TECHNICAL SPECIFICATION

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First edition

Photography — Photographic reflection prints —

Part 2:
Evaluation of colour variation in printing

Photographie — Tirages photographiques par réflexion —

Partie 2: Évaluation de la variation de couleur dans l'impression

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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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 42, *Photography*.

A list of all parts in the ISO 20791 series can be found on the ISO website.

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Introduction

In photographic reflection colour prints, density and colour are essential quality attributes of an image. However, the density and colour of prints can fluctuate during repeated continuous printing or vary between two printings done at different times or days, even if the same input data and printer settings are used. This is a critical issue, particularly in the following cases:

a)   When the same photographic image is reprinted to make an extra copy and there is obvious difference in density and colour between the original and the reprint when they are compared side by side, the customer might be dissatisfied with this difference.

b)   When a photo book is produced by binding up photographic prints into different pages in a book, and the difference in the density and colour between adjacent pages is easily noticeable, this difference might be considered unsatisfactory by the customer.

c)   When a customer and a print shop agree to the image quality of prints based on a sample or a proof print, and the difference between the proof sample and the actual prints is discernible, this might lead to customer dissatisfaction.

Moreover, colour management for high quality printing is attainable only with a stable printing system. If the colour and density of the actual print differ from that of the designated proof print or sample used as the basis for the colour management, the quality of the actual print may be different from the desired image quality.

To improve the reproducibility of printing, or to select the appropriate printing system, the evaluation of colour variation in printing is crucial. Although the evaluation of colour variation in graphic printing is described in ISO/TS 15311-1, standardized evaluation methods and procedures for quantifying colour variation specific to photographic prints are also necessary.

— test target design for the print ranging from a small size to large size;

— sampling procedures (within a job and between jobs);

— measurements and evaluation of colour variation and

— reporting (evaluation results, parameter and mode of printing).

The objective of this document is to provide standard procedures to evaluate colour variation in photographic printing.

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Photography — Photographic reflection prints —

Part 2:
Evaluation of colour variation in printing

1 Scope

This document describes the procedures for evaluation of colour variation in the printing of photographic reflection colour prints. The following procedures are described to evaluate colour variation in printing within a consecutive print job, between several print jobs, or between multiple photographic images printed in different areas of a large sheet:

a) test targets for small and large photographic prints;

b) printing procedures and conditions;

c) sampling in correspondence to the production scale;

d) measurement of colour;

e) calculation and analysis of colour variation and

f) reporting.

The procedures presented in this document are applicable for prints with a size of available picture area ranging from 35 cm² (e.g. 5 cm × 7 cm) to 5 400 cm² (e.g. 60 cm × 90 cm). This document is applicable to any of the photographic printing technologies, including inkjet, thermal dye transfer, electrophotography and silver halide (chromogenic) technologies.

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 5-4, *Photography and graphic technology — Density measurements — Part 4: Geometric conditions for reflection density*

ISO 11664-1, *Colorimetry - Part 1: CIE standard colorimetric observers*

ISO 11664-4, *Colorimetry - Part 4: CIE 1976 L*a*b* Colour space*

ISO 18944, *Imaging materials — Reflection colour photographic prints — Test print construction and measurement*

ISO/TS 21139-1:2019, *Permanence and durability of commercial prints — Part 1: Definition of use profiles and guiding principles for specifications*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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 https://www.electropedia.org/

3.1 Terms

3.1.1
job
one sequence of printing initiated by the order from the print operation system

Note 1 to entry: Even if a pause is automatically inserted between printings, one sequence ordered from the operating system is considered as one job.

3.2 Abbreviations

CIE   International Commission on Illumination
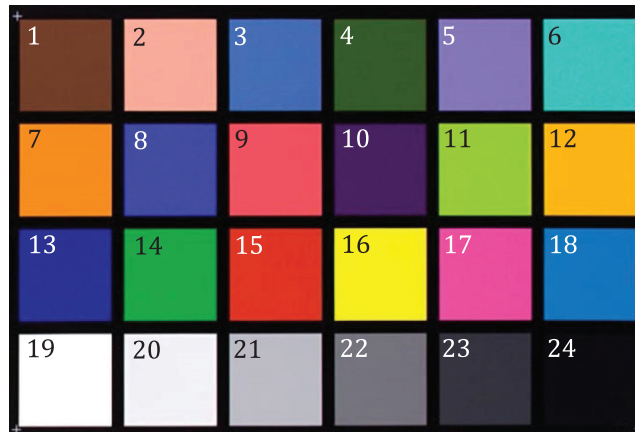
CIELAB   CIE 1976 ($L*a*b*$) colour space

4 Test target

The test target shall be composed of the colour patches in Macbeth Color Checkers shown in Figure 1. The colour codes in sRGB as defined in IEC 61966-2-1[4] are shown in Table 1.

The size of each square colour patch area shall be large enough to cover measured area plus positioning error. The appropriate size depends on the equipment used. Aperture size requirement shall comply with the geometric conditions in ISO 5-4.

Table 1 — Colour patch of the test target (RGB value in 8 bit)

|		R	G	B			R	G	B
1	Dark skin	115	82	68	13	Blue	56	61	150
2	Light skin	194	150	130	14	Green	70	148	73
3	Blue sky	98	122	157	15	Red	175	54	60
4	Foliage	87	108	67	16	Yellow	231	199	31
5	Blue flower	133	128	177	17	Magenta	187	86	149
6	Bluish green	103	189	170	18	Cyan	8	133	161
7	Orange	214	126	44	19	White	243	243	242
8	Purple blue	80	91	166	20	Neutral 8	200	200	200
9	Moderate red	193	90	99	21	Neutral 6.5	160	160	160
10	Purple	94	60	108	22	Neutral 5	122	122	121
11	Yellow green	157	188	64	23	Neutral 3.5	85	85	85
12	Orange yellow	224	163	46	24	Black	52	52	52

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NOTE   The numbers shown in the figure are only added here as reference and do not represent an integral part of the test target when printed.

Figure 1 — An example of the test target design

When the print size is larger than 35 cm^2 (e.g. 5 cm × 7 cm) and smaller than 2 600 cm^2 (e.g. 43 cm × 60 cm), the 24 solid patches shall be positioned at the centre of the print, as shown in Figure 2.
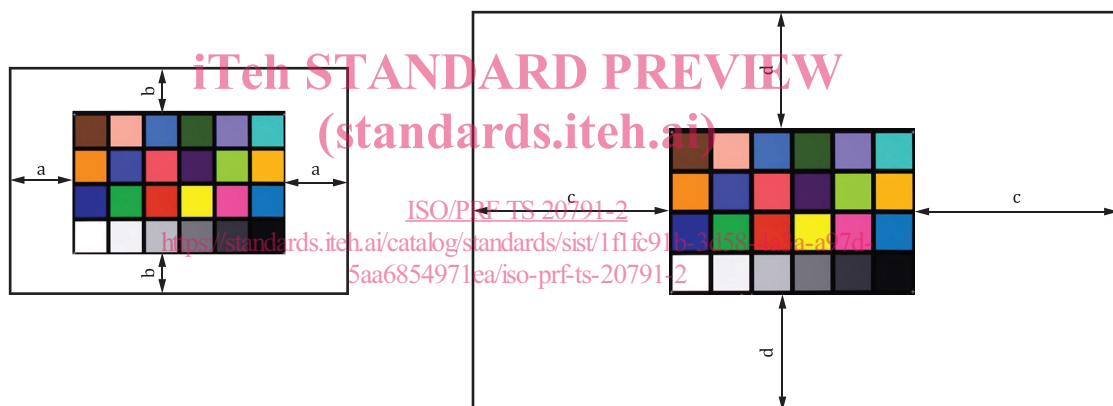

Key

a, b, c, d   The distance between each edge of the print and the test target.

Figure 2 — An example of the test target arrangement for small (left) and medium (right) print

When the print size is equal to or larger than 2 600 cm^2 (e.g. 43 cm × 60 cm), and smaller than 5 400 cm^2 (e.g. 60 cm × 90 cm), the 24 solid patches shall be positioned at the leading edge of the print, as shown in Figure 3. Other layouts may be used, but the layout used shall be reported.
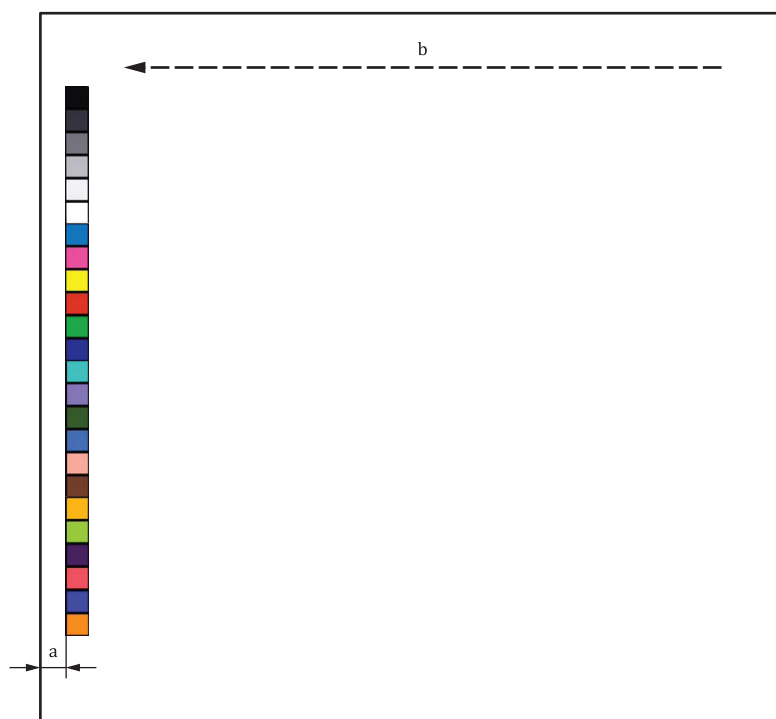
Key

ᵃ The distance between the edge and the patch, g = 25 mm.

ᵇ The printing direction.

Figure 3 — An example of the test target arrangement for large size print

When multiple photographic images (pages) need to be printed on one larger sheet described in the previous paragraph, the above test target shall be printed at the centre of each location corresponding to where each image (page) will be printed on the large sheet. When the locations of the images to be printed are not specified, the locations may be the centre and near each of the four corners of the large sheet.

ISO 18944 shall be referred to for more details concerning dimensions.

5 Printing

5.1 Environmental conditions

The standard ambient environmental conditions shall be the temperature of 23 °C ± 3 °C, relative humidity of 50 % RH ± 10 % RH and air pressure of 101 kPa ± 20 kPa.

The printing test shall be done under this standard ambient environmental condition. However, if it is not possible to conduct the test under the standard condition, the test may be done under uncontrolled environmental conditions. In this case, the temperature and relative humidity shall be measured regularly every 30 min and shall be reported.

In addition to the defined standard ambient environment, it is recommended that the test be performed under different temperature and relative humidity conditions, for example, at the higher end (e.g., 35 °C, 90 % RH) and the lower end (e.g., 5 °C, 10 % RH) of the "operating environment" specified for the printing system. The temperature and relative humidity conditions of the test shall be reported.

5.2 Procedures

The test target described in Clause 4 shall be printed consecutively. The number of sheets ranges from 10 to 100 sheets or more. However, the number of sheets will be determined based on the actual situation of normal printing work.

The default printing mode of the printing systems shall be applied. However, a particular printing mode can be used if a particular print mode other than the default mode is normally used for the application. In any case, the printer setting and printing mode shall be reported.

The printer should be in standard operating condition for printing of the test targets, which may require warming-up. According to the actual practice of the printing system, the printing state should be selected from 1-a) active state of on mode, 1-b) ready state of on mode, 2) off mode, 3) sleep mode, or 4) standby mode defined in Energy Star Programme Requirements for Imaging Equipment – Eligibility Criteria ver. 2.0 (2014)[5].

Furthermore, if the printing system has an automatic calibration function as the default mode, then the automatic calibration shall be applied. Nevertheless, any additional setting shall be reported. If the calibration of the printing system is carried out manually, the calibration shall be done in the same manner based on common practice. The manual implementation of the calibration shall be reported.

It is worth noting that colour variation of printing may occur depending on the time within a day, from day to day, and between different seasons (from the coldest winter period to the hottest summer).

"Consecutive printing" is referred to here as one consecutive printing initiated with an order from the operating system. Even if a pause is automatically inserted between printings, it is recognised as one consecutive printing job in this document.

6 Sampling

6.1 Reproducibility within a job

During continuous printing within a job, all sheets shall be sampled. For simple testing, for example, the sampling shown in Table 2 may be performed. However, the details of the sampling shall be reported. Sampling can be varied depending the objective of the test. An example of other protocol is described in ISO 15311-1[3].

Table 2 — Example of sampling for simple testing

	Total number of sheets	Sheets to be sampled
a	10	1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th
b	50	1st, 2nd, 3rd, 5th, 10th, 20th, 30th, 40th, 50th
c	100	1st, 2nd, 3rd, 5th, 10th, 20th, 40th, 60th, 80th, 100th

6.2 Colour variation between jobs

Sampling for evaluating variation between jobs (in a day or different days) shall be determined based on 6.1.

6.3 Colour variation between printed images located in different areas on a large sheet

When multiple images will be printed on different locations within a large sheet, each location shall be sampled. The test target shown in Table 1 and Figure 1 shall be printed at the centre of each location on the sheet corresponding to where each image will be printed. The layout of the test target for each location is shown in Figure 2. The layout of individual images (sampling locations) in a large sheet should be determined according to the actual job using the printing system. When the locations of the