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Paints and varnishes — Determination of specular gloss of non-metallic paint films at 20 degrees, 60 degrees and 85 degrees

Peintures et vernis — Détermination de la réflexion spéculaire de feuils de peinture non métallisée à 20 degrés, 60 degrés et 85 degrés

[Revision of third edition (ISO 2813:1994) and ISO 2813:1994/Cor.1:1997]

ICS 87.040

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO-lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five-month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

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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 2813 was prepared by Technical Committee 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. The main technical changes are:

a) the term “specular gloss” has been replaced by “gloss”;

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

c) in the annex parameters and sources of error for the determination of gloss are specified.

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

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

ISO 4618:2006, *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 Examples of degrees of gloss are high gloss, gloss, silk gloss, semigloss, satin, matt, and dead matt.

[ISO 4618:2006]

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

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

NOTE 3 To define the gloss scale, polished black glass with a refractive index of 1,567 is assigned to the value of 100 for 20°, 60°, and 85° geometries, i.e. to the black plate glass the gloss value of 100 GU is assigned for all geometries.

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

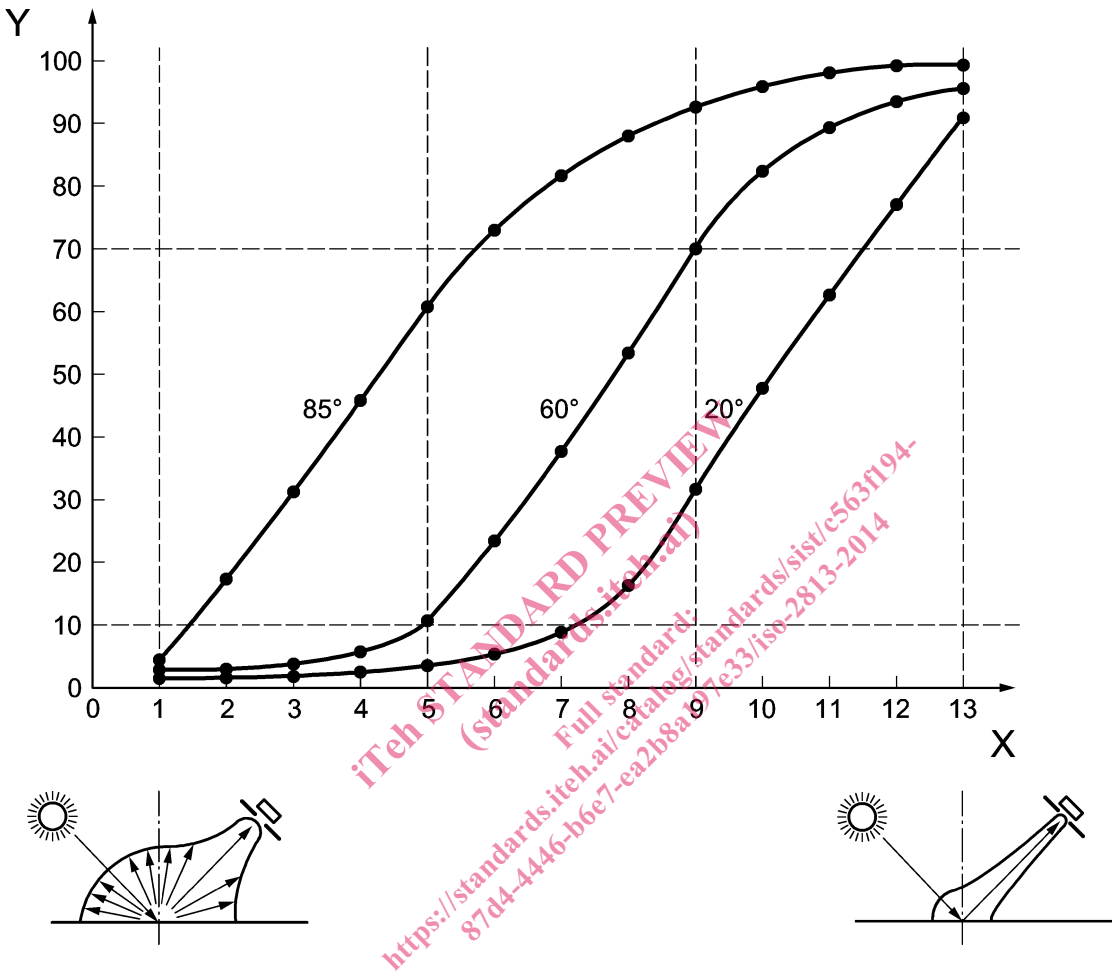
Gloss is a visual perception caused by looking at surfaces. The specular reflection of objects is even more distinct when light is reflected more directionally from the surface. The incident light is reflected on high-gloss surfaces only in the main specular direction. On matt surfaces the light is not 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 heavily. 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 exemplifies 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°.



Key

1 Gloss value
2 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.

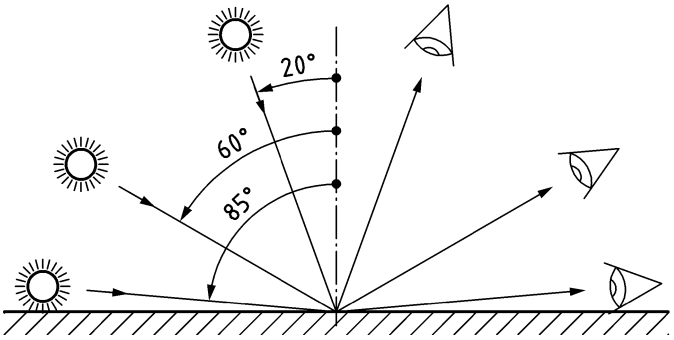


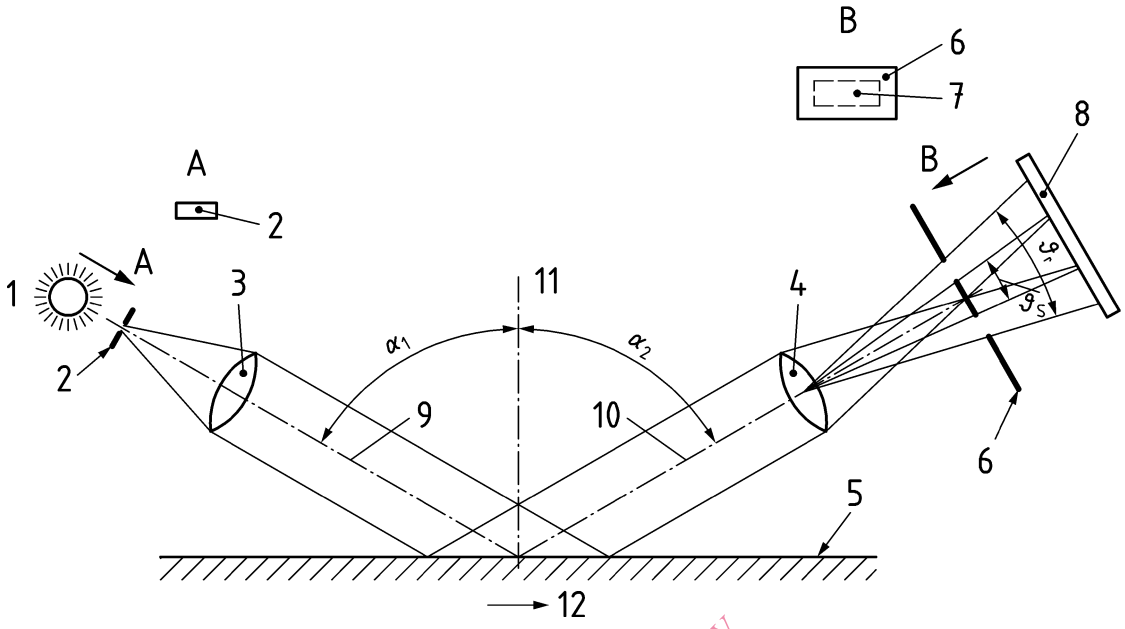
Figure 2 — Measuring angles

6 Apparatus and means of calibration

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 light 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)
2 Source image aperture
3 Source lens
4 Receptor lens
5 Test surface
6 Receptor field stop
7 Image of the source aperture in the receptor field stop
8 Photo detector (receptor)
9 Optical axis of the incident beam
10 Optical axis of the receptor beam
11 Surface normal of the test specimen
12 Direction of measurement
α_1 Angle between 9 and 11, in degrees
α_2 Angle between 10 and 11, in degrees
ϑ_r Receptor aperture angle
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 equation (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 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.

6.2 Measurement standards (certified reference material, working measurement standards)[1)]

6.2.1 High-gloss standard A (working measurement standard)

Plane black glass plate with the following properties:

— Surface grinded and polished;

— Gloss values ≥ 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 shall be recorded on the standard:

— Direction of measurement;

— Geometry (geometries);

— Assigned gloss value(s).

Further details are to be taken from annex B.

6.2.2 Medium-gloss standard B (working measurement standard)

For testing the linearity medium-gloss standards may be used. The medium-gloss standard may be of ceramic tile, black glass, or other materials with uniform gloss. Thickness, rear side, and edges shall be constructed in a way so that interfering light, scattered light, and reflected light from the edges and the rear side are avoided.

The following specifications shall be recorded on the standard:

— Direction of measurement;

— Geometry (geometries);

— Dedicated gloss value(s).

Further details are to be taken from annex B.

6.2.3 Zero standard C (working measurement standard)

Plane plate made of metal, glass, or rigid plastic (e.g. Poly(methyl methacrylate) – PMMA) with a coating whose gloss for all geometries is lower than 0,1 GU.

NOTE 1 As coating material for the zero standard black flock has been proved.

NOTE 2 Glossmeters 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.

Further details are to be taken from annex B.

1) Terms see ISO/IEC GUIDE 99.