Designation: C 565 – 93 (Reapproved 2005)

An American National Standard

Standard Test Methods for Tension Testing of Carbon and Graphite Mechanical Materials[1]

This standard is issued under the fixed designation C 565; 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 These test methods cover the apparatus, specimen, and procedures for the tension testing of carbon and graphite mechanical materials with a grain size smaller than 0.79 mm (1/32 in.).

1.2 The values stated in SI units are to be regarded as the 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]

C 709 Terminology Relating to Manufactured Carbon and Graphite

C 749 Test Method for Tensile Stress-Strain of Carbon and Graphite

E 4 Practices for Force Verification of Testing Machines

E 6 Terminology Relating to Methods of Mechanical Testing

3. Terminology

3.1 *Definitions:* For definitions of terms relating to manufactured carbon and graphite, see Terminology C 709. The definitions of terms relating to tension testing in Terminology E 6 shall be considered as applying to the terms used in these test methods.

4. Significance and Use

4.1 These test methods may be used for quality control testing of established grades of carbon and graphite materials, in the development of new grades, and for other purposes where relative strength levels are the primary quantities of interest. This test method may be applicable only if the ratio of specimen diameter to grain size, or flaw size, is greater than 5.

4.2 These test methods do not substitute for that described in Test Method C 749, but are useful where less sophisticated data and less expensive techniques are sufficient.

4.3 Carbon and graphite materials exhibit significant physical property differences within parent materials. Exact sampling patterns and grain orientations must be specified in order to make meaningful tensile strength comparisons.

5. Apparatus

5.1 *Testing Machine*— The machine used for tension testing shall conform to the requirements of Practices E 4. The testing machine shall have a capacity that the breaking load of the test specimen falls between 10 and 90 % of the scale capacity.

5.2 *Gripping Devices*—Gripping devices that conform to those illustrated in Fig. 1 shall be used. These gripping devices shall be attached to the heads of the testing machine through chain connectors. Fig. 2 shows the gripping device connected to the heads. Extreme care shall be taken that the axis of the test specimen is located on the center line of the head of the testing machine.

6. Test Specimens

6.1 Test specimens shall be produced to the configuration shown in Fig. 3.

6.2 Improperly prepared test specimens often cause unsatisfactory test results. It is important, therefore, that care be exercised in the preparation of specimens, particularly in the machining and polishing.

6.3 The specimen shall be hand polished with No. 000 dry paper until no circular grooves are visible to the naked eye.

6.4 The acceptable fracture zone of the specimen shall be 19 mm (3/4 in.) long with the center of the zone at the point of minimum diameter. Marks indicating fracture zone limits may be applied with ink or layout dope, but no scratching, punching, or notching of the specimen is permissible.

6.5 To determine the cross-sectional area, the diameter of the specimen at the narrowest point shall be used. The dimension shall be recorded to the nearest 0.02 mm (0.001 in.).

[1] These test methods are under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and are the direct responsibility of Subcommittee D02.F0 on Manufactured Carbon and Graphite Products.

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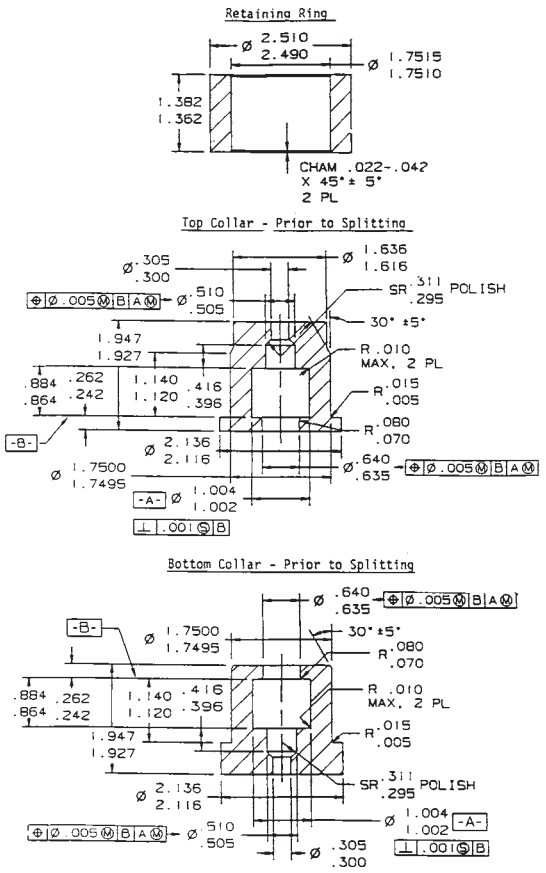
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.



NOTE 1—All dimensions are in inches.

NOTE 2—Material is stainless steel.

NOTE 3—Surface finish of working surfaces, 11 microinches AA or better.

NOTE 4—Break all sharp corners.

NOTE 5—Top and bottom collars to be split into two 180° sections. Max cutwidth not to exceed 1/16 in.

FIG. 1 Gripping Devices

7. Speed of Testing

7.1 Speed of testing may be defined in terms of free-running of the crosshead speed or in terms of rate of stressing the specimen. Both methods are permissible.

7.2 When free-running crosshead speed is used, the speed shall be 0.50 ± 10 % mm (0.020 ± 10 % in.)/min.

7.3 When rate of stressing the specimen is used, an applied force of 890 ± 220 N (200 ± 50 lbf)/min shall be used.

8. Tensile Strength

8.1 Calculate the tensile strength by dividing the maximum load carried by the specimen during a tension test by the cross-sectional area of the specimen as defined in 6.5. The weight of the bottom grip assembly must be accounted for in the tensile strength calculation.

8.2 If any part of the fracture takes place outside the acceptable fracture zone as defined in 6.4, the test shall be discarded but reported.

9. Report

9.1 Report the following:

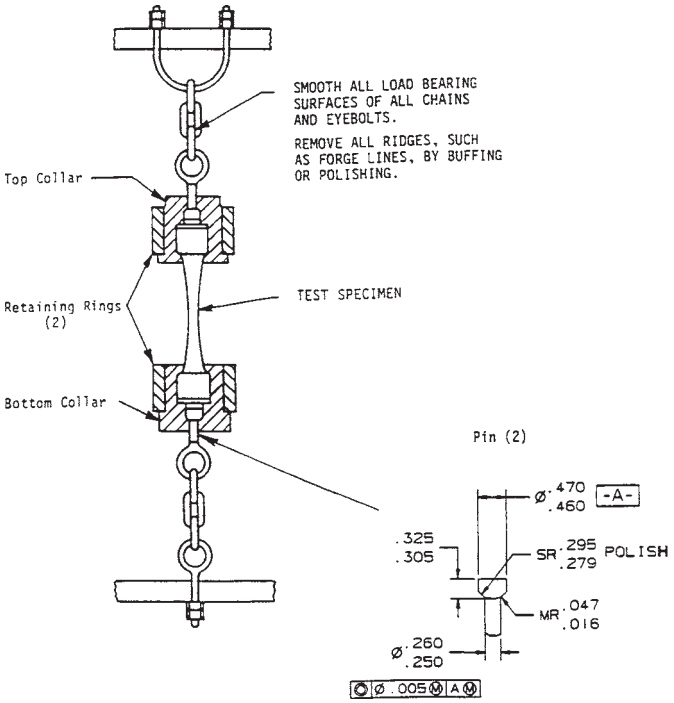
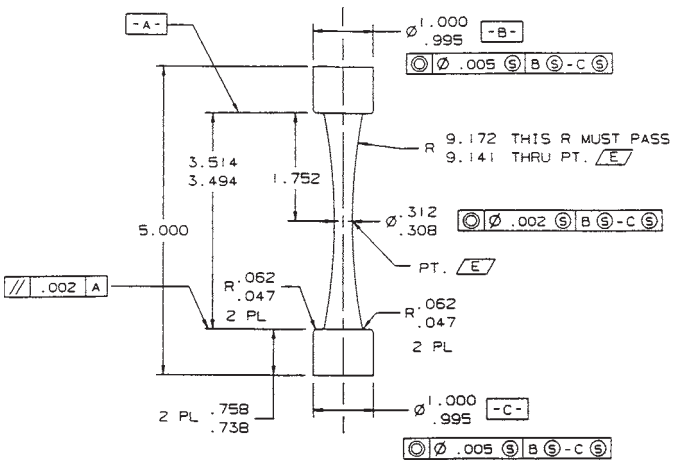


FIG. 2 Test Setup



NOTE 1—All dimensions are in inches.

NOTE 2—Specimen shall be hand-polished on 9.141 to 9.172 radius with No. 000 dry paper until no circular grooves are visible to the naked eye.

FIG. 3 Test Specimen

9.1.1 Identification; manufacturer, grade number, lot number, and original material size;

9.1.2 Average ultimate tensile strength (MPa or psi);

9.1.3 Method of loading (see Section 7);

9.1.4 Number of samples tested;

9.1.5 Number of samples reported;

9.1.6 Standard deviation (MPa or psi); and

9.1.7 Specimen orientation.

10. Precision and Bias

10.1 These test methods are intended to be less sophisticated than the method described in Test Method C 749. For this

reason an interlaboratory test program was not performed, but rather a direct comparison of the two tensile-test techniques was made. Two graphite grades of low variability were tested by two different laboratories, one with extensive experience with Test Method C 749, the other in the technique of this standard.

10.2 The details of the experiments, the data base, and the statistical analyses may be obtained from ASTM.[3]

10.3 *Precision*—Approximately 20 specimens of the two materials were supplied for testing under these test methods and ten specimens for testing under Test Method C 749. The resulting data were examined for outliers by the Dixon Test, Grubb's *T*-Test, and skewness. The data sets were examined for normality by the Kolmogorov-Smirnov Test and for skewness and kurtosis. No outliers were found and only kurtosis for the two ten-specimen sets was found to be significant. This does not invalidate a test on means.

10.3.1 By the approximate *T*-test, the means for the two techniques were found to be the same for any significance level α equal to or less than 0.60 (two sided) corresponding to an observed difference in means of 0.9 %. An *F*-test on variance ratios between the two tests showed a significant difference at α equal to or greater than 0.025 (one sided) for the observed variance ratio of about five.

10.3.2 It is concluded that these test methods will quite satisfactorily produce mean values of tensile strengths, but are not satisfactory for producing good estimates for variance (standard deviation) unless proven by other measurement techniques for the material in question.

10.4 *Bias*—Bias has not been determined.

11. Keywords

11.1 carbon; graphite; tensile strength

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR: C05-1006.