



Article: Experiments in Restorative Copying of Reflection Colour Prints

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Experiments in Restorative Copying of Reflection Colour Prints

by Lincoln Ross

Introduction

As more and more colour photographs become part of both private and public collections, the need to provide facsimiles for publishing and viewing becomes apparent. Also, with the increased use of cold storage to preserve faded originals, the need for accurate facsimiles will continue to grow.

There are currently two methods employed for the accurate duplication of colour reflection materials. They are the tri-colour separation method and the digital recording of images. Unfortunately, the latter requires quite a large capital outlay, and the former is time consuming and labour intensive. Another method which this author has investigated is called pre-exposure for contrast reduction. A modified version of this technique is used in the restoration of motion picture films. Testing several films, two prove to be very good at reproducing the original image. Another method, employing Kodak Internegative film, type 4112 was also used with good results.

Before even venturing on a restorative copying technique for colour photographs a method of accurately copying the original had to be found, as this would be the basis for any type of subsequent restoration treatment.

Objectives

There are several objectives that have to be met in producing a copy print from an original reflection print. First, the contrast must be maintained. Second, the colours must match those of the original, and third, the material the copy is printed on should be more stable than the original as it must withstand greater abuse. This third criteria is the most easily satisfied by two materials currently available, Ilford Cibachrome and Kodak Ektaflex. Though neither of them are for long term storage, they do display the best light and dark storage

stability of all colour print materials. For this project Cibachrome and both Ektaflex positive and negative materials were used.

One problem with copying originals is the contrast and the characteristic curve of the film used in the copying process. If the inherent contrast is too great and if the characteristic curve has too short a straight line then the contrast in the copy print will increase and have some distortion. With most pictorial reversal films this curve is very steep with considerable toe and shoulder area. Kodak has three films available for duplicating transparencies or reflection materials. They are, Kodak Ektachrome duplicating film 6121, and Kodak Vericolor Internegative Film types 4112 and 4114. Fuji also makes a duplicating film.

The second problem is the proper recording of the colours existing in the original print. The aforementioned films have such qualities. Their characteristic curves have long straight-line portions with all three dyes responding equally with proper filtration. As seen in this curve of the Ektachrome duplicating film, there is a long straight-line portion with a slight curve in the higher density region.

Original Materials

Unlike black-and-white material, which can have a density range exceeding 2.00, most colour photographs have a density range less than 1.6. This is due in part to the fact that most reflection prints are and have been produced using the negative-positive process, which traditionally produces average contrast prints. Other factors that affect the contrast and colour are the type of print surface (glossy vs. matt finish), and the extent of dye fading.

Equipment and Materials

For this project 4"x5" film was used. Two reasons for this are the reduction ratio is small and a twenty-one step density tablet could not be read from a 35mm format. The camera was a Sinar P fitted with a Schnieder Symmar S 150mm lens. Two polarized Broncolor flash units were used, with a polarizing filter in front of the camera lens. The variance of the light intensity across the original print was no more than 1/10 of a stop. Kodak color compensating filters were added or removed from

a holder set in front of the camera lens.

Processing was done in a small one-shot chemistry developing unit called "the Enterprise". Process control strips were monitored and showed to be consistent through the d-min, low density, and high density areas. The d-max areas fluctuated from batch to batch but it would have little effect on the flashed transparencies as their maximum density was no greater than 2.4 density units. For the internegative film, process control is not such a problem as the C-41 process is much more consistent. Again, this processing was done in the "Enterprise". Processing of the Ektaflex prints requires one activator solution so results were consistent from batch to batch. Cibachrome A-11 material was drum processed using the P-30 chemicals.

Experimental Method

As in black and white copying, the straight-line portion of the characteristic curve, derived from the grey scale of the copy print, must have a slope of 1 (45 degree angle). To find out the contrast required in the negative or interpositive, the contrast of the printing material has to be determined. A 21-step density strip was placed in contact with the print material and exposed under an enlarger. The filtration was adjusted so as to produce a neutral density scale on the print. Density readings were taken using red, green and blue status A filters. The response of both Ektaflex and Cibachrome is outlined below.

For the Ektaflex material the slope is very steep ($\gamma = 1.55$) with a straight-line portion approximately equal to 1.40. The Cibachrome material has a lower slope ($\gamma = 1.05$) with a straight-line portion equal to 1.55. Therefore the γ of the films must be 0.65 and 0.95 respectively.

For the Ektaflex negative material the internegative should have a γ of 0.35 as the γ of the Ektaflex print material is 2.83. This material has a straight-line portion roughly equal to 1.55. To begin with the duplicating films γ was slightly greater than 1.

To reduce contrast a pre-flash, or pre-exposure, was given to the film. This initial exposure to a white card reduces the sensitivity of the film. The film is then exposed to the original reflection print. Unfortunately, the straight line becomes distorted as the pre-flash exposure is increased, therefore an adjustment in the second exposure is required.

Until this point only the exposure and contrast of the materials

has been considered. The colour is corrected for after the proper exposure has been determined. Filtration in the pre-flash and the second exposure was adjusted to produce a sensitometrically neutral characteristic curve, where all three dyes respond equally.

A very low slope and good colour balance was achieved using the Fuji and Kodak duplicating films for printing on Ektaflex reversal paper.

Printing of Film Materials

Prints were balanced to match the grey scale beside the colour print. The resulting scene showed a definite shift in colour. Correcting for this through filtration in the enlarger increases contrast in some colours and decreases the contrast of others.

Internegative Film

The Kodak Vericolor Internegative film, 4112, exposed to produce a gamma of 0.35 produced Ektaflex prints which had a gamma of 1. Visually, these prints lacked contrast. This phenomena occurs in black&white copying as well, and is corrected by increasing the contrast of the negative. By adjusting the exposure, an internegative with a gamma of 0.42 produced a closer facsimile of the original.

Restoration

In restoring original prints, transparencies are used as they do not have the orange coloured mask that is incorporated into all negative materials. The following procedure is similar to Kodak's density difference technique for restoring faded ektachrome transparencies. The difference in this procedure being that we are starting with a reflection print. For those of you not familiar with Kodak's method, the original transparency is sandwiched together with a second transparency that has been exposed to compensate for the dye loss in the original. The theory behind it being that the dye loss of the original transparency can be compensated for by a second transparency.

Both films are registered and placed in contact with a third piece of film, which is given two exposures. The first exposure is through both sheets of film. The second is through only one, with the colour filtration being changed for each exposure. The Kodak method relies on the measuring of a maximum density area to correct for dye losses. Kodak recommends this technique for transparencies that have less than 30% dye loss in each layer. From reflection prints both transparencies may be produced and processed at the same time. The first is exposed to match the original, while the second is exposed through filters calculated to correct for the dye loss of the print.

One item copied was a portrait of two young girls, printed on a reversal material manufactured by Kodak. Since I know the ages of both young ladies, this paper dates from 1966. In this example the skin tones are important, therefore the second transparency is exposed to compensate for the dye loss in that area. The reference used was a MacBeth Colour Checker. This plaque has a series of colour patches ranging from a grey scale to flesh tones to mid-day blue sky. Tri-colour readings are taken from the skin tone area of the plaque and were used as a guide. From this example there is no way to determine what the original image looked like. With the dye loss coupled with yellow stain the restoration to what is visually pleasing is the only possibility.

Results

The pre-flash method produced transparencies with good contrast and colour balance in both Kodak and Fuji duplicating films. Using the pre-exposure technique the contrast of the duplicating films could be adjusted to produce a very low gamma while still retaining a long straight-line portion. The gamma of the Internegative film should be 0.35 for printing on Ektaflex negative material. This author found a more accurate facsimile was produced with an internegative with a gamma of 0.42. The most accurate method of producing a copy print is by using the internegative film, as compared to other negative films, it has a longer straight-line portion, allowing greater latitude in exposure.

Conclusions

Restoration to the transparency stage is possible. Accurate reproductions of the original can be made, and with modifications to the Kodak density difference method a restored transparency can be produced.

The best copy prints were produced using Kodak Internegative film 4114 printed onto Ektaflex print material. Even if the print materials were capable of reproducing the colours of the transparency, the straight-line portion of Cibachrome and Ektaflex materials is 1.55 and 1.40 density units respectively. Original prints with density ranges equal to or less than that could be reproduced accurately.

Lincoln Ross is currently working in Picture Conservation,
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