure guide set to the printing time and meter-candle values used above, rotate the top dial only until the "MAX" arrow points to the density of the step referred to in Step 7. The correct

analyzer number will now appear in the window.

The exposure for a good negative on Flexichrome Stripping Film is now determined by using this analyzer number and the "MAX" arrow opposite the maximum density of the negative, selecting a convenient meter-candle and printing time combination. (Avoid reading catch-lights or specular reflections for the maximum negative density.)

The Photographic Analyzer can also be used to determine the density range of the negative (maximum minus minimum density) which is necessary in the desired contrast control and filter recommendations of the manufacturer. Note the test procedure is based on development without contrast control.

The Analyzer number determined for a newly opened box of stripping film may change depending upon the time and conditions of storage after opening. To minimize changes in speed and quality of the film, follow the manufacturer's instructions regarding storage of the stripping film.

Kodak Ektacolor Process—Proper exposure and processing of Ektacolor Film results in a complimentary colored negative, which in effect can be considered a color corrected set of separation negatives balanced in contrast and density range. The cyan, magneta and yellow matrices are then made directly on Pan Matrix Film through the tricolor and color compensation filters as required.

The exposure of the matrices may be determined by two methods, as outlined in the manufacturer's instructional data, either by reading the color density of the complimentary colored negative or by trial exposures. The desired result is a set of balanced matrices which will have equal densities in those areas which correspond to the neutrals, or the gray card in the original subject.

The Weston Analyzer has been designed to read neutral density values and not color densities with filters of the Ektacolor negatives, therefore the trial exposure determination method may be used and as the density of the gray card image on the three matrices should match, the analyzer can be used to verify the exposures.

GLOSSARY

ADDITIVE PROCESS: A process for reproducing scenes or objects in natural colors by combining the three primary colors (red, blue, and green). In the additive process, the object or scene is photographed and projected through the **same** primary filters. The process is called "Additive" because the addition of the three primary colors of light produce white. Lumiere Filmcolor, Finlay Process and Dufaycolor Film are additive process films.

ANALYZER NUMBER: A paper-speed rating which, when used with the Exposure Guide, correlates the negative density with exposure for the particular enlarger or printer for which the paper was calibrated.

COLOR TEMPERATURE: A figure indicating the color of an object in terms of the absolute temperature to which a black body must be raised to emit that color. It does not mean actual temperature, since a blue sky may have a color temperature in the order of 12000°K to 24000°K.

COMPLEMENTARY COLORS: Two colors of light which, when added together in proper proportions, produce the sensation of white or gray. Also, two colors of dye or pigment which, when superimposed in the proper proportions, produce a gray.

CONTRAST: The tone or density range of a print or negative. A negative having a low density range would be considered as being soft or low in contrast, while a negative having a high density range would be considered hard or contrasty.

D LOG E CURVE: A characteristic curve of a film or paper to show the correlation between photographic exposure and resulting photographic density. So called because the logarithm of exposure is plotted against density, this being used as the best method to present the characteristics graphically.

DENSITOMETER (TRANSMISSION): An instrument which measures the density of a photographic negative.

DENSITY (TRANSMISSION): The opacity of a negative to light. Expressed mathematically: $D = \log O$, or $D = \log \frac{1}{T}$, where D=density, O=opacity and T=transmission. For example, a negative having an opacity of 100 would have a density of 2 and a transmission of 0.01 or 1%.

DENSITY (REFLECTION): The light absorbing quality of a surface. Expressed mathematically: $D=\log\frac{1}{R}$ where R is the reflection factor of the surface.

DODGING: Selective shading of the print while on the enlarging easel or printing platen, to hold back exposure of certain areas in order to accentuate other areas.

ENLARGER, CONDENSER TYPE: One in which the light rays are concentrated through the negative by means of condenser lenses.

ENLARGER, DIFFUSION TYPE: One in which the light rays from the source are diffused by means of a ground glass or other diffusing medium.

EXPOSURE GUIDE: A component supplied with the Analyzer to correlate Meter Candles, Printing Time, and Negative Density to the Photographic Paper or Film Characteristics.

FILM SPEED: A rating assigned to a film. Its value is dependent upon the exposure necessary to produce a definite density. In the Weston Film Speed System, it is equal to four divided by the meter-candle-seconds necessary to produce a density equal to the recommended gamma of the film being tested.

FILTER (COLORED): A piece of colored glass, gelatine, or other material which cuts out a part of the color spectrum. For example, a yellow filter has a high blue absorption and is frequently used to diminish the brightness of a blue sky, in order to reproduce the clouds.

FILTER FACTOR: The number of times the normal exposure of a film should be increased to compensate for the loss of light in the filter.

FILTER (NEUTRAL DENSITY): A gray filter used to cut down transmitted light evenly in order to alter the exposure.

FLATNESS: Lacking in contrast or having a low density range.

FOOT-CANDLE: Unit of illumination. It is the illumination on a surface all points of which are one foot from a point source of one candle power. 1 foot-candle=10.76 meter-candles.

GAMMA: A numerical value representing the rate of change of density with exposure. In the D Log E curve, it is equal to the tangent of the angle formed by the straight line portion of the curve with respect to the base. This definition assumes the use of graph paper having scales such that 0 to 2 in Log E is equal to 0 to 2 in Density. A negative made of a normal scene and having a low gamma would be considered flat, while a negative having a high gamma would be considered contrasty. To obtain true-tone prints, a low gamma negative would have to be printed on a high gamma (hard) paper and, conversely, a high gamma negative would have to be printed on a low gamma (soft) paper.

GRAY SCALE: A paper scale having a series of graduated tones from white to black. (When made on film it is usually referred to as a step wedge.)

H & D CURVE: A characteristic curve of a film or paper, first used by Hurter and Driffield to show the correlation between photographic exposure and resulting photographic density. (See also D Log E Curve.)

ILLUMINATION: See FOOT-CANDLE or METER-CANDLE.

ILLUMINATION METER: An instrument for measuring the illumination falling on a surface. The photometric unit is the FOOT-CANDLE, although in photography the METER-CANDLE is usually used.

IMBIBITION PRINTING: The method of making photographic prints through the use of a relief film whereby the absorbed dye is transferred to a mordanted paper. The quantity of dye transferred is approximately proportional to the thickness of the gelatin relief.

MASKING: In color photography, masking is often done to reduce contrast. The mask may consist of a thin negative printed from the transparency. This negative and the transparency are registered and bound together, and the color separation negatives are made from the combination. The resulting print will then be less contrasty than the original transparency. Masking is also used to make color corrections.

MATRIX: In the Wash-Off process, when the relief is dyed preparatory to making the print, it is known as the matrix.

METER CANDLE: Unit of illumination. It is the illumination on a surface all points of which are one meter (3.28 feet) from a point source of one candlepower. 1 meter-candle=0.093 foot-candle.

MORDANTED PAPER: A gelatin coated paper especially treated to hold the dyes in such a manner that dye images will be sharp and reasonably free from bleeding.

NEGATIVE DENSITY RANGE: Difference between maximum and minimum density of a negative. A negative having a low density range would be considered flat, while a negative having a high density range would be considered contrasty.

ONE-SHOT CAMERA: In this type of camera all three color-separation negatives are exposed at the same time. An optical system capable of splitting the light beam and directing it through the blue, green, and red filters to the three films is one type of a One-Shot Camera. An advantage of the One-Shot Camera is that moving objects can be photographed.

PHOTOELECTRIC CELL: The photoelectric cell used in the Analyzer is a barrier layer dry-disc type of cell able to convert light energy directly into electrical energy.

PLATEN: The surface of a contact printer on which the paper is exposed.

PRIMARY COLORS: The three primary colors of light are red, green, and blue-violet. When these colors are used in the proper proportions, all other colors can be produced. Pigment colors, sometimes referred to as "printing primary colors" are blue-green (cyan), magenta, and yellow, often referred to by the artist and color worker as blue, red and yellow.

PRINTER NEGATIVE: In most color processes, the three color-separation negatives are exposed through the red, green, and blue filters. These negatives are designated in terms of their complementary colors, thus the negative exposed through the red filter is called the "blue-green printer", the negative exposed through the green filter is called the "red printer", and the negative exposed through the blue filter is called the "yellow printer".

RECIPROCITY LAW: When photographic film or paper is exposed to light a photochemical reaction occurs. It is generally assumed that Exposure is the product of Light and Time and that equal products will produce the same effect. This is true only within certain limits of light and time and the variation in the effect for equal products is generally designated as the failure of the reciprocity law.

RECORD NEGATIVE: The term "record negative" as used in this instruction book refers to the negatives exposed through the red, green, and blue filters in order to establish time-gamma curves. The "red record negative" is the negative exposed through the red filter, the "green record negative" is the negative exposed through the green filter, and the "blue record negative" is the negative exposed through the blue filter.

RELIEF: In the Wash-Off Relief process, a relief is a positive made from one of the three color-separation negatives. These reliefs are used to transfer the yellow, blue-green, and magenta dyes to the final print.

SEPARATION NEGATIVES: In order to reproduce a given object, scene, or color transparency, it is necessary to produce a set of separation negatives to break up the scene into its primary colors. In actual practice, one negative is exposed through a red filter, one through a blue filter, and one negative through a green filter.

STEP WEDGE: A transparent base having a series of graduated densities thereon.

SUBTRACTIVE PROCESS: A process for reproducing scenes or objects in natural colors. The scene, or object, is photographed through the red, green, and blue filters, as in the additive process. The positives, which are made from the separation negatives, are in colors **complementary** to the filters. Wash-Off Relief, Carbro, Kodachrome, and Ansco Color are all subtractive processes. It is called subtractive because each color subtracts from white light its complementary color, thus if the three colors are placed in a beam of white light, all color will be subtracted resulting in black.

TANNING: The process of hardening the gelatin of wash-off relief film, carbro tissue, etc., is known as tanning.

TIME-GAMMA CURVE: A curve showing the relationship between Developing Time and the resulting contrast or Gamma. A Time-Gamma curve is desirable when making color separation negatives in order to obtain correct balancing.

VEILING: In color photography, the black-and-white prints made from color-separation negatives are printed so that the whites are on the gray side. The object of this "veiling" is to compensate for slight losses in the bleaching and tanning of the wash-off or carbro tissue.

WEDGE: See gray scale or step wedge.

TABLE SHOWING RELATIONSHIP BETWEEN DENSITY, OPACITY, AND TRANSMISSION

Density	Opacity	Transmission (%)	Density	Opacity	Transmission (%)	Density	Opacity	Transmission (%)
0	1.0	100.						
.1	1.3	80.	1.1	13.	8.	2.1	130	0.8
.2	1.6	63.	1.2	16.	6.3	2.2	160	0.63
.3	2.0	50.	1.3	20.	5.	2.3	200	0.5
.4	2.5	40.	1.4	25.	4.	2.4	250	0.4
.5	3.2	32.	1.5	32.	3.2	2.5	320	0.32
.6	4.0	25.	1.6	40.	2.5	2.6	400	0.25
.7	5.0	20.	1.7	50.	2.	2.7	500	0.2
.8	6.3	16.	1.8	63.	1.6	2.8	630	0.16
.9	8.0	13.	1.9	80.	1.3	2.9	800	0.13
1.0	10.0	10.	2.0	100.	1.0	3.0	1000	0.10

FORMULA:

$$D = \text{Log } O = \log \frac{1}{T}$$

LEGEND:

D = Density
O = Opacity
T = Transmission (actual)

The Weston Photographic Analyzer is manufactured and sold under the following patents owned by the Weston Electrical Instrument Corporation.

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