Designation: C1126 – 15

Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation[1]

This standard is issued under the fixed designation C1126; 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.

1. Scope

1.1 This specification covers faced or unfaced, rigid cellular phenolic thermal insulation. Boards shall be faced or unfaced. Tubular forms covered by this standard shall be unfaced. It does not apply to field expanded cellular phenolic materials.

NOTE 1—If a facer or vapor retarder is to be used for the tubular form, then refer to Practice C921.

1.2 Materials covered by this specification are used as roof insulation; sheathing or rigid board for non-load bearing, building material applications; and pipe insulation for use between −40 and 257°F (−40 and 125°C). Type II and Type III materials with an appropriate vapor retarder covering on the warm surface are used to a lower temperature limit of −290°F (−180°C). (See 7.3.)

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 This specification covers closed cell rigid cellular phenolic thermal insulation manufactured using blowing agents with an ozone depletion potential of 0 (ODP 0).

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.*
For specific precautionary statements, see Section 16.

2. Referenced Documents

2.1 *ASTM Standards:*[2]
C165 Test Method for Measuring Compressive Properties of Thermal Insulations
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
C209 Test Methods for Cellulosic Fiber Insulating Board
C335/C335M Test Method for Steady-State Heat Transfer Properties of Pipe Insulation
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
C550 Test Method for Measuring Trueness and Squareness of Rigid Block and Board Thermal Insulation
C585 Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
C921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions
C1058/C1058M Practice for Selecting Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation
C1303/C1303M Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation
C1363 Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
D1621 Test Method for Compressive Properties of Rigid Cellular Plastics
D1622 Test Method for Apparent Density of Rigid Cellular Plastics
D1623 Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
D2126 Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
D6226 Test Method for Open Cell Content of Rigid Cellular Plastics
E84 Test Method for Surface Burning Characteristics of Building Materials
E96/E96M Test Methods for Water Vapor Transmission of Materials

[1] This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.22 on Organic and Nonhomogeneous Inorganic Thermal Insulations.

Current edition approved May 1, 2015. Published August 2015. Originally approved in 1989. Last previous edition approved in 2014 as C1126 – 14. DOI: 10.1520/C1126-14.

[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 The definitions and terms in Terminology C168 shall apply to this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *foam core*—rigid cellular thermal installation without any facers or barriers on the surface of the installation.

3.2.2 *closed cell material*—foam where more than 90 % of the cells are totally enclosed by cell walls, and not interconnected with other cells.

3.2.3 *open cell material*—foam whose cells are not totally enclosed by its walls and therefore exhibits a predominance of interconnecting cells.

3.2.4 *ozone depletion potential (ODP)*—a relative index indicating the extent to which a chemical product causes ozone depletion.

3.2.4.1 *Discussion*—The reference level of 1 is the potential of trichlorofluoromethane (R-11 or CFC-11) to cause ozone depletion. ODP 0 is an ozone depletion potential of zero.

4. Classification

4.1 The thermal insulation shall be of the following types:

4.1.1 *Type I*—For use as roof insulation board. Produced without integral vapor retarder facers.

4.1.2 *Type II*—For use as sheathing or rigid panel for non-load bearing applications. Produced with integral vapor retarder facers.

4.1.3 *Type III*—For use as pipe insulation. Produced without integral vapor retarder facers.

4.1.3.1 *Type III, grade 1*—Density, min 2 lbs/ft^3

4.1.3.2 *Type III, grade 2*—Density, min 3.75 lbs/ft^3

4.1.3.3 *Type III, grade 3*—Density, min 5 lbs/ft^3

4.1.3.4 *Type III, grade 4*—Density, min 7.5 lbs/ft^3

5. Ordering Information

5.1 Orders for materials purchased under this specification shall include the following information:

5.1.1 Designation of this specification.

5.1.2 Product name and type.

5.1.3 Size and dimensions.

5.1.4 Quantity of material.

5.1.5 Special requirements for inspection and/or testing.

5.1.6 Pipe insulation jacketing (optional).

6. Materials and Manufacture

6.1 *Foam Core Chemical Composition*—The foam shall be produced by a chemical reaction of a phenolic resin, surfactant, blowing agent, and other additives as needed.

6.2 *Facings*—Facing on Type II material shall be adhered to the core stock and suitable for the service intended. They shall be supplied as agreed upon between manufacturer and purchaser.

7. Physical Properties

7.1 The material shall conform to the requirements as shown in Table 1 and Table 2.

7.2 The Type III higher density material shall conform to the requirements as shown in Table 2.

7.3 Not all physical properties at temperatures below –40°F (–40°C) have been fully tested, and the user shall consult the manufacturer for any properties and performance required at these lower temperatures.

8. Dimensions and Tolerances

8.1 *Dimensions*—The dimensions shall be as agreed upon between the purchaser and the supplier, but commonly shall be as follows:

8.1.1 *Type I*—Width, 24 in., 36 in., or 48 in. (610 mm, 915 mm, or 1220 mm). Length, 48 in. or larger (1220 mm or larger).

8.1.2 *Type II*—Width, 48 in. (1220 mm). Length, 96 in. or larger (2440 mm or larger).

8.1.3 *Type III*—Pipe insulation with dimensions that are in accordance with Practice C585.

8.2 *Tolerances*—Unless otherwise agreed upon between the purchaser and the supplier, the tolerances shall be as follows:

8.2.1 *Types I and II*— When measured at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity, these types shall conform to the following:

8.2.1.1 *Length*—Not to exceed ±¼ in. (±6.4 mm).

8.2.1.2 *Width*—Not to exceed ±¼ in. (±6.4 mm).

8.2.1.3 *Thickness*—Not to exceed ±⅛ in. (±3.1 mm).

8.2.2 *Type III*—Thicknesses available for various pipe and tube sizes shall be in accordance with Practice C585. The average measured length shall not differ from the standard dimension of the manufacturer by more than ±¼ in. (6.4 mm).

8.3 *Other Parameters for Types I and II:*

8.3.1 *Squareness*—Board squareness shall be within required tolerance if the two diagonal measurements of the board differ by no more than ¼ in. (6.4 mm).

8.3.2 *Straightness*—Unless otherwise specified, the boards shall be furnished with straight edges which shall not deviate by more than 1/32 in./ft (2.6 mm/m).

8.3.3 *Flatness*—The boards shall not depart from absolute flatness by more than 1/16 in./ft of width or length (5.2 mm/m).

8.3.4 The straightness and flatness shall be determined in accordance with Practice C550, except that a straight edge longer than the dimension being determined shall be used.

9. Workmanship, Finish, and Appearance

9.1 The insulation shall have no defects that adversely affect its service qualities.

10. Qualification Requirements

10.1 For the purpose of initial material or product qualification, each Type of insulation shall meet the applicable test results of Table 1 and Table 2.

10.2 Acceptance qualification for lots and shipments of qualified product shall be agreed upon by purchaser and supplier.

10.3 When it is anticipated that phenolic foam will be in direct contact with metal, the foam supplier shall provide the proper installation procedure. In some cases, type 1 phenolic foams contain some compounds which promote corrosion in the presence of liquid water. There are currently no directly

TABLE 1 Physical Property Requirements

NOTE 1—As Type II insulation is produced with integral vapor retarder facers, the orientation of the facer is important in preventing moisture penetration into the insulation and the water vapor permeance of the Type II faced insulation is valid as long as the facer does not fail.

Property	Unit	Type I	Type II
Density, min lbs/ft^3 (kg/m^3)		N/A[A]	2 (32)
Compressive resistance, min (faced or unfaced) at 10 % deformation or yield whichever occurs first	psi (kPa)	16 (108)	18 (124)
Closed cell content minimum %	%	90	90
Tensile strength, min (faced)	psf (Pa)	150 (7180)	N/A[A]
Apparent Thermal Conductivity, max[B] (foam core):	Btu·in./h·ft^2·°F (W/mK)		
–250°F (–157°C) mean temp.		N/A[A]	0.12 (0.017)
–200°F (–129°C) mean temp.		N/A[A]	0.13 (0.018)
–150°F (–101°C) mean temp.		N/A[A]	0.14 (0.019)
–100°F (–73°C) mean temp.		N/A[A]	0.15 (0.021)
–50°F (–46°C) mean temp.		N/A[A]	0.15 (0.021)
–0°F (–17°C) mean temp.		N/A[A]	0.15 (0.021)
40°F (4°C) mean temp.		0.16 (0.022)	0.15 (0.021)
75°F (24°C) mean temp.		0.17 (0.025)	0.15 (0.021)
110°F (43°C) mean temp.		0.19 (0.028)	0.17 (0.024)
150°F (65°C) mean temp.		N/A[A]	N/A[A]
200°F (93°C) mean temp.		N/A[A]	N/A[A]
Dimensional stability, 1 week[C] Exposure (foam core):	% lin chg, max		
257 ± 4°F (125 ± 2°C), ambient RH		N/A[A]	N/A[A]
-40 ± 6°F (–40 ± 3°C), ambient RH		2	2
158 ± 4°F (70 ± 2°C), 97 ± 3 % RH		2	2
Water absorption, max, (foam core):	% by volume	3.0	3.0
Water vapor permeance, perms, (facer only)	grains/h·ft^2·in.·Hg (ng/s·m^2·Pa)	[D]	≤1.0 (57)[E]
Water vapor permeability, max, perm-in. (foam core)	Perm-inch (ng/s·m·Pa)	5.0 (7.2)	5.0 (7.2)
Flame spread index, max[F,G] (foam core)		25	25
Smoke developed index, max[F,G] (foam core)		50	50

[A] N/A = not applicable.
[B] Apparent Thermal Conductivity tests shall be used for classification purposes only. The thermal conductivity values shown in this table were obtained using Test Method C518 or C177.
[C] Dimensional stability data at lower temperature will be added when testing is complete.
[D] No minimum or maximum values are required for Type I material. It is expected roof design will reflect actual building and environmental conditions. Under certain circumstances a vapor retarder is required.
[E] Consult manufacturer for certain application in cold climates where greater permeance values are desirable.
[F] 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 the actual fire conditions.
[G] In some cases facings used on composite products cause the flame spread index and smoke developed index of the composite to be significantly different than those of the foam core itself.

applicable ASTM corrosion tests for phenolic foams. An attempt will be made to develop a meaningful corrosion test and will be incorporated into the standard when it becomes available.

11. Sampling

11.1 Unless otherwise specified in the purchase order or contract, sampling shall be in accordance with Practice C390.

12. Specimen Preparation

12.1 Unless otherwise specified in the test procedure, all tests shall be made on specimens conditioned at least 24 h at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity.

12.2 All Type II test specimen have facers present and Type I and Type III test specimens are foam core samples except where otherwise indicated.

12.3 All cut edges shall be smooth and free of any mechanical damage which would affect test results.

12.4 Where foam is tested with facings, care shall be taken to avoid delamination of the specimen during sample preparation.

13. Test Methods

13.1 Properties of the insulation shall be determined in accordance with the following methods.

13.2 *Test Conditions*— Tests shall be conducted at standard laboratory conditions of 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity unless otherwise specified.

13.3 *Closed-Cell Content*—Determine in accordance with Test Method D6226.

13.4 *Density*—Determine by using Test Method D1622.

TABLE 2 Physical Property Requirements

NOTE 1—As Type II insulation is produced with integral vapor retarder facers, the orientation of the facer is important in preventing moisture penetration into the insulation and the water vapor permeance of the Type II faced insulation is valid as long as the facer does not fail.

Property	Unit	Type III[A] Grade 1	Type III[A] Grade 2	Type III[A] Grade 3	Type III[A] Grade 4
Density, min lbs/ft^3 (kg/m^3)		2 (32)	3.75 (60)	5 (80)	7.5 (120)
Compressive resistance, min (faced or unfaced) at 10 % deformation or yield whichever occurs first	psi (kPa)	18 (124)	30 (207)	50 (345)	75 (517)
Closed cell content minimum %	%	90	90	90	90
Tensile strength, min (faced)	psf (Pa)	N/A[B]			
Apparent Thermal Conductivity, max[C] (foam core):	Btu·in./h·ft^2·°F (W/mK)				
–250°F (–157°C) mean temp.		0.15 (0.021)	0.19 (0.027)	0.2 (0.029)	0.21 (0.030)
–200°F (–129°C) mean temp.		0.16 (0.022)	0.2 (0.029)	0.21 (0.030)	0.22 (0.032)
–150°F (–101°C) mean temp.		0.17 (0.024)	0.21 (0.030)	0.22 (0.032)	0.23 (0.033)
–100°F (–73°C) mean temp.		0.18 (0.026)	0.22 (0.032)	0.23 (0.033)	0.24 (0.035)
–50°F (–46°C) mean temp.		0.19 (0.028)	0.23 (0.033)	0.24 (0.035)	0.25 (0.036)
–0°F (–17°C) mean temp.		0.18 (0.026)	0.22 (0.032)	0.23 (0.033)	0.24 (0.035)
40°F (4°C) mean temp.		0.18 (0.026)	0.22 (0.032)	0.23 (0.033)	0.24 (0.035)
75°F (24°C) mean temp.		0.18 (0.026)	0.22 (0.032)	0.23 (0.033)	0.24 (0.035)
110°F (43°C) mean temp.		0.19 (0.028)	0.23 (0.033)	0.24 (0.035)	0.25 (0.036)
150°F (65°C) mean temp.		0.20 (0.029)	0.24 (0.035)	0.25 (0.036)	0.26 (0.037)
200°F (93°C) mean temp.		0.25 (0.036)	0.29 (0.042)	0.3 (0.043)	0.31 (0.045)
Dimensional stability, 1 week[D] Exposure (foam core):	% lin chg, max				
257 ± 4°F (125 ± 2°C), ambient RH		2	2	2	2
-40 ± 6°F (–40 ± 3°C), ambient RH		2	2	2	2
158 ± 4°F (70 ± 2°C), 97 ± 3 % RH		2	2	2	2
Water absorption, max, (foam core):	% by volume	3.0	3.0	3.0	3.0
Water vapor permeance, perms, (facer only)	grains/h·ft^2·in.·Hg (ng/s·m^2·Pa)				
Water vapor permeability, max, perm-in. (foam core)	Perm-inch (ng/s·m·Pa)	5.0 (7.2)	5.0 (7.2)	5.0 (7.2)	5.0 (7.2)
Flame spread index, max[E,F] (foam core)		25	25	25	25
Smoke developed index, max[E,F] (foam core)		50	50	50	50

[A] Type III test samples shall be obtained from a free-rise block of foam, except where otherwise specified.
[B] N/A = not applicable.
[C] Apparent Thermal Conductivity tests shall be used for classification purposes only. The thermal conductivity values shown in this table were obtained using Test Method C518 or C177.
[D] Dimensional stability data at lower temperature will be added when testing is complete.
[E] 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 the actual fire conditions.
[F] In some cases facings used on composite products cause the flame spread index and smoke developed index of the composite to be significantly different than those of the foam core itself.

13.5 *Compressive Resistance*—Determine in accordance with Test Method C165, Procedure A or Test Method D1621, Procedure A at a crosshead speed of 0.1 in./min (2.5 mm/min) for each 1 in. (25 mm) of specimen thickness, on faced or unfaced sample in the direction normal to its application, except for Type III. Type III will be tested in the direction normal to rise. If the thickness is less than 1 in., it shall be tested at the product thickness. See Footnote A of Table 1.

13.5.1 In some cases, insulation foams are anisotropic and, therefore, strength properties vary with direction. The manufacturer shall be consulted if additional information is required.

13.6 *Tensile Strength*— Determine by using Test Method D1623, Type C specimen, faced, in the direction normal to its application.

13.7 *Thermal Performance:*

13.7.1 *Foam Thermal Conductivity:*

13.7.1.1 Determine the apparent thermal conductivity on core foam by Test Method C177 or Test Method C518 in conjunction with Practice C1045 using temperature differences as indicated in Practice C1058/C1058M. In some cases above ambient temperature where the insulation is used in pipe application, Test Method C335/C335M is applicable. Precondition the samples at 73 ± 2°F (23 ± 1°C), 50 ± 5 % relative humidity for 72 h. Foam core specimens shall be cut such that the direction of heat flow during the test is parallel to the rise direction (also called vertical, or height direction). The specimens shall be aged as 1-in. (25 mm) thick specimens for 180 days at 73 ± 2°F (23 ± 1°C), 50 ± 5 % relative humidity prior to testing. Time to reach steady state before readings are taken shall be a minimum of 24 h. In the event of dispute, Test Method C177 shall be used.

NOTE 2—For phenolic insulation, the core thickness has an impact on

measured thermal resistance. As thickness increases the thermal resistance increases as thickness decreases the thermal resistance decreases. The thermal resistance of phenolic thermal insulation is significantly influenced by installation and service related variables such as age, encapsulation within gas-barrier materials, environmental conditions, and mechanical abuse and in some cases is reduced from measured values after exposure to conditions of use. For specific design recommendations using a particular product, consult the manufacturer.

13.7.1.2 Apparent thermal conductivity shall be reported at mean temperatures of 40°F (4°C), 75°F (24°C), and 110°F (43°C). For Type III product, report also at 150°F (65°C) using a cold-face temperature of 75 ± 15°F (24 ± 8°C) and a hot-face temperature of 225 ± 15°F (107 ± 8°C). Time to reach steady state before readings are taken shall be 24 h minimum. For Type II and Type III product report also at mean temperatures of −250°F (−157°C), −200°F (−129°C), −150°F (−101°C), −100°F (−73°C), −50°F (−46°F), and 0°F (−17°C). The mean apparent thermal conductivity of the material tested shall not be greater than the value stated by the manufacturer. The thermal conductivity of individual specimens tested shall not be more than 110 % of the manufacturer. In the event of dispute, Test Method C177 shall be used. See Note 3.

NOTE 3—In some cases the redistribution of moisture in phenolic foams is slow enough to increase the time required to reach stable heat flow in the thermal conductivity tests. The equilibrium values measured after 24 h best represent the heat insulating properties expected under stable temperature gradient conditions. If the equilibrium value is obtained in less than 24 h, then it is acceptable to take proper measurements and to report the equilibrium time.

13.7.2 *Product Thermal Resistance*—The thermal resistance of the product as used shall be agreed upon by purchaser and supplier. Use Test Methods C177, C518, C1363, in conjunction with Practice C1045 for all Types, with Test Method C177 being the referee method. In some cases above ambient temperature where the insulation is used in pipe application, Test Method C335/C335M is applicable. The mean thermal resistance of the material tested shall not be less than the manufacturer's stated value. The thermal resistances of individual specimens tested shall not be less than 90 % of the manufacturer's stated values. See Note 4.

NOTE 4—The thermal transmission properties of phenolic foam board and pipe insulation vary with temperature, temperature gradient, moisture content, thickness, and shape. Note that the apparent thermal conductivity requirements in Table 1 are based on samples tested under the conditions specified in 13.7.1. These are comparative values for establishing specification compliance. In some cases they do not represent the installed performance of the insulation under use conditions; differing substantially from the test conditions. Test Method C1303/C1303M provides an alternative technique for predicting long-term thermal resistance when the material meets the homogeneous material definition of 3.2.5 of Test Method C1303/C1303M.

13.8 *Dimensional Stability*—Determine by using Test Method D2126 with test specimens being exposed to the following conditions:

Temperature, °F (°C)	Relative Humidity, %
257 ± 4 (125 ± 2) (Type III only)	Ambient
−40 ± 6 (−40 ± 3)	Ambient
158 ± 4 (70 ± 2)	95 ± 3

13.8.1 Each of the test specimens shall be conditioned 48 hours at 73.4 ± 4°F (23 ± 2°C) and 50 ± 5 % relative humidity prior to testing. See Note 5.

NOTE 5—This standard used the dimensional stability test to indicate maximum surface use temperature for Type III insulation.

13.8.2 These requirements are for qualification of foams. Consult manufacturer for in-service performance data.

13.9 *Water Absorption*— For the purposes of this specification, determine in accordance with Test Method C209. Length of test shall be 2 h. (Facings affect the determined value.)

13.10 *Water Vapor Permeance and Permeability*—Determine permeance in accordance with Test Method E96/E96M, Desiccant Method on faced specimen. Determine permeability in accordance with Test Method E96/E96M, Desiccant Method on foam core specimen. In applications where the surface being insulated operates at below ambient temperature, the use of a water vapor retarder applied to the outer surface of this insulation is required.

13.11 *Burning Characteristics*—For the purpose of this specification, surface burning characteristics of the unfaced foam shall be determined in accordance with Test Method E84 on foam core specimens tested at the maximum thickness intended for use, not to exceed 4 in. (102 mm). The requirements of Table 1 and Table 2 shall apply where required by applicable regulations or by the purchaser. As with other building materials, it is possible that phenolic foams will continue to burn or smolder after a fire exposure; therefore, total extinguishment is required. It is possible that facings used on composite products will cause the flame spread index and smoke developed index of the composites to be significantly different than the foam core rating. For composites (or faced foam materials), the flame spread and smoke developed indexes of the system are different from those of the foam core and shall be provided by the supplier as required.

14. Inspection

14.1 Inspection of the material shall be agreed upon by the purchaser and the supplier as part of the purchase agreement.

15. Rejection and Rehearing

15.1 Material that fails to conform to the requirements of this specification *shall* be rejected. Rejection shall be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the tests, the producer or supplier shall have the option to request retesting.

15.2 At the agreement of the buyer and seller, the seller shall have the right to reinspect a rejected shipment and resubmit same after removal of the nonconforming portion.

16. Health and Safety Precautions

16.1 When applying Type III product on a hot pipe operating at 140°F (60°C) or higher in closed or confined spaces, adequate ventilation shall be provided, and care shall be taken to avoid burns. Consult the manufacturer for details.

17. Packaging and Package Marking

17.1 Unless otherwise agreed upon between the purchaser and the supplier, materials under this specification shall be packaged per the standard commercial practice of the manufacturer.

17.2 Unless otherwise specified, shipping containers shall be marked with the name and designation of the manufacturer, type, size, thickness, product thermal resistance, and quantity of material in the container.

18. Keywords

18.1 cellular phenolic thermal insulation; faced phenolic foam thermal insulation; phenolic foam thermal insulation; rigid thermal insulation; unfaced phenolic foam thermal insulation