SLOVENSKI STANDARD
SIST EN 14086:2003

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Papir, karton in lepenka – Merjenje zrcalnega sijaja – 45-stopinjski sijaj z vzporednim snopom svetlobe, metoda po DIN

Paper and board - Measurement of specular gloss - 45° gloss with a parallel beam, DIN method

Papier und Pappe - Bestimmung des Glanzes - Messung mit einem parallelen Strahl bei 45°, DIN-Verfahren

Papiers et cartons - Mesurage du brillant spéculaire - Brillant a 45° avec un faisceau parallele, méthode DIN

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Paper and board - Measurement of specular gloss - 45° gloss with a parallel beam, DIN method

Papiers et cartons - Mesurage du brillant spéculaire - Brillant à 45° avec un faisceau parallèle, méthode DIN

Papier und Pappe - Bestimmung des Glanzes - Messung mit einem parallelen Strahl bei 45°, DIN-Verfahren

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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Contents

Foreword

This document (EN 14086:2003) has been prepared by Technical Committee CEN /TC 172, "Pulp, paper and board", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2003, and conflicting national standards shall be withdrawn at the latest by July 2003.

This Standard is in relation to EN ISO 8254 respectively ISO 8254 with the following parts

— EN ISO 8254-1 "Paper and board – Measurement of specular gloss – Part 1: 75° gloss with a converging beam, TAPPI method

— EN ISO 8254-2 "Paper and board – Measurement of specular gloss – Part 2: 75° gloss with a parallel beam, DIN method

— ISO/DIS 8254-3 "Paper and board – Measurement of specular gloss – Part 3: 20° gloss

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

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 centered 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 glossy class has reflectometer values, measured according to this European Standard, above approximately 7, the matt class has reflectometer values lower 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 European Standard describes measurement at an angle of incidence of 45° using a parallel beam geometry commonly known as the 45° DIN method. A second European Standard describes measurement at an angle of 75° (see EN ISO 8254-2).

1 Scope

This European Standard specifies a photometric test method for the assessment of visual gloss by means of a reflectometer value measured at an angle of 45°. It is applicable to plane paper and board surfaces of high gloss, commonly called glossy papers and boards, having reflectance values, measured according to this European Standard, above approximately 7. Materials containing optical brightning agents may be measured.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

CIE-Publication No. 38, *Radiometric and photometric characteristics.*

EN ISO 186, *Paper and board — Sampling to determine average quality (ISO 186:1994).*

EN 20187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples (ISO 187:1990).*

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

3 Terms and definitions

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

3.1
indicatrix
angular distribution of the reflected light which is measured as illuminance on the receptor.

3.2
reflectometer
instrument for measuring quantities pertaining to reflection of light.

3.3
reflectometer value
measured variable 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 Annex 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 (see 5.2.2).

3.4
specular gloss
reflectometer value as defined in 3.3.

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

NOTE 2 These definitions are based on definitions in CIE Publication No. 17.4.

4 Principle

The sample is illuminated with a collimated beam at an angle of 45 ° 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 Apparatus

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.

NOTE 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 realisation 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 at $n = 1{,}567$ at a wavelength of 587,6 nm (He-d-line). A black glass plate or quartz wedge with a refractive index of a wavelength of 587,6 nm (see ISO 7944) known to 3 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

$$K(n,\varepsilon_1) = \frac{\left[\dfrac{n^2\cos\varepsilon_1 - (n^2-\sin^2\varepsilon_1)^{½}}{n^2\cos\varepsilon_1 + (n^2-\sin^2\varepsilon_1)^{½}}\right]^2 + \left[\dfrac{(n^2-\sin^2\varepsilon_1)^{½} - \cos\varepsilon_1}{(n^2-\sin^2\varepsilon_1)^{½} + \cos\varepsilon_1}\right]^2}{\left[\dfrac{1{,}567^2\cos\varepsilon_1 - (1{,}567^2-\sin^2\varepsilon_1)^{½}}{1{,}567^2\cos\varepsilon_1 + (1{,}567^2-\sin^2\varepsilon_1)^{½}}\right]^2 + \left[\dfrac{(1{,}567^2-\sin^2\varepsilon_1)^{½} - \cos\varepsilon_1}{(1{,}567^2-\sin^2\varepsilon_1)^{½} + \cos\varepsilon_1}\right]^2} \tag{2}$$

For $\varepsilon_1 = 45°$:

$$K(n,45°) = 8{,}374 \cdot \left[\left[\frac{0{,}7071\cdot n^2 - (n^2-0{,}5)^{½}}{0{,}7071\cdot n^2 + (n^2-0{,}5)^{½}}\right]^2 + \left[\frac{(n^2-0{,}5)^{½} - 0{,}7071}{(n^2-0{,}5)^{½} + 0{,}7071}\right]^2\right] \tag{3}$$

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

5.2.3 Working gloss 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 matt. A reflectometer system conforming to the description given in annex A must 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 must be assigned only for a particular direction of the incident light radiation and the working gloss standard must 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 organisations.

For the purpose of this European Standard, an intermediate gloss standard with an assigned reflectometer value of about 50 is required.

NOTE 1 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.

NOTE 2 As reflectometer values of gloss standards may change due to environmental influence, they should be checked once per year.

NOTE 3 An organisation capable of calibrating gloss standards is listed in annex B.

6 Sampling

Sampling is not included in this European Standard. If the mean quality of a lot is to be determined, sampling shall be in accordance with EN ISO 186. If the tests are made on an other type of sample, make sure that the test pieces are representative of the sample received.

7 Preparation of test pieces

7.1 Conditioning

Condition the samples at 23°C and 50 % r.h. according to EN 20187 and keep them in this climate throughout the test.

7.2 Preparation

Prepare test pieces, ensuring that they are free from any scratches, dust, folds or other damage. For each side of the paper to be tested, cut at least five test pieces. The surface to be measured must not be touched by hand.

If the measurement field area (see annex A.1) is less than 100 mm², the minimum number of test pieces shall be increased. In that case, the minimum number of test pieces is determined as:

$$N = 5 \cdot \frac{100}{A} \tag{4}$$

where

A is the actual measurement area in mm²;

N is the minimum number of test pieces rounded to the next higher integer.

8 Procedure

8.1 Calibration

8.1.1 Place the zero-gloss standard (5.2.1) against the test piece port of the instrument. Adjust the reflectometer value to 0,0 ± 0,1 scale unit by means of the zero adjustment device.

8.1.2 Place the primary gloss standard (5.2.2) or a working standard (5.2.3) against the test piece port of the instrument. Adjust the reflectometer value by means of the calibration device so that the scale reading agrees with the value assigned to the primary gloss standard or the working gloss standard.

8.1.3 Place an intermediate gloss standard with a reflectometer value of about 50 (5.2.4) against the port of the reflectometer. Check that the reflectometer value agrees to within 0,5 reflectometer unit with the value assigned to the gloss standard.