Instruction manual for photographing 2D objects

RIJKS MUSEUM

HASSELBLAD

Instruction manual for photographing 2D objects

Contents

Introduction

The Rijksmuseum's collection comprises approximately 8.000 paintings and 750.000 works on paper. It is our concern that all two-dimensional works are digitized in a correct manner.
It is considered vitally important that the museum maintains high standards of quality in every respect and this manual is intended to contribute to this.

The manual concerns photography of two-dimensional objects; works of art on paper and paintings. Only those aspects that determine the measurable quality of a photograph are taken into consideration here. The photography of painting brings other aspects into play as well; these we shall address in an additional chapter.
Various types of software will be discussed; some of these are freely available online.
In the final chapter we discuss briefly the backgrounds of materials used and motivate reasons for our decisions.

We made grateful use of manuals written in the past for the Rijksmuseum by Scott Geffert, as well as data from' Metamorfoze Preservation Imaging Guidelines' by Hans van Dormolen.

This manual is intended first and foremost for the Rijksmuseum's photographers, so as to ensure that all photography at the Rijksmuseum may conform to our standards of quality.
However, as it pertains to all aspects of photographing two-dimensional objects it could also be a useful document for other photographers of cultural heritage.

We welcome any remarks or suggestions. Relevant and/or necessary additions will be included in future versions.

Carola van Wijk (c.van.wijk@rijksmuseum.nl)

Henni van Beek (h.van.beek@rijksmuseum.nl)

Staff Photographers, Image Department, Rijksmuseum, Amsterdam

Photography of 2D objects with Hasselblad and Phocus 2.8.1

To make a good color profile, start from the following position:
Works on paper are photographed from above on a reproduction table.
The camera should be set at an average height; allowing for an object of A2 size approximately.
In order to photograph a painting, position the camera in front of the canvas at approximately 2 meters distance. In our situation (depending on which type of camera/lens is in use) this would equal a sampling rate of 300 ppi. Sampling rate is the number of pixels per inch. In this manual we shall not speak of resolution, since that word allows multiple interpretations and could lead to confusion.
The ColorChecker Digital SG Target is placed on an evenly grey background (lab value 50), or is positioned directly against the painting to be photographed.

Phocus:

Configure the following starting position in the toolset
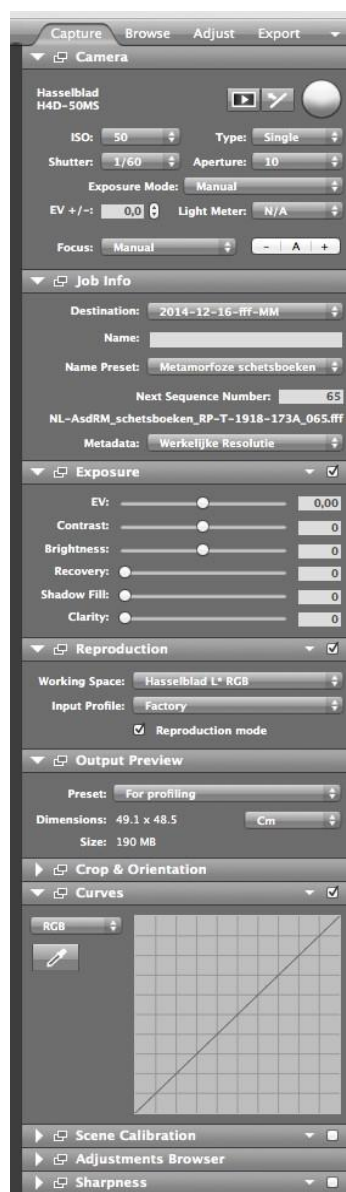
Capture tab:

- Exposure: EV=0, all other parameters 0
- Reproduction: Working space: Hasselblad L* RGB
            Input profile: Factory
            Reproduction mode activated
- Curves: Default
- Scene calibration and sharpness: off

Export tab:

Create output preset: for calibration
-File Format: TIFF-16
-PPI: 300
-Dimensions: Full Size
-Output profile: Source
(Preset 'for calibration' needs to be created and stored only once.)
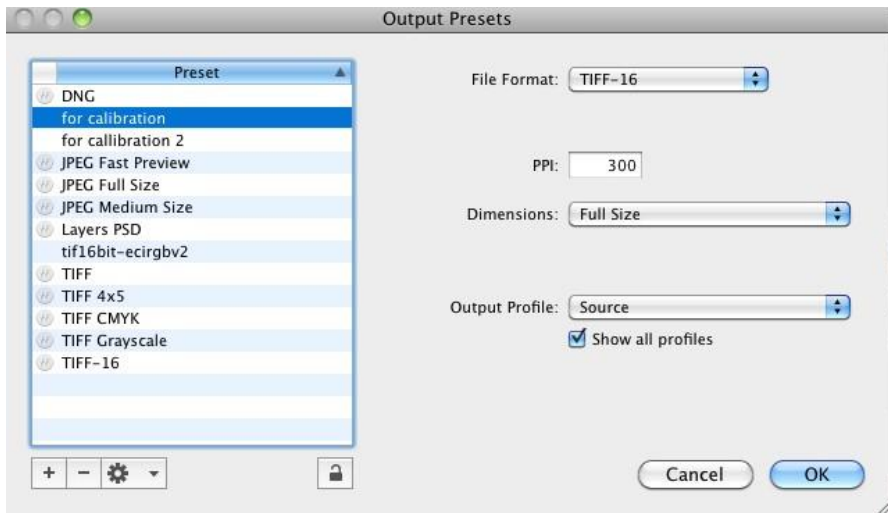
Make sure the area to be photographed is lighted evenly.
At the Rijksmuseum we use Broncolor lightbars.

Take a picture and neutralize it on G5.

Light the card to the extent that E5 = pixel value 246 (RGB output).
To achieve this, EV adjustment may be required; maximum deviation +/- 0.09
In case larger steps are needed, adjust the flash generator.

Scene calibration:

1. **Do not** apply for the photography of paintings.
2. For works on paper it can prove useful in certain cases.

This requires a purely white and clean surface on the shooting table. It should exceed the area to be photographed in size. First of all, lighting must be even. To check this, the reflected light in all corners and the center can be measured in Phocus. Preferably, differences in measurement should not be larger than 8 pixel values. In order to reduce such differences, scene calibration can be applied, but is not strictly necessary. Reducing these differences will be needed, however, if the Munsell Linear Gray Scale Target is placed at one of the edges; otherwise the required values of this target will be harder to achieve.

After applying a scene calibration, verify whether differences in pixel value have indeed been reduced.

Note: a scene calibration is only applicable for the distance of a specific camera position. Every change in position will require a new scene calibration.

Creating a Scene Calibration:

Take a picture of the clean white surface, frame-filling and slightly unfocused.
Click 'Create...', name and save.
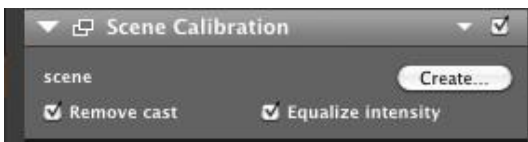
Export the image file together with the 'for calibration' settings and quit Phocus.

Camera profiling software: basiccolor input 3.5.1

- Open basiccolor input
- Select Target image
- Open Reference with the ColorChecker Digital SG File
- Select: reflective > GretagMacbeth > Digital Color Checker SG > Digital Colorchecker SG
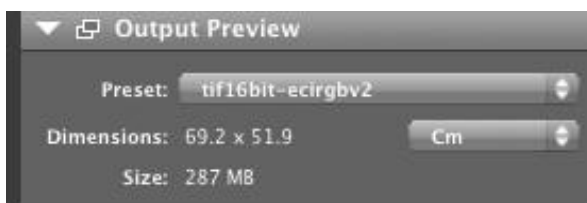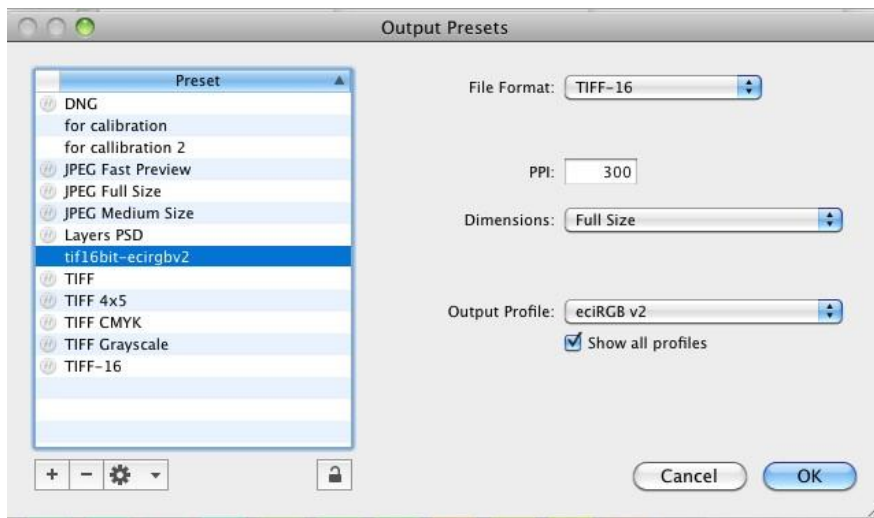 spectral.txt
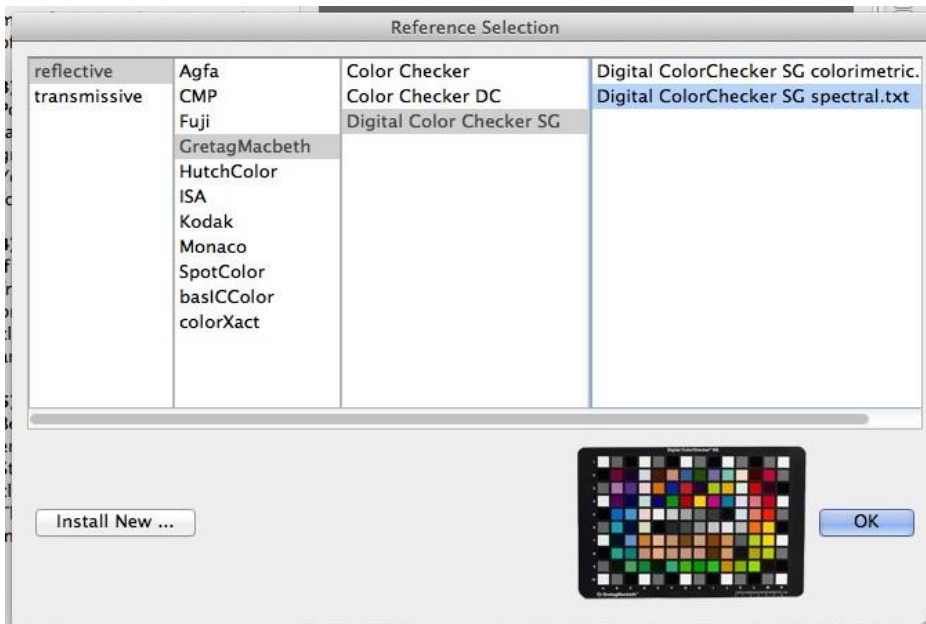
- Position the grid over your target image and align the grid with the target patches.
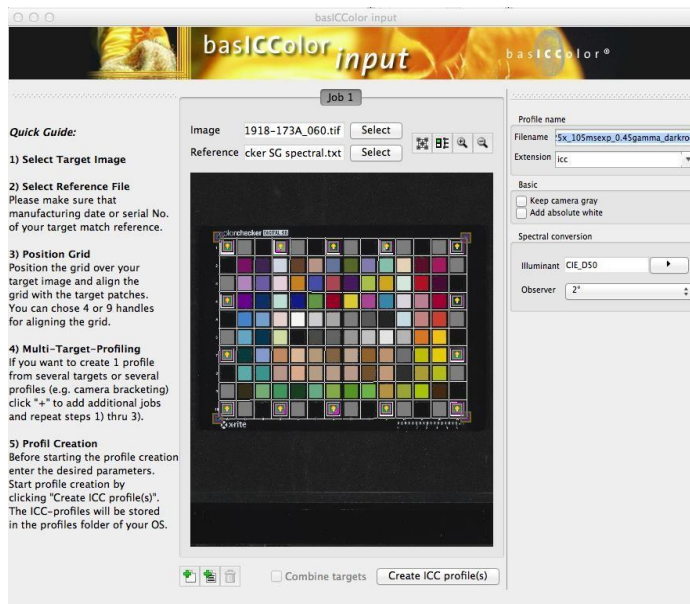
- Name your profile, including data concerning photograph, camera objective and date.
- Illuminant = D50
- Observer 2 gr
- Create icc profile

Checking neutrals

- Open Phocus
- Activate the image of the ColorChecker Digital SG
- Set Output to the profile in use: tif16bit-eciRGBv2

- Load the profile in Reproduction

- Activate Reproduction mode

- Check neutrals using the Metamorfoze lighting chart. After adjustments of the curve, all measured values must be in accord with given tolerances; those values circled in the chart (p. 9) are ideal values. In case of deviation from these, try to aim for consistency, so that all values deviate more or less equally.
  Generally speaking, under-exposure is preferable to over-exposure.

- Circled values in the chart are preferred pixel values, with RGB it is best to choose the pixel values for green. The two other values in the chart indicate maximum deviations.
- Values measured on the ColorChecker Digital SG can be adjusted on the curve if need be.
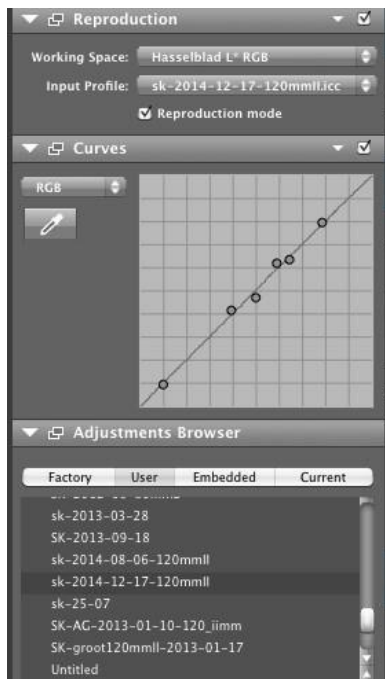
- Save the curve using the name of your color profile, adding an indication of the distance.

Metamorfoze lighting chart neutrals ColorChecker Digitial SG

VAK	L*	8 BIT PIXELWAARDE eCIRGBV2	8 BIT PIXELWAARDE ADOBE RGB (1998)	VAK	L*	8 BIT PIXELWAARDE eCIRGBV2	8 BIT PIXELWAARDE ADOBE RGB (1998)
E5	98,52	251	251	K7	47,60	121	112
	96,52	246	245		45,60	116	108
	94,52	241	239		43,60	111	103
J6	91,02	232	228	G6	42,15	107	99
	89,02	227	223		40,15	102	95
	87,02	222	217		38,15	97	90
F5	81,43	208	201	I5	37,27	95	88
	79,43	203	195		35,27	90	84
	77,43	197	190		33,27	85	79
I6	77,16	197	189	F6	32,68	83	78
	75,16	192	184		30,68	78	74
	73,16	187	178		28,68	73	69
K6	72,76	186	177	K8[21]	22,31	57	56
	70,76	180	172		20,31	52	52
	68,76	175	166		18,31	47	48
G5	67,06	171	162	J5	17,95	46	48
	65,06	166	156		15,95	41	44
	63,06	161	151		13,95	36	40
H6	62,28	159	149	E6[22]	8,75	22	31
	60,28	154	144		6,75	17	28
	58,28	149	139		4,75	12	23
H5	51,72	132	122				
	49,72	127	118				
	47,72	122	113				

## Focal points regarding the reproduction of paintings

- Take care that the painting in question is lighted evenly.

- For a capture of the ColorChecker Digital SG in order to create a profile, position the
  camera at 2 meters distance from the canvas.

- In case of a larger or smaller distance between camera and painting, readjustment of curve and/or
  lighting may be required. Check the chart capture via deltae. If necessary, create a new color profile.

- **Do not** apply scene calibration

- Posttest of the sampling rate:

For this purpose a ruler is photographed together with the painting out of its frame. Front as well as
backside. This also applies when photographing a painting in parts (see page 20).

Place the ruler next to the painting at the same distance from the camera. This way it is always possible
to calculate the sampling rate after the fact. Output sampling rate is 300 ppi.
The Munsell Gray Scale is of little use here, since with the photography of paintings it is virtually
impossible to contain all values within this chart's tolerance levels.

Verifying ColorChecker Digital SG with Deltae

- Go to **deltae**, register and log in

- Check your target in deltae: via upload
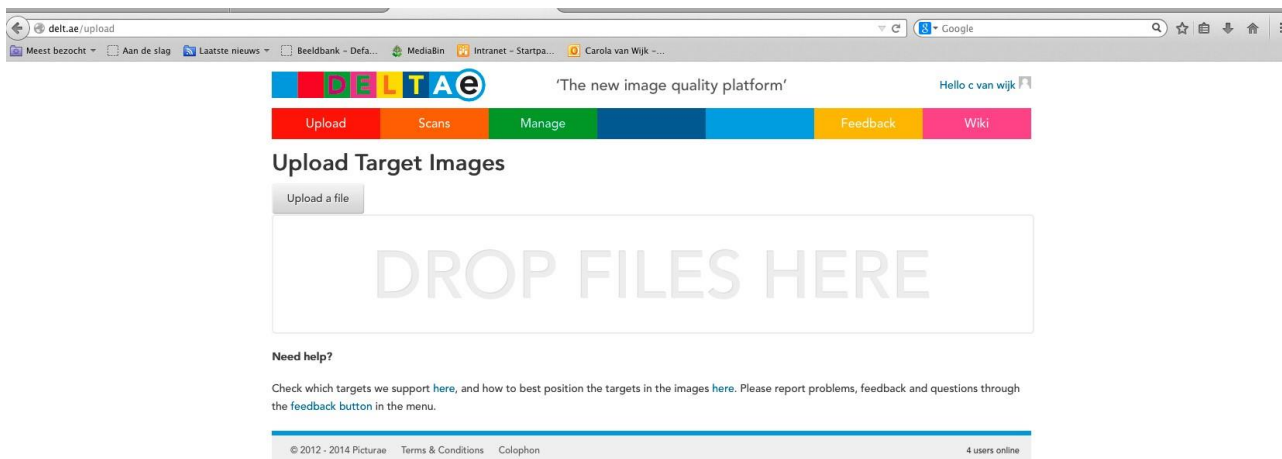
- Click on the green field to go to a new window containing detailed information, alongside profiles that can be downloaded.
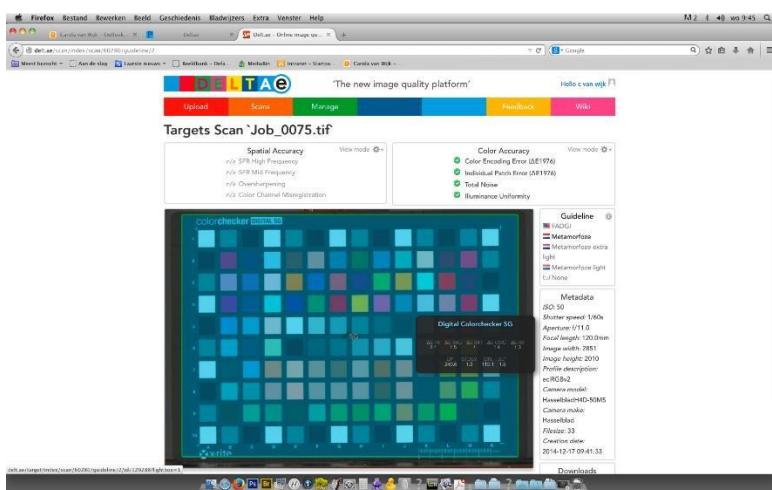
- One should be aware that actual results will not be identical to Metamorfoze Preservation Imaging Guidelines. Neutrals, for instance, need to be checked extensively, the darkest patches in particular.
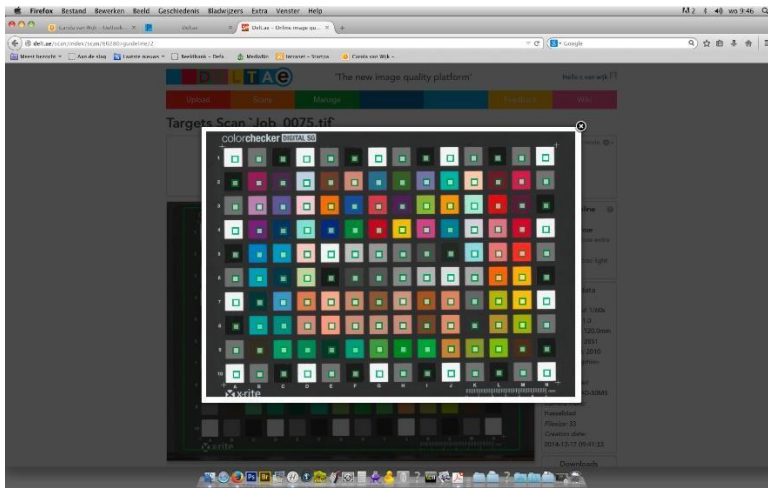
- Changing the camera's position in relation to the object, will again require verification of lighting positions and curve. This can be done with the ColorChecker Digital SG or (if works on paper are the object) the Munsell Linear Gray Scale. Adjust the curve if necessary. Small adjustments with the EV parameter (+/- 0.09 maximum) and larger ones on the flash generator.
- Every change in distance between camera and object will require a
   new checking of neutrals and consultation of Deltae to verify if
   settings are still in accordance with standards. If this is not the
   case despite curve adjustments, you will need to create a new color profile
   and curve.

Verifying Colorchecker Digital SG with iQ analyzer 5.2.17

Check the file in the iQ Color analyzer, concerning delta E
Ensure that you have a good picture (16 bit tiff) of the ColorChecker Digital SG test chart against a middle grey background.
Tab *color*
Chart layout: ColorCheckerSG.chart
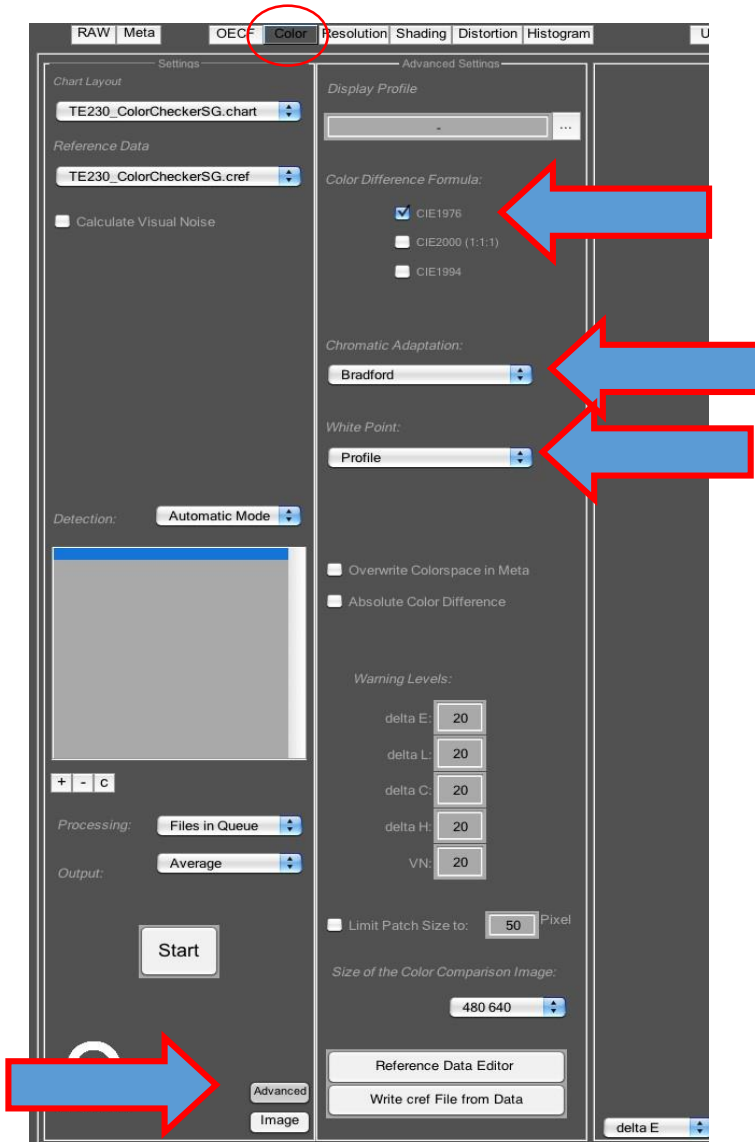Reference data: ColorCheckerSG.ref
Detection : Automatic Mode
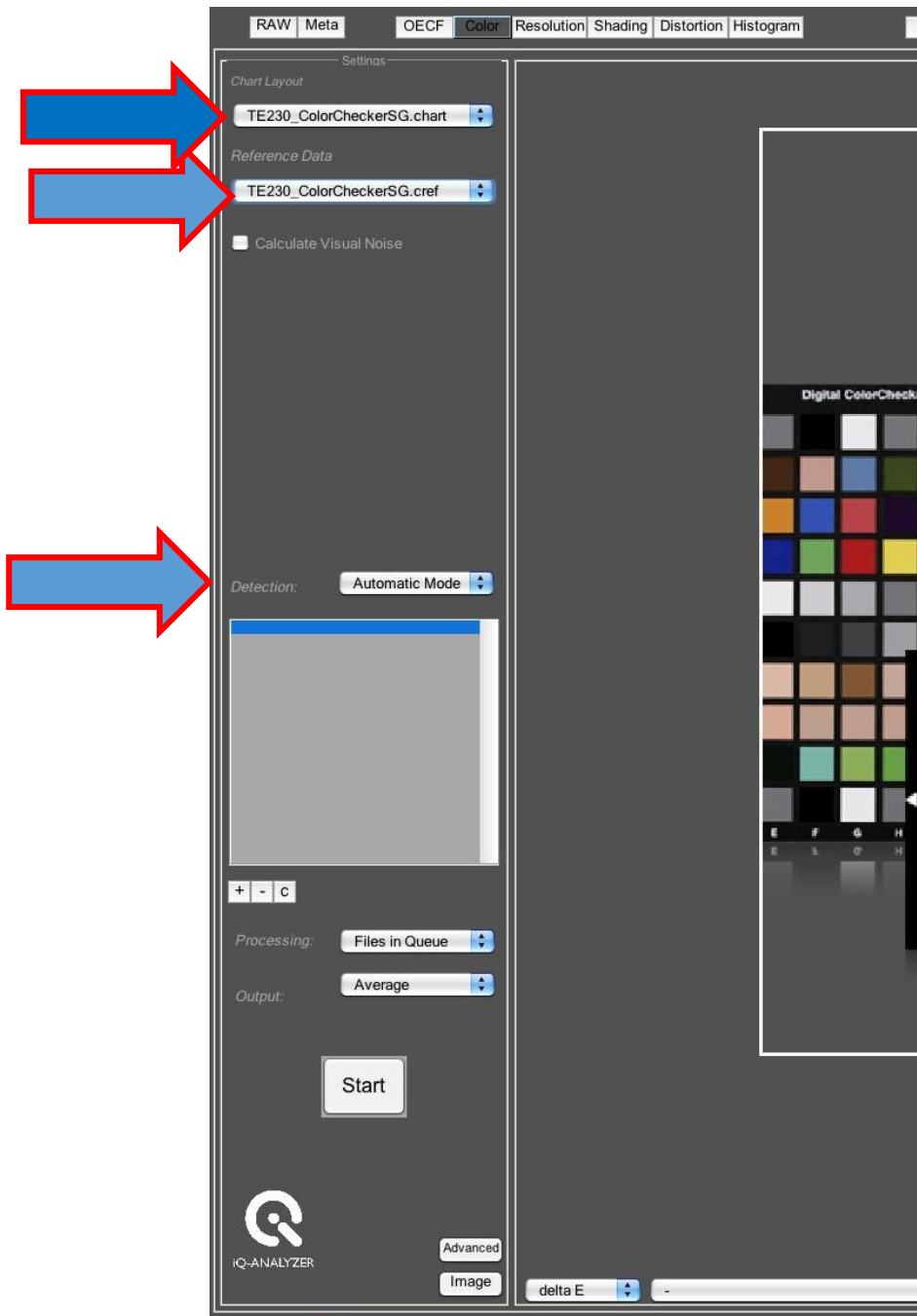
- Color tab
  Activate 'Advanced' button at the bottom of the left column
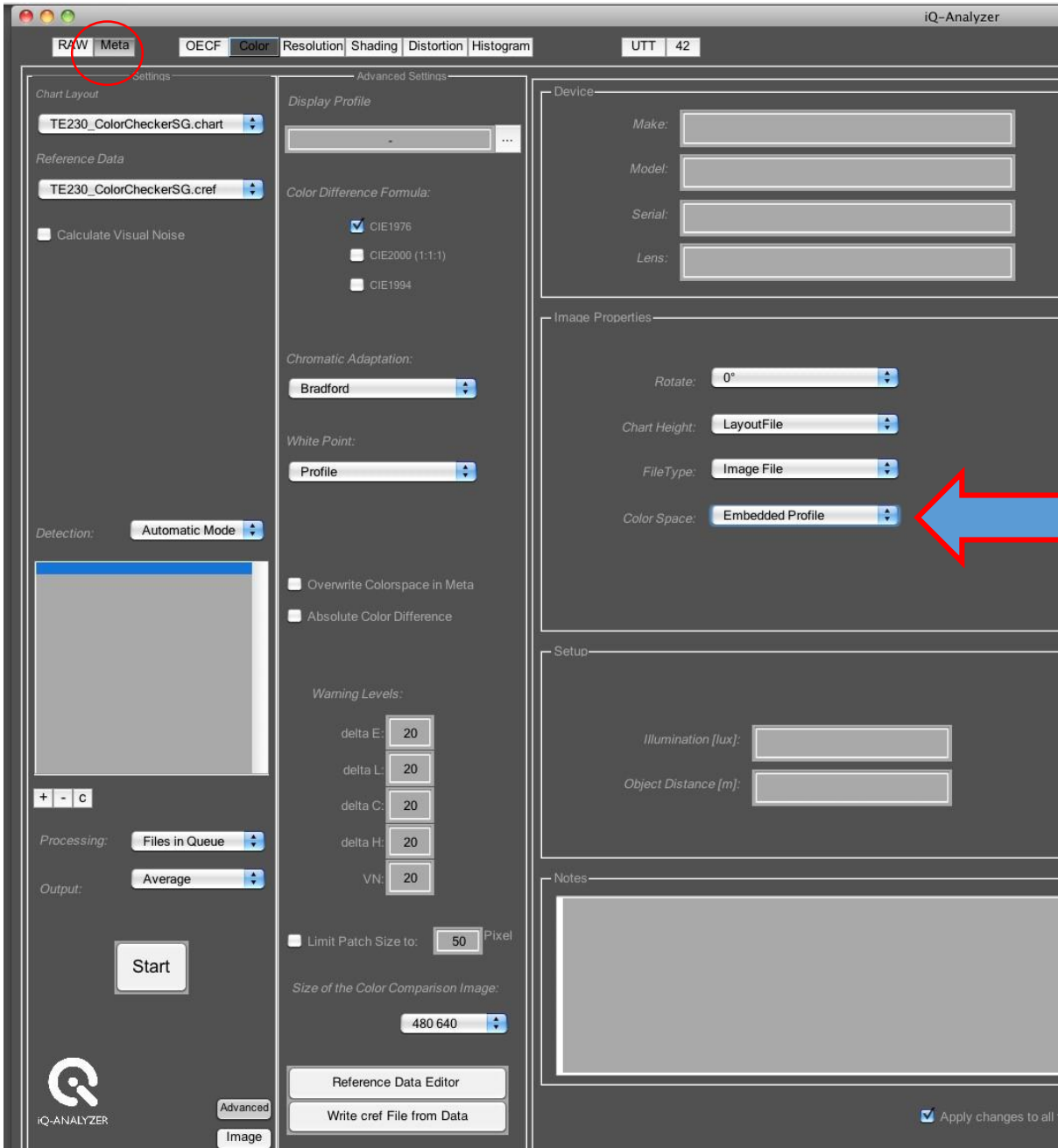 Advanced settings:
  Color Difference Formula: CIE1976
  Chromatic adaptation: Bradford
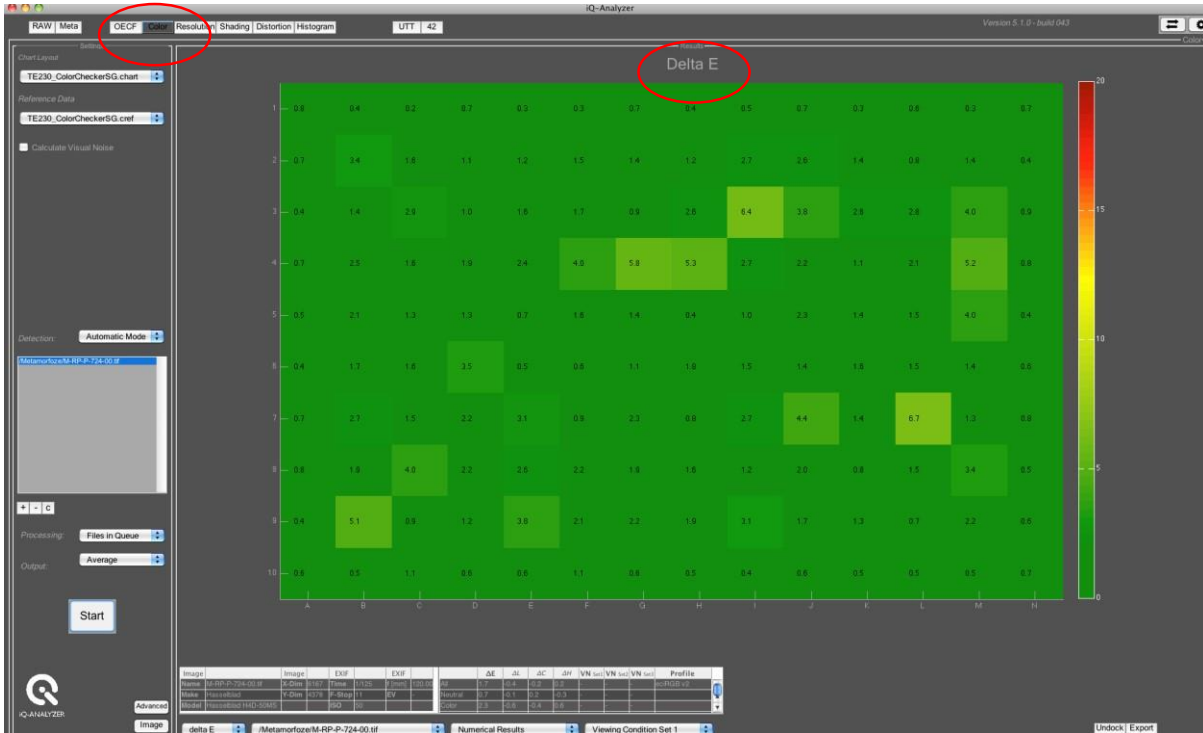 White point: Profile

- Meta tab

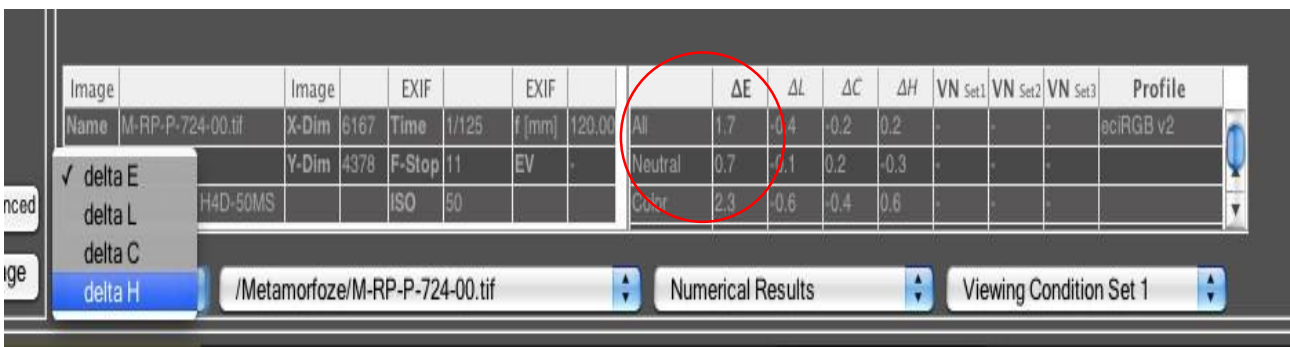Color space: Embedded Profile

- Color tab again

Load image via +, then click 'Start'.

delta e results:

None of the boxes may contain values above 10, read average values.

delta e, the value for 'all' must not be larger than 4.

This chart enables a reading of Delta E All: shows the difference between the measured file and its reference file, concerning L, C and H.
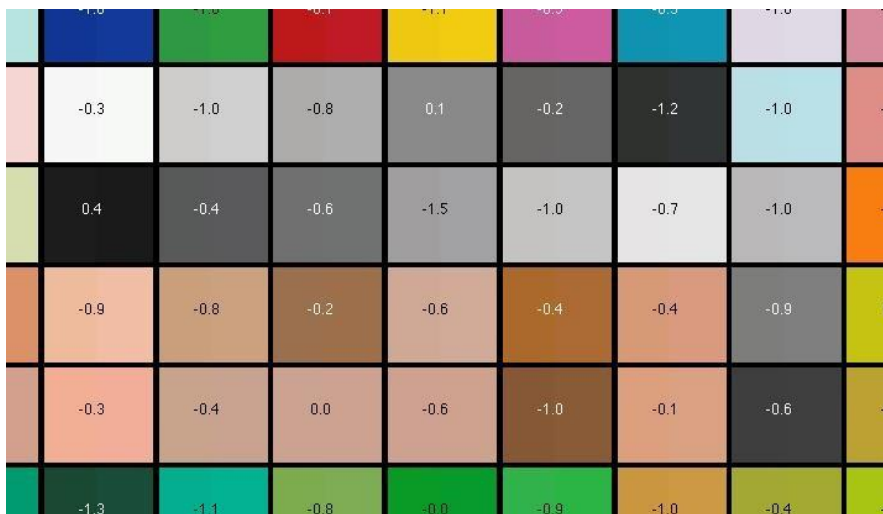Delta L stands for luminance or luminosity
Delta C stands for chroma or saturation
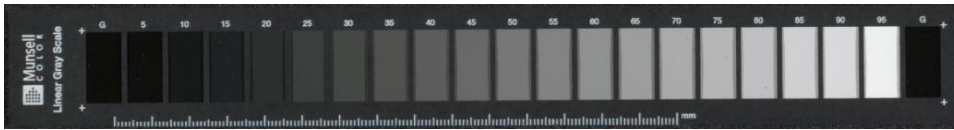Delta H stands for hue

Select Delta L (bottom left) and Visual Comparison (bottom right) for a readout of neutrals:
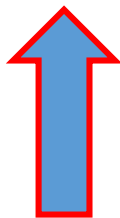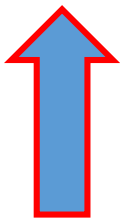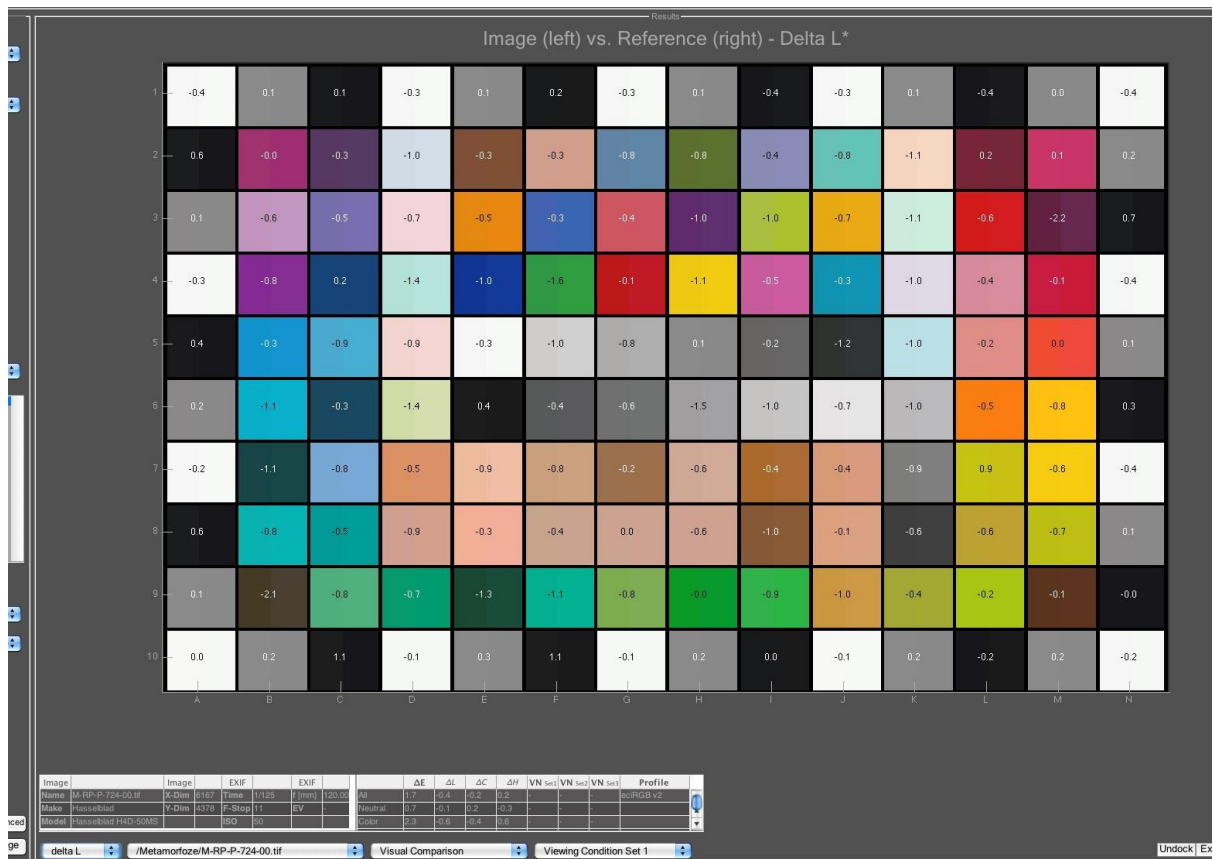
Values of individual neutrals should all be between -2 and +2.

The Munsell Linear Gray Scale

This chart is used as object level target for photographing works on paper. For the background we use middle grey.

It is minimally required that patches with values 95 to 50 fit into the image. The ruler should be photographed as well. If parts of other objects will thus be included in the image, these can be covered with an appropriate type of mounting board or cardboard.

L* values are indicated on this chart. The figure below also shows pixel values and their tolerances for the current color space (eciRGBv2).
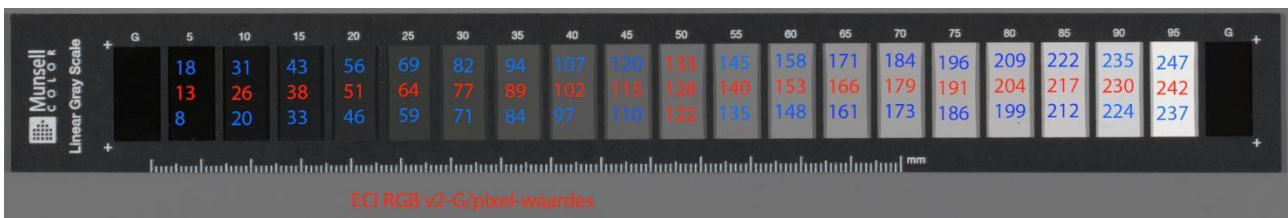
For measurements to be consistent the chart should be placed horizontally, at the bottom of the image range, from black to white.

1. Portrait style:

2. Landscape style:

Note: background is a middle grey sheet of cardboard or mounting board.

Deviations on the chart must not be more than +/- 2 L* or 5 pixel values.

Photographing a painting in parts

Requisites:

- 3 small tripods
- A4 size white paper
- Laser rangefinder
- Laser pen, mirror, screw thread
- Measuring tape
- Level, digital level

Determining image resolution:
Suppose that a painting is to be captured at 400 ppi. Check the width in pixels of the camera's sensor, let's say this is 6000. Dividing 6000 by 400 gives you the width in inches, in this case 15". Metric conversion: 15" x 2,54 = 38 cm. This is the required width for 400 ppi. If you take care to have these 38 cm. in the frame - aim at a ruler - you will be able to measure the working distance.
Required overlap:
Based on a minimally required 25% overlap of separate photographs, the horizontal movement necessary between captures will be: 0.75 x 38 = 28.5 cm.

Instructions:
Place two of the tripods at the required distance from the painting using the rangefinder.
Required distance is the camera's distance. This distance is defined by the number of parts in which the painting is to be photographed. With the equipment used by us, the distance is approximately 2 meters.

painting

Attach the laser pen horizontally to the third tripod.
Aim the laser pen at the two other tripods, so that they are aligned with the laser beam.
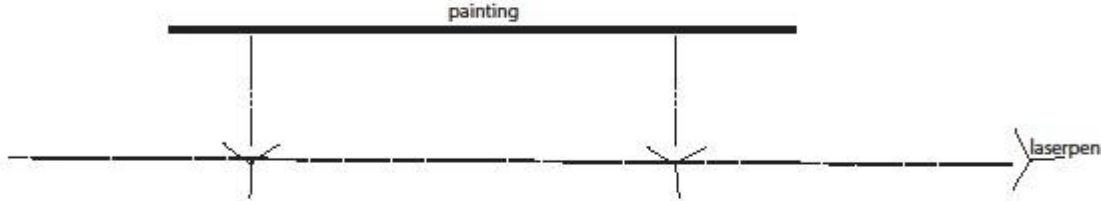

The first tripod can now be removed. Move the second tripod until it's no longer in front of the painting, but still aligned with the laser beam.
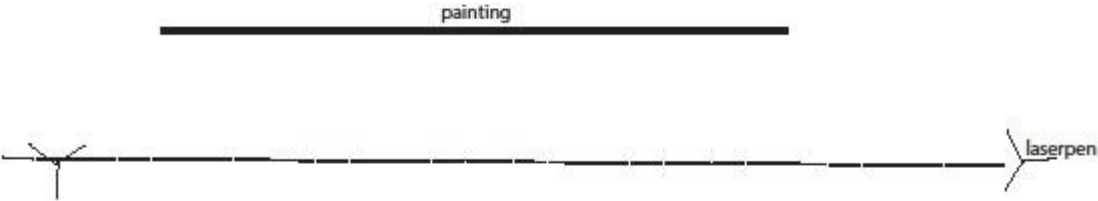
Subsequently:

In case the painting is not completely vertical, measure the vertical angle with the digital level. Set the camera at the same vertical angle. Position the camera in front of the painting.
Attach a mirror to the side of the camera, on the same side as the laser pen. Adjust the laser pen's height if necessary. Its beam should be aimed at the mirror's center. Punch a hole in the sheet of white paper and thus attach it to the laser pen. Make a panning movement with the camera, in such a way that the reflected laser beam falls on the sheet of paper in the same vertical line as the original <u>laser point</u>. This is a guarantee for accuracy.
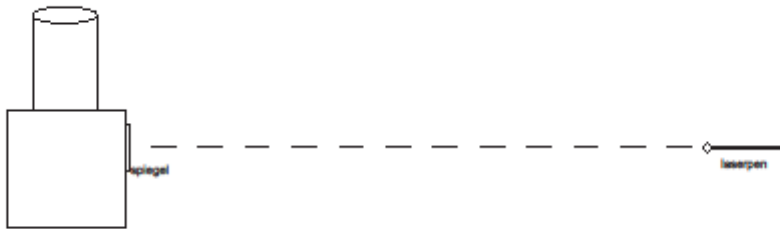
Start top left with the first capture. It is now possible to calculate how large a part of the painting is in the picture. Since the separate parts will be stitched together, 25% overlap is needed. Now you can calculate how far the tripod will have to be moved for the next capture. Make sure the camera remains positioned correctly: aim the laser at the same point in the mirror and repeat the action described above.

Take care that the camera is in focus at the first capture; if procedures are followed correctly no further adjustments will be required.

Repeat all actions until the top section of the painting has been captured.
If it applies, the next (lower) section is to be photographed the same way. Do keep in mind that after lowering the tripod, the camera must be positioned in the same angle as before.

If the painting's position is not completely vertical, then for the second (horizontal) section and any following after it, all actions described above will have to be repeated from the start, with the exception that the camera's focus cannot be readjusted. Check that you stay in focus. If this is not the case, something else went wrong in the procedures.

Save and store:

When photographing paintings in parts, a required addition to the metadata is an indication, in the 'description' field, of which part of the painting is depicted in the image in question.

The figure below, for example, represents a painting photographed in 16 parts.
More parts would mean more numbers and characters.
In the metadata 'description' field: first picture (top left) = 'part 1A', next picture = 'part 1B', etc.
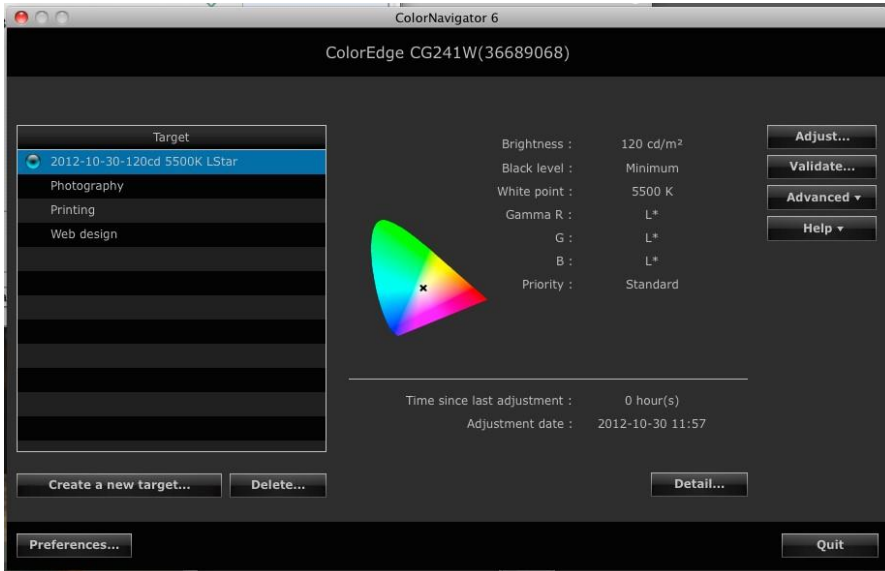
1A	1B	1C	1D
2A	2B	2C	2D
3A	3B	3C	3D
4A	4B	4C	4D

Note: pages 33 - 39 contain a detailed explanation of PTGui software and how it can be used for stitching separately photographed parts of a painting together.
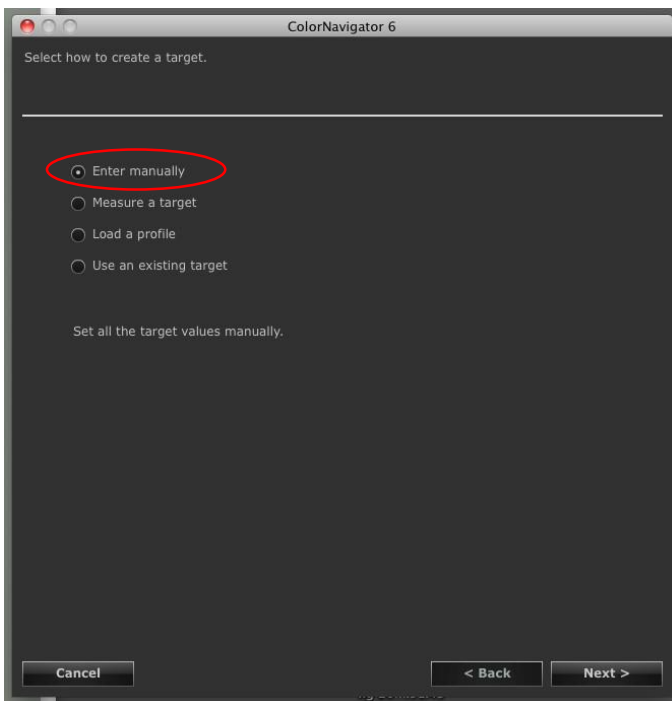
Monitor (Eizo) profiling
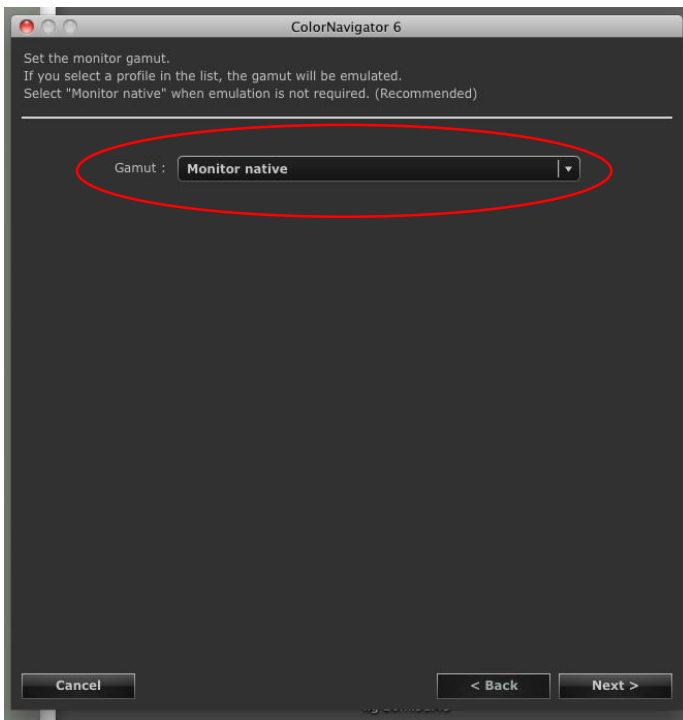
Software:

colornavigator 6
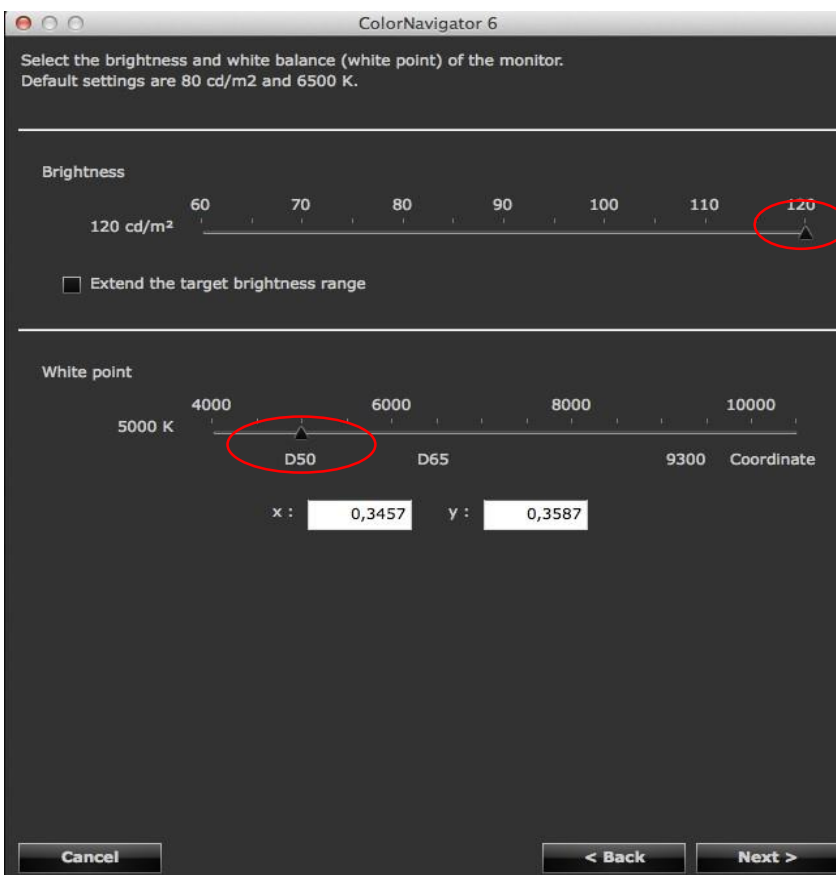
- Create target

-enter manually
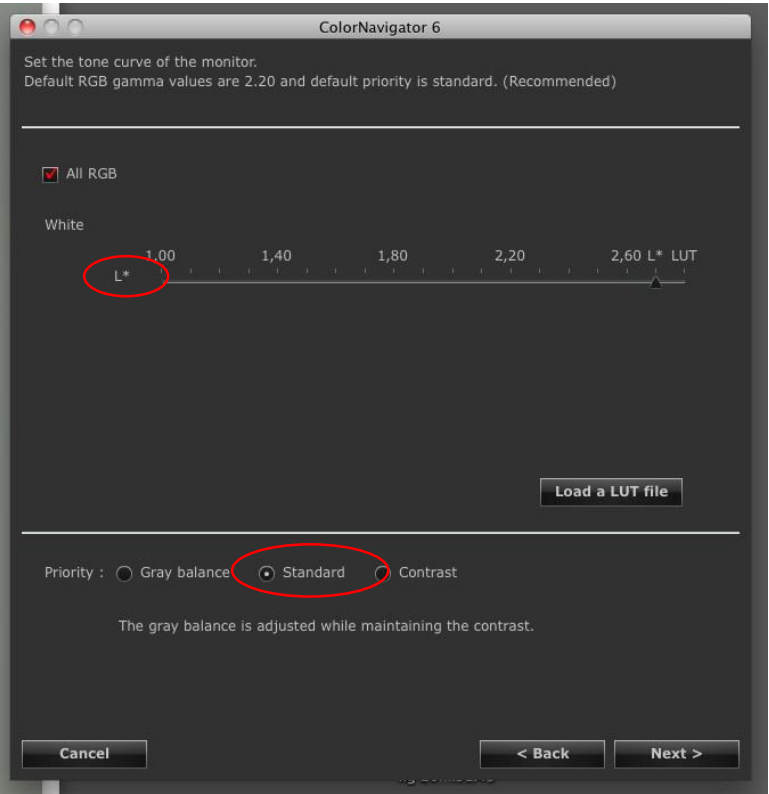
Gamut: monitor native

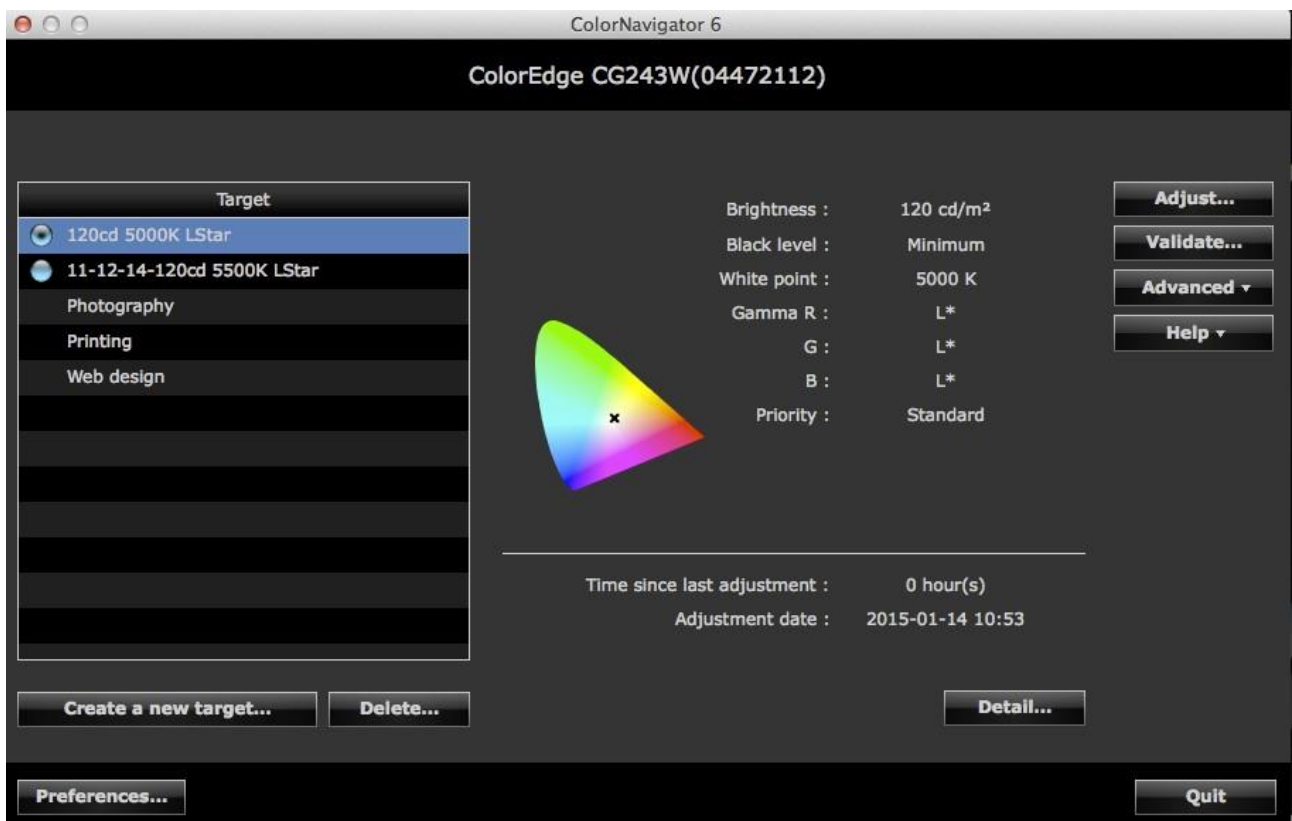
 - Brightness: 120
- White point: 5000 K

Default black level is off

- L*
- Priority standard

- Add the correct date to the new target and save:
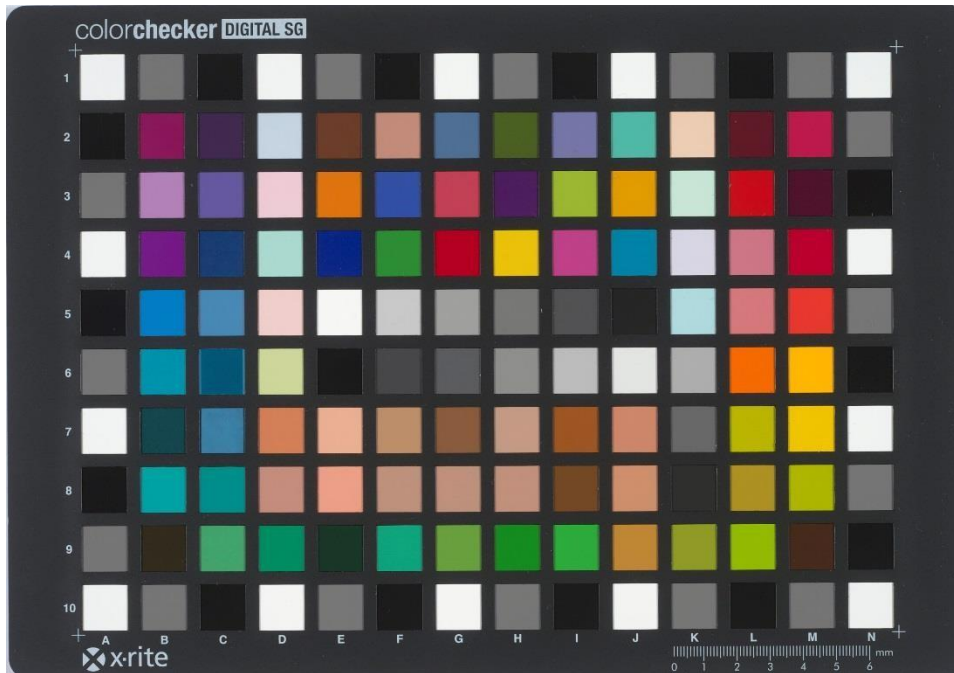 HD > Library > Colorsync > Profiles > Displays.

Targets, background and sampling rate

(Various types of software use different names for this test chart; we use X-Rite's most recent version.)
Targets should always be treated with care; leave no fingerprints and do not damage or remove the coating.

Targets:

ColorChecker Digital SG

The ColorChecker Digital SG is the main tool for the creation of a photograph.

The ColorChecker Digital SG is used to create color profiles.

The inclusion of a ruler on the chart enables a calculation of the sampling rate.
Do note that the ruler misses a millimeter in the first centimeter.

Various types of software make use of this chart to provide information about neutrals (gray values) as well as color.
The chart is of less use for the measurement of gain modulation, because distances between the grey boxes are chosen rather randomly

For readings of the ColorChecker Digital SG, two software packages are recommended:

iQ analyzer

Gives you the possibility to draw conclusions from the results of the chart measurement quite simply, provided you have some knowledge of tolerances.
Allows evaluation of delta E, H, C and L.

Shows the average values for neutrals.

DeltaE

Software developed by Picturae, freely available online.

The advantage of Deltae is that various targets in one file can be measured at the same time.
It has a clear interface and is user-friendly.

Furthermore, the **claimed sampling rate** can be read in Deltae, which is not possible with iQ analyzer.

Almost every type of target gets a complete readout, as opposed to iQ analyzer, which cannot interpret image resolution and sampling efficiency.

Deltae does have an additional advantage: it enables the creation of color profiles without extra software.

Slanted edge QA-62

A target by means of which both the claimed and the obtained sampling rate can be read.
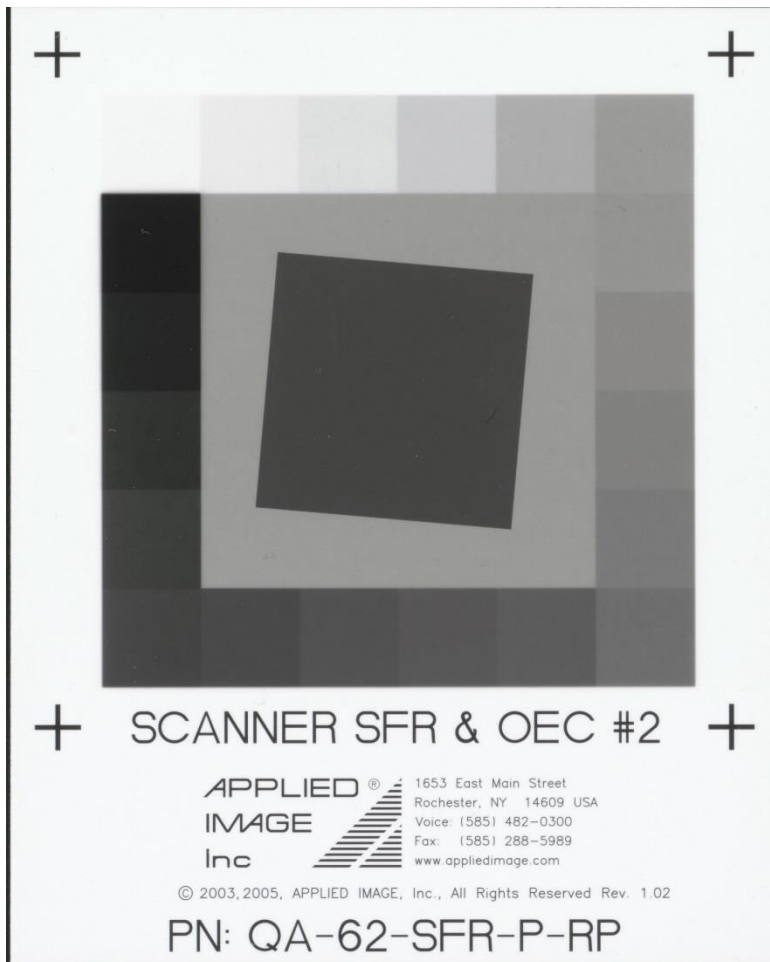
To measure the horizontal and vertical sampling rate the Rijksmuseum uses the software program called IM Check.
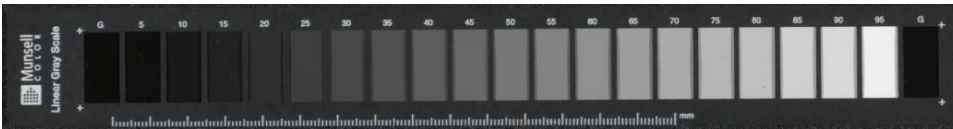
In Deltae, the sampling rate can be measured, but only in average values, whereas it is preferable that horizontal and vertical values are measured separately.

Note: for the results of your measurements to be accurate, take care that the target is placed upright in the frame.

Set the 'straighten' parameter in Phocus to 0.

Munsell Linear Gray Scale

We use this as object level target for works on paper; it is photographed alongside every such object.

Good points are:
- Grays are neutral and L*-based.
- Patches have incremental values of 5 L*. This allows for readings of gain modulation.
  This is the chart's linear aspect.
- The darkest patch has a value of L 5, whereas the ColorChecker Digital SG does
  not get darker than L 7. Neither is the ColorChecker Digital SG linear.
- This is the first gray scale chart on the market with such a large gamut.

We recommend a detailed reading of the 'Metamorfoze Preservation Imaging Guidelines'.
Many concepts used in this manual are explained comprehensively there and Metamorfoze tolerances are also mentioned. A pdf containing these guidelines is freely available on the their website.
Metamorfoze

Background

Prints and drawings are, more often than not, on white paper and usually mounted on white or light-colored materials, so there tends be a lot of white in the photograph, for which reason we have chosen to use a neutrally gray background instead of black. Most profiles give better results on gray than on black. This rule applies less to paintings.

Sampling rate

1) Claimed sampling rate
2) Obtained sampling rate

The difference is:
Claimed sampling rate predicts the number of pixels to be expected theoretically under optimal conditions, but tells nothing about the quality of actual results. Obtained sampling rate does relate to results, including focus and quality of the camera's lens.
If obtained and claimed sampling rate are identical, this is called a **sampling efficiency** of 100%.

At the Rijksmuseum we have decided not to work with obtained sampling rate.
We have no wish to limit ourselves in terms of printing sizes, therefore photography in one fixed sampling rate will not suffice. Apart from that, greater detail that can result from greater proximity to the object, is an important argument.

We assume that our photographers focus well and we have chosen to work with large files which allow for greater detail. Our pilot-project has shown that focusing with the aid of life view results in a sampling efficiency of 85% or more, especially when using the Hasselblad 120 II mm.

Determining the sampling rate (claimed, not obtained):

Use the ruler on the Munsell Linear Gray Scale Target.
Open your file in Photoshop, select the ruler tool. Take care that measuring units are set to 'centimeters' in Preferences.
Measure the ruler's length in the photograph. Let's suppose that it is 30 cm; now divide that by 15 (actual length of the Munsell ruler) = 2. Multiply this figure by the image resolution (for example, 300 ppi). The outcome of this being that the claimed sampling rate is 600 ppi.

(30 : 15) x 300 (image resolution) = 600 ppi.

Measured size divided by known size times image resolution equals claimed sampling rate.

Stitching a painting with PTGui

PTGui is software used for stitching photographs together to create panoramic images, but which can be used in such a way that partial images of two-dimensional objects, such as paintings, can be stitched together.

Step 1

Start the application and 'Load images...'.
Now it is a matter of setting the parameters to fool the software.
Enter values for Focal length that are much higher than the actual distance. The software will not be able to tell the difference between a sideways movement and a pan - which it expects. For this reason the 'Automatic' box should not be activated.
Focal length can easily be set at 1,000,000 mm., as in the example below.
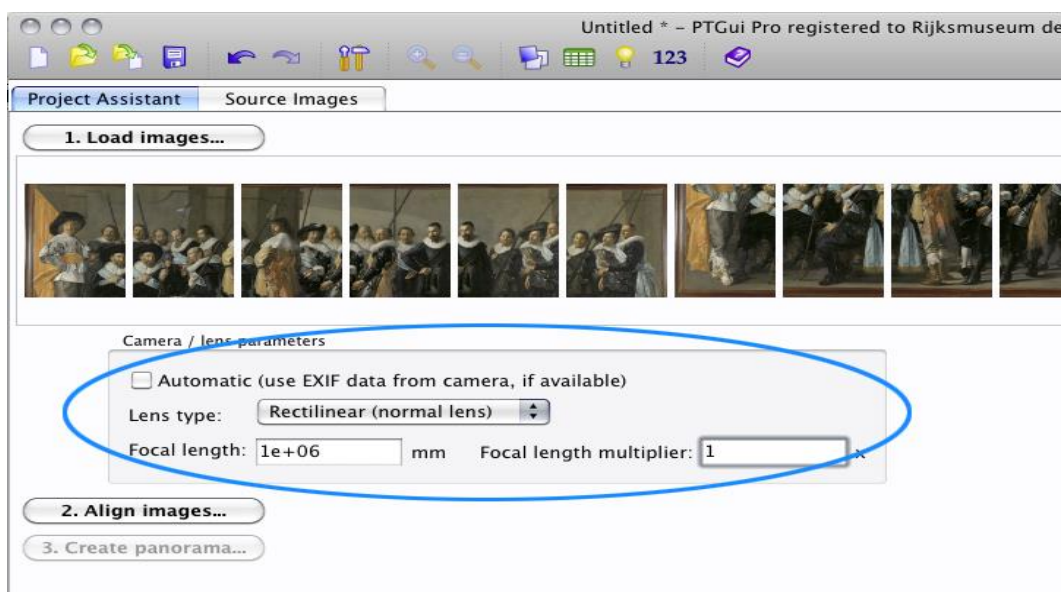
Step 2

Here there's a choice between an *easy* and *advanced* section of the manual.

Step 2a

Choose 'Align images...' and wait until PTGui is ready. How long this will take depends on the number and size of the partial images.
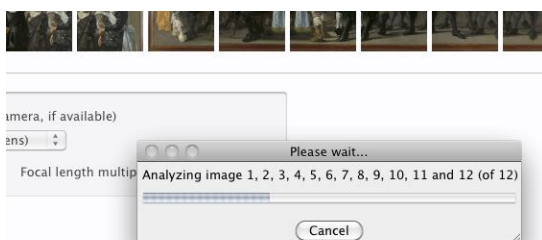
When this is done, a new window will appear: the Panorama Editor, allowing for adjustments.

In our example, the entire panorama tends to sag towards the bottom right. Press the '123' button to start Numerical Transform; 'Roll' can be used for corrections. Each time the command 'Apply' is given, your correction will be executed anew. Image quality is not affected by such corrections.
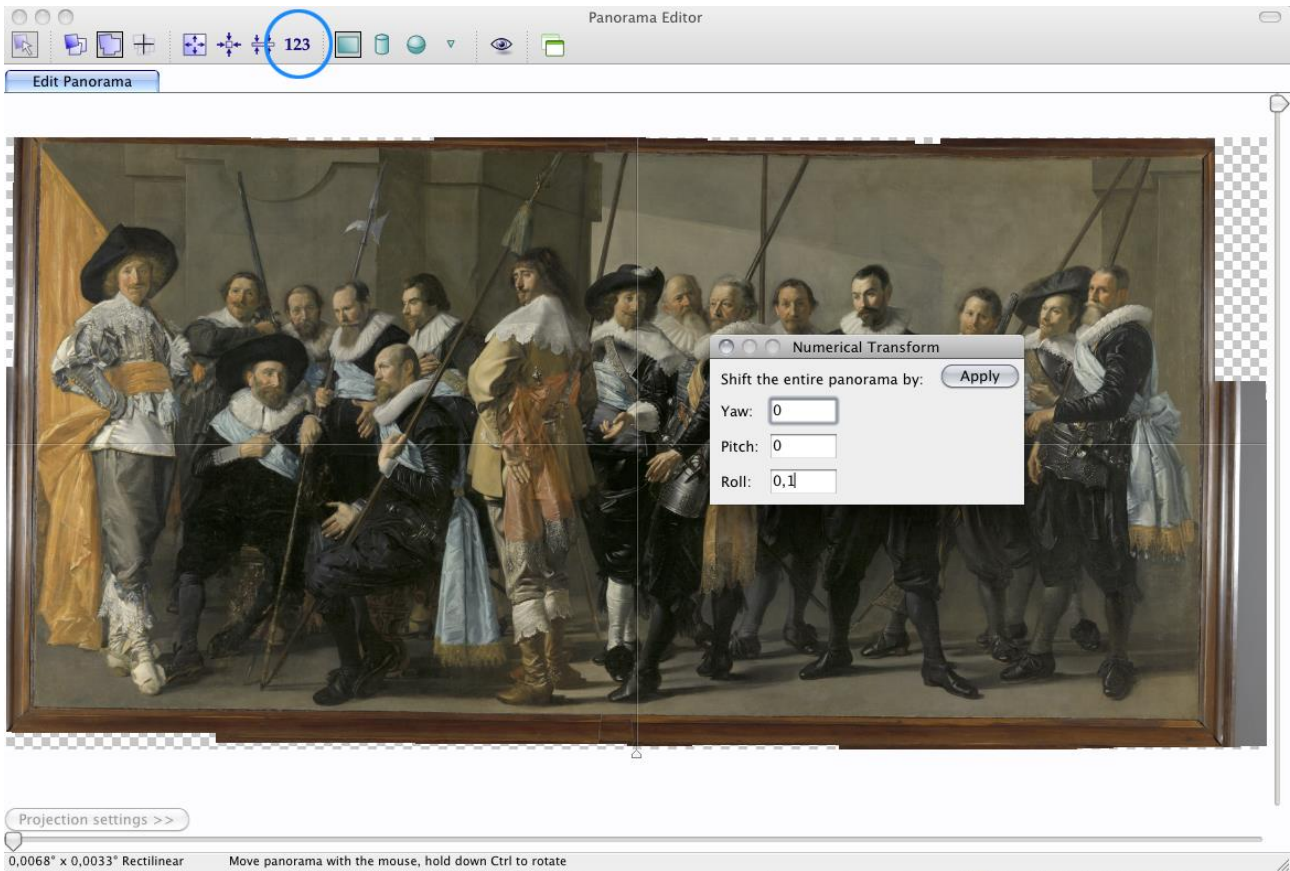
Broadly speaking, this stitch appears to be OK. There is the possibility that a number of your partial images are *orphaned,* which is to say they didn't find a place during the automatic *alignment.* Part(s) of the picture will be missing in the Panorama Editor. You will be notified if this happens.
At any rate we recommend checking the control points generated by the software.
In the next step.
Choice

Easy:
- if the object is completely visible in the Panorama Editor, go to step 3: Create panorama...

- *Advanced:*
- if partial images are lacking in the Panorama Editor, they are orphaned and you will need to add
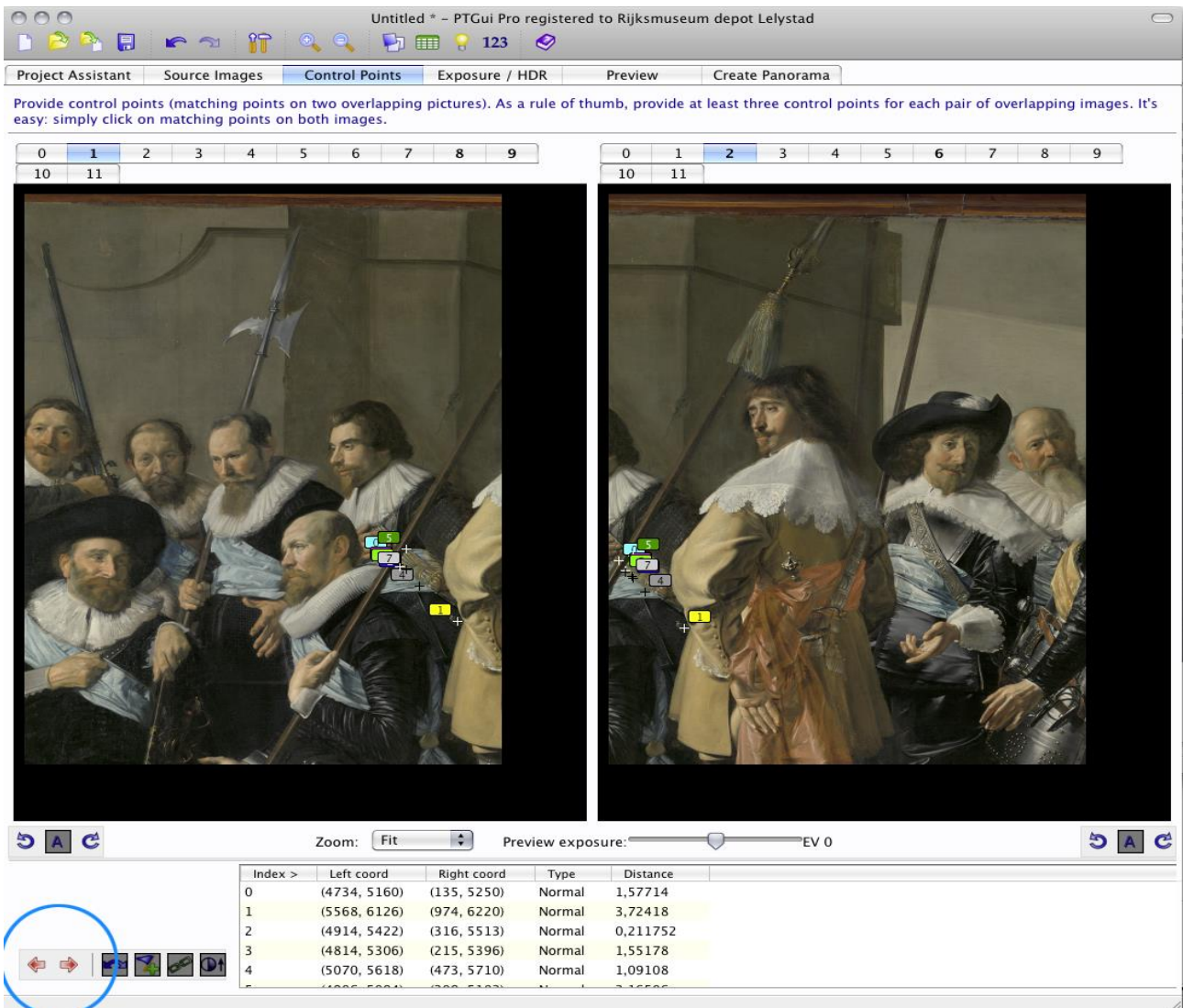 control points.
- if you choose to check whether all overlapping pictures have control points.

   In both cases, proceed with step 2b.

Step 2b

Often there are either no control points to be found between pairs of overlapping pictures, or all control points are in a cluster.

Go back to the main window and select the Control points tab.

In this example we see that all control points are indeed clustered. To look at other picture pairs, use the red arrows, bottom left. This sequence is of a horizontal row, but vertical picture pairs can be viewed this way too. In this case that would be, for example, images 0 and 6, 1 and 7, etc.
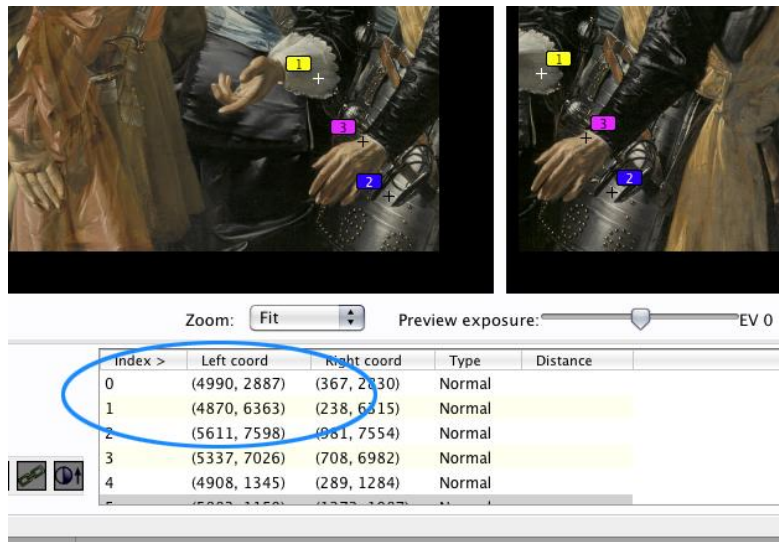
Step 2c

Adding control points

Click on one of the pictures and *matching* control point 8 will appear.
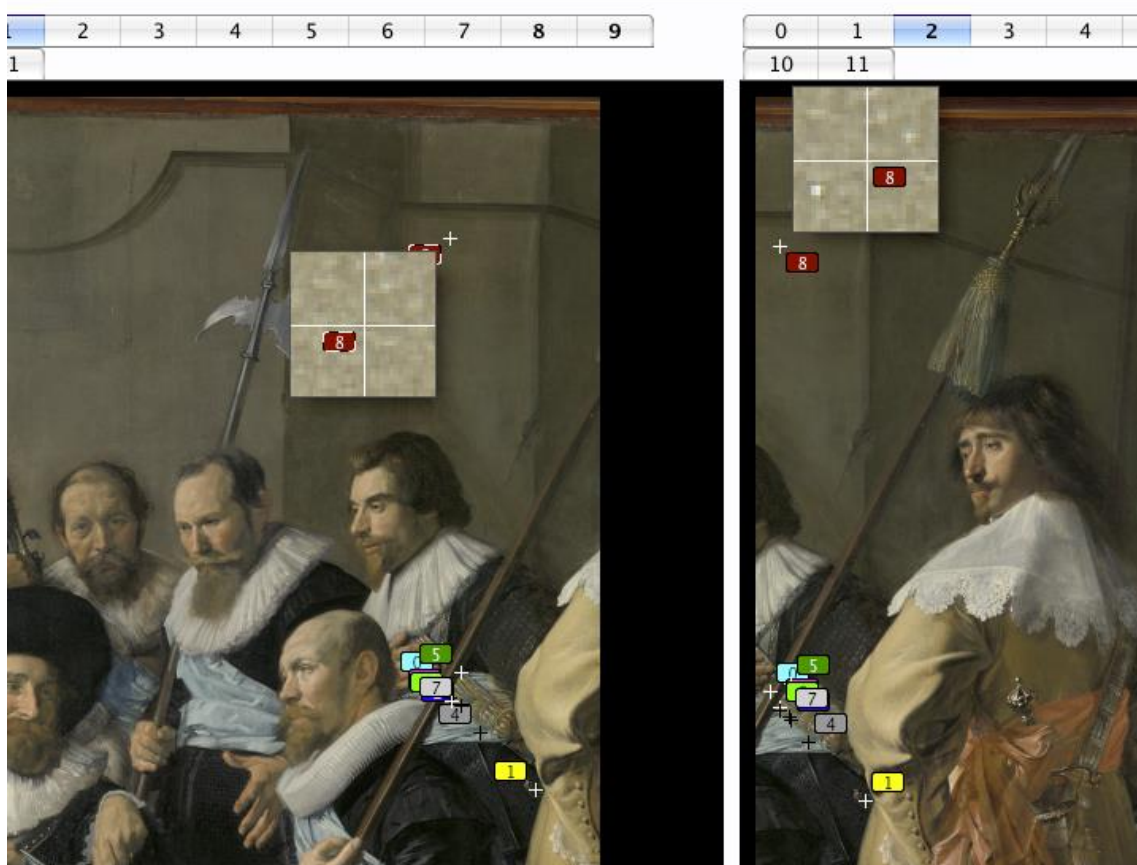

Add more points, spread equally across the field.

In case no control points can be found between a pair of overlapping pictures, add 2 points at correct positions in both images. Usually the software cannot detect the first 2 points. All following points will get a match. Then delete the first 2 points you made, since they were inaccurate.
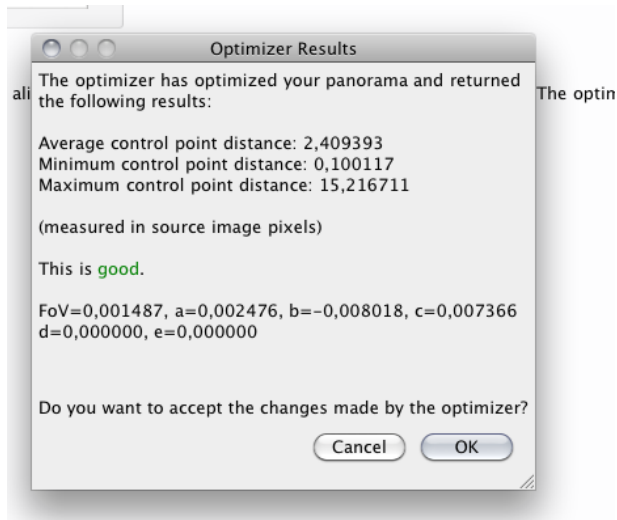That would be points 0 and 1, in the figure below.

Select *Control Points > Generate Control Points*... for the software to generate additional points.

Step 2d

Return to the Project Assistant. Here you are notified that control points have been modified, requiring that the project be optimized. Click 'optimize'.
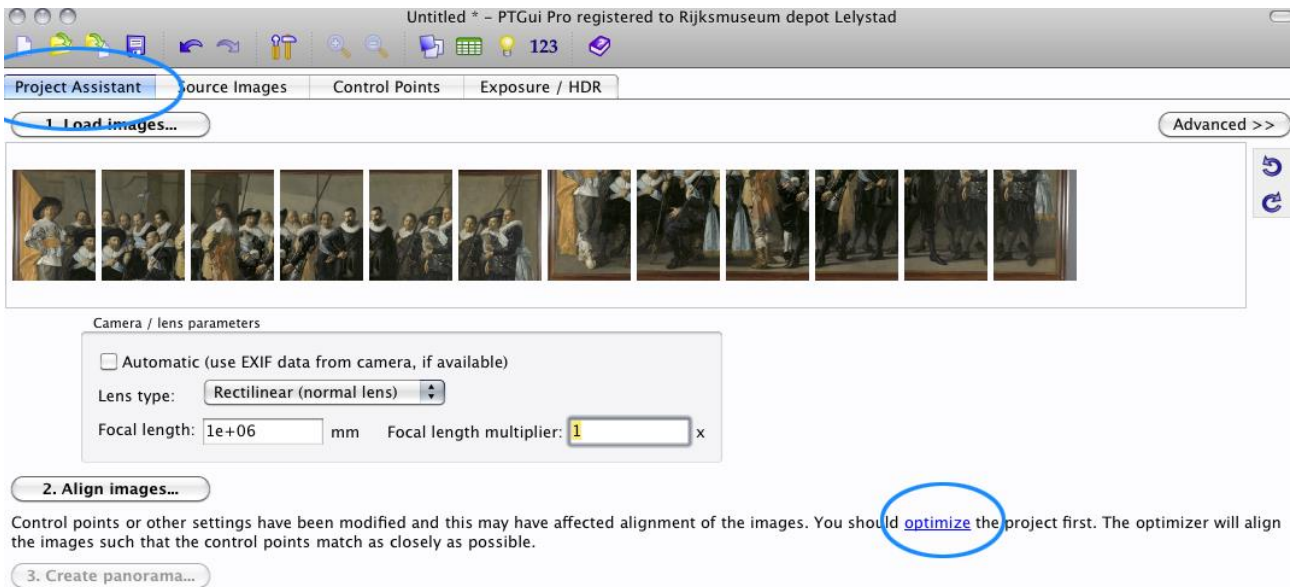
A new window will appear, with an evaluation:

Click 'OK'.

Another option is: select *Control Points > Delete Worst Control Points*. This will remove all statistically bad points. Not necessarily points with bad scores, but those located outside the image, that deform things unnecessarily.
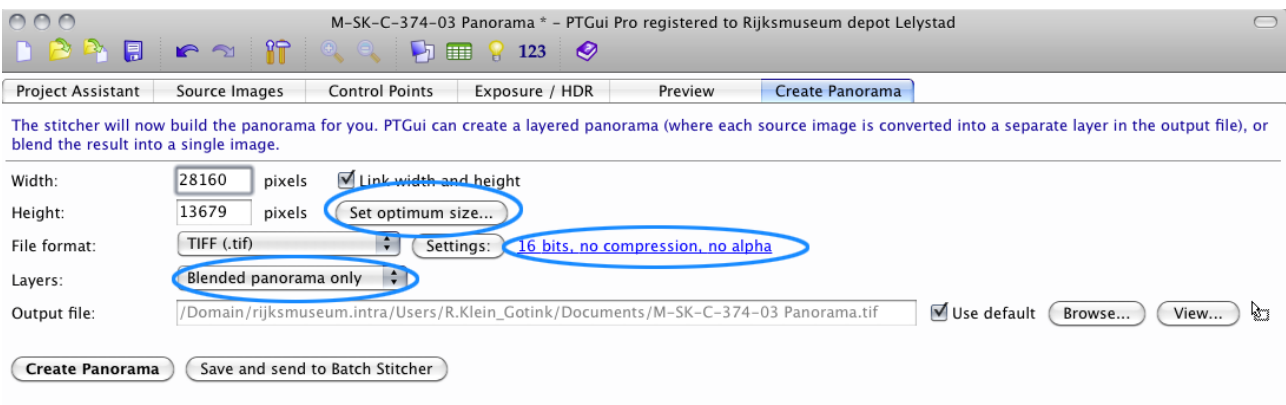Having set and optimized all the required control points, brings you to the final step.

Step 3

Create panorama

Return to the Project Assistant tab, select '3. Create Panorama...'

Settings

- Set optimum size...: Maximum size (no loss of detail). Always choose maximum!!
- File format: TIFF is preferable. Files larger than 2 GB cannot be stored as TIFF (in some cases 4 GB is the maximum size). In which case PSB is an option - Photoshop Big, quite similar to TIFF.
- *Settings:* 16 bits, no compression, no alpha (preferably).
- *Layers:* optional. File size will increase significantly, without any clear advantages.
- *Output file:* Choose a name and location to store your project. These can always be altered later.
- Make sure your hard disk has sufficient (= more than plenty) storage capacity, or use an external hard disk if need be; in which case, go to Preferences > Folders & Files > Temporary Folders to ensure that its storage capacity gets used.
-

Click *Create Panorama.*

Colophon