Designation: C1552 – 16

Standard Practice for Capping Concrete Masonry Units, Related Units and Masonry Prisms for Compression Testing[1]

This standard is issued under the fixed designation C1552; 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 practice covers apparatus, materials, and procedures for capping concrete masonry units, related units, including coupons or other specimens obtained from such units, and masonry prisms for compression testing.

NOTE 1—The testing laboratory performing these test methods should be evaluated in accordance with Practice C1093.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *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]

C140 Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

C617 Practice for Capping Cylindrical Concrete Specimens

C1093 Practice for Accreditation of Testing Agencies for Masonry

C1232 Terminology of Masonry

C1314 Test Method for Compressive Strength of Masonry Prisms

3. Terminology

3.1 Terminology defined in Terminology C1232 shall apply for this practice.

4. Significance and Use

4.1 This practice describes procedures for providing plane surfaces on the two bearing surfaces of units and prisms. The purpose of this standard is to provide consistent and standardized procedures for capping units and prisms for compression testing. The procedures are based on those contained (or previously contained) in Test Methods C140, Practice C617, and Test Method C1314.

NOTE 2—Specimens capped using this practice will vary significantly in size and weight. Appropriate care and handling may differ based on specimen size and weight. Provide care and handling as needed to provide for proper capping based on the physical characteristics of the specimen being capped.

5. Apparatus

5.1 *Capping Plate*—If used, the capping plate shall be made of steel having a thickness of not less than 1 in. (25.4 mm), or a polished plate of granite or diabase at least 3 in. (76 mm) thick. The capping surface shall be plane within 0.002 in. in 12 in. (0.05 mm in 300 mm) and shall be free of gouges, grooves, and indentations greater than 0.010 in. (0.25 mm) deep or greater than 0.05 in.^{2} (32 mm^2) in surface area. At the time of capping, the capping surface shall be level within 1⁄16 in. (1.6 mm) over the length of the plate.

5.1.1 *Capping Wear Plate*—If used, the capping wear plate shall be placed directly on top of the capping plate and shall meet the requirements of 5.2. At the time of capping, the wear plate surface shall be level within 1⁄16 in. (1.6 mm) over the length of the plate. Do not use a capping wear plate with sulfur capping materials.

NOTE 3—A capping wear plate has been found to reduce the potential of damage to the capping plate. The capping wear plate is typically more resistant to scratches and can be replaced at less cost than that required to resurface the capping plate. See Fig. 1 for a schematic of capping setup when using gypsum cement materials.

5.2 *Casting Plate*—If used, the casting plate shall be of transparent glass with a thickness of not less than ½ in. (13 mm). The casting plate shall be plane within 0.002 in. in 12 in. (0.05 mm in 300 mm).

6. Materials

6.1 *Capping Materials:*

6.1.1 *High Strength Gypsum Cement Capping Materials:*

[1] This practice is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.04 on Research.

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[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**

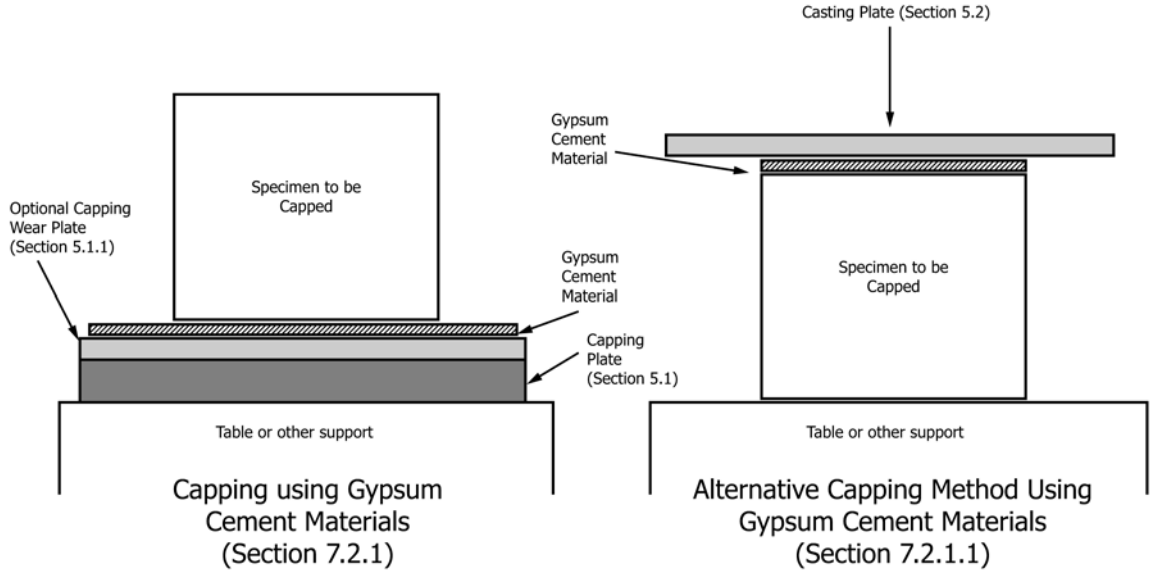

FIG. 1 Gypsum Capping Schematic

6.1.1.1 In addition to the compressive strength testing required in 6.2, qualification tests shall be made to determine the effects of water-cement ratio and age on compressive strength. Procedures used for preparing the high strength gypsum cement capping materials shall ensure that water-cement ratios used for each batch provide the required strength.

NOTE 4—The water-gypsum cement ratio should typically be between 0.26 and 0.30. Use of low water-gypsum cement ratios and vigorous mixing will usually permit development of 3500 psi (24.1 MPa) at ages of one or two hours. Higher water-gypsum cement ratios extend working time, but reduce strength.

6.1.1.2 Do not add fillers or extenders to the high strength gypsum cement.

NOTE 5—Retarders extend working time for capping materials but their effects on required water-cement ratio should be determined prior to use.

NOTE 6—See Appendix X1 for more information on high-strength gypsum capping materials and product recommendations.

6.1.2 *Sulfur Capping Materials:*

6.1.2.1 Proprietary or laboratory prepared sulfur mixtures shall contain 40 to 60 % sulfur by weight, the remainder being ground fire clay or other suitable inert material passing a No. 100 (150-µm) sieve with or without a plasticizer.

6.1.3 Use only capping materials identified in 6.1.1 and 6.1.2. Do not use other capping materials.

NOTE 7—Examples of materials that have been found to be unsuitable for capping purposes include, but are not limited to: low-strength molding plaster, plaster of paris, mixtures of plaster of paris and portland cement, and other cement-based materials.

6.2 *Compressive Strength of Capping Materials*—The compressive strength of the capping material shall be at least 3500 psi (24.1 MPa) at an age of 2 h. The cube molds and methods of preparing and testing the cubes shall be in accordance with Practice C617. The capping material shall be placed in the cube at capping consistency. Store the filled molds in laboratory air. Remove cubes of sulfur material after solidification is complete and remove cubes of gypsum cement material from the molds not more than 15 min prior to testing. Test cubes at an age of 2 h ± 10 min after completing the filling of the molds.

6.2.1 The strength of the capping material shall be determined on receipt of a new lot and at intervals not exceeding three months. If a given test of the capping material fails to conform to the strength requirements, the package from which the material was sampled shall not be used unless two additional subsequent samples are taken from the same package and both of these subsequent samples conform to the strength requirements. If the strength tests from an individual package are inadequate, randomly obtain and test three additional samples from the lot. These additional samples shall be taken from separate packages, if available. Unless these three samples conform to the strength requirements, no part of the lot shall be used.

7. Procedure

7.1 *Preparation of Specimens for Capping*—Use an abrasive stone to remove loose protrusions from the surfaces of the specimens to be capped. Refer to the appropriate compression test method (Test Methods C140 or Test Method C1314) for other specimen preparation requirements.

7.2 *Capping Test Specimens*—Cap top and bottom bearing surfaces of specimens by one of the methods in 7.2.1 or 7.2.2. Use alignment devices as needed to make sure the caps meet the requirements of 7.4.

NOTE 8—Various alignment devices have been demonstrated to be effective. For capping with sulfur materials, which sets quickly, alignment jigs make sure that the specimen is placed on the capping plate correctly in the first motion. For capping with gypsum cement materials, levels placed across the top of specimen have proven to work well. Bullseye levels work particularly well with smaller specimens.

7.2.1 *Capping Using Gypsum Cement Materials*—See Fig. 1 for capping setup. Spread the gypsum cement capping material evenly on the capping plate or capping wear plate that

has been lightly coated with oil or sprayed with a TFE-fluorocarbon coating (Note 9). Bring the surface of the specimen to be capped into contact with the capping material; firmly press down the specimen with a single motion, holding it so that its axis is at right angles to the capping surface to comply with the requirements of 7.4. Do not disturb the specimen until the capping material has solidified.

7.2.1.1 *Alternative Capping Method Using Gypsum Cement Materials*—See Fig. 1 for capping setup. Spread the gypsum cement capping material evenly on the top surface of the specimen. Bring the casting plate, which has been lightly coated with oil or sprayed with TFE-fluorocarbon coating (Note 9), into contact with the capping paste; firmly press down the plate with a single motion holding it so it is at right angles to the specimen. Within 30 s, lightly adjust the plate to achieve a resulting cap that will comply with the requirements of 7.4. Do not further disturb the specimen or casting plate until the capping material has solidified.

NOTE 9—The use of oil or TFE-fluorocarbon coatings on capping or casting plates is not necessary if it is found that the plate and specimen can be separated without damaging the cap.

NOTE 10—Generally, specimens can be removed from capping or casting plates after 30 min without damaging the cap. However, the length of time to assure setting of the cap will vary depending on a variety of factors such as the water-gypsum cement ratio used, environmental conditions, the properties of the specimen being capped, and the temperature of the mix water.

7.2.2 *Capping Using Sulfur Capping Materials:*

7.2.2.1 (**Warning—**Hydrogen sulfide gas is often produced during capping when sulfur capping material is contaminated with organic materials such as paraffin or oil. The gas is colorless and has a notoriously bad odor of rotten eggs; however, the odor is not a reliable warning sign, since the sensitivity to the odor disappears rapidly on exposure. High concentrations are lethal and less concentrated dosages may produce nausea, stomach distress, dizziness, headache, or irritation of the eyes. For this and other safety reasons, locate the capping station in a well-ventilated area and the melting pot under a hood with an exhaust fan.)

7.2.2.2 (**Warning—**Sulfur capping materials are used in a hot, molten state. Adequate protection is required to prevent contact with eyes, hands and other parts of the body.)

7.2.2.3 Heat the sulfur mixture in a thermostatically controlled heating pot to a temperature of 265 to 290°F (129 to 143°C) to maintain fluidity after contact with the capping surface. Verify sulfur capping material temperature using an all-metal thermometer placed at the center of the mass. Verify temperature at hourly intervals during capping operations.

7.2.2.4 Empty the pot and recharge with fresh materials periodically to ensure that the oldest material in the pot has not been used more than five times. Fresh sulfur capping material shall be dry at the time it is placed in the pot as dampness may cause foaming. Keep water away from the molten sulfur capping material for the same reason.

7.2.2.5 Warm the capping plate before use to slow the rate of hardening of the molten sulfur capping material and to permit the production of thin caps. Lightly oil the surface of the capping plate (Note 9) and stir the molten sulfur capping material immediately prior to pouring each cap.

7.2.2.6 Form a rectangular mold on the capping plate whose dimensions are approximately ½ in. (13 mm) greater than the overall dimensions of the specimen. The mold must be sufficiently rigid to not move or deflect during the capping operation, and large enough to accommodate the specimen to be capped and the sulfur capping material without overflow. (See Note 11.) Fill the mold to a depth of ¼ in. (6 mm) with the hot sulfur compound. Bring the surface of the specimen to be capped quickly into contact with the liquid, holding the specimen so that its axis is at right angles to the surface of the capping liquid to achieve a resulting cap that will comply with the requirements of 7.4.

NOTE 11—The use of four 1-in. square steel bars has been found to be adequate for forming this capping mold.

7.2.2.7 Do not disturb the specimen until the sulfur compound has solidified and cooled.

7.3 Once the caps have solidified and, in the case of sulfur capping materials, cooled, separate the specimen from the capping or casting plates in such manner as to prevent damage to the caps and specimens.

7.4 Caps shall be perpendicular within 0.08 in. in 8 in. (2 mm in 200 mm) or 0.5° of the vertical axis of the specimen. For specimens up to 12 in. in length, the surfaces of the caps shall be plane within 0.002 in. in 12 in. (0.05 mm in 300 mm). For specimens greater than 12 in. in length, the surfaces of the caps shall be in plane within 0.002 in. in any 12 in. (0.05 mm in 300 mm) span.

7.5 The average thickness of the cap shall not exceed ⅛ in. (3 mm).

7.6 Do not patch caps. Remove imperfect caps and replace with new ones. Do not test the specimens until the cap has achieved the desired strength based on qualification testing. Cap age shall be at least two hours.

7.7 *Capping Verifications:*

7.7.1 During each day of capping operations, verify the planeness of both caps prior to compression testing on at least one randomly selected specimen. Verify by making a minimum of four measurements in two different orientations on each cap to ensure that the surface of the caps do not depart from a plane by more than 0.002 in. in 12 in. (0.05 mm in 300 mm).

7.7.2 During each day of capping operations, verify the perpendicularity of both caps prior to compression testing on at least one randomly selected specimen. Verify by making a minimum of one check against each face for both caps to ensure that the caps are perpendicular within 0.08 in. in 8 in. (2 mm in 200 mm) or 0.5°. Specimens less than 4 in. (100 mm) in height are exempt from this verification requirement.

7.7.3 Record the results of these verifications in the quality control documentation of the laboratory. At a minimum, the records shall include date(s) of verifications, person(s) performing the verifications, and whether or not the caps comply with the planeness and perpendicularity requirements.

NOTE 12—One method of verifying planeness is with a straightedge and feeler gauge. The straightedge is placed on the cap of the unit, and a check is made to see if the feeler gauge can fit between the cap and the straightedge. Other methods for determining planeness may be used.

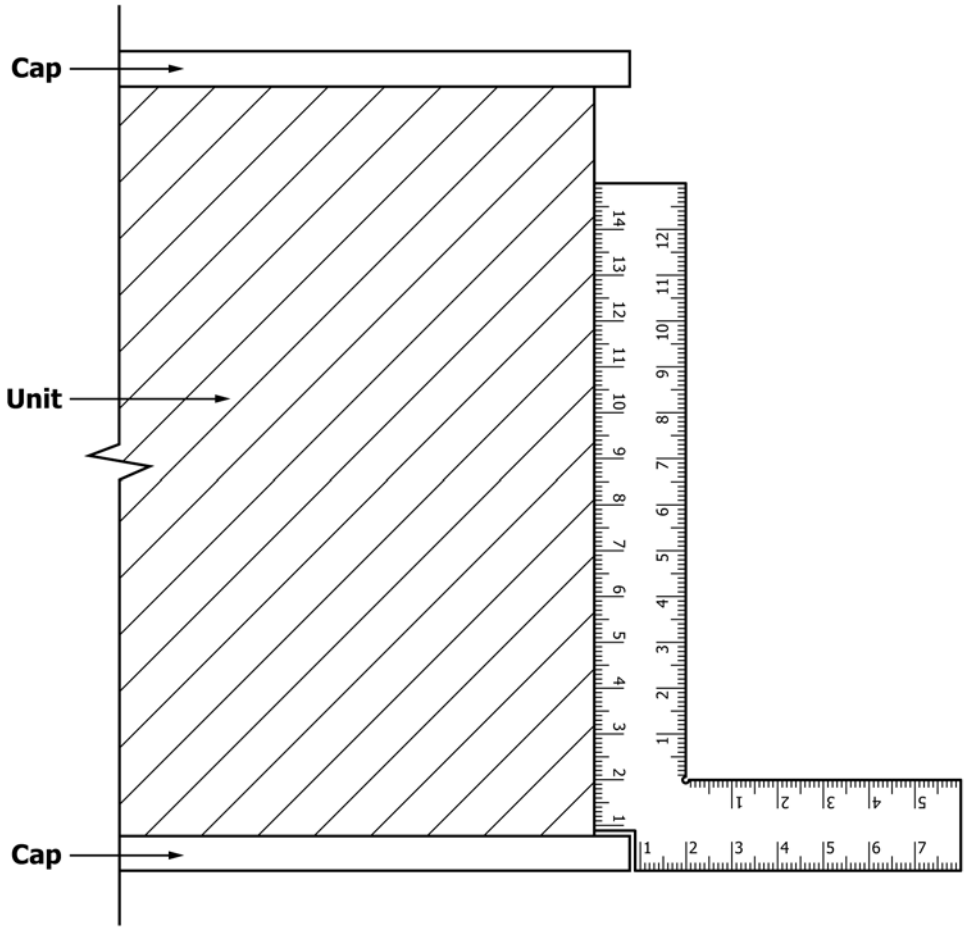

FIG. 2 Example of a Carpenter's Square with a Notch Cut Out of the Bottom to Accommodate the Bottom Cap of the Specimen

One method of verifying perpendicularity is with a carpenter's square and a round wire of the proper thickness. The capped unit is placed on a level surface, and the carpenter's square is placed next to a face. It may be necessary to cut a notch out of the bottom of the carpenter's square in order to accommodate the bottom cap of the specimen (see Fig. 2). It may also be necessary to trim the top of the carpenter's square to avoid contact with the top cap of the specimen. A check is made to see if the round wire gauge can fit between the unit and the carpenter's square. Other methods for determining perpendicularity may be used.

8. Keywords

8.1 cap; capping; capping materials; capping plate; casting plate; compressive strength; gypsum cement; sulfur

APPENDIX

(Nonmandatory Information)

X1. HIGH-STRENGTH GYPSUM CAPPING MATERIALS

X1.1 High-strength gypsum capping materials have been successfully used for capping of many concrete products, especially concrete masonry products. Currently, gypsum capping materials are required for capping of concrete paving units in accordance with Test Methods C140.

X1.2 An important factor in producing high-quality gypsum caps is to use a water-to-cement ratio that yields a material fluid enough to spread while being viscous enough to allow the units being capped to be pushed into it forming a consistent thin cap.

X1.2.1 Related to this rheological property, suitable high-strength gypsum materials should provide a range of viscosities as the water-to-cement ratio is raised or lowered. As such, to produce the desired consistent thin caps, larger and heavy products, such as masonry prisms, may require the use of a lower water to cement ratio to produce a more viscous capping material, while smaller and lighter units, such as concrete paving units, may require the use of a higher water-to-cement ratio to produce a less viscous capping material.

X1.3 Suitable high-strength gypsum materials should also provide sufficient working time to allow the material to be spread out on the capping plate and not harden before units are placed in the material.

X1.4 Suitable high-strength gypsum materials that have been successfully used include Hydro-Stone (trademarked) Gypsum Cement, available from USG (United States Gypsum Company), and Denscal (trademarked) ST Plaster, available from Georgia-Pacific. Other suitable materials may also be available.

SUMMARY OF CHANGES

Committee C15 has identified the location of selected changes to this standard since the last issue (C1552 – 15) that may impact the use of this standard. (December 1, 2016)

(1) Revised 7.7.2 to exempt specimens less than 4 in. (100 mm) in height from perpendicularity checks.

Committee C15 has identified the location of selected changes to this standard since the last issue (C1552 – 14a) that may impact the use of this standard. (December 1, 2015)

(1) Revised 7.4 and 7.7.2 to add the option of measuring perpendicularity in degrees.