



Designation: D4729 – 19

Standard Test Method for In Situ Stress and Modulus of Deformation Using the Flat Jack Method¹

This standard is issued under the fixed designation D4729; 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 flat jack test measures the natural or altered in situ stress at a rock surface either for a surface outcrop or an underground excavation surface. The modulus of deformation and the long-term deformational properties (creep) may also be evaluated for the applied stress range, however long-term creep is not covered by this method.

1.2 This method covers square flat jacks that are placed in a rock slot and if required encapsulated in the slot.

1.3 Deformation readings are taken at the surface, but this standard does not exclude deformation readings being taken below the surface, such as using a flat jack which is set up to obtain displacement data internally.

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

1.4.1 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.

1.5 *Limitation*—The flat jack test measures the average stress normal to the surface of the test chamber, underground excavation, or outcrop. In situ stress levels must be determined by theoretical interpretations of these data.

1.6 *Assumptions and Factors Influencing the Data:*

1.6.1 The stress relief is assumed to be an elastic, reversible process. In nonhomogeneous or highly fractured materials, this may not be completely true.

1.6.2 The equations assume that the rock mass is isotropic and homogeneous. Anisotropic effects may be estimated by testing in different orientations.

1.6.3 The flat jack is assumed to be 100 % efficient. The design and size requirements of 7.1 were determined to satisfy this requirement to within a few percent.

1.6.4 The jack is assumed to be aligned with the principal stresses on the surface being measured. Shear stresses are not canceled by jack pressure. Orientating the tests in three directions in each plane tested prevents the misalignment from being excessive for at least one of the tests.

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

1.7.1 The gravitational system of inch-pound units is used when dealing with inch-pound units. In this system, the pound (lbf) represents a unit of force (weight), while the unit for mass is slugs. The slug unit is not given unless dynamic ($F=ma$) calculations are involved. For standards involving the determination of mass or the use of density and unit weight, include the following numbered paragraph.

1.7.2 The slug unit of mass is typically not used in commercial practice; that is, density, balances, and so on. Therefore, the standard unit for mass in this standard is either kilogram (kg) or gram (g) or both. Also, the equivalent inch-pound unit (slug) is not given/presented in parentheses.

1.7.3 It is common practice in the engineering/construction profession to concurrently use pounds to represent both a unit of mass (lbm) and of force (lbf). This practice implicitly combines two separate systems of units; the absolute and the gravitational systems. It is scientifically undesirable to combine the use of two separate sets of inch-pound units within a single standard. As stated, this standard includes the gravitational system of inch-pound units and does not use/present the slug unit for mass. However, the use of balances or scales recording pounds of mass (lbm) or recording density in lbm/ft³ shall not be regarded as nonconformance with this standard.

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.

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