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Paper and board — Measurement of specular gloss —

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

Papiers et cartons — Mesurage du brillant spéculaire —
Partie 2: Brillant à 75° avec un faisceau parallèle, méthode DIN

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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 6, *Paper, board and pulps*.

This second edition cancels and replaces the first edition (ISO 8254-2:2003), which has been editorially revised (minor revision) to update the bibliographic references.

ISO 8254 consists of the following parts, under the general title *Paper and board — Measurement 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*

Annex A forms a normative part of this part of ISO 8254. Annex B is for information only.

Introduction

Visual gloss is a sensory impression which cannot yet be described completely. Some important physical variables which influence gloss are however known. The sensory perception of gloss under a suitable illumination results from a physical stimulus due to reflection of light from a surface. This reflection is defined by an indicatrix which changes with the angle of incidence. The maximum indicatrix value which is decisive for visual gloss impression is associated with specular reflection, at an angle of reflection which is approximately equal to the angle of incidence. The reflectometer value is determined by averaging the reflection in a defined angular region centred in the specular direction.

NOTE 1 A reflectometer value is a measure of the visual gloss only when the optical conditions of measurement, such as angles and apertures of illumination and observation, are similar to the conditions of viewing.

NOTE 2 Because luminance and structure enter to some extent into the reflectometer value of the test piece, only the comparison of test pieces with nearly the same luminance and structure is meaningful. The influence of luminance on the measurement result decreases rapidly with increasing reflectometer value and increasing angle of reflection.

The proportion of specular reflection in the entire reflection increases with increasing angle of incidence. Very matt surfaces generate a noticeable degree of specular reflection and, therefore, a noticeable gloss effect only above a certain minimum angle of incidence. On the other hand, a large angle of incidence reduces the ability to differentiate between surfaces of high gloss.

NOTE 3 Manufacturers of coated papers usually divide their products into two classes according to their surface gloss: matt coating and gloss coating. However, these classes are only defined approximately. The matt class has reflectometer values, measured according to this part of ISO 8254, from 0 to approximately 20. The glossy class has reflectometer values higher than this value. As there is no precise correlation between reflectometer values measured with different geometries, it is advisable to compare the reflectometer values only within a single class of papers and using the same measuring geometry.

This part of ISO 8254 describes measurement at an angle of incidence of 75° using a parallel beam geometry commonly known as the 75° DIN method. Precision data are not available at the time of publication.

NOTE 4 EN 14086 describes measurement at an angle of 45°.

Paper and board — Measurement of specular gloss —

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

1 Scope

This part of ISO 8254 specifies a photometric test method for the assessment of visual gloss by means of a reflectometer value measured at an angle of 75°. It is applicable to plane paper and board surfaces of gloss levels below 65, measured according to this part of ISO 8254. It should be the preferred method for paper and board surfaces of gloss levels below 20, measured according to this part of ISO 8254. Materials containing optical brightening agents may be measured.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

ISO 10110-5, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 5: Surface form tolerances*

CIE 038-1977, *Radiometric and photometric characteristics of materials and their measurement*

3 Terms and definitions

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

3.1
indicatrix
angular distribution of the reflected light which is measured as illuminance (lm m^{-2}) on the receptor

3.2
reflectometer
instrument for measuring quantities pertaining to reflection

3.3
reflectometer value
measured value which, for a given angle of incidence, is proportional to the integral of the reflection indicatrix within the solid angle defined by the apertures (see A.2.1) and is equal to 100 times the ratio of the value obtained for the sample to that of a defined specularly reflecting surface (5.2.2)

3.4
specular gloss
reflectometer value as defined in 3.3

Note 1 to entry: The defined specularly reflecting surface thus has an assigned reflectometer value of 100. Reflectometer values are therefore not percentages.

4 Principle

The sample is illuminated with a collimated beam at an angle of 75° to the normal, and the reflectometer value is measured within a solid angle defined by a given aperture at an angle of reflection equal to the angle of incidence. The scale of the reflectometer is calibrated with reference to the reflection from a black glass plate or a quartz wedge with a specific refractive index.

5 Equipment

5.1 Reflectometer

The reflectometer shall consist of the following principal components: a collimator, a decollimator, an electric supply for the light source device, a photoelectronic receptor and a sample holder, as described in Annex A.

5.2 Gloss standards

The reflectometer is calibrated by means of a zero-gloss standard and a high gloss standard with a reflectometer value between about 80 and 100. This high gloss standard can be either a primary gloss standard or a working gloss standard.

Intermediate gloss standards with assigned reflectometer values are used to check the adjustment of the device.

As reflectometer values of gloss standards may change due to environmental influences, they should be checked at least once per year.

5.2.1 Zero-gloss standards

A zero-gloss standard is a gloss standard which, in the ideal case, absorbs all light falling on it. A black cavity lined with black velvet or felt is one realization of such a gloss standard that has been proven in practice.

5.2.2 Primary gloss standards

A primary gloss standard is a gloss standard whose reflectometer value can be calculated by means of its refractive index using the Fresnel equation. The reflectometer value is defined as being equal to 100 for a black glass plate or a fused quartz wedge with a nominal refractive index of n = 1,567 at a wavelength of 587,6 nm (He-d- line). A black glass plate or quartz wedge with a refractive index at a wavelength of 587,6 nm (see ISO 7944) known to three decimal places can be used as primary gloss standard. The top surface of the glass plate or quartz wedge shall be plane to within 2 fringes per centimetre as measured by an optical interference method in a wavelength region of (600 ± 100) nm

according to ISO 10110-5. If the refractive index n differs from 1,567, the reflectometer value R shall be calculated as

$$R = 100 \cdot K \tag{1}$$

where

$$K\left(n, \varepsilon_1\right) = \frac{\left[\frac{n^2 \cos\varepsilon_1 - \left(n^2 - \sin^2\varepsilon_1\right)^{1/2}}{n^2 \cos\varepsilon_1 + \left(n^2 - \sin^2\varepsilon_1\right)^{1/2}}\right]^2 + \left[\frac{\left(n^2 - \sin^2\varepsilon_1\right)^{1/2} - \cos\varepsilon_1}{\left(n^2 - \sin^2\varepsilon_1\right)^{1/2} + \cos\varepsilon_1}\right]^2}{\left[\frac{1{,}567^2 \cos\varepsilon_1 - \left(1{,}567^2 - \sin^2\varepsilon_1\right)^{1/2}}{1{,}567^2 \cos\varepsilon_1 + \left(1{,}567^2 - \sin^2\varepsilon_1\right)^{1/2}}\right]^2 + \left[\frac{\left(1{,}567^2 - \sin^2\varepsilon_1\right)^{1/2} - \cos\varepsilon_1}{\left(1{,}567^2 - \sin^2\varepsilon_1\right)^{1/2} + \cos\varepsilon_1}\right]^2} \tag{2}$$

For $\varepsilon_1 = 75°$:

$$K\left(n, 75°\right) = 1{,}890 \cdot \left[\left[\frac{0{,}2588 \cdot n^2 - \left(n^2 - 0{,}9330\right)^{1/2}}{0{,}2588 \cdot n^2 + \left(n^2 - 0{,}9330\right)^{1/2}}\right]^2 + \left[\frac{\left(n^2 - 0{,}9330\right)^{1/2} - 0{,}2588}{\left(n^2 - 0{,}9330\right)^{1/2} + 0{,}2588}\right]^2\right] \tag{3}$$

It is recommended that the refractive index be defined by means of the critical angle of total reflection, i.e. by means of an Abbe refractometer.

5.2.3 Working standards

Any clean non-fluorescent flat surface, which has a reflectometer value between 80 and 100, can be used as a working gloss standard. Care has to be taken to ensure that only a negligible reflection from the reverse side of the gloss standard can reach the surface which is measured. This can be achieved by giving the gloss standard the shape of a wedge, or making it opaque. The surface which is not measured should be matte. A reflectometer system conforming to the description given in Annex A shall be used to establish the relationship with the primary gloss standard. When the gloss standard is measured in two perpendicular directions and in the directions of their diagonals, the difference shall not be more than ±1 unit. If this is not the case, the reflectometer value of the working gloss standard shall be assigned only for a particular direction of the incident light radiation and the working gloss standard should be used only in that direction.

5.2.4 Intermediate gloss standards

Intermediate gloss standards are gloss standards with assigned reflectometer values between 0 and 100 and which are calibrated by technically competent organizations.

For the purpose of this part of ISO 8254, an intermediate gloss standard with an assigned reflectometer value of about 20 is required.

The surfaces of gloss standards should not be touched with hard instruments, as this can damage the surface. Gloss standards are generally put against the sample port of the reflectometer. Measurements should always be made at the same position on the gloss standard. If the sample port of the reflectometer is located at this place, any damage will be avoided. Gloss standards should be cleaned very carefully with a soft cloth to avoid surface deterioration.

As reflectometer values of gloss standards may change due to environmental influence, they should be checked once per year.

NOTE An organization capable of calibrating gloss standards is listed in Annex B.