



Standard Practice for Extensometers Used in Rock¹

This standard is issued under the fixed designation D 4403; 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 (€) indicates an editorial change since the last revision or reapproval.

€¹ NOTE—Editorial changes were made throughout in December 2000.

1. Scope *

1.1 This practice covers the description, application, selection, installation, data collecting, and data reduction of the various types of extensometers used in the field of rock mechanics.

1.2 Limitations of each type of extensometer system are covered in Section 3.

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

1.4 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.5 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgement. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

1.6 *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. Significance and Use

2.1 Extensometers are widely used in the field of engineering and include most devices used to measure displacements, separation, settlements, convergence, and the like.

2.2 For tunnel instrumentation, extensometers are generally used to measure roof and sidewall movements and to locate the tension arch zone surrounding the tunnel opening.

2.3 Extensometers are also used extensively as safety monitoring devices in tunnels, in underground cavities, on poten-

tially unstable slopes, and in monitoring the performance of rock support systems.

2.4 An extensometer should be selected on the basis of its intended use, the preciseness of the measurement required, the anticipated range of deformation, and the details accompanying installation. No single instrument is suitable for all applications.

3. Apparatus

3.1 *General*—Experience and engineering judgment are required to match the proper type of extensometer systems to the nature of investigation for a given project.

3.1.1 In applications for construction in rock, precise measurements will usually allow the identification of significant, possibly dangerous, trends in rock movement; however, precise measurement is much less important than the overall pattern of movement. Where measurements are used to determine rock properties (such as in plate-jack tests), accurate measurements involving a high degree of precision are required. For in-situ rock testing, instrument sensitivity better than 0.0012 in. (0.02 mm) is necessary for proper interpretation.

3.1.2 Most field measurements related to construction in rock do not require the precision of in-situ testing. Precision in the range of 0.001 to 0.01 in. (0.025 to 0.25 mm) is typically required and is readily obtainable by several instruments.

3.1.3 As the physical size of an underground structure or slope increases, the need for highly precise measurements diminishes. A precision of 0.01 to 0.04 in. (0.25 to 1.0 mm) is often sufficient. This range of precision is applicable to underground construction in soil or weak rock. In most hard rock applications, however, an instrument sensitivity on the order of 0.001 in. (0.025 mm) is preferred.

3.1.4 The least precision is required for very large excavations, such as open pit mines and large moving landslides. In such cases, the deformations are large before failure and, thus, relatively coarse precision is required, on the order of 1 % of the range where the range may be 3 ft. (1 m) or more.

3.1.5 For long-term monitoring, displacements are typically smaller than those that occur during construction. Therefore, greater precision may be required for the long-term measurements.

3.2 Extensometers:

¹ This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.12 on Rock Mechanics. Current edition approved Aug. 31, 1984. Published November 1984.