



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

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1. 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. The values given in parentheses are for information only.

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**.

3.2 *Definitions of Terms Specific to This Standard:*

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

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products 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.

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 (2.25 in.) 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.

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 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 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.

5.3 The bearing block diameter shall be between $\frac{1}{10}$ and $\frac{1}{20}$ of the specimen support span, 12 mm (0.50 in.) to 6 mm (0.25 in.). A hardened steel bearing block 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 (2.25 in.) diameter and 165 mm (6.50 in.) 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 (0.002 in./