



# Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)<sup>1</sup>

This standard is issued under the fixed designation C1107/C1107M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification covers packaged dry, hydraulic cement grout (nonshrink) intended for use under applied load (such as to support a structure, a machine, and the like) where a change in height below initial placement height is to be avoided.

1.2 Grouts covered are composed of hydraulic cement, fine aggregate, and other ingredients. They require only the addition of mixing water for use.

1.3 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.

1.4 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>

**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

**C157/C157M** Test Method for Length Change of Hardened

Hydraulic-Cement Mortar and Concrete

**C185** Test Method for Air Content of Hydraulic Cement Mortar

**C305** Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

**C702** Practice for Reducing Samples of Aggregate to Testing Size

**C827** Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures

**C939** Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)

**C1090** Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout

**C1437** Test Method for Flow of Hydraulic Cement Mortar

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to Terminology **C125**.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *consistency, flowable, n*—a grout consistency having a flow of 125 to 145 by the flow test in accordance with the applicable provisions of Test Method **C1437**; the flow after 5 drops of the flow table in 3 s.

3.2.2 *consistency, fluid, n*—a grout consistency having a time of efflux of 10 to 30 s when tested by the flow cone procedure of Test Method **C939**.

3.2.3 *consistency, plastic, n*—a grout consistency having a flow of 100 to 125 by the flow test in accordance with the applicable provisions of Test Method **C1437**; the flow after 5 drops of the flow table in 3 s.

## 4. Ordering Information

4.1 When the purchaser specifies that properties of the packaged, dry grout meet the requirements of this specification, also specify which, if any, of the optional requirements apply.

4.2 When the grout is to be used in contact with stressed tendons or other corrosion-sensitive, load-bearing structural members, the purchaser shall supply this information to the manufacturer and obtain assurances that the material meets relevant chloride, nitrite, nitrate, sulfide, and sulfate requirements, and any other material limitations imposed by the applicable codes and standards (see **Note 1**).

<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 Dec. 15, 2014. Published March 2015. Originally approved in 1991. Last previous edition approved in 2014 as C1107/C1107M – 14. DOI: 10.1520/C1107\_C1107M-14A.

<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.

4.3 When the grout is to be used in abnormal or aggressive environments, the purchaser shall supply this information to the manufacturer and obtain assurance that the grout has a successful history of performance in the same or similar exposures.

NOTE 1—Since all conditions of use cannot be anticipated, this specification requires nonshrink grout to exhibit no shrinkage when tested in a laboratory-controlled, moist-cured environment, and requires only the reporting of the observed height change, usually shrinkage, when test specimens are subjected to some degree of drying. It is suggested that users consult with manufacturers on specific applications to determine the applicability of specific test results.

## 5. Materials

5.1 The materials used as ingredients in packaged, dry, grout include hydraulic cement, fine aggregate, and other ingredients.

## 6. Performance Requirements

6.1 All test specimens for performance evaluation shall be prepared using the highest water-to-solids ratio, maximum flow, or most fluid consistency stated on the package.

6.2 Specimens shall be made at  $23.0 \pm 2.0^{\circ}\text{C}$  [ $73.5 \pm 3.5^{\circ}\text{F}$ ] from freshly mixed grout and from grout that has been retained in the mixer for the maximum usable working time allowed by the manufacturer. The results of tests performed on specimens made from both conditions shall meet the requirements prescribed in **Table 1**.

6.3 Additional specimens shall be prepared from freshly mixed grout and from grout that has been retained in the mixer

for the maximum usable working time allowed by the manufacturer using materials and equipment conditioned to temperatures representing the maximum and minimum usable temperatures specified by the manufacturer. The results of tests performed on specimens stored at the temperature extremes shall meet the requirements prescribed in **Table 1**, except that the compressive-strength requirements do not have to be met at minimum usable temperature.

6.4 Specimens for testing shall be stored continuously at the three required temperatures ( $23.0 \pm 2.0^{\circ}\text{C}$  [ $73.5 \pm 3.5^{\circ}\text{F}$ ], maximum usable temperature specified by the manufacturer, and minimum usable temperature specified by the manufacturer).

## 7. Sampling

7.1 Use whole packages of grout selected at random from the lot of grout to be examined.

7.2 Where lesser quantities of grout will serve the purpose, select 3000 g [7 lb] of dry grout from a whole package in accordance with the mechanical-splitter method in Practice **C702**. For high-density grouts, adjust the mass to provide an equivalent volume.

## 8. Batching

8.1 Grout mixtures shall be produced in the following conditions:

8.1.1 Batch grout mixtures at temperature conditions corresponding to the maximum recommended temperature limit and

**TABLE 1 Performance Requirements**

	Tests at Standard Conditions		Tests at Minimum Temperature		Tests at Maximum Temperature	
	Fresh Mix	Retained Grout at Maximum Working Time	Fresh Mix	Retained Grout at Maximum Working Time	Fresh Mix	Retained Grout at Maximum Working Time
Highest water to solids ratio, maximum flow, or most fluid consistency	Report Consistency	Report Consistency	Report Consistency	Report Consistency	Report Consistency	Report Consistency
Temperature, $^{\circ}\text{C}$ [ $^{\circ}\text{F}$ ]	Report	Report	Report	Report	Report	Report
Yield, $\text{m}^3$ [ $\text{ft}^3$ ]	Report	Report	Report	Report	Report	Report
Minimum compressive strength, MPa [psi] at:						
1-day <sup>A</sup>	7.0 [1000]	7.0 [1000]	Report	Report	7.0 [1000]	7.0 [1000]
3-day	17.0 [2500]	17.0 [2500]	Report	Report	17.0 [2500]	17.0 [2500]
7-day	24.0 [3500]	24.0 [3500]	Report	Report	24.0 [3500]	24.0 [3500]
28-day	34.0 [5000]	34.0 [5000]	Report	Report	34.0 [5000]	34.0 [5000]
Early height change (maximum % at time of final setting)	+4.0 %	+4.0 %	+4.0 %	+4.0 %	+4.0 %	+4.0 %
Height change of moist cured hardened grout:						
1-day	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %
3-day	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %
14-day	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %
28-day	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %	0.0 to +0.3 %

<sup>A</sup>When required, the purchaser shall specify in the purchase contract.

at a temperature corresponding to the minimum temperature stated by the manufacturer.

8.1.2 For standard temperature testing, maintain the grout mixture and the testing equipment at a temperature of  $23 \pm 2^{\circ}\text{C}$  [ $73.5 \pm 3.5^{\circ}\text{F}$ ].

8.2 Bring all materials and equipment to be used in preparing test specimens to the specified test temperature,  $\pm 3^{\circ}\text{C}$  [ $\pm 5^{\circ}\text{F}$ ] prior to use.

8.2.1 When the controlled-environment test room is too small to accommodate large equipment, immediately prior to use, bring the mixer to the desired testing temperature by filling it with water at the appropriate temperature and agitating it by turning the mixer on. When this water has stabilized at the desired temperature, discard it and start preparing the batch immediately.

8.3 The manufacturer is not prohibited from including, in the package instructions, procedures for adjusting the mixing water temperature to achieve limitations imposed on the grout use temperatures. Use of this technique shall not abrogate the extended mixing time requirement of this specification.

## 9. Proportioning

9.1 The minimum and maximum amount of water recommended by the manufacturer on the package shall be used to determine conformance with the requirements of this specification. If the manufacturer provides maximum flow (thinnest consistency) information on the package, conduct consistency tests to an accuracy of  $\pm 5\%$  to determine the amount of water to be added for testing. In either case, express the weight of water so determined as a ratio of water to dry grout material by weight. If both are given, make tests at whichever involves the larger amount of water by ratio of dry grout mixture.

## 10. Mixing

10.1 Either the mixer described in Practice C305 or the mortar mixer described in 10.1.2 shall be used for performance qualifications. In the event of a dispute, the mixer described in 10.1.2 shall be used for the referee test.

NOTE 2—The referee test is a test made to settle disagreement as to the conformance to the specified requirements.

10.1.1 *Bench Scale Epicyclic Mixer*—The mortar-mixing apparatus shall be as specified in Practice C305. However, the mixer shall be provided with a bowl positioner to enable clearance of the largest sized aggregate in the mixture being tested.

10.1.2 *Mortar Mixer*—A110 to 125-L [ $4$  to  $4\frac{1}{2}\text{-ft}^3$ ] capacity horizontal shaft stationary drum mortar mixer (see Note 3) is required. The mortar mixer shall have a metal shell with horizontal mixing blades. The mixing blades shall be angled so that adjacent paddle arms reverse the flow of the grout in the mixing drum during rotation of the horizontal shaft. The mixing blades shall have adjustable wiper blades that wipe the inner surfaces of the mixing chamber. The wiper blades shall be rubber or other flexible, wear-resistant material that does not deleteriously react with the grout mixture. The wiper blades shall be adjusted to continuously wipe the curved inner surface of the mixing chamber below the grout level and the ends of

the chamber. The horizontal shaft shall rotate the mixing paddles at 28 to 35 r/min. The mixer shall be clean, pre-wetted, and drained and essentially free of hardened mortar and other foreign material that can be removed with a trowel or by reasonably striking with a hammer.

NOTE 3—An electric motor-driven mixer is preferable in the laboratory to avoid noise and exhaust fumes. For greater safety, the mixer should be equipped with a lever-operated clutch. While these comments are selected safety precautions, it is the user's responsibility to see that any equipment in use is not hazardous in a physical or mechanical way to operators and attendant personnel, and that safe work practices are required at all times.

### 10.2 *Mixing Procedure for Bench Scale Mixing:*

10.2.1 Use a 3000-g [7-lb] sample to determine the consistency classification and to determine the water content of grout tested at maximum flow or most fluid consistency.

10.2.2 Weigh all grout on a balance or on a platform scale to the nearest 0.1 %.

10.2.3 Measure the water by mass or volume to the nearest 0.1 %. If the manufacturer recommends maximum water content, calculate the percent water from the packaging information and use that amount of water to prepare the grout mixture. If the manufacturer recommends maximum flow or most fluid consistency, use the suggested water content as a starting point and adjust water as necessary to achieve the maximum flow or most fluid consistency stated on the package. If the required consistency has not been met, make additional adjustments to estimate the water content to use for the next batch. Discard current batch and repeat with newly established water content.

10.2.4 Place water in the bowl. Start the mixer at speed 1. Add the dry grout material to the water over approximately 30 sec. After 1 min, stop the mixer for 15 sec and scrape into the batch any grout that may have collected on the side of the bowl. Switch to speed 2 and mix for a total of 5 min as measured from first contact of dry material with water. Use other mixing procedures if recommended by the manufacturer.

NOTE 4—It is advisable to cover the bowl with a lid while mixing. A metal disc in which a slit has been cut to accommodate the mixer shaft has been found suitable. If excessive splash-over occurs, a larger mixer should be used.

10.2.5 Prepare required specimens from additional batches of grout as needed. Use the water content established above for all successive batches. When testing grout at the end of its working time, a separate batch of grout shall be mixed continually until the time of test unless otherwise recommended by the manufacturer.

### 10.3 *Procedure for Using The Mortar Mixer:*

10.3.1 Prepare all specimens from a single batch of grout using the horizontal shaft stationary drum mortar mixer. Perform tests to verify compliance with performance requirements.

10.3.2 With materials and equipment brought to the testing temperature, use enough whole bags of material to produce at least 56 L [ $2\text{ ft}^3$ ] of mixed grout. Use this batch for both freshly-mixed and delayed-mixed testing at one specified temperature. Place the total required amount of mixing water in the mixer (see Note 5).

10.3.2.1 When testing a grout to a maximum water to solids ratio, use the weighed contents of the packages to determine the amount of water to be used.

10.3.2.2 When testing a grout to a maximum recommended flow or most fluid consistency, adjust the water content at the time of mixing to achieve the recommended consistency. With the mixer running, add the grout material to the water in a steady flow, sliding it into the mixer along the side away from the discharge. After mixing for 1 min, stop the mixer for not more than 30 s and scrape down the sides and blades. Mix for an additional 5 min after all the dry material has been added, unless otherwise recommended by the manufacturer. If the required consistency has not been met, make additional adjustments to estimate the water content to use for the next batch. Discard current batch and repeat with newly established water content.

NOTE 5—Extensive lumping generally occurs during the procedure for adding grout to water. If it occurs repeatedly, try adding about 80 % of the water, then add all of the dry grout material. Add the remaining water after about 1 min of mixing. If lumping persists, contact the grout manufacturer for recommendations.

10.3.3 After completely mixing, discharge a portion of the material through a 9.5-mm [ $\frac{3}{8}$ -in.] mesh screen into a clean, pre-wetted container. If lumps or balls of partially mixed material remain on the screen, reject the entire batch and start over.

10.3.4 Leave the portion of grout to be tested later in the mixer with the mixer running, unless otherwise recommended by the manufacturer, for the period recommended by the manufacturer as the maximum usable working time.

10.3.5 If the manufacturer requires other equipment or a different mixing procedure, or both, when using a particular grout, they shall be used if adequately detailed in the manufacturer's instructions.

## 11. Test Methods

### 11.1 Consistency:

11.1.1 Determine the consistency of the grout mixture in accordance with Test Method **C827**, Preparation of Mixtures, with the exception of temperature. To adjust for consistency, repeat the procedure starting with dry material. Do not add water or dry material to an existing mixture.

11.1.2 Determine the consistency with the required water content, at the temperature extremes allowed by the manufacturer, both with freshly mixed grout and grout mixed to the maximum allowed usable working time. The consistency at the end of the maximum allowed usable working time at each of the allowed temperature extremes shall remain within the specified flow ranges.

11.1.3 Do not adjust the water at extreme conditions unless recommended by the manufacturer. When water adjustment is recommended, perform tests required by this specification to verify that the water-adjusted grout meets the requirements of this specification.

11.2 *Yield*—Determine the yield of the grout using the 400-mL cylindrical measure described in Test Method **C185**.

11.2.1 *Calculation*—Calculate the density of the grout in accordance with Test Method **C138/C138M** and calculate the yield of freshly mixed grout per package of specified mass as follows:

$$Y = (1 + A) \frac{W_t}{W} \quad (1)$$

where:

$Y$  = Yield of grout, L [ft<sup>3</sup>] (expressed to nearest 0.5 L [0.01 ft<sup>3</sup>]),

$W$  = Unit weight of grout, kg/m<sup>3</sup> [lb/ft<sup>3</sup>],

$A$  = Fraction of water added to grout,

$$\frac{\text{Mass of Water}}{\text{Mass of Dry Grout}}$$

$W_t$  = Net weight marked on package, kg [lb].

11.3 *Early Age Height Change*—Determine the early-age height change of grout in accordance with the applicable portions of Test Method **C827**.

### 11.4 Height Change of Hardened Grout:

11.4.1 Determine height change of hardened grout at 1, 3, 14, and 28 days in accordance with Test Method **C1090** and report.

11.4.2 At 28 days age, leave specimens in the apparatus and expose to 50 % relative humidity air, in accordance with Test Method **C157/C157M**, until 56 days age. Determine the net change in specimen height after 28 days of moist curing followed by 28 days of storage in 50 % relative humidity air at  $23 \pm 2$  °C [ $73 \pm 5$  °F].

11.5 *Compressive Strength*—Determine compressive strength in accordance with the applicable portions of Test Method **C109/C109M** except as modified in this section.

11.5.1 For fluid or flowable grouts, fill each mold in the set halfway. Puddle each with a gloved finger five times to consolidate. Fill the mold and puddle again. When filling the mold, use sufficient material so that after the final consolidation the mold is slightly overfilled. Bring the excess grout to the center and finish the surface by cutting off the excess with the straight edge of a trowel held vertically and drawn across the top of the mold with a sawing motion. Plastic grouts shall be consolidated as described in Test Method **C109/C109M**.

11.5.2 Cover the cube molds with a cover plate, taking care that the grout does not prevent seating of the plate. The cover plate shall be flat, rigid, nonreactive and not less than 6 mm [ $\frac{1}{4}$  in.] thick. The cover plate shall overlap the cube mold by not less than 6 mm [ $\frac{1}{4}$  in.]. The cube mold shall be level and the cover plate shall be restrained so that contact is maintained between the upper surface of the cube mold and cover plate.

NOTE 6—Known methods of providing restraint include the use of two C clamps, a mass of at least 7 kg [15 lb], and wing nuts attached to studs between the cube mold base and cover plate.

11.5.3 For compressive strength specimens, strip molds at  $24 \pm \frac{1}{2}$  h after molding or according to manufacturer's instructions. Place specimens in moist cabinet or moist room protected from dripping water. Three cubes shall be tested at each age—1, 3, 7, and 28 days. All test specimens for a given



test age shall be tested for compressive strength within the permissible tolerances prescribed by Test Method **C109/C109M**.

## 12. Report

12.1 Report the following information:

12.1.1 Source and identification of grout tested,

12.1.2 Details of any variations and options practiced by the tester that are recommended or allowed by the manufacturer or others. Also, designate by whom exceptions are allowed or recommended,

12.1.3 Number and size of each grout specimen, the date molded, and the date demolded if the specimens were stripped at an interval other than  $24 \pm \frac{1}{2}$  h in accordance with the manufacturer's instructions.

12.1.4 Consistency at the time the specimens were molded and the water to dry solids ratio,

12.1.5 Mixing temperature and curing temperature,

12.1.6 Identify the usable working time, and temperature range within which the grout specimens were prepared, placed, cured, and tested,

12.1.7 Height change from placement to time of final setting, %,

12.1.8 Height change of hardened, moist-cured grout at specimen age of 1, 3, 14, and 28 days, %,

12.1.9 Height change of hardened grout at 56 days of age when exposed to air drying for 28 days after 28 days of moist-curing, %,

12.1.10 Compressive strength of cubes at 1, 3, 7, and 28 days, and

12.1.11 Yield, determined in **11.2**.

## 13. Inspection and Rejection

13.1 Inspection of the dry grout material shall be agreed upon between the purchaser and the manufacturer as part of the purchase contract.

13.2 Any material that fails to conform to any of the requirements in this specification shall be designated as nonconforming material. In the event of a failure to conform to any part of the requirements of this specification when using the mixer described according to Practice **C305**, the mortar mixing

procedure as described in **10.1.2** shall be used to resolve compliance with the specification. The purchaser has the right to reject any nonconforming material. Rejection shall be reported to the producer or supplier in writing.

## 14. Certification

14.1 The manufacturer shall, at the time of purchase, provide the purchaser, on request, a certification under terms of the purchase contract, that the product meets the requirements of this standard.

## 15. Product Marking

15.1 All packages shall show at least the following information in clearly legible form:

15.1.1 Brand name, usable working time for high and low temperatures within which the grout will meet the requirements of this specification, net weight,

15.1.2 Date of manufacture and the recommended use expiration date, and

15.1.3 Lot identification number.

15.2 The following additional information shall be either marked on package or attached to it:

15.2.1 Surface preparation, mixing, placing, and curing instructions,

15.2.2 Maximum amount of mixing water to be used, or maximum recommended consistency,

15.2.3 Yield at maximum mixing water content, or maximum consistency. The yield claimed shall not be greater than that measured in **11.2**,

15.2.4 Recommended maximum usable working time, "pot-life," and approximate consistency at end of that time. Usable working time shall not exceed the time after initial mixing that grout retains properties required in this specification, and

15.2.5 High and low temperatures during preparation and placement within which the grout will meet the requirements of this specification.

## 16. Keywords

16.1 dry hydraulic cement grout; grout; nonshrink hydraulic cement grout; packaged dry grout; shrinkage compensated grout

## SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this standard since the last issue (C1107/C1107M – 14) that may impact the use of this standard. (Approved Dec. 15, 2014)

(1) Revised **Table 1** while keeping the same strength and height change requirements.



## **C1107/C1107M – 14a**

*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)). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; <http://www.copyright.com/>*