



Standard Test Method for Modulus of Rupture in Bending of Electrode Graphite¹

This standard is issued under the fixed designation C1025; 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.

^{ε1} NOTE—Updated units of measurement throughout editorially in May 2010.

1. Scope—Scope*

1.1 This test method covers determination of the modulus of rupture in bending of specimens cut from graphite electrodes using a simple square cross section beam in four-point loading at room temperature.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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

C651 Test Method for Flexural Strength of Manufactured Carbon and Graphite Articles Using Four-Point Loading at Room Temperature

C709 Terminology Relating to Manufactured Carbon and Graphite

C783 Practice for Core Sampling of Graphite Electrodes

E4 Practices for Force Verification of Testing Machines

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions*—For definitions of terms relating to manufactured carbon and graphite, see Terminology **C709**.

3.1 *Definitions of Terms Specific to This Standard: Definitions:*

3.1.1 *electrode graphite, n*—a type of manufactured graphite with less restrictive controls on homogeneity and purity, commonly produced to carry current in electric arc furnaces, as a consumable item in electrical discharge machining, and as a structural material in plastic-injection molds.

3.1.2 *flexural strength, n*—property of solid material that indicates its ability to withstand a flexural or transverse load, obtained through a measurement of the ultimate load-carrying capacity of a specified beam in bending.

3.1.3 *modulus of rupture in bending—bending, n*—the value of maximum stress in the extreme fiber of a specified beam loaded to failure in bending computed from the calculations in Section **bending, 9**.

4. Significance and Use

4.1 This test method provides a means for determining the modulus of rupture of a square cross section graphite specimen machined from the electrode core sample obtained according to Practice **C783**, with a minimum core diameter of ~~57 mm~~, **57 mm**. This test method is recommended for quality control or quality assurance purposes, but should not be relied upon to compare materials of radically different particle sizes or orientational characteristics. For these reasons as well as those discussed in **4.2** an absolute value of flexural strength may not be obtained.

¹ This test method is under the jurisdiction of ASTM Committee **D02** on Petroleum Products—Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee **D02.F0** on Manufactured Carbon and Graphite Products.

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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.

*A Summary of Changes section appears at the end of this standard

4.2 *Specimen Size*—The maximum particle size and maximum pore size vary greatly for manufactured graphite electrodes, generally increasing with electrode diameter. The test is on a rather short stubby beam, therefore the shear stress is not insignificant compared to the flexural stress, and the test results may not agree when a different ratio or specimen size is used.

5. Apparatus

5.1 The testing machine shall conform to the requirements of Sections 14 and 17 of Practices E4.

5.2 The four-point loading fixture shall consist of bearing blocks or roller assemblies which ensure that forces applied to the beam are normal only and without eccentricity. (See Test Method C651.) The directions of loads and reactions may be maintained parallel by judicious use of linkages, rocker bearings, and flexure plates. Eccentricity of loading can be avoided by the use of spherical or cylindrical bearings. Provision must be made in fixture design for relief of torsional loading to less than 5 % of the nominal specimen strength. Refer to Fig. 1 for a suggested four-point fixture with a semi-articulating roller configuration.

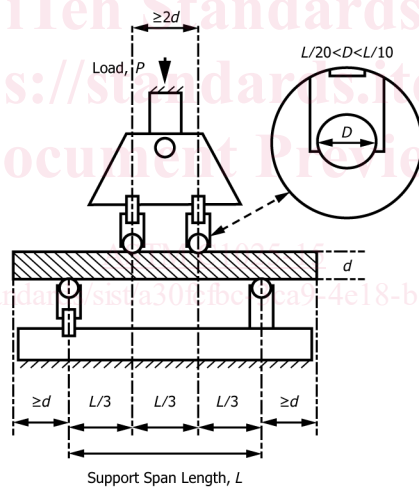
5.3 The bearing block diameter shall be between 1/10 and 1/20 of the specimen support span, 12 mm to 6 mm. A hardened steel bearing block, roller assembly, or its equivalent is necessary to prevent distortion of the loading member.

6. Test Specimen

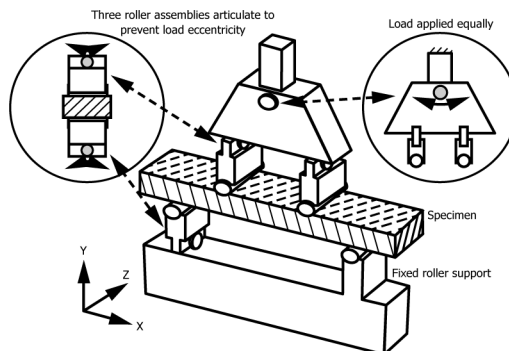
6.1 *Sampling*—A core sample (minimum of 57 mm diameter and 165 mm long) shall be obtained from the electrode in accordance with Practice C783.

6.2 *Preparation*—A test specimen shall be prepared from the core to yield a parallelepiped of square cross section. The faces shall be parallel and flat within 0.002 mm/mm of length. Specimen edges shall be free from visible flaws and chips. All surfaces shall be smooth with a surface texture equivalent to that obtained from a precision band saw or better.

6.3 The square cross section specimen shall be 38 mm by 38 mm and at least 153 mm long.



(a)



(b)

FIG. 1 Beam with Four-Point Loading (Not to Scale)