Designation: D2134 – 93 (Reapproved 2012)

Standard Test Method for Determining the Hardness of Organic Coatings with a Sward-Type Hardness Rocker[1]

This standard is issued under the fixed designation D2134; 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 This test method covers the determination of the relative degree of surface hardness of organic coatings using a specific apparatus widely used in the coatings industry.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *This test method does not purport to address all of the safety problems, 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]

D823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels

D1005 Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers

D1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base (Withdrawn 2006)[3]

D1400 Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base (Withdrawn 2006)[3]

D3924 Specification for Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials

D4138 Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means

3. Significance and Use

3.1 Sward-type hardness rocker instruments have been used by the coatings industry for more than a half a century as a nondestructive test instrument to measure cure and ultimate surface hardness of organic coatings (see Refs. **(1)** through **(11)**).[4] An accepted standard test method for the use of such an instrument is long overdue.

3.2 In previous task group work designed to establish an ASTM method for measuring hardness of organic coatings with Sward-type hardness rocker instruments, round-robin test results continually showed poor interlaboratory reproducibility. This lack of interlaboratory agreement could have resulted from dimensional variations among instruments, with the contact rocker rings as the most likely offender in that regard. There are several producers of Sward-type hardness rockers making instruments that differ among themselves in net weight and ring radius. Some of them exceed the measurements and net weight called for in this test method.

3.3 This test method, however, is useful within laboratories to quickly screen and measure the surface hardness of candidate coatings.

4. Apparatus

4.1 *Hardness Tester*—The hardness tester shall consist of two flat, chromium-plated bronze rings with uniformly round outside edges. These rings are separated and held in position with a weighted lower member and three horizontal lightweight spacer bars with the topmost one supporting a weight adjustable in height. A rack across the center section supports two bubble tube-type levels that are used to measure the amplitude of the oscillations of the hardness tester. The rate of

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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] The last approved version of this historical standard is referenced on www.astm.org.

[4] Boldface numbers in parentheses refer to the list of references at the end of this test method.

change in amplitude is used as a measure of hardness or softness of the test surface. The hardness tester shall meet the following characteristics:

Weight	100 ± 10 g
Diameter	10 ± 0.025 cm (4.000 ± 0.010 in.)
Width between rings	2.5 ± 0.0125 cm (1.000 ± 0.005 in.)
Period	50 swings on glass plate in 60.0 ± 0.5 s
Calibration	Decrease in amplitude of 6° taken between approximately 22° and 16° from the vertical, after 50 swings on glass

The hardness tester should be equipped with a clear cover to protect it from air currents during operation. A suitable tester is illustrated in Fig. 1.

4.2 *Glass Plates*—Glass panels approximately 15cm^2 (6 in.^{2}) and a minimum of 2 mm (78 mils) thick are required. Preferably these should be plate glass; however, carefully inspected smooth window glass may be substituted.

5. Test Specimen

5.1 The substrate shall be at least a 50 by 100 by 0.25-mm (2 by 4 by 0.01-in.) smooth piece.

5.2 The organic coating specimen shall be a thin film on the substrate with a dry thickness of 25 to 50 µm (1 to 2 mils). Other dry film thicknesses can be used if agreed upon between the purchaser and the seller. It is very important that the dry film thickness is uniform.

5.3 The organic coating shall be air dried or heat cured, or both, using recommended conditions dependent upon the type of organic coating. Only coatings visually free of holes, craters, orange peel, dust specks, or other surface irregularities shall be used for this test.

6. Calibration of Hardness Tester

6.1 Calibrate the hardness tester on plate glass placed on a leveling table. After the tester is leveled, start oscillation of the tester so that the bubble in the left-hand tube slightly overlaps the mark. Place the cover in position and start the count (beginning with zero) when the bubble in the left-hand tube just fails to reach the mark. Stop the count when the bubble in the right-hand tube just fails to reach the mark.

6.2 The hardness tester shall make 50 ± 1 complete oscillations in 60 ± 0.5 s. If the number of swings is not 50, adjust the angle of the left-hand bubble tube to give the correct value. The time for 50 swings can be changed by adjustments in the position of the weight on the vertical screw.

7. Conditioning

7.1 *Conditioning*—Condition the test specimens at 23 ± 2°C (73.5 ± 3.5°F) and 50± 5 % relative humidity for not less than 24 h prior to test in accordance with Specification D3924, for those tests where conditioning is required. In cases of disagreement, the tolerances shall be ±1°C (±1.8°F) and ±2 % relative humidity.

7.2 *Test Conditions*—Conduct tests in the standard laboratory atmosphere of 23 ± 2°C (73.5 ± 3.5°F) and 50 ± 5 % relative humidity, unless otherwise specified in the test methods or in Specification D3924. In cases of disagreement, the tolerances shall be ±1°C (±1.8°F) and ±2 % relative humidity.

8. Procedure

8.1 Prepare three panels of the organic coating to be tested in accordance with one of the practices described in Practices D823. Prior to testing, condition the panels for 7 days at the conditions specified in Section 7.

8.2 Measure the dry film thickness of the organic coating using Test Methods D1005, D1186, D1400, or D4138.

8.3 Determine the initial hardness of the coated panel in duplicate, using the procedure in Section 6, measuring parallel to the long direction of the coating. The number of complete oscillations multiplied by 2 gives the hardness value.

NOTE 1—The rings of the hardness tester should be cleaned after each measurement with acetone or other suitable solvent and polished with a dry, lint-free cloth.

NOTE 2—With clear organic coatings, inspect the panel from the back side to determine if uniform contact has been made.

9. Report

9.1 The report shall include the following:

9.1.1 Name of rocker producer,

9.1.2 Identification of the substrate material,

9.1.3 Identification of the organic coating,

9.1.4 Method of coating application,

9.1.5 Dry film thickness of organic coating,

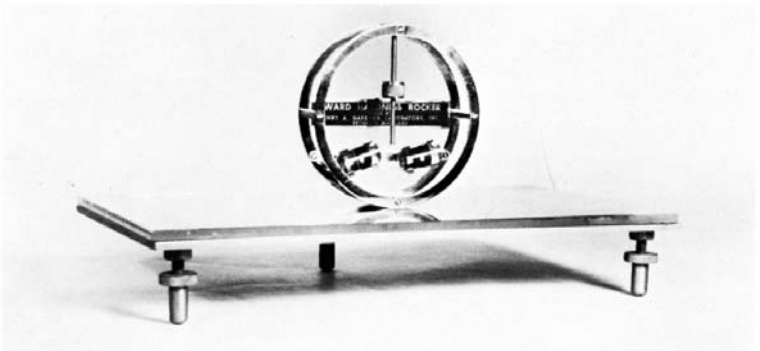

FIG. 1 Rocker Hardness Tester

9.1.6 Conditions used for curing test film, and
9.1.7 Mean average of the four readings.

10. Precision and Bias

10.1 *Precision*—The precision of this test method is being determined.

10.2 *Bias*—This method has no bias because the value of hardness is defined only in terms of this test method.

11. Keywords

11.1 hardness; hardness tests—Sward hardness; surface hardness

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