Designation: C490/C490M – 21

Standard Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete[1]

This standard is issued under the fixed designation C490/C490M; 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 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 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 non-conformance with the standard.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C219 Terminology Relating to Hydraulic and Other Inorganic Cements

C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes

C1005 Specification for Reference Masses and Devices for Determining Mass and Volume for Use in Physical Testing of Hydraulic Cements

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology 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 Specification C1005.

5.2 *Molds,* shall have either one or two compartments and shall be constructed as shown in Fig. 1 or Fig. 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 11¼-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 10-in. or 250-mm 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 6¼-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.

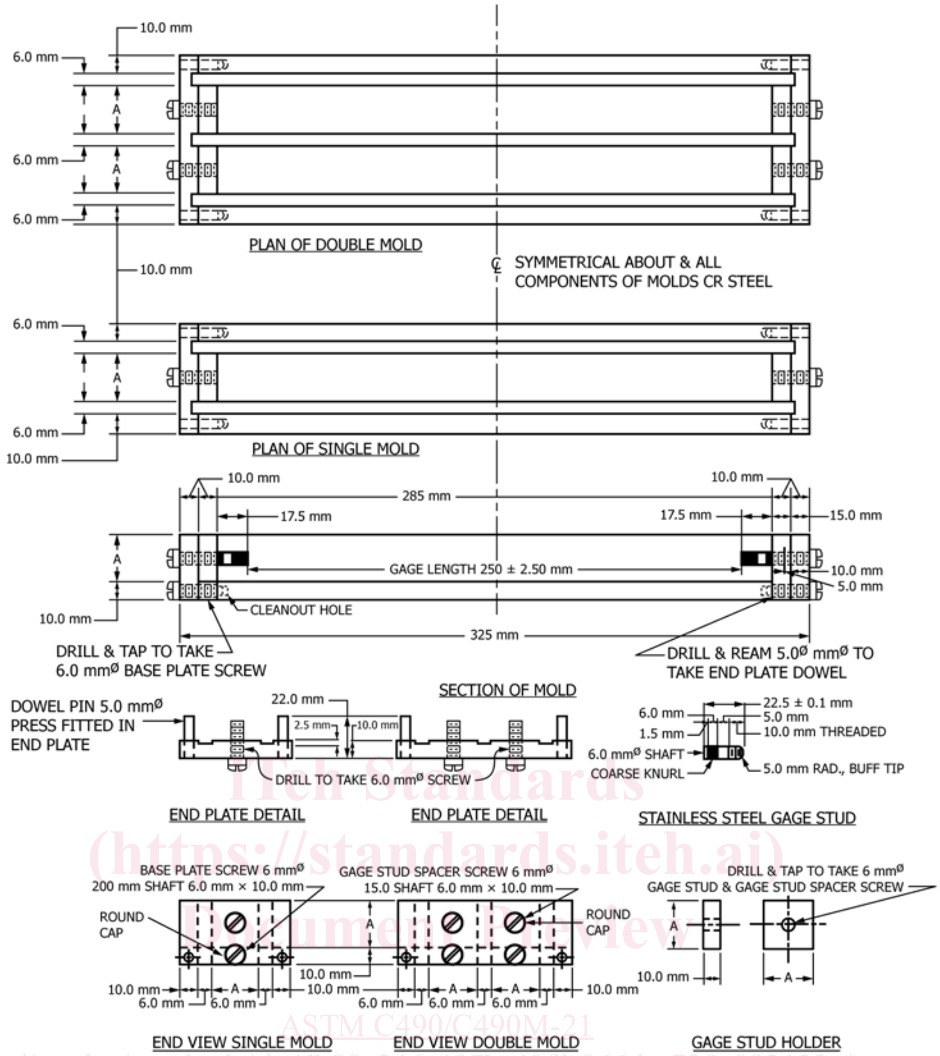
5.2.1 The gauge length shall be considered as the nominal length between the innermost ends of the gauge studs. The parts of the molds shall be tight fitting and firmly held together when assembled, and their surfaces shall be smooth and free of pits. The molds shall be made of steel or other hard metal 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 Fig. 1, the

[1] This practice is under the jurisdiction of ASTM Committee C01 on Cement and is the direct responsibility of Subcommittee C01.95 on Coordination of Standards.

Current edition approved Dec. 1, 2021. Published December 2021. Originally approved in 1962. Last previous edition approved in 2017 as C490/C490M – 17. DOI: 10.1520/C0490_C0490M-21.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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



NOTE 1—Dimension A to be specified by the purchaser.

FIG. 1 Molds (SI Units)

tolerance on dimension A is ±0.7 mm. For the molds shown in Fig. 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 Fig. 1 or Fig. 2. The gauge studs shall be of American Iron and Steel Institute (AISI)[3] 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 Fig. 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 Fig. 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.

5.3 *Length Comparator,* for determining length change of specimens, shall be designed to accommodate the size of specimen employed and to provide or permit a positive means of contact with the gauge studs and the convenient and rapid obtaining of comparator readings (Note 1).

5.3.1 The comparator for determining length changes of specimens produced in the molds shown in Fig. 1 shall provide a dial micrometer or other measuring device graduated to read in 0.002-mm units or less, accurate within 0.002 mm in any 0.020-mm range, and within 0.004 mm in any 0.200-mm range, and sufficient range (at least 8.0 mm) in the measuring

[3] Details on this material are available from American Iron and Steel Institute (AISI), 1140 Connecticut Ave., NW, Suite 705, Washington, DC 20036, http://www.steel.org.

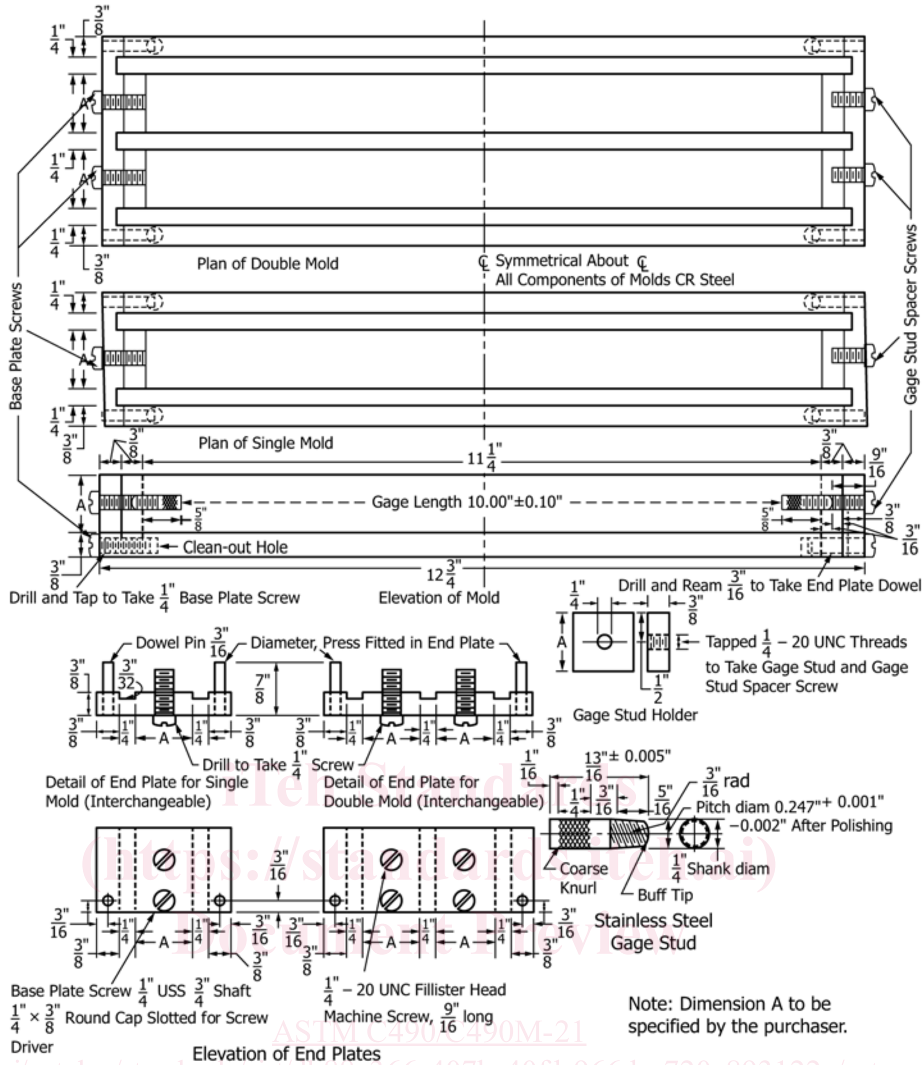


FIG. 2 Molds (Inch-Pound Units)

device to allow for small variations in the actual length of various specimens. The terminals of the comparator shall be plane, polished and heat-treated. They shall be fitted with collars held in place with set screws. The collars shall extend 1.5 ± 0.1 mm beyond the plane face of the terminal. The collars shall allow free rotation of the gauge stud tips that fit inside the collars and have an inside diameter no more than 0.5 mm larger than the average diameter of that portion of the gauge stud tips that fit into the collars.

NOTE 1—One type of instrument that has been found satisfactory for use with small prisms is shown in Fig. 3. A horizontal comparator should be used with prisms with a cross section greater than 9 in.^{2} or 58 cm^2.

5.3.2 The comparator for determining length changes of specimens produced in the molds shown in Fig. 2 shall provide a dial micrometer or other measuring device graduated to read in 0.0001-in. units, accurate within 0.0001 in. in any 0.0010-in. range, and within 0.0002 in. in any 0.0100-in. range, and sufficient range (at least 0.3 in.) in the measuring device to allow for small variations in the actual length of various specimens. The terminals of the comparator shall be plane, polished and heat-treated. They shall be fitted with collars held in place with set screws. The collars shall extend 0.062 ± 0.003 in. beyond the plane face of the terminal. The collars shall allow free rotation of the gauge stud tips that fit inside the collars and have an inside diameter no more than 0.02 in. larger than the average diameter of that portion of the gauge stud tips that fit into the collars.

5.3.3 The design shall provide a means for checking the measuring device against a reference bar at regular intervals.

5.4 *Reference Bar*, shall have an overall length of 295 ± 3.0 mm or 170 ± 3.0 mm [11 ⅝ ± ⅛ in. or 6 ⅝ ± ⅛ in.], whichever is appropriate for the specimen in use. The bar shall be of a steel alloy having a coefficient of thermal expansion not greater than two millionths per degree Celsius. Each end of the reference bar shall be fitted with heat treated, hardened, and polished tips machined to the same shape as the contact end of the gauge studs used in test specimens. That portion of the bar that extends into the comparator's collar shall have a diameter of 6 ± 0.25 mm [0.250 ± 0.010 in.], and the length of that portion shall extend beyond the depth of the collar. Except for the tips, which are attached after heat treatment, no part of the reference bar shall be heat treated (Note 2). The central