



Standard Specification for Mineral Fiber Thermal Insulating Cement¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers mineral fiber thermal insulating materials in the form of dry cement, which, when mixed with a suitable proportion of water, applied as a plastic mass, and dried in place, affords resistance to heat transmission on surfaces operating at temperatures between 250 and 1900°F (about 121 and 1038°C).

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI equivalents of inch-pound units are given in parentheses and may be approximate.

1.3 The following safety hazards caveat pertains only to the test methods section 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:

- C 163 Practice for Mixing Thermal Insulating Cement Samples²
- C 166 Test Method for Covering Capacity and Volume Change Upon Drying of Thermal Insulating Cement²
- C 168 Terminology Relating to Thermal Insulating Materials²
- C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus²
- C 353 Test Method for Adhesion of Dried Thermal Insulating or Finishing Cement²
- C 354 Test Method for Compressive Strength of Thermal Insulating or Finishing Cement²
- C 356 Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat²
- C 390 Criteria for Sampling and Acceptance of Preformed Thermal Insulation Lots²

¹ 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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² *Annual Book of ASTM Standards*, Vol 04.06.

- C 405 Practice for Estimating Consistency of Wet-Mixed Thermal Insulating Cement²
- C 411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation²
- C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus²
- C 1045 Practice for Calculating Thermal Transmission Properties From Steady-State Heat Flux Measurements²
- C 1058 Practice for Selecting Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation²
- C 1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus²
- E 136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C³

3. Terminology

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

4. Materials and Manufacture

4.1 Mineral fiber thermal insulating cement shall be composed of mineral fiber, with a suitable proportion of heat-resistant binder.

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

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

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 Section 10.

5.2 *Maximum Use Temperature*—When tested in accordance with paragraph 10.8, 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 10.9, the dried cement specimen, using 10.6.7.1,

³ *Annual Book of ASTM Standards*, Vol 04.07.

TABLE 1 Physical Requirements

Dry covering capacity, min, ft ² , 1 in. in thickness per 100 lb of dry cement (m ² , 1 cm in thickness per 100 kg of dry cement)	30 (15.3)
Volume change (shrinkage) upon drying, max, %	35 (35)
Compressive strength at 5 % deformation, min, psi (kPa)	10 (69)
Dry adhesion to steel, min, psi (kPa)	4 (27.6)
Linear shrinkage (length) after heat soaking at 1600°F (871°C) max, %	5 (5)
Apparent thermal conductivity, max, Btu-in./h-ft ² -°F (W/m-K): ^A	
At mean temperature of 200°F (93°C)	0.70 (0.101)
At mean temperature of 500°F (260°C)	0.85 (0.123)
At mean temperature of 700°F (371°C)	0.95 (0.137)
At mean temperature of 900°F (482°C)	1.2 (0.173)

^A The user is advised that some applications could require the knowledge of the thermal conductivity of the insulating cement at mean temperatures above those shown. Consult the manufacturer for data at mean temperatures exceeding those listed.

shall not exceed the recorded temperature rise more than 54°F (30°C) with no flaming or weight loss exceeding 5%.

6. Qualification Requirements

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

- 6.1.1 Consistency,
- 6.1.2 Compressive strength,
- 6.1.3 Linear shrinkage,
- 6.1.4 Apparent thermal conductivity, and
- 6.1.5 Dry adhesion to steel.

7. Sampling

7.1 The cement shall be sampled, for the purpose of tests, using one of the following procedures. Unless otherwise specified or agreed upon between the purchaser and the manufacturer or supplier, the cement shall be sampled using the manufacturer's standard procedure.

7.1.1 Use Criteria C 390. Each bag shall represent a unit.

7.1.1.1 In a single sampling plan by attributes the acceptability of a lot will be determined by the number of units of product in the sample that do not conform to the specifications. The acceptable quality level (AQL) and limiting quality level (LQL) of an acceptance sampling plan, expressed as percentages of the units nonconforming, are characteristics of the sampling plan and are not to be viewed as product specifications.

7.1.2 Use the average of the test data from the number of test specimens required by the appropriate test method to represent the average for the entire lot.

7.2 The specimen for test is to be taken from the middle of a bag, so as to be representative of material from the entire bag.

8. Number of Tests and Retests

8.1 If the average of the test data obtained using 7.1.2 fails to conform to the requirements of this specification, a second sample shall be taken from the lot. Average the results of the retest with the results of the original test to determine compliance with this specification.

9. Specimen Preparation

9.1 Mix specimens for testing in accordance with Practice C 163.

9.2 *Water-Cement Ratio for Proper Troweling Consistency*—For each lot of cement to be tested, determine

the ratio by weight of water to be mixed with cement to obtain satisfactory troweling consistency. For tests to determine compliance with this specification, the water-cement ratio shall be that which gives the measured consistency of 20 to 30 % by the Deformation Method when determined in accordance with Practice C 405.

10. Test Methods

10.1 *Consistency*— Practice C 405.

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

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

10.4 *Compressive Strength*—Test Method C 354.

10.5 *Linear Shrinkage*— Test Method C 356.

10.6 *Apparent Thermal Conductivity*

10.6.1 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 1½ in. (38 mm).

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

10.6.1.2 Test Method C 1114 shall not be used at temperatures or resistance ranges other than those with comparable results to Test Method C 177.

10.6.2 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.

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

10.6.4 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.

10.6.5 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.

10.6.6 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 1—Caution: While it is recommended that the specification data be presented as thermal 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 thermal 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 thermal conductivity versus temperature relationship from Practice C 1045 and the specific hot and cold surface temperatures, is required to determine the effective thermal conductivity for comparison to the specification requirements.

10.6.7 Prepare the test specimens as follows:

10.6.7.1 Mold test specimens in a mold of suitable size and shape for the equipment to be used and 1½ in. (38 mm) in depth. The cement shall be mixed with water in accordance with Practice C 163. Place the mold in a horizontal position on a piece of glass 14 in. (360 mm) or 15 in. (380 mm) square, or slightly larger than the specimen required. Place the mixed cement in the mold, trowel the top surface of the cement smooth, and place a sheet of ordinary writing paper on top of the cement. Place a ⅛-in. (3-mm) thick steel plate 14 in. (360 mm) or 15 in. (380 mm) square, or slightly larger than the specimen required, having nine equally spaced holes ⅜ in. (5 mm) in diameter in the central area 10 in. (250 mm) in diameter, on top of the mold and use a pointed pin to puncture the paper immediately under the holes in the steel plate. Invert this entire assembly and remove the glass plate, trowel the surface of the cement smooth and flush with the top of the mold, and then carefully remove the mold. Place the perforated plate with the molded cement on an open shelf of an oven having a volume at least 50 times that of the specimens to be dried. The oven chamber shall be adequately vented in such a manner as to ensure complete circulation of the atmosphere of the entire oven chamber preferably by fan or other forced circulation method. The test specimens shall remain in the oven for at least 48 h at a temperature of 215°F (102°C) to 250°F (121°C). Upon removal from the oven, the surfaces of the specimens shall be made plane and parallel by cutting, sandpapering, or rubbing, or by a combination of these methods. The lateral dimensions of the specimens shall be governed by the size of the apparatus.

10.7 *Dry Adhesion to Steel*—Test Method C 353.

10.8 *Maximum Use Temperature*—Shall be tested after drying, using 10.6.7.1, a sample of material 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. The test surface shall be at the intended surface temperature when test begins. No special requirements for heat up shall be specified by the manufacturer.

10.9 *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 of this specification may be rejected. Rejection should be reported to the manufacturer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the manufacturer 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 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 insulating cement; mineral fiber; thermal insulation

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