ANSI®
IT8.7/2-1993
Reaffirmed 1999

AMERICAN NATIONAL STANDARD

# Graphic technology–
# Color reflection target for input scanner calibration

SECRETARIAT
NPES THE ASSOCIATION FOR SUPPLIERS OF PRINTING, PUBLISHING AND CONVERTING TECHNOLOGIES

APPROVED JUNE 21, 1993
AMERICAN NATIONAL STANDARDS INSTITUTE, INC.

*PRINTED AS A PUBLIC SERVICE BY*

NPES THE ASSOCIATION FOR SUPPLIERS OF PRINTING, PUBLISHING AND CONVERTING TECHNOLOGIES
1899 Preston White Drive
Reston, Virginia 20191-4367
Telephone: (703) 264-7200
FAX: (703) 620-0994

This is a preview of "ANSI IT8.7/2-1993". Click here to purchase the full version from the ANSI store.



Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat whose name appears on the title page of this standard.

**CAUTION NOTICE:** This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard periodically. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

**American National Standards Institute**
**11 West 42nd Street, New York, New York 10036**

Copyright ©1993 by NPES The Association for Suppliers of Printing and Publishing Technologies
All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Printed in the United States of America

This is a preview of "ANSI IT8.7/2-1993". Click here to purchase the full version from the ANSI store.



# FOREWORD

(This foreword is not a part of American National Standard IT8.7/2-1993, Graphic technology–Color reflection 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 Suppliers of Printing, Publishing and Converting Technologies, 1899 Preston White Drive, Reston, VA 20191-4367. 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:

Chairman, Paul Hanson
Vice Chairman, S. Thomas Dunn
Secretary, William K. Smythe, Jr.

This is a preview of "ANSI IT8.7/2-1993". Click here to purchase the full version from the ANSI store.



At the time it approved this standard, the IT8 Committee had the following personnel:

| Organization Represented | Name of Representative |
|---|---|
| AD/SAT, Inc. | James B. Jenkins (Obs.) |
| Association for Information and Image Management | Jean Baronas<br>Marilyn Courtot (Alt.) |
| ASG Sherman Graphics, Inc. | John Gagliano |
| Adobe Systems Incorporated | Steve Zilles |
| Advanced Vision Research | George Tharakan |
| Agfa Division/Miles Inc. | Patrick Thomas<br>Paul Delabastita (Alt.) |
| American Association of Advertising Agencies | Don Greifenkamp |
| American Color | Grant Hall (Obs.) |
| Applied Graphics Technologies | Murray Oles (Obs.) |
| Autologic Incorporated | Randy Bowen (Obs.) |
| Banta Prepress Group | Melene Follert (Obs.) |
| Barco Industries | Hans L.F. De Stecker (Obs.)<br>Karel Roose (Obs.) |
| CalComp | William C. Kress |
| Case Hoyt/Rochester | Ken Nowicki (Obs.) |
| Color Response | Karl G. Schnellinger |
| Colorhouse, Inc. | Bill Klocke (Obs.)<br>Bill Sieps (Obs.) |
| Crosfield Electronics Ltd. | Tony Johnson |
| Crown Graphics | Robert Gartner (Obs.) |
| Cymbolic Sciences International | Alistair Reed<br>Mark Bunce (Alt.) |
| Dainippon Screen | Bruce C. Shifrin |
| Fraunhofer-Institut | Jurgen Schonhut (Obs.) |
| Du Pont Electronic Imaging | John C. Ufford<br>Robert C. Strum (Alt.) |
| Dunn Technology, Inc. | S. Thomas Dunn<br>Patrice M. Dunn (Alt.) |
| Eastman Kodak Company | David Q. McDowell<br>Chris Goldsmith (Alt.) |
| Flexographic Technical Association | Lu Linares (Obs.) |
| Fuji Photo Film U.S.A., Inc. | Lawrence C. Warter |
| Gerber Systems Corporation | Frank Wilk |
| Graphic Arts Technical Foundation | Richard Warner |
| Gravure Association of America | Gregory Tyszka |
| Hanson Graphics of Memphis | Paul M. Hanson |
| Harper House, Inc. | Chris Jackson (Obs.) |
| Hyphen Incorporated | Ian Rutledge (Obs.) |
| International Association of Diecutting & Diemaking | Ronald Ballard |
| International Prepress Association | Henry L. Hatch<br>Paul F. Borth (Alt.) |
| Kieffer-Nolde, Inc. | Thomas Klamm (Obs.) |
| Kreber Graphics | Joe Kreber (Obs.) |
| Linotype-Hell Company | Dieter Preuss<br>Ted J. Cooper (Alt.) |
| Magazine Publishers Association | Kevin Hickey |
| Mandel Company | Lee Catlett (Obs.) |
| McGraw Hill Inc. | Cesare Del Vaglio (Obs.) |
| The Mitre Corporation | Bradley R. Dunkle (Obs.) |
| National Association of Printers and Lithographers | William Mullins |
| NPES The Association for Suppliers of Printing and Publishing Technologies | Richard S. Fisch |
| National Computer Graphics Association | Robert Willis (Obs.) |
| Newspaper Association of America | John W. Iobst |
| Oceana | Mark Rand |
| Optronics | Bruce Harrison |
| PMSI - Photo Mechanical Services, Inc. | Tom Holzinger (Obs.) |
| Page Imaging | Bob Manuel (Obs.) |
| Peerless Engraving | Sam Bracy (Obs.) |
| Phototype Color Graphics | Harold Wyckoff (Obs.) |
| Pindar Graphics PLC | Graham Cook (Obs.) |
| Polychrome Corporation | Gary H. Dolgins<br>Hideyuki Shoji (Alt.) |
| Quad/Tech, Inc. | Alan Darling (Obs.) |
| Quality House of Graphics | Ozzie Aslanian (Obs.) |
| Quebecor Printing (USA) Corp. | Terry Bush |
| R. R. Donnelley & Sons Company | James D. Mason |
| Research & Engineering Council of the Graphic Arts Industry | Fred Rogers<br>Harold A. Molz (Alt.) |
| Ringier America, Inc. | Joseph Kleine-Jaeger<br>Mark O. Jones (Alt.) |
| Schawk Inc. | Phillip DeWulf (Obs.) |
| Scitex Corporation Ltd. | Edna Shachar |
| Screaming Technology Inc. | Ken Filarski<br>David Lewis (Alt.) |
| Shandata | Brian M. Cluer |
| Shira Computers Ltd. | Rene Dubois |
| Technical Association of the Graphic Arts | David Q. McDowell<br>Paul R. Guy (Alt.) |
| 3M Company | Ran Bedekar<br>Richard S. Fisch (Alt.) |
| Xyvision Design Systems, Inc. | Alan Green |

**IT8 Subcommittee 4**

David McDowell, Chair
Mary Abbott, Secretary SC4

Yigal Accad
Ted J. Cooper
Gary H. Dolgins
S. Thomas Dunn
Richard Fisch
Jack Fraser
Paul Hoffenberg
Richard Holub
Toru Hoshino
Miyuki Hosoi
Po-Chieh Hung
Tony Johnson
Jun Komaki
William Kress
Matty Litvak
John W. Long
David McDowell
Noboru Ohta
Dieter Preuss
Mark Rand
Danny Rich
Raymond Roosen
Tom Schuneman
Edna Shachar
Bruce Shifrin
Hideyuki Shoji
Robert Strum
Eran Steinberg
Arthur Taggi
Modest Vereychen
Lawrence C. Warter
Sandy Whitenack

This is a preview of "ANSI IT8.7/2-1993". Click here to purchase the full version from the ANSI store.



# Graphic technology — Color reflection target for input scanner calibration

## Contents

Page

Introduction . . . . . . . . 1

1 Scope . . . . . . . . 3

2 Normative references . . . . . . . . 3

3 Definitions . . . . . . . . 3

4 Requirements . . . . . . . . 6
4.1 Target design . . . . . . . . 6
4.2 Target layout and physical characteristics . . . . . . . . 6
4.3 Patch size . . . . . . . . 9
4.4 Color gamut mapping . . . . . . . . 9
4.5 Neutral and dye scale values . . . . . . . . 10
4.6 Neutral scale mapping . . . . . . . . 11
4.7 Allowable tolerances on patch values . . . . . . . . 11
4.8 Spectral measurement and colorimetric calculation . . . . . . . . 12
4.9 Data reporting . . . . . . . . 12
4.10 Data file format . . . . . . . . 13
4.11 Useable target life . . . . . . . . 16

Annexes

A (informative) Gamut mapping - computational reference . . . . . . . . 17

B (informative) Application notes . . . . . . . . 19

C (informative) Data file format . . . . . . . . 22

This is a preview of "ANSI IT8.7/2-1993". Click here to purchase the full version from the ANSI store.



# Graphic technology — Color reflection 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 reflection products use various combinations of proprietary dye sets to produce visual responses that simulate the color appearance of natural scene elements. The ability to produce the same color appearance from different combinations of dyes is referred to as metamerism. Because both 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 photographic paper dye set used to create the target. This standard is intended to address the color photographic paper 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 patches meet the values needed for both numerical and visual analysis.

This standard represents the second part of a multi-part standard which addresses graphic arts color definition issues. IT8.7/1, "Graphic technology — Color transmission 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 ($\Delta E^*_{ab}$) is believed to provide a reasonable distribution of target patches in the most effective manner.

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 photographic papers, all manufacturers of these papers 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

This is a preview of "ANSI IT8.7/2-1993". Click here to purchase the full version from the ANSI store.



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 reflection measurements were made using 0/45 or 45/0 geometry as defined in the ISO densitometry standards. The reference white was assumed to be a perfect diffuser. The use of an absolute reference rather than paper Dmin allows all colors that have the same colorimetric definition to also look the same when viewed at the same time.

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 paper 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 $\Delta E^*_{ab}$, 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.

<u>**Manufacturing tolerances**</u>

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.

This is a preview of "ANSI IT8.7/2-1993". Click here to purchase the full version from the ANSI store.



# Graphic technology — Color reflection target for input scanner calibration

## 1 Scope

This standard defines the layout and colorimetric values of a target which can be manufactured on any color photographic paper and which is intended for use in the calibration of a photographic paper/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 5/1:1984, *Photography — Density measurements — Part 1: Terms, symbols and notations*
3. ISO 1011:1973, *Color paper for general use — Sizes of sheet material*
4. CIE 17.4 (1987), *International Lighting Vocabulary (fourth edition)*
5. CGATS.5-1993, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

## 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 4.