Designation: C 346 – 87 (Reapproved 2004)ε1

Standard Test Method for 45-deg Specular Gloss of Ceramic Materials[1]

This standard is issued under the fixed designation C 346; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—Keywords were added editorially in September 2004.

1. Scope

1.1 This test method covers the determination of the specular gloss of porcelain enameled specimens, but may be applicable to other specimens having similar reflection characteristics. This test method may be used to compare the gloss of porcelain enameled specimens or to provide an index of acid or abrasion resistance by measurement of gloss loss.

NOTE 1—Specular gloss is one of several related appearance attributes that produce the sensation of glossiness. For this reason, specular gloss measurements may not always correlate well with visual rankings of glossiness.

NOTE 2—Improved correlations with visual judgments can sometimes be achieved by the use of instruments with different geometries than those specified herein. Refer to Test Method D 523 for 20, 60, and 85-deg geometries. Values generally cannot be predicated for one geometry from measurements made with another.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 523 Test Method for Specular Gloss

E 97 Method of Test for Directional Reflectance Factor, 45-Deg 0-Deg, of Opaque Specimens by Broad-Band Filter Reflectometry[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *specular gloss*—ratio of reflected to incident light, times 1000, for specified apertures of illumination and reception when the axis of reception coincides with the mirror image of the axis of illumination.

NOTE 3—In this operational definition, the quantity defined as specular gloss is composed of surface-reflected and body-reflected components. For some low-gloss measurements, an approximate evaluation of the surface-reflected component of specular gloss may be required (see Section 9).

3.1.2 *45-deg specular gloss*—fraction of visible light incident upon the specimens at 45° to the normal that is reflected in the direction of mirror reflection.

NOTE 4—Under ideal conditions, the incident beam should consist of parallel light, and only light reflected in the true direction of mirror reflection should be accepted for measurement.

3.1.3 *source aperture*—angular size (solid angle) of the light source (lamp filament, if an incandescent source is used) measured from the center of the incident beam lens.

3.1.4 *receptor aperture*—angular size (solid angle) of the receptor window, measured from the center of the receptor lens.

4. Significance and Use

4.1 This test method may be used to compare the gloss of porcelain enamel, ceramic, and other finishes or to provide a comparison of their resistance to attack from acid, alkali, or other environmental factors by measurement of gloss loss.

5. Apparatus

5.1 *Instrumental Components*—The apparatus shall consist of an incandescent light source and lens furnishing an incident beam of rays of required aperture, means for locating the surface of the specimen, and a receptor located to receive the required pyramid of rays reflected from the specimen. The receptor shall be a photosensitive device having maximum response near the middle of the visible region of the spectrum.

5.2 *Geometric Conditions*—The axis of the incident beam shall be 45° from the perpendicular to the specimen surface. The axis of the receptor beam shall be coincident with the mirror image of the axis of the incident beam. A flat piece of polished black glass in the specimen position shall form an

[1] This test method is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.12 on Materials for Porcelain Enamel and Ceramic-Metal Systems, and is based on the "Gloss Test for Porcelain Enamels," *Bulletin T-18*, of the Porcelain Enamel Institute, 1111 N. 19th St., Suite 200, Arlington, VA 22209.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Withdrawn.

image of the source in the center of the receptor window. The angular dimensions of the source and receptor shall be as specified below:

Apertures	In Plane of Measurement,[A] deg	Perpendicular to Plane of Measurement,[A] deg
Source	1.4 ± 0.4	3.0 ± 1.0
Receiver	8.0 ± 0.1	10.0 ± 0.2

[A] "Plane of measurement" is the plane containing axes of illuminating and viewing beams.

6. Specular Gloss Standards

6.1 *Specular Gloss Standards*—Primary working standards shall be highly polished, plane, black-glass surfaces, or surfaces of liquids for which the gloss is calculated from the angle of incidence and the refractive index of the material by using Fresnel's equation. Polished black glass of refractive index 1.540 shall be assigned a 45-deg specular gloss value of 55.9. For the usual variation of refractive index of black glass, a change in index of 0.001 changes the gloss reading by 0.14.

6.2 *Secondary Working Standards*—Secondary working standards of ceramic tile, glass, porcelain enamel, or other materials having hard and uniform surfaces may be calibrated from the primary standards on a glossmeter determined to be in strict conformance with the requirements prescribed in 5.2.

6.3 For greatest accuracy, always orient the standards to the position in which they were originally calibrated.

6.4 The importance of the cleanliness of glass standards cannot be overemphasized. They must always be handled carefully to avoid abrading the surfaces. One or two deep scratches will not reduce the gloss as much as a large number of almost imperceptible abrasions.

6.4.1 Never use abrasive cleaners or scouring powders on standards.

6.4.2 When standards are washed in soap and water, a thin film of soap or oil may remain on the tile surface, thus resulting in a spurious gloss value. This effect has been found to be most noticeable for metal tiles and for higher angle and low gloss values.

6.4.3 The use of a mild detergent is recommended. Reproducible cleaning of standards can be accomplished by brushing them in a solution of detergent and water, 3 g/L (1 tbsp/gal) with a nylon brush followed by a forced rinse in hot water (temperature near 66°C (150°F)), with the tile immediately *blotted* dry with a clean paper towel. The tile must not be rubbed with the hand or paper towel, either during washing or drying.

7. Test Specimens

7.1 Only surfaces of good planarity shall be tested, if possible, since surface warpage, waviness, or curvature will affect test results seriously.

8. Procedure

8.1 Operate the glossmeter according to the instructions of the manufacturer.

8.2 Set the instrument to read the assigned gloss value of a highly polished working standard; then read the gloss of lower glass standards having poorer image-forming characteristics. If the instrument readings for the latter standards do not agree with the assigned values to within two gloss units, the instrument optics may require readjustment; preferably, this should be done by the manufacturer.

8.3 Measure the gloss of at least three portions of each specimen surface. This will give an indication of gloss uniformity.

8.4 For evaluation of change of gloss of a single specimen, which may be used as a measurement of surface deterioration of porcelain enameled or ceramic specimens, exercise particular care to see that the glossmeter is in exactly the same position on the specimen for measurements before and after treatment and that the illuminating beam is oriented the same on the specimen. For best results, make several measurements on each specimen in different reproducible positions.

NOTE 5—For small square or rectangular specimens, such as those frequently used for laboratory tests, a specimen stop attached to the glossmeter head will permit exact duplication of specimen position and orientation.

9. Evaluation of Components of Specular Gloss

9.1 When required (Note 6), an approximate evaluation of the two components of specular gloss may be made as follows:

9.1.1 *Body-Reflected Component*—Obtain an approximate evaluation of the body-reflected component (formerly called "diffuse correction") of specular gloss by one of the following two procedures:

9.1.1.1 Adjust a goniophotometer to read 45-deg specular gloss; then illuminate the specimen perpendicularly and view it at 45 deg with the same receptor aperture as specified in 5.2. Read the magnitude of the body-reflected component.

9.1.1.2 Alternatively, measure the 45-deg, 0-deg luminous directional reflectance in accordance with Method E 97; express their reflectance as a decimal fraction and multiply by 5.5 to obtain an approximate value for the body-reflected component of specular gloss.

9.1.2 *Surface-Reflected Component*—Subtract the body-reflected component from the measured specular gloss to obtain the surface-reflected component.

NOTE 6—Evaluation of surface-reflected and body-reflected components of specular gloss will ordinarily be required only when comparing low-gloss specimens having quite different diffuse (body) reflectance.

10. Calculation

10.1 In computing the percent of gloss retained or lost, make a separate computation for each location measured and average results after computation.

10.2 Calculate percent change in gloss as follows:

$$\text{Gloss loss, \%} = \frac{G_i - G_f}{G_i} \times 100$$

$$\text{Gloss retained, \%} = \frac{G_f}{G_i} \times 100$$

where:
G_i = initial gloss (before treatment), and
G_f = final gloss (after treatment).

11. Report

11.1 Report the average specular gloss reading of each specimen. When required, report the surface-reflected and body-reflected components separately.

11.2 Report the presence of any specimen for which portions of the test surface differ in gloss from the average by more than 10 % of the average.

11.3 Identify the glossmeter by the name of the manufacturer and model designation.

11.4 Identify the standards used, if desired.

12. Precision and Bias

12.1 The precision and bias of this test method is being established.

13. Keywords

13.1 ceramic materials-glazed; glass coating; porcelain enamel; specular gloss