

# HutchColor™

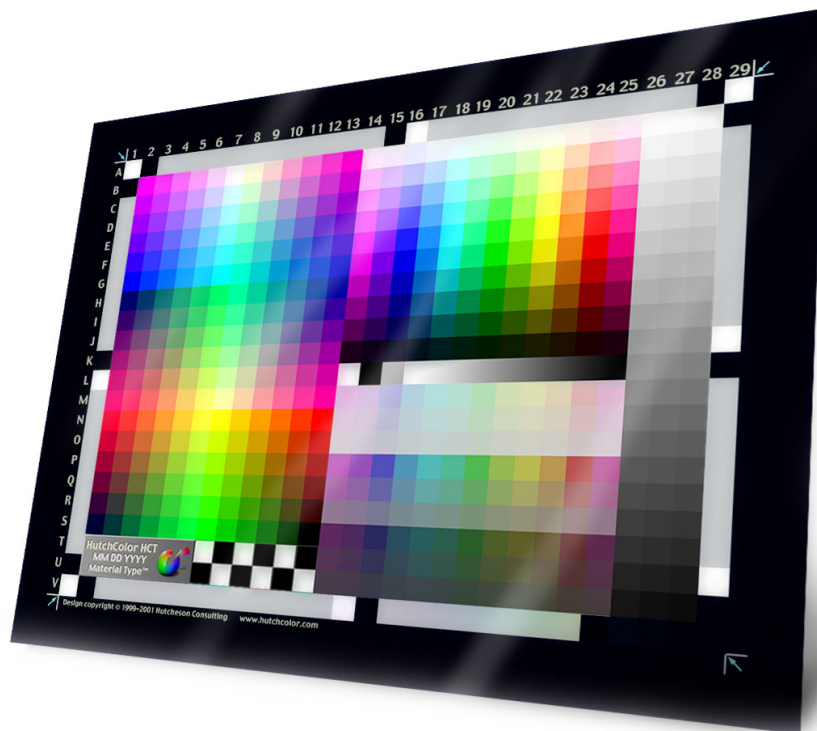
# HCT™

## Precision Scanner Target

### USER GUIDE

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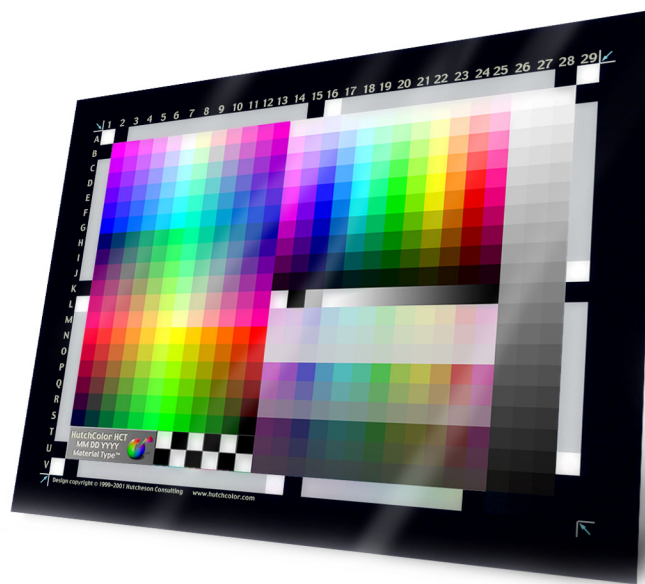
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## Introducing the HCT™

The HutchColor HCT is a high-precision color target for ICC scanner and camera profiling. Designed for extremely demanding users, it has about twice as many patches as the standard IT8.7/1 & 2 ('IT8') target layout, a better sampling of dark colors and almost three times as many gray scale steps. These features, combined with individually-measured reference data, help it characterize a scanner or camera more accurately, especially in high density (shadow) tones.



*The HCT Precision Scanner Target*

### Benefits and limitations

For drum- and flat-bed scanning the HCT yields more precise color and tonal accuracy, especially in richly-saturated colors and very dark shadows. This leads to more precise scans and better correction of underexposed originals, however the amount of improvement may be affected by scanner setup, viewing conditions, subject matter and user-expectations.

For fine-art reproductions and product photography, the HCT provides a higher dynamic range and wider color gamut than typical camera targets, so a greater portion of the camera's color space is characterized. However, as with all camera targets, color matching quality is also affected by variations in lighting spectra, camera filtration and spectral reflectance differences between the colorants in the subject and the target's photographic dyes.

It should be remembered that all ICC "capture" profiles (camera or scanner) are optimized to accurately reproduce the dyes or colorants in the target itself. If the subject's colorants have different spectral reflectance curves, color accuracy may suffer due to "metamerism failure". There is no simple solution for this, except manual editing in Photoshop.

### Media and formats

The HCT was originally available in the following formats but availability may be reduced without notice as film emulsions become discontinued by their respective manufacturers.

### Reflection:

5x7 inch Fuji Crystal Archive paper.  
Kodak Ultra Endura.

### Transmission:

4x5 inch Ektachrome™ and Fujichrome™.  
6x7cm (2-1/4 x 2-3/4 inch) Ektachrome and Fujichrome.  
35mm Ektachrome and Fujichrome.

*NOTE: 35mm and 6x7 cm targets are cut to size from 8x10 inch sheet film and are not created on actual 35mm or 120 film, however because similar dyes are used in all product sizes, they produce equivalent results.*

### Choosing an emulsion:

Either Fujichrome or Ektachrome HCT targets seem to reproduce Agfachrome™, Ektachrome and Kodachrome originals quite well on Heidelberg (Hell) 3000-series and Fuji (Crosfield) Drum scanners. Other scanners like the ICG drum scanner and most CCD desktop scanners require custom Ektachrome or Fujichrome profiles for optimum color matching. If only one emulsion is chosen for general use, pick the film type you scan most often.

## Differences from IT8.7/1 and 2 scanner targets

- The IT8 was designed in the 1980s as a visual scanning guide, then adopted for scanner profiling with no change. The HCT was designed specifically for scanner profiling.
- With over 500 discrete patches the HCT contains around twice as many samples as the IT8's 252 (Kodak) or 288 (Fuji and Agfa) patches.
- All HCT targets (except 35mm) are individually measured for highest accuracy. 35mm targets are produced in very small batches on a sheet of 8 x 10 inch film. Two 6x7 cm targets on the same sheet are measurement and averaged to produce an extremely accurate "batch-averaged" data file for the whole sheet.
- The HCT specification does not define colorimetric values for any patch, but allows the widest dynamic range and color gamut possible with the base material. HCT colorimetric values are proportional to, and distributed more evenly throughout, the media's available color space.
- Special emphasis is given to very dark patches, colored and neutral, so the HCT can better characterize deep shadow details, which are virtually ignored by the IT8.
- Special manufacturing gives the HCT a wide density range that better represents the dynamic range of live originals. This means there is less chance that an HCT profile will 'clip' or 'plug' important detail in over- or under-exposed areas.
- A 63-step gray scale improves the analysis of non-linear scanner performance, especially in very light and dark tones – especially important with older or badly-calibrated scanners.
- The gray scale contains 21 "nominally neutral" patches plus 42 "not-quite-gray" patches (absent from the IT8) with subtle red, green, blue, cyan, magenta and yellow color biases, to more accurately characterize a device's near-neutral performance.
- Twelve scales of fully saturated color extending from white through maximum saturation to black, replace the six scales in the IT8 which extend only from white to maximum saturation.

## Requirements

- The HCT must be in good condition, without fading, staining or damage.
- Each HCT has its own unique reference file which matches the target serial number.
- Most benefits will be seen in a 'raw' workflow where all image optimization is done afterwards on the RGB image (see 'Recommended Workflow'.)
- As with any other target, when profiling digital cameras, extreme care must be taken to avoid surface reflections or uneven lighting when capturing the target.

## Dye fading and measurement accuracy

Due to the delicate nature of photographic dyes, even with careful storage and handling the HCT may fade or change color over time, however recent testing<sup>1</sup> indicates they are highly stable.

Within limits, worn or faded HCTs may be restored in value by re-measuring. An HCT re-measurement service is available through the HCT dealer network.

*NOTE: Customer-measured data may not agree with supplied reference data due to dye fading and/or instrumentation differences. Although reference data are supplied to three or more decimal places, the least significant digits are uncertain and may be safely ignored by the profiling software.*

## Manufacturing date vs. measuring date

Batch dates marked on each target indicate the date of exposure and development, not the measuring date. Measurements are made as near as possible to the shipping date.

Anticipating the demise of various emulsion types, large batches of HCT targets were produced some years ago and placed in archival storage. Small quantities are measured and packaged as needed to ensure measurement data are as fresh as possible.

An HCT's manufacturing date does not have any impact on its quality, effectiveness or longevity.

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<sup>1</sup> To evaluate long-term stability, five HCT targets of various emulsion types were re-measured in 2011 and the new CIELAB data compared to ten-year-old original measurements. The worst delta E of all patches on all five targets was 1.7 (probably due to dust or positioning) and the average delta E on all five targets was less than 1.0. This kind of error is in the same range as typical instrument variation and indicates the HCT emulsions are extremely stable.

## Compatible software

HCT targets are (or were) compatible with the following software, and possibly others.

- Color Solutions *basIColor input* ([www.color-solutions.de](http://www.color-solutions.de))
- Color Solutions *basIColor scan+*
- FFEI *RealPro ColourCloud* ([www.colorprofiling.com](http://www.colorprofiling.com))
- PictoColor *inCamera* ([www.pictocolor.com](http://www.pictocolor.com).)
- Qualux *Complete R1* ([www.qualux.com](http://www.qualux.com).)
- TGLC inc. *PerfX Color Management Pro* ([www.tglc.com](http://www.tglc.com))
- X-Rite *i1Profiler 1.5+* ([www.xrite.com](http://www.xrite.com))
- X-Rite EyeOne Match
- X-Rite MonacoProfiler 4.0+
- X-Rite MonacoDCcolor
- X-Rite ProfileMaker 5

For latest additions and alterations to this list go to [www.hutchcolor.com/hct.htm](http://www.hutchcolor.com/hct.htm).

If your scanner or camera profiling software does not support the HCT, please contact the manufacturer and/or HutchColor, LLC.

## Trial software

From time to time third-party demo or trial profiling software may be provided on the CD (subject to availability). Inclusion of these trial packages does not constitute an endorsement of, or license to use, these packages, and no support is offered for their installation or use by HutchColor, LLC.

# Scanner profiling

## Scanning or capturing the target

Make sure the target is clean and mounted in the same manner as live work. Scan the target without USM and save it as an RGB TIFF image, with at least 750 pixels in the long dimension, or as required by your software. Larger files will not increase profile quality. 16-bit-per-channel files may improve profile quality (slightly), especially if the device's default response is very dark or light. For setup tips see the 'Scanning\_Guide' at [www.hutchcolor.com/CMS\\_notes.html](http://www.hutchcolor.com/CMS_notes.html). Pay particular attention to disabling automatic features, fixed end points and optimized tone curve.

## Qualifying the target scan

Ideally, every patch in the target scan must contain slightly different values from it's neighbor patches. No patch should have RGB values as high as 255 or as low as 0. Failure to observe these rules may lead to clipping or reversals in the profile.

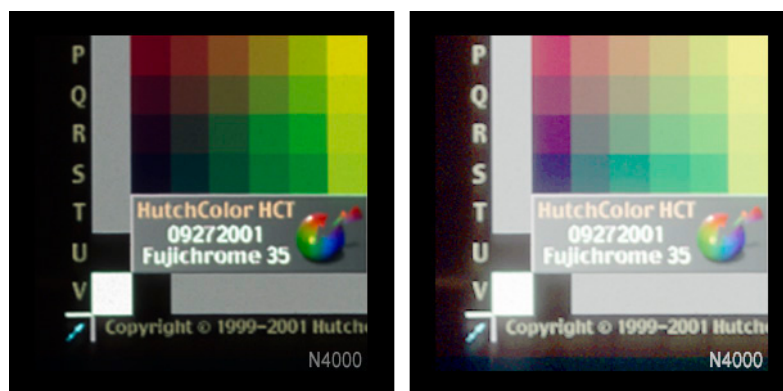
## CCD scanner evenness

Flatbed scanners, especially some 35mm slide scanners, often suffer from uneven illumination across the image which will negatively affect profile accuracy. To check for evenness, scan a flat tint of evenly-exposed slide film (about 0.30 to 0.60 density) and examine the RGB values across the entire area. Variations greater than +/- 002 in either R, G or B across the frame (ignoring dust or scratches) may be cause for alarm.

## Scanner flare

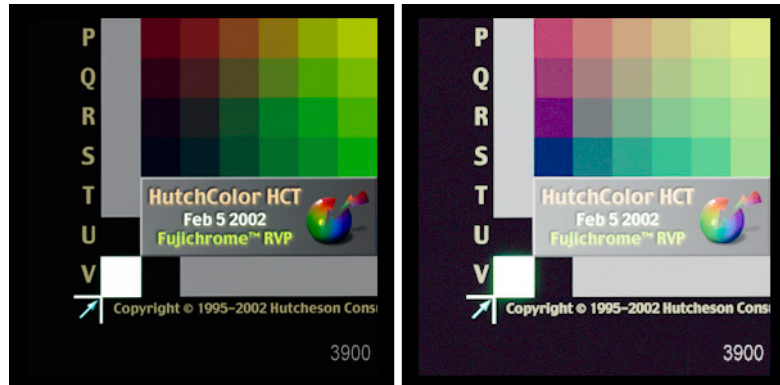
Most flat bed scanners - especially 35mm scanners - suffer from enough optical flare to reduce profile quality. This happens when light is scattered from neighboring patches or clear areas surrounding the target. Profile errors due to flare include excessive contrast, plugged shadow tones, incorrect gray balance and inaccurate colors.

Flare can be detected by opening a typical scan and temporarily setting a high gamma number, like 3.0, in Photoshop. (Gamma is the middle slider in the Levels control.)



*Flare in a typical 35mm scanner, with normal gamma (left) and gamma 3.0 (right)*





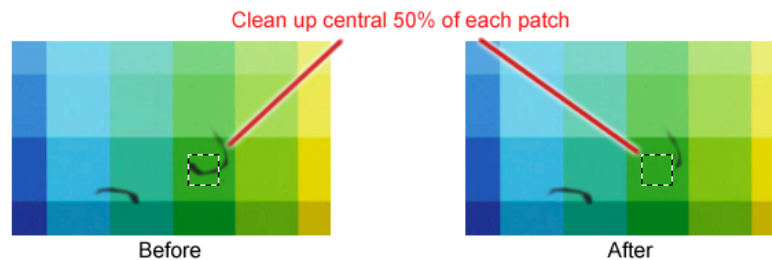
*Flare in a drum scanner, with normal gamma (left) and gamma 3.0 (right)*

The best cure for flare is to change scanners or clean the optical system. If these are not viable, use the largest target possible. For example, never use a 35mm target when a 6x7cm or 4x5 inch target is available. Flare can be reduced by scanning the target two or four times, in 180° or 90° steps, then carefully registering the separate scans as Photoshop layers set to 'Darken' mode, then flattening the assembly to a single TIFF image.

Flare may also be minimized by applying low-amplitude, large-radius USM to a duplicate Photoshop layer set to 'Darken', but this method is highly experimental.

## Clean-up in Photoshop

Examine the target at 100% magnification and CAREFULLY remove any blemishes with the clone brush (rubber stamp) tool. Be careful not to clone from one patch to another! Most profiling software uses only the central 50% of each patch. Ignore blemishes near the patch edge.



*Blemishes outside the central 50% of each patch can be ignored*

**WARNING:** Do NOT attempt to remove grain from the target scan, e.g. with an anti-noise filter. Believe it or not, a grainy target scan can actually improve profile accuracy because, when averaged by the software, grain can actually increase the effective bit-depth of the image!

## White reference for reflective scanning

Prior to scanning the target the scanner or digital camera must be calibrated on the same white reference material used in live work. Some scanners self-calibrate while other manufacturers supply a reference material. If none of these are available, calibrate on a piece of extremely bright, white, MATTE material. Ensure a steady supply and replace the white calibration patch whenever it gets dirty.

**CAUTION:** Many scanner operators calibrate on the border of the photographic print or artwork. In an ICC workflow this may invalidate the profile's color balance, introducing an opposite color cast to the resulting scan.

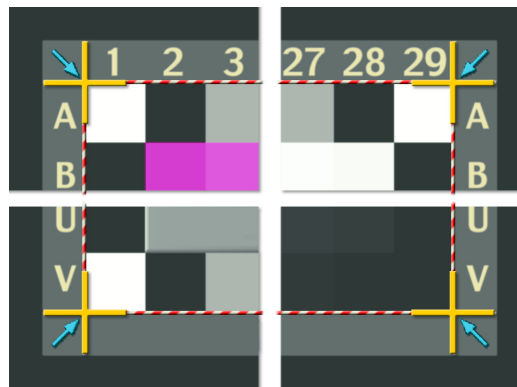
## Orientation and cropping

The target scan must be upright and right-reading with the text block in the lower left-hand corner. Some software requires the target to be exactly square, i.e. rows and columns exactly horizontal and vertical. If necessary, rotate the target in Photoshop prior to creating the profile.

Precise cropping is usually NOT necessary in Photoshop. If desired, rough-crop the target to about two or three patch-widths larger all round.

The profiling software should ask you to locate the position of the target's corners with a cursor, in effect "cropping" the target scan. Cropping methods and tools vary but the HCT's cropping points (shown below) are the same for all software. Position the profiling software's crop tool on the small crop marks embedded in the target. Corner marks may differ slightly from the illustration. Some HCTs contain small arrows pointing to the corner points.

If the crop marks are difficult to see, simply align the crop tool on the outside edge of the outer-most patches, as shown here.



*Cropping the target in the profiling software*

## Extended-range profiles

Due to film and development variations, occasional live images may have higher or lower max/ min dye densities than the HCT, which may result in RGB values outside the range 'recognized' by the profile, and in turn may lead to lost detail in very dark or light areas. An easy way to avoid this problem is to extend the range of the target scan before making the profile.

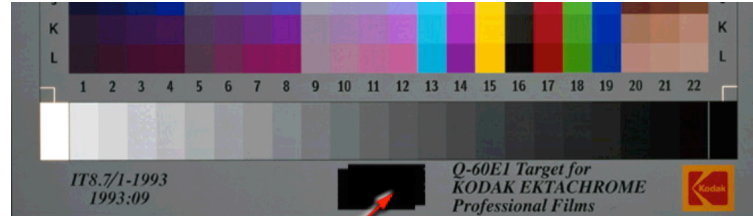
### Extending shadow detail

If the transparent target<sup>2</sup> has a lower D-max than typical slide film, the scanner profile may fail to 'see' very dark shadow details in dark or under-exposed transparencies whose D-max exceeds that of the target. This problem is greatest in IT8.7/1 targets but may occur to a smaller extent with the HCT due to emulsion or processing variations. An effective way of solving this is to modify the target scan to 'fool' the software into thinking the target has a wider density range.

*NOTE: This procedure does not truly characterize the scanner at higher densities, but it does increase the profile's sensitivity to match the scanner's maximum shadow sensitivity. Because most scans are adjusted to optimize the subject, the net result is virtually the same as scanning a longer-range target.*

### Add an 'Infinite density' patch

- Prior to scanning the target, add a double thickness of blackened film, Silver tape, or some other highly opaque material in the scan area, to represent infinite black density.



Two layers of black film or silver tape

Adding an 'infinite density' patch to the IT8 target

- On the transparent HCT the serial number sticker serves as a handy infinite density patch.
- Set up the scanner and create the target scan as described earlier.

*NOTE: Because the added infinite density patch may also be affected by flare, the only reliable way to determine the 'infinite density' response of a scanner with excessive flare is to make a separate scan of high density black material (e.g. a piece of unexposed slide film) to which an infinite density patch has been added, then cut-and-paste that patch into the edge of your HCT scan in Photoshop. The separate scan should be masked to avoid any stray light in the scan.*

### Modify the raw RGB scan

- Open the target scan in Photoshop and compare the RGB values in the infinite black patch to those in the blackest step of the target gray scale.

<sup>2</sup> This trick is not necessary with reflective targets.

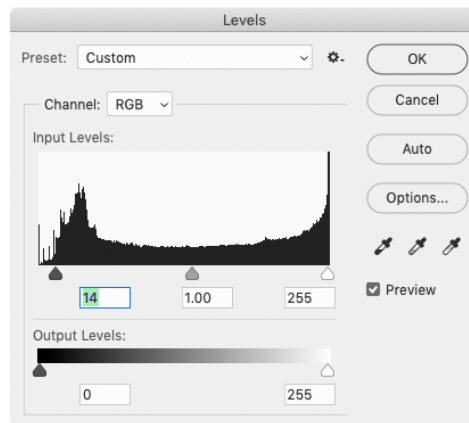


*Comparing the 'infinite density' patch and the darkest gray scale RGB values*

- Subtract the infinite density patch RGB values from the values measured in the blackest step of the gray scale to get three numbers indicating the R, G and B differences.
- e.g. (in the example shown above)

	Target black	–	∞ D	=	Difference
<b>R</b>	<b>21</b>	–	<b>3</b>	=	<b>17</b>
<b>G</b>	<b>22</b>	–	<b>3</b>	=	<b>18</b>
<b>B</b>	<b>17</b>	–	<b>3</b>	=	<b>14</b>

- In Photoshop's Levels control, enter the smallest or the average of the R, G and B differences in the top left box, then click OK.



*Extending shadow contrast in Levels*

## Create an 'Extended' profile

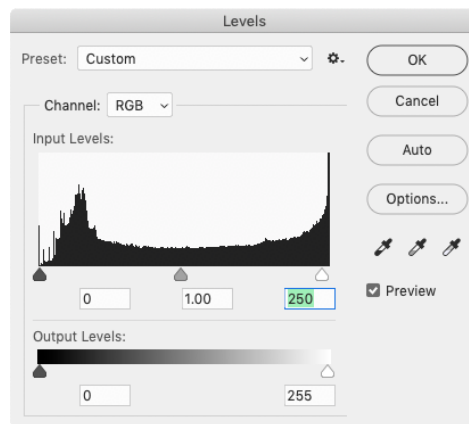
- Save the modified target scan with the suffix 'xt' (for 'extended'.) Keep a copy of the original scan in case you want to modify the amount of extension in a subsequent profile.
- In the scanner profiling software, use the extended target file to create the scanner profile. Also build a normal profile with the un-extended HCT in case some originals don't need expansion.

## Extending highlight detail

If a profiling target has a higher D-min (darker white) than a typical original, the resulting profile may fail to recognize very light details in over-exposed transparencies. To solve this, you can fool the software into thinking the target has a lighter white by extending the highlight contrast of the target scan. (Both highlight and shadow detail can be extended at the same time).

This method of highlight extension is ideal for capturing painted artwork or wash drawings, where the white art board and certain white paints can be much brighter than the white of a target made on photographic paper.

- In Photoshop's Levels control, reduce the top right number until the HCT white patch reads the same maximum RGB value found when scanning artwork substrate. An increase of about ten RGB units in the HCT's white patch (produced by a Levels highlight entry of about 245) is usually enough.
- Make sure the Levels change does not drive RGB values in the HCT white patch past 254. If it does, either reduce the amount of extension or change the scanner's RGB setup to get a lower RGB value in the HCT white patch, then scan the target again.



*Extending highlight contrast in Levels*

- Note that if you scan both artwork and photographic prints you should make two profiles from the reflective HCT, one for photographic prints, with no extension, and one for painted artwork, with the extended highlight method.

**CAUTION:** *In most cases extended profiles will improve shadow detail, shadow colors and/or highlight details compared to 'normal' profiles. However an extended profile is technically less accurate than a 'normal' profile, and the difference may be more apparent with larger originals.*

## Lightening 'dark' 35mm profiles

35mm scanner profiles often produce results that seem too dark, even when great care has been taken in scanning and creating the profile. This is often seen as a failure of either the target or the profiling software, but the explanation is usually much simpler.

### Darkness caused by flare in the target scan

Optical flare in the target scan can make 35mm images seem darker than expected, because if flare makes the darkest patch in the target produce lighter-than-normal RGB values, the profile will

associate those falsely-light RGB values with the true “darkness” ( $L^*$ ) of what is really a very dark patch. This means the profile will add density to images with less scanner flare.

An 'extended range' profile will often solve this problem.

## Darkness caused by viewing conditions

Another explanation for the apparent 'darkness' of 35mm profiles is that 35mm transparencies submitted for reproduction are usually selected under non-standard viewing conditions that make them seem lighter than if they were viewed on a normal light box. For example, 35mm slides are usually viewed under a magnifying loupe or on a slide projector which produces a pure-black surround. Unless the eye can simultaneously see some of the illuminating source at the side of the image (e.g. part of the light box), we have no way of judging relative brightness, or exposure, so even a quite dark image can look pleasing when it would look too dark if seen on a light table. The same thing happens when 4x5 or 8x10 inch transparencies are viewed inside a black mask.

For this reason, a scanner profile that works well for 4x5 or 8x10 inch transparencies viewed on a light box (with some surrounding area of white) will usually SEEM too dark when used on 35mm transparencies, or larger transparencies viewed inside a black mask.

The simple solution is to make an “auto-lightening” profile, as described below.

## Auto-lightening profiles

If, after setting white and black (e.g. with Photoshop Levels), all scans seem consistently too dark, you can build a lightening effect into the scanner profile by DARKENING the HCT scan slightly with a simple curve or levels adjustment. This fools the profiling software into believing the darkness is a scanner characteristic, which it 'corrects' with a complimentary amount of lightening. If you adjust the darkening curve to suit your average original, most images will look pleasing after assigning the profile and setting white and black.

Just remember an auto-lightening scanner profile that works well for 35mm scans may cause large-format or normally-exposed transparencies to appear too light.

## Pseudo-chrome profiles

The following method can be used to make an excellent scanner profile for any film type for which there is no available HCT target. This is commonly the case for older emulsions that are no longer manufactured. Provided you have some representative examples of the film type in question, a good eye for color, and a lot of patience, you can edit any Ektachrome® or Fujichrome® HCT profile to reproduce that emulsion with remarkably accurate results.

Note that this process is relatively non-scientific, relying on visual judgment rather than physical measurements. If you are not comfortable comparing a proof or monitor screen to an original, or are not familiar with Photoshop, have someone else perform this process for you.

### The Kodachrome® difference

These instructions use Kodachrome film as an example, because (a) there is no Kodachrome HCT available at the time of writing, and (b) Kodachrome uses strange dyes that reproduce differently on most scanners, compared to the dyes in most other slide films.

On most scanners, Kodachrome transparencies produce a strong blue or blue-magenta cast, because the yellow dye used in Kodachrome film appears weaker through typical scanner filters than it does to the human eye. Traditionally this yellow weakness would be corrected by intensifying the yellow printer and lightening the cyan and magenta printers (CMYK workflow) or by lightening the red and green channels and darkening the blue channels (RGB workflow), but this is tedious and not practical if you scan a lot of Kodachromes. Making a pseudo-Kodachrome profile eliminates the need to edit each Kodachrome scan separately in Photoshop.

### Requirements

You will need a selection of sample 35mm or 120 slides on the emulsion you are profiling, including some with large areas of grays or near-neutral grays, and some with large areas of reds, yellows, greens, cyans, blues and magentas.

The most efficient way of making a pseudo-chrome profile involves subjective visual corrections on a computer monitor, for which you will need an accurately-calibrated monitor with a top-quality ICC profile.

You should also have an intensity-variable D50 viewing box alongside the monitor, with which to compare the screen to the sample transparencies. The best viewer is the GTI SOFV-1e (or 2e), which should be dimmed so the empty transparency viewer is only about 10% brighter than a blank white screen (255 red, 255 green, 255 blue) in Photoshop.

If you do not have a profiled monitor and intensity-variable viewer, corrections will have to be tested with prints made on an accurately-profiled printer.

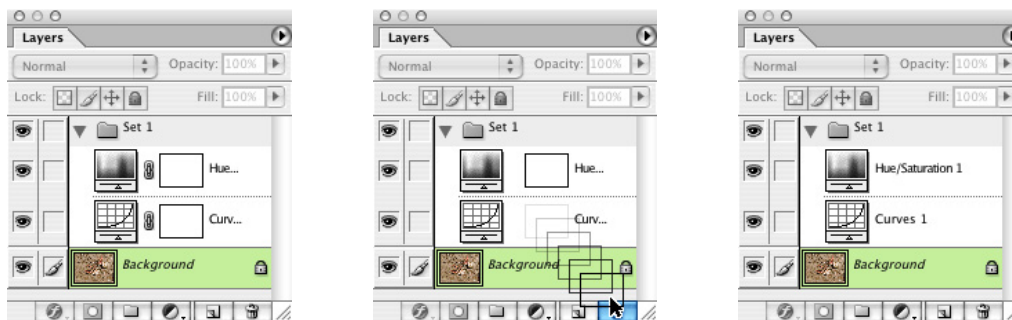
### Preparation

- Scan an HCT target (Fujichrome or Ektachrome) and make a normal ICC scanner profile from it. Save the raw scan of the HCT target.
- Select several Kodachrome originals, including at least one with large areas of neutral or near-neutral grays, and others with a range of saturated colors in each of the main color families; reds, yellows, greens, cyans, blues, magentas.

*NOTE: There are at least three generations of Kodachrome film, including Kodachrome, Kodachrome II, and Kodachrome 25, Kodachrome 64 and others. Because each generation used different dyes, they*

*may need different profiles, but a profile made for the latest generation of Kodachrome should work well with older Kodachromes.*

- Tape the Kodachromes together to form a collage at least 4 inches by 5 inches in size.
- Scan the collage using the same setup as the HCT target. In Photoshop, open both the HCT scan and the Kodachrome collage scan, then assign the normal ICC scanner profile to both.
- On the Kodachrome collage scan, open the Layers window and create an Adjustment Layer Group (“Set” in older Photoshop versions). Make a Curves adjustment layer and above it, create a Hue/Saturation adjustment layer, but do not apply any edits to either layer.
- Disconnect the masks that appeared automatically on each adjustment layer by clicking their ‘chain’ icons, then dragging the masks into the trash can at the bottom of the Layers window.



*Removing the layer masks from the Adjustment Layer Set*

- Remove the collage of original Kodachromes from the scanner and place it, along with the original HCT, in a D-50 transparency viewer dimmed to match the brightness of the monitor. The HCT scan should look similar to the actual HCT target. If not, either adjust the intensity of the viewing booth, or adjust the color balance of the monitor, or re-create the scanner and/or monitor profiles until the displayed HCT scan matches the target as closely as possible.

## Correcting gray balance

- Compare the displayed collage with the actual Kodachrome originals in terms of overall gray balance. Ask yourself; “Is the screen image too red, too yellow, too green, too cyan, too blue, too magenta, or a combination of these errors?”

*HINT: Scanned Kodachromes are usually too blue, or lacking in yellow dye density. Typically this bluish cast is most noticeable in mid-tones, becoming less obvious towards highlight and shadow regions. Occasionally there may be a different type of color cast in highlights or shadows, but this usually indicates a scanner problem, and is not normally an emulsion-based effect.*

- To correct any apparent gray balance error, edit the Red, Green and/or Blue curves of the “Curves 1” layer, ideally with one mid-tone curve point, or at the most two or three curve points. The goal is to make the gray areas on screen look as close as possible to the same gray areas in the physical transparencies.
- Continue until all near-gray areas in the displayed images match the same areas in the physical Kodachrome transparencies as closely as possible.

*IMPORTANT: At this stage, IGNORE any errors in saturated colors. For example, if reds are too “cool” or yellows are too “green”, do NOT attempt to correct these errors with Curves.*



## Correcting individual color hues

- Once gray balance has been corrected, compare the color of the displayed collage with the originals. Ask yourself; “Do the individual red, yellow, green, cyan, blue and magenta color families in the displayed image match the physical originals?”

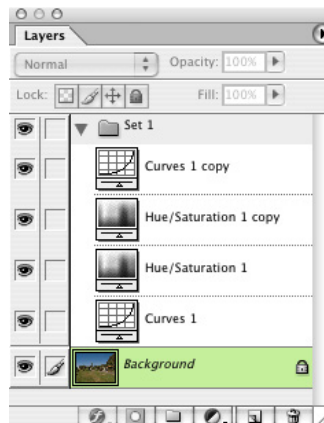
*HINT: Correcting gray balance often corrects color errors but colors may still need additional corrections.*

- Be sure any color errors you observe are not a result of the monitor. Remember certain highly saturated colors in the original transparencies may be outside the gamut of your monitor and may appear incorrect in terms of hue, saturation or lightness.
- If there are no obvious color errors, go straight to “Modifying the HCT scan”.
- If one or more colors need correction, adjust the appropriate color region(s) in the Hue/Saturation adjustment layer until the displayed image matches the physical originals as closely as possible.

*NOTE: If you are not working with an accurately-profiled monitor, make some estimated changes then reproduce the collage on a profiled printer. Compare the print to the collage in a viewing booth and repeat until the print is as close as possible to the original collage.*

## Modifying the HCT scan

- Once the Curves and Hue/Saturation correction layers are adjusted optimally, drag the whole Adjustment Layer Group (or Set) from the collage image to the original HCT scan from which you made the scanner profile. (In order to drag a layer Group from one image to another, both images must be open at once.)
- In the layer Group on the HCT scan, duplicate both the “Curves 1” and “Hue/Saturation 1” layers, then move the “Curves 1 copy” layer to the top of the stack, as shown below;

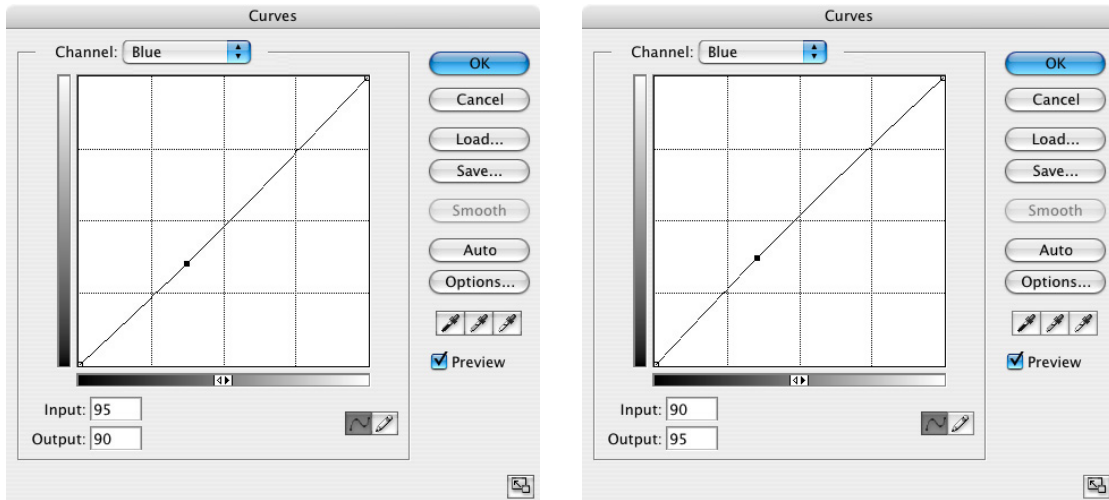


*The adjustment layers set on the HCT scan*

## Curves inversion

- On the “Curves 1 copy” layer, swap the Input and Output values for each control point on the R, G and B channels. For example, if the Blue curve in the “Curves 1” layer goes from Input 95 to Output 90, change the “Curves 1 copy” layer to Input 90 to Output 95, as shown below.

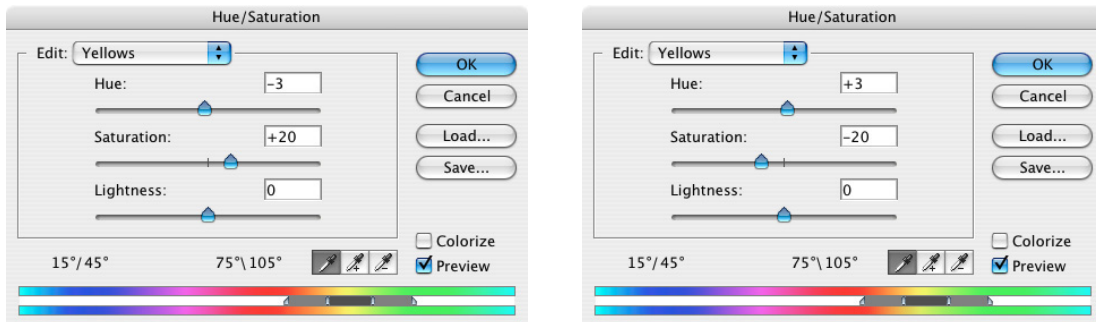
*IMPORTANT: Do not change the original Curves 1 layer.*



Typical Blue correction in the “Curves 1” layer (left) and its inversion in the “Curves 1 copy” layer (right)

### Hue/saturation inversion

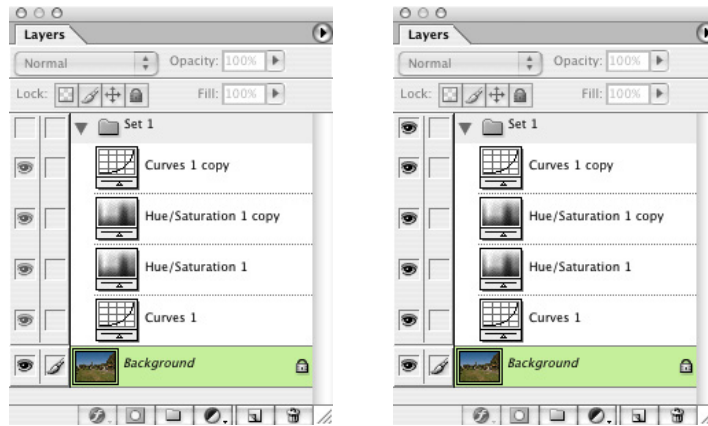
- On the “Hue/Saturation 1 copy” layer, change the polarity (sign) of any number you applied in any channel. For example, if you decreased the Yellow Hue by -3 in the “Hue/Saturation 1” layer, increase it to +3 in the “Hue/Saturation 1 copy” layer, as shown below.



Typical Yellow correction in the “Hue/Saturation 1” layer (left) and its inversion in the “Hue/Saturation 1 copy” layer (right)

### Testing the inversions

- The whole point of the inversion process is to make the two Curves layers cancel each other, and the two Hue/Saturation layers cancel each other. You can test this by toggling the Group 1 (Set 1) eyeball on and off.
- If there is no visible difference between “Group on” and “Group off”, then the two Curves layers and the two Hue/Saturation layers must cancel each other. If you DO see a difference, check that the “... copy” layers are exact opposites of their respective correction layers. If necessary, adjust the “... copy” layers till there is no difference between “Group on” and “Group off”.

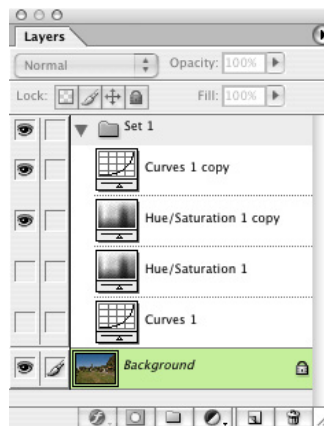


Switching the whole Layers Set off (left) and on (right) by clicking the Set 1 eyeball

- Save a copy of the edited HCT image in PSD format with “Layers” checked to simplify any later fine-tuning of your new profile.

## Saving the modified HCT scan

- Disable the “Curves 1” and “Hue/Saturation 1” layers by clicking their eyeballs, as shown in the next diagram.



Switching off the correction layers leaves only the inverted layers active

**NOTE:** The image of the HCT target should now look as if it had been created on Kodachrome film (or whatever emulsion you are trying to profile). Typically this means it will look bluer than the actual HCT transparency target in the viewer, but the actual difference depends on scanner and film involved.

- Flatten the HCT image (Layer – Flatten Image) and “Discard hidden layers”.
- Save a TIFF copy of the flattened HCT image. Name the flattened image something different from the original scan, for example “Pseudo-Kodachrome HCT”.

## Making the “pseudo-chrome” profile

- Make a new profile from the modified HCT scan and include the name of the film type you are working with (e.g. “Kodachrome”) in the profile title.

## Testing the new profile

- Assign the new profile to the sample collage scan and compare the displayed image to the actual transparencies in the viewer. They should be as close (when using the new profile) as the original HCT image is to the HCT target (when using the normal profile).
- Test the accuracy of the new profile by making a printed reproduction and comparing it in a D-50 viewing booth to the original transparency collage. Qualify the result by comparing a reproduction of the raw HCT image with the normal profile assigned to it.
- If the results look good, this is your Kodachrome profile (or the profile for your specific emulsion type). If you need to make more corrections, go back to the layered HCT file, alter the adjustment layers as necessary, and repeat the cycle to make a new profile.

***REMEMBER:** this process can be used for any emulsion type (not just Kodachrome) on which there is no available profiling target.*

# Camera profiling

*IMPORTANT: As with all camera targets, HCT profiles are optimized for the dyes or colorants in the target itself. If the subject matter's colorants have different spectral reflectance curves, color accuracy may suffer from some degree of "metamerism failure". There is no simple solution for this, except manual color editing in Photoshop..*

Due to the difference between target colorants and the colorants in real-world subject matter, no profiling method can give perfect results all the time from all types of subject. A REALISTIC expectation is that a good camera profile should reduce some of the gross errors usually experienced, but some additional color correction will often be needed to match certain types of subject, no matter how good the profile is.

## Defining goals

There are two logical goals in profiling a digital camera. Choosing the most appropriate goal is the key to creating a useful profile and workflow. The main difference between the following two approaches lies in how the camera is adjusted during live capture, compared to the profiling capture setup.

## Copy work (scanner on a tripod)

The simple goal in copy work or fine-art reproduction is the most accurate reproduction possible where the camera is in effect a 'scanner on a tripod'. Copy-work may require a custom profile for each individual set or setup, but a single profile may serve indefinitely so long as the same lighting, camera and camera settings are used.

## Film-type profiling

For editorial, sports, commercial or fashion photography, a more realistic goal is a profile that delivers stable performance in spite of changes in lighting or exposure. This idea is similar to standardizing on a single film type. 'Film-type' profiles may reproduce the subject less accurately than 'copy' profiles, but should give a constant starting point that is closer to actual scene color than possible with color film.

## Camera profiling issues

Some of the problems that can limit camera profile quality include;

- Target colorants (e.g. dyes) are different from those in the original
- Target white is darker than subject white
- Target black is lighter than subject black
- Target colors are less saturated than subject colors
- Uneven lighting over the target
- Flare in the camera's optical system
- Reflections on the target
- Inappropriate camera software curve
- Improper camera 'white balance' or 'gray balance'

## Benefits of the HCT in camera profiling

The HCT camera target attempts to solve some typical profiling problems with;

- About twice as many patches as other targets for smoother, more accurate profiles
- A wider range of dark, saturated colors to better represent deep saturated tones
- A wide range of light and dark colors to help one profile suit multiple media types
- A glossy surface to represent the dynamic range of oil paintings

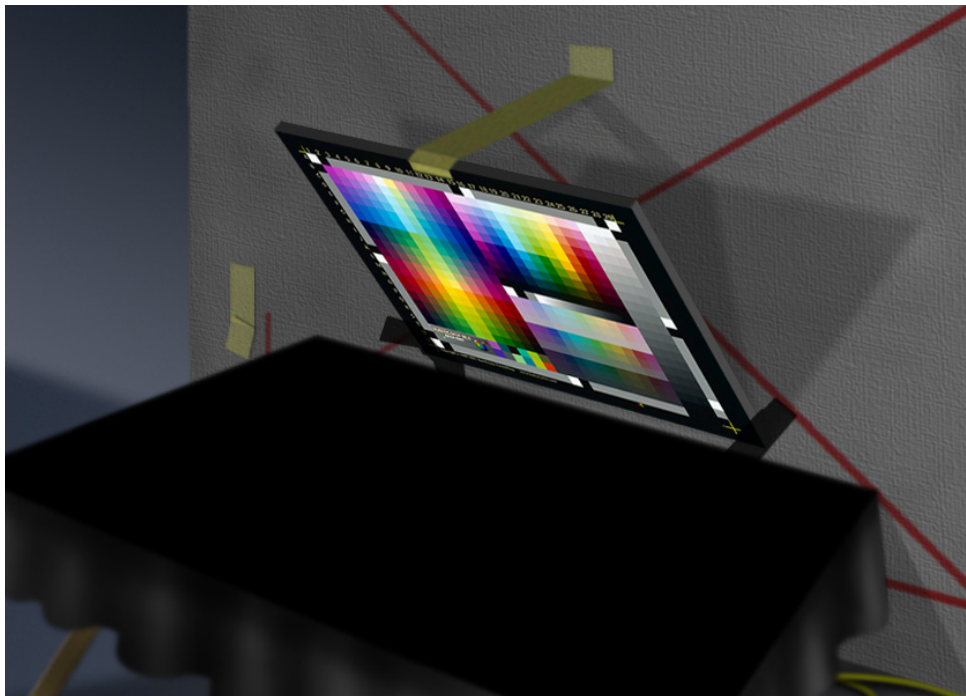
## Eliminating reflections

**CAUTION:** *Reflections on the target may reduce profile accuracy.*

The glossy surface of the camera HCT helps reproduce deeply saturated colors in glossy originals, but it also poses a special challenge during capture.

For best results, reduce reflections by as many of the following methods as possible.

- Darken the location (good first step whatever else is done)
- Place the lights at a shallow angle to the copy, typically 30° or less
- Narrowly baffle the lights to eliminate light falling on anything but the target
- Drape the camera with black velvet and cut a hole for the lens to avoid reflections
- Cross-polarize (see next section)
- Tilt the target slightly to face a velvet “black trap” suspended above or below it



*HCT target angled towards a black velvet-covered board to avoid reflections*

Tilting the target is a simple way of eliminating reflections but produces a perspective distortion in the target capture. This can be corrected later in Photoshop, in case the profiling software won't accept a distorted target image.

## Cross-polarizing

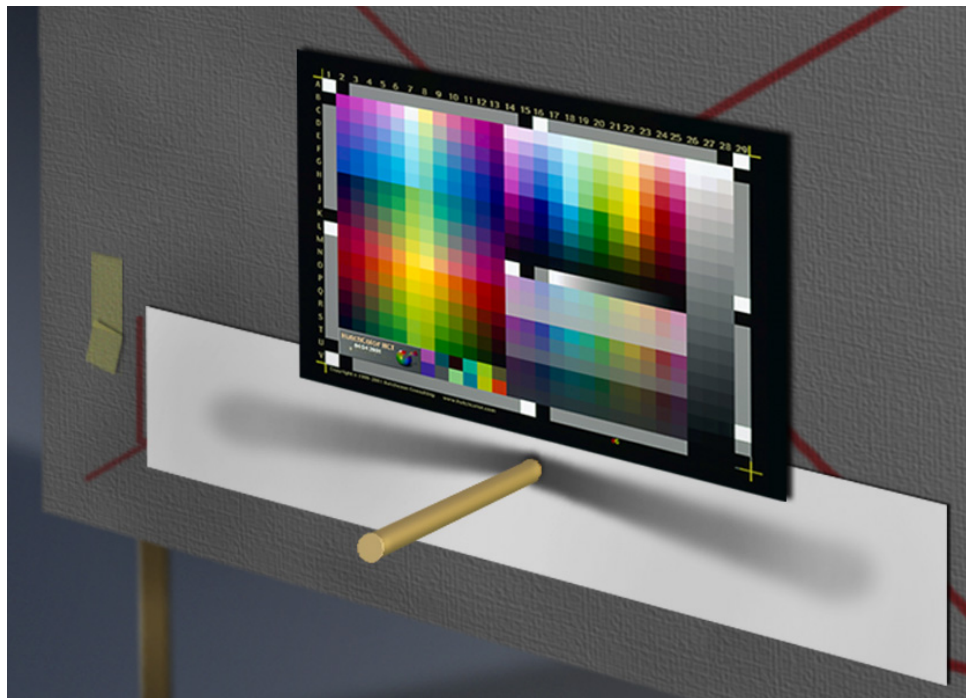
A popular technique in artwork capture is to polarize the lights with large sheets of polarizing material and use another polarizing filter rotated 90° to this over the lens. The main benefit is that specular reflections from raised portions of the original, like brushstrokes or varnish cracks, are largely eliminated. Images with no specular highlights may not be improved at all by the process, however matte colors will tend to become more saturated.

A disadvantage of cross-polarizing is loss of light intensity - up to six  $f$  stops - which can limit depth of field and productivity. If you use cross-polarizing in live work, be sure to generate the profile with the same setup.

## Lighting evenness

One of the most important requirements is even lighting across the target, or more specifically, across the image plane inside the camera. Here are some techniques to ensure evenness.

- With a stick (or finger) check that the shadows cast by each light in the center of the target plane are equal, as shown in the following diagram. If one shadow is darker than another, move the light on that side closer to the subject.



*Testing lighting evenness with shadows from each light*

- To minimize lens fall-off, use only the central area of the lens circle.
- Place the lights well back so that fall-off from one side of the target to another is negligible.

Note that the profiling capture doesn't have to use the same lighting POSITION as the actual image, so long as the same TYPE of light, reflector, diffuser, filters, etc are used. If light position or angles are changed between profiling and live capture, just make sure the camera EXPOSURE and BALANCE are adjusted to compensate.

## Initial camera setup

Most digital cameras provide some means of altering the camera's reproduction curve, exposure and 'white balance' or 'gray balance'. Changing these settings in live work may limit or negate the value of a camera profile. For consistent results one 'fixed' curve and exposure / white balance method determined at the time of profiling should be used for all live work.

For the most flexible and valuable captures, use the longest – range curve (lowest contrast) possible and shoot in 16 bits RAW, or the highest bit mode available. When adjustable, keep saturation and sharpness at their weakest settings.

A fixed setup may restrict some photographers who like to adjust subject contrast or create special effects in camera software. With care, the camera curve can be adjusted for live work (see "Changing the camera for live work") but remember that a fixed camera curve is no different than shooting with film. It is generally better to use a fixed curve, adjusting only exposure and balance in the camera software, and controlling contrast with lighting or in Photoshop.

## Camera exposure

Camera exposure is set by adjusting aperture, exposure time, ISO (sensitivity) and/or light intensity. Try to leave any digital exposure tools – e.g. (+) or (-) buttons in the curve window – at their default settings and try to avoid using the curve tool to affect exposure.

The ideal goal is to adjust exposure until the brightest white in the scene, or a dummy white patch (e.g. a square of bright white card) reaches a level determined when the profile was built – typically between 245 and 250 in all three colors.

When possible, always shoot with the lowest ISO setting to reduce noise.

## White (or gray) balance

To ensure repeatable performance of a profiled camera, white-balance the camera whenever lighting, filtration or the lens is changed. The exception is when a filter is used for a special effect. The method of balancing depends on the camera software. Typically a piece of neutral white or gray card is used. You can cut your own cards out of a large sheet of illustration board, or buy pre-made cards designed expressly for digital camera work.

Some software can balance on the same white card used to set exposure. This is only advised if the software performs the balancing act on the hi-bit 'linear' data, in which case white is the best indicator of color balance. Check with your manufacturer.

Note that due to metamerism failure or UV or IR reflectance, the camera profiling target may take on a slight color cast (compared to the standard gray card you will use for balancing production shots) which will permanently add the opposite cast to the profile. If there is no error between the target material and the standard gray card, use the gray card to balance the profiling exposure. If the target takes on a color cast, balance on a neutral patch of the target **ONLY FOR THE PROFILE EXPOSURE** but use the standard gray card during production work.

## Camera profiling curve

One of the advantages of digital photography is the ability to create your own camera 'curve'. This is like designing your own film emulsion. But once a profile is created, whatever curve was active at the time the target was captured is effectively 'cancelled' by the profile – at least with most profiling software. So the best curve for camera profiling may NOT necessarily be the curve you would expect.



The ideal camera profiling curve should capture a full range of subject tones from deepest blacks to very bright highlights and distribute the camera's RGB values evenly throughout the visible range. The best default curve for art copying should be almost a straight line from highlights to middle-tones, with a slow roll-off in deep shadows. This curve will produce the best profile from most targets and make an excellent starting point when critical product matching is required. Ironically, shooting with a 'straight line' curve will often make the subject look a little 'flatter' than normally desired, at least in the basic capture. If the subject looks flat it is easy to add contrast with a slight highlight roll-off at the time of live capture, but generally it is safer to do any curve moves later in editing software.

Remember it is better to profile and shoot with a straight-line camera curve and add editorial contrast later, than to shoot with a strong 'S' curve and try to compensate later for blown-out highlights or plugged shadows.

## Contrast or 'f-stop' range

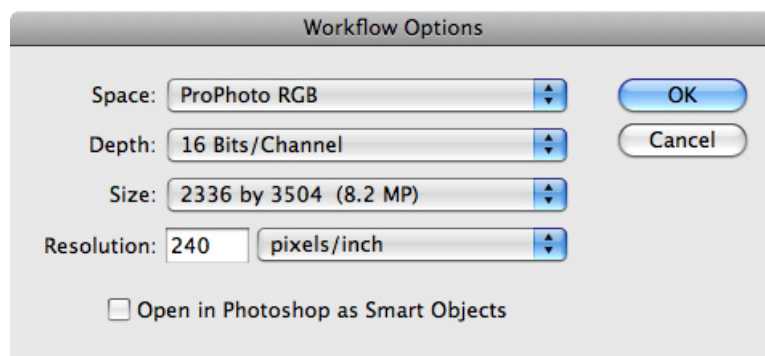
If your camera software expresses dynamic range in f-stops, extend the black end to yield a long range of at least 8 f-stops, or more. Although you may seldom use the extra range, it's better to have it and not need it than need it and not have it. If most subjects look a little flat or 'smoky' in deep shadows it's a simple matter to correct this later in Photoshop. But with too little shadow detail, or not enough f-stops, deep shadows may 'plug-in' or 'block-up' (don't you just love those terms?) which is difficult or impossible to correct in Photoshop.

## Bit depth and file format

For maximum quality and the greatest possible post-capture editing capabilities, always save images in the highest bit-depth possible and in a "RAW" format.

## Profiling via Photoshop's RAW workflow

- Import the target capture with Workflow Options set to 16 bits / Channels and ProPhoto RGB. This retains the maximum possible gamut and precision.



- Save the image as TIFF and create the profile in the software of your choice.
- Import live images with the identical Photoshop RAW settings.
- After importing a live image as ProPhoto RGB, assign your custom profile to display the image correctly. Do not convert from ProPhoto RGB to the custom profile.
- Convert the image from your custom profile to your working space before editing.

**CAUTION:** ProPhoto RGB is a dangerous editing space encompassing illegal (non-existent) CIE Lab values. Safer editing spaces for highly-saturated images are DonRGB or BestRGB.

## Adjusting profiling curve, exposure and balance

The camera curve, exposure and balance used when creating a profile should be determined together, as they can affect each other. Each camera software is different but the following steps are a good guide for most cameras. If your camera has no capture software, make a series of exposures or exports (if you have the ability to alter the file during export) until you get a file that meets the following criteria as closely as possible.

- To ensure the basic curve has a sufficiently wide sensitivity range, place a black trap in the scene with the target to simulate the darkest black the camera is likely to encounter. A good black trap can be made by lining a black plastic 35mm film canister (remember film?) with black felt. Make sure no direct light falls inside the canister.
- If your camera software displays a curve over a histogram, start with a curve wide enough to include both the blackest and whitest regions of the HCT (including black trap) simultaneously. If necessary, edit a basic curve to extend the range as needed.
- Set the optimum exposure by adjusting aperture, integration time, ISO sensitivity and/or light intensity until the brightest white patch of the target reads about 245-250 in all three colors.
- When possible, always profile and shoot at the lowest ISO setting to reduce noise. In some cases it may be desirable to create different profiles for different ISO settings.
- Adjust the shadow end of the curve until the black trap reads between 2 and 10 in all channels. If the black trap consistently reads 0, at least try to get the darkest patch of the HCT (patch V28) above 0 in all channels. If possible, make sure the camera curve has at least an 8 f-stop range from white to black (may not be possible on some cameras.)
- Tweak the curve until it is almost a straight line with roughly equal separation throughout the scale but slightly less contrast in shadows.
- Adjust overall curve height at the middle tone until patch L27 on the HCT measures somewhere between 100 and 130 in all colors.
- Balance may be set one of two ways. If there is no metamerism error between the target material and the standard gray card you will use during production work, use the gray card to balance the profiling exposure. If the target takes on a color cast due to metamerism failure or UV or IR reflection, balance on a neutral gray or white patch of the TARGET for the profile exposure but use the standard GRAY CARD during production work.

## Using the profile

There are two primary uses for a camera profile: to display the image correctly in the camera software or image editing software like Photoshop, and to ensure a good reproduction on an output device.

Most medium-format camera software will allow you to select your own profile to be used during framing and capture. Generally this is set in the Preferences under a heading like "Profiles" or ICC". For this to be effective you also need a good monitor profile. What you see on the monitor at the time of capture should now be a good simulation of the original, except in very saturated colors that may be outside the monitor's gamut. Remember that the appearance on your monitor will be greatly affected by the intensity and color temperature of the ambient lighting.

Some camera software will allow you to embed the profile in a 'raw' RGB capture. This is ideal if you want to preserve the maximum quality in a high-bit file, yet maintain the integrity offered by the profile. Always make sure the recipient or output process is ICC-aware and knows how to use the camera profile correctly.

Some camera software will convert from your selected camera profile into a 'working space' of your choice when the file is saved or exported. If the final destination is a commercial press or wide-

format ink jet printer or any other device with a wider color gamut than a typical monitor, be sure to select a wide-gamut working space like DonRGB, Wide-Gamut RGB or BestRGB and avoid converting into a narrow space like sRGB, ColorMatchRGB, AdobeRGB or AppleRGB. These will actually clip some colors, especially rich reds, cyans and bright yellows, that would be preserved in a wider color space.

If exporting for exclusive use on the web, the safest space to convert into is sRGB, but this should only be done on a copy image to preserve the integrity of the original capture or master edited image.

Having converted into a selected space, make sure the camera or editing software embeds the correct profile in the final image, and that the output process is ICC-aware and can use the camera profile correctly.

## Changing camera settings for live work

Production lighting will usually be different than when the target was captured. So long as the same type of lighting is used, the main adjustment needed from capture to capture is exposure, which should be adjusted using a combination of lighting position, aperture and exposure time. The goal is to bring the whitest area of the image to about the same level that the white patch of the target was at when the profile was made.

Camera balance should also be checked and if necessary adjusted for each new setup. Use a standard piece of gray card as described earlier.

Having created a profile, many photographers would like to be able to adjust the camera curve to suit each subject. This is acceptable so long as (a) the profile is 'sensitive' to a full range of values from 0, 0, 0, to 255, 255, 255 and (b) you remember that the more you change the curve, the less the profile will match the colors and contrast of the subject.

Note that for critical copy work or product photography, any departure from the curve used when the profile was built will make it harder to match the original.

When evaluating the capture, always make sure the camera or viewing software uses the profile correctly. If so, what you see on screen should be a close match to the subject with no additional adjustments. If not, either the profile or the software or the camera settings may be at fault.

Setting a relatively high contrast with a pronounced 'S' curve will emulate a 'film-like' look, but a lower contrast curve will give more realistic results, closer to the appearance of the actual scene. For product photography, where the ultimate goal is to reproduce the product as it actually appears, lower contrast curves are best. For snapshot photography a higher contrast curve is sometimes preferred, but for fine-art or landscape work a softer curve reproduces nature more truthfully than film.

## Sending RGB captures for output

Always attach or embed the correct camera or working space profile in the delivered RGB file and make sure the recipient understands how to use the profiles correctly.

Avoid converting to CMYK unless the printer sends you a profile and takes responsibility for it's quality. Remember that converting to CMYK makes YOU responsible for bad color on press!

Try to resist 'pumping' contrast or saturation during or after exposure. This can lead to clipped highlights or plugged shadows that just make it harder to get good detail in the CMYK separations.

If you must edit the image, make the changes as adjustment layers and send the layered file to the printer.

## Recommended workflow

The following workflow acquires a 'raw RGB' scan without any image-specific scanner adjustments, and applies a 'static' scanner profile to the raw scan. This workflow is recommended for all demanding work, especially when the best possible match to the original is required.

### Basic step-by-step overview

1. Scan an image with identical settings to the profiling scan with highlight and shadow densities fixed at about 0.10 and 4.00 respectively. Do NOT set highlight or shadow on the scanner.
2. Do NOT scan with any USM.
3. In Photoshop 6 (or higher), assign the scanner profile then (optionally) convert the image to an RGB working space like DonRGB4 ([www.hutchcolor.com/profiles.html](http://www.hutchcolor.com/profiles.html)).
4. View the image through the CMYK profile with Command - Y.
5. Create an adjustment layer for Levels and set the optimum white and black point of the image.
6. If necessary, create a Curves adjustment layer to lighten or darken or remove a color cast.
7. If necessary, create a Hue/Saturation adjustment layer to correct specific colors.
8. Save the RGB image with adjustment layers for use on subsequent corrections.
9. Convert the image to CMYK by 'Image - Mode - Convert to Profile' using perceptual intent and Apple CMM. Be sure to flatten the image in the conversion to apply the adjustment layers.
10. Apply USM to the CMYK image and submit a proof.

*NOTE: As with all workflows, accuracy and consistency are dependent on many factors, only one of which is the profile. Following this workflow does not necessarily guarantee accurate results.*

### Advanced workflow training

For more detailed instructions or custom RGB workflow training, contact the author at [don@hutchcolor.com](mailto:don@hutchcolor.com).

# Profile testing

## Quick visual test

Assign the profile to the target scan used to build the profile. If the image looks like the target on a properly profiled monitor, the profile is probably good. Scan some live images and view them the same way. You may need to set white and black in Levels for best results.

*NOTE: This test assumes you have a perfect monitor profile, which is seldom the case.*

## Printed test

To eliminate possible monitor errors, print the target scan on a well-profiled output device. Make two conversions, one using Intent: Perceptual and one using Intent: Absolute Colorimetric, both with Black Point Compensation OFF.

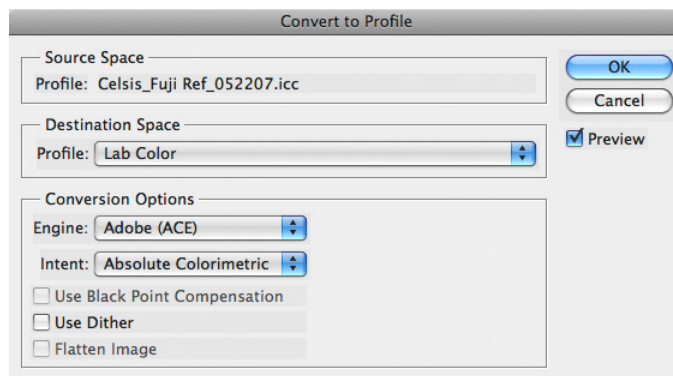
The perceptual conversion tests the profile's general performance but may not reproduce saturated colors or contrast accurately due to gamut compression in the output profile. The Absolute conversion should reproduce in-gamut grays, in-gamut colors and mid-range contrast accurately but may not look pleasing due to gamut limitations in the output device.

If at least one of the conversions looks like the target under proper viewing conditions (D-50 transmission and overhead), the scanner profile is probably good. Repeat with live images.

If neither conversion is acceptable (allowing for limitations in the output device) there may be an error in EITHER the scanner OR the output profile. We need to resort to more scientific testing.

## CIELab test

Open the target scan in Photoshop 6 and convert it to Lab Color, as follows. Record the Lab values in several key patches including middle grays, pastels and saturated colors.



*Converting the target scan to CIELab in Photoshop*

Open the reference data file in Microsoft Excel, BBEdit or another text editor and compare the Lab values for the same patches with the values recorded in Photoshop. Ideally all Photoshop samples should have a\* and b\* values within about + or – 1.0 of the reference file. Allow more tolerance in L\* values, e.g. + or – 2.0, but all L\* errors should be in roughly the same direction (e.g. all high or all low.) Extremely dark patches may show more errors due to approximations in the profiling software or limitations in the scanner itself.

Note that good scanner profiles are a compromise between precision and smoothness. If a profile reproduces all target patches perfectly, the profile may be favoring precision at the expense of smoothness, and may cause contouring, color reversals or other anomalies in live work.

## Causes of error

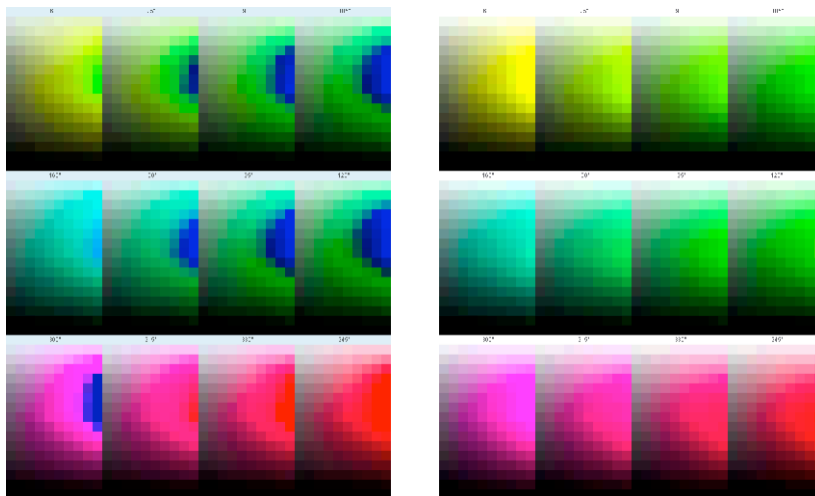
Profile errors may be due to numerous factors including, but not limited to;

- Using the wrong reference file
- Incorrect cropping
- Uneven scan illumination or balance across the target (especially with digital cameras.)
- Non-linearity of the scanner response curve
- 'Crossed' RGB curves or clipping or plugging in one or more of the scanner's RGB curves
- Inappropriate scanner response curve (too dark, too light or wrong curve shape)
- Matrix or 3-D color processing in the scanner software prior to making the profile
- Optical flare in the scanner or camera system
- Color changes in the target caused by fading, staining or mishandling

## Extreme gamut test

Good profiling software should reproduce RGB values outside the gamut of the target scan reasonably well, so that originals with higher contrast or saturation than the target will be handled correctly. To test extreme gamut compression, assign the scanner profile to the RGBXPLORER image available free at [www.hutchcolor.com/targetsandimages.html](http://www.hutchcolor.com/targetsandimages.html).

A bad profile may show sudden hue or lightness changes in one or more slices. A good profile will reproduce each slice smoothly, with no sudden hue or lightness changes.



*Bad gamut compression*

*Good gamut compression*

# Care and maintenance

## General care

The HCT is a valuable original. Return it to its protective packaging immediately after use.

Always keep the HCT in the same packaging it came in. All HCT packaging materials have been carefully chosen for archival safety with color film materials.

Handle targets by the extreme edge only. Avoid touching the working area (square patches).

Light is the enemy of photographic originals. The dyes used in photographic color film and paper are effectively bleached over time by exposure to light. Never leave a transparent or reflective HCT on a light box, except when judging color.

## Cleaning a transparent HCT

Remove finger marks, residual tape adhesive and mounting fluid from transparent HCTs with any high-quality film cleaning solution. Avoid hard scrubbing that may scratch the film.

If the target already looks clean, don't clean it unnecessarily. Excessive cleaning risks scratching or degrading the target.

If a small but stubborn spot appears in the working area it may be safer to leave it there and retouch it out later, rather than risk scratching the target while attempting to remove it.

## Cleaning a reflective HCT

Remove dust from reflective targets prior to scanning with a blower brush or oil-free anti-static brush. Oily deposits or finger marks should come off with LIGHT PRESSURE from a clean, lint-free cloth and film cleaning fluid. Be sure the fluid is intended for photographic prints.

Avoid polishing with harsh scanner wipes that may scratch the print's surface.

## Water-based cleaning (extreme cases only!)

**WARNING:** *This should only be attempted with equipment designed for washing and drying photographic materials, and by workers experienced in handling wet emulsions.*

In extreme cases water-based stains on transparent or reflective HCTs may be removed by washing the HCT for about thirty minutes in clean running water, then drying it again.

The biggest dangers when washing transparencies and prints are (a) scratching the soft emulsion, (b) dust accumulating during drying and (c) a change in color or density.

After an HCT has been water-washed it may change color slightly, possibly invalidating the reference file. If this happens you should have it re-measured. HCT re-measuring services (except 35mm) are available through your HCT dealer.

You can check if an HCT has changed due to washing and drying by scanning it immediately before and after washing. If its RGB values remain within +/- 1 or 2 then it has NOT changed.

**NOTE:** *Washing photographic paper or film in water will temporarily turn the emulsion a pale, which seems to ruin the target, but this milky color will disappear when the material dries.*

## Longevity

The useful life of an HCT target depends on how the target is handled, used, viewed, and stored, as well as on the aging characteristics of the emulsion itself. Due to the wide number of variables, HutchColor, LLC cannot guarantee a specific lifetime for an HCT target.

The emulsions on which HCT targets are made are claimed to have excellent long-term keeping qualities and better than average resistance to dye fading.

## Testing the target

You can test any scanner target (that you have previously used), as follows:

- Scan the target on the same device you profiled previously, with identical scanner settings.
- Make a new profile using the EXACT SAME profiling software and settings as before.
- In Photoshop, assign the new profile to the target scan, or to any typical raw RGB scan.
- Assign the old profile and observe any change on screen.
- If the image appears the same to the eye with both profiles, the target is still good.
- If the image on screen changes significantly, the target has probably changed.
- If the change is unacceptable, you can either have the target re-measured (see your dealer or the HCT website for pricing and availability) or you can buy a new target.



## Frequently-asked questions

### Older reference file date

Q: The HCT website says "Actual measurements are made as near as possible to the shipping date." but my brand-new HCT has a reference file dated several years ago. Did I receive an old target by mistake? How will this affect the quality of my profiles?

A: HCT targets are measured as near as possible to the date when they are shipped TO THE WHOLESALER, but we cannot control how long a target will sit in the wholesaler's inventory.

Recent tests on a selection of control targets that were NOT REFRIGERATED produced a PEAK (worst case) error after more than three years of LESS THAN 1.0 DELTA-E(ab) from the original reference file. This is well within the tolerances of a good spectrophotometer, and approximates the error produced by reading the same target twice on the same day.

Although these tests indicate a very long shelf life, unshipped HCT targets are kept in refrigerated storage until they are shipped.

### Does my software support the HCT?

Q: I have (or am thinking of buying) software called (insert your software name here). Does it support the HCT target?

A: If you do not see the software listed on the HCT website, it may support the HCT but we may not yet be aware of this. Please ask the software manufacturer directly, and if it does, please let us know and we will up-date the HCT website accordingly, after testing the software.

### Grainy or noisy scans

Q: Upon enlarging the HCT target scan I notice a lot of grain in the patches. Should I attempt to smooth out the grain before creating the profile?

A: NO! Any grain you see is a normal product of film emulsions and/or the scanner, and is actually valuable in helping an 8-bit per channel scanner "see" more than the normal 256 tone levels. Good profiling software will integrate (average) the grainy pixels to produce an RGB value with better than 8 bit precision. If you try to smooth the HCT target scan (or even a live original) for example with a noise filter, you will actually be reducing the precision of the profile.

### MonacoPROFILER rejects the target scan

Q: MonacoPROFILER tells me there is a problem with the target scan and refuses to build a profile. I have scanned and cropped the HCT correctly. What's going on?

A: This is the result of over-cautious software combined with a slight change in the target design. Monaco software is pre-programmed to reject any target scan whose gray scale RGB values are outside a certain tolerance. In the latest HCT design, some of the gray-scale patches have been altered to be slightly pastel-colored, which improves profile accuracy in near-neutrals, but this puts the patches over the RGB tolerance limit expected by Monaco.

The Windows solution is to modify the "neutral ramp bumps error maximum:" value.

The Macintosh solution is to alter the "maximum initial  $\Delta E$  error maximum:" value.

You can get full instructions on how to do this from Monaco support, but here are some suggestions. Note that these instructions MAY NOT BE ACCURATE, and may not work, or remain necessary, as the software evolves.

In Windows go to;

C:\ Program Files\ Monaco Systems\ MonacoPROFILER 4.6.1\ Preferences\ ScannerData.rtf

... and make a note of the NEUTRALRAMPBUMPS value.

Now modify the registry key in a terminal window by typing;

RUN REGEDIT

HKEY\_CURRENT\_USER\ Software\ Monacosys\ MonacoProfiler\ ScanLimits/  
NEUTRALRAMPBUMPS

Adjust the value to be greater than the value found in ScannerData.rtf.

In Mac OS X go to;

Library\ Application Support\ Monaco\ MonacoPROFILER\ Input Statistics

... and note the "maximum initial  $\Delta E$ :" value.

Now go to;

Library\ Application Support\ Monaco\ MonacoPROFILER\ Input Limits

... and increase the " maximum initial  $\Delta E$  error maximum:" value to slightly greater than what was reported in the statistics file.

If you still can't build a profile, contact Monaco Systems for help.

## Gray patches not neutral

Q: Some of the patches in the gray scale seem to have color in them. Won't that upset the balance of my profile?

A: No. So long as the reference file contains the actual CIELAB value of each patch, the software should make a good profile. In the latest HCT design, some of the patches that were originally 'gray' have slight pastel-color variations to improve profile accuracy in near-neutrals.

## Dark 35mm profiles

Q: Why do all my 35mm slides look too dark? I followed the instructions exactly.

A: Relax, this is quite normal and no, it is seldom a failure of the target or even the profiling software. There are probably several factors at work.

First there is the problem of flare. If the darkest patch in the target produces lighter-than-normal RGB values due to optical flare from adjacent patches (very common in 35mm scanners), the resulting profile will add density to live images in which flare may be less active or nonexistent. An 'extended range' profile may solve density problems caused by flare but see 'Scanner flare' on the Instructions page for other suggestions.

Secondly, 35mm transparencies submitted for reproduction are usually selected under non-standard viewing conditions that make them appear lighter than they really are. So a scanner profile that works well for 4x5 or 8x10 inch transparencies will usually SEEM too dark when used on 35mm transparencies. In this case the simple solution is to make a modified profile just for 35mm scans with a built-in lightening edit. See 'Lightening dark 35mm profiles' on the Instructions page for more details.

## HCT profiles darker than IT8 profiles

Q: My HCT profile makes images look a little darker and 'flatter' (lower contrast) than my IT8 profile. How can that be an improvement?

A: This is a normal and intentional result of the HCT having a lighter white patch and darker black patch than a typical IT8. The HCT's extended density range creates a profile that accurately captures the very lightest and darkest tonal values that might ever be encountered in any original, but this means 'average' originals with less extreme end densities will at first look a little flat. The problem disappears after setting highlight and shadow, for example with Photoshop's Levels control.

IT8 profiles generate more apparent contrast with less editing because most IT8 transparent have a lower contrast (lighter black patch and darker white patch) than the HCT. While images will often look better with no edits using an IT8 profile, but there is a real danger of losing extreme highlight detail in extremely light image areas (for example metallic reflections) or losing deep shadow detail in extremely high-density originals or under-exposed transparencies.

## Lost catch-light detail

Q: When I scan some 35mm chromes with burnt-out highlights, why do I lose the very lightest tones?

A: Although we work very hard to ensure the HCT's white patches represent the lowest possible D-min (minimum density), some originals may have an even lighter D-min, which may not be recognized by some profiles. This may be caused by varying thickness or different plastics in the base. You can solve this by extending the highlight range of the HCT target scan prior to making the profile. (See '*Extended-range profiles.*')

## Missing reference file

Q: I've lost the CD. How can I get a new reference file?

A: Go to [http://www.hutchcolor.com/HCT\\_data.htm](http://www.hutchcolor.com/HCT_data.htm) and download the file with the same number as your target. If it's a 35mm target, download the file whose two code numbers encompass yours, eg. 35mm target 6018 uses reference file number '6000-6028'.

## The software won't accept the reference file

Q: My profiling software refuses to accept (or produces bad results with) the supplied reference file.

A: Some very early reference files had an error in the file format. Corrected files were uploaded on 08/29/01. Please download a new copy of your reference file.

## Which reference file?

Q: The CD that came with my HCT contains many reference files. Some produce good results but some make awful profiles. Which one should I use?

A: Every HCT comes with a numbered sticker attached. The reference file with exactly the same number is the only correct file for your target. Some other reference files may happen to produce reasonable results while others will be very unacceptable. The reasonable results indicate targets from the same batch as yours. The unacceptable ones came from a different batch.

## 35mm reference files

Q: Why can't I find a reference file with the same number as my 35mm target?

A: 35mm targets are produced in small batches of about 25 at a time, all cut from a single sheet of 8x10 inch film. Use the reference file whose two code numbers encompass yours, e.g. 35mm target number 6018 uses reference file number '6000-6028'

## Really weird results in any software

Q: Why are my HCT profiles giving weird colors and/or a high error report?

A: Sounds like you cropped the target wrong in the profiling software. Nothing spoils a scanner profile quicker than incorrect cropping. Maybe you used the wrong reference file. Go back and create the profile again and pay close attention to cropping and selecting the correct reference file. If that doesn't solve the problem, check your scanner settings. Did they change between capturing the target and scanning live work?.

## ColorBlind software problems in saturated colors

Q: I made a profile with ColorBlind Professional but it seems to be wildly inaccurate in very saturated colors. Is this a fault in my HCT or the reference file?

A: Neither. It's a fault in the ColorBlind software. Whether you profile with the IT8 target or the HCT, ColorBlind Pro scanner profiles often exhibit reversals or false color if presented with RGB values outside the range of the target scan. This can be tested by assigning the scanner profile in Photoshop to the RGBXPLORER test image at [www.hutchcolor.com/Images\\_and\\_targets.html/](http://www.hutchcolor.com/Images_and_targets.html/). The problem can be reduced by lowering the quality setting from 4 to 3 or 2, but with a subsequent loss of profile accuracy. For best results use another software.

## ColorBlind software problems in grays

Q: How can I reduce the gray balance error I'm getting with ColorBlind HCT profiles?

A: Switch off "Gray Correction" in the dialog just prior to saving the profile. To see the dialog box in versions prior to 4.0, hold down Control + Option before clicking Create.

## Patches with a checkerboard pattern

Q: Upon enlarging the HCT test scan to check for dust I noticed a faint pixelation pattern in some patches. Should I send the HCT back for replacement?

A: No, everything is normal. Some HCT patches may contain a low contrast checkerboard pattern, noticeable under magnification or in the test scan. This pattern is INTENTIONAL and does not reduce the target's performance. Do NOT try to eliminate the pattern by blurring or cloning as that will reduce the quality of the profile.

## Digital camera problems

Q: Why can't I get a decent camera profile?

A: The most likely causes are reflections on the target surface, or uneven lighting. Take great care to light the target evenly and make sure there are no reflections on its surface. An easy way to test this is to place a mirror or piece of shiny black plastic in place of the HCT, look through the lens or make a capture of this 'reflection tester' and move it around till it shows no reflections, then replace it with the target.

If this doesn't work you may be experiencing metamerism failure - a largely unavoidable problem in digital photography that stems from differences between the colorants in your subject and the dyes in the target, combined with camera filtration and lighting issues. Try profiling and shooting under tungsten illumination. It may be hot and slow but tungsten usually reduces metamerism problems.

## Warranty

All HCT targets manufactured and packaged by HutchColor, LLC are warranted to be free of manufacturing defects for six months from date of purchase. Because all photographic materials, even with careful storage and handling, may fade or change color over time, this warranty does NOT cover fading or deterioration of the HCT due to aging, exposure to light, improper storage or handling, or normal wear and tear. Liability is limited to re-measuring or replacement of the target at the sole discretion of HutchColor, LLC. A charge will be made for re-measuring if the problem is determined to be due to aging, wear and tear and/or improper storage or handling. All claims related to measurement accuracy must be made within 90 days and must be accompanied by the target in its original packaging, complete with serial number sticker. Return shipping is payable by the client. Minor design differences, or cosmetic blemishes outside the working area, are NOT covered by this warranty. HutchColor, LLC does NOT recommend or warrant any third party hardware or software used with the HCT. Because ICC profiles are critically dependent on software and hardware, the performance and/or measurable accuracy of ICC profiles made from the HCT are NOT warranted by HutchColor, LLC.

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