
Standard Method of Test for Coefficient of Thermal Expansion of Hydraulic Cement Concrete

AASHTO Designation: T 336-22¹

Technically Revised: 2022

Technical Subcommittee: 3c, Hardened Concrete



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1. SCOPE

- 1.1. This test method covers determination of the coefficient of thermal expansion (CTE) of hydraulic cement concrete cores and cylinders. Because it is known that the degree of saturation of concrete influences its measured coefficient of thermal expansion, the specimens must be in a saturated condition for this procedure.
- 1.2. The values stated in SI units shall be regarded as the standard.
- 1.3. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*
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2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- M 201, Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
 - M 339M/M 339, Thermometers Used in the Testing of Construction Materials
 - R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
 - R 39, Making and Curing Concrete Test Specimens in the Laboratory
 - R 100, Making and Curing Concrete Test Specimens in the Field
 - T 22M/T 22, Compressive Strength of Cylindrical Concrete Specimens
 - T 24M/T 24, Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- 2.2. *ASTM Standards:*
- C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
 - E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E228, Standard Test Method for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer
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- < E289, Standard Test Method for Linear Thermal Expansion of Rigid Solids with Interferometry
- < E879, Standard Specification for Thermistor Sensors for General Purpose and Laboratory Temperature Measurements
- < E1137/E1137M, Standard Specification for Industrial Platinum Resistance Thermometers

2.3. *International Electrotechnical Commission Standard:*

- < IEC 60751:2008, Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors

3. SUMMARY OF TEST METHOD

- 3.1. This method determines the CTE of a cylindrical concrete specimen, maintained in a saturated condition, by measuring the length change of the specimen due to a specified temperature change. The measured length change is corrected for any change in length of the measuring apparatus (previously determined), and the CTE is then calculated by dividing the corrected length change by the temperature change and then the specimen length, as described in the section on calculations.

4. SIGNIFICANCE AND USE

- 4.1. Measurement of the CTE permits assessment of the potential for length/volume change of concrete due to a uniform temperature change and of the potential deformation of a concrete structure due to a temperature gradient through the concrete. As an example, for pavement slabs on grade, uniform temperature change will affect the openings at joints and a temperature gradient through the thickness of these same slabs will produce curling of the slabs. The results of this test can be used to better estimate slab movement and stress development due to temperature change.

5. APPARATUS

- 5.1. *Concrete Saw*—Capable of sawing the ends of a cylindrical specimen perpendicular to the axis and parallel to each other.
- 5.2. *Balance*—A scale or balance having a capacity of 20 kg (44 lb) and an accurateness of 0.1 percent over its range.
- 5.3. *Caliper*—Comparator or other suitable device to measure the specimen length to the nearest 0.1 mm (0.004 in.).
- 5.4. *Calibration Specimen*—A calibration specimen with a known coefficient of thermal expansion shall be used to determine the correction factor of the equipment. The specimen shall be composed of a material that is essentially linearly elastic, noncorroding, nonoxidizing, nonporous, and nonmagnetic, and it shall have a known thermal coefficient of expansion not to exceed 20 micro strain/°C determined over the temperature range of 10 to 50°C (50 to 122°F) (see Note 1).
Option 1: An ISO 9001 or equivalent laboratory should determine the CTE of the calibration specimen according to ASTM E228 or ASTM E289 within the temperature range of 10 to 50°C (50 to 122°F) and provide a certificate of the CTE value (see Note 2). Option 2: Manufacturer determines the CTE of the calibration specimen determined from a properly calibrated CTE device meeting T 336 requirements. The CTE device used to determine the CTE of calibration specimens must be calibrated and verified using specimens that have previously been determined following Option 1. The CTE value and date tested shall be marked on the calibration specimen. The diameter of the calibration specimen should be large enough to firmly rest on the semispherical