

Cultural Heritage

Color Reproduction Guide



CulturalHeritage

Cover Image:

Fruit Piece; Jan van Huysum, Digital image courtesy of the Getty's Open Content Program.

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Colophon & Acknowledgments

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1

BASIC REFERENCES AND TOOLS NEEDED

1.1 The Importance of Color/Tone Accuracy

The goal of digitization is to create Preservation Digital Objects (a TIFF or JPG2000) to serve as a surrogate to the original object, replacing physical access to that original object, aiding its preservation and broadening access to its content. The FADGI, Metamorfoze and ISO imaging guidelines outline those elements of image quality that are required to achieve such surrogacy.

Many institutions focus on the resolution (PPI) and sharpness (sampling efficiency) requirements of the FADGI, Metamorfoze, and ISO guidelines. But the color accuracy and tonal accuracy requirements are just as important.

There are three requirements for achieving preservation-grade color and tone:

- **Preservation-grade Hardware**
- **Preservation-grade Color Profile**
- **Preservation Workflow**

This guide addresses these three requirements in the context of solutions provided by the Digital Transitions Division of Cultural Heritage. Please do not hesitate to contact us with questions, feedback, or to arrange an in person or remote training on the topics covered in this document.

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1.2 Tools Used in this Document

Software:	Phase One Capture One CH basIColor Input (for optional creation of custom in-situ profiles)
Color Targets:	ISA Golden Thread Device Level Target (for FADGI validation) X-Rite ColorChecker SG (for creating custom profiles)
Validation:	ISA Golden Thread (preferred for FADGI validation) Delt.ae (not as complete as Golden Thread, but free)
Even Fielding:	Plain gray paper cardboard. White can also work if care is taken to expose it correctly (see 3.4.1).

1.3 Guideline References

For detailed information about the FADGI and Metamorfoze and ISO guidelines, please refer to:

Federal Agencies Digitization Guidelines Initiative (FADGI), Technical Guidelines for the Still Image Digitization of Cultural Heritage Materials
www.digitizationguidelines.gov

Metamorfoze Preservation Imaging Guidelines
www.metamorfoze.nl

Photography -- Archiving systems -- Image quality analysis
ISO 19262, ISO 19263, ISO 19264

Digitization Program Planning by Digital Transitions, a Comprehensive and Practical Overview of Cultural Heritage Digitization
www.dtdch.com/digitization-program-planning/

1.4 Types of Color Profiles

An essential requirement for accurate color and tone is the use of a preservation-grade color profile. There are a variety of types of color profiles that can be used with capture devices.

Standard Commercial Profiles:

General purpose cameras and photography software are designed to provide “pleasing” color in contexts such as casual snapshots or wedding photography. Such profiles are sometimes known as “abstract profiles” as they are not intended to produce accurate color. For example, commercial cameras and software will often attempt to render skintone with less variation than is actually present in order to even out blotches in the face. This can have adverse effects on paper tones; because they are similar to skintones profiles that attempt to render skintone with less variation will also remove subtle variations of paper tone that may reveal something of the condition, provenance, or meaning of paper-based cultural heritage items.

This is just one example of the consequence of using a camera and software designed to provide “pleasing” rather than “accurate” color. Such cameras and software will not pass FADGI or Metamorfoze standards and should not be used for Cultural Heritage digitization.

In-Situ Profiles:

Because most camera/software combinations come with profiles that are designed for “pleasing” color, there are a variety of software packages available that allow the user to create more accurate color profiles. These work by having the user capture a single image of a single color chart in whatever situation the camera is set up and extrapolating from this single image a more general color response; this is called “in-situ profiling”. If executed with expertise and care this process can result in preservation-grade color profiles.

However it is a time consuming, tedious, and error-prone process. For best results the user must also measure their specific target with at least one colorimeter (preferably more) since every copy manufactured target varies slightly from the “average” of that target type. It also requires an impractical adherence to the 45° lighting angle and creates profiles that are fragile to slight changes in setup. Moreover, most users validate the quality of an in-situ profile by another capture of the target used to create the profile in the first place, unaware of the circularity of this logic. Still, in-situ profiling is the only viable option for cultural heritage imaging when bespoke profiles cultural heritage profiles are not available for a specific [camera+light+software] setup.

Bespoke Cultural Heritage Profiles:

The color science team at Phase One creates and validates bespoke cultural heritage color profiles through a lengthy process. They capture many color targets, each measured carefully by a spectrophotometer, in a nearly ideal environment (e.g. dark walls, no flare, no glare). The target captures are analyzed using proprietary software they’ve created in-house for just this purpose. Like any profiling software this creates profiles that can over fit specific points of data, so the color science team adjust these profiles using a database of real-world captures taken under slightly varying conditions. These candidate profiles are sent to several partner institutions for feedback and further tweaked as needed. The end result is a robust preservation-grade profile with color accuracy across a variety of subtle changes in setup, without the fuss of in-situ profiling.

2

Hardware Setup

2.1 Camera Setup

There are several important aspects to take into account when selecting and preparing a camera for an accurate reproduction workflow.

A solid and sturdy repro stand is required to support good still captures. It should hold the camera exactly perpendicular to the object, isolate the camera from environmental vibration, and allow fine-tuned movement of the camera to easily return the camera to known capture positions. All DT reprographic stations meet these requirements.

If shooting objects (e.g. vases) a sturdy tripod or studio stand is useful. All DT reprographic stations can be removed from the reproduction stand and placed on a tripod or studio stand. This document focuses on flat reproduction, but many of the concepts can be applied to object photography.

The choice of a suitable camera system for reproduction workflow can be a dedicated repro camera such as the DT RCam or SLR-type camera such as the Phase One XF on which the creation of capture-induced vibration is minimized by use of leaf shutter lenses and optional sensor-based electronic shutter. A high-quality lens hood should be used to decrease the chance of veiling glare which can negatively impact the contrast of the camera.

The quality of the lens and sensor also contribute to the quality of color and tonal accuracy. For example, even a very slight flare can alter contrast and wreak havoc with the profiling process. The Schneider LS lenses and Rodenstock HR lenses used in our solutions are very flare-resistant and provide excellent contrast. Likewise a sensor with 16-bit output, such as that from Phase One digital backs, provide more precise data for profiling and validation than sensors with 8-bit to 14-bit output such as those from Canon, Nikon, Sony, Pentax, Fuji, Microbox and scanners such as i2s or Epson.



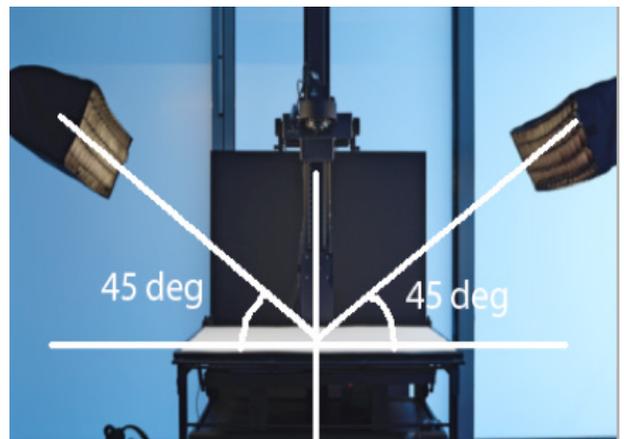
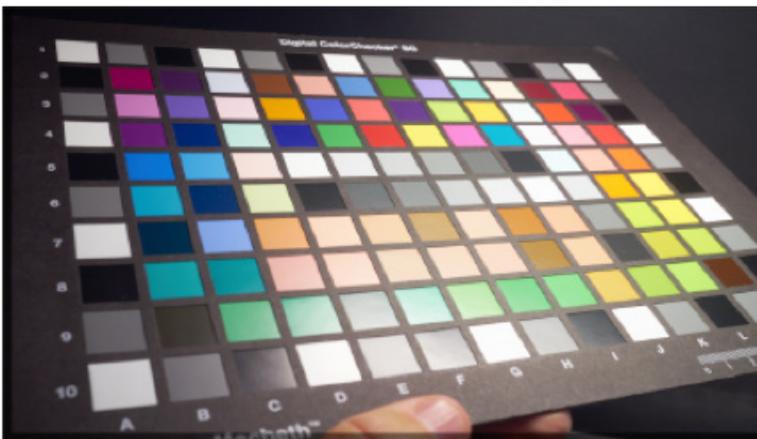
2.2 Lighting Set-up & Shielding

A proper lighting setup and a well controlled environment are important for accurate reproduction of tone and color. The room should have gray or dark walls and ceilings rather than white, which can reflect stray light back onto the object from unintended angles. The station should be well isolated from neighboring workstations (if any) using curtains, walls, or dark foamcore V-flats. The area surrounding the object which is outside the camera view should also be dark or black to avoid stray light and veiling glare.

The lighting itself should use hoods or grids to minimize stray light, preferably made from a hard inflexible material that is conducive to lighting consistency from one day to the next (fabric grids are workable, but not ideal). The DT Photon LED system has optional hard metal hoods for this reason.

For the creation of in-situ profiles the lights should be positioned as close to an incident angle of 45 degrees as possible. With this requirement in place, the captured colors of a color target can be matched to the spectrophotometer-measured values delivered with your color target.

If the lights are installed such that the incident angle is varying from the 45 degree, this can greatly influence the measured color values of the patches of the color target. In such cases, the use of the captured color values as basis for generating an ICC profile using 3rd party software can generate unreliable results. A capture of the ColorChecker SG color target using lights positioned to deliver incident angles between 30 and 60 degrees can deliver color differences of up to 11 deltaE.



However, in normal digitization 45-degree illumination can be highly impractical. It can create reflections and specular highlights, especially on glossy material or material that is not perfectly flat. Consequently, a lower angle such as 35-degrees is preferred for day to day digitization.

Lower lighting angles can be used to accentuate the texture and dimensionality of the object. It's also possible to light only from one side to further accentuate shadows, and then use the LCC Tool in Capture One to even the brightness of the subject. These techniques are covered in the DTDCH Webinar Series at dtdch.com/videos/

3

Workflow for Bespoke CH Profiles

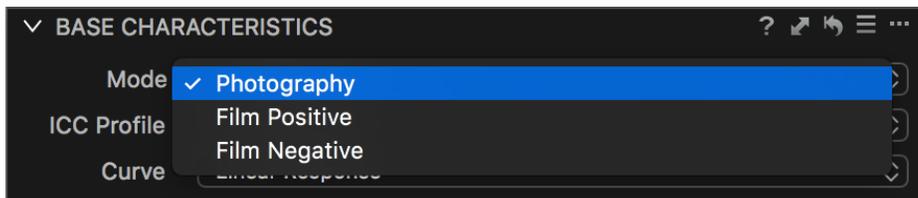
3.1 Set Mode

Capture One CH contains several helpful tools and features that are specially designed for a reproduction workflow. This chapter shows the basic setup of Capture One CH and guides through the steps necessary for achieving a high quality and accurate reproduction workflow complying with the most stringent requirements of the FADGI, Metamorfoze, and ISO Imaging Guidelines.

From the tool panel, select the Color tool tab



The Base Characteristics tool includes additional options not available in Capture One Pro



A Mode selection is added in the Base Characteristics tool and is unique to Capture One CH. It allows the user to select basic parameters for various common workflows and easily choose between the different options. Three modes are available:

- Photography:** All reprographic and photographic tasks other than scanning film.
- Film Positive:** Use this mode for reproducing positive films.
- Film Negative:** Use these modes only for reproducing negative films.

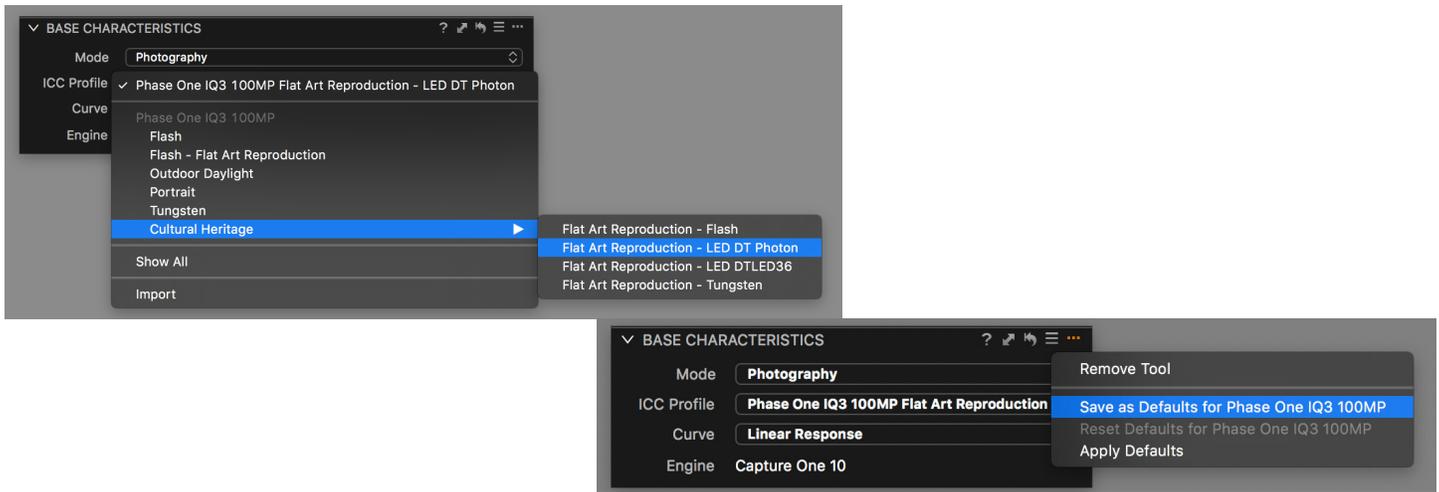
These two film modes take into account the very non-linear tone/color distribution found in film originals. DT makes a high-performance film scanning solution, but film scanning is not covered by this document.

Tip:

The **Repro Negative** mode inverts the image tonal value internally. This is most often used when capturing negative film materials, so that the image appears on screen as a standard (positive) image. When using this mode with negative materials all tools in Capture One CH behave normally, like with any positive original.

3.2 Set Color Profile

1. For 2D flat art reproduction and digitization of books, choose the specialized ICC-Profile in Capture One CH made for your light source. Unless you plan on changing light sources frequently you should then select [...] and Save As Defaults to skip this step in the future.



Profile Description

- Flash** For a setup with strobes such as Profoto using heads and rectangular soft boxes
- LED DT Photon** For the DT Photon and DT Photon XL LEDs made by Digital Transitions
- LED DTLED36** For the first generation LED light from Digital Transitions, the DT 36 INCH LED.
- Tungsten** For Tungsten lights (3200K)
- LED Rosco** For the Rosco, Model LitePad Axiom Daylight LED. Only available for some backs.
- North Light HID** For the legacy Northlight HID light. Only available for some backs.

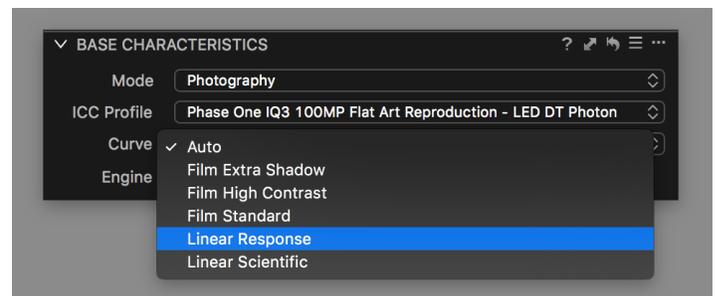
For more information about Capture One CH specialized ICC-Profiles please refer to Chapter 1.4

3.3 Set Curve

Choose the “Linear Response” curve for most flat art reproduction. The linear response curve is linear throughout most of the tonal range, but provides slight compression of bright highlights that preserves tone and color in highlights. Select [...] and Save As Defaults to skip this step in the future.

The “Linear Scientific” provides absolutely linear tonal values. However because it is completely linear it will often lead to inelegantly clipped highlights when used with materials that have any gloss or dimensionality. So we recommend this curve only if you are reproducing artwork with no dimensionality or gloss.

Linear Scientific is also used for creating in-situ profiles, as in the workflow presented in Chapter 4.



3.4.1 Capture LCC Raw File

The Lens Cast Calibration (LCC) Tool helps you to create luminance uniformity for your reprographic setup.

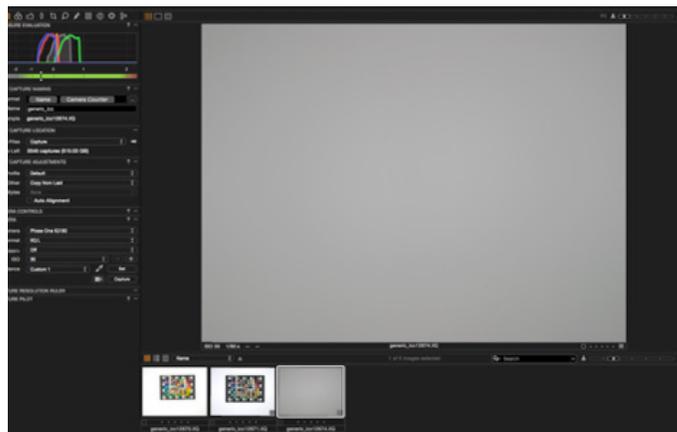
1. Place a plain gray cardboard on the surface of your repro table.

Make sure that you place it flat and flush against the table and that it covers the complete field of view. It is important that there are no objects other than the gray board visible in the image. Therefore choose a plain gray cardboard that is larger than the material you want to photograph.



2. Capture an image of the cardboard covered scene using the same aperture and lighting as you'll use for the actual object. It's very important that no part of the image is blown out (e.g. 255 RGB value) or anywhere close to it. With a gray board this is easy to achieve with a normal exposure.

However, if needed adjust only shutter speed or the strength of the light source for balancing the exposure. The aperture has a significant influence on this reference and should be set to the value you want to use for image capture. The resulting image should look similar to the sample shown.



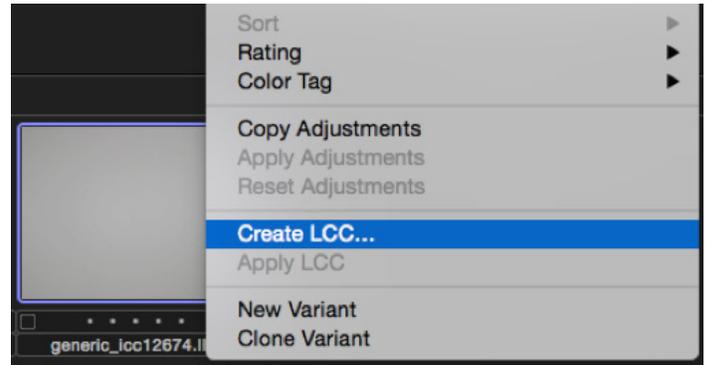
3.4.2 Create LCC Reference

You can now generate an LCC profile from the image of the gray cardboard. There are two possible ways to begin:

Method One

Right-Click on the thumbnail of the gray cardboard and select Create LCC.

Tip: On a Mac without a right mouse button, use "CTRL + mouse click" for entering the context menu.



Method Two

Via the Lens tool tab select the image of the captured gray cardboard in the Browser and choose Create LCC in the LCC tool.

After pressing Create LCC (either started with the first or second method), a dialog box will open showing the following options for the LCC profile that will be calculated. **DO NOT** check any of the options. Press Create to start the calculating process.

After calculating you should see the selected reference image of the captured gray cardboard marked as a LCC reference file. The letters LCC will appear above the thumbnail image. In the LCC tool the boxes for Color Cast and Enable Uniform Light should be checked and available. You have now created a valid LCC Profile for this capture setup.

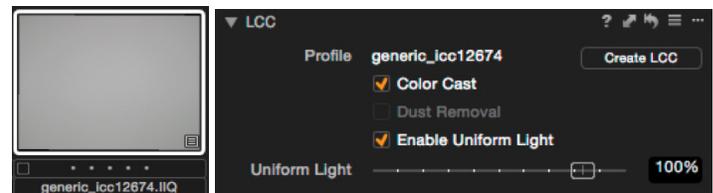
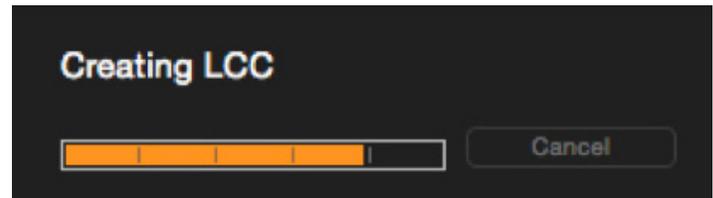
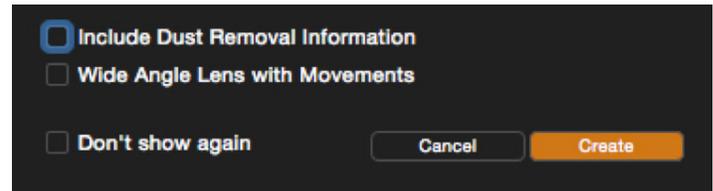
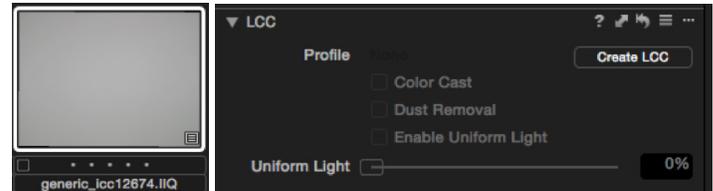
Note:

An LCC profile is only valid and usable for images taken with the same Digital Back or Camera under identical lighting conditions. You have to prepare a new LCC Profile to create luminance uniformity if you:

- Change the aperture
- Change the distance to the subject
- Change the angles of the light setup
- Change the lens or digital back

Tip:

You may wish to rename the capture of the gray board before you generate the LCC from it. For example, you could name it "72mm, f8, 600ppi distance". This will be the name of the LCC that is subsequently applied to incoming captures and will be more intuitive.

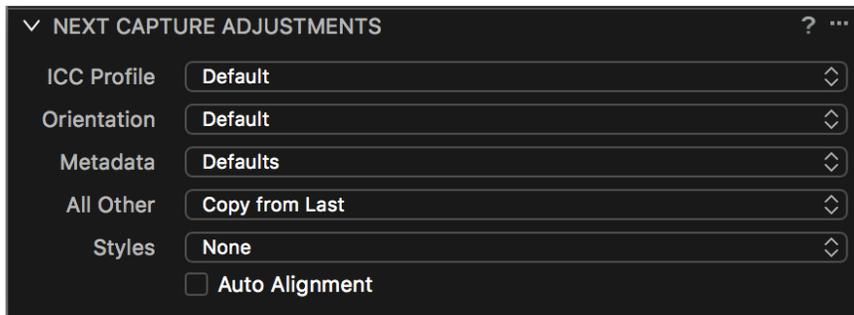


3.5.1 Application of LCC (Automatic)

In the Camera tool tab there is a tool called Next Capture Adjustments. When shooting tethered with the camera attached to the computer, you can choose the settings and adjustments to be applied to the next capture. The factory default setting is useful in this example to automatically apply the LCC profile.

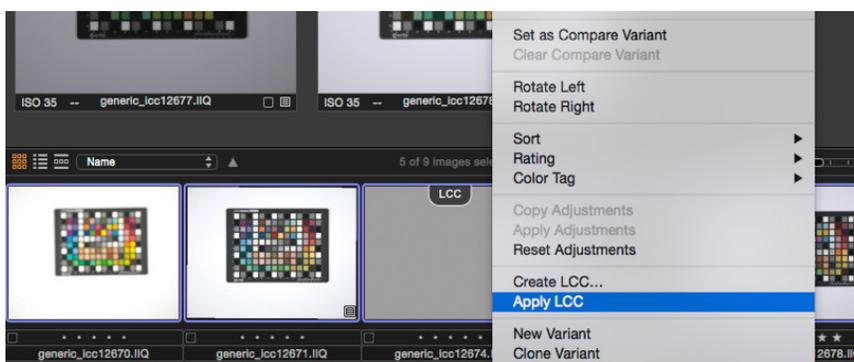
The first option - ICC Profile is set to Default in the factory default settings so it will choose the ICC Profile you set in the Base Characteristics tool (See also Chapter 3.2)

The All Other option is set to Copy from Last by default. This will ensure that every setting that is made with one of the Tools in Capture One is automatically applied to the next captured image. This includes the newly created LCC profile from the last image. All subsequent images will be precisely corrected, using this LCC, until you make changes to the lighting.



3.5.2 Application of LCC (Manual)

To manually apply an LCC profile to another image, select the LCC reference image (with the letters LCC tagged above) together with all images that you wish to apply this LCC profile to. Then Right-click on one of the images with your mouse or CTRL-click to access the context menu and select Apply LCC.

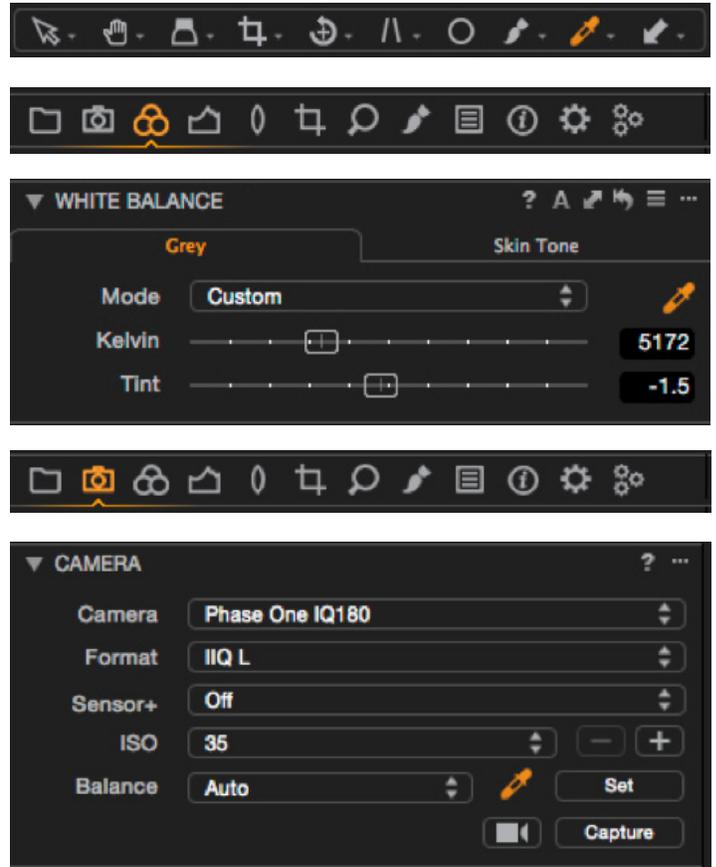


3.6 Set White Balance

Setting the correct white balance is as important as setting the correct exposure. The white balance can be measured with the white balance picker.

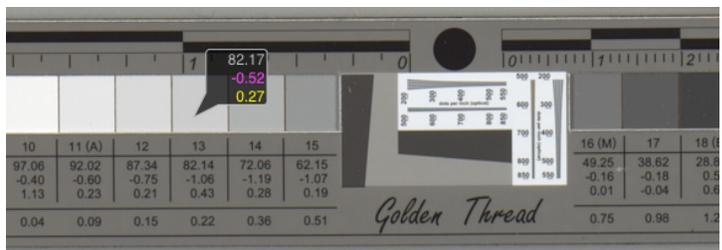
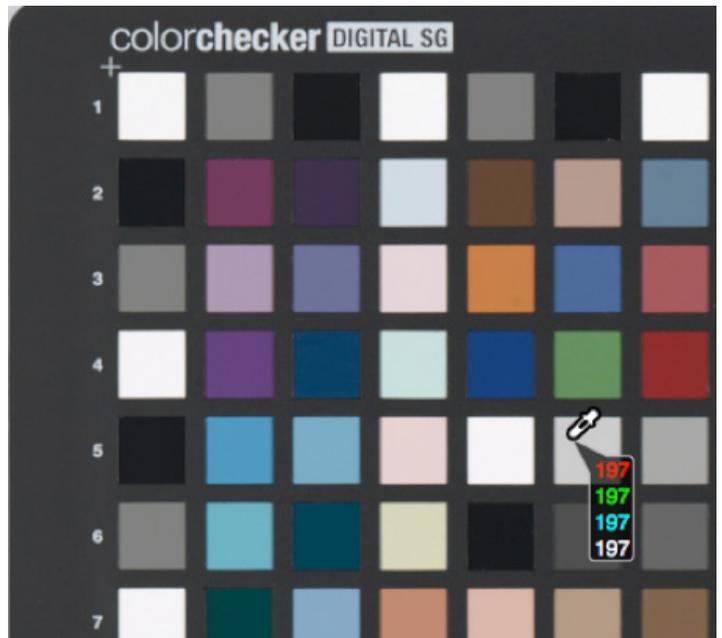
The White Balance picker is located in the Cursor Tools.

It can also be found in the Color Tool Tab in the White Balance Tool or in the Capture Tool Tab in the Camera Tool.



The ideal patch to set White Balance is Patch 13 on the ISA Golden Thread target or patch F5 on a ColorChecker SG.

Click on that patch with the White Balance cursor. If using RGB values should become equal after clicking to set the White Balance, or have a maximum of one or two values in difference. If using LAB values the A and B values should drop to a fraction of a point.



3.7 Set Exposure

To ensure correct exposure, you will make sure a specific patch in your chosen target conforms to its ideal value.

How to Measure

Hover the cursor over the patch in the viewer and its values are shown in the middle above the image.

Capture One also provides an option to have multiple readouts displayed in various areas of the image. Click and hold on the second to last cursor icon and select Add Color Readout.

LAB vs RGB

RGB values vary based on which output color space is used while LAB values are the same in any output color space.

To use LAB Readouts rather than RGB select [View > LAB Readout > GoldenThread (ICC)].

NOTE: LAB values are only available in Capture One CH. They are not available in Capture One DB / Pro.

What to Aim For

The Golden Thread ISA Target patch 15 should have a Luminance value of 62.2 or an RGB value of 149.

The ColorChecker SG target patch G5 should have a Luminance value of 65.1 or an RGB value of 156.

NOTE: The above values are based on the “average target” and assume use of the Adobe 1998 output and a 45° angle of illumination. See Chapter 6.3 for additional aim point information and Chapter 6.4 for more technical details.

What to Adjust

To achieve the correct exposure you should mainly rely on changing the shutter speed (for DT Photons) or strobe power (for strobes such as Profoto). However, small positive values (e.g. <0.2 stops) can be used on the Exposure slider in Capture One.

Why Measure Gray Rather than White or Black

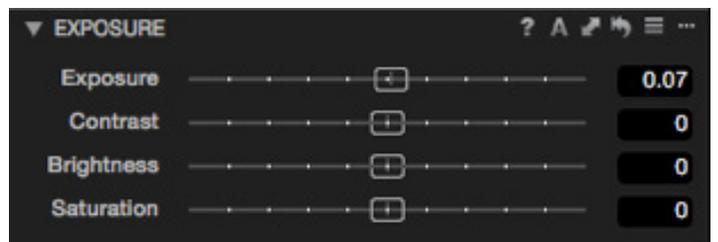
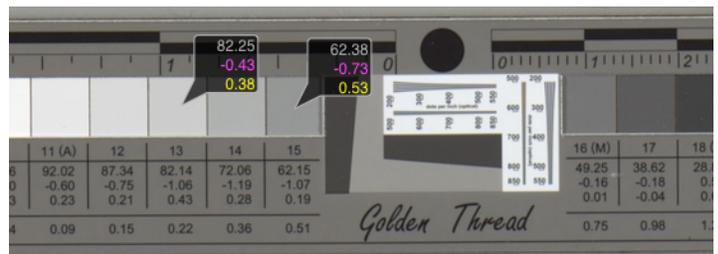
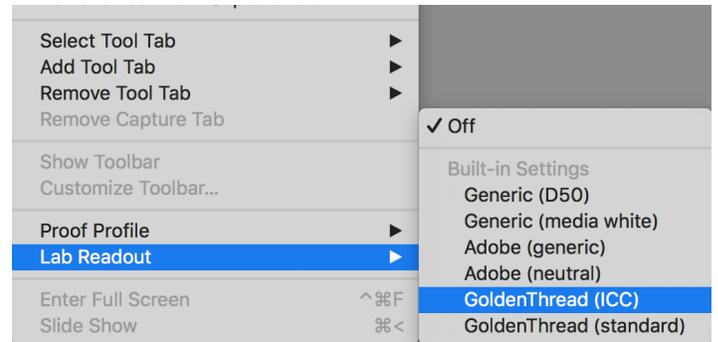
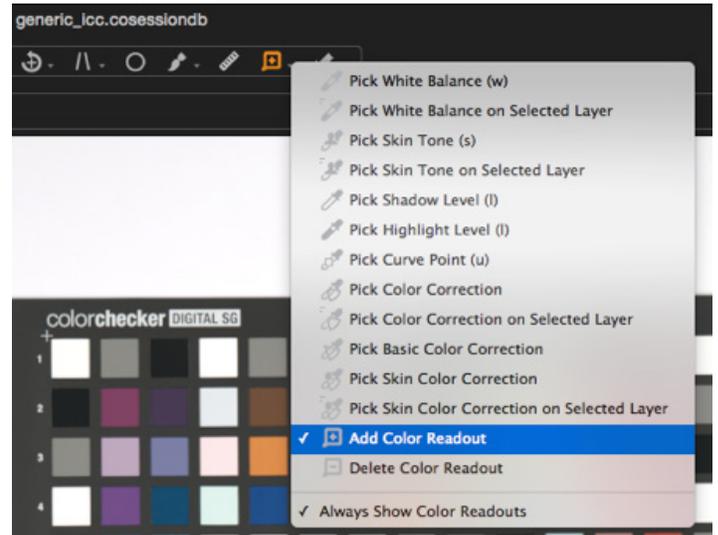
Some guides would suggest using a white patch (e.g. patch 10 on an ISA target or Patch E5 on a ColorChecker SG) to set the exposure. This is acceptable when Linear Scientific curve is selected. But the Linear Response curve has a slight rolloff in the highlights, so setting the exposure based on a white patch when using Linear Response will result in an overexposed image.

Using the recommended gray patches works equally well with Linear Response and Linear Scientific.

How Accurate Must You Be

A point or two of variation is not necessarily cause for alarm. This is especially true if you have not measured your specific physical chart; every manufactured chart is slightly different.

Chapter 5 “Image Quality Analysis & Standards Validation” covers methods to analyze your capture to determine its quality of reproduction.



4

Workflow for In-Situ ICC Profiles

A preservation-grade ICC profile is essential to achieving accurate color and tone. Capture One CH already contains a wide list of ready-made ICC profiles for high accuracy color reproduction for digitizing projects in Cultural Heritage use. These profiles are created with expertise and care, specifically for the combination of digital back model and lighting. Combined with the individual digital back factory calibration (a multi-hour process!) these profiles are extremely accurate and robust. If these profiles suit your workflow (i.e. you are using one of the light sources and digital backs for which a profile is already included in Capture One CH) then using that profile is always preferable to the cumbersome, error prone, and fragile process of in-situ profiling.

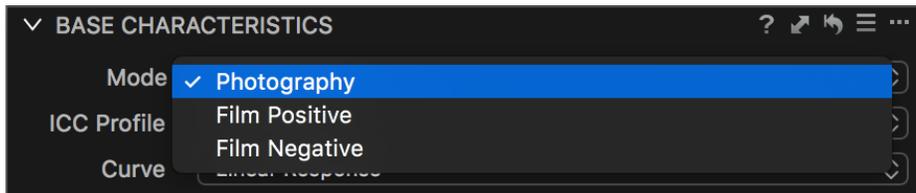
However, sometimes these ready-made ICC profiles of Capture One CH do not fit your environment, equipment or lighting. Alternatively, you may be using Capture One Pro or Capture One DB, which do not contain our ready-made ICC profiles made for Reproduction use. The following Chapter shows a possible workflow for creating a custom ICC-Profile using 3rd Party Software. In this example we use basicColor Input.

4.1 Set Mode

From the tool panel, select the Color tool tab



The Base Characteristics tool includes additional options not available in Capture One Pro



For generating an in-situ profile select Photography.

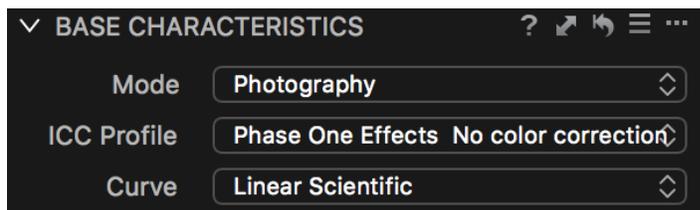
For more information on other modes see Section 3.1.

4.2 Set Color Profile

Because we are capturing an image that will be used to generate a profile, it is important that we show the native unprofiled response of the camera. Otherwise we will be “double profiling” the system.

To do so, under ICC Profile, select “Effects > No Color Correction”. It may be necessary to select Show All from the ICC Profile Menu in order to gain access to all the ICC-profiles; the No Color Correction Profile can be found in the Effects sub-folder.

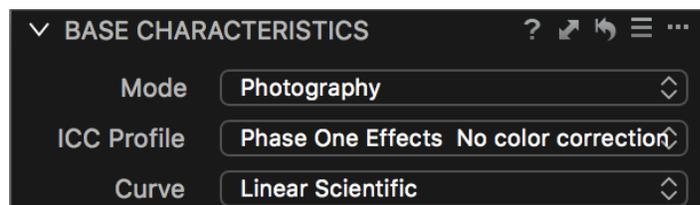
Note: Later, when capturing an image using the in-situ profile (rather than capturing an image to create that profile), you will be changing this setting to use the profile created in this Chapter, rather than the “No Color Correction” profile.



4.3 Set Curve

When creating an in-situ profile it's essential to provide the profiling software an image of the color chart that has an absolutely linear response. Therefore choose the “Linear Scientific” curve .

Later, when using the in-situ profile to capture material (rather than capturing an image to create that profile), you may want to switch to Linear Response. See Chapter 3.3 for more information on curves for day-to-day captures.



4.4.1 Capture LCC Raw File

The Lens Cast Calibration (LCC) Tool helps you to create luminance uniformity for your reprographic setup.

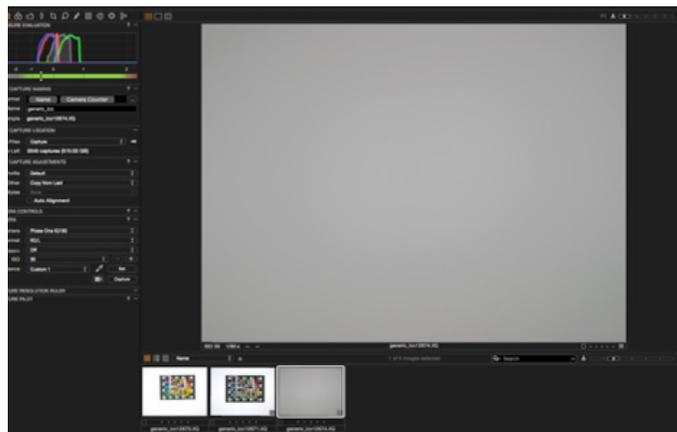
1. Place a plain gray cardboard on the surface of your repro table.

Make sure that you place it flat and flush against the table and that it covers the complete field of view. It is important that there are no objects other than the gray board visible in the image. Therefore choose a plain gray cardboard that is larger than the material you want to photograph.



2. Capture an image of the cardboard covered scene using the same aperture and lighting as you'll use for the actual object. It's very important that no part of the image is blown out (e.g. 255 RGB value) or anywhere close to it. With a gray board this is easy to achieve with a normal exposure.

However, if needed adjust only shutter speed or the strength of the light source for balancing the exposure. The aperture has a significant influence on this reference and should be set to the value you want to use for image capture. The resulting image should look similar to the sample shown.

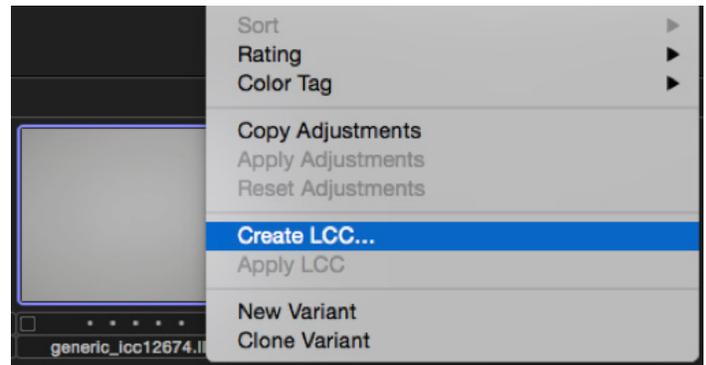


4.4.2 Create LCC Reference

Method One

Right-Click on the thumbnail of the gray cardboard and select Create LCC.

Tip: On a Mac without a right mouse button, use "CTRL + mouse click" for entering the context menu.

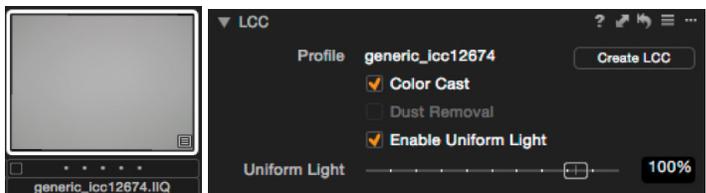
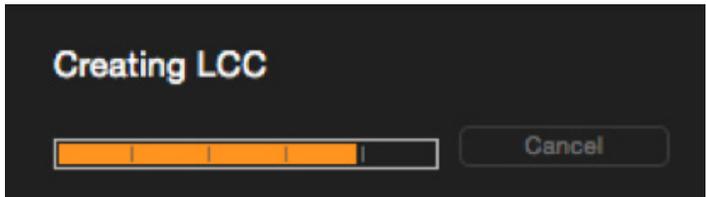
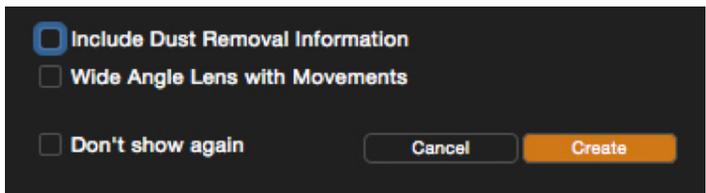
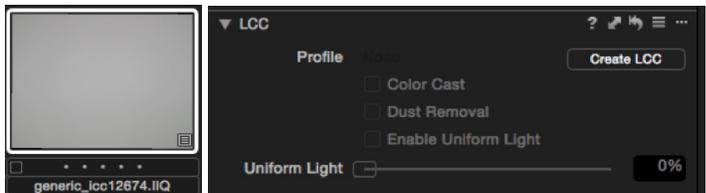


Method Two

Via the Lens tool tab select the image of the captured gray cardboard in the Browser and choose Create LCC in the LCC tool.

After pressing Create LCC (either started with the first or second method), a dialog box will open showing the following options for the LCC profile that will be calculated. **DO NOT** check any of the options. Press Create to start the calculating process.

After calculating you should see the selected reference image of the captured gray cardboard marked as a LCC reference file. The letters LCC will appear above the thumbnail image. In the LCC tool the boxes for Color Cast and Enable Uniform Light should be checked and available. You have now created a valid LCC Profile for this capture setup.



Note:

An LCC profile is only valid and usable for images taken with the same Digital Back or Camera under identical lighting conditions. You have to prepare a new LCC Profile to create luminance uniformity if you:

- Change the aperture
- Change the distance to the subject
- Change the angles of the light setup
- Change the lens or digital back

Tip:

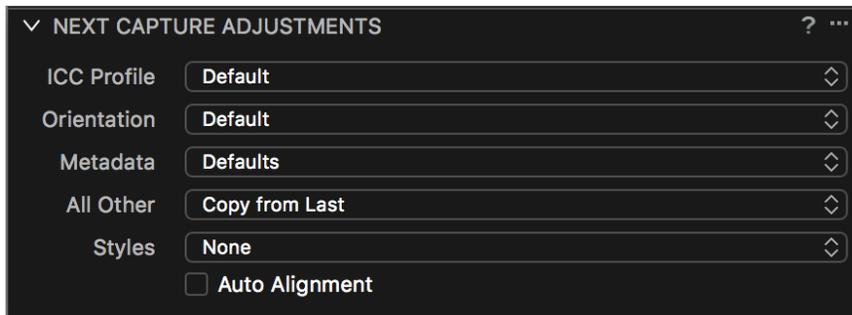
You may wish to rename the capture of the gray board before you generate the LCC from it. For example, you could name it "72mm, f8, 600ppi distance". This will be the name of the LCC that is subsequently applied to incoming captures and will be more intuitive.

4.5.1 Application of LCC (Automatic)

In the Camera tool tab there is a tool called Next Capture Adjustments. When shooting tethered with the camera attached to the computer, you can choose the settings and adjustments to be applied to the next capture. The factory default setting is useful in this example to automatically apply the LCC profile.

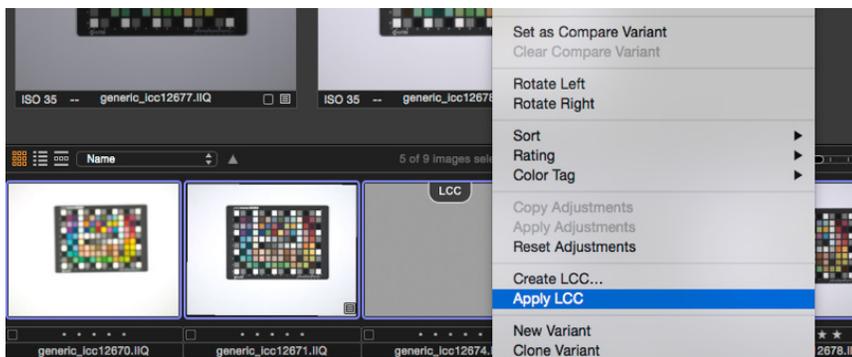
The first option, ICC Profile, is set to Default in the factory default settings so it will choose the ICC Profile you set in the Base Characteristics tool (See also Chapter 3.2)

The All Other option is set to Copy from Last by default. This will ensure that every setting that is made with one of the Tools in Capture One is automatically applied to the next captured image. This includes the newly created LCC profile from the last image. All subsequent images will be precisely corrected, using this LCC, until you make changes to the lighting.



4.5.2 Application of LCC (Manual)

To manually apply an LCC profile to another image, select the LCC reference image (with the letters LCC tagged above) together with all images that you wish to apply this LCC profile to. Then Right-click on one of the images with your mouse or CTRL-click to access the context menu and select Apply LCC.

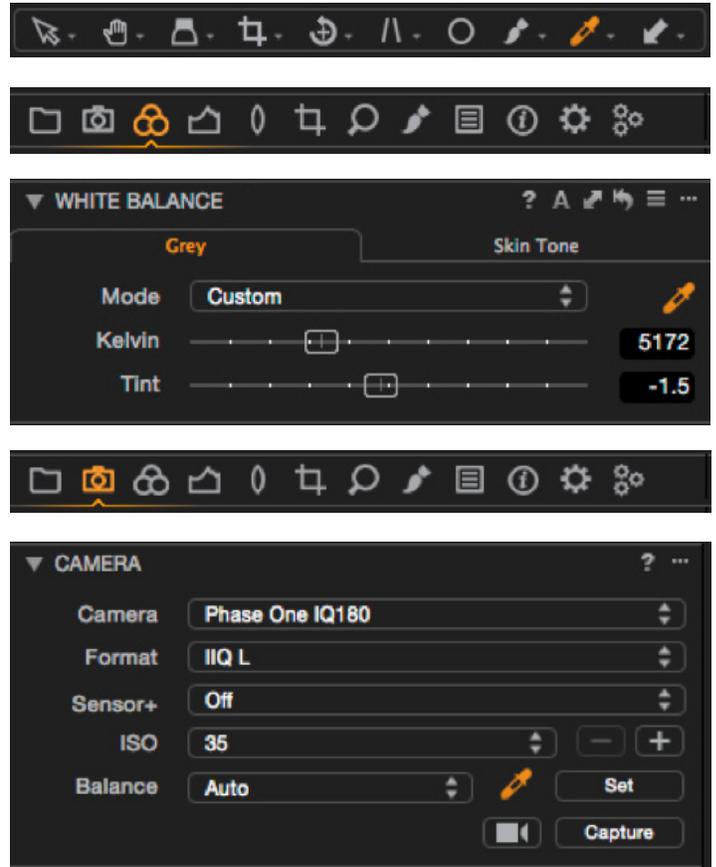


4.6 Set White Balance

Setting the correct white balance is as important as setting the correct exposure. The white balance can be measured with the white balance picker.

The White Balance picker is located in the Cursor Tools.

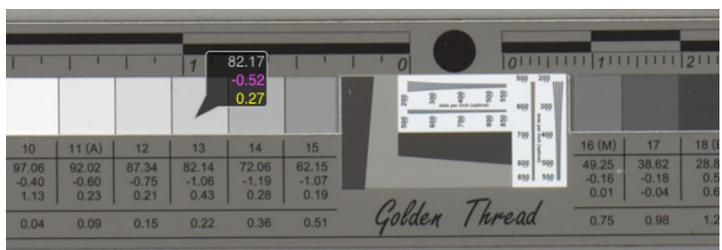
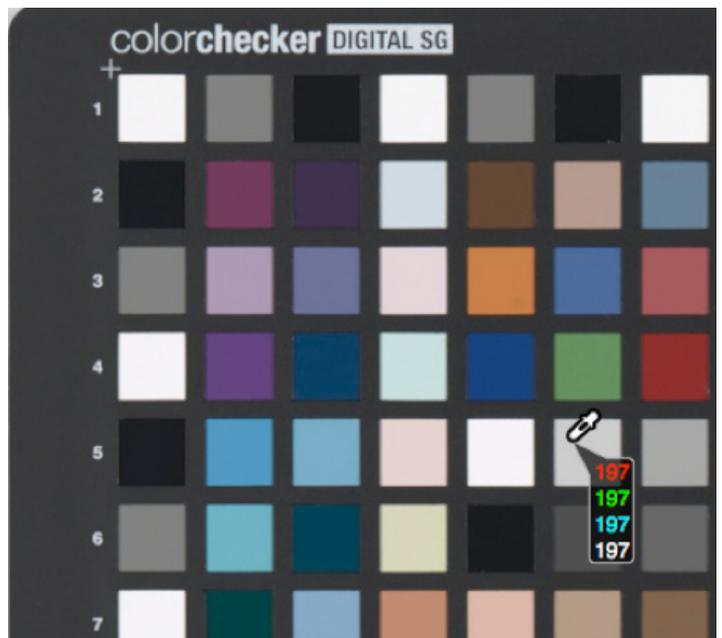
It can also be found in the Color Tool Tab in the White Balance Tool or in the Capture Tool Tab in the Camera Tool.



The ideal patch to set White Balance is Patch 13 on the ISA Golden Thread target or patch F5 on a ColorChecker SG.

Click on that patch with the White Balance cursor.

If using RGB values, they should become equal after clicking to set the White Balance, or have a maximum of one or two values in difference. If using LAB values, the A and B values should drop to a fraction of a point of each other.



4.7 Set Exposure

To ensure correct exposure, you will make sure a specific patch in your chosen target conforms to its ideal value.

How to Measure

Hover the cursor over the patch in the viewer and its values are shown in the middle above the image.

Capture One also provides an option to have multiple readouts displayed in various areas of the image. Click and hold on the second to last cursor icon and select Add Color Readout.

LAB vs RGB

RGB values vary based on which output color space is used while LAB values are the same in any output color space.

To use LAB Readouts rather than RGB select [View > LAB Readout > GoldenThread (ICC)].

NOTE: LAB values are only available in Capture One CH. They are not available in Capture One DB / Pro.

What to Aim For

The Golden Thread ISA Target patch 15 should have a Luminance value of 62.2 or an RGB value of 149.

The ColorChecker SG target patch G5 should have a Luminance value of 65.1 or an RGB value of 156.

NOTE: The above values are based on the "average target" and assume use of the Adobe 1998 output and a 45° angle of illumination. See Chapter 6.3 for additional aim point information and Chapter 6.4 for more technical details.

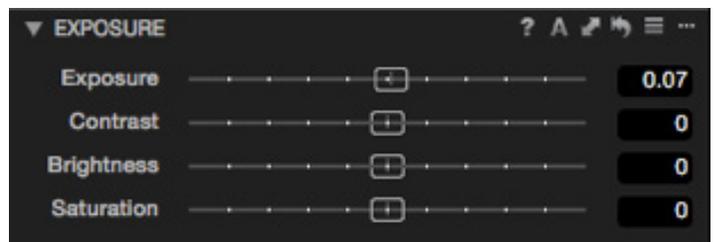
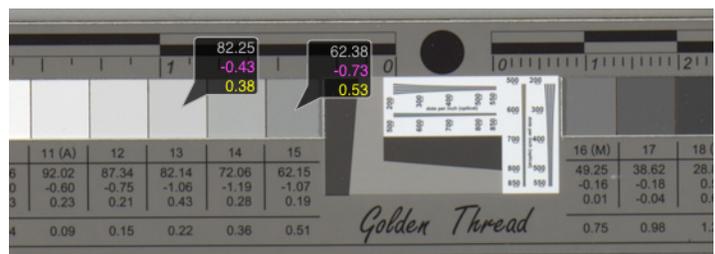
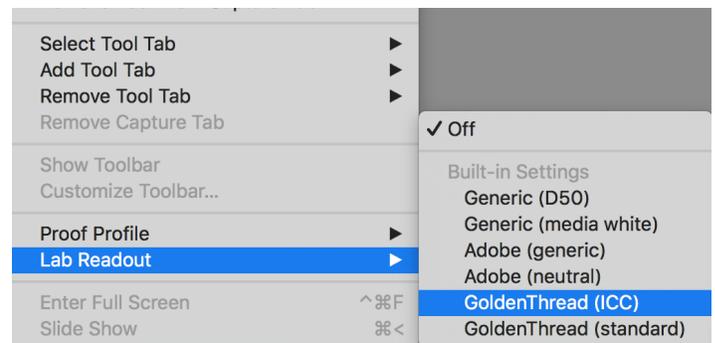
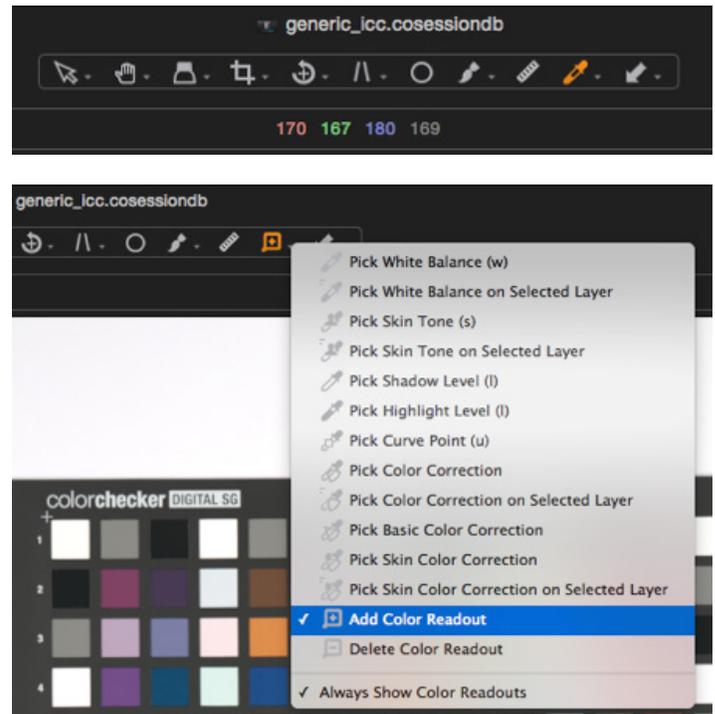
What to Adjust

To achieve the correct exposure you should mainly rely on changing the shutter speed (for DT Photons) or strobe power (for strobes such as Profoto). However, small positive values (e.g. <0.2 stops) can be used on the Exposure slider in Capture One.

How Accurate Must You Be

For the purposes of creating an in-situ profile you should aim to be as accurate as possible. After adjusting shutter speed or strobe power, use the exposure slider which can be used in 0.01 stop increments. Only use positive values on this slider.

For best results creating profile you should measure the values of your specific chart; every manufactured chart is slightly different. See Chapter 6.5.



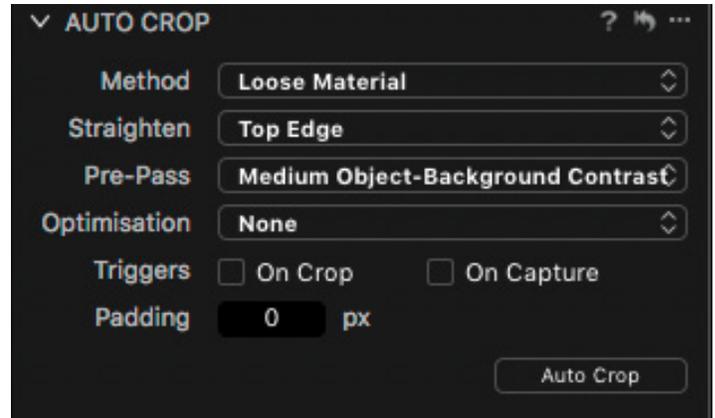
4.8.1 Crop Target

The **CCSG target** has to be cropped out of the image. The export file should only contain the target.

If you are using **Capture One CH** the easiest way is to use the **Autocrop Tool**

1. Select the image to be cropped.
2. Select Method: Loose Material
3. Select Straighten: Top Edge
4. Select Prepass: Medium Obj:BG Contrast
5. Click the Auto Crop Button

The **CCSG target** should be automatically straightened and cropped.

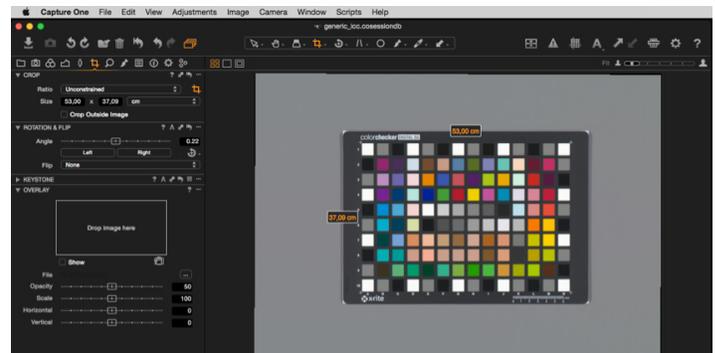
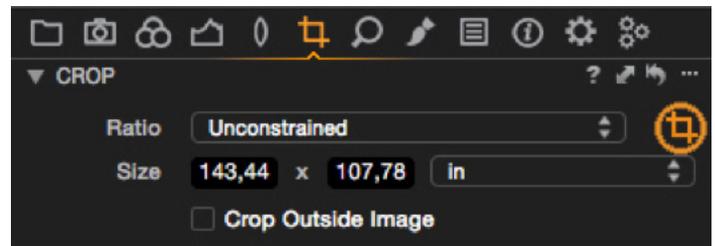


As an alternative to AutoCrop (e.g. when using Capture One Pro rather than Capture One CH)

From the Tool panel, select the **Crop Tool Tab**

Select the **crop tool** and create a crop that only includes the ColorChecker SG.

From the Tool panel, select the **Rotation & Flip Tool**. Select the **Straighten Tool** and draw a line along the edge of the **ColorChecker SG** target or between the crosses if your **CCSG** has them.



Tip:

You can also find the **Crop** and the **Straighten** tools in the **Cursor Tools**.

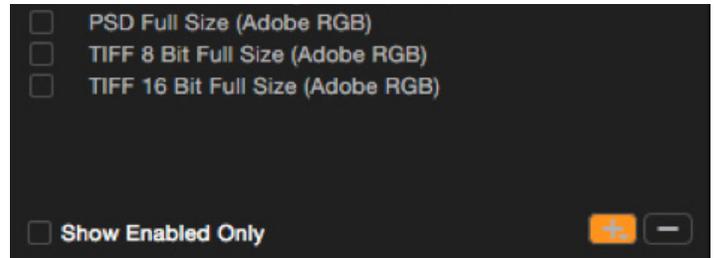


4.8.2 Export Target

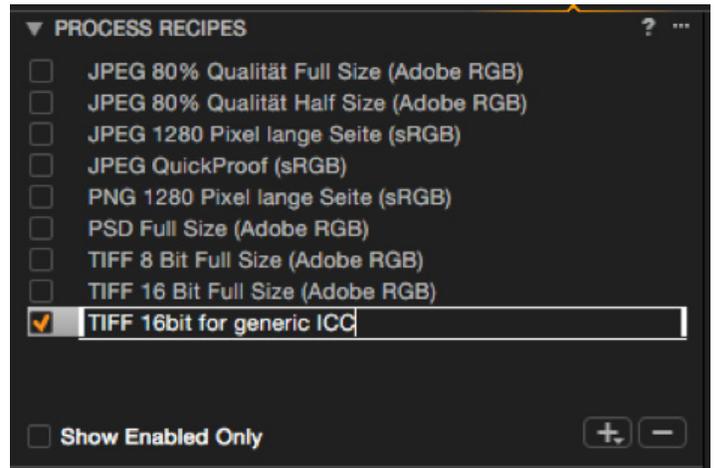
1. From the tools panel, select the Output tool tab.



2. Add a new recipe by clicking on the + button and type in a name for the new recipe.

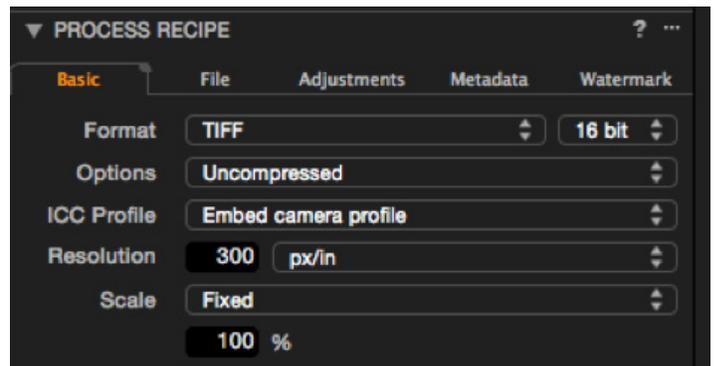


3. Choose the **TIFF** File Format in **16bit, uncompressed**.



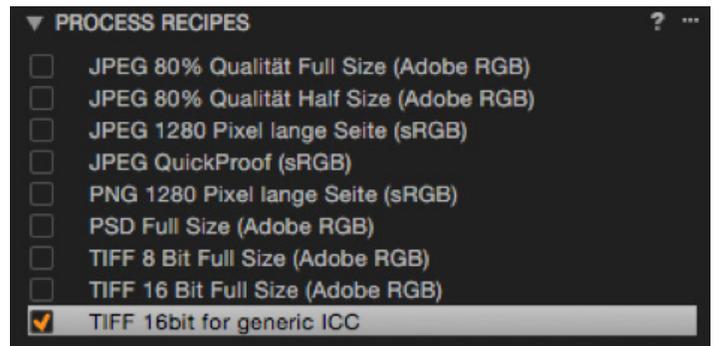
4. Choose the **Embed camera profile** ICC Profile

Note: These settings along with the **No Color Correction** and **Linear Scientific** that you chose in the **Base Characteristic tool** ensure that you export a completely linear file.



5. **Select and Check Process Recipe**

Ensure that the box to the left of your new defined Recipe is checked, and no other Recipes are checked.



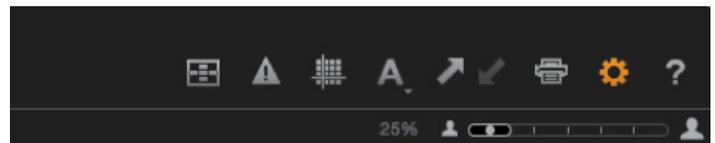
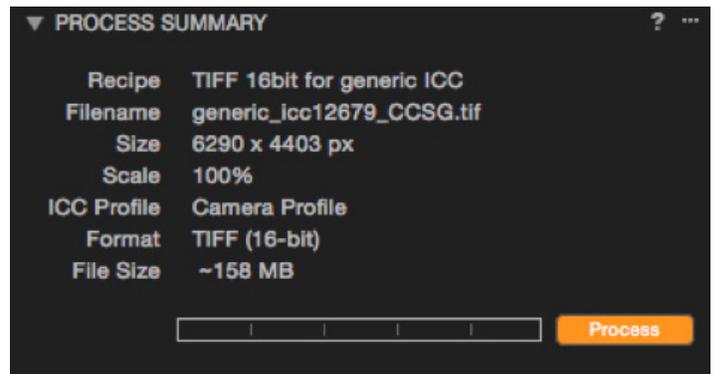
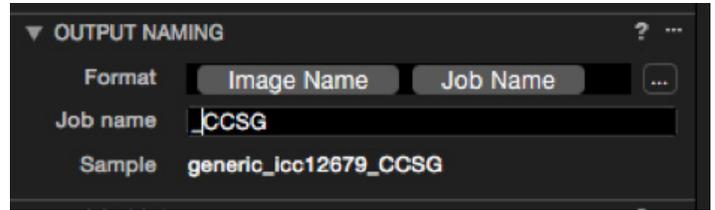
Tip:

To easily identify the exported reference image you can use the Output Naming Tool located in the Output Tool Tab and add a Job name. For example, add “_CCSG” to the reference image.

6. To export the **TIFF** file select the image in the browser.

7a. Click **Process** in the **Process Summary Tool** that is located in the **Output Tool Tab**.

7b. Or click the **Process Symbol** in the upper Toolbar.

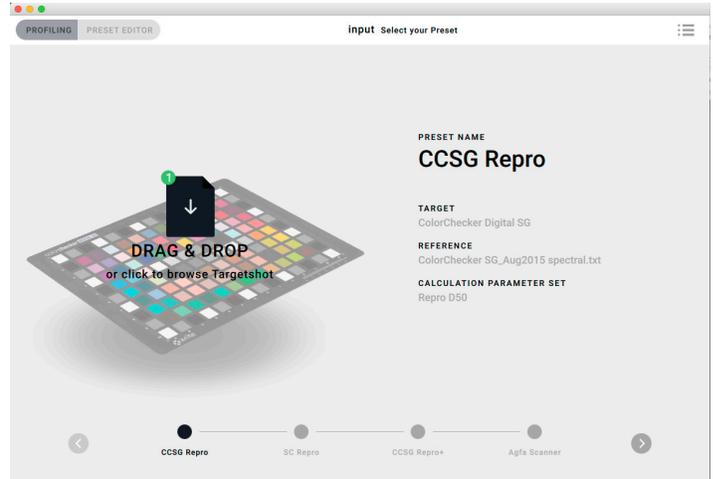


4.9. Create Profile in basIColor Input

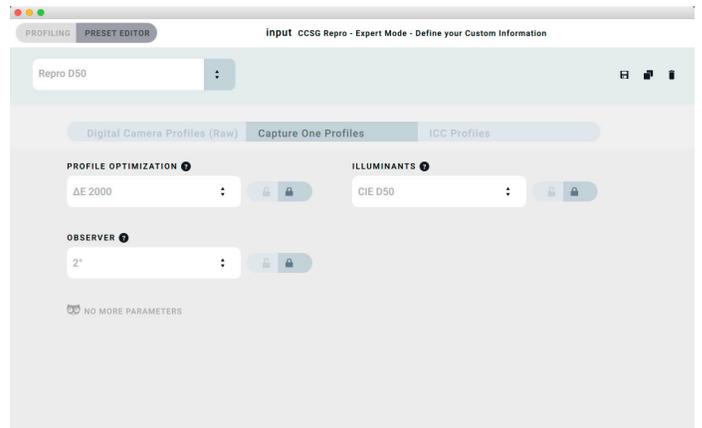
basIColor Input 5 can be used to analyze the capture of the ColorChecker SG and create an in-situ profile. It is available for both MacOS and Windows. Digital Transitions is a dealer for basIColor.

The steps below assume basIColor Input 5 is already installed and activated per the Installation Guide.

1. Select the CCSG Repro preset.



Here are the settings the CCSG Repro preset uses:



When to use another preset

The CCSG Repro preset is appropriate for calibrating using an X-Rite ColorChecker SG target and strobe or DT Photon. If you are using another target or another illuminant select the appropriate preset or create a new preset by selecting Preset Editor.

About the Reference

Targets such as the ColorChecker SG vary in slight ways from year to year. Moreover every copy manufactured varies slightly from the “average” of that target type. For best results check the “Reference” listed in the CCSG Repro preset against the age of your target. Advanced users can also improve the accuracy and consistency of the calibration process by measuring the patches of their target using SpectraShop (see Chapter 6.5) and loading those values into basIColor.

2. Drag and drop the TIFF from Chapter 4.8.2 onto the “Drag and Drop” icon.

Place the grid over the image of your X-Rite ColorChecker SG using the four corners of the Grid to move and fit. Ensure that all measuring fields cover only a single patch.

After placing the grid correctly you will have a first view of the quality of your reference image. The sun symbols are placed over the white patches around the chart's edges. If they show green borders this means the illumination is acceptably even.

3. Name your profile

Tip: If the profile follows the naming convention used for **Phase One ICC Profiles, Capture One CH** will automatically place it together with the **Original ICC-Profiles** that came by default with **Capture One**.

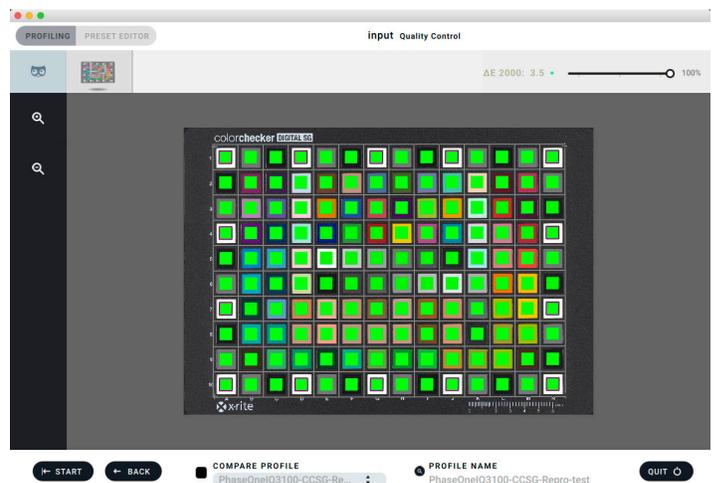
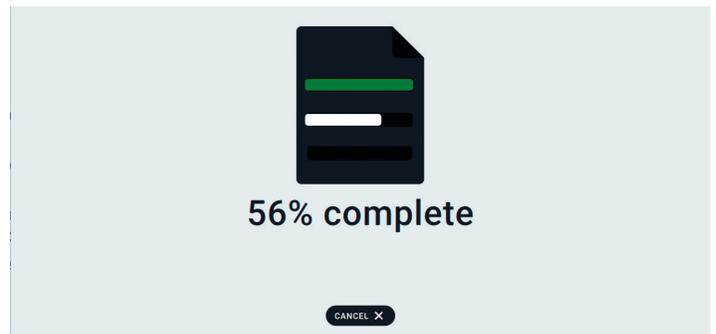
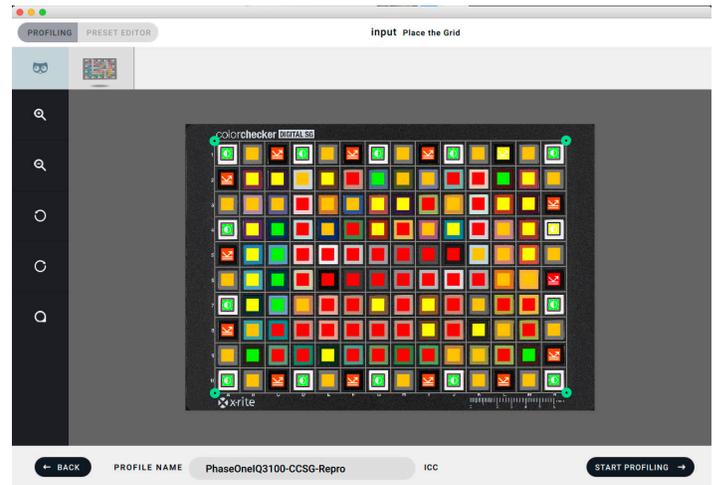
The naming convention is the **Product Name** (no spaces) followed by a dash. For example:

PhaseOneQ180-CustomICCprofile.icc or
PhaseOneQ3100-Nameitasyoulike.icc

4. Click “Start Profiling”

Once complete you will be able to compare your ICC profile to other ICC profiles on your system. You can also drag the slider on the top right to determine which percentage of patches are less than or equal to the ΔE listed.

The new **ICC-profile** will be automatically saved in the **ColorSync Folder** of your Operating System.

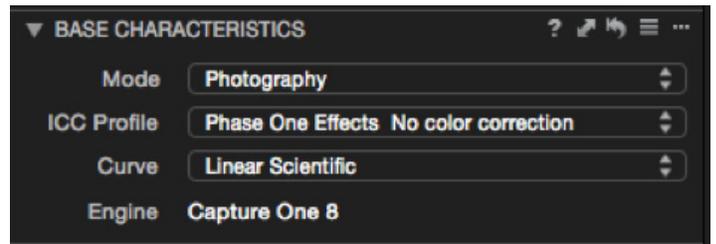


4.10. Set Capture One to Use Profile

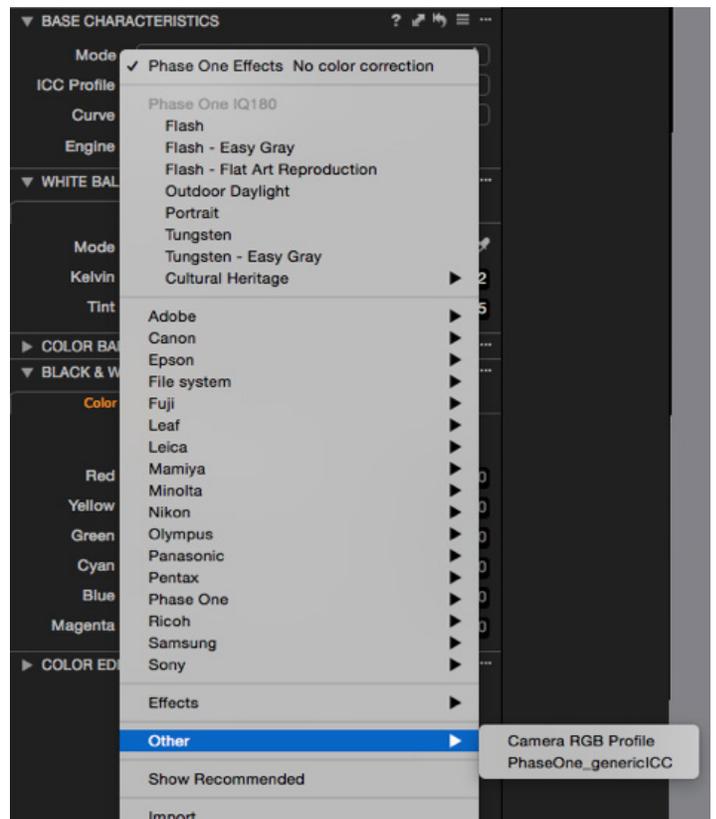
1. Restart **Capture One** if you added a **custom ICC Profile** from another application. This allows **Capture One** to recognize the new profile and to add it to the list in the **Base Characteristics** tool in the **Color** tool tab.



2. In the **Base Characteristics** tool, change the **ICC-Profile** from **Phase One Effects > No Color Correction** to your own custom made profile.



Note: As noted in Chapter 4.9 item 3, if you follow the naming convention used for **Phase One ICC Profiles**, **Capture One** will automatically list the profile alongside other profiles for your camera model. If not, the new **ICC-Profile** will appear in the **Other** Chapter in the **ICC Profile** dropdown menu.



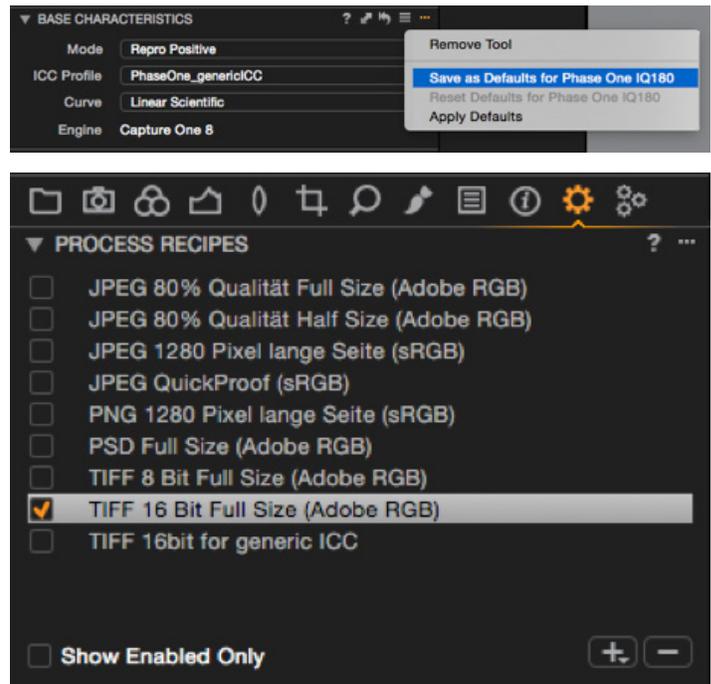
3. To ensure that this new **custom ICC profile** is the new **default ICC profile** for your reproduction workflow, save it by clicking on the ... icon on the top-right corner of the **Base Characteristics** tool and select Save as Default.

4. Before continuing with your reproduction workflow, consider changing the **Base Characteristics Curve** to **Linear Response** rather than **Linear Scientific** (see Chapter 3.3) and change your **Output Format** to one that is recommended for your archive or guideline.

For the Preservation Digital Object (the archival master file) choose:

Metamorfoze	TIFF 16bit ECI RGB v2
Metamorfoze Light	TIFF 8bit ECI RGBv2 or AdobeRGB 1998
Metamorfoze Extra Light	TIFF 8bit Adobe RGB 1998
FADGI 4-star	TIFF 16bit AdobeRGB1998

See Chapter 6.4 about the impact of this color profile selection on RGB values.



5

Image Quality Analysis & Standards Validation

5.1. How and When to Measure

Accuracy of Reproduction – Numerically Defined

The workflows described in previous Chapters help you produce faithful reproductions – to record with the highest objective image quality. In this Chapter we discuss two ways to quantify and track that quality numerically, and to compare it against standards such as FADGI and METAMORFOZE.

When to Include a Target

It is our opinion (argued in our Digitization Program Planning guide available at dtdch.com), that an Object Level Target be included alongside the object in every capture. This provides intra-frame annotation of the size of the object and confirms the accuracy of the tone, color, and detail to naive future viewers who otherwise have no objective way to know whether the image is a faithful reproduction. Including a target in every capture also allows managers and administrators to evaluate the consistency of work being produced, and to compare the results over time to look for trends and quickly identify emerging issues.

While this target should remain in the Preservation Digital Object it may not be desirable to have it in all derivatives. Capture One CH's AutoCrop tool can be leveraged to create derivatives (for example, a JPG for use on the web) in which the target is automatically cropped out.

5.2. Comparing Delt.ae & Golden Thread

Automatic Machine Analysis

Including a target in and of itself, does nothing to quantify the accuracy of reproduction; the target must be analyzed. Although it's theoretically possible to do this by hand in a program like Adobe Photoshop this would be impractical. Instead dedicated image analysis programs exist to automatically identify and analyze a target and provide easily readable results such as “pass/fail” or “4 Star FADGI Compliant”. Two popular such programs are the website Delt.ae and Golden Thread (made by Image Science Associates).

Delt.ae: Free, Online, But Limited

The first is a website run by Picturae. It is free to use and does not require installation or licensing. It provides basic feedback on sharpness, color and tone accuracy, noise and mis-registration, and illumination uniformity. However it has four major limitations. First, at the time of writing of this guide it had not been updated since 2012, which means it lacks more recent targets such as the ISA Standard Film Target and updates to standards such as the FADGI 2016 update. Second, it is an online service only, with no desktop agent to upload files which limits it's speed/utility for higher volume analysis. Third, it provides very limited batch comparison functionality, limiting the view of multiple files to showing only a few columns of feedback. Finally, it's algorithms are fairly generic and do not account for some of the more nuanced elements of analyzing a target (see the next paragraph for more details). Still, this tool is free and a new user can get started using it in just a few minutes.

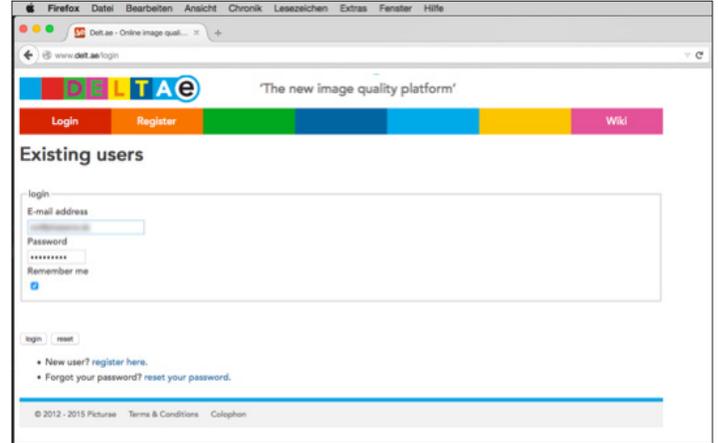
Golden Thread by Image Science Associates

Created and maintained by image scientist Don Williams, Golden Thread is commercial desktop software which provides a more robust, detailed, and complete set of image analysis tools. Its support is ongoing and new targets and revised imaging standards are incorporated soon after becoming available. It runs on the desktop (no uploading of large files required) and provides a complete set of comparison tools. Finally the algorithms are tweaked for maximum accuracy. As one example Golden Thread includes high-accuracy real-world measurement of each supported target to know exactly how sharp the target actually is; this can lead to a difference of several percent of sampling efficiency. Golden Thread also actively seeks out areas of each color/tone patch that are clean, avoiding the dust and mar issues that routinely effect the accuracy of other image analysis software. The software requires payment, installation, and activation, but is our suggested solution for any institution serious about analyzing and monitoring image quality.

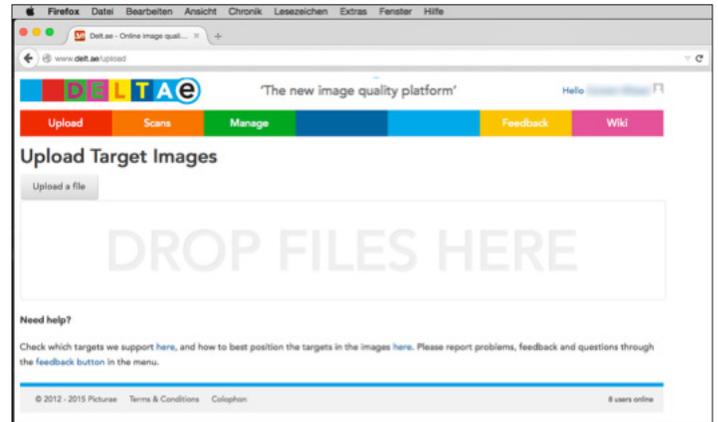
5.3. Delt.ae Workflow

Example procedure for verification of an image to Metamorfoze and FADGI Imaging Guidelines using www.delt.ae with a Golden Thread Device Level Target:

1. Open www.delt.ae in your Browser and login into your account with your Email address and Password. If you are new to this service please register.



2. Upload your file.



3. Once upload is complete the file will process automatically and you can click on results to see the report.

file	status	
generic_icc12681_CC...eadTarget.tif	uploading	<div style="width: 50%; background-color: #007bff; height: 10px;"></div> 0.1GB Cancel
file	status	
generic_icc12681_CC...eadTarget.tif	queued	
file	status	
generic_icc12681_CC...eadTarget.tif	processing	<div style="width: 20%; background-color: #007bff; height: 10px;"></div>
file	status	
generic_icc12681_CC...eadTarget.tif	done	results

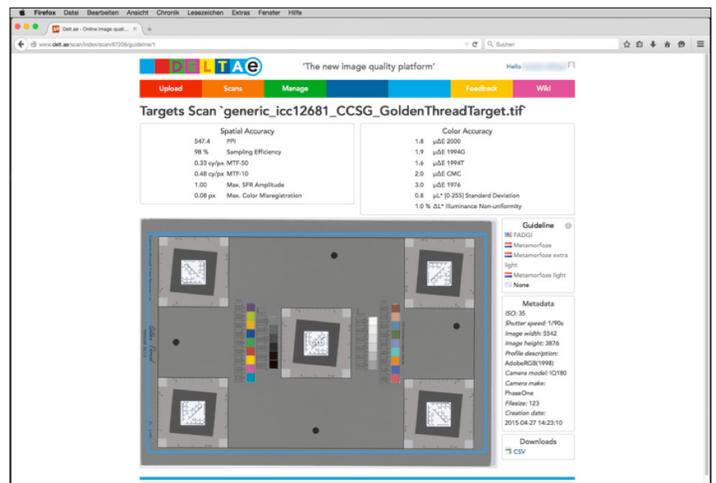
4. Results of the Golden Thread Device Level Target for FADGI Imaging Guidelines: You will find the rating for Spatial Accuracy and Color Accuracy in the two top boxes.



5. In the Guideline box, on the right, you can choose between the different Guidelines. The results appear in the two top boxes. The image to the right shows the ratings according to the Metamorfoze Imaging Guideline.



6. If you select None in the Guideline box, you will see all measured results in numbers in the upper boxes.

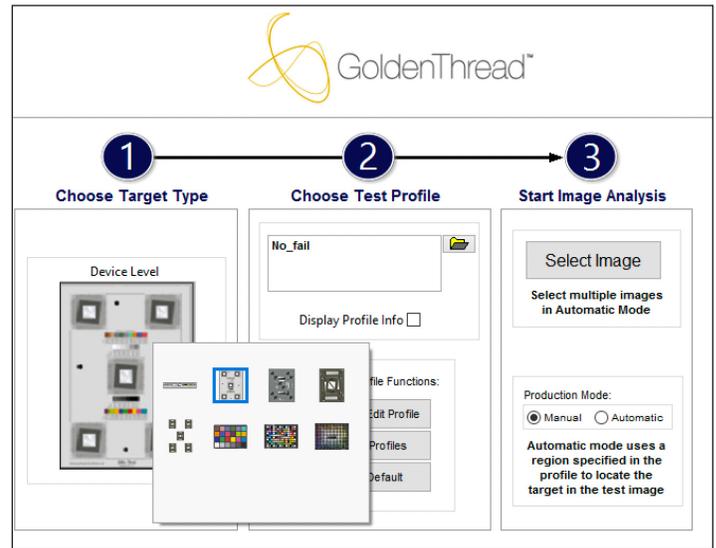


5.4. Golden Thread Workflow

Example procedure for verification of an image to FADGI Imaging Guidelines using Golden Thread with a Golden Thread Device Level Target:

The steps below assume Golden Thread is already installed and activated per the Installation Guide.

1. Select the type of target you captured.



2. Select a Test Profile.

Golden Thread is more flexible than Delt.ae in the criteria (called “Test Profiles”) against which the test image is compared. Each Test Profile specifies a combination of Color Profile, Capture PPI, and target FADGI star rating. Common Test Profiles are preloaded; [Create / Edit Profile] can create creation of additional custom profiles.

Color Profile: The correct RGB values depend on the color profile used. Therefore the Test Profile specifies the intended color profile.

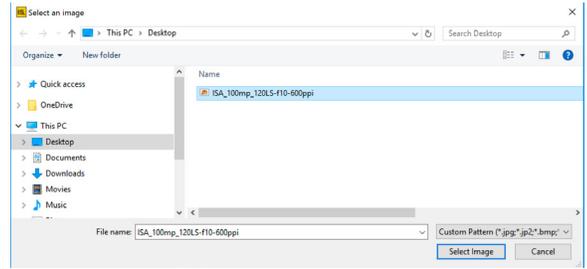
Capture PPI: The ability to test against a specific Target PPI is useful when an institution, client, or manager has specified a Target PPI to be used. In this case FADGI mandates the actual capture PPI be within a specific percentage of that target PPI.

Target FADGI Rating: The preloaded profiles set benchmarks based on FADGI 1-star, 2-star, 3-star, or 4-star quality. It is our opinion (argued in our Digitization Program Planning guide available at dtdch.com), that all digitization should be done to the highest possible quality.

AdobeRGB	3/11/17 12:57 PM	File folder	
eciRGBv2	3/11/17 12:57 PM	File folder	
Manuscript	3/11/17 12:57 PM	File folder	
Newspaper	3/11/17 12:57 PM	File folder	
PhotoPrint	3/11/17 12:57 PM	File folder	
ProPhoto	3/11/17 12:57 PM	File folder	
sRGB	3/11/17 12:57 PM	File folder	
No_fail	2/29/16 7:07 PM	Configuration sett...	8 KB

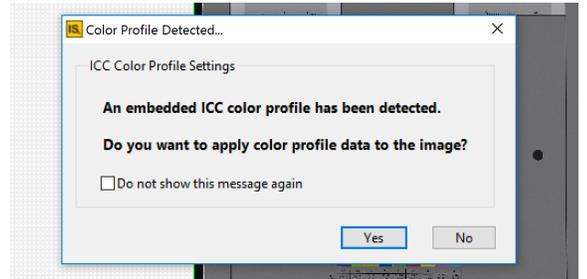
200_AdobeRGB_1s	2/29/16 7:07 PM	Configuration sett...	8 KB
200_AdobeRGB_2s	2/29/16 7:07 PM	Configuration sett...	8 KB
200_AdobeRGB_3s	2/29/16 7:07 PM	Configuration sett...	8 KB
200_AdobeRGB_4s	2/29/16 7:07 PM	Configuration sett...	8 KB
300_AdobeRGB_1s	2/29/16 7:07 PM	Configuration sett...	8 KB
300_AdobeRGB_2s	2/29/16 7:07 PM	Configuration sett...	8 KB
300_AdobeRGB_3s	2/29/16 7:07 PM	Configuration sett...	8 KB
300_AdobeRGB_4s	2/29/16 7:07 PM	Configuration sett...	8 KB
400_AdobeRGB_1s	2/29/16 7:07 PM	Configuration sett...	8 KB
400_AdobeRGB_2s	2/29/16 7:07 PM	Configuration sett...	8 KB
400_AdobeRGB_3s	2/29/16 7:07 PM	Configuration sett...	8 KB
400_AdobeRGB_4s	2/29/16 7:07 PM	Configuration sett...	8 KB
600_AdobeRGB_1s	2/29/16 7:07 PM	Configuration sett...	8 KB
600_AdobeRGB_2s	2/29/16 7:07 PM	Configuration sett...	8 KB
600_AdobeRGB_3s	2/29/16 7:07 PM	Configuration sett...	8 KB
600_AdobeRGB_4s	2/29/16 7:07 PM	Configuration sett...	8 KB

3. Select the file.



4. Select to use the ICC profile

For most workflows it makes sense to analyze the file based on the ICC Profile embedded in that file.

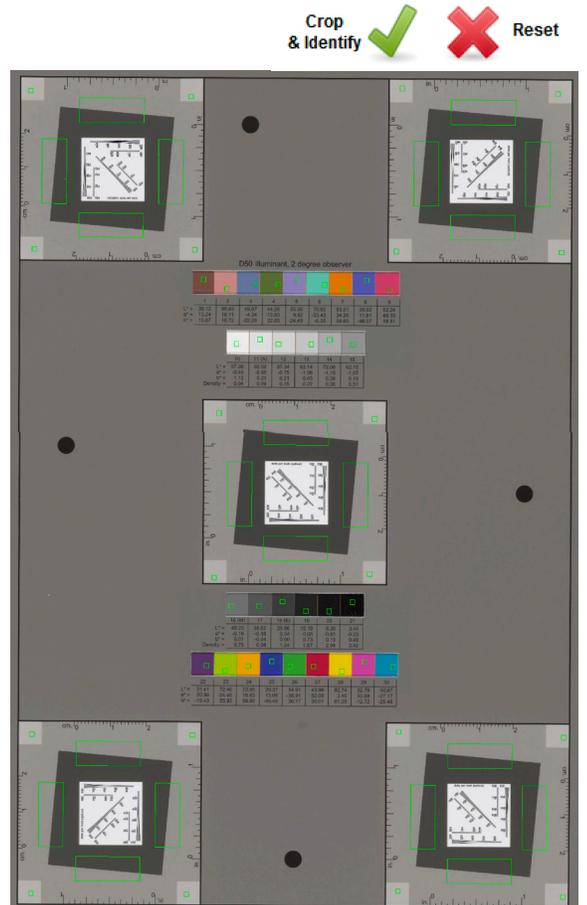


5. Click Crop & Identify. Check results.

Golden Thread will automatically identify, rotate, and deskew the target from the image.

For larger files analysis may take a minute or two.

The user interface will then highlight in green rectangles all of the regions of interest (ROIs) that will be used for analysis. Check that these ROIs align well to the target.



NOTE: Golden Thread uses a sophisticated algorithm to identify the most consistent area within each patch. This helps avoid errant readings caused by dust or small imperfections on the target. When checking the ROIs ensure only that each ROI falls entirely within the intended patch.



6. Click Run.



For larger files analysis may take a minute or two.

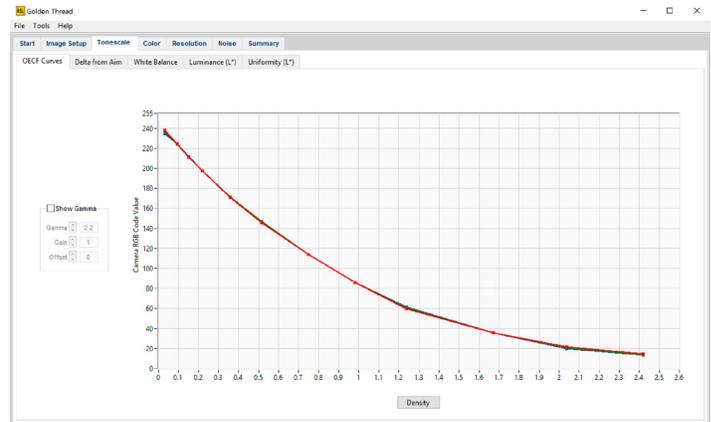
7. Review Results

Detailed analysis of the abundant feedback provided by Golden Thread is outside the scope of this document.

However, the summary tab is a good place to start any evaluation. If all metrics are passing further scrutiny is not generally required. If a metric is failing dive deeper to see which specific measurement is failing, and by how much. Scale is very important in this regard; the summary tab will indicate the same "FAIL" evaluation of metrics that are narrowly outside the acceptable value range, as on values that are wildly incorrect.

If the measurements are significantly deficient look for any trends or patterns to help establish theories as to what is causing the issue.

NOTE: By default Golden Thread loads the first analysis tab (OECF Curves). In [File > Settings] this can be modified to first load another tab such as Summary.



Show Details?

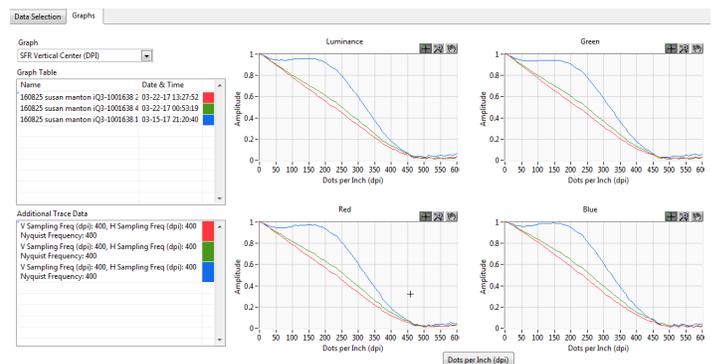
Measurement	Pass/Fail ?	Lower Limit	Value	Upper Limit
Tonescale	PASS			
White Balance	PASS			
Uniformity	PASS			
Color - Delta E 2000	PASS			
Color - Registration	PASS			
Sampling Frequency	PASS			
Resolution 10% SFR	PASS			
Resolution 50% SFR	PASS			
Noise	PASS			

Pass

8. Data Comparison

The menu item [Tools > Data Comparison...] brings up an interface that is useful to compare the results from 2 or more files.

For example, an experienced manager may produce a reference capture and have their operators produce a target at the start of every shift. Data Comparison can then be used to compare the stability/consistency of the results of those operators.



5.5. Visual Overlay

Visual overlays for the ColorChecker SG Target and Golden Thread ISA Targets can be found on at www.dtdch.com/dtdch-nominal-target-overlays/. These can be used in Capture One CH to provide a visual comparison of a captured target to its nominal values.

1. Check your Proof Profile Settings

See Chapter 6.4 and ensure that you select an overlay labeled for use with the output color profile you are using.

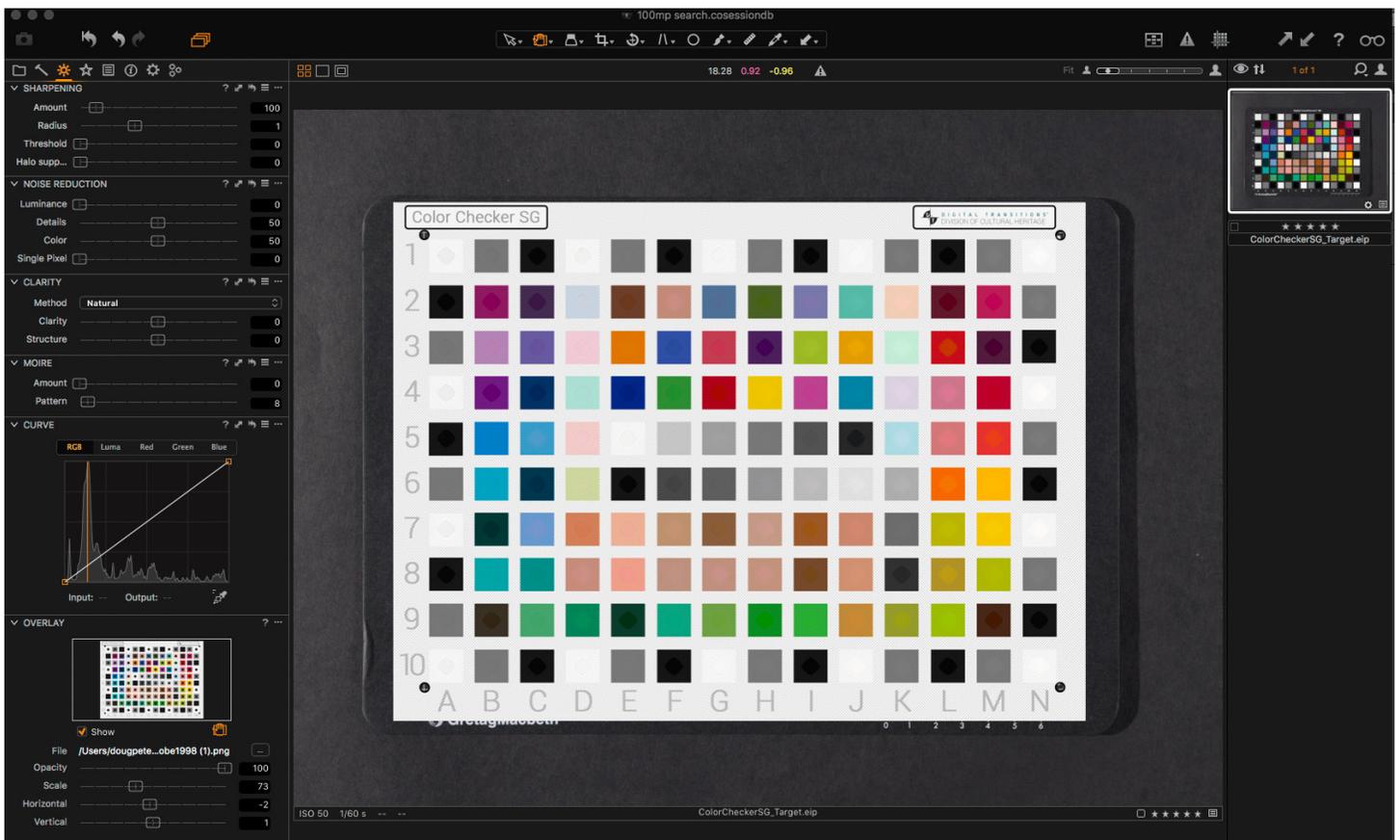
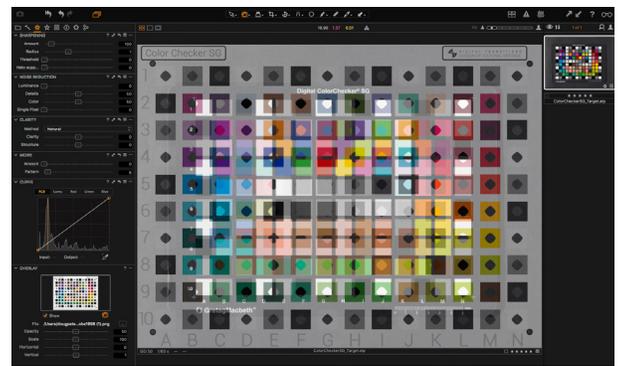
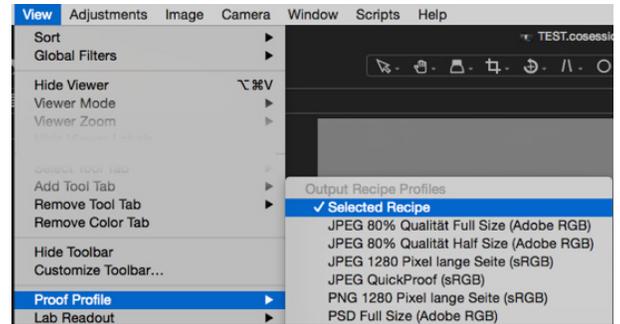
2. Select the Overlay File in the Overlay Tool

In the CH Admin workspace this is located under the Admin tab. To add to another workspace right click in the tools and select Add Tool > Overlay.

Drag the overlay file from the Finder to where it says "Drop image here" or click the [...] and select the file.

3. Resize & Move Overlay; Set Opacity to 100%

Using the Scale, Horizontal, and Vertical sliders move the target to fit the capture of the target. Set the opacity to 100%.



6

Other Considerations

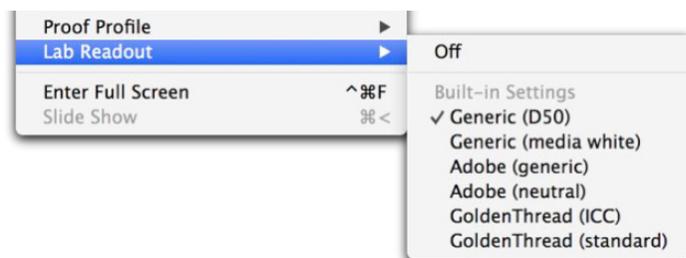
6.1. Capture One CH LAB Readouts

LAB in Other Apps

Most ICC profiles can be interpreted in several ways. To obtain the same results as a 3rd party implementation, it is necessary to select an interpretation that matches this behavior. This is done under [View > Lab Readout]. Capture One CH supports many variations on the interpretation. However, in some circumstances it may be necessary to configure the 3rd party application as well. Generally, it is necessary to disable **Black Point Compensation (BPC)** in the 3rd party application for color spaces that are unable to represent black. Note that some applications enables BPC when the Perceptual rendering intent is selected regardless of any other setting. Also note that LAB values are not available when using “Embed Camera Profile” as your output recipe (as in Chapter 5 “Workflow for In-Situ ICC Profiles”).

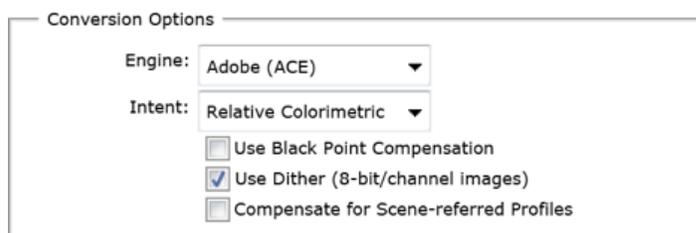
Generic

There are two generic options available in Capture One: Generic (D50) and Generic (media white). The first converts Lab values using D50 as the white point. This will match most 3rd party implementations including the following: **Delt. ae (by Picturae)** and **CMS (by Marti Maria)**. The second option, which uses media white as the white point, can be used to match colors while avoiding chromatic adaptation. For this option, the Lab coordinates need to be measured with a device that takes into account the light source of the specific profile. For sRGB and Adobe RGB (1998), this is D65.



Adobe Photoshop

By default, Adobe Photoshop® uses the Adobe Color Engine (ACE) for color management. To match this, select one of the Adobe modes: Adobe (generic) or Adobe (neutral). The latter should be chosen for the sRGB profile, because ACE may detect that a certain ICC-profile is an sRGB profile and silently fix any technical issues.



Also, since Capture One does not support Black Point Compensation it is necessary to disable this in Photoshop to match output profiles that are unable to represent black. To this end, it is necessary to disable BPC. Even if BPC is disabled, Photoshop® may still apply BPC if the Perceptual intent is selected. Thus the following settings should be used in Photoshop under Color Settings.

Golden Thread (Image Science Associates)

Golden Thread, by Image Science Associates, can analyze an image using either an ICC profile or a built-in specification of a standard color space. If you set Golden Thread to use the ICC profile, then in Capture One CH select [LAB Readout > GoldenThread (ICC)]. Otherwise select [LAB Readout GoldenThread (standard)] option. Note that the output profile in Capture One must match the option used in the analysis. While Golden Thread will not use the profile directly in this mode, Capture One CH must still apply the conversion to the correct color space.

6.2. Advantages Of Instant Capture

There are several important advantages of using a reprographic camera system vs. a scanner for digitization project purposes.

Image Quality

The reprographic camera system delivers an extremely high-resolution capture, with accurate colors and a very high dynamic range. The camera system delivers instant captures and it does so without any movements of the subject matter, or of the sensor. Thus compared to a scanner, the reprographic camera system is faster, it is free of maintenance, and it delivers the highest quality “scans”, complying with the toughest requirements of FADGI 4 Star, Metamorfoze, and ISO guidelines. On top of that, the reprographic camera system is less susceptible to environmental influences of vibration, dust and false light getting into the capture.

RAW Workflow

Every capture made by a reprographic camera system using digital back technology produces a RAW file with all the captured pixel information, all associated basic transformations (color, etc) and all metadata. No matter what transformations or processing the raw file is used for, it is always kept intact as RAW. This means you can, at any time, revert to the original file and use the data for new transformations and new purposes. The creation of RAW images happens without the bias of operators and manufacturers, and it provides the user with the highest degree of control and the ability to create a true preservation digital asset.

Almost all scanner-based solutions assume a given target output file format and output specification and deliver the scans accordingly. Many Repro Scanners have built in Curves, Color and Sharpening attributes that cannot be turned off. The resulting scans cannot be re-purposed.

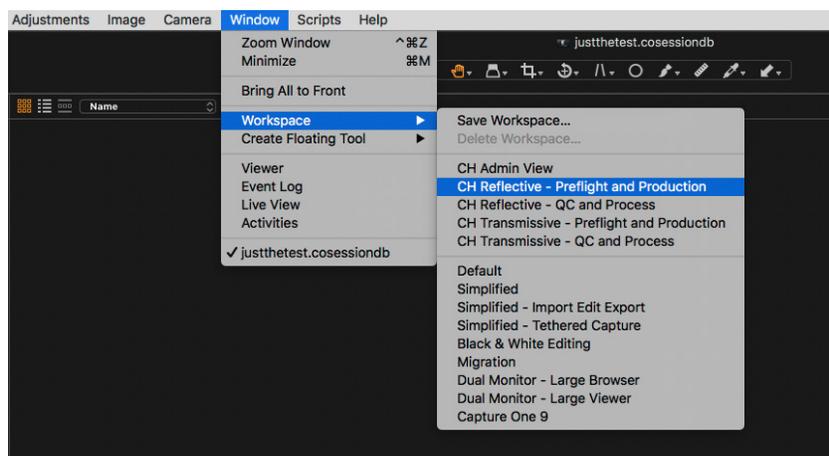
Productivity / Preflight

The reprographic camera may take a little more effort for initial set-up of the scanning environment and for preparing the daily production. To ease this, the objects to be digitized are usually collated by size (i.e. doing a batch of A4 sized items followed by a batch of A2 items, rather than switching many times between those two sizes. This supports a two-stage workflow:

- Preflight operations performed to set up for a given object size
- Production workflow for capturing many objects of that size

These workflows are supported by specific Workspaces of Capture One CH, which when selected, sets the user interface to include only the needed functions.

Below are the default CH workspaces of Capture One CH:



6.3. Target Reference Values

These values are based on an average example of each target type. Every physical target manufactured will vary slightly from the average. Golden Thread now measures every specific ISA target and uses a QR Code to pass those values to Golden Thread. For other targets we suggest you measure your specific target using a colorimeter and software such as SpectraShop by Robin Myers (see Chapter 6.5)

Values using LINEAR SCIENTIFIC and Golden Thread ICC LAB Method (see Chapter 6.1)

		Adobe RGB 1998 Gamma 2.2		ProPhoto RGB (ROMM) Gamma 1.8		ECI-RGB-v2 (L*)		Embed Gamma 1.8
		RGB	LAB	RGB	LAB	RGB	LAB	RGB
ColorChecker SG	E5	245	96.5	242	96.5	246	96.5	242
ColorChecker SG	F5	195	79.4	184	79.4	203	79.4	184
ColorChecker SG	G5	156	65.1	140	65.1	166	65.1	140
Golden Thread	10	246	97.1	244	97.1	248	97.1	244
Golden Thread	13	203	82.1	193	82.1	209	82.1	193
Golden Thread	15	149	62.2	132	62.2	159	62.2	132

Values using LINEAR RESPONSE and Golden Thread ICC LAB Method (see Chapter 6.1)

		Adobe RGB 1998 Gamma 2.2		ProPhoto RGB (ROMM) Gamma 1.8		ECI-RGB-v2 (L*)		Embed Gamma 1.8
		RGB	LAB	RGB	LAB	RGB	LAB	RGB
ColorChecker SG	E5	231*	91.8	225*	91.8	234*	91.8	225
ColorChecker SG	F5	195	79.3	184	79.3	203	79.3	184
ColorChecker SG	G5	156	65.1	140	65.1	166	65.1	140
Golden Thread	10	233	92.6	228	92.6	236	92.6	228
Golden Thread	13	202	81.8	192	81.8	209	81.8	192
Golden Thread	15	149	62.2	132	62.2	149	62.2	132

*Because of the slight highlight rolloff in the Linear Response curve very small changes in exposure can change the highlight patch values by several digits. Therefore when using Linear Response it is easier and more consistent to set exposure based on gray patches as noted in Chapter 3.7.

Note: By default Capture One CH proofs the on-screen image (and therefore any RGB values) using the color profile of the selected recipe. See Chapter 6.4 for more information.

6.4. Soft Proofing & RGB Values

The RGB values of an image change based on which color profile is applied to that image. Even when no visual change takes place they can be radically different. This is because RGB values are mathematically tied to the color space you measure them in, unlike LAB values which are independent of the color space.

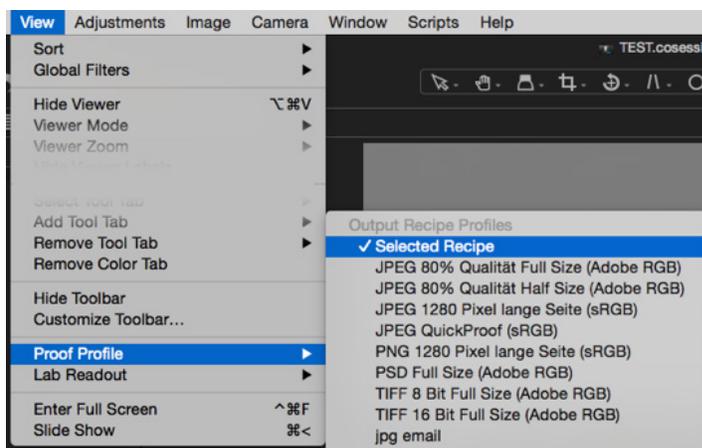
By default, Capture One proofs the on-screen image (and therefore any RGB values) using the color profile of the selected recipe. For example, if you create two output recipes, using ProPhoto RGB for one and Adobe (1998), for the other and switch between them you'll notice the RGB values of any given patch value change, even though the visual appearance of the target does not.

Therefore, when using RGB values, it is very important to be aware of the recipe you have selected, and to use the values that are relevant to that color profile in table 6.4. The steps below help you check this:

1. Check the setting of View > Proof Profile

The default option is "Selected Recipe".

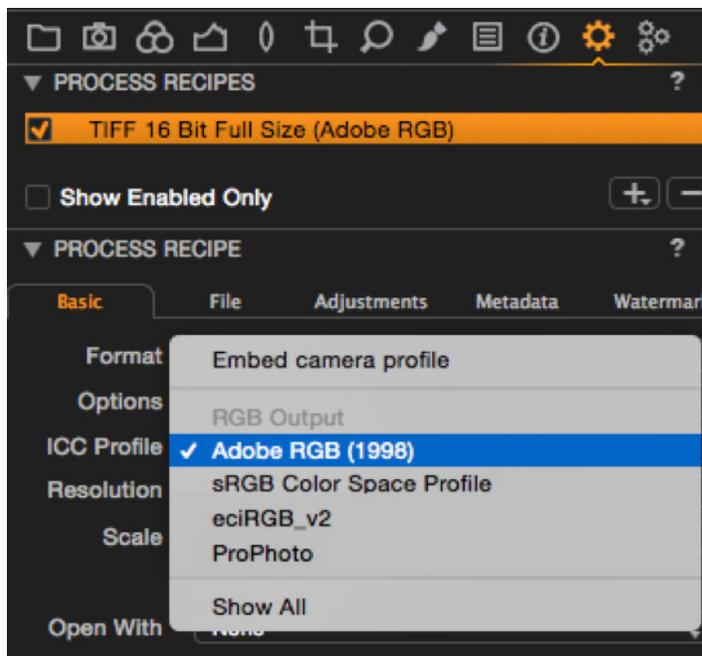
This is a good option as long as you stay aware of which recipe is selected.



2. Check the Color Profile of the Selected Recipe

In the process recipes the orange highlighted recipe is said to be "selected" while a checkbox is used to indicate if the recipe is "enabled" (and will be included in the recipes used when you select to process).

In your selected recipe you need to specify the ICC profile to be used for the destination workspace. Color values in Capture One are now in relation to that workspace.



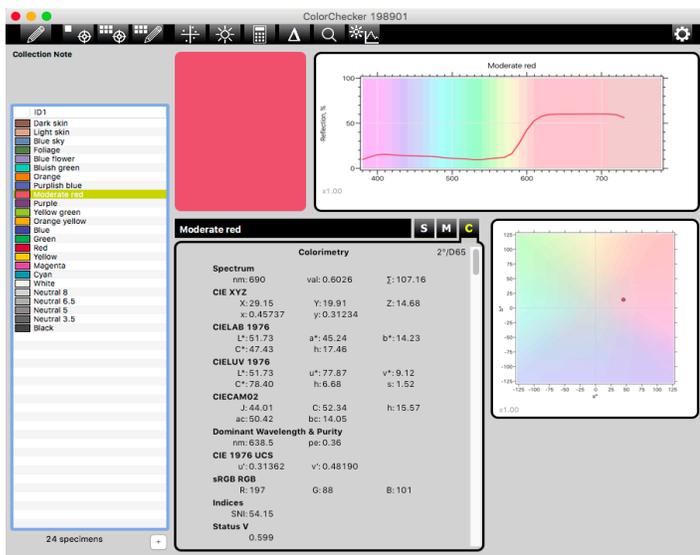
6.5. Spectral Evaluation

This guide has focused on the basics of attaining a faithful reproduction of the original material. But color in particular is a very complicated topic; entire academic tomes have been written about the nature and science of color. Color is a sensation created in a viewer by the combination of the spectral response of the physical object, the spectral output of the light falling on it, and the physiological and psychological response of the viewer. Therefore you cannot define a "color" without specifying an illuminant, and consumer terms such as "6500 Kelvin" is insufficient to fully describe the spectrum of a light. Similarly one set of RGB or LAB values does not fully describe an object.

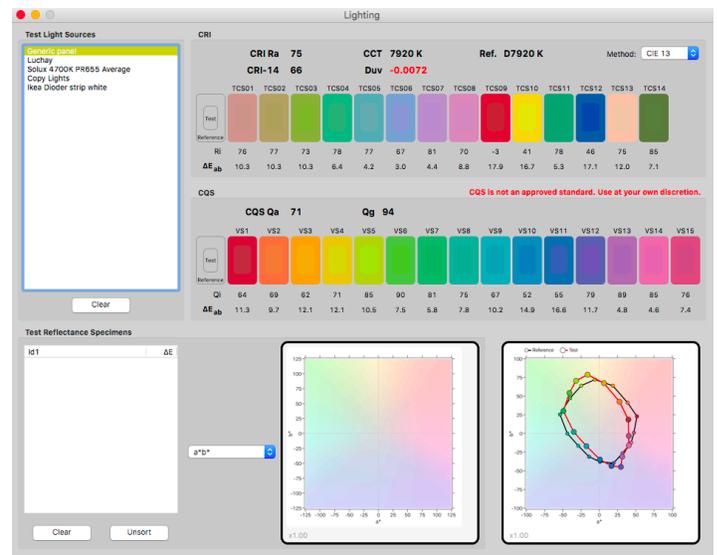
Because color is defined by spectrum any investigation into color that is more than skin deep requires tools that can measure and work with spectrum rather than RGB or LAB values. Spectral analysis can be used to investigate, for example, situations in which the color of two objects match under one type of lighting but not another (a situation broadly falling under the term "metamerism"). Another use of spectral analysis is to identify the pigments or materials used by an artist without requiring physical samples to be taken.

One powerful tool for spectral analysis is Spectra Shop (www.rmimaging.com/spectrashop.html) made by Robin Myers. Among other things SpectraShop can be used, along with a spectrophotometer to:

- Measure the spectrum of a light source, including the CRI, CRI-14, or CQS scores of that spectrum.
- Measure the patches of a specific physical target as suggested in Chapters 6.3 and 1.4.
- Measure the spectral content of a specific object to help facilitate identification of its physical makeup.



SpectraShop's Main Collection Window



SpectraShop's Lighting Evaluation Tool

7

Workflow Summaries

7.1. Workflow for Bespoke CH Profiles | Summary

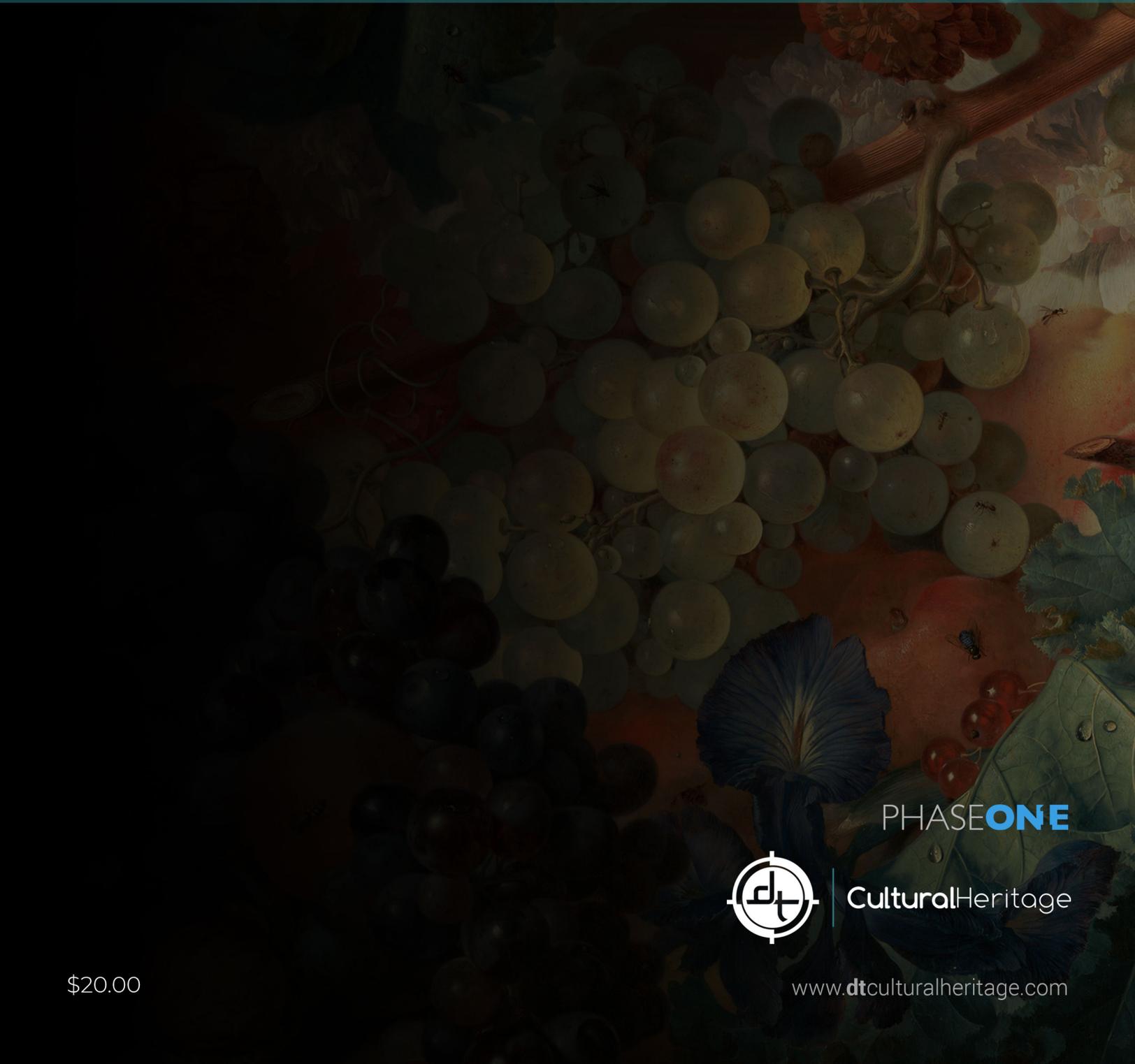
This summary is not meant to replace a thorough reading of Chapter 3, but as a quick reference for those who have. It assumes the use of Capture One CH with a process recipe set to Adobe 1998 color profile and the imaging of flat non-transmissive material.

Section	Page	Step	Summary
3.1	11	Set Mode	[Base Characteristics > Mode > Photography]
3.2	12	Set Color Profile	If using DT Photon: [Base Characteristics > ICC Profile > Cultural Heritage - Flat Art Reproduction - LED DT Photon] If using Strobe: [Base Characteristics > ICC Profile > Cultural Heritage - Flat Art Reproduction - Flash]
3.3	12	Set Curve	[Base Characteristics > Curve > Linear Response]
3.4	13	Capture LCC File & Create LCC	Insert and Capture image of gray cardboard Right Click thumbnail and select Create LCC
3.5	15	Application of LCC	[Next Capture Adjustments > All Other > Copy From Last]
3.6	16	Set White Balance	ISA Golden Thread: White balance on patch 13 ColorChecker SG: White balance on patch F5
3.7	17	Set Exposure	ISA Golden Thread: patch 15 should have an L value of 62 ColorChecker SG: patch G5 should have an L value of 65 If needed adjust shutter speed (if using DT Photon) or strobe output (if using strobe).

7.2. Workflow for In-Situ Profiles | Summary

This summary is not meant to replace a thorough reading of Chapter 4, but as a quick reference for those who have. It assumes the use of Capture One CH and basIColor 5.

Section	Page	Step	Summary
4.1	19	Set Mode	[Base Characteristics > Mode > Photography]
4.2	20	Set Color Profile	[Base Characteristics > ICC Profile > Effects > No Color Correction]
4.3	20	Set Curve	[Base Characteristics > Curve > Linear Scientific]
4.4	21	Capture LCC File & Create LCC	Insert and Capture image of gray cardboard Right Click thumbnail and select Create LCC
4.5	22	Application of LCC	[Next Capture Adjustments > All Other > Copy From Last]
4.6	24	Set White Balance	ISA Golden Thread: White balance on patch 13 ColorChecker SG: White balance on patch F5
4.7	25	Set Exposure	ISA Golden Thread: patch 15 should have an L value of 62 ColorChecker SG: patch G5 should have an L value of 65 If needed adjust shutter speed (if using DT Photon) or strobe output (if using strobe).
4.8	26	Crop & Export Target	Crop target using AutoCrop or manual Crop and Straighten tools Process using recipe set to 16 bit TIFF with Embed Camera Profile
4.9	29	Create Profile in basIColor Input 5	In basIColor 5... Select CCSG Repro Preset Drag in the TIFF that was processed in Capture One CH Follow name template [MakeModel-CustomName.icc] Click Start Profiling
4.10	31	Set Capture One to Use Profile	Restart Capture One [Base Characteristics > ICC Profile > Your Profile Name] [Base Characteristics > Curve > Linear Response] [... > Save as Default]



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