Professional Printing Techniques for Ansco Color Negative-Positive Motion Picture Film

By KARL SCHADLICH

Printing from Ansco color negative onto Ansco positive is relatively simple, but it does require certain changes in technique, equipment and timing. These requirements are described. The technique of timing for color printing with color correction filters is described with particular attention to some of the reasons why anticipated results are not always attained.

The transition from black-and-white to color printing has brought about new problems. New printing techniques must be developed and new skills acquired in order to turn out quality prints. These problems are encountered with all kinds of color film. They are of general interest and a number of the more important ones as they apply to current motion-picture color products will be reviewed.

The Ansco Color Negative-Positive Process has been described in the *Journal*.[1] The process is conventional and follows the flow chart as shown in Fig. 1. Release prints are made from Type 844 original negatives or from Type 846 duplicate negatives.

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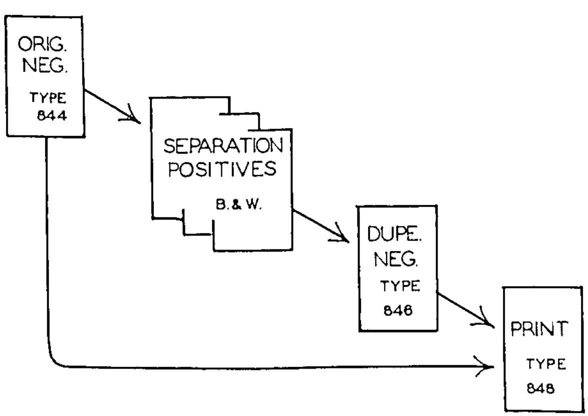

Fig. 1. Ansco Color Negative-Positive Process.

The original photography is done on Type 844 camera negative film. To provide for protection and/or special effects, a set of separation positives can be made from the original negative, and a duplicate negative in turn, is made from the separations on Type 846 duplicating negative film. Usually a printing master is composed of intercut Type 844 and Type 846 negative films.

Both negative types contain the same image dyes so that there can be no difference in effective printing density. The print stock is Ansco Color Positive Type 848. It is balanced to be used for prints from complementary color negatives such as Types 844 and 846. Figure 2 shows the sensitometric characteristics of Type 848 which, with normal processing,

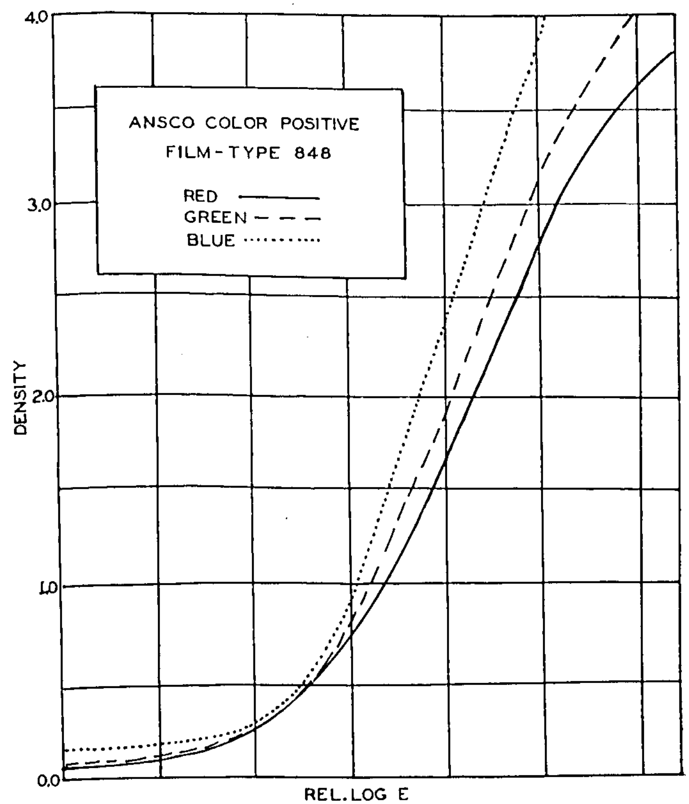

Fig. 2. Sensitometric characteristics of Ansco Color Positive Film Type 848.

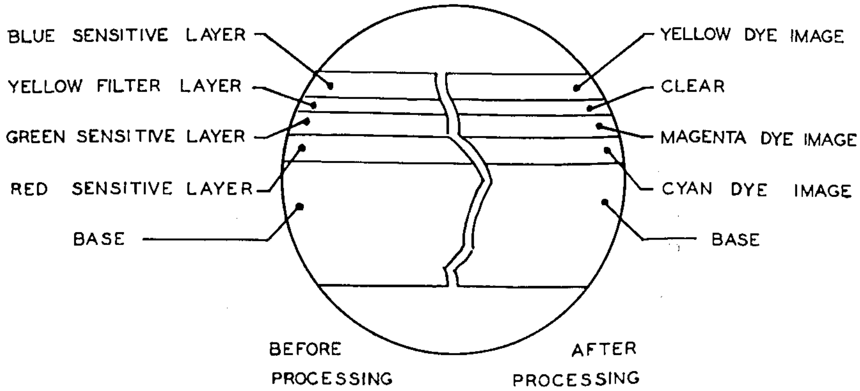

Fig. 3. Layer arrangement of Ansco Color-Type 848 Positive Film.

has red gamma 2.4, green gamma 2.5, and blue gamma 3.2.

The layer arrangement of Type 848 is shown in Fig. 3. The layer sensitivities are indicated on the left, and the resultant subtractive system dyes are indicated on the right.

Either additive or subtractive printing may be used. Additive printing consists of an exposure through each of three narrow-band red, green and blue filters. In effect, each layer of the color film is exposed individually and the intensity of each exposure is controlled so that the proper amount of each dye is formed to produced a balanced print. The three color exposures can be consecutive or simultaneous depending upon the printer.

Subtractive printing consists of a single white light exposure, but the white light is modulated with color correction filters to give the ratio of red, green and blue that will yield a balanced print.

Additive printing is preferable because more precise control is feasible. Also, some degradation is avoided because the overlapping sensitivity regions that contribute to degradation are suppressed. By contrast, the color correction filters used in subtractive printing tend to suppress the regions of maximum sensitivity, thus accentuating exposure where the sensitivities overlap.

Unfortunately, additive printing is ordinarily more expensive than subtractive printing. Modification of existing equipment is more difficult and is likely to result in a high-cost, slow-speed printer. Modified printers for subtractive printing are much more common because they are less expensive and easier to build and operate.

In addition to the usual printer requirements, a means of making scene-to-scene changes of both color filtration and light intensity is required to print Ansco-Color Negative-Positive subtractively. The printer should have about two stops more light intensity for color printing than would be used for ordinary black-and-white fine-grained positive. In order to balance the printer light, the optical system and the emulsion to each other, a basic filter pack is required. To protect these filters, we prefer a heat-reflecting glass such as the Calflex* rather than a heat absorbing glass, although either can be used successfully. A relatively large lamp operated at low voltage is preferable for stability. We use a 750-w lamp at 85 v. With an efficient optical system, there is enough light to print at 90 ft/min.

Many modifications of existing printers have been made and used successfully. We have used the Frank Herrnfeld Engineering Corp. modification of the Bell & Howell, Models D and J, printers with good success.[2] Other modifications are probably equally good, and the choice depends mainly upon personal preference.

The most difficult part of color printing is timing. Good timing is an art brought to its highest accomplishment by experience. Consistently good results will come from keen interpretation, good judgment and experience.

Sensitometry is of limited assistance in timing. The major value of sensitometry is to predict the differences when changing from one emulsion to another. This is not always an unqualified aid because it is difficult to anticipate precise pictorial results from sensitometry alone.

The best way to select the proper exposure is from scene tests made from the negative. Scene testers may be of many forms. One scene tester exposes a 16-frame platten containing a range of 16 different color correction filters.[2] The range which we have found to be most useful is shown in Table I. Large or small color increments may be used. Small increments require less interpolation, but do not cover as large a range and there is less latitude in the selection of the basic filter pack for gross correction. Conversely larger increments provide a greater range the basic filter pack is less critical, but the results require more interpolation. Usually, three or more platten exposures are made from each negative at different intensity levels to provide a density range. From these processed scene test strips, a satisfactory exposure and balance can be selected. Obviously, if the density and color increments are large enough to provide a practical range, then some interpolation is usually necessary.

Table I. Filter Range for Use on the Scene Tester.

1 – No Filter	9 – Y.15/M.15
2 – C.15	10 – Y.30/M.30
3 – C.30	11 – Y.40/M.20
4 – C.15/M.15	12 – Y.40
5 – C.30/M.30	13 – Y.25
6 – M.40	14 – Y.10
7 – M.25	15 – Y.15/C.15
8 – M.10	16 – Y.30/C.30

* Calflex filters are available from Photovolt Corp., 95 Madison Ave., New York, N.Y.

A suitable scene tester should be optically as much like the printer as possible so that the exposure will match the printer or at least provide a reasonable working correlation. This means that the lamps, exposure time, heat reflecting filters, and collimating lenses should match. The optical paths should also match or at least be similar. Mechanically, the scene tester should be designed so that the negative can be handled, wound to the scenes selected for testing and framed with the platten, without damage. A means of winding and advancing the raw stock for each exposure is also required.

Frequent cross-check tests should be made between the scene tester and the printers using representative negatives so that the correlation will be maintained. After the timer has attained some experience, he will not usually find it necessary to test each individual scene. An experienced timer can often group the scenes, select representative ones for testing, and select a suitable printing balance for each scene by judging minor differences.

In actual practice, the timer lists each scene with the total filtration and printer light selected for each scene. Table II shows a simple example. From this list, a basic filter pack can be selected which will be common to each scene. The remaining differences then become the scene-to-scene changes.

Table II. Selection of Basic Filter Pack.

Scene No.	Printer Light	Total Filtration	Scene-to-Scene Change
1	Light 10	Y.25/M.20	Y.10/M.05
2	" 12	Y.30/M.40	Y.15/M.25
3	" 9	Y.15/M.15	No filter
4	" 11	Y.30/M.25	Y.15/M.10
5	" 10	Y.35/M.15	Y.20
Basic Filter Pack		Y.15/m.15	

We are now ready to print. If all has been done correctly, a good print should result. But, a number of factors have been operating which may result in a print which is not satisfactory. If so, it is necessary to retime, and reprint until the error is corrected and a good print is obtained.

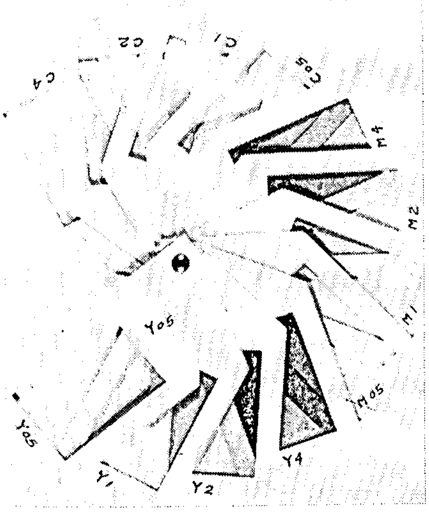

Fig. 4. Pieces of three subtractive filters mounted into card holders.

Unsatisfactory prints may be caused by poor correlation between scene tester and printer, change in processing, misjudgment in interpolation of scene tests, poor correlation between projector and viewer or poor judgment in favoring the balance of individual scenes.

It is important to match the color temperature of viewing tables and editing machines to the projector. This can be done by using daylight lamps and/or conversion filters. The blue plastic sheeting of the type used in flashlamp shields is inexpensive and effective for conversion. The Corning Glass No. 590 is also very satisfactory, but is more expensive.

We have found that the simple device shown in Fig. 4 is quite helpful in timing. It consists of pieces of the three subtractive filters mounted into card holders so that that they can be conveniently used. The scene tests or prints from which the timing is being done, can be viewed through various filter combinations in order to get some idea of the degree of color correction desired. This is limited because a color density filter contributes equal density throughout the scale. Actually, this does not occur in a print because then the shift is along the Log E axis, but by viewing, the shift is along the density axis. This means, that in printing for any given density change at the midrange, there is less change in the toe and no change at fog level. It takes a little experience to allow for this limitation.

After the desired amount of correction has been decided upon, the filter that will produce this result can be selected. The effective gamma of the print film is related to this selection (Fig. 5). If the print gamma is 2.0, the density change in the print will be twice the change in exposure. For example, if 0.10 more yellow density is required in the reprint, then 0.05 less yellow filtration should be used. Ansco color positive has a mean gamma of well over 2.0, but we find that for this purpose, it should be considered as 2.00. This is due to the differences between ordinary density measurements and effective printing density.

Occasionally, it will be helpful to compare an unknown negative with a negative whose printing conditions are known in order to find the proper exposure. The viewing filters can be used to advantage in this case. Sometimes large enough areas of flesh tone, or grey color are available to make density measurements.

These measurements or the viewing filters, will give some indication of the difference in filtration and exposure. Because density differences in the negatives are effective along the Log E axis, the gamma factor of the print is not concerned in this use of the viewing filters, and the actual value is used.

It is important to remember that we are concerned with three kinds of density in printing.[3] These are densities measured by the usual color densitometer, effective printing density and visual density. The densitometer will give the highest values. For Ansco color negative-positive, the effective printing densities relative to the MacBeth Color Densitometer[4] readings are red, 85%; green, 82%; and blue 77%. These values are approximate and will vary somewhat depending primarily upon the correction filters used. The visual densities by projection will also vary depending upon projection or viewing conditions, but will be somewhat lower than effective printing densities. Because of this, an estimated allowance should be made when using densitometer measurements for calculating printing differences.

A change in filtration will affect not only the color, but also the density of the print. Estimating this density change is the particular problem that many people find most difficult. The exposure allowance relative to the filter's color density, should be about 50% for cyan filters, 40% for magneta filters, and 25% for yellow filters. For example, a C-10 cyan filter will affect the overall density of a print about 0.05 or about 1 B & H printer step. This is a rule which attempts to account for both the neutral density value of the filter, and the apparent density change due to a change of one layer. Actually, the problem is too complex to formulate any simple rule. However, this guide is accurate enough to give good results when used judiciously.

The number of filter combinations needed in practice runs into hundreds. It is impractical to provide such a variety in single foils, so combinations are used. The make-up of combinations can result in filters of equivalent correction, but differing in the number of foils. Obviously

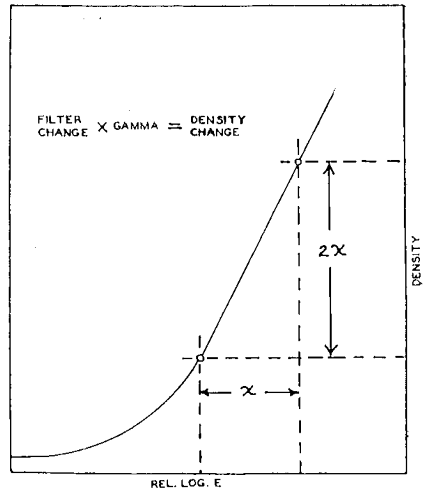

Fig. 5. Effect of gamma upon filter changes.

they will not have equal neutral density value. The least number of foils possible should be used. Ansco supplies a sufficient variety of foils so that the more common correction combinations are available as single foils, and it is very rare that more than two foils are required.

Consideration of these problems might lead one to believe that the commercial practicability of color printing is questionable. Certainly, the timing problem is difficult, and it would be unrealistic to minimize it.

Fortunately, one important factor works to the timer's advantage. Under projection conditions, the eye will accept a rather wide range of balances. This range is somewhat greater than the range that will be accepted when viewing reflection prints under ordinary viewing conditions in illuminated surroundings. The eye is a remarkably good comparison photometric instrument, but very poor at absolute measurements. The eye will overlook small errors in timing, but will not tolerate abrupt changes in balance from scene to scene, especially when the subject material provides a comparison reference.

The major problems may be overcome by skill, training and judgment. After some experience is gained, problems which seem difficult at first, become just a simple part of the day's routine.

References

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4. Monroe H. Sweet, "An improved photomultiplier tube color densitometer," *Jour. SMPTE, 54:* 35–62, Jan. 1950.