TECHNIQUES

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Using KODAK Matrix Film / 4150 to Make Dye Transfer Prints from Color Negatives

Written for Kodak by Ctein

This process was originally worked out and the steps written by Tom Rankin of Frog Prince, a dye transfer laboratory in San Francisco, while he was making a series of dye transfer prints for the Smithsonian Institution in 1989.

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INTRODUCTION

The dye transfer process is a method for producing color prints of the finest quality. It offers unparalleled control over color balance, saturation, and tone rendition. It also provides excellent image stability.

You can make dye transfer prints from either color transparencies, in-camera separations, or color negatives. If you are starting with a transparency, first make three black-and-white color-separation negatives from it, then print these separations onto KODAK Matrix Film / 4150, a blue-sensitive film.

You can also use Matrix Film / 4150 to make prints from negatives. The method involves first making black-and-white separation positives from the original color negative, making second-generation black-and-white separation negatives from those positives, and printing them onto Matrix Film.

In both cases, you develop the three exposed matrices in KODAK Tanning Developer.

Finally, you dye the matrices in cyan, magenta, and yellow dyes, then transfer the matrix images in register onto a gelatin-coated receiving paper.

The techniques covered in this publication describe how to make prints from negatives using Matrix Film / 4150; this is not a tutorial in the entire dye transfer process. If you are unfamiliar with dye transfer printing, see the publications listed in the bibliography for complete instructions in the process.

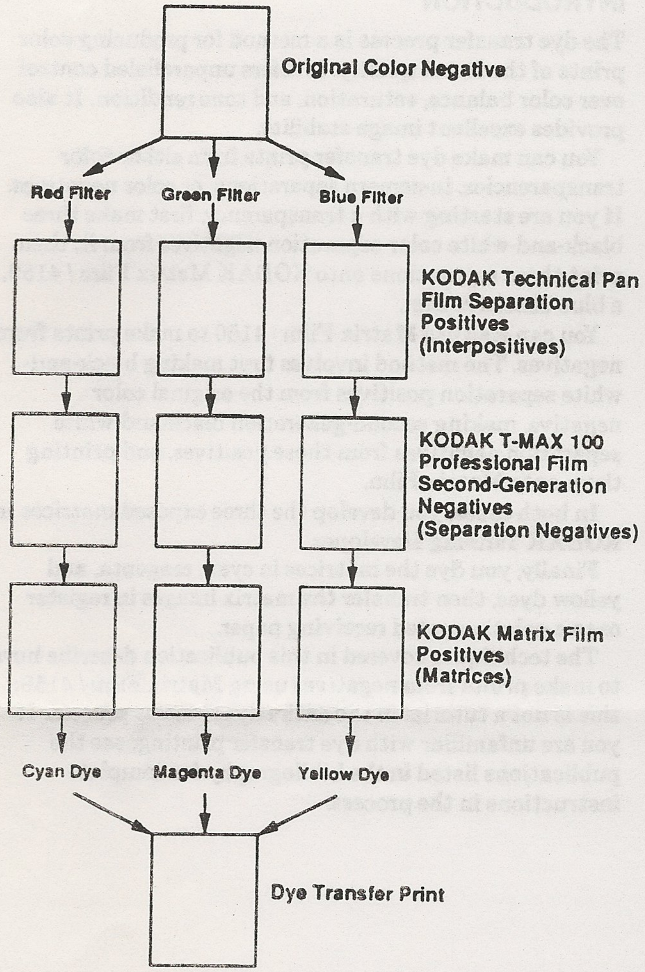
Kodak

THE *KODAK* MATRIX FILM / 4150 METHOD

There are four steps to making dye transfer prints from color negatives via Matrix Film:

1. Using KODAK Technical Pan Film, make three black-and-white separation interpositives from the original color negative.
2. Using KODAK T-MAX 100 Professional Film, make a black-and-white separation negative from each of the three interpositives.
3. Produce a finished matrix on Matrix Film / 4150 from each of the three separation negatives.
4. Register and punch the processed, dry matrices for printing.

Steps 3 and 4 are much the same as those used in making prints from transparencies, but they may not be familiar to dye transfer workers who have been printing color negatives with KODAK Pan Matrix Film / 4149. The first 2 steps may involve new techniques and materials from those previously used for making prints from negatives.



Although the approach for using Matrix Film is more involved than with Pan Matrix Film, there are several advantages to printing color negatives this way. Matrix Film is available in sheets up to 20½ x 25¼ inches and in 42-inch x 100-foot rolls. It requires less precise handling and is less subject to fogging and abrasion marks. It also can be handled under a red safelight. The basic techniques for making black-and-white separation negatives are already familiar to workers producing prints from transparencies.

The intermediate generations of positive and negative images used in this method afford a high degree of control over the contrast and relative curve shapes for the three primary color images. By modifying the exposure and development of the intermediates, you can achieve substantial increases in image contrast and correct for color crossover due to improper processing or storage of the negative. Although the these corrections could have been made with Pan Matrix Film, the new method described in this publication offers considerably more flexibility.

Materials and Equipment

Printing color negatives via Matrix Film requires the following materials and equipment in addition to those normally used for printing negatives on Pan Matrix Film:

Anti-Newton-Ring Spray
Film Cleaner Spray
KODAK DEKTOL Developer
(optional: to make highlight masks)
KODAK HC-110 Developer
KODAK Matrix Film / 4150
KODAK Photographic Step Tablet No. 1A, 2, or 3
(uncalibrated)
KODAK Rapid Fixer
KODAK Register Punch
KODAK 1 Safelight Filter / Red (for use with Matrix Film)
KODAK Technical Pan Film 2415, 4 x 5-inch sheets or larger
KODAK T-MAX 100 Professional Film, 4 x 5-inch sheets or larger
KODAK T-MAX RS Developer and Replenisher
KODAK WRATTEN Gelatin Filter No. 29 (deep red tricolor)
KODAK WRATTEN Gelatin Filter No. 99 (green) or
No. 61 (deep green tricolor) plus No. 16 (yellow-orange)
KODAK WRATTEN Gelatin Filter No. 98 (blue) or
No. 47B (deep blue tricolor) plus No. 2B
KODAK WRATTEN Neutral Density Filter No. 96

In addition, you will need an enlarger and enlarging lens capable of projecting 4 x 5-inch or larger separation negatives. The enlarger does not need to have a color head, although, as explained later, it is useful.

Although you can balance the printmaking process by eye, it requires considerable skill. Because your final print will be three generations removed from the original negative, you will find it difficult to pin down which generation may have a color or contrast imbalance or a process problem without a densitometer. For best results, use a black-and-white transmission densitometer.

Use the following information as a guide and/or starting point. Your own initial and subsequent testing will determine your processing procedures and final aims.

Characteristics of Good Separations

Each intermediate film has a characteristic (exposure-vs-density) curve. This curve is not a straight line but a drawn-out "S," with a "toe" and a "shoulder." Exposure values that fall on the toe or the shoulder of the film curve, i.e., those corresponding to highlight and shadow detail, are compressed and have lower contrast. If the compression is too great, the highlights will look flat and lifeless, and the shadow detail will be murky and difficult to see in the finished print.

There are two intermediate generations between the color negative and the matrices, so the tone distortions produced by each film are compounded. Tones placed on the low-contrast toe of the first generation interpositives will fall on the low-contrast shoulder in the second-generation separation negatives, which further lowers their contrast. Although Matrix Film has a more linear characteristic curve than Pan Matrix Film, you must take care to prevent excessive compression of the highlights and shadows. Select film/developer combinations that produce the straightest possible curves for each intermediate generation.

Matrix Film has about 10% lower contrast than Pan Matrix Film. To produce prints of comparable contrast, the second-generation separation negatives must be slightly more contrasty than the original color negative. The separation negatives must also have a density range sufficient to produce a full tone scale in the final print. The exposure range that produces both a maximum white and black in prints from normally processed Matrix Film is about 70:1, or between 1.8 and 1.9 density units (DU).

T-MAX 100 Professional Film developed in KODAK T-MAX RS Developer and Replenisher will produce a straight characteristic curve with the desired density range for the second-generation separation negatives. The separation negatives should be slightly overexposed, so that density which corresponds to just-black in the final print will be 0.3 DU. This lifts the shadow values off the flat toe of the film's characteristic curve, holding shadow contrast. The density that will print as just-white should be approximately 1.8 DU higher than the just-black density of the separation negative. The development time producing these characteristics creates an average mid-range gamma of 0.8–0.9 (see *Processing and Evaluating Separation Negatives*).

These are key aim points for the process. The separation negatives must have a maximum image density of at least 2.1 DU (0.3 plus 1.8). To avoid placing this highlight detail on the extreme shoulder of the film curve, the development should actually be able to produce a maximum density (D-max) between 2.3 and 2.5 DU on T-MAX 100 Professional Film.

That puts restrictions on the contrast and development of the Technical Pan Film interpositives. Use Technical Pan Film developed to an average mid-range gamma of 1.5 in KODAK HC-110 Developer, Dilution B. A good Technical Pan Film interpositive is also slightly overexposed, so that the values which correspond to just-white in the final print have a density of at least 0.3 DU in the separation. This preserves highlight separation but does not push the shadow densities very far onto the shoulder of the film curve. Shadows that reproduce as black should have a density approximately 2.0 DU greater than the clean highlight (white) areas.

If you encounter problems producing good prints from normal color negatives, work backwards from the matrices, not forward from the negative. Determine that the separation negatives have suitable exposure and contrast characteristics, then check the interpositives.

You may find that the precise density, contrast and processing requirements for good prints will vary slightly from these recommendations. This may be due to differences in your printing technique as well as variations in equipment and your local water supply.

Because of this, make your first print from a well-known control negative and match these results against your own standards. Include a KODAK Step Tablet (negative) with your control negative. This will reveal any deficiencies in your process, and you can readily compare the results to those you get from the standard process.

The density range of the step tablet is also much greater than that which you can reproduce in a normal print. This means that films exposed for the mid range of the step tablet will have printable minimum and maximum densities and also have true D-max and D-min densities produced by the extreme over- and underexposure at the ends of the step tablet. The data from these end steps will show if your development produces a density range that meets the basic requirements described.

Once you have obtained a test print that meets your objectives, take density readings from (1) the steps in the tablet, (2) the intermediate positives, and (3) the separation negatives. Then plot exposure and gamma curves from this data. After you have found the best aim points for your operation, you will rarely need to make such extensive density measurements and plots. You can usually tell if the films will produce good final prints by measuring only the just-black and just-white densities in your interpositives and separation negatives.

If you want to try alternative films or developers, you should evaluate them in comparison to the prints and characteristic curves you obtained by following the recommendations in this publication. Do not assume that your normally-favored technique will produce equally satisfactory results; run tests to confirm it. In particular, you should plot characteristic curves and their gammas at each exposure level to insure that a substitute combination does not produce more contrast loss in the highlights or shadows than the recommended combinations.

Masking

The two-generation separation method required in making prints from negatives via Matrix Film makes distortion of the tone scale a more serious problem than it is when separating transparencies. However, the procedures described here produce good tonal separation in the highlights and shadows, so you probably won't need to mask to correct the tone scale if you follow these steps. Substitute procedures may require you to make a highlight mask to enhance highlight contrast in the final print. Highlight masking (described later) adds time, cost, and complexity to the printmaking process, and may increase problems due to dust and misregistration.

If the original negative's density range exceeds the range of Technical Pan Film, too much of the subject's tonal scale will be forced onto the toe and shoulder areas of the interpositives, resulting in prints having poor shadow and highlight separation. You cannot correct this by shortening the development time for Technical Pan Film; rather, reducing the development will aggravate the situation.

Accordingly, you will need to make a contrast-reducing mask (see *Masking for Reduced Contrast*), when the original negative is more contrasty than normal or represents an unusually long subject-brightness range. When in doubt, mask; if you slightly over-mask the negative, you can easily restore the print's contrast by increasing the Technical Pan Film development time without sacrificing tonal quality.

Experienced transparency printers should note that color-correction masking is usually unnecessary when separating color negatives. The negatives have built-in correction masks, and the prints will nearly always exhibit excellent color with no additional masking.

Registration

Labs that are already set up to print transparencies should have an array of registration equipment including sheet-and roll-film register punches, carriers, and exposure easels. However, labs that have been working from color negatives may not have this equipment.

To maintain the most compatibility with existing facilities, this method doesn't require you to have anything more than a rigid enlarging setup and a matrix-film register punch, preferably set on a light table. As long as you don't alter the size of the image between the different color-separation exposures, you can produce excellent registration in the final print.

MAKING THE INTERPOSITIVES

Sharpness

The quality of the separation positives is very important. If your interpositives are the least bit unsharp, the results will be unacceptable after two more generations of reproduction. To achieve the sharpest final prints, your interpositives should be on 4 x 5-inch or larger sheet film. Contact (1:1) separations from size 135 or 120 roll-film originals will not provide sufficient sharpness. Technical Pan Film, because of its fine grain and high resolving power, is the recommended film for making the interpositives.

Setting Up the Negative

Place a KODAK Photographic Step Tablet in the enlarger film carrier next to your negative. If you are working from 35 mm format, use a Tablet No. 1A; for larger formats, use Tablets No. 2 or No. 3. The larger tablets produce more precise results, because they have 0.15 DU steps instead of the 0.3 DU steps found in the Tablet No. 1A.

You do not need to use the full tablet; cut a strip from the tablet the same width as the distance between steps (about 4 mm). Sandwich the tablet strip with a piece of unexposed but processed color negative film; this will roughly match the exposures for the tablet to those of a real negative. If you are using an oversized glass carrier, simply place the tablet/negative sandwich next to the negative that you will be printing. A glass carrier is desirable because it will prevent negative popping during or between exposures. If you are using a glassless carrier, you will probably have to cut out part of one side of the carrier to accommodate the step tablet.

Otherwise, you install and print your negative much as though you were making a regular print. Place the negative into the carrier emulsion down and the interpositive film onto the easel emulsion up. This produces a mirror-reversed interpositive. Later, when you print it onto T-MAX 100 Professional Film, the image will be reversed again, and the final separation negatives will have the correct orientation.

Use an enlarging lens of the highest quality, at or near its optimum aperture. For enlarging lenses used with size-135 negatives, the aperture will usually be *f*/5.6; for lenses projecting 120-format negatives, *f*/8. Apertures within a half stop of this will also produce satisfactory results. Use a grain focuser to adjust the focus of the projected image.

Determining Exposure

You will be making your separation exposures through sharp-cutting red, green, and blue filters that have different exposure factors. For the red exposure, use a No. 29 filter. For the green exposure, use either a No. 61 plus a No. 16 or a No. 99 filter. For the blue exposure, use a No. 47B plus a 2B or a No. 98 filter.

Technical Pan Film has good reciprocity characteristics between 1 and 60 seconds; however, there is some change in both film speed and contrast with exposure times longer that a few seconds. Keep the separation exposure times within a factor of 2 of each other; this will prevent a significant contrast or density mismatch between interpositives. For example, if you are printing a bare step tablet with a quartz-halogen light source, the relative exposures for the No. 29 red, No. 99 green, and No. 47B blue filter exposures will be approximately in the ratio 1:7:21, primarily because an incandescent lamp is very weak in the blue part of the spectrum. You cannot use exposure times in this ratio, because of the mismatch due to resulting reciprocity failure. Even if you make the red exposure at an *f*-stop that's ½ stop smaller than optimum and the other two exposures ½ stop wider than optimum, the ratio of times will be 1:3.5:10.5.

The solution is to combine a 1.0 ND (neutral density) filter with the No. 29 filter, which increases the red exposure by a factor of ten (3⅓ stops). That produces relative exposure times of 1:0.7:2. In addition, you can close down the enlarger lens by ½ stop from best aperture for the green exposure and open it up by ½ stop for the blue. That would produce exposure time ratios of 1:1:1.4—well within the desirable factor-of-2 range.

If you're working with color-head enlargers, you can dial in filtration to equalize the exposures without using ND filters or changing *f*-stops. You can use the following calculations: 100 units of CC filtration corresponds to a 1.0 ND filter for the complementary color.

If you are printing a color negative, the exposure ratio will vary with the type of film and the color balance of the scene, so no general recommendation is possible. Use the following exposure-time ratios as a starting point for KODAK VERICOLOR III Professional Film shot under daylight and printed with a quartz-halogen light source: red—1, green—35, and blue—100. Combine a 2.0 ND filter with the No. 29 red filter, close the lens down by ½ stop from optimum for the green exposure, and open it by ½ stop for the red and blue exposures. This will produce a time ratio of 1:0.7:1. If you use a dichroic enlarger head, dial CC45M + CC200C, then use equal exposure times and apertures for all three interpositives.

Your actual exposure times will vary with the image format, enlarger, and particular negative. As a starting point, assume the times will be 4 stops greater that they would be to expose a 4 x 5-inch print on KODAK EKTACOLOR Paper.

You do not need a vacuum registration exposure easel to expose the interpositives. Technical Pan Film in 4 x 5-inch size will lie flat in a regular paper easel, and you do not need to expose the interpositives in register. If you wish to produce white borders on your final print, use an adjustable print easel and crop the image as desired, just as when working with conventional printing materials.

Using a Color Densitometer or Analyzer

Once you have made a good set of interpositives from a negative, you can use the exposure and filtration information to calibrate a color analyzer. You can then use the analyzer to estimate filter packs and exposure times for making interpositives from other negatives.

To calibrate the analyzer, make readings from the enlarged negative, using your normal procedures, much as if you were printing on color paper. The only difference is that you make the readings through the appropriate separation filter. Make the red channel calibration and future readings with the No. 29 filter under the enlarger lens. Similarly, read the green channel through the No. 99 filter and the blue channel through the No. 98 filter.

Processing the Interpositives

Process Technical Pan Film interpositives in KODAK HC-110 Developer, Dilution B (1:31 dilution). This developer produces good tonal separation in the shoulder, minimizing contrast loss in the shadows of the picture. Do not substitute other developers or alter the processing method or temperature without confirming that the changes produce better shadow contrast. Use fresh developer for each set of interpositives.

Each of the interpositives should develop to the same gamma when given the same developing time. If the resulting gammas are not the same, adjust the developing time(s) where needed to obtain matched curves among the three interpositives. Develop the three interpositives individually. To achieve a gamma of approximately 1.5, develop the interpositives for 1¾ minutes with constant agitation at 68°F (20°C) in a tray.

Rinse the films in a 2% acetic acid stop bath for 15 seconds and fix them in KODAK Rapid Fixer for 2 minutes. Wash the interpositives for 10 minutes in 68°F running water; you can cut the wash in half by using KODAK Hypo Clearing Agent, as described in the instructions packaged with Technical Pan Film.

Rinse the washed interpositives in a working solution of KODAK PHOTOFLO Solution, mixed with distilled water, and hang to dry in a dust-free place.

Evaluating the Interpositives

After the interpositives have dried, inspect them carefully on a light table. They should be free from obvious flaws and dust spots. Under inspection through a magnifier, they should show as much fine detail as the original negative. Except when you are working from ultra-fine grained negatives, such as those made with KODAK EKTAR 25 Professional Film, you should be able to clearly see the grain of the original negative reproduced in the separations. The corners also should look just as sharp as the center.

If the interpositives pass visual inspection, measure their densities and contrasts and compare them to the aim points. You can best determine the contrast from the step tablet, even if your original subject included a gray scale. Photographed gray scales often contain subtle color biases, due to contamination by reflected light from other objects or light sources in the scene. This can distort the density readings and lead you to believe there is a contrast mismatch in the interpositives when none exists.

The exception to this is when you want to specifically balance an image to the photographed gray scale or correct known distortions in the negative, such as those resulting from long-term deterioration or faulty processing. In these cases, you will obtain the best corrections by balancing your separations to the photographed gray scale. Of course, you may find that you need to significantly alter both exposure and individual interpositive development times to balance the density and contrast of such negatives.

In either case, measure and plot exposure-vs-density curves from the step tablet or the in-image gray scale. Until you are completely familiar with the process and are certain you are getting reliable and reproducible results, you should make complete density and gamma plots from each generation of separations. Once you have the process under control, you can reduce this to measuring just a selected highlight and shadow point on the tablet, to verify that your process is on target.

Look for an average mid-range gamma of about 1.5 in the step tablet. Technical Pan Film has a pronounced toe and shoulder, so the gamma will vary between steps; pick a density range from about 0.6 DU to 1.6 DU over which to measure the average gamma.

Once you have established that the contrast of the three interpositives is correct via the step tablet, check some densities in the image proper. The spectral transmission characteristics of a step tablet are slightly different from that of a dye image. Because each type of color film also has different transmission characteristics, it's impossible to provide a set of exposure-correction factors which will produce an accurate correlation between tablet and color negative densities.

Furthermore, you will rarely need an "ideally exposed" set of separations, as they would be right only for a perfectly color-balanced color negative. One of the most important advantages of using color negatives is that you can correct for less-than-ideal lighting conditions and color temperatures when you print them.

The image highlights that you want to print as white should have a density of approximately 0.3 DU. The shadow tones that you want to print as black should measure approximately 2.0 DU darker than the highlights. If they do not, change the print or negative contrast as discussed later.

You will find it difficult to determine correct color balance without some reference point in the negative. If your subject contains a neutral gray object of intermediate density (not white or black), you can take density readings off that point in the interpositives. If they fail to match within 0.1–0.2 DU, make a new set of interpositives with appropriate exposure adjustments.

If there is no such reference point in the scene, there is no direct way to determine if the color balance of your interpositives is correct. You can use the just-black and just-white density measurements to identify gross errors, but these tones often have color casts which aren't readily apparent to the eye but which may produce misleading interpositive density readings. In short, there is no simple way to "proof" a print via this method; you must complete the full process to make a test print or test strip.

MAKING THE SEPARATION NEGATIVES

Exposing the Negatives

Expose the T-MAX 100 Professional Film separation negatives by either projecting the interpositives at a 1:1 magnification ratio, or by contact-printing them. Projection produces the cleanest separation negatives; there are fewer surfaces to collect dust and fewer opportunities for Newton rings to occur. Also, scratches do not project as obviously. Unfortunately, few enlarging lenses are well-corrected for 1:1 magnifications.

Nearly all enlarger optical systems have a small amount of flare. This can degrade the tonal separation in the highlights of the print by introducing a small amount of light fog into the thinnest areas of the separation negatives. If you make projected separation negatives, run comparison tests against contact-printed separation negatives to confirm that there was no tonal degradation produced during projection.

Contact exposures produce good sharpness and excellent tonal fidelity, but cleanliness is important. In particular, the glass of the contact frame must be clean and free of even minute scratches.

Newton rings cause the most serious problems. Newton rings are colored interference fringes that appear when very smooth, transparent surfaces are very close to each other, but aren't in perfect contact. When you expose interpositives and separation negatives emulsion-to-emulsion, you won't get Newton rings because the emulsion surfaces are too rough. The source of Newton rings will be the contact between the base side of the interpositives and the underside of the contact-frame glass. An excellent preventative is to spray the underside of the glass with Beseler Tetenal Anti-Newton Spray. This coats the glass with a transparent, but slightly rough surface, which eliminates Newton rings. If there is a need to remove the coating at a later time, use Beseler Tetenal Film Cleaner Spray.

Determining Exposure. If you make projected separation negatives, you must work at the optimum aperture of your enlarging lens. Since you are working at a fixed magnification, your exposure time will be determined solely by the brightness of the light source, which usually produces unacceptably short exposure times of a fraction of a second. Put a No. 1.0 or 2.0 ND filter in the light path to reduce the light level to a usable level.

This will not be a problem with contact separation negatives, where you can both stop down the lens and raise it from the contact frame. An exposure time of 5 to 20 seconds is ideal. You may want to adjust the exposure times for the different separation negatives to compensate for known errors in the interpositives. For instance, suppose a known middle-gray patch has a density of 1.2 in one interpositive and 1.3 in another. The second interpositive is 0.1 DU denser, which corresponds to an exposure increase of 26% for the corresponding separation negative (antilog [0.1]=1.26).

Processing and Evaluating Separation Negatives

Develop the T-MAX 100 Professional Film separation negatives in T-MAX RS Developer and Replenisher. This fast-acting, two-part liquid developer produces extremely good shoulder separation, with virtually no contrast roll-off in the highlights. Do not substitute other developers or alter the processing temperature without confirming that the changes produce equal or better highlight separation. Although T-MAX RS Developer is replenishable, use fresh developer for each set of separation negatives. Mixed and unused T-MAX RS Developer working solution has a shelf life of six months.

T-MAX 100 Professional Film requires very active development to achieve the D-max of 2.4 needed to produce a print with a full tonal scale. Develop the film for approximately 9 minutes at 75 °F (24 °C) with continuous agitation. You may use tray development; an 8 x 10-inch color print drum also produces excellent results and holds temperature well.

Rinse the films in a 2% acetic acid stop bath for 30 seconds and fix them in KODAK Rapid Fixer for 5 minutes.*

Wash the separation negatives for 20 minutes in 75°F (24°C) running water: You can cut the wash in half by using Hypo Clearing Agent, as described in the instructions packaged with the film.

Treat the separation negatives in a working solution of PHOTO-FLO Solution which has been mixed using distilled water. Then hang them to dry in a dust-free place.

The processed separation negatives should have an average mid-range gamma of 0.8–0.9 when plotted against the densities of the Technical Pan Film interpositives. Since the interpositives have a mid-range gamma of 1.5, the overall contrast of the separation negatives will be slightly higher than that of the original color negative. They also should be slightly overexposed, so that the separation-negative density corresponding to just black in the final print is 0.3 DU. The separation-negative density that you want to print as white should be approximately 1.8 DU higher than the just-black density. To produce adequate highlight separation, the development should produce a D-max between 2.3 and 2.5 DU on T-MAX 100 Professional Film. Look for this D-max in borders of the film which were masked during exposure of the interpositives.

MAKING MATRICES

If your finished separation negatives meet the process aim points, they will produce satisfactory prints of normal contrast from normally developed matrices, printed using normal-contrast dyes. You can correct slight errors in the contrast or density range of the separation negatives during the matrix-making steps, so long as you have them in balance (same contrast and similar densities).

Exposing and Processing Matrices

You can safely handle and process Matrix Film under a red (No. 1) safelight. Your exposure times will vary depending upon the just-black density of your separation negatives. On an Omega Super Chromega D enlarger, a starting exposure for an 8 x 10-inch print made from 4 x 5-inch separation negatives would be *f*/11 for 10 seconds.

Expose each of the three matrices from a different separation negative. To be sure that the finished matrices will register, don't adjust the enlarger height or the lens focus between exposures. There may be slight differences in the position of the image on the Matrix Film when you switch separation negatives, but all three images will print to the same size.

If you are printing from unregistered separation negatives in this way, you do not need a pin-register enlarging easel for the Matrix Film. Use a vacuum easel to expose your matrices; otherwise, slight film curling caused by changes in humidity could produce misregistered colors in your final prints.

Registering and Punching Matrices

Process your exposed matrices by following the standard procedures given in the instructions packaged with the film. After they are processed, dye them in the appropriate color dye and hang them to dry. Once they are dry, you can register and punch them as described in the Matrix Film instruction sheet. From this point on, the printing process is identical to that for making dye transfer prints via other methods.

CONTRAST CONTROL

As mentioned previously, you can correct slight errors in separation-negative contrast. The simplest way is to make contrast adjustments in the matrices by changing the ratio of KODAK Tanning Developer A and B in the mixed developer. The normal A:B ratio is 1:2. If you reduce the ratio—for example, to 1:1—you produce less contrast. Conversely, if you increase the ratio, you produce higher contrast.

You can also change the contrast of the final print by changing the acidity of the dye solutions (see instructions packaged with the dyes). By raising or lowering the pH of the dyes, you can readily change the contrast of the print by more than 15% in either direction. By combining these two techniques, you can produce prints of widely varying contrast from a single set of separation negatives.

In theory, you could correct substantial contrast and exposure imbalances in the separation negatives through skilled manipulation of Matrix Film development and dye acidity. This should be a course of last resort, when you do not have the option of making new separation negatives. In almost every case, it takes considerably more time and money to make matrices, adjust dye sets, and make test prints from a flawed set of separation negatives than it does to make new ones.

Masking for Increased Contrast

Sometimes, you may find that even carefully made separations do not give you sufficient brilliance in the print highlights. In that case, make a set of three highlight masks, one for each separation. The highlight mask is a very thin, high-gamma negative, made by contact-printing each of the interpositives onto a sheet of high-contrast film. You intentionally underexpose the mask film so that the processed mask has a D-max of only 0.3 to 0.4 DU. This negative mask increases image contrast only in the highlights.

You can make highlight masks using Technical Pan Film processed in undiluted KODAK DEKTOL Developer at 68°F (20°C) for 3 minutes. The processed mask has a gamma of about 3.5 and carries only the highest 0.1 DU of highlight detail from the image. Because of this, highlight-mask exposure is extremely critical. There is no practical

*For optimum results, always use fresh fixer with T-MAX 100 Professional Film, as the fixer will be exhausted more rapidly with this film than with other films. If your negatives show a magenta stain after fixing, the fixer may be near exhaustion or a longer fixing time is required. A slight stain will have no printing effect. If the stain is pronounced and/or irregular, refix the film in fresh fixer or bathe it in Hypo Clearing Agent for 2 minutes at 65 to 75°F (18 to 24°C) followed by a 10-minute wash.

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way to recommend a starting exposure under these circumstances, except to note that it typically will be a very small percentage of the exposure required to make the T-MAX 100 Professional Film separation negatives.

To use the highlight masks, sandwich them with the normal separation negatives when making the matrices. The masks add density and contrast only to the highlights, restoring tonal separation which is normally lost on the shoulders of the film curves.

Note that the highlight mask is an addition to the matrix-making part of the process—it doesn't require any changes in the interpositives or separation negatives, and it is made from the interpositives, not the original negative. For these reasons, you do not need highlight masks unless you find that the print produced from the unmasked separation negatives lacks brilliance. You will need to remake the matrices, of course, but you won't have to repeat the earlier separation steps.

Masking for Reduced Contrast

Frequently, a color negative will be too contrasty to make a good print using normal procedures. Most commonly, this is due to an exceptionally long brightness range in the original subject. It may also be caused by negative overdevelopment.

In the former case, you can correct the contrast with a contrast-reduction mask made on KODAK Pan Masking Film / 4570. You can reduce the contrast when making the separations or the matrices or when making prints, but this will also reduce color saturation, which is usually not desirable. Because an overly contrasty negative has an unusually long density range, it is likely that you will force significant image tones onto the toe or shoulder of the film curve. Those values will render flat and lifeless in the final print, even if you can make the overall contrast of the image acceptable.

If the original negative is overdeveloped, you will want to reduce color saturation as well as contrast in your prints. In this case, make the interpositives on T-MAX 100 Professional Film instead of Technical Pan Film. Use a development time of 10 to 12 minutes in T-MAX RS Developer at 75°F (24°C), depending upon the degree of contrast reduction needed.

Processing KODAK Technical Pan Film for Increased Contrast

Negatives that are too low in contrast are often the result of underexposure or fading of the negative. Or it simply may be that the subject was very low in contrast, as in an aerial or extreme-telephoto shot. Such negative images suffer from decreased color saturation as well as contrast.

You can increase both color saturation and contrast by increasing the development time of the Technical Pan Film interpositives in HC-110 Developer, Dilution B. With sufficient development, you can increase the gamma of the interpositives as much as 60%. If you need even greater increases, KODAK DK-50, D-19, and DEKTOL Developers will give up to 150% of normal contrast.

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