



Standard Test Methods for Abrasion Resistance of Porcelain Enamels¹

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1. Scope

1.1 These test methods cover determination of the resistance of porcelain enamels to surface abrasion and subsurface abrasion.

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:

C 346 Test Method for 45-deg Specular Gloss of Ceramic Materials²

3. Summary of Test Methods

3.1 The first of the tests described herein is intended for the determination of the resistance to surface abrasion of porcelain enamels for which the unabraded 45° specular gloss is more than 30 gloss units. It consists essentially of measuring the specular gloss of the specimens before and after a specified abrasive treatment of the surface, and taking the percentage of the original specular gloss that is retained after treatment as the surface abrasion index.

3.2 The second test is intended for the determination of the resistance to surface abrasion of porcelain enamels for which the unabraded 45° specular gloss is 30 gloss units or less. It consists of determining the weight loss by a specified abrasive treatment and multiplying this weight loss by an adjustment factor associated with each abrasive tester, lot of abrasive, and lot of calibrated plate glass standards used. The adjusted weight loss is taken as an index of resistance to surface abrasion.

3.3 The third test is intended for the determination of the resistance of porcelain enamels to subsurface abrasion. It consists of determining the slope of the linear portion of the abrasion time-weight loss curve and multiplying by an adjustment factor associated with each abrasion tester, lot of abrasive, and lot of calibrated plate glass standards used. The

adjusted slope is taken as an index of resistance to subsurface abrasion.

4. Significance and Use

4.1 When a porcelain enamel is first subjected to abrasion of the type involved in these tests, the rate of wear or attrition is relatively low. As the enamel is subjected to continued abrasion, the rate of wear increases until it reaches a steady value. Thereafter, the rate of wear remains almost constant until the enamel is penetrated and the underlying ground coat or metal exposed. The abrasion that occurs during the period of increasing rate-of-weight loss is defined as surface abrasion and results in reduced gloss and cleanability with high-gloss enamels and a modification of color, appearance, or surface texture, or combination thereof with low-gloss enamels. The abrasion that occurs during the period of steady rate-of-weight loss is defined as subsurface abrasion and results in the destruction of the continuity of the coating. These two types of abrasion are not necessarily proportional, and since it is desirable to be able to determine the resistance of porcelain enamel to both types of abrasion, it is necessary to deal with each one separately.

5. Apparatus

5.1 *Balance*, having a capacity of approximately 200 g and accurate to 0.0001 g.

5.2 *Alloy Balls*³—Rust-resisting alloy balls of the type used for bearings, $\frac{5}{32}$ in. (4 mm) in diameter. About 4 lb (1.8 kg) are required. Second-grade balls are satisfactory.

5.3 *Apparatus for Measuring Specular Gloss*,⁴ conforming to the requirements of Test Method C 346 and having a repeatable precision of not less than ± 0.5 gloss unit. Means shall be provided for positioning the specimen, with respect to the gloss head, so that, for a given orientation, the position of the specimen during the final gloss reading may be controlled to within $\frac{1}{16}$ in. (1.6 mm) of that during the original gloss reading.

NOTE 1—Care should be taken to keep the interior of the glossmeter free of dust. If a glossmeter is used with the opening at the top, a piece of phenolic resin or similar material should be placed over the opening when

¹ These test methods are under the jurisdiction of ASTM Committee B-8 on Metallic and Inorganic Coatings and are the direct responsibility of Subcommittee B08.12 on Materials for Porcelain Enamel and Ceramic-Metal Systems.

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² *Annual Book of ASTM Standards*, Vol 02.05.

³ Balls meeting the requirements of this paragraph are available from the Mobay Corporation, 5601 Eastern Avenue, Baltimore, MD 21224.

⁴ Suitable instruments are available from: Pacific Scientific Company, Gardner/Neotec Instrument Division, 2431 Linden Lane, Silver Spring, MD 20910; and Hunter Lab, 11495 Sunset Hills Road, Reston, VA 22090.