Phenolic foam thermal insulation products for buildings and building services end use applications

Part 1 - Specification for phenolic foam (PF) products for use as thermal insulation for building wall cavities

3.10

Contents

Foreword

Publishing Information.

This British Standard was published by BSI and came into effect on xx xxx 2010. It was prepared by Subcommittee PRI/72/3, *Phenolic*, under the authority of Technical Committee PRI/72, *Rigid Cellular Materials*. It is part 1 of a 7-part standard covering the various applications of phenolic foam insulation products in the building and construction industry.

Information about this document

Part 1 of this standard has been introduced to specify the requirements needed to ensure fitness for purpose of phenolic foam thermal insulation products used in the insulation of building wall cavities in the United Kingdom. Parts 1-6 of this non-conflicting standard meet the requirement of BS EN 13166 that 'The levels required for a given application are to be found in regulations or non-conflicting standards'.

Contractual and legal obligations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

1 Scope

This British Standard specifies the composition, classification and physical property performance limit values for thermoset phenolic foam thermal insulation products for installation into building wall cavities. Such products include phenolic foam slabs, blocks, boards and profiled sheets, which may also be faced with flexible or rigid facings.

The nominal temperature range in which the material is suitable for use in insulation products is – 200 °C to + 120 °C as stated in BS EN 13166.

NOTE Guidance on using products made from PF foam at temperatures below – 180 °C is given in Annex A.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 476: Part 6, *Fire tests on building materials and structures – method of test for fire propagation of products.*

BS 476: Part 7, *Fire tests on building materials and structures – method for the classification of surface spread of flame of products.*

BS EN 826, *Thermal insulating products for building applications — Determination of compression behaviour.*

BS EN 1602, *Thermal insulating products for building applications. Determination of the apparent density.*

BS EN 1603, *Thermal insulating products for building applications — Determination of dimensional stability under constant normal laboratory conditions (23 °C/50% relative humidity).*

BS EN 1609, *Thermal insulating products for building applications — Determination of short term water absorption by partial immersion.*

BS EN 12086, *Thermal insulating products for building applications — Determination of water vapour transmission properties.*

BS EN 12089, *Thermal insulating products for building applications — Determination of bending behaviour.*

BS EN 12667, *Thermal performance of building materials and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Products of high and medium thermal resistance.*

BS EN 12939, *Thermal performance of building material and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Thick products of high and medium thermal resistance*.

BS EN 13166, *Thermal insulation products for buildings — Factory made products of phenolic foam (PF) — Specification*.

BS EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*.

BS EN 15715, *Thermal insulation products – Instructions for mounting and fixing for reaction to fire testing – Factory made products.*

3 Classification

The products shall be classified in accordance with the requirements specified in Table 1.

Table 1 — Physical property requirements

Physical Property		Value[a]	Method of Test
Minimum density (kg/m^3) [b]		25	BS EN 1602
Maximum declared value of thermal conductivity (W/m·K)[c]		0.025	BS EN 12667 or BS EN 12939 as specified in BS EN 13166
Minimum compressive strength at 10% strain, (kPa)[c]		CS(Y) 100	BS EN 826
Minimum bending strength in any direction, (kPa)[c]		200	BS EN 12089
Dimensional stability: maximum percentage linear change, 23°C/50% RH.[c]		0.5	BS EN 1603
Dimensional stability under specified conditions[c] 48h at (23±2)°C and (90±5)% RH 48h at (70±2)°C 48h at (70±2)°C and (90±5)% RH 48h at (-20±2)°C		 *l* & *w* ±0.5%, *t* ±1.5% *l* & *w* ±1.5%, *t* ±3% *l*, *w* & *t* ±1.5% *l*, *w* & *t* ±1.5%	BS EN 1604
Flatness[c]: *t* = <50 mm 50 to 100 mm >100 mm		≤10.0 ≤ 7.5 ≤ 5.0	BS EN 825
Minimum water vapour resistance (Z) (MNs/g)[b]		25	BS EN 12086
Minimum reaction to fire performance[b]	either BS 476	I < 12, i < 6	BS 476, Part 6
		Class1	BS 476, Part7
	or Euroclass	Class C	BS EN 13501-1
NOTE: Products conforming to this standard shall have a minimum fire performance of Euroclass B when tested to BS EN 13501-1 using the appropriate standard test configuration of assemblies simulating end-use applications as specified in Table 5 of BS EN 15715.			

[a] Manufacturer's declared closed cell content > 90%
[b] For foam excluding facings. For mechanical properties of foam products, other than those indicated, or for actual mechanical properties of high density products, please refer to the manufacturer's literature.
[c] For product as placed on the market.
l = length, w = width, t = thickness, RH = relative humidity.

4 Composition

4.1. General

The insulation products shall consist of phenolic foam of uniform cellular structure together with any flexible or rigid facings on one or both sides.

4.2. Facings

Flexible facings may be functional or decorative (e.g. paper, metal foil, glass tissue, etc.).

NOTE The type of facing and the degree of their bonding are crucial to ensure good service performance for laminated insulation boards. The degree of bonding, if a required property, should conform to the recommendations given in Annex B when determined according to the procedure given in Annex B.

5 Dimensions and dimensional tolerances of PF thermal insulation board products

5.1 Length and Width

Length, l, and width, b, shall be determined in accordance with BS EN 822. No test result shall deviate from the nominal values by more than the tolerances given in Table 2 for the corresponding dimensions.
Products with a surface facing or natural skin shall be tested without removing them.

Table 2 — Tolerances for length and width

Dimensions in millimetres

Dimensions	Length	Width
< 1250	± 5,0	± 3,0
1 250 to 2 000	± 7,5	± 7,5
2 001 to 4 000	± 10,0	± 7,5
> 4000	± 15,0	± 10,0

5.2 Thickness

Thickness, d, shall be determined in accordance with BS EN 823. No test result shall deviate from the nominal thickness, d_N, by more than the tolerance given in Table 3 for the labelled class

Table 3 — Classes for thickness tolerances

Dimensions in millimetres

Nominal thickness	Tolerance	
	T1	T2
< 50	± 2,0	± 1,5
50 to 100	–2,0 +3,0	± 1,5
> 100	–2,0 +5,0	± 1,5

5.3 Squareness

Squareness shall be determined in accordance with BS EN 824. The deviation from squareness on length and width, S_b, shall not exceed 8 mm/m. The deviation from squareness on thickness, S_d, shall not exceed 2 mm.

5.4 Flatness

Deviation from flatness of the board shall be determined in accordance with EN 825. The deviation from flatness, S_{max}, shall not exceed the tolerances given in Table 4 for the corresponding nominal thickness, d_N.

Table 4 — Tolerances for deviation from flatness

Dimensions in millimetres

Nominal thickness	Tolerance
< 50	□ 10.0
50 to 100	□ 7.5
> 100	□ 5.0

6 Physical properties

The physical properties shall conform to the requirements specified in Table 1, when tested in accordance with the methods indicated therein.

NOTE: For further information on the reaction to fire performance of PF insulation products see Annex C.

7 Sampling

Sampling for factory production control purposes shall follow the relevant requirements of Table B.1 of BS EN 13166.

8 Installation

Notes on best practice for installation of PF insulation products in cavity walls are given in Annex D.

9 Designation

Boards shall be given the following minimum designation:

"BS xxxx – 1:2009/BS EN 13166: XX: Y, sn, dn" where, in accordance with Table 1,

- XX is the thermal conductivity in mW/mK
- Y, sn, dn is the fire classification in application (using standard test configuration of assembly 2 in BS EN 15715).

Further information, in accordance with BS EN 13166, may be included in the designation.

10 Marking and labelling

The product, packaging and invoices shall be marked with at least the following information:

a) manufacturer's name and trademark;

b) product designation as given in Clause 9;

c) manufacturer's description and/or product reference.

NOTE: The designation shall be given in current product literature and/or the product label.

Annex A (informative)

Notes for designers and product users

a) Materials of apparent density 25 kg/m^3 to 60 kg/m^3 are normally found suitable for most thermal insulation purposes within the scope of this standard.

b) In designing insulation systems with phenolic foams, care should be taken to prevent ingress of water.

c) Adequate precautions should be taken to prevent moisture being interposed between metal and foam surfaces.

d) For normal use, rigid phenolic foam materials are suitable for use in the temperature range - 180 °C to + 120 °C.

NOTE The lower temperature limit is selected to indicate the unsuitability of these materials for insulation of liquid oxygen plants. These materials can however be used at temperatures down to – 200 °C provided that precautions are taken to prevent the condensation of atmospheric oxygen in or on the insulation.

e) It is recommended that the nominal thickness of the insulation board be used in calculating insulation board design *'U'* values. However, the U-value of the board including rigid facings is obtained by taking into account the thermal resistance of any rigid facings.

NOTE. The method of determining the thermal resistance of the building envelope is given in BS EN ISO 6946.

Annex B (informative)

Method for the determination of areas of unbonded facings

B.1 Principle

The unbonded area is established by removing loose facing material after cutting up the specimen.

B.2 Apparatus

B.2.1 Bandsaw or similar fine toothed saw.

B.2.2 Means for measuring the dimensions of unbonded areas, i.e. a rule with an accuracy of 0.5 mm.

B.3 Test specimen

The test specimen should be rectangular with a length and breadth not exceeding 1200 mm x 600 mm. The thickness of the test specimen should be the full thickness of the insulation board laminate including facings.

B.4 Number of test specimens

One test specimen should be tested.

B.5 Conditioning

Test specimens should be conditioned immediately before testing for a period of not less than 16 h at a temperature of (23 ± 2) ^{0}C and a relative humidity of (50 ± 5) %.

B.6 Procedure

Conduct the test at (23 ± 2) ^{0}C. Mark the test specimen in a manner that identifies the upper and lower faces. Cut the test specimen parallel to either axis into strips 50 mm wide, each strip being marked so as to identify its original position relative to the other strips (see Figure B.1). Examine both faces of each strip to determine whether any of the facings are not bonded to the core.

Remove any areas of facing and measure the unbonded area(s).

NOTE 1. The necessity for identifying each individual strip and its relative position is to enable unbonded areas of the facing that may extend continuously across more than one strip to be computed as a single area. Individual areas may therefore be computed as well as the sum total of all such areas.

NOTE 2. Felt marker pens are most suitable for marking the edges of the test specimen.

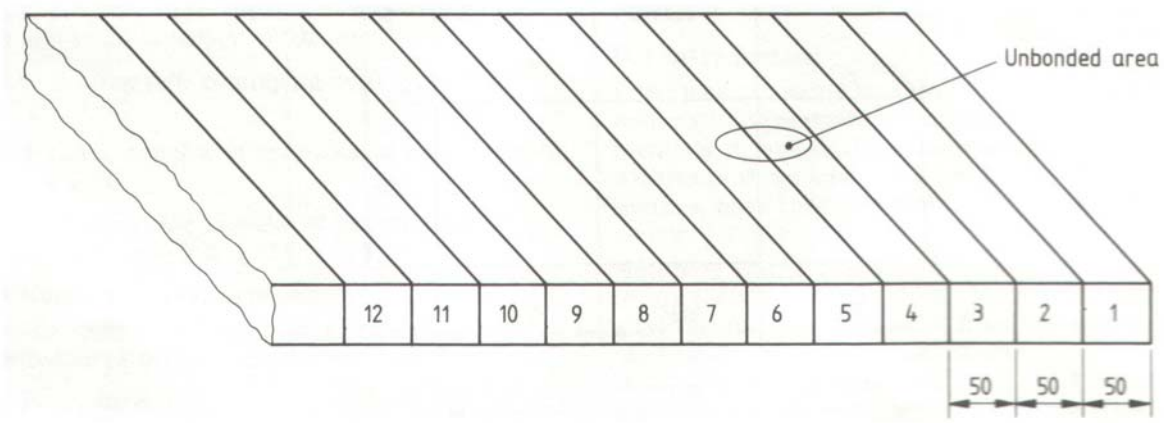
B.7 Expression of results

Measure all unbonded areas individually as well as the sum total of all such areas and express the results as a percentage of the original area of the test specimen.

B.8 Test report

The test report should include the following:

(a) the identification of the insulation board tested;
(b) the individual unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(c) the sum of the unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(d) the description and date of this specification, i.e. BS xxxx-1:2009.



All dimensions are in millimetres.

Figure B.1 Determination of area(s) of unbonded facings: cutting and marking of the test specimen

Annex C (informative)

Burning characteristics of phenolic foams, recommendations regarding their use and storage

C.1 Burning properties of phenolic foam and recommendations for use

Any risk of ignition and fire growth associated with the foam in building construction, industry, transport, etc. should be assessed in accordance with the recommendations of BS 6336. That is, consideration should be given to the design of the end product formed from, or incorporating, the foam and the risks to which it might be exposed.

This standard is concerned only with the specification of phenolic foam as a basic material, designed for insulating purposes, with burning characteristics of a specified class when tested in accordance with BS EN 13501-1, using the appropriate mounting and fixing procedures, as specified in BS EN 15715.

The fire characteristics of phenolic foam measured in accordance with BS EN 13501-1 can be affected by the blowing agent used and any facings applied to the boards. The production of smoke and flaming droplets may be assessed in accordance with BS EN 13823, which forms a part of the BS EN 13501-1 classification system. It would be expected that the smoke levels registered by this test would be zero or very close to zero and that flaming droplets would not be produced by thermoset phenolic foam thermal insulation products.

An alternative classification for reaction to fire is the use of BS 476, Parts 6 & 7 as indicated in table 1.

C.2 Recommended practices for storage, handling and fabrication of thermoset phenolic foam thermal insulation and PF foam products

The following recommended practices should be taken into account for the storage and fabrication of thermoset phenolic foam thermal insulation and PF foam products.

a) Best practice standards should be maintained.

b) Sensible fire precautions should be observed.

c) Reference should be made to Material Safety Data Sheets when carrying out COSHH or other risk assessment procedures.

Annex D (informative)

Information on the installation of the insulation boards into wall cavities

D.1 Information on the installation of the insulation boards into wall cavities

The walls are constructed leading with either the inner or outer leaf. It is recommended that the inner leaf be constructed ahead of the outer leaf, as Phenolic insulation boards fastened to the cavity face of the inner leaf gives a slightly enhanced thermal performance. It is essential that the spacing of wall ties/clips allows the long edge of each board to be secured at a minimum of two joints.

D.2 Procedure

A section of the inner leaf is built with the first row of wall ties, at approximately 600 mm horizontal spacing, where the insulation is to begin. It is recommended that the wall ties are not placed directly on the damp-proof course. The first run of boards may commence below damp-proof course level to provide some edge insulation for the floor (see Figure D.1).

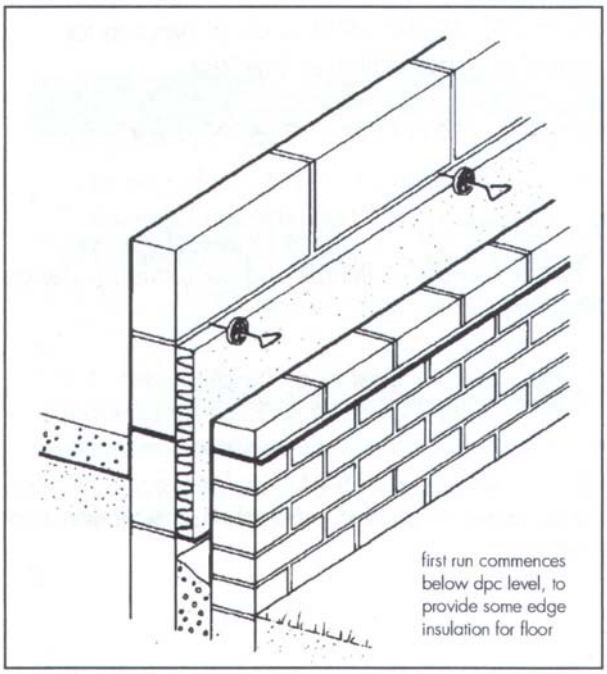


Figure D.1 Installation of Phenolic insulation boards

The leading leaf is built up to the required height, with wall ties placed at a vertical height of 450 mm. Excess mortar is cleaned from the cavity face of the leading leaf, and the boards are placed on the wall ties, behind the retaining clips, to form a closely butt-jointed run.

The second row of wall ties is fitted to retain the tops of the boards. It is essential that all wall ties slope downwards towards the outer leaf (see Figure D.2) and at centres not exceeding 900 mm to ensure that each board is secured at a minimum of three points. Additional ties may be required to satisfy the structural requirements of BS 5628: Part 3: 2001 and/or to ensure adequate retention of boards or cut pieces.

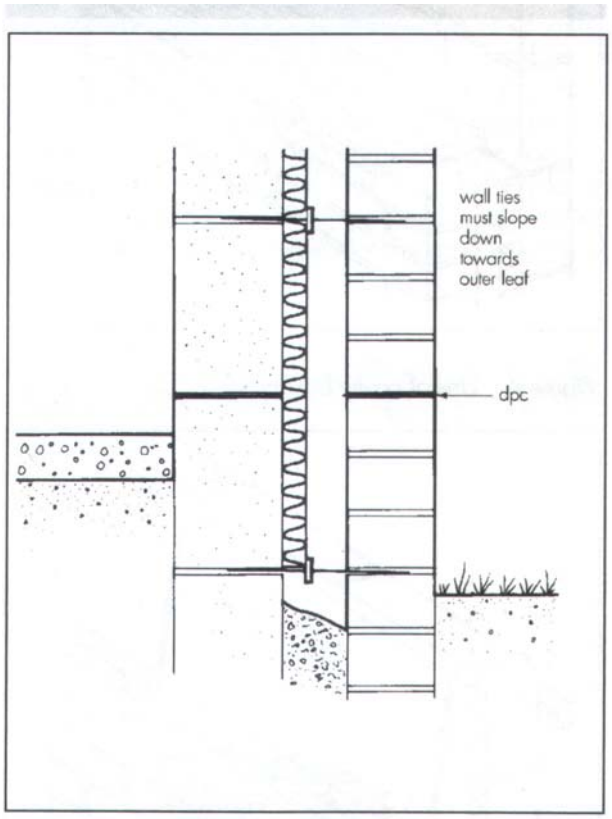


Figure D.2 Installation of wall ties

The other leaf is then built up to the level of the top of the boards.

Progressive staggering of boards and wall ties as construction proceeds should be in accordance with the manufacturer's recommendations.

Bibliography

Standards publications

BS 5946, *Method of test for determination of the punking behaviour of phenol-formaldehyde foam*.

BS 6336, *Guide to the development of fire tests, the presentation of test data and the role of tests in hazard assessment*.

BS EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*.

BS EN 11925-2:2002, *Reaction to fire tests. Ignitability of building products subjected to direct impingement of flame. Single flame source test.*

Phenolic foam thermal insulation products for buildings and building services end use applications

Part 2 - Specification for phenolic foam (PF) products for use as thermal insulation products for wall linings and ceilings

3.10

Contents

Foreword

Publishing Information.

This British Standard was published by BSI and came into effect on xx xxx 2010. It was prepared by Subcommittee PRI/72/3, *Phenolic*, under the authority of Technical Committee PRI/72, *Rigid Cellular Materials*. It is part 2 of a 7-part standard covering the various applications of phenolic foam insulation products in the building and construction industry.

Information about this document

Part 2 of this standard has been introduced to specify the requirements needed to ensure fitness for purpose of phenolic foam thermal insulation products used in the insulation of wall linings and ceilings in the United Kingdom. Parts 1-6 Parts 1-6 of this non-conflicting standard meet the requirement of BS EN 13166 that 'The levels required for a given application are to be found in regulations or non-conflicting standards'.

Contractual and legal obligations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

1 Scope

This British Standard specifies the composition, classification and physical property performance limit values for thermoset phenolic foam thermal insulation products used in the insulation of internal wall linings and ceilings. Such products include phenolic foam slabs, blocks, boards and profiled sheets, which may be faced with flexible or rigid facings.

The nominal temperature range in which the material is suitable for use in insulation products is – 200 °C to + 120 °C as stated in BS EN 13166.

NOTE Guidance on using products made from PF foam at temperatures below – 180 °C is given in Annex A.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 476: Part 6, *Fire tests on building materials and structures – method of test for fire propagation of products.*

BS 476: Part 7, *Fire tests on building materials and structures – method for the classification of surface spread of flame of products.*

BS EN 826, *Thermal insulating products for building applications — Determination of compression behaviour.*

BS EN 1602, *Thermal insulating products for building applications. Determination of the apparent density.*

BS EN 1603, *Thermal insulating products for building applications — Determination of dimensional stability under constant normal laboratory conditions (23 °C/50% relative humidity).*

BS EN 1609, *Thermal insulating products for building applications — Determination of short term water absorption by partial immersion.*

BS EN 12086, *Thermal insulating products for building applications — Determination of water vapour transmission properties.*

BS EN 12089, *Thermal insulating products for building applications — Determination of bending behaviour.*

BS EN 12667, *Thermal performance of building materials and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Products of high and medium thermal resistance.*

BS EN 12939, *Thermal performance of building material and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Thick products of high and medium thermal resistance*.

BS EN 13166, *Thermal insulation products for buildings — Factory made products of phenolic foam (PF) — Specification*.

BS EN 13467, *Thermal insulating products for building equipment and industrial installations — Determination of dimensions, squareness and linearity of preformed pipe insulation*.

BS EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*.

BS EN 15715, *Thermal insulation products – Instructions for mounting and fixing for reaction to fire testing – Factory made products.*

3 Classification

The products shall be classified in accordance with the requirements specified in Table 1.

Table 1 — Physical property requirements

Physical Property		Value[a]	Method of Test
Minimum density (kg/m^3) [b]		25	BS EN 1602
Maximum declared value of thermal conductivity (W/m·K)[c]		0.025	BS EN 12667 or BS EN 12939 as specified in BS EN 13166
Minimum compressive strength at 10% strain, (kPa)[c]		CS(Y) 100	BS EN 826
Minimum bending strength in any direction, (kPa)[c]		200	BS EN 12089
Dimensional stability: maximum percentage linear change, 23°C/50% RH.[c]		0.5	BS EN 1603
Dimensional stability under specified conditions[c] 48h at (23±2)°C and (90±5)% RH 48h at (70±2)°C 48h at (70±2)°C and (90±5)% RH 48h at (-20±2)°C		 *l* & *w* ±0.5%, *t* ±1.5% *l* & *w* ±1.5%, *t* ±3% *l*, *w* & *t* ±1.5% *l*, *w* & *t* ±1.5%	BS EN 1604
Flatness[c]: *t* = <50 mm 50 to 100 mm >100 mm		≤10.0 ≤ 7.5 ≤ 5.0	BS EN 825
Minimum water vapour resistance (Z) (MNs/g)[b]		25	BS EN 12086
Minimum reaction to fire[b] performance[b]	either BS 476	I < 12, i < 6	BS 476, Part 6
		Class1	BS 476, Part7
	or Euroclass	Class C	BS EN 13501-1

NOTE: Products conforming to this standard shall have a minimum fire performance of Euroclass B when tested to BS EN 13501-1 using the appropriate standard test configuration of assemblies simulating end-use applications as specified in Table 5 of BS EN 15715.
[a] Manufacturer's declared closed cell content > 90% [b] For foam excluding facings. For mechanical properties of foam products other than those indicated or for actual mechanical properties of high density products, please refer to the manufacturer's literature. [c] For products as placed on the market. *l* = length, *w* = width, *t* = thickness, RH = relative humidity.

4. Composition

3.1 General

The insulation products shall consist of phenolic foam of uniform cellular structure together with any flexible or rigid facings on one or both sides.

4.2 Flexible facings

Flexible facings may be functional or decorative (e.g. paper, metal foil, glass tissue, etc.).

NOTE The type of facing and the degree of their bonding are crucial to ensure good service performance for laminated insulation boards. The degree of bonding, if a required property, should conform to the recommendations given in Annex B when determined according to the procedure given in Annex B.

4.3 Substantial rigid facings

Substantial rigid facings shall consist of mineralised building board (Euroclass A1 or A2) such as calcium silicate or plasterboard.

5 Dimensions and dimensional tolerances of PF thermal insulation products

5.1 Length and Width

Length, *l*, and width, *b*, shall be determined in accordance with BS EN 822. No test result shall deviate from the nominal values by more than the tolerances given in Table 2 for the corresponding dimensions.

Products with a surface facing or natural skin shall be tested without removing them.

Table 2 — Tolerances for length and width

Dimensions in millimetres

Dimensions	Length	Width
< 1250	± 5,0	± 3,0
1 250 to 2 000	± 7,5	± 7,5
2 001 to 4 000	± 10,0	± 7,5
> 4000	± 15,0	± 10,0

5.2 Thickness

Thickness, *d*, shall be determined in accordance with BS EN 823. No test result shall deviate from the nominal thickness, d_N, by more than the tolerance given in Table 3 for the labelled class.

Table 3 — Classes for thickness tolerances

Dimensions in millimetres

Nominal thickness	Tolerance	
	T1	T2
< 50	± 2,0	± 1,5
50 to 100	–2,0 +3,0	± 1,5
> 100	–2,0 +5,0	± 1,5

5.3 Squareness

Squareness shall be determined in accordance with BS EN 824. The deviation from squareness on length and width, S_b, shall not exceed 8 mm/m. The deviation from squareness on thickness, S_d, shall not exceed 2 mm.

5.4 Flatness

Deviation from flatness of the board shall be determined in accordance with BS EN 825. The deviation from flatness, S_{max}, shall not exceed the tolerances given in Table 4 for the corresponding nominal thickness, d_N.

Table 4 — Tolerances for deviation from flatness

Dimensions in millimetres

Nominal thickness	Tolerance
< 50	□ 10.0
50 to 100	□ 7.5
> 100	□ 5.0

6 Physical properties

The physical properties shall conform to the requirements specified in Table 1, when tested in accordance with the methods indicated therein.

NOTE For further information on the reaction to fire performance of PF insulation products see Annex C.

7 Sampling

Sampling for factory production control purposes shall follow the relevant requirements of Table B.1 of EN 13166.

8 Installation

Notes on best practice for installation of PF insulation products in wall linings and ceilings are given in Annex D

9 Designation

Boards shall be given the following minimum designation:

"BS xxxx – 2:2009/BS EN 13166: XX: Y,sn,dn" where, in accordance with Table 1,

- XX is the thermal conductivity in mW/mK
- Y, sn, dn is the fire classification in application (using standard test configuration of assembly 2 in BS EN 15715).

Further information, in accordance with BS EN 13166, may be included in the designation.

10 Marking and labelling

The product, packaging and invoices shall be marked with at least the following information:

a) manufacturer's name and trademark;

b) product designation as given in Clause 9;

c) manufacturer's description and/or product reference.

NOTE: The designation shall be given in current product literature and/or on the product label.

Annex A (informative)

Notes for designers and product users

a) Materials of apparent density 30 kg/m^3 to 60 kg/m^3 are normally found suitable for most thermal insulation purposes within the scope of this standard.

b) In designing insulation systems with phenolic foams, care should be taken to prevent ingress of water.

c) Adequate precautions should be taken to prevent moisture being interposed between metal and foam surfaces.

d) For normal use, rigid phenolic foam materials are suitable for use in the temperature range - 180 °C to + 120 °C.

NOTE The lower temperature limit is selected to indicate the unsuitability of these materials for insulation of liquid oxygen plants. These materials can however be used at temperatures down to – 200 °C provided that precautions are taken to prevent the condensation of atmospheric oxygen in or on the insulation.

e) It is recommended that the nominal thickness of the insulation board be used in calculating insulation board design *'U'* values. However, the U-value of the board including rigid facings is obtained by taking into account the thermal resistance of any rigid facings.

NOTE. The method of determining the thermal resistance of the building envelope is given in BS EN ISO 6946.

Annex B (informative)

Method for the determination of areas of unbonded facings

B.1 Principle

The unbonded area is established by removing loose facing material after cutting up the specimen.

B.2 Apparatus

B.2.1 Bandsaw or similar fine toothed saw.

B.2.2 Means for measuring the dimensions of unbonded areas, i.e. a rule with an accuracy of 0.5 mm.

B.3 Test specimen

The test specimen should be a right parallelepiped with a length and breadth not exceeding 1200 mm x 600 mm. The thickness of the test specimen should be the full thickness of the insulation board laminate including facings.

B.4 Number of test specimens

One test specimen should be tested.

B.5 Conditioning

Test specimens should be conditioned immediately before testing for a period of not less than 16 h at a temperature of (23 ± 2) ^{0}C and a relative humidity of (50 ± 5) %.

B.6 Procedure

Conduct the test at (23 ± 2) ^{0}C. Mark the test specimen in a manner that identifies the upper and lower faces. Cut the test specimen parallel to either axis into strips 50 mm wide, each strip being marked so as to identify its original position relative to the other strips (see Figure B.1). Examine both faces of each strip to determine whether any of the facings are not bonded to the core.

Remove any areas of facing and measure the unbonded area(s).

NOTE 1. The necessity for identifying each individual strip and its relative position is to enable unbonded areas of the facing that may extend continuously across more than one strip to be computed as a single area. Individual areas may therefore be computed as well as the sum total of all such areas.

NOTE 2. Felt marker pens are most suitable for marking the edges of the test specimen.

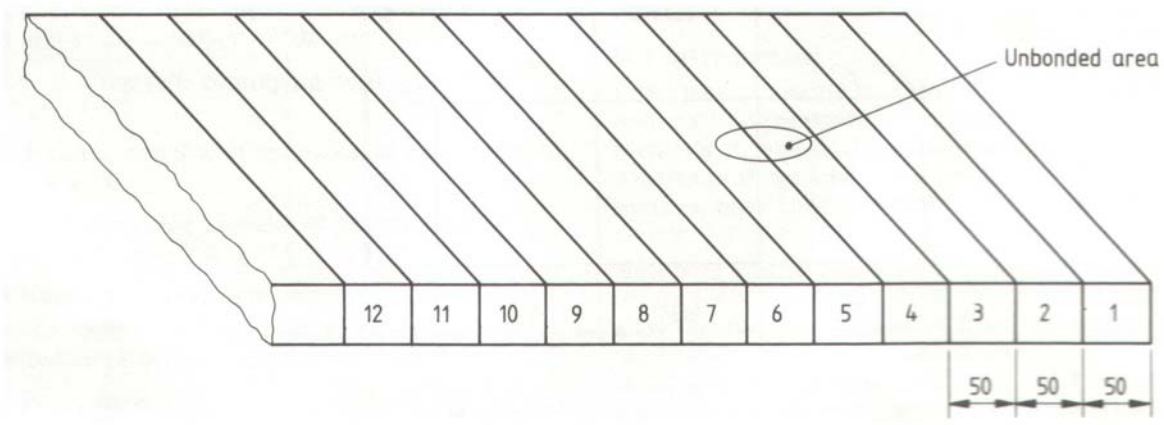
B.7 Expression of results

Measure all unbonded areas individually as well as the sum total of all such areas and express the results as a percentage of the original area of the test specimen.

B.8 Test report

The test report should include the following:

(a) the identification of the insulation board tested;
(b) the individual unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(c) the sum of the unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(d) the description and date of this specification, i.e. BS xxxx-1:2009.



All dimensions are in millimetres.

Figure B.1 Determination of area(s) of unbonded facings: cutting and marking of the test specimen

Annex C (informative)

Burning characteristics of phenolic foams, recommendations regarding their use and storage

C.1 Burning properties of phenolic foam and recommendations for use

Any risk of ignition and fire growth associated with the foam in building construction, industry, transport, etc. should be assessed in accordance with the recommendations of BS 6336. That is, consideration should be given to the design of the end product formed from, or incorporating, the foam and the risks to which it might be exposed.

This standard is concerned only with the specification of phenolic foam as a basic material, designed for insulating purposes, with burning characteristics of a specified class when tested in accordance with BS EN 13501-1, using the appropriate mounting and fixing procedures, as specified in BS EN 15715.

The fire characteristics of phenolic foam measured in accordance with BS EN 13501-1 can be affected by the blowing agent used and any facings applied to the boards. The production of smoke and flaming droplets may be assessed in accordance with BS EN 13823, which forms a part of the BS EN 13501-1 classification system. It would be expected that the smoke levels registered by this test would be zero or very close to zero and that flaming droplets would not be produced by thermoset phenolic foam thermal insulation products.

An alternative classification for reaction to fire is the use of BS 476, Parts 6 & 7 as indicated in table 1.

C.2 Recommended practices for storage, handling and fabrication of thermoset phenolic insulating foam and PF foam products

The following recommended practices should be taken into account for the storage and fabrication of phenolic insulating foam and PF foam products.

a) Best practice standards should be maintained.

b) Sensible fire precautions should be observed.

c) Reference should be made to Material Safety Data Sheets when carrying out COSHH or other risk assessment procedures.

Annex D (Informative)

Information on the installation of insulation boards onto internal wall linings and ceilings

D.1 Design considerations

Attention is drawn to the Building Regulations for England and Wales [2] which require the application of cavity barriers to minimize the spread of flame within any cavity formed within a construction. The Building Regulations Approved Document B [1] Section 9 gives specific
guidance on the requirements.

In wall constructions it is recommended that the boards are not used below a height of 2400 mm where mechanical damage might occur to the face of the board. Impact resistant facings are suggested for such situations.

Where roof lights and ventilators are specified, they should be compatible with the insulated building element to maintain the spread of flame requirements under the Building Regulations [2] and the designed insulation performance, as well as to preserve a good appearance.

D.2 Storage of boards

Boards should be stored in flat and dry conditions. Boards are normally supplied in protective wrapping. The package provides protection against accidental exposure, but should not be considered adequate for long term outside protection. If outside storage is unavoidable, the boards should be stacked clear of the ground and covered with a securely anchored weatherproof sheet.

D.3 Handling

Boards should be carried on edge. Horizontal carrying can impose an undesirable strain on the boards. The boards should not be slid over each other and accordingly they should be handled with care and placed in position to avoid surface and edge damage.

D.4 Cutting of the boards

Boards should be cut using a sharp knife or fine toothed saw.

D.5 Vapour barriers

The water vapour resistance of the boards is adequate for most standards lining systems, depending on the board joints. Where the humidity is liable to exceed 65% RH at 21°C, a high humidity fixing specification should be incorporated. Consideration should be given to vapour barrier continuity by means of jointing seals (see D.6).

D.6 Humidity: condensation risks

The major characteristic of thermoset phenolic insulation boards is their high thermal resistance value i.e. "R"value. Their prime function is to provide a highly efficient thermal insulant for a building element. In carrying out this function, they also become a separating agent between two different temperature and humidity environments.

The air below the board lining (under or over purlin) is likely to be warmer than the air above the lining. The migration of humid air from below to above can therefore lead to interstitial condensation problems. Many buildings where Thermoset Phenolic insulation boards are installed as a lining are lightweight structures and therefore characterized by a fast thermal response. In many instances, the occupancy levels and processes produce high levels of temperature and humidity. Therefore, extreme care should be taken to avoid the conditions that could generate condensation within the roof/lining element.

Bibliography

Standards publications

BS 5946, *Method of test for determination of the punking behaviour of phenol-formaldehyde foam.*

BS 6336, *Guide to the development of fire tests, the presentation of test data and the role of tests in hazard assessment.*

BS EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item.*

BS EN 11925-2:2002, *Reaction to fire tests. Ignitability of building products subjected to direct impingement of flame. Single flame source test.*

Phenolic foam thermal insulation products for buildings and building services end use applications

Part 3 - Specification for phenolic foam (PF) products for use as thermal insulation for flat roofs

3.10

Contents

Foreword

Publishing Information.

This British Standard was published by BSI and came into effect on xx xxx 2009. It was prepared by Subcommittee PRI/72/3, *Phenolic*, under the authority of Technical Committee PRI/72, *Rigid Cellular Materials*. It is part 3 of a 7-part standard covering the various applications of phenolic foam insulation products in the building and construction industry.

Information about this document

Part 3 of this standard has been introduced to specify the requirements needed to ensure fitness for purpose of phenolic foam thermal insulation products used in the insulation of flat roofs in the United Kingdom. Parts 1-6 of this non-conflicting standard meet the requirement of BS EN 13166 that 'The levels required for a given application are to be found in regulations or non-conflicting standards'.

Contractual and legal obligations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

1 Scope

This British Standard specifies the composition, classification and physical property performance limit values for thermoset phenolic foam thermal insulation products used in the insulation of flat roofs. Such products include phenolic foam slabs, blocks, boards and profiled sheets, which may also be faced with flexible or rigid facings.

The nominal temperature range in which the material is suitable for use in insulation products is – 200 °C to + 120 °C as stated in BS EN 13166.

NOTE Guidance on using products made from PF foam at temperatures below – 180 °C is given in Annex A.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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BS 476: Part 7, *Fire tests on building materials and structures – method for the classification of surface spread of flame of products.*

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BS EN 12939, *Thermal performance of building material and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Thick products of high and medium thermal resistance*.

BS EN 13166, *Thermal insulation products for buildings — Factory made products of phenolic foam (PF) — Specification*.

BS EN 13467, *Thermal insulating products for building equipment and industrial installations — Determination of dimensions, squareness and linearity of preformed pipe insulation*.

BS EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*.

BS EN 15715, *Thermal insulation products – Instructions for mounting and fixing for reaction to fire testing – Factory made products.*

BS 6399, *Loading for buildings - Part 2: Code of practice for wind loads.*

EN ISO 6946, *Building components and building elements. Thermal resistance and thermal transmittance. Calculation method.*

BS 3690-2, *Bitumens for building and civil engineering. Specification for bitumens for industrial purposes.*

3 Classification

The products shall be classified into one of two types, A or B, in accordance with the requirements specified in Table 1.

Table 1 — Physical property requirements

Physical Property		Value[a]	Method of Test
Minimum density (kg/m^3) [b]		30	BS EN 1602
Maximum declared value of thermal conductivity (W/m·K)[c]		0.025	BS EN 12667 or BS EN 12939 as specified in BS EN 13166
Minimum compressive strength at 10% strain, (kPa)[c]		CS(Y) 150	BS EN 826
Minimum bending strength in any direction, (kPa)[c]		200	BS EN 12089
Dimensional stability: maximum percentage linear change, 23°C/50% RH.[c]		0.5	BS EN 1603
Dimensional stability under specified conditions[c] 48h at (23±2)°C and (90±5)% RH 48h at (70±2)°C 48h at (70±2)°C and (90±5)% RH 48h at (-20±2)°C		 *l* & *w* ±0.5%, *t* ±1.5% *l* & *w* ±1.5%, *t* ±3% *l*, *w* & *t* ±1.5% *l*, *w* & *t* ±1.5%	BS EN 1604
Flatness[c]: *t* = <50 mm 50 to 100 mm >100 mm		≤10.0 ≤ 7.5 ≤ 5.0	BS EN 825
Minimum water vapour resistance (Z) (MNs/g)[b]		25	BS EN 12086
Minimum reaction to fire performance[b]	either BS 476	I < 12, i < 6	BS 476, Part 6
		Class1	BS 476, Part7
	or Euroclass	Class C	BS EN 13501-1

NOTE: Products conforming to this standard shall have a minimum fire performance of Euroclass B when tested to BS EN 13501-1 using the appropriate standard test configuration of assemblies simulating end-use applications as specified in table 5 of BS EN 15715.
[a] Manufacturer's declared closed cell content > 90% [b] For foam excluding facings. For mechanical properties of foam products other than those indicated or for actual mechanical properties of high density products, please refer to the manufacturer's literature. [c] For product as placed on the market. *l* = length, *w* = width, *t* = thickness, RH = relative humidity.

4 Composition

4.1. General

The insulation products shall consist of phenolic foam of uniform cellular structure together with any flexible or rigid facings on one or both sides.

4.2. Facings

Flexible facings may be functional or decorative (e.g. paper, metal foil, glass tissue, etc.).

NOTE The type of facing and the degree of their bonding are crucial to ensure good service performance for laminated insulation boards. The degree of bonding, if a required property, should conform to the recommendations given in Annex B when determined according to the procedure given in Annex B.

5 Dimensions and dimensional tolerances of PF thermal insulation products

5.1 Length and Width

Length, *l*, and width, *b*, shall be determined in accordance with BS EN 822. No test result shall deviate from the nominal values by more than the tolerances given in Table 2 for the corresponding dimensions.
Products with a surface facing or natural skin shall be tested without removing them.

Table 2 — Tolerances for length and width

Dimensions in millimetres

Dimensions	Length	Width
< 1250	± 5,0	± 3,0
1 250 to 2 000	± 7,5	± 7,5
2 001 to 4 000	± 10,0	± 7,5
> 4000	± 15,0	± 10,0

5.2 Thickness

Thickness, *d*, shall be determined in accordance with BS EN 823. No test result shall deviate from the nominal thickness, d_N, by more than the tolerance given in Table 3 for the labelled class

Table 3 — Classes for thickness tolerances

Dimensions in millimetres

Nominal thickness	Tolerance	
	T1	T2
< 50	± 2,0	± 1,5
50 to 100	–2,0 +3,0	± 1,5
> 100	–2,0 +5,0	± 1,5

5.3 Squareness

Squareness shall be determined in accordance with BS EN 824. The deviation from squareness on length and width, S_b, shall not exceed 8 mm/m. The deviation from squareness on thickness, S_d, shall not exceed 2 mm.

5.4 Flatness

Deviation from flatness of the board shall be determined in accordance with BS EN 825. The deviation from flatness, S_{max}, shall not exceed the tolerances given in Table 4 for the corresponding nominal thickness, d_N.

Table 4 — Tolerances for deviation from flatness

Dimensions in millimetres

Nominal thickness	Tolerance
< 50	□ 10.0
50 to 100	□ 7.5
> 100	□ 5.0

6 Physical properties

The physical properties shall conform to the requirements specified in Table 1, when tested in accordance with the methods indicated therein.

NOTE For further information on the reaction to fire performance of PF insulation products see Annex C.

7 Sampling

Sampling for factory production control purposes shall follow the relevant requirements of Table B.1 of BS EN 13166.

8 Installation

Notes on best practice for spanning capabilities of PF insulation products in flat roofs are given in Annex D. Product installation varies with geographical location and manufacturer's technical advice must be sought. Requirements for additional fixing should be assessed in accordance with BS 6399, Part 2.

9 Designation

Boards shall be given the following minimum designation:

"BS xxxx – 3:2009/BS EN 13166: XX: Y, sn,dn" where, in accordance with Table 1,

- XX is the thermal conductivity in mW/mK
- Y, sn, dn is the fire classification in application (using standard test configuration of assembly 2 in BS EN 15715).

Further information, in accordance with BS EN 13166, may be included in the designation.

10 Marking and labelling

The product, packaging and invoices shall be marked with at least the following information:

a) manufacturer's name and trademark;

b) product designation as given in Clause 9;

c) manufacturer's description and/or product reference.

NOTE: The designation shall be given in current product literature and/or on the product label.

Annex A (informative)

Notes for designers and product users

a) Materials of apparent density 30 kg/m^3 to 60 kg/m^3 are normally found suitable for most thermal insulation purposes within the scope of this standard.

b) In designing insulation systems with phenolic foams, care should be taken to prevent ingress of water.

c) Adequate precautions should be taken to prevent moisture being interposed between metal and foam surfaces.

d) For normal use, rigid phenolic foam materials are suitable for use in the temperature range - 180 °C to + 120 °C.

NOTE The lower temperature limit is selected to indicate the unsuitability of these materials for insulation of liquid oxygen plants. These materials can however be used at temperatures down to – 200 °C provided that precautions are taken to prevent the condensation of atmospheric oxygen in or on the insulation.

Annex B (informative)

Method for the determination of areas of unbonded facings

B.1 Principle

The unbonded area is established by removing loose facing material after cutting up the specimen.

B.2 Apparatus

B.2.1 Bandsaw or similar fine toothed saw.

B.2.2 Means for measuring the dimensions of unbonded areas, i.e. a rule with an accuracy of 0.5 mm.

B.3 Test specimen

The test specimen should be a right parallelepiped with a length and breadth not exceeding 1200 mm x 600 mm. The thickness of the test specimen should be the full thickness of the insulation board laminate including facings.

B.4 Number of test specimens

One test specimen should be tested.

B.5 Conditioning

Test specimens should be conditioned immediately before testing for a period of not less than 16 h at a temperature of (23 ± 2) ^{0}C and a relative humidity of (50 ± 5) %.

B.6 Procedure

Conduct the test at (23 ± 2) ^{0}C. Mark the test specimen in a manner that identifies the upper and lower faces. Cut the test specimen parallel to either axis into strips 50 mm wide, each strip being marked so as to identify its original position relative to the other strips (see Figure B.1). Examine both faces of each strip to determine whether any of the facings are not bonded to the core.

Remove any areas of facing and measure the unbonded area(s).

NOTE 1. The necessity for identifying each individual strip and its relative position is to enable unbonded areas of the facing that may extend continuously across more than one strip to be computed as a single area. Individual areas may therefore be computed as well as the sum total of all such areas.

NOTE 2. Felt marker pens are most suitable for marking the edges of the test specimen.

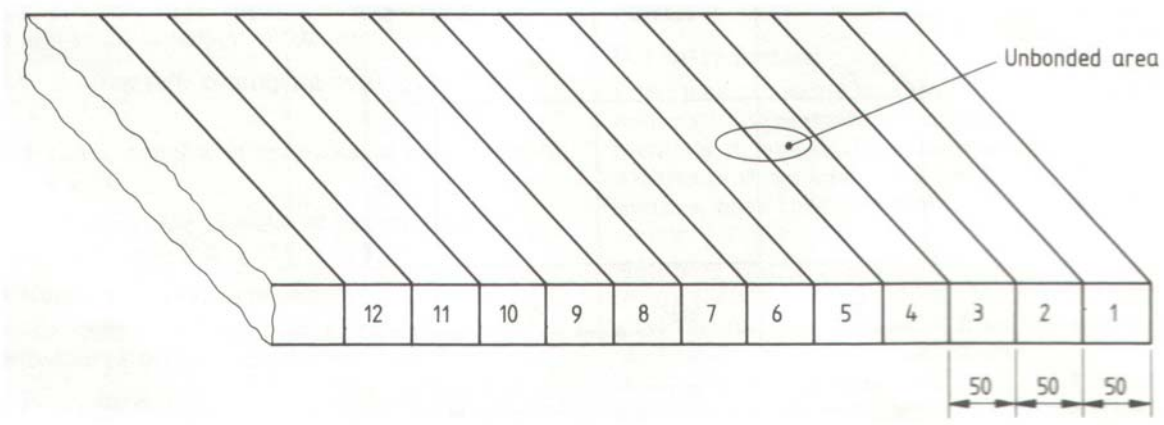
B.7 Expression of results

Measure all unbonded areas individually as well as the sum total of all such areas and express the results as a percentage of the original area of the test specimen.

B.8 Test report

The test report should include the following:

(a) the identification of the insulation board tested;
(b) the individual unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(c) the sum of the unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(d) the description and date of this specification, i.e. BS xxxx-1:2007.



All dimensions are in millimetres.

Figure B.1 Determination of area(s) of unbonded facings: cutting and marking of the test specimen

Annex C (informative)

Burning characteristics of phenolic foams, recommendations regarding their use and storage

C.1 Burning properties of phenolic foam and recommendations for use

Any risk of ignition and fire growth associated with the foam in building construction, industry, transport, etc. should be assessed in accordance with the recommendations of BS 6336. That is, consideration should be given to the design of the end product formed from, or incorporating, the foam and the risks to which it might be exposed.

This standard is concerned only with the specification of phenolic foam as a basic material, designed for insulating purposes, with burning characteristics of a specified class when tested in accordance with BS EN 13501-1 using the appropriate mounting and fixing procedures as specified in BS EN 15715.

The fire characteristics of phenolic foam measured in accordance with BS EN 13501-1 can be affected by the blowing agent used and any facings applied to the boards. The production of smoke and flaming droplets may be assessed in accordance with BS EN 13823, which forms a part of the BS EN 13501-1 classification system. It would be expected that the smoke levels registered by this test would be zero or very close to zero and that flaming droplets would not be produced by thermoset phenolic foam thermal insulation products.

An alternative classification for reaction to fire is the use of BS 476, Parts 6 & 7 as indicated in table 1.

C.2 Recommended practices for storage, handling and fabrication of thermoset phenolic insulating foam and PF foam products

The following recommended practices should be taken into account for the storage and fabrication of phenolic insulating foam and PF foam products.

a) Best practice standards should be maintained.

b) Sensible fire precautions should be observed.

c) Reference should be made to Material Safety Data Sheets when carrying out COSHH or other risk assessment procedures.

Annex D (Informative)

Information on the installation of phenolic foam insulation boards roofs.

D.1 General

The attention of designers is drawn to the need for the finished construction to comply with the relevant Building Regulations.

D.1.1 Guidance on sampling

In cases of doubt or dispute as to whether a consignment of roofboards complies with this specification, a possible procedure is to select one roofboard at random for test from each 500 roofboards of a consignment supplied or from the total, if this is less than 500.

In the event of non-compliance by any roofboard with this specification, two more roofboards should be tested from the same group of 500. If either of these roofboards does not comply, the whole consignment should be considered not to comply with this specification.

D.1.2 Traffic aspects: heavy duty roofs

The compressive strength of 150kPa normal to the plane of the roofboard is suitable for roofboards to be used in roofs which are subjected to normal pedestrian access traffic only. Consideration should be given to providing independent walkways or extra surface structures for roofs carrying higher loads.

D.1.3 Fire aspects

The attention of designers is drawn to the need for the final roofing total composition to give the appropriate grading in accordance with BS 476: Part 3: 2004.

D.1.4 'Robustness' of roofboard

The designer's attention is drawn to the need for the roofboard to possess sufficient robustness to withstand the handling procedures concerned with its delivery and installation. This requrment is normally ensured by the product complying with the bending strength requirement of Table 1.

D.1.5 Roofboard design '*U*' values

It is recommended that the nominal thickness of the insulation board be used in calculating insulation board design '*U*' values. However, the U-value of the board including substantial rigid facings is obtained by taking into account the thermal resistance of any rigid facings.

NOTE. The method of determining the thermal resistance of the roof assemblies is given in BS EN ISO 6946.

D.2 Profiled metal deck flat roofs.

D.2.1 Consideration of board thickness.

When installing PF thermal insulation boards into profiled metal deck flat roofs, the recommended board thickness is related to the width of the trough openings in the metal deck. Recommendations on this matter are given in Table D.1

Table D.1 Relationships between roof-board thickness and metal deck trough openings

Trough opening mm	Minimum roof-board thickness mm
< 75	25
> 75 to ≤100	30
>100 to ≤125	35
>125 to ≤150	40
>150 to ≤175	45
>175 to ≤200	50
>200 to ≤225	55
>225 to ≤250	60

D.3 Built-up roofs

D.3.l Introduction

Thermoset phenolic roofboards should be installed in accordance with BS 6229:2003. However, that code of practice does not contain specific recommendations for the use of phenolic roofboards. Until such time as a new standard for built-up bitumen felt is produced, these recommendations will provide guidance for the use of phenolic roofboards under built-up felt roofing. The recommendations given in D.3.2 to D.3.3 follow guidelines issued by the Flat Roofing Alliance. These have been in existence for a number of years and experience has shown that if followed they produce satisfactory results.

D.3.2 Methods of attachment

Generally, roofboards should be laid close-butted with staggered end joints and bonded to the supporting deck or bituminous vapour check or barrier using hot applied bonding bitumen. The need for a vapour barrier between the deck and the roofboard should be assessed by considering the total system in accordance with BS 5250:2000. On troughed metal decking, in order to avoid unsupported edges, roofboards are normally cut to length (in the factory or on site) to match the pitch of the decking. Roofboards should be laid with the long edge at right angles to the span of the deck and with the end joints staggered. An alternative is to lay the roofboards diagonally. As an alternative to bedding on hot bitumen, roofboards may be bonded using proprietary cold adhesives. In these situations it is essential that the installer follows the recommendations of the manufacturer. Bonded roofboards may also require additional mechanical anchorage in areas of high wind uplift, as recommended in BS 6399-3:1988, Clause 6.

D.3.4 Moisture protection

Roofboards should be protected from moisture ingress prior to use.

D.4 Single-ply roofs

D.4.1 General

Thermoset phenolic roofboards should be installed in accordance with the Design Guide of the Single Ply Roofing Association.

D.4.2 Moisture protection

Roofboards should be protected from moisture ingress prior to use and should not be left uncovered, exposed to rain, hail or snow, or immersed in water prior to use of during the construction operations.

D.4.3 Ketone based adhesives

Attention is drawn, when using adhesives to adhere the membrane to the boards, to follow the membrane manufacturer's instructions so as to avoid ketonic based adhesives coming into contact with the core.

Whilst phenolic cored rigid based boards are renowned for their general chemical stability and as an example remain unimpaired when exposed to many hydrocarbons, alcoholic based and aqueous based materials, they are softened when exposed to ketonic solvents.

Annex E (informative)

Dimensional stability in built-up roofing – Bitumen pour test

E.1 General

The dimensional stability of the roofboard should be such that the average change in any dimension is not greater than 0.15%when tested in accordance with the method in this annex.

E.2 Principle

The changes in dimensions of 300 mm x 300 mm test specimens of the roofboard are measured after the application of one layer of roofing felt, fully bonded to the roofboard using hot bitumen.

E.3 Apparatus

E.3.1 *Bitumen,* of grade 95/25 conforming to BS 3690-2:1989.

E.3.2 *Length gauge,* capable of measuring up to 500 mm to accuracy of 0.1 mm.

E.3.3 *Roofing felt,* conforming to type 3B of BS 747:2000.

E.4 Number of test specimens

Four 300 mm x 300 mm roofboard test specimens should be selected from the roofboard being tested.

E.5 Procedure

Measure each test specimen as follows. Mark each edge of the specimens with two marks at 1/3 and 2/3 of the distance along each edge, as shown in Figure E.1. Measure the distances X_1, X_2, Y_1, and Y_2 using the length gauge to an accuracy of 0.1 mm. Bond each of the four test specimens to the roofing felt by first applying to the uppermost surface of a horizontal roofboard just sufficient bitumen at 240°C to 250 °C to cover the upper surface and then rolling on the felt in the manner described fully in BS 8218:1998. Immediately after bondings re-measure for each of the four test specimens the distances X_1, X_2, Y_1 and Y_2. Repeat these measurements at 1 h, 2 h, 6 h, 8 hand 24 h after bonding. Determine each of these values for each test specimen:
a) the maximum percentage expansion obtained relative to the corresponding unbonded distance;
b) the maximum percentage contraction obtained relative to the corresponding unbonded distance.

E.6 Calculation of results

Using the information determined in E.5 a) and b) calculate:
a) the total percentage dimensional change as the sum of the two values;
b) the mean total percentage dimensional change for all the X distances on all four test specimens;
c) the mean total percentage dimensional change for all the Y distances on all four test specimens;

d) the average total percentage dimensional change as the average of the two values calculated in b) and c).

E.7 Test report

The test report shall include the following:
a) the identification of the roofboard tested;
b) the average mean total percentage dimensional change (in %);
c) the number and date of this British Standard, i.e. BS 4841-3:2006.

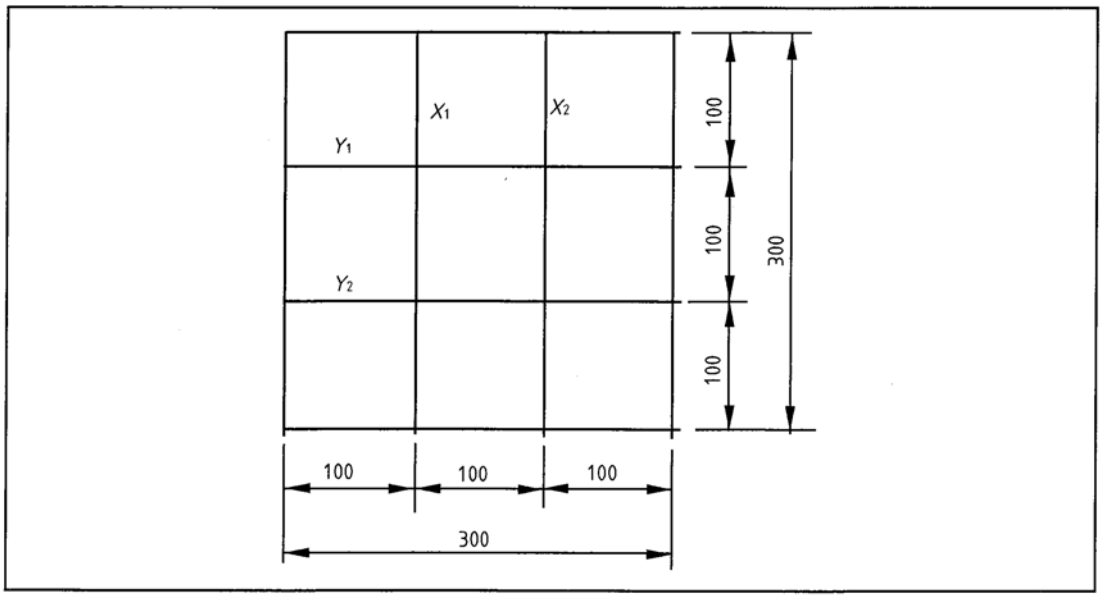


Figure E.1. See reference in clause E.5

Bibliography

Standards publications

BS 5946, *Method of test for determination of the punking behaviour of phenol-formaldehyde foam*.

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Phenolic foam thermal insulation products for building and building services end use applications

Part 4 - Specification for phenolic foam (PF) products for use as thermal insulation for framing and pitched roofs

3.10

Contents

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BS EN 1609, *Thermal insulating products for building applications — Determination of short term water absorption by partial immersion.*

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BS EN 12089, *Thermal insulating products for building applications — Determination of bending behaviour.*

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BS EN 12939, *Thermal performance of building material and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Thick products of high and medium thermal resistance*.

BS EN 13166, *Thermal insulation products for buildings — Factory made products of phenolic foam (PF) — Specification*.

BS EN 13467, *Thermal insulating products for building equipment and industrial installations — Determination of dimensions, squareness and linearity of preformed pipe insulation*.

BS EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*.

BS EN 15715, *Thermal insulation products – Instructions for mounting and fixing for reaction to fire testing – Factory made products.*

3 Classification

The products shall be classified in accordance with the requirements specified in Table 1.

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Minimum density (kg/m^3) [b]		25	BS EN 1602
Maximum declared value of thermal conductivity (W/m·K)[c]		0.025	BS EN 12667 or BS EN 12939 as specified in BS EN 13166
Minimum compressive strength at 10% strain, (kPa)[c]		CS(Y) 100	BS EN 826
Minimum bending strength in any direction, (kPa)[c]		200	BS EN 12089
Dimensional stability: maximum percentage linear change, 23°C/50% RH.[c]		0.5	BS EN 1603
Dimensional stability under specified conditions[c] 48h at (23±2)°C and (90±5)% RH 48h at (70±2)°C 48h at (70±2)°C and (90±5)% RH 48h at (-20±2)°C		*l* & *w* ±0.5%, *t* ±1.5% *l* & *w* ±1.5%, *t* ±3% *l*, *w* & *t* ±1.5% *l*, *w* & *t* ±1.5%	BS EN 1604
Flatness[c]:	*t* = <50 mm 50 to 100 mm >100 mm	≤10.0 ≤ 7.5 ≤ 5.0	BS EN 825
Minimum water vapour resistance (Z) (MNs/g)[b]		25	BS EN 12086
Minimum reaction to fire	either BS 476	I < 12, i < 6	BS 476, Part 6
		Class1	BS 476, Part7

performance[b]	or Euroclass	Class C	BS EN 13501-1
NOTE: Products conforming to this standard shall have a minimum fire performance of Euroclass B when tested to BS EN 13501-1 using the appropriate standard test configuration of assemblies simulating end-use applications as specified in Table 5 of BS EN 15715.			
[a] Manufacturer's declared closed cell content > 90% [b] For foam excluding facings. For mechanical properties of foam products other than those indicated or for actual mechanical properties of high density products, please refer to the manufacturer's literature. [c] For product as placed on the market. *l* = length, *w* = width, *t* = thickness, RH = relative humidity.			

4 Composition

4.1 General

The insulation products shall consist of phenolic foam of uniform cellular structure together with any flexible or rigid facings on one or both sides.

4.2 Facings

Flexible facings may be functional or decorative (e.g. paper, metal foil, glass tissue, etc.).

NOTE The type of facing and the degree of their bonding are crucial to ensure good service performance for laminated insulation boards. The degree of bonding, if a required property, should conform to the recommendations given in Annex B when determined according to the procedure given in Annex B.

5 Dimensions and dimensional tolerances of PF thermal insulation products

5.1 Length and Width

Length, *l*, and width, *b*, shall be determined in accordance with BS EN 822. No test result shall deviate from the nominal values by more than the tolerances given in Table 2 for the corresponding dimensions.
Products with a surface facing or natural skin shall be tested without removing them.

Table 2 — Tolerances for length and width

Dimensions in millimetres

Dimensions	Length	Width
< 1250	± 5,0	± 3,0
1 250 to 2 000	± 7,5	± 7,5
2 001 to 4 000	± 10,0	± 7,5
> 4000	± 15,0	± 10,0

5.2 Thickness

Thickness, *d*, shall be determined in accordance with BS EN 823. No test result shall deviate from the nominal thickness, d_N, by more than the tolerance given in Table 3 for the labelled class

Table 3 — Classes for thickness tolerances

Dimensions in millimetres

Nominal thickness	Tolerance	
	T1	T2
< 50	± 2,0	± 1,5
50 to 100	–2,0 +3,0	± 1,5
> 100	–2,0 +5,0	± 1,5

5.3 Squareness

Squareness shall be determined in accordance with BS EN 824. The deviation from squareness on length and width, S_b, shall not exceed 8 mm/m. The deviation from squareness on thickness, S_d, shall not exceed 2 mm.

5.4 Flatness

Deviation from flatness of the board shall be determined in accordance with BS EN 825. The deviation from flatness, S_{max}, shall not exceed the tolerances given in Table 4 for the corresponding nominal thickness, d_N.

Table 4 — Tolerances for deviation from flatness

Dimensions in millimetres

Nominal thickness	Tolerance
< 50	□ 10.0
50 to 100	□ 7.5
> 100	□ 5.0

6 Physical properties

The physical properties shall conform to the requirements specified in Table 1, when tested in accordance with the methods indicated therein.

NOTE For further information on the reaction to fire performance of PF insulation products see Annex C.

7 Sampling

Sampling for factory production control purposes shall follow the relevant requirements of Table B.1 of BS EN 13166.

8 Installation

Notes on best practice for installation of PF insulation products in framing and pitched roofs are given in Annex D.

9 Designation

Boards shall be given the following minimum designation:

"BS xxxx – 4:2009/BS EN 13166: XX: Y, sn, dn" where, in accordance with Table 1,

- XX is the thermal conductivity in mW/mK
- Y, sn, dn is the fire classification in application (using standard test configuration of assembly 2 in BSEN 15715).

Further information, in accordance with BS EN 13166, may be included in the designation.

10 Marking and labelling

The product, packaging and invoices shall be marked with at least the following information:

a) manufacturer's name and trademark;

b) product designation as given in Clause 9;

c) manufacturer's description and/or product reference.

NOTE: The designation shall be given in current product literature and/or on the product label.

Annex A (informative)

Notes for designers and product users

BS 5970 gives guidance on the design of thermal insulation systems. However, certain points that have special relevance to cellular condensation polymers and which would equally apply to rigid phenolic foams are given in a) to d).

a) Materials of apparent density 30 kg/m^3 to 60 kg/m^3 are normally found suitable for most thermal insulation purposes within the scope of this standard.

b) In designing insulation systems with phenolic foams, care should be taken to prevent ingress of water.

c) Adequate precautions should be taken to prevent moisture being interposed between metal and foam surfaces.

d) For normal use, rigid phenolic foam materials are suitable for use in the temperature range - 180 °C to + 120 °C.

NOTE The lower temperature limit is selected to indicate the unsuitability of these materials for insulation of liquid oxygen plants. These materials can however be used at temperatures down to – 200 °C provided that precautions are taken to prevent the condensation of atmospheric oxygen in or on the insulation.

Annex B (informative)

Method for the determination of areas of unbonded facings

B.1 Principle

The unbonded area is established by removing loose facing material after cutting up the specimen.

B.2 Apparatus

B.2.1 Bandsaw or similar fine toothed saw.

B.2.2 Means for measuring the dimensions of unbonded areas, i.e. a rule with an accuracy of 0.5 mm.

B.3 Test specimen

The test specimen should be a right parallelepiped with a length and breadth not exceeding 1200 mm x 600 mm. The thickness of the test specimen should be the full thickness of the insulation board laminate including facings.

B.4 Number of test specimens

One test specimen should be tested.

B.5 Conditioning

Test specimens should be conditioned immediately before testing for a period of not less than 16 h at a temperature of (23 ± 2) ^{0}C and a relative humidity of (50 ± 5) %.

B.6 Procedure

Conduct the test at (23 ± 2) ^{0}C. Mark the test specimen in a manner that identifies the upper and lower faces. Cut the test specimen parallel to either axis into strips 50 mm wide, each strip being marked so as to identify its original position relative to the other strips (see Figure B.1). Examine both faces of each strip to determine whether any of the facings are not bonded to the core.

Remove any areas of facing and measure the unbonded area(s).

NOTE 1. The necessity for identifying each individual strip and its relative position is to enable unbonded areas of the facing that may extend continuously across more than one strip to be computed as a single area. Individual areas may therefore be computed as well as the sum total of all such areas.

NOTE 2. Felt marker pens are most suitable for marking the edges of the test specimen.

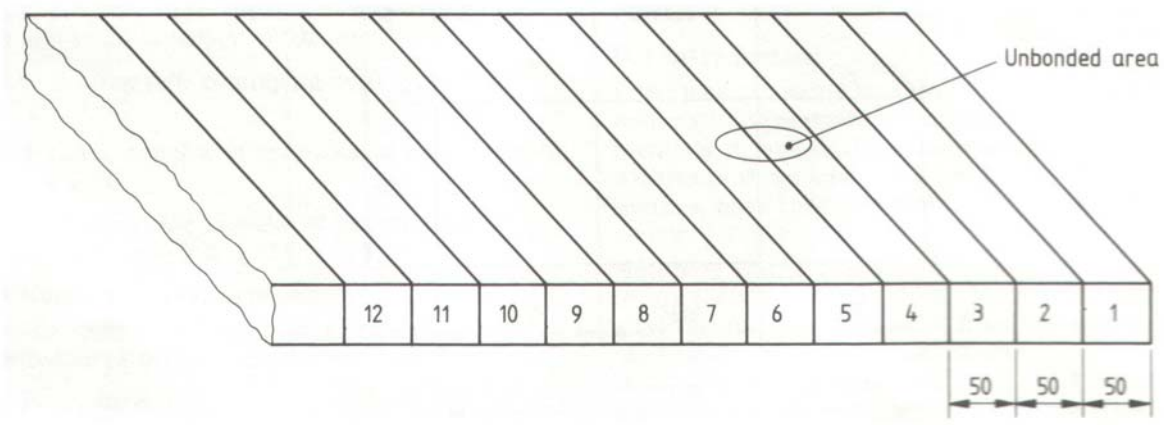
B.7 Expression of results

Measure all unbonded areas individually as well as the sum total of all such areas and express the results as a percentage of the original area of the test specimen.

B.8 Test report

The test report should include the following:

(a) the identification of the insulation board tested;
(b) the individual unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(c) the sum of the unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(d) the description and date of this specification, i.e. BS xxxx-1:2007.



All dimensions are in millimetres.

Figure B.1 Determination of area(s) of unbonded facings: cutting and marking of the test specimen

Annex C (informative)

Burning characteristics of phenolic foams, recommendations regarding their use and storage

C.1 Burning properties of phenolic foam and recommendations for use

Any risk of ignition and fire growth associated with the foam in building construction, industry, transport, etc. should be assessed in accordance with the recommendations of BS 6336. That is, consideration should be given to the design of the end product formed from, or incorporating, the foam and the risks to which it might be exposed.

This standard is concerned only with the specification of phenolic foam as a basic material, designed for insulating purposes, with burning characteristics of a specified class when tested in accordance with BS EN 13501-1 using the appropriate mounting and fixing procedures as specified in BS EN 15715.

The fire characteristics of phenolic foam measured in accordance with BS EN 13501-1 can be affected by the blowing agent used and the facings applied to the boards. The production of smoke and flaming droplets may be assessed in accordance with BS EN 13823, which forms a part of the BS EN 13501-1 classification system. It would be expected that the smoke levels registered by this test would be zero or very close to zero and that flaming droplets would not be produced by thermoset phenolic foam thermal insulation products.

The fire performance of insulation boards in isolation is not significant in terms of this end-use application since the UK Building Regulations Approved Document B gives no fire requirements for products installed within frames or pitched roofs. It relates only to linings. For these the appropriate Euroclass (BS EN 13501-1) results must be sourced.

An alternative classification for reaction to fire is the use of BS 476, Part 7 as indicated in table 1.

Further information may be obtained on the fire performance of wall structures using fire resistance test methods.

C.2 Recommended practices for storage, handling and fabrication of thermoset phenolic insulating foam and PF foam products

The following recommended practices should be taken into account for the storage and fabrication of phenolic insulating foam and PF foam products.

a) Best practice standards should be maintained.

b) Sensible fire precautions should be observed.

c) Reference should be made to Material Safety Data Sheets when carrying out COSHH or other risk assessment procedures.

Bibliography

Standards publications

BS 5946, *Method of test for determination of the punking behaviour of phenol-formaldehyde foam*.

BS 6336, *Guide to the development of fire tests, the presentation of test data and the role of tests in hazard assessment*.

BS EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*.

Phenolic foam thermal insulation products for building and building services end use applications

Part 5 - Specification for phenolic foam (PF) products for use as thermal insulation for flooring

3.10

Contents

Foreword

Publishing Information.

The British Standard was published by BSI and came into effect on xx xxx 2009. It was prepared by Subcommittee PRI/72/3, *Phenolic*, under the authority of Technical Committee PRI/72, *Rigid Cellular Materials*. It is part 5 of a 7-part standard covering the various applications of phenolic foam insulation products in the building and construction industry.

Information about this document

Part 5 of this standard has been introduced to specify the requirements needed to ensure fitness for purpose of phenolic foam thermal insulation products used in the insulation of floors the United Kingdom. Parts 1-6 of this non-conflicting standard meet the requirement of BS EN 13166 that 'The levels required for a given application are to be found in regulations or non-conflicting standards'.

Contractual and legal obligations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

1 Scope

This British Standard specifies the composition, classification and physical property performance limit values for thermoset phenolic foam thermal insulation products for application in floors. Such products include phenolic foam slabs, blocks, boards and profiled sheets, which may also be faced with flexible or rigid facings.

The nominal temperature range in which the material is suitable for use in insulation products is – 200 °C to + 120 °C as stated in BS EN 13166.

NOTE Guidance on using products made from PF foam at temperatures below – 180 °C is given in Annex A.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 476: Part 6, *Fire tests on building materials and structures – method of test for fire propagation of products.*

BS 476: Part 7, *Fire tests on building materials and structures – method for the classification of surface spread of flame of products.*

BS 5970, *Code of practice for thermal insulation of pipework and equipment in the temperature range of -100°C to +870°C*

BS 1521, *Specification for waterproof building papers.*

BS EN 823, *Thermal insulating products for building applications — Determination of thickness.*

BS EN 824, *Thermal insulating products for building applications — Determination of squareness.*

BS EN 825, *Thermal insulating products for building applications — Determination of flatness.*

BS 1521:1972. *Specification for waterproof building papers.*

BS EN 826, *Thermal insulating products for building applications — Determination of compression behaviour.*

BS EN 1602, *Thermal insulating products for building applications. Determination of the apparent density.*

BS EN 1603, *Thermal insulating products for building applications — Determination of dimensional stability under constant normal laboratory conditions (23 °C/50% relative humidity).*

BS EN 1609, *Thermal insulating products for building applications — Determination of short term water absorption by partial immersion.*

BS EN 12086, *Thermal insulating products for building applications — Determination of water vapour transmission properties.*

BS EN 12089, *Thermal insulating products for building applications — Determination of bending behaviour.*

BS EN 12667, *Thermal performance of building materials and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Products of high and medium thermal resistance.*

BS EN 12939, *Thermal performance of building material and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Thick products of high and medium thermal resistance*.

BS EN 13166, *Thermal insulation products for buildings — Factory made products of phenolic foam (PF) — Specification*.

BS EN 13467, *Thermal insulating products for building equipment and industrial installations — Determination of dimensions, squareness and linearity of preformed pipe insulation*.

BS EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*.

3 Classification

The materials shall be classified in accordance with the requirements specified in Table 1.

Table 1 — Physical property requirements

Physical Property	Value[a]	Method of Test
Density (kg/m^3) [b]	25	BS EN 1602
Maximum declared value of thermal conductivity (W/m·K)[c]	0.025	BS EN 12667 or BS EN 12939 as specified in BS EN 13166
Minimum compressive strength at 10% strain, (kPa)[c]	CS(Y) 100	BS EN 826
Minimum bending strength in any direction, (kPa)[c]	200	BS EN 12089
Dimensional stability: maximum percentage linear change, 23°C/50% RH.[c]	0.5	BS EN 1603
Dimensional stability under specified conditions[c] 48h at (23±2)°C and (90±5)% RH 48h at (70±2)°C 48h at (70±2)°C and (90±5)% RH 48h at (-20±2)°C	 *l* & *w* ±0.5%, *t* ±1.5% *l* & *w* ±1.5%, *t* ±3% *l*, *w* & *t* ±1.5% *l*, *w* & *t* ±1.5%	BS EN 1604

Flatness[c]: t = <50 mm 50 to 100 mm >100 mm	≤10.0 ≤ 7.5 ≤ 5.0	BS EN 825
Minimum water vapour resistance (Z) (MNs/g)[c]	25	BS EN 12086
Minimum fire performance (Euroclass)[c]	Class F (no performance determined)	BS EN 13501-1
[a] Manufacturer's declared closed cell content > 90% [b] For mechanical properties of foam products other than those indicated or for actual mechanical properties of high density products, please refer to the manufacturer's literature. [c] For product as placed on the market. l = length, w = width, t = thickness, RH = relative humidity.		

4 Composition

4.1 General

The insulation product shall consist of phenolic foam of uniform cellular structure. The marketed product may also be faced on one or both sides with a flexible or rigid facing product.

4.2 Facings

Flexible facings may be functional or decorative (e.g. paper, metal foil, glass tissue, etc.).

NOTE The type of facing and the degree of their bonding are crucial to ensure good service performance for laminated insulation boards. The degree of bonding, if a required property, should conform to the recommendations given in Annex B when determined according to the procedure given in Annex B.

5 Dimensions and dimensional tolerances of PF thermal insulation products

5.1 Length and Width

Length, l, and width, b, shall be determined in accordance with BS EN 822. No test result shall deviate from the nominal values by more than the tolerances given in Table 2 for the corresponding dimensions.
Products with a surface facing or natural skin shall be tested without removing them.

Table 2 — Tolerances for length and width

Dimensions in millimetres

Dimensions	Length	Width
< 1250	± 5,0	± 3,0
1 250 to 2 000	± 7,5	± 7,5
2 001 to 4 000	± 10,0	± 7,5
> 4000	± 15,0	± 10,0

5.2 Thickness

Thickness, *d*, shall be determined in accordance with BS EN 823. No test result shall deviate from the nominal thickness, d_N, by more than the tolerance given in Table 3 for the labelled class

Table 3 — Classes for thickness tolerances

Dimensions in millimetres

Nominal thickness	Tolerance	
	T1	T2
< 50	± 2,0	± 1,5
50 to 100	–2,0 +3,0	± 1,5
> 100	–2,0 +5,0	± 1,5

5.3 Squareness

Squareness shall be determined in accordance with BS EN 824. The deviation from squareness on length and width, S_b, shall not exceed 8 mm/m. The deviation from squareness on thickness, S_d, shall not exceed 2 mm.

5.4 Flatness

Deviation from flatness of the board shall be determined in accordance with BS EN 825. The deviation from flatness, S_{max}, shall not exceed the tolerances given in Table 4 for the corresponding nominal thickness, d_N.

Table 4 — Tolerances for deviation from flatness

Dimensions in millimetres

Nominal thickness	Tolerance
< 50	□ 10.0
50 to 100	□ 7.5
> 100	□ 5.0

6 Physical properties

The physical properties shall conform to the requirements specified in Table 1, when tested in accordance with the methods indicated therein.

NOTE For further information on the reaction to fire performance of PF insulation products see Annex C.

7 Sampling

Sampling for factory production control purposes shall follow the relevant requirements of Table B.1 of BS EN 13166.

8 Installation

Manufacturer's guidance should be followed.

9 Designation

Boards shall be given the following minimum designation:

"BS xxxx – 5:2009/BS EN 13166: XX: Y, sn, dn" where, in accordance with Table 1,

- XX is the thermal conductivity in mW/mK
- Y, sn, dn is the fire classification

Further information, in accordance with BS EN 13166, may be included in the designation.

10 Marking and labelling

The product, packaging and invoices shall be marked with at least the following information:

a) manufacturer's name and trademark;
b) product designation as given in Clause 9;
c) manufacturer's description and/or product reference.

NOTE: The designation shall be given in current product literature and/or on the product label.

Annex A (informative)

Notes for designers and product users

BS 5970 gives guidance on the design of thermal insulation systems. However, certain points that have special relevance to cellular condensation polymers and which would equally apply to rigid phenolic foams are given in a) to d).

a) Materials of apparent density 30 kg/m^3 to 60 kg/m^3 are normally found suitable for most thermal insulation purposes within the scope of this standard.

b) In designing insulation systems with phenolic foams, care should be taken to prevent ingress of water.

c) Adequate precautions should be taken to prevent moisture being interposed between metal and foam surfaces.

d) For normal use, rigid phenolic foam materials are suitable for use in the temperature range - 180 °C to + 120 °C.

NOTE The lower temperature limit is selected to indicate the unsuitability of these materials for insulation of liquid oxygen plants. These materials can however be used at temperatures down to – 200 °C provided that precautions are taken to prevent the condensation of atmospheric oxygen in or on the insulation.

Annex B (informative)

Method for the determination of areas of unbonded facings

B.1 Principle

The unbonded area is established by removing loose facing material after cutting up the specimen.

B.2 Apparatus

B.2.1 Bandsaw or similar fine toothed saw.

B.2.2 Means for measuring the dimensions of unbonded areas, i.e. a rule with an accuracy of 0.5 mm.

B.3 Test specimen

The test specimen should be a right parallelepiped with a length and breadth not exceeding 1200 mm x 600 mm. The thickness of the test specimen should be the full thickness of the insulation board laminate including facings.

B.4 Number of test specimens

One test specimen should be tested.

B.5 Conditioning

Test specimens should be conditioned immediately before testing for a period of not less than 16 h at a temperature of (23 ± 2) ^{0}C and a relative humidity of (50 ± 5) %.

B.6 Procedure

Conduct the test at (23 ± 2) ^{0}C. Mark the test specimen in a manner that identifies the upper and lower faces. Cut the test specimen parallel to either axis into strips 50 mm wide, each strip being marked so as to identify its original position relative to the other strips (see Figure B.1). Examine both faces of each strip to determine whether any of the facings are not bonded to the core.

Remove any areas of facing and measure the unbonded area(s).

NOTE 1. The necessity for identifying each individual strip and its relative position is to enable unbonded areas of the facing that may extend continuously across more than one strip to be computed as a single area. Individual areas may therefore be computed as well as the sum total of all such areas.

NOTE 2. Felt marker pens are most suitable for marking the edges of the test specimen.

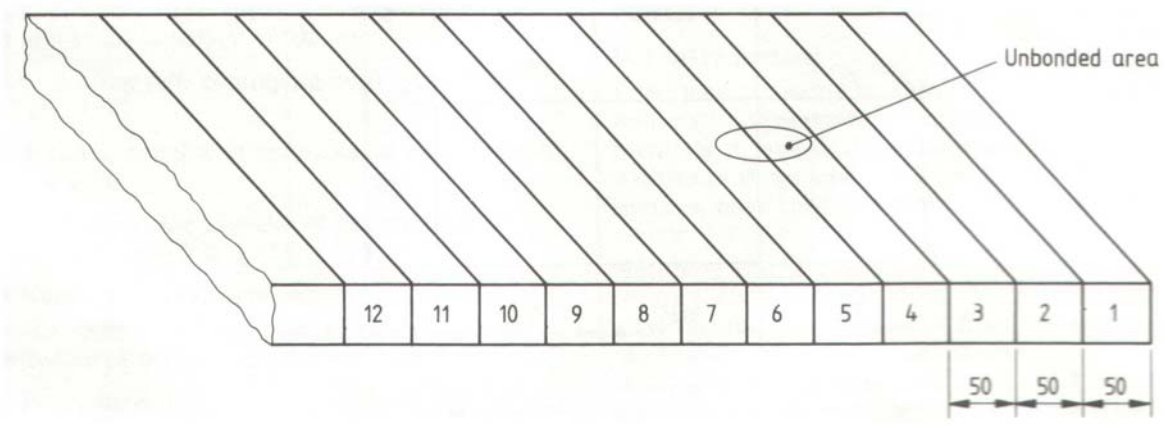
B.7 Expression of results

Measure all unbonded areas individually as well as the sum total of all such areas and express the results as a percentage of the original area of the test specimen.

B.8 Test report

The test report should include the following:

(a) the identification of the insulation board tested;
(b) the individual unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(c) the sum of the unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(d) the description and date of this specification, i.e. BS xxxx-1:2007.



All dimensions are in millimetres.

Figure B.1 Determination of area(s) of unbonded facings: cutting and marking of the test specimen

Annex C (informative)

Burning characteristics of phenolic foams, recommendations regarding their use and storage

C.1 Burning properties of phenolic foam and recommendations for use

Any risk of ignition and fire growth associated with the foam in building construction, industry, transport, etc. should be assessed in accordance with the recommendations of BS 6336. That is, consideration should be given to the design of the end product formed from, or incorporating, the foam and the risks to which it might be exposed.

This standard is concerned only with the specification of phenolic foam as a basic material, designed for insulating purposes, with burning characteristics of a specified class when tested in accordance with BS EN 13501-1 using the appropriate mounting and fixing procedures as specified in BS EN 15715.

The fire characteristics of phenolic foam measured in accordance with BS EN 13501-1 can be affected by the blowing agent used and any facings applied to the boards. The production of smoke and flaming droplets may be assessed in accordance with BS EN 13823, which forms a part of the BS EN 13501-1 classification system. It would be expected that the smoke levels registered by this test would be zero or very close to zero and that flaming droplets would not be produced by thermoset phenolic foam thermal insulation products.

No reaction to fire requirements are specified for use of phenolic insulation products in floors, hence the minimum Class F (no performance determined) requirement is specified in Table 1.

An alternative classification for reaction to fire is the use of BS 476, Parts 6 & 7 as indicated in table 1.

C.2 Recommended practices for storage, handling and fabrication of thermoset phenolic insulating foam and PF foam products

The following recommended practices should be taken into account for the storage and fabrication of phenolic insulating foam and PF foam products.

a) Best practice standards should be maintained.

b) Sensible fire precautions should be observed.

c) Reference should be made to Material Safety Data Sheets when carrying out COSHH or other risk assessment procedures.

Annex D (informative)

Information of the installation of the insulation boards in floors

D.1 Laying below the floor slab

After the site has been prepared and foundations, where appropriate, built to damp-proof course level, the damp-proof membrane (minimum 300 micron/1200 gauge polyethylene) should be laid over the well compacted, sand blinded hardcore with joints well lapped and folded to prevent the passage of ground water. The membrane should be brought up the surrounding foundation walls until it is sufficiently above the height of the wall damp-proof course (DPC) so that it will connect with or form the DPC. The PF insulation boards should be laid break-bonded with the joints tightly butted. A strip of the boarding should be placed vertically around the perimeter of the floor slab to prevent cold bridging of the slab. Boards are overlaid with a separating layer of building paper in accordance with BS 1521:1972, grade B1F or polyethylene sheet (not less than 125 micron/500 gauge). The subsequent application of the concrete slab and screed or other flooring material is similar to those laid over an uninsulated floor.

D.2 Laying below the floor screed

The PF boards are laid loose over the concrete floor slab or beam and block floor with the necessary water and vapour proof protection. Boards should be tightly butted, staggered and laid to a break-bonded pattern. The floor slab should be uniformly flat, without steps or gaps, to provide continuous bearing support to the PF insulation boards. Beam and block floors should be level and grouted. A thin section of board should be used around the perimeter of the floor area being insulated. This should be placed vertically against the abutting wall so that is connects with the insulation laid over the slab and protects the edge of the screed, so preventing cold bridging of the floor screed. Boards are overlaid with a separating layer of building paper in accordance with BS 1521:1972, grade B1F or polyethylene sheet (not less than 125 microns/500 gauge) between the screed and the PF boards to prevent the wet screed penetrating the joints between the boards. Use a sand and cement screed laid to a minimum thickness of 65mm for domestic construction and 75mm elsewhere.

D.3 Laying in suspended timber floors

The application of PF insulation boards in suspended floor construction should be carried out before commencement of floor boarding. The PF boards should be cut to fit tightly between joists. They should be supported on softwood timber battens, proprietary galvanised steel saddle clips or galvanised nails partially driven into the sides of the joists. Battens or nails should be placed at an appropriate height to suit the thickness of the board being employed and nails should remain 40mm proud of the joists. The boards should then be laid between the joists so that they are supported by the battens or nails. Any narrow gaps between a joist

and perimeter wall should be insulated by specially cut pieces of board. They should be supported on blocks nailed to the underside of the joists. Where water services, including central heating pipes, run below the floor boards the PF insulation can be lowered to create an insulated duct for the services. Access from beneath the floor could be obtained later by removal of the nail supports from the underside.

D.4 Laying between battens under a timber floor

The subfloor should be level and flat. The PF boards cut to fit snugly between the battens. Any narrow gaps between the battens and the perimeter wall should be insulated by specially cut pieces of board. Board joints should be tightly butted.

Bibliography

Standards publications

BS 5946, *Method of test for determination of the punking behaviour of phenol-formaldehyde foam*.

BS 6336, *Guide to the development of fire tests, the presentation of test data and the role of tests in hazard assessment*.

BS EN 11925-2:2002, *Reaction to fire tests. Ignitability of building products subjected to direct impingement of flame. Single flame source test.*

BS EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*.

BS EN 15715, *Thermal insulation products – Instructions for mounting and fixing for reaction to fire testing – Factory made products.*

Phenolic foam thermal insulation products for building and building services end use applications

Part 6 - Specification for phenolic foam (PF) products for use as thermal insulation for ventilated or unventilated multi-storey façades

3.10.

Contents

Foreword

Publishing Information.

The British Standard was published by BSI and came into effect on xx xxx 2009. It was prepared by Subcommittee PRI/72/3, *Phenolic*, under the authority of Technical Committee PRI/72, *Rigid Cellular Materials*. It is part 6 of a 7-part standard covering the various applications of phenolic foam insulation products in the building and construction industry.

Information about this document

Part 6 of this standard has been introduced to specify the requirements needed to ensure fitness for purpose of phenolic foam thermal insulation products used in the insulation of ventilated or un-ventilated multi-story façades in the United Kingdom. Parts 1-6 of this non-conflicting standard meet the requirement of BS EN 13166 that 'The levels required for a given application are to be found in regulations or non-conflicting standards'.

Contractual and legal obligations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

1 Scope

This British Standard specifies the composition, classification and physical property performance limit values for thermoset phenolic foam thermal insulation products used in the insulation of ventilated or un-ventilated multi-story façades. Such products include phenolic foam slabs, blocks, boards and profiled sheets, which may also be faced with flexible or rigid facings.

The nominal temperature range in which the material is suitable for use in insulation products is – 200 °C to + 120 °C as stated in BS EN 13166.

NOTE Guidance on using products made from PF foam at temperatures below – 180 °C is given in Annex A.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN 822, *Thermal insulating products for building applications — Determination of length and width.*

BS EN 823, *Thermal insulating products for building applications — Determination of thickness.*

BS EN 824, *Thermal insulating products for building applications — Determination of squareness.*

BS EN 825, *Thermal insulating products for building applications — Determination of flatness.*

BS 5946, *Method of test for determination of the punking behaviour of phenol-formaldehyde foam.*

BS 5970, *Code of practice for thermal insulation of pipework and equipment in the temperature range of -100°C to +870°C.*

BS EN 13950, *Gypsum plasterboard thermal/acoustic insulation composite panels. Definitions, requirements and test methods.*

BS 476: Part 6, *Fire tests on building materials and structures – method of test for fire propagation of products.*

BS 476: Part 7, *Fire tests on building materials and structures – method for the classification of surface spread of flame of products.*

BS EN 826, *Thermal insulating products for building applications — Determination of compression behaviour.*

BS EN 1602, *Thermal insulating products for building applications. Determination of the apparent density.*

BS EN 1603, *Thermal insulating products for building applications — Determination of dimensional stability under constant normal laboratory conditions (23 °C/50% relative humidity).*

BS EN 1609, *Thermal insulating products for building applications — Determination of short term water absorption by partial immersion.*

BS EN 12086, *Thermal insulating products for building applications — Determination of water vapour transmission properties.*

BS EN 12089, *Thermal insulating products for building applications — Determination of bending behaviour.*

BS EN 12667, *Thermal performance of building materials and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Products of high and medium thermal resistance.*

BS EN 12939, *Thermal performance of building material and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Thick products of high and medium thermal resistance*.

BS EN 13166, *Thermal insulation products for buildings — Factory made products of phenolic foam (PF) — Specification*.

BS EN 13467, *Thermal insulating products for building equipment and industrial installations — Determination of dimensions, squareness and linearity of preformed pipe insulation*.

BS EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*.

BS EN 15715, *Thermal insulation products – Instructions for mounting and fixing for reaction to fire testing – Factory made products.*

3 Classification

The materials shall be classified in accordance with the requirements specified in Table 1.

Table 1 — Physical property requirements

Physical Property	Value[a]	Method of Test
Density (kg/m^3) [b]	25	BS EN 1602
Maximum declared value of thermal conductivity (W/m·K)[c]	0.025	BS EN 12667 or BS EN 12939 as specified in BS EN 13166
Minimum compressive strength at 10% strain, (kPa)[c]	CS(Y) 100	BS EN 826
Minimum bending strength in any direction, (kPa)[c]	200	BS EN 12089
Dimensional stability: maximum percentage linear change, 23°C/50% RH.[c]	0.5	BS EN 1603

Dimensional stability under specified conditions[c] 48h at (23±2)°C and (90±5)% RH 48h at (70±2)°C 48h at (70±2)°C and (90±5)% RH 48h at (-20±2)°C		*l* & *w* ±0.5%, *t* ±1.5% *l* & *w* ±1.5%, *t* ±3% *l*, *w* & *t* ±1.5% *l*, *w* & *t* ±1.5%	BS EN 1604
Flatness[c]: *t* = <50 mm 50 to 100 mm >100 mm		≤10.0 ≤ 7.5 ≤ 5.0	BS EN 825
Minimum water vapour resistance (Z) (MNs/g)[b]		100	BS EN 12086
Minimum reaction to fire performance[b]	either BS 476	I < 12, i < 6	BS 476, Part 6
		Class 1	BS 476, Part 7
	or Euroclass	Class C	BS EN 13501-1
NOTE: Products conforming to this standard shall have a minimum fire performance of Euroclass B when tested to BS EN 13501-1 using the appropriate standard test configuration of assemblies simulating end-use applications as specified in Table 5 of BS EN 15715.			
[a] Manufacturer's declared closed cell content > 90% [b] For foam excluding facings. For mechanical properties of foam products other than those indicated or for actual mechanical properties of high density products, please refer to the manufacturer's literature. [c] For product as placed on the market. *l* = length, *w* = width, *t* = thickness, RH = relative humidity.			

4 Composition

4.1 General

The insulation product shall consist of phenolic foam of uniform cellular structure. The marketed product may also be faced on one or both sides with a flexible or rigid facing product.

4.2 Flexible facings

Flexible facings may be functional or decorative (e.g. paper, metal foil, glass tissue, etc.).

NOTE. The type of facings and the degree of their auto-adhesive or subsequent bonding are crucial to ensure good service performance for the laminated insulation boards. The degree of bonding, if required, should comply with the requirements given Annex B when evaluated according to the procedure given in Annex B.

5 Dimensions and dimensional tolerances of PF thermal insulation products

5.1. General

When rigid facings are part of the product, consideration should be given to the limitations of the facing dimensions (e.g. plasterboard to BS EN 13950). The overall tolerances from BS EN 13166, in 5.2 to 5.5, may not be possible to achieve.

5.2 Length and Width

Length, *l*, and width, *b*, shall be determined in accordance with BS EN 822. No test result shall deviate from the nominal values by more than the tolerances given in Table 2 for the corresponding dimensions.
Products with a surface facing or natural skin shall be tested without removing them.

Table 2 — Tolerances for length and width

Dimensions in millimetres

Dimensions	Length	Width
< 1250	± 5,0	± 3,0
1 250 to 2 000	± 7,5	± 7,5
2 001 to 4 000	± 10,0	± 7,5
> 4000	± 15,0	± 10,0

5.3 Thickness

Thickness, *d*, shall be determined in accordance with BS EN 823. No test result shall deviate from the nominal thickness, d_N, by more than the tolerance given in Table 3 for the labelled class.

Table 3 — Classes for thickness tolerances

Dimensions in millimetres

Nominal thickness	Tolerance	
	T1	T2
< 50	± 2,0	± 1,5
50 to 100	–2,0 +3,0	± 1,5
> 100	–2,0 +5,0	± 1,5

5.4 Squareness

Squareness shall be determined in accordance with BS EN 824. The deviation from squareness on length and width, S_b, shall not exceed 8 mm/m. The deviation from squareness on thickness, S_d, shall not exceed 2 mm.

5.5 Flatness

Deviation from flatness of the board shall be determined in accordance with BS EN 825. The deviation from flatness, S_{max}, shall not exceed the tolerances given in Table 4 for the corresponding nominal thickness, d_N.

Table 4 — Tolerances for deviation from flatness

Dimensions in millimetres

Nominal thickness	Tolerance
< 50	□ 10.0
50 to 100	□ 7.5
> 100	□ 5.0

6 Physical properties

The physical properties shall conform to the requirements specified in Table 1, when tested in accordance with the methods indicated therein.

NOTE For further information on the reaction to fire performance of PF insulation products see Annex C.

7 Sampling

Sampling for factory production control purposes shall follow the relevant requirements of Table B.1 of BS EN 13166.

8 Installation

Manufacturer's guidance should be followed.

9 Designation

Boards shall be given the following minimum designation:

"BS xxxx – 6:2009/BS EN 13166: XX: Y, sn, dn" where, in accordance with Table 1,

- XX is the thermal conductivity in mW/mK
- Y, sn, dn is the fire classification in application (using standard test configuration of assembly 2 in BS EN 15715)

Further information, as per BS EN 13166, may be included in the designation.

10 Marking and labelling

The product, packaging and invoices shall be marked with at least the following information:

a) manufacturer's name and trademark;

b) product designation as given in Clause 9

c) manufacturer's description and/or product reference.

NOTE: The designation shall be given in current product literature and/or on the product label.

Annex A (informative)

Notes for designers and product users

BS 5970 gives guidance on the design of thermal insulation systems. However, certain points that have special relevance to cellular condensation polymers and which would equally apply to rigid phenolic foams are given in a) to d).

a) Materials of apparent density 30 kg/m^3 to 60 kg/m^3 are normally found suitable for most thermal insulation purposes within the scope of this standard.

b) In designing insulation systems with phenolic foams, care should be taken to prevent ingress of water.

c) Adequate precautions should be taken to prevent moisture being interposed between metal and foam surfaces.

d) For normal use, rigid phenolic foam materials are suitable for use in the temperature range - 180 °C to + 120 °C.

NOTE The lower temperature limit is selected to indicate the unsuitability of these materials for insulation of liquid oxygen plants. These materials can however be used at temperatures down to – 200 °C provided that precautions are taken to prevent the condensation of atmospheric oxygen in or on the insulation.

Annex B (informative)

Method for the determination of areas of unbonded facings

B.1 Principle

The unbonded area is established by removing loose facing material after cutting up the specimen.

B.2 Apparatus

B.2.1 Bandsaw or similar fine toothed saw.

B.2.2 Means for measuring the dimensions of unbonded areas, i.e. a rule with an accuracy of 0.5 mm.

B.3 Test specimen

The test specimen should be a right parallelepiped with a length and breadth not exceeding 1200 mm x 600 mm. The thickness of the test specimen should be the full thickness of the insulation board laminate including facings.

B.4 Number of test specimens

One test specimen should be tested.

B.5 Conditioning

Test specimens should be conditioned immediately before testing for a period of not less than 16 h at a temperature of (23 ± 2) ^{0}C and a relative humidity of (50 ± 5) %.

B.6 Procedure

Conduct the test at (23 ± 2) ^{0}C. Mark the test specimen in a manner that identifies the upper and lower faces. Cut the test specimen parallel to either axis into strips 50 mm wide, each strip being marked so as to identify its original position relative to the other strips (see Figure B.1). Examine both faces of each strip to determine whether any of the facings are not bonded to the core.

Remove any areas of facing and measure the unbonded area(s).

NOTE 1. The necessity for identifying each individual strip and its relative position is to enable unbonded areas of the facing that may extend continuously across more than one strip to be computed as a single area. Individual areas may therefore be computed as well as the sum total of all such areas.

NOTE 2. Felt marker pens are most suitable for marking the edges of the test specimen.

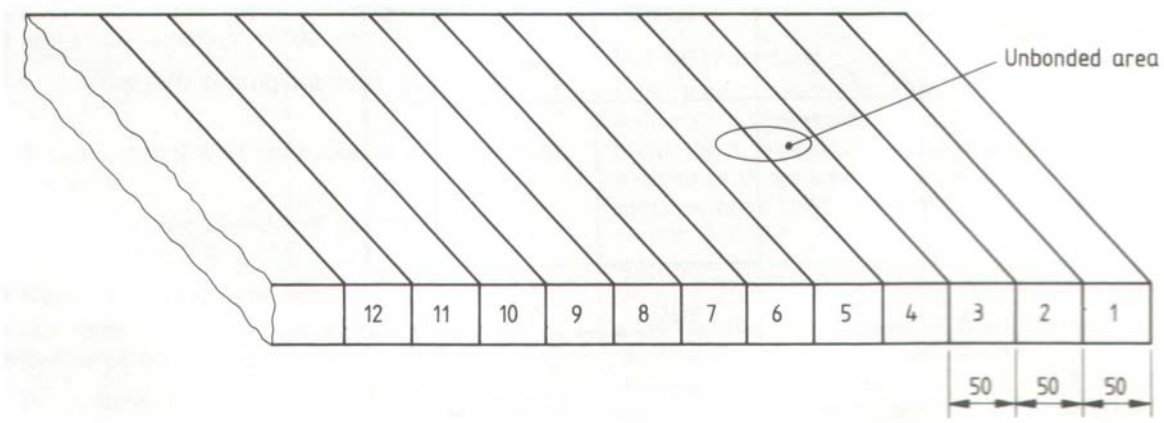
B.7 Expression of results

Measure all unbonded areas individually as well as the sum total of all such areas and express the results as a percentage of the original area of the test specimen.

B.8 Test report

The test report should include the following:

(a) the identification of the insulation board tested;
(b) the individual unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(c) the sum of the unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(d) the description and date of this specification, i.e. BS xxxx-1:2007.



All dimensions are in millimetres.

Figure B.1 Determination of area(s) of unbonded facings: cutting and marking of the test specimen

Annex C (informative)

Burning characteristics of phenolic foams, recommendations regarding their use and storage

C.1 Burning properties of phenolic foam and recommendations for use

C.1 Burning properties of phenolic foam and recommendations for use

Any risk of ignition and fire growth associated with the foam in building construction, industry, transport, etc. should be assessed in accordance with the recommendations of BS 6336. That is, consideration should be given to the design of the end product formed from, or incorporating, the foam and the risks to which it might be exposed.

This standard is concerned only with the specification of phenolic foam as a basic material, designed for insulating purposes, with burning characteristics of a specified class when tested in accordance with BS EN 13501-1, using the appropriate mounting and fixing procedures, as specified in BS EN 15715.

The fire characteristics of phenolic foam measured in accordance with BS EN 13501-1 can be affected by the blowing agent used and any facings applied to the boards. The production of smoke and flaming droplets may be assessed in accordance with BS EN 13823, which forms a part of the BS EN 13501-1 classification system. It would be expected that the smoke levels registered by this test would be zero or very close to zero and that flaming droplets would not be produced by thermoset phenolic foam thermal insulation products.

An alternative classification for reaction to fire is the use of BS 476, Parts 6 & 7 as indicated in table 1.

Although Phenolic foam generally presents a low risk when it comes to fire it is required that Current Building Regulations / Standards are consulted with regard to the requirements for and provision of fire stops. Cavity barriers at the junction of the external wall and roof space should be provided. The design and installation of cavity barriers must take into account anticipated differential movement for example within framed structures. Where there is a height differential and a cavity within a façade system additional fire barriers are necessary to prevent the ‘chimney effect’ (flames in confined spaces can elongate up to ten times when seeking oxygen and fuel to support combustion) . This occurrence is independent of the materials used to line the cavities and is controlled by pressure differentials relating to height and cavity size. Considering the foregoing it is advised that all façade insulations used within high rise buildings (above 18 metres) should be assessed in accordance with BR 135 *Fire performance of external thermal insulation for walls of multi-storey buildings.*

C.2 Recommended practices for storage, handling and fabrication of thermoset phenolic foam thermal insulation and PF foam products

The following recommended practices should be taken into account for the storage and fabrication of thermoset phenolic foam thermal insulation and PF foam products.

a) Best practice standards should be maintained.

b) Sensible fire precautions should be observed.

c) Reference should be made to Material Safety Data Sheets when carrying out COSHH or other risk assessment procedures.

Annexe D (informative)

Information on the general installation of the insulation into ventilated or unventilated multi-storey façade systems.

Because façade systems are bespoke they utilise many different mechanisms for attaching the cladding panels to the wall structure, specific site-work guidance should be sort from the system manufacturer.

In the absence of any other installation guidance it is advised to fully restrain the rigid Phenolic insulation boards against the substrate in a brick bond pattern with suitable insulation fasteners. Boards should be installed with a minimum 200mm staggered bond with fasteners located between 50 and 150mm from edges and corners of the board.

Cutting should be carried out either by fine toothed saw or with a sharp knife.. It is important to ensure a tight fit between boards. Ensure accurate trimming to achieve close butting joints and continuity of insulation.

Exposed edges of installed Phenolic insulation should be protected from inclement weather. Gaps and joints in the insulation envelope may be covered with manufacturer's approved 75mm wide self adhesive tape applied to all external joints of the insulation board to provide a weather-tight finish.

Where there a storey height of 18metres or more above ground level it is recommended that the Phenolic insulation is installed against a non combustible substrate. A non combustible substrate can be either concrete, block work or a non combustible building board that sheaths the inner frame. It has been proven that fire development within high rise façade systems can be irrespective of the materials used within the building envelope. Therefore all façade insulations used above 18 metres must be assessed in accordance with BR 135 Fire performance of external thermal insulation for walls of multi-storey buildings.

Bibliography

Standards publications

BS 5946, *Method of test for determination of the punking behaviour of phenol-formaldehyde foam*.

BS 6336, *Guide to the development of fire tests, the presentation of test data and the role of tests in hazard assessment*.

BS EN 11925-2:2002, *Reaction to fire tests. Ignitability of building products subjected to direct impingement of flame. Single flame source test.*

BS EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*.

Phenolic foam thermal insulation products for building and building services end use applications

Part 7 - Specification for phenolic foam (PF) products for use as thermal insulation for ductwork, pipework, tanks and vessels

3.10.

Contents

Foreword

Publishing Information.

The British Standard was published by BSI and came into effect on xx xxx 2009. It was prepared by Subcommittee PRI/72/3, *Phenolic*, under the authority of Technical Committee PRI/72, *Rigid Cellular Materials*. It is part 7 of a 7-part standard covering the various applications of phenolic foam insulation products in the building and construction industry.

Information about this document

This standard has been introduced to specify the requirements needed to ensure fitness for purpose of phenolic foam thermal insulation products used in the insulation of ductwork, pipework, tanks and vessels in the United Kingdom. Part 7 of this non-conflicting standard meets the requirement of BS EN 14314 that 'The levels required for a given application can be found in regulations and invitations to tender'.

Contractual and legal obligations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

1 Scope

This British Standard specifies the composition, classification and physical property performance limit values for thermoset phenolic foam thermal insulation products for building equipment and industrial installations such as ductwork, pipework, tanks and vessels. Such products include slabs (blocks, boards and profiled sheets) and profiled sections (pipe sections and radiused or bevelled lags) either cut from blocks or manufactured using a continuous process.

The nominal temperature range in which the material is suitable for use in insulation products is – 200 °C to + 120 °C as stated in EN 14314.

NOTE Below and operating temperature of -50°C, special tests regarding the suitability of the product for the intended application are advised. Manufacturer's advice should be heeded at all times.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 476: Part 6, *Fire tests on building materials and structures – method of test for fire propagation of products.*

BS 476: Part 7, *Fire tests on building materials and structures – method for the classification of surface spread of flame of products.*

BS EN 822, *Thermal insulating products for building applications — Determination of length and width.*

BS EN 823, *Thermal insulating products for building applications — Determination of thickness.*

BS EN 824, *Thermal insulating products for building applications — Determination of squareness.*

BS EN 825, *Thermal insulating products for building applications — Determination of flatness.*

BS EN 826, *Thermal insulating products for building applications — Determination of compression behaviour.*

BS EN 1602, *Thermal insulating products for building applications. Determination of the apparent density.*

BS EN 1603, *Thermal insulating products for building applications — Determination of dimensional stability under constant normal laboratory conditions (23 °C/50% relative humidity).*

BS EN 1609, *Thermal insulating products for building applications — Determination of short term water absorption by partial immersion.*

BS EN 11925-2:2002, *Reaction to fire tests. Ignitability of building products subjected to direct impingement of flame. Single flame source test.*

BS EN 12086, *Thermal insulating products for building applications — Determination of water vapour transmission properties.*

BS EN 12089, *Thermal insulating products for building applications — Determination of bending behaviour.*

BS EN 12667, *Thermal performance of building materials and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Products of high and medium thermal resistance.*

BS EN 12939, *Thermal performance of building material and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Thick products of high and medium thermal resistance*.

BS EN 13166, *Thermal insulation products for buildings — Factory made products of phenolic foam (PF) — Specification*.

BS EN 13467, *Thermal insulating products for building equipment and industrial installations — Determination of dimensions, squareness and linearity of preformed pipe insulation*.

BS EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*.

BS EN 14314, *Thermal insulation products for building equipment and industrial installations - Factory made phenolic foam (PF) products – Specification.*

BS EN 15715, *Thermal insulation products – Instructions for mounting and fixing for reaction to fire testing – Factory made products.*

BS EN ISO 12241, Thermal Insulation for building equipment and industrial installations-Calculation Rules.

3 Classification

3.1 Method of Production

Products may be manufactured either by a continuous process or by cutting from discontinuous block.

3.1.1 Product cut from block

The materials shall be classified into one of four types, A, B, C, and D in accordance with the requirements specified in Table 1. and 2 according to method of manufacture.

NOTE They differ principally in closed cell content and density and give variations in other properties as indicated in Table 1.

Table 1 — Physical property requirements of block foam for cutting to product shape

Physical Property	Type				Method of Test
	A[a]	B[b]	C[b]	D[b]	
Minimum density (kg/m^3) [c]	30	60	80	≥ 120	BS EN 1602
Maximum declared value of thermal conductivity (W/m·K)	0.022	0.031	0.036	0.036	BS EN 12667 or BS EN 12939 as specified in BS

					EN 14314.
Minimum compressive strength or compressive strength at 10% strain, (kPa)	CS(Y) 75	CS(Y) 170	CS(Y)50 440	CS(Y) 800	BS EN 826
Dimensional stability: maximum percentage linear change Test conditions 7 days at (–15 ± 2)°C 7 days at (+130 ± 2)°C 7 days at (+70 ± 2)°C	 0.5 3.0 1.5	 0.5 3.0 1.5	 0.5 3.0 1.5	 0.5 3.0 1.5	BS EN 1603
Maximum water vapour permeability at 38 °C and 88 % relative humidity, (ng/Pa·s·m)	5.5	10	10	10	BS EN 12086
Water vapour transmission (g/m^2/24h)	30	15	15	15	BS EN 12086
Apparent water absorption, maximum percentage, volume/volume (%)	7.5	10	10	10	BS EN 1609
NOTE: Products conforming to this standard shall have a minimum fire performance of Euroclass C when tested to BS EN 13501-1 using the appropriate standard test configuration of assemblies simulating end-use applications as specified in Table 5 of BS EN 15715.					
[a] Manufacturer's declared closed cell content > 90%. [b] Manufacturer's declared closed cell content < 90%. [c] For mechanical properties of foam products with densities other than those indicated or for actual mechanical properties of high density products, please refer to the manufacturer's literature. [d] For product as placed on the market.					

3.1.2 Products manufactured by continuous processes

The materials shall be classified into one of two types, A or B, in accordance with the requirements specified in Table 2.

Table 2 – Physical property requirements of products manufactured using a continuous process

Physical Property	Type			Method of Test
	A[a]	B_1[a]	C[a,c]	
Minimum density (kg/m^3) [b]	30	50	30	BS EN 1602
Maximum declared value of thermal conductivity (W/m·K)[d]	0.025	0.025	0.025	BS EN 12667 or BS EN 12939 as specified in EN 14314.

Minimum compressive strength or compressive strength at 10% strain, (kPa)[d]		CS(Y) 120	CS(Y) 200	CS(Y) 75	BS EN 826
Minimum bending strength in any direction, (kPa)[d]		200	400	n/a	BS EN 12089
Maximum water vapour transmission ($G/m^2/24h$)[b]		n/a	n/a	15	BS EN 12086
Minimum water vapour resistance (Z) (MNs/g)[d]		100	100	n/a	BS EN 12086
Dimensional stability: Maximum percentage linear change, 23°C/50%RH.[d]		0.5			BS EN 1603
Dimensional stability under specified conditions[d] 48h at (23±2)°C and (90±5)%RH 48h at (70±2)°C 48h at (70±2)°C and (90±2)%RH 48h at (-20±2)°C		 *l* & *w* ± 0.5%, *t* ± 1.5% *l* & *w* ± 1.5%, *t* ± 3% *l*,*w* & *t* ± 1.5% *l*,*w* & *t* ± 1.5%		n/a	BS EN 1604
Flatness[d]: *t* = <50mm *t*= 50 to 100 mm *t* = >100 mm		[10.0 [7.5 [5.0		n/a	BS EN 825
Dimensional stability: maximum percentage linear change[d] Test conditions 7 days at (–15 ± 2)°C 7 days at (+130 ± 2)°C 7 days at (+70 ± 2)°C		n/a		 0.5 3.0 1.5	BS EN 1603
Minimum reaction to fire performance[d]	either BS 476	I < 12, i < 6			BS 476 Part 6
		Class 1			BS 476 Part 7
	or Euroclass	Class C	Class C	Class C	BS EN 13501-1
NOTE: Products conforming to this standard shall have a minimum fire performance of Euroclass C when tested to BS EN 13501-1 using the appropriate standard test configuration of assemblies simulating end-use applications as specified in Table 5 of BS EN 15715.					
[a] Closed cell content > 90%. [b] For foam excluding facings. For mechanical properties of foam products with densities other than those indicated or for actual mechanical properties of high density products, please refer to the manufacturer's literature. [c] Pipework sections. [d] For product as placed on the market					

l = length, w = width, t = thickness, RH = relative humidity. n/a = not applicable.

4 Composition

The material shall consist of phenolic foam of uniform cellular structure. The marketed product may also be faced on one or both sides with a flexible or rigid facing product.

5 Dimensions and dimensional tolerances of PF thermal insulation products

5.1 Board Product

5.1.1 Linear dimensions

Dimensional tolerances for length, l, width, b, and thickness, d, of factory made products shall be as specified in Table 3 when measured in accordance with BS EN 822 and BS EN 823. No test result shall deviate from the declared values by more than the tolerances given in Table 3.

Product with surface facings or natural skins shall be tested without removing them.

Table 3 – Width, length and thickness tolerances for board products

Dimensions in mm

Delivered length or width	Length	Width	Thickness
<1250	± 5	± 5	± 1.5
1250 - 2000	± 7.5	± 7.5	±1.5
2001 - 4000	± 10	not applicable	± 1.5
>4000	± 15	not applicable	± 1.5

5.1.2 Squareness

Deviation from squareness, S_b, of boards and slabs shall not exceed 10mm/m on length and width and shall not exceed 2mm on thickness when measured in accordance with BS EN 824.

Product with surface facings or natural skins shall be tested without removing them.

5.1.3 Flatness

Deviation from flatness, S_{max}, shall not exceed 10mm. when measured in accordance with BS EN 825

Product with surface facings or natural skins shall be tested without removing them.

5.2 Profiled sections

5.2.1 *Dimensional tolerances*

The length, l, thickness, d, and inside diameter, D_i, of pipe sections, segments and prefabricated ware shall be determined in accordance with BS EN 13467. No test result shall deviate from the declared values by more than the tolerances given in Table 4.

Products with a surface facing or natural skin shall be tested without removing the skin or skins.

Table 4 — Dimensional tolerances for profiled sections

Form of delivery	Length	Width	Thickness	Inside diameter
Pipe section	± 3 mm	—	± 2 mm	–0 mm + 2 mm[a] –0 mm + 3 mm[b]
Segments	+ 3 mm	± 2 mm	± 2 mm	–0 mm + 4 mm
Prefabricated ware	+ 3 mm	—	± 2 mm	—

[a] Applies to inside diameters less than 170 mm.

[b] Applies to inside diameters of 170 mm and greater.

NOTE Smaller tolerances may be declared by the manufacturer .

5.2.2 *Pipe sections*

5.2.2.1 *Sections cut from block*

Pipe sections cut from block shall be in two semi-circular pieces with the longitudinally mating surfaces flat and in the same plane, so that when the two pieces are put together no gaps exist between the mating surfaces.

It is common practice for the mating faces whilst still being flat in the lengthwise direction to have a variable profile in the radial direction. This is acceptable provided that the mating surfaces so created still fit snugly together. In many cases this practice enhances the snugness of the fit.

The ends shall be flat and normal to the longitudinal axis of the pipe section. For a single-layer pipe insulation system or the first layer of a multi-layer system the permissible deviation on the bore shall be given on the quoted pipe outside diameter. For the second or subsequent layer or layers of multi-layer systems the permissible deviation on the bore shall be given on the mating inner layer outside diameter.

5.2.2.2 *Pipe section made by a continuous process*

Pipe sections made by a continuous process shall be slit along one edge to allow fitting to the pipe. The slit, having been cut radially into circular section product, will be expected to have good mating faces, creating a snug fit, when fitted to the pipe.

The ends shall be flat and normal to the longitudinal axis of the pipe section. For a single-layer pipe insulation system or the first layer of a multi-layer system the permissible deviation on the bore shall be given on the quoted pipe outside diameter. For the second or subsequent layer or layers of multi-layer systems the permissible deviation on the bore shall be given on the mating inner layer outside diameter.

5.2.2.3 *Linearity*

The linearity, *L*, of the pipe section shall be determined in accordance with BS EN 13467. The deviation from linearity, *L*, shall not exceed 6 mm.
Products with a surface facing or natural skin shall be tested without removing the facing, skin or skins.

5.2.2.4 *Squareness*

The deviation from squareness, *v*, of the pipe shall be determined in accordance with BS EN 13467. For pipe sections and segments the deviation from squareness, *v*, shall not exceed 3 mm.
Products with a surface facing or natural skin shall be tested without removing the facing, skin or skins.

5.2.3 *Radiused and bevelled lags*

The mating bevelled edges shall be flat, so that when they are put together to form a cylinder no gaps exist between abutting lags.

The ends shall be flat and normal to the longitudinal axis of the lag. The dimensional tolerances shall conform to the requirements specified Table 3.

6 Physical properties

The physical properties shall conform to the requirements specified in Table 1 and 2 as necessary, when tested in accordance with the methods indicated therein.

NOTE 1: For further information on reaction to fire performance, see Annex C.

NOTE 2: For further physical property data refer to individual manufacturers' data sheets.

7 Sampling

Sampling for factory production control purposes shall follow the relevant requirements of BS EN 14314.

8 Installation

Manufacturer's guidance should be followed.

9 Designation

Boards shall be given the following minimum designation:

"BS xxxx – 7:2009 / EN 14314: XX; Y, sn, dn", where, in accordance to Tables 1 or 2 as relevant:

- XX is the thermal conductivity in W/m/^{o}C
- Y, sn, dn is the fire classification in application (using standard test configuration of assembly 2 in BS EN 15715).

Further information, in accordance with BS EN 14314, may be included in the designation.

10 Marking and labelling

The product, packaging and invoices shall be marked with at least the following information:

a) manufacturer's name and trademark;

b) product designation, as given in clause 9

c) manufacturer's description and/or product reference.

NOTE: The designation shall be given in current product literature and/or on the product label.

Annex A (informative)

Notes for designers and product users

BS 5970 gives guidance on the design of thermal insulation systems. In addition, the following points should be noted:

a) Materials of apparent density between 30 kg/m^3 and 60 kg/m^3 are normally found suitable for most thermal insulation purposes within the scope of this standard.

b) In designing insulation systems with phenolic foams, care should be taken to prevent ingress of water.

c) Adequate precautions should be taken to prevent moisture being interposed between metal and foam surfaces.

d) For normal use, rigid phenolic foam materials are suitable for use in the temperature range - 180 °C to + 120 °C.

NOTE The lower temperature limit is selected to indicate the unsuitability of these materials for insulation of liquid oxygen plants. These materials can however be used at temperatures down to – 200 °C provided that precautions are taken to prevent the condensation of atmospheric oxygen in or on the insulation.

e) Calculations for insulation thickness should be in accordance with BS EN ISO 12241.

Annex B (informative)

Method for the determination of areas of unbonded facings

B.1 Principle

The unbonded area is established by removing loose facing material after cutting up the specimen.

B.2 Apparatus

B.2.1 Bandsaw or similar fine toothed saw.

B.2.2 Means for measuring the dimensions of unbonded areas, i.e. a rule with an accuracy of 0.5 mm.

B.3 Test specimen

For boards and slabstock the test specimen should be rectangular with a length and breadth not exceeding 1200 mm x 600 mm. The thickness of the test specimen should be the full thickness of the insulation board laminate including facings.

For pipe sections and radiused and bevelled lags the test specimen shall be linear not exceeding 1000mm.

B.4 Number of test specimens

One test specimen should be tested.

B.5 Conditioning

Test specimens should be conditioned immediately before testing for a period of not less than 16 h at a temperature of (23 ± 2) ^{0}C and a relative humidity of (50 ± 5) %.

B.6 Procedure

B.6.1 General

Conduct the test at (23 ± 2) ^{0}C. Mark the test specimen in a manner that identifies the upper and lower faces. Cut the test specimen parallel to either axis into strips 50 mm wide, each

strip being marked so as to identify its original position relative to the other strips (see Figure B.1). Examine both faces of each strip to determine whether any of the facings are not bonded to the core.

B.6.2 Board and slabstock

Remove any areas of facing and measure the unbonded area(s).

NOTE 1. The necessity for identifying each individual strip and its relative position is to enable unbonded areas of the facing that may extend continuously across more than one strip to be computed as a single area. Individual areas may therefore be computed as well as the sum total of all such areas.

NOTE 2. Felt marker pens are most suitable for marking the edges of the test specimen.

B.6.3 Pipe section and radiused and bevelled lags

The suirface area shall be calculated as: $As = \pi D \times l$ where D is pipe section external diameter (mm) and l is length (mm). Unbonded area (Ab) is identified and calculated in mm^2. Unbonded area is expressed as a percentage of total surface: $(\Sigma Ab/As) \times 100$

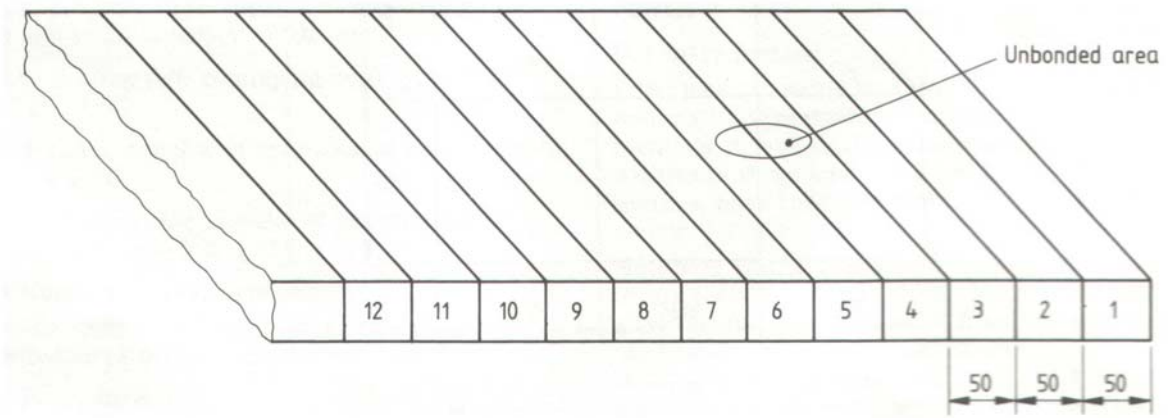
B.7 Expression of results

Measure all unbonded areas individually as well as the sum total of all such areas and express the results as a percentage of the original area of the test specimen.

B.8 Test report

The test report should include the following:

(a) the identification of the insulation board tested;
(b) the individual unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(c) the sum of the unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;
(d) the description and date of this specification, i.e. BS xxxx-1:2007.



All dimensions are in millimetres.

Figure B.1 Determination of area(s) of unbonded facings: cutting and marking of the test specimen

Annex C (informative)

Burning characteristics of phenolic foams, recommendations regarding their use and storage and recommendations for the fabrication of phenolic foam products

C.1 Burning properties of phenolic foam and recommendations for use

Any risk of ignition and fire growth associated with the foam in building construction, industry, transport, etc. should be assessed in accordance with the recommendations of BS 6336. That is, consideration should be given to the design of the end product formed from, or incorporating, the foam and the risks to which it might be exposed.

This standard is concerned only with the specification of phenolic foam as a basic material, designed for insulating purposes, with burning characteristics of a specified class when tested in accordance with BS EN 13501-1 using the appropriate mounting and fixing procedures as specified in BS EN 15715.

The fire characteristics of phenolic foam measured in accordance with BS EN 13501-1 can be affected by the blowing agent used and the facings applied to the boards. The production of smoke and flaming droplets may be assessed in accordance with BS EN 13823, which forms a part of the BS EN 13501-1 classification system. It would be expected that the smoke levels registered by this test would be zero or very close to zero and that flaming droplets would not be produced by thermoset phenolic foam thermal insulation products.

An alternative classification for reaction to fire is the use of BS 476, Parts 6 & 7 as indicated in tables 1 and 2.

C.2 Recommended practices for storage, handling and fabrication of phenolic insulating foam and PF foam products

The following recommended practices should be taken into account for the storage and fabrication of phenolic insulating foam and PF foam products.

a) Best practice standards should be maintained.

b) Sensible fire precautions should be observed.

c) Reference should be made to Material Safety Data Sheets when carrying out COSHH or other risk assessment procedures.

Bibliography

Standards publications

BS 5946, *Method of test for determination of the punking behaviour of phenol-formaldehyde foam*.

BS 5970, *Code of practice for thermal insulation of pipework and equipment in the temperature range of – 100 °C to + 870 °C*.

BS 6336, *Guide to the development of fire tests, the presentation of test data and the role of tests in hazard assessment*.

BS EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*.