



# Standard Test Method for Flexural Strength of Manufactured Carbon and Graphite Articles Using Four-Point Loading at Room Temperature<sup>1</sup>

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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

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

<sup>ε1</sup> NOTE—Updated 9.1.10 and Fig. 1 editorially in May 2010.

## 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 inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered 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:*<sup>2</sup>

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

**C709** Terminology Relating to Manufactured Carbon and Graphite

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

<sup>1</sup> 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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<sup>2</sup> 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.

## 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *flexural strength*—a measure of the ultimate load-carrying capacity of a specified beam in bending.

## 4. Apparatus

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

4.2 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 **C78**.)

4.2.1 The bearing block diameter shall be between 1/10 and 1/20 of the specimen support span. A hardened steel bearing block or its equivalent is necessary to prevent distortion of the loading member.

4.3 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 the attached figure for a suggested four-point loading fixture.

## 5. Test Specimen

5.1 *Preparation*—The test specimen shall be prepared to yield a parallelepiped of rectangular cross section. The faces shall be parallel and flat within 0.001 in. (0.025 mm)/in. of length. In addition, the samples having a maximum particle size less than 0.006-in. (0.152-mm) diameter must be finished so that the surface roughness is less than 125  $\mu$ m. AA. Sample edges should be free from visible flaws and chips.

5.2 *Size*—The size of the test specimen shall be selected such that the minimum dimension of the specimen is greater than 5 times the largest particle dimension. The test specimen shall have a length to thickness ratio of at least 8, and a width to thickness ratio not greater than 2.

5.3 *Measurements*—All dimensions shall be measured to the nearest 0.5 %.