



Designation: D 4341 – 93 (Reapproved 1998)

Standard Test Method for Creep of Cylindrical Hard Rock Core Specimens in Uniaxial Compression¹

This standard is issued under the fixed designation D 4341; 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 creep behavior of intact cylindrical hard rock core specimens in uniaxial compression. It specifies the apparatus, instrumentation, and procedures for determining the strain as a function of time under sustained load. Hard rocks are those with maximum strain at failure of less than 2 %.

NOTE 1—Most hard brittle rocks fail in uniaxial compression at strain levels of less than 2 %.

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.*

2. Referenced Documents

2.1 ASTM Standards:

- D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock²
- D 4543 Practice for Preparing Rock Core Specimens and Determining Dimensional and Shape Tolerances²
- E 4 Practices for Force Verification of Testing Machines³

3. Summary of Test Method

3.1 A rock core sample is cut to length and the ends are machined flat. The specimen is placed in a loading frame and, if required, heated to the desired test temperature. Axial load is rapidly applied to the specimen and sustained. Deformation is monitored as a function of elapsed time.

4. Significance and Use

4.1 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 the stability analysis of these structures.

4.2 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.

5. Apparatus

5.1 *Loading Device*—The loading device shall be of sufficient capacity to apply load at a rate conforming to the requirements specified in 9.5 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 E 4 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 %.

5.2 *Elevated-Temperature Enclosure*— The elevated temperature enclosure may be either an enclosure that fits in the loading apparatus or an external system encompassing the complete test apparatus. The enclosure may be equipped with humidity control for testing specimens in which the moisture content is to be controlled. For high temperatures, a system of heaters, insulation, and temperature measuring devices are normally required to maintain the specified temperature. Temperature shall be measured at three locations, with one sensor near the top, one at midheight, and one near the bottom of the specimen. The average specimen temperature based on the midheight sensor shall be maintained to within $\pm 1^\circ\text{C}$ of the

¹ This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.12 on Rock Mechanics.

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² *Annual Book of ASTM Standards*, Vol 04.08.

³ *Annual Book of ASTM Standards*, Vol 03.01.