INTERNATIONAL STANDARD

ISO 2813

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

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

Reference number
ISO 2813:1994(E)

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.

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.

International Standard ISO 2813 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

This third edition cancels and replaces the second edition (ISO 2813:1978), the whole text of which has been technically revised.

Annex A forms an integral part of this International Standard. Annex B is for information only.

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

1 Scope

This International Standard is one of a series of standards dealing with the sampling and testing of paints, varnishes and related products.

It specifies a test method for determining the specular gloss of paint films using a reflectometer geometry of 20°, 60° or 85°. The method is not suitable for the measurement of the gloss of metallic paints.

a) The 60° geometry is applicable to all paint films, but for very high gloss and near-matt films 20° or 85° may be more suitable.

b) The 20° geometry, which uses a smaller receptor aperture, is intended to give improved differentiation between high-gloss paint films (i.e. films with a 60° specular gloss higher than about 70 units).

c) The 85° geometry is intended to give improved differentiation between low-gloss paint films (i.e. films with a 60° specular gloss lower than about 10 units).

NOTES

1 The same geometry should, of course, be retained for a series of measurements even if this means disregarding the suggested limits.

2 In some cases, the determination of specular gloss may not correspond to a visual assessment.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1512:1991, *Paints and varnishes — Sampling of products in liquid or paste form.*

ISO 1513:1992, *Paints and varnishes — Examination and preparation of samples for testing.*

ISO 2808:1991, *Paints and varnishes — Determination of film thickness.*

3 Definition

For the purposes of this International Standard, the following definition applies.

3.1 specular gloss: The ratio of the luminous flux reflected from an object in 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.

NOTE 3 To define the specular-gloss scale, polished black glass with a refractive index of 1,567 is assigned the value of 100 for geometries of 20°, 60° and 85°.

4 Required supplementary information

For any particular application, the test method specified in this International Standard needs to be completed by supplementary information. The items of supplementary information are given in annex A.

5 Apparatus

Ordinary laboratory apparatus and glassware, together with the following:

5.1 Substrate for tests where a liquid paint sample is supplied

The substrate shall be glass of mirror quality, preferably of thickness at least 3 mm and of dimensions at least 150 mm × 100 mm. The largest dimension shall be at least equal to the length of the illuminated area.

NOTE 4 Although the method as written is restricted to paints, clear varnishes may be tested by using as the substrate either black glass or clear glass roughened and covered on the back and edges by black paint.

5.2 Film applicator

A block applicator, having a recess ground from the underface to form a gap 150 µm ± 2 µm deep when placed on an optically plane surface, or other means of applying a paint film, shall be used.

NOTE 5 The block applicator produces a wet-film thickness of approximately 75 µm.

5.3 Glossmeter

The glossmeter shall consist of a light source and a lens that directs a parallel beam of light onto the surface under test, and a receptor housing containing a lens, field stop and photoelectric cell to receive the required cone of reflected light. The glossmeter shall have the following characteristics.

a) **Geometry**

The axis of the incident beam shall be at 20° ± 0,1°, 60° ± 0,1° or 85° ± 0,1° (see table 1) to the normal to the surface under test. The axis of the receptor shall coincide with the mirror image of the axis of the incident beam to within ±0,1°. With a flat piece of polished black glass or a front-reflecting mirror in the test panel position, an image of the source shall be formed at the centre of the receptor field stop (receptor window). (See figure 1 for a general indication of the essential features.) To ensure averaging over the whole surface, the width of the illuminated area of the test panel shall be significantly larger than likely surface structures: a generally accepted value is 10 mm.

The dimensions of the source image and receptor apertures and the associated tolerances shall be as indicated in table 1. The angular dimensions of the receptor field stop shall be measured from the receptor lens.

b) **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

$$\tau(\lambda) = k \frac{V(\lambda) \cdot S_C(\lambda)}{s(\lambda) \cdot S_S(\lambda)}$$

where

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

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

$s(\lambda)$ is the spectral sensitivity of the receptor;

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

k is a calibration constant.

NOTE 6 The tolerances have been chosen so that errors in the source and receptor apertures will not produce reading errors of more than one gloss unit at any point on a 100-unit scale (see 5.4.1).

By agreement, CIE standard illuminant A may also be used for a transition period. This shall be stated in the test report.

c) **Vignetting**

There shall be no vignetting of rays that lie within the field angles specified in 5.3 a).

d) **Receptor meter**

The receptor measurement device shall give a reading proportional to the light flux passing the receptor field stop to within 1 % of the full-scale reading.

NOTE 7 A commonly used receptor meter arrangement uses a barrier-layer photocell in conjunction with a high-resistance galvanometer. This is not satisfactory as the galvanometer output is markedly non-linear, but this can be overcome by connecting a low-input-impedance electronic amplifier between the photocell and the galvanometer.

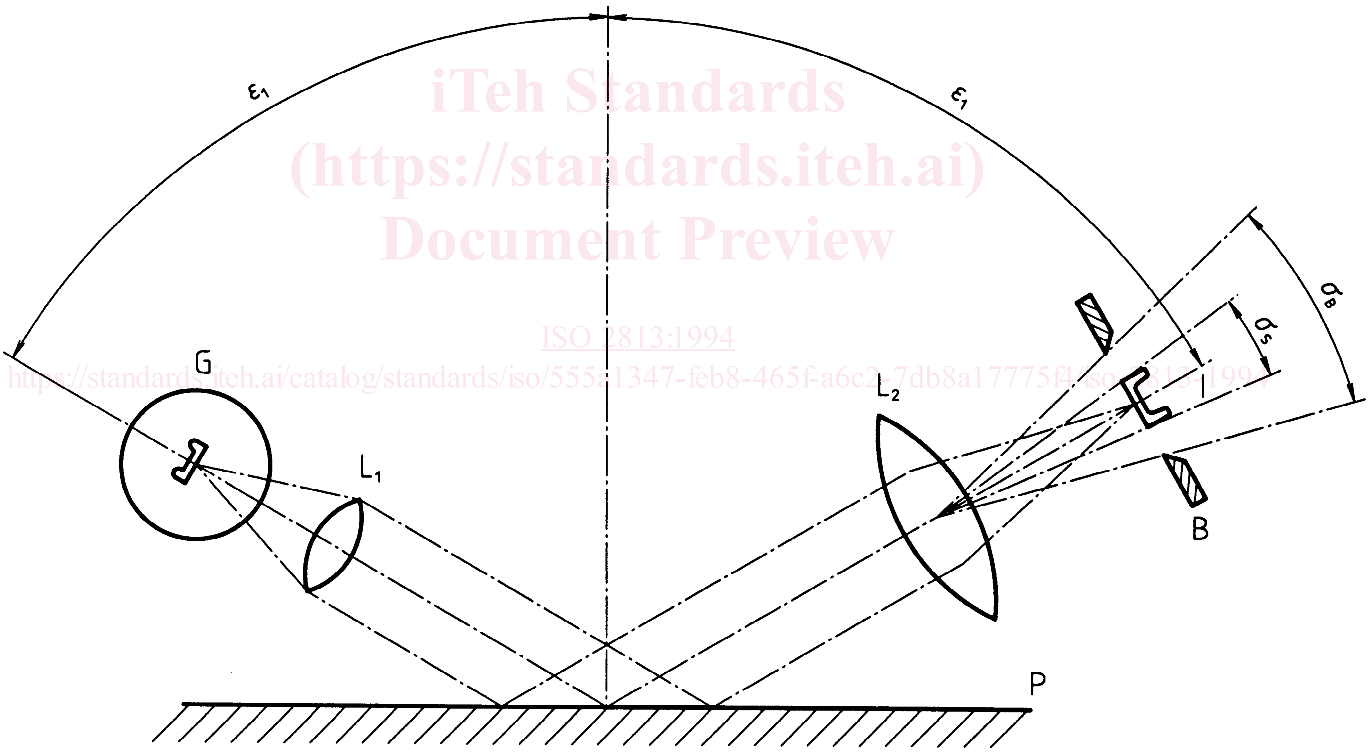
In addition, the apparatus shall have a sensitivity control enabling the photocell current to be set to any desired value on the instrument scale.

Table 1 — Angles and relative dimensions of source image and receptor aperture

Parameter	In plane of measurement[1]			Perpendicular to plane of measurement		
	angle σ [2]	2 tan $\sigma/2$	relative dimension	angle σ [2]	2 tan $\sigma/2$	relative dimension
Source image aperture	0,75° ± 0,25°	0,013 1 ± 0,004 4	0,171 ± 0,075	2,5° ± 0,5°	0,043 6 ± 0,008 7	0,568 ± 0,114
Receptor aperture (20° geometry)	1,80° ± 0,05°	0,031 4 ± 0,000 9	0,409 ± 0,012	3,6° ± 0,1°	0,062 9 ± 0,001 8	0,819 ± 0,023
Receptor aperture (60° geometry)	4,4° ± 0,1°	0,076 8 ± 0,001 8	1,000 ± 0,023	11,7° ± 0,2°	0,204 9 ± 0,003 5	2,668 ± 0,046
Receptor aperture (85° geometry)	4,0° ± 0,3°	0,069 8 ± 0,005 2	0,909 ± 0,068	6,0° ± 0,3°	0,104 8 ± 0,005 2	1,365 ± 0,068

1) The receptor aperture in the plane of measurement for the 60° geometry has been taken as unity.

2) Source image aperture angle: σ_S; receptor aperture angle: σ_B.



G = lamp
L_1 and L_2 = lens
B = receptor field stop
P = paint film
$\varepsilon_1 = \varepsilon_2$
σ_B = receptor aperture angle
σ_S = source image aperture angle
I = image of filament

Figure 1 — Schematic diagram of a glossmeter (section through the plane of measurement)

5.4 Reference standards

5.4.1 Primary reference standard

The primary reference standard shall be highly polished black glass, the top surface being plane to within two fringes per centimetre, as measured by optical-interference methods.

NOTE 8 It is not intended that the primary reference standards be used for daily calibration of glossmeters.

Glass with a refractive index, measured at a wavelength of 587,6 nm, of 1,567 shall be assigned the specular-gloss value of 100. If glass of this refractive index is not available, a correction is needed. Values of specular gloss for polished black glass of various refractive indices at the three angles of incidence are given in table 2.

The primary standard shall be checked at least every two years because of the possibility of ageing. In the event of degradation, the original gloss can be restored by optical polishing with cerium oxide.

NOTES

9 The most readily available glass of the required planarity is now manufactured by the "float" process. This glass is unsuitable for use as a primary reference standard because the refractive index of the bulk of the glass differs from that of the surface. It is preferable to use an optically plane glass made by some other process, or to remove the surface of the float glass and repolish to optical planarity.

10 The refractive index should preferably be determined by means of an Abbe refractometer.

11 If the absolute reflectance of the primary reference standard is required, the Fresnel equation may be used, inserting the refractive index of the standard in the equation.

5.4.2 Working reference standards

The working reference standards may be of ceramic tile, vitreous enamel, opaque glass, polished black glass or other materials with uniform gloss, but shall be of good planarity and have been calibrated against a primary reference standard over a given area and for a given direction of illumination. The working reference standards shall be uniform and stable and shall be calibrated by a technically competent organization. At least two standards of different gloss levels shall be available for each glossmeter geometry.

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

Table 2 — Specular-gloss values for polished black glass

Refractive index *n*	Angle of incidence		
	20°	60°	85°
1,400	57,0	71,9	96,6
1,410	59,4	73,7	96,9
1,420	61,8	75,5	97,2
1,430	64,3	77,2	97,5
1,440	66,7	79,0	97,6
1,450	69,2	80,7	98,0
1,460	71,8	82,4	98,2
1,470	74,3	84,1	98,4
1,480	76,9	85,8	98,6
1,490	79,5	87,5	98,8
1,500	82,0	89,1	99,0
1,510	84,7	90,8	99,2
1,520	87,3	92,4	99,3
1,530	90,0	94,1	99,5
1,540	92,7	95,7	99,6
1,550	95,4	97,3	99,8
1,560	98,1	98,9	99,9
1,567 1)	100,0 1)	100,0 1)	100,0 1)
1,570	100,8	100,5	100,0
1,580	103,6	102,1	100,2
1,590	106,3	103,6	100,3
1,600	109,1	105,2	100,4
1,610	111,9	106,7	100,5
1,620	114,3	108,4	100,6
1,630	117,5	109,8	100,7
1,640	120,4	111,3	100,8
1,650	123,2	112,8	100,9
1,660	126,1	114,3	100,9
1,670	129,0	115,8	101,0
1,680	131,8	117,3	101,1
1,690	134,7	118,8	101,2
1,700	137,6	120,3	101,2
1,710	140,5	121,7	101,3
1,720	143,4	123,2	101,3
1,730	146,4	124,6	101,4
1,740	149,3	126,1	101,4
1,750	152,2	127,5	101,5
1,760	155,2	128,9	101,5
1,770	158,1	130,4	101,6
1,780	161,1	131,8	101,6
1,790	164,0	133,2	101,6
1,800	167,0	134,6	101,7

1) Primary reference standard.

5.4.3 Zero reference standard

For checking the zero point of the reflectometer a suitable standard (for example black velvet, black felt of a black box) shall be used.