



Designation: E1795 – 17

Standard Specification for Non-Reinforced Liquid Coating Encapsulation Products for Leaded Paint in Buildings¹

This standard is issued under the fixed designation E1795; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This specification covers minimum material performance requirements and laboratory test procedures for non-reinforced liquid coating encapsulation products (single or multiple-coat systems) for leaded paint in buildings. Performance properties addressed in this specification are:

- 1.1.1 Impact resistance,
- 1.1.2 Adhesion,
- 1.1.3 Dry Abrasion Resistance,
- 1.1.4 Water Vapor Transmission,
- 1.1.5 Water and Chemical Resistance,
- 1.1.6 Surface Burning Characteristics,
- 1.1.7 Volatile Organic Compound (VOC) Content,
- 1.1.8 Weathering,
- 1.1.9 Aging,
- 1.1.10 Scrub Resistance,
- 1.1.11 Mildew Resistance,
- 1.1.12 Paintability/Repairability,
- 1.1.13 Flexibility, and
- 1.1.14 Tensile Properties.

1.2 This specification does not address the selection of an encapsulation product for specific use conditions. Specific use conditions may require performance values other than those stated in this specification. See Guide E1796.

1.3 This specification complements Specification E1797 for reinforced liquid coating encapsulation products.

1.4 This specification does not cover the use of encapsulation products on industrial steel structures nor on residential coated metal surfaces because no corrosion control requirements are included.

1.5 This specification applies to any non-reinforced liquid applied product that relies primarily on adhesion for attachment to the surface. These products are used to encapsulate a leaded paint surface with the intent of reducing human exposure to lead.

¹ This specification is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.23 on Lead Hazards Associated with Buildings.

Current edition approved March 1, 2017. Published March 2017. Originally approved in 1995. Last previous edition approved in 2012 as E1795-12. DOI: 10.1520/E1795-17.

1.6 The results of the test methods included in this specification will not necessarily predict field performance.

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

1.8 *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 requirements prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

- D16 Terminology for Paint, Related Coatings, Materials, and Applications
- D522/D522M Test Methods for Mandrel Bend Test of Attached Organic Coatings
- 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
- D1212 Test Methods for Measurement of Wet Film Thickness of Organic Coatings
- D1308 Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
- D1475 Test Method For Density of Liquid Coatings, Inks, and Related Products
- D1653 Test Methods for Water Vapor Transmission of Organic Coating Films
- D2370 Test Method for Tensile Properties of Organic Coatings
- D2486 Test Methods for Scrub Resistance of Wall Paints
- D2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- D3273 Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

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.

- D3274 Test Method for Evaluating Degree of Surface Disfigurement of Paint Films by Fungal or Algal Growth, or Soil and Dirt Accumulation
- D3359 Test Methods for Measuring Adhesion by Tape Test
- D3891 Practice for Preparation of Glass Panels for Testing Paint, Varnish, Lacquer, and Related Products
- D3924 Specification for Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials (Withdrawn 2016)³
- D3925 Practice for Sampling Liquid Paints and Related Pigmented Coatings
- D3960 Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
- D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
- D4214 Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
- D4414 Practice for Measurement of Wet Film Thickness by Notch Gages
- D4708 Practice for Preparation of Uniform Free Films of Organic Coatings
- D7091 Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals
- E84 Test Method for Surface Burning Characteristics of Building Materials
- E1605 Terminology Relating to Lead in Buildings
- E1796 Guide for Selection and Use of Liquid Coating Encapsulation Products for Leaded Paint in Buildings
- E1797 Specification for Reinforced Liquid Coating Encapsulation Products for Leaded Paint in Buildings
- E2239 Practice for Record Keeping and Record Preservation for Lead Hazard Activities
- G154 Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
- 2.2 *Federal Test Methods Standard 141C*:⁴
 - 2011 Preparation of Steel Panels
 - 2012 Preparation of Tin Panels
- 2.3 *Federal Test Methods Standard 141D*:⁴
 - 3011 Condition in Container

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to Terminologies **D16** and **E1605**.

3.2 *Definition of Term Specific to This Standard*

3.2.1 *lead inaccessibility*—the ability of an encapsulation product to resist or inhibit the transport of lead to its surface.

4. Classification

4.1 *Type I: Interior Use Only*—Type I defines encapsulation products intended for interior use. These products shall meet the requirements of this specification except those for weath-

ering and exterior aging (that is, test methods described in **10.9** and **10.10.1** not conducted).

4.2 *Type II: Exterior Use Only*—Type II defines encapsulation products intended for exterior use. These products shall meet the requirements of this specification except that for interior aging (that is, test method described in **10.10.2** not conducted).

4.3 *Type III: Either Exterior or Interior Use*—Type III defines encapsulation products intended for either interior or exterior use. These products shall meet all the requirements of this specification.

5. Performance Requirements

5.1 Performance requirements that shall be met for a non-reinforced liquid coating encapsulation product are given in **Table 1**.

NOTE 1—In addition to those given in **Table 1**, performance requirements for three other properties are of concern for liquid coating encapsulation products. These are combustion toxicity, emissions during application and curing, and lead accessibility. However, requirements for these properties cannot be included in this specification at this time because there are no adequate ASTM or Federal test methods for determining them. Requirements for two of these properties, combustion toxicity and emissions during application and curing, may be subject to regulations or ordinances promulgated by authorities having jurisdiction. The user of this specification is advised to determine whether such regulations or ordinances exist. The addition of requirements for these properties to this specification will be undertaken when suitable test methods are available.

6. Sampling

6.1 A 3.8-L (1-gal) sample is usually sufficient for the recommended tests.

6.2 Prior to sampling, establish the condition of the container since damage to it may cause evaporation, skinning, or other undesirable effects. Excessive storage time and temperature fluctuations may cause settling or changes in viscosity. Materials beyond the manufacturer's stated shelf life shall not be sampled.

6.3 Thickening, settling, and separation are undesirable and objectionable if the coating, after storage, cannot be readily made suitable for application with a reasonable amount of stirring. Determine the conditions in the container in accordance with Method 3011 of the Federal Test Method Standard No. 141C.

6.4 Sample the encapsulant in accordance with Practice **D3925**. Determine the density in accordance with Test Method **D1475** and repeat until two successive readings agree within 90 g (0.2 lb). Samples for testing may then be taken.

6.5 Report the size of the container from which the sample was taken and product identification codes.

7. Number of Tests

7.1 The number of tests that shall be conducted for each performance property is given in **Table 1**.

8. Retesting

8.1 In cases where encapsulation products fail to pass one or more requirements of this specification, retesting shall be

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

TABLE 1 Performance Requirements for Reinforced Liquid Coating Encapsulation Products

Performance Property	Minimum Performance Requirement	Tested in Accordance with Section	Minimum Number of Tests
Impact resistance	9 J (80 in-lbf) without cracking to the substrate	10.2	Two panels
Adhesion	5A rating	10.3	Two panels each tested at three locations
Dry abrasion resistance	Film thickness loss: <20 %	10.4	Two panels
Water vapor transmission	No minimum; report test result ^A	10.5	Three cups
Water and chemical resistance—spot test	After 1 h recovery period, no evidence of blistering, cracking, or delamination	10.6/10.6.1	Two tests for each reagent
Water and chemical resistance—immersion test	After 24 h recovery, indistinguishable hardness of the exposed and unexposed surfaces	10.6/10.6.2	Two panels each tested at three locations
Surface burning characteristics	After 2 h drying period, adhesion rating: 5A Flame spread index (FSI) <25 Smoke development rating <50	10.7	One panel
Volatile organic compound (VOC) content	No minimum; report test result ^B	10.8	See Practice D3960
Weathering—exterior end-use products	After exposure: chalking: 8 rating adhesion: 5A rating flexibility: no cracking or other visual defects tensile properties: <35 % change from initial value	10.9	Chalking and Adhesion: two panels each tested at three locations ^C Flexibility: three panels Tensile properties: ten specimens
Aging—exterior and interior end-use products	After minimum 6 h recovery: adhesion: 5A rating flexibility: no cracking or other visual defects tensile properties: <35 % change from initial value	10.10.1: for exterior products 10.10.2: for interior products	Adhesion: two panels each tested at three locations Flexibility: three panels Tensile properties: ten specimens
Scrub resistance	No erosion of the encapsulant to the substrate after 1200 cycles	10.11	Two panels
Mildew resistance	Mildew resistance rating: 8	10.12	Three panels
Paintability	Adhesion rating: 5A	10.13.1	Two panels each tested at three locations
Repairability	Adhesion rating: 5A	10.13.2	Two panels each tested at three locations
Flexibility	No cracking or other visual defects	10.14	Three panels
Tensile Properties	No minimum; report test result ^A	10.15	Ten specimens

^A Minimum performance depends on architectural and end use conditions (see **1.2**).

^B VOC requirements may be specified in ordinances promulgated by authorities having jurisdiction.

^C The chalking and adhesion tests can be conducted on the same panels provided that chalking is first performed.

permitted. Both the original data and the retesting data for each requirement for which retesting was conducted shall be used in determining whether the requirement is met.

9. Test Specimens

9.1 A non-reinforced liquid coating encapsulation product shall be comprised of all principal components in the system, including the base and top coats and primer, if specified, for field application. Except for adhesion testing and dry abrasion testing, where specialty primers may be used for flash rust resistance, primers shall not be used solely for product performance testing in accordance with this specification.

9.2 Preparation of Test Panels:

9.2.1 The test specimen (substrate) shall be the encapsulant coated test panel.

9.2.2 Prior to product application, the tin-plated steel panels shall be solvent cleaned in accordance with Method 2012 of the Federal Test Method Standard No. 141C. Supplement the test panel cleaning procedure with an additional cleaning so that water wets the entire surface of the panel. Dry and wipe clean.

9.2.3 Product application shall be performed using the draw-down procedure in accordance with Practices **D823**. Determine dry-film thickness in accordance with Test Method **D1005** for free films and Practice **D7091** for films on steel panels except when the manufacturer's written instructions

reference only wet-film thickness. In this case, determine wet-film thickness in accordance with Test Methods **D1212** or Practice **D4414**. If a range of thickness is specified by the manufacturer for field application, the minimum value of this range shall be used for product testing in accordance with this specification. Dry-film thickness shall remain constant for all tests.

9.2.4 Preparation of steel panels shall be in accordance with Method 2011 of Federal Test Method Standard No. 141C.

9.2.5 Preparation of glass panels shall be in accordance with Practice **D3891**.

9.2.6 Curing shall be performed under standard laboratory conditions in accordance with Specification **D3924**. Cure time shall be 7 days unless otherwise agreed upon between the purchaser and seller. Cure time shall remain constant for all tests.

9.3 Preparation of Free-Film Specimens:

9.3.1 Free-film specimens shall be prepared in accordance with Practice **D4708**.

9.4 Laboratory Conditions:

9.4.1 Where applicable, all test methods and practices included in this specification shall be performed under standard laboratory conditions in accordance with Specification **D3924**.

ASTM standard conditions for laboratory testing are 23 ± 2 °C (73.5 ± 3.5 °F) and 50 ± 5 % relative humidity.

10. Test Methods

10.1 The laboratory testing shall be performed on the entire non-reinforced liquid coating encapsulation product system, whether single or multiple coat, as applied in the field.

10.2 *Impact Resistance*—Determine impact resistance in accordance with Test Method **D2794** using 0.80 mm (0.032 in.) zinc phosphate treated, cold-rolled steel panels as substrate and 16 mm ($\frac{5}{8}$ in.) punch diameter. The impact shall be applied directly to the encapsulant coating. After impact, examine the encapsulant coating visually for the presence of cracks using 5 to 7 \times magnification.

10.3 *Adhesion*—Determine the degree of adhesion in accordance with Test Methods **D3359**, Method A, using 0.25 mm (0.010 in.) tin plated steel panels as substrate.

10.4 *Dry Abrasion Resistance*—Determine dry abrasion resistance in accordance with Test Method **D4060** using CS-17 wheels, a 1 kg mass, and 0.80-mm (0.032-in.) cold-rolled steel panels as substrate. Where applicable, it is not prohibited to use specialty primers on the steel panel for flash rust resistance, although such primers may not be a component of the encapsulant product system. If used, subtract the thickness of the primer coat from the total film thickness of the test panel when calculating the percent film-thickness loss occurring during abrasion. Conduct the abrasion for 1000 cycles. Before initiating abrasion, draw diagonal lines with a marking pen from corner to corner across the test panel to measure film loss consistently. Measure initial and final film thickness on four abrasion locations on the encapsulant surface according to Practice **D7091** using an electronic thickness gage. Select these four locations along the diagonal lines approximately 30 mm (1.25 in.) from all four corners of the test panel.

10.5 *Water Vapor Transmission*—Determine the water vapor transmission in accordance with Test Methods **D1653**, Method A (Dry Cup Method), Condition A. Test the encapsulant product as a free film that has a thickness specified by the manufacturer for product application.

10.6 *Water and Chemical Resistance*—Determine the resistance to water and chemicals in accordance with Test Method **D1308**, using 0.25-mm (0.010-in.) tin-plated steel panels as the substrates for the immersion test and glass panels as the substrates for the spot tests.

10.6.1 *Spot Test*—Conduct the spot test using the reagents listed in 10.6.1.1 through 10.6.1.9. For each reagent, add 3 mL to a cotton ball placed on the coated glass panel. Cover the cotton ball with a watch glass or other suitable device. Remove the cotton ball after 24 h and gently pat the specimen dry with a paper towel. Then allow the specimen to recover for 1 h, and examine it by unaided eye for evidence of blistering, cracking, or delamination. After a 24-h recovery period, evaluate for evidence of softening by lightly rubbing the reagent-exposed area and an adjacent unexposed area with a wood tongue depressor; judge whether the hardness of the exposed and unexposed areas can be subjectively distinguished.

10.6.1.1 *Ethyl Alcohol*, (50 %/50 % ethyl alcohol/water by volume).

10.6.1.2 *Acetic Acid*, (5 %/95 % glacial acetic acid/water by volume).

10.6.1.3 *Sodium Hydroxide*, (5 %/95 % sodium hydroxide/water by mass).

10.6.1.4 *Hydrochloric Acid*, (5 %/95 % hydrochloric acid (37 %)/water by volume).

10.6.1.5 *Citric Acid*, (5 %/95 % citric acid/water by mass).

10.6.1.6 *Corn Oil*.

10.6.1.7 *Phosphoric Acid*, (2 %/95 % phosphoric acid/water by volume).

10.6.1.8 *Trisodium Phosphate*, (5 %/95 % trisodium phosphate/water by mass).

10.6.1.9 *Distilled Water*.

10.6.2 *Immersion Test*—Conduct the immersion test by immersing one half of the panel in distilled water for 24 h at standard laboratory conditions. Protect the backs, sides, and edges of the panel against rusting. After removal from the water, allow the panel to dry for 2 h at standard laboratory conditions before testing for adhesion in accordance with 10.3.

10.7 *Surface Burning Characteristics*—Determine surface burning characteristics in accordance with Test Method **E84** using Sterling Board or equivalent as substrate.

10.8 *Volatile Organic Compound (VOC) Content*—Determine VOC content in accordance with Practice **D3960**.

10.9 *Weathering*—For non-reinforced liquid coating encapsulation products designated for exterior use, determine the degree of weathering in accordance with Practice **G154**. Conduct practice for 1000 h under fluorescent lamps with a peak emission at 313 nm and a time/temperature cycle of 4 h ultraviolet (UV) at 60 °C and 4 h condensation at 50 °C. After exposure, evaluate the degree of chalking in accordance with Test Methods **D4214**, Method A, using wool felt of a contrasting color. Determine the degree of adhesion in accordance with 10.3. Test flexibility in accordance with 10.14. Evaluate tensile properties in accordance with 10.15.

10.10 *Aging*—There is no applicable ASTM or federal test method for measuring aging for encapsulation products; however, the following aging exposures shall be performed.

10.10.1 *Exterior Products*—Expose panels coated with exterior use products to twelve cycles (three cycles shall be performed on one day, resulting in a four-day test) with each cycle involving the following time/temperature changes: 50 ± 2 °C (120 ± 5 °F) for 1 h, room temperature for 15 min, -15 °C (0 °F) for 1 h, and room temperature for 15 min. Store panels at -15 °C (0 °F) overnight. After exposure, allow the specimens to recover for at least 6 h. Then, determine the degree of adhesion in accordance with 10.3. Test flexibility in accordance with 10.14. Evaluate tensile properties in accordance with 10.15.

10.10.2 *Interior Products*—Expose the panels coated with interior use products to 40 °C for a period of 2 weeks. After exposure, allow the panels to recover at least 6 h. Then, determine the degree of adhesion in accordance with 10.3. Test flexibility in accordance with 10.14. Evaluate tensile properties in accordance with 10.15.

NOTE 2—Testing of the encapsulant product may be conducted to observe any color change due to weathering or aging, or both. Agreement between the purchaser and seller may be used to determine acceptable performance.

10.11 *Scrub Resistance*—Determine scrub resistance in accordance with Test Methods **D2486**, Method A.

10.12 *Mildew Resistance*—Determine resistance to mildew in accordance with Test Method **D3273**. Determine rating in accordance with Test Method **D3274**.

10.13 *Paintability/Repairability*—There are no applicable ASTM or federal test methods to measure these properties; however, the following two procedures shall be performed.

10.13.1 *Paintability*—Apply the encapsulation product to a 0.25-mm (0.010-in.) tin plated steel panel. After curing, apply a coat of a commercially available acrylic latex paint in accordance with the paint manufacturer’s specification for film thickness. After the cure time specified for the latex paint has elapsed, determine the degree of adhesion between the encapsulant and the latex paint in accordance with **10.3**.

10.13.2 *Repairability*—Apply the encapsulation product to a 0.25-mm (0.010-in.) tin plated steel panel. After curing, apply another coat of encapsulant to the panel. Apply both coats in accordance with the encapsulants manufacturer’s specification for film thickness. After the cure time for the encapsulant has elapsed, determine the degree of adhesion between the two coats of encapsulant in accordance with **10.3**.

NOTE 3—Coats of different colors applied to the test panel may aid in the identification of visual defects in the coated surface after performance of the adhesion test.

10.14 *Flexibility*—Determine flexibility in accordance with Test Methods **D522/D522M**, Method A, using a conical mandrel and 0.25-mm (0.010-in.) tin plated steel panel as substrate. After a 1-s bend, examine the encapsulant at a distance of 6.4 mm (¼ in.) from the 3.2-mm (⅛-in.) end of the conical mandrel for the presence of cracking and other defects.

10.15 *Tensile Properties*—Determine tensile properties in accordance with Test Method **D2370**. Test shall be performed on free film, not less than 0.075 mm (0.003 in.) thick. Specimens shall be 100 mm (4 in.) in length and 13 mm

(0.5 in.) in width. Use a gage length of 50 mm (2 in.) and a crosshead speed of 10 ± 1 mm/min (0.5 ± 0.05 in./min). Determine percent elongation at 700 kPa (100 psi).

11. Record Keeping

11.1 All supporting data and reports of tests conducted shall be kept by the encapsulant supplier in accordance with Practice **E2239**.

12. Report

12.1 The report shall include the following:

12.1.1 The name, address, phone number, and e-mail address of the laboratory performing the tests as well as the name of the quality assurance supervisor responsible for the testing,

12.1.2 A brief description of the encapsulation product tested including the use of any primers, base and topcoats, application instructions, and substrates used for preparing test panels,

12.1.3 Dry film thickness of the cured encapsulation product,

12.1.4 Cure conditions including time, temperature, and relative humidity,

12.1.5 Product identification codes,

12.1.6 Description of the acrylic latex paint (used in the paintability test, **10.13.1**) including brand name and the manufacturer’s product code,

12.1.7 Test specimen identification codes, and

12.1.8 The average results of all of the performance tests conducted in accordance with this specification.

13. Marking

13.1 Containers shall be marked, at a minimum, with the following information:

13.1.1 Usable shelf life and proper storage conditions, and

13.1.2 ASTM classification type (see Section 4).

14. Keywords

14.1 abatement; encapsulant; encapsulation; lead; leaded paint; liquid coating; liquid coating encapsulation product; non-reinforced liquid coating encapsulation product

APPENDIX

(Nonmandatory Information)

X1. ALPHABETICAL LIST OF TEST METHODS AND PRACTICES

X1.1 This appendix presents a summary table of the ASTM test methods and practices, and also federal test method standards included in the specification.

TABLE X1.1 Alphabetical List of Test Methods and Practices

Test Method	Section	ASTM Test Method or Practice	Federal Test Method Std. No. 141C
Adhesion	10.3	D3359	
Aging	10.10		
Chalking	10.9	D4214	
Condition in container	6.3		3011
Density	6.4	D1475	
Dry abrasion resistance	10.4	D4060	
Dry-film thickness	9.2.3	D1005, D7091	
Film application on test panels	9.2.3	D823	
Flexibility	10.14	D522/D522M	
Free film preparation	9.3.1	D4708	
Glass panel preparation	9.2.5	D3891	
Impact resistance	10.2	D2794	
Mildew resistance	10.12	D3273, D3274	
Paintability	10.13.1	D3359	
Sampling	6.4	D3925	
Scrub resistance	10.11	D2486	
Standard laboratory conditions	9.4.1	D3924	
Steel panel preparation	9.2.4		2011
Surface burning characteristics	10.7	E84	
Tensile properties	10.15	D2370	
Tin panel preparation	9.2.2		2012
VOC content	10.8	D3960	
Water and chemical resistance	10.6	D1308	
Water vapor transmission	10.5	D1653	
Weathering	10.9	G154	
Wet-film thickness	9.2.3	D1212, D4414	

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