



Standard Specification for Mortar Cement¹

This standard is issued under the fixed designation C 1329; 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 three types of mortar cement for use where mortar for masonry is required.

1.2 The values stated in SI units are to be regarded as the standard. Values in SI units shall be obtained by measurement in SI units or by appropriate conversion, using the Rules for Conversion and Rounding given in IEEE/ASTM SI 10, of measurements made in other units.

1.3 The text of this standard refers to notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.4 The following safety hazards caveat pertains only to Section 16. *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 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 128 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

C 140 Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

C 151 Test Method for Autoclave Expansion of Portland Cement

C 183 Practice for Sampling and the Amount of Testing of Hydraulic Cement

C 185 Test Method for Air Content of Hydraulic Cement Mortar

C 187 Test Method for Normal Consistency of Hydraulic Cement

C 188 Test Method for Density of Hydraulic Cement

C 219 Terminology Relating to Hydraulic Cement

C 230/C 230M Specification for Flow Table for Use in Tests of Hydraulic Cement

C 266 Test Method for Time of Setting of Hydraulic-Cement Paste by Gillmore Needles

C 305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

C 430 Test Method for Fineness of Hydraulic Cement by the 45-μm (No. 325) Sieve

C 511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes

C 778 Specification for Standard Sand

C 780 Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

C 1072 Test Method for Measurement of Masonry Flexural Bond Strength

C 1357 Test Methods for Evaluating Masonry Bond Strength

C 1506 Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters

IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI): The Modern Metric System

3. Terminology

3.1 **Definitions**—Terms used in this specification are defined in Terminology C 219.

3.2 Definition of Term Specific to This Standard:

3.2.1 **mortar cement**—a hydraulic cement, primarily used in masonry construction, consisting of a mixture of portland or blended hydraulic cement and plasticizing materials (such as limestone or hydrated or hydraulic lime), together with other

¹ This specification is under the jurisdiction of ASTM Committee C01 on Cement and is the direct responsibility of Subcommittee C01.11 on Masonry Cement.

Current edition approved January 1, 2004. Published January 2004. Originally approved in 1996. Last previous edition approved in 2003 as C 1329 – 03a.

² *Annual Book of ASTM Standards*, Vol 04.01. See the section on Safety Precautions in the Manual of Cement Testing.

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.

materials introduced to enhance one or more properties such as setting time, workability, water retention, and durability.

3.2.1.1 *Discussion*—Mortar cement is similar to masonry cement in use and function (See Specification C 91). However, this specification requires lower air contents and includes a flexural bond strength requirement.

4. Classification

4.1 Mortar cements are classified as Type N, S, or M, according to the physical requirements prescribed in Table 1.

5. Physical Properties

5.1 Mortar cement shall conform to the applicable requirements prescribed in Table 1 for its classification.

6. Sampling

6.1 At the option of the purchaser, the cement shall be sampled and tested to verify compliance with this specification, sampling and testing shall be performed in accordance with Practice C 183.

6.2 Practice C 183 is not designed for manufacturing quality control and is not required for manufacturer's certification.

7. Temperature and Humidity

7.1 The temperature and relative humidity of the air in the vicinity of the mixing slab and dry materials, molds, base plates, and mixing bowl shall conform to the requirements of Test Method C 109/C 109M.

7.2 The moist cabinet or moist room shall conform to the requirements of Specification C 511.

8. Fineness

8.1 Determine the residue on the 45- μ m (No. 325) sieve in accordance with Test Method C 430.

9. Normal Consistency

9.1 Determine the normal consistency by the Vicat apparatus in accordance with Test Method C 187.

10. Autoclave Expansion

10.1 Determine the autoclave expansion in accordance with Test Method C 151. After molding, store the bars in the moist

cabinet or room for $48 \text{ h} \pm 30 \text{ min}$ before removal from the molds for measurement and testing in the autoclave. Calculate the difference in length of the test specimen before and after autoclaving to the nearest 0.01 % of the effective gage length, and report as the autoclave expansion of the mortar cement.

11. Time of Setting

11.1 Determine the time of setting by the Gillmore needle method in accordance with Test Method C 266.

12. Density

12.1 Determine the density of the mortar cement in accordance with Test Method C 188, using kerosine as the liquid. Use the density so determined in the calculation of the air content of the mortars.

13. Blended Sand

13.1 The sand shall be a blend of equal parts by weight of graded standard sand and 20–30 standard sand conforming to Specification C 778.

14. Preparation of Mortar

14.1 *Proportions for Mortar*—Mortar for air entrainment, compressive strength, and water retention tests shall be proportioned to contain 1620 g of sand and a mass of cement, in grams, as indicated in Table 2. The sand shall consist of 810 g of graded standard sand and 810 g of 20–30 standard sand (Note 1). The quantity of water, measured in millilitres, shall be such as to produce a flow of 110 ± 5 as determined by Test Method C 109/C 109M.

NOTE 1—Historically, field-mixed mortar has been proportioned by volume measured in increments or fractions of 1 ft³. The comparable whole SI-unit volume to 1 ft³ is 28 L. The specified mortar proportions approximate the 1:3 nominal proportions by volume, commonly specified for construction, on the basis of the following assumed mass and volume relationships:

The mass of dry sand in 28 L of loose damp sand is 36 kg.

28 L of Type N mortar cement has a mass of 32 kg.

28 L of Type S mortar cement has a mass of 34 kg.

28 L of Type M mortar cement has a mass of 36 kg.

For example, the amount of cement needed to provide a 1:3 volume proportion of cement to sand using a Type N mortar cement is calculated as follows:

TABLE 1 Physical Requirements

Mortar Cement Type	N	S	M
Fineness, residue on a 45- μ m (No. 325) sieve, max, %	24	24	24
Autoclave expansion, max, %	1.0	1.0	1.0
Time of setting, Gillmore method:			
Initial set, min, not less than	120	90	90
Final set, min, not more than	1440	1440	1440
Compressive strength (average of three cubes):			
The compressive strength of mortar cubes, composed of 1 part cement and 3 parts blended sand (half graded standard sand and half standard 20–30 sand) by volume, prepared and tested in accordance with this specification, shall be equal to or higher than the values specified for the ages indicated below:			
7 days, MPa (psi)	3.5 (500)	9.0 (1300)	12.4 (1800)
28 days, MPa (psi)	6.2 (900)	14.5 (2100)	20.0 (2900)
Flexural bond strength			
28 days, min, MPa (psi)	0.5 (70)	0.7 (100)	0.8 (115)
Air content of mortar:			
Min, volume %	8	8	8
Max, volume %	17	15	15
Water retention value, min, %, of original flow	70	70	70

TABLE 2 Cement in Laboratory Batch of Mortar

Mortar Cement Type	Mass of Cement, g
N	480
S	510
M	540

$$A = 1620 \times (C/B) = 1620 \times (32/108) = 480 \quad (1)$$

where:

A = number of grams of cement to be used in the mortar with 1620 g of sand,

B = $3 \times 36 = 108$ kg, the mass of dry sand in 84 (or 3×28) L of loose damp sand, and

C = mass of Type N mortar cement per 28 L.

14.2 Mixing of Mortars—Mix the mortar in accordance with Practice C 305.

14.3 Determination of Flow—Determine the flow in accordance with Test Method C 109/C 109M.

15. Air Entrainment

15.1 Procedure—If the mortar has the correct flow, use a separate portion of the mortar for the determination of entrained air. Determine the mass of 400 mL of mortar in accordance with Test Method C 185.

15.2 Calculation—Calculate the air content of the mortar, and report it to the nearest 1 % as follows:

$$D = (W_1 + W_2 + V_w)/[(W_1/S_1) + (W_2/S_2) + V_w]A \\ = 100 - (W_m/4D) \quad (2)$$

where:

D = density of air-free mortar, g/cm³,

W_1 = mass of cement, g,

W_2 = mass of sand, g,

V_w = mL-g of water used,

S_1 = density of cement, g/cm³,

S_2 = density of standard sand, 2.65 g/cm³,

A = volume percent of entrained air, and

W_m = mass of 400 mL of mortar, g.

16. Compressive Strength

16.1 Test Specimens:

16.1.1 Molding—Immediately after determining the flow and mass of 400 mL of mortar, return all of the mortar to the mixing bowl and remix for 15 s at the medium speed. Then mold the test specimens in accordance with Test Method C 109/C 109M, except that the elapsed time for mixing mortar, determining flow, determining air entrainment, and starting the molding of cubes shall be within 8 min.

16.1.2 Storage—Immediately after molding, store all test specimens in the molds on plane plates in a moist cabinet or moist room for 48 to 52 h in such a manner that the upper surfaces shall be exposed to the moist air. Then remove the cubes from the molds, and place them in the moist cabinet or moist room for 5 days in such a manner as to allow free circulation of air around at least five faces of the specimens. At the age of 7 days, immerse the cubes for the 28-day tests in saturated lime water in storage tanks of noncorrodible materials.

16.2 Procedure:

16.2.1 Test the cube specimens immediately after their removal from the moist cabinet or moist room for 7-day specimens, and immediately after their removal from storage water for all other specimens. If more than one specimen at a time is removed from the moist cabinet or moist room for 7-day tests, cover these cubes with a damp cloth until the time of testing.

16.2.2 The remainder of the testing procedure shall conform to Test Method C 109/C 109M.

17. Water Retention

17.1 Water retention shall be determined in accordance with the procedures in Test Method C 1506.

18. Flexural Bond Strength

18.1 Flexural bond strength shall be determined in accordance with the test method for laboratory prepared specimens of Test Methods C 1357, except sand shall be a blend of equal mass of graded and standard 20-30 sand conforming to Specification C 778 and mortar shall be proportioned to contain mass of cement in kg equal to 0.20 times the net mass in kg printed on the bag and 22.0 kg of sand. The flexural bond strength of mortar cement shall be determined as the average gross area flexural bond strength of 30 joints minus 1.28 times the standard deviation of the sample.

19. Storage

19.1 The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment, and in a suitable weathertight building that will protect the cement from dampness and minimize warehouse set.

20. Inspection

20.1 Adequate facilities shall be provided to the purchaser for the necessary inspection and sampling.

20.2 All packages shall be in good condition at the time of inspection.

21. Rejection

21.1 At the option of the purchaser, the cement shall be rejected if it fails to meet any of the requirements of this specification.

21.2 At the option of the purchaser, packages more than 2 % below the mass marked thereon shall be rejected. At the option of the purchaser, the entire shipment shall be rejected if the average mass of packages in any shipment, as shown by weighing 50 packages taken at random, is less than that marked on the packages.

21.3 At the option of the purchaser, cement remaining in storage prior to shipment for a period greater than six months after testing shall be retested and, at the option of the purchaser, shall be rejected if it fails to meet any of the requirements of this specification.

22. Manufacturer's Certification

22.1 Upon request of the purchaser in the contract or order, a manufacturer's report shall be furnished at the time of

shipment stating the results of the tests made on samples of the material taken during production or transfer and certifying that the applicable requirements of this specification have been met.

23. Packaging and Package Marking

23.1 When mortar cement is delivered in packages, the brand, name of the manufacturer, type of mortar cement, and net mass of the package in kilograms (Note 2) shall be indicated plainly thereon. Similar information shall be pro-

vided in the shipping documents accompanying the shipment of mortar cement in bulk.

NOTE 2—To facilitate the change to SI units, a standard metric package size of 32 kg for Type N, 34 kg for Type S, and 36 kg for Type M will provide convenient mass increments reasonably similar to the traditional 70-, 75-, and 80-lb packages.

24. Keywords

24.1 flexural bond strength; masonry; mortar; mortar cement

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