

HH-I-1751/3A  
 October 10, 1973  
 SUPERSEDING  
 HH-I-1751/3  
 August 2, 1973

## FEDERAL SPECIFICATION

### INSULATION SLEEVING, THERMAL, PIPE COVERING (CELLULAR GLASS)

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

#### 1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers cellular boro-silica glass thermal insulation sleeving used for special purposes.

#### 1.2 Classification.

1.2.1 Types and classes. Cellularglass thermal insulation sleeving shall be furnished in the following types and classes, as specified (see 6.2):

Type I - Pipe and tubing insulation.

- Class 1 - Regular (uncovered).
- 2 - Aluminum jacketed.
- 3 - Glass fabric wrapped.
- 4 - Vinyl-aluminum foil jacketed.

Type II - Special shapes.

1.3 The complete requirements for procuring thermal insulation sleeving described herein shall consist of this document and the latest issue of specification HH-I-1751/GEN and documents referenced therein.

#### 2. APPLICABLE DOCUMENTS

2.1 The latest issue of Federal Specification HH-I-1751/GEN and documents referenced therein.

##### Federal Specification:

HH-C-466 - Cloth, Glass (For Membrane Waterproofing and Built-Up Roofing).

##### Military Specification:

MIL-A-148 - Aluminum Foil.

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

##### American Society for Testing and Materials (ASTM) Standards:

- C 240 - Testing Cellular Glass Insulation Block.
- C 303 - Method of Test for Density of Preformed Block-Type Thermal Insulation.
- C 355 - Test for Water Vapor Transmission of Thick Materials.
- C 552 - Specification for Cellular Glass Block and Pipe Thermal Insulation.
- E 96 - Test for Water Vapor Transmission of Materials in Sheet Form.

(Applications for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

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## 3. REQUIREMENTS

3.1 Type I and II.

3.1.1 Material. The basic material shall consist of a glass composition that has been foamed or cellulated under molten conditions, annealed, and set to form a rigid material with sealed cells, and unless otherwise specified shall meet the requirements of ASTM C 552, except for Quality Assurance, packing, marking and packaging requirements.

3.1.2 Thermal conductivity. When tested in accordance with 4.4.1 of HH-I-1751/GEN the sleeving K factors shall be in accordance with table I.

TABLE I. Thermal conductivity	
Max., BTU-In/Hr. Sq. Ft. °F. (Mean Temperature)	Types I and II (K)
0	0.375
50	.40
75	.415
100	.43
200	.51
300	.60
400	.70

3.1.3 Fire hazard classification. When tested in accordance with 4.4.2 of HH-I-1751/GEN the insulation sleeving shall have a flame spread rating not greater than 25. The smoke developed rating shall not be greater than 50.

3.1.4 Compressive strength. When tested in accordance with 4.4.1 of this specification, the thermal insulation sleeving compressive strength shall withstand 75 pounds per square inch.

3.1.5 Density. When tested in accordance with 4.4.2 of this specification the density shall not be less than 7.0 pounds and not more than 9.5 pounds per cubic foot.

3.1.6 Flexural strength. When tested in accordance with 4.4.3 of this specification, the material shall have a minimum flexural strength (modulus of rupture) of 60 pounds per square inch.

3.1.7 Water absorption. When tested in accordance with 4.4.4 of this specification, the volume of water absorbed as a result of increase in weight, shall not exceed 0.5 percent by volume.

3.1.8 Water-vapor transmission. When tested in accordance with 4.4.5 of this specification, the water-vapor permeability shall not exceed 0.005 grains per square foot per hour per inch of mercury (Hg) per inch of thickness at 30°F.

3.1.9 Dimensional tolerances. Dimensional tolerances for length, width, and thickness of materials furnished under this specification shall be  $\pm 1/8$  inch.

3.2 Type I, pipe and tubing insulation. Pipe and tubing insulation shall conform to table II, III, or IV, as applicable. Pipe insulation shall be of class 1, 2, 3, or 4, as specified (see 6.2). Tubing insulation shall be either class 1 or class 4, as specified. Each insulation section or segment shall be true to shape and roundness, with square edges and ends. Unless otherwise specified (see 6.2), the bands and strans are not required.

3.2.1 Class 1, uncovered. Uncovered pipe insulation shall be furnished in 18-inch or 24-inch lengths and in either half section or segmental form, as specified under the notes of table II. Uncovered tubing insulation shall be furnished in 18-inch or 24-inch lengths in half sections for copper tubing sizes, as specified under the notes of table II and table III.

3.2.2 Class 2, aluminum jacketed. The aluminum jacket shall be 4 mils thick, alloy 1145-0 (annealed) dry aluminum foil applied to the insulation with hot asphalt. The aluminum foil shall conform to MIL-A-148. Sizes, thicknesses, and lengths of aluminum jacketed pipe insulation shall be furnished as specified under the notes of table II and table III.

3.2.3 Class 3, glass-fabric wrapped. The glass-fabric wrap shall be 20 by 20 glass-fiber mesh material conforming to MIL-C-466. This mesh shall be applied to the insulation with hot asphalt. Sizes and lengths of the glass-fabric wrapped pipe insulation shall be furnished, as specified under the notes of table II and table III.

3.2.4 Class 4, vinyl aluminum-foil jacketed. The kraft-paper aluminum-foil jacketed pipe and tubing insulation shall be factory assembled in sections. Jacket material shall be aluminum-foil laminated fire-resistant kraft paper. The aluminum foil shall be not less than 0.35 mils (0.00035 inch) thick and the kraft paper shall have a basic weight of not less than 10 pounds per 1,000 square feet. The water-vapor transmission of the jacket material shall not exceed 0.01 perms when tested as specified in 4.4.6.1. Sizes shall be furnished as specified under the notes of table IV.

TABLE II. Outside diameter of type I., class 1, 2, and 3, cellular glass pipe tubing insulation

Pipe Sizes	Nom. 1"	Nom. 1 1/2"	Nom. 2"	Nom. 2 1/2"	Nom. 3"	Nom. 3 1/2"	Nom. 4"
Nom. O.D.	O.D. of covering	O.D. of covering	O.D. of covering	O.D. of covering	O.D. of covering	O.D. of covering	O.D. of covering
1/4"	5.40	2.88	3.50	4.50	5.56	6.63	7.63
3/8"	5.75	2.88	4.00	5.00	5.56	6.63	7.63
1/2"	5.90	2.88	4.00	5.00	5.56	6.63	7.63
3/4"	1.050	2.38	4.00	5.00	5.56	6.63	8.63
1"	1.315	3.50	4.50	5.56	6.63	7.63	8.63
1 1/4"	1.660	3.50	4.50	5.56	6.63	7.63	8.63
1 1/2"	1.900	4.00	5.00	5.56	6.63	7.63	8.63
2"	2.375	4.50	5.56	6.63	7.63	8.63	9.63
2 1/2"	2.875	5.00	5.56	6.63	7.63	8.63	9.63
3"	3.500	5.56	6.63	7.63	8.63	9.63	10.75
3 1/2"	4.000	6.63	7.63	8.63	9.63	10.75	11.75
4"	4.500	6.63	7.63	8.63	9.63	10.75	11.75
4 1/2"	5.000	7.63	8.63	9.63	10.75	11.75	12.75
5"	5.563	7.63	8.63	9.63	10.75	11.75	12.75
6"	6.625	8.63	9.63	10.75	11.75	12.75	14.00
7"	7.625	9.63	10.75	11.75	12.75	14.00	15.00
8"	8.625	10.75	11.75	12.75	14.00	15.00	16.00
9"	9.625	11.75	12.75	14.00	15.00	16.00	17.00
10"	10.750	12.75	14.00	15.00	16.00	17.00	18.00
11"	11.750	14.00	15.00	16.00	17.00	18.00	19.00
12"	12.750	15.00	16.00	17.00	18.00	19.00	20.00
14"	14.000	16.00	17.00	18.00	19.00	20.00	21.00
15"	15.000	17.00	18.00	19.00	20.00	21.00	22.00
16"	16.000	18.00	19.00	20.00	21.00	22.00	23.00
17"	17.000	19.00	20.00	21.00	22.00	23.00	24.00
18"	18.000	20.00	21.00	22.00	23.00	24.00	25.00
19"	19.000	21.00	22.00	23.00	24.00	25.00	26.00
20"	20.000	22.00	23.00	24.00	25.00	26.00	27.00
21"	21.000	23.00	24.00	25.00	26.00	27.00	28.00
22"	22.000	24.00	25.00	26.00	27.00	28.00	29.00
23"	23.000	25.00	26.00	27.00	28.00	29.00	30.00
24"	24.000	26.00	27.00	28.00	29.00	30.00	31.00
		27.00	28.00	29.00	30.00	31.00	32.00

Notes: All types of pipe insulation in sizes and thicknesses listed above the dashed line are furnished in 24-inch lengths; all listed below the dashed line are furnished in 18-inch lengths. Uncovered pipe insulation in sizes and thicknesses listed above the solid line are furnished in half-section form; all listed below the solid line are furnished in segmental form. Aluminum jacketed and glass fabric finish-wrapped insulation are furnished only in sizes and thicknesses listed above the solid line.

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TABLE III. Outside diameter of type I, class 1, 2, and 3, cellular glass pipe tubing insulation

Nom. tube size	Copper Tubing Sizes							
	Tube O.D.	1" Nom. O.D.	1 1/2" Nom. O.D.	2" Nom. O.D.	2 1/2" Nom. O.D.	3" Nom. O.D.	3 1/2" Nom. O.D.	4" Nom. O.D.
1/2"	.63	2.83	3.50	4.50	5.56	6.63	7.63	8.63
5/8"	.75	2.83	4.00	5.00	5.56	7.63	8.63	9.63
3/4"	.88	2.88	4.00	5.00	6.63	7.63	8.63	9.63
1"	1.13	2.88	4.00	5.00	6.63	7.63	8.63	9.63
1 1/4"	1.38	3.50	4.50	5.56	6.63	7.63	8.63	9.63
1 1/2"	1.63	3.50	4.50	5.56	6.63	7.63	8.63	9.63
2"	2.13	4.00	5.00	5.63	7.63	8.63	9.63	10.75
2 1/2"	2.63	4.50	5.56	6.63	7.63	8.63	9.63	10.75
3"	3.13	5.00	6.63	7.63	8.63	9.63	10.75	11.75
3 1/2"	3.63	5.56	6.63	7.63	8.63	9.63	10.75	11.75
4"	4.13	6.63	7.63	8.63	9.63	10.75	11.75	12.75
5"	5.13	7.63	8.63	9.63	10.75	11.75	12.75	14.00
6"	6.13	8.63	9.63	10.75	11.75	12.75	14.00	15.00

Notes: All types of tube insulation in size and thicknesses listed above the dashed line are furnished in 24-inch lengths, all listed below the dashed line are furnished in 18-inch lengths.

TABLE IV. Outside diameter of type I, class 4, cellular pipe and tubing insulation

Iron pipe				Copper tubing			
Nom. pipe size (inch)	Pipe O.D.	Nominal thickness		Nom. tube size (inch)	Tube O.D.	Nominal thickness	
		1"	1 1/2"			1"	1 1/2"
1/2	.84	2.88	4.00	1/2	.63	2.83	3.50
3/4	1.05	2.88	4.00	5/8	.75	2.88	4.00
1	1.32	3.50	4.50	3/4	.88	2.88	4.00
1 1/4	1.66	3.50	4.50	1	1.13	2.88	4.00
1 1/2	1.90	4.00	5.00	1 1/4	1.38	3.50	4.50
2	2.38	4.50	5.56	1 1/2	1.63	3.50	4.50
2 1/2	2.88	5.00	5.56	2	2.13	4.00	5.00
3	3.50	5.56	6.63	2 1/2	2.63	4.50	5.56
3 1/2	4.00	6.63	7.63	3	3.13	5.00	6.63
4	4.50	6.63	7.63	3 1/2	3.63	5.56	6.63
4 1/2	5.00	7.63	8.63	4	4.13	6.63	7.63
5	5.56	7.63	8.63	5	5.13	7.63	8.63
6	6.63	8.63	9.63	6	6.13	8.63	9.63
8	8.625	--	11.75				
10	10.750	--	14.00				
12	12.750	--	16.00				

Notes: Insulation for pipe and tubing up to and including 6-inch nominal size shall be furnished in 24-inch lengths. Insulation for pipe above 6-inch nominal size shall be furnished in 18-inch lengths.

3.3 Type II, special shapes. Special shapes are segments of insulation cut to fit cylindrical surfaces, dished or spherical shaped heads, or other odd shaped surfaces. Full details of the special shapes shall be set forth in the contract or order (see 6.2 and 6.3).

3.4 Workmanship. Insulation shall not have visual defects that adversely affect its serviceability.

#### 4. QUALITY ASSURANCE PROVISIONS.

4.1 The applicable Quality Assurance Provisions of Federal Specification HH-I-1751/GEN and the documents therein, shall apply with the following additional requirements.

##### 4.2 Sampling.

4.2.1 In accordance with 4.2.1 of HH-I-1751/GEN, unless otherwise specified (see 6.2).

##### 4.3 Examination.

4.3.2 Inspection of preparation for delivery. An inspection shall be made to determine that the packaging, packing, and marking requirements comply with section 5. Defects shall be scored in accordance with table II of HH-I-1751/GEN.

##### 4.4 Test Methods.

4.4.1 Compressive strength. Determination of the compressive strength shall be in accordance with ASTM C 240, (see 3.1.1).

4.4.2 Density. Determination of the density shall be in accordance with ASTM C 303, (see 3.1.5).

4.4.3 Flexural strength. Determination of the flexural strength shall be in accordance with ASTM C 240, (see 3.1.6).

4.4.4 Water absorption. Water absorption shall be in accordance with ASTM C 240 (see 3.1.7).

4.4.5 Water-vapor transmission. Determination of the water-vapor transmission shall be in accordance with ASTM C 355, (see 3.1.8).

##### 4.4.6 Vinyl aluminum-foil jacket tests.

4.4.6.1 Water-vapor transmission. Determination of the water-vapor transmission of the jacket material, shall be in accordance with ASTM E 96, procedure E, (see 3.2.4).

#### 5. PREPARATION FOR DELIVERY

5.1 In accordance with Federal Specification HH-I-1751/GEN and documents referenced therein:

#### 6. NOTES

6.1 Cellular-glass insulation is also intended for hot, cold, and dual-temperature piping and tubing, process equipment, boilers and ducts, operating between minus 450°F. and plus 800°F.

6.1.1 Cellular-glass insulation is also available for special uses such as under-ground chilled water pipe insulation, certain marine applications, flotation purposes and other applications.

6.2 Ordering data. In accordance with 6.2 of HH-I-1751/GEN.

- (a) Type and class of insulation required (see 1.2).
- (b) Pipe or tubing sized and nominal O.D. of covering required in accordance with table II, III, or IV, as applicable, and when brands and straps are required (see 3.2).
- (c) Shape and dimensions for special shapes (see 3.3 and 6.3).

6.3 Special shapes are available as follows:

6.3.1 Curved segments. Curved sidewall segments are special pieces cut to fit cylindrical surfaces.

6.3.2 Special-shaped head segments. Special-shaped head segments are individual pieces made to fit dished or spherical shaped heads. They are not cut to fit knuckle radii. Perimeter cutting of head insulation should be done in the field.

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6.4 Fire hazard information. Type I, class 1 is inert material, intrinsically noncombustible. Type I, class 4 pipe covering can be considered noncombustible if it fulfills the requirements of 3.1.3. Type I, class 2 and class 3 materials are considered combustible.

6.4.1 Noncombustible definition. A material shall be considered noncombustible if the following conditions exist after completion of the fire test in accordance with ASTM E 84:

a. No part of the material will ignite and burn when subjected to fire. Any material which liberates flammable gas when heated to a temperature of 1300°F. for five minutes shall not be considered noncombustible.

b. Materials having a structural base of noncombustible material, as defined in a., with a surface not over 0.125 thick which as a flame-spread rating not higher than 50.

c. Materials, other than as described in a. and b., having a surface flame-spread rating not higher than 25 without evidence of continued progressive combustion. In addition, the materials shall be of such composition that surfaces that would be exposed by cutting through the material in any way would not have a flame-spread rating higher than 25 and would show no evidence of continued progressive combustion.

MILITARY CUSTODIANS:

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