



Standard Test Methods for Creep of Rock Core Under Constant Stress and Temperature¹

This standard is issued under the fixed designation D7070; 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 creep behavior of intact soft and hard rock core in fixed states of stress and temperature. They specify the apparatus, instrumentation, and procedures for determining the strain as a function of time under sustained load. Hard rocks are those with a maximum axial strain at failure of less than 2 %. Soft rocks include such materials as salt and potash, which often exhibit very large strain at failure.

1.2 This standard replaces and combines the following Standard Test Methods now to be referred to as Methods:

Method ‘A’ (D5341 Creep of Hard Rock Core Specimens in Uniaxial Compression at Ambient/Elevated Temperatures);

Method ‘B’ (D4405 Creep of Soft Rock Core Specimens in Uniaxial Compression at Ambient or Elevated Temperature); and

Method ‘C’ (D4406 Creep of Rock Core Specimens in Triaxial Compression at Ambient or Elevated Temperature).

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 method used to specify how data are collected, calculated, or recorded in this standard is not directly related to the accuracy to which the data can be applied in design or other uses, or both. How one applies the results obtained using this standard is beyond its scope.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

1.5 *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 to determine the applicability of regulatory limitations prior to use. For specific precautionary statements, see Section 7.*

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

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2. Referenced Documents

2.1 *ASTM Standards:*²

[D653](#) Terminology Relating to Soil, Rock, and Contained Fluids

[D2113](#) Practice for Rock Core Drilling and Sampling of Rock for Site Investigation

[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

[D4543](#) Practices for Preparing Rock Core as Cylindrical Test Specimens and Verifying Conformance to Dimensional and Shape Tolerances

[D5079](#) Practices for Preserving and Transporting Rock Core Samples

[D6026](#) Practice for Using Significant Digits in Geotechnical Data

[E4](#) Practices for Force Verification of Testing Machines

[E122](#) Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

3. Terminology

3.1 Refer to Terminology [D653](#) for specific definitions.

4. Summary of Test Method

4.1 A section of rock core specimen is cut to length, and the ends are machined flat to produce a cylindrical test specimen. For the Uniaxial Compression Method, the specimen is placed in a loading frame. For Triaxial Compression Method, the specimen is placed in a triaxial loading chamber and subjected to confining pressure. If required, the specimen is heated to the desired test temperature. Axial load is applied rapidly to the specimen and sustained. Deformation is monitored as a function of elapsed time.

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.

5. Significance and Use

5.1 There are many underground structures that are created for permanent or long-term use. Often, these structures are subjected to an approximately constant load. Creep tests provide quantitative parameters for stability analysis of these structures.

5.2 The deformation and strength properties of rock cores measured in the laboratory usually do not accurately reflect large-scale in situ properties, because the latter are strongly influenced by joints, faults, inhomogeneities, weakness planes, and other factors. Therefore, laboratory values for intact specimens must be employed with proper judgment in engineering applications.

NOTE 1—Notwithstanding the statements on precision and bias contained in this test method; the precision of this test method 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. Users of this test method are cautioned that compliance with Practice D3740 does not in itself assure reliable testing. Reliable testing depends on many factors; Practice D3740 provides a means of evaluating some of these factors.

6. Apparatus

6.1 *Loading Device*—The loading device shall be of sufficient capacity to apply load at a rate conforming to the

requirements specified in 10.6 and shall be able to maintain the specified load within 2 %. It shall be verified at suitable time intervals in accordance with the procedures given in Practices E4 and comply with the requirements prescribed in this test method.

NOTE 2—By definition, creep is the time-dependent deformation under constant stress. The loading device is specified to maintain constant axial load and therefore, constant engineering stress. The true stress, however, decreases as the specimen deforms and the cross-sectional area increases. Because of the associated experimental ease, constant load testing is recommended. However, the procedure permits constant true-stress testing, provided that the applied load is increased with specimen deformation so that true stress is constant within 2 %.

6.2 *Triaxial Apparatus*—The triaxial apparatus shall consist of a chamber in which the test specimen may be subjected to a constant lateral fluid pressure and the required axial load. The apparatus shall have safety valves, suitable entry ports for filling the chamber, and associated hoses, gauges, and valves as needed. Fig. 1 shows a typical test apparatus and associated equipment.

6.3 *Triaxial Flexible Membrane*—This membrane encloses the rock specimen and extends over the platens to prevent penetration by the confining fluid. A sleeve of natural or synthetic rubber or plastic is satisfactory for room temperature tests; however, metal or high-temperature rubber jackets such as viton are usually required for elevated temperature tests. The

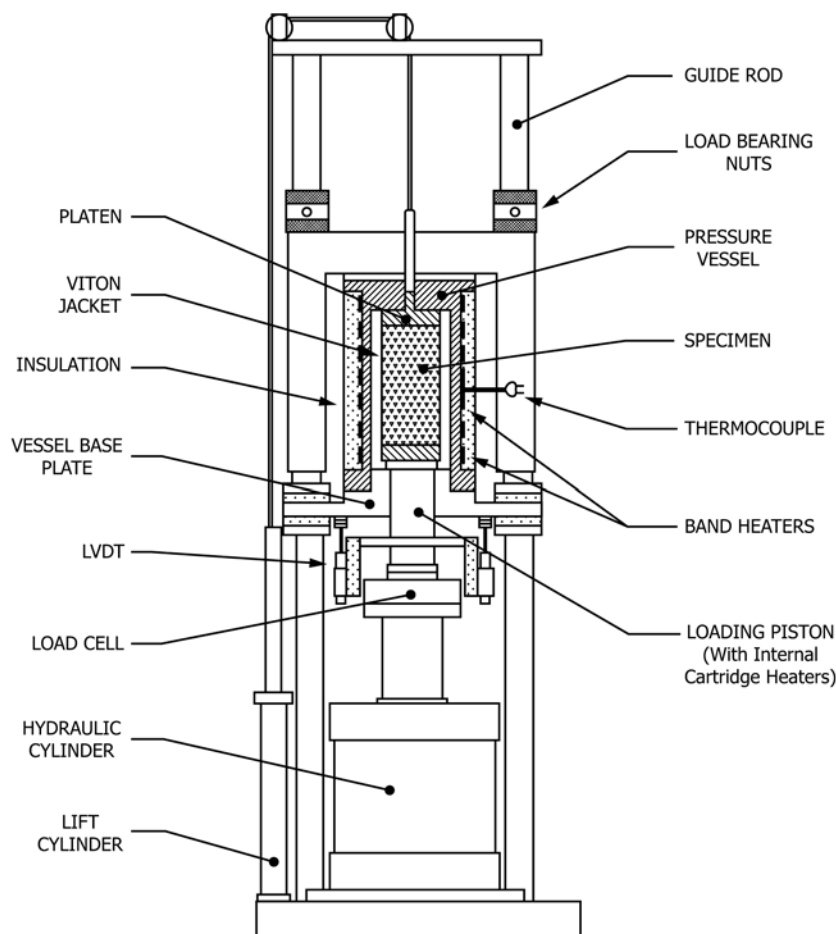


FIG. 1 Test Apparatus