
Standard Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete

AASHTO Designation: R 70M/R 70-23¹

Technically Revised: 2023

Technical Subcommittee: 3a, Cement, Lime, and Concrete Materials

ASTM Designation: C490/C490M-21



**American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. This practice covers the requirements for the apparatus and equipment used to prepare specimens for the determination of length change in hardened cement paste, mortar, and concrete; the apparatus and equipment used for the determination of these length changes, and the procedures for its use.
- 1.2. Methods for the preparation and curing of test specimens, conditions of testing and curing, and detailed procedures for calculating and reporting test results are contained in applicable test methods.
- 1.3. The values stated in either SI units or inch-pound units are to be regarded separately as the standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

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
- 2.2. *ASTM Standards:*
 - C219, Standard Terminology Relating to Hydraulic and Other Inorganic Cements
 - C1005, Standard Specification for Reference Masses and Devices for Determining Mass and Volume for Use in the Physical Testing of Hydraulic Cements

3. TERMINOLOGY

- 3.1. For definitions of terms used in this test method, refer to ASTM C219.

4. SIGNIFICANCE AND USE

- 4.1. This practice is intended to provide standard requirements for apparatus common to many test methods used in connection with cement and concrete and standardized procedures for its use. The detailed requirements as to materials, mixtures, specimens, conditioning of specimens, number of specimens, ages at which measurements are to be made, interpretation of results, and precision and bias are left to be dealt with in specific test methods.

5. APPARATUS

- 5.1. *Reference Masses and Devices for Determining Mass and Volume*—Shall conform to the requirements of ASTM C1005.
- 5.2. *Molds*—Shall have either one or two compartments and shall be constructed as shown in Figure 1 or Figure 2. Molds for test specimens used in determining the length change of cement pastes and mortars shall provide for 25-by-25-by-285-mm prisms having a 250-mm gauge length, or for 1-by-1-by-11¹/₄-in. prisms having a 10-in. gauge length. Molds for test specimens used in the length change of concretes shall provide for prisms of the desired cross section having a 250-mm or 10-in. gauge length. In some routine tests, 25-by-25-by-160-mm specimens with a gauge length of 125 mm or 1-by-1-by-6¹/₄-in. specimens with a gauge length of 5 in. are permitted, but in case of dispute, results obtained with specimens of 250-mm (10-in.) gauge length shall govern.
- 5.2.1. The gauge length shall be considered as the nominal length between the innermost ends of the gauge studs. The parts of the molds shall be tight fitting and firmly held together when assembled, and their surfaces shall be smooth and free of pits. The molds shall be made of steel or other hard metal not readily attacked by the cement paste, mortar, or concrete. The sides of the molds shall be sufficiently rigid to prevent spreading or warping. For the molds shown in Figure 1, the tolerance on Dimension A is ± 0.7 mm. For the molds shown in Figure 2, the tolerance on Dimension A is ± 0.03 in.
- 5.2.2. Each end plate of the mold shall be equipped to hold properly in place, during the setting period, one of the gauge studs shown in Figure 1 or Figure 2. The gauge studs shall be of American Iron and Steel Institute (AISI)² Type 316 stainless steel or other corrosion-resistant metal of similar hardness. Gauge studs of Invar or similar metal shall be used when specimens are tested at widely different temperatures. To prevent restraint of the gauge studs before demolding of the specimen, the device for holding the gauge studs in position shall be so arranged that, if necessary, it can be partially or completely released after the compaction of the paste or mortar into place in the mold. The gauge studs shall be set so that their principal axes coincide with the principal axis of the test specimen. For the molds shown in Figure 1, gauge studs shall extend into the specimen 17.5 ± 0.5 mm and the distance between the inner ends of the gauge studs shall be 250.0 ± 2.5 mm, and 250 mm shall be considered the gauge length for calculating length change. For the molds shown in Figure 2, gauge studs shall extend into the specimen 0.625 ± 0.025 in. and the distance between the inner ends of the gauge studs shall be 10.00 ± 0.10 in., and 10 in. shall be considered the gauge length for calculating length change.