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Prepared by

Committee for Graphic Arts Technologies Standards (CGATS)

Graphic technology — Methodology for Establishing Printing Aims Based on a Shared Near-neutral Gray-scale

SECRETARIAT
NPES THE ASSOCIATION FOR SUPPLIERS OF PRINTING, PUBLISHING AND CONVERTING TECHNOLOGIES

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This Technical Report was developed in cooperation with Print Properties and Colorimetric Working Group of IDEAlliance.

Questions and comments regarding this Technical Report should be addressed to the CGATS Secretariat, NPES The Association for Suppliers of Printing, Publishing and Converting Technologies, 1899 Preston White Drive, Reston, Virginia 20191.

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Foreword

This CGATS Technical Report was prepared by the members of CGATS Subcommittee 3, Metrology & Process Control, in cooperation with the members of the GRACoL Working Group and the IDEAlliance Print Properties and Colorimetric Council. At the time of its approval, the following were the Participating Members and Observers of CGATS SC3.

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Introduction

Work within the IDEAlliance Print Properties Colorimetric Council to develop printing aims for a variety of processes (e.g. SWOP3, SWOP5, GRACoL, etc.) led to the realization that press calibration based on common 3-color gray balance and common near-neutral tone scale aims across families of printing conditions, simplified printing process control and movement of data between those printing conditions.

This document represents a shared effort between ANSI CGATS and the IDEAlliance Print Properties Colorimetric Council to document the fundamental principles behind the shared near-neutral gray-scale approach to press calibration and characterization data set development. It is not the intent of this document to provide how-to instructions or applications but rather to provide a common reference for such materials.

The expectation of the print buyer is that the image should look the same regardless of what type of printing press or paper is being used. The reality of the printer is that this expectation is difficult to meet.

Content is being shared across various types of printing. An image may be printed in a newspaper ad, in a magazine ad, and also on a cereal box. In other situations the print buyer might be looking for the best price from the printer, and may not care what type of press is used. Or, an individual printer may have the capability and latitude to decide, based on workload at the time, what type of press the job will run on. Changes in the paper to be used can also introduce modifications of the result.

A colorimetric match is not, in general, possible simply because different types of printing and different types of stock may have different gamuts. A color that is specified and printed on one type of press may just not be attainable on another. On the other hand, it is generally possible to find a reasonable compromise where the overall impression generated by two images is the same. This is something that has not been scientifically quantified. There is not an algorithm currently that can measure the extent that two images with slightly different color are perceived to match. It may be that, for the purposes of retail advertising, that this problem is not solvable. The colors that are important in an image of the color of a woman's face depend a lot on whether the ad is for make-up, hair coloring, or lipstick.

There are two important principals for process color printing. First, reproduction of tone scale and color for grays and near neutrals is a primary factor in assessing color quality. Second, for many images, an overall scaling of the gamut (called perceptual intent in ICC profiles) is preferable to clipping of the gamut at the edge (called relative colorimetric rendering intent). This is not necessarily true for product colors.

This technical report describes a near-neutral scale tone reproduction and gray balance aim that has been adopted by the IDEAlliance Print Properties Colorimetric Council as a common feature of its characterization data sets. This aim was used to develop the characterization data associated with the family of Reference Printing Conditions in ISO 15339-1. It can also be used for the calibration of any 3- or 4-color printing system or device to the same near-neutral scale aim.

In the traditional process control, one seeks to maintain standardized CIELAB values for the solids and overprints through overall process control and by final adjustment of the ink film thickness or pigment concentration on press. Tone value increase is measured on the printed sheet and accounted for through plate curves. Press maintenance helps to keep the tone value increase of the press constant. Thus the overall goal of traditional process control is to control the solids and the single ink tone scales. This has been shown to produce acceptable results in many situations. Under these conditions, the shared near-neutral gray-scale method and the traditional process control approach produce very similar results.

The aim points developed over the years for various types of printing (both process and substrate) are the result of optimization of that particular process and substrate, and are not the result of a deliberate attempt to harmonize the results from all the different processes. The basis of the "shared near-neutral gray-scale" method is the premise that since gray balance is generally perceived as being very important in image perception, the appropriate place to put aim points is in the near-neutral gray area.

Another shortcoming of the traditional printing aim points is that all are based on a specified paper color. Unfortunately paper color varies between paper types and even batch-to-batch within a given paper type. The color of the paper is important for several reasons. Clearly, the color of a tint is very dependent on the color of the paper, since much of the paper is visible. Second, since inks are translucent, the measured CIELAB values of a solid depend on the color of the paper. Third, it is perhaps not well appreciated that the perceived color of fixed CIELAB values depends on the color of the paper, since when no other white reference is available, the brain uses the paper as a white reference to compare other colors against. The “shared near-neutral gray-scale” method is based on a paper relative approach.

Simply put, the shared near-neutral gray-scale method is a set of definitions and equations that allow one to set aim points for printing. These definitions and equations are shared across printing platforms and substrates so that disparate printing methods can achieve some amount of similarity of the near-neutral tone scale. The method defines a relationship between the magenta (M) and yellow (Y) tone values and the cyan (C) tone values that is defined to be a substrate relative near-neutral tone scale. This set is identical across all print platforms and substrates. A computation is also provided that defines the absolute (measureable) color of this “neutral gray” as a function of the substrate color and the cyan tone value.

The shared near-neutral gray-scale method also includes an equation for the aim near-neutral tone reproduction curve based on the CIELAB L* of the three color overprint solid and separately for the black tone reproduction curve based on the black solid. This defines the “neutral print density” of any particular point on the near-neutral tone scale. This neutral print density can be directly converted into CIELAB L*. The goal of the aim near-neutral tone reproduction curve computation is to have (irrespective of printing process and substrate) the target neutral print densities reasonably close from the highlight end up to about 30% of the tonal range. At the shadow end of the tonal range the target neutral print density diverges depending on the CIELAB L* of the three color overprint solid.

Graphic technology — Methodology for Establishing Printing Aims Based on Shared Near-neutral Gray-scale Appearance

1 Scope

This Technical Report defines a methodology for establishing individual printing tone reproduction and near-neutral gray-scale aims, and families thereof, based on a shared near-neutral gray-scale definition.

This methodology can be used to establish such aims for any CMYK printing system regardless of the printing process used or gamut involved.

2 Normative references

The following referenced documents are indispensable for the application 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 13655:2009, *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

3.1
apparent neutral gray-scale
a range of tones from full coverage to unprinted substrate in which the appearance of each tone is that of a paper relative achromatic or gray stimulus

3.1
tone value (TV)
(data⟩ proportional printing value encoded in a data file and interpreted as defined in the file format specification, usually indicating the fraction of a picture element covered by ink

NOTE Tone value is expressed in units of percent of the solid or fully covered picture element.

3.2
tone value increase (TVI)
difference between the apparent tone value on the print and the tone value in the digital data file

3.3
near-neutral gray-scale
a predefined series of CMY tone values, from full coverage to unprinted substrate, in which the measured value of each tone is defined in terms of an achromatic stimulus as modified by the color of the paper