



Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar¹

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1. Scope

1.1 This test method covers the measurement of unrestrained drying shrinkage of masonry mortars.

1.2 This test method is applicable to Specification C 270 Type N, Type S, and Type M mortars under the property or proportion specifications. Due to the tendency to damage lower strength specimens during demolding, it is not applicable to lower strength mortars, such as Type O mortars.

1.3 This test method is intended for research purposes only.

1.4 The values stated in SI units are to be regarded as the standard. The values in parentheses are provided for information only.

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:

C 109 Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)²

C 157 Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete³

C 270 Specification for Mortar for Unit Masonry⁴

C 305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortar of Plastic Consistency²

C 490 Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete²

C 511 Specification for Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes²

C 778 Specification for Standard Sand²

3. Significance and Use

3.1 The drying shrinkage of mortar as determined by this test method is a measure of the decrease in length of test specimens under controlled drying conditions, after an initial period of moist curing.

3.2 Since test specimens are not completely unrestrained during the initial period of moist curing, measurements of drying shrinkage by this test method are most useful for comparative purposes rather than as absolute values.

3.3 *The drying shrinkage of unrestrained laboratory tested mortar samples is different from that experienced in a masonry wall where influences include restraint, masonry unit absorption, ambient temperature and humidity, thickness of joint, length of continuous wall, etc.*

4. Apparatus

4.1 *Scales and Weights, Glass Graduates, and Length Comparator*, conforming to requirements of Specification C 490.

4.2 *Molds* (for test specimens), providing for 25 by 25 by 285-mm (1 by 1 by 11.25-in.) prisms having an effective gage length of 250 mm (10 in.), and conforming to the requirements of Specification C 490.

4.3 *Studs*, conforming to the requirements of Specification C 490.

4.4 *Tamper and Demolding Apparatus*, conforming to requirements of Test Method C 157.

4.5 *Trowel*, having a straight edged steel blade 100 to 150 mm (4 to 6 in.) in length.

5. Temperature and Humidity

5.1 *Molding Room*—The temperature of the molding room, dry materials, mixing water, and the relative humidity of the air in the molding room shall conform to the requirements of Specification C 490.

5.2 *Moist Storage Facility*—The temperature and humidity of the air in the moist storage facility shall conform to the requirements of Specification C 511.

5.3 *Drying Room and Controls*—The drying room and controls shall conform to the requirements of Test Method C 157.

¹ This test method is under the jurisdiction of ASTM Committee C12 on Mortars for Unit Masonry and is the direct responsibility of Subcommittee C12.02 on Research and Methods of Test.

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² *Annual Book of ASTM Standards*, Vol 04.01.

³ *Annual Book of ASTM Standards*, Vol 04.02.

⁴ *Annual Book of ASTM Standards*, Vol 04.05.



6. Test Specimens

6.1 Number of Test Specimens:

6.1.1 Make five test specimens. Although the number of test specimens may consist of five specimens made from a single batch of mortar, it is preferable that 15 specimens be made with five specimens being made from each of three batches, with each batch being made on a different day.

6.2 Preparation of Test Specimens:

6.2.1 *Proportioning Mortar Materials*—Measure materials for testing according to the procedures outlined in Specification C 270 for the determination of the compressive strength of mortar.

6.2.2 To test the behavior of cementitious components of a mortar independent of the qualities of the masonry sand, use standard graded sand meeting the requirements of Specification C 778.

6.3 Mixing Mortar:

6.3.1 Mix the mortar according to the requirements of Practice C 305.

6.3.2 Mix the mortar to a flow of 110 ± 5 , as determined by the applicable sections of Test Method C 109.

6.3.3 *Molding of Specimens*—Mold the specimens in conformance with the requirements of Test Method C 157.

6.4 Curing and Storage of Test Specimens:

6.4.1 Cure, store, and measure the test specimens in conformance with the requirements of Test Method C 157 except:

6.4.1.1 Moist cure the specimens in the molds for $48 \pm \frac{1}{2}$ h.

6.4.1.2 After $48 \pm \frac{1}{2}$ h remove the specimens from the molds and moist cure until specimen age is $72 \pm \frac{1}{2}$ h from the time of molding.

7. Preparation of Apparatus

7.1 Prepare specimen molds in conformance with requirements of Specification C 490.

8. Procedure

8.1 *Measurement*—Remove the specimens from the moist storage at the age of $72 \pm \frac{1}{2}$ h, wipe with a damp cloth, and immediately measure their length with a length comparator meeting the requirements of Specification C 490.

NOTE 1—The initial measurement of specimen length may be taken either immediately after demolding or at alternative initial moist curing ages when the effect of that variable on drying shrinkage is the subject of investigation.

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8.1.1 Place specimens in drying room conforming to requirements of Test Method C 157 with a clearance of at least 25 mm (1 in.) on all sides.

8.1.2 Measure the length of the specimens after 4, 11, 18 and 25 days of air storage *unless otherwise specified*.

NOTE 2—Drying shrinkage may not stabilize in the 25-day time period of air storage. Plotting results of measurements at the specified number of days of drying in air storage may be used to determine if additional measurements at extended drying ages are desirable or to estimate ultimate drying shrinkage.

9. Calculation

9.1 Calculate the percent shrinkage, S , of the five specimens as follows:

$$S = [(L_1 - L)/L_0] \times 100 \quad (1)$$

where:

L_0 = effective gage length, cm (in.),

L_1 = initial measurement after removal from moist cure, cm, (in.), and

L = measurement during or after drying, cm (in.)

9.2 Calculate the mean of the drying shrinkage of the five bars.

10. Report

10.1 Report the following information:

10.1.1 Identification of mortar specimen materials,

10.1.2 Date and number of specimens molded,

10.1.3 Proportions and flow of mortar,

10.1.4 Total elapsed number of days drying in air storage,

10.1.5 Percent shrinkage as determined for each specimen and the number of days of drying in air storage at which measurement of length change was taken, and

10.1.6 The individual and mean values of the drying shrinkage of the five specimens at each age measured.

10.1.7 Note any changes from curing and drying procedures specified by this test method.

11. Precision and Bias

11.1 Data necessary to determine the precision and bias are not available at this time.

12. Keywords

12.1 drying shrinkage; masonry; mortar; unrestrained