How to create a CPM on transparent media (Acrylic/Policarbonate/Polyester …)

This document describes the considerations that have to be made when creating a CPM on clear (transparent) media, for frontlit applications.

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1. Introduction

a. Clear media are referred to as transparent, colorless substrates, clear as glass and free of any mechanical surface treatments - such as frosting or etching effects - preserving 100% see-through characteristics. Thicknesses vary from < 0,5 mm up to 40 mm. Some types are available with a corona surface treatment to improve ink adhesion properties.

Most common types in inkjet
- **Polyester** - PET / *Axpet, Vivak, Petgag*
- **Acrylic** - PMMA / *Vikuglas, Plexiglas, Altuglas, Acrylite, Palglas*
- **PVC** / *Astraglas, Providur, Palclear*
- **Polycarbonate** / *Lexan, Makrolon, Apex, Palsun*

b. Application - HQ Photographical Reproductions and S&D
The applications highlighted in this document focus on <u>frontlit</u> prints only. They typically have the image printed (mirrored) on the back of the clear material, so it can be <u>viewed correctly from the front side</u>, through the glass. This provides the printed image with an enhanced feeling of depth and color thanks to the thick, high gloss surface of the glass. The thicker the clear sheet, the stronger the effect.
The image is either covered by a white ink layer and glued to a second plate of the same clear material, or is directly mounted/laminated on a white aluminum sandwich panel (without white ink layer).
Lenticular plates/prints can also be categorized as clear media.

Clear sheets with the image printed on the back side, mirrored and covered with a white ink layer (C+W).

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c. Required equipment

Any spectrophotometer capable of measuring in reflective mode, supported by Asanti RIP.

Barbieri Spectro LFP

Both spectrophotometers, Barbieri's Spectro LFP and X-Rite's EyeOne (iO), would be qualified to do the job. However, the Spectro LFP has the edge when measuring color from clear media, and color accuracy is essential:

Most clear media are **prone to scratching**, and can be easily damaged when the measurement head makes physical contact, while gliding over the surface.
You can easily identify traces of scratches left by the measurement device after measurements are made. The light emitted by the spectrophotometer can be partially scattered by these scratches, and can eventually cause reading errors, which you will not be notified of.

X-Rite EyeOne iO

On one hand, **physical contact with the clear sheet is absolutely necessary**, but the abrasion caused by the gliding of the measurement head can't be avoided in any way using the EyeOne (iO).
The Barbieri LFP on the other hand, offers an **Up/Down measuring method**, preserving full contact with the clear media, while avoiding any abrasion of the clear sheet's top surface. It'll take roughly double the amount of time to measure the color charts, but it's worth every patch!

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Asanti / spectrophotometer compatibility chart					
Spectrophotometer	**Asanti v1**	**Asanti v2**	**Asanti v3**	**Asanti v4**	**Asanti v5**
X-Rite Eye One (iO)	X	X	X	X	X
X-Rite Eye One Pro2 (iO)	-	-	X	X	X
X-Rite Eye One Pro3 Plus (iO)	-	-	-	-	X
X-Rite Eye One iSis	-	-	-	X	X
X-Rite eXact	-	-	-	X	X
Barbieri LFP (series 1, 2, 3)	-	-	X	X	X
Barbieri LFP qb	-	-	-	-	X
Barbieri Spectropad	-	-	-	X	X
Konica Minolta FD-5	-	-	-	X	X
Konica Minolta FD-7	-	-	-	X	X

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2. Dedicated Clear Media CPMs

As with any substrate, a dedicated CPM is important when color critical reproductions are the subject. Clear media shouldn't have a significant impact on the color appearance, because they're supposed to be color neutral and transparent. But they do require a dedicated CPM nonetheless, for 3 main reasons:

- The smooth, flat surface of the clear media changes the otherwise rough top surface of the printed UV ink layer. Contrary to what's normal, the ink drops are viewed from their bottom side, and so changes the way incident light is reflected by the ink layer.
- The color appearance/intensity is additionally impacted by the high gloss surface of the clear media.
- As with any other reflective substrate, the white point used to support the color image - either the white ink layer or the white of the panel on which the print is mounted - will influence the color appearance. This requires a specific white point correction.

Note: A soft, yet visibly present color cast can occur, caused by the clear sheet. This can't be automatically corrected for in the CPM though, and will require a manual adjustment through a steering file correction. More on this on pages 9-15.

a. Is it mandatory to use the same clear media when creating a CPM?

The answer is NO. In most cases you will be forced even not to. As explained earlier, the color appearance is largely dependent by the way the ink layer is received by, and looked at through the glass, rather than anything else. And more importantly, a spectrophotometer proves only useful when the distance between the ink layer and the measuring head is kept as short as possible.

As illustrated here, when the printed side is not facing the measurement head, the light emitted by the spectrophotometer is not reflected back into the optics' path when the glass is too thick. This will cause erratic dark, inaccurate measurements. So it is of the utmost importance to **use clear sheets that are as thin as possible**, preferably < 1mm.
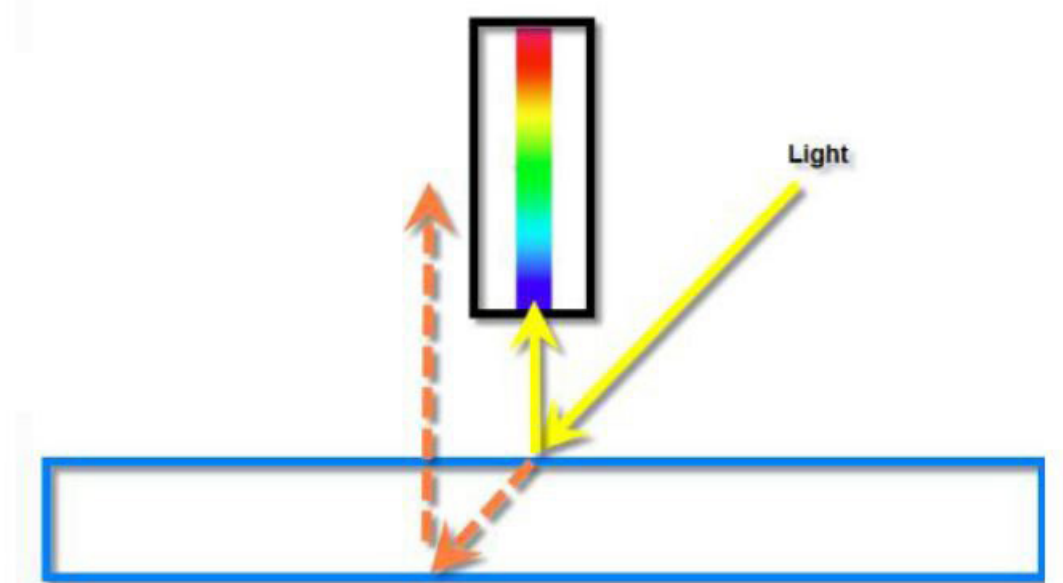

image source: Barbieri white paper 'How to measure glass / plexiglas'
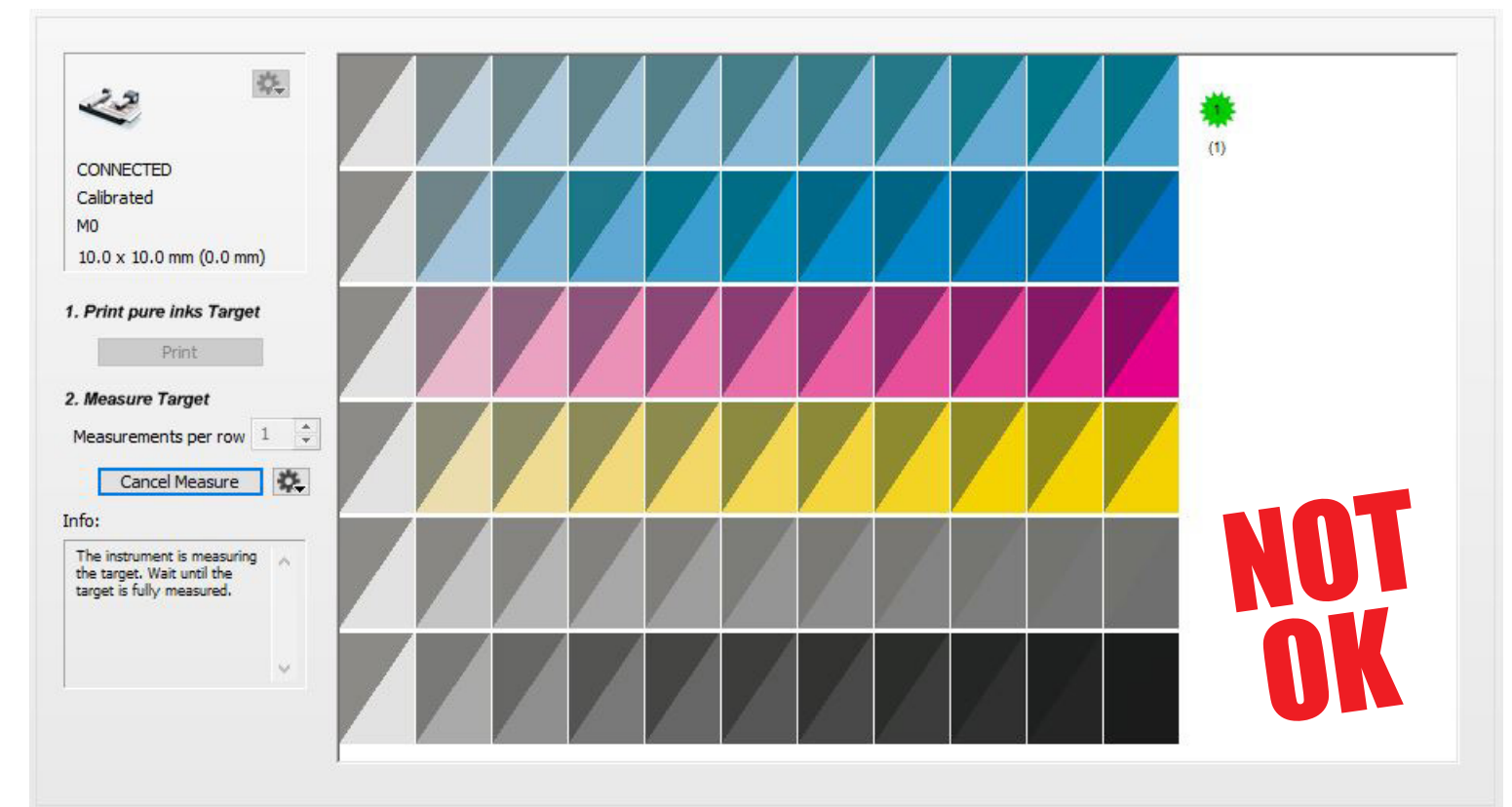
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b. Evidence when measurements can't be trusted

This is how Asanti displays the measurements when the **gap between the measurement head and the printed layer is too big**.

The top left part of the patch, representing the actual measurement, appears significantly darker than the bottom right part of the patch, representing the expected value.

For this example, we used a 4 mm thick acrylic. Other side effects can play, such as substrate-specific interreflection, and partial loss of incident light coming from the measurement device under 90° angle and reflected by the high gloss surface.

This is how Asanti displays the measurements when the **gap between the measurement head and the printed layer is ok**.

Top left and bottom right parts of each patch are in line of each other, and you can assume that the measurements can be trusted. For this example, we used a 0.4 mm thick PET sheet.
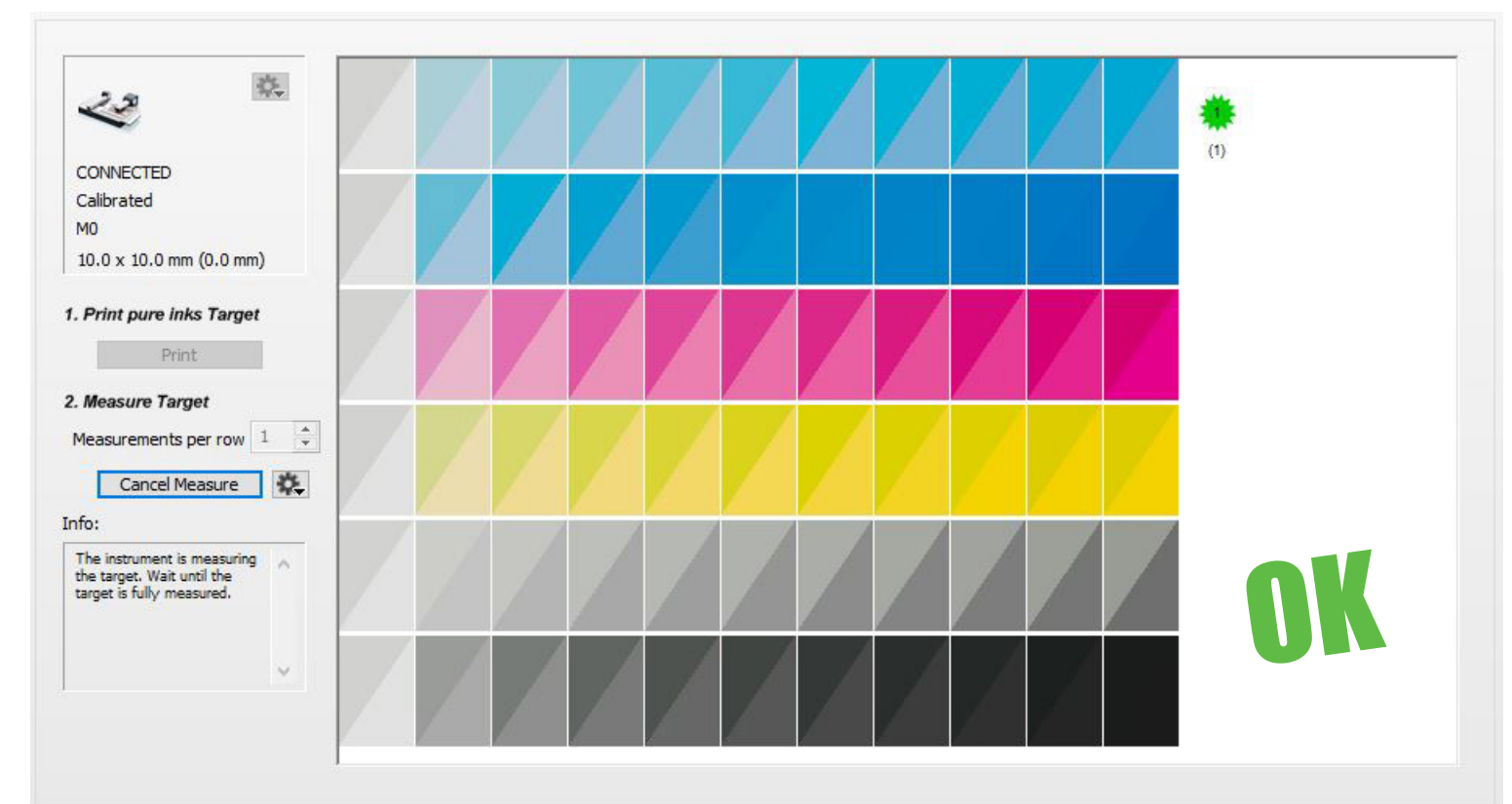
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c. Other considerations when making clear media CPMs

Prior to making any color measurements, one needs to carefully think over and define the Asanti Print Mode Settings:

- Define the **white ink percentage** that is required to properly cover the printed image. Agfa's generic Print Modes are topped at 85% white opacity, but you may not need this amount of white to have a good coverage.
- Very often, a **primer layer** is required to attain a decent adhesion of the ink to polymer based materials, unless a surface treatment (e.g. corona) is already applied. As the primer is color neutral, it will not affect the color appearance as such, but it most likely will affect the dot gain as opposed to printing directly on the low surface energy substrate.
- Consider setting the **shuttle traveling to the full machine width,** allowing the substrate to cool down as much as possible from the heat it is exposed to, distributed by the UV lamps.
- **Print everything mirrored**, including the color charts.
- **Use the standard white chart holder** of the spectrophotometer to position the C+W color charts on.
  In case you intend to mount the print to a white background of a different kind (e.g. a dibond panel), make sure to **prepare an A4 piece of this material**, so the color charts (without white ink) can be easily mounted on it.
- Try using the **WF-MediumGCR-VisualNeutral** steering file. We've been particularly impressed by the overall consistent neutrality of black & white output when the CPM is built this way from the start. It will not compensate for any color cast provoked by a clear sheet, but it will contribute to deliver stable neutrals across the entire tone scale.

When printing color charts, make sure to have the print head **nozzles in pristine condition, for both color and white**!
Any print error due to nozzle failures is unacceptable when color targets are reproduced. The color patches should be free of any print anomalies, and the dot positioning should be optimal. Therefore it's advised to briefly make a short run of a full color image first (e.g. the Tauro's MaxInk chart), making sure that the nozzles are adequately warmed up.

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d. Steering file adjustment, why?

While a thin clear sheet used for the CPM creation may not expose any color cast at all, it may occur that certain thicker media do so. This will be most obvious when neutral (black & white) images are printed.

As it is impossible to properly measure color from thick clear media in the first place, it is also impossible to automatically correct for it in a CPM. Therefore a manual neutral adjustment in Asanti may be required to tackle this unwanted dominant.

e. Identify the issue first

Be well aware how the printed image looks like. This is best done by printing a neutral (color managed) black & white image.

- Are the neutrals (the grays) dominated by a color cast?
- Is every tone equally affected, or are the midtone to shadow areas of the print more affected than the lighter areas?
- Is the color cast pointing in one direction (e.g. green only), or in different directions on different parts of the tonal range (e.g. a cyan cast in the shadows vs. a magenta cast in the hihglights)? If more than one color cast is visible (crossover casts), there is either a profile issue at play, or effects of metamerism kick in. Crossover casts can change under different lighting conditions (indoor vs. outdoor) and can turn out very complex.

Making a correct analysis of these 3 questions makes already for half of the work!

The Lab color model

The correction procedure described on the following pages is a manual operation. It relies on your ability to see color. If you don't excel at this, have someone by your side who does, to help and guide you through the exercise.
A basic understanding of how the Lab color model works is also required.
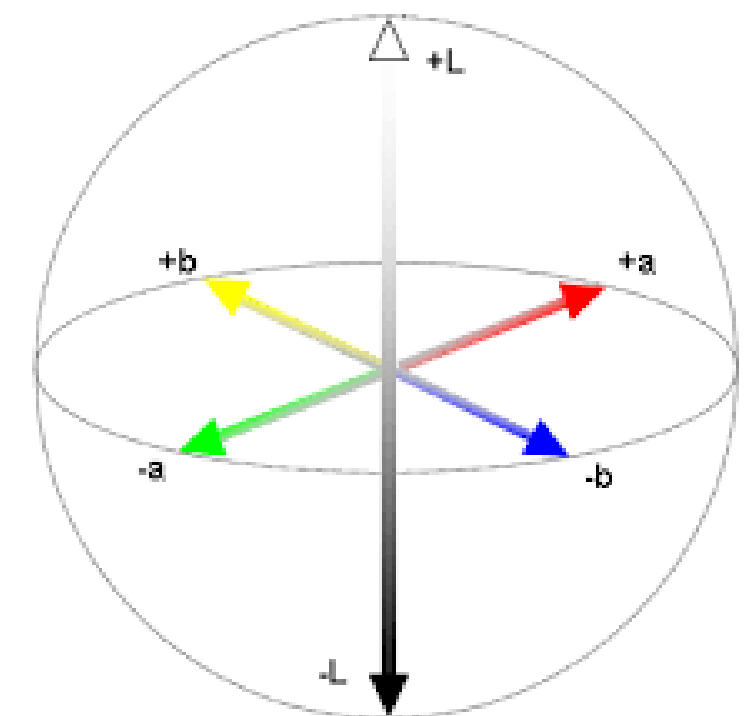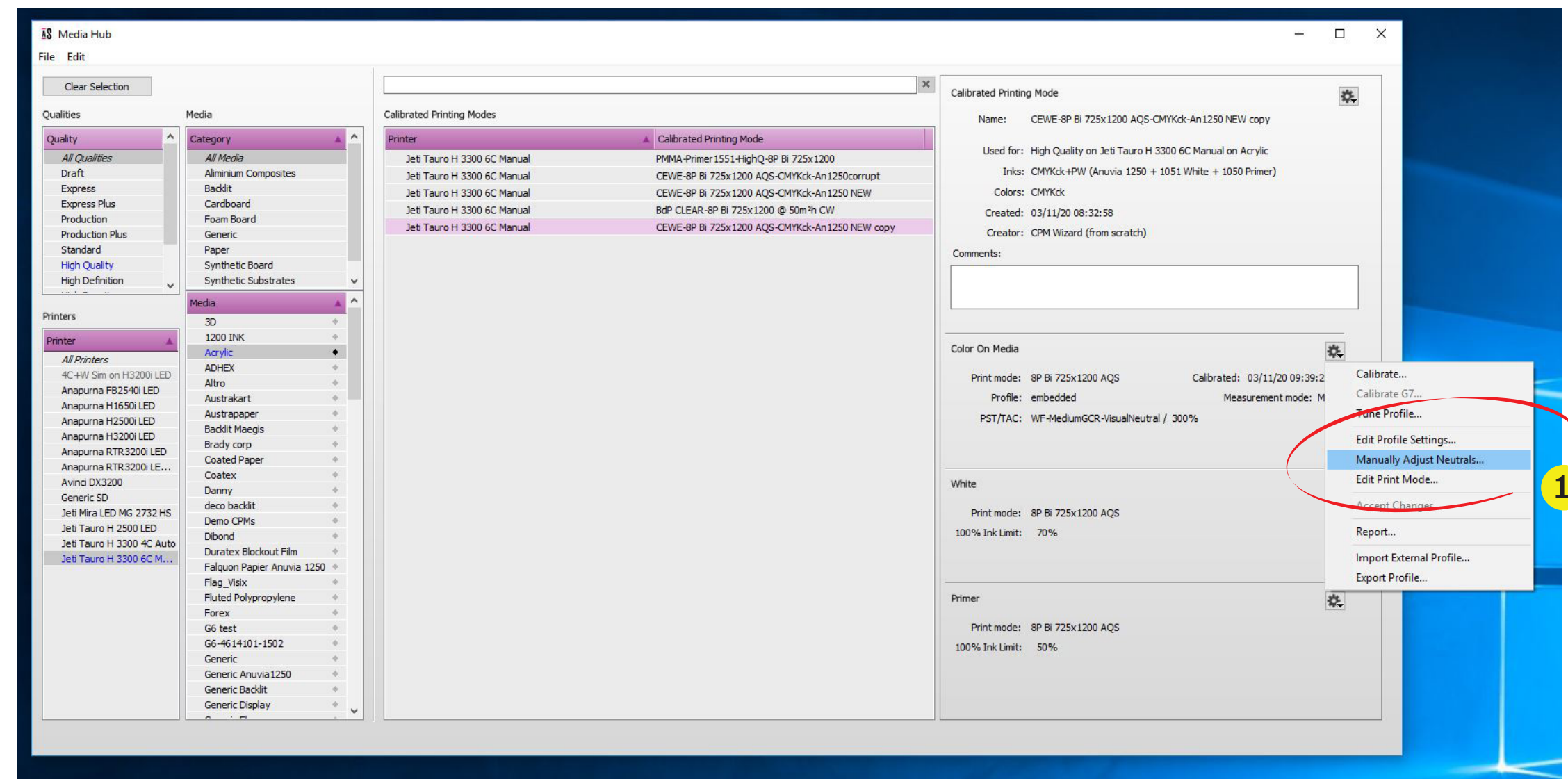
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f. Manually Adjust Neutrals tool in practice

Note: The Manual Adjust Neutrals tool is available from Asanti 3.0 onwards.
         The illustrations on the following pages are Asanti 4.2 screenshots.

STEP 1, getting access to the Manually Adjust Neutrals tool:

Open Asanti's Media Hub for the printer containing the clear media CPM. Browse to the CPM and select Manually Adjust Neutrals …[1] under the Color On Media cogwheel.

Tip: Just to make sure that you keep the original CPM untouched and safe, you may want to duplicate the CPM first, and work on the duplicate.

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The **Manual Neutral Adjustment** window appears.
What is in there?

- A graph with a neutral tone correction line[1], by default flat, at position 0
  The y-axis represents the range in which corrections can be made. In this case -/+3, as defined under Range[2]
  The x-axis represents the tone scale, from black (L0) to white (L100)
- ab Channel[3] selector
- Adjustment for Rendering Intent[4] selector (Perceptual, Relative Colorimetric, Absolute Colorimetric)

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STEP 2, manipulating the curve:

General/Linear adjustments

In this example, we assume the output to show a greenish color cast, gradually increasing towards the shadows.
In this case you'd want to select the a Channel, and move the neutral correction line positively upwards. Here a is pushed +2 in the dark areas, and the highlights are kept untouched. So gradually from white to black, the image will receive more red to compensate for the green cast.

Local adjustments

In case you see the greenish color cast appear mainly from the midtones up to the shadow areas, you can easily add extra points to the neutral correction line by clicking on it. The point(s) can then be dragged down, to exclude the lighter image areas from the correction.

Tip: Crossover casts caused by metamerism are hard to get rid of with this technique. Instead, apply a stronger GCR curve, or make A dedicated ICC profile, for the intended viewing light source condition. (currently only possible with QMS tool)
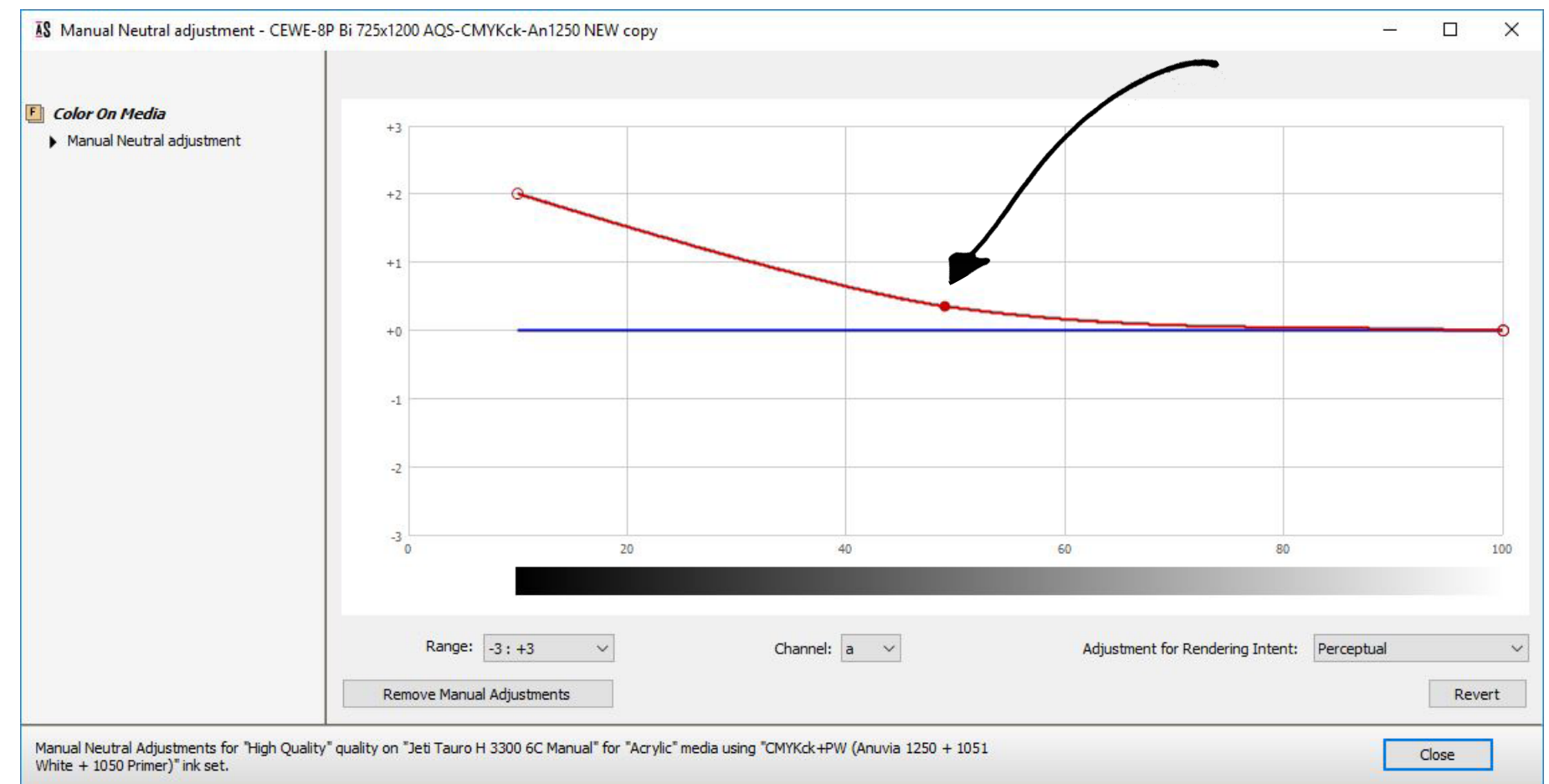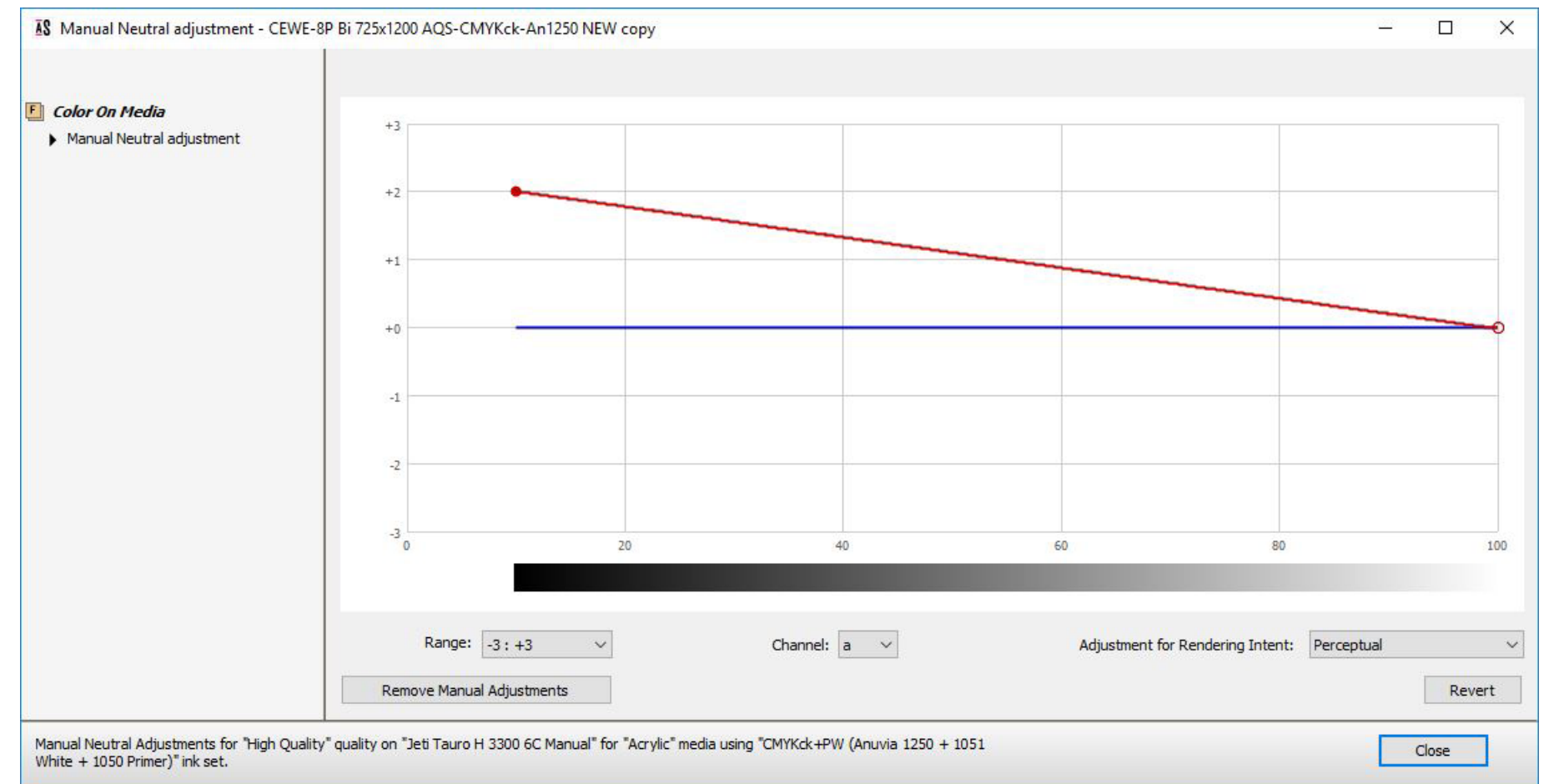
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Rendering Intent

Corrections are only valid for the Rendering Intent that is currently selected. In this case the curve will only be applied to the Perceptual Rendering Intent.

If you want to have the same correction also applied to the Relative Colorimetric Intent, you need to select the Intent first and repeat the above.
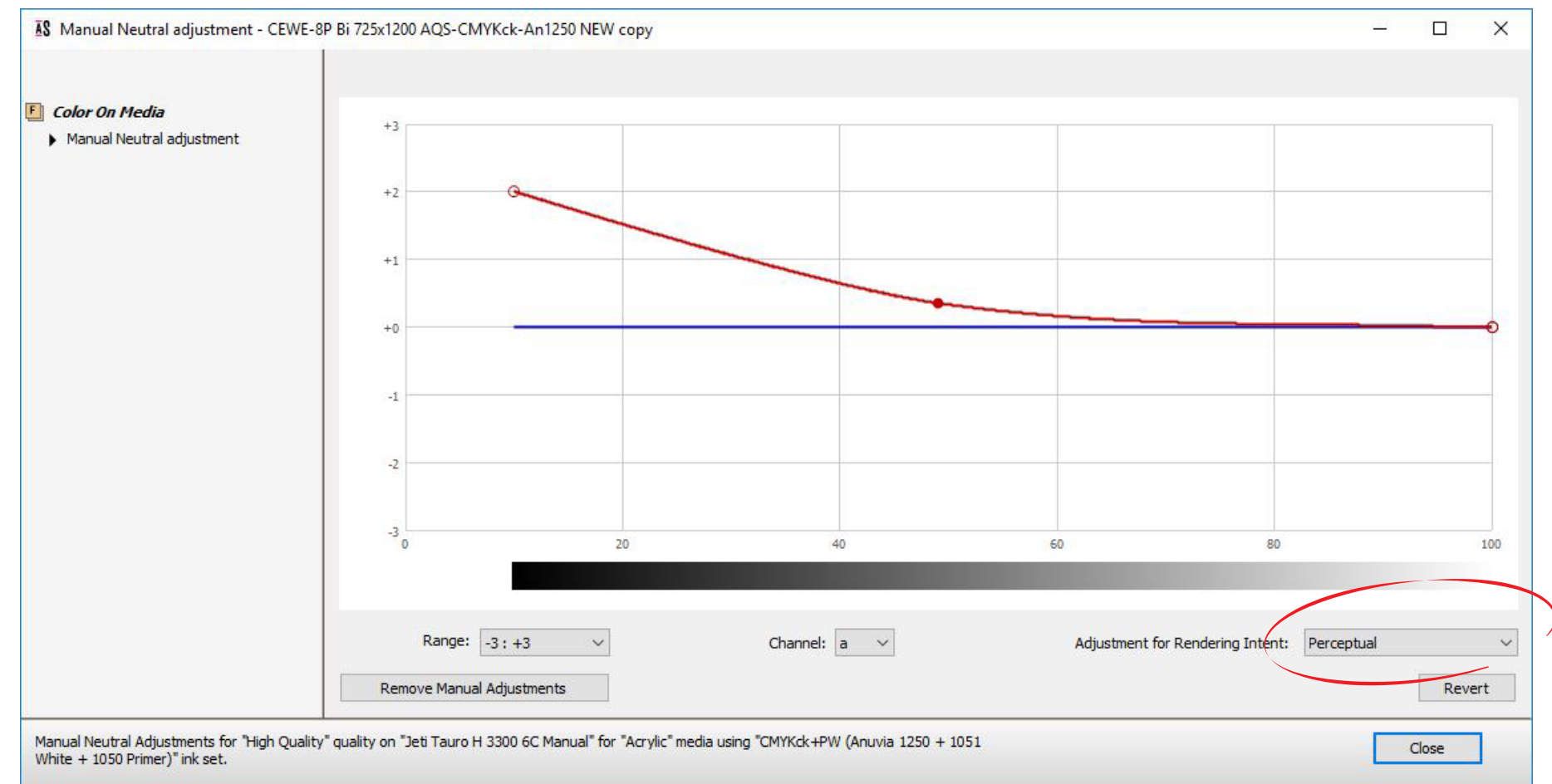
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**STEP 3**, applying the correction(s):

To eventually apply the correction curve, click the Close button, and confirm to save the changes by clicking Yes.

The CPM is now rebuilt, and immediately ready to use.

Make a new print, using the appropriate Rendering Intent (otherwise you won't see any change) and compare the result with the original output that showed the color cast. Judge the results under decent lighting conditions, and decide which steps to take from here.

Note: The Manual Neutral Adjustments applied to the CPM are **non-destructive**, meaning that you can return to the Manual Neutral Adjustment window at any time, and resume the process exactly from where you left the tool previously.
The adjustments can be altered as many times as needed, until you've reached the desired effect.
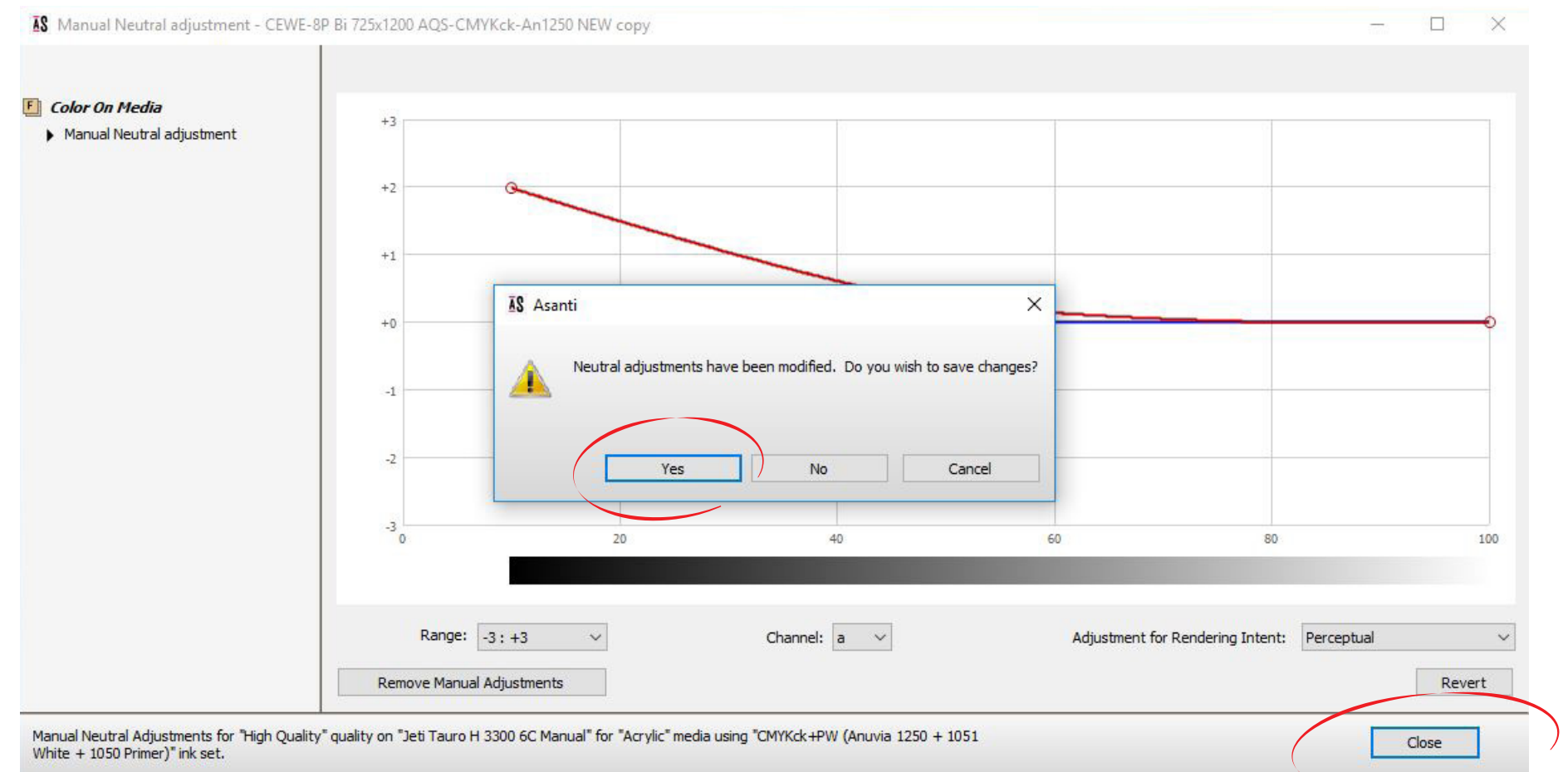
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g. Limitation of the Manually Adjust Neutrals tool

- The scale of the manual neutral correction works only Lab Relative, not Lab Absolute. Therefore, the white can't be corrected in any way, only the black point can.
  Be aware that the the nature of this correction is based on a visual judgement only, as it is impossible to measure Lab values directly from the final print when thick clear media are used.
- This approach to correct for a color cast, may need some time and practice before a satisfactory result is reached. It is advised to make one adjustment at a time to clearly keep track of the changes on the output. Also bear in mind that small, subtle corrections may already make for a rather big impact, bringing the output within visual tolerances. This is especially the case when judging (near) neutral images.

- This document can be shared with Agfa end users.
- In case the content of this document raises questions, please contact your local (ISS) Agfa Application Specialist.