



Standard Test Methods for Measurement of Thermal Expansion of Rock Using a Dilatometer¹

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1. Scope

1.1 These test methods cover the laboratory measurement of the linear (one-dimensional) thermal expansion of rocks using a dilatometer.

1.2 These test methods are applicable between temperatures of 25°C to 300°C. Both bench top and confined measurement techniques are presented. Rocks of varying moisture content can be tested.

1.3 For satisfactory results in conformance with these test methods, the principles governing the size, construction, and use of the apparatus described in these methods should be followed. If the results are to be reported as having been obtained by this method, then all pertinent requirements prescribed in this method shall be met.

1.4 These test methods do not establish details of construction and procedure to cover all test situations that might offer difficulties to a person without technical knowledge concerning the theory of heat flow, temperature measurement, and general testing practices. Standardization of these test methods does not reduce the need for such technical knowledge. It is recognized also that it would be unwise, because of the standardization of this method, to resist in any way the further development of improved or new methods or procedures by research workers.

1.5 *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:

E 83 Practice for Verification and Classification of Extensometers²

E 228 Test Method for Linear Thermal Expansion of Solid Materials with Vitreous a Silica Dilatometer³

¹ These test methods are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are the direct responsibility of Subcommittee D18.12 on Rock Mechanics.

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² Annual Book of ASTM Standards, Vol 03.01.

³ Annual Book of ASTM Standards, Vol 14.02.

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *sample thermal strain, ϵ_t* —change in length of a unit length of sample when the sample is subjected to heat. The mathematical expression is:

$$\epsilon_t = (L_2 - L_1)/L_0 \quad (1)$$

where:

L_1 and L_2 = specimen lengths corresponding to temperatures T_1 and T_2 , and

L_0 = the original specimen length at some reference temperature T_0 .

Thermal strain is also equal to the specimen thermal displacement, δ_t , divided by the original sample length:

$$\epsilon_t = \delta_t/L_0 \quad (2)$$

3.1.2 *mean coefficient of linear expansion, α_m* —between two temperatures, T_1 and T_2 , is defined as follows:

$$\alpha_m = (L_2 - L_1)/[L_0(T_2 - T_1)] \quad (3)$$

where:

L_1 and L_2 = specimen lengths at temperatures T_1 and T_2 , respectively. Therefore, α_m is obtained by dividing the linear thermal strain, $(L_2 - L_1)/L_0$, by the change in temperature units are inch/inch or centimetre/centimetre per temperature change in °F or °C, respectively. α_m is often expressed in parts per million per degree.

3.1.3 Upon heating ($T_2 > T_1$), an increase in the length of the rock sample will give a positive value of α_m . If a decrease in length (contraction) is observed, α_m will become negative.

4. Summary of Test Methods

4.1 The application of heat to a rock causes it to expand. This expansion divided by the original length of the rock specimens is the thermal strain from which coefficients of expansion can be calculated. This standard covers two methods for measuring rock expansion. The primary difference between the two methods is in the type of dilatometer used.

4.1.1 *Test Method I*—Test Method I is the procedure used when making unconfined or bench top measurements. The method and apparatus are similar to that described in Test