



Standard Test Method for Flexural Strength of Manufactured Carbon and Graphite Articles Using Four-Point Loading at Room Temperature¹

This standard is issued under the fixed designation C651; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This test method covers determination of the flexural strength of manufactured carbon and graphite articles using a simple 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

C78 Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

C1161 Test Method for Flexural Strength of Advanced Ceramics at Ambient Temperature

E4 Practices for Force Verification of Testing Machines

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

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

3. Terminology

3.1 *Definitions:*

3.1.1 *flexural strength, n*—property of a 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.

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

4. Significance and Use

4.1 This test method may be used for material development, quality control, characterization, and design data generation purposes.

4.2 This test method determines the maximum loading on a graphite specimen with simple beam geometry in 4-point bending, and it provides a means for the calculation of flexural strength at ambient temperature and environmental conditions.

5. Apparatus

5.1 The testing machine shall conform to the requirements of Practices E4.

5.2 The four-point loading fixture shall consist of bearing blocks or cylindrical bearings spaced in a third-point loading configuration (see Test Method C78).

5.3 The fixture shall ensure that forces applied to the beam are normal only and without eccentricity through the use of spherical bearing blocks (see Test Method C78) or articulating roller bearing assemblies (see Test Method C1161).

5.3.1 The bearing block or roller bearing diameter shall be between $\frac{1}{10}$ and $\frac{1}{20}$ of the specimen support span. A hardened steel bearing block or its equivalent is necessary to prevent distortion of the loading member. Support surfaces must be free to pivot or rotate to relieve frictional constraints.

5.4 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 bearing blocks or articulating roller bearings. Provision must be made in fixture design for the relief of torsional loading to less than 5 % of the nominal specimen strength. Refer to the attached figure for a suggested four-point loading fixture.

6. Test Specimen

6.1 *Preparation*—The test specimen shall be prepared to yield a parallelepiped of rectangular cross section. The faces shall be parallel and flat within 0.025 mm/mm of length. In addition, the samples having a maximum particle size less than 0.150 mm in diameter must be finished so that the surface

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