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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Methods for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes[1]

This standard is issued under the fixed designation C 267; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 These test methods are intended for use as a relatively rapid test to evaluate the chemical resistance of resin, silica, silicate, sulfur, and hydraulic materials, grouts, monolithic surfacings, and polymer concretes under anticipated service conditions. These test methods provide for the determination of changes in the following properties of the test specimens and test medium after exposure of the specimens to the medium:

1.1.1 Weight of specimen,

1.1.2 Appearance of specimen,

1.1.3 Appearance of test medium, and

1.1.4 Compressive strength of specimens.

NOTE 1—These test methods have been found to be unsatisfactory for evaluation of furan and phenolic mortars in hydrofluoric acid in concentrations above 35 %. Although the mortars may perform well in service, the test specimens generally fail by cracking when tested at such high hydrofluoric acid concentrations by these test methods.

1.2 Test Method A outlines the testing procedure generally used for systems containing aggregate less than 0.0625 in. (1.6 mm) in size. Test Method B covers the testing procedure generally used for systems containing aggregate from 0.0625 to 0.4 in. (1.6 to 1.0 mm) in size. Test Method C is used for systems containing aggregate larger than 0.4 in.

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

1.4 *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 470 Specifications for Molds for Forming Concrete Test Cylinders Vertically[2]

C 579 Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes[3]

C 904 Terminology Relating to Chemical-Resistant Nonmetallic Materials[3]

C 1312 Practice for Making and Conditioning Chemical-Resistant Sulfur Polymer Cement Concrete Test Specimens in the Laboratory[3]

E 4 Practices for Force Verification of Testing Machines[4]

3. Terminology

3.1 *Definitions*—For definitions of terms used in these test methods, see Terminology C 904.

4. Significance and Use

4.1 The results obtained by these test methods should serve as a guide in, but not as the sole basis for, selection of a chemical-resistant material for a particular application. No attempt has been made to incorporate into these test methods all the various factors that may affect the performance of a material when subjected to actual service. The strength values obtained by these test methods should not be used to evaluate the compressive strength of chemical-resistant materials. The appropriate ASTM test method for the specific material should be used for determining and evaluating the compressive strength.

5. Apparatus

5.1 *Equipment*, capable of weighing materials or specimens to ±0.3 % accuracy.

5.2 *Equipment for Mixing*, consisting of a container of suitable size, preferably made of corrosion-resistant metal, or a porcelain pan, and a strong, sturdy spatula or trowel.

5.3 *Specimen Molds*:

5.3.1 *Test Method A*—These molds shall be right cylinder 1± 1/32 in. (25 ± 0.8 mm) in diameter by 1 ± 1/32 in. high. The molds may be constructed in any manner that will allow formation of a test specimen of the desired size. Typical molds consist of a 1-in. thick, flat plastic sheet in which 1-in. diameter, smooth-sided holes have been cut, and to the bottom of which a ¼-in. (6-mm) thick, flat plastic sheet (without

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[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.05.

[4] *Annual Book of ASTM Standards*, Vol 03.01.

matching holes) is attached by means of screws or bolts. Alternately, the molds may consist of sections of round plastic tubing or pipe, 1 in. in inside diameter and 1 in. long, having sufficient wall thickness to be rigid and retain dimensional stability during the molding operation, and a ¼-in. thick, flat plastic sheet on which one open end of each section can be rested. With the latter style of mold, the tubing segment may be sealed with a material, such as caulking compound or stopcock grease. For most types of specimens it is satisfactory to simply seal one end of the tubing segment with masking tape.

NOTE 2—For use with sulfur mortars an additional piece of flat plastic sheet at least ⅛ in. (3 mm) thick containing a ¼-in. (6-mm) hole and a section of plastic tubing or pipe 1 in. (25 mm) in diameter by 1 in. high are required. They are used to form a pouring gate and reservoir in the preparation of sulfur mortar specimens.

5.3.2 *Test Method B*—Molds for the 2-in. (50-mm) cube specimens shall be tight fitting and leakproof. The molds shall have not more than three cube compartments and shall be separable into not more than three parts. The parts of the molds, when assembled, shall be positively held together. The molds shall be made of metal not attached by the material. The sides of the molds shall be sufficiently rigid to prevent spreading or warping. The interior faces of the molds shall be manufactured to ensure plane surfaces with a permissible variation of 0.002 in. (0.05 mm). The distances between opposite faces shall be 2 ± 1⁄16 in. (50 ± 0.8 mm). The height of the molds, measured separately for each cube compartment, shall be 2 ± 1⁄16 in. The angle between adjacent interior faces and between interior faces and top and bottom planes of the mold shall be 90 ± 0.5° measured at points slightly removed from the intersection of the faces.

5.3.3 *Test Method C*:

5.3.3.1 For polymer concretes other than sulfur polymer cement concretes, molds shall be right cylinders made of heavy gage metal or other rigid nonabsorbent material. The cylinder diameter shall be at least four times the nominal maximum aggregate size in the mix. The minimum cylinder diameter shall be 2 in. (50 mm). The cylinder height shall be two times the diameter. The plane of the rim of the mold shall be at right angles to the axis within 0.5°. The mold shall be at right angles to the axis within 0.5°. The mold shall not vary from the prescribed diameter by more than 1⁄16 in. (1.5 mm) nor from the prescribed height by more than ⅛ in. (3 mm). Molds shall be provided with a flat base plate with a means for securing it to the mold at a right angle to the axis of the cylinder in the instance of reusable metal molds. For molds other than metal, a mechanically attached smooth flat metal or integrally molded flat bottom of the same material as the sides shall be used. Single-use molds shall conform to Specifications C 470.

5.3.3.2 For molds to be used for preparing sulfur polymer cement concrete specimens, refer to Practice C 1312.

NOTE 3—The material from which the mold is constructed must be chemically inert and have antistick properties. Polyethylene, polypropylene, polytetrafluoroethylene, and metal forms having either a sintered coating of tetrafluoroethylene or a suitable release agent compatible with the material being tested are satisfactory. Because of their superior heat resistance, only trifluorochloroethylene and tetrafluoroethylene mold release agents should be used with sulfur materials.

5.4 *Analytical Balance*, of adequate capacity, suitable for accurate weighing to 0.001 g.

5.5 *Micrometer*, suitable for accurate measurement to 0.001 in. (0.03 mm).

5.6 *Containers*:

5.6.1 *Wide-Mouth Glass Jars*, of sufficient capacity, fitted with plastic or plastic-lined metal screw caps for low-temperature tests involving media of low volatility.

5.6.2 *Erlenmeyer Flasks*, of sufficient capacity, each fitted with standard-taper joints and a reflux condenser attachment for use with volatile media.

5.6.3 *Containers*, as described in 5.6.1 and 5.6.2 having an inert coating on their inner surfaces, or containers of a suitable inert material for use with media which attack glass.

5.7 *Constant-Temperature Oven or Liquid Bath*, capable of maintaining temperature within a range of ±4°F (±2°C).

5.8 Testing machine may be of any type of sufficient capacity which will provide the rates of loading prescribed. It shall have been verified to have an accuracy of 1.0 %, or better, within twelve months of the time of use in accordance with Practices E 4. The testing machine shall be equipped with two steel bearing blocks with hardened faces, one of which is a spherically seated block that will bear on the top bearing plate, and the other a plain rigid block that will support the bottom bearing plate. The diameter of the spherical bearing block shall be at least 75 % of the width of the specimen. The bearing faces shall not depart from a plane by more than 0.001 in. (0.025 mm) in any 6-in. (150-mm) diameter circle.

6. Test Media

6.1 The test media shall consist of the media to which the chemical-resistant materials are to be exposed in service.

7. Test Specimens

7.1 The number of 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 a minimum of three cylinders for one medium at a single temperature and for each test interval. In addition one set of at least three specimens shall be available for test immediately following the conditioning period, and other sets of at least three, equivalent to the number of test temperatures, 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.

NOTE 4—For calcium aluminate cements, strength and weight changes are a natural phenomena, with the degree of change being dependent upon the test conditions involved. Therefore, when conducting chemical resistance tests on these products, additional sets of control samples should be prepared for testing at each test temperature and each test interval. The immersion medium for these control samples will be potable water.

7.2 Make all specimens for a single determination from a single mix.

7.3 *Test Method A*—Prepare test specimens to be used in accordance with Test Method A as described in 8.1. Test specimens shall be right cylinders 1 + 1/32 in., − 1/16 in. (25 + 0.8, − 1.6 mm) in diameter by 1 ± 1/16 in. (25 ± 1.6 mm) high. If the faces of the specimen are not flat, smooth, and normal to the cylinder axis, they may be sanded, ground, or machined to specification. Exercise care that the frictional heat developed during such operations does not damage the specimens.

7.4 *Test Method B*—Prepare test specimens to be used in accordance with Test Method B as described in 8.1. Test specimens shall be cubes with dimensions of 2 + 1/16 in., − 1/8 in. (50 + 1.5, − 3.0 mm). If the faces of the cube are not flat, smooth, and normal to each other, they may be sanded, ground, or machined to specification. Exercise care that the frictional heat developed during such operations does not damage the specimens.

7.5 *Test Method C*:

7.5.1 For polymer concretes other than sulfur concretes, prepare the test specimens to be used in accordance with 8.2.

7.5.1.1 Do not test specimens if any individual diameter of a cylinder differs from any other diameter of the same cylinder by more than 2 %.

7.5.1.2 Neither end of compressive test specimens, when tested, shall depart from perpendicular to the axis by more than 0.5° (approximately equivalent to 1/8 in. in 12 in. (3 mm in 300 mm). Compression test specimens that are not flat within 0.002 in. (0.05 mm) shall be sawed, ground, or capped in accordance with 8.2.1.2. Determine the diameter used for calculating the cross-sectional area of the test specimen to the nearest 0.01 in. (0.25 mm) by averaging two diameters measured at right angles to each other at about mid-height of the specimen.

7.5.2 For preparing sulfur polymer cement concrete test specimens, refer to Practice C 1312.

8. Preparation of Specimens

8.1 *Specimen Preparation for Test Methods A and B*:

8.1.1 *Resin, Silicate, and Silica Materials*—Mix a sufficient amount of the components in the proportions and in the manner specified by the manufacturer of the materials. Fill the molds one-half full. Remove any entrapped air by using a cutting and stabbing motion with a spatula or rounded-end rod. Fill the remainder of the mold, working down into the previously placed portion. Upon completion of the filling operation, the tops of the specimens should extend slightly above the tops of the molds. When the molds have been filled, strike off the excess material, even with the top of the mold. Permit the material to remain in the mold until it has set sufficiently to allow removal without danger of deformation or breakage.

8.1.1.1 *Silicate Materials*—Some silicates may require covering during the curing period. After removal from the molds, acid-treat the specimens, if required, in accordance with the recommendations given by the manufacturer. No other treatment shall be permitted. Record the method of treatment in 13.1.3.

8.1.2 *Sulfur Materials*:

8.1.2.1 *Sulfur Mortars*—Slowly melt a minimum of 2 lb (900 g) of the material in a suitable container at a temperature of 265 to 290°F (130 to 145°C) with constant agitation. Stir to lift and blend the aggregate without beating air into the melt. Place the piece of plastic sheet containing the 1/4-in. (6-mm) round hole over the open face of the mold with the hole centered on the face. On top of the piece of plastic sheet and surrounding the hole, place a section of plastic tubing or pipe 1 in. (25 mm) in diameter by 1 in. high. Pour the melted material through the hole into the mold and continue to pour until the section of tubing or pipe is completely filled. The excess material contained in the hole in the plastic sheet acts as a reservoir to compensate for shrinkage of the material during cooling. Allow the specimen to remain in the mold until it has completely solidified. Upon removal, file, grind, or sand the surface flush, removing the excess material remaining at the pouring gate.

8.1.2.2 *Sulfur Polymer Cement Concretes*—Prepare specimens in accordance with Practice C 1312.

8.2 *Specimen Preparation for Test Method C*:

8.2.1 *Polymer Concretes Other than Sulfur Polymer Cement Concretes*—Prepare specimens in accordance with 8.1 with the following additional considerations:

8.2.1.1 The use of vibrators may be required. The type and method of vibrating will be as recommended by the manufacturer and shall be specified in the test report.

8.2.1.2 *Filling and Capping for Cylindrical Resin, Silicate, and Silica Specimens*—The top layer may be filled to slightly below the top edge of the mold. The top surface of the specimen shall be finished as much as practicable to a plane perpendicular to the axis of the specimen. The flatness of the finished specimen shall be within 0.010 in. (0.25 mm). Specimens exceeding this tolerance shall be machined flat or a capping compound shall be applied if the test load is to be applied to the surface.

8.2.1.3 Capping, if used, shall be made as thin as practicable and shall be applied before removal of the polymer concrete from the molds.

8.2.1.4 If a polymer paste or mortar is used for capping, it is preferable that the polymer used be the same as the one used to make the specimen. Fillers used may be the fine portion used in the polymer concrete or another mineral powder.

8.2.1.5 For capping in the mold, a suitable capping compound may be made from a polymer mortar. The surface of the polymer concrete shall be wiped off after hardening, and a polymer mortar or polymer paste with suitable fillers shall be deposited and pressed down uniformly to the top edge of the mold with a capping plate. In order to prevent the capping plate from bonding to the paste or mortar, the underside of the capping plate shall be covered with a release agent.

8.2.1.6 For capping after mold removal, stiff polymer paste or mortar or a low-melting-point alloy for capping shall be used. A suitable apparatus to maintain parallel ends on the specimen shall be used.

NOTE 5—Any capping compound to be used with polymer concrete should be tested to ascertain that its strength is high enough to prevent premature failure in the cap when testing in high compressive strength polymer concretes. Cap failure may result in substantially lower compressive strength results.