



Designation: C674 – 13 (Reapproved 2023)

Standard Test Methods for Flexural Properties of Ceramic Whiteware Materials¹

This standard is issued under the fixed designation C674; 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 cover determination of the modulus of rupture and the modulus of elasticity of fired ceramic whitewares bodies, formed by any fabrication method, and are applicable to both glazed and unglazed test specimens.

1.2 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units may be approximate.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *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. Summary of Test Methods

2.1 The specimens, either cylindrical, or rectangular, are supported on knife edges over a suitable span and a direct load is applied at the midpoint between the supports at a uniform rate until breakage occurs. The modulus of elasticity may be determined by halting the applied load at definite intervals and measuring the deflection of the specimen at the midpoint to the nearest 0.001 in. (0.025 mm).

3. Significance and Use

3.1 These test methods provide a means for determining the modulus of rupture and the modulus of elasticity, which may be required in product specifications.

4. Apparatus

4.1 *Testing Machine*—Any suitable testing machine may be used, provided uniform rates of direct loading can be maintained.

¹ These test methods are under the jurisdiction of ASTM Committee C21 on Ceramic Whitewares and Related Products and are the direct responsibility of Subcommittee C21.03 on Methods for Whitewares and Environmental Concerns.

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4.1.1 For all specimens the loading rate should be such that the specimen should fail in approximately 1 min. Table 1 lists loading rates that shall be used for each size specimen. For strengths of specimens intermediate of those specified, interpolation can be used to obtain the equivalent loading rate.

4.1.2 For the prescribed rectangular specimens the loading rate shall be 1000 lb $\pm$ 150 lb (454 kg $\pm$ 68 kg)/min.

4.2 *Bearing Edges*—For the support of the test specimen, two steel (or high-strength ceramic) knife edges rounded to a radius of 0.125 in. (3.18 mm) shall be provided. The load shall be applied by means of a third steel knife edge rounded to a radius of 0.125 in. When testing rectangular specimens, the supporting members for the bearing edges shall be constructed to provide a means for alignment of the bearing surfaces with the surfaces of the test specimen (it being possible that the rectangular specimen may be wedge-shaped or twisted). The apparatus shown in Figs. 1 and 2 are suggested as suitable devices for ensuring proper spacing and alignment of the bearing edges for rectangular test specimens.

5. Test Specimens

5.1 *Preparation of Specimens*—Form, fire, and finish the specimens by the appropriate methods, following practices used in actual production.

5.2 *Dimensions*—The specimens shall be approximately 1.125 in. (28.6 mm), 0.750 in. (19.2 mm), 0.500 in. (12.7 mm), or 0.250 in. (6.4 mm) in diameter, whichever diameter is most comparable to that of the finished product. The length shall be 6 in. $\pm$ 0.50 in. (153 mm $\pm$ 12.7 mm) to permit an overhang of at least 0.25 in. (6.4 mm) at each end when mounted on the supports. Note that the 0.25 in. specimens may be 3.75 in. $\pm$ 0.25 in. (95 mm $\pm$ 7 mm) long.

5.2.1 The dry-pressed specimens shall be rectangular bars approximately 1 in. (25.4 mm) by 0.50 in. (12.7 mm) in cross section and at least 4.50 in. (114 mm) in length to permit an overhang of at least 0.25 in. at each end when mounted on the supports.

5.3 *Handling*—Observe all due precautions in the forming, drying, and firing to produce straight test specimens of uniform cross section.

5.4 *Storage*—Cool test specimens taken warm from the kiln in a desiccator. If the testing must be delayed, store the bars in the desiccator, or in an electric oven at 110 °C, and then cool

TABLE 1 Loading Rates for Specimens

Specimen Size, in. (mm)	Span, in. (mm)	Nominal MOR, ksi (MPa)		
		10 (69)	30 (207)	50 (345)
		Loading Rate, lb/min (kg/s)		
1.125 (28.6) diameter	5 (127)	1100 (8.32)	3400 (25.70)	5600 (42.34)
0.750 (19.2) “	5 (127)	300 (2.27)	1000 (7.56)	1700 (12.85)
0.500 (12.7) “	5 (127)	100 (0.76)	300 (2.27)	500 (3.76)
0.250 (6.4) “	3 (76)	20 (0.15)	60 (0.45)	100 (0.76)
1 by 0.50 (25.4 by 12.7)	4 (102)	400 (3.02)	1250 (9.45)	2100 (15.88)

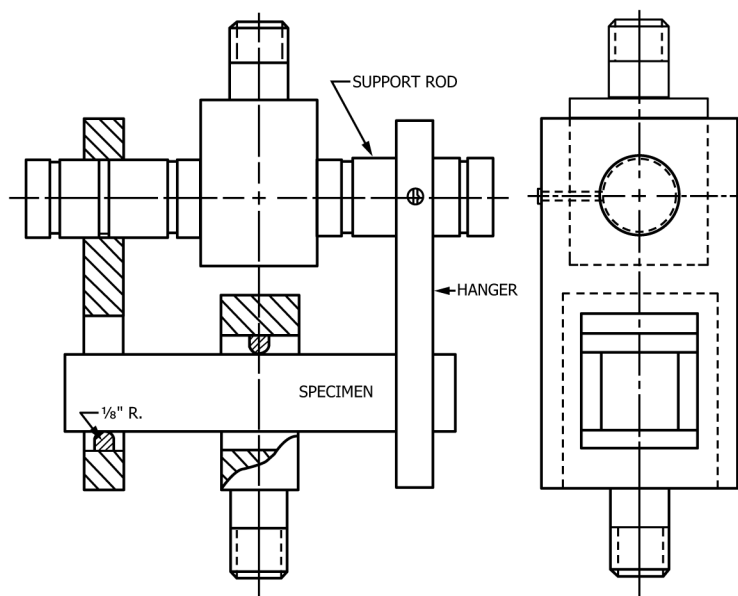


FIG. 1 Suggested Bearing Edge and Specimen Support

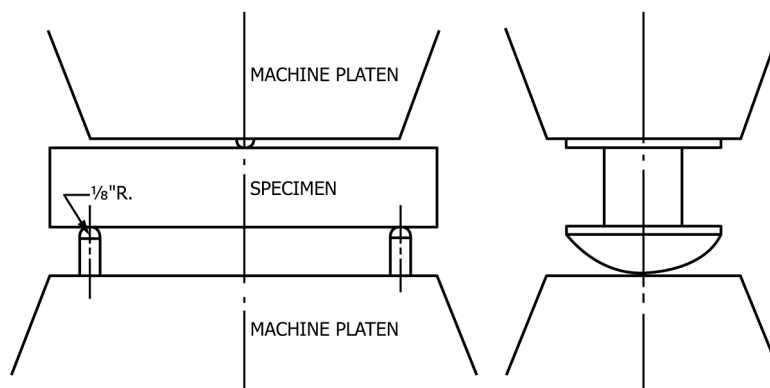


FIG. 2 Alternative Suggested Bearing Edge and Specimen Support

in a desiccator before testing. When removing specimens from a hot kiln, take care to avoid thermal shock which will lead to erroneous results.

MODULUS OF RUPTURE

6. Procedure

6.1 Test at least ten dry specimens at room temperature.

NOTE 1—The modulus of elasticity may be determined as described in

Sections 10 – 11 on the same type specimens used for the modulus of rupture test.

6.2 Place the cylindrical specimen on the bearing edges, spaced 5 in. (127 mm) $\pm$ 2 % between centers, with the specimen overhanging each end by at least 0.25 in. (6.4 mm). Apply the load at a right angle to the specimen and midway ($\pm$ 2 %) between the supporting edges. Apply the load uniformly at the appropriate rate for the specimen size (see 4.1.1)