Designation: C580 – 18 (Reapproved 2023)

Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes[1]

This standard is issued under the fixed designation C580; 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 U.S. Department of Defense.

1. Scope

1.1 This test method covers the determination of flexural strength and modulus of elasticity in flexure of cured chemical-resistant materials in the form of molded rectangular beams. These materials include mortars, brick and tile grouts, structural grouts, machinery grouts, monolithic surfacings (60 mils or greater), and polymer concretes. These materials shall be based on resin, silicate, silica, or sulfur binders.

1.2 A bar of rectangular cross section is tested in flexure as a simple beam in center point loading: the bar rests on two supports and the load is applied by means of a loading nose midway between supports.

1.3 Method A outlines the testing procedure generally used for systems containing aggregate less than 0.2 in. (5 mm) in size. Method B covers the testing procedure generally used for systems containing aggregate from 0.2 in. to 0.4 in. (10 mm) in size. Method C is used for systems containing aggregate larger than 0.4 in.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *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, health, and environmental 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]

C904 Terminology Relating to Chemical-Resistant Nonmetallic Materials

C1312 Practice for Making and Conditioning Chemical-Resistant Sulfur Polymer Cement Concrete Test Specimens in the Laboratory (Withdrawn 2021)[3]

E4 Practices for Force Calibration and Verification of Testing Machines

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

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, see Terminology C904.

4. Significance and Use

4.1 This test method is generally applicable to rigid and semirigid materials. Although flexural strength cannot be determined for those materials that do not break, tangent modulus of elasticity can be determined.

4.2 The results obtained by this test method 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 this test method all the various factors that may affect the performance of a material when subjected to actual service.

[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 D01.46 on Industrial Protective Coatings.

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

4.3 In addition to the tangent modulus of elasticity, a secant modulus is calculated at the point on the stress-strain (load-deflection) graph where the strain is 50 % of the maximum strain.

5. Apparatus

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

5.2 *Equipment for Mixing Materials,* shall consist of a container of suitable size, preferably corrosion-resistant, a spatula, trowel, or mechanical mixer, and a ⅜ in. diameter rod with a rounded end, for use in casting specimens.

5.3 *Specimen Molds:*

5.3.1 *Method A*—Molds to permit the casting of bars 1 in. ± 1⁄16 in. (25 mm ± 1 mm) square by 10 in. (250 mm) minimum length.

5.3.1.1 For sulfur mortars, the following additional equipment is required:

(1) Cover Plate, of a size sufficient to enclose the open side of the bar mold. The base plate from another similar bar mold has been found to be acceptable.

(2) C-Clamp, large enough to fasten the cover plate securely over the bar mold.

(3) Melting Chamber, of sufficient volume and heat capacity to melt the sulfur mortar sample and maintain the temperature of the melt between 260 °F and 290 °F (127 °C and 143 °C).

(4) Laboratory Mixer, of such a type and speed to be capable of lifting the aggregate without beating air into the melt.

(5) Ladle, of sufficient capacity to completely pour one bar.

(6) Masking Tape, 1 in. (25 mm), or an equivalent.

5.3.2 *Method B*—Molds to permit the casting of bars 2 in. ± 1⁄8 in. (50 mm ± 3 mm) square by 12 in. (300 mm) minimum length.

5.3.3 *Method C*—Molds to permit casting of rectangular beams shall have a minimum cross-sectional dimension of 2 in. and at least three times the nominal maximum size of the coarse aggregate in the polymer concrete (Note 1). The bar length shall be at least three times the beam depth plus 2 in.

NOTE 1—The nominal maximum size of coarse aggregate is that size next larger than the largest sieve on which at least 15 % of the coarse aggregate by weight is retained.

5.4 *Testing Machine*—The testing machine shall be of any type sufficient to provide the required load and the rate of deflection 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 E4. It shall be equipped with an appropriate device to record deflection and produce a graph of load versus deflection.

5.5 *Loading Nose and Supports*—The loading nose and supports shall have cylindrical surfaces. To avoid excessive indentation, the radius of the nose and supports shall be at least 1⁄8 in. for Method A specimens, ¼ in. for Method B specimens, and ½ in. for Method C specimens.

6. Test Specimens

6.1 All specimens for a single determination shall be made from a single mix containing sufficient amounts of the components in the proportions and in the manner specified by the manufacturer of the materials. If the proportions so specified are by volume, the components shall be weighed and the corresponding proportions by weight shall be reported.

6.1.1 *Number of Specimens*—Prepare a minimum of six test bar specimens for each material tested. Additional specimens may be required to establish the cross head speed in 9.3.2.

6.2 *Specimen Size:*

6.2.1 For Method A, the specimen shall be 1 in. ± 1⁄16 in. (25 mm ± 1 mm) square by 10 in. to 14 in. (254 mm to 356 mm) long.

6.2.2 For Method B, the specimens shall be 2 in. ± 1⁄8 in. (25 mm ± 1 mm) square by 12 in. to 16 in. (305 mm to 406 mm) long.

6.2.3 For Method C, the specimens shall be rectangular beams with cross section as in 5.3.3 and with a length equal to the span plus 2 in. to 12 in. (51 mm to 305 mm).

6.3 *Specimen Preparation Temperature:*

6.3.1 *Resin, Silicate, and Silica Materials*—The standard temperature of the materials, molds, apparatus, and the ambient temperature of the mixing area shall be 73 °F ± 4 °F (23 °C ± 2 °C), unless otherwise specified by the manufacturer. Record the actual temperature.

6.3.2 *Sulfur Mortars*—The material shall be maintained at 275 °F ± 15 °F. The temperature of the molds and the ambient temperature of the mixing area shall be 73 °F ± 4 °F (23 °C ± 2 °C). Record the actual temperature.

6.3.3 *For Sulfur Concrete,* the material, mold, apparatus, and mixing equipment shall be 275 °F ± 15 °F (135 °C ± 8 °C), unless otherwise specified by the manufacturer. Refer to Practice C1312.

6.4 *Molding Test Specimens:*

6.4.1 Lubricate the mold by applying a thin film of an appropriate mold release or lubricant.

6.4.2 *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.

6.4.3 *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 the report section under Conditioning Procedure.

6.4.4 *Sulfur Mortars:*