



# Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete<sup>1</sup>

This standard is issued under the fixed designation C 387/C 387M; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope\*

1.1 This specification covers the production, properties, packaging, and testing of packaged, dry, combined materials for concrete and mortars. The classifications of concrete and mortar covered are defined in Section 3.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 The following safety hazards caveat pertains only to the test method portion of this specification. *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 33 Specification for Concrete Aggregates
- C 39/C 39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C 91 Specification for Masonry Cement
- C 109/C 109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
- C 125 Terminology Relating to Concrete and Concrete Aggregates
- 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 144 Specification for Aggregate for Masonry Mortar
- 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 207 Specification for Hydrated Lime for Masonry Purposes
- 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 270 Specification for Mortar for Unit Masonry
- C 305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
- C 330 Specification for Lightweight Aggregates for Structural Concrete
- C 494/C 494M Specification for Chemical Admixtures for Concrete
- C 566 Test Method for Total Evaporable Moisture Content of Aggregate by Drying
- C 595 Specification for Blended Hydraulic Cements
- C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- C 702 Practice for Reducing Samples of Aggregate to Testing Size
- C 989 Specification for Slag Cement for Use in Concrete and Mortars
- C 1157 Performance Specification for Hydraulic Cement
- C 1240 Specification for Silica Fume Used in Cementitious Mixtures
- C 1329 Specification for Mortar Cement
- 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
- C 1506 Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.43 on Packaged Dry Combined Materials.

Current edition approved Feb. 1, 2009. Published February 2009. Originally approved in 1956. Last previous edition approved in 2008 as C 387/C 387M – 08.

<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.

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

**E 96/E 96M Test Methods for Water Vapor Transmission of Materials**
**3. Terminology**

3.1 *Definitions*—For definitions of terms used in this specification, refer to Terminology **C 125**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *concrete, high-early strength, n*—in packaged, dry, combined materials, a product for building and repair requiring a more rapid than normal strength development such as required for the earlier removal of forms.

3.2.2 *concrete, normal strength*, *n*—in packaged, dry, combined materials, a product for general building and repair where thickness exceeds 50 mm [2 in.].

3.2.2.1 *Discussion*—Typical uses include building or repairing sidewalks, patios, steps, footings, and for setting posts.

3.2.3 *concrete, normal strength, lightweight, n*—in packaged, dry, combined materials, a concrete product for building and repair where the lightest concrete density is desirable.

3.2.3.1 *Discussion*—These mixtures will produce concrete that is about 25 to 35 % lower in density than normal weight concrete.

3.2.4 *concrete, normal strength, lightweight using normal weight sand, n*—in packaged, dry, combined materials, a concrete product for building and repair where a lower density is desirable.

3.2.4.1 *Discussion*—These mixtures will produce concrete that is about 15 to 25 % lower in density than normal weight concrete.

3.2.5 *mortar for unit masonry, n*—in packaged, dry, combined materials, a packaged mortar for laying brick, block, and stone, and for masonry repairs.

3.2.5.1 *Discussion*—These products are packaged versions of the masonry mortars that are specified in Specification **C 270**.

3.2.6 *mortar, high-strength, n*—in packaged, dry, combined materials, a product for building or repair requiring a thickness of less than 50 mm [2 in.], or where a high strength mortar mixture is required.

3.2.6.1 *Discussion*—Typical uses include topping and patching existing concrete structures. Often referred to as “sand mix.”

**4. Ordering Information**

4.1 The purchaser shall specify the material desired as concrete, high strength mortar, or mortar for use with unit masonry, and the respective physical requirements as specified in **Table 1** shall govern.

**5. Materials**

5.1 Materials used as ingredients in packaged, dry, combined materials for mortar and concrete shall conform to at least one of the following requirements:

5.1.1 *Aggregates*, shall conform to Specification **C 33**, Specification **C 144**, or Specification **C 330**.

5.1.2 *Air-Entraining Admixtures*, shall conform to Specification **C 260**.

5.1.3 *Blended Cement*, shall conform to Specification **C 595** or Performance Specification **C 1157**.

5.1.4 *Chemical Admixtures*, shall conform to Specification **C 494/C 494M**.

5.1.5 *Flyash*, shall conform to Specification **C 618**.

5.1.6 *Ground Granulated Blast-Furnace Slag*, shall conform to Specification **C 989**.

5.1.7 *Hydrated Lime*, shall conform to Type S or Type SA of Specification **C 207**.

5.1.8 *Latex and Powder Polymer Modifiers*, shall conform to Specification **C 1438**.

NOTE 1—Type II latex polymers should not be used in applications that may be more than superficially wet in service.

5.1.9 *Masonry Cement*, shall conform to Specification **C 91**.

5.1.10 *Mortar Cement*, shall conform to Specification **C 1329**.

5.1.11 *Portland Cement*, shall conform to Type I, IA, II, IIA, III or IIIA of Specification **C 150**.

5.1.12 *Silica Fume*, shall conform to Specification **C 1240**.

**6. Preparation of Aggregate**

6.1 All aggregates prepared in the laboratory for the purpose of establishing the correct proportions for the product shall be dried, without disintegration, to a moisture content of less than 0.1 % by mass. Verify moisture content using a ventilated oven in accordance with Test Method **C 566**.

**TABLE 1 Physical Requirements**

Kind of Material	Compressive Strength, MPa [psi] min		
	3 days	7 days	28 days
<i>Concrete:</i>			
High-early strength	17.0 [2500]	24.0 [3500]	...
Normal strength:			
Normal weight	...	17.0 [2500]	24.0 [3500]
Lightweight using normal weight sand <sup>A</sup>	...	17.0 [2500]	24.0 [3500]
Lightweight	...	17.0 [2500]	24.0 [3500]
<i>Mortar:</i>			
High-strength mortar		20.0 [3000]	35.0 [5000]
Mortar for unit masonry:			
Type M	Shall comply with property requirements of Specification <b>C 270</b> <sup>B</sup>		
Type S			
Type N			

<sup>A</sup> Lightweight concrete using normal weight sand may contain some portion of lightweight fines.

<sup>B</sup>The performance requirements for 28-day compressive strength, water retention, and air content are those for mortars made from masonry cement unless otherwise specified. Manufacturers wishing to comply with the air content requirements for mortar-cement mortar or cement-lime mortar must specify the ingredients used and comply with the applicable portions of Specification **C 270**.

## 7. Proportioning

7.1 The proportions of cementitious material and aggregate shall be such that the strength requirements will be met when an amount of mixing water is used that produces for concrete the slump specified in 13.3 and for mortar the flow specified in 15.2.

## 8. Physical Properties

8.1 Packaged, dry, combined materials for concrete, high strength mortar, and mortar for use with unit masonry shall conform to the respective physical requirements as given in Table 1 for the material specified when the prescribed amount of water is added.

## 9. Packaging and Package Marking

9.1 All packages shall be identified as conforming to Specification C 387, and as to kind and type of material listed in Table 1 and the net mass in each bag printed thereon.

9.2 The yield in liters (or cubic feet), and the amount of water recommended for mixing shall be marked on the package.

NOTE 2—The amount of water recommended should be the amount required to produce a slump of 50 to 75 mm [2 to 3 in.].

9.3 *Container Construction*—The material from which the containers are made shall have water vapor transmission not greater than 100 g/m<sup>2</sup> in 24 h as determined in accordance with Procedure B of Test Methods E 96. The strength of the container shall be adequate for the mass of concrete or mortar it is intended to contain.

## 10. Rejection

10.1 The purchaser has the right to reject material that fails to conform to the requirements of this specification. Rejection shall be reported to the Producer or supplier promptly and in writing.

## SAMPLING AND TESTING

### 11. Accuracy of Measurement

11.1 Use scales conforming to the applicable sections of *Handbook 44*.<sup>3</sup> 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.

11.2 Record the mass of concrete in kilograms (pounds) to a minimum accuracy of 0.05 kg [0.1 lb.]. Record the mass of mortar in grams to an accuracy of within 1 g or 0.1%, whichever is greater.

### 12. Sampling Concrete

12.1 Use a sufficient quantity of whole packages to conduct all testing from a single batch.

### 13. Mixing and Testing Concrete

13.1 Determine the net mass of concrete in the package (or packages), then empty into a clean, watertight container.

13.2 Mix the concrete, determine the properties of the fresh concrete, and mold and cure the specimens in accordance with the applicable provisions of Practice C 192/C 192M, or modifications of them as outlined herein. Test the strength of the concrete in accordance with Test Method C 39/C 39M.

13.3 Mix the entire sample of the combined, dry material for concrete either by hand or by machine, except that hand mixing is not applicable to air-entrained concrete. Add mixing water in sufficient amount to produce a slump of 50 to 75 mm [2 to 3 in.].

13.4 Use a watertight, clean metal container for hand mixing, using either a blunted bricklayer's trowel, hands protected by rubber gloves, or a shovel, whichever is more convenient. Mix the dry batch until the materials appear to be uniformly distributed. Add water while mixing until the con-

crete is homogeneous in appearance and has the desired slump. If prolonged mixing is required because of the addition of mixing water in increments while adjusting the slump, the batch must be discarded and a new batch made without interrupting the mixing to make trial slump tests.

13.5 Place all materials in the mixer to be used for machine mixing. A mixing period of 3 min followed by a 3-min rest, followed by 2-min final mixing is suggested, unless a different procedure is better adapted to the mixer being used. Cover the open end of the mixer during the rest period to reduce evaporation. Test the slump in accordance with Test Method C 143/C 143M upon completion of the mixing. If the slump test of the mixed batch shows that additional water is required, return the sample used for the slump test promptly to the mixer, add additional water, and remix the batch for 2 min. Retest the slump. If the slump is not from 50 to 75 mm [2 to 3 in.], discard the batch.

13.6 Discharge the mixed batch into a clean, watertight container that has been predampened, then remix the batch by hand, using a scoop or trowel, until the batch appears to be uniform. Promptly determine the density in kilograms per cubic meter (or pound per cubic foot) in accordance with Test Method C 138/C 138M. Return samples used for the slump and unit weight test to the container, then remix the batch by hand and mold the specimens.

13.7 Mold six cylinders from each batch, using three cylinders for test at 7 days and three at 28 days, except that in the case of high early strength concrete, three cylinders shall be tested at 3 days and three at 7 days. Compression test specimens shall be cylindrical with a length equal to twice the diameter. The minimum specimen diameter shall be 75 mm [3 in.], but the maximum diameter is not limited, provided the number of specimens for a test as required in this section are molded from a single batch and the sample taken in accordance with 12.1. For acceptance, the average of the strengths of the three specimens tested at each age shall not be less than the

<sup>3</sup> *Specifications, Tolerances, and Other Technical Requirements of Weighing and Measuring Devices, Handbook 44*, National Bureau of Standards.

compressive strength required in **Table 1** for the type of concrete under test and no individual specimen shall have a strength less than 90 % of the required strength.

13.8 The report of the tests of the concrete shall include the following:

13.8.1 Net mass of dry, combined material in the bag or bags determined by subtracting the mass of the empty bag or bags from the gross mass of the package.

13.8.2 Amount of mixing water (*W*) calculated in terms of kilograms (or pounds) per bag, based on mass of the bag.

$$W = (W_b/A)B$$

*W<sub>b</sub>* = mass of water added to batch,

*A* = mass of dry material in batch, and

*B* = printed mass of bag contents.

13.8.3 Slump in millimetres (or inches) in accordance with Test Method **C 143/C 143M**.

13.8.4 Density (*D*) in kilograms per cubic meter (or pounds per cubic foot) in accordance with Test Method **C 138/C 138M**.

13.8.5 Yield (*Y*) of concrete as determined by Test Method **C 138/C 138M** in terms of liters (or cubic feet) per bag, based on printed mass of bag contents.

13.8.6 Air content, if required, shall be determined by one of the following Test Methods: **C 138/C 138M**, **C 173/C 173M**, (suggested for lightweight concrete); or **C 231**. The method used to determine the air content shall be reported.

13.8.7 Compressive strength at the ages specified in **Table 1**; report the method of mixing the concrete. State the size of the cylinder used in the report.

## 14. Sampling Mortar

14.1 The contents of an entire package of dry, combined material for mortar for unit masonry or for concrete mortar shall be used as a sample. Determine the gross mass of the package and contents to the nearest 0.05 kg [0.1 lb.]. Empty the entire contents of the package into a clean, watertight container. Determine the mass of the empty package and calculate the net mass of the package from the gross mass of the package and contents. Reduce the sample to the proper size for testing in accordance with Practice **C 702**.

## 15. Mixing and Testing Mortar

15.1 Mortar mixing equipment shall be as specified in Practice **C 305**, except that the mixer must be provided with a bowl positioning adapter (**Note 3**) to ensure clearance for the largest size aggregate in the mix being tested. The mixing procedure shall be modified as given in **15.2**.

**NOTE 3**—Description of such an adapter may be obtained from the Cement and Concrete Reference Laboratory of the National Institute of Standards Technology.

15.2 Mix  $3000 \pm 3$  g [ $6.61 \pm 0.01$  lbs.] of mortar in accordance with Practice **C 305** with the exception that the combined material is added at the time of cement addition in Practice **C 305**. Additional water may be added in the final mix period to adjust the flow. Determine the flow in accordance with Test Method **C 1437**. Use sufficient water to produce a flow of  $110 \pm 5$  %.

15.3 *Compressive Strength*—Specimens shall be 50-mm [2-in.] cubes molded, cured, and tested in accordance with procedures in Specification **C 270** for mortars for unit masonry and in accordance with Test Method **C 109/C 109M** for high-strength mortars.

15.4 *Density and Yield*—Determination of density of the mixed mortar and yield per package of mortar.

15.4.1 Vigorously remix the remaining mortar by hand for 10 s using a spoon. Consolidate the mortar into a 400-mL measure in accordance with Test Method **C 185**.

15.4.2 Determine the net mass (*M*) of the mortar in the 400-mL measure to the nearest 1 g.

15.4.3 Calculate the density of the mortar in kilograms per cubic metre (or pounds per cubic foot) using the equations:

$$D_k = 2.5M \text{ or } (D_p = 0.156M) \quad (1)$$

where:

*D<sub>k</sub>* = density in kilograms per cubic metre

*D<sub>p</sub>* = density in pounds per cubic foot

15.4.4 Calculate the yield (*Y*) per package in litres (cubic feet) as follows:

$$Y = (1 + R)PC/D \quad (2)$$

where:

*R* = ratio of mass (or weight) of mixing water to mass (or weight) of dry combined material in the batch of mortar.

*P* = the net mass (or weight) printed on the package.

*C* = Conversion factor. To determine the yield in litres, *P* must be in kilograms per cubic metre. The conversion factor is 1000. To determine the yield in pounds per cubic foot; *P* must be in pounds and *D* must be in pounds per cubic foot. The conversion factor is 1.

15.5 *Water Retention*—For mortars for unit masonry, determine the water retention in accordance with Test Method **C 1506**.

15.6 *Air Content* (required for mortars for unit masonry and optional for high-strength mortars)—If the mixture proportions are known, calculate the air content in accordance with Specification **C 270**. If the proportions are not known, use Test Method **C 138/C 138M**, or Test Method **C 173/C 173M**, or Test Method **C 231** to determine air content.

15.7 The report of the tests shall include:

15.7.1 Net mass (or weight) of dry, combined material in the bag determined to 0.05 kg [0.1 lb],

15.7.2 Amount of mixing water (*W*) calculated in accordance with the formula specified in **13.8.2**,

15.7.3 Flow, in accordance with Test Method **C 1437**,

15.7.4 Density (*D*) in kilograms per cubic metre (or pounds per cubic foot) as determined in **15.4** in accordance with Test Method **C 138/C 138M**,

15.7.5 Yield (*Y*) of mortar in liters (or cubic feet) as determined in **15.4**,

15.7.6 Air content, if measured, and test method used to determine air content,

15.7.7 Water retention in percent, if measured, and

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



## 16. Keywords

16.1 aggregate-cement aggregate combinations; cement mortars; combined concrete/mortar materials; concrete admixtures; concrete, packaged; concrete specifications; dry combined concrete/mortar materials; mortar-cement mortar; mortar, packaged; packaged dry combined materials; packaged concrete/mortar materials

## SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this specification since the last issue, C 387/C 387M – 08, that may impact the use of this specification. (Approved February 1, 2009)

- (1) Revised Section 1.
- (2) Added new Section 3 Terminology and renumbered subsequent sections.

Committee C09 has identified the location of selected changes to this specification since the last issue, C 387/C 387M – 06a, that may impact the use of this specification. (Approved December 1, 2008)

- (1) Revised 6.1.

*ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*

*This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.*

*This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or [service@astm.org](mailto:service@astm.org) (e-mail); or through the ASTM website ([www.astm.org](http://www.astm.org)).*