



Standard Test Method for Determination of In Situ Stress in Rock Mass by Overcoring Method—USBM Borehole Deformation Gage¹

This standard is issued under the fixed designation D 4623; 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 determination of the ambient local stresses in a rock mass and the equipment required to perform in situ stress tests using a three-component borehole deformation gage (BDG). The test procedure and method of data reduction are described, including the theoretical basis and assumptions involved in the calculations. A section is included on troubleshooting equipment malfunctions.

NOTE 1—The gage used in this test method is commonly referred to as a USBM gage (U.S. Bureau of Mines three-component borehole deformation gage).²

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are provided for information only.

1.3 *This standard does not purport to address all of the safety problems, 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 3148 Test Method for Elastic Moduli of Intact, Rock Core Specimens in Uniaxial Compression³

D 4394 Test Method for Determining the In Situ Modulus of Deformation of Rock Mass Using the Rigid Plate Loading Method³

D 4395 Test Method for Determining the In Situ Modulus of Deformation of Rock Mass Using the Flexible Plate Loading Method³

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

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 Considerable information presented in this test method was taken from *Bureau of Mines Information Circular No. 8618*, and Hooker, V.E., and Bickel, D.L., "Overcoring Equipment and Techniques Used in Rock Stress Determination," Denver Mining Research Center, Denver, CO, 1974.

³ *Annual Book of ASTM Standards*, Vol 04.08.

3.1.1 *deformation*—displacement change in dimension of the borehole due to changes in stress.

3.1.2 *in situ stress*—the stress levels and orientations existing in the rock mass before excavation.

4. Summary of Test Method

4.1 The overcore test measures the diametral deformation of a small-diameter borehole as it is removed from the surrounding stress field by coaxially coring a larger diameter hole. Deformation is measured across three diameters of the small hole, spaced 60° apart, using a deformation gage developed by the U.S. Bureau of Mines. With knowledge of the rock deformation moduli, the measured borehole deformation can be related to the change in stress in a plane perpendicular to the borehole. This change in stress is assumed to be numerically equal, although opposite in sense to the stresses existing in the parent rock mass. Deformation measurements from three nonparallel boreholes, together with rock deformation moduli, allow calculation of an estimate of the complete three-dimensional state of stress in the rock mass.

5. Significance and Use

5.1 Either virgin stresses or the stresses as influenced by an excavation may be determined. This test method is written assuming testing will be done from an underground opening; however, the same principles may be applied to testing in a rock outcrop at the surface.

5.2 This test method is generally performed at depths within 50 ft (15 m) of the working face because of drilling difficulties at greater depths. Some deeper testing has been done, but should be considered developmental. It is also useful for obtaining stress characteristics of existing concrete and rock structures for safety and modification investigations.

5.3 This test method is difficult in rock with fracture spacings of less than 5 in. (130 mm). A large number of tests may be required in order to obtain data.

5.4 The rock tested is assumed to be homogeneous and linearly elastic. The moduli of deformation and Poisson's ratio of the rock are required for data reduction. The preferred method for determining modulus of deformation values involves biaxially testing the recovered overcores, as described in Section 8. If this is not possible, values may be determined from uniaxial testing of smaller cores in accordance with Test

*A Summary of Changes section appears at the end of this standard.