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StandardTest Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry[1]

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This standard has been approved for use by agencies of the Department of Defense.

INTRODUCTION

This test method provides a standard procedure for sampling and testing mortars for composition and plastic and hardened properties, either before or during actual construction. The procedures outlined in the Annexes are considered applicable for evaluating various combinations of portland cement, lime, and masonry cement for mortars common to plain and reinforced unit masonry construction.

The test procedures describe methods for the measurement of mortar composition and mortar properties. No attempt is made to claim or substantiate specific correlations between the measured properties and mortar performance in the masonry. However, data from these test methods can be combined with other information to formulate judgments about the quality of the masonry.

Testing using these procedures is limited to the preconstruction evaluation of masonry mortars within the laboratory, to the evaluation of masonry mortars at the construction site, and in establishing the degree of quality control exercised during mortar production at the construction site.

1. Scope*

1.1 This test method covers procedures for the sampling and testing of mortars for composition and for their plastic and hardened properties, either before or during their actual use in construction.

NOTE 1—Guide C1586 provides guidance on evaluating mortar and clarifies the purpose of both this test method and Specification C270.

NOTE 2—The testing agency performing this test method should be evaluated in accordance with Practice C1093.

1.2 *Preconstruction Evaluation*—This test method permits comparisons of mortars made from different materials under simulated field conditions. It is also used to establish baseline values for comparative evaluation of field mortars.

1.3 *Construction Evaluation*—Use of this method in the field provides a means for quality assurance of field-mixed mortar. It includes methods for verifying the mortar mix proportions, comparing test results for field mortars to preconstruction testing, and determining batch-to-batch uniformity of the mortar.

1.4 The test results obtained under this test method are not required to meet the minimum compressive values in accordance with the property specifications in Specification C270.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *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.* For specific hazards statements, see Section 8.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

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

[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**

C128 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
C173/C173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
C187 Test Method for Amount of Water Required for Normal Consistency of Hydraulic Cement Paste
C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
C270 Specification for Mortar for Unit Masonry
C470/C470M Specification for Molds for Forming Concrete Test Cylinders Vertically
C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
C617 Practice for Capping Cylindrical Concrete Specimens
C1093 Practice for Accreditation of Testing Agencies for Masonry
C1180 Terminology of Mortar and Grout for Unit Masonry
C1231 Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders
C1586 Guide for Quality Assurance of Mortars
E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

3. Terminology

3.1 Terminology defined in Terminology C1180 shall apply for this test method.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 Terms peculiar to testing masonry mortar are indicated and defined below:

3.2.2 *disturbed sample*—any plastic mortar test sample which is taken at some time after mixing and bulk sampling, that is further remixed or molded immediately prior to test, or both.

3.2.3 *undisturbed sample*—any plastic mortar test sample molded immediately after mixing and sampling that sits on a vibration-free surface until tested.

3.3 During sampling, the following descriptions will identify sample locations:

3.3.1 *Batch mixer samples* are those obtained during or immediately after the discharge of the mortar from the batch mixer.

3.3.2 *Mortar board samples* are those obtained from the mortar board after some established time period from the end of mixing, and before retempering. Retempered mortar board samples are those obtained from the mortar board after retempering. Since mortar on a mason's mortar board is disturbed by the activity of the mason, samples from a mason's mortar board shall be so identified to differentiate them from samples taken from a mortar board used exclusively for test purposes.

4. Summary of Test Method

4.1 Preconstruction evaluation of mortar systems involves the preparation of one or more trial batches which are mixed in the laboratory using mechanical batch mixers. These trial batches are sampled and used in establishing the plastic and hardened properties of the mixtures. Because all the trial mixtures are prebatched by weight, additional characteristics of the mortars may be calculated and used in an analysis of mortar performance.

4.2 During actual construction, evaluation of masonry mortars is possible by sampling the mortar at various stages of construction, and performing tests on both its plastic and hardened properties. The test results permit further verification of preconstruction testing, and reflect batch-to-batch variations introduced during mortar production and use at the construction site. More immediate corrective action for the mixing procedure is thereby attainable.

4.3 The following test methods may be singly or collectively incorporated into the testing to establish mortar composition, and mortar plastic and hardened properties:

4.3.1 Annex A1—Consistency by Cone Penetration Test Method,

4.3.2 Annex A2—Consistency Retention of Mortars for Unit Masonry,

4.3.3 Annex A3—Initial Consistency and Consistency Retention or Board Life of Masonry Mortars Using a Modified Concrete Pentrometer,

4.3.4 Annex A4—Mortar Aggregate Ratio Test Method,

4.3.5 Annex A5—Mortar Air Content Test Method,

4.3.6 Annex A6—Compressive Strength of Molded Masonry Mortar Cylinders and Cubes, and

5. Significance and Use

5.1 During preconstruction and construction evaluations, use of these test methods establishes specific and overall performance characteristics for the mortar system.

5.2 Preconstruction testing of mortars prebatched by weight provides information for the selection of the individual mortar system best suited for the masonry to be constructed. The recommended tests and their significance are as follows:

5.2.1 Consistency determinations by cone penetration (Annex A1) allow gaging the water additions for all mortars included in the preconstruction test series. Even if the mortar consistency as measured at the construction site is at a different penetration value than those measured during the preconstruction tests, the cone preparation test serves to standardize water additions for mortars being considered as alternatives before construction. Additional testing of mortar water content-consistency relationships (Annex A4) will allow relating these two factors to batch-to-batch variations at the construction site.

5.2.2 Consistency retention by cone penetration (Annex A2) using disturbed or undisturbed mortar samples provides a means of establishing the early-age setting and stiffening characteristics of the mortars. Because laboratory testing is conducted under static climatic conditions, consistency retention test results reflect the relative performance of the mortar systems under test. The same general relationships are expected to hold during testing at the construction project, except as they are influenced by jobsite weather conditions.

5.2.3 Mortar water-content determinations (Annex A4) allow measurement of the water content of the mortar mixture. Mortars prebatched using moist masonry sand may be mathematically analyzed for mortar water content; however, this

test, when used for preconstruction evaluation, establishes the effectiveness of the test method and serves as the control or base for tests performed at the construction site.

5.2.4 Mortar aggregate ratio testing (Annex A4) provides a method for determining the ratio of aggregate-to-cementitious materials. The sieving operation employed during this test is incapable of separating an individual cementitious material when more than one such material is used, but can accurately establish the aggregate-to-cementitious materials ratio of the mixture.

5.2.5 Mortar air-content testing (Annex A5) is useful in establishing the value of this component of the mortar. This test is of particular importance in evaluating mortars that contain air-entraining portland cement, air-entraining lime, masonry cement or any combination thereof.

5.2.6 Compressive strength testing (Annex A6) of molded mortar cylinders and cubes establishes one of the characteristics of hardened mortar. Mortar compressive strength test values are not representative of the actual compressive strength of mortar in the assembly and are not appropriate for use in predicting the compressive strength that would be attained by the mortar in the masonry assembly. The measured compressive strength of a molded mortar specimen is almost always lower than the strength of the same mortar in the wall, primarily as a result of differences in mortar water content and specimen shape. Mortar compressive strength is influenced by mortar water content at the time of set. Because molded mortar specimens are not in contact with absorptive masonry units and are not subjected to other mechanisms of water loss, they have higher water contents than mortar in the wall. Higher water contents almost always result in lower strengths. Specimen size and shape also affect compressive strength. Cylinders and cubes exhibit different strengths even when made from the same mortar mix. Both of these specimen configurations yield lower strengths than what would be attained if a specimen having the same size and configuration of a typical mortar joint could be reliably tested.

NOTE 3—When cube and cylinder test specimens from like mixtures are to be compared, the cylinder compressive strength is approximately 85 % of the cube compressive strength.

5.3 Testing during the actual construction may employ one or more of the test methods described in 4.2. Repetitive testing using these test methods on consecutive or intermittent batches provides a method for measurement of batch-to-batch variations in the mortar production. Testing during actual construction may be referenced to laboratory testing and used to predict later age mortar characteristics. In addition to the comments in 5.2, the following test meanings may be obtained from construction project testing:

5.3.1 Consistency by cone penetration (Annex A1) is used as a quick reference for indicating batch-to-batch variations in mix ingredients and mixing time. Erratic consistency readings indicate poor control during batching and mixing, but they do not indicate if cement, sand, or water additions are improper. Other test methods must be used to isolate and identify the unsatisfactory proportioning or mixing procedure, for example, cement to aggregate, mortar water, or air content tests.

5.3.2 Consistency retention by cone penetration (Annex A2) tests establishes the early-age setting and stiffening characteristics of the mortar. These properties are influenced by mix proportions and ingredients, weather conditions, effects of chemical additives, and mixing time.

5.3.3 Individual and repeated evaluations of mortar water content (Annex A4) show the ability of the mixer operator to properly and consistently add water to the mixer.

5.3.4 Individual and repeated tests for mortar aggregate ratio (Annex A4) show the ability of the mixer operator to properly and consistently add the cementitious material and sand to the mixer, and will establish batch-to-batch variations in the composition of the mortar.

5.3.5 Individual and repetitive tests for mortar air content (Annex A5) show the changes caused by variations in mixing time, mixing efficiency and other factors.

5.3.6 Comparison of compressive strength tests (Annex A6) of field batched mortars to preconstruction mortar compression tests, each conducted in accordance with this test method, can be used to identify variations in mortar mix constituents and/or proportions. Variations in compressive strength values typically indicate changes in mix water content, mixing procedures, mix materials, material proportions, and environmental conditions.

NOTE 4—Variations in the measured compressive strengths of field-sampled mortar and between the measured compressive strengths of construction and pre-construction mortar samples should be expected. Many of these variations result from sampling mortar from the mixer or mortarboard and do not necessarily translate into significant mortar strength variations in the wall. Unit suction will remove water from the mortar in the wall and the curing conditions are different. However, significant variation between measured compression strength values should prompt evaluation of probable causes of this variation. Conducting companion mortar aggregate ratio tests would assist in determining if changes in mix constituents and proportions are the likely cause. (See 5.2.6 for additional information).

6. Test Method Limitations

6.1 During mortar aggregate ratio testing, no attempt has been made to establish the proportions of either portland cement to lime or portland cement to masonry cement in the mixture. Additional testing could establish this proportioning, however, batching operations should be supervised to ensure the correct proportioning of these ingredients.

6.2 Due to the greater ability to weigh materials accurately, mix on a precise schedule, and control other factors relating to the production and testing of mortar under laboratory conditions as compared to field conditions, the principal purpose of this test method is to provide a means to identify, measure, evaluate, and control differences that exist between laboratory and jobsite mortars.

6.3 There is no ASTM standard method for measuring the composition or physical properties of hardened mortars removed from a structure.

7. Apparatus

7.1 The apparatus required for this test, along with the apparatus for sampling (see Section 9) are given in the individual tests included in the annexes.

8. Hazards

8.1 During any period that the alcohol used in the mortar aggregate ratio test is exposed to the atmosphere, and particularly when the test sample is being dried, the tester should be aware that alcohol is a very flammable material. Prior to drying the sample in an oven, place the sample in a shallow pan and flash off the alcohol by intentional ignition in an open, well-ventilated area.

9. Sampling

9.1 This section deals with the sampling of individual mortar ingredients and of the mortar itself for preconstruction evaluation in the laboratory and construction evaluation at the jobsite.

9.2 Complete the sampling of materials as follows:

9.2.1 Bagged material, such as portland cement, lime, and masonry cement, shall be of the type and brand that will be used or is being considered for use in the actual construction. Obtain full-bag lots in sufficient quantity for completing the desired tests.

9.2.2 Aggregate for test purposes shall be from the same source and of the same description as will be used or is being considered for use in the actual construction. Obtain a representative sample of sufficient quantity to complete the desired tests.

9.2.3 Water for test purposes need not be the same as that to be used in construction, except when it is known or suspected that the properties of the water available for mortar production at the construction site will have a measurable effect upon the mortar properties. In normal testing, clean, potable water shall be acceptable for test purposes.

9.3 Obtain plastic mortar samples both in the laboratory and at the construction project by taking uniformly distributed incremental samples, and mixing them to form a bulk sample from which the quantity of mortar required for a specific test or specimen can be randomly taken. When preconstruction testing is performed, the sampling method used in construction testing shall be the same as that used during preconstruction testing.

NOTE 5—Many factors, including sampling, can affect the characteristics of fresh mortar. Sampling should be done in a consistent manner. Unless specific time-dependent properties of the mortar are being evaluated, sampling should be done in accordance with 9.3.1.

9.3.1 Take batch mixer samples immediately after mixing, either during the discharge of the mixer or after the mortar has been discharged into the mortar receptacle. If samples are taken during the discharge of the mixer, they shall be taken at any time except for the first and last 10 % of the batch. Samples of the mortar taken after discharge from the mixer shall be representative of the entire batch.

9.3.2 Take mortar for mortar board tests in accordance with 9.3.1, and place upon mortar boards typical of those used or to be used at the project. For construction site testing, expose the test mortar on the board(s) to climatic conditions typical of those on the jobsite. When mortar from a mason's mortar board is used for test purposes, identify it further to reflect this exception for proper data interpretation. Thoroughly hand-mix mortar selected for testing with a trowel immediately before sampling for tests or specimens. Record the lapsed time from the end of mixing as part of the test data.

9.3.3 Take retempered mortar board samples from the mason's mortar board at recorded time periods after mixing and retempering. Thoroughly hand-mix all mortar on the board with a trowel before sampling.

9.4 Record sampling procedures to include the date, time, place, and method of sampling. When applicable, note and record the climatic conditions.

10. Test Specimens

10.1 During preconstruction evaluation of masonry mortars, measure plastic mortar properties using a single test specimen for each part of the tests. For determining hardened mortar properties, prepare three test specimens for each test age and property.

10.2 During construction evaluation of masonry mortars, measure plastic mortar properties using a single test specimen for each part of the method of test. For determining hardened mortar properties, prepare three test specimens for each test age and property.

10.3 During actual construction evaluation of masonry mortars, and when batch-to-batch variations are to be established, sample three consecutive batches and test for plastic and hardened properties.

11. Procedure

11.1 *Mortar Preparation*—Prepare and mix the mortar for preconstruction evaluation in the laboratory using the materials (see 9.2.3, regarding water) and proportions intended for use in construction. Use a mechanical batch mixer similar to that intended for use in construction.

11.1.1 Use masonry sand in the damp, as-received condition, and handle in such a manner as to prevent segregation. Correct the water added to the mortar as free water in sands above the saturated, surface-dry condition, in accordance with Test Method C128. Report the total water used in the mix.

11.1.2 Prebatch the mortar materials, by weight, to meet the desired volume proportions.

11.1.3 *Mixing*—Mix the mortar following this sequence:

11.1.3.1 For each batch, mix mortar in accordance with mixing instructions provided. If no instructions are provided, mix in accordance with the method below. Charge the mixer for preconstruction evaluation tests as follows:

(1) approximately ½ to ¾ of the estimated mixing water required,

(2) ½ to all of the sand,

(3) all the cementitious materials and mix briefly, and

(4) add the remainder of the sand, if any, and the balance of the mixing water required to produce the desired consistency. Inasmuch as laboratory procedures permit a more rapid combination of materials than is generally achieved under actual construction conditions, time delays between the various mixing sequences must be made to approximate jobsite situations.

(5) Mix the mortar at normal speed for 3 to 5 min after the completion of the charging sequence. Mortar shall be mixed for a minimum of one minute after subsequent water additions.

NOTE 6—For best results, mix mortar in the same way each time it is sampled. Alternative mixing equipment may require shorter mixing times than traditional paddle mixers.

11.1.3.2 Determine the cone penetration value of the mortar for preconstruction evaluation tests in accordance with Annex A1.

NOTE 7—There is some disagreement regarding the relative values of the cone penetration test versus the flow table test. The cone penetration test is selected for this procedure since a flow table mounted in accordance with applicable ASTM specifications is not practically portable, and correlation between laboratory and field would be lost if one procedure used the flow table and the other the cone penetrometer.

11.2 Complete the preconstruction and construction evaluation in accordance with the test methods appended, Annex A1-Annex A6.

12. Report

12.1 A complete report shall include the following information:

12.1.1 Name and address of the testing laboratory,

12.1.2 Identification of the report and the date of issue,

12.1.3 Name and address of the client and the identification of the project,

12.1.4 Description and identification of the test sample, including:

12.1.4.1 Description of constituent mortar materials,

12.1.4.2 Identification of mixing procedures,

12.1.4.3 For field-batched mortar, material proportions, and

12.1.4.4 For preblended dry mortar materials, reference to lot number, run number, or other marking provided by the manufacturer.

12.1.5 Date of receipt of the test sample,

12.1.6 Date(s) of sampling and identification of sampling method used,

12.1.7 Date(s) of test performance,

12.1.8 Identification of the standard test method used and a notation of any known deviation from the test method,

12.1.9 Name of the person(s) accepting technical responsibility for the test report,

12.1.10 Identification of subcontractor test results, if applicable.

12.2 A complete report shall also include the test results and all pertinent data relating to the conduct and conditions of the tests in the test report, as required by the applicable Annex. The data sheet in Annex A7 is suggested as a general format for the development of report forms.

13. Keywords

13.1 aggregate ratio; air content; compressive strength; concrete penetrometer; cone penetrometer; consistency; consistency retention; mortar

ANNEXES

(Mandatory Information)

A1. CONSISTENCY BY CONE PENETRATION TEST METHOD

A1.1 Scope

A1.1.1 This test method covers a procedure for determining the consistency of mortars for unit masonry by measuring the penetration of a conical plunger into a mortar sample.

A1.2 Apparatus

A1.2.1 *Unit Measure*—A cylindrical measure having an inside diameter of 3 ± 1/16 in. (76 ± 1.6 mm) and a depth of approximately 3 15/32 in. (88.1 mm), adjusted by standardization with water to contain 400 ± 1 ml at 73.4°F (23°C). For purposes of this test, the capacity of the measure in millilitres is the weight of the water content of the measure, in grams, divided by 0.998. The measure shall have a uniform wall thickness. The thickness of the wall and bottom shall not be less than 0.115 in. The total weight of the empty measure shall not be more than 900 g. The measure shall be made of a metal not attacked by the cement mortar. The 400-mL measure can be calibrated readily by filling with distilled water at 73.4°F (23°C) to a point where the meniscus extends appreciably above the top of the measure, placing a clean piece of plate glass on the top of the measure, and allowing the excess water to be squeezed out. The absence of air bubbles as seen through the glass ensures that the measure is completely full. Care should be taken that the excess water is wiped from the sides of the container before weighing.

A1.2.2 *Straightedge*—A steel straightedge not less than 4 in. (101.6 mm) long and not less than 1/16 in. (1.59 mm) nor more than 1/8 in. (3.2 mm) in thickness.

A1.2.3 *Tamper*—In accordance with Test Method C109/C109M. The tamping face shall be flat and at right angles to the length of the tamper.

A1.2.4 *Tapping Stick*—A maple wood rod, having a diameter of 5/8 in. (15.9 mm) and a length of 6 in. (152.4 mm).

A1.2.5 *Spoon,* metal, kitchen-type, with the handle cut off to make the overall length approximately 9 in. (228.6 mm) and with the bowl of the spoon being approximately 4 in. (101.6 mm) long, 2½ in. (63.5 mm) in width at the widest portion, and ½ to ¾ in. (12.7 to 19.05 mm) deep.

A1.2.6 *Cone Penetrometer*—A Vicat apparatus, conforming to the physical requirements of Test Method C187, shall be modified to allow reading cone penetrations to a depth of 89 mm. The frame shall be raised 2 in. (50.8 mm) to accommodate the unit measure and the plunger in the raised position. The indicator scale shall be extended to allow measuring a full drop of 89 mm. The plunger shall be an aluminum cone, 1⅝ in.

(41.3 mm) in diameter by 3⅝-in. (92.08-mm) long, blunted to a hemisphere a distance of ⅛ in. (3.2 mm) making the overall length 3½ in. (88.9 mm). The base of the cone shall be drilled and tapped on the centerline for threading to a stainless steel tube of proper size and able to slide freely in the guides of the apparatus. The weight of the tube shall be adjusted so that the combined weight of the cone, tube and index pointer is 200 ± 2 g.

A1.3 Procedure

A1.3.1 Immediately after the mortar is sampled, fill the unit measure. Using the spoon, place the mortar gently into the measure in three layers of equal volume, tamping each layer 20 times with the tamper in one complete revolution around the inner surface of the measure. Consider one complete up-and-down motion of the tamper held in a vertical position as one tamping. In tamping the first layer, do not strike the tamper forcibly against the bottom of the measure. In tamping the second and third layers, each layer is tamped in one complete revolution (rotation) with only sufficient pressure to adequately fill the measure and eliminate voids within the mortar. After the measure has been filled and tamped in the above prescribed manner, tap the sides of the measure lightly with the side of the tapping stick once each at five different points at approximately equal spacing around the outside of the measure in order to preclude entrapment of extraneous air. Take care that no space is left between the mortar and the inner surface of the measure as a result of the tamping operation. Then cut the mortar off to a plane surface flush with the top of the measure, by drawing the straightedge with a sawing motion across the top of the measure, making two passes over the entire surface, the second pass being made at right angles to the first. Take care in the striking-off operation that no loose sand grains cause the straightedge to ride above the top surface of the measure. Complete the entire operation of filling and striking off the measure within 1½ min. Wipe off all mortar and water adhering to the outside of the measure.

A1.3.2 Raise the penetration plunger and slide the unit measure underneath the plunger until the point of the plunger rests on the edge of the container. Tighten the set screw just enough to hold the plunger and move the indicator opposite the zero point of the scale.

A1.3.3 Center the container under the plunger and release the plunger with a swift, definite turn of the set screw while holding the entire apparatus firmly with the other hand.

A1.3.4 Read the depth of penetration in millimetres or at the end of 30 s.

A1.4 Report

A1.4.1 Report the depth of cone penetration to the nearest 1 mm.

A2. CONSISTENCY RETENTION OF MORTARS FOR UNIT MASONRY

A2.1 Scope

A2.1.1 This method describes a procedure for determining the consistency retention of mortars after various time intervals by the cone penetration test method. Both disturbed and undisturbed sample testing are included in the method. Unless otherwise stipulated, only the disturbed sample testing will be required.

A2.2 Apparatus

A2.2.1 In addition to the apparatus required for completing the cone penetration test in Annex A1, extra unit measures and glass cover plates are required when using the undisturbed sample test procedure for each test time to be included in the determination of consistency retention. No additional equipment is necessary using the disturbed mortar sample test procedure.

A2.3 Procedure

A2.3.1 *Disturbed Samples*—When testing disturbed mortar samples, sample and use the mortar in filling the mortar test container immediately prior to conducting the test. Sample the mortar as it is discharged from the mixer, and place on a mortar board reserved for test purposes. This mortar shall not be used by the mason, or disturbed until immediately prior to testing. Just before the test, remix the mortar sample with a trowel until it is of uniform consistency. Then agitate or handle the mortar just enough to allow proper consolidation of the mortar in the test container. After the mortar sample has been consolidated in the mold as described in Annex A1, immediately complete the test. The normal interval between tests is 15 min.

A2.3.2 *Undisturbed Samples*—When testing undisturbed mortar samples, prepare the test specimens for all test ages immediately after the mortar is discharged from the mixer. Prepare one test specimen in accordance with Annex A1 for each test age. One test container will be required for each test. Immediately after filling the test container, cover the sample with a cover plate and invert the entire assemblage and place upon a firm, level surface. Immediately prior to testing, turn the assemblage upright and remove the cover plate. The normal interval between tests is 15 min. Two options are available under this test procedure. The method given for undisturbed samples in A2.3.2 minimizes, by the use of the cover plate, the effects of surface moisture evaporation on the consistency of the mortar. Although a mason seldom uses a board of mortar which has sat undisturbed for some time without mixing it with his trowel first, some mortar study programs may wish to include determinations of these surface effects. If this is desired, vary the procedure by not covering and not inverting the test molds for the interval between their preparation and testing. The test report must note the use of this alternate procedure when it is employed.