



# Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement<sup>1</sup>

This standard is issued under the fixed designation C 449/C 449M; 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 mineral fiber (rock or slag) insulating and finishing cement shipped in dry-mix form, including hydraulic-setting binder, which, when mixed with water and applied in accordance with the manufacturer's directions, affords a smooth surface as a final finish for heated surfaces up to 1200°F (649°C) for specific applications. The actual temperature limit shall be agreed upon between the purchaser and the manufacturer.

NOTE 1—Precautionary measures should be taken with this material as with other hydraulic-setting mixtures. This material should be used within the time period recommended by the manufacturer.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 The following safety hazards caveat pertains only to the test method (Section 10) described in 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.*

1.4 When the installation or use of thermal insulation materials, accessories, and systems may pose safety or health problems, the manufacturer shall provide the user with appropriate current information regarding any known problems associated with the recommended use of the company's products and shall also recommend protective measures to be employed in their safe utilization. The user shall establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.

## 2. Referenced Documents

### 2.1 ASTM Standards:

- C 163 Practice for Mixing Thermal Insulating Cement Samples<sup>2</sup>
- C 166 Test Method for Covering Capacity and Volume

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.20 on Homogeneous Inorganic Thermal Insulations.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.06.

Change Upon Drying of Thermal Insulating Cement<sup>2</sup>

C 168 Terminology Relating to Thermal Insulating Materials<sup>2</sup>

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot Plate Apparatus<sup>2</sup>

C 354 Test Method for Compressive Strength of Thermal Insulating or Finishing Cement<sup>2</sup>

C 356 Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat<sup>2</sup>

C 390 Criteria for Sampling and Acceptance of Preformed Thermal Insulation Lots<sup>2</sup>

C 405 Practice for Estimating Consistency of Wet-Mixed Thermal Insulating Cement<sup>2</sup>

C 411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation<sup>2</sup>

C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus<sup>2</sup>

C 795 Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel<sup>2</sup>

C 1045 Practice for Calculating Thermal Transmission Properties from Steady-State Heat Flux Measurements<sup>2</sup>

C 1058 Practice for Selecting Temperatures for Reporting and Evaluating Thermal Properties of Thermal Insulation<sup>2</sup>

C 1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus

E 136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C<sup>3</sup>

## 3. Terminology

3.1 *Definitions*—Definitions found in Terminology C 168 shall be considered as applying to the terms used in this specification.

## 4. Materials and Manufacture

4.1 Mineral fiber insulating and finishing cement shall be composed of mineral fiber and suitable fillers, premixed with a hydraulic setting binder such that when mixed with clean, fresh water, the cement will attain its initial set in approximately 2 to 4 h as usually applied.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.07.

4.2 The mineral fiber shall consist of rock or slag or glass processed from a molten state into fibrous form.

4.3 Asbestos shall not be used as an ingredient or component part in the manufacture of this product.

4.4 Ceramic fiber shall not be used as an ingredient or component part in the manufacture of this product.

NOTE 2—**Caution:** In the presence of moisture or water, a hydraulic-setting binder, usually portland cement, will chemically react with aluminum-containing materials such as aluminum lagging and powdered aluminum pigmented paints or coatings.

**5. Other Requirements**

5.1 The cement shall conform to the requirements given in Table 1. Conformance shall be based on results of tests on specimens first mixed with water according to the ratio for proper troweling consistency determined in accordance with Practice C 405.

5.2 *Maximum Use Temperature*—When tested in accordance with paragraph 10.6, the dried cement shall not warp, flame, or glow during hot surface exposure. No evidence of melting or fiber degradation shall be evident upon post-test inspection.

5.3 *Non-combustibility*—When tested in accordance with paragraph 10.7, the dried cement specimen, using 9.2, shall not exceed the recorded temperature rise more than 54°F (30°C) with no flaming or weight loss exceeding 5%.

5.4 When the cement is to be used in contact with austenitic stainless steel, distilled or demineralized water shall be used for mixing. The cured and dried product, processed in accordance with Section 9 on Specimen Preparation, shall conform to the requirements of Specification C 795.

**6. Qualification Requirements**

6.1 The following requirements are employed for purposes of initial material or product qualifications:

- 6.1.1 Dry covering capacity.
- 6.1.2 Volume change upon drying.
- 6.1.3 Compressive strength.
- 6.1.4 Linear shrinkage.
- 6.1.5 Apparent thermal conductivity.

**7. Sampling**

7.1 The cement shall be sampled for acceptance tests in

**TABLE 1 Physical Requirements**

NOTE 1—Conformance to these physical requirements shall be based on the average of the results of tests on specimens prepared in accordance with Section 9.

Dry covering capacity min ft <sup>2</sup> @ 1 in. thickness per 100 lb of dry cement (m <sup>2</sup> @ 1 cm thickness per 100 kg of dry cement)	24 (12.5)
Volume change (shrinkage) upon drying, max %	10.0
Compressive strength at 5 % deformation, min psi (kPa)	100 (689.5)
Linear shrinkage (length) after 24 h heat soak at 1200°F (649°C), max %	5.0
Apparent thermal conductivity, max Btu.in./h.ft <sup>2</sup> .°F (W/m.K):	
Mean temperature° F (°C),	
75 (24)	0.60 (0.087)
200 (93)	0.90 (0.130)
400 (204)	1.15 (0.166)
600 (316)	1.1 (0.159)

accordance with Table 1 (Sampling Plan and Acceptance Criteria for Inspection Requirements) of Criteria C 390, with each bag representing a shipping unit.

7.2 The test specimen shall be taken from the middle of a bag, so as to be representative of material from the entire bag. A “grain thief” or equivalent shall be used to obtain the specimen from the bag.

**8. Number of Tests and Retests**

8.1 The number of tests shall be as required in 7.1 or as otherwise agreed to between the manufacturer and the user.

8.2 If the average of the test data obtained on the required number of specimens fails to comply with the requirements of Table 1, the lot shall be resampled and retested. The results of the retest shall be averaged with the results of the original tests to determine compliance with this specification.

**9. Specimen Preparation**

9.1 Specimens for testing shall be mixed with demineralized or distilled water in accordance with Practice C 163. Allow ingredients to expand/swell by standing for at least 15 min before running qualification tests.

9.2 Test specimens for 5.2, 10.3, 10.5, 10.6, 10.7 and Table 1 shall be prepared as follows:

9.2.1 Mold test specimens on a mold of suitable size and shape for the equipment to be used and a max. of 2 in. (51 mm) in depth. The cement shall be mixed with demineralized water in accordance with Practice C 163. Place the mold in a horizontal position on a piece of glass slightly larger than the specimen required. Place the mixed cement in the mold, trowel the top surface of the cement smooth, and allow to cure under ambient laboratory conditions for 24 h.

9.2.2 Remove the specimen from the mold and dry until constant dried weight is achieved. Drying can be accomplished either by heating in a well ventilated oven at 215 to 250°F (101 to 121°C) for 48 h or by heating in a ventilated 500 to 900 watts microwave oven until no change in specimen weight.

9.2.3 Upon removal from the oven, the surfaces of the specimens shall be made plane and parallel by cutting, sandpapering, or by a combination of these methods. The lateral dimensions of the specimens shall be governed by the test requirements.

**10. Test Methods**

10.1 *Dry Covering Capacity*—Test Method C 166.

10.2 *Volume Change Upon Drying*—Test Method C 166.

10.3 *Compressive Strength*—Test Method C 354.

10.4 *Linear Shrinkage*—Test Method C 356.

10.5 *Apparent Thermal Conductivity*

10.5.1 The thermal conductivity as a function of temperature for the representative specimens shall be determined with data obtained from a series of thermal tests utilizing Test Methods C 177, C 518, or C 1114 as appropriate for the material under study. Specimen shall be tested at a maximum thickness of 2 in. (51 mm).

10.5.1.1 Test Method C 518 shall not be used at temperatures or resistances other than those in the range of the calibration.

10.5.1.2 Test Method C 1114 shall not be used at temperatures or resistance ranges other than those with comparable

results to Test Method C 177.

10.5.2 The test method selected shall have proven correlation with Test Method C 177 over the temperature range of conditions used. In cases of dispute, Test Method C 177 shall be considered as the final authority for material having flat geometry.

10.5.3 Practice C 1058 may be used to obtain recommended test temperature combinations for testing purposes.

10.5.4 As specified in Practice C 1045, the range of test conditions must include at least one test where the hot surface temperature is greater than, or equal to, the hot limit of the temperature range of desired data and at least one test where the cold surface temperature is less than, or equal to, the cold limit of the temperature range desired. Additional tests, at least two, shall be distributed somewhat evenly over the rest of the temperature range.

10.5.5 Conduct the final analysis of the thermal data shall be conducted in accordance with Practice C 1045 to generate a thermal conductivity versus temperature relationship for the specimen.

10.5.6 The final step of Practice C 1045 analysis would be to calculate the thermal conductivity using the equations generated at a set of mean temperatures for comparison to the specification.

**NOTE 3—Caution:** While it is recommended that the specification data be presented as conductivity versus temperature, several existing specifications may contain mean temperature data from tests conducted at specific hot and cold surface temperatures. In these cases, the conductivity as a function of temperature from the Practice C 1045 analysis may provide different results. To insure that the data is compatible, a Practice C 680 analysis, using the conductivity versus temperature relationship from Practice C 1045 and the specific hot and cold surface temperatures, is required to determine the effective conductivity for comparison to the specification requirements.

10.6 *Maximum Use Temperature*—Shall be tested, using 9.2, in accordance with Test Method C 411 at the insulation's maximum use temperature and at the manufacturer's maximum recommended thickness at that temperature. No special requirements for heat up of material shall be specified by the manufacturer.

10.7 *Non-combustibility*—May be determined with passing Test Method E 136 when all four specimens meet the reported conditions.

## 11. Inspection

11.1 The following requirements are employed for purposes of acceptance sampling of lots or shipments of qualified cement:

11.1.1 Dry covering capacity.

11.1.2 Volume change upon drying.

## 12. Rejection and Rehearing

12.1 Material that fails to conform to the requirements in this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing in case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

12.2 In case of rejection, the manufacturer or supplier shall have the right to reinspect the rejected shipment and resubmit the lot after removal of that portion not conforming to the specified requirements.

## 13. Certification

13.1 When specified in the purchase order or contract, the purchaser shall be furnished with certification that samples representing each lot have been either tested or inspected as directed in this specification, and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

## 14. Packaging

14.1 Unless otherwise specified or agreed upon by the purchaser and the manufacturer or supplier, the cement shall be packaged in the manufacturer's standard commercial containers.

## 15. Keywords

15.1 cement; finishing; hydraulic-setting; insulating; mineral fiber; thermal; thermal conductivity

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