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Standard Test Methods for Evaluating Polymer Modifiers in Mortar and Concrete¹

This standard is issued under the fixed designation C 1439; 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 These test methods provide a means of determining the effect of adding polymer modifiers to reference concrete or mortar.

1.2 Most sections of ASTM test methods and practices for hydraulic cement mortar and concrete apply to the preparation and testing of specimens made with polymer-modifiers. However, there are some exceptions, most notably curing, that need special procedures in order to develop the properties inherent with polymer-modification. These test methods cover these exceptions.

1.3 For testing polymer-modified mortar and concrete specimens, the procedures in this standard supersede those in the referenced ASTM test methods and practices. These test methods are not applicable to dry, packaged mortar and concrete.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

~~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.~~

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. (Warning—Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.²)

2. Referenced Documents

2.1 *ASTM Standards:*³

- C 33 Specification for Concrete Aggregates
- C 39/C 39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C 109/C 109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
- C 127 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
- C 128 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
- C 138/C 138M Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- C 143/C 143M Test Method for Slump of Hydraulic-Cement Concrete
- C 150 Specification for Portland Cement
- C 173/C 173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- C 185 Test Method for Air Content of Hydraulic Cement Mortar
- C 192/C 192M Practice for Making and Curing Concrete Test Specimens in the Laboratory
- C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C 260 Specification for Air-Entraining Admixtures for Concrete
- C 305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
- C 403/C 403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
- C 494/C 494M Specification for Chemical Admixtures for Concrete
- C 778 Specification for Standard Sand
- C 1202 Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
- C 1404/C 1404M Test Method for Bond Strength of Adhesive Systems Used With Concrete as Measured by Direct Tension

¹ These test methods are under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and are the direct responsibility of Subcommittee C09.44 on Polymer-Modified Concrete and Mortars

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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.

³ Section on Safety Precautions, Manual of Aggregate and Concrete Testing, *Annual Book of ASTM Standards*, Vol. 04.02.

³ 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.

C 1437 Test Method for Flow of Hydraulic Cement Mortar

C 1438 Specification for Latex and Powder Polymer Modifiers for Hydraulic Cement Concrete and Mortar

3. Significance and Use

3.1 These test methods are used to develop data for comparison with the requirements of Specification C 1438. Standardized procedures are used to compare the properties of specimens made from test mixtures of polymer-modified concrete or mortar with the properties of specimens made from reference mixtures. These test methods are not intended to simulate job conditions.

4. Materials

4.1 *polymer modifier*— the polymer modifier of the required type as furnished by the supplier.

4.2 *antifoam agent*— antifoam agent of the type recommended by the manufacturer, if one is not incorporated in the polymer modifier.

4.3 *cement*—portland cement conforming to Specification C 150; if necessary, blend into a single lot prior to test. Use same lot for both test and reference mixtures.

4.4 *aggregates*—fine and coarse aggregates for concrete conforming to Specification C 33; if necessary, blend each into a single lot prior to test. Use same lot for both test and reference mixtures.

4.5 *graded sand*— sand for mortar mixtures conforming to Specification C 778; if necessary, blend into a single lot prior to test. Use same lot for both test and reference mixtures.

5. Proportioning of Concrete and Mortar Mixtures

5.1 *Concrete Mixture Proportioning* —Make the test and reference concrete with proportions similar to those shown for a nominal cubic-meter batch.

5.1.1 *Test Concrete*— Make the test concrete conforming to the following requirements:

	Parts by Mass, kg
Portland cement	390 ± 3
Fine aggregate ^A	975 ± 6
Coarse aggregate #8 ^A	780 ± 6
Polymer Modifier	^B
Antifoam agent	^C
Potable water	^D

^A Saturated-surface-dry basis as described in Test Methods C 127 and C 128.

^B The level recommended by the manufacturer.

^C If the polymer modifier does not contain an antifoam agent, add the type and dosage recommended by the manufacturer, to the polymer modifier prior to mixing the concrete.

^D The amount of water to give a slump of 90 ± 15 mm.

5.1.2 *Reference Concrete*—Make the reference concrete conforming to the following requirements:

	Parts by Mass, kg
Portland cement	390 ± 3
Fine aggregate ^A	975 ± 6
Coarse aggregate #8 ^A	780 ± 6
Air-entraining admixture	^B
Potable water	^C

^A Saturated-surface-dry basis as described in Test Methods C 127 and C 128.

^B The amount of air-entraining admixture, meeting Specification C 260, to give an air content within 2 % of the test concrete and not exceeding 7.0 %.

^C The amount of water to give a slump of 90 ± 15 mm.

5.2 *Mortar Mixture Proportioning* :

5.2.1 *Test Mortar*— Make the test mortar conforming to the following proportions:

	Parts by Mass, kg
Portland cement	100 ± 2
Graded sand ^A	275 ± 10
Polymer modifier	^B
Antifoam agent	^C
Potable water	^D

^A Saturated-surface-dry basis as described in Test Methods C 128.

^B The level recommended by the manufacturer.

^C If the polymer modifier does not contain an antifoam agent, add the type and dosage recommended by the manufacturer, to the polymer modifier prior to mixing the mortar.

^D The amount of water that produces a flow of 105 to 115 % when tested according to Test Method C 1437.

5.2.2 *Reference Mortar*— Make the reference mortar conforming to the following proportions:

	Parts by Mass, kg
Portland cement	100 ± 2
Graded sand ^A	275 ± 10
Air-entraining admixture	^B
Potable water	^C

^A Saturated-surface-dry basis as described in Test Methods C 128.

^B The amount of air-entraining admixture, meeting Specification C 260, to give an air content that is within 2 % of the test mortar and not exceeding 12.0 %.

^c Amount of water that produces a flow of 105 to 115 % when tested according to Test Method C 1437.

6. Procedure

6.1 *General*—Mix concretes and mortars in mechanical mixers in batches of such size as to leave about 10 % excess after molding test specimens and testing the unhardened mixtures.

6.2 *Temperature*— Before mixing the concrete or mortar, bring the materials to a uniform temperature, as described in Practice C 192/C 192M for concrete and Test Method C 109/C 109M for mortar.

6.3 *Polymer Modifier*— Store the polymer modifier in a dry place, in moisture-proof containers. Mix the polymer modifier thoroughly before use to ensure uniformity.

6.4 *Reference Concrete and Mortar* —Prepare reference concrete or mortar in compliance with Practice C 192/C 192M or Test Method C 109/C 109M, respectively.

NOTE 1—For trial batches to establish the amounts of water and air-entraining admixture to achieve the specified fresh properties, it is permissible to add these ingredients in increments and remix the batches. With the first increment of water and air-entraining admixture, if applicable, follow the mixing procedures specified in the previous section. If the slump, or flow, or air content is less than required, add additional water or air-entraining admixture and remix the batch. For mortar mixtures, remix at slow speed for 30 s. For concrete, remix the batch for 1 min. Remixing is permitted as often as necessary, provided the elapsed time from the start of initial mixing to the completion of mixing does not exceed 30 min. Cover the mixer to minimize evaporation when tests of fresh properties are being performed. These are trial batches only and are not to be used for testing.

6.5 *Test Mortar*— For mixing test mortar, follow Practice C 305, with the following changes:

6.5.1 *For Latex Polymer Modifiers* :

6.5.1.1 Place all the polymer modifier (with antifoam agent, as required) and mixing water in the bowl.

6.5.1.2 Add the cement to the bowl; start the mixer and mix at the slow speed (140 ± 5 r/min) for 30 s.

6.5.2 *For Powder Polymer Modifiers* :

6.5.2.1 Blend all the polymer modifier (with antifoam agent, as required) and cement, within 1 h of mixing the mortar.

6.5.2.2 Place the water in the bowl.

6.5.2.3 Add the cement/polymer modifier blend to the water; start the mixer and mix at the slow speed (140 ± 5 r/min) for 30

6.6 *Test Concrete*— For mixing test concrete, follow Practice C 192/C 192M, with the following changes:

6.6.1 *For Latex Polymer Modifiers* —Prior to starting rotation of the mixer, add the coarse aggregate, polymer modifier, and approximately half of the water. Rotate the mixer a few revolutions, then add the fine aggregate, cement and remaining water. Mix the concrete for 3 min, followed by a 1 minute rest, followed by 1 min final mixing. Cover the open end of the mixer during the rest period to prevent evaporation. Take precautions to compensate for mortar retained by the mixer so that the discharged batch, as used, will be correctly proportioned (see Note 2).

6.6.2 *For Powder Polymer Modifiers* —Blend all the polymer modifier (with antifoam agent, as required) and cement, within 1 h of mixing the concrete. Prior to starting rotation of the mixer, add the coarse aggregate and approximately half of the water. Rotate the mixer a few revolutions, then add the fine aggregate, cement/polymer modifier blend, and remaining water. Mix the concrete for 3 min, followed by a 1 min rest, followed by 1 min final mixing. Cover the open end of the mixer during the rest period to prevent evaporation. Take precautions to compensate for mortar retained by the mixer so that the discharged batch, as used, will be correctly proportioned (see Note 2).

NOTE 2—It is difficult to recover all of the mortar from mixers. To compensate for this difficulty one of the following procedures may be used to ensure the correct final proportions in the batch:

(1) “*Buttering the Mixer*”—Just prior to mixing the test batch, the mixer is “buttered” by mixing a batch proportioned to simulate closely the test batch. The mortar adhering to the mixer after discharging is intended to compensate for loss of mortar from the test batch.

(2) “*Over-Mortaring the Mixture*”—The test mixture is proportioned by the use of an excess mortar, the amount established in advance, to compensate for that which, on the average, adheres to the mixer. In this case the mixer is cleaned before mixing the test batch.

7. Tests of Freshly Mixed Concrete and Mortar

7.1 *Concretes*—Test samples of the freshly mixed concrete in accordance with the following methods:

7.1.1 *Slump*—Test Method C 143/C 143M.

7.1.2 *Air Content*— Test Method C 173/C 173M or C 231.

7.1.3 *Unit Weight*— Test Method C 138/C 138M.

7.1.4 *Time of Setting*— Test Method C 403/C 403M.

7.2 *Mortars*—Test samples of the freshly mixed mortar in accordance with the following methods:

7.2.1 *Flow*—Test Method C 1437.

7.2.2 *Unit Weight*— Test Method C 185.

7.2.3 *Time of Setting*— Test Method C 403/C 403M.

7.2.4 *Air Content*.

7.2.5 *Test Mortar*:

7.2.5.1 *Mass per 400 mL of Test Mortar* —When the quantity of mixing water has been found that produces a flow of 105 to 115 %, immediately determine the mass per 400 mL of mortar, following the procedures in Test Method C 185.