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Standard Test Methods for Chemical Resistance and Physical Properties of Carbon Brick[1]

This standard is issued under the fixed designation C1106; 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 These test methods are intended for use as short-term tests for evaluating the physical properties of carbon brick and their chemical resistance at various temperatures in immersion service. These test methods provide a means of determining the following changes in the carbon brick specimen and the test media:

1.1.1 Weight, appearance, and compressive strength of the carbon brick specimen.

1.1.2 Appearance of the test media before, during, and after testing of the carbon brick specimen.

1.2 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.

1.3 *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:*[2]

C904 Terminology Relating to Chemical-Resistant Nonmetallic Materials

E4 Practices for Force Verification of Testing Machines

3. Terminology

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

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, the selection of a chemical-resistant carbon brick for a particular application. No attempt has been made to incorporate into these test methods all the factors that may affect the performance of carbon brick when subjected to various actual service conditions.

5. Apparatus

5.1 *Equipment,* capable of weighing materials or specimens to ±0.01 g accuracy.

5.2 *Micrometer or Vernier Caliper* , having a range suitable for measuring brick specimens to within 0.001 in. (0.025 mm).

5.3 *Masonry Saw,* suitably equipped to permit wet cutting (water only) of carbon brick with a diamond edge blade.

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

5.5 *Testing Machine,* may be of any type of sufficient capacity that will provide the rates of loading prescribed. It shall have been documented to have an accuracy of ±1.0 %, or better, within 12 months of the time of use in accordance with Practices E4. 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.

5.6 *Containers:*

5.6.1 *Wide-Mouthed Glass Jars,* of sufficient capacity, fitted with plastic or plastic-lined metal screw caps or other suitable sealed containers for low-temperature tests involving media of low viscosity.

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

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.

[1] These test methods are under the jurisdiction of ASTM Committee C03 on Chemical-Resistant Nonmetallic Materials and are the direct responsibility on Subcommittee C03.01 on Mortars and Carbon Brick.

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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.

5.7 *Hot Plate, Heating Mantel, or Pail Heater,* suitable for boiling water.

5.8 *Sander,* suitable for smoothing surfaces.

6. Test Specimens

6.1 The test specimens shall be wet cut using a masonry saw from representative full brick as received from the manufacturer.

6.1.1 All faces of the specimens shall be approximately plane and smooth. Adjacent faces must be normal to each other. If the faces are not suitably plane, smooth, and with adjacent faces normal to each other, the surfaces may be sanded, ground, or machined to specification. Exercise care that the frictional heat developed during such operations does not damage the specimens.

6.1.2 Specimens with scores, trademark indentations, chips, cracks, or other imperfections must be discarded.

6.1.3 The number of test specimens required is set forth in the respective test method.

7. Compressive Strength Test Method

7.1 *Test Specimens*—A minimum of six, 2 in. (50 mm) cube specimens shall be prepared in accordance with Section 6 of this standard.

NOTE 1—When cutting the full brick, the original depth orientation shall be noted on the cube specimens.

7.2 *Measurement of Specimens*—Measure to the nearest 0.001 in. (0.025 mm), the cross-section dimensions of those two opposite faces of the specimen that will be in contact with the upper and lower bearing blocks of the testing machine and thus perpendicular to the load axis. Record the dimensions for each respective specimen.

7.3 *Temperature of Test*—Compression tests shall be performed at 73 ± 4°F (23 ± 2°C).

7.4 *Placing the Specimen:*

7.4.1 Orient the test cube under the load plate of the compression testing machine such that when the load is applied it will be in the direction of the original depth of the brick.

7.4.2 Center the test cube under the load plate of the compression testing machine to within 1⁄16 in. (2 mm) in any direction of true center such that the load is applied to the top or bottom face of the test specimen.

7.5 *Rate of Loading:*

7.5.1 Apply the load continuously and without shock. Test at a uniform rate of 3000 psi (20.7 MPa)/min.

7.5.2 Load the test specimen to failure and record the maximum load (*W*) indicated by the testing machine.

7.6 *Calculations:*

7.6.1 From the dimensions measured in 7.2 for each respective specimen, calculate the areas of the two specimen faces that were perpendicular to the load axis, and then calculate the average area (*A*) of the two.

7.6.2 Calculate the individual compressive strength (*C*) of each specimen as follows:

$$C = W/A \tag{1}$$

where:

C = compressive strength of the specimen, psi (MPa),
W = maximum load, lb (N), and
A = average of the areas of the upper and lower bearing surfaces of the test specimen, in.^{2} (mm^2).

7.6.3 Calculate the average compressive strength in accordance with Section 12.

7.7 *Report:*

7.7.1 Name of brick manufacturer.

7.7.2 Brand name of brick.

7.7.3 Manufacturer's lot number.

7.7.4 Full brick dimensions.

7.7.5 Any defects in the specimens.

7.7.6 Individual and average compressive strength values.

8. Water Absorption

8.1 *Test Specimens*—A minimum of four quarter-brick specimens shall be prepared in accordance with Section 6 of this standard. The four quarter-brick specimens shall be obtained by taking a representative carbon brick and first halving the brick shape lengthwise and then taking these two halves and cutting each of them lengthwise. Of the four respective test specimens prepared, each will have four original faces from the full brick shape before it was cut up and two faces will have been created by sawing the original brick into the four pieces.

8.2 *Preparing the Specimens*—Rinse the four specimens with a fine spray of distilled water. Place the test specimens in a constant-temperature oven set at 216 ± 4°F (102 ± 2°C) until they reach a constant weight. Allow the specimens to cool in a dessicator to 73 ± 4°F.

8.2.1 The constant dry weight of the respective test specimens shall be determined to the nearest 0.01 g after the specimens have cooled to 73 ± 4°F. Record the dry weight (W_D) of each specimen.

8.3 *Test Procedure:*

8.3.1 Place the test specimens in distilled water and boil for 2 h. During the boiling period, keep the specimens entirely covered with water and allow no contact with the heated sides or bottom of the container.

8.3.2 After the boiling period, remove the heat source and allow the specimens to cool to room temperature, 73 ± 4°F (23 ± 2°C). Be sure to keep the test specimens completely covered with water during this cooling down stage.

8.3.3 After cooling, remove and blot each specimen with a damp cotton cloth to remove all liquid droplets from the surface. Excessive blotting will introduce error by withdrawing liquid from the pores of the specimen.

8.3.4 Determine the saturated weight (W_S) of each specimen by weighing each to the nearest 0.01 g.

8.4 *Calculation:*

8.4.1 The water absorption is expressed as a percentage of the dry weight (W_D) of the specimen compared to the saturated weight (W_S) of the specimen calculated as follows:

$$\text{Water Absorption, \%} = \frac{(W_S - W_D)}{W_D} \times 100 \tag{2}$$