Designation: C387/C387M – 15

Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar[1]

This standard is issued under the fixed designation C387/C387M; 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 This specification covers the production, properties, packaging, and testing of packaged, dry, combined materials for concrete and high strength mortar. The classifications of concrete and mortar covered are defined in Section 3.

NOTE 1—The scope of this standard does not cover mortars for unit masonry. Dry preblended mortars for unit masonry are covered by Specification C1714/C1714M.

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. Some values have only SI units because the inch-pound equivalents are not used in practice.

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:*[2]

C33 Specification for Concrete Aggregates
C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
C91 Specification for Masonry Cement
C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
C125 Terminology Relating to Concrete and Concrete Aggregates
C138/C138M Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
C143/C143M Test Method for Slump of Hydraulic-Cement Concrete
C144 Specification for Aggregate for Masonry Mortar
C150 Specification for Portland Cement
C173/C173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
C185 Test Method for Air Content of Hydraulic Cement Mortar
C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory
C207 Specification for Hydrated Lime for Masonry Purposes
C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
C260 Specification for Air-Entraining Admixtures for Concrete
C270 Specification for Mortar for Unit Masonry
C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
C330 Specification for Lightweight Aggregates for Structural Concrete
C494/C494M Specification for Chemical Admixtures for Concrete
C566 Test Method for Total Evaporable Moisture Content of Aggregate by Drying
C595 Specification for Blended Hydraulic Cements
C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
C702 Practice for Reducing Samples of Aggregate to Testing Size
C989 Specification for Slag Cement for Use in Concrete and Mortars
C1116 Specification for Fiber-Reinforced Concrete and Shotcrete
C1157 Performance Specification for Hydraulic Cement
C1240 Specification for Silica Fume Used in Cementitious Mixtures
C1329 Specification for Mortar Cement

[1] This specification is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregatesand is the direct responsibility of Subcommittee C09.43 on Packaged Dry Combined Materials.

Current edition approved Oct. 1, 2015. Published December 2015. Originally approved in 1956. Last previous edition approved in 2011 as C387/C387M–11b. DOI: 10.1520/C0387_C0387M-15.

[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**

C1437 Test Method for Flow of Hydraulic Cement Mortar
C1438 Specification for Latex and Powder Polymer Modifiers for use in Hydraulic Cement Concrete and Mortar
C1600/C1600M Specification for Rapid Hardening Hydraulic Cement
C1714/C1714M Specification for Preblended Dry Mortar Mix for Unit Masonry

3. Terminology

3.1 *Definitions—*

3.1.1 For definitions of terms used in this specification, refer to Terminology C125.

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.

3.2.1.1 *Discussion*—This product allows for earlier removal of forms and allows concrete projects to be put into service much sooner than with normal strength concrete.

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, 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.

3.2.5.1 *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 or high strength mortar 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 C33, Specification C144, or Specification C330.

5.1.2 *Air-Entraining Admixtures,* shall conform to Specification C260.

5.1.3 *Blended Cement,* shall conform to Specification C595 or Performance Specification C1157.

5.1.4 *Chemical Admixtures,* shall conform to Specification C494/C494M.

5.1.5 *Fly ash and natural pozzolans,* shall conform to Specification C618.

5.1.6 *Ground Granulated Blast-Furnace Slag,* shall conform to Specification C989.

5.1.7 *Hydrated Lime,* shall conform to Type S or Type SA of Specification C207.

5.1.8 *Latex and Powder Polymer Modifiers,* shall conform to Specification C1438.

NOTE 2—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 C91.

5.1.10 *Mortar Cement,* shall comply with C1329.

5.1.11 *Portland Cement,* shall conform to Type I, IA, II, IIA, III or IIIA of Specification C150.

5.1.12 *Silica Fume,* shall conform to Specification C1240.

5.1.13 *Fibers,* shall conform to the applicable portions of Specification C1116.

5.1.14 *Rapid hardening hydraulic cement,* shall comply with Specification C1600/C1600M.

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 C566.

TABLE 1 Physical Requirements

Kind of Material	Compressive Strength, MPa [psi] min		
	3 days	7 days	28 days
Concrete:			
High-early strength	17.0 [2500]	24.0 [3500]	. . .
Normal strength:			
Normal weight	. . .	17.0 [2500]	24.0 [3500]
Lightweight using normal weight sand[A]	. . .	17.0 [2500]	24.0 [3500]
Lightweight	. . .	17.0 [2500]	24.0 [3500]
Mortar:			
High-strength mortar		20.0 [3000]	35.0 [5000]

[A] Lightweight concrete using normal weight sand may contain some portion of lightweight fines.

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 15.3 and for mortar the flow specified in 17.2.

8. Sampling

8.1 A lot for the purposes of weight uniformity is defined as the quantity of packaged material normally placed on a pallet. In general, this quantity will weigh from 900 to 1800 kg [2000 to 4000 lb].

8.2 A unit sample is a single package of material randomly selected from the lot.

9. Physical Properties

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

10. Packaging and Package Marking

10.1 All packages shall be identified as conforming to Specification C387, and as to kind and type of material listed in Table 1 and the net mass in each bag printed thereon.

10.2 The yield in liters [cubic feet], and the amount of water recommended for mixing shall be marked on the package.

NOTE 3—The amount of water recommended should be the amount required to produce a slump of 50 to 75 mm [2 to 3 in.] for concrete and a flow of 110 ± 5 % for high strength mortar.

10.3 *Container Construction*—The strength of the container shall be adequate for the mass of concrete or mortar it is intended to contain.

10.4 The net weight in each container. The contents of any container shall not vary by more than 2% from the net weight stated in the markings. The average net weight of filled containers in a lot shall be not less than the weight stated in the markings.

11. Rejection

11.1 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.

11.2 The purchaser has the right to reject product in damaged or dampened containers.

12. Storage

12.1 Product must be stored in a dry area and shall not be stored in direct contact with the ground or floor.

SAMPLING AND TESTING

13. Accuracy of Measurement

13.1 Use scales conforming to the applicable sections of *Handbook 44*.[3] New and reconditioned scales shall be accurate to ±0.1 % of the total capacity of the scale. When scales have been in use, they shall be accurate to ±0.4 % of the total capacity of the scale.

13.2 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.

14. Sampling Concrete

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

15. Mixing and Testing Concrete

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

15.2 Mix the concrete, determine the properties of the fresh concrete, and mold and cure the specimens in accordance with the applicable provisions of Practice C192/C192M, or modifications of them as outlined herein. Test the strength of the concrete in accordance with Test Method C39/C39M.

15.3 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.].

15.4 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.

15.5 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

[3] *Specifications, Tolerances, and Other Technical Requirements of Weighing and Measuring Devices, Handbook 44,* National Bureau of Standards.

C143/C143M 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.

15.6 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 C138/C138M. Return samples used for the slump and unit weight test to the container, then remix the batch by hand and mold the specimens.

15.7 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 14.1. 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.

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

15.8.1 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.

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

15.8.3 Slump in millimetres (or inches) in accordance with Test Method C143/C143M.

15.8.4 Density (D) in kilograms per cubic meter (or pounds per cubic foot) in accordance with Test Method C138/C138M.

15.8.5 Yield (Y) of concrete as determined by Test Method C138/C138M in terms of liters (or cubic feet) per bag, based on printed mass of bag contents.

15.8.6 Air content, if required, shall be determined by one of the following Test Methods: C138/C138M, C173/C173M, (suggested for lightweight concrete); or C231. The method used to determine the air content shall be reported.

15.8.7 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.

16. Sampling Mortar

16.1 The contents of an entire package of dry, combined material for high strength 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 C702.

17. Mixing and Testing Mortar

17.1 Mortar mixing equipment shall be as specified in Practice C305, except that the mixer must be provided with a bowl positioning adapter (See Note 4) to ensure clearance for the largest size aggregate in the mix being tested. The mixing procedure shall be modified as given in 17.2.

NOTE 4—Description of such an adapter may be obtained from the Cement and Concrete Reference Laboratory of the National Institute of Standards Technology.

17.2 Mix 3000 ± 3 g [6.61 ± 0.01 lbs.] of mortar in accordance with Practice C305 with the exception that the combined material is added at the time of cement addition in Practice C305. Additional water may be added in the final mix period to adjust the flow. Determine the flow in accordance with Test Method C1437. Use sufficient water to produce a flow of 110 ± 5 %.

17.3 *Compressive Strength*—Specimens shall be 50-mm [2-in.] cubes molded, cured, and tested in accordance with Test Method C109/C109M.

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

17.4.1 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 C185.

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

17.4.3 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_k = density in kilograms per cubic metre
D_p = density in pounds per cubic foot

17.4.4 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.

17.5 *Air Content* (optional)—If the mixture proportions are known, calculate the air content in accordance with Specification C270. If the proportions are not known, use Test Method C138/C138M, or Test Method C173/C173M, or Test Method C231 to determine air content.

17.6 The report of the tests shall include:

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

17.6.2 Amount of mixing water (*W*) calculated in accordance with the formula specified in 15.8.2,

17.6.3 Flow, in accordance with Test Method C1437,

17.6.4 Density (D) in kilograms per cubic metre [pounds per cubic foot] as determined in 17.4 in accordance with Test Method C138/C138M,

17.6.5 Yield (*Y*) of mortar in liters [cubic feet] as determined in 17.4,

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

17.6.7 Compressive strength at ages specified in Table 1.

18. Keywords

18.1 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, C387/C387M–11b, that may impact the use of this specification. (Approved Oct. 1, 2015)

(1) Added 8.1 and 8.2 to define a lot.

(2) Added 10.4 to define the weight tolerance requirements.