Color Charts for Fine Art Imaging

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Targets for fine art imaging (FAI) come in two basic flavors; ones primarily used for checking the physics of the system, and ones for checking each image capture.

Artwork Targets

Artwork targets are imaged with the artwork and answer questions about the quality of the image and the conditions used to make the image.

They should be small enough to fit within the frame with the artwork but not take up too much of the image. As such, these are best in a strip format. As with the system targets, many are available mounted on a rigid substrate.

The purposes of an artwork target are to insure the items which vary with each image are set properly and to capture this information. These items can be used to evaluate the quality of the artwork image.

System Targets

System targets get information about the imaging device (camera or scanner), the optics involved, the system alignment, the processing of the image information, and more.

They are usually large enough to fill the camera’s frame yet small enough for use on flatbed scanners. These targets are often supplied in two versions; one mounted on a rigid substrate (such as aluminum) and the other available as a flexible paper sheet. The rigid substrate versions are intended for use with cameras and flatbed scanners. Unmounted targets are designed for use with scanners using document feed systems.

System targets are designed with features to check the items which do not vary from image to image but are inherent in the system components. In addition to the features of the artwork targets, the system targets have multiple slant edge or resolution targets and geometric features used to evaluate the optical, sensor and processing system components. Software programs are required to process the geometry, resolution, spatial frequency response, dynamic range and other properties.

Color Checker Family

In the Jurassic period of imaging, i.e. the time before cell phones, there few test targets. The most common were the ColorChecker and the Kodak Q-13/14 Color Separation Guide and Gray Scale set.

The first ColorCheckers made their appearance in 1976. They were designed to test film capture and processing. They were very well designed, adapting over the years in the change from film to digital imaging. The ColorChecker is comprised of 24 patches; a 6 step gray scale, 6 primary patches (red, green, blue, cyan, magenta, yellow) and 12 patches to test color reproduction. These patches are paint pigment formulations applied to a paper substrate then mounted onto a cardboard or plastic substrate.

The ColorChecker family now consists of the ColorChecker Classic (an updated version of the original), the Mini ColorChecker (business card sized), the ColorChecker SG (140 semi-gloss patch target containing a 15 step gray scale, 44 patches of a white/gray/black pattern around the target periphery) and 81 patches providing a good sampling of the color space.

The latest member of the ColorChecker family is the ColorChecker Passport which is three targets in a single package; a white balancing target, a ColorChecker Classic target, and a Photo Enhancement target.

Used mainly for ICC profile creation, the Mini and Classic ColorCheckers can be used for additional functions. Some photographers place then along an edge of the artwork so that the grayscale is just within the image. This allows for setting and checking the neutral balance and the exposure. It also permits checking the setup for veiling glare.

The new ColorChecker Passport can be used for the same functions as the Mini and Classic ColorCheckers. When the Passport is opened to display both the ColorChecker Classic and Photo Enhancement charts, it is possible to use the shadow and highlight gray on the Photo Enhancement chart to produce an extended 11 step grayscale. The highly saturated spectral colors from the Photo Enhancement chart can also be used to improve profile generation. So far no profile generation programs use the Photo Enhancement chart for these purposes.

The design of the ColorChecker SG does not allow placing its full grayscale along the edge of an artwork image, but it has some other useful features. The white/gray/black patches around the edge, combined with the grayscale in the targets center allow for using this target to evaluate the light falloff (both lens and lighting) for an image. The 15 step grayscale permits using this target for more accurately determining the Opto-Electronic Conversion Function (OECF, sometimes known as the tonal reproduction curve) for the camera or scanner. The semigloss patch surfaces enable using the target for noise evaluation, in addition to its most common usage for generation color profiles.

There is an area of the ColorChecker SG with a similar color patch layout to the ColorChecker Classic. This allows using the SG with profiling software which only processes the Classic target. Caution, when doing this be sure to make a custom reference file for these patches because they have semigloss surfaces instead of the matte surfaces of the Classic. Therefore the SG patches will have different spectral and colorimetric values.

Kodak Q-13 and Q-14

Roaming the photo studios In the same prehistoric period as the ColorChecker were the Kodak Q-13 and Q-14 products, each consisting of a Color Separation Guide and a Gray Scale. They were made in a strip format, intended to
be imaged with the subject and used to guide the color separator in preparing plates for offset printing. They were helpful then, but now that color separators are an endangered, if not an extinct species, the Color Separation Guide half of the set has limited value. It is a half-toned set of colors consisting of only the four printing inks; cyan, magenta, yellow, black. These inks have little or no relationship to the pigments used in artworks and they offer too limited a sampling of the imaging system’s color space for good profile generation.

The Gray Scale half of the set is still useful. Consisting of individual ink patches from black to white, and with good spectral neutrality, they can be used to help set the neutral balance, exposure and check for veiling glare. The 20 step gray scale works well for OECF determination.

**IT8.7/2**

In the neolithic imaging age, the early 1990s, the IT8.7 targets were developed for scanning film transparencies and prints. They are available in 35 mm and 4x5 inch transparency targets (IT8.7/1) from Kodak (as the Q-60 products), Fujifilm and Agfa. Photo print versions (IT8.7/2) are also available in a 5x7 inch format.

These targets are very useful for imaging photographic originals and are being used by some photographers for artwork imaging. Because these are photographic film materials, all the color and neutral patches are made from three photographic dyes (cyan, magenta and yellow). When used as references for imaging anything other than photo transparencies and prints, their spectral characteristics are completely unrelated to the pigments and materials used in artworks rendering them of little value. The gray scales on the IT8.7 targets are not spectrally neutral. The dye ratios vary from patch to patch, displaying changing color casts to the neutrals as the lightness changes.

The IT8.7 targets should only be used for their original intended purpose, imaging photographic transparencies and prints.

**QPcard™ 201**

Advancing in time to almost the current time is the QPcard 201. This target is not as well known as the ColorChecker but it can be used for fine art imaging. The QPcard comes in a package of two. They are designed to be disposable, discarded when damaged. The back of the target has a strip of low tack adhesive for attaching to the copy surface.

The QPcard is made of ink patches applied to a paper substrate. Consisting of a 7 step gray scale and 20 color patches it offers enough information for profiling. At this time the only profiling software that works with the QPcard is from the card’s manufacturer.

**Universal Test Target**

Now we come to the Modern Age, the one of the iPad, Created to support the Metamorfoze imaging

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**Metamorfoze Imaging Specifications**

These specifications are being developed by the National Library of the Netherlands and the National Archives for imaging archives, periodicals, artworks and other similar items. They are being investigated by other organizations with the idea of extending their use to other artworks such as drawings, paintings, etcetera.

specifications, the Universal Test Target (UTT) from Image Engineering is an imaging system target. It is approximately an A3 size with the ability to be tiled with other UTT targets for large size applications.

The target itself comes in two versions; a paper version for sheet fed scanners and one mounted on an aluminum substrate. The target is an inkjet print with photo print inserts.

Most of the target is covered with a gray and white checkerboard pattern. Rulers are found along two edges. Four identical 20 step gray scales and two identical sets of 27 color patches are also part of the target. Along one edge is a strip target subset of the gray and color patches. There are also nine photo print insets consisting of a slant edge target and an ISO resolution target.

The checkerboard can be used to set the neutral balance, test lens and lighting uniformity, check for parallel alignment of the subject and image planes, test for optical distortion and chromatic aberration. The gray scales are used for determining the OECF. The gray checkerboard squares or the gray scale patches are intended to be used for noise analysis. The scales and gray rulings along two edges can be used with scanners to check for banding and non-uniform scanning.

The color patches are intended for checking the system color accuracy and possibly creating profiles, along with the gray scales.

The edge slant targets can be analyzed by software to give the resolution and the signal frequency response for the system. The ISO resolution targets are available for use when an analysis program is not available.

Although the UTT was produced as an inkjet target to make it easily scalable and keep costs down there are some major flaws with that choice that make it unsuitable for many of the intended purposes.

Across the entire surface of the chart is a pattern of yellow dots. This indicates the target image was passed through a color management system which added yellow dots to compensate for a slightly bluer paper white. The dot patterns used by an inkjet printer to print the image give all the gray patches a high noise level. Combined with the yellow dots this increases the noise of each patch, decreasing the signal to noise ratio, and lessens the usefulness of the target for noise analysis. Since the inkjet patches have a high inherent noise level due to the dot
patterning, the photo print insets are the only areas that should be used for noise analysis.

Spectral analysis of the gray patches shows them to be not spectrally neutral. This means that they will exhibit color casts depending on the illumination. There is also a slight color tint to the patches that changes with lightness. This is a common problem using color inkjet printing for gray scales.

The four inks (cyan, magenta, yellow and black) used by inkjet printers do not correlate well with the pigments used in artworks. This makes an inkjet print a poor source for color profiling and color reproduction accuracy assessment.

The UTT has many features that make it suitable for optical testing of the imaging system but it is less useful for neutral balancing, noise and color analysis.

**ISA Targets**

Similar in concept to the Universal Test Target, but implemented in a different way are the Device Level and Object Level targets from Image Science Associates as part of their Golden Thread package.

The Device Level target is a photo print target mounted on an aluminum substrate with paint patch inserts used as a system target. There are five slant edge and resolution targets for determining the spatial frequency response and the system resolution. Each resolution target has four gray patches in the corners which can be used to analyze the image uniformity. The uniform gray photo print background can also be used for uniformity checking.

The gray scale and color patches are paint on paper patches insets. The color patches are the same ones used in the ColorChecker Classic, so they have the same spectral characteristics and a matte surface. The 12 step gray scale patches have glossy surfaces which allow them to represent a longer lightness range than the ColorChecker Classic’s matte finish patches. In addition to OECF determination, the glossy gray patches are good for noise analysis. However they must be carefully lit to eliminate any reflections.

For an artwork target ISA offers the Object Level target, which is a subset of their Device Level target. It is also a photo print mounted on an aluminum substrate with paint patch inserts. There is only one slant edge and resolution chart in the middle of the target. The neutrals and color patches extend the length of the target to both sides of the resolution chart.

The ISA Device and Object Targets are the best targets available now for artwork imaging, although not complete.

**What is Missing?**

The UTT and the ISA Device Targets have many features for measuring the optical, geometric and processing performance of the system. However, most of these values are fixed in the choice of imaging device (e.g. digital scanning insert, digital SLR, scanner), the lens and the software used to produce the images. Once these items are selected, they do not change from image to image until one of the system components is changed. So it is that the system level chart, while useful, will probably rest on the shelf until new system components are selected.

There are some things which can change from image to image so they should be checked with a target. These items include the exposure, lighting, filtration, focus, sensitivity and other values. Ideally an artwork target will aid the photographer in setting these variables. It will also record information in the image which will help assess the quality of the image after it has been captured. Since the artwork target will be used extensively, probably with every...
image captured, it should be the one most carefully selected.

None of the currently available targets can answer all the necessary questions for an artwork image. The growing need for such targets, both from the commercial fine art reproduction market, the institutional and government markets, offer hope that a target will be forthcoming.

<table>
<thead>
<tr>
<th>Chart</th>
<th>Name</th>
<th>Manufacturer</th>
<th>Size</th>
<th>Colorants</th>
<th>Usage</th>
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<tbody>
<tr>
<td></td>
<td>ColorChecker Classic and Mini</td>
<td>X-Rite</td>
<td>Classic 11.25 x 8 in. Mini 3.25 x 2.25 in.</td>
<td>Paint</td>
<td>Artwork</td>
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<td>X-Rite</td>
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<td>IT8.7/2</td>
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<td>Photo print dye</td>
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<td>Color Control Patches</td>
<td>Kodak</td>
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</tbody>
</table>

1 Matte finish patches can have too high an inherent noise level so semi-gloss and gloss patches only are recommended.
2 Only the photo print patches should be used for noise analysis. The inkjet squares have too high a noise level.
Resources

Chart Manufacturers

ColorCheckers
- X-Rite xrite.com

Device Target, Object Target
- Image Science Associates imagescienceassociates.com
- Q-13, Q-14, Q-60 (IT8.7)
- Kodak kodak.com

QPcard
- QPcard qpcard.se

Universal Test Target
- Image Engineering image-engineering.de

Metamorfoze
- www.metamorfoze.nl/en/index.html