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Graphic technology — Image quality evaluation methods for printed matter

Part 21: Measurement of 1D distortions of macroscopic uniformity utilizing scanning spectrophotometers

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National foreword

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Part 21: Measurement of 1D distortions of macroscopic uniformity utilizing scanning spectrophotometers

Technologie graphique - Méthodes d'évaluation de la qualité d'image pour les imprimés —

Partie 21: Mesure des distorsions 1D d'uniformité macroscopique à l'aide de spectrophotomètres à balayage

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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 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).

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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 18621 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

The subject of image quality is broad and complex, due to its multidimensionality and the apparent characteristics of human vision. Many different methods can be available to provide a measure of a particular visual attribute in some particular viewing context and aimed at a particular printing technology. It is a challenge to have image quality evaluation methods that are independent of the marking technology, i.e. correlate with human perception to provide visual significance to measured differences across many printing technologies. The evaluation of perceived image quality is an active field of research.

The uniformity that can be achieved, or in fact the lack thereof, is an important factor in the evaluation of the overall print quality. Uniformity refers to the subjective impression of the homogeneity of the colour in extended areas up to the document size. Colour uniformity refers to all types of unintended but visible variations in colour, that may go in any direction in colour space and may have any spatial pattern. Spatial patterns include 1D, 2D, periodic, aperiodic, localized, large-scale and small-scale variations. They can be identified as streaks or streakiness, banding, gradients, mottle, moiré and others.

When evaluating perceived uniformity, the intended viewing distance should be taken into account. For practical application it is also common practice to distinguish 2 categories of uniformity that depend on the spatial frequency (or actually the angular frequency as seen by the eye):

— Microscopic uniformity such as graininess that is related to the imaging process and generally consists of a 2D random noise pattern. It is visually relevant for image objects as small as few square mm in size in case of normal reading distance (40 cm).

— Macroscopic uniformity involves distortions in the homogeneity that extend beyond few mm in one or both geometric dimensions. It is generally visible across the document page size with examples called banding, cording stripes or streaks.

This document focuses on the macroscopic uniformity that exhibits 1D type patterns that extend more or less across the printed area of a page. It uses well established colour measurement instruments as the basic measurement device, especially systems that can be combined with automated XY-tables for performing well defined measurements in a complete 2D grid of measurement locations in an easy way. These systems generally have a minimum pitch in both dimensions of 6 mm. This method takes a much more rigorous approach than the 9-point sample method that is defined in ISO 12647-7 that is applicable to proofing systems.

The measurement method derives a single valued Macro-Uniformity-Score on a scale that ranges from 100 (“perfect uniformity”) to 0 (“extremely poor uniformity”). It is based on the evaluation of the average colour differences that occur in horizontal and vertical rows separately and adds them up to arrive at a single value. Then a formula is applied to compute the Macro-Uniformity-Score that is shown to correlate well with the perception of representative streaks or stripes of toner-based printing systems as well as inkjet-based systems.

This document describes a methodology in such a way that other documents can apply it for specific use cases. Such documents will typically need to apply additional constraints on test pages and process control in order to ensure that the resulting Macro-Uniformity-Score can be compared between different printing devices, substrates and ink sets.

TECHNICAL SPECIFICATION **ISO/TS 18621-21:2020**

Graphic technology — Image quality evaluation methods for printed matter —

Part 21: Measurement of 1D distortions of macroscopic uniformity utilizing scanning spectrophotometers

1 Scope

This document defines a measurement method for the evaluation of distortions in the macroscopic uniformity of printed areas that are oriented in the horizontal and vertical direction, such as streaks and bands.

It provides requirements for the layout of the test form, the use of a colour measurement device taking measurements in a 2D sampling grid, and the formula to compute the Macro-Uniformity-Score.

This document does not cover any non-adjacent or non-horizontal nor vertical patterns. Due to the used spatial frequency, the Macro-Uniformity-Score does not measure high frequency (fine) patterns such as missing nozzles.

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

3 Terms and definitions

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

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
banding
appearance of repeated 1-dimensional patterns within an area that should look homogeneous

Note 1 to entry: The related artefacts are called bands or stripes.

[SOURCE: ISO/TS 15311-1:2020, 3.1, modified]

3.2
CIEDE2000 colour difference
colour difference (ΔE00) as defined in ISO/CIE 11664-6 with the default weights for lightness, chroma and hue (1:1:1)

Note 1 to entry: The unit is 1[1].