
**Graphic technology — Print quality
requirements for printed matter —**
Part 2:
**Commercial print applications
utilizing digital printing technologies**

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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*.

A list of all parts in the ISO/TS 15311 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

0.1 General

When producing a colour reproduction, it is important that the persons responsible for data creation, colour separation, proofing and printing operations have previously agreed to a set of parameters that define the visual characteristics and other technical properties of the planned print product. It is equally important that they have agreed to the method that will be used to verify that the printed output meets these aims and tolerances. This document identifies the minimum essential metrics and optional metrics for analysing printing output produced for the general commercial print marketplace.

This marketplace has evolved in recent years from using classical reproduction processes such as offset, letterpress, gravure, screen printing and flexography to include the many varied digital printing systems that are being developed to meet a wide range of potential needs depending on how the user chooses to prioritize speed, quality and cost. Along with and commensurate with this change has been a shift in technical emphasis from using quality control of the printing process and expecting statistically based predictable printing results to using colour management and other inherent measures of print quality directly on the printed page. ISO/TS 15311-1 helps identify these metrics.

This document deals with the assessment of printed sheets and does not consider how the process of printing the sheets is controlled. For reference, those methods for process control for conventional print processes are described in ISO 12647-2 to ISO 12647-6. Additionally, ISO/PAS ISO 15339 establishes principles for the use of colour characterization data as the definition of the intended relationship between input data and printed colour in all printing applications. There is no ISO standard for process control for digital printing; the inherent process control method is generally specified by the digital printing system manufacturer. No matter what method is used for process control, this document may be used to assess the printed results.

With this in mind, this document is intended to aid the printer and their customer, the print buyer, to define the inherent quality of the sheet using targets that can be included directly on the sheet (including the margin trim waste) or at least implied by the content of the images on the sheet itself. It is intended to be a more direct approach to relate digital printing to visual results while achieving the same quality levels of consistency that the industry has come to know and trust in their process controlled printed sheet. While this document is necessary for any digital printing system output due to the lack of a process control standard for digital printing, it could also be used to assess the resultant quality of any printed sheet that had been printed using process control methods from any of the classical printing processes if the printer and print buyer have previously agreed.

More importantly, because of the wide range of digital printing devices in terms of speed, quality, run length and sheet or board size, and the equally wide range of quality needs in the various printing market places, there presently is no cross-market agreement as to what constitutes “acceptable” quality. This document gives guidance in applying the appropriate metrics to develop custom tolerances for assessing printing system output, but it does not suggest specific acceptable quality levels. While it has many of the same metrics as ISO 12647-7 and ISO 12647-8, those standards include aims and tolerances limited to specified proofing application which are generally much tighter quality levels than normal digital printing.

The metrics involved in this document have been selected from ISO/TS 15311-1. In a few cases if representative metrics, for necessary aspects of judging quality such as legibility, are not included in ISO/TS 15311-1, **suggested** metrics have been drawn from other sources. All **specified** metrics are directly measurable on the printed sheet. Some **suggested** metrics, including more comprehensive targets, which are at least indirectly measurable on another sheet printed on the same unit at approximately the same time as the subject sheet, indicate the state that the process was in at the time of printing. This document also includes other **optional** metrics for anyone who desires to analyse other aspects of the printed sheet that are not essential to everyday transactions and which may require special tests conducted in sophisticated laboratories. These will probably be used only to compare the capabilities of various digital printing systems.

Since the role and the process of digital printing are both rapidly evolving, as indicated above, the printer and print buyer must jointly agree on the expected quality range for each of the required tests in advance of their printed job. Because there are many different types of digital printing equipment, specific machine expectations must come from the manufacturers of each piece of equipment.

0.2 Identification of suitable colour metrics

When selecting the set of metrics to be included in this document, only those metrics that have a clear definition and that correlate well with human perception are used. Since this is an area of significant research activity we expect many new metrics to emerge in the next few years. For this reason we anticipate the need to revise this document within a very short time scale as new metrics are tested and found to be reliable.

In many cases the existing standards use CIE dEab rather than CIEDE2000. Although these are not interchangeable quantities, dEab has been superseded by CIEDE2000 in ISO TC 130 standards and in this document. Similarly, printing density is seldom used to measure colour and where the referenced standards specify printing density we have used CIELab colour measurement.

0.3 Reporting schema

As with any parameter that is used as part of a product specification it is important for readers to understand clearly what the metric means. For this reason ISO/TS 15311-1 includes a reporting schema that should be followed when reporting measurements in conformance with this document. This document includes optional reporting forms.

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Graphic technology — Print quality requirements for printed matter —

Part 2:

Commercial print applications utilizing digital printing technologies

1 Scope

This document gives guidance to print buyers and other users of print for assessing printed products on isotropic substrates that are typically held at a viewing distance of 30 to 50 cm. It specifies the proper application of required, recommended and optional metrics, measurement methods and, where appropriate, reporting requirements in the general commercial market.

Although this document is expected to be used primarily to measure prints from digital printing systems the metrics are general and may be applied to other kinds of print.

This document does not provide process control aims or tolerances as these differ widely for different types of commercial applications.

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

ISO/TS 15311-1, *Graphic Technology — Requirements for printed matter for commercial and industrial production —Part 1: Measurement methods and reporting schema*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 15311-1 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

digital printing system

system that prints one unique iteration at a time for either variable data or classical printing applications, including but not limited to electrophotographic and ink-jet marking engines

**3.2
printing condition**

components or settings used for printing that significantly constitute the final visual appearance of the print product

Note 1 to entry: A typical printing condition comprises the printer, the substrate, the ink or toner, the used interpreter (RIP), the colour management software, the reference printing condition to be simulated and the print mode.

**3.3
spot colour**

non-process colour that is used in addition to, or in place of, a process colour and is normally applied with a single impression

Note 1 to entry: When associated with a corporate product identity, a spot colour is also known as a brand colour.

**3.4
print substrate**

intended substrate to be used for production printing

4 Requirements

4.1 General

4.1.1 Applications

This document for printed output may be applied to two separate use applications:

- 1) Printing output from a new general commercial printing system production run. The print buyer and the printer shall agree on aim values and tolerances for the metrics described in this document. Aims and tolerances should be developed through use-case analysis. Measured values and ranges for typical commercial print output for a number of regions are provided in [Annex C](#).
- 2) Printing output intended to represent the capabilities of a specified digital printing system. This shall not be implied to represent the capabilities of that model or similar models of digital printing systems without documenting that it is representative of that group which is outside the scope of this document. For this application no goals or tolerances are required, but aims and results shall be reported. All care should be taken to ensure that the samples are representative of the specified system. For multiple sheets and full press runs, sampling, measurement and reporting should be done as described in ISO/TS 15311-1.

The application type shall be reported. It should be noted that there are no provisions for non-colour related information such as varnishes, die cutting and other overlays.

4.1.2 Measurement

All colour measurements shall be made in accordance with ISO 13655. The measurement conditions (M0, M1, M2 or M3) and the backing to be used (white or black backing) shall be in accordance with those specified for the characterization data set being used, and if that is not possible, the conversion in ISO 13655:2017, A.4 should be performed.

Metrics shall be assumed to apply to the assessment of a single printed sheet unless otherwise specified and to the printing condition as defined in [3.2](#).

4.1.3 Data reference communication

All print elements shall be prepared as colorimetrically defined data. All evaluation and reference print output shall have been targeted to pre-approved data sets. Referenced colorimetric data sets should

be in conformance with ISO 15930. The intended printing condition shall be defined by the ICC output profile.

In order to determine a match of a printed sheet to a characterization data set or a printing condition, according to this document, the following information shall be documented:

- the characterization data set to be used as the reference;
- the colour tolerances (if a visual match is required) and the category of colour reproduction (“absolute” or “media-relative”) for the image content;
- the colour tolerances (if a visual match is required) for spot colours, if present;
- if a partial colour reference (PCR) is requested, information about the affected region for which the requirements should apply, see [Annex A](#) for more information;
- additional use-case-dependent requirements, such as minimum image resolution or line width, should be defined on an individual basis. It is recommended that guidelines provided by trade organizations such as the GWG or PDF/X-ready are used.

4.2 Print quality measures

4.2.1 Overview

The intended viewing distance is 30 to 50 cm.

Recommended targets for all metrics in this document and a suggested appropriate range for each test are provided in [Annex D](#).

Metrics specified in this document, to be used for evaluation of commercial printing system output, are defined and specified in ISO/TS 15311-1. Other properties such as legibility, which are desirable to test, but for which a test has not been validated in Part 1, will be referenced to the best-known alternative.

For all printing system output under evaluation, the evaluation report should include the printing device, print condition, substrate the RIP and so on.

4.2.2 Colour and tone reproduction and surface finish

4.2.2.1 General

The following requirements concern image quality attributes that are closely related to colour and surface finish. Evaluations based on this document shall report the required evaluation metrics plus aims and custom tolerance where applicable. Unless otherwise reported, the colour measurement method shall be assumed to be absolute colour.

NOTE There is presently no unambiguous cross-media definition for the metric tone value range/sharpness. An accepted industry method is ISO 12647-8:2012, 4.2.6.

4.2.2.2 Print substrate

The print substrate shall conform with print buyer specifications for type of surface, mass-per-area, colour, fluorescence and gloss. Substrate attributes shall be reported as shown in ISO/TS 15311-1:2016, Table 2.

4.2.2.3 Absolute colour reproduction (process colours)

For the purposes of this document, commercial printed output is separated into two types:

- 1) output used to establish the colorimetric match (setup) of the printing system being tested (deviation from the intended reference printing condition) throughout the entire colour gamut using ISO 12642-2 (or similar) colour charts and other appropriate test forms;
- 2) output limited to practical printing quality assessment using control strips (representative subsets of the full colour charts) which previously were included on the output to monitor variation during the print run.

Absolute colour reproduction testing and reporting for control strip applications (substrate, CSMax, CSAve, CSAveNeutral) shall be required. Absolute colour reproduction testing and reporting for colour chart applications (CCAveSurface, CCAve, CC95 %) should be required.

Targets and test methods and reporting shall be as defined in ISO/TS 15311-1. The control strip patch requirements shall be as defined in [Annex B](#).

The print buyer shall specify goals and tolerances for the categories listed in [Table 1](#), as required by the application. These requirements shall be specified in advance and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

Table 1 — Absolute colour evaluations metrics

Test type	Test identification
Patch e) substrate by comparison to the reference data set	e) dE ₀₀
Maximum colour difference for all control strip patches	CSMax dE ₀₀
Average colour difference for control strip patches	CSAve dE ₀₀
Average chromaticness difference for CMY neutral control strip patches	CSAveNeutral dCh ^a
Average colour difference for selected surface gamut patches	CCAveSurface dE ₀₀
Average colour difference for the characterization chart	CCAve dE ₀₀
95th percentile for the characterization chart	CC95 % dE ₀₀
^a ΔCh is the CIELAB chromaticness difference between two colours of approximately the same lightness projected onto a constant lightness plane in the CIELAB colour space. This is calculated the same way as ΔEc	

4.2.2.4 Media relative colour reproduction (process colours)

Media relative colour reproduction testing and reporting may be required for evaluating a press sheet. Where required, targets, test methods and reporting shall be as defined in ISO/TS 15311-1.

4.2.2.5 Gloss

Gloss testing and reporting should be required for evaluating a press sheet.

For proper colour measurement and meaningful analysis the gloss of solid tone colours should be the same category as the substrate on which they are printed (differential gloss).

If gloss is measured, it shall be measured, referenced and reported as defined in ISO/TS 15311-1:2016, 4.3.2.6.

4.2.2.6 Colour deviation of multiple samples of printed matter

Colour deviation testing and reporting should be required. If required, colour deviation of printed matter is evaluated by an average colour difference of all colours on the control strip. The average colour difference is an average of CIE DE2000 values between the average CIE L*a*b* of all samples and CIE L*a*b* of target colour. The samples shall be selected from printed matter in accordance with ISO/TS 15311-1:2016, 4.2. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

4.2.3 Homogeneity

4.2.3.1 Banding (monochrome)

A visual assessment by an experienced operator and reporting of banding should be required, and monochrome banding testing and reporting may be required. If required, streaks and bands on 50 % tone of black, cyan and magenta shall be measured as defined in ISO/TS 15311-1:2016, 4.3.3.2. The target shall be 160 × 100 mm and should be 160 × 160 mm. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

4.2.3.2 Large area uniformity

A visual assessment by an experienced operator and reporting of large area uniformity should be required, and large area uniformity testing and reporting may be required. If required, large area uniformity of C65 % M50 % Y50 % K50 %, C40 % M30 % Y30 % K30 %, C20 % M15 % Y15 % K15 % tone values combinations shall be measured as defined in ISO/TS 15311-1:2016, 4.3.3.3. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

4.2.3.3 Mottle (monochrome)

A visual assessment by an experienced operator and reporting of mottle should be required, and monochrome mottle testing and reporting may be required. If required, mottle of 70 %, 40 % and 20 % tone of black, cyan and magenta shall be measured as defined in ISO/TS 15311-1:2016, 4.3.3.4. The target shall be 25,4 × 25,4 mm and should be 30 × 30 mm. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

4.2.3.4 Graininess (monochrome)

A visual assessment by an experienced operator and reporting of graininess should be required, and monochrome graininess testing and reporting may be required. If required, graininess of 70 %, 40 % and 20 % tone of black, cyan and magenta shall be measured as defined in ISO/TS 15311-1:2016, 4.3.3.5. The target shall be 25,4 × 25,4 mm and should be 30 × 30 mm. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

4.2.3.5 Show-through

Show-through testing and reporting may be required. If required, show-through shall be measured as defined in ISO/TS 15311-1:2016, 4.3.3.6. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

4.2.3.6 Colour variation within printed matter

Colour variation testing and reporting should be required. If required, colour variation within printed matter shall be evaluated by an average colour difference of solids of the primary and secondary colours

and representative mid-tone values (e.g. 40 %, 50 %) of the primary colours, and should be evaluated by an average colour difference of control strip colours. The average colour difference is an average of CIE DE2000 values between the average CIE L*a*b* of all samples and CIE L*a*b* of each sample. The 95 percentile colour difference is a 95 percentile of CIE DE2000 values between the average CIE L*a*b* of all samples and CIE L*a*b* of each sample. The samples shall be selected from printed matter in accordance with ISO/TS 15311-1:2016, 4.2. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

4.2.4 Detail rendition capabilities

4.2.4.1 General

NOTE There is presently no unambiguous cross-media definition for the metric legibility/sharpness. An accepted industry method is ISO 12647-8:2012, 4.2.9.

4.2.4.2 Line width

Line width testing and reporting may be required. If required, both vertical and horizontal lines of black, and, where possible, cyan and magenta shall be measured as defined in ISO/TS 15311-1:2016, 4.3.4.2. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

4.2.4.3 Line darkness

Line darkness testing and reporting may be required. If required, line darkness for both vertical and horizontal black lines shall be measured as defined in ISO/TS 15311-1:2016, 4.3.4.3. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

4.2.4.4 Line raggedness

Line raggedness testing and reporting may be required. If required, line raggedness for both vertical and horizontal lines of black, and, where possible, cyan and magenta shall be measured as defined in ISO/TS 15311-1:2016, 4.3.4.5. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

4.2.4.5 Line blurriness

Line blurriness testing and reporting may be required. If required, line blurriness of both vertical and horizontal lines of black, and, where possible, cyan and magenta shall be measured as defined in ISO/TS 15311-1:2016, 4.3.4.4. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case and suggested guidelines for these requirements are provided in [Annexes C](#) and [D](#).

4.2.5 Artefacts

The prints shall be visually assessed by an experienced operator for contouring and other artefacts such as random defects caused by the printing system. Any finding shall be reported.

4.2.6 Permanence

4.2.6.1 General

Permanence testing and reporting should be required. If required, all permanence tests shall begin immediately following the print stabilization period specified by the manufacturer but not later than a

week. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case.

4.2.6.2 Indoor light stability

Indoor light stability testing and reporting may be required. If required, indoor light stability shall be measured as defined in ISO/TS 15311-1. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case.

NOTE The colour change ("fading") of the primary and secondary colour solids over time (24 h), in the dark, are typically $dE_{00} = 2$ or smaller.

4.2.6.3 Weathering

Weathering testing and reporting may be required. If required, weathering shall be measured as defined in ISO/TS 15311-1. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case.

4.2.6.4 Thermal stability

Thermal stability testing and reporting may be required. If required, thermal stability shall be measured as defined in ISO/TS 15311-1. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case.

4.2.6.5 Abrasion resistance

Abrasion resistance testing and reporting may be required. If required, an abrasion test should be performed after the print stabilization period and reported. Abrasion resistance should be measured according to ISO 18947, as described in ISO/TS 15311-1. The Taber rub test (defined in ASTM 1478-06) or the Prüfbau Quartant (using an abrasion pressure of 0,5 N/cm² and two swings) may also be used. The maximum percentage loss in density reading should not exceed 50 % of the starting value after the print stabilization period. If the printing has been coated or surface finished, this shall be reported. Aims and tolerances, if required, shall be specified in advance by the print buyer for the intended use case.

NOTE Friction devices do not apply the same motion, force and stress on the material to be tested, so they do not lead to the same results, and there is presently no unambiguous cross-media definition for this metric. An accepted industry goal from ISO 12647-7 is referenced.

Annex A (informative)

Partial colour reference (PCR)

If nothing is said between print buyer and print service provider, the entire content of a document is treated with equal importance. PCR refers to workflows or print jobs where only some elements are required to be of high colour accuracy. This might be the case for transactional and promotional application where only dedicated objects are of primary concern. These are often expressed as “brand colours” which are specifically defined colorimetrically as part of a product look or identification.

Important steps to be communicated between sender and receiver:

- identify the colorimetrically defined objects by means of a region of interest;
- define quality type, colour accuracy level and colour appraisal type (side-by-side or media-relative);
- multiple objects with different requirements are possible;
- define minimum aims for the remaining image content (if needed).

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Annex B (normative)

Control strip from ISO 12647-8

The control elements of the CMYK control strip, identified in the list below, shall be included while keeping the total number of patches within reasonable limits. To provide compatibility with characterization data, as many control patches as possible should be selected from ink value combinations as detailed in ISO 12642-2. The control patch types to be used are a selection of critical tertiary colours such as flesh tones, brown, aubergine or violet (e.g. 15 patches).

A CMYK digital control strip shall be printed on every validation print. That control strip shall consist of at least the following patches:

- a) solid tones of the chromatic primaries, their secondaries and black C,M,Y,R,G,B,K (7 patches);
- b) mid-tones of the chromatic primaries and black C,M,Y,K;
- c) a minimum five-step near-neutral tone scale composed of the primaries C,M,Y, which is approximately equally spaced in CIE L^* from substrate (or simulated substrate) to the three-colour minimum L^* and shall have a chroma less than 2;
- d) a tone step scale composed of the primary colour K (of the target printing condition) such that the L^* approximately matches the steps of the previously defined three-colour scale; and
- e) the simulated print substrate colour of the production printing condition (one patch).

NOTE Grey balance patches composed of suitable CMY mixtures serve a useful purpose for quick visual checks of whether the CMY tone values have changed, for example, from one print to the next.

Annex C (informative)

C.1 Representative IDEAlliance example from printer's submissions to a known colour space

The following are results from an IDEAlliance G7 certification program where printers from commercial marketplaces submitted samples printed to a known colour space. This summary includes the results of 10 randomly selected samples and gives an indication of the range of results that might be experienced when printers try to meet quality commercial tolerances.

Metric	Measured differential from goal
CS sub	≤ 1,4 dE00
CSMax dE00	≤ 3,6 dE00
CSAve dE00	≤ 1,4 dE00
CSAveNeutral dCh	≤ 0,9 dCh
Other patches	≤ 4,3 dE00
CCAveSurface dE00	≤ 2,3 dE00
CCAve dE00	≤ 2,2 dE00
CC95 % dE00	≤ 2,6 dE00
Banding (monochrome)	n/a
Large area uniformity (maximum dE00)	≤ 1,2 dE00
Mottle (monochrome)	n/a
Graininess (monochrome)	n/a
Shine through	n/a
Colour variation within printed matter	≤ 2,1 dE00
Resolution per 4.2.4.1	n/a
Line width not required for colour	n/a
Line blurriness not required for colour	n/a
Line raggedness not required for colour	n/a

C.2 Representative FOGRA print quality examples

These three examples were developed by FOGRA as representative quality options for their domestic standard for digital printing. These metrics have been excerpted from their document and extrapolated to match the format and requirements of this document.

EXAMPLE 1 From full-page colour advertisements, large-format professional studio photos (fine art) or similar uses.

Metric	Typical measured differential from goal
CS Sub dE00	≤ 3,5 dE00
CSAve dE00	≤ 2,5 dE00
CSMaxNeutral dCh	≤ 2,5 dCh
CS95 %	≤ 4,5 dE00
CCAveSurface dE00	3,5 dE00
CCAve dE00	≤ 3,5 dE00
CC95 % dE00	≤ 5,0 dE00
Banding (monochrome)	≤ 0,5
Large area uniformity (maximum dE00)	≤ 1,5 dE00
Mottle (monochrome)	≤ 0,5
Graininess (monochrome)	≤ 0,5
Shine through	< 2
Colour variation within printed matter	≤ 3E ₀₀ *
Resolution per 4.2.4.1	≤ 1 %
Line width not required for colour	≤ 0,1 mm
Line blurriness not required for colour	≤ 100 μm
Line raggedness not required for colour	≤ 50 μm
Abrasion resistance	≤ 50 %

EXAMPLE 2 From product advertising, collaterals, print products with aesthetic applications such as culture, fashion, art or architecture.

Metric	Typical measured differential from goal
CS Sub dE00	≤ 3,5 dE00
CSAve dE00	≤ 4,5 dE00
CSMaxNeutral dCh	≤ 3,5 dCh
CS95 %	≤ 5,5 dE00
CCAveSurface dE00	≤ 4,5 dE00
CCAve dE00	≤ 4,5 dE00
CC95 % dE00	≤ 6,0 dE00
Banding (monochrome)	≤ 1,0
Large area uniformity (maximum dE00)	≤ 2,5 dE00
Mottle (monochrome)	≤ 1,0
Graininess (monochrome)	≤ 1,0
Shine through	< 4
Colour variation within printed matter	≤ 4 dE00
Resolution per 4.2.4.1	≤ 2 %
Line width not required for colour	≤ 0,5 mm
Line blurriness not required for colour	≤ 200 μm
Line raggedness not required for colour	≤ 100 μm
Abrasion resistance	≤ 50 %

EXAMPLE 3 From a non-aesthetic production printing or editorial sections of periodicals and publications.

Metric	Typical measured differential from goal
CS Sub dE00	≤ 3,5 dE00
CSAve dE00	≤ 5,5 dE00
CSMaxNeutral dCh	≤ 4,5 dCh
CS95 %	≤ 6,5 dE00
CCAveSurface dE00	≤ 5,5 dE00
CCAve dE00	≤ 5,5 dE00
CC95 % dE00	≤ 7,0 dE00
Banding (monochrome)	≤ 2,0
Large area uniformity (maximum dE00)	≤ 3,5 dE00
Mottle (monochrome)	≤ 2,0
Graininess (monochrome)	≤ 2,0
Shine through	< 8
Colour variation within printed matter	≤ 5
Resolution per 4.2.4.1	≤ 3 %
Line width not required for colour	≤ 1,0 mm
Line blurriness not required for colour	≤ 300 μm
Line raggedness not required for colour	≤ 200 μm
Abrasion resistance	≤ 50 %

C.3 Representative JPMA (Japan Printing Machinery Association) print quality examples

This example was developed by JPMA as criteria for the Japan Colour Digital Printing certification program. These metrics have been excerpted from their document and extrapolated to match the format and requirements of this document.

Metric	Typical measured differential from goal
CS Sub	≤ 3 dE00
CSMax dE00	≤ 6 dE00
CSAve dE00	≤ 2 dE00
CSAveNeutral dCh	≤ 2,0 dCh
Other patches	n/a
CCAveSurface dE00	≤ 3 dE00
CCAve dE00	≤ 2 dE00
CC95 % dE00	≤ 4 dE00
Banding (monochrome)	n/a
Large area uniformity (maximum dE00)	≤ 2 dE00
Mottle (monochrome)	n/a
Graininess (monochrome)	n/a
Shine through	n/a
Colour variation within printed matter Ave dE00	≤ 1 dE00
Colour variation within printed matter 95 % dE00	≤ 3 dE00
Line width not required for colour	n/a
Line blurriness not required for colour	n/a

Metric	Typical measured differential from goal
Line raggedness not required for colour	n/a
Abrasion resistance	n/a
Colour deviation of average colour reproduction of printed matter	$\leq 3,0$ dE00

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Annex D (informative)

Specified targets and suggested tolerance ranges for digital printing metrics in all markets

ISO 15311-2 test	Required targets	Suggested range
A. Established industry metrics		Full range of industry accepted tolerances
Substrate patch	None	$1,0 < dE_{00} < 4,5$
Control strip patch max	ISO 12647-8 control strip (Annex B)	$1,5 < dE_{00} < 8,5$
Control strip average	ISO 12647-8 control strip (Annex B)	$1,0 < dE_{00} < 5,5$
Control strip neutral average	ISO 12647-8 control strip (Annex B)	$1,5 < \text{avg. } dCh < 4,0$
Colour charts average surface	ISO 12642-2 (or similar)	$2,0 < dE_{00} < 6,0$
Colour charts average	ISO 12642-2 (or similar)	$1,5 < dE_{00} < 5,5$
Colour charts 95 %	ISO 12642-2 (or similar)	$2,0 < dE_{00} < 7,0$
B. Proposed new metrics		Expected ranges (subject to verification)
Banding (monochrome)	See below	$0 < \text{per ISO/TS 15311-1} < 4$
Large area uniformity ($\text{Max } E_{00}^*$)	—	$0,5 < \text{per ISO/TS 15311-1} < 5$
Mottle (monochrome)	See below	$0 < \text{per ISO/TS 15311-1} < 4$
Graininess (monochrome)	See below	$0 < \text{per ISO/TS 15311-1} < 4$
Shine through	See below	$0 < \text{per ISO/TS 15311-1} < 6$
Colour variation within printed matter	—	$1,0 < \text{per ISO/TS 15311-1} < 4$
Line width (not required for colour)	See below	Measure and report only
Line blurriness (not required for colour)	See below	Measure and report only
Line raggedness (not required for colour)	See below	Measure and report only
Tone value range per 4.2.2.1	—	$0-100 < \text{dots} < 4-96$

The suggested ranges are for the guidance of the print buyer. They are divided into two categories: those for metrics with a long history of documented results; and those for the new metrics that have recently been incorporated and have only the initial indication of expected results. These two groups should be treated accordingly by the print buyer when specifying aims and tolerances. It is also strongly advised that the specified aims and tolerances should be use-case dependent. Requirements that are tighter than needed are more likely to increase cost than quality. A best-case lower limit is provided because, although specific printing runs may be even closer to goal values than the lower limit, these are the tightest tolerances that can be expected from the best equipment under the best conditions.

Table D.1 — Definitions and recommendations for test patterns

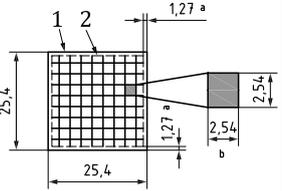
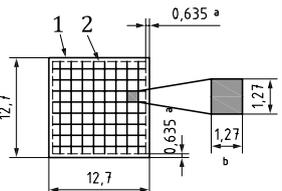
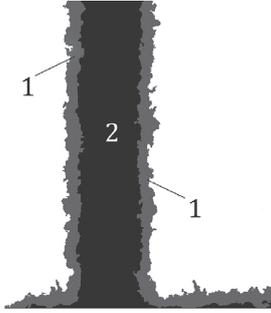
	ISO/TS 15311-2	ISO/TS 15311-1:2016	ISO/ IEC TS 24790:2012	Proposal
Attribute	4.2.3 Homogeneity	4.3.3 Uniformity	5.2 Large area graphic image attributes	
Banding	<p>4.2.3.2 Banding (monochrome)</p> <p>If required, streaks and bands shall be measured as defined in ISO/TS 15311-1.</p>	<p>4.3.3.2 Banding - monochrome</p> <p>When measuring banding the method defined in ISO/IEC TS 24790:2012, 5.2.9 shall be used.</p> <p>Banding has no measurement unit but typically produces a number in the range 0-5.</p>	<p>5.2.9 Banding</p> <p>Find a nominally uniform ROI of at least 160 mm (x-direction) by 100 mm (y-direction), contained wholly within the inner boundary edge of an image element.</p> 	<p>Size: at least 160 × 100 mm</p> <p>160 × 160 mm (recommended)</p> <p>Tint: 50 %</p> <p>Colour: K</p> <p>C,M (recommended)</p>
Mottle	<p>4.2.3.4 Mottle (monochrome)</p> <p>If required, mottle shall be measured as defined in ISO/TS 15311-1.</p>	<p>4.3.3.4 Mottle - monochrome</p> <p>When reporting Mottle the method defined in ISO/IEC TS 24790 shall be used.</p> <p>Mottle has no measurement unit but produces a number in the range 0-5.</p>	<p>5.2.6 Mottle</p> <p>Find an ROI of a minimum dimension of at least 25,4 mm contained wholly within the inner boundary of an image element.</p>  <p>1 wavelett-processed ROI</p> <p>2 cropped ROI</p>	<p>Size: at least 25,4 × 25,4 mm</p> <p>30 × 30 mm (recommended)</p> <p>Tint: 20, 40, 70 %</p> <p>Colour: K</p> <p>C,M (recommended)</p>
Graininess	<p>4.2.3.5 Graininess (monochrome)</p> <p>If required, graininess shall be measured as defined in ISO/TS 15311-1.</p>	<p>4.3.3.5 Graininess - monochrome</p> <p>When reporting graininess the method defined in ISO/IEC TS 24790 shall be used.</p> <p>Graininess has no measurement unit but produces a number in the range 0-5.</p>	<p>5.2.5 Graininess</p> <p>Find an ROI of a minimum dimension of at least 12,7 mm contained wholly within the inner boundary of an image element.</p>  <p>1 wavelett-processed ROI</p> <p>2 cropped ROI</p>	

Table (continued)

	ISO/TS 15311-2	ISO/TS 15311-1:2016	ISO/ IEC TS 24790:2012	Proposal
Attribute	4.2.4 Detail rendition capabilities	4.3.4 Detail rendition capabilities	5.3 Character and line image attributes	
Line width	<p>4.2.4.2 Line width</p> <p>If required, line width shall be measured as defined in ISO/TS 15311-1.</p>	<p>4.3.4.2 Line width</p> <p>Where this measure is reported the width of the line measured normal to the line from edge threshold to edge threshold as defined in ISO/IEC TS 24790 shall be used.</p> <p>The line width of a black-only line shall be reported and the line width of a CMY line should be reported. Both vertical and horizontal lines shall be measured and the specified line width shall be reported.</p> <p>Measurement units shall be mm.</p>	<p>5.3.3 Line width</p> <p>Find an ROI that includes lines at least 1 mm long and background.</p> <p>The recommended width of the ROI is no less than (line width) $0029 + 2$ mm, the height no less than 5 mm.</p>  <p>1 stroke width 2 edge threshold R_{40} 3 line width</p>	1
Line blurriness	<p>4.2.4.3 Line blurriness</p> <p>If required, line blurriness shall be measured as defined in ISO/TS 15311- 1 (for 0,100 mm line).</p>	<p>4.3.4.4 Line blurriness</p> <p>Where blurriness is reported a noticeable transition of blackness from background to character shall be measured using the method defined in ISO/ IEC TS 24790.</p> <p>Where blurriness is measured both edges of line shall be measured and the average of them shall be reported. At least vertical and horizontal line shall be measured. The line width of the evaluated line shall be specified and reported</p> <p>Measurement units shall be mm.</p>	<p>5.3.5 Blurriness</p> <p>Find an ROI that includes lines at least 1 mm long and background.</p> <p>The recommended width of the ROI is no less than (line width) $+2$ mm, the height no less than 5 mm.</p>  <p>1 region between boundary edges 2 image segment</p>	