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Standard Test Method for Compressive (Crushing) Strength of Fired Whiteware Materials[1]

This standard is issued under the fixed designation C773; 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 This test method covers two test procedures (A and B) for the determination of the compressive strength of fired whiteware materials.

1.2 Procedure A is generally applicable to whiteware products of low- to moderately high-strength levels (up to 150 000 psi or 1030 MPa).

1.3 Procedure B is specifically devised for testing of high-strength ceramics (over 100 000 psi or 690 MPa).

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:*[2]

E4 Practices for Force Verification of Testing Machines

E6 Terminology Relating to Methods of Mechanical Testing

E165 Practice for Liquid Penetrant Examination for General Industry

3. Significance and Use

3.1 Resistance to compression is the measure of the greatest strength of a ceramic material. Ideally, ceramics should be stressed this way in use. This test is a measure of the potential load-bearing usefulness of a ceramic.

PROCEDURE A

4. Apparatus

4.1 *Testing Machine*—Any testing machine conforming to Practices E4 and to the requirements for speed of testing prescribed in Sections 5 and 12 of this test method, may be used.

4.2 *Spherical Bearing Block*—In vertical testing machines, the spherical bearing block shall be spring suspended from the upper head of the machine in such a manner that the upper platen of the machine (lower face of the spherical bearing block) remains in a central position (spherical surfaces in full contact) when not loaded. The spherical surfaces shall be well lubricated, and the center of curvature shall lie on the lower face of the platen. The diagonal or diameter of the platen shall be only slightly greater than the diagonal of the 1½-in. (38.1-mm) square contact blocks to facilitate accurate centering of the specimens.

4.3 *Contact Blocks*—Cold-rolled steel contact blocks shall be used between the test specimen and the platens of the machine. These blocks shall be 1½ in. (38.1 mm) square by ⅝ to ¾ in. (15.9 to 19.1 mm) thick, and the contact faces shall be surface ground until plane and parallel. The contact blocks shall be resurfaced, if necessary, after each strength test, and may be reused only so long as the thickness remains over ½ in. (12.7 mm). If the contact block is cracked during testing, it shall be replaced.

[1] This test method is under the jurisdiction of ASTM Committee C21 on Ceramic Whitewares and Related Products and is the direct responsibility of Subcommittee C21.03 on Methods for Whitewares and Environmental Concerns.

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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.

TABLE 1 Typical Loading Rates to Cause Failure in 1 min

NOTE 1—The loading rate of 16 000 lbf/min (70 kN/min) shall be used for the first three tests of an unknown material to determine the general strength classification group. Some specimens crack before ultimate failure; the load at which the first audible crack occurs shall be noted, but only the load on the specimen at ultimate failure shall be used for calculation of compressive strength.

Compressive Strength, psi (MPa)	Specimen Diameter, in. (mm)	Loading Rate, lbf/min (kN/min)
10 000(69)	1.00(25.4)	8000(35)
50 000(345)	0.64(16.3)	16 000(70)
150 000(1034)	0.45(11.5)	24 000(105)

4.4 *Cushion Pads*—Cushion pads shall be used between the test specimens and the contact blocks to aid in distributing the load. New cushion pads shall be used for each specimen. Suitable materials for cushion pads, selected in accordance with the compressive strength range of the material being tested, are shown in the following table:

Compressive Strength Range, psi (MPa)	Cushion Pad
5000 to 50 000 incl (34.5 to 345)	blotting paper, 1/64 in. (0.4 mm) thick
Over 50 000 to 150 000 incl (345 to 1030.0)	mild steel, 1/32 in. (0.8 mm) thick (65 HRB max)

5. Procedure

5.1 Dye-check specimens in accordance with Test Method E165 before testing. Discard any pieces exhibiting cracks or flaws visible to the unaided eye.

5.2 Clean the test specimens with a suitable solvent after grinding and immerse in an ultrasonic bath filled with hot detergent solution. Then rinse specimens in hot water, dry at 110 ± 2°C (230 ± 4°F) for 2 h and cool to room temperature in a desiccator.

5.3 Carefully center the specimen in the machine between the contact blocks. Place an appropriate guard around the specimen to contain flying fragments at failure; eye protection should be used by the operator.

5.4 Apply the load continuously and without impact shock until ultimate failure. The rate of loading to be used shall depend on the compressive strength of the material being tested, as shown in Table 1.

6. Calculation

6.1 Calculate the compressive strength of each specimen as follows:

$$C = P/A \quad (1)$$

where:

C = compressive strength of the specimen, psi or MPa;
P = total load on the specimen at failure, lbf or N; and
A = calculated area of the bearing surface of the specimen, in.^{2} or mm^2.

7. Report

7.1 Report the following information:
7.1.1 The procedure used,
7.1.2 Type of testing machine (hydraulic or screw),
7.1.3 Material and size of contact blocks or of cushioning materials,
7.1.4 Description of material being tested (Note 1),
7.1.5 Rate of loading,
7.1.6 Number of specimens tested,
7.1.7 Dimensions and load at failure of each specimen, and
7.1.8 Compressive strength of each specimen tested, rounded off to the nearest 100 psi (1.0 MPa), together with the average compressive strength of the sample tested and the standard deviation.