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Office equipment — Print quality measurement methods for colour prints~~—~~ —

Part 2:
Registration and magnification accuracy

Proof stage

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Foreword

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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 document 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 or www.iec.ch/members_experts/refdocs).

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 28, *Office equipment*.

A list of all parts in the ISO/IEC 22592 series can be found on the ISO and IEC websites.

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 and www.iec.ch/national-committees.

Introduction

Measurement methods that quantitatively evaluate geometric property attributes of duplex print sets need to be standardized, as most of the office documents are currently printed as duplex print sets comprising several sheets printed colour images on both surface of substrates.

There are several standard measurement methods to evaluate image quality attributes of printed images formed by office equipment, i.e. colour reproductions, line reproductions, image structures of sharpness and graininess, gloss properties. Included are ISO/IEC 19799, ISO/IEC 24790 and ISO/IEC 29112. ISO/IEC 24790 specifies the measurement methods for large area density uniformity of graininess, mottle and banding, as well as line qualities. ISO/IEC 29112 specifies methods for measuring sharpness attributes of edge blurriness and raggedness, special frequency response, etc. ISO/IEC 19799 specifies the methods for gloss uniformity. By utilizing those documents, users can obtain consistent test results when they comply with the protocols specified in the documents.

While there are no standard methods to measure colour reproduction consistencies and geometrical accuracies in consecutive printing, and image stabilities in typical use case of print images formed by office equipment and used in office environments. In the current state, each printer distributer and its user can provide test results for those attributes measured by its own test methods and procedures, which are often convenient for its product, resulting in misleading customers in the selection of a printing system suitable for their use cases. The ISO/IEC 22592 series can provide standard methods and procedures for those print image attributes: ISO/IEC 22592-1 for colour consistency, this document for geometrical accuracies, and ISO/IEC 22592-3 for image stabilities. By using these International Standards, consistent and comparable test results suitable for typical use cases of office prints can be obtained independent of data providers.

The measurement methods described in this document are used to access geometric properties of a print set formed by a printing system on a substrate. When test results are compared among various printing systems, it is essential to use the same product of substrates and set equivalent printing conditions under default printer settings among the printing systems.

As for the metrics for registration and magnification based on images captured by an RGB scanner, prints with four primary colourants other than cyan, magenta, yellow and black are not suitable for the measurement methods described in this document. For example, if a print includes a light colourant image of a primary colour in addition to a standard colourant image, registration and magnification of this print will not be measured correctly because the complementary colour channel of the primary in a scanned image of the print includes two kinds of sources for registration and magnification.

Electrophotography, thermal inkjet, or piezoelectric inkjet technologies are commonly used to form such prints. The main purpose of this document is to provide objective measurement methods for geometric property attributes of duplex print sets, however, some attributes are also applicable for a set of simplex prints.

This document prescribes the following:

— ~~——~~digital test charts for the measurements in which colour codes and locations in page to be measured are specified,

— ~~——~~a test chart to measure the positional accuracy of a scanner,

— ~~——~~conformance requirements for the positional accuracy of a scanner to utilize registration and magnification measurements,

— ~~—~~measurement methods relating to the registration including accuracy of printed positions to substrate for each colour and printed position variations among colours,

— ~~—~~measurement methods relating to the magnification including absolute magnitude of printed size to input and relative difference in the magnitude among colours,

— ~~—~~measurement methods for the variations of the registration and magnification within a page (within-page variation), between front and back sides (side-to-side variation), among the sheets in the same print set (sheet-to-sheet variations).

Some attributes, such as the attribute “within a printed image”, “sheet-to-sheet variations”, are also applicable for a simplex print set comprising several sheets which are printed colour images on one surface of a substrate and no image on the other surface.

Some prints show uneven surfaces caused by thermal fusing process of electrophotographic printers or drying process in ink jet printers as well as by storage humidity changes from a highly humid condition to dry condition. Flatness of a print surface is an important aspect for print integrity. On the other hand, there is no proper measure standardized corresponding well with visual impression of flatness. Annex A~~Annex A~~ describes one of the methods to quantify degree of flatness. A further study needed to include this method into the scope of this document.

In this document, colour codes for the test charts are defined in sRGB colour space specified in IEC 61966-2-1 as is common in office documents.

Office equipment — Print quality measurement methods for colour prints —

Part 2:
Registration and Magnification accuracy

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of this document. Users should therefore consider printing with a colour printer.

1 Scope

This document specifies test methods as well as test charts to measure the geometric property attributes and those variations in duplex colour prints typically used in office environment. This document is applicable to duplex prints comprising several sheets which are printed colour images on both surfaces of a substrate.

"Within-page variation" and "sheet-to-sheet variation" are also applicable for a simplex print set comprising several sheets, which are printed colour images on one surface of a substrate and no image on the other surface.

Prints with four primary colourants other than cyan, magenta, yellow and black are outside the scope of this document.

Included are digital prints formed by using a multifunction or single function printer. When a duplex print set is evaluated, duplex printers which are capable to print images on both sides of substrate automatically are applicable, while simplex printers which require a manual arrangement of substrates between the front side and back side printing to form duplex prints are out of scope of this document. The printers of the maximum applicable substrate size of A4 or larger are suitable for the measurements.

The geometric property attributes included are registration and magnification of a print set.

Microscopic geometrical density variations, such as graininess, mottle and line raggedness, are outside the scope of this document.

The sources of variations considered are locations in a page, print side in a sheet, print order of sheets in a print set, and variations among primary colours.

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/IEC 24790, *Information technology — Office equipment — Measurement of image quality attributes for hardcopy output — Monochrome text and graphic images*

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminology 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
back side
print side (3.9~~(3.9)~~) corresponding to an even page of input data in a duplex *print set* (3.8~~(3.8)~~)

3.2
cockle
local deformation of a sheet of print due to unequal shrinkage or swelling giving it a slightly crumpled appearance

3.3
colour-to-colour variation
change in an attribute among the primary colours of the printer to evaluate

3.4
curl
deviation from a flat surface

3.5
fast scan direction
FSD
direction parallel to the sensor array of a scanner

3.6
front side
print side (3.9~~(3.9)~~) corresponding to an odd page of input data in a duplex *print set* (3.8~~(3.8)~~)

3.7
magnification
absolute magnitude of printed size to input

3.8
print set
set of sheets printed in a print operation

3.9
print side
one of the duplex print surfaces, either *front side* (3.6~~(3.6)~~) or *back side* (3.1~~(3.1)~~)

3.10
registration
accuracy of printed positions to substrate for each colour

3.11
slow scan direction
SSD
direction perpendicular to the sensor array of a scanner

3.12
sheet-to-sheet variation
change in an attribute at the same input data on the same *print side* (3.9~~(3.9),~~), either the *front side* (3.6~~(3.6)~~) or *back side* (3.1~~(3.1),~~), within a *print set* (3.8~~(3.8)~~)

3.13
side-to-side variation
change in an attribute at the same input data in the same sheet between the *front side* (3.6~~(3.6)~~) and *back side* (3.1~~(3.1)~~)

3.14
spots per inch
spi
spots per 25,~~4mm~~4 mm

[SOURCE: ISO/IEC 24790:2017, 3.34]

3.15
within-page variation
change in an attribute by location within a page

3.16
waviness
geometrical distortion of the print, generally at high-density image area

4 Print preparation procedures

4.1 Printing environment

Printers shall be installed in the environment range of a temperature of (23 ± 5) °C, with a relative humidity (RH) of (50 ± 10) % at least 2 h prior to print operations and the print operations shall be completed in the same environment range. The substrate to be used shall be placed in a paper tray when the printers are installed. Prior to the installation of printers, additional conditioning of papers under the same environment for temperature and humidity described above for more than 24 h is recommended to stabilize the water content of the papers which often affects image qualities of prints.

If a printer has not been used for a long period or if the environmental difference between storage and evaluation area is large, it is recommended to install it 12 h prior to the test and to print 10 or more sheets for warm up before the test.

4.2 Printing materials

An A4 size plain paper shall be used because it corresponds well with a typical usage case of office prints. Coated papers for ink jet or lithography may be used for a specific usage case with a rational explanation in reporting. The grammage of the paper shall be from 60 g/m² to 90 g/m². Any other grammage for paper

may be used for a specific usage case with a rational explanation in reporting. The name, grammage and supplier of the paper shall be reported.

It is recommended to measure the dimensions of the papers prior to tests and after printing.

Toner or ink materials recommended by the manufacturer of the printer to be tested shall be used. Any other materials provided by the other suppliers than the printer manufacturer may be used as long as product name and supplier are included in the report.

Any other printing materials, such as photoreceptors in electrophotographic printer, print head in ink jet printer, shall be in accordance with the recommendations by the printer manufacturer. The printing materials provided by the third-party suppliers may be used as long as product name and supplier are included in the report.

4.3 Printer settings

No reduction or enlargement in printed size shall be made. Modifications in colour and tone reproduction, sharpness enhancement, or noise reduction in the printer settings shall not be used. The printing mode by which an input image is printed at the centre of a substrate shall be selected. No binding margin shall be arranged.

Test prints shall be formed using driver and printer settings, except the parameters above mentioned, that are appropriate for a typical usage case in office. Default settings for the substrate subjected to evaluation, which correspond to initial settings when a printer shipped out recommended to be used. When performances of printing systems are compared, the default settings for each printing system shall be selected. The driver and printer settings used shall be described in the test report.

NOTE It is important to check if the size and position in a substrate are consistent. In some application viewers or printer settings for PDF files, settings related to size modification or printed position in a substrate at the previous print operation remain unchanged.

A4 size substrate shall be used. For the printers of the maximum applicable substrate size of A3 or larger, the feed direction parallel to the short edge direction of A4 substrate shall be selected and the feed direction perpendicular to the short edge direction of A4 substrate may optionally be selected. In the printers of the maximum applicable substrate size of A4, the feed direction shall be in accordance with printer setting for A4 size substrate. Long edge binding shall be selected in duplex printing.

4.4 Printing operations

Printing may be initiated under any operational mode defined in Reference [7~~[3],~~], i.e. 'On Mode' ('Active State', 'Ready State'), 'Off Mode' or 'Sleep Mode'. In order to evaluate overall performance of a printing system, it is recommended to carry out the tests under multiple operational modes. When performances of printing systems are compared, the same operational mode shall be used. The operational mode selected shall be included in the report.

It is recommended to prepare a duplicated print set for each measurement for backup, and to carry out measurements with the duplicated sets for measurement of noise reduction.

4.5 Conditioning the prints after printing

Prior to measurements, each print set shall be conditioned in a controlled environment for at least 24 h after printing to stabilize the dimension of sheet comprising the print set. The controlled environment shall be the relative humidity between 30 % to 70 % and the temperature between 15 °C to 28 °C.

5 General requirements for measurements

5.1 Measurement environmental conditions

All measurements in this document shall be completed in a controlled environment of relative humidity (50 ± 20) % and temperature (21,5 ± 6,5) °C.

In case that a high measurement accuracy is required, the relative humidity and temperature should be (50 ± 10) % and (23 ± 5) °C, respectively, to mitigate the influence of dimension changes in the conformance test chart and print samples with environment.

It is recommended to complete a series of measurements as a short duration as possible to prevent from the change in dimensions of the conformance test chart and print samples with environmental changes.

5.2 Scanner conformance

5.2.1 General

In case a scanning system is used for the measurements, the scanning system shall meet the requirements described in Clause 5~~Clause 5.~~

A scanning system used for the measurements in this document shall be tested using the test chart described in 5.2.2~~5.2.2~~ and procedures specified in 5.2.4~~5.2.4~~ to ensure the measurement results conform to the requirements of this document.

The scanning system is calibrated suitably if it can obtain a value within acceptable tolerances of the goal values given in 5.2.7~~5.2.7~~ for each attribute of registration and magnification.

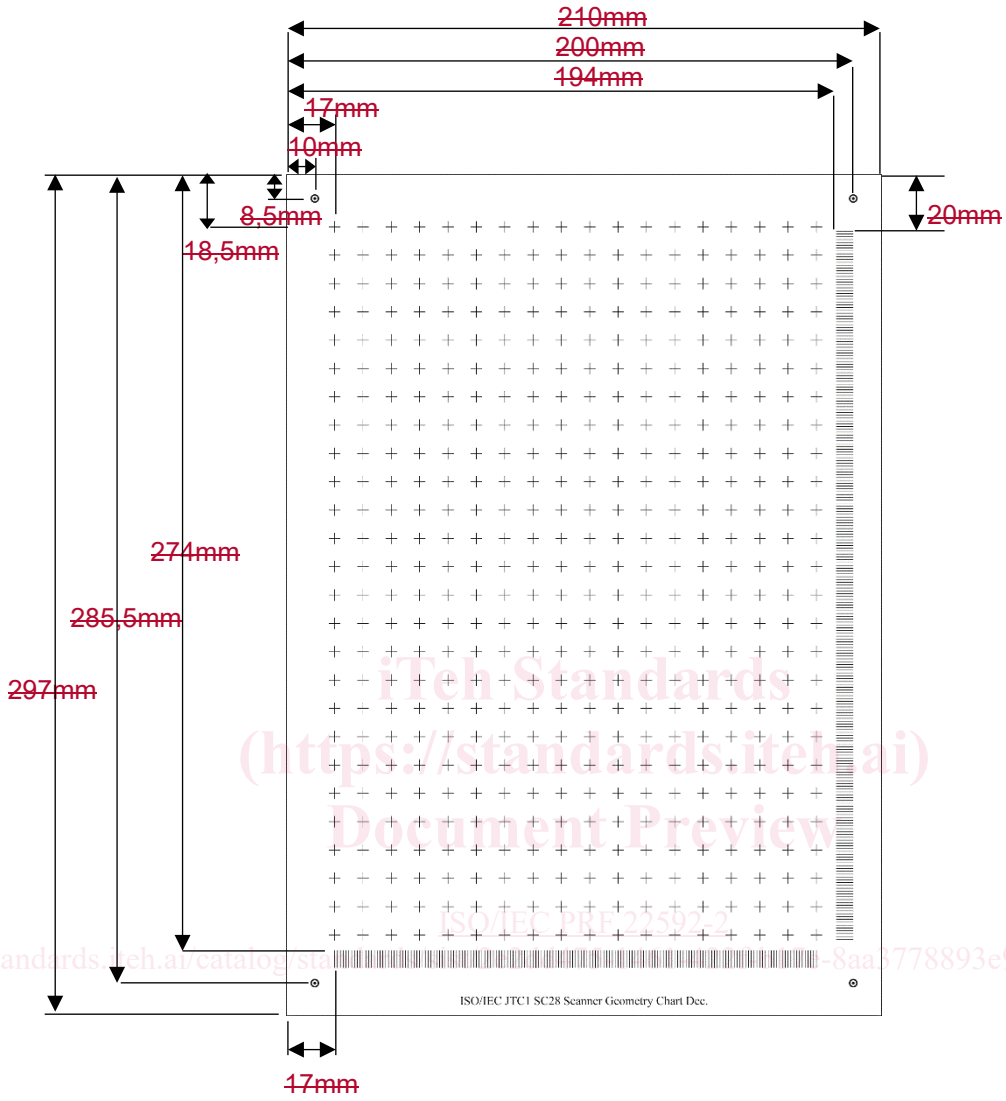
The conformance test shall be completed at least within six months prior to evaluations.

5.2.2 Test chart for scanner conformance

The outline of the test chart to evaluate positional accuracy of scanner is described in Figure 1~~Figure 1.~~. The size is A4. Widths of line components are all 100 µm.

The substrate material shall be transparent PET with a coated layer of a high-γ photosensitive emulsion for photolithographic process on its surface. The thickness of the PET film should be from 0,05 mm to 0,2 mm considering handling and durability in scanning operations. A photolithographic process for such as colour masks in a liquid crystal display shall be used to develop the image described in Figure 1~~Figure 1~~ on the surface of the substrate. Positional accuracy shall be 5 µm in a narrow area and 10 µm in page wide.

Information about one of the test charts complying with the requirements in this document can be obtained at https://standards.iso.org/iso-iec/22592/-2/ed-1/en~~.~~.



~~a) Layout of test chart~~