



# Standard Test Method for Rate of Water Absorption of Masonry Mortars<sup>1</sup>

This standard is issued under the fixed designation C 1403; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This test method covers a standardized laboratory procedure for determining the relative water absorption by capillary uptake (wicking) characteristics of masonry mortars. This test method is not applicable for determining the effectiveness of water repellent coatings.

1.2 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

1.3 *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:*<sup>2</sup>

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

**C 270** Specification for Mortar for Unit Masonry

**C 305** Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

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

**C 778** Specification for Standard Sand

**C 1180** Terminology of Mortar and Grout for Unit Masonry

**C 1437** Test Method for Flow of Hydraulic Cement Mortar

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

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

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology **C 1180**.

## 4. Significance and Use

4.1 This test method provides a laboratory procedure for determining the relative water absorption properties over time of mortars used for masonry construction. Because the specimens are made under laboratory conditions and do not take into account the effect of the masonry substrate or field mixing procedures, this method is not intended for field use. Data generated from this test method may be useful for determining the relative effectiveness of water repellent admixtures or the effect of other admixtures or mortar components on the water repellency of a mortar. However, use caution in interpreting the results. While the resistance of masonry to water penetration may be related to the water absorption of the mortar, it also depends on other factors, such as the workmanship, extent of bond, and the properties of the masonry units and mortar.

## 5. Apparatus

5.1 *Balance*—A balance sensitive to 0.1 g.

5.2 *Uptake Container*—A watertight container with a minimum cross sectional area that is at least 50 % greater than the total area of the specimens' test surface(s) and a minimum depth of 75 mm (3 in.). Provide a cover for the container to minimize evaporation.

5.2.1 Use specimen supports that allow a minimum of 3 mm (0.12 in.) clearance from the bottom of the container and that cover a maximum of 10 % of the area of the specimen's test surface. Use supports made of a material that does not float in water and that does not rust, expand, or contract as a result of water exposure.

5.2.2 The container shall be flat so that when a specimen is set on the supports the water level as specified in 7.4 shall not vary by more than 1 mm (0.04 in.) from one end of the specimen to the opposite end.

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

5.3 *Specimen Molds*—Metal 50-mm or 2-in. cube specimen molds with removable plastic water tight disposable liners. The plastic liners shall be rigid enough to retain their shape when free standing and filled with mortar.

5.4 *Spoon*—A metal spoon approximately 230 mm (9 in.) in length and with a bowl approximately 100 mm (4 in.) in length.

5.5 *Straightedge*—A steel straightedge not less than 150 mm (6 in.) long and approximately 1.5-3.0 mm ( $\frac{1}{16}$  to  $\frac{1}{8}$  in.) thick.

5.6 *Tamper*—A tamper made of a nonabsorptive, nonabrasive, nonbrittle material such as a rubber compound having a Shore A durometer hardness of  $80 \pm 10$ , or seasoned oak wood rendered nonabsorptive by immersion for 15 minutes in paraffin at approximately 200°C (392°F), and having a cross section of 13 by 25 mm (0.5 by 1.0 in.) and a convenient length of 127 to 152 mm (5 to 6 in.). The tamping face of the tamper shall be flat and at right angles to the length of the tamper.

5.7 *Trowel*, having a steel blade 100 to 150 mm (4 to 6 in.) in length, with straight edges.

5.8 *Tapping Stick*—A hardwood rod, having a diameter of 16 mm ( $\frac{5}{8}$  in.) and a length of 150 mm (6 in.).

5.9 *Timing Device*—A suitable timing device capable of indicating elapsed time up to 24 h to the nearest 1 min.

5.10 *Calipers*—Suitable calipers with parallel jaws for measuring the dimensions of the hardened specimens to the nearest 0.5 mm.

## 6. Specimen Preparation

6.1 Prepare mortar according to Practice C 305, adjusting the water as necessary to obtain a flow of  $110 \pm 5$  as determined by Test Method C 1437. Record the flow. If an admixture is being added to the mortar, the dosage rate, time of addition, and mixing sequence shall follow the manufacturer's recommendation. If there is no manufacturer's recommendation, add a liquid admixture with the water and add a dry admixture with the cementitious components. Record the type and amount of each material by weight used in the mortar. In addition, record the type and amount by weight or volume of any admixture used and when it was added to the mix. If applicable, record the kind of mortar (cement-lime, mortar cement, or masonry cement), the type (O, N, S, or M), and whether the mortar is made to the proportion or property specification of Specification C 270.

6.1.1 To test the behavior of mortar components independent of the qualities of the masonry sand use a blend of equal parts by weight of graded standard sand and standard 20 - 30 sand conforming to Specification C 778.

6.2 Prepare 50-mm or 2-in. cube specimens according to Test Method C 109/C 109M except the mortar shall be the mortar prepared in 6.1 and the molds shall be as specified in 5.3. Make a minimum of three replicate specimens from each mortar batch.

6.3 Immediately upon completion of casting, place the test specimens in a moist closet or moist room conforming to the requirements of Specification C 511. Keep all test specimens in their molds and in the moist closet or moist room for  $24 \pm 1$  h with their upper surfaces exposed to the moist air but protected from dripping water.

6.4 At  $24 \pm 1$  h from the time of mixing remove the specimens from the molds. Mark the side of each specimen indicating which surface is top, as cast. Cure the specimens in a moisture tight plastic bag at  $24 \pm 8^\circ\text{C}$  ( $75 \pm 15^\circ\text{F}$ ) for a total 28 days from the time of casting.

6.5 At the age of 28 days  $\pm 12$  h from the time of casting, remove the specimens from the plastic bag and dry in a ventilated oven at 110 to 115°C (230 to 240°F) for not less than 24 h and until two successive weighings at intervals of 2 h show an increment of loss not greater than 0.2 % of the last previously determined weight of the specimen. Remove the specimens from the oven and cool in ambient conditions ( $24 \pm 8^\circ\text{C}$  ( $75 \pm 15^\circ\text{F}$ )) and a relative humidity of less than 80 % for a minimum of 2 h and until the specimens reach ambient temperature. Begin testing within 24 h after reaching ambient temperature.

## 7. Procedure

7.1 Calculate the area of the test surface for each specimen from the length and width of the test surface. The test surface is the top face of the cube, as cast. Using calipers, measure the length of the cube test surface to the nearest 0.5 mm at three locations along its height and record as  $L_1$  the average length in millimetres to the nearest 0.5 mm. Using calipers, measure the width of the cube test surface to the nearest 0.5 mm at three locations along its height and record as  $L_2$  the average width in millimetres to the nearest 0.5 mm.

7.2 Record as  $W_0$  the initial weight in grams to the nearest 0.1 g of each individual specimen immediately prior to testing.

7.3 Place the uptake container on a flat level surface. Place all specimens in the uptake container(s) with their top faces, as cast, in contact with the specimen supports as illustrated in Fig. 1.

7.4 Add room temperature ( $24 \pm 8^\circ\text{C}$  ( $75 \pm 15^\circ\text{F}$ )) water to the uptake container(s) so that the specimens are partially immersed in  $3.0 \pm 0.5$  mm ( $0.12 \pm 0.02$  in.) of water. When adding water make sure not to splash water onto the specimens. Cover the uptake container(s) to minimize evaporation.

7.5 Monitor the specimens during the first 1 min and after 5  $\pm 1$  min to make sure the water level is adequate during the initial absorption phase. Add water as necessary to maintain the immersion depth as specified in 7.4. When adding water make sure not to splash water onto the specimens. Cover the uptake container(s) to minimize evaporation.

7.6 At 0.25, 1, 4, and 24 h, measure the weight in grams to the nearest 0.1 g of each specimen and record as  $W_T$  where  $T$  is the measurement time in hours. Wipe off surface water from each specimen with a damp cloth prior to each weighing (see Note 1). Complete the wipe within 10 s of removal from contact with the water and complete weighing within 1 min.

NOTE 1—The wipe-off cloth should be damp enough so it does not wick water off the specimen surface but not so damp that it is dripping water. Experience has shown that the cloth may need to be wrung out every 8 to 12 cubes to keep it from getting too wet.

7.7 After each weighing, replace the specimens into the uptake container(s) and add water as necessary to maintain the immersion depth specified in 7.4. When adding water, make sure not to splash water onto the specimens. Re-cover the uptake container(s).

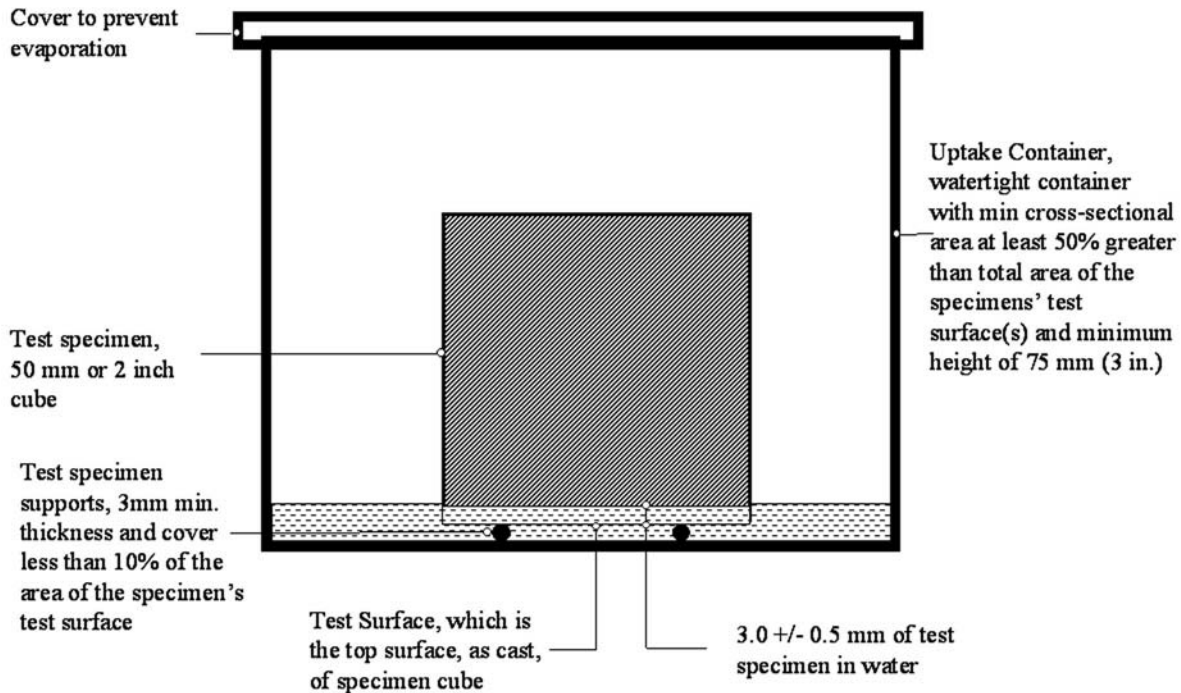


FIG. 1 Specimen Configuration During Testing

## 8. Calculation

8.1 Calculate and record as  $A_T$  the water absorption in grams/100 cm<sup>2</sup>, at each time period,  $T$ , for each specimen, as follows:

$$A_T = (W_T - W_0) \times 10\,000 / (L_1 \times L_2) \quad (1)$$

where:

$W_T$  = the weight of the specimen at time  $T$  in grams to the nearest 0.1 g,

$W_0$  = the initial weight of the specimen in grams to the nearest 0.1 g,

$L_1$  = the average length of the test surface of the mortar specimen cube in mm to the nearest 0.5 mm, and

$L_2$  = the average width of the test surface of the mortar specimen cube in mm to the nearest 0.5 mm.

8.2 Calculate and record as,  $A_T$  (avg), the average  $A_T$  for each set of three or more replicate specimens at each time interval.

## 9. Report

9.1 Report the mortar mixture, as follows:

9.1.1 The type and amount of each material by weight used in the mortar,

9.1.2 The type and amount by weight or volume of any admixture used in the mortar and when it was added to the mix,

9.1.3 The actual flow of the mortar batch(es), and

9.1.4 If applicable:

9.1.4.1 The kind of mortar (cement-lime, mortar cement, or masonry cement),

9.1.4.2 The type (O, N, S, or M) used, and

9.1.4.3 Whether the mortar was made to the proportion or property specification of Specification C 270.

9.2 Report the water absorption test results, as follows:

9.2.1 For each specimen, report:

9.2.1.1  $L_1$ , the average length of the test surface of the mortar specimen cube in mm to the nearest 0.5 mm,

9.2.1.2  $L_2$ , the average width of the test surface of the mortar specimen cube in mm to the nearest 0.5 mm,

9.2.1.3  $W_0$ , the initial weight of the specimen in g to the nearest 0.1 g,

9.2.1.4  $W_T$ , the weight of the specimen at each time  $T$  in g to the nearest 0.1 g, and

9.2.1.5  $A_T$ , the water absorption of the specimen at each time  $T$  in g/100 cm<sup>2</sup>.

9.2.2 For each set of three or more replicates, report:

9.2.2.1  $A_T$ (avg), the average water absorption at each time  $T$  in g/100 cm<sup>2</sup>.

## 10. Precision and Bias

10.1 A precision and bias statement is not available for this test method.

## 11. Keywords

11.1 absorption; absorption rate; masonry mortar; water repellent

## SUMMARY OF CHANGES

Committee C12 has identified the location of selected changes to this standard since the last issue (C 1403 – 05) that may impact the use of this standard. (Approved Dec. 15, 2006.)

(I) Subsection 2.1 was revised and Section 3 was added to this test method. All subsequent sections were renumbered. reference Terminology C 1180 for definitions of terms used in

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