Designation: D 6037 – 96

Standard Test Methods for Dry Abrasion Mar Resistance of High Gloss Coatings[1]

This standard is issued under the fixed designation D 6037; 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.

1. Scope

1.1 Two test methods are included. Test Method A uses a device that contains an abrasive wheel. Test Method B uses a device that contains a wheel that has been fitted with abrasive paper. Either method can be used to evaluate the dry abrasion mar resistance of coatings applied to planar, rigid surfaces. Each test method provides good discrimination between highly mar resistant coatings.

1.2 Mar resistance is assessed by measuring the gloss of abraded and unabraded areas. Mar resistance is directly related to the coating's ability to retain gloss in abraded areas.

NOTE 1—The mar resistance values obtained by these test methods have no absolute significance. They should only be used to derive relative performance rankings for test panels that have been prepared from the series of coatings that are currently being evaluated. If mar resistance values are quoted between laboratories, it is essential that a common standard be measured and that the values be compared to that standard. Even then, the values should be used with caution.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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:*

D 523 Test Method for Specular Gloss[2]

D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products[2]

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels[2]

D 1005 Test Methods for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers[2]

D 1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base[2]

D 1400 Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base[2]

D 2240 Test Method for Rubber Property—Durometer Hardness[3]

D 3924 Specification for Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer and Related Materials[2]

D 4449 Test Method for Visual Evaluation of Gloss Differences Between Surfaces of Similar Appearance[2]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *mar resistance*—the ability of a coating to resist permanent deformation or fracture, resulting from the application of a dynamic mechanical force. These test methods measure resistance to visible damage caused by mild abrasion.

4. Summary of Test Methods

4.1 The coatings that are being evaluated are applied at uniform dry film thickness to planar panels of uniform surface texture. After drying or curing, or both, the panels are marred. Mar resistance is assessed by measuring the coating's gloss within the abraded and unabraded areas of test panels. Mar resistance is directly related to the coating's ability to retain gloss in abraded areas.

5. Significance and Use

5.1 Coatings, particularly the high gloss coatings used on automobiles, boats, toys, etc., are subject to a wide variety of conditions (for example, wiping, cleaning, and exposure) that can mar their surface. The ability of these coatings to maintain their appearance is an important product attribute. These test methods provide a way to estimate the ability of high gloss coatings to resist mar damage.

5.2 These test methods do not provide fundamental values. However they are suitable for estimating the ability of high gloss coatings to resist mar.

5.3 Since the susceptibility of coatings to marring varies

[1] This test method is under the jurisdiction of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.23 on Physical Properties of Applied Paint Films.

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[2] *Annual Book of ASTM Standards*, Vol 06.01.

[3] *Annual Book of ASTM Standards*, Vol 09.01.

widely, the number of cycles that are needed to cause "relevant" mar damage also varies. Usually, 2 to 50 cycles are sufficient.

TEST METHOD A

6. Apparatus

6.1 *Application Equipment*, as described in Practices D 609, and D 823.

6.2 *Film Thickness Measuring Apparatus*, as described in Test Methods D 1005, D 1186 or D 1400.

6.3 *Abrader*[4]—The abraser so constructed that wheels of several degrees of abrasiveness may be readily used. In this method only the 500-g load is used unless otherwise specified.

6.4 *Refacing Disc*—An S-11 refacing disc[4] for resurfacing the abrasive wheels. The load selected is the same as the test load.

6.5 *Abrasive Wheels*—"Calibrase" wheels CS-10[4], unless otherwise specified or agreed. Wheels that have worn to the diameter of the wheel label should not be used. If the time of the test is not within one year from date of purchase, the following test may provide an indication of the degree of hardening which has occurred.

6.5.1 If required, measure hardness in accordance with Test Method D 2240 on at least four points equally spaced on the center of the abrading surface and one point on each side surface of the wheel. The test on the abrading surface shall be made with pressure applied vertically along the diameter of the wheel, and the reading taken 10 s after full pressure is applied. If any reading on a wheel exceeds the equivalent of 90 units on a Shore A scale, the wheel should be considered suspect for this method.

NOTE 2—The abrasive quality of a "Calibrase" wheel may change with hardness. Hardness can change with time and storage conditions. However, abrasive quality can't be inferred from hardness measurements alone. Many other factors can also affect abrasive quality.

6.6 *Glossmeter*, with 20° geometry complying with Test Method D 523 but with an opening no larger than 1 by 3 in. (25 by 75 mm) to accommodate 4 by 4-in. (100 by 100-mm) test panels. In addition, geometry that places the panel with the test surface facing upwards tends to minimize the chance of stray light affecting the measurement when complete coverage of the opening is not attained.

NOTE 3—Subjective evaluations may be made visually by comparing abraded panels with a measured abraded standard using one of the procedures in Test Method D 4449.

7. Preparation of Specimens

7.1 Prepare a minimum of two 4 by 4-in. panels for each coating that is being tested. Prepare and coat panels in accordance with Practices D 609 and D 823.

7.1.1 Panels,[5] that is, metal panels with a ¼-in. (6-mm) hole drilled in the center to accommodate the mounting spindle, are available.

7.1.2 If it is not convenient to apply test coatings to panels,[5] other planar, distortion-free substrates can be used by substituting a "Drive Pin Type" specimen holder for the standard panel holder.

NOTE 4—It is important that the panels be planar for reproducible results. Cutting and drilling of painted panels has not been satisfactory.

NOTE 5—Measurements are color dependent. Dark colors give lower values of gloss retention. To standardize, it is recommended that testing be done using a black coating. Clearcoats are applied over a black basecoat. For other colors a black panel should be included as a control.

8. Conditioning

8.1 Cure the coated panels under conditions of temperature and humidity as agreed upon between the purchaser and the seller.

8.2 Unless otherwise agreed upon between the purchaser and the seller, condition the coated panels for at least 24 h at 73.5 ± 3.5°F (23° ± 2°C) and 50 ± 5 % relative humidity in accordance with Specification D 3924. Conduct the test in the same environment or immediately after removal therefrom.

9. Procedure

9.1 Using a glossmeter that has been properly adjusted, measure the 20° gloss at four positions within the test area that will be abraded. Record the mean of these four readings as "Unabraded Gloss".

NOTE 6—It is recommended that the panel be marked, or a template be created, to ensure that measurements are taken in the area that will be abraded.

9.2 Mount the pair of "Calibrase" wheels to be used on their respective flange holders, taking care not to handle them by their abrasive surfaces. Select the same load to be used in the test and affix it to the abraser. Mount an S-11 refacing disc on the turntable. Reface new wheels for 100 cycles. Reface previously used wheels for 50 cycles. Reface the wheels for 50 cycles before abrading each specimen. In each case brush the residue from the resurfacing operation off each wheel. Discard the S-11 refacing disc after each use.

9.3 Mount the test panel on the turntable and subject it to abrasion for a selected number of cycles. An abrasion of 10 cycles and 500 g-load are typically used, unless otherwise agreed upon. Use a soft camel's hair brush or compressed air to remove residue from the specimen after abrasion.

9.4 Repeating 9.1, measure the gloss at four positions within the abraded area. Record the mean of these four readings as "Abraded Gloss".

9.4.1 If the panel was marked for measurement of unabraded gloss, it can be easily placed in the correct position for measuring abraded gloss. However, to compensate for any

[4] The sole source of supply of the apparatus known to the committee at this time is Taber Industries, 455 Bryant Street, North Tonawanda, NY 14120. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

[5] The sole source of supply of primed Taber panels known to the committee at this time is ACT Laboratories, 273 Industrial Drive, Hillsdale, MI. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.