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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Tensile Stress-Strain of Carbon and Graphite¹

This standard is issued under the fixed designation C 749; 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 1 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 RR:C05-1000, show the ranges of materials that have been tested, the ranges of specimen configurations, and the agreement between the testers.

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 *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.*

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

E 4 Practices for Force Verification of Testing Machines²

E 6 Terminology Relating to Methods of Mechanical Testing²

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods³

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method³

3. Terminology

3.1 **Definitions**—The terms as related to tension testing as given in Terminology E 6 shall be considered as applying to the terms used in this test method.

¹ This test method is under the jurisdiction of ASTM Committee C-5 on Manufactured Carbon and Graphite Products and is the direct responsibility of Subcommittee C05.03 on Property Measurements (Chemical, Physical, and Sampling).

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² Annual Book of ASTM Standards, Vol 03.01.

³ Annual Book of ASTM Standards, Vol 14.02.

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 This test method is intended to be used for both carbons and graphites whose particle sizes are of the order of 1 mil to ¼ in. (0.0254 to 6.4 mm) and larger. This wide range of carbons and graphites can be tested with uniform gage 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 2) 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 to ensure fracture within the gage section commensurate with experienced variability in machining and testing care at different facilities. The constant gage diameter permits rigorous analytical treatment.

6. Apparatus

6.1 **Testing Machine**—The machine used for tensile testing shall conform to the requirements of Practices E 4. The testing machine shall have a load measurement capacity such that the breaking load of the test specimen falls between 10 and 90 % of the scale capacity. This range must be linear to within 1 % over 1 % increments either by design or by calibration.

6.2 Strain Measurements:

6.2.1 The axial strain can be measured at room temperature by the use of strain gages, mechanical extensometers, Tucker-man gages, optical systems, or other devices applied diametrically opposite in the gage length portion of the specimen. Two opposing gages provide some compensation for bending and some assurance that it was not severe. Different graphites require different attachment procedures and extreme care is necessary. A proven device for mounting the specimen with minimum damage and for enabling the specimen to receive