



Standard Test Method for Rock Bolt Long-Term Load Retention Test¹

This standard is issued under the fixed designation D 4436; 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 The objective of this test method is to determine the time over which rock bolt tension decreases from the installed value to a designated minimum value.

1.2 This test method is applicable to any anchor system which is not fully encapsulated immediately upon installation, including mechanical, cement grout, resin (epoxy, polyester, and the like) or other similar systems.

1.3 The values stated in inch-pound units are to be regarded as the standard.

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:*

D 4435 Method for Rock Bolt Anchor Pull Test²

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *load*—the total axial force on the rock bolt.

3.1.2 *design load*—the load specified for the rock bolt during the life of the project.

3.1.3 *installation load*—the load on the bolt immediately after installation.

3.1.4 *stand time*—the time required for the bolt load to decrease from the installation load to the design load.

4. Summary of Test Method

4.1 A rock bolt is installed in the same manner and in the same material as its intended support use. The load on the bolt is monitored over a period of time, usually several weeks.

5. Significance and Use

5.1 Rock bolts are used for support in a variety of mining

and civil engineering situations³. After a bolt is installed, the load generally decreases over time due to deterioration of the borehole wall, creep, and other factors. This process may be arrested by fully encapsulating the bolt shortly after installation. This is generally done by pumping the bolt hole full of cement grout, though synthetic resins may also be used. The rate of load loss determines the interval during which the bolt must be encapsulated during construction.

5.2 The local characteristics of the rock, such as roughness of the borehole and induced fractures, are significant factors in the load loss characteristics of the bolt. To obtain realistic values, the test holes should be drilled using the same methods as those used for the construction boreholes.

5.3 In establishing a testing program, the following factors should be considered:

5.3.1 Load retention tests should be conducted in all rock types where construction bolts will be installed. If the rock is anisotropic, for example, bedded or schistose, the tests should be conducted in the same orientations relative to the anisotropy as the construction bolts will be installed.

5.3.2 In each rock type, at each orientation, and for each anchor system, a sufficient number of tests should be conducted to determine the average and minimum long-term capacities within a fixed uncertainty band at the 95 % confidence level. The allowable uncertainty band depends on the project and involves such factors as rock quality, expected project lifetime, and importance of the areas to be bolted. The uncertainty band determination will require considerable engineering judgment. As a rough guideline, at least six long-term tests for a single set of variables have been found necessary to satisfy the statistical requirements.

5.3.3 The design load and installation load on the rock bolt system should be predetermined. The installation load is less than the anchor capacity, as determined by Method D 4435. The design load is less than the installation load; the amount depends on rock properties and the minimum time required to encapsulate the bolts. Alternatively, this method can be run for a predetermined time interval based on construction requirements, and a realistic design load can be determined from the data.

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 For additional information see, "Suggested Method for Monitoring Rock Bolt Tension Using Load Cells," *Suggested Methods for Rock Bolt Testing*, International Society for Rock Mechanics Commission on Standardization of Laboratory and Field Tests, 1974.