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Paper and board — Measurement of specular gloss —

Part 1: 75° gloss with a converging beam, TAPPI method

Papiers et cartons — Mesurage du brillant spéculaire —

Partie 1: Brillant à 75° avec un faisceau convergent, méthode TAPPI

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 8254-1 was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*.

This second edition cancels and replaces the first edition (ISO 8254-1:1999). It has been technically revised, in part to harmonize the wavelength specified in 5.2.1 with that specified in ISO 8254-2:2003 and ISO 8254-3:2004. The reference wavelength defining the high-gloss reference standard has been changed from 589,26 nm (sodium D line) to 587,56 nm (helium d line), but this change has a negligible effect on the measured specular gloss value.

ISO 8254 consists of the following parts, under the general title *Paper and board — Determination of specular gloss*:

— *Part 1: 75° gloss with a converging beam, TAPPI method*

— *Part 2: 75° gloss with a parallel beam, DIN method*

— *Part 3: 20° gloss with a converging beam, TAPPI method*

Introduction

This part of ISO 8254 deals with the assessment of the “gloss” of a paper or board surface by determining an optical property called the “specular gloss” which is here defined in terms of a measurement made at 75° using a converging beam geometry, commonly known as the TAPPI method and described in TAPPI 480 om-92[1]. Other parts of this International Standard deal with measurements made at 75° using a collimated beam geometry known as the DIN method, and with measurements made at 20°. Gloss results are greatly dependent on the angle of measurement and on the type of incident beam (converging or collimated), so conditions of measurement shall be carefully defined.

The definition of gloss (3.1) relates to a mode of visual perception, whereas the method described uses a physical measurement of mixed regular and diffuse reflection. The exact correlation between the visual perception and the scale established by the physical measurement is not known. However, this physical gloss scale has proved to be useful for a number of technical applications and consequently its standardization is justified.

Paper and board — Measurement of specular gloss —

Part 1:
75° gloss with a converging beam, TAPPI method

1 Scope

This part of ISO 8254 specifies a method for measuring the specular gloss of paper at an angle of 75° to the normal to the paper surface. Although its chief application is to coated papers, it may also be used for glossy uncoated papers such as supercalendered papers.

NOTE 1 This method does not provide an assessment of image-reflecting quality and should not be used for cast-coated, lacquered, highly varnished or waxed papers or for high-gloss ink films. For these purposes, measurements at other angles, for example 20°, are preferred, although the present method has been shown to be suitable for gloss measurements of most other ink films on paper or paperboard. Differences in the colour and the diffuse reflectances of these ink films have a negligible effect on gloss measured according to this part of ISO 8254. For example, measurements on white and black surfaces which are otherwise identical give a value for the white surface that is less than one gloss unit higher than the value for the black surface.

NOTE 2 The methods specified in ISO 2813, *Paints and varnishes — Determination of specular gloss of non-metallic paint films at 20°, 60° and 85°*, may be applicable to certain grades of paper.

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 186, *Paper and board — Sampling to determine average quality*

ISO 187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples*

3 Terms and definitions

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

3.1
gloss
mode of appearance by which reflected highlights of objects are perceived as superimposed on the surface due to the directionally selective properties of that surface

[CIE Publication No. 17.4:1987, definition 845.04.73[5]]

3.2
regular reflection
reflection at the specular angle in accordance with the laws of geometrical optics, without diffusion

[CIE Publication No. 17.4:1987, definition 845.04.45[5]]

3.3
diffuse reflection
diffusion by reflection in which, on the macroscopic scale, there is no regular reflection

[CIE Publication No. 17.4:1987, definition 845.04.47[5]]

3.4
specular angle
angle with respect to the normal to the surface, equal and opposite to and in the same plane as the angle of incidence

3.5
reflectometer
instrument for measuring quantities pertaining to the reception of reflected light

3.6
indicatrix
angular distribution of the reflected light

3.7
reflectometer value
measured variable which, for a given angle of incidence, is proportional to the integral of the reflection indicatrix within a defined solid angle and is equal to 100 times the ratio of the value obtained for the sample to that of a defined standard specularly reflecting surface

NOTE The value of 100 is a scale factor, since the defined specularly reflecting surface has an assigned reflectometer value of 100. It does not mean that the value is a percentage.

3.8
specular gloss
gloss observed or measured at the specular angle

3.9
specular gloss value
value equal to the reflectometer value measured in a reflectometer having the geometrical characteristics defined in Annex A and calibrated with respect to a defined primary gloss standard having the values specified in 5.2.1

NOTE 1 The specular gloss value is thus equal to 100 times the ratio of the luminous flux reflected by the test surface into a specified aperture at the specular angle to that from a standard specularly reflecting surface under the same conditions of illumination.

NOTE 2 The specular gloss value is a dimensionless quantity and is not a percentage.

4 Principle

Light incident on the test piece surface at an angle of 75° to the normal and reflected from the surface at an angle of 75° from the normal into a defined aperture is detected by a photodetector, the output of which is displayed.

5 Apparatus

5.1 Gloss meter, i.e. a reflectometer having the general arrangement and relative dimensions of the principal parts as described in Annex A. It shall consist of:

a) a source of light;

b) a lens giving a converging beam of light incident to the test piece;

c) a suitable device such as a suction plate to hold the test piece flat, if required;

d) a photodetector to receive and measure light reflected by the test piece under conditions specified in Annex A.

These components are combined in a light-tight housing that is matt black inside and is structurally and optically stable at the operating temperature.

5.2 Gloss standards, consisting of the following.

5.2.1 Primary gloss standard. The theoretical primary specular gloss standard is an ideal, completely reflecting plane mirror having an assigned gloss value of 384,4 gloss units. A black glass which is flat and clean and has a polished surface, having a refractive index of 1,540 at 587,56 nm (the helium d line), may be shown by the Fresnel equation [3] to measure 100 gloss units on this scale.

5.2.2 High-gloss reference standard, consisting of a clean plaque of polished black glass for which the 75° specular reflectance has been computed from its refractive index as measured at a wavelength of 587,56 nm.

If the refractive index differs from 1,540, the gloss value, G, shall be calculated as:

$$G = 100 \times K \tag{1}$$

where

$$K(n,\varepsilon) = \frac{\left[\dfrac{n^2\cos\varepsilon - \left(n^2 - \sin^2\varepsilon\right)^{0,5}}{n^2\cos\varepsilon + \left(n^2 - \sin^2\varepsilon\right)^{0,5}}\right]^2 + \left[\dfrac{\left(n^2 - \sin^2\varepsilon\right)^{0,5} - \cos\varepsilon}{\left(n^2 - \sin^2\varepsilon\right)^{0,5} + \cos\varepsilon}\right]^2}{\left[\dfrac{1{,}540^2\cos\varepsilon - \left(1{,}540^2 - \sin^2\varepsilon\right)^{0,5}}{1{,}540^2\cos\varepsilon + \left(1{,}540^2 - \sin^2\varepsilon\right)^{0,5}}\right]^2 + \left[\dfrac{\left(1{,}540^2 - \sin^2\varepsilon\right)^{0,5} - \cos\varepsilon}{\left(1{,}540^2 - \sin^2\varepsilon\right)^{0,5} + \cos\varepsilon}\right]^2} \tag{2}$$

where

n is the refractive index of the glass;

ε is the angle of incidence.

When $\varepsilon = 75°$, the equation reduces to:

$$K(n,75°) = 1{,}922\left(\left[\frac{0{,}2588n^2 - \left(n^2 - 0{,}933\right)^{0,5}}{0{,}2588n^2 + \left(n^2 - 0{,}933\right)^{0,5}}\right]^2 + \left[\frac{\left(n^2 - 0{,}933\right)^{0,5} - 0{,}2588}{\left(n^2 - 0{,}933\right)^{0,5} + 0{,}2588}\right]^2\right) \tag{3}$$