Designation: D3967 – 16

Standard Test Method for Splitting Tensile Strength of Intact Rock Core Specimens[1]

This standard is issued under the fixed designation D3967; 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 testing apparatus, specimen preparation, and testing procedures for determining the splitting tensile strength of rock by diametral line compression of disk shape specimens.

Note 1—The tensile strength of rock determined by tests other than the straight pull test is designated as the "indirect" tensile strength and, specifically, the value obtained in Section 9 of this test is termed the "splitting" tensile strength.

1.2 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to inch-pound units, which are provided for information only and are not considered standard. Reporting of test results in units other than SI shall not be regarded as nonconformance with this test method.

1.3 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026.

1.3.1 The procedures used to specify how data are collected/recorded or calculated, in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of this standard to consider significant digits used in analysis methods for engineering design

1.4 *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]

D653 Terminology Relating to Soil, Rock, and Contained Fluids
D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
D6026 Practice for Using Significant Digits in Geotechnical Data
E4 Practices for Force Verification of Testing Machines
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
E2586 Practice for Calculating and Using Basic Statistics

3. Terminology

3.1 *Definitions:*

3.1.1 For common definitions of terms in this standard, refer to Terminology D653.

4. Summary of Test Method

4.1 Samples are selected from rock cores or cored from platen samples for testing as described. A section of rock core sample is cut perpendicular to the core axis to produce disk shape specimens until the required number of specimens are obtained. Each specimen is then marked to indicate the desired orientation of the applied loading on the specimen by drawing a diametral line on each end surface on the specimen. Each specimen is positioned inside the testing machine in such way that diametrical line is coincidental with the loading axis of the testing machine either curved or flat platens. Each specimen is then tested by applying a continuously increasing compressive load until it fails within 1 to 10 minutes of the start of loading.

5. Significance and Use

5.1 By definition the tensile strength is obtained by the direct tensile test. However, the direct tensile test is difficult

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.12 on Rock Mechanics.

Current edition approved Nov. 1, 2016. Published November 2016. Originally approved in 1981. Last previous edition approved in 2008 as D3967 – 08. DOI: 10.1520/D3967-16.

[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.

*A Summary of Changes section appears at the end of this standard and expensive for routine application. The splitting tensile test appears to offer a desirable alternative, because it is much simpler and inexpensive. Furthermore, engineers involved in rock mechanics design usually deal with complicated stress fields, including various combinations of compressive and tensile stress fields. Under such conditions, the tensile strength should be obtained with the presence of compressive stresses to be representative of the field conditions.

5.2 The splitting tensile strength test is one of the simplest tests in which such stress fields occur. Also, by testing across different diametrical directions, possible variations in tensile strength for anisotropic rocks can be determined. Since it is widely used in practice, a uniform test method is needed for data to be comparable. A uniform test is also needed to make sure that the disk specimens break diametrically due to tensile stresses perpendicular to the loading diameter.

NOTE 2—The quality of the results produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Loading Device*—A device of sufficient capacity to apply and measure the load at a rate conforming to the requirements in 8.3. It shall be verified at suitable time intervals in accordance with Practices E4 and shall comply with the requirements prescribed therein.

6.1.1 *Bearing Platens*—The loading device shall be equipped with two opposing steel bearing platens having a Rockwell hardness of not less than 58 HRC through which loading is transmitted. The bearing faces shall not depart from a plane by more than 0.0125 mm (0.0005 in.) when the platens are new and shall be maintained within a permissible variation of 0.025 mm. The bearing platens diameter shall be at least as great as the specimen's thickness (see Note 3).

6.1.2 *Spherical Seating*—One of the bearing surfaces on the loading device should be spherically seated and the other one a plain rigid platen. The diameter of the spherical seat shall be at least as large as the test specimen, but the diameter of the sperical seat shall not exceed from twice the diameter of specimen. Center of the sphere in the spherical seat coincides with the center of loaded side of the specimen. The spherical seat shall be lubricated to assure its free movement. The movable part of the platen shall be held closely in the spherical seat, but the design shall be such that the bearing face can be rotated and tilted through small angles in any direction. If the spherical seat's diameter exceeds twice the diameter of the test specimen, then the spherical seat shall be placed in the locked position with the faces of the bearing platens meeting the requirements of 6.1.1.

6.1.3 *Rigid Seating*—If a spherical seat is not used, then the faces of the loading device bearing platens shall be parallel to 0.0005 mm/mm of the platen diameter. This criterion shall be met when the platens are in the loading device and separated approximately by diameter of the test specimen.

NOTE 3—False platens, due to the contact with abrasive rocks, these platens tend to roughen after a number of specimens have been tested, and hence need to be surfaced from time to time.

6.2 *False, Flat or Curved Bearing Platens*—During testing, the specimen can be placed in direct contact with the loading device bearing platens or false platens with bearing faces conforming to the requirements of this standard, may be used (see Fig. 1 for false flat platens). These shall be oil hardened to more than 58 HRC, and surface ground. With contact by abrasive rocks, these platens tend to roughen after a number of specimens have been tested, and hence need to be re-surfaced from time to time.

6.2.1 *False Flat Bearing*—The bearing faces of false flat bearing platens shall not depart from a plane by more than 0.0125 mm (0.0005 in.) when the platens are new and shall be maintained within a permissible variation of 0.025 mm. The bearing platen's diameter shall be at least as great as the specimen thickness.

6.2.2 *Curved Supplementary Bearing Platens*—These may be used to reduce the contact stresses on the test specimen. The radius of curvature of the supplementary bearing platens shall be so designed that their arc of contact with the specimen will in no case exceed 15° or that the width of contact is less than $D/6$, where D is the diameter of the specimen.

NOTE 4—Since the equation used in 9.1 for splitting tensile strength is derived based on a line load, the applied load should be confined to a very narrow strip if the splitting tensile strength test is to be valid. But a line

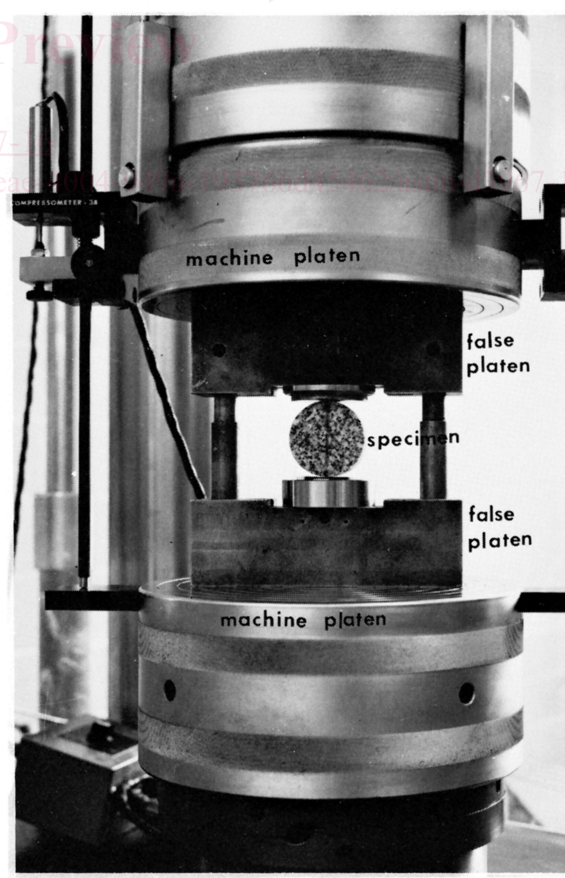

FIG. 1 One Proposed Testing Setup for Splitting Tensile Strength