The New X-Rite Standard for Graphic Arts

(XRGA)

Introduction

Color is a fundamental factor in the creation of almost all products. In most industries, effective control and communication between designer, manufacturer and retailer are essential to obtaining high product quality and cost efficiency. However, methods for specifying and communicating color are often process-specific and the interpretation of color data across workflows can be ambiguous. This makes color consistency difficult to achieve, especially in cross-media color reproduction. In industries where color is mission-critical, the most accurate and reliable way to measure and control color is through the use of high quality spectrophotometers- or spectrodensitometers that objectively characterize the intrinsic value of color.

We understand this intrinsic value to be unchanging, meaning that all measurements taken for the same color sample should, in theory, be the same. However, graphic arts professionals know this is generally not the case in practice. Why is that?

Reasons behind measurement variance

Every physical color sample has its own reflectance "fingerprint", which is typically measured using a spectral measurement device. The sample's unique spectral response is measured by comparing the ratio of light reflected or transmitted from a surface as a function of wavelength, to that from a known reference standard. Many companies offer spectral instrumentation to accomplish this task, with the ability to perform spot, scanning, and inline (embedded) measurements. Over time, users often find themselves using measurement instruments from many different manufacturers for color control. They also use instruments with varied measurement functionality at different points in their workflow. This will often lead to a common and troublesome situation where measurements report slightly different results for the same sample. This can be especially problematic when databases are built using a particular instrument model that doesn't satisfactorily agree with results from other models used by a different department or site. The variance in color measurements ultimately results from the fact that each manufacturer uses slightly different physical calibration standards for their instruments.

Systematic differences characterized in X-Rite study

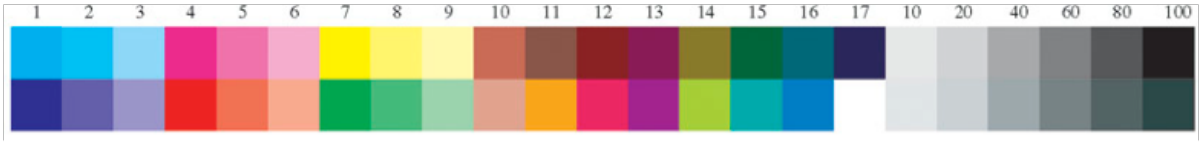
In 2006, the two leaders in the field of color science and technology, X-Rite and GretagMacbeth, merged to form the new X-Rite, Inc. The former X-Rite and the former GretagMacbeth each had, for historical reasons, different calibration standards for graphic arts instrumentation. Both companies maintained their standard over time to guarantee the compatibility of measurement data with their instruments for their customers. The continuity of standards was a benefit to each company's customer base, but instruments from each of the former companies exhibit systematic differences on a given sample. It is the goal of the new X-Rite that inter-model color agreement is optimized for advances in color science so that all of our customers – regardless of their legacy affiliation - can enjoy high quality data exchange between sites that use different instrumentation.

Figure 1:
Left to Right: SpectroEye, i1Pro, 530

X-Rite conducted a study designed to quantify the systematic differences between measurements obtained using instruments from both former companies, and to ultimately arrive at the definition of a new corporate X-Rite standard for its graphic arts instrumentation. We quantify the systematic differences under the term “inter-model” agreement, which is different from the inter-instrument agreement that is typically specified for each product. Popular models from each company were chosen for the study, and measurements were performed under typical working conditions on printed substrates.

Measurements were performed on a typical media wedge (fig. 2) in No-Filter mode, referred to as M0 in ISO-13655. This is the most common filter setting used in graphic arts applications. The following instruments were used in this study: GretagMacbeth: i1Pro, Spectrolino, SpectroEye; X-Rite: 530, 938, 939.

Figure 2: Media Wedge



Test samples:

Substrates:

- Altona Test Suite gloss-coated, matt-coated, gloss-coated LWC, uncoated white, uncoated slightly yellowish (equals ISO paper types 1 to 5)
- Japan Color coated, uncoated, matt coated, art
- Digital Printing, High quality inkjet photo paper from Fuji

Colors:

- UGRA/FOGRA Media Wedge (46 patches)

Measurement procedures and conditions:

- All measurements were performed in accordance with ISO-13655 standards.
- All measurements were performed on the same black backing material.
- All tests were performed in an air-conditioned room with temperature monitoring and control (23°C +/- 1°C). Humidity was controlled at 65%.
- The media wedge was measured with each instrument, at an interval of 4 seconds between the measurements in No-Filter mode (M0).

Data analysis:

- Colorimetric calculations were executed for D50 illuminant and the 2° standard observer functions.
- The colorimetric differences between two instrument types on every single patch of the media wedge were calculated using 1976 CIEL*a*b (dE*ab) formulas.
- The mean and maximal 95% values of the colorimetric differences for all patches in an instrument-to-instrument comparison were calculated.

For the sake of brevity and clarity, we present data for one substrate type: high quality photo paper used for digital printing. Results were found to be almost independent of substrate type, so this is a minor abbreviation of the test results. Full results can be supplied upon request.

The data shows very good agreement for each manufacturer-specific group, among former X-Rite instruments (530, 938 and 939), as well as among former GretagMacbeth instruments (i1Pro, Spectrolino, SpectroEye). Inter-model agreement is not as good between former X-Rite and former GretagMacbeth instruments when considered together. The differences illustrate the consequence of using different calibration standards by each of the former companies. The differences between the two families of instruments are significant for graphic arts applications, and create difficulties for color data exchange between sites that may use instruments from each former company.

	530		938		939		i1Pro		SpectroEye	
dE*ab	**mean**	**95%**	**mean**	**95%**	**mean**	**95%**	**mean**	**95%**	**mean**	**95%**
938	0.27	0.48								
939	0.39	0.85	0.33	0.82						
i1Pro	0.90	2.70	0.92	2.40	0.96	2.44				
SpectroEye	1.08	2.94	1.06	2.89	1.03	2.80	0.56	1.36		
Spectrolino	0.91	2.47	0.88	2.36	0.83	2.14	0.47	1.01	0.37	0.83

Table 1: Results of Inter-Model Agreement with Legacy Calibration Standards

The new X-Rite standard - XRGA

The inter-model agreement study quantifies the systematic differences between former X-Rite and former GretagMacbeth calibration standards. With this knowledge, we have defined a new corporate X-Rite Standard for Graphic Arts (XRGA), which achieves the following goals:

- Incorporates improved methods for calibration
- Maintains traceability to the American National Institute of Standards and Technology (NIST)
- Best implementation with respect to existing standards
- Improves inter-model agreement for existing instruments
- Preserves good agreement among former X-Rite instruments and former GretagMacbeth instruments
- Provides a single standard for all future graphic arts instruments to be delivered by X-Rite

X-Rite has developed a set of proprietary matrix transforms that enable measurements taken by either a former X-Rite or a former GretagMacbeth instrument to be easily expressed in the new corporate standard. Transformation of the previously displayed data (Table 1) demonstrates significant improvement provide when using XRGA. The improved results are illustrated in Table 2.

	530		938		939		i1Pro		SpectroEye	
dE*ab	mean	95%	mean	95%	mean	95%	mean	95%	mean	95%
938	0.27	0.48								
939	0.39	0.85	0.33	0.82						
i1Pro	0.49	1.03	0.50	1.11	0.51	1.23				
SpectroEye	0.60	1.26	0.56	1.25	0.43	0.85	0.56	1.36		
Spectrolino	0.56	1.17	0.55	1.28	0.44	0.95	0.47	1.01	0.37	0.83

Table 2: Inter-model agreement using the new X-Rite Standard (XRGA)

Inter-model agreement conclusions

- Inter-model agreement is almost independent on the substrate type.
- Inter-model agreement between former X-Rite instruments (530, 938 and 939), as well as between former GretagMacbeth instruments (i1Pro, Spectrolino, SpectroEye) is not changed with the new XRGA standard.
- The new XRGA standard provides good inter-model agreement among all X-Rite instruments.

What this means to X-Rite customers

For most of our products, the switch to XRGA results in very small differences in measurement values, so many customers will not need to make any changes. The table below shows the differences that can be expected for the instruments involved in this study:

dE*ab	mean	95%
530	0.27	0.66
938	0.27	0.66
939	0.28	0.66
i1Pro	0.60	1.61
SpectroEye	0.60	1.63
Spectrolino	0.60	1.63

Table 3: Differences Between Legacy Standards and the new X-Rite Standard (XRGA) (measurements performed on Digital Printing, High quality proof paper)

Former X-Rite instruments are very near the new X-Rite Standard. For customers who experience larger differences after moving to the new standard, X-Rite will provide seamless means to move existing databases to the new XRGA standard.

All customers will benefit from the use of the new XRGA standard:

a. Significantly improved inter-model agreement

b. Traceable to NIST

c. Improved printing specification agreement

d. Improved data exchange

All future graphic arts instruments delivered by X-Rite will also conform to XRGA.

Since the introduction of XRGA, the existing legacy GretagMacbeth and X-Rite products have been switched over to the new XRGA standard. Tools are available to aid in the transition of legacy data where applicable and, in some cases, are included in many new versions of X-Rite software products, such as IFS, Color iQC, and X-RiteColor Master. All new X-Rite graphic arts products will conform to XRGA when introduced for sale.

ColorPort , is a free software utility, that can be used to transform data to XRGA. ColorPort v2.x can be downloaded from the X-Rite website (http://www.xrite.com/product_overview.aspx?ID=1336&Action=support&SoftwareID=1105) and can be used to save data in either the XRGA standard or an instrument's native response. This allows you to immediately adopt the standard if you wish, or to do your own trials regarding the impact of this standard to your existing workflow.

Instruments supported in ColorPort include:

530	SpectroEye	i1iO	DTP22	DTP70
938	SP62/64*	i1iSis	DTP41	Spectroscan
939	i1Pro	DTP20 (Pulse)	DTP45	

**SP62/64, while supported by ColorPort, will not be transformed to XRGA as it pertains only to 0/45 and 45/0 instruments and not sphere illumination.*

Additional information and Frequently Asked Questions are posted on our website.
To find out how the XRGA applies to you, and for any additional information please see: www.xrite.com/xrga.

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