



Standard Practice for Testing Chemical-Resistant Broadcast and Slurry-Broadcast Resin Monolithic Floor Surfacing¹

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1. Scope

1.1 This practice covers methods for preparing test specimens and testing procedures for broadcast or slurry-broadcast monolithic floor surfacings in areas where chemical resistance is required.

1.2 These floor surfacings are applied by various application methods including squeegees, rollers, trowels, notched trowels, and gage rakes onto suitably prepared concrete substrates. The surfacings bond to the substrate upon curing to provide a nominal thickness of 60 mils (1.5 mm) or greater.

1.3 *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:

- C 413 Test Method for Absorption of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing²
- C 811 Practice for Surface Preparation of Concrete for Application of Chemical-Resistant Resin Monolithic Surfacing²
- C 904 Terminology Relating to Chemical-Resistant Non-metallic Materials²
- C 905 Test Methods for Apparent Density of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing and Polymer Concretes²
- C 1028 Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method³
- D 635 Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position⁴
- D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials⁴

D 1308 Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes⁵

D 2047 Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine⁶

D 4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser⁷

D 4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers⁵

2.2 ACI Standards:

ACI 503R, Appendix A, Test Method A.1, Field Test for Surface Soundness and Adhesion⁸

3. Terminology

3.1 *Definitions*—For definitions of terms relating to this standard, refer to Terminology C 904.

4. Significance and Use

4.1 Because the sample is prepared in a manner as it would be applied in the field, the test specimens may be considered representative of the application of a specified surfacing. Such methods include application by squeegees, rollers, trowels, notched trowels, and gage rakes.

4.2 These systems vary in several ways, including the number of layers or application steps, the surface finish, and variation in composition.

4.3 The results obtained in carrying out this practice should serve as a guide in comparing similarly applied surfacings. No attempt has been made to incorporate into this practice all of the various factors that may affect the performance of such applications when subjected to actual service.

5. Types of Resins, Fillers, and Setting Agents (Hardeners)

5.1 The liquid resins may be epoxy, polyester, vinyl ester, or others capable of forming chemical-resistant surfacing material when mixed with a suitable setting agent and filler.

5.2 The fillers may be silica, carbon, or other chemical-resistant materials. The filler may also be combined as a premix with the liquid resin or the setting agent.

¹ This practice is under the jurisdiction of ASTM Committee C03 on Chemical-Resistant Nonmetallic Materials and is the direct responsibility of Subcommittee C03.02 on Mortar and Monolithics.

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² *Annual Book of ASTM Standards*, Vol 04.05.

³ *Annual Book of ASTM Standards*, Vol 15.02.

⁴ *Annual Book of ASTM Standards*, Vol 08.01.

⁵ *Annual Book of ASTM Standards*, Vol 06.02.

⁶ *Annual Book of ASTM Standards*, Vol 15.04.

⁷ *Annual Book of ASTM Standards*, Vol 06.01.

⁸ Available from ACI International, PO Box 9094, Farmington Hills, MI 48333.

5.3 The setting agent (hardener) is usually supplied separately and added to the resin prior to use in accordance with the manufacturer's recommendations.

6. Sample Preparation

6.1 A 36 in. by 36 in. (900 mm by 900 mm) piece of suitable material that will allow the release of the applied surfacing after it has hardened shall be positioned on a rigid horizontal surface.

NOTE 1—A 5 mil polyethylene terephthalate sheet has been found suitable.

6.2 The floor surfacing shall be applied in accordance with the manufacturer's recommendations to a nominal thickness as it would be specified in an actual installation.

6.2.1 The standard temperature of the system constituents, the horizontal surface, and the temperature in the vicinity of the mixing and application area shall be $73.4 \pm 4^\circ\text{F}$ ($23 \pm 2.2^\circ\text{C}$) unless otherwise specified by the manufacturer. The actual temperature(s) shall be recorded.

6.3 After the system has been applied, age the prepared sample for a period of 7 days at $73.4 \pm 4^\circ\text{F}$.

6.4 Using a wet cutting saw, trim 6 in. (150 mm) off each side of the 36 in. by 36 in. cured sample to yield a 24 in. by 24 in. (610 mm by 610 mm) representative sample, free of any edge effects.

7. Thickness Test

7.1 Starting at any corner of the 24 in. by 24 in. representative surfacing sample, and approximately 1 in. (25 mm) in from the edge, use a micrometer and measure the thickness of the sample at approximately 6 in. (150 mm) intervals along the perimeter of the sample. Record the individual thickness readings and the average of the individual readings. The average value shall be reported as the cured thickness of the surfacing.

8. Abrasion Test

8.1 Test specimens as required by Test Method D 4060 shall be cut from the 24 in. by 24 in. representative surfacing sample using a wet cutting saw.

8.2 The abrasion resistance of the surfacing shall be determined in accordance with Test Method D 4060. A CS17 wheel with a 1000 g weight shall be operated for 5000 cycles and the average milligram of weight loss per 1000 cycles shall be reported. For more abrasion resistant floors a H-22 wheel may be used.

9. Flexural Strength and Modulus of Elasticity

9.1 Test specimens as required by Test Methods D 790 shall be cut from the representative surfacing sample using a wet cutting saw.

9.2 The flexural strength and the modulus of elasticity shall be determined in accordance with Test Methods D 790.

NOTE 2—Flexural strengths on systems less than $\frac{1}{8}$ in. (3 mm) thick may give erratic and questionable results.

9.2.1 Test pieces shall be placed in the testing apparatus such that the center loading nose will be applied to the top face of the test specimen.

10. Chemical Resistance

10.1 Dependent upon the chemical resistance that is required of the system, either immersion testing or "spot" testing shall be used.

10.1.1 For chemical-resistant immersion testing, the test specimens shall be the same as those required by Test Methods D 790 and shall be cut from the representative surfacing sample using a wet cutting saw.

10.1.2 The test conditions (test media, temperature, etc.) shall simulate the anticipated service conditions as closely as possible.

10.1.3 The number of test specimens required is dependent upon the number of test media to be employed, the number of different temperatures at which testing is performed, and the frequency of test intervals. The test specimens shall consist of sets of three for one medium at a single temperature and for each test interval. In addition, other sets of at least three, equivalent to the number of test temperatures, shall be available for the total test period. Calculate the total number of specimens required as follows:

$$N = n(M \times T \times I) + nT + n \quad (1)$$

where:

N = number of specimens,

n = number of specimens for a single test,

M = number of media,

T = number of test temperatures, and

I = number of test intervals.

10.1.4 Using a micrometer, measure the length, width, and thickness of each test specimen to the nearest 0.001 in. (0.0254 mm). Using a volume displacement in water method, determine the volume of the specimen to the nearest 0.01 cc.

10.1.5 Specimens shall be dried in an oven to constant weight. Each specimen shall be weighed to the nearest 0.001 g on an analytical balance and the weight recorded.

10.1.6 Using a Shore Hardness Tester, measure and record the hardness of each specimen.

10.1.7 Prior to immersion, record a brief description of the color and surface appearance of the specimens and the color and clarity of the test medium.

10.1.8 Place the test specimens in a suitable container or containers, taking care to prevent the specimens from coming in contact with each other. The total number of specimens per container is not limited except by the ability of the container to hold the specimens, plus the required amount of test medium per specimen. Add sufficient quantity of the test medium to completely immerse each specimen, and place the closed container in a constant-temperature oven adjusted to the required temperature or in a suitably adjusted liquid bath. Examine the specimens after 1, 7, 14, 28, 56, and 84 days of immersion to determine the rate of attack. Other test periods may be employed if desired.

10.1.9 Clean the specimens by three quick rinses in running cold tap water and quick dry by blotting with a paper towel between each rinse. For each test specimen, after final blotting, allow the specimen to dry for $\frac{1}{2}$ h before weighing. Weigh all specimens to the nearest 0.001 g.

10.1.9.1 Using a micrometer, measure the length, width and

thickness of all specimens to the nearest 0.001 in. Using a volume displacement in water method, measure the volume of the specimen to the nearest 0.01 cc.

10.1.9.2 Using a Shore Hardness Tester, measure the hardness of all specimens.

10.1.10 Note any indication of surface attack on the specimen, any discoloration of the test medium, and the formation of any sediment.

10.1.11 Discard and replace the test medium with fresh material after each inspection period. Replace media that are known to be unstable, for example aqueous sodium hypochlorite, as often as necessary in order to maintain the original chemical composition and concentration.

10.1.12 *Weight Change of Tested Specimens:*

10.1.12.1 *Weight Change*—Calculate to the nearest 0.01 % the percentage loss or gain in weight of the specimens during immersion for each examination period, taking the initial constant dried weight as 100 % as follows:

$$\text{Weight Change, \%} = [(W - W_D) / W_D] \times 100 \quad (2)$$

where:

W_D = initial dried weight of specimen, g, and

W = weight of specimen after immersion, g.

10.1.12.2 Construct a graph employing the average percentage of weight change of all the specimens at a given examination period after immersion in a particular test medium at a given temperature, plotting the percentage of weight change as the ordinate and the test period, in days, as the abscissa.

10.1.13 *Volume Change of Tested Specimens:*

10.1.13.1 *Volume Change*—Calculate to the nearest 0.01 % the percentage increase or decrease in volume of the specimens during immersion for each examination period, taking the initial volume as 100 % as follows:

$$\text{Volume Change, \%} = [(V - V_I) / V_I] \times 100 \quad (3)$$

where:

V_I = initial volume of specimen, cc, and

V = volume of specimen after immersion, cc.

10.1.13.2 Construct a graph employing the average percentage of volume change of all the specimens at a given examination period after immersion in a particular test medium at a given temperature, plotting the percentage of volume change as the ordinate and the test period, in days, as the abscissa.

10.1.14 *Hardness Change of Tested Specimens:*

10.1.14.1 *Hardness Change*—Calculate to the nearest 0.01 % the percentage increase or decrease in hardness of the specimens during immersion for each examination period, taking the initial hardness as 100 % as follows:

$$\text{Hardness Change, \%} = [(H - H_I) / H_I] \times 100 \quad (4)$$

where:

H_I = initial hardness of the specimen, and

H = hardness of specimen after immersion.

10.1.14.2 Construct a graph employing the average percentage of hardness change of all the specimens at a given examination period after immersion in a particular test medium at a given temperature, plotting the percentage change in

hardness change as the ordinate and the test period, in days, as the abscissa.

10.1.15 *Change in Flexural Strength and Modulus of Elasticity:*

10.1.15.1 Determine the flexural strength of the tested specimens in accordance with Test Methods D 790 for all specimens at a given examination period after immersion in a particular test medium at a given temperature.

10.1.15.2 *Flexural Strength Change*—Calculate to the nearest 0.01 % the percentage increase or decrease in flexural strength of the specimens during immersion for each examination period, taking the initial flexural strength as 100 % as follows:

$$\text{Flexural Strength Change, \%} = [(S - S_I) / S_I] \times 100 \quad (5)$$

where:

S_I = initial flexural strength of specimens, psi (MPa), and

S = flexural strength of specimen after immersion.

10.1.15.3 Construct a graph employing the average percentage change of the flexural strength of all specimens at a given examination period after immersion in a particular test medium at a given temperature, plotting the percentage of flexural strength change as the ordinate and the test period, in days, as the abscissa.

10.1.16 For chemical-resistant “spot” testing, Test Method D 1308 shall be used. This test method covers the determination of the effect of household chemicals on clear and pigmented organic finishes resulting in any objectionable gloss, blistering, softening, swelling, loss of adhesion, or special phenomena. This is considered a less severe test, but it may be sufficient for many situations.

11. Water Absorption

11.1 Water absorption shall be determined in accordance with Test Method C 413 with the following exceptions being noted.

11.1.1 The test specimens shall be 2 in. by 2 in. (50 mm by 50 mm) pieces, cut from prepared representative surfacing sample using a wet cutting saw.

11.1.2 The cut specimens shall be rinsed and blotted dry and placed in a desiccator for a minimum of 16 h before beginning the test.

11.1.3 The glass beaker used to hold the specimens shall be sized accordingly to accommodate the 2 in. by 2 in. test specimens.

12. Apparent Density

12.1 Using 1 in. by 1 in. test specimens to be cut from the prepared representative surfacing sample using a wet cutting saw, the apparent density of the surfacing shall be determined in accordance with Test Methods C 905, Density Method 2.

13. Flammability

13.1 Flammability of the surfacing shall be determined in accordance with Test Method D 635.

13.1.1 The test specimens shall be cut from the representative surfacing sample using a wet cutting saw.

14. Slip Resistance

14.1 The static coefficient of friction of the surfacing shall

be determined in accordance with Test Method C 1028 or Test Method D 2047.

15. Adhesion to Concrete

15.1 The concrete to which the surfacing is to be applied shall be prepared in accordance with Practice C 811. The specific method used in preparing the concrete surface shall be reported.

15.2 The floor surfacing shall be applied to the prepared concrete substrate in accordance with the manufacturer's recommendations.

15.3 After the applied surfacing has cured in accordance with the manufacturer's recommendations, the adhesion of the surfacing to the concrete shall be determined by either of the following tests:

15.3.1 *ACI 503R*—This test is often referred to as the “pipe cap bond test.”

15.3.2 *Test Method D 4541*—Use this test method, with a 1-1/2 in. (40 mm) minimum diameter loading fixture (dolly, stud, button) being specified. If this test method is used, core drill the coating around the perimeter of the loading fixture. Care must

be exercised to drill just to the interface of the coating and concrete. The core shall be not more than 1/8 in. greater in diameter than the fixture.

16. Report

16.1 Report the following information with respect to the floor surfacing tested:

16.1.1 Manufacturer's name,

16.1.2 Manufacturer's name for the surfacing,

16.1.3 Generic description of the surfacing,

16.1.4 Manufacturing codes of the surfacing components,

16.1.5 Application method(s) involved for each application step specified,

16.1.6 Actual cured thickness of the applied surfacing,

16.1.7 Conditioning procedure followed in sample preparation, and

16.2 All test results and methods used shall be reported.

17. Keywords

17.1 broadcast; chemical-resistant; floor protection; flooring; monolithic topping; slurry broadcast; surfacing

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