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Standard Specification for Vermiculite Loose Fill Thermal Insulation[1]

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

ε[1] NOTE—Keywords were added editorially in December 1996.

[1] This specification is under the jurisdiction of ASTM Committee C-16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.23 on Blanket and Loose Fill Insulation.

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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 may 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 − 459 from −119 to 1400°F (−272 to + 760°C). 850°F (−84 to 454°C). For specialized applications, refer to manufacturer's instructions.

1.2 The specification also covers the composition and properties of vermiculite that has been surface-treated to produce water repellency for installations where liquid moisture may be a factor.

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 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 and health practices and determine the applicability of regulatory limitations prior to use.* For specific hazard statements, see Section 12.

2. Referenced Documents

2.1 *ASTM Standards:*

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates[2]

C 168 Terminology Relating to Thermal Insulating Materials Insulation[3]

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus[3]

C 390 Criteria 390 Practice for Sampling and Acceptance of Preformed Thermal Insulation Lots[3]

C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus[3]

C 520 Test Methods for Density of Granular Loose Fill Insulations[3]

E 84 Test Method for Surface Burning Characteristics of Building Materials[4]

E 136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C[4]

3. Terminology

3.1 The terms used in this specification are defined in Terminology C 168.

4. Classification

4.1 Vermiculite insulation shall be specified by two type designations and five classes, as follows:

[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.06.

[4] *Annual Book of ASTM Standards*, Vol 04.07.

4.1.1 *Vermiculite Loose Fill Insulation—Type I*—The 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 *Vermiculite Loose Fill Insulation—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 Vermiculite loose fill insulation has five grade designations established by range of particle size distribution as shown in Table 1.

5. Ordering Information

5.1 All purchase orders should designate both type and grade of insulation desired. If type designation is omitted, Type I will be furnished. The type and grade classifications in this specification differ from the classifications in earlier issues. Purchasers referencing this specification should include the date of issue.

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 weighing 55 lb/ft^3(880 kg/m^3), is expanded in high-temperature furnaces to densities in the range from 3.0 to 8.0 lb/ft^3 (148 to 128 kg/m^3). As a naturally occurring mineral, it is classifiable as an elementary building material. It is noncombustible as determined by Test Method E 136. Material must pass combustion test criteria of Test Method E 136.

7. Physical Requirements

7.1 The physical requirements listed in this section are defined as Inspection Requirements (see ~~Criteria~~ Practice C 390, 5.1.2; see also Terminology C 168). The insulation shall conform to the following requirements:

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

7.2 The physical properties listed in this section of the specification are defined as Qualification Requirements (see ~~Criteria~~ Practice C 390, 5.1.1). The insulation shall conform to the following requirements:

Thermal resistance, °F·h·ft^2/Btu (K·m^2/W)		See Table 2	
Moisture absorption, max, % by weight/ 14 days	3.5		3.5
Combustibility		No flaming, glowing, or smoking	
Surface-burning characteristics (Test Method E 84):			
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 ~~Criteria~~ Practice C 390.

9. Test Methods

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

9.1.1 *Bulk Density*—Test Methods C 520, Method A.

9.1.2 *Grading*—Test Method C 136, except that when a mechanical sieving device is used, the sieving time shall be 5 min and the test specimen shall be 50 g of material.

9.1.3 *Thermal Resistance*—Tests for thermal resistance may be made in accordance with Test Methods C 177 or C 518. Test at the design density. The thermal resistance of the various types shall not be lower than the values listed in Table 2, except that the average thermal resistance of any four specimens may fall up to 5 % below the value in the table. Determine the thermal

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)

TABLE 2 Nominal Thermal Resistance Values

Grade Designation		Thermal Resistance[A] for 1 in. (25.4 mm) Thickness °F·h·ft²/Btu				
−119 (−84)	40(4°C)	75 (0–Premium	1–Large	2–Medium	3–Fine	4)–Super Fine
0—Premium		...	...	2...	...	3 (0.41)
–119	(–84)	...	...	...	...	3.4 (0.59)
1—Large		...	...	2...	...	3 (0.41)
–58	(–50)	...	...	...	...	3.0 (0.52)
2—Medium		...	...	...	...	2.3 (0.41)
–13	(–25)	...	...	...	...	2.7 (0.48)
3—Fine	(24)	2.3 (0.40)	2.3 (0.40)	2.3 (0.40)	2.3 (0.40)	2.3 (0.40)
75	(24)	2.3 (0.40)	2.3 (0.40)	2.3 (0.40)	2.3 (0.40)	2.3 (0.40)
212	(100)	...	...	2.3..	...	1.8 (0.41)
212	(100)	...	...	...	...	1.8 (0.32)
4—Super Fine	3.4(0.58)	2.5 (0.43)	...	...	...	1.6 (0.28)
302	(150)	...	...	...	...	1.6 (0.28)
392	(200)	...	...	...	...	1.4 (0.25)
482	(250)	...	...	...	...	1.2 (0.22)
572	(300)	...	...	...	...	1.1 (0.19)
662	(350)	...	...	...	...	0.9417)
662	(350)	...	...	...	...	0.94 (0.17)
752	(400)	...	...	...	...	0.84 (0.15)
850	(454)	...	...	...	...	0.73 (0.13)

[A] The thermal values in this table are given at 1 in. (25.4 mm) of thickness with a gradient of 50°F (28°C). Test data that cover the thickness range from 1 to 6 in. show that thermal resistance per inch of thickness is essentially linear with respect to thickness. Test values do not deviate on the low side from the value in the table by more than 5 %.

TABLE 3 Grading Cumulative Percent Retained

Grade Designation	U. S. Sieve No.						
	⅜ in. (9.5 mm)	4 (4.75 mm)	8 (2.36 mm)	16 (1.18 mm)	30 (600 µm)	50 (300 µm)	100 (150 µm)
0—Premium	30–80		80–100				
1—Large	0–10			90–100			
2—Medium		0–10	45–90		95–100		
3—Fine			0–10		90–100		
4—Super Fine				0–5		60–98	90–100

resistance (*R*-value) at mean temperature of 75°F (24°C) and 40°F (4°C), at design density and in accordance with the current editions of Test Methods C 177 or C 518. Report the direction of heat flow. Thermal resistance at other mean temperatures may be determined if required.

9.1.4 *Moisture Absorption*—The test specimen shall be a sample of approximately 50 g. Loose fill the sample and level into a sample holder 9 by 9 by 5 in. (228 by 228 by 127 mm) deep.

9.1.4.1 Condition with minimum air movement across the sample surface. Condition at 50 ± 2 % relative humidity and 120°F (48.9°C) to constant weight and record. State the density of the sample conditioned to constant weight in the report of results.

9.1.4.2 Increase the relative humidity to 90 ± 2 %. Condition to constant weight by check-weighing at 24-h intervals. Determine the moisture pickup as a percent of conditioned weight.

9.1.4.3 Record percent absorption at 14 days.

9.1.4.4 *Precision and Bias*—This test establishes a typical property of vermiculite. It is an inherent characteristic. It is only intended to indicate absorption under high humidity conditions which are known to be characteristic of its usual insulation 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 50 mm inside diameter by 300 mm long 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.

9.1.5.2 *Sample Preparation*—Spoon a representative sample into the test cylinder to a level slightly above the 400-mL mark. Compact it by dropping the tube from a height of approximately 75 mm on a large rubber stopper (No. 15 recommended) for a total of ten drops. As the sample compacts to a level below the 400-mL mark, add additional material so that after the tenth drop, the level of the sample is within 3 mL of the 400-mL mark.

9.1.5.3 *Procedure*—With the tube supported in a vertical position and a beaker positioned under the tube, rapidly pour 250 mL of cold tap water onto the vermiculite. Take care while pouring, that the stream hits the middle of the surface of the bed of vermiculite and does not merely slide down the side of the test cylinder. Allow the water to drain through the bed of vermiculite for exactly 3 min. Tilt the tube at approximately 45° to drain water collected on the screen. Tilt it only momentarily for this purpose. Measure the collected water in the 250-mL graduate.

9.1.5.4 *Calculation*—Report the amount of collected water as "millilitres repelled." Report results as the mean of three independent tests.

9.1.5.5 *Precision and Bias*—The purpose of this test is to confirm that the intended degree of surface treatment has been accomplished to achieve water repellency. The specified characteristic is a minimum (no range or maximum). Quantitative values for conforming products exceeding the limits have no commercial significance.

9.1.6 *Wickability—Vermiculite Insulation (Type II Only)*:

9.1.6.1 *Apparatus*—(*a*) Rigid plastic tube 50 mm in inside diameter by 300 mm long with a 150-µm (100-mesh) screen covering firmly fastened or adhered to the bottom. (*b*) 50-mm long compaction plug, fitting snugly inside the sample holder to give standard compaction to the sample. (*c*) Tubing rack capable of supporting the sample tube. (*d*) Water immersion tray.

9.1.6.2 *Sample Preparation*—Spoon a representative sample into the test cylinder to a level slightly below the top of the cylinder. Compact it with the plug until a moderate resistance pressure is felt. In no event shall compaction be more than 24 mm.

9.1.6.3 *Procedure*—Place the sample tube, screen end down, on a rack in the water immersion tray. The water level in the tray shall be 50 mm above the bottom of the tube. Allow the sample to remain in the position and allow to wick water for 5 min. Remove the tube from the tray onto a tared 75-mm watch glass so that all water that is allowed to drain, is caught by the watch glass and is included in the weight of water picked up by the sample. Determine the weight of the water picked up by the sample in grams.

9.1.6.4 *Calculation*—Report the amount of water picked up by the vermiculite sample through this wicking action as grams. Report results as a mean of three independent tests.

9.1.6.5 *Precision and Bias*—See 9.1.5.5.

10. Inspection

10.1 Inspection of the materials shall be made as agreed upon between the purchaser and the manufacturer as part of the purchase contract.

11. Packaging and Marking

11.1 *Packaging*—Unless otherwise specified, the insulation shall be packed in the manufacturer's standard commercial container. The insulation shall be packed to ensure carrier acceptance and safe delivery at destination in containers complying with the rules and regulations applicable to the mode of transportation.

11.2 *Marking*—Shipping containers shall be marked with the name of the insulation, minimum weight of container, and the name of the manufacturer. For residential insulation, a chart shall also be affixed or printed on the container listing the minimum thickness, maximum net coverage area, and minimum weight per square foot at *R* values of 11, 19, and 22. In addition to this chart, the following statements must be added: 1. "*R* means resistance to heat flow. The higher the *R*-value, the greater the insulation power. 2. To get the marked *R*-value, it is essential that this insulation be installed properly. If you do it yourself, follow the instructions carefully."

12. Health and Safety Precautions

12.1 *Preinstallation*—The insulation material should be handled and stored in accordance with manufacturer's instructions. It should be kept dry and free of extraneous materials. It is noncombustible.

12.2 *Installation*:

12.2.1 The insulating material should be poured into the spaces and cavities to be insulated in a manner that minimizes free-fall and impact. This will minimize crushing and breakdown of insulation particles and the unnecessary formation of dust.

12.2.2 Pourable loose fill insulation, which is commonly installed in confined, poorly ventilated attic spaces, may generate a buildup of airborne dust. Inhalation of dust can be injurious to health. Refer to manufacturer's instructions regarding recommended installation practices.

13. Keywords

13.1 loose fill; thermal insulation; thermal resistance; vermiculite; water repellency