Designation: D6132 – 13 (Reapproved 2017)

Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Coating Thickness Gage[1]

This standard is issued under the fixed designation D6132; 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 describes the use of ultrasonic film thickness gages to measure accurately and nondestructively the dry film thickness of organic coatings applied over a substrate of dissimilar material. Measurements may be made on field structures, on commercially manufactured products, or on laboratory test specimens. These types of gages can accurately measure the dry film thickness of organic coatings on a variety of substrates such as concrete, wood, wallboard, plastic, fiber composites and metal.

1.2 This test method is not applicable to coatings that will be readily deformable under load of the measuring instrument as the instrument probe is placed directly on the coating surface to take a reading.

1.3 The effective range of instruments using the principle of ultrasonics is limited by gage design. A thickness range of 8 µm to 7.60 mm (0.3 to 300 mils) has been demonstrated.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *This standard does not purport to address 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.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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

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

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *SSPC—The Society for Protective Coatings Standards:*[3]

PA 2 Procedure for Determining Conformance to Dry Coating Thickness Requirements

PA 9 Measurement of Dry Organic Coating Thickness on Cementitious Substrates Using Ultrasonic Gages

2.3 *ASME—The American Society of Mechanical Engineers:*[4]

B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *accuracy, n*—the measure of the magnitude of error between the result of a measurement and the true thickness of the item being measured.

3.1.1.1 *Discussion*—An accuracy statement predicts the ability of a coating thickness gage to measure the true thickness of a coating to be measured. Accuracy statements provide the performance capability across the full functional measurement

[1] This test method is under the jurisdiction of ASTM Committee D01 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] 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] Available from Society for Protective Coatings (SSPC), 800 Trumbull Dr., Pittsburgh, PA 15205, http://www.sspc.org.

[4] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

range of the gage. Accuracy statements frequently include a fixed portion that remains constant across the measurement range, plus a variable portion that is related to the measurement result for a particular thickness.

3.1.2 *adjustment, n*—the physical act of aligning a gage's thickness readings to match those of a known thickness sample (removal of bias), in order to improve the accuracy of the gage on a specific coating.

3.1.2.1 *Discussion*—An adjustment will affect the outcome of subsequent readings.

3.1.3 *calibration, n*—the high-level, controlled and documented process of obtaining measurements on traceable calibration standards over the full operating range of the gage, then making the necessary gage modification (as required) to correct any out-of-tolerance conditions.

3.1.3.1 *Discussion*—Calibration of coating thickness gages is typically performed by the equipment manufacturer, their authorized agent, or by an accredited calibration laboratory in a controlled environment using a documented process. The outcome of the calibration process is to restore/realign the gage to meet/exceed the manufacturer's stated accuracy.

3.1.4 *certification, n*—documentation of the state of condition of the gage, which can (but not required by definition) be accompanied by corrective action (such as adjustment or calibration, or both, or the replacement of components) necessary to correct any out-of-tolerance conditions.

3.1.5 *coating thickness standard, n*—coated metal plates, or uncoated shims of flat sheet, with assigned values traceable to a National Metrology Institution.

3.1.6 *couplant, n*—a substance such as water, oil, grease, or paste used to avoid the retarding of sound transmission by air between the transducer and the test piece during ultrasonic examination.

3.1.7 *dry film thickness, n*—the thickness of a coating (or coating layers) as measured from the surface of the substrate.

3.1.8 *gage (gauge), n*—an instrument for measuring quantity, or an instrument for testing.

3.1.8.1 *Discussion*—In this test method, the term "gage" refers to an instrument for quantifying coating thickness.

3.1.9 *manufacturer's specifications, n*—a statement or set of statements that describes the performance characteristics of the gage under a given set of conditions.

3.1.9.1 *Discussion*—Manufacturer's specifications typically include the range of measurement, accuracy statement, operating temperature range, power source, dimensions and weight, and conformance to industry standards.

3.1.10 *measurement (reading), n*—the value obtained when placing the probe of a thickness gage in contact with a surface.

3.1.11 *micrometer (micron), n*—one one-thousandth of a milimetre (0.001 mm); 25.4 microns =1 mil.

3.1.12 *mil, n*—a U.S. term referring to the imperial unit of measure of one one-thousandth of an inch (0.001 in.) referred to elsewhere in the world as "one thou;" 1 mil = 25.4 microns.

3.1.13 *reference sample, n*—a specimen, coated with a material that is as close as possible in composition to the intended application, used to adjust and/or verify the accuracy of an ultrasonic coating thickness measuring gage for a specific project.

3.1.13.1 *Discussion*—A coated reference sample may or may not have thickness values traceable to a National Metrology Institution. However, the reference sample should be marked with the stated value and the degree of accuracy. The coating thickness of the sample should be equal to or slightly greater than the user's coating thickness measurement requirement and the coating material must have the same acoustic velocity and attenuation as the coating to be measured.

3.1.14 *substrate, n*—the base material, the type of surface, or the component that is being coated.

3.1.15 *verification of accuracy, n*—obtaining measurements on coating thickness standards, comprising of at least one thickness value close to the expected coating thickness, prior to gage use for the purpose of determining the ability of the coating thickness gage to produce thickness results within the gage manufacturer's stated accuracy.

4. Summary of Test Method

4.1 Instruments complying with this test method measure thickness by emitting an ultrasonic pulse into the coating that is reflected back from the substrate to the probe. The travel time is converted into a thickness reading. The instrument's probe must be placed directly on the coating surface to take a reading.

4.2 After verifying accuracy on a known coated part of the object or material of the same kind, the instrument probe is coupled with the coated specimen, after proper cure and conditioning according to the coating manufacturer's instructions.

4.3 It should be recognized that the accuracy of the measurements can be influenced when:

4.3.1 The coated object to be measured is not planar with respect to the transducer face at the point of measurement,

4.3.2 Coating density is not uniform, and

4.3.3 The substrate peak-to-valley surface profile of the coated specimen exceeds the coating thickness.

NOTE 1—The height of surface profile can be determined in accordance with ASME B46.1.

5. Significance and Use

5.1 Many coating properties are markedly affected by the film thickness of the dry film such as adhesion, flexibility, wear, durability, chemical resistance, and hardness. To be able to compare results obtained by different operators, it is essential to measure film thickness carefully.

5.2 Most protective and high performance coatings are applied to meet a requirement or a specification for the dry-film thickness of each coat, or for the complete system, or both. Coatings must be applied within certain minimum and maximum thickness tolerances in order that they can fulfill their intended function. In addition to potential performance deficiencies, it is uneconomical to apply more material than necessary when coating large areas such as floors and walls.