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Graphic technology — Prepress digital data exchange — Colour targets for input scanner calibration —

Part 1:
Colour targets for input scanner calibration

Technologie graphique — Échange de données numériques de préimpression — Cibles de couleur pour étalonnage à l'entrée du scanner

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Contents

Page

Foreword iv
Introduction v
1 Scope 1
2 Normative references 1
3 Terms and definitions 1
4 Requirements 4
4.1 Target design 4
4.2 Transmission targets 4
4.2.1 Target layout and physical characteristics 4
4.2.2 Patch size 9
4.2.3 Colour gamut mapping 9
4.2.4 Neutral and dye scale values 10
4.2.5 Neutral scale mapping 11
4.3 Reflection targets 11
4.3.1 Target layout and physical characteristics 11
4.3.2 Patch size 13
4.3.3 Colour gamut mapping 14
4.3.4 Neutral and dye scale values 14
4.3.5 Neutral scale mapping 15
4.4 Allowable tolerances on patch values 15
4.4.1 Uncalibrated targets 15
4.4.2 Calibrated targets 16
4.5 Spectral measurement and colorimetric calculation 16
4.6 Data reporting 16
4.7 Data file format 16
4.7.1 File format 16
4.7.2 Keyword syntax and usage 16
4.7.3 Data format identifiers 17
4.8 Useable target life 19
Annex A (informative) **Gamut mapping — Computational reference** 20
Annex B (informative) **Application notes** 22
Bibliography 25

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 130, *Graphic technology*.

This first edition of ISO 12641-1 cancels and replaces ISO 12641:1997, which has been technically revised to take account of the technical advancements in the related fields and the associated equipment.

ISO 12641 consists of the following parts, under the general title *Graphic technology — Prepress digital data exchange*:

— *Part 1: Colour targets for input scanner calibration*

An additional part dealing with advanced colour targets for input scanner calibration is planned.

Annexes A and B are for information only.

Introduction

The technical requirements of this part of ISO 12641 are identical to the American National Standards IT8.7/1-1993 and IT8.7/2-1993. These Standards resulted from the joint efforts of an international industry group that included participants representing a broad range of prepress vendors, film manufacturers, and users. This group, initially identified as the digital data exchange standards (DDES) committee, later became the founders of the ANSI IT8 (Image Technology) accredited standards committee which is responsible for electronic data exchange standards in graphic arts prepress.

Purpose of this part of ISO 12641

Colour input scanners do not all analyse colour the same way the human eye does. These devices are designed to optimize the signal generated when typical materials are scanned. Colour reflection and transparency products use various combinations of proprietary dye sets to achieve visual responses that simulate the colour appearance of natural scene elements. The ability to achieve the same colour appearance from different combinations of dyes is referred to as metamerism. Because both photographic dyes and input scanner sensitivities vary from product to product, there is variability in the input scanner response to metameric colours produced by the various materials. The intent of this part of ISO 12641 is to define an input test target that will allow any colour input scanner to be calibrated with any film or paper dye set used to create the target. This part of ISO 12641 is intended to address the colour reflection and 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 colour space to optimize the spacing of target patches. The tolerances developed for individual coloured patches meet the values needed for both numerical and visual analysis.

Design of the target

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

The design goal was to define a target that would have, as its main part, as many common coloured patches as was practical, regardless of the dye set used. The remainder of the target is intended to define the unique colour characteristics of the particular dye set used to create a specific target; the values for each target patch is to be established using a common procedure.

To provide a reasonable measure of the colour gamut that is within the capability of modern colour papers and films, all manufacturers of these products were invited to provide colour dye data along with the necessary minimum and maximum density data for each of their image forming colour 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 colour gamut that each paper and film 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 method used in selecting aim values.

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**, 9-12 (1986)[1].

2. M. Inui, "Fast Algorithm for Computing Color Gamuts," *Colour Research and Application*, **18**, 341-348 (1993)[4].

All computations were based upon the use of the CIE 2 degree observer and D_{50} illuminant. All transmission measurements were made using diffuse/normal or normal/diffuse geometry as defined for total transmittance. All reflection measurements were made using 0°/45° or 45°/0° geometry as defined in ISO 13655. The reference white was assumed to be a perfect diffuser. The use of an absolute reference allows all colours on similar media (reflection or transmission) 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 colour gamuts for film and paper that were 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 goal was to have all coloured patches defined in the same way (regardless of the product used) and to have as many patches as practical. The defined colour gamut therefore required a pattern with a consistent reference. An existing colour input target provided by Eastman Kodak Company under the designation of "Kodak Colour Reproduction Guides, Q-60™" was used as a guide in the development of the target. The Q-60™ target used 12 approximately uniformly spaced 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 ΔE^*_{ab}, it does provide an easily understandable and defined patch arrangement. It was adopted for these targets 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 patches of their own determination beyond those which are required by this International 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 colour calibration. Different tolerances were therefore defined for differing applications, with the objective of minimizing variations as far as was reasonable.

Graphic technology — Prepress digital data exchange — Colour targets for input scanner calibration —

Part 1: Colour targets for input scanner calibration

1 Scope

This part of ISO 12641 defines the layout and colorimetric values of targets for use in the calibration of a photographic product/input scanner combination (as used in the preparatory process for printing and publishing). One target is defined for positive colour transparency film and another is defined for colour photographic paper.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1008, *Photography — Paper dimensions — Pictorial sheets*

ISO 1012, *Photography — Films in sheets and rolls for general use — Dimensions*

ISO 13655, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
CIE tristimulus value
amount of the three reference colour stimuli, in the CIE-specified trichromatic system, required to match the colour of the stimulus considered

Note 1 to entry: In the 1931 CIE standard colorimetric system, the tristimulus values are represented by the symbols X, Y, Z.

3.2
CIELAB colour difference
CIE 1976 *L, *a**, *b** colour difference**
ΔE^*_{ab}
difference between two colour stimuli defined as the Euclidean distance between the points representing them in L^*, a^*, b^* space

$$\Delta E^*_{ab} = \left[\left(\Delta L^* \right)^2 + \left(\Delta a^* \right)^2 + \left(\Delta b^* \right)^2 \right]^{1/2}$$

where

ΔL^*, Δa^*, and Δb^* is the difference between corresponding values for the two stimuli.

[SOURCE: International Lighting Vocabulary 845-03-55]

3.3
CIELAB colour space
CIE 1976 *L, *a**, *b** colour space**
three-dimensional, approximately uniform, colour space produced by plotting in rectangular coordinates the quantities L^*, a^*, and b^* defined by the Formulae:

$$L^* = 116\left[\mathrm{f}\left(Y/Y_\mathrm{n}\right)\right] - 16$$
$$a^* = 500\left[f\left(X/X_\mathrm{n}\right) - f\left(Y/Y_\mathrm{n}\right)\right]$$
$$b^* = 200\left[f\left(Y/Y_\mathrm{n}\right) - f\left(Z/Z_\mathrm{n}\right)\right]$$

where for

$$X/X_n > 0{,}008\ 856,\ \mathrm{f}\left(X/X_n\right) = \left(X/X_n\right)^{1/3}$$
$$Y/Y_n > 0{,}008\ 856,\ \mathrm{f}\left(Y/Y_n\right) = \left(Y/Y_n\right)^{1/3}$$
$$Z/Z_n > 0{,}008\ 856,\ f\left(Z/Z_n\right) = \left(Z/Z_n\right)^{1/3}$$

and for

$$X/X_\mathrm{n} > 0{,}008\ 856,\ f\left(X/X_\mathrm{n}\right) = 7{,}786\ 7\left(X/X_\mathrm{n}\right) + 16/116$$
$$Y/Y_\mathrm{n} > 0{,}008\ 856,\ f\left(Y/Y_\mathrm{n}\right) = 7{,}786\ 7\left(Y/Y_\mathrm{n}\right) + 16/116$$
$$Z/Z_\mathrm{n} > 0{,}008\ 856,\ f\left(Z/Z_\mathrm{n}\right) = 7{,}786\ 7\left(Z/Z_\mathrm{n}\right) + 16/116$$

and

$$X_\mathrm{n} = 96{,}422,$$
$$Y_\mathrm{n} = 100{,}000\ \textit{and}$$
$$Z_\mathrm{n} = 82{,}521,\ \textit{for the conditions of ISO 13655}.$$

Further

$$C^*_\mathrm{ab} = \left(a^{*2} + b^{*2}\right)^{1/2}$$

and

$$h_\mathrm{ab} = tan^{-1}\left(b^*/a^*\right)$$

where

$$0\Upsilon \le h_\mathrm{ab} < 90\ \Upsilon \quad \textit{if} \quad a^* > 0,\ b^* \ge 0$$
$$90\Upsilon \le h_\mathrm{ab} < 180\ \Upsilon \quad \textit{if} \quad a^* \le 0,\ b^* > 0$$
$$180\Upsilon \le h_\mathrm{ab} < 270\ \Upsilon \quad \textit{if} \quad a^* < 0,\ b^* \le 0$$
$$270\Upsilon \le h_\mathrm{ab} < 360\ \Upsilon \quad \textit{if} \quad a^* \ge 0,\ b^* < 0$$

[SOURCE: CIE Publication 15.2]

3.4
transmittance factor
ratio of the measured flux transmitted by the sample material to the measured flux when the sample material is removed from the sampling aperture of the measuring device

3.5
transmission density
logarithm to base 10 of the reciprocal of the transmittance factor

3.6
reflectance factor
ratio of the measured flux reflected from the sample material to the flux reflected from a perfect reflecting diffuser

3.7
reflection density
logarithm to base 10 of the reciprocal of the reflectance

3.8
colour gamut
subset of perceivable colours reproducible by a device or medium

3.9
dye set
combination of light absorbing dyes

Note 1 to entry: Usually referred to as cyan, magenta, and yellow. Used in a particular photographic product which produce object colours by the selective subtraction of the incident light.

3.10
dye scale
array of physical areas having varying amounts of one or more (cyan, magenta, or yellow) dyes

3.11
neutral scale
array of physical areas having combination of dye amounts such that their chroma is equal to, or near, zero

3.12
metameric colour stimuli
spectrally different colour stimuli having the same tristimulus values

[SOURCE: International Lighting Vocabulary 845-03-05]

3.13
minimum density
Dmin
density corresponding to the maximum transmittance factor (film) or reflectance factor (paper) that a photographic product can achieve

Note 1 to entry: It is not necessarily neutral in colour and should not be confused with minimum neutral density.

3.14
minimum neutral density
minimum density that a photographic product can achieve (maximum transmittance or reflectance factors) and maintain a $C^*_{ab} = 0$

Note 1 to entry: It should not be confused with minimum density (Dmin).

3.15
maximum density
Dmax
density corresponding to the minimum transmittance or reflectance factor that a photographic product can achieve

Note 1 to entry: It is not necessarily neutral in colour and should not be confused with maximum neutral density.

3.16
maximum neutral density
density corresponding to the maximum density that a photographic product can achieve (minimum transmittance or reflectance factors) and maintain a $C^*_{ab} = 0$

Note 1 to entry: It should not be confused with maximum density (Dmax).

3.17
input scanner
device capable of converting the light reflectance or transmittance of a photographic (or other hardcopy) sample into an electronic signal, where the electronic signal is arranged to have an organized relationship to the spatial areas of the image evaluated

3.18
product-specific target areas
portions of the test target whose requirements are specifically defined, but whose values are a function of the particular product used to make the target

3.19
vendor-optional target areas
portions of the test target whose content is not specified but is available for use by the manufacturer of the target

4 Requirements

All colorimetry referenced within this part of ISO 12641 shall be based on D_{50} illuminant, CIE 1931 Standard Colorimetric Observer (2 degree observer) as defined in CIE 15.2, and computational procedures further defined in 4.5. The reference white is the D_{50} illuminant.

4.1 Target design

The target is designed with five distinct sections. These are the following:

— sampled colour area;

— colour dye scales;

— neutral dye scale;

— Dmin/Dmax area;

— vendor-optional area.

4.2 Transmission targets

4.2.1 Target layout and physical characteristics

4.2.1.1 Type 1, 4 in × 5 in film: The layout of the Type 1 colour transmission input calibration target as viewed from the support side of the film shall be as shown in Figure 1. This layout is intended for use with film material having a size of 4 in × 5 in (10,2 cm × 12,7 cm) in accordance with ISO 1012. All non-image areas of the target shall be approximately neutral and shall have a lightness of (L^*) of approximately 50. The non-image area shall extend at least 4,5 mm beyond the row and column borders on the top and sides at least 10 mm on the bottom to provide for identification information.

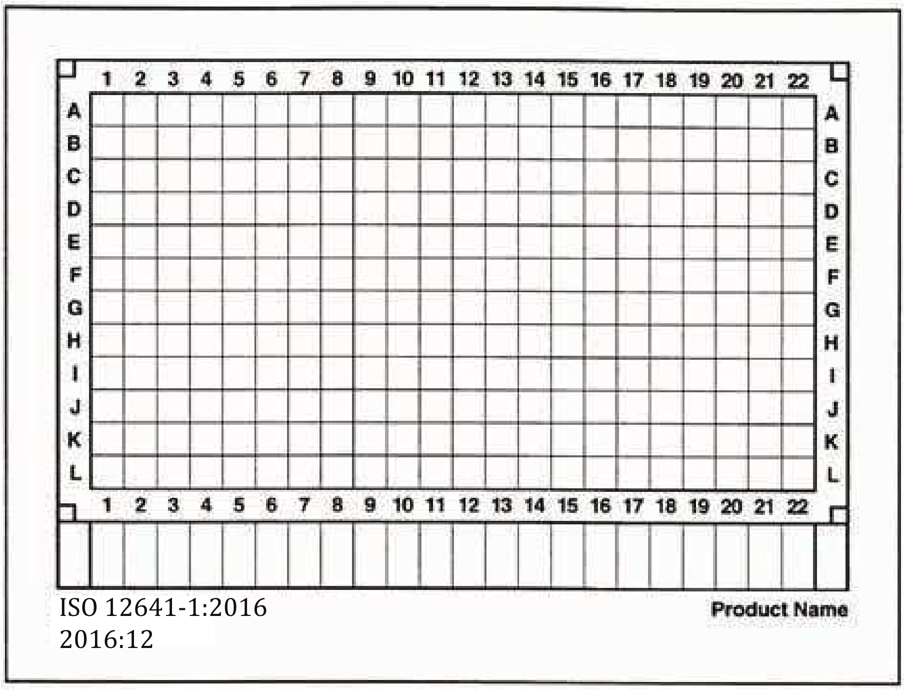

Figure 1 — Layout, Type 1 colour transmission target

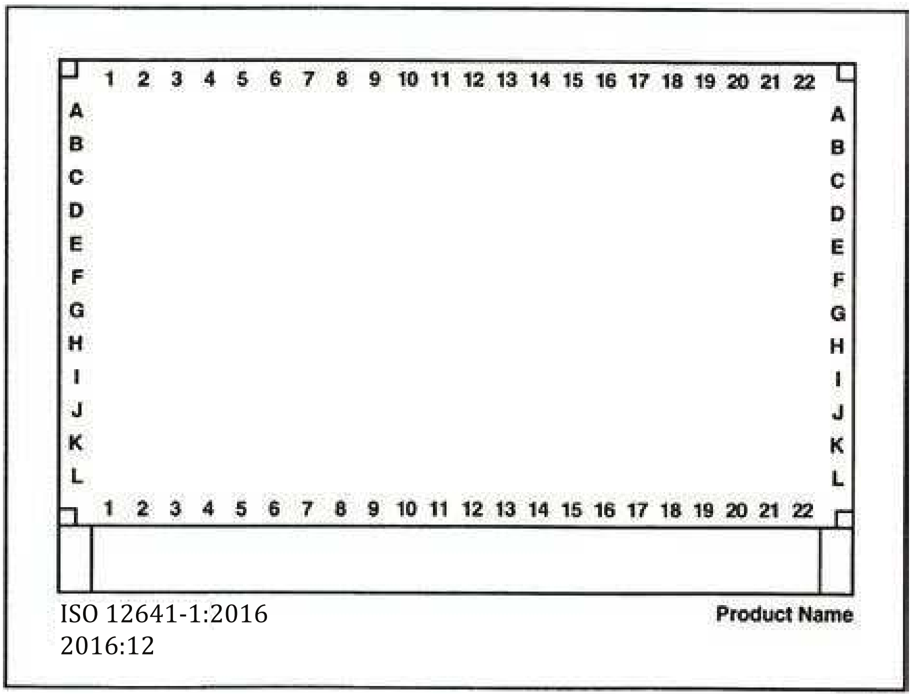

Figure 2 — Type 1 target, row, and column numbering

Target row and column numbering shall be of high density and as shown in Figure 2. Vertical lines may be used to separate columns 12 and 13, 15, 16 and 17, and 19 and 20. Indicators may be used at the intersection of target patches. These may be points, crosses, or other symbols, and may be of any density or colour desired. If used, they shall be less than 0,3 mm in width. No other marking lines shall be included within the body of the A1 through L19 portion of the target.

Lines shall be included to separate the Dmin area from the first step and the Dmax area from the last step of the 22-step neutral scale along the bottom of the target.

Unless otherwise noted, all lines shall be neutral and have a lightness (L^*) no greater than that specified for the background.

Fiducial marks shall be included in each corner of the main body of the target as shown in Figure 3. These shall be arranged such that they "point" towards the inside or centre of the target.

Because target patches are 4,5 mm × 4,5 mm in size (see 4.2.2), the intersection of the lines of the fiducial marks shall be offset 4,5 mm in both the horizontal and vertical direction from the centre of the nearest patch to provide a reference for automatic measurement alignment.

Fiducial marks shall be clear lines on the neutral background and shall be approximately 0,1 mm in width.

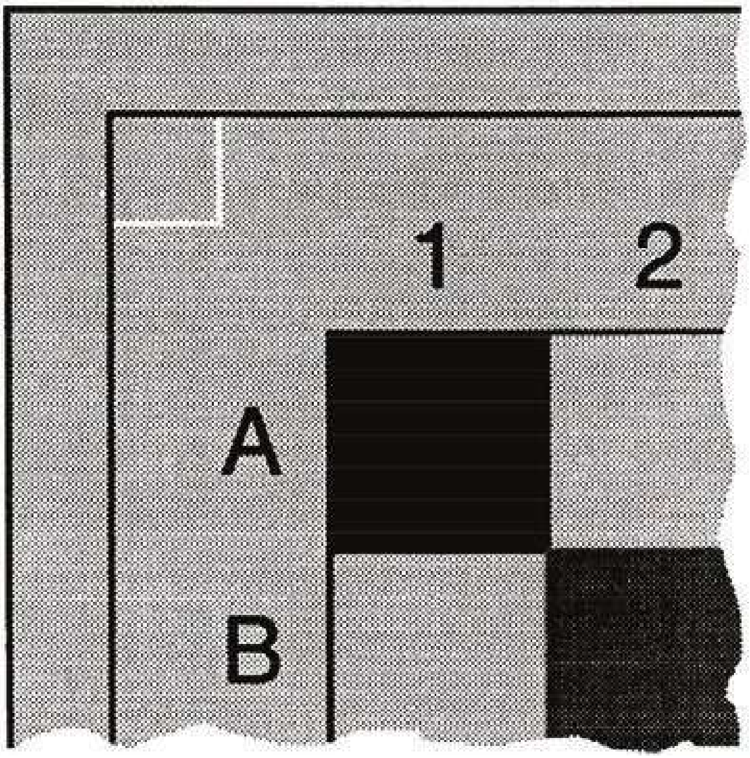

Figure 3 — Fiducial mark design

The area at the bottom of the target shall contain the following information in English text:

a) ISO 12641-1:2016;

b) the name of the film product or product family;

c) the year and month of production of the target in the form yyyy:mm;

d) an area of at least 10 mm × 25 mm for addition of a unique identification.

NOTE Targets bearing the designation IT8.7/1-1993 are prepared in accordance with ANSI IT8.7/1-1993 whose technical requirements are identical to those of this part of ISO 12641.

4.2.1.2 Type 2, 35 mm film: The Type 2 layout of the colour transmission input calibration target, as viewed from the support side of the product, shall be as shown in Figure 4 (frames 35-1 through 35-7). This layout is intended for use on film material having a basic format of 35 mm. This layout may be provided either as a single strip of film or as seven mounted 35 mm transparencies.

The target shall be divided as follows:

Frame	35-1	The Dmin, neutral scale, and Dmax patches from the bottom of Type 1 target format
Frame	35-2	Columns 1 through 4 of the Type 1 target format
Frame	35-3	Columns 5 through 8 of the Type 1 target format
Frame	35-4	Columns 9 through 12 of the Type 1 target format
Frame	35-5	Columns 13 through 16 of the Type 1 target format
Frame	35-6	Columns 17 through 19 of the Type 1 target format
Frame	35-7	Columns 20 through 22 of the Type 1 target format

In addition, each frame shall have a six step neutral scale as column *N* with L^* values as follows:

Step 1	82(top)
Step 2	66
Step 3	50
Step 4	34
Step 5	18
Step 6	2

All non-image areas of the target shall be approximately neutral and shall have a lightness (L^*) of approximately 50.

Each frame of the target shall contain the following information in English text:

a) ISO 12641-1:2016;

b) a frame number of the form 35-X;

c) the name of the film product or product family;

d) the year and month of production of the target in the form yyyy:mm.

NOTE Targets bearing the designation IT8.7/1-1993 are prepared in accordance with ANSI IT8.7/1-1993 whose technical requirements are identical to those of this part of ISO 12641.

If provided as individually mounted transparencies, this same information shall be repeated on the mount.

The frame numbering and reference lines shall be high in density and as shown in Figure 5.

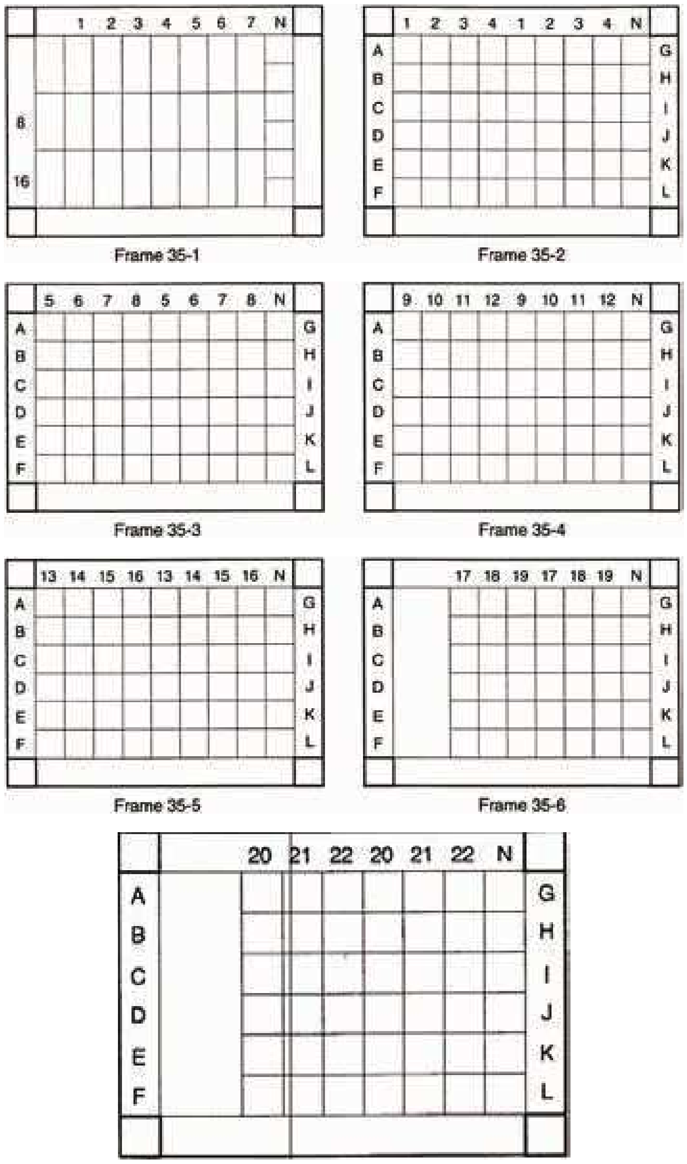

Figure 4 — Layout, Type 2 colour transmission target

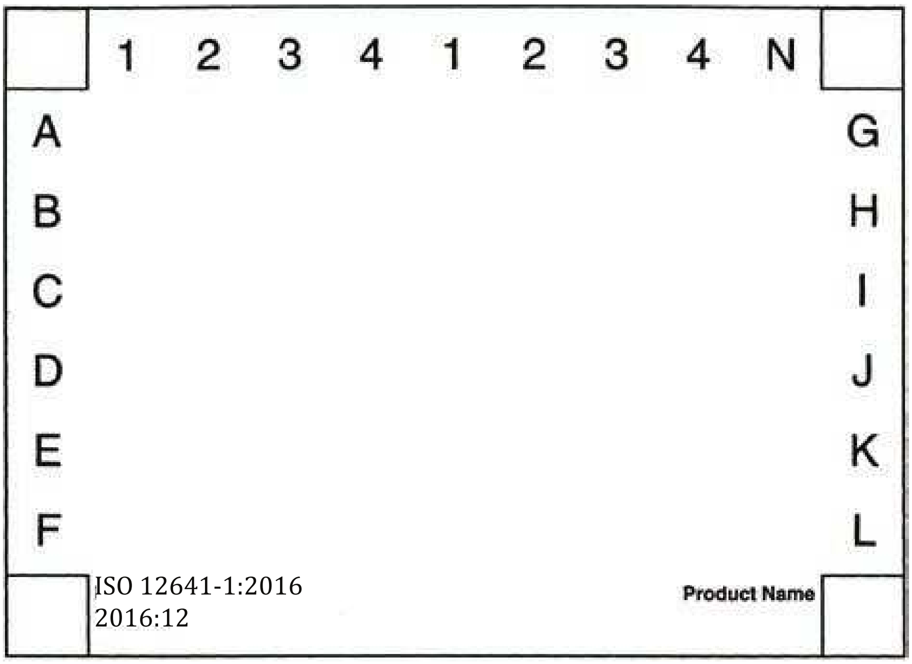

Figure 5 — Type 2 target, row and column numbering

Divider lines shall be included in Frame 35-1 between Dmin and step 1 of the neutral scale, and step 22 of the neutral scale and Dmax.

Unless otherwise noted, all lines shall be neutral and have a lightness (L^*) no greater than that specified for background.

4.2.1.3 Type 3, 35 mm film version of Type 1 target (optional): A 35 mm version of the Type 1 target may be provided at the discretion of the film vendor. If provided, it shall contain labelling information to ensure that scanned data from the 35 mm version of the target cannot be confused with scanned data from the full size version of the target. This target shall be a reduced size version of the Type 1 target, but shall not be required to meet the colorimetric requirements of this specification. Colours achieved will be the best efforts of the manufacturer.

NOTE See Annex B for recommendations on use of this format of the test target.

4.2.2 Patch size

The transmission targets shall be made with patch dimensions as follows:

— Type 1: 4,5 mm × 4,5 mm;

— Type 2: 3,2 mm × 3,2 mm.

The Dmin area, the 22-step neutral scale, and the Dmax area shall be two patches high.

4.2.3 Colour gamut mapping

The hue angle, lightness, and chroma of the target patches contained in the sampled colour area portion of the target, Rows A through L and Columns 1 through 12, shall be in accordance with Table 1 under the measurement conditions of 4.5.

Where a product is not capable of achieving specific chroma values indicated in this specification, the patch corresponding to that value shall be exposed as a background neutral as defined in 4.2.1.1. In all cases, patches in columns 4, 8, and 12, as shown in Table 1, shall be included.

4.2.4 Neutral and dye scale values

The specific values of patches A13 through L19 shall be defined by the manufacturer of the film used to create a specific target. The batch mean (for uncalibrated targets) or measured CIE X Y Z and L^* C^*_{ab} h^*_{ab} values (for calibrated targets) of these patches shall be reported by the manufacturer in accordance with 4.6.

The criteria by which the aim values for these patches shall be determined (under the measurement conditions of 4.5) are as follows:

Patch A16 shall be the minimum neutral density ($C^*_{ab} = 0$) that the product can normally achieve.

Patch L16 shall be the maximum neutral density ($C^*_{ab} = 0$) that the product can normally achieve.

Patch B16 through K16 shall be equally spaced in L^* between the L^* values of patches A16 and L16.

Patches A13 through L13 shall contain the same amounts of cyan dye as used to create the neutral patches of A16 through L16.

Patches A14 through L14 shall contain the same amounts of magenta dye as used to create the neutral patches of A16 through L16.

Patches A15 through L15 shall contain the same amounts of yellow dye as used to create the neutral patches of A16 through L16.

Patches A17 through L17 shall contain the same amounts of magenta and yellow dye (will appear red) as used to create the neutral patches of A16 through L16.

Patches A18 through L18 shall contain the same amounts of cyan and yellow dye (will appear green) as used to create the neutral patches of A16 through L16.

Patches A19 through L19 shall contain the same amounts of cyan and magenta dye (will appear blue) as used to create the neutral patches of A16 through L16.

NOTE It is recognized that it will be difficult to achieve these aim dye amounts, particularly in patches of high density, because of overlapping spectral sensitivities. Manufacturers are expected to achieve these goals to the extent possible.

Table 1 — Hue angle, lightness, and chroma for transmission target

Row	Hue angle	L1	C1	C2	C3	C4	L2	C1	C2	C3	C4	L3	C1	C2	C3	C4
A	16	15	10	21	31	(1)	35	15	30	44	(1)	60	8	16	24	(1)
B	41	20	11	23	34	(1)	40	17	34	51	(1)	65	7	15	22	(1)
C	67	30	11	22	34	(1)	55	20	40	60	(1)	70	9	17	26	(1)
D	92	25	9	18	27	(1)	50	17	35	52	(1)	75	23	46	69	(1)
E	119	30	11	22	33	(1)	60	20	39	59	(1)	75	12	25	37	(1)
F	161	25	10	21	31	(1)	45	17	35	52	(1)	65	12	25	37	(1)
G	190	20	7	14	21	(1)	45	14	29	43	(1)	65	11	23	34	(1)
H	229	20	7	15	22	(1)	40	13	25	48	(1)	65	7	15	22	(1)
I	274	25	14	27	41	(1)	45	10	21	31	(1)	65	6	12	17	(1)
J	299	10	17	34	51	(1)	35	13	27	14	(1)	60	7	14	21	(1)
K	325	15	10	26	39	(1)	30	17	35	52	(1)	55	12	23	35	(1)
L	350	15	10	21	31	(1)	30	16	33	49	(1)	55	10	21	31	(1)
	Column		1	2	3	4		5	6	7	8		9	10	11	12

(1) These values are specific to the product used to create the target and equal to maximum C^*_{ab} available at the hue angle and L^* specified. They are to be defined by the manufacturer of the product used to make the target.

4.2.5 Neutral scale mapping

The neutral scale lying along the bottom of the target shall have the following L^* aim values, based on the measurement conditions of 4.5, reading from left to right across the target. C^*_{ab} aim values shall be 0.

Step 1	82	Step 2	78
Step 3	74	Step 4	70
Step 5	66	Step 6	62
Step 7	58	Step 8	54
Step 9	50	Step 10	46
Step 11	42	Step 12	38
Step 13	34	Step 14	30
Step 15	26	Step 16	22
Step 17	18	Step 18	14
Step 19	10	Step 20	6
Step 21	4	Step 22	2

The patch located to the left of Step 1 of the grey scale (column 0) shall be at the Dmin of the product. The patch to the right of Step 22 (column 23) of the grey scale shall be at product Dmax.

4.3 Reflection targets

4.3.1 Target layout and physical characteristics

The layout of the colour reflection input calibration target shall be as shown in Figure 6. This layout is intended for use on material having a basic format of 5 in × 7 in (12,7 cm × 17,8 cm) in accordance with ISO 1008.

All non-image areas of the target shall be approximately neutral and shall have a lightness (L^*) of approximately 50. The non-image area shall extend at least 4,5 mm beyond the row and column borders on the top and sides and at least 10 mm on the bottom to provide for identification information.

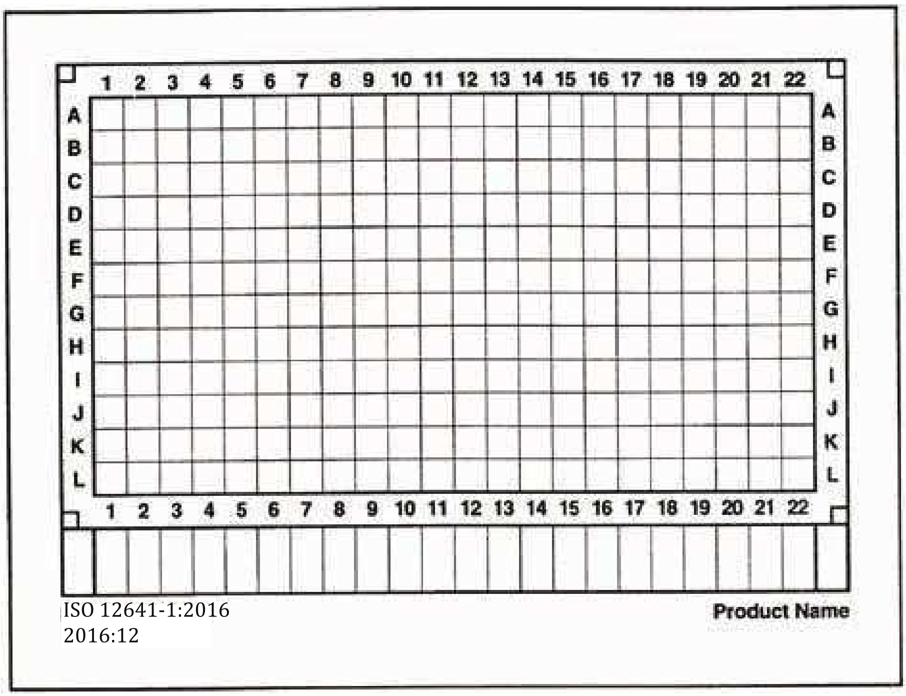

Figure 6 — Layout, colour reflection target

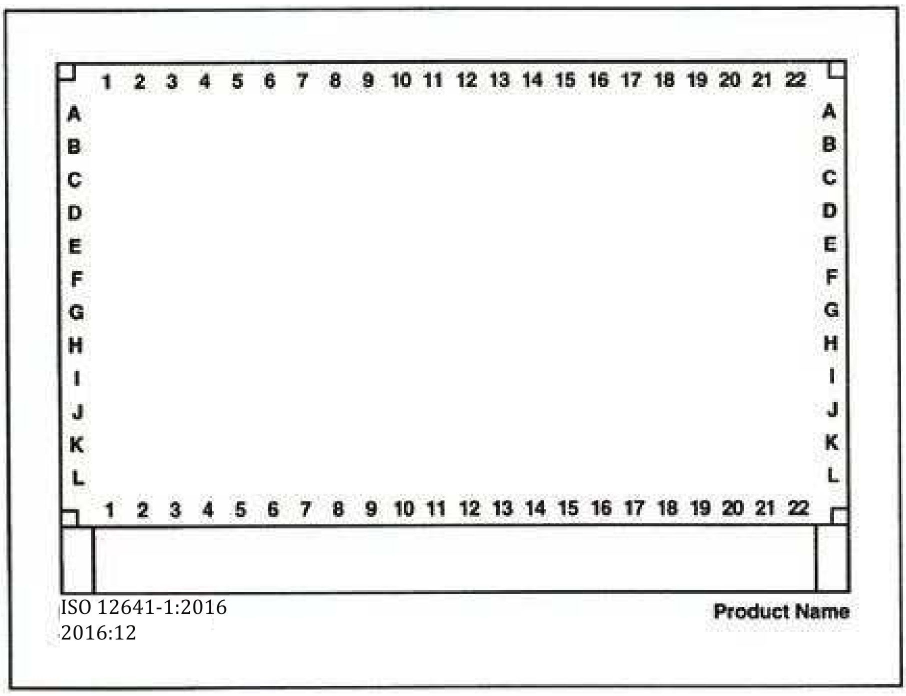

Figure 7 — Reflection target, row, and column numbering

Target row and column numbering shall be of high density and as shown in Figure 7. Vertical lines may be used to separate columns 12 and 13, 15, 16 and 17, and 19 and 20.

Indicators may be used at the intersection of target patches. These may be points, crosses, or other symbols, and may be of any density or colour desired. If used, they shall be less than 0,3 mm in width. No other marking lines shall be included within the body of the A1 through L19 portion of the target.

Lines shall be included to separate the Dmin area from the first step and the Dmax area from the last step of the 22-step neutral scale along the bottom of the target.

Unless otherwise noted, all lines shall be neutral and have a lightness (L^*) no greater than that specified for background.

Fiducial marks shall be included in each corner of the main body of the target as shown in Figure 8. These shall be arranged such that they "point" toward the inside or centre of the target.

Because target patches are 6,5 mm × 6,5 mm in size (see 4.3.2) the intersection of the lines of the fiducial marks shall be offset 6,5 mm in both the horizontal and vertical direction from the centre of the nearest patch to provide a reference for automatic measurement alignment.

Fiducial marks shall be white lines on the neutral background and shall be approximately 0,1 mm in width.

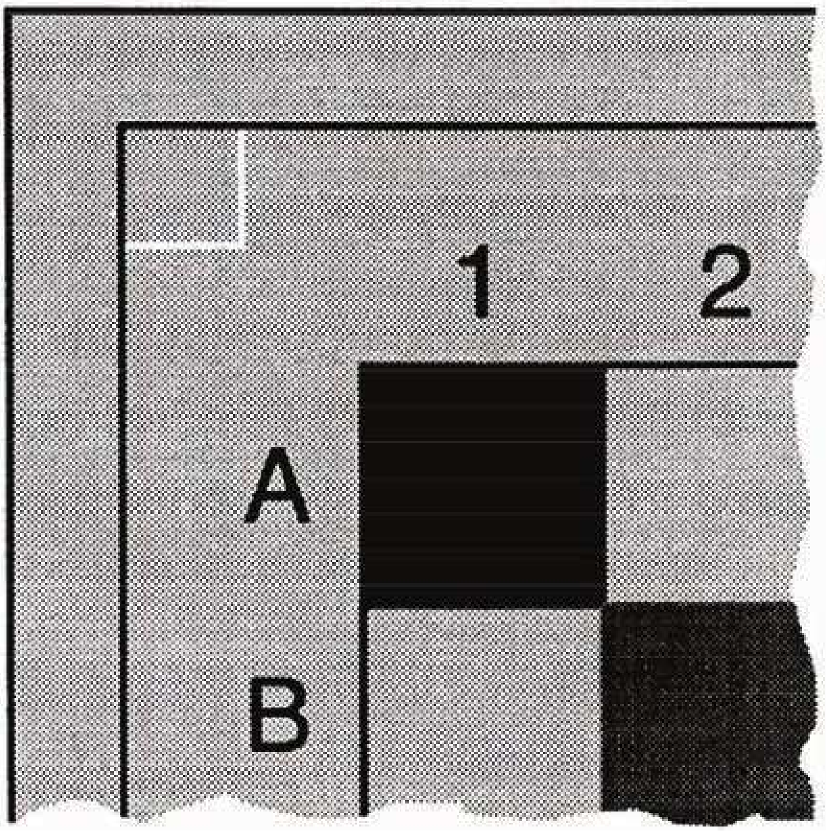

Figure 8 — Fiducial mark design

The area at the bottom of the target shall contain the following information in English text:

a) ISO 12641-1:2016;

b) the name of the paper product or product family

c) the year and month of production of the target in the form yyyy:mm;

d) an area of at least 10 mm × 25 mm for addition of a unique identification.

NOTE Targets bearing the designation IT8.7/2-1993 are prepared in accordance with ANSI IT8.7/2-1993 whose technical requirements are identical to those of this part of ISO 12641.

4.3.2 Patch size

The reflection target shall be made with patch dimensions of 6,5 mm × 6,5 mm.

The Dmin area, the 22-step neutral scale, and the Dmax area shall be two patches high.

4.3.3 Colour gamut mapping

The hue angle, lightness, and chroma of the target patches contained in the sampled colour area portion of the target, Rows A through L and Columns 1 through 12, shall be in accordance with Table 2 under the measurement conditions of 4.5.

Where a product is not capable of achieving specific chroma values indicated in this specification, the patch corresponding to that value shall be exposed as a background neutral as defined in 4.3.1. In all cases, patches in columns 4, 8, and 12 as shown in Table 2, shall be included.

4.3.4 Neutral and dye scale values

The specific values of target patches A13 through L19 shall be defined by the manufacturer of the paper used to create a specific target. The batch mean (for uncalibrated targets) or measured CIE X Y Z and L^* a^* b^* values (for calibrated targets) of these patches shall be reported by the manufacturer in accordance with 4.6.

The criteria by which the aim values for these patches shall be determined (under the measurement conditions of 4.5) shall be as follows:

Patch A16 shall be the minimum neutral density ($C^*_{ab} = 0$) that the product can normally achieve.

Patch L16 shall be the maximum neutral density ($C^*_{ab} = 0$) that the product can normally achieve.

Patches B16 through K16 shall be equally spaced in L^* between the L^* values of patches A16 and L16.

Patches A13 through L13 shall contain the same amounts of cyan dye as used to create the neutral patches of A16 through L16.

Patches A14 through L14 shall contain the same amounts of magenta dye as used to create the neutral patches of A16 through L16.

Patches A15 through L15 shall contain the same amounts of yellow dye as used to create the neutral patches of A16 through L16.

Patches A17 through L17 shall contain the same amounts of magenta and yellow dye (will appear red) as used to create the neutral patches of A16 through L16.

Patches A18 through L18 shall contain the same amounts of cyan and yellow dye (will appear green) as used to create the neutral patches of A16 through L16.

Patches A19 through L19 shall contain the same amounts of cyan and magenta dye (will appear blue) as used to create the neutral patches of A16 through L16.

NOTE It is recognized that it will be difficult to achieve these aim dye amounts, particularly in patches of high density, because of overlapping spectral sensitivities. Manufacturers are expected to achieve these goals to the extent possible.

Table 2 — Hue angle, lightness, and chroma for reflection target

Row	Hue angle	L1	C1	C2	C3	C4	L2	C1	C2	C3	C4	L3	C1	C2	C3	C4
A	16	20	12	25	37	(1)	40	15	30	44	(1)	70	7	14	21	(1)
B	41	20	12	24	35	(1)	40	20	36	54	(1)	70	8	16	24	(1)
C	67	25	11	21	32	(1)	55	22	44	66	(1)	75	10	20	30	(1)
D	92	25	10	19	29	(1)	60	20	40	60	(1)	80	10	21	31	(1)

(1) These values are specific to the product used to create the target and equal to maximum C^*_{ab} available at the hue angle and L^* specified. They are to be defined by the manufacturer of the product used to make the target.

Table 2 *(continued)*

Row	Hue angle	L1	C1	C2	C3	C4	L2	C1	C2	C3	C4	L3	C1	C2	C3	C4
E	119	25	11	21	32	(1)	45	16	32	48	(1)	70	9	18	27	(1)
F	161	15	9	19	28	(1)	35	14	28	42	(1)	70	6	12	18	(1)
G	190	20	10	20	30	(1)	40	13	25	38	(1)	70	6	13	19	(1)
H	229	20	9	18	27	(1)	40	12	24	36	(1)	70	7	13	20	(1)
I	274	25	12	24	35	(1)	45	9	19	28	(1)	70	5	10	15	(1)
J	299	15	15	29	44	(1)	40	11	22	33	(1)	70	6	11	17	(1)
K	325	25	16	33	49	(1)	45	14	28	42	(1)	70	8	16	24	(1)
L	350	20	13	26	38	(1)	40	16	32	48	(1)	70	8	15	22	(1)
	Column		1	2	3	4		5	6	7	8		9	10	11	12

(1) These values are specific to the product used to create the target and equal to maximum C^*_{ab} available at the hue angle and L^* specified. They are to be defined by the manufacturer of the product used to make the target.

4.3.5 Neutral scale mapping

The neutral scale lying along the bottom of the target shall have the following L^* aim values, based on the measurement conditions of 4.5, reading from left to right across the target. C^*_{ab} aim values shall be 0.

Step 1	87	Step 2	83
Step 3	79	Step 4	75
Step 5	71	Step 6	67
Step 7	63	Step 8	59
Step 9	55	Step 10	51
Step 11	47	Step 12	43
Step 13	39	Step 14	35
Step 15	31	Step 16	27
Step 17	23	Step 18	19
Step 19	15	Step 20	11
Step 21	9	Step 22	7

The patch located to the left of step one of the grey scale (column 0) shall be at the Dmin of the product. The patch to the right of step 22 (column 23) of the grey scale shall be at product Dmax.

4.4 Allowable tolerances on patch values

4.4.1 Uncalibrated targets

4.4.1.1 For all targets manufactured: For the patches contained within A1 through L3, A5 through L7, and A9 through L11, 99 % shall be within 10 ΔE^*_{ab} of the aim values specified in Table 1 or Table 2 as appropriate.

4.4.1.2 For each manufacturing batch: 99 % of the patches within the manufacturing batch shall be within 5 ΔE^*_{ab} of the reference as follows:

— the references for patches A1 through L19, Dmin and Dmax shall be the reported batch mean;

— for the 22-step neutral scale the reference shall be the values specified in 4.2.5 or 4.3.5 as appropriate.

Although the user is most concerned with the statistics of the patches on a particular target, the manufacturer of targets should apply statistics to the individual patches within a manufacturing run. The above statistics apply to individual patches within the run and not to patches on a particular target. The above requirements, therefore, should not be interpreted that 99 % of the patches on each target are within the tolerances specified in this part of ISO 12641. Details of quality control statistical procedures used may be requested from the manufacturer of targets.

4.4.2 Calibrated targets

Calibrated targets are uncalibrated targets which have been measured. The measured values for each patch shall be provided together with a certificate as to the degree of conformance of the measuring laboratory to an accredited measurement assurance program (MAP) sponsored by a recognized national standardizing laboratory.

NOTE The goal is that all measurements will be accurate within $\Delta E^*_{ab} \leq 2$.

4.5 Spectral measurement and colorimetric calculation

Measurement of the target shall be carried out in accordance with ISO 13655.

4.6 Data reporting

For all targets, the batch-specific mean and standard deviation colorimetric data for each patch shall be available from the originator of targets manufactured in accordance with this part of ISO 12641. Mean and standard deviation values shall be provided as X, Y, Z tristimulus values. Mean values shall also be provided as L^*, a^*, b^* and standard deviation as ΔE^*_{ab}. All values shall be provided to two decimal places.

When calibrated targets are offered, the measured colorimetric data for all target patches shall be provided. These data shall be reported as X, Y, Z tristimulus values, to two decimal places. Measurements shall be in accordance with 4.5.

The data shall be available digitally in the data format specified in 4.7. Other data may be provided as optional information (e.g. CIELAB, other illuminants, etc.).

4.7 Data file format

4.7.1 File format

The file format shall be an ASCII format keyword value file. The first 7 characters in the file shall be: IS 12641.

Fields within the file shall be separated by white space. Valid white space characters are space (position 2/0 of ISO/IEC 646), carriage return (position 0/13 of ISO/IEC 646), newline (position 0/10 of ISO/IEC 646), and tab (position 0/9 of ISO/IEC 646). Keywords may be separated from values using any valid white space character. Only the space or tab shall precede a keyword on a line. Comments shall be preceded by a single comment character (a single character keyword). The comment character is the "#" (position 2/3 of ISO/IEC 646) symbol. Comments may begin any place on a line, and shall be terminated by a newline, or carriage return. Keywords and data format identifiers are case sensitive and shall be upper case.

4.7.2 Keyword syntax and usage

The specific syntax and usage information for each keyword follows.

All files shall contain the following required keywords:

ORIGINATOR - Identifies the specific organization or system that created the data file.

DESCRIPTOR - Describes the purpose or contents of the data file.

CREATED - Date of creation of data file.

MANUFACTURER - Identifies the manufacturer of the input scanner calibration target.

PROD_DATE - Identifies year and month of production of the target in the form yyyy:mm.

SERIAL - Serial number of individual target.

MATERIAL - Identifies material used in creating input scannercalibration target.

NUMBER_OF_FIELDS - Number of fields (data format identifiers) that are included in the data format definition that follows.

BEGIN_DATA_FORMAT - Begins definition of field position/interpretation of a data set.

END_DATA_FORMAT - Ends data format definition.

NUMBER_OF_SETS - Number of repeats or sets of data corresponding to the data format fields that are included in the data to follow.

BEGIN_DATA - Marks the beginning of the stream of data sets.

END_DATA - Marks the end of the stream of data sets.

Additionally defined, but not required, keywords are the following:

- Single character indicating comment follows.

KEYWORD - Used to define vendor specific keywords.

INSTRUMENTATION - Used to report the specific instrumentation used (manufacturer and model number) to generate the data reported.

MEASUREMENT_SOURCE - Identifies the illumination used for spectral measurements.

ILLUMINANT - Defines the illuminant used when calculating tristimulus values.

OBSERVER - Defines whether 2” or 10” observer has been used in the calculation of tristimulus values.

FILTER_STATUS - Defines spectral response of the instrument used for densitometry.

Unless otherwise noted, each keyword has a character string value associated with it. All character string values shall be enclosed in quotes (position 2/2 of ISO/IEC 646) regardless of whether or not there is white space contained within the string. Enclosed in quotes means beginning and ending the character string with the ” symbol. The ” symbol itself shall be represented within a string as “”.

Comments shall be preceded by the comment character (#), and shall end with a new line, or carriage return. Comments need not be enclosed in ” symbols.

The value associated with keywords NUMBER_OF_FIELDS and NUMBER_OF_SETS shall be an integer.

The BEGIN_, END_ keywords do not have explicit values associated with them but enclose either the data format definition or associated data streams.

4.7.3 Data format identifiers

The data format (enclosed by BEGIN_DATA_FORMAT and END_DATA_FORMAT) describes the meaning of each field of data within a set. Data formats shall be composed of identifiers listed below or defined keywords. Unknown entries in the data format definition shall be read, but may be ignored by automated readers. Data format identifiers shall be uppercase. The data type associated with each data format shall be assumed to be real (may contain a decimal point) unless separately defined as integer (I) or character string (CS). Character string data shall be enclosed in quotes except in the case of SAMPLE — ID where the quotes are not required if the sample identifier does not contain white space.

Each set of data (data repeat) shall end with a line terminator character (newline or carriage return).

The following are the data format identifiers.

SAMPLE_ID (CS) - Identifies sample which data represents

STRING (CS) - Identifies label, or other non-machine readable value; value shall begin and end with a ” symbol

D_RED - Red filter density

D_GREEN - Green filter density

D_BLUE - Blue filter density

D_VIS - Visual filter density

RGB_R - Red component of *RGB* data

RGB_G - Green component of *RGB* data

RGB_B - Blue component of *RGB* data

SPECTRAL_NM - Wavelength of measurement expressed in nanometres

SPECTRAL_PCT - Percentage reflectance/transmittance at the wavelength specified in

SPECTRAL_NMXYZ_X - X component of tristimulus data

XYZ_Y - Y component of tristimulus data

XYZ_Z - Z component of tristimulus data

XYY_X - x component of chromaticity data

XYY_Y - y component of chromaticity data

XYY_CAPY - Y component of tristimulus data

LAB_L - L^* component of CIELAB data

LAB_A - a^* component of CIELAB data

LAB_B - b^* component of CIELAB data

LAB_C - C^*_{ab} component of CIELAB data

LAB_H - h_{ab} component of CIELAB data

LAB_DE - CIE ΔE^*_{ab}

STDEV_X - Standard deviation of X (tristimulus data)

STDEV_Y - Standard deviation of Y (tristimulus data)

STDEV_Z - Standard deviation of Z (tristimulus data)

STDEV_L - Standard deviation of L^*

STDEV_A - Standard deviation of a^*

STDEV_B - Standard deviation of b^*

STDEV_DE - Standard deviation of CIE ΔE^*_{ab}

Although not required, it is strongly recommended that data format identifiers be placed on a single line. However, the maximum line length shall not exceed 240 characters. In addition, the data associated with a data format should use the same location(s) for carriage return and/or line feeds to enhance human readability.

4.8 Useable target life

The useable life of a target is a function of its exposure to light and the storage conditions used. Each manufacturer shall provide the monitoring procedure to be used for each target type as part of the documentation of the target.

Annex A
(informative)

Gamut mapping — Computational reference

A.1 General

When cyan, magenta, and yellow dyes are mixed, the mixture results in a specific colour and the tristimulus values can be determined by the usual CIE procedure. The mixture colour can then be plotted as one point in colour space. If mixtures with different mixing amounts are successively produced, the tristimulus values will be contained within a finite range, called a colour gamut. The tristimulus values representing the boundary of the colour gamut may be determined by producing and measuring a large number of dye mixtures. Figure A.1 shows a cross-section of such a colour gamut.

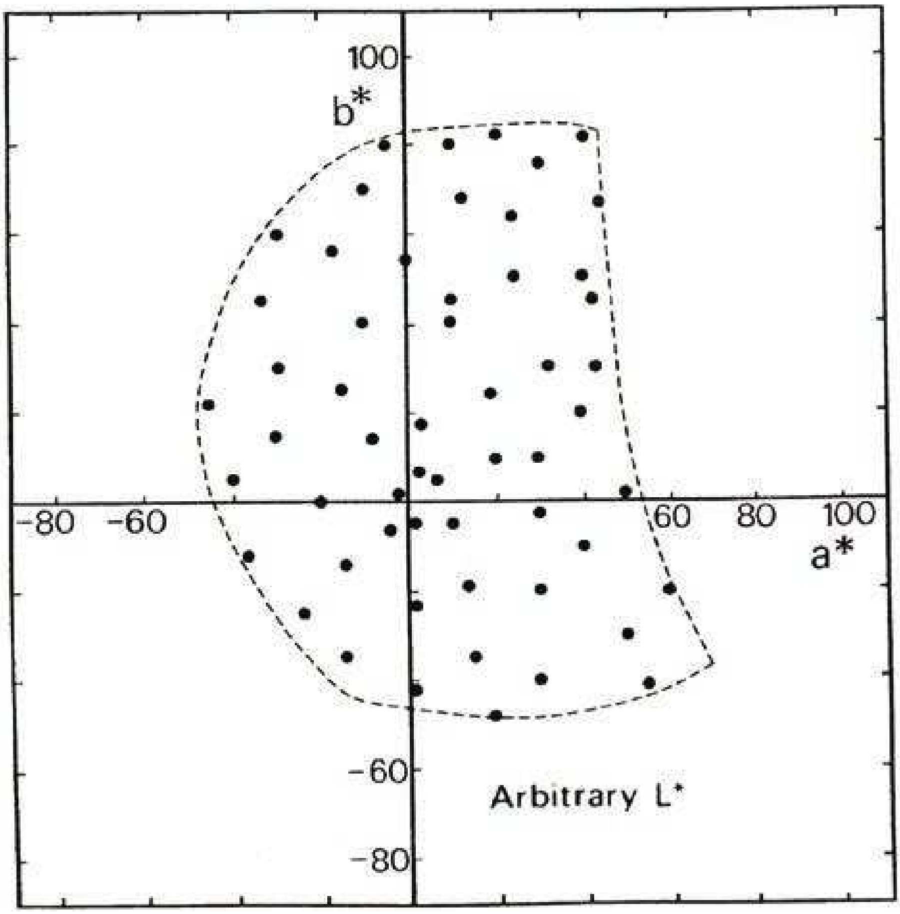

Figure A.1 — Colour gamut

Using the above procedure for calculating colour gamuts is rather cumbersome and not very precise. Instead, a computer algorithm, used to trace the outer boundary of colour gamut by successive colour matching, has been developed and used by the companies who participated in the development of this part of ISO 12641. This allows the colour gamut to be computed directly. In an attempt to space target colours as a function of visual response, the CIELAB colour space was chosen to be used for target colour selection. In addition, the 12 hue angles previously used in the Kodak Q60TM target were chosen for use in these targets. It should be noted that the colour gamut obtainable by the three dyes depends upon their spectral absorption bands. The three dyes currently used in colour photography are different from one manufacturer to another, and the colour gamuts obtainable are accordingly different among manufacturers. Therefore, the colour gamut obtainable with each product was computed for each of the hue angles selected. From this data, the envelope of colour gamut common to all of the products was determined. Then, in order to be more conservative, a target gamut was selected that represented a reduction in chroma (C^*_{ab}) to 80 % of the value of the common envelope. Figure A.2 shows such a plot for a hypothetical photographic paper.

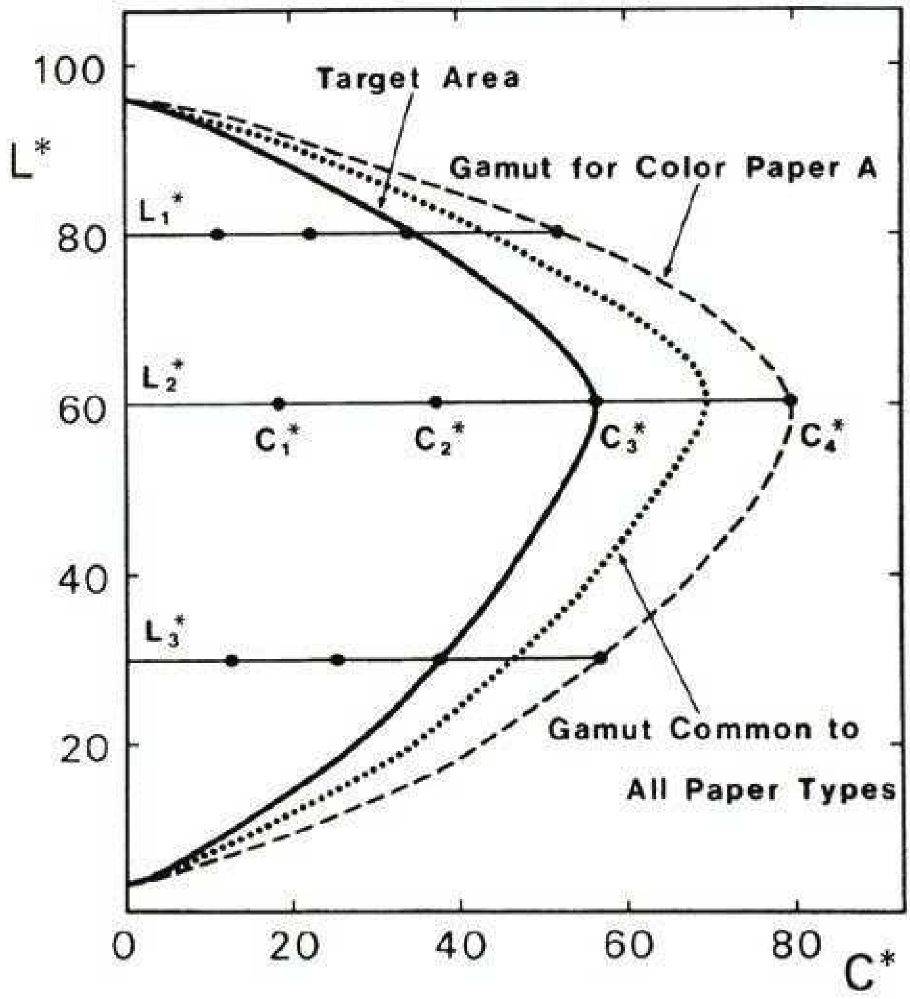

Figure A.2 — Target gamut

Using the hue angle plots of L^* versus C^*_{ab}, three levels of L^* were selected for each hue angle as $L1^*$, $L2^*$, $L3^*$. One level of L^* was chosen at or near the cusp of the plot and the other two were chosen in such a way that they best represent the shape of the colour gamut. At each particular L^* level, three equally spaced values of C^*_{ab}, were selected as C1, C2, and C3. This procedure was used to select the 108 (12 × 3 × 3) colours that are common to all targets. In addition, the target design specifies that a fourth colour is selected that corresponds to the maximum chroma at each hue angle and lightness, included on the target. This allows the gamut limiting characteristics of individual colour products to be shown. These colours are identified as C4.

Annex B
(informative)

Application notes

B.1 General

When calibrating colour input scanners, we need to recognize that there are at least two distinct ways in which an input scanner may be operated. The calibration procedure for each is different. The two methods are described as follows:

— **Method A:** Colour digitizer. In this mode, the input scanner has a simple objective: to capture the colour information of the original image being scanned for subsequent processing elsewhere. The output data should, therefore, bear some unique relationship to the tristimulus values of the original. In general, the data output by the input scanner will be typically coded as *RGB*. If the digitizer has a suitable calibration facility, the *RGB* may be converted to *XYZ*, to a different *RGB* (e.g. gamma corrected suitable for high definition TV), to *L*a*b** or to *L*u*v** prior to coding. Alternatively, the image file may be left unmodified but have a profile added to define the conversion from device *RGB* to a colorimetric domain. This can then be used for subsequent processing.

— **Method B:** Gamut 'mapped' colour digitizer. In this mode, the input scanner is operated in a device dependent manner. The calibration facilities (software or hardware) in the input scanner converts the *RGB* data directly into that required by the output device. It may directly define the colorant amounts required (e.g. C*MYK* printing) or the exposure levels required (e.g. *RGB* transparency recorders) or the gamma corrected drive voltages required (e.g. CRT displays). A special case may be that in which the required gamut mapping is applied to the original data but the data may still be transmitted as *XYZ*, *L *a *b* or *L*u *v* colour data rather than, say, colorant amount specification. The output data in this mode shall be used, therefore, bear some unique relationship to the tristimulus values of the reproduction.

Clearly, such "gamut mapped" or device dependent data can, in some cases, be transformed back into the original data. However, the transformation is unlikely to be simple and may produce artefacts. The calibrated input target provides colours with known *XYZ* values as an input to the colour input scanner. Further, these known *XYZ* values cover the full colour gamut of the specific material on which the target has been imaged. Thus, the data can be used directly to create the characterization data for Method A, or in combination with gamut mapping to a specific output device, the resultant data may be used to compute the transformation required to obtain gamut mapped CIE data. Deriving the transformation for a specific output device may be achieved by combining the separate transformations from input scanner into tristimulus data and tristimulus data into device data. However, this requires information on gamut mapping, appearance and "preferred" colour to be accommodated. In graphic arts it has traditionally been more common to derive a single transformation by empirical means.

While the above discussion assumes that the input scanner can undertake the transformation to provide data in a specific format, it is not essential. The transformation may be carried out at any stage in the process prior to output (monitor or printer). The advent of colour management is, in fact, generally separating the colour transformation from the scanning process. However, the principle described in the following clause is applicable to the procedure regardless of where it is carried out.

B.2 Characterization

The primary objective of the target is to enable the user to characterize his system using whatever facility exists. The precise detail of the procedure cannot be specified; it depends upon the particular application. In general terms, however, the image will be scanned using the default setting of the input scanner. The characterization package(s) would then be used to obtain the correct colour output.

Note that this frequently includes gamut compression; generally such an assessment is often made subjectively by the user. The target provides a limited range of colours reasonably uniformly distributed in lightness and chroma through the CIELAB colour space. The selection of equal chroma intervals at fixed hue angles ensures that the sample intervals increase with chroma which is desirable for normal colour reproduction objectives. Other colours of high chroma are present in the dye scales if additional samples are required. Data obtained by scanning the target may be used to derive a transformation which maps the data back to the tristimulus values provided with the calibrated target or some transformation of them. As already stated, this transformation may be carried with the scanned image as a profile or the image data may be transformed directly. If an uncalibrated target is used either the aim values provided in this part of ISO 12641 or the batch average data provided by the manufacturer of the target will be used.

While these may provide less accurate transformations, experience to date indicates that the variation within batches may be of the same magnitude as the uncertainty in measurement. The within-batch variability should also be provided by the manufacturer of targets provided in accordance with this part of ISO 12641. A single means of deriving the transformation cannot be specified; it is application dependent. However, the following guidelines may be helpful. The list should not be seen as an ordered checklist of actions to go through; most of the items are mutually exclusive. However, provision of an appropriate selection of them should enable reasonable characterization to be achieved. Which transformation is used depends upon device characteristics and accuracy required. Generally, the greater the deviation in spectral sensitivity of the input scanner from colour matching functions, the more complex will be the transformation into CIE data (or its derivatives) in order to obtain the level of accuracy required. This may not be the case for transformations into device data.

a) Using least squares fitting, obtain a set of polynomials, which map input scanner code values into tristimulus values. The required order of these polynomials is determined by the input scanner characteristics (among them, spectral sensitivity and data encoding scheme) and the colour accuracy required. If a transparency image is to be used for printing on reflection materials the tristimulus values can be rescaled to transform from dark surround to light surround viewing conditions.

b) Set up a coarse three-dimensional look-up table between the input scanner code values and the tristimulus values provided and interpolate for intermediate values. This look-up table may be computed from the polynomials and, if needed, tristimulus value rescaling function determined in (a).

c) Obtain correct tone (or lightness) reproduction and “balance” (same hue and chroma) for the neutrals. At the simple level this may be obtained by defining three one-dimensional functions, one for each channel.

d) Add to (c) a set of functions to correct for hue and chroma, each of which may be modified as a function of the other, if required.

B.3 Closed system calibration

Visual assessment, possibly supplemented by colour or density measurement, is another means of achieving calibration for a specific device (e.g. colour monitor, printing press or transparency recorder) without a two-stage transformation via colorimetric data. Using such a system, the target is scanned and output on the device(s). Where no gamut mapping is involved any of the methods described in the previous subclause may be used, based upon measurements made on the reproduction. Unfortunately, this is not the normal situation. In such circumstances, visual assessment (ideally under controlled viewing conditions) is often used to determine the quality of the match. To achieve an acceptable match the parameters of the colour transformation may be determined using one (or more) of the following methods:

a) obtain “best” tone reproduction and balance using neutral scale;

b) compromise neutral scale reproduction to enhance colours;

c) enhance hue and chroma of non-neutral colours selectively.

Facilities to achieve the above are provided in traditional graphic arts input scanners and are becoming increasingly available in colour management systems.

B.4 35 mm transparency

While the calibration procedure using the 35 mm version is exactly the same as for the 4 in × 5 in transparency, a few special comments may prove helpful.

Consistent, uniform colours for the single slide 35 mm version of the target are not guaranteed because of manufacturing difficulties. To obviate this, the target has been divided into seven sections. For most of the methods described above, it will be necessary to scan all seven sections to obtain reasonable accuracy. However, the division has been made such that full neutral and colour scales are contained on three sections (with each section containing a six-step neutral scale). This may suffice when using a procedure which corrects for tone with a limited hue and chroma correction facility. For periodically checking a calibration such a process is generally adequate.

Where 35 mm versions of the full target are being supplied they may be uncalibrated. This is because manufacturing difficulties are likely to make them non-uniform, and also accurate measurement facilities are not readily available in all laboratories. Users wishing to calibrate their samples may achieve this by finding a laboratory with the appropriate facility, but should bear in mind that the non-uniformity makes the measurements achieved very dependent upon the position within the patch in which the measurement is made. An alternative approach is for the user to do this using the input scanner as the measuring device.

For the material under consideration, it is clear that a colour transformation may be determined to convert input scanner values into *XYZ* (or some derivative) using one of the methods described above and a calibrated seven-section 35 mm transparency set. This same transformation may then be used to "calibrate" the single frame transparency by scanning it, averaging the data in each patch and applying the transform. Whether the averaging is carried out before or after the data are transformed may affect the result to some extent, and a reasonable case may be made for averaging in *XYZ*; however, averaging before is generally easier, and in practice the differences should not be significant for an input scanner which provides transmittance (as opposed to logarithmic or gamma-corrected data).

In general, such a procedure works fairly well, although the accuracy achieved is clearly only as good as the transform produced in the first instance. There is an additional source of error which can be significant in some input scanners. This error arises from flare within the optical system. If the input scanner optical design is such that it illuminates a relatively large area (with some degree of flare in the system), since the patches in the single frame 35 mm target are small, such a design means that the colour measured for any spot is dependent upon the adjacent colours. Such a problem will also manifest itself when scanning images on the same input scanner, and will be dependent upon image content. However, if the input scanner measured data are then used to calibrate a better designed input scanner, it can give rise to errors.

B.5 Product naming

All of the targets contain information specifying the photographic product or product family, date of production, and manufacturing batch number. It is advisable to include this area in the scan for future reference.

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[5] ISO 128-40, *Technical drawings — General principles of presentation — Part 40: Basic conventions for cuts and sections*

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