



# Standard Specification for Perlite Loose Fill Insulation<sup>1</sup>

This standard is issued under the fixed designation C 549; 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.

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

## 1. Scope

1.1 This specification covers the composition and physical properties of expanded perlite loose fill insulation. The specification also includes the testing procedures by which the acceptability of the material is 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  $-459$  to  $1400^{\circ}\text{F}$  ( $1$  to  $1033$  K). For specialized applications, refer to the manufacturer's instructions.

1.2 The specification also covers the composition and properties of perlite that has been surface-treated to produce dust suppression for installations where dust is a factor.

1.3 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.

1.4 *When the installation or use of thermal insulation materials, accessories and systems, may pose safety or health problems, the manufacturer shall provide the user 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.* For additional precautionary statements, see Section 12.

1.5 *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.*

<sup>1</sup> 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. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

**C 136** Test Method for Sieve Analysis of Fine and Coarse Aggregates

**C 168** Terminology Relating to Thermal Insulation

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

**C 390** Practice for Sampling and Acceptance of Thermal Insulation Lots

**C 518** Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

**C 520** Test Methods for Density of Granular Loose Fill Insulations

**E 84** Test Method for Surface Burning Characteristics of Building Materials

**E 136** Test Method for Behavior of Materials in a Vertical Tube Furnace at  $750^{\circ}\text{C}$

**E 177** Practice for Use of the Terms Precision and Bias in ASTM Test Methods

## 3. Terminology

3.1 Terms used in this specification are defined in Terminology **C 168**.

## 4. Classification

4.1 Perlite loose fill insulation shall conform to the physical requirements of 7. Expanded perlite that has been treated to limit the amount of dust generated during application shall be identified on the product label.

## 5. Ordering Information

5.1 All purchase orders shall designate the density of insulation desired or require conformance with the properties

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

in 7.1. The purchase order shall designate surface-treated product when desired.

## 6. Materials and Manufacture

6.1 Perlite is a generic term for a naturally occurring siliceous mineral which is mined, crushed, sieved and dried to produce a crude perlite ore. The crude ore, in the form of particles of varying size, weighing 60 to 75 lb/ft<sup>3</sup> (960 to 1200 kg/m<sup>3</sup>), is expanded in high-temperature furnaces to densities in the range from 2.0 to 11.0 lb/ft<sup>3</sup> (32 to 176 kg/m<sup>3</sup>). As a naturally occurring mineral, it is classified as an elementary building material. It is noncombustible as determined by Test Method E 136.

## 7. Physical Requirements Physical Requirements

7.1 The physical requirements listed in this section are defined as inspection requirements (see Criteria C 390). The insulation shall conform to the following requirements:

Bulk density, lb/ft <sup>3</sup> (kg/m <sup>3</sup> )	2–11 (32–176)
Grading (particle size):	
Percentage retained, maximum (by weight), Sieve No. 4 (4.75 mm), %	5
Small-scale fire test	no sparking or ignition

7.2 The physical requirements listed in this section are defined as Qualification Requirements (see Criteria C 390). The insulation shall conform to the following requirements:

Thermal resistance, h-ft <sup>2</sup> ·°F/Btu (m <sup>2</sup> ·K/W)	See Table 1
Moisture absorption, weight %/14 days, max, %	1.0

Combustibility (by Test Method E 136)	noncombustible
Surface burning characteristics:	
Flame spread, max	0 25
Smoke developed, max	0 50
Dust suppression: (for surface treated product)	
Weight of collected material, max, mg	85

## 8. Sampling

8.1 For purposes of standard tests, sampling shall be in accordance with Criteria C 390.

## 9. Test Methods

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

9.2 *Grading*—Test Method C 136, except that when a mechanical sieving device is used, the sieving time shall be 5 min and the test sample shall be 0.11 ± 0.02 lb (50 ± 9g) of material.

9.3 *Small-Scale Fire Test*:

9.3.1 *Scope*—The purpose of this quality control test is to confirm that excessive coating or organic material has not been added during processing.

9.3.2 *Significance*—This specification measures and describes the response of materials, products, or assemblies to heat and flame under controlled condition, but does not by itself incorporate all factors required for fire risk assessment of materials, products or assemblies under actual conditions.

9.3.3 *Procedure*—Hold a 0.02 to 0.03 lb (9 to 14g) specimen of the perlite insulation in a suitable fixture (such as 6 by 6 by 2-in. (152 by 152 by 51-mm) deep wire mesh basket

constructed from 100-mesh (150 μm) stainless steel woven wire cloth) and positioned in direct contact with the flame of a Bunsen burner for about 20 s. Sparking or ignition indicates failure to conform to the requirements of 7.1

9.3.4 *Precision and Bias*—No statement is made about either the precision or the accuracy of the small-scale fire test for determining resistance of the perlite insulation to heat and flame since the result merely states whether there is conformance to the criteria for success specified in the procedure.

9.4 *Thermal Resistance*—Tests of thermal resistance shall be determined in accordance with Test Method C 177 or C 518. Testing shall be done at the design density and representative thickness. The arithmetic average thermal resistance of four specimens shall exceed 95% the value in Table 1. The thermal resistance (*R*-value) shall be determined at mean temperature of 75 ± 1°F (24 ± 0.5°C) and a temperature difference of 40°F (22°C). Report the direction of heat flow. Thermal resistance at other mean temperatures may be determined if required.

9.5 *Moisture Absorption*—The test specimen shall be 0.11 ± 0.05 lb (50 ± 23 g) of product. Fill and level the product into a specimen holder 9 by 9 by 5 ± 0.1 in. (228 by 228 by 127 ± 3 mm) deep.

9.5.1 Precondition in accordance with Test Method C 177 or C 518. Conditioning shall be with minimum air movement across the specimen surface. Condition at 50 ± 2 % relative humidity and 120 ± 2°F (49 ± 1°C) to constant weight and record. State the density of the specimen conditioned to constant weight in the report of results.

9.5.2 Increase the relative humidity to 90 ± 2 %. Condition to constant weight by weighing at 24-h intervals. Determine the moisture pickup as a percent of conditioned weight determined in 9.5.1 at 50 ± 2% relative humidity and 120 ± 2°F (49 ± 1°C).

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

9.6 *Surface Burning Characteristics* of perlite insulation shall be determined in accordance with Test Method E 84 at a thickness that is representative of end use with a material artificially supported in the test apparatus. Perlite with surface treatment to suppress dust shall be tested using Test Method E 136 to demonstrate non-combustibility.

9.7 *Dust Suppression*:

9.7.1 *Apparatus*:

9.7.1.1 *Glass Plate*, 16½ by 16½ by ¼ in. (420 by 420 by 6.4 mm).

9.7.1.2 *Clear Methacrylate Sheet Box*, open bottom, 15½ by 15½ by 19⅝ in. (390 by 390 by 500 ± 3 mm) high with a hole in the center of the top 2⅛ in. (52.4 mm) in diameter.

9.7.1.3 *Plastic Tube*, 2 ± 0.1 in. outside diameter by 1.8 ± 0.1 in. inside diameter (50 by 45 ± 3 mm), 17.75 ± 0.25 in. (450 ± 6 mm) long, with a rubber washer such that the washer snugly fits the outside diameter of the plastic tube and has a larger outside diameter than the hole in the box.

9.7.1.4 *Beaker*, 2000-mL.

**TABLE 1 Thermal Resistance**

Thermal Resistance for 1 in. (0.0254m) Thickness, h-ft <sup>2</sup> ·°F/Btu (m <sup>2</sup> ·K/W)			
Mean Temp	Density <sup>A</sup>	Low Temperature Applications	
°F (°C)		4.1-7.4 (66-118)	7.4-11 (118-176)
-300 (-184)	9.1–7.7 (1.6-1.4)	7.7-6.3 (1.4-1.1)	6.3–5.2 (1.1–0.92)
-200 (-129)	6.5-5.7 (1.1–1.0)	5.7–4.8 (1.0–0.85)	4.8–4.0 (0.85–0.70)
-100 (-73)	5.1–4.5 (0.90–0.79)	4.5–3.8 (0.79–0.67)	3.8–3.3 (0.67–0.58)
0 (-18)	4.2–3.7 (0.74–0.65)	3.7–3.2 (0.65–0.56)	3.2–2.8 (0.56–0.49)
40 (4)	3.9-3.5 (0.69–0.62)	3.5-3.0 (0.62–0.53)	3.0–2.6 (0.53–0.46)
75 (24)	3.7–3.3 (0.65–0.58)	3.3–2.8 (0.58–0.49)	2.8–2.5 (0.49–0.44)
100 (38)	3.6–3.2 (0.63–0.56)	3.2–2.8 (0.56–0.49)	2.8–2.4 (0.49–0.42)
High Temperature Applications			
	3 (48)	8 (128)	11 (176)
200 (93)	2.5 (0.44)	3.0 (0.53)	2.3 (0.41)
300 (149)	1.9 (0.33)	2.5 (0.44)	2.0 (0.35)
400 (204)	1.6 (0.28)	2.1 (0.37)	1.8 (0.32)
500 (260)	1.3 (0.23)	1.9 (0.33)	1.5 (0.26)
600 (316)	1.1 (0.19)	1.6 (0.28)	1.3 (0.23)
700 (371)	0.96 (0.17)	1.4 (0.25)	1.2 (0.21)
800 (427)	0.84 (0.15)	1.2 (0.21)	1.0 (0.18)
1000 (538)	0.65 (0.11)	0.96 (0.17)	0.81 (0.14)
1200 (649)	0.52 (0.092)	0.76 (0.13)	0.63 (0.11)
1400 (760)	0.42 (0.074)	0.60 (0.11)	0.49 (0.086)

<sup>A</sup>lb/ft<sup>3</sup> (kg/m<sup>3</sup>)

9.7.1.5 *Laboratory Funnel* with a minimum nozzle inside diameter of 1 in. (25.4 mm).

9.7.1.6 *Graduated Cylinder*, 1000-mL.

9.7.1.7 *Small Brush*.

9.7.1.8 *Scale* capable of measuring mass to within 0.000002 lb (0.001 g).

9.7.2 *Specimen Preparation*—Spoon a representative specimen of the product into the graduated cylinder to the 1000-mL level.

9.7.3 *Procedure*:

9.7.3.1 Place the glass plate flat on a suitable work surface.

9.7.3.2 Place the 2000-mL beaker in the exact center of the glass plate.

9.7.3.3 Place the plastic box on the glass plate such that the box is centered on the plate and hole in top of the box is centered directly over the 2000-mL beaker.

9.7.3.4 Insert the plastic pipe into the hole in the top of the box such that it protrudes down into the box such that the clear vertical distance from the bottom of the tube to the top of the 2000-mL beaker is 1<sup>3</sup>/<sub>16</sub> in. (21 mm). The tube is supported in the vertical position by the rubber washer.

9.7.3.5 Place the laboratory funnel into the plastic tube.

9.7.3.6 Pour 1000 mL of test material into the funnel such that it empties of all material in 10 s. It is the intent to have a uniform stream of material falling into the box for 10 s.

9.7.3.7 After all visible material has settled onto the glass plate, carefully remove the plastic box and gently sweep the material that has collected on the glass plate into a pile, remove it, and determine its weight.

9.7.4 *Calculations*:

9.7.4.1 Report the amount of test material in milligrams as “milligrams collected.”

9.7.4.2 Report results as the average of five or more independent tests with no single reading over 0.00022 lb (100 mg) with separate samples taken from the same source.

9.7.5 *Precision and Bias*—The single-specimen, single-operator, single-day precision is a standard deviation of  $4.4 \times 10^{-5}$  lb (0.02 g) for the dust-suppressed material over a range from  $2.2 \times 10^{-5}$  to  $1.8 \times 10^{-4}$  (0.01 to 0.08 g) as defined in Practice E 177.

## 10. Inspection

10.1 Inspection of the materials shall be made as agreed upon by 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.

## 12. Health and Safety Precautions

12.1 *Preinstallation*—Handle and store in accordance with manufacturer’s instructions. Keep it dry and free of extraneous materials.

12.2 *Installation*:

12.2.1 Pour the insulating material 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 unnecessary formation of dust.

12.2.2 Refer to the manufacturer’s instructions regarding recommended installation practices concerning the use of respiratory and eye protection.

### 13. Keywords

13.1 dust suppression; inorganic insulation; loose fill; perlite; thermal insulation

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