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

Peintures et vernis — Détermination de l'indice de brillance à 20°, 60° et 85°

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Foreword

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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).

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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 fourth edition cancels and replaces the third edition (ISO 2813:1994), which has been technically revised. It also incorporates the Technical Corrigendum ISO 2813:1994/Cor.1:1997.

The main technical changes are:

a) the title has been changed;

b) the scope has been extended to include gloss measurement of metallic coatings;

c) the term "specular gloss" has been replaced by "gloss";

d) the gloss value is indicated in gloss units (GU);

e) a new annex (Annex A) concerning possible sources of error has been added;

f) a new annex (Annex B) concerning calibration standards has been added;

g) a new annex (Annex C) concerning gloss calculation of primary reference standards has been added;

h) a new annex (Annex D) concerning details on precision has been added;

i) the precision data are the results of a large interlaboratory test.

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

1 Scope

This International Standard specifies a method for determining the gloss of coatings using the three geometries of 20°, 60° or 85°. The method is suitable for the gloss measurement of non-textured coatings on plane, opaque substrates.

NOTE On test specimens different from these mentioned above, comparative gloss measurements are possible. However, it is not ensured that the obtained gloss values correspond to the visual gloss perception (see Annex A).

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 4618:2014, *Paints and varnishes — Terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618 and the following apply.

3.1
gloss
optical property of a surface, characterized by its ability to reflect light specularly

Note 1 to entry: Examples of degrees of gloss are high gloss, gloss, silk gloss, semigloss, satin, matt, and dead matt.

[SOURCE: ISO 4618:2014, 2.132]

3.2
geometry
identification of a method of gloss measurement using a specified angle with assigned apertures

3.3
gloss value
ratio multiplied by 100 of the luminous flux reflected from a specimen to that reflected by a glass surface with a refractive index of 1,567 at a wavelength of 587,6 nm in specular direction for a specified reflection angle and specified aperture angles of light source and receptor

Note 1 to entry: The gloss value is indicated in gloss units (GU). It is not permitted to interpret and express gloss values as "% reflection".

Note 2 to entry: Gloss values measured on coatings are expressed rounded to the nearest integer (without decimals).

Note 3 to entry: To define the gloss scale, polished black glass with a refractive index of 1,567 at a wavelength of 587,6 nm is assigned to the value of 100 for 20°, 60° and 85° geometries.

Note 4 to entry: A glass surface with a reflective index of 1,567 at a wavelength of 546,1 nm (which is the central wavelength of the spectral luminous efficiency function) may be used.

Note 5 to entry: The gloss value is influenced by the surface characteristics, e.g. roughness, texture, structure, of the sample.

4 Principle

With a reflectometric apparatus, gloss values are determined on coated surfaces, correlating with the visual gloss perception. In this context (glossmeter), the ratio of the gloss of the coating and the gloss of a polished plane glass plate with specified reference refractive index is obtained.

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

— measuring angles;

— field stop apertures;

— spectral adaptation;

— reference refractive index.

5 Basic principles of the gloss measurement

Gloss is a visual perception caused by looking at surfaces. The specular reflection of objects is even more distinct when light is reflected more directionally from the surface. The incident light is reflected on high-gloss surfaces only in the main specular direction. On matt surfaces the light is not only reflected in the main specular direction but also diffusely scattered in all solid angles. The more uniformly the light is scattered into the space the smaller is the intensity of the directed component and the matter the surface appears.

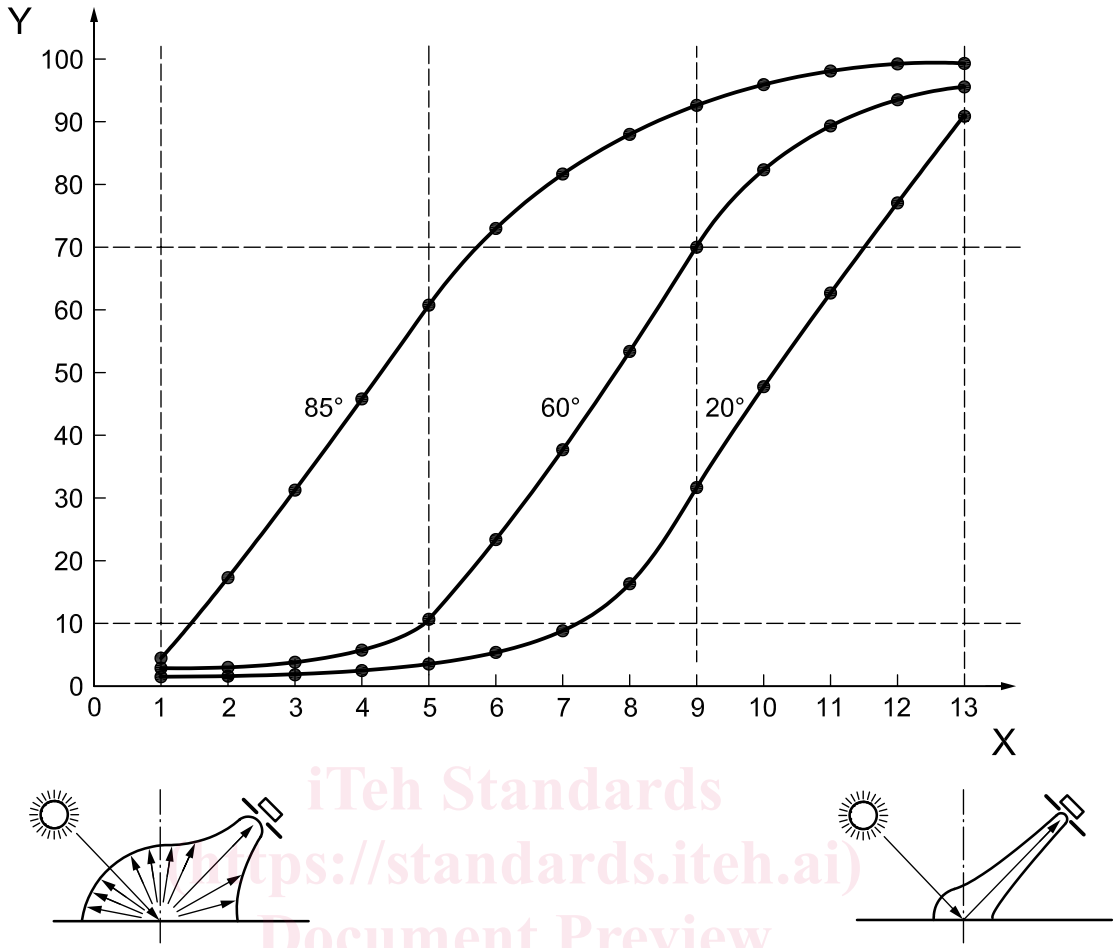
The principle of gloss measurement is based on the measurement of the directionally reflected light. In this context its intensity is measured in a defined angular field around the reflection angle. The intensity of the reflected light depends on the surface material and the incident angle. Accordingly, on coated surfaces with increasing incident angle more light is reflected. The remaining light is refracted at the interface air/coating, and within the coating diffusion and/or absorption of the light occurs.

The gloss values are not related to the intensity of the incident light but to the reflection properties of a black, polished glass standard with specified refractive index.

For different viewing angles the gloss perception can vary widely. For example matt surfaces can appear glossy under grazing incidence of light and low viewing angle, because under these reflection conditions a lot of light is reflected directionally and also the intensity of diffusion is low.

Figure 1 illustrates the relation between the gloss perception of visually equally classified coating specimens (from matt to glossy) and the assigned gloss values for the measuring angles of 20°, 60° and 85°.

EXAMPLE Visual classification 9 corresponds to 35 GU under 20°, 70 GU under 60° and 95 GU under 85°.



Key

Y gloss value

X increasing gloss perception from matt to glossy

Figure 1 — Gloss curves

Due to the non-linearity of the characteristic curves in accordance with Figure 1, the gloss for each measuring angle can only be differentiated over a specific range. In practice – depending on the degree of gloss of the specimen surface – the following measuring angles have been proved (see Figure 2):

— 20° geometry for high-gloss surfaces;

— 60° geometry for semigloss surfaces;

— 85° geometry for matt surfaces.

For each gloss value the geometry shall be indicated.

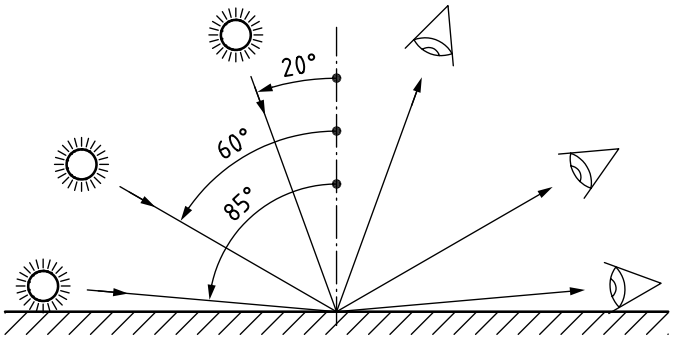


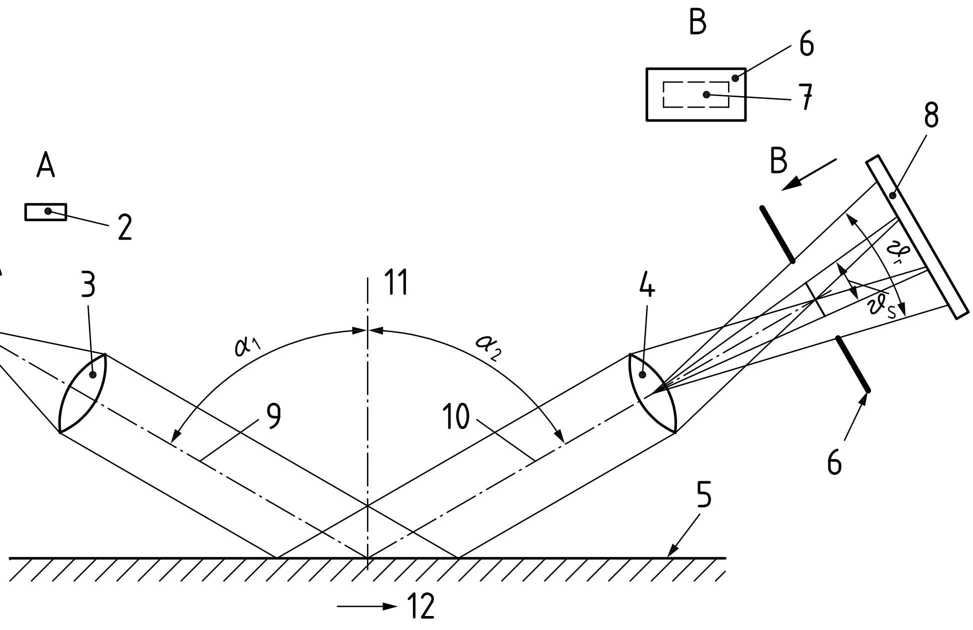
Figure 2 — Measuring angles

6 Apparatus and calibration equipment

6.1 Glossmeter

6.1.1 Optical construction and course of beam

The course of beam of the glossmeter is illustrated in Figure 3. The light of a source is collimated onto the test surface at a specified angle, and the reflected light is received by a lens at the same angle and focused onto a photo detector.



Key

1	light source (source)	9	optical axis of the incident beam
2	source image aperture	10	optical axis of the receptor beam
3	source lens	11	surface normal of the test specimen
4	receptor lens	12	direction of measurement
5	test surface	α_1	angle between 9 and 11
6	receptor field stop	α_2	angle between 10 and 11
7	image of the source aperture in the receptor field stop	ϑ_r	receptor aperture angle
8	photo detector (receptor)	ϑ_S	source image aperture angle

Figure 3 — Course of beam of the glossmeter

6.1.2 Geometries

The axis of the incident beam shall be at an angle (α_1) of (20,0 ± 0,1)°, (60,0 ± 0,1)°, or (85,0 ± 0,1)° 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.

The optical axis of the receptor beam shall coincide with the mirror image of the optical axis of the incident beam to within ± 0,1°, i.e. the condition $|\alpha_1 - \alpha_2| \leq 0,1°$ shall be fulfilled (see Figure 3).

The dimensions of the source aperture and the receptor aperture and the permissible tolerances shall be as indicated in Table 1.

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

The direction of measurement (see Figure 3) shall be obvious on the apparatus.

Table 1 — Angles of source image aperture and receptor aperture

	Aperture angle	
	In parallel to plane of reflection	**Perpendicular to the plane of reflection**
Source image aperture (all geometries)	0,75° ± 0,10°	2,5° ± 0,1°
Receptor aperture (20° geometry)	1,80° ± 0,05°	3,6° ± 0,1°
Receptor aperture (60° geometry)	4,4° ± 0,1°	11,7° ± 0,2°
Receptor aperture (85° geometry)	4,0° ± 0,3°	6,0° ± 0,3°

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.

NOTE 3 By specifying the aperture angles it is ensured that for the gloss measurement only a maximum proportion of the scattered light is received.

6.1.3 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).

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

where

$V(\lambda)$ is the CIE photopic luminous efficiency;

$S_C(\lambda)$ is the spectral power distribution of CIE illuminant C;

$L(\lambda)_{rel}$ is the relative spectral sensitivity of the receptor;

$L_S(\lambda)$ is the spectral power distribution of the illuminating source;

k is a calibration constant.

NOTE By means of such filtering the gloss values refer to a uniform illuminant (C) and are adapted spectrally to the gloss perception of an observer.

6.1.4 Technical requirements for the glossmeter

The receptor measurement device shall give a reading proportional to the light flux passing the receptor field stop with a deviation of 1 GU at maximum.

The apparatus shall be calibratable and adjustable.

NOTE For glossmeters with automatically proceeding calibration routine the calibration and adjustment are carried out automatically.

