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Foreword

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

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

Methods for measuring the transparency or opacity of printing inks and paints have been described in a number of publications[1]–[4]. Standard methods[1] for paints are based on the reflectance of the colorant when printed over a black background relative to the reflectance of the black background without coloration. The contrast ratio method described in Reference [1] is widely used in the industry for evaluating opacity, but results can vary significantly depending on how it is used especially where white ink printed upon on transparent substrates are measured, or where a standard test substrate is not used.

Methods of measuring opacity and transparency are based on the reflectance of printed and unprinted areas of a substrate. Reflectance is defined as the luminous reflectance factor and expressed as the CIE Y tristimulus value, which is not as perceptually uniform as other derived CIE colour spaces such as 1976 CIELAB. Transparency is related to opacity but is not equal or equivalent to opacity. ISO 2846-1 includes a measure of transparency.

In the transparent imaging model introduced from PDF 1.4, objects can be less than fully opaque, and all of the objects in a stack can potentially contribute to the final appearance of the page. PDF uses the term "solidity" rather than opacity, but these terms are essentially the same. An opacity or "solidity" value of 1,0 describes an ink that completely hides the inks beneath, while a value of 0,0 describes a transparent ink that completely reveals the inks beneath[5], for example a clear varnish. Document creators specify the opacity of one or more inks, and anticipate that this specified opacity is consistent with the visual appearance of both preview and final print. This document is intended to be used to measure the opacity of inks printed using a known configuration of a printing system and so the measured value is not the opacity of the ink per se but of the ink as printed. This aspect is especially important when assessing inks printed using inkjet printers. For the opacity value so measured to be useful, it is important to communicate details of the configuration of the printing system used so that the printing can be repeated.

There is thus a need for a metric for opacity which has better agreement with visual perception. For consistency with the PDF model, it is expected that the metric produces values in the range 0 to 100 for fully transparent and fully opaque prints respectively. These requirements exclude the use of the contrast ratio metric.

The method described in this document was tested using the data reported in Reference [6], and it was shown to correlate well with the visual perception of opacity.

This document is limited to the opacity of "opaque" white inks, as the published work cited in this document was limited to the evaluation of such inks. A method is described in Annex A showing how this document could be extended to test coloured inks. We anticipate that in the future this standard could be extended if there is a need and adequate experimental data. For this reason, the visual opacity metric defined in this document is not the simplest formula that fits the experimental data, but is one that gives good results and can readily be extended to colour inks and substrates if required. The metric is based on functions used in the Spot Colour Tone Value (SCTV) defined in ISO 20564.

Opaque white inks are formulated to be relatively opaque to light in order to hide any underlying matter, in contrast to "transparent" white inks which are formulated to permit transmission of light and are commonly used to extend coloured inks. For the purpose of this document, white ink is an ink formulated with an opaque white colorant that has a neutral colour and a reflectance factor greater than 80 %, and which is intended to have high opacity.

This document is also limited in the range of substrates to which it is intended to apply. Substrates should be either transparent, or have a CIELAB L* lightness of 80 or above and a CIELAB C^*_{ab} chroma of 20 or less.

Various factors can affect the appearance of opacity on a given substrate, including the presence of optical brightening agents in the ink or substrate, and to minimize such effects, it is assumed that the material is viewed and measured under standard conditions, where the viewing condition is defined by ISO 3664[7] P1 or P2 condition and the measurement by ISO 13655 M1 condition.