



Designation: C1403 – 22

Standard Test Method for Rate of Water Absorption of Masonry Mortars¹

This standard is issued under the fixed designation C1403; 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 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 standard. No other units of measurement are included in this standard.

1.2.1 Inch-pound units are given in parentheses for temperature specification and 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

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

[C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars \(Using 2-in. or \[50 mm\] Cube Specimens\)](#)

[C230/C230M Specification for Flow Table for Use in Tests of Hydraulic Cement](#)

[C270 Specification for Mortar for Unit Masonry](#)

[C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency](#)

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

[C778 Specification for Standard Sand](#)

[C1180 Terminology of Mortar and Grout for Unit Masonry](#)

[C1384 Specification for Admixtures for Masonry Mortars](#)

[C1437 Test Method for Flow of Hydraulic Cement Mortar](#)

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology [C1180](#).

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.

NOTE 1—This test method is specified in Specification [C1384](#) for demonstrating compliance of mortar admixtures classified as Water Repellent. In this compliance testing, the admixed mortar is compared to a reference mortar made with the same mortar materials except that it does not include the admixture. For quality control testing of water repellent preblended dry mortar mixes, the reference mortar is not typically available since the water repellent additive is added during the manufacturing process prior to bagging the final product. In these cases, the procedure in [Annex A1](#) can be used to determine the relative resistance of the mortar to absorption by capillary uptake.

5. Apparatus

5.1 *Balance*—A balance readable and accurate 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. Provide a cover for the container to minimize evaporation.

¹ 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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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

5.2.1 Use specimen supports that allow a minimum of 3 mm clearance from the bottom of the container and that cover no more than 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 from one end of the specimen to the opposite end.

5.3 *Specimen Molds*—Metal nominal 50-mm 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.

NOTE 2—For this test method, actual specimen dimensions are measured and used to calculate absorption per a unit area; therefore, 2-in. cube specimen molds can be used interchangeably with 50-mm cube specimen molds.

5.4 *Mixer, Bowl, and Paddle*—An electrically-driven mechanical mixer of the type equipped with paddle and mixing bowl, as specified in Practice C305.

5.5 *Flow Table and Flow Mold*, conforming to the requirements of Specification C230/C230M.

5.6 *Tamper and Trowel*, conforming to the requirements of Test Method C109/C109M.

5.7 *Moist Cabinet or Room*, conforming to the requirements of Specification C511.

5.8 *Oven*—A ventilated oven of appropriate size capable of maintaining a uniform temperature of $110 \pm 5^\circ\text{C}$ ($230 \pm 9^\circ\text{F}$).

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 0.1 mm.

6. Specimen Preparation

6.1 Prepare mortar according to Practice C305, adjusting the water as necessary to obtain a flow of 110 ± 5 as determined by Test Method C1437. 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 C270.

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 C778.

6.2 Prepare 50-mm cube specimens according to Test Method C109/C109M 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 C511. Keep all test specimens in their molds and in the moist closet or moist room for 24 ± 1 h with their upper surfaces exposed to the moist air but protected from dripping water.

6.4 At 24 ± 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 $24 \pm 8^\circ\text{C}$ ($75 \pm 15^\circ\text{F}$) until placing in the oven in accordance with 6.5.

6.5 Unless another age is specified, at the age of 28 days ± 12 h from the time of casting, remove the specimens from the plastic bag and dry in a ventilated oven at $110 \pm 5^\circ\text{C}$ ($230 \pm 9^\circ\text{F}$) 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 0.1 mm at three locations along its height and record as L_1 the average length in millimetres to the nearest 0.1 mm. Using calipers, measure the width of the cube test surface to the nearest 0.1 mm at three locations along its height and record as L_2 the average width in millimetres to the nearest 0.1 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. Provide a minimum space of 12 mm between specimens and 25 mm between specimens and the wall of the uptake container.

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 ± 0.5 mm 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 ± 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.

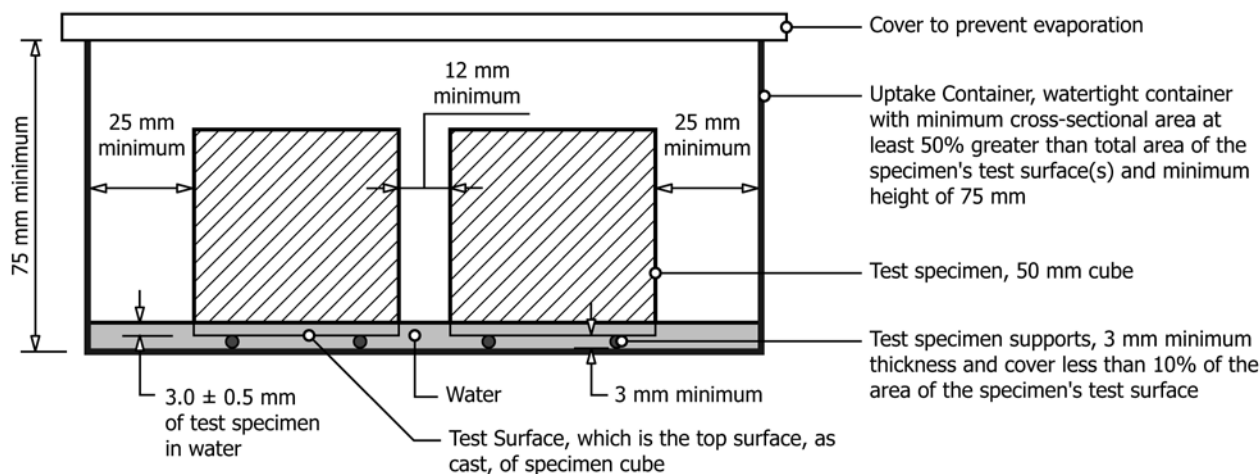


FIG. 1 Specimen Configuration During Testing

7.6 At 0.25 h ± 0.5 min, 1 h ± 2 min, 4 h ± 10 min, and 24 h ± 15 min, 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 3). Complete the wipe within 10 s of removal from contact with the water and complete weighing within 1 minute.

NOTE 3—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).

8. Calculation

8.1 Calculate and record as A_T the water absorption in grams/100 cm², 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 0.1 mm, and

L_2 = the average width of the test surface of the mortar specimen cube in mm to the nearest 0.1 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 C270.

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 0.1 mm,

9.2.1.2 L_2 , the average width of the test surface of the mortar specimen cube in mm to the nearest 0.1 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 cm².

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 cm².

9.3 Report the age of specimens when tested.

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