BRITISH STANDARD

Rigid polyisocyanurate (PIR) and polyurethane (PUR) products for building end-use applications

Part 3: Specification for laminated boards (roofboards) with auto-adhesively or separately bonded facings for use as roofboard thermal insulation under built up bituminous roofing membranes

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Publishing and copyright information

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 15, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard was published by BSI and came into effect on 20 July 2006. It was prepared by Subcommittee PRI/72/4, *Polyurethane*, under the authority of Technical Committee PRI/72, *Rigid cellular materials*.

Supersession

This part of BS 4841 supersedes BS 4841-3:1994, which is withdrawn.

Information about this document

BS 4841-3:1987 was based on a draft quality assurance guide[1)], derived from a co-operative study between the British Rigid Urethane Foam Manufacturers' Association (BRUFMA) and the Felt Roofing Contactors' Advisory Board (FRCAB)[2)]. It provided requirements for two types of thermal insulating polyurethane and polyisocyanurate cored roofboards, faced on the two major faces with either auto-adhesively or separately bonded facings, and suitable for use beneath built-up bituminous felt roofing membranes.

This edition introduces technical changes to reflect a full revision of the standard whilst taking into account the European Standard BS EN 13165:2001 (including amendments 1 and 2) for PIR and PUR factory made insulation products and now incorporates the European test methods. Attention is drawn to BS 8217:1984 which describes the recommended practice for laying the roofboards conforming to this standard, into roof structures and their weatherproofing, to maximise their service performance after installation.

Additional information for the guidance of users, installers and designers is given in informative Annexes A, B, C, D and E to this standard.

The other parts of BS 4841 have also been revised to reflect recent technical advances and to take into account the European Standard BS EN 13165:2001 (including amendments 1 and 2).

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

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 cannot confer immunity from legal obligations.

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1) First issued by BRUFMA and FRCAB in 1979.
2) Now the Flat Roofing Alliance.

1 Scope

This British Standard specifies requirements for rigid polyisocyanurate (PIR) and polyurethane (PUR) cored laminated boards (roofboards) with auto-adhesively or separately bonded flexible and/or rigid facings, for use as roofboard thermal insulation under built-up bituminous roofing membranes. The standard also applies to product roofboards with one flexible and one rigid facing.

NOTE 1 Because of the changes introduced into this standard, products conforming to this standard also conform to BS EN 13165:2001 incorporating amendments 1 and 2.

NOTE 2 Additional information for the guidance of users, installers and designers is given in informative Annexes A, B, C, D and E to this standard.

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 3690-2:1989, *Bitumens for building and civil engineering – Part 2: Specification for bitumens for industrial purposes*

BS EN 300:1997, *Oriented strand boards (OSB) – Definitions, classification and specifications*

BS EN 636:2003, *Plywood – Specifications*

BS EN 822:1995, *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 825:1995, *Thermal insulating products for building applications – Determination of flatness*

BS EN 826:1996, *Thermal insulating products for building applications – Determination of compression behaviour*

BS EN 1426, *Methods of test for petroleum and its products – Bitumen and bituminous binders – Determination of needle penetration*

BS EN 1427, *Methods of test for petroleum and its products – Bitumen and bituminous binders – Determination of softening point – Ring and ball method*

BS EN 1607:1997, *Thermal insulating products for building applications – Determination of tensile strength perpendicular to faces*

BS EN 13165:2001, *Thermal insulation products for buildings – Factory made rigid polyurethane foam (PUR) products – Specification*

BS EN 13169:2001, *Thermal insulation products for buildings – Factory made products of expanded perlite (EPB) – Specification*

BS EN 13170:2001, *Thermal insulation products for buildings – Factory made products of expanded cork (ICB) – Specification*

BS EN 13171:2001, *Thermal insulation products for buildings – Factory made wood fibre (WF) products – Specification*

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

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this part of BS 4841 the following terms and definitions apply.

3.1.1 auto-adhesively bonded facing

NOTE These facings can be flexible or rigid.

facing that becomes bonded onto the PIR or PUR core during the process of creating it

3.1.2 separately bonded facing

NOTE These facings can be flexible or rigid.

facing that is bonded onto the PIR or PUR core in a separate manufacturing process

3.1.3 polyisocyanurate product

rigid cellular plastics insulation material or product with a substantially closed cell structure mainly based on polymers of the isocyanurate type

3.1.4 polyurethane product

rigid cellular plastics insulation material or product with a substantially closed cell structure mainly based on polymers of the polyurethane type

3.2 Symbols

d_N is the nominal thickness of the product in mm

λ_D is the declared thermal conductivity in mW/(m·K)

S_b is the deviation from squareness in mm/m

S_{max} is the maximum deviation from flatness in mm/m

4 Construction and composition

4.1 General

The roofboards shall consist of an insulating core (**4.2**) with either two bonded flexible facings (**4.3**), or two rigid facings (**4.4**) or one flexible facing (**4.3**) and one rigid facing (**4.4**).

4.2 Core product type

The cores of the product type shall be of rigid polyisocyanurate (PIR) or polyurethane (PUR).

4.3 Flexible facings

4.3.1 General

Both flexible facings of the roofboards shall be either functional or decorative, e.g. paper, metal foil, bitumen coated glass flexible facing (**4.3.2**), glass/polyethylene/glass facing (**4.3.3**), mineral coated (**4.3.4**) or plain glass flexible facings (**4.3.5**). The two faces need not be identical.

4.3.2 Bitumen coated glass flexible facing

Bitumen coated glass facings shall be a bitumen coated glass tissue made by coating one face of a minimum 60 g/m^2 wet process glass tissue with oxidized bitumen which has a softening point in the range of 110 °C to 125 °C when measured according to BS EN 1427 and a penetration in the range of 1 mm to 1.5 mm when measured in accordance with BS EN 1426.

NOTE The bitumen used improves the moisture resistance of the facing and is highly compatible with bitumen roof covering systems.

4.3.3 Glass/polyethylene/glass flexible facing

The glass/polyethylene/glass facing shall be based on two layers of minimum 40 g/m^2 wet process glass tissue, between which is sandwiched a layer of polyethylene.

The polyethylene layer shall be fully covered and adhered to the glass tissue. There shall be no exposed polyethylene face on either the core side or the exposed face.

4.3.4 Mineral coated glass flexible facing

The mineral coated glass flexible facing shall have a minimum weight of glass tissue between 50 g/m^2 and 60 g/m^2.

4.3.5 Plain glass flexible facing

The plain glass flexible facing shall have a minimum weight of glass tissue of 60 g/m^2.

4.4 Rigid facings

Rigid facings shall be either:

- cork conforming to BS EN 13170:2001; or
- perlite conforming to BS EN 13169:2001; or
- plywood conforming to BS EN 636:2003; or
- wood fibre conforming to BS EN 13171:2001; or
- rigid PVC sheet; or
- rubber sheet; or
- orientated strand board (OSB) conforming to BS EN 300:1997 Grade OSB/3.

NOTE The type of flexible and/or rigid facings and the degree of their bonding are crucial to ensure good service performance for the laminated roofboards. The degree of bonding, if required, should conform to the requirements given in Annex A when evaluated according to the procedure given in Annex A.

5 Requirements

5.1 Thermal resistance and thermal conductivity

The declared thermal conductivity λ_D of the flexible faced roofboards or core product shall be determined on the product in accordance with BS EN 13165:2001 (including amendments 1 and 2). The declared values of thermal conductivity for the roofboards shall not exceed 29 mW/m·K at 10 °C.

*NOTE See also **B.5** for information on roofboard design U values and thermal resistance.*

5.2 Dimensions

5.2.1 Length and width

The length and width of roofboards shall be as given in Table 1 when measured in accordance with BS EN 822:1995.

Table 1 **Tolerances for lengths and widths**

Dimensions mm	**Tolerances** mm
< 1000	± 5
1000 to 2000	± 7.5
2001 to 4000	± 10
> 4000	± 15

NOTE UK manufacturers usually quote for their products' lengths and widths with a maximum deviation of ± 3 mm for those dimensions up to and including 1200 mm. Those with dimensions greater than 1200 mm may have lower tolerances than are quoted in Table 2.

5.2.2 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 tolerances given in Table 2 for the declared class.

Table 2 **Classes for thickness tolerances**
Dimensions in millimetres

Class	**Nominal thicknesses**		
	< 50	**50 to 75**	**> 75**
	Tolerances		
T1	± 3	± 4	+6, –3
T2	± 2	± 3	+5, –2
T3	± 1.5	± 1.5	± 1.5

5.2.3 Squareness

Squareness shall be determined in accordance with BS EN 824. The deviation from squareness on length and width, S_b, shall not exceed 6 mm/m.

5.2.4 Flatness

Flatness shall be determined in accordance with BS EN 825:1995. The maximum deviation from flatness, S_{max}, shall not exceed the values given in Table 3.

Table 3 **Deviation from flatness**

Full size product length m	**Full size product area** m^2	**Deviation from flatness** S_{max} mm
$\leqslant 2.50$	$\leqslant 0.75$	$\leqslant 5$
	> 0.75	$\leqslant 10$

5.3 Compressive strength

5.3.1 Normal to the major plane of the board

When tested in accordance with BS EN 826:1996 the minimum compressive strength of the board shall be 150 kPa, which corresponds to the designation CS (10\Y) 150 given in BS EN 13165:2001 (including amendments 1 and 2).

NOTE 1 See Figure 1.

*NOTE 2 See **B.1** for information on heavy duty roofs.*

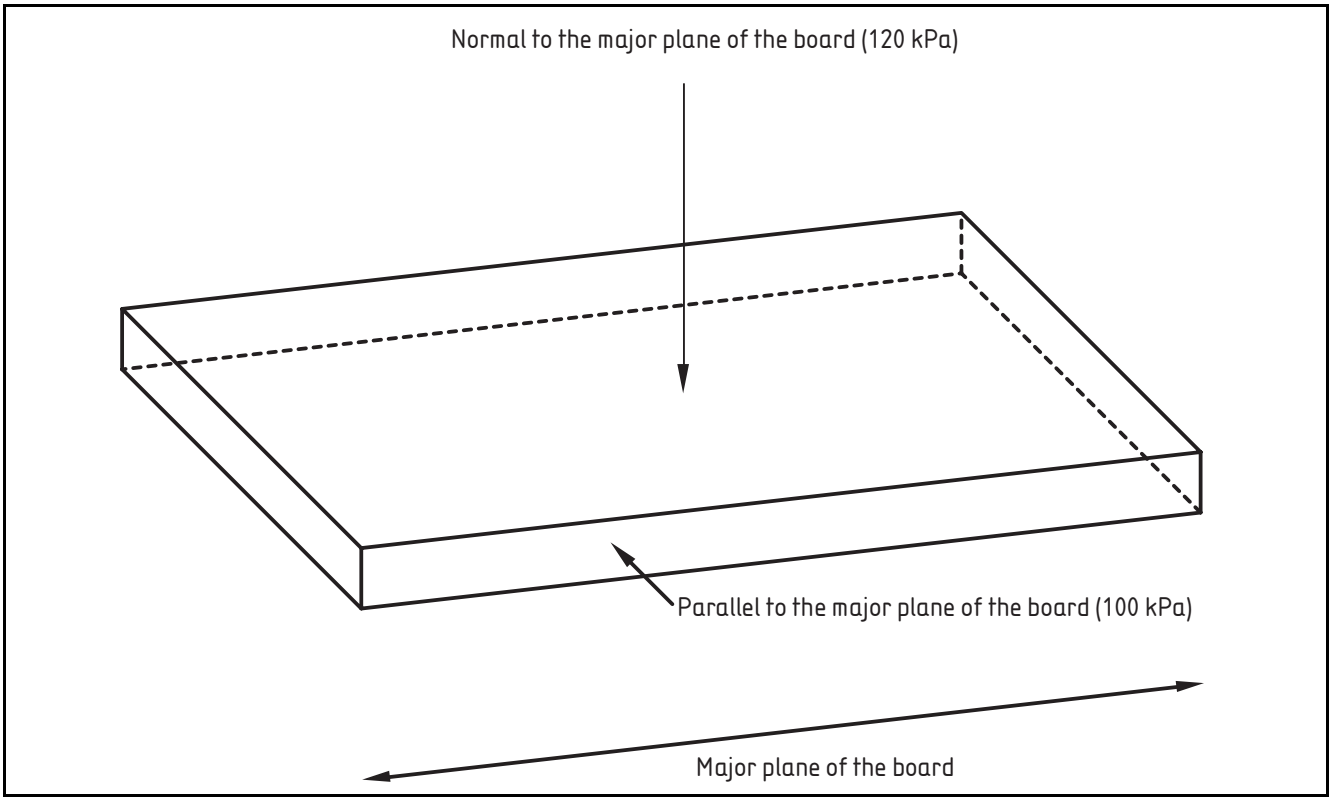
*NOTE 3 Experience has shown that it is essential for satisfactory fitness for purpose that roofboards conform to the imposed loadbearing requirements of BS 6399-1:1996, **6.2** and **6.3** when mounted on a troughed metal substrate, where the appropriate trough opening is determined from the roofboard thickness (see Table B.1).*

5.3.2 Parallel to the major plane of the board

When tested in accordance with BS EN 826:1996 the minimum compressive strength of the core shall be 100 kPa, which corresponds to the designation CS (10\Y) 100 given in BS EN 13165:2001 (including amendments 1 and 2).

NOTE See Figure 1.

Figure 1 **Diagram to explain orientations for compressive strength measurements**



5.4 Dimensional stability under specified temperature and humidity conditions

When tested in accordance with the procedure in BS EN 13165:2001, **4.2.6** (including amendments 1 and 2) the roofboards shall have a performance of at least DS(TH)5.

NOTE Experience has shown that in the UK conditions where hot bitumen may be used for bonding the roofing membrane to the roofboards, in order to ensure fitness for purpose, the dimensional stability of the roofboard should be such that its performance satisfies the recommendations of Annex A.

5.5 Tensile strength normal to the major plane of the board

When tested in accordance with BS EN 1607:1997 roofboards shall have a tensile strength of at least TR60 (60 kPa).

5.6 Reaction to fire

When classified by the procedure given in BS EN 13501-1 the roofboards shall have a minimum classification of class F.

NOTE 1 Class F is "No performance determined".

NOTE 2 The fire performance of roofboards in isolation is not significant since the UK Building Regulations Approved Document B [1] requires testing of the complete roofing assembly, of which the roofboard forms an internal part. These assemblies are subject to the requirements of the external fire performance, which is determined by testing according to BS 476-3:2004.

NOTE 3 It is intended that BS 476-3:2004 will become the fourth method in DD ENV 1187.

*NOTE 4 It should be noted therefore that the heat source used during testing according to BS 476-3:2004 is applied directly to the covering roofing membrane (see **B.2**). However, it is required under the European Construction Products Directive for a fire performance to be declared for the product in isolation when it is placed on the market. Accordingly, the way of satisfying this requirement is given in **5.6**.*

NOTE 5 For further information on the reaction to fire performance of PIR or PUR insulating products see Annex C.

6 Designation

NOTE The use of BS EN 13165 in this designation should be interpreted as including amendments 1 and 2.

The roofboards shall be given the following designation:

"BS 4841-3:2006/BS EN 13165: XX: Y: W"

where:

- XX is the thermal conductivity of the board without rigid facings, λ_D, in mW/m·K (see 5.1);
- Y is the reaction to fire classification (see **5.6**);
- W is the insulating core type, either PIR or PUR (see **4.2**).

7 Marking

The product, packages or invoices shall be marked with at least the following information:

a) manufacturer's name or trademark;

b) product designation as given in Clause **6**[1)];

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

[1)] Marking BS 4841-3:2006/BS EN 13165 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of this specification and BS EN 13165. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third party certification of conformity.

Annex A (informative) Method for the determination of areas of unbonded facings

A.1 Principle

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

A.2 Apparatus

A.2.1 *Bandsaw or similar fine toothed saw.*

A.2.2 *Means for measuring the dimensions of unbonded areas with an accuracy of 0.5 mm, e.g. a rule.*

A.3 Test specimen

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

A.4 Number of test specimens

One test specimen should be tested.

A.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) °C and a relative humidity of (50 ± 5)%.

A.6 Procedure

Conduct the test at (23 ± 2) °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 A.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 might 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.

A.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.

When tested in accordance with **A.1** to **A.6** roofboards should have no single area of non-adhesion between the facing and the core exceeding 72 cm^2, and in total the unbonded areas for any one face should not exceed an area greater than 5% of that face.

A.8 Test report

The test report should include the following:

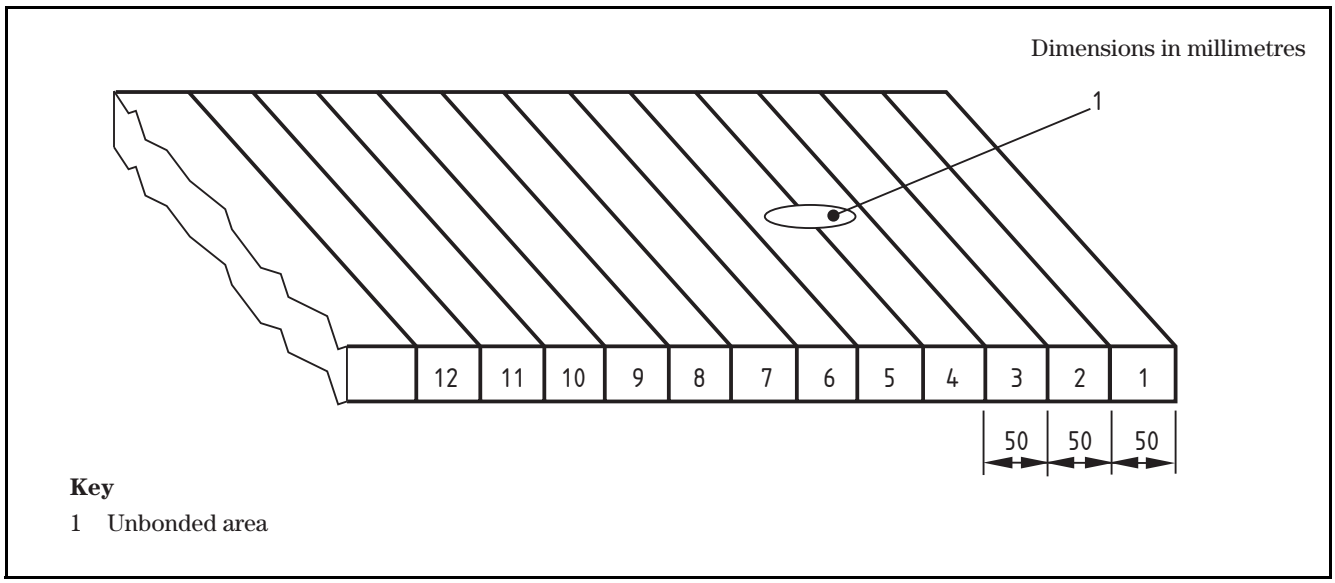
a) the identification of the roofboard tested;

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 4841-3:2006.

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



Annex B (informative) Information for users and designers

B.1 Traffic aspects: heavy duty roofs

The compressive strength of 150 kPa normal to the plane of the roofboard called for as a minimum in **5.3.1** 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.

B.2 Fire aspects (see also Annex C)

The attention of designers is drawn to the need for the final roofing total composition to give the appropriate grading in accordance with BS 476-3:2004 since this is the performance specified in Approved Document B of the Building Regulations [1].

B.3 Guidance on sampling

In cases of doubt or dispute as to whether a consignment of roofboards conforms to 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-conformance 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 conform, the whole consignment should be considered not to conform to this specification.

B.4 Spanning metal deck troughs

The designer's attention is also drawn to the fact that it is essential for PIR or PUR insulating roofboards to conform to the minimum thicknesses given in Table B.1 when used over metal decks having trough openings.

Table B.1 **Relationships between roofboard thickness and metal deck trough openings**

Trough opening mm		**Minimum roofboard thickness** mm
	< 75	25
> 75	$\leqslant 100$	30
> 100	$\leqslant 125$	35
> 125	$\leqslant 150$	40
> 150	$\leqslant 175$	45
> 175	$\leqslant 200$	50
> 200	$\leqslant 225$	55
> 225	$\leqslant 250$	60

B.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.

Annex C (informative) Reaction to fire performance of PIR and PUR products and recommendations regarding their use

The fire performance of the finished structure or article which contains PIR and PUR is most relevant when considering the possible fire hazard associated with PIR and PUR forms.

PIR and PUR insulation products are organic materials and hence are combustible. The risk of ignition and fire growth associated with PIR and PUR products in building construction should be assessed in accordance with BS 6336 i.e. consideration should be given to the design of the end product formed from or incorporating the PIR or PUR core and the risks to which it might be exposed. In general, the performance of the latter is primarily controlled by the type of finish or facing used on the roofboard in conjunction with the core and the way in which the composite is used.

Care should be taken during the construction or repair of any structure or article that contains PIR and PUR products. Care is specifically needed when using these products to avoid contact with naked flames, for example when using the torch-on method of bonding for the subsequent layers of bituminous membranes unless precise instructions are available on safety measures appropriate to the individual application.

Annex D (informative) Information on the installation of roofboards into built-up roofs

D.1 Introduction

PIR and PUR roofboards should be installed in accordance with BS 6229:2003. However, that code of practice does not contain specific recommendations for the use of PIR and PUR. Until such time as a new standard for built-up bitumen felt is produced, these recommendations will provide guidance for the use of PIR and PUR roofboards under built-up felt roofing. The recommendations given in **D.2** to **D.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.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 Moisture protection

Roofboards should be protected from moisture ingress prior to use.

Annex E (informative) Dimensional stability in built-up roofing

E.1 Bitumen pour test

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 × 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 an 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 × 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 bonding remeasure 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 h and 24 h after bonding. Determine each of these distances on 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

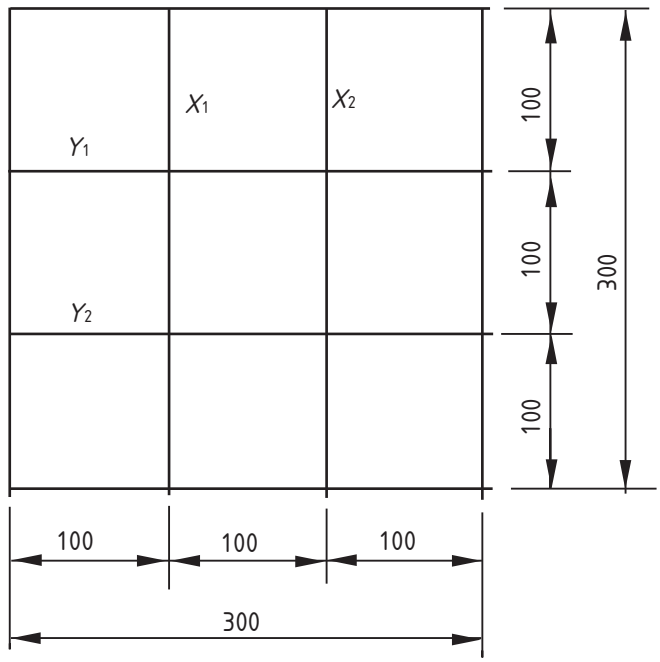
The test report shall include the following:

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 **Marking pattern for test specimens used in the method described in E.2**



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Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 476-3:2004, *Fire tests on building materials and structures – Part 3: Classification and method of test for external fire exposure to roofs*

BS 747:2000, *Reinforced bitumen sheets for roofing – Specification*

BS 6229:2003, *Flat roofs with continuously supported coverings – Code of practice*

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

BS 6399-1:1996, *Loading for buildings – Part 1: Code of practice for dead and imposed loads*

BS 6399-3:1988, *Loading for buildings – Part 3: Code of practice for imposed roof loads*

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

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

DD ENV 1187, *Test methods for external fire exposure to roofs*

Other publications

[1] GREAT BRITAIN, The Building Regulations Approved Document B, Fire Safety, 2004. London:The Stationery Office.

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