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Standard Specification for Packaged, Dry, Combined Materials for Surface Bonding Mortar¹

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1. Scope

1.1 This specification covers the materials, properties, and packaging of dry, combined materials for use as surface bonding mortar with concrete masonry units that have not been prefaced, coated, or painted.

1.2 This specification does not cover design or application. Consult the manufacturer for specific recommendations.

1.3 **Appendix X1** of this specification contains the recommended tests for evaluation of surface bonded masonry assemblages used to establish design loads for the composite wall.

1.4 **Appendix X2** through **Appendix X5** of this specification contain additional tests that may be performed on surface bonding mortar.

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.* This hazard statement applies only to Section 9 of this specification.

2. Referenced Documents

2.1 *ASTM Standards:*²

C91 Specification for Masonry Cement

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

C138/C138M Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

C144 Specification for Aggregate for Masonry Mortar

C150 Specification for Portland Cement

C187 Test Method for Amount of Water Required for Normal Consistency of Hydraulic Cement Paste

C191 Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle

C207 Specification for Hydrated Lime for Masonry Purposes

C260 Specification for Air-Entraining Admixtures for Concrete

C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

C348 Test Method for Flexural Strength of Hydraulic-Cement Mortars

C349 Test Method for Compressive Strength of Hydraulic-Cement Mortars (Using Portions of Prisms Broken in Flexure)

C359 Test Method for Early Stiffening of Hydraulic Cement (Mortar Method)

C494/C494M Specification for Chemical Admixtures for Concrete

C595/C595M Specification for Blended Hydraulic Cements

C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C666/C666M Test Method for Resistance of Concrete to Rapid Freezing and Thawing

C1157 Performance Specification for Hydraulic Cement

C1600 Specification for Rapid Hardening Hydraulic Cement

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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.

[E72 Test Methods of Conducting Strength Tests of Panels for Building Construction](#)
[E96/E96M Test Methods for Water Vapor Transmission of Materials](#)
[E119 Test Methods for Fire Tests of Building Construction and Materials](#)
[E447 Test Method for Compressive Strength of Laboratory Constructed Masonry Prisms \(Withdrawn 1997\)³](#)
[E514 Test Method for Water Penetration and Leakage Through Masonry](#)
[E518 Test Methods for Flexural Bond Strength of Masonry](#)
[E519 Test Method for Diagonal Tension \(Shear\) in Masonry Assemblages](#)

3. Terminology

3.1 Definitions:

3.1.1 *surface bonding mortar*—a product containing hydraulic cement, glass fiber reinforcement with or without inorganic fillers, or organic modifiers in a prepackaged form requiring only the addition of water prior to application.

4. Materials and Manufacture

4.1 The materials used as ingredients in packaged, dry, combined materials for surface bonding mortar shall conform to the following requirements:

4.1.1 *Hydraulic Cements*—Hydraulic cements used shall conform to the following ASTM specifications:

4.1.1.1 *Portland Cement*—Type I, IA, II, IIA, III, or IIIA of Specification [C150](#).

4.1.1.2 *Blended Hydraulic Cements*—Type IS, ISA, IP, or IPA of Specification [C595/C595M](#).

4.1.1.3 *Hydraulic Cement*—Type GU, HE, MS, or MH of Specification [C1157](#).

4.1.1.4 *Masonry Cement*—Specification [C91](#).

4.1.1.5 *Rapid Hardening Hydraulic Cement*, Type GRH, MRH, VRH, or URH of Specification [C1600](#).

4.1.2 *Hydrated Lime*—Type S or SA of Specification [C207](#).

4.1.3 *Pozzolan*—Class N, F, or S of Specification [C618](#).

4.1.4 *Aggregates*—Aggregates shall conform to Specification [C144](#) with the exception of grading. The maximum allowable particle size shall not exceed one third of the recommended application thickness of the surface bonding mortar with uniform distribution of particle size.

4.1.4.1 All aggregates shall be dried, without decomposition, to a moisture content of less than 0.1 weight %, computed on material dried substantially to constant weight at 221 to 230°F (105 to 110°C).

4.1.5 *Glass Fibers*—Glass fibers shall be chopped strands of a minimum ½-in. (13-mm) length to provide significant reinforcement in a cementitious matrix.

4.1.5.1 Glass fibers for use in surface bonding mortar, that will be subjected to wetting, humid atmosphere, or contact with moist ground have the potential to react with the available alkalis present in the portland-cement matrix, causing strength reduction of the surface bonding mortar.

4.1.5.2 The producer shall show evidence satisfactory to the purchaser that glass composition, cement matrix, or both, have been designed to reduce significantly or eliminate this unfavorable reaction.

4.1.6 *Additives*—Additives may be added as part of the packaged, dry, combined materials for purposes such as plasticity, air entrainment, water repellency, set acceleration, chemical bonding, and coloring. See Specifications [C260](#) and [C494/C494M](#).

4.1.6.1 Admixtures or mortar colors shall not be added to the surface bonding mortars at the time of mixing unless provided for in the contract specifications, and, after the materials are so added, the surface bonding mortars shall conform to the physical requirements prescribed in [Table 1](#).

4.1.6.2 *Antifreeze Compounds*—No antifreeze liquid, salts, or other substances shall be used in surface bonding mortar to lower the freezing point.

NOTE 1—Calcium chloride, when provided for in the contract specifications, and expressly recommended by the manufacturer, may be used as an accelerator in amounts not exceeding ½ % by weight of the total bag weight.

5. Proportioning

5.1 The proportions of materials such as hydraulic cements, aggregate, and glass fibers shall be such that the requirements of [Table 1](#) will be met when an amount of mixing water is used that is recommended by the manufacturer to produce a working consistency or that produces a consistency penetration of 65 to 75 mm by the Cone Penetrometer Test Method of [Annex A2](#).

6. Physical Requirements

6.1 Packaged, dry, combined materials for surface bonding mortar shall conform to requirements for physical properties prescribed in [Table 1](#), when the prescribed amount of water is added.

³ The last approved version of this historical standard is referenced on www.astm.org.

TABLE 1 Physical Requirements

Flexural Strength ^A (average of three prisms)		
The flexural strength of prisms of surface bonding mortar prepared and tested in accordance with this specification shall be equal to or higher than the values specified for the ages indicated as follows:		
	psi	(MPa)
1 day	450	3.1
7 days	700	4.8
28 days	800	5.5
Compressive Strength (average of prisms broken in flexure)		
The compressive strength of modified cubes of surface bonding mortar prepared and tested in accordance with this specification shall be equal to or higher than the values specified for the ages indicated as follows:		
	psi	(MPa)
1 day	1600	11
28 days	3500	24.1
Time of setting, Vicat needle, initial set, minimum, min		45
final set, max, h		8
Water retention flow after suction, min. % of original flow, min		75

7. Sampling and Testing

7.1 Accuracy of Measurement:

7.1.1 Weigh all surface bonding mortar on scales conforming to the applicable sections of National Institute of Standards and Technology Handbook 44, “Specifications, Tolerances and Regulations for Commercial Weighing and Measuring Devices.”

NOTE 2—New and reconditioned scales shall be accurate to $\pm 0.1\%$ of the total capacity of the scale. When scales have been in use, they shall be accurate to $\pm 0.4\%$ of the total capacity of the scale.

7.1.2 Record all weights in pounds or kilograms to a minimum accuracy of 0.1 lb (0.05 kg). Record all weights in grams to an accuracy of 1 g or 0.1 %, whichever is greater.

8. Sampling Surface Bonding Mortar

8.1 Use the contents of an entire package of surface bonding mortar as a sample. Weigh the package, then place it in a clean, watertight container. Open the package by cutting it down one side and across the top and bottom. Empty the contents of the package into the container then carefully remove and weigh the empty bag. Mix the contents thoroughly by hand, using a scoop or trowel, then secure a representative sample weighing not less than 9 lb (4 kg) nor more than 12 lb (5.4 kg). If the package from which the sample is secured weighs 20 lb (9 kg) or more, reduce its contents to the required weight by quartering.

9. Mixing and Testing Surface Bonding Mortar

9.1 Mortar mixing equipment shall be as specified in Practice C305, except that the clearance adjustment bracket shall be set for the largest size aggregate in the mix being tested. The mixing procedure shall be as given in Annex A1.

9.2 Determine the surface bonding mortar plastic and hardened properties using the following appended test methods:

9.2.1 Annex A3—Flexural Strength of Surface Bonding Mortar.

9.2.2 Annex A4—Compressive Strength of Surface Bonding Mortar.

9.2.3 Annex A5—Time of Setting of Surface Bonding Mortar.

9.2.4 Annex A6—Water Retention of Surface Bonding Mortar.

9.3 Mix a representative portion of the sample of the dry, combined surface bonding mortar weighing 3000 ± 3 g. Use a proportionate amount of the water recommended by the manufacturer to produce a working consistency or a sufficient amount of mixing water to produce a cone penetration of 2½ to 3 in. (65 to 75 mm). Determine the consistency and weight of 400 mL of the mortar, in accordance with Annex A2, then mold 1.575 by 1.575 by 6.3-in. (40 by 40 by 160-mm) prisms in the quantity necessary to test for the desired ages. If insufficient mortar is available, make further batches of mortars using the same water to achieve the required consistency.

9.3.1 Calculate the unit weight in pounds per cubic foot (kilograms per cubic metre) and yield in cubic feet (cubic metres) or the yield in square feet per inch (square metres per millimetre) of thickness, from the weight of the mortar in the 400-mL measure used for the consistency test in Annex A2.

9.3.2 Specimens for flexural strength shall be 1.575 by 1.575 by 6.3-in. (40 by 40 by 160-mm) prisms molded, cured, and tested in accordance with Annex A3, with the broken halves of prisms tested in compression as modified cubes in accordance with Annex A4.

9.3.3 Determine the time of setting by Vicat needles in accordance with **Annex A5**.

9.3.4 Determine the water retention in accordance with **Annex A6**.

9.4 The report of the tests shall include the following:

9.4.1 Net weight of dry, combined material in the bag determined to 0.1 lb (0.05 kg), by subtracting the weight of the empty bag from the gross weight of the package.

9.4.2 Amount of mixing water, W , calculated in pounds (kilograms) per bag based on printed weight of the bag (**Note 3**).

9.4.3 Unit weight, U , in pounds per cubic foot (kilograms per cubic metre) in accordance with Test Method **C138/C138M** (**Note 3**).

9.4.4 Yield, Y , of surface bonding mortar calculated from the unit weight in cubic feet (cubic metres) per bag, based on printed weight of bag (**Note 1**).

NOTE 3—Calculate W , U , and Y as follows:

$$W = R_w B \quad (1)$$

$$U = 0.156 W_m$$

$$Y = (1 + R_w) B / U$$

where:

R_w = ratio of weight of mixing water to weight of dry, combined material in batch of surface bonding mortar calculated to three decimal places,

B = the printed bag weight, and

W_m = weight in grams of surface bonding mortar in the 400-mL measure.

9.4.5 Water retention in percent.

9.4.6 Flexural Strength at ages specified in **Table 1**.

9.4.7 Compressive strength at ages specified in **Table 1**.

9.4.8 Time of setting, initial and final in hours.

10. Basis of Rejection

10.1 The packaged, dry, combined surface bonding mortar may be rejected if it fails to meet any of the requirements of this specification.

10.2 Packages varying more than 2 % from the weight printed on the bag or produce a yield less than that printed on the bag may be rejected, and if the average weight of packages in any shipment as shown by weighing 50 packages taken at random is less than that printed on the bag, the entire shipment may be rejected. <https://standards.iteh.ai/>

10.3 All broken packages may be rejected. <https://standards.iteh.ai/standards/sist/eb37b36e-f7ab-46ce-b6fa-697382f941b3/astm-c887-13>

11. Marking and Packaging

11.1 All packages shall be identified as conforming to Specification C887 and the net weight in each bag printed thereon.

11.2 All packages shall be marked appropriately with the manufacturer's code or open date of production. All containers shall have a prominently located **CAUTION STATEMENT**, warning of potential hazard to handlers of materials therein.

11.3 The minimum yield in cubic feet (cubic metres) or the yield in square feet per inch (square metres per millimetre) of thickness, and the amount of water recommended for mixing shall be marked on the package.

NOTE 4—The amount of water recommended by the manufacturer should be the amount required to produce a working consistency under normal 73.4°F (23°C) climatic conditions.

11.4 *Container Construction*—The material from which the containers are made shall have water vapor transmission not greater than 100 g/m² in 24 h as determined in accordance with Procedure B of Test Methods **E96/E96M**.

12. Keywords

12.1 dry stacked; fiber reinforced; mortar; packaged; surface bonding

A1. LABORATORY MECHANICAL MIXING OF SURFACE BONDING MORTAR**A1.1 Scope**

A1.1.1 This method covers the mechanical mixing of surface bonding mortars of plastic consistency.

A1.2 Apparatus

A1.2.1 The apparatus shall be in accordance with the requirements of Practice **C305**.

A1.3 Temperature and Humidity

A1.3.1 The temperature of the room shall be maintained between 68 and 81.5°F (20 and 27.5°C), and the temperature of the dry materials, paddle, and bowl shall be within the above range at the time of test. The temperature of the mixing water shall not vary from 73.4°F (23°C) by more than $\pm 3^\circ\text{F}$ (1.7°C).

A1.3.2 The relative humidity of the laboratory shall be not less than 50 %.

A1.4 Procedure for Mixing Surface Bonding Mortar

A1.4.1 Place the dry paddle and dry bowl in the mixing position in the mixer and introduce the materials for a batch as follows:

A1.4.1.1 Place all the mixing water in the bowl.

A1.4.1.2 Add the surface bonding mortar to the water.

A1.4.1.3 Start the mixer and mix at a slow speed (140 ± 5 rad/min) for 1 min.

A1.4.1.4 Quickly switch to medium speed (285 ± 10 rpm) and mix for 30 s.

A1.4.1.5 Stop the mixer and let the mortar stand for 1½ min. During the first 15 s of this interval, quickly scrape down into the batch any material that may have collected on the sides of the bowl; then, for the remainder of this interval, cover the bowl with the lid.

A1.4.1.6 Remove the lid and finish mixing for 1 min at medium speed (285 ± 10 rad per min).

A1.4.1.7 In any case requiring a remixing interval, any mortar adhering to the side of the bowl shall be scraped quickly down into the batch with the scraper prior to remixing.

A2. CONSISTENCY TEST OF SURFACE BONDING MORTAR BY CONE PENETROMETER

A2.1 Scope

A2.1.1 This method covers the procedure for determining the consistency of surface bonding mortars by measuring the penetration of a conical plunger into a mortar sample.

A2.2 Apparatus

A2.2.1 *Unit Measure*—A cylindrical measure having an inside diameter of $3 \pm \frac{1}{16}$ in. (76 ± 1.5 mm) and a depth of approximately $3\frac{1}{32}$ in. (88.1 mm), adjusted by standardization with water to contain 400 ± 1 mL at 73.4°F (23°C) (see **Note A2.1**). 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 be not less than 0.115 in. The measure shall be made of a metal not attacked by the cement mortar.

NOTE A2.1—The 400-mL measure can be calibrated readily by filling with distilled water at 73°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.

A2.2.2 *Straightedge*—A steel straightedge not less than 4 in. (101.6 mm) long and not less than $\frac{1}{16}$ in. (1.59 mm) nor more than $\frac{1}{8}$ in. (3.2 mm) in thickness.

A2.2.3 *Spatula*—A spatula with a metal blade 6 in. (152.4 mm) in length and $\frac{1}{2}$ in. (12.7 mm) in width with straight edges and a wooden handle.

A2.2.4 *Tapping Stick*—A maple wood rod, having a diameter of $\frac{5}{8}$ in. (15.9 mm) and a length of 6 in. (152.4 mm).

A2.2.5 *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, $2\frac{1}{2}$ in. (63.5 mm) in width at the widest portion, and $\frac{1}{2}$ to $\frac{3}{4}$ in. (12.7 to 19.05 mm) deep.

A2.2.6 *Cone Penetrometer*—A Vicat apparatus, conforming to the physical requirements of Method **C187**, shall be modified to allow reading cone penetrations to a depth of $3\frac{1}{2}$ in. (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, $1\frac{1}{8}$ in. (41.3 mm) in diameter by $3\frac{5}{8}$ in. (92.08 mm) long, blunted to a hemisphere a distance of $\frac{1}{8}$ in. (3.2 mm) making the overall length $3\frac{1}{2}$ in. (89 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.

A2.3 Procedure

A2.3.1 Immediately after the surface bonding mortar is mixed, in accordance with **Annex A1**, fill the unit measure. Using the spoon, place the mortar gently into the measure in three layers of equal volume, spading each layer 20 times with the spatula in one complete revolution around the inner surface of the measure. After the measure has been filled and spaded, 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. 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 or glass fibers cause the straightedge to ride above the top surface of the measure. Complete the entire operation of filling and striking off the measure within $1\frac{1}{2}$ min. Wipe off all mortar and water adhering to the outside of the measure.