BRITISH STANDARD

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

Part 4: Specification for laminated boards (roofboards) with auto-adhesively or separately bonded facings for use as roofboard thermal insulation under non-bituminous single-ply roofing membranes

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 13, 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*.

Information about this document

This British Standard has been introduced to specify the requirements needed to ensure fitness for purpose of those polyurethane and polyisocyanurate cored laminated insulation boards (roofboards) with auto-adhesively or separately bonded flexible and/or rigid facings used in the single-ply roofing application in the United Kingdom. The requirements have been written so that products conforming to BS 4841-4 also conform to BS EN 13165:2001 (including amendments 1 and 2) whilst satisfying the specified minimum performance levels of the properties included in the current standard.

Attention is drawn to BS 8217:2005 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 and D to this standard.

The other parts of BS 4841 have 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.

1 Scope

This British Standard specifies requirements for polyisocyanurate (PIR) and polyurethane (PUR) cored thermally insulated laminated boards (roofboards) with auto-adhesively or separately bonded flexible and/or rigid facings, for use in roofs under non-bituminous single-ply roofing membranes. This specification is also applicable to roofboards with OSB or plywood facings bonded in place after the initial product has been created (see Clause **4**).

NOTE 1 Additional information for the guidance of users, installers and designers is given in informative Annexes A, B, C, and D to this standard.

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

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 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 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 13170:2001, *Thermal insulation products for buildings – Factory made products of expanded cork (ICB) – 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, symbols and definitions

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	nominal thickness of the product in mm
λ_D	declared thermal conductivity in mW/(m·K)
S_b	deviation from squareness in mm/m
S_{max}	maximum deviation from flatness in mm/m

4 Construction and composition

4.1 General

The insulation boards 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 facing (**4.3.5**).

NOTE Both facings need not be identical.

4.3.2 Bitumen coated glass flexible facing

The bitumen coated glass facing 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.

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:

- plywood conforming to BS EN 636:2003 service class 3, exterior conditions; or
- orientated strand board (OSB) conforming to BS EN 300:1997 Grade 3; or
- cork conforming to BS EN 13170:2001; or
- any flexible or rigid rubber sheet.

NOTE The type of facings and the degree of their bonding are crucial to ensure good service performance for the laminated insulation boards. The degree of bonding, if required, should conform to the recommendations 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 boards or core product shall be determined in accordance with BS EN 13165:2001 (including amendments 1 and 2). The declared values shall not exceed 29 mW/m·K at 10 °C.

*NOTE See also **B.7** for information on roofboard design U values and thermal resistance.*

5.2 Dimensions

5.2.1 Length and width

The length and width of insulation boards 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		
T2	± 2	± 3	+5, –2
T3	± 1.5	± 1.5	± 1.5

NOTE UK manufacturers and producers have voluntarily accepted the values in Table 3 which are generally lower than those given for Class T2 in Table 2.

Table 3 **Thickness tolerances**

Nominal thickness mm	**Tolerances** mm
20 to 30	± 1.5
31 to 49	± 2.0
⩾50	± 3.0

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 4.

Table 4 **Deviation from flatness**

Full size product length m	**Full size product area** m^2	**Deviation from flatness** 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).

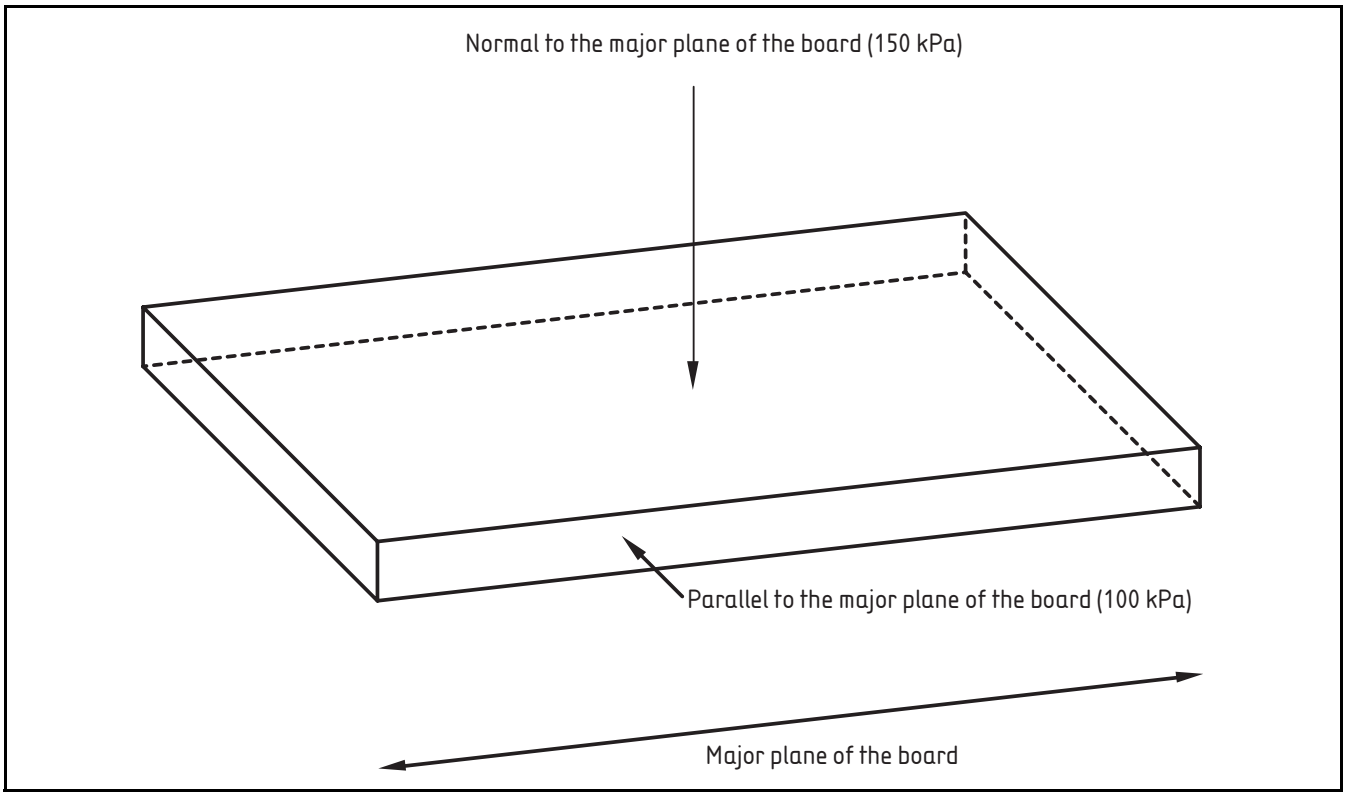
NOTE 1 See Figure 1.

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

*NOTE 3 See also **B.4** for information on robustness.*

*NOTE 4 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).*

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



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.

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**, the insulation boards shall have a performance of at least DS(TH)5.

5.5 Tensile strength normal to the major plane of the board

When tested in accordance with BS EN 1607:1997 the insulation boards shall have a tensile strength of not less than (60 kPa).

5.6 Reaction to fire

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

NOTE 1 Class F is also "No performance determined".

NOTE 2 The fire performance of roofboards in isolation is not significant since the UK Building Regulations Approved Document B 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 the 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 CPD 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 boards shall be given the following designation:

"BS 4841-4:2006/BS EN 13165: XX: Y: W"

where:

- XX is the thermal conductivity in mW/m·K (see **5.1**);
- Y is the reaction to fire classification (see **5.6**);
- W is the 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 4841-1:2006/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 area 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 laminated insulation board 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** boards should have no single area of non-adhesion between the facing and the insulation product 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 insulation board tested;

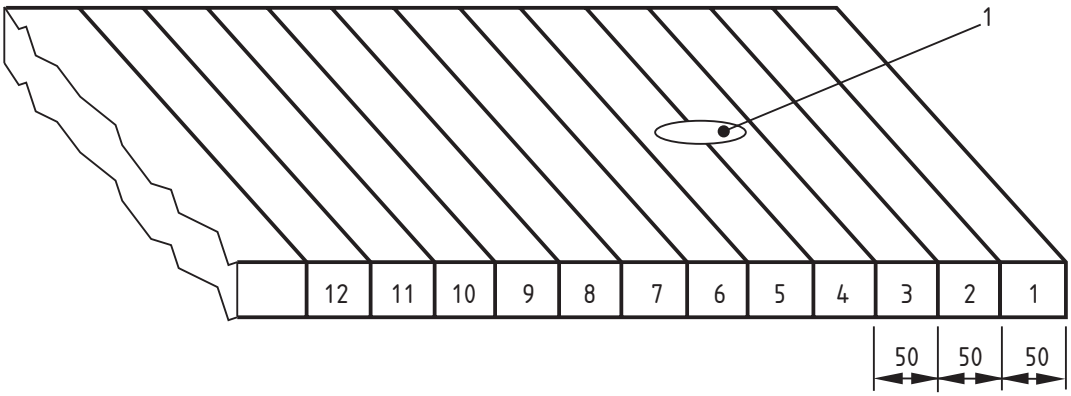
b) the individual unbonded areas for each face measured, expressed as a percentage of the original area of the test specimen;

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 4841-4:2006.

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

Dimensions in millimetres



Key

1 Unbonded area

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** is suitable for roofboards to be used in roofs which are subjected to normal pedestrian access traffic only. It is essential to consider 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.

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 any roofboard not conforming to 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 Robustness of roofboard

The designer's attention is drawn to the need for the roofboard to be sufficiently robust to withstand the handling procedures concerned with its delivery and installation.

B.5 Spanning metal deck troughs

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

B.6 Information contained in the SPRA design guide

The attention of designers is also drawn to the additional BRUFMA document for the mechanical fixing procedures of roofboards under single ply roofing membranes (BRUFMA/ID/1/2001 [2]).

Attention is also drawn to the SPRA Design Guide [1] for additional guidance.

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

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

B.7 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 insulation is most relevant when considering the possible fire hazard associated with PIR and PUR forms.

PIR and PUR cores 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 6336:1998 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.

Annex D (informative) Information on the installation of roofboards into single-ply roofs

D.1 Introduction

PIR and PUR roofboards should be installed in accordance with the Design Guide of the Single Ply Roofing Association [1].

D.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 or during the construction operations.

D.3 Ketone based adhesives

Attention is drawn, when using adhesives to adhere the membrane to the boards, to the membrane manufacturer's instructions so as to avoid ketonic based adhesives coming into contact with the core. This includes the mandatory taping of all board joints with an appropriate foil tape.

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

It is important to distinguish between ketonic adhesives which affect the core and non ketonic based polyurethane adhesives which have no deleterious effects. Taping of the joints is not required with polyurethane based adhesive types which are known to have no effect on the core. In case of doubt, advice from the insulation manufacturer or adhesive manufacturer should be sought.

Bibliography

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 roofs*

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

BS 6336:1998, *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 8217:2005, *Reinforced bitumen membranes for roofing – Code of practice*

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

BS EN 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] SPRA Design Guide for Single Ply Roofing, *The Single Ply Roofing Association.*[2)]

[2] BRUFMA/ID/1/2001, *Mechanical fixing for rigid polyurethane (PUR) and polyisocyanurate (PIR) roofboards beneath single-ply waterproofing membranes.*

[2)] Available from http://www.spra.co.uk.

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