



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

This standard is issued under the fixed designation C 387; 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 (ε) indicates an editorial change since the last revision or reappraisal.

<sup>ε1</sup> NOTE—Value in Table number 1 was editorially corrected July 2001.

## 1. Scope

1.1 This specification covers the production, properties, packaging, and testing of packaged, dry, combined materials for concrete and mortars. The types of concrete and mortar covered are described in the following paragraphs in this section. Some of the mixtures covered by this specification may not be available in some areas.

1.1.1 *High-Early Strength Concrete*—For concrete building and repair jobs requiring a more rapid strength development such as required for the earlier removal of forms.

1.1.2 *Normal Strength Concrete*:

1.1.2.1 *Normal Weight Concrete*—For general concrete building and repair jobs where thicknesses exceed 50 mm (2-in.). Typical uses include building or repairing sidewalks, patios, steps, footings, and for setting posts.

1.1.2.2 *Lightweight Concrete Using Normal Weight Sand*—For concrete building and repair jobs where lower concrete weights are desirable. These mixtures will produce concrete which is about 15 to 25 % lighter in weight than normal weight concrete.

1.1.2.3 *Lightweight Concrete*—For concrete building and repair jobs where the lightest concrete weight is desirable. These mixtures will produce concrete which is about 25 to 35 % lighter in weight than normal weight concrete.

1.1.3 *High-Strength Mortar*—For general concrete work requiring thicknesses of less than 50 mm (2-in.) or where a high-strength grout mixture is required. Typical uses include topping, patching, and stuccoing. Often referred to as *sand mix*.

1.1.4 *Mortars for Unit Masonry*—For laying brick, block, and stone, and for masonry repairs. The following three types of masonry mortar are covered:

1.1.4.1 *Type N*—For general masonry work requiring normal mortar properties.

1.1.4.2 *Type S*—For use where a higher strength masonry mortar is required.

1.1.4.3 *Type M*—For use where the highest strength masonry mortar is required.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are provided for information purposes only.

1.2.1 Values in SI units shall be obtained by measurement in SI units or by appropriate conversion of measurements made in other units, using the Rules for Conversion and Rounding given in IEEE/ASTM SI 10.

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*:

C 33 Specification for Concrete Aggregates<sup>2</sup>

C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens<sup>2</sup>

C 91 Specification for Masonry Cement<sup>3</sup>

C 109/C 109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)<sup>3</sup>

C 138 Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete<sup>2</sup>

C 143 Test Method for Slump of Hydraulic Cement Concrete<sup>2</sup>

C 144 Specification for Aggregate for Masonry Mortar<sup>4</sup>

C 150 Specification for Portland Cement<sup>3</sup>

C 173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method<sup>2</sup>

C 185 Test Method for Air Content of Hydraulic Cement Mortar<sup>3</sup>

C 192 Practice for Making and Curing Concrete Test Specimens in the Laboratory<sup>2</sup>

C 207 Specification for Hydrated Lime for Masonry Purposes<sup>3</sup>

C 231 Test Method for Air Content of Freshly Mixed

<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 Concrete.

Current edition approved Aug. 10, 2000. Published September 2000. Originally published as C 387 – 56 T. Last previous edition C 387 – 99.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 04.05.

**TABLE 1 Physical Requirements**

| Kind of Material                                  | Water Retention, min, % | Compressive Strength, min |                          |             |
|---|-------------------------|---------------------------|--------------------------|-------------|
|   |                         | 3 days                    | 7 days                   | 28 days     |
| <i>Concrete:</i>                                  |                         |                           |                          |             |
| High-early strength                               | ...                     | 17.0 (2470)               | 24.0 (3480) <sup>A</sup> | ...         |
| Normal strength:                                  |                         |                           |                          |             |
| Normal weight                                     | ...                     | ...                       | 17.0 (2470)              | 24.0 (3480) |
| Lightweight using normal weight sand <sup>B</sup> | ...                     | ...                       | 17.0 (2470)              | 24.0 (3480) |
| Lightweight                                       | ...                     | ...                       | 17.0 (2470)              | 24.0 (3480) |
| High-strength mortar                              |                         |                           | 20.0 (2900)              | 35.0 (5075) |
| Mortar for unit masonry:                          |                         |                           |                          |             |
| Type M  | 75                      | ...                       | ...                      | 17.0 (2470) |
| Type S  | 75                      | ...                       | ...                      | 12.0 (1740) |
| Type N  | 75                      | ...                       | ...                      | 5.0 ( 725)  |

<sup>A</sup> Editorially corrected July 2001.

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

Concrete by the Pressure Method<sup>2</sup>

C 260 Specification for Air-Entraining Admixtures for Concrete<sup>2</sup>

C 305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency<sup>3</sup>

C 330 Specification for Lightweight Aggregates for Structural Concrete<sup>2</sup>

C 494/C 494M Specification for Chemical Admixtures for Concrete<sup>2</sup>

C 595 Specification for Blended Hydraulic Cements<sup>3</sup>

C 618 Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete<sup>2</sup>

C 702 Practice for Reducing Samples of Aggregate to Testing Size<sup>2</sup>

C 989 Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars<sup>2</sup>

C 1157 Performance Specification for Blended Hydraulic Cement<sup>3</sup>

C 1240 Specification for Use of Silica Fume as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout<sup>2</sup>

C 1329 Specification for Mortar Cement<sup>3</sup>

C 1438 Specification for Latex and Powder Polymer Modifiers for Hydraulic Cement Concrete and Mortar<sup>2</sup>

E 96 Test Methods for Water Vapor Transmission of Materials<sup>5</sup>

IEEE/ASTM SI 10— Standard for Use of the International System of Units (SI): The Modern Metric System<sup>6</sup>

### 3. Ordering Information

3.1 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.

### 4. Materials

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

4.1.1 *Aggregates*, shall conform to the requirements of Specification C 33, Specification C 144, or Specification C 330.

4.1.2 *Air-Entraining Admixtures*, shall conform to the requirements of C 260.

4.1.3 *Blended Cement*, shall comply with Specification C 595 or Specification C 1157.

4.1.4 *Chemical Admixtures*, shall conform to the requirements of Specification C 494/C 494M.

4.1.5 *Flyash*, shall conform to the requirements of Specification C 618.

4.1.6 *Ground Granulated Blast-Furnace Slag*, shall conform to the requirements of Specification C 989.

4.1.7 *Hydrated Lime*, shall conform to Type S of Specification C 207.

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

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

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

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

4.1.12 *Silica Fume*, shall conform to the requirements of Specification C 1240.

### 5. Preparation of Aggregate

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

### 6. Proportioning

6.1 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 12.2 and for mortar the flow specified in 14.2.

### 7. Physical Properties

7.1 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.

<sup>5</sup> Annual Book of ASTM Standards, Vol 04.06.

<sup>6</sup> Annual Book of ASTM Standards, Vol 14.04.

## 8. Packaging and Package Marking

8.1 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.

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

NOTE 1—The amount of water recommended should be the amount required to produce a 50 to 75-mm (2 to 3-in.) slump.

8.3 *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.

## 9. Rejection

9.1 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

### 10. Accuracy of Measurement

10.1 Use scales conforming to the applicable sections of *Handbook 44*.<sup>7</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.

10.2 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.

### 11. Sampling Concrete

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

### 12. Mixing and Testing Concrete

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

12.2 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, or modifications of them as outlined herein. Test the strength of the concrete in accordance with Test Method C 39.

12.3 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.).

12.4 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 concrete 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.

12.5 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 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.

12.6 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. Return samples used for the slump and unit weight test to the container, then remix the batch by hand and mold the specimens.

12.7 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 11.1. For acceptance, the average of the strengths of the three specimens tested at each age shall not be less than the 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.

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

12.8.1 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.

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

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

<sup>7</sup> *Specifications, Tolerances, and Other Technical Requirements of Weighing and Measuring Devices, Handbook 44*, National Bureau of Standards.

$W_b$  = mass of water added to batch,  
 $A$  = mass of dry material in batch, and  
 $B$  = printed mass of bag contents.

12.8.3 Slump in millimetres (or inches) in accordance with Test Method C 143.

12.8.4 Density ( $D$ ) in kilograms per cubic meter (or pounds per cubic foot) in accordance with Test Method C 138.

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

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

12.8.7 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.

### 13. Sampling Mortar

13.1 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.

### 14. Mixing and Testing Mortar

14.1 Mortar mixing equipment shall be as specified in Practice C 305, except that the mixer must be provided with a bowl positioning adapter ( Note 2) to ensure clearance for the largest size aggregate in the mix being tested. The mixing procedure shall be modified as given in 14.2.

NOTE 2—Description of such an adapter may be obtained from the Cement and Concrete Reference Laboratory of the National Institute of Standards Technology.

14.2 Mix  $3000 \pm 3$  g 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 109/ C 109M. Use sufficient water to produce a flow of  $110 \pm 5$  %.

14.3 Specimens shall be 50-mm (2-in.) cubes molded, cured, and tested in accordance with Test Method C 109/ C 109M, except that the 15 s of mixing required after the flow test has been made shall be at slow speed, and except that specimens for Type N mortar for unit masonry shall be cured and tested in accordance with Specification C 91.

14.4 Determination of density of the mixed mortar and yield per bag of mortar.

14.4.1 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.

14.4.2 Determine the net mass ( $M$ ) of the mortar in the 400-ml measure to the nearest 1g.

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

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

where:

$D_k$  = Density in kilograms per cubic meter

$D_p$  = Density in pounds per cubic foot

14.4.4 Calculate the yield ( $Y$ ) per package in litres (cubic feet) as follows:

$$Y = (1 + R)PC/D$$

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.

14.5 In the case of masonry mortar, make the water retention test in accordance with the Section on Water Retention of Specification C 91.

14.6 The report of the tests shall include:

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

14.6.2 Amount of mixing water ( $W$ ) calculated in accordance with the formula specified in 12.8.2,

14.6.3 Flow, in accordance with Test Method C 109/ C 109M,

14.6.4 Density ( $D$ ) in kilograms per cubic meter (or pounds per cubic foot) as determined in 14.4 in accordance with Test Method C 138,

14.6.5 Yield ( $Y$ ) of mortar in liters (or cubic feet) as determined in 14.4,

14.6.6 Air content, if required, may be determined by either of Test Methods C 138, C 173, or C 231, except that only Test Method C 173 is applicable to lightweight mortar. The method shall be reported.

14.6.7 Water retention in percent, in the case of masonry mortar, and

14.6.8 Compressive strength at ages specified in Table 1.

### 15. Keywords

15.1 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

 **C 387**

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