

Standard Test Method for Tensile Stress-Strain of Carbon and Graphite¹

This standard is issued under the fixed designation C749; 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 This test method covers the testing of carbon and graphite in tension to obtain the tensile stress-strain behavior, to failure, from which the ultimate strength, the strain to failure, and the elastic moduli may be calculated as may be required for engineering applications. Table 2 lists suggested sizes of specimens that can be used in the tests.

NOTE 1—The results of about 400 tests, on file at ASTM as a research report, show the ranges of materials that have been tested, the ranges of specimen configurations, and the agreement between the testers. See Section 11.

NOTE 2—For safety considerations, it is recommended that the chains be surrounded by suitable members so that at failure all parts of the load train behave predictably and do not constitute a hazard for the operator.

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. Conversions are not provided in the tables and figures.

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

C565 Test Methods for Tension Testing of Carbon and Graphite Mechanical Materials

E4 Practices for Force Verification of Testing Machines

E6 Terminology Relating to Methods of Mechanical Testing

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

E691 Practice for Conducting an Interlaboratory Study to

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.

Current edition approved Oct. 1, 2015. Published November 2015. Originally approved in 1973. Last previous edition approved in 2013 as C749 – 13. DOI: 10.1520/C0749-15.

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.

Determine the Precision of a Test Method

3. Terminology

3.1 Definitions:

3.1.1 The terms as related to tension testing as given in Terminology E6 shall be considered as applying to the terms used in this test method.

3.1.2 *modulus of elasticity, n* —the ratio of a force applied to a material to the increment of dimensional change along the force axis, commonly defined as the ratio of tensile stress to tensile strain.

3.1.3 *tensile strength, n* —property of solid material that indicates its ability to withstand a uniaxial tensile load, converted to unit stress based on the original cross-section area of the tensile test specimen.

3.1.4 *ultimate tensile strength, n* —the maximum tensile stress applied in stretching a specimen to rupture.

4. Summary of Test Method

4.1 A tensile specimen (Fig. 1) is placed within a load train assembly made up of precision chains and other machined parts (Fig. 2). A load is applied to the specimen provided with means of measuring strain until it is caused to fracture. This test yields the tensile strength, elastic constants, and strain to failure of carbons and graphites.

5. Significance and Use

5.1 The round robin testing on which the precision and bias for this test method have been determined employed a range of graphites (see Table 2) whose grain sizes were of the order of 1 mil to ¼ in. (0.0254 mm to 6.4 mm) and larger. This wide range of carbons and graphites can be tested with uniform gauge diameters with minimum parasitic stresses to provide quality data for use in engineering applications rather than simply for quality control. This test method can be easily adapted to elevated temperature testing of carbons and graphites without changing the specimen size or configuration by simply utilizing elevated temperature materials for the load train. This test method has been utilized for temperatures as high as 4352 °F (2400 °C). The design of the fixtures (Figs. 2-9 and Table 1) and description of the procedures are intended to bring about, on the average, parasitic stresses of less than 5 %. The specimens for the different graphites have been designed

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