
**Graphic technology — Prepress digital
data exchange —**

**Part 2:
Advanced colour targets for input
scanner calibration**

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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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

This first edition, together with ISO 12641-1:2016, cancels and replaces ISO 12641:1997, which has been technically revised.

A list of all parts in the ISO 12641 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

More than 1 000 000 targets, both transmissive and reflective, have been produced based on ISO 12641 and used in the past decades for calibrating scanners.

Based on the demands for higher quality from scientific institutions, museums, art and cultural heritage archives, and special public administration applications for ID-documents, a need was recognized to achieve a better scanner colour characterization. Very dark patches (chromatic and achromatic) are nearly unrepresented by the target layout of ISO 12641-1. Advanced target designs require more patches for an enhanced sampling of saturated and pastel colours (especially for archiving applications). They offer chances for improving the analysis of non-linear scanner performance. Such modern or advanced targets however could not be based on any ISO standard, which results in a lack of standardization.

In order to keep consistency and compatibility with the existing legacy targets, ISO 12641 was made as a multipart standard where ISO 12641-1 remains unchanged from the 1997 edition and the new ISO 12641- 2 specifies the requirements for advanced targets.

The discussion revealed that a new standard should also provide a flexible framework for new targets to come. Combining this with the need to reflect modern available targets, this document provides general requirements in the main part and provides exemplary transmissive and reflective targets in the informative [Annexes A](#) and [B](#), respectively. Self-emissive targets are covered by this document if they are designed to simulate the targets using transmission of light through an optical filter.

Traditionally, data has been provided in ACSII format using a keyword file. This document however requires the usage of the modern exchange format CxF/X-2.

Traditionally, ISO 12641-1 has been aimed at the colour characterization of input scanning devices. This document continues that tradition but also provides the framework for targets for other input processes such as digital cameras or for quality assurance applications.

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Graphic technology — Prepress digital data exchange —

Part 2:

Advanced colour targets for input scanner calibration

1 Scope

This document defines a framework for advanced reflective and transmissive layouts and colorimetric values of targets for use in the calibration and characterization of image capturing devices.

This document defines a framework for target creation and data reporting. This framework can be used for both ISO defined and custom targets for both reflective and transmissive use.

Self-emissive targets are not covered by this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 12637-1, *Graphic technology — Vocabulary — Part 1: Fundamental terms*

ISO 13655:2017, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

ISO 17972-2, *Graphic technology — Colour data exchange format (CxF/X) — Part 2: Scanner target data (CxF/X-2)*

ISO 17972-3, *Graphic technology — Colour data exchange format (CxF/X) — Part 3: Output target data (CxF/X-3)*

ISO 28178, *Graphic technology — Exchange format for colour and process control data using XML or ASCII text*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12637-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

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 space

three-dimensional, approximately uniform, colour space produced by plotting in rectangular coordinates the quantities L^* , a^* and b^*

Note 1 to entry: Refer to ISO 13655:2017 for the description of how to compute CIELAB.

3.3

colour gamut

subset of perceivable colours reproducible by a device or medium

3.4

maximum density

D_{max}

density corresponding to the minimum transmittance or *reflectance factor* (3.9) that a photographic product can achieve

3.5

maximum neutral density

density corresponding to the *maximum density* (3.4) that a photographic product can achieve [minimum transmittance or *reflectance factors* (3.9)] and maintain a $C^*_{ab} = 0$

3.6

minimum density

D_{min}

density corresponding to the maximum *transmittance factor* (3.10) (film) or *reflectance factor* (3.9) (paper) that a photographic product can achieve

3.7

minimum neutral density

minimum density (3.6) that a photographic product can achieve [maximum transmittance or *reflectance factors* (3.9)] and maintain a $C^*_{ab} = 0$

3.8

proof print

proof prints possible as hard-copy proof and proofs produced as a reflection copy on a proofing substrate

3.9

reflectance factor

ratio of the measured flux reflected from the specimen to the flux reflected from a perfect reflecting diffuser

3.10

transmittance factor

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

3.11

sampled colour area

portions of the test target whose content is specified

3.12

x-y scanner

dual axis electronic device that generates a two-dimensional representation of a photographic (or other hardcopy) sample

4 Technical requirements

4.1 General

All colorimetry referenced within this document should be based on D50 illuminant, CIE 1931 Standard Colorimetric Observer (2-degree observer) as defined in ISO 13655.

For all target values measured, the device measurement mode should be recorded with the corresponding reference file by the target manufacturer.

4.2 Target design

Each target should be a shape that matches the scanner requirements. For x-y scanners, the target shall be rectangular and planar. A target is designed of a mandatory section called main body or sampled colour area, an identification section and additional sections that can be used optionally by vendors.

4.3 Target layout and physical characteristics

Targets should be produced on a single substrate material, though some custom targets might choose to combine two or more substrates to achieve the gamut of colour needed to characterize the scanner. A code for the substrate used shall be added to the material tag. The main body (sampled colour area) of advanced target layouts shall meet the following parameters:

- a) Each patch shall be rectangular and uniform and the minimum amount of patches should be greater than 288. The patches shall be structured by means of rows and columns, see [Annex A](#) for transmission examples, and [Annex B](#) for reflection examples.
- b) Fiducial marks and indicator definitions used for section separation 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. No other marking lines shall be included within the body of the target. They should be included in each corner of the main body of the target and if present shall be arranged that they “point” towards the inside or centre of the target. Fiducial marks shall be clear lines on the neutral background.
- c) The minimum patch size shall be 2 mm × 2 mm.
- d) The target material used should be consistent with the production material to be characterized.
- e) Non-patch areas shall be neutral and should have a maximum CIELAB $C^* = 3,5$ and a lightness (L^*) of 50 with $\Delta E^*_{ab} < 3$.
- f) The non-image area should extend at least 1 mm beyond the image (patches).
- g) The identification section shall be placed at the bottom of the target and provide the following information:
 - ISO 12641-2 advanced target;
 - materials used (film product, paper product, alternate materials, paint, dyes, etc.), see [4.2](#). If detailed information is too verbose to fit on the bottom of the target, it shall be provided in the form of additional accompanying documentation or URL;
 - the year and month of production of the target in the form yyyy:mm;
 - an area for addition of a unique identification. As an example, it can comprise additional information such as bar codes.

4.4 Tolerances on patch values

4.4.1 Batch targets

Batch targets are more than 2 targets, with only one averaged reference file.

95 % of all patches of the main body section of each target shall be within $\Delta E_{00} = 7$ of the aim values specified by the batch target manufacturer.

4.4.1.1 Batch deviation

For batch targets the target manufacturer shall specify the mean colour value for each patch. 99 % of all patches of the main body section of each target shall be within $\Delta E_{00} = 3,5$ of the aim values specified by the target manufacturer. The concrete number shall be reported by the target manufacturer.

4.4.2 Calibrated targets

Calibrated targets are individually measured targets with a corresponding reference file. The measured values for each patch shall be specified. In addition to the requirements of [4.4.1](#) the average colour difference shall be within $\Delta E_{00} \leq 3$ and should be $\Delta E_{00} \leq 2$.

4.5 Spectral measurement and colorimetric calculation

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

4.6 Data reporting

For batch 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 document. Mean and standard deviations shall be computed for X, Y, Z tristimulus values and for L*, a*, b* colour space coordinates. The 95th percentile of the distribution of colour differences in ΔE_{00} units shall be reported as an estimate of the dispersion of the results.

For calibrated targets, the measured colorimetric or spectral data for all target patches shall be provided. These data shall be reported as either X, Y, Z tristimulus values, to two decimal places or spectral values in the form of 0 % to 100 %. Measurements shall be in accordance with [4.4](#).

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

The File Format shall be defined as in ISO 17972-2 CxF™ (Colour Exchange Format) or ISO 28178. [Annex C](#) provides a complete mapping of all keywords from ISO 17972. An example of these in a CxF/X-2 of the exemplary targets defined in [Annex C](#). A file is also provided.

If target formatting is communicated it shall use the additional layout parameters provided in ISO 17972-3.

4.8 Usable target life

The usable 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)

Example of advanced transmission targets — Layout and physical characteristics

A.1 Type 1, 4" × 5" film

The layout of the Type 1 colour transmission input calibration target as viewed from the support side of the film should be shown in [Figure A.1](#). This layout is intended for use with film material having a size of 10,2 cm × 12,7 cm (4" × 5") in accordance with ISO 1012. All non-image areas of the target should be approximately neutral with a CIELAB $C^* < 3,5$ and should have a lightness of $L^* = 50$ with $\Delta E_{00} < 3$. The non-image area should 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. 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 should be less than 0,3 mm in width. No other marking lines should be included within the body of the A1 through X34 portion of the target.

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

Fiducial marks should be included in each corner of the main body of the target as shown in [Figure A.2](#). These should be arranged such that they "point" towards the inside or centre of the target.

Because target patches are 2,9 mm × 2,9 mm in size, the intersection of the lines of the fiducial marks should be offset 2,9 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 should be clear lines on the neutral background and should be approximately 0,1 mm in width.

A.2 Type 2, 6 cm × 7 cm film

The Type 2 layout of the colour transmission input calibration target, as viewed from the support side of the product, should be as shown in [Figure A.1](#). This layout is intended for use on film material having a size of 6 cm × 7 cm in accordance with ISO 1012. All non-image areas of the target should be approximately neutral ($a^* = 0$, $b^* = 0$) and should have a lightness of $L^* = 50$ with $\Delta E_{00} < 3$. The non-image area should extend at least 2 mm beyond the row and column borders on the top and sides at least 8 mm on the bottom to provide for identification information.

Target row and column numbering should be $D_{vis} > 2,0$ and as shown in [Figure A.1](#). 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 should be less than 0,3 mm in width. No other marking lines should be included within the body of the A1 through X34 portion of the target.

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

Fiducial marks should be included in each corner of the main body of the target as shown in [Figure A.2](#). These should be arranged such that they "point" towards the inside or centre of the target.

Because target patches are 1,7 mm × 1,7 mm in size, the intersection of the lines of the fiducial marks should be offset 1,7 mm in both the horizontal and vertical direction from the centre of the nearest patch to provide a reference for automatic measurement alignment.