

Graphic technology — Process control — Certified reference material for opaque area calibration of transmission densitometers

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Summary of pages

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**Graphic technology — Process control —
Certified reference material for opaque area
calibration of transmission densitometers**

*Technologie graphique — Maîtrise de procédé — Matériel de référence
certifié pour la calibration des densitomètres transmission en pourcentage
de superficie opaque*



Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 12645 was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

Annexes A to E of this International Standard for information only.

Introduction

In the graphic arts, the modulation of transmittance or reflectance is often achieved by printing half-tones rather than continuous tones, as would be the case in photography.

The process control of the generation and transfer of half-tone patterns is essential to the graphic arts industry. For the process control of transmission type material one monitors the percentage of the total area that is virtually opaque. Measurements are carried out on well-defined half-tone control patches which contain regularly-spaced, circular half-tone dots. The measuring instrument is either a densitometer or a colorimeter of the spectrophotometer or tristimulus type. The opaque area percentage is usually set equal to the ratio of the relative transmittance factors of the half-tone and that of the solid. With densitometers one calculates the transmittance factors from the ISO standard diffuse (opal) densities, the corresponding expression for the ratio has been given by Murray and Davies, see [E.2] and equations (1) and (2) of clause 3.

In principle, the opaque area percentage for positive-polarity films should be identical to the tone value as defined in the graphic arts; for negative-polarity films it should be identical to 100 % minus the tone value. In reality, however, there may be errors which produce small deviations between the two quantities; there is thus a need for an independent check on the determination of the tone value by densitometers and colorimeters.

In the graphic arts process chain, particularly important steps are "image setting", "film duplication" and "platemaking". During these steps, there is no highly diffusive medium present which could be compared to the opal-glass diffuser of densitometers according to ISO 5-2 [E.3]. It would thus appear that the opal-glass instrument is not the best solution for graphic arts applications. However, the opal-glass design permits a relatively simple construction; such instruments are widely used in the graphic arts industry.

When calibrating a densitometer with a stepped density reference material (at least two steps), usually both the zero point and the slope factor are adjusted. The latter is the ratio of the density difference between the steps as read by the densitometer and the density difference as reported by a national standardizing laboratory. If the ratio deviates from 1, the base of the logarithm used for converting transmittance factor into transmittance factor density is not 10 as required by definition. As a consequence, the tone values calculated from the densities may deviate from the opaque area percentages. It is important to note that the (absolute) ISO standard diffuse density calibration of a densitometer may be dependent on the thickness of the sample. The stepped density reference material used for the density calibration should therefore have the same thickness as the samples to be measured, otherwise only relative densities can be measured. For many graphic arts applications, however, absolute density measurements are not the issue but the control of the opaque area percentage of half-tone film. This quantity determines the size of image elements, such as half-tone dots or lines, produced by transfer steps such as film duplication and platemaking. The densitometer is then zeroed on the clear film and the densities of a half-tone and a solid are measured. The Murray-Davies-formula, [E.2] and equations (1) and (2) of clause 3, is used to determine tone values from the density values, see also ISO 12647-1.

It is known that transmission densitometers of the opal type are subject to multiple oblique-angle interreflections between the opal and the surfaces close to it, see ISO 5-2 [E.3]. These include the two surfaces of the sample and those on the side of the instrument opposing the opal. For samples of low density, reflections from all those surfaces may contribute to the efflux measured at the back of the opal. At (absolute) ISO standard diffuse densities near zero, the densities read by an opal instrument are thus slightly lower than those of a diffuse sphere type instrument; 0,03 is a typical difference. This effect has to be taken into account if transmission densities or reflectance factors read by instruments of different design are compared. For samples of higher densities, the reflections from all surfaces but the surface next to the opal are effectively suppressed. During the measurement of a half-tone pattern, the latter influences the interreflection effect in two ways: The image elements may have a reflectance different from the film base, they also tend to attenuate reflections from surfaces further removed from the opal. Therefore, the tone values determined from densities measured with an opal instrument may differ from the actual opaque area percentage of the sample which can be determined by microscopic measurement or by a sphere type instrument (which does not show the interreflection effect).

ISO 12647-1 specifies that transmission densities shall be measured by instruments complying to ISO 5-2, thus there can be no ambiguity when quoting (absolute) ISO standard diffuse densities such as clear film densities.

The interreflection effect can be artificially attenuated if the opal is kept at a distance of, say, 25 mm from the measured object. Another method is to place a neutral filter with a density of at least 0,3 between the opal and the sample. The filter tends to attenuate the light coming back from the opal towards the sample and also the reflections.

The interreflection effect may produce a discrepancy of typically 3 % between the tone value of a half-tone as determined with a transmission densitometer of the opal type and the opaque area percentage as determined from independent measurements of the dot pattern. The discrepancy cannot be circumvented by proper zeroing or adjustment of the slope factor of the instrument, it depends on the magnitude of the opaque area percentage. Thus there is a need for an independent check on the tone value determination by a transmission densitometer and, if necessary, the establishment of a table that converts tone values into opaque area percentages. This International Standard specifies requirements for two types of reference materials that provide half-tone control patches with dot patterns of accurately defined dimensions that may serve as "Certified reference materials" (CRM) if the requirements of ISO 15790¹⁾ are also fulfilled.

Reference materials may be produced from half-tone film material or a thin glass slab with a chromium deposit. The latter's advantages are a very small fringe width, a wavelength-independent attenuation and a good uniformity of opaque area percentage over the control patch. The thickness, the scattering properties and the wavelength dependence of the transmission density differ from those of graphic arts film material. It might thus be suspected that this invalidates the use of such a reference material as a standard. It has been shown, however, that thickness changes of less than 1 mm shift only the zero point of a densitometer, thus the densitometric opaque area percentage calculation is not affected. Other test series showed that interposing films of varying scattering properties between the chromium/glass reference material and the opal did not affect the opaque area percentage determination, within the measurement accuracy. The absence of a wavelength dependence can be regarded as an asset: Since the wavelength dependencies of graphic arts films differ much from each other, there is no established dependence that could be used for such a reference material.

1) See informative annex E.