



Dichro 45

**computerized colorhead/
instruction manual**

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IMPORTANT SAFEGUARDS®

When using your photographic equipment, basic safety precautions should always be followed, including the following:

1. Read and understand all instructions.
2. Close supervision is necessary when any appliance is used by or near children. Do not leave appliance unattended while in use.
3. Care must be taken as burns can occur from touching hot parts.
4. Do not operate appliance with a damaged cord or if the appliance has been dropped or damaged — until it has been examined by a qualified serviceman.
5. Do not let cord hang over edge of table or counter or touch hot surfaces.
6. If an extension cord is necessary, a cord with a suitable current rating should be used. Cords

rated for less amperage than the appliance may overheat. Care should be taken to arrange the cord so that it will not be tripped over or pulled.

7. Always unplug appliance from electrical outlet when not in use. Never yank cord to pull plug from outlet. Grasp plug and pull to disconnect.
8. Let appliance cool completely before putting away. Loop cord loosely around appliance when storing.
9. To protect against electrical shock hazards, do not immerse this appliance in water or other liquids.
10. To avoid electric shock hazard, do not disassemble this appliance, but take it to a qualified serviceman when some service or repair work is required. Incorrect reassembly can cause electric shock hazard when the appliance is used subsequently.

SAVE THESE INSTRUCTIONS

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CONTENTS

Important Safeguards	Inside Cover
Specifications	Inside Cover
Introduction	Inside Cover
I. Installation Instructions	2
II. Operating Instructions	4
III. Controls and Components	5
Descriptions	5

IV. Changing Mixing Chambers	6
V. Theory of Operation	8
VI. Color Printing	10
VII. Black and White Printing	10
VIII. Alignment and Calibration	11
IX. Maintenance	Inside Back Cover
Warranty and Service Information	Back Cover

DICHRO 45 SPECIFICATIONS

Line Voltage:

Model #8282, 120V $\pm 10\%$, 60 Hz
Model #8286, 220/240V $\pm 10\%$, 50 Hz

Electronic: Internally stabilized, solid state, microprocessor based

Lamp: Catalog #5108 — 82V, 250W

Type of Filtration: Dichroic Interference Filters

Filtration: Yellow, Magenta, Cyan

Auxiliary Filtration: IR, UV filtration integral in each mixing chamber

Mixing Chambers: Interchangeable —

Standard 4 x 5 (Catalog #8293)

Optional 6 x 7 (Catalog #8292)

35mm (Catalog #8291)

Condenser light source
with adapter (Catalog #8294)

Blower: Self-contained centrifugal type

Dimensions: 17½" (451mm) wide, 7" (178mm) high, 9½" (232mm) deep. Overall height mounted on enlarger, measured from support stage:
Diffusion mode — 8" (203mm); Condenser mode — 13½" (343mm)

Weight (with mixing chamber): 16 lbs. (7.27 kg)

Shipping Dimensions: 24½" (622mm) wide,

16½" (422mm) high, 16½" (422mm) deep

Shipping Weight: 24½ lbs. (11kg)

INTRODUCTION

Congratulations! With your purchase of the Beseler Dichro 45 Computerized Colorhead you have acquired a truly versatile and unique colorhead. The Dichro 45 is a solid-state, microprocessor based dichroic colorhead incorporating a self-contained, stabilized power supply and cooling system. It represents the latest in electronic technology applied to color printing. The color of the light is measured by means of photodetectors in the colorhead. The Dichro 45 then calculates the filtration values and displays this data on seven segment LED displays.

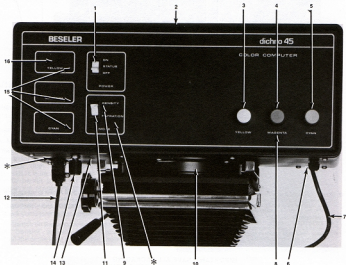
The colorhead is designed to work equally well with the Beseler 45MX or 45MX II enlarger, and installation is simple. The Dichro 45 offers diffusion or condenser (optional) color and black and white printing for formats ranging from sub-miniature to 4" x 5" negatives.

The Dichro 45 is easy to operate and maintain. Because it is so advanced and radically different from earlier color printing systems, we strongly recommend that you thoroughly read this instruction manual to fully acquaint yourself with the colorhead and learn how to take advantage of its

many capabilities.

If you desire to begin printing immediately with your Dichro 45, we suggest that you familiarize yourself with the colorhead and its controls (Figures 1 and 2 with descriptions) and then follow the direc-

tions in Section I, Installation Instructions, and Section II, Operating Instructions. The remainder of the manual contains additional valuable information which will increase your understanding of the Dichro 45.



1. **POWER SWITCH** 3-position switch:
"Off" — Colorhead off
"Status" — Checks several functions of colorhead
"On" — Operate position

2. **ACCESS DOOR** Provides entry to the colorhead to change mixing chamber or lamp.

3. **YELLOW FILTRATION CONTROL**
Sets desired amount of yellow filtration.

4. **MAGENTA FILTRATION CONTROL**
Sets desired amount of magenta filtration.

5. **CYAN FILTRATION CONTROL** Sets desired amount of cyan filtration.

6. **WHITE LIGHT LEVER** Removes filters from light path for "white light" focusing. Paper saver circuit prevents wasted color print paper by not permitting exposure to unfiltered light. Off is forward; on is rearward.

7. **POWER CORD** Three-prong plug connects to convenience outlet on enlarger (or wall outlet).

8. **FILTRATION CONTROL LEGEND**
"Y", "M", "C" legends are lighted whenever colorized is on.

9. **MODE LEGENDS** Lighted legend displays "D" in density mode, "F" in filtration mode.

10. **MOUNTING COLLAR** To attach colorhead to a Beseler 45M series enlarger.

11. **MODE SWITCH** 2-position switch:
"Density" — Colorhead measures and displays density of all three colors.

- "Filtration" — Colorhead subtracts neutral density component and displays filtration.

12. **TIMER CORD** 6-pin connector attaches to the colorhead; two-prong plug connects to outlet on timer.

13. **ZERO CONTROLS** Used to adjust zero readings on LED display when calibrating colorhead.

14. **BRIGHTNESS CONTROL** Adjusts the brightness of the LED displays and the legend displays.

15. **DISPLAY LEGENDS** "Y", "M", "C" are lighted when LED displays are showing color values in density or filtration mode. The legend lights are off during status or white light operation.

16. **LIGHT EMITTING DIODE (LED) DISPLAYS** Display density and filtration values. The top display shows yellow information, the middle magenta, and the bottom cyan. Also display status messages and "white light" information.

*24-pin receptacle and "M" LED reserved for use with Beseler D.A.T.A. Module Cat. # 8283.

Figure 1

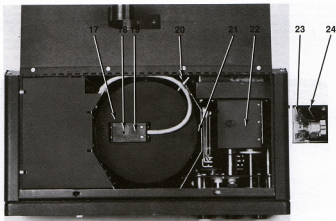


Figure 2

17. MIXING CHAMBER Interchangeable chambers available to optimally illuminate the selected format (4 x 5, 6 x 7, 35mm, condenser).

18. MIXING CHAMBER LIGHT ATTENUATOR Adjusts light level coupled to light sensing diodes to provide consistent readouts from one mixing chamber to the next.

19. SENSOR HOLDER Contains light detectors which measure filtered light in the mixing chamber.

20. LOCATING PIN AND SLOT Correctly position mixing chamber in color-head.

21. HEAT ABSORBING GLASS Two-piece glass absorbs infra-red, ultra-violet radiation.

22. LAMP DOOR Access to change lamp.

23. LAMP Type 8106; 62 volts, 250 watts.

24. LAMP EJECTOR Aids in removing lamp.

IMPORTANT: SAVE ALL PACKAGING MATERIALS. IF YOU EVER NEED TO SHIP THE DICHRO 45, THE ORIGINAL PACKAGING MATERIALS MUST BE USED TO PROTECT IT IN TRANSIT.

I. INSTALLATION INSTRUCTIONS

The Dichro 45 Computerized Colorhead is a self-contained unit, and is shipped with a 4 x 5 diffusion mixing chamber and 250 watt lamp in place. The timer cord is wrapped separately in the carton. To mount the colorhead onto a Beseler 4 x 5 enlarger for diffusion printing, just follow these simple instructions:

A. If your enlarger is equipped with a Resistrol accessory, unplug it, as it cannot be used in conjunction with the colorhead.

B. Adjust the negative stage of the enlarger to the 4" x 5" position on the negative size scale. Lock in

place the negative stage by tightening the negative stage lock knob on your enlarger.

NOTE: The illumination system of the colorhead requires that the upper bellows remain in the 4 x 5 position (fully collapsed) during diffusion printing with all negative sizes.

C. Remove the two screws holding the negative size scale in place and detach scale.

If your enlarger does not have a condenser lamp-house, pull forward the housing latches and go on to step E.

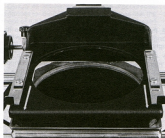


Figure 3

D. Unplug the condenser lamphouse power cord and remove the lamphouse/condenser assembly by pulling forward the support stage latches (see Fig. 3) and lifting the assembly clear of the enlarger. Store the assembly in a safe, dust-free place.

E. Place the colorhead on the enlarger so that the colorhead mounting collar (Fig. 1, item 10) slides into the opening in the support stage (see Fig. 4).

F. Once the colorhead is sitting squarely on the enlarger, lock it in place by pushing back the latches.



Figure 4

G. The lamp and the electronic power supplies in the colorhead are stabilized. **DO NOT** use an external stabilized power supply unless you are sure the stabilizer output is a good sine wave. The Dichro 45 has two line cords — one for AC line voltage, the other to connect to the timer. The power cord (Fig. 1, item 7) is on the right and should be plugged into the convenience outlet on the enlarger motor box. The six-pin connector on the timer cord (Fig. 1, item 12) is inserted into its counterpart receptacle on the left underside of the colorhead. The two-prong plug is inserted in the "Enlarger" outlet on your timer. See Figure 5 for typical AC connections. You are now ready to begin diffusion printing with your Dichro 45 Computerized Colorhead.

IMPORTANT

The system must be connected to a grounded, 3-wire AC outlet.

This grounds the chassis and provides protection for the electronic components against inadvertent electro-static discharges from the operator's body.

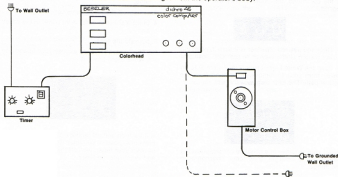


Figure 5

For Enlargers Without Convenience Outlet, Connect Directly to Grounded Wall Outlet.

II. OPERATING INSTRUCTIONS

The Dichro 45 is sophisticated in design and performance, yet it is simple to operate. You can begin using the colorhead after you have installed it on the enlarger. As with all very sensitive light measuring devices it is suggested that you turn your unit on 5-10 min. before operation (such as when you enter your darkroom before a printing session). Follow these steps below to make your color prints.

A. Push the Power Switch (Fig. 1, item 1) to the Status position. The cooling blower will start to run and the three-tier LED display will show



for approximately three seconds. Then the upper tier will display a legend informing you of the mixing chamber in the colorhead. For example:



At this point, you may wish to adjust the LED display brightness to a comfortable level by turning the Display Brightness Control (Fig. 1, item 14) counterclockwise to increase light levels and clockwise to decrease the light intensity.

B. If the desired mixing chamber is not in the colorhead, change diffusion chambers according to instructions in Section IV. If there is no chamber in the colorhead, the upper display will show the legend



C. Once the desired chamber is inserted, push the Power Switch all the way up to the "On" position.

D. Push the White Light Lever (Fig. 1, item 6) to on (away from you) to remove all filtration from the optical path. The LED display will read



Insert your negative in a negative carrier, place the carrier in the enlarger, then focus and compose the image.

E. Pull the White Light Lever to off (back to its original position) to place the dichroic filters in the light path.

F. Place the Mode Switch (Fig. 1, item 11) in the "Filtration" position, so the neutral density component in your selected filter pack will be automatically subtracted, and the LED display will present the true color values.

NOTE: In either Density or Filtration mode, with all of the filtration controls full counterclockwise, the LED displays may not read all zeros. This is normal and is an indication of the small variations in both color and intensity which occur as the lamp in your colorhead ages. See Section VIII-B for instructions on zeroing the display readouts.

G. Dial in your selected filtration values by turning the Filtration Controls (Fig. 1, items 3, 4 and 5) clockwise to increase and counterclockwise to decrease. Remember that in color printing you will need only two types of filtration (most likely yellow and magenta for color negatives). Make sure you dial out all filtration from the unused filter by turning that control counterclockwise as far as it will go.

NOTE: The LED display for filtration levels may, occasionally, exhibit "rollover," that is, a tendency for the last digit to fluctuate. This means that the precision circuitry of the colorhead is determining an intermediate value. Small fluctuations can usually be disregarded. You can, if you desire, adjust your filtration dials to tune in the level that the display is trying to indicate.

H. When you have adjusted your filter pack:

1. Make sure the White Light Lever is off;
2. set your timer for the appropriate exposure time;
3. switch off the timer focus control;
4. place a sheet of color print paper in the easel; and
5. activate the timer.

NOTE: If you attempt to expose your image and the White Light Lever is on,



will flash on and off (about once per second) and prevent exposure. You must then cancel out and/or reset your timer, turn off the White Light Lever and reactivate the timer.

III. CONTROLS AND COMPONENTS DESCRIPTIONS

The Dichro 45 has many features and functions that permit color printing to be done quickly and accurately. Complete explanations and descriptions of each function and feature are detailed below.

A. DISPLAY Three groups of 0.3"-high, four-digit, seven-segment light emitting diodes (LED's) provide the data display. The Dichro 45 has several display modes:

- 1. Density or Filtration values for Yellow, Magenta and Cyan** Three digits per color for all three colors are simultaneously provided. When the value is negative, a minus (-) sign is displayed. A typical display might be



LED indicators labeled "Y", "M" and "C" are located beneath their respective filtration value displays and are on whenever the colorhead is displaying color value, and off when other information is displayed.

- 2. Status Indication** The display shows



to let you know the program and displays are operating and, after approximately 3 seconds, changes to mixing chamber indication.

- 3. Mixing Chamber Indication** Readout appears during second phase of status check to show which chamber is in the colorhead:

MIXING CHAMBER	DISPLAY READOUT
None	0 0 0
35mm (Cat. No. 8291)	d 3 5
6 x 7 (Cat. No. 8292)	d 6 7
4 x 5 (Cat. No. 8293)	d 4 5
Condenser (Cat. No. 8294)	C a n d

4. White Light Indication reads



when filters are retracted by white light lever. Flashes on and off if white light lever is kept on during an exposure.

B. POWER SWITCH Three position switch (OFF, STATUS, ON). Lower position is off; middle position activates blower, status check and mixing chamber indication; upper position turns on colorhead for color printing.

C. FILTRATION CONTROLS By turning the appropriate knob, any desired amount of yellow, magenta or cyan filtration may be introduced into the light path. LED indicators beneath each control are labeled "Y", "M" and "C" respectively.

D. WHITE LIGHT LEVER/PAPER SAVER CIRCUIT The White Light Lever removes the dichroic filters from the light path for easy "white light" focusing. Pushing the lever away from you moves the filters out of the light path. Pulling the lever toward you returns the filters to their original position.

The Paper Saver circuit built into the colorhead will prevent the lamp from turning on if the filter retractor is engaged in the "white light" position, thereby preventing the loss of a sheet of paper due to exposure to unfiltered light. The LED displays the legend



as a reminder that you have no filtration in the optical path. Additionally, if you should ignore this reminder and attempt to expose the image, the legend will flash on and off at a rate of about once per second when you activate the timer.

E. BRIGHTNESS CONTROL A provision for adjusting the digital display and legend brightness is incorporated into the Dichro 45 as an operator convenience. After switching on the colorhead, turn the brightness control to adjust the intensity of the illuminated readout to your personal preference.

F. MODE SWITCH Two-position switch enables you to see the amount of neutral density in your filter pack and to subtract it out. The upper switch position places the LED filtration readouts in the DENSITY (D) mode; that is, the neutral density in your selected filter pack is displayed. To subtract

out the neutral density on the display, simply place the mode switch in the lower, or FILTRATION (F), position.

EXAMPLE: If you were to dial in 100 units of Magenta, the display for each mode might be as follows:

	Y	M	C		Y	M	C
Density	3	100	2		-5	100	2
				or			
Filtration	1	98	0		0	105	7

As you can see, in the Filtration mode, the neutral density on the display has been subtracted by the computer. Remember, when subtracting from a negative number, the net result is addition; therefore, all values will increase, as in the example on the right, whenever a negative reading appears in the density mode and you switch to filtration. See Section V for additional details.

G. MIXING CHAMBERS A 4 x 5 diffusion mixing chamber is standard with the Dichro 45. Accessory mixing chambers for 6 x 7 and 35mm diffusion printing (catalog #8292 and 8291 respectively) and a condenser chamber (catalog #8294) are available from your Beseler dealer. All chambers include IR

and UV filtration. During the latter half of the status check, the upper LED display indicates which chamber is in the colorhead.

H. COOLING SYSTEM The Dichro 45's cooling system is of flow-through design, incorporating a self-contained centrifugal blower. The blower, located on the right side of the housing, pulls in cool air through the inlet on the left, across the electronics and the lamp and out the exhaust vent on the right. The blower is secured on vibration mounts which prevent undue vibration from reaching the negative and lens stages and distorting the image.

I. STABILIZED POWER SUPPLY The voltages for the colorhead's lamps and electronics are internally stabilized over an AC line voltage range of $\pm 10\%$ from the normal. A separate stabilized power supply is not required.

J. CONTROL SETTINGS AND DISPLAYS The Dichro 45 has the capability to provide a wide variety of data from its controls and to display this information on the LED display. The following chart outlines the colorhead's controls, their functions and the displays that appear.

IV. CHANGING MIXING CHAMBERS

The Dichro 45 comes with a 4 x 5 diffusion mixing chamber as standard equipment. Optional diffusion chambers for 6 x 7 and 35mm formats and a Condenser Mixing Chamber are available from your Beseler dealer.

Whenever you wish to change mixing chambers, be sure the power switch is in the "off" position. Dis-

connect the power cord as a safety precaution and follow the procedure outlined below:

A. Open the Access Door by rotating latches 90° (see Fig. 6). Disconnect the sensor holder (Fig. 2, item 19) from the Mixing Chamber by gently pulling up (see Fig. 7). Carefully lift out the chamber.

B. Pick up the other chamber and make sure the mixing chamber window (heat absorbing glass — Fig. 2, item 21) and the locating pin (Fig. 2, item 20) are on the right; that is, toward the lamp.










Figure 6



Figure 7

SWITCH SETTINGS

DISPLAY

Power	Mode (D) Density (F) Filtration	White Light	Timer	
1. Status	D or F	Off or On	Off	 followed in 3 seconds by 
2. Status	D or F	Off or On	On	Same as above. If switch is moved from on to status, lamp will go off.
3. On (When first turned on)	D or F	Off	Off	
4. On	D	Off	On	 Typical
5. On	F	Off	On	 Typical
6. On	D or F	On	On or Off	
7. On	D or F	On	Turn On from Off	 Blinks at rate of approx. once per second

C. Insert the chamber into the colorhead and engage the locating pin in the slot on the right side of the chamber area housing. See Fig. 8. Slide the chamber into place.

D. Connect the sensor holder, close the access door and turn latches 90° to relock.

V. THEORY OF OPERATION

The color of light provided by the Dichro 45's illumination system is controlled by three dichroic filters — yellow, magenta and cyan — which are adjusted by means of controls on the front panel of the colorhead. The yellow filter control sets the amount of blue light in the system; the magenta filter controls the amount of green light; and the cyan filter controls the amount of red light. The sensor holder contains three gallium arsenide phosphide photo-detectors, each of which measures a separate primary color — red, green or blue. It is, therefore, possible to get a direct reading of the amount of filtration in the colorhead's illumination system. These measurements are routed through a microprocessor in the electronics section, and the filtration values are indicated on three individual LED digital displays.

An advantage of this system is that the filtration values indicated are true, **measured values** rather than the approximate or nominal values indicated on calibrated dials or filters. As a result, inaccuracies in filtration readings, which normally result from lamp changes, filter changes and mechanical variations are eliminated. The Dichro 45 achieves a level of accuracy and precision previously obtainable only through the use of a separate color analyzer. Additionally, the use of a microprocessor (a small computer) results in a "smart" colorhead, enabling the user to deal with color printing values in a way not previously practical.

To fully realize the capabilities of the Dichro 45, it is helpful to understand the meaning and significance of color printing values. Colored transparent filters used in enlarger filter drawers for color printing are typically designated in terms of GP (Color Printing) or CC (Color Compensating) units ranging in value from 2.5 to perhaps 50.*

The values displayed by the Dichro 45 have the same meaning, but represent true measured values of filtration rather than nominal designations. As a



Figure 8

result, a number of factors not normally considered are automatically accounted for with this system. These factors include imperfections and variations in the filters and variations in the mechanical, optical and illuminating systems. While it is not possible to entirely eliminate these variables from any system, the Dichro 45's ability to recognize and display their effects enables the user to accurately control filtration.

For example, the imperfection in color filters is that they absorb small amounts of light other than that for which they were intended. The magenta filter is primarily a green light absorber, and it would be desirable if it did not absorb any red or blue light. However, even the best magenta filters available absorb some red light and some blue light, resulting in increased cyan and yellow filtration readings on the Dichro 45 when the magenta filtration is increased. Similarly, but to a somewhat lesser extent, the yellow and cyan dichroic filters absorb light other than blue and red respectively.

Because the Dichro 45 always indicates the true value of the filtration in the illumination system, it is possible to compensate for these imperfections in the filters by adjusting the filtration controls to arrive precisely at the desired filtration. These imperfections occur in all dichroic colorheads, but

*Technically, these numbers are derived from the common logarithm of the absorption value of the filter to its complementary color. Yellow filters are designated in terms of their blue absorption, magenta in terms of green and cyan in terms of red. The formula for determining these values is:

$$CC = 100 \times \log \frac{1}{\text{Transmittance}}$$

As an example, the value of a yellow filter which transmits only one half (.5) of the blue light it receives would be calculated:

$$\begin{aligned} CC \text{ Yellow} &= 100 \times \log \frac{1}{.5} \\ &= 100 \times \log 2 \quad \log 2 = .30 \\ &= 100 \times .30 \\ &= 30 \end{aligned}$$

This filter would be called CC 30 Yellow, or, simply, 30Y.

the Dichro 45 allows you to see the inaccuracies and correct for them. For example, suppose that the amount of magenta filtration needs to be increased by 30 units. Making this adjustment will cause a corresponding, though smaller, increase in the amount of yellow and cyan filtration (due to filter imperfections) which will be indicated on the Dichro 45's displays. It may then be desirable to **decrease** the amount of yellow or cyan filtration, using the appropriate filter controls. This would bring the yellow and cyan filtration back to their original values, thereby compensating for the unwanted blue and red absorption of the magenta dichroic filter.

Changing lamps or mixing chambers may also introduce small variations in the color of the illumination, and these variations will be displayed by the Dichro 45 in terms of the filtration changes they represent. As there is some difference in the characteristics of dichroic filters, it may be noted that the maximum units of filtration obtainable may differ from one color channel to another, and from one colorhead to another. Small shifts in filtration caused by small changes in component characteristics due to temperature and time may be observed occasionally, and these may be compensated for by adjusting the appropriate color control.

Neutral Density

In addition to the unwanted, or secondary, density described above, all filters, either alone or in combination with others, have a certain amount of **neutral density**. The term neutral density implies equal amounts of absorption of red, green and blue light. The effect of neutral density in an illumination system is to decrease the total amount of light without changing color. Those who have worked with color materials may be accustomed to subtracting out neutral density from filter packs in order to determine the net effective filtration desired. Neutral density will always occur when more than two of the dichroic filters are in the system, and may occur to a lesser degree when only one or two filters is used.

As an example of neutral density, suppose that the following values of filtration are introduced into the colorhead's illumination system:

60Y
40M
20C

By use of a little simple arithmetic, these values may be expressed to show the neutral density (ND) component as follows:

$$\begin{aligned} 60Y &= 40Y + 20Y \\ 40M &= 20M + 20M \\ 20C &= 20C \end{aligned}$$

It can now be seen that there are 20 units each of yellow, magenta and cyan which combine to form 20 units of neutral density, resulting in a filter pack of

40Y + 20M + 20ND. The effective filtration is 40Y + 20M, with the 20ND serving only to reduce the total available illumination without affecting the color (filtration) of the illumination. Note that when all three color channels show density values, the neutral density component is always equal to the lowest of these values.

When the Dichro 45 is in the DENSITY mode, the effective density of each of the filters is indicated on the displays. Switching into the FILTRATION mode mathematically subtracts out the neutral density. The effective filtration is indicated on the displays, and the light output is still reduced. While it is generally more convenient to work in the FILTRATION mode, the DENSITY mode may be used to advantage when it is desirable to know how much neutral density is in the system.

It is also possible to use neutral density as a means of reducing the light output of the colorhead without altering the effective filtration. This may be useful where a particular f/stop-exposure time combination is desired and there is more light available than is necessary. To introduce neutral density, increase all three filtration levels by the same amount. A convenient method for doing this is as follows:

1. With the mode switch in the FILTRATION position, note the values of the two colors which are being used.
2. Determine how much neutral density is desired, or by what factor it is desired to reduce the light output (see table).
3. Switch into the DENSITY mode and note the values indicated on each of the displays.
4. Adjust each of the controls until **each** of the displays is increased by the value determined in step 2 above. This may require adjusting each control several times to fine tune the values.
5. Switch back into the FILTRATION mode. The displays should now indicate the same values noted in step 1 above.

Due to the spectral sensitivity characteristics of color photographic papers, raising the level of neutral density in this manner may produce slight changes in the color balance of the print.

To reduce illumination by this factor:	Add this much filtration in each color:
10%	005
20%	010
30%	015
40%	022
50%	030
60%	040
70%	052
80%	070
90%	100
1 f/stop	030
2 f/stops	060
3 f/stops	090

VI. COLOR PRINTING

The following information should help you to get started making color prints from negatives with your new Dichro 45 Colorhead.

A. Put your negative into the enlarger. Size, compose and focus the image as usual.

B. Dial in the recommended starting filter pack of 50M + 90Y for Kodak 74RC paper. Set your lens to 1/8 in the DIFFUSION mode and 1/16 in the CONDENSER mode.

C. Make a test strip for density, varying only the exposure time (not the lens aperture or the filter pack).

D. Evaluate the test strip for density.

1. If any section of the test strip shows exactly the right density, you're all done testing. Record the exposure time which produced it.

2. If one section of the test strip is too light and the adjoining section is too dark, an intermediate exposure time is required. For example: If the exposure time for the light section was 10 seconds and the exposure time for the dark section was 20 seconds, the proper exposure time will be somewhere in between 10 and 20 seconds. (If in doubt, you might want to make a second test strip using intermediate exposure times such as 12-14-16-18 seconds.)

3. If all four sections are too light, open up the aperture of your enlarging lens by two full f/stops and repeat the test using the same exposure times. (The original test strip was underexposed.)

4. If all four sections are too dark, close down the aperture of your enlarging lens by two full f/stops and repeat the test using the same exposure times (the original test strip was overexposed).

5. Once the aperture setting and exposure time have been determined, the next step is to identify the PREDOMINANT color on the correctly exposed section of the test strip.

E. Identify the Predominant Color.

If your test strip happens to be perfectly color-balanced, you are immediately ready to make a color print without making any adjustment to the filter pack. It's far more likely, however, that your test strip will have a predominant color cast which you will want to remove before making your full-size color print. You must first identify the predominant color cast and then refer to the COLOR BALANCING table for directions on how to remove it.

VII. BLACK AND WHITE PRINTING

The Dichro 45 may be used for black and white printing in either the Condenser (optional) or Diffusion mode. Because of the nature of the black and white negative, a condenser system provides higher

Color Balancing Table

If first print made from a negative is too:	Or the first print made from a slide is too:	MAKE THIS CORRECTION BEFORE EXPOSING THE NEXT PRINT:
Yellow	Blue	Add Yellow or Subtract Cyan and Magenta
Magenta	Green	Add Magenta or Subtract Cyan and Yellow
Cyan	Red	Add Cyan or Subtract Yellow and Magenta
Blue	Yellow	Subtract Yellow or add Cyan and Magenta
Green	Magenta	Subtract Magenta or add Cyan and Yellow
Red	Cyan	Subtract Cyan or add Yellow and Magenta

The table shows what adjustments are necessary to color correct prints made from negatives or slides.

Experience will show how much of an adjustment is necessary for prints requiring varying degrees of correction and what starting filter pack to use in making a first print. Note that there are two possibilities for each correction. Do not make a correction which results in more than two filters being used at any one time. If all three filters are used at the same time, they will cancel each other out resulting in neutral density filtration and loss of illumination.

If you have just started color printing, it is a good idea to save those prints with which you are not satisfied. On the back mark the filtration and exposure with which they were made and compare them to your final prints. This is the best method of learning the effects of changing filtration (and exposure) on your Dichro 45 Colorhead.

contrast and more apparent definition. However, where dust and scratches may be a problem, or for negatives that have been retouched, a diffusion system will produce cleaner looking prints and minimize the necessity for spotting.

It is generally desirable to set all filtration dials to get readouts as close as possible to "000" during black and white printing. When printing with variable contrast papers, the colorhead can be used to control contrast, without the need of an additional set of filters. The table below shows what filtration settings will approximate various paper grades on Kodak Polycontrast® paper.

Polycontrast Grade	Filtration
1	25Y
1½	12Y + 9M
2	4Y + 21M
2½	7Y + 40M
3	10Y + 70M
3½	20Y + 140M

VIII. ALIGNMENT AND CALIBRATION

There are two user accessible alignment and calibration adjustments on the Dichro 45 — the mixing chamber light attenuator and the display zero potentiometers.

A. Mixing Chamber Light Attenuator

The light level coupled to the light sensing diodes in the sensor holder may vary slightly from chamber to chamber due to manufacturing tolerances. An attenuator is incorporated into each mixing chamber to permit these variations to be minimized. Follow the procedure below to check and adjust the attenuator.

CAUTION: Close the access door as soon as you have completed your adjustment.

1. Switch on the colorhead, place the mode switch in "Density", and adjust the filtration controls so that the same level of filtration shows up on each display. For example:



2. Remove the mixing chamber and insert the next chamber you wish to use. (See Section IV for instructions on changing mixing chambers.)
3. Do not touch the filtration controls or the mode switch. Turn on the colorhead and check your displays. If your filtration readings are lower than those you dialed in for the previous chamber, you must attenuate the light reaching the sensing diodes. If the readings are higher, you must increase the light reaching the diodes.
4. An adjusting screw for the attenuator is reached via an aperture (Fig. 2, item 18) in the sensor holder. See Fig. 9. To **attenuate** the light, turn

An alternate method to printing on variable contrast papers is possible. With the colorhead switch in the "Density" mode you can monitor the output of all three colors and adjust neutral density in the system. The table below shows the filtration settings required to approximate various paper grades while keeping the exposure time constant through the use of neutral density.

Polycontrast Grade	Filtration (Constant Exposure)
1	50Y + 25M + 25C
1½	55Y + 55M + 45C
2	40Y + 55M + 35C
2½	30Y + 65M + 25C
3	25Y + 85M + 15C
3½	25Y + 145M + 05C

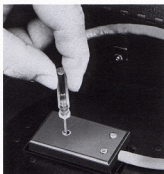


Figure 9

the screw clockwise, using the screwdriver provided, until the readouts match those set for the previous chamber.

5. To **increase** the light level, turn the attenuator screw counterclockwise until the readouts match those of the other chamber.

NOTE: The light attenuator affects only the light perceived by the sensing diodes and does not alter the light output of the chamber.

If the readouts are off by a unit or two, for example:



you need not compensate for this minor deviation, as it represents the true value of the color of the chamber's light, which may be slightly different from chamber to chamber due to manufacturing tolerances. If you wish, you can set the readouts to the desired values by following the procedure outlined in Part B of this section.

B. Display Zero Potentiometers

The Dichro 45 reads its own light output, and it is capable of revealing subtle changes in the lamp and the dichroic filters that may be caused by heat, wear and age. A lamp's color or output may vary slightly over a period of time, or heat may alter the filters' properties. The advanced optics and electronics of the colorhead will pick up these small changes and display them on the LED readout. Therefore, you will not always get a readout of "000" in all three filtration displays when all filtration has been dialed out, even though the colorhead is in perfect working order. You may wish to "zero" these displays for your convenience, or you may wish to calibrate your colorhead or bring its readings in line with other Dichro 45's to provide consistency from one colorhead to the next.

For these reasons, the Dichro 45 has zero potentiometers which correspond to each filtration display, and are located on the underside of the colorhead, beneath the LED displays. The cyan potentiometer is nearest the front of the colorhead, magenta is behind that and yellow is farthest from the front. To change a readout from a positive number to "000", use the small screwdriver provided to turn the appropriate potentiometer counterclockwise. See Fig. 10. To change a reading from negative to "000", turn the potentiometer clockwise.

Appropriate application procedures for the zero potentiometers are explained below.

1. "000" IN ALL THREE DISPLAYS/ALL FILTRATION DIALED OUT

The filtration displays are "zeroed" at the factory with the lamp in place, in the Density mode. When you initially switch on your colorhead, the displays should read



when all filtration has been dialed out. If they do not, you can make adjustments per the instructions above. Whenever you change lamps, you can zero the displays in this manner.

If you should change mixing chambers, you can attain "000" displays in all three chambers by dialing out all filtration (turn knobs full counterclockwise) and adjusting the mixing chamber light attenuator to raise or lower the readings to "000."

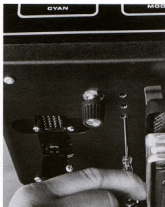


Figure 10

2. "000" IN ALL THREE DISPLAYS/WITH REPEATABILITY

By using a color analyzer program, you can attain "000" readings in all three displays on any number of Dichro 45 Computerized Colorhead in your lab. Follow the procedure below:

- a. Dial out all filtration in the Density mode and use the potentiometers to zero the colorhead displays.
- b. Switch on the color analyzer and position its probe directly beneath the enlarger lens.
- c. Set up a white light program:
 1. Turn the analyzer channel selector to Cyan and adjust the analyzer cyan control(s) until the meter is nulled or the digital display reads "000."
 2. In the same manner, null the meter or zero the display for yellow and magenta.
 3. If your analyzer has a programmable module, set up the program on a module. If not, note the position(s) of the cyan, yellow and magenta analyzer controls.
- d. When a lamp is replaced, use the analyzer to help zero the displays:
 1. Switch on the colorhead and the analyzer. Insert the program module in the analyzer or position the analyzer controls per your white light program.
 2. Set all three colorhead filtration controls fully counterclockwise. Open the lens aperture until the analyzer indicates the need to

add filtration in all three colors. Identify the color which requires the least addition of filtration (analyzer reads closest to zero, or null). Close the lens aperture to zero (or null) the analyzer reading for that color. For the other two colors, adjust the appropriate colorhead filtration controls to bring the analyzer to zero (or null).

IX. MAINTENANCE

The Dichro 45 requires virtually no regular maintenance, other than to be kept free of dust when not in use. The only maintenance procedure is to change the lamp when it burns out.

Lamp Changing Procedure (Beseler Catalog No. 8108)

1. Allow the lamp to cool prior to attempting to change it.
2. Disconnect the power cord as a safety precaution.
3. Open the access door on top of the Colorhead by turning the latches 90° (see Fig. 6).
4. Locate the lamp compartment and lift up door (Fig. 2, item 22).
5. Pull lamp ejector (item 24) to right and remove old

3. Adjust the colorhead zero potentiometers until each colorhead display reads "000."

e. To attain equivalent readings with a second Dichro 45, position the analyzer probe beneath that colorhead and follow the procedure outlined in paragraph (d) above.

lamp. See Fig. 11.

6. Insert new lamp firmly into socket until pins are fully seated. Close lamp door; close and lock access door.

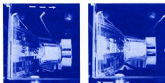


Figure 11

OPERATING HINTS

Using a Color Analyzer with Your Dichro 45

The color measurement circuitry built into the Dichro 45 colorhead is not intended to replace the color analyzer which you may now be using and, in fact, cannot, as it reads the color of light before it passes through the negative.

Your color analyzer, when used properly, will continue to allow you to efficiently store your predetermined color programs, analyze your unknown negatives and determine exposure times.

Please remember that a color analyzer is not intended to measure absolute color filtration but rather to serve as a comparator which remembers the color of the light used to make a "perfect print" and allow you to return to that color when analyzing an unknown negative.

The proper use of a color analyzer is to come to a zero or "null" position on each channel by adjusting the color controls on the colorhead. You should only be concerned with "nulling" the analyzer and not with any changes in the colorhead displays. The meter numbers or readouts on a color analyzer are intended to give you the direction (plus or minus) and approximate magnitude of any required changes. Do not expect the exact same changes to take place on your color analyzer that occur on the colorhead. These are two distinct devices which each perform their own function and do not necessarily "follow" each other.

Additionally, different color analyzers will reflect different changes because of various types of light detectors and separation filters being used, which result in differing spectral response characteristics.

Filtration Ranges

You may notice that the maximum filtration readings in your Dichro 45 will be different for each color. If you have purchased more than one Dichro 45 colorhead or have compared yours to one owned by a friend, you may have also discovered that the maximum filtration in any one given color may vary from colorhead to colorhead.

This is not a defect, nor does it make one colorhead better than another. It is merely a situation which only becomes evident in a colorhead which reads actual color values, as opposed to conventional colorheads which only display approximate color value.

Conventional colorhead dials, which show maximum filtration of anywhere from 130 to 200 units of each color, indicate only an approximation of color value. Until the advent of the Dichro 45 colorhead, it had been impractical to precisely calibrate colorheads to indicate the differences that have always existed in all dichroic filters. Regardless, this type of calibration would have been meaningful only for the original lamp in any given colorhead, requiring re-calibration every time a lamp was changed.

Now, for the first time, as you are seeing actual color values, you are also seeing the differences which exist between dichroic filters and, in fact, the differences which exist between colorheads. Now, for the first time, you can adjust for these differences with the Dichro 45.

In actual use, the colorhead is rarely, if ever, required to produce densities in excess of 150 units of any given color. For this reason it is unimportant whether the maximum effective range of any filter is 170 units or 240 units. In actuality the filters in your Dichro 45 colorhead will fall somewhere between these two numbers.

LIMITED ONE YEAR WARRANTY

Applicable in U.S.A., outside U.S.A. see local distributor.

Beseler Photo Marketing Company, Inc., Florham Park, New Jersey warrants its products (with the exception of lamps), to the original purchaser only, to be free from defects in materials and workmanship for a period of one (1) year from the date of purchase.

This Warranty does not apply to our products which show evidence of accidental damage, misuse or abuse by you. The Warranty also does not apply to our products which are defective or damaged by tampering or attempted repair by an unauthorized Beseler agent.

Beseler exclusively limits this Warranty to repair or replace (at Beseler's option) the defective part of its product. If you decide to send our product to our authorized repair outlet, you must insure the product and prepay all transportation expenses. Beseler will not be liable for damages caused in the course of shipping the product to you. You must allow at least six (6) weeks for correction of the defect.

ANY IMPLIED WARRANTIES OF FITNESS FOR USE, OR MERCHANTABILITY, THAT MAY BE CREATED BY OPERATION OF LAW ARE LIMITED TO THE ONE (1) YEAR WARRANTY PERIOD.

Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

IMPORTANT! KEEP THIS INFORMATION HANDY FOR FUTURE REFERENCE KEEP YOUR SALES RECEIPT!

SERVICE INFORMATION:

Applicable in U.S.A., outside U.S.A. see local distributor.

Should you need service for your BESELER photographic equipment after the warranty has expired, please follow these steps:

PACK the product in the original packaging material to protect it in transit.

ENCLOSE complete information showing your name and address, what is wrong with the equipment, and the return shipping address. Tape the information to the equipment to ensure it does not get thrown out with the packing material.

ADDRESS the package to: BESELER SERVICE MANAGER, 8 Fernwood Road, Florham Park, NJ 07932.

PREPAY FREIGHT CHARGE AND INSURE the package against damage or loss in transit.

ESTIMATES. We will gladly provide estimates upon request. There is a flat estimate charge of \$7.50 payable in advance. The estimate charge will be credited towards the cost of the repair.

NO LIABILITY IS ASSUMED FOR EXPENSES OR DAMAGES RESULTING FROM INTERRUPTION IN OPERATION OF EQUIPMENT, DAMAGE TO FILM OR PAPER, OR FOR INCIDENTAL, DIRECT OR CONSEQUENTIAL DAMAGES OF ANY NATURE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

In the event there is any defect in materials and workmanship of our product you may contact our Customer Service Department at Beseler Photo Marketing Company, Inc., 8 Fernwood Road, Florham Park, New Jersey 07932. This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state. You may also have implied warranty rights. In the event of a problem with warranty service or performance, you may be able to go to a Small Claims Court, a State Court, or a Federal District Court.

IMPORTANT:

THIS WARRANTY SHALL NOT BE VALID AND BESELER SHALL NOT BE BOUND BY THIS WARRANTY IF OUR PRODUCT IS NOT OPERATED IN ACCORDANCE WITH BESELER'S WRITTEN INSTRUCTIONS.

You must prove the date of purchase by producing a sales receipt indicating that you are the original purchaser.

No work will be undertaken or billed until written approval of the estimate is received.

CHARGES. Your local Beseler dealer has a list of current price ranges to service Beseler photographic equipment. Any repair likely to exceed the maximum recommended service price will be estimated and held for your approval before work is begun.

PAYMENT. Your check for \$7.50 must accompany your request for an estimate; alternatively, you may charge your VISA or MASTER CHARGE account. Repairs must be paid in full prior to return to owner. Personal checks or VISA/MASTER CHARGE accepted. (If you pay by VISA or MASTER CHARGE, please give the account number and expiration date.)

OBsolete EQUIPMENT. Beseler reserves the right to refuse to repair equipment that has been discontinued for five (5) years.

IN-WARRANTY SERVICE. There is no charge for service performed during the warranty period. **PROOF OF PURCHASE** is required for warranty service and must be enclosed with the return. Terms of the warranty are explained above.



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