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Graphic technology— Color transmission target for input scanner calibration

SECRETARIAT
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FOREWORD

(This foreword is not a part of American National Standard IT8.7/1-1993,
Graphic technology — Color transmission target for input scanner calibration.)

The intent of this standard is to define an input test target that will allow any color input scanner to be calibrated with any film dye set used to create the target.

The IT8 Committee was accredited by the American National Standards Institute in 1987 to facilitate the development of standards for digital data exchange.

The IT8 Committee recommends the voluntary implementation and use of this standard by the prepress segment of the graphic arts industry at its earliest convenience.

Suggestions for improving this standard are welcome. They should be sent to Secretariat, NPES The Association for the Suppliers of Printing and Publishing Technologies, 1899 Preston White Drive, Reston, VA 22091-4367. Technical questions and requests for clarification should also be addressed in writing to the Secretariat.

This standard was prepared by IT8 Subcommittee 4 and was processed and approved for submittal to ANSI by Accredited Standards Committee IT8. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time this standard was approved the leadership of IT8 was as follows:

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Graphic technology — Color transmission target for input scanner calibration

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Graphic technology — Color transmission target for input scanner calibration

Introduction

Purpose

Color input scanners do not all analyze color the same way the human eye does. These devices are designed to optimize the signal generated when typical materials are scanned. Color transparency products use various combinations of proprietary dye sets to achieve visual responses that simulate the color appearance of natural scene elements. The ability to achieve the same color appearance from different combinations of dyes is referred to as metamerism. Because both film dyes and scanner sensitivities vary from product to product, there is a variability in the scanner response to metameric colors produced by the various materials.

The intent of this standard is to define an input test target that will allow any color input scanner to be calibrated with any film dye set used to create the target. This standard is intended to address the color transparency products which are generally used for input to the preparatory process for printing and publishing.

The target was designed to be useable for calibration by visual comparison and as a numerical data target for electronic systems and future development. The target design made use of a uniform color space to optimize the spacing of target patches. The tolerances developed for individual colored patches meet the values needed for both numerical and visual analysis.

This standard represents the first part of a multi-part standard which addresses graphic arts color definition issues. IT8.7/2, "Graphic technology — Color reflection target for input scanner calibration" and IT8.7/3, "Graphic technology — Input data for characterization of 4-color process printing" are companion documents.

Technical background

Design of target

The CIE 1976 ($L^*a^*b^*$) or CIELAB color space was chosen as the space to be used for the design of the color calibration target. Uniform spacing in hue, lightness and chroma, and tolerancing in terms of differences in these parameters (ΔE^*_{ab}) is believed to provide a reasonable distribution of colored patches in the most effective manner. Although CIELAB was defined by CIE with reference to reflection viewing conditions, tolerancing in terms of vector differences (ΔE) does provide a reasonable error estimate for transmission materials.

The design goal of the committee was to define a target that would have, as its main part, as many common colored patches as was practical, regardless of dye set used. It was determined that the remainder of the target should define the unique color characteristics of the particular dye set used to create a specific target; the values for each target element should be established using a common procedure.

To provide a reasonable measure of the color gamut that is within the capability of modern color films, all manufacturers of these films were invited to provide color dye data along with the necessary minimum and maximum density data for each of their image forming color dye sets. Data were provided by Agfa Company, Eastman Kodak Company, Fuji Photo Film Company, and Konica Corporation. These data

were then used to estimate the CIELAB color gamut that each dye set could produce. This estimate was achieved by mathematical modelling (by several of the participating companies) using methods which were different but gave very similar results. Annex A provides additional reference material concerning the methodology used in selecting aim values.

NOTE — The following documents provide reference information on the computational methods used in gamut determination:

1. N. Ohta, "The Color Gamut Obtainable by the Combination of Subtractive Color Dyes. V. Optimum Absorption Bands as Defined by Nonlinear Optimization Technique." *Journal of Imaging Science*, 30[1], 9-12(1986).
2. M. Inui, "A Fast Algorithm for Computing the Colour Gamut of Subtractive Colour Mixture." *Journal of Photographic Science*, 38[4,5], 163-164 (1990).

All computations were based upon the use of the CIE 2 degree observer and D50 illuminant. All transmission measurements were made using diffuse/normal or normal/diffuse geometry as defined for total transmittance. The use of an absolute reference rather than film D_{min} allows all colors that have the same colorimetric definition to also look the same when viewed together.

The gamut plots developed were then used to determine the color gamut that was common to all of the provided dye families. The limiting values of chroma were then reduced to 80% of their computed values to create a "common gamut" for purposes of target design.

The committee goal was to have all colored patches defined in the same way (regardless of film used) and to have as many patches as practical. The defined color gamut therefore required a pattern with a consistent reference. An existing color input target provided by Eastman Kodak Company under the designation of "Kodak Color Reproduction Guides, Q-60™" was used as a guide in the development of the target. The Q-60™ target used 12 uniformly spaced (approximately) hue angles in CIELAB. These were sampled at three chroma values at each of three lightness levels. Although this pattern does not provide equal spacing in terms of CIELAB ΔE^*_{ab} , it does provide an easily understandable and defined element arrangement. It was adopted by the committee for the IT8 target with the addition of a fourth product-specific chroma value at each hue angle/lightness combination.

Lightness levels were chosen for each hue angle to best characterize the gamut at that hue angle. The three common chroma values were then chosen such that one fell on the computed 80% chroma limit common to all the products and the others were equally spaced in chroma between this value and the neutral. The fourth chroma, which is product-specific, was defined to be the maximum available from each product at the specific hue angle and lightness level. This provided a consistent mapping for all products.

It was also felt to be important to include scales in each of the individual dyes, dye pairs, and a dye neutral along with areas to define product minimum and maximum densities.

A "vendor-optional" area was provided so that different target manufacturers could add unique elements of their own determination beyond those which are required by this standard.

Manufacturing tolerances

In order to permit practical production of these targets, tolerances had to be set which were capable of being achieved over a significant number of targets. However, this conflicted with the relatively narrow tolerances required for numerical color calibration. Different tolerances were therefore defined for differing applications, with the objective of minimizing variations as far as was reasonable.

Graphic technology - Color transmission target for input scanner calibration

1 Scope

This standard defines the layout and colorimetric values of a target which can be manufactured on any positive color transparency film and which is intended for use in the calibration of a photographic film/scanner combination (as used in the preparatory process for printing and publishing).

2 Normative references

The following documents contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. The American National Standards Institute (ANSI) maintains a register of currently valid American National Standards.

1. CIE 15.2 (1986), *Colorimetry (second edition)*
2. ISO 1012:1973, *Color film for general use — Sizes of sheet material*
3. CIE 17.4 (1987), *International Lighting Vocabulary (fourth edition)*
4. CGATS.5-1993, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*
5. ISO/IEC 646:1991, *Information technology - ISO 7-bit coded character set for information interchange*

3 Definitions

For the purpose of this Standard, the following definitions apply:

3.1 CIE tristimulus values: Amounts of the three reference color stimuli, in the CIE-specified trichromatic system, required to match the color of the stimulus considered.

NOTE — In the 1931 CIE standard colorimetric system, the tristimulus values are represented by the symbols X, Y, Z. See References 1 and 3.