



Designation: C516 – 19

Standard Specification for Vermiculite Loose Fill Thermal Insulation¹

This standard is issued under the fixed designation C516; 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.

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

1. Scope

1.1 This specification covers the composition and physical properties of expanded or exfoliated vermiculite loose-fill insulation. The specification also includes the testing procedures by which the acceptability of the material shall be determined. These testing procedures deal primarily with material performance in the temperature range associated with the thermal envelope of buildings; however, the commercially usable temperature range for this insulation is from -119 to 850°F (-84 to 454°C). Refer to manufacturer's instructions for specialized applications.

1.2 The specification also covers the composition and properties of vermiculite that has been surface-treated to produce water repellency for installations.

1.3 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.

1.4 The following applies to Test Method E84 and Test Method E136. This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products, or assemblies under actual fire conditions.

1.5 The following applies to Test Method E84 and Test Method E136. Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.

1.6 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.

1.7 The following safety hazards caveat pertains only to the test methods portion, Section 9, 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For specific hazard statements, see Section 12.

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C168 Terminology Relating to Thermal Insulation
- C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
- C390 Practice for Sampling and Acceptance of Thermal Insulation Lots
- C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- C520 Test Methods for Density of Granular Loose Fill Insulations
- E84 Test Method for Surface Burning Characteristics of Building Materials
- E136 Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C

¹ This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.23 on Blanket and Loose Fill Insulation.

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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.

3. Terminology

3.1 *Definitions*—Refer to Terminology C168 for definitions relating to insulation.

4. Classification

4.1 Vermiculite insulation is classified by type and grade designations, as follows:

4.1.1 *Type I*—Product that results from the expanding or exfoliating of natural vermiculite ore by grading and heating to meet the requirements of this specification.

4.1.2 *Type II*—Expanded vermiculite that has been surface-treated to produce water repellency and limit absorption of moisture from both liquid and vapor phase.

4.1.3 Grade designations established by range of particle size distribution and bulk density are shown in Table 1 and Table 2.

5. Ordering Information

5.1 All purchase orders shall identify both type and grade of insulation desired. If type designation is omitted, Type I will be furnished. Purchasers referencing this specification shall include the date of issue of the standard specification being referenced.

6. Materials and Manufacture

6.1 Vermiculite is a micaceous mineral which is mined and processed to produce a high-purity concentrate. The concentrate, in the form of flakes of varying size and thickness with approximate weight of 55 lb/ft³ (880 kg/m³), is expanded in high-temperature furnaces to produce densities in the range from 3.0 to 8.0 lb/ft³ (48 to 128 kg/m³). Vermiculite is a naturally occurring material and is able to be used as a building material. It shall comply with the criteria for noncombustible materials in accordance with Test Method E136.

7. Physical Requirements

7.1 The physical requirements listed in this section are defined as Inspection Requirements (see Practice C390, section 5.1.2). The insulation shall conform to the following requirements:

	Type I	Type II
Bulk density, lb/ft ³ (kg/m ³)	See Table 1	See Table 1
Grading (particle size)	See Table 2	See Table 2
Water properties, max g wicked in 5 min	N.A.	3 determined in accordance with 9.1.6

TABLE 1 Density Specifications

Grade Designation	Bulk Density, lb/ft ³ (kg/m ³)	
	min	max
0—Premium	3.0 (48)	5.0 (80)
1—Large	3.7 (59)	5.5 (88)
2—Medium	4.0 (64)	6.0 (96)
3—Fine	4.5 (72)	7.0 (112)
4—Super Fine	5.5 (88)	8.0 (128)

7.2 The physical properties listed in this section of the specification are defined as Qualification Requirements (see Practice C390, section 5.1.1). The insulation shall conform to the following requirements:

Thermal resistance, °F·h·ft ² /Btu (K·m ² /W)	See Table 3	
Moisture absorption, max, % by weight/14 days	3.5	3.5
Combustibility	No flaming, glowing, or smoking	
Surface-burning characteristics (Test Method E84):		
Flame spread, max	0	0
Smoke developed, max	0	0
Water properties, min, mL of water repelled	N.A.	175

8. Sampling

8.1 For purposes of standard tests, sampling shall be in accordance with Practice C390.

9. Test Methods

9.1 The physical properties, as listed in Section 7, shall be determined in accordance with the following methods:

9.1.1 *Bulk Density*—Test Methods C520, Method A.

9.1.2 *Grading*—Test Method C136, except that when a mechanical sieving device is used, the sieving time shall be 5 min and the test specimen shall be 0.11 lb (50 g) of material.

9.1.3 *Thermal Resistance*—Tests for thermal resistance shall be determined at design density in accordance with Test Methods C177 or C518. The thermal resistance of the various types shall not be lower than the values listed in Table 3. Determine the thermal resistance (*R*-value) at mean temperature 75°F (24°C) and 40°F (4°C). Report the direction of heat flow. Determine the thermal resistance at other mean temperatures when required.

9.1.4 *Water Vapor Sorption*—The test specimen shall be approximately 0.11 lb (50 g). Fill the insulation to be tested loosely in the 9 by 9 by 5 in. (228 by 228 by 127 mm) specimen holder and level.

9.1.4.1 Condition with minimum air movement across the test specimen surface. Condition at 50 ± 2 % relative humidity and 120 ± 5°F (48.9 ± 3°C) to constant weight and record. Record and report the density of the conditioned specimen.

9.1.4.2 Increase the relative humidity to 90 ± 2 % relative humidity and 120 ± 5°F (48.9 ± 3°C) for 14 days. Determine the weight gain after 14 days of exposure.

9.1.4.3 Calculate the percent weight gain after 14 days of exposure to the elevated humidity.

9.1.4.4 *Precision and Bias*—This test establishes a typical property of vermiculite. It is an inherent characteristic. It is intended to indicate absorption under high humidity conditions which are known to be characteristic of its usual end use.

9.1.5 *Water Repellency (Type II Only)*—Determine the water repellency of Type II vermiculite insulation in accordance with the following procedure:

9.1.5.1 *Apparatus*—(a) Rigid plastic tube with inside diameter 50 mm and length 300 mm with a 150-µm (100-mesh) screen covering firmly fastened or adhered to the bottom. The tube shall be marked at 400 mL from the screen-covered end. (b) No. 15 rubber stopper. (c) 250-mL graduated cylinder. (d) 500-mL beaker.