

BS EN ISO 13803:2014



BSI Standards Publication

# Paints and varnishes — Determination of haze on paint films at 20 degrees

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**National foreword**

This British Standard is the UK implementation of EN ISO 13803:2014. It supersedes BS EN ISO 13803:2004 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee STI/10, Test methods for paints.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Date	Text affected

English Version

## Paints and varnishes - Determination of haze on paint films at 20 degrees (ISO 13803:2014)

Peintures et vernis - Détermination du voile sur des feuillets de peinture à 20 degrés (ISO 13803:2014)

Beschichtungsstoffe - Bestimmung des Schleiers von Beschichtungen bei 20° (ISO 13803:2014)

This European Standard was approved by CEN on 24 August 2014.

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## Foreword

This document (EN ISO 13803:2014) has been prepared by Technical Committee ISO/TC 35 "Paints and varnishes" in collaboration with Technical Committee CEN/TC 139 "Peintures et vernis" 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of an identical text or by endorsement, at the latest by April 2015, and conflicting national standards shall be withdrawn at the latest by April 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 13803:2004.

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### Endorsement notice

The text of ISO 13803:2014 has been approved by CEN as EN ISO 13803:2014 without any modification.

# Contents

Page

<b>Foreword</b> .....	<b>iv</b>
<b>Introduction</b> .....	<b>v</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Principle</b> .....	<b>1</b>
<b>5 Apparatus and materials</b> .....	<b>2</b>
5.1 Hazemeter.....	2
5.2 Measurement standards (certified reference material, working measurement standards).....	6
<b>6 Test panels</b> .....	<b>7</b>
6.1 Substrate.....	7
6.2 Preparation and coating.....	7
6.3 Drying and conditioning.....	7
6.4 Thickness of coating.....	7
<b>7 Calibration and adjustment of the hazemeter</b> .....	<b>7</b>
7.1 Preparation of the apparatus.....	7
7.2 Zero point check.....	7
7.3 Calibration and adjustment.....	7
<b>8 Procedure</b> .....	<b>8</b>
8.1 General.....	8
8.2 Haze measurement of coatings from liquid paints and powder coating materials on glass plates.....	8
8.3 Haze measurement on other coated dry substrates.....	8
<b>9 Precision</b> .....	<b>8</b>
9.1 General.....	8
9.2 Repeatability limit $r$ .....	8
9.3 Reproducibility limit $R$ .....	9
<b>10 Test report</b> .....	<b>9</b>
<b>Annex A (normative) Calculation of linear haze</b> .....	<b>10</b>
<b>Bibliography</b> .....	<b>11</b>

## 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](http://www.iso.org/directives)).

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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 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

This second edition cancels and replaces the first edition (ISO 13803:2000), which has been technically revised. The main technical changes are:

- a) the symbols have been adapted to the revision of ISO 2813;
- b) an introduction and a principle clause have been added;
- c) the supplementary test conditions have been included in the test report;
- d) the normative references have been updated.

## Introduction

High quality surfaces are expected to have a clear and brilliant appearance. Microstructures can cause a milky appearance. This effect is described as haze. A high gloss surface with microscopic texture has diffused light with low intensity adjacent to the main direction of reflection. The majority of the incident light is reflected in the specular direction which will make the surface appear high glossy with image forming qualities, but with a milky haziness on top of it.

The phenomenon haze can be seen on high gloss surfaces only. Therefore, the 20° geometry is used like with a gloss meter. The aperture range of a 20° gloss meter is 1,8°. Two additional sensors next to the gloss detector measure the intensity of the diffused light responsible for haze. Thus, the specularly reflected and the scattered light are measured simultaneously. In order to better correlate with the visual perception, haze is displayed in a logarithmic scale – the lower the haze reading the better the surface.

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# Paints and varnishes — Determination of haze on paint films at 20°

## 1 Scope

This International Standard specifies a test method for determining the haze of coatings. The method is suitable for the haze measurement of non-textured coatings on plane, opaque substrates.

The use of the 20° geometry means that the method is closely related to the measurement of gloss at 20° in ISO 2813. The application of this method is intended to give improved differentiation between high-gloss surfaces, for example in the field of assessment of dispersion characteristics.

## 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 1514, *Paints and varnishes — Standard panels for testing*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 2813, *Paints and varnishes — Determination of gloss value at 20°, 60° and 85°*

## 3 Terms and definitions

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

### 3.1

#### **haze**

milky opalescence in high-gloss or clear coatings

[SOURCE: ISO 4618:2014, 2.137]

### 3.2

#### **geometry**

identification of a method of haze measurement using a specified angle with assigned apertures

[SOURCE: ISO 2813:2014, 3.2, modified — the term “gloss” has been replaced with “haze”.]

### 3.3

#### **haze value**

ratio of the luminous flux reflected and diffusely scattered from an object adjacent to the specular direction for a specified source and receptor angle to the luminous flux reflected from glass with a refractive index of 1,567 in the specular direction, this glass being assigned the value of 100 on the linear haze scale

Note 1 to entry: The measurement of haze value is related to the measurement of gloss in accordance with ISO 2813.

## 4 Principle

With a reflectometric apparatus haze values are determined on coated surfaces, correlating with the visual haze perception.

The method of haze measurement is specified by the following parameters:

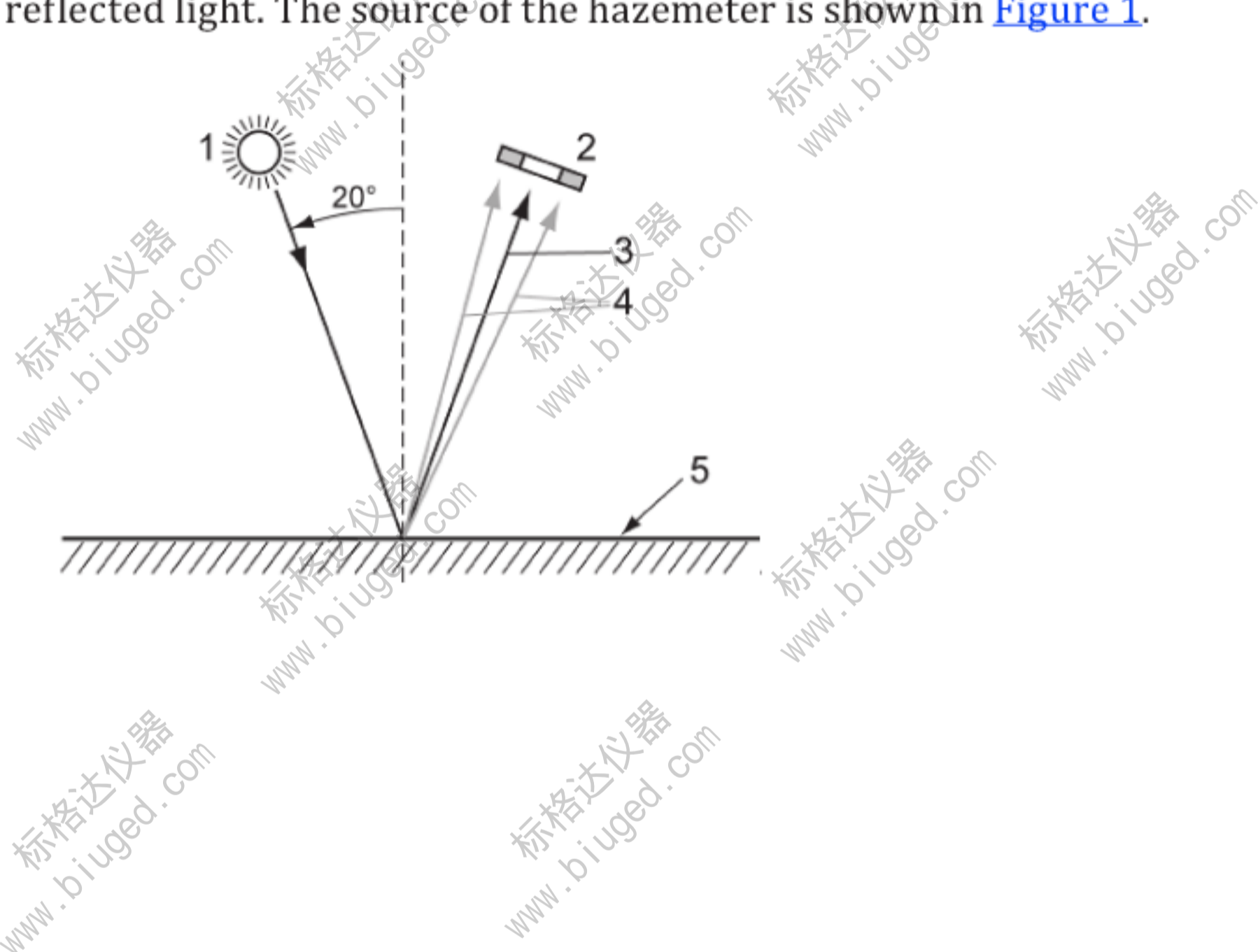
- measuring angles;
- field stop apertures;
- spectral adaptation;
- reference refractive index.

## 5 Apparatus and materials

### 5.1 Hazemeter

#### 5.1.1 General

The hazemeter shall consist of a light source and a lens that directs a parallel beam of light onto the surface under test, plus a receptor housing containing a lens, a field stop and a photoelectric cell to receive the required cone of reflected light. The source of the hazemeter is shown in [Figure 1](#).



#### Key

- 1 light source
- 2 sensor
- 3 gloss
- 4 haze
- 5 test surface

**Figure 1 — Measuring angle of 20°**

#### 5.1.2 Geometries

The axis of the incident beam shall be at an angle  $\alpha_1 = (20,0 \pm 0,1)^\circ$  (see [Figure 1](#)) to the normal to the surface under test. With a flat piece of polished black glass or a front reflecting mirror instead of the test panel position, the source field stop shall be reproduced at the centre of the receptor field stop (see [Figure 3](#)).

The optical axis of the receptor shall be coincident with the mirror image of the axis of the incident beam to within  $\pm 0,1^\circ$ , i.e. the condition  $|\alpha_1 - \alpha_2| < 0,1^\circ$  shall be fulfilled (see [Figure 2](#)).

The dimensions of the source aperture and the receptor aperture and the permissible tolerances shall be as indicated in [Table 1](#).

In order to average out the entire surface, the width of the illuminated area on the test panel shall be significantly larger than possible surface irregularities: a generally accepted value is 10 mm.

The angular dimensions of the receptor field stop shall be measured from the receptor lens.

There shall be no vignetting of rays that lie with the specified angular fields.

The photoelectric cell shall give a reading proportional to the light flux passing the receptor field stop, to a deviation within 1 % of the full-scale reading

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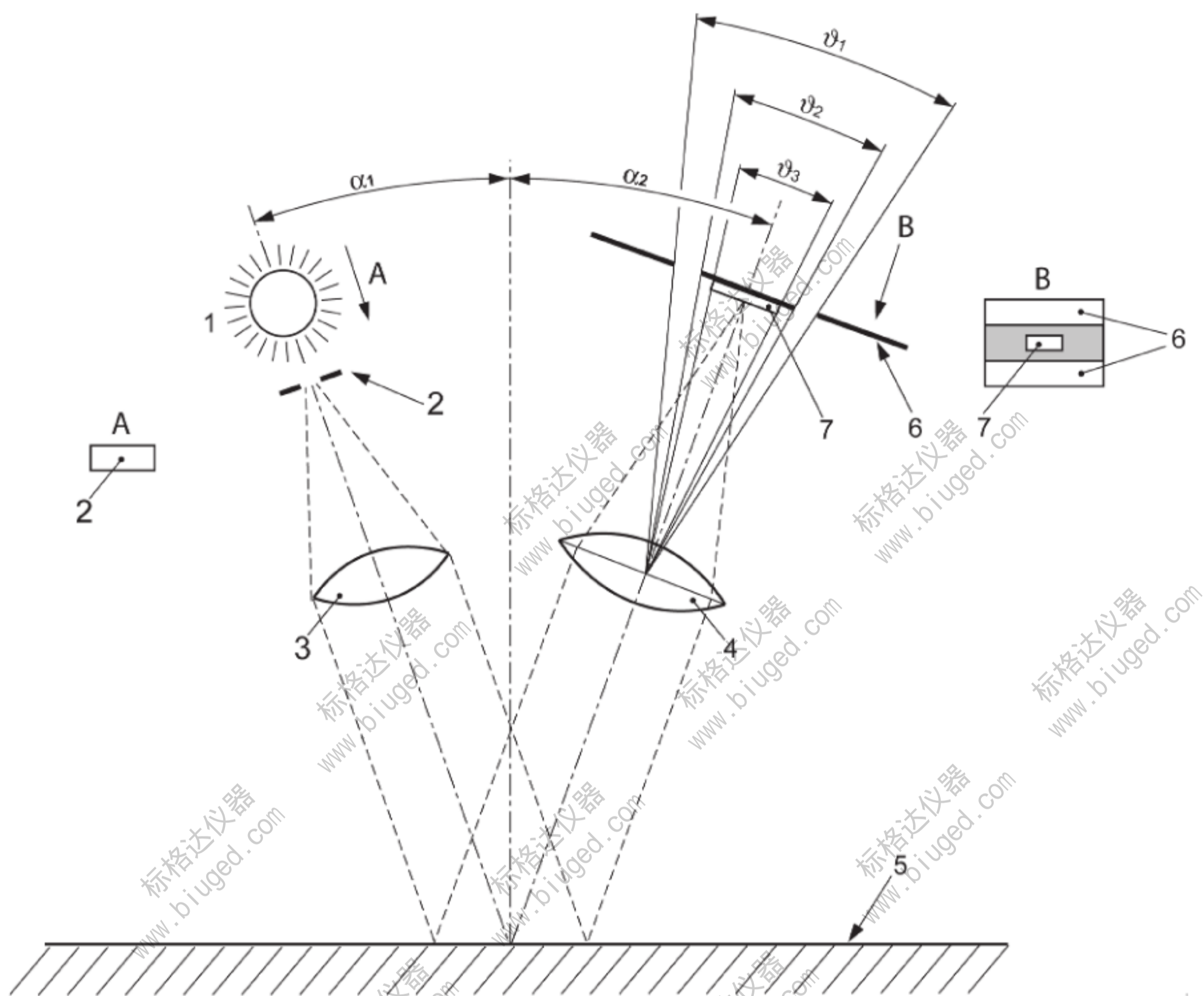
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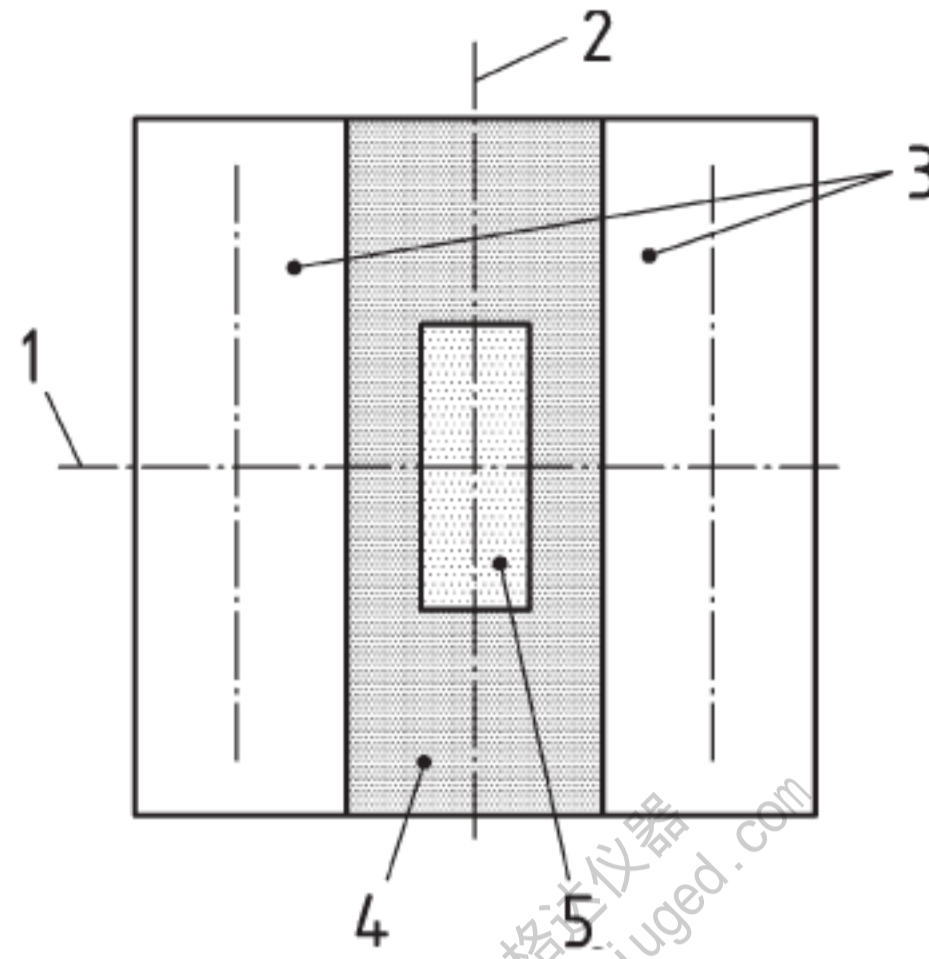
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**Key**

- 1 light source
- 2 source image aperture
- 3 source lens
- 4 receptor lens
- 5 test surface
- 6 receptor area
- 7 image of the source aperture in the receptor field stop
- $\alpha_1$  angle of the beam against surface normal
- $\alpha_2$  reflection angle of the beam refracted from medium 2 (against surface normal)
- $\vartheta_1$  receptor aperture
- $\vartheta_2$  central opaque zone of the receptor aperture
- $\vartheta_3$  source image aperture angle

**Figure 2 — Course of beam of the hazemeter**



**Key**

- 1 plane of measurement
- 2 plane perpendicular to plane of measurement
- 3 receptor area
- 4 receptor field stop
- 5 image of the source aperture in the receptor field stop

**Figure 3 — Receptor field stop**

**5.1.3 Filtering at the receptor**

Filtering at the receptor shall be done in such a way that the transmittance of the filter  $\tau(\lambda)$  is given by Formula 1:

$$\tau(\lambda) = k \frac{V(\lambda) \times S_C(\lambda)}{L(\lambda)_{\text{rel}} \times L_S(\lambda)} \quad (1)$$

where

- $V(\lambda)$  is the CIE photopic luminous efficiency;
- $S_C(\lambda)$  is the spectral power distribution of CIE illuminant C;
- $L(\lambda)_{\text{rel}}$  is the relative spectral sensitivity of the receptor;
- $L_S(\lambda)$  is the spectral power distribution of the light source;
- $k$  is the calibration constant.

**Table 1 — Angles of source image aperture and receptor aperture**

	Angle	
	in parallel to plane of reflection	perpendicular to plane of reflection
Source image aperture $\vartheta_3$	$0,75^\circ \pm 0,10^\circ$	$2,50^\circ \pm 0,1^\circ$
Receptor aperture $\vartheta_1$	$5,50^\circ \pm 0,25^\circ$	$5,50^\circ \pm 0,25^\circ$
Central opaque part of receptor aperture $\vartheta_2$	$2,00^\circ \pm 0,1^\circ$	$5,50^\circ \pm 0,25^\circ$

NOTE 1 In [Figure 3](#) the plane of reflection corresponds to the plane of illustration.

NOTE 2 In [Figure 3](#) only the aperture angles in parallel to the plane of reflection are illustrated.

## 5.2 Measurement standards (certified reference material, working measurement standards)<sup>1)</sup>

### 5.2.1 High gloss standard A (working measurement standard)

Plane black glass plate with the following properties:

- surface grinded and polished;
- gloss values  $\geq 88$  GU.

Thickness, rear side, and edges shall be made in such a way that interfering light, scattered light, and reflected light from the edges and the rear side are avoided.

The following specifications parameters shall be recorded on the standard:

- direction of measurement;
- geometry (geometries);
- assigned gloss value(s).

Further details are to be taken from ISO 2813.

### 5.2.2 Haze standard B (working measurement standard)

Haze standards, made of ceramic tile, vitreous enamel, opaque glass, or other materials with uniform haze. They shall have been calibrated against a primary reference standard for an indicated area and direction of illumination. Working reference standards shall be uniform and stable. At least two standards of different haze levels shall be available.

The haze standard shall be checked periodically by comparison with primary reference standards.

### 5.2.3 Zero standard C (working measurement standard) in accordance with ISO 2813

Plane plate made of metal, glass, or rigid plastics [e.g. poly(methyl methacrylate) – PMMA] with or without a coating whose gloss for all geometries is lower than 0,1 GU.

NOTE 1 Black flock has been proved suitable for use as coating material for the zero standard.

NOTE 2 Hazemeters with automatically proceeding calibration routine do not require a zero standard, since the zero calibration and the offset adjustment are carried out with the light source turned off.

1) See terms in ISO/IEC Guide 99.

## 6 Test panels

### 6.1 Substrate

Unless otherwise agreed, select the substrate corresponding to the intended practical use from the substrates described in ISO 1514. The test panels shall be plane and free of deformations.

### 6.2 Preparation and coating

Prepare each test panel in accordance with ISO 1514 and coat it in accordance with the specified method with the coating material or multi-coat system to be tested.

### 6.3 Drying and conditioning

Dry/harden (stove, if applicable) and age, if applicable, each coated test panel for the specified period of time and under the specified conditions. Condition the coated test panels before the test at  $(23 \pm 2)$  °C and a relative humidity of  $(50 \pm 5)$  % for at least 16 h. Other specifications for conditioning may be agreed and shall be indicated in the test report.

Finger prints, dust, or other contaminations on the surface lead to changes and/or imprecise haze values. Consequently, the coated test panels shall be stored and handled accordingly.

### 6.4 Thickness of coating

Determine the dry film thickness of the coating, in micrometres, in accordance with one of the methods specified in ISO 2808.

For comparative measurements the film thicknesses shall correspond.

## 7 Calibration and adjustment of the hazemeter

### 7.1 Preparation of the apparatus

Calibrate the apparatus at the start of every period of operation and during operation at intervals sufficiently frequent to ensure correct measuring values.

### 7.2 Zero point check

Use the zero standard C (5.2.3) to check the zero point.

If the measuring value on this standard is not within  $\pm 0,1$  gloss unit (GU) of zero, calibrate the apparatus or subtract the deviation from subsequent readings.

NOTE Hazemeters with automatically proceeding calibration routine do not require a zero reference standard, since the zero calibration and the offset adjustment are carried out with the light source turned off.

### 7.3 Calibration and adjustment

Using the high gloss standard A or that of the two working reference standards having higher haze value, adjust the instrument to the selected value for haze in the upper part of the scale. Calibration with the high gloss standard A may be performed in two ways (the manufacturer of the instrument should recommend one of the two calibration methods to his customer):

- a) by tilting the standard in the plane of measurement by an angle of  $0,7^\circ$  to  $0,9^\circ$  (in either direction) to project the image of the light source into a non-obscured part of the receptor aperture;
- b) by removing temporarily the central obscuring part of the receptor aperture.

Next take a second working reference (with lower haze) and make a measurement with the same control settings. If the reading is within one scale unit of the assigned value, the tolerance requirement is met, but if the reading is outside this tolerance carry out an additional measurement with a further working reference standard. If both values differ by more than one scale unit from the assigned values, adjust the instrument in accordance with the manufacturer's instructions and repeat the calibration procedure until the working reference standards can be measured with the required accuracy. If the repeat value is within one scale unit, tests may be carried out. However, calibration checks shall be carried out before each test determination.

## 8 Procedure

### 8.1 General

Haze measurements in accordance with this International Standard are only meaningful if determined on surfaces of good planarity. Any curvature or local unevenness of the substrate will affect the test results. Unless agreed otherwise, the direction of brush marks, raised wood grain, or similar regular texture effects shall be in parallel to the plane of incidence and reflection of the instrument.

The measured linear haze value  $H_{\text{linear}}$  will depend on the lightness of the specimen. With specimens of different lightness, comparable results can nevertheless be obtained by compensating for lightness differences and reporting as logarithmic haze values  $H_{\log 20}$  as specified in [Annex A](#).

### 8.2 Haze measurement of coatings from liquid paints and powder coating materials on glass plates

After calibrating and adjusting the hazemeter, for test coatings on a glass plate take three readings in different positions in parallel to the direction of application. If the spread of results is less than 0,5 units, report the mean value as the  $H_{\text{linear}}$  value; otherwise take three further measurements and report the mean and range of all six values.

### 8.3 Haze measurement on other coated dry substrates

By means of the hazemeter measure on at least five representative positions with the 20° geometry and the agreed direction of measurement. If the deviation of the readings is less than 5 GU, report the mean value rounded to full unit as the haze value. Otherwise take further readings and report the mean value of all values.

## 9 Precision

### 9.1 General

The following precision data have been obtained under laboratory conditions. In practice there are parameters that can lead to significantly higher deviations of measuring values.

### 9.2 Repeatability limit $r$

The repeatability limit  $r$  is the value below which the absolute difference between the mean values of two separate sets of three values, obtained on a coating of the same product on glass plate, can be expected to lie when this method is used under repeatability conditions. In this case, the results are obtained on identical material by one operator in one laboratory within a short interval of time using the same equipment and following the standardized test method. In this International Standard,  $r$  is 1 % of the mean values or 0,2 units, whichever is the larger, with a 95 % probability.



### 9.3 Reproducibility limit $R$

The reproducibility limit  $R$  is the value below which the absolute difference between the mean values of two separate sets of three values, obtained on a coating of the same product on glass plate, can be expected to lie when this method is used under reproducibility conditions. In this case, the results are obtained on identical material by operators in different laboratories within a short interval of time using the same equipment and following the standardized test method. In this International Standard,  $R$  is 5 % of the mean values or 1 unit, whichever is the larger, with a 95 % probability.

## 10 Test report

The test report shall contain at least the following information:

- a) all details for complete identification of the coating tested (manufacturer, trade name, batch number, etc.);
- b) a reference to this International Standard (i.e. ISO 13803);
- c) any details on the preparation of test specimens, including
  - 1) material (including thickness) and surface preparation of the substrate (see [6.1](#)),
  - 2) method for coating the substrate (see [6.2](#)),
  - 3) duration and conditions for hardening (drying/hardening, including stoving) of the coating and, if applicable, ageing conditions of the coating before measuring (see [6.3](#)),
  - 4) dry film thickness of the coating, in micrometres, including the method of measurement in accordance with ISO 2808 and indication if it is a single coat or a coating system (see [6.4](#));
- d) identification (type, manufacturer) of the hazemeter used;
- e) the results of the tests, expressed as the mean linear haze value  $H_{\text{linear}}$  or, by agreement, as the mean logarithmic haze value ( $H_{\log 20}$ ) and, where required, the number, mean value, and extreme values of replicate results;
- f) any deviation from the test method specified;
- g) details of any specific points on which agreements between the interested parties were necessary;
- h) any unusual features (anomalies) observed during the test;
- i) the date of the test.

## Annex A (normative)

### Calculation of linear haze

Linear haze values may be converted, by agreement, to logarithmic values using the following equations.

$$H_{\text{comp}} = H_{\text{linear}} - \frac{Y_{\text{specimen}}}{Y_{\text{BaSO}_4}} \times H_{\text{linear, BaSO}_4}$$

$$H_{\log 20} = k \times \log \left( \frac{H_{\text{comp}}}{20} + 1 \right)$$

where

- $H_{\text{comp}}$  is what is referred to as the lightness-compensated haze value;
- $H_{\log 20}$  is the logarithmic haze value of the specimen;
- $H_{\text{linear}}$  is the linear haze value of the specimen;
- $H_{\text{linear, BaSO}_4}$  is the linear haze value of a BaSO<sub>4</sub> standard;
- $Y_{\text{specimen}}$  is the tristimulus value  $Y$  of the specimen (see Note 1);
- $Y_{\text{BaSO}_4}$  is the tristimulus value of a BaSO<sub>4</sub> standards (see Notes 1 and 2);
- $k$  is a constant ( $k = 1\,285$  is used in order to give an  $H_{\log}$  value of 1 000 at an  $H_{\text{linear}}$  value of 100).

Conversion using this empirically derived function gives the following advantages.

The lightness-compensated haze value  $H_{\text{comp}}$  gives comparable results on specimens with different lightness levels, because the luminous flux entering the haze receptor is reduced by the diffuse reflection in accordance with Lambert's law.

The logarithmic haze value  $H_{\log 20}$  gives good correlation with visual assessment, in accordance with Weber-Fechner's law.

NOTE 1 The tristimulus value  $Y$ , as defined in ISO 11664-3, gives a measure of the lightness. It is required that the conditions of measurement used are: 45°:0°, illuminant C and 2° observer. Slightly different conditions will not result in significant errors.

NOTE 2 BaSO<sub>4</sub> is used here as a good substitute for a perfectly reflecting diffusor. Other materials with similar properties may also be used.

## Bibliography

- [1] ISO 4618:2014, *Paints and varnishes — Terms and definitions*
- [2] ISO 11664-3, *Colorimetry — Part 3: CIE tristimulus values*
- [3] ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

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