



Designation: C 689 – 03

Standard Test Method for Modulus of Rupture of Unfired Clays¹

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1. Scope

1.1 This test method covers the determination of the modulus of rupture of ceramic whiteware clays both dry and after conditioning at 50 or 80 % relative humidity, or both.

1.2 *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 322 Test Method for Sampling Ceramic Whiteware Clays²

3. Apparatus

3.1 *Conditioning Cabinet*—Any suitable airtight cabinet with means for circulating air, or vacuum desiccator, wherein prescribed specimens can be conditioned as desired before testing. Specimens for dry strength shall be stored with silica gel desiccant. Specimens for 50 % relative humidity shall be stored over a saturated solution of sodium dichromate ($\text{Na}_2\text{CR}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$), and specimens for 80 % relative humidity shall be stored over a saturated solution of ammonium chloride (NH_4Cl).

3.2 *Testing Machine*—Any suitable testing machine may be used, provided a uniform rate of direct loading can be maintained at no more than 1 lb/min (4.4 N/min) using the prescribed specimens. For the support of the test specimen, two steel bars having a diameter of 0.5-in. (12.7-mm) shall be provided. The load shall be applied by means of a third steel bar having a diameter of 0.5-in. (12.7-mm). All three bars are to be smooth polished steel without surface defects such as scratches or gouges.

4. Test Specimen Preparation

4.1 *Preparation of Extruded Specimens*—100 % clay specimen preparation: The test sample shall be blunged with

sufficient distilled water to give complete dispersion and produce a slip of sufficient viscosity to avoid noticeable settling of particles (usually in the range of 25 to 50 percent solids). Slip shall be sieved through a No. 120 (125 μm) sieve or equivalent. After aging 24 h the slip shall be dewatered to a plastic condition preferably by filter pressing. At this point the moisture content must be adjusted to optimum conditions for forming by some measure of plasticity such as Pfefferkorn apparatus, plumb bob penetration, or other acceptable means. After the water of plasticity has been adjusted (usually will range from 20 to 50 %), test specimens shall be formed by extrusion. Where hand-operated extruder is used without vacuum, the plastic clay shall be thoroughly hand-wedged to eliminate entrapped air as a preliminary to forming test pieces. Where a vacuum extruder is used, a vacuum of not less than 25 in. (635 mm) Hg shall be maintained during forming operation.

4.1.1 *Clay-Flint Specimens*—to be used in the case of strong clays that are considered bonding materials. Prepare specimens as in 4.1 using a mixture of clay and 200 mesh potters flint in a 1/1 ratio blend that has been thoroughly dry mixed.

4.1.2 *Solid Cast Specimens*—100 % clay and clay-flint specimens should be prepared by making a high solids slurry deflocculated to minimum viscosity. Adjust the solids content of the slurry to obtain a viscosity between 100-500 cps. The slurry should be cast in plaster molds until solid, then dried in accordance to the procedure outlined in 4.3 and 4.4.

4.2 *Dimension*—The test specimens shall be round bars of 0.50 (12.8 mm) diameter, and at least 4.5 in. (114 mm) in length to permit an overhang of at least 0.25 in. at each end when mounted on the supports.

4.3 *Handling and Warpage*—All due precaution shall be observed in the forming and drying to produce straight test specimens. No specimen shall be used that shows a warpage greater than 1 % of its overall length. The bars shall be checked from time to time during drying for straightness, and before they stiffen, corrective straightening may be encouraged by rotating the bars so that drying occurs from another surface region. Defective bars due to warpage, flaws, or voids shall be rejected.

4.4 *Drying and Storage*—The extruded specimens shall be placed on a lightly oiled pallet and allowed to dry at room atmospheric conditions 68 to 104°F (20 to 40°C) for 24 h. Then the specimens shall be dried in a drier at 140°F (60°C) and low

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 C21.04 on Clays.

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² *Annual Book of ASTM Standards*, Vol 15.02.