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IS 101-4-4 (1988): Methods of sampling and Test for Paints, Varnishes and Related Products, Part 4: Optical Test, Section 4: Gloss [CHD 20: Paints, Varnishes and Related Products]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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AMENDMENT NO. 1 NOVEMBER 1990
TO
IS 101 (Part 4/Sec 4) : 1988 METHODS OF
SAMPLING AND TEST FOR PAINTS,
VARNISHES AND RELATED PRODUCTS

PART 4 OPTICAL TEST

Section 4 Gloss

(Third Revision)

(Page 1, clause 1) — Insert the following new clause after clause 1 and renumber clause 1.1 as 1.2:

'1.1 a) The 60° geometry method is applicable to all paint films but, for very high-gloss paints or those of near-matt sheen, the 20° or the 85° geometry method may be more suitable.

b) The 20° geometry method is intended for obtaining improved differentiation of high-gloss paints, that is those with a 60° gloss higher than 70 units.

This does not mean, however, that the 60° geometry method cannot be used for paints having a 60° gloss higher than 70 units.

c) The 45° or 85° geometry method is intended for obtaining improved differentiation of low-gloss paints, that is those with a 60° gloss lower than 30 units.

This does not mean, however, that the 60° geometry method cannot be used for paints having a 60° gloss lower than 30 units.'

(Page 1, clause 2.4.1, line 6) — Substitute '1.567' for '1.523'.

(Page 2, clause 2.4.1, equation) — Substitute the following for the existing second part of the numerator:

$$\left[\frac{(n^2 - \sin^2 E_1)^{\frac{1}{2}} - \cos E_1}{(n^2 - \sin^2 E_1)^{\frac{1}{2}} + \cos E_1} \right]^2$$

(CHD 20)

*Indian Standard***METHODS OF SAMPLING AND TEST FOR PAINTS,
VARNISHES AND RELATED PRODUCTS****PART 4 OPTICAL TEST****Section 4 Gloss***(Third Revision)*

1. Scope — Prescribes two methods for measurement of specular gloss of paint films with 20°, 45°, 60° and 85° geometry. The methods are not suitable for measurement of the gloss of metallic paints.

1.1 Two procedures are specified, the first being for assessment of a film prepared from a liquid film and the second for assessment of an existing painted surface.

2. Apparatus

2.1 Substrate — It shall be plate glass of mirror quality, with a minimum thickness of 3 mm and size at least 150 × 100 mm.

2.2 Film Applicator — A block applicator having a slot ground from the undersurface to form a gap of $100 \pm 2 \mu\text{m}$ deep when the applicator is placed on optically plane surface, shall be used to apply the test film. Such an applicator applies wet film of thickness approximately 50 μm , corresponding to a spreading rate of 20 m²/l.

2.3 Glossmeters — The glossmeter shall consist of a light source and a lens that directs a parallel or slightly converging beam of light on to the surface under test and a receptor housing containing a lens, field stop and photoelectric cell to receive the required cone of reflected light.

- a) **Geometric conditions** — The axis of the incident beam shall be at $20 \pm 0.2^\circ$, $45 \pm 0.5^\circ$, $60 \pm 0.2^\circ$ and $85 \pm 0.2^\circ$ respectively, perpendicular to the surface under test. The axis of the receptor shall coincide with the mirror image of the axis of the incident beam. With a flat piece of polished black glass or other front surface mirror in the test panel position, an image of the source shall be formed at the centre of the receptor field stop (receptor window). The width of illuminated area of the test panel shall be not less than 10 mm.

The angle between the axis of the receptor beam and the perpendicular shall be equal to the corresponding angle of the incident beam with same tolerance.

- b) **Vignetting** — There shall be no vignetting of rays that lie within the field angles specified in 2.3 (a).
- c) **Receptor meter** — The receptor measurement device shall give an indication proportional to the light flux passing the receptor field stop within 1 percent of full scale reading.

A generalized dimensions of a 45° glossmeter is given in Fig. 1.

2.4 Standards

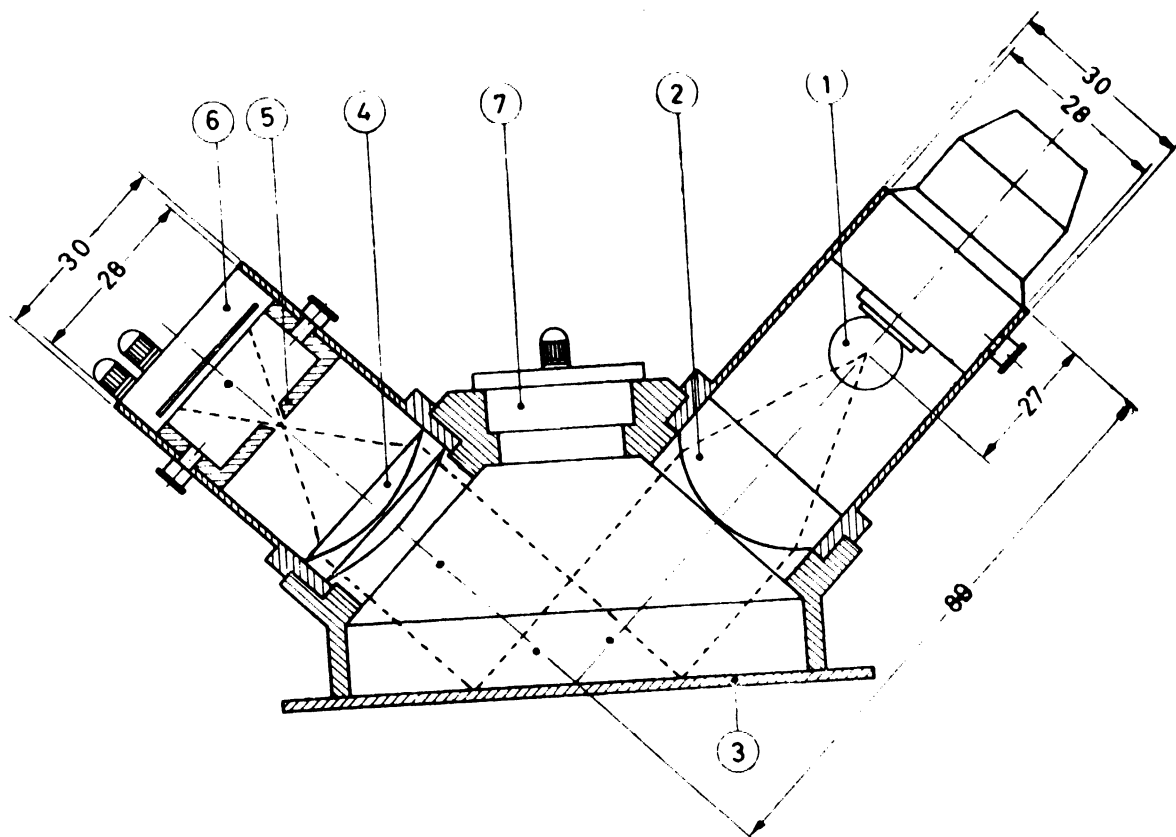
2.4.1 Primary standards — The primary standard shall either be highly polished black glass or clear glass with back and edges roughed and coated with black paint, the top surface being plane to within two fringes per centimetre, as measured by optical interference methods. It is not intended that the primary standard should be used for daily calibration of the glossmeters.

The standard shall be highly polished clean glass, plane within 2 fringes per cm and with a refractive index $N_D = 1.523 \pm 0.002$. The exposed area of the upper surface of glass shall have the same dimensions as the base of the search unit. The undersurface and edges of the glass shall be roughened and coated with black paint to prevent the ingress of stray light or any internal reflection.

Adopted 30 March 1988

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|-----------------|------------------------------------|
| 1. Light Source | 5. Diaphragm |
| 2. Lens | 6. Position of Photocell |
| 3. Specimen | 7. Position of Photocell for 45°-0 |
| 4. Lens | Diffuse Reflectance Measurement |

All dimensions in millimetres.

FIG. 1 GLOSSMETER

The specular reflection value of this standard shall be taken as 100 units. Other glasses (plane glass blackened as above, or plane polished black glass) may be used only if they have been calibrated against the standard and have given specular reflection values between 99 and 101 units.

If the absolute reflectance of the primary standard is required, the Fresnel equation may be used, inserting the refractive index of the standard in the equation as given below:

$$R' (n, E) = \frac{\left[\frac{n^2 \cos E_1 - (n^2 - \sin^2 E_1)^{\frac{1}{2}}}{n^2 \cos E_1 + (n^2 - \sin^2 E_1)^{\frac{1}{2}}} \right]^2 + \left[\frac{(n^2 - \sin^2 E_1)^{\frac{1}{2}} - \cos E_1}{(n^2 - \sin^2 E_1)^{\frac{1}{2}} + \cos E_1} \right]^2}{\left[\frac{1.567^2 \cos E_1 - (1.567^2 - \sin^2 E_1)^{\frac{1}{2}}}{1.567^2 \cos E_1 + (1.567^2 - \sin^2 E_1)^{\frac{1}{2}}} \right]^2 + \left[\frac{(1.567^2 - \sin^2 E_1)^{\frac{1}{2}} - \cos E_1}{(1.567^2 - \sin^2 E_1)^{\frac{1}{2}} + \cos E_1} \right]^2} \times 100$$

where

- R' = specular reflection value,
 n = refractive index of glass, and
 E_1 = angle of incidence.

Note — Thus for a glass of refractive index 1.567 and $E_1 = 60^\circ$ R' comes to 93.6.

2.4.2 Working standards — These standards may be of ceramic tile, vitreous enamel, opaque glass or other uniform glass materials but shall be of good planarity and should have been calibrated against a primary standard for an indicated area and the direction of illumination. Such standards shall be checked periodically by comparison with primary standards. The working standards shall be uniform and stable and shall be calibrated by technically competent organizations. At least two standards of different glass levels, shall be available for each glossmeter geometry.

3. Procedure

3.1 Assessment of Liquid Paint Samples

3.1.1 Preparation of test film — The test film should preferably be applied in a manner and at a film thickness corresponding to the normal use of the paint, the method being specified or agreed. If no other method is specified or agreed, apply the paint at $27 \pm 2^\circ\text{C}$ and 65 ± 5 percent relative humidity, at a spreading rate of approximately $20 \text{ m}^2/\text{l}$ to freshly degreased plate glass (see 2.1).

Mix the paint samples thoroughly by vigorous stirring immediately before application to break down any thixotropic structure, taking care not to incorporate air bubbles into the paint. Apply about 2 ml of paint in a line across one end of the glass plate and spread to a smooth film by drawing down the applicator block with a firm pressure at a velocity of about 100 mm/s.

Dry (or stove and age) the coated test panels for the specified time and under specified conditions in a horizontal position and in a dust-free atmosphere and unless otherwise specified condition them at $27 \pm 2^\circ\text{C}$ and a relative humidity of 65 ± 5 percent for a minimum of 16 h, with free circulation of air and without exposure to direct sunlight. Then carry out the appropriate test procedure as soon as possible.

Note --- Caution is advised with regard to the reproducibility of brush applied films.

3.1.2 Thickness measurement — Measure the thickness in micrometres, of the film by an appropriate method and report with the method of measurement.

3.1.3 Gloss measurement techniques — Carry out the setting of glossmeter at the start of every period of operation and during operation at intervals sufficiently frequent to ensure that the instrument response is practically constant. To calibrate, adjust the instrument to read correctly the gloss of the higher gloss working standard, then read the gloss of the lower gloss working standard (see 2.4.2). If the instrument reading for the second standard does not agree to within 1 gloss unit of the assigned value, do not use the glossmeter without re-adjustment, preferably by the manufacturer.

After calibrating the glossmeter, take three readings on test film in different positions parallel to the direction of application, checking back to the higher gloss working standard to ensure that there is no drift in readings. If the spread of results is less than 5 units, report the mean value as the specular reflection value, otherwise take three further measurements and report the mean and extremes of all the six values. For measurement of films on substrates other than plate glass, take six measurements, preferably three in each of the two directions at right angles and report the mean and the extreme values.

3.2 Assessment of Paint Films on Substrates

3.2.1 General — Gloss measurements by this method are only meaningful for films on surfaces of good planarity because any curvature or local unevenness of substrate may seriously affect the test results. If not otherwise agreed, the direction of brush marks, raised grain or similar regular texture effects shall be parallel to the plane of incidence and reflection of the instrument.

3.2.2 Gloss measurement technique — Proceed as in 3.1.3 making six measurements on different areas or in different directions on the surface (except for films with directional texture, such as brush marks). If the variation between extreme values is greater than 10 units or 20 percent of the mean value, reject the test panel. Otherwise, report the mean and extreme values.

EXPLANATORY NOTE

This standard is one of a series of Indian Standards on paints, varnishes and related products. The method of test prescribed is required to be completed by the following supplementary information:

- a) Material and surface preparation of substrates;
- b) Method of application of test coat to the substrate;
- c) Duration and conditions of drying of coated panel; and
- d) Thickness, in micrometres of the coating and whether it is a single coat or a multi-coat system.

The specular reflection value determined by this method depends on the refractive index of the coating as well as on the planeness or texture of the surface. For most conventional gloss paints, with refractive indices between 1.5 and 1.55, comparison between specular reflection values provides a satisfactory indication of gloss. Data is being collected for 60° and other specular angles geometry and progressively the values will be changed from 45 to 60° and other specular angles geometry values, in the material specifications. This standard supersedes 7.7 of IS : 101 - 1964 'Methods of test for ready mixed paints and enamels (*second revision*)'.