



Standard Specification for Expanded or Exfoliated Vermiculite 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 expanded or exfoliated vermiculite thermal insulating material in the form of dry cement or plaster, intended to be mixed with a suitable proportion of water, applied as a plastic mass, and dried in place, for use as insulation on surfaces operating at temperatures between 100°F (38°C) and 1800°F (982°C). The cement shall not be used where it will be exposed to combustion conditions, such as the hot face lining of a furnace.

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 method portion, Section 10, 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.*

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. The manufacturer shall also recommend protective measures to be employed in the safe utilization of said products.

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

¹ This specification is under the jurisdiction of ASTM Committee C-16 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 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
- C 405 Practice for Estimating Consistency of Wet-Mixed Thermal Insulating Cement²
- C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus²
- C 1058 Practice for Selecting Temperatures for Reporting and Evaluating Thermal Properties of Thermal Insulation²

3. Terminology

3.1 Definitions:

3.2 Terminology C 168 shall be considered as applying to the terms used in this specification.

4. Materials and Manufacture

4.1 The cement shall be composed predominantly of expanded or exfoliated vermiculite, with a suitable proportion of heat-resistant binder. 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.

6. Qualification Requirements

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

6.1.1 Consistency,

TABLE 1 Other Requirements

Consistency	
Method A, %	35 to 45
Method B, in. (mm)	7 (178) to 9 (229)
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)	50 (26)
Volume change upon drying, max,%	20
Compressive strength, min, psi (kPa) at 5 % deformation	5 (34.5)
Linear shrinkage max % 24 h at 1800°F (980°C)	5
Apparent thermal conductivity, max, Btu-in./h-ft ² ·°F (W/m·K)	
At mean temperatures of:	
200°F (95°C)	0.95 (0.137)
500°F (260°C)	1.10 (0.159)
700°F (370°C)	1.20 (0.173)
Dry adhesion to steel, min, psi(kPa)	3.5 (24.2)

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.

7.1.1 Inspection Requirements:

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

7.1.1.2 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 Qualification Requirements:

7.1.2.1 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 7.1.2.1 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 The amount of water to be used in preparing samples for all tests shall be that amount which results in the specified consistency, 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*—Test Method C 177 or Test Method C 518, except prepare the test specimens as follows:

10.6.1 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. (356 mm) or 15 in. (381 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. (356 mm) or 15 in. (381 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. (254 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.

10.6.2 Temperature of test shall be in accordance with Practice C 1058.

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

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 between the purchaser and the manufacturer or supplier, the cement shall be packaged in the manufacturer's standard commercial containers.

15. Keywords

15.1 cement-thermal insulating; expanded/exfoliated vermiculite thermal insulating cement; sampling-thermal insulating-thermal insulating materials; thermal conductivity; thermal insulating materials-cement

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