



# Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Over Concrete Using an Ultrasonic Gage<sup>1</sup>

This standard is issued under the fixed designation D 6132; 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 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 coating on concrete substrates. This test method should be proven for other substrates such as wood, hardboard, plastic, and glass prior to specifying this procedure for use.

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 0.5 to 275 mils (10 μm to 7 mm) has been demonstrated.

1.4 The values stated in inch-pounds are to be regarded as the standard. The SI values given in parentheses are provided for information only.

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.*

## 2. Referenced Documents

### 2.1 ASTM Standards:

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels<sup>2</sup>

D 1005 Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers<sup>2</sup>

D 4138 Test Method for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive Means<sup>3</sup>

E 691 Practice for Conducting an Interlaboratory Study to

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 06.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 06.02.

Determine the Precision of a Test Method<sup>4</sup>

### 2.2 Steel Structures Painting Council Standard:

SSPC-PA2 Measurement of Dry Paint Thickness with Magnetic Gages<sup>5</sup>

## 3. Summary of Test Method

3.1 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 must be placed directly on the coating surface to take a reading.

3.2 After verifying the calibration 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.

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

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

3.3.2 The surface roughness of the coated specimen exceeds the coating thickness, and

3.3.3 Coating density is not uniform.

## 4. Significance and Use

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

4.2 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.

4.3 Surface roughness can affect the accuracy of this test

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>5</sup> Available from Steel Structures Painting Council, Post Office Box 641256, Pittsburgh, PA 15264-1256.

method. A rough surface has a tendency to scatter the ultrasonic pulse and odd readings may occur occasionally.

4.4 This test method may not be applicable to measure organic coating thickness on all substrates. The instrument's ability to detect a distinct interface between the coating and the substrate may be impeded if the coating and the substrate are of similar composition or if the coating is nonhomogeneous. Verify operation on a known thickness of the coating/substrate combination if these circumstances are thought to exist.

4.5 Multilayered coatings have many interfaces and the instrument will measure to the interface separating the two most acoustically different materials.

4.6 The use of this test method is not necessarily limited by the type of substrate material as nondestructive magnetic-type or eddy current means.

## 5. Apparatus

5.1 *Ultrasonic Gage*<sup>6</sup>—an electronic gage with a transducer using an ultrasonic principle and numerical techniques (see Fig. 1).

## 6. Test Specimen

6.1 When this test method is used in the field, the specimen is the coated structure or article on which the dry film thickness is to be evaluated.

6.2 For laboratory use, apply the materials to be tested to panels of the same composition, structure or article on which the dry film thickness is to be evaluated. Cure the organic coating in accordance with the coating manufacturer's instruction.

NOTE 1—Coatings should be applied in accordance with Practices D 823, or as agreed upon between the purchaser and the seller.

## 7. Calibration of Apparatus

7.1 Although most ultrasonic instruments are pre-calibrated, calibration should be checked by measuring a known thickness of the coating as determined by:

7.1.1 Using a cross-sectioning method, or

7.1.2 Nondestructively (that is, not destroying film integrity) removing and measuring the coating with a micrometer in accordance with Test Method D 1005, or

7.1.3 Cutting the product and comparing it to a shim of known thickness.

7.2 Roughness adversely affects calibration. Therefore the calibration standard should be smooth.

7.3 Best calibration results are achieved on coatings with a thickness equal to or greater than the coating thickness range to be measured.

NOTE 2—The thickness of an organic coating can be determined in accordance with the Test Method D 4138. While this is a destructive test

<sup>6</sup> The PosiTector® 100, a patent pending apparatus from DeFelsko Corp, 802 Proctor Ave., Ogdensburg, NY 13669, is available from them as well as distributors. It has been found suitable for this use in the round-robin studies. Interested parties are invited to submit information regarding the identification of acceptable alternatives to this patented item to the Committee on Standards, ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Your comments will receive careful consideration at a meeting of the responsible technical committee,<sup>1</sup> which you may attend.



**FIG. 1 Ultrasonic Thickness Gage**

method, it will provide an alternative test method to ensure measurements made in accordance with this test method are in the correct range.

## 8. Procedure

8.1 Use the instrument only after calibration has been verified in accordance with Section 7.

8.2 Ensure that the coating is dry prior to use of the instrument.

8.3 Unless the coating is soft, a couplant may be required to transmit the ultrasonic pulse from the instrument's probe into the coating. Water is ideal for smooth, thin coatings. For rough coatings, a glycol gel is best, provided it is not a contaminant for the coating to be measured. Other liquids such as liquid soap may be used. For specific information regarding the use of couplants, refer to the gage manufacturer's instructions.

8.4 Place the instrument's probe flat on the surface and apply constant pressure. Hold the probe steady during the measurement.

8.5 Take a sufficient number of readings to characterize the surface.

NOTE 3—SSPC-PA2 specifies the location and number of readings needed to characterize the surface.

## 9. Report

9.1 Record the following information at the time of the measurements and include in the report:

- 9.1.1 Type of substrate,
- 9.1.2 Type of coating, coating thickness,
- 9.1.3 Instrument used, serial number, and any special calibration, and
- 9.1.4 Mean, and standard deviation of the thickness readings found.

9.2 Depending upon the application, it may be useful to record the individual readings as well. For rough substrates or coatings, it is recommended to measure the coating in accordance with SSPC-PA2.

## 10. Precision and Bias

10.1 *Precision*—Estimates are based on an interlaboratory study in which one operator in each of five laboratories

measured three different epoxy coatings on two different concrete panels using this test method and an ultrasonic gage. Samples represented a wide range of dry film thickness. The results are being analyzed in accordance with Practice E 691.

10.2 *Bias*—The bias for test method for measuring dry film thickness is being determined.

## 11. Keywords

11.1 coating thickness; dry film thickness; nondestructive thickness; paint thickness; ultrasonic thickness gage

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