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Agrément Certificate  
**10/4744**  
Product Sheet 2

## BAUDER BITUMINOUS ROOFING SYSTEMS

## BAUDER TOTAL GREEN ROOF WATERPROOFING SYSTEMS

### PRODUCT SCOPE AND SUMMARY OF CERTIFICATE

This Certificate relates to Bauder Total Green Roof Waterproofing Systems, for use on zero fall, flat roofs and pitched roofs in roof garden applications (intensive and extensive).

#### AGRÉMENT CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

#### KEY FACTORS ASSESSED

**Weathertightness** — the systems will resist the passage of moisture to the interior of the building (see section 5).

**Thermal performance** — the systems can be used to improve the thermal performance of a roof (see section 6).

**Condensation risk** — roofs incorporating the systems will adequately limit the risk of interstitial and surface condensation (see section 7).

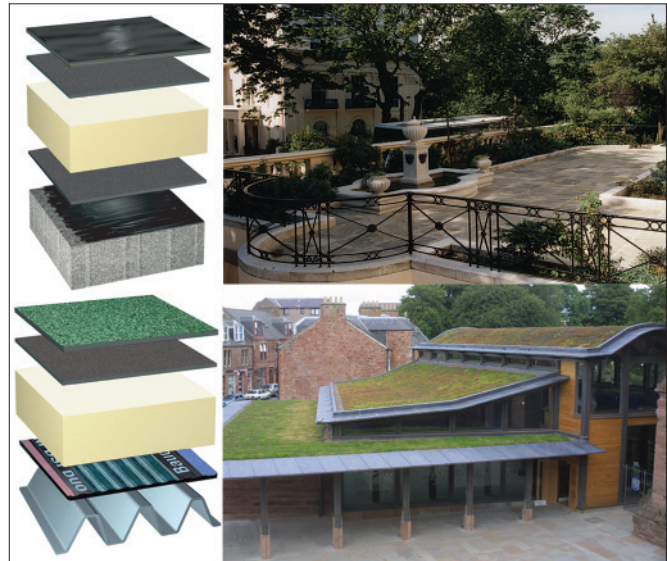
**Properties in relation to fire** — in the opinion of the BBA, the systems, when used in a suitable specification, will enable a roof to be unrestricted under Building Regulations (see section 8).

**Resistance to wind uplift** — results of tests indicate that the systems will enable a roof to be unrestricted under Building Regulations (see section 9).

**Resistance to foot traffic** — the systems will accept the limited foot traffic and loads associated with installation and maintenance of the system without damage (see section 10).

**Resistance to plant growth** — the membrane adequately resists plant root penetration (see section 11).

**Durability** — evidence from tests confirm that exposed waterproofing membranes will have a life in excess of 30 years. When fully protected and subject to normal service conditions in roof garden and green roof specifications, the systems can provide an effective barrier to the transmission of liquid water and water vapour for the design life of the roof in which it is incorporated (see section 13).



The BBA has awarded this Agrément Certificate to the company named above for the systems described herein. These systems have been assessed by the BBA as being fit for their intended use provided they are installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Simon Wroe  
Head of Approvals — Materials

Greg Cooper  
Chief Executive

Date of First issue: 26 March 2010

*The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at [www.bbacerts.co.uk](http://www.bbacerts.co.uk)*

*Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct.*

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# Regulations

In the opinion of the BBA, Bauder Total Green Roof Waterproofing Systems, if used in accordance with the provisions of this Certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations:



## The Building Regulations 2000 (as amended) (England and Wales)

<b>Requirement:</b> B4(2)	<b>External fire spread</b>
<b>Comment:</b>	When used in irrigated roof gardens or green roofs use of the systems will be unrestricted under this Requirement. See sections 8.1 to 8.4 of this Certificate.
<b>Requirement:</b> C2(b)	<b>Resistance to moisture</b>
<b>Comment:</b>	Data for water resistance on the systems, including joints, indicate that these systems meet this Requirement. See section 5.1 of this Certificate.
<b>Requirement:</b> C2(c)	<b>Resistance to moisture</b>
<b>Comment:</b>	The vapour control layer component of the systems can contribute to enabling a roof to satisfy the requirements of this Regulation. See sections 7.1 to 7.4 of this Certificate.
<b>Requirement:</b> L1(a)(i)	<b>Conservation of fuel and power</b>
<b>Comment:</b>	See sections 6.2 to 6.5 of this Certificate
<b>Requirement:</b> Regulation 7	<b>Materials and workmanship</b>
<b>Comment:</b>	The systems are acceptable. See section 13.1 and the <i>Installation</i> part of this Certificate.



## The Building (Scotland) Regulations 2004 (as amended)

<b>Regulation:</b> 8(1)(2)	<b>Fitness and durability of materials and workmanship</b>
<b>Comment:</b>	The systems satisfy the requirement of this Regulation. See sections 12.1, 12.2, 13.1 and the <i>Installation</i> part of this Certificate.
<b>Regulation:</b> 9	<b>Building standards — construction</b>
<b>Standard:</b> 2.8	<b>Spread from neighbouring buildings</b>
<b>Comment:</b>	When used in irrigated roof gardens or green roofs use of the membranes can be regarded as having low vulnerability under clause 2.8.1 <sup>(1)(2)</sup> of this Standard. See sections 8.1 to 8.4 of this Certificate.
<b>Standard:</b> 3.10	<b>Precipitation</b>
<b>Comment:</b>	Data for water resistance on the systems, indicate that the use of these systems will enable a roof to satisfy the requirements of this Standard, with reference to clauses 3.10.1 <sup>(1)(2)</sup> and 3.10.7 <sup>(1)(2)</sup> . See section 5.1 of this Certificate.
<b>Standard:</b> 3.15	<b>Condensation</b>
<b>Comment:</b>	The vapour control layer component of the systems can contribute to enabling a roof to satisfy this Standard, with reference to clauses 3.15.1 <sup>(1)</sup> , 3.15.3 <sup>(1)</sup> , 3.15.5 <sup>(1)</sup> and 3.15.6 <sup>(1)</sup> . See sections 7.1 to 7.4 of this Certificate.
<b>Standard:</b> 6.1	<b>Carbon dioxide emissions</b>
<b>Standard:</b> 6.2	<b>Building insulation envelope</b>
<b>Comment:</b>	See sections 6.2 to 6.5 of this Certificate.
<b>Regulation:</b> 12	<b>Building standards — conversions</b>
<b>Comment:</b>	All comments given for these systems under Regulation 9, also apply to this Regulation, with reference to clause 0.12.1 <sup>(1)(2)</sup> and Schedule 6 <sup>(1)(2)</sup> . (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



## The Building Regulations (Northern Ireland) 2000 (as amended)

<b>Regulation:</b> B2	<b>Fitness of materials and workmanship</b>
<b>Comment:</b>	The systems are acceptable. See section 13.1 and the <i>Installation</i> part of this Certificate.
<b>Regulation:</b> B3(2)	<b>Suitability of certain materials</b>
<b>Comment:</b>	The systems are acceptable. See section 12.1 and 12.2 of this Certificate.
<b>Regulation:</b> C4(b)	<b>Resistance to ground moisture and weather</b>
<b>Comment:</b>	Data for water resistance on the systems indicate that the use of these systems will enable a roof to satisfy the requirements of this Regulation. See section 5.1 of this Certificate.
<b>Regulation:</b> C5	<b>Condensation</b>
<b>Comment:</b>	The vapour control layer component of the systems can contribute to enabling a roof to satisfy the requirements of this Regulation. See sections 7.1 to 7.4 of this Certificate.
<b>Regulation:</b> E5(b)	<b>External fire spread</b>
<b>Comment:</b>	When used in irrigated roof gardens or green roofs use of the systems will be unrestricted under the requirements of this Regulation. See sections 8.1 to 8.4 of this Certificate.
<b>Regulation:</b> F2(a)(i)	<b>Conservation measures</b>
<b>Regulation:</b> F3	<b>Target carbon dioxide Emissions Rate</b>
<b>Comment:</b>	The insulation element of the systems will enable a roof to satisfy the Elemental Method of Limiting heat loss. See sections 6.2 to 6.5 of this Certificate.

Information in this Certificate may assist the client, CDM co-ordinator, designer and contractors to address their obligations under these Regulations.

See sections: 1 Description (1.2 and 1.3), 2 Delivery and site handling (2.4) and 14 Installation – General (14.9).

## Non-regulatory Information

### NHBC Standards 2008

NHBC accepts the use of Bauder Total Green Roof Waterproofing Systems, when installed and used in accordance with this Certificate, in relation to *NHBC Standards, Chapter 7.1, Flat roofs and balconies.*

## Technical Specification

### 1 Description

1.1 Bauder Total Green Roof Waterproofing Systems consist of the following waterproofing membranes, vapour control layers and insulation boards:

- Bauder PLANT E – an elastomer modified bitumen torch-on capsheet reinforced with a 250 gm<sup>-2</sup> polyester fleece
- Bauder K5E – an elastomer modified bitumen torch-on capsheet reinforced with a 250 gm<sup>-2</sup> polyester fleece
- Bauder Rootbar – an elastomer modified bitumen torch-on capsheet reinforced with a 60 gm<sup>-2</sup> glass fleece and copper foil
- BauderTEC KSA DUO – an elastomer modified bitumen, heat-activated, self-adhesive underlay reinforced with a glass lattice
- Bauder G4E – an elastomer modified bitumen torch-on underlay reinforced with a 200 gm<sup>-2</sup> woven glass
- Bauder VB4-Expal – an elastomer modified bitumen torch-on vapour control layer reinforced with a 60 gm<sup>-2</sup> glass fleece and aluminium/polyester foil
- BauderTherm DS1 DUO – an elastomer modified bitumen, heat-activated, self-adhesive vapour control layer reinforced with a 60 gm<sup>-2</sup> glass fleece and aluminium/polyester foil
- BauderPIR Flatboard – a polyisocyanurate insulation board, manufactured to EN 13165 : 2008, for fully bonding on flat roofs
- BauderPIR Tapered – a polyisocyanurate insulation board, manufactured to EN 13165 : 2008, for fully bonding on flat roofs
- BauderPIR FA-TE – a polyisocyanurate insulation board, manufactured to EN 13165 : 2008, for partially bonding in conjunction with BauderTherm DS1 DUO on flat roofs.

1.2 The membranes are manufactured to the nominal characteristics given in Table 1:

Table 1 Nominal characteristics – membranes

Characteristics (units)	Bauder PLANT E	Bauder K5E	Bauder Rootbar	BauderTEC KSA DUO	Bauder G4E	Bauder VB4-Expal	BauderTherm DS1 DUO
Thickness (mm)	5.2	5.0	5.0	3.0	4.0	3.5	4.0
Roll width (m)	1.00	1.00	1.00	1.00	1.00	1.00	1.08
Roll length (m)	5.0	5.0	5.0	7.5	7.5	7.5	7.5
Roll weight (kg)	30.0	27.0	35.0	26.3	36.0	33.8	36.5
Mass per unit Area (kg.m <sup>-2</sup> )	6.0	5.8	7.0	3.5	4.8	4.5	4.5
Lower surface	thermofusible polyethylene	thermofusible polyethylene	thermofusible polyethylene	perforated peel off film	thermofusible polyethylene	thermofusible polyethylene	perforated peel off film
Upper surface finish	Green slate	mica	thermofusible polyethylene	thermofusible polyethylene	mica	mica	polyethylene/mica and heat activated adhesive strips

1.3 The insulation boards are manufactured to the nominal characteristics given in Table 2.

Table 2 Nominal characteristics – insulation boards

Characteristic (units)	BauderPIR Flatboard	BauderPIR Tapered	BauderPIR FA-TE
Thickness (mm)	30–200 (in 10 mm increments)	20 upwards <sup>(1)</sup>	30–200 (in 10 mm increments)
Width (mm)	600	800	600
Length (mm)	1200	1200	1200
Minimum density (kg·m <sup>-3</sup> )	30	30	28
Compressive strength	CS(10\Y)120	CS(10\Y)120	CS(10\Y)120
Thermal conductivity (W·m <sup>-1</sup> ·K <sup>-1</sup> )	0.028 (< 80 mm) 0.027 (80–119 mm) 0.026 (≥120 mm)	0.030 (< 80 mm) 0.029 (80–119 mm) 0.028 (≥120 mm)	0.023
Surface finish	mineralised glass fibre	none	aluminium

(1) The tapered board is available with fall ratios of 1:33, 1:40, 1:50, 1:60, 1:67 and 1:100.

#### 1.4 Other materials for use with the systems include:

- Bauder intensive substrate — a lightweight growing medium for roof garden specifications
- Bauder extensive substrate — a lightweight growing medium for plug planting or hydroplanting for green roofs specifications
- Bauder Xero Flor XF301 Sedum Blanket — a pre-cultivated vegetation blanket on a nylon loop and geotextile base carrier with special substrate for use in green roof specifications. The product has an integral 8 mm moisture retention fleece attached to the underside
- Bauder FSM 600 and FSM 1100 Protection Mat — a recycled polyester/polypropylene fibre mix mat for protection of the waterproofing layer
- Bauder Eco-Mat Protection Fleece — a recycled polyester/polypropylene fleece for protection of the waterproofing layer when used in green roof specifications
- Bauder Pro-mat Protection Mat — a recycled shredded rubber mat for protection of the waterproofing layer when used in green roof specifications
- Bauder PE Foil Separation Layer — a polyethylene membrane used in a double layer between the waterproofing layer and the protection layer
- Bauder Filter Fleece — a polypropylene fleece for use as a filtration layer preventing fines from washing into the drainage layer
- Bauder SDF Mat — ultraviolet-resistant nylon loops thermally bonded to geotextile facings for use as a filter and drainage layer in green roof specifications
- Bauder PLT 10 — a high-density polyethylene studded (10 mm depth) board with a geotextile fleece attached to the top face of the studs, for use as a filter and drainage layer
- Bauder DSE 20 — a profiled high-density polyethylene studded (20 mm depth) board, for use as a water storage and drainage layer in roof garden specifications
- Bauder DSE 40 — a profiled high density polyethylene board (40 mm depth) for use as a water storage and multi-directional drainage layer in roof garden specifications
- Bauder DSE 60 — a profiled high-density polyethylene (60 mm board depth) depth, for use as a water storage and multi-directional drainage layer in roof garden specifications
- Bauder Versicell 20 — a recycled polypropylene drainage and protection board for high loading applications in roof garden systems
- Bauder Reservoir Board — a profiled expanded polystyrene board, for use as a water storage and drainage layer
- Bauder Drainage Board — a profiled expanded polystyrene board for use as a water drainage layer
- Bitumen grade 95/25 — for use in bonding insulation
- Bitumen Primer and Fast Drying Bitumen Primer — for use in preparing substrates prior to installation of the vapour control layer.

1.5 The membranes are manufactured using the same conventional continuous bitumen coating techniques as for traditional bituminous felts.

1.6 Quality control checks are carried out on the raw materials, the coating mass and the final product.

## 2 Delivery and site handling

2.1 The membranes are delivered to site in rolls with either paper wrappers or tape bands bearing the product name and production code. The rolls are packed on pallets and shrunk wrapped in UV protective (white) polyethylene.

2.2 The insulation boards are delivered to site packaged in shrink wrap plastic.

2.3 Rolls should be stored upright on a clean, level surface, away from excessive heat and kept under cover. The self-adhesive products should be stored out of direct sunlight.

2.4 The insulation boards should be kept dry, on pallets, kept off the ground and under cover.

2.5 Bitumen Primer and Fast Drying Bitumen Primer is classified as Flammable, Harmful and Toxic to aquatic organisms under *The Chemical (Hazard Information and Packaging for Supply) Regulations 2009* (CHIP4) and should be handled accordingly. The primer must be stored away from ignition sources and extremes of temperature must also be avoided.

## Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the Bauder Total Green Roof Waterproofing Systems.

### Design Considerations

#### 3 General

3.1 Bauder Total Green Roof Waterproofing Systems are satisfactory as roof waterproofing specifications including vapour control layers and thermal insulation for green roofs (extensive planting) on flat, sloping and completely flat roofs with limited access and pedestrian traffic, as a partially or fully bonded system and roof gardens (intensive planting).

3.2 Flat roofs are defined for the purpose of this Certificate as those roofs having a minimum finished fall of 1:80. Pitched roofs are defined for the purpose of this Certificate as those having falls greater than 1:6. Completely flat roofs are defined for the purpose of this Certificate as those having a finished fall of less than 1:80.

3.3 Roof Garden specifications can be used on pitches of up to 20° provided the waterproofing system and landscaping are properly supported at the base of the slope and the specification is in accordance with the Certificate holder's recommendations. Above 1:6 (10°) the waterproofing is mechanically fastened and support battens are incorporated to counteract the shear force imposed by the roof garden build-up.

3.4 When designing flat roofs, twice the minimum finished fall should be assumed, unless a detailed analysis of the roof is available, including for example overall and local deflection and direction of falls.

3.5 Limited access roofs are defined for the purpose of this Certificate as those roofs subjected only to pedestrian traffic for such duties as maintenance of the roof covering and cleaning of gutters. Where traffic in excess of this is envisaged, special precautions such as additional protection to the membrane must be taken.

3.6 Structural decks to which the membranes are to be applied must be suitable to transmit the dead and imposed loads experienced in service.

3.7 Dead loads, wind loading and imposed loads are calculated in accordance with BS 6399-1 : 1996, BS 6399-2 : 1997 and BS 6399-3 : 1998, respectively.

3.8 Decks to which the products are to be applied must comply with the relevant requirements of BS 6229 : 2003, BS 8217 : 2005 and, where appropriate, *NHBC Standards Chapter 7.1 Flat roofs and balconies*.

3.9 Dead loads could also be dramatically increased if the drains become partially or completely clogged causing waterlogging of the drainage soil layers.

#### 4 Practicability of installation

The system should only be installed by contractors who have been trained and approved by the Certificate holder.

#### 5 Weathertightness



5.1 Results of test data confirm that the waterproofing membranes and joints in the membranes, when completely sealed and consolidated, will adequately resist the passage of moisture to the inside of the building and so meet the requirements of the national Building Regulations. See Table for *Physical properties — general*:

**England and Wales** — Approved Document C, Requirement C2(b), Section 6

**Scotland** — Mandatory Standard 3.10, clauses 3.10.1 and 3.10.7

**Northern Ireland** — Regulation C4(b).

5.2 The membranes are impervious to water and when used in the systems described will give a weathertight roofing capable of accepting minor structural movements without damage.

#### 6 Thermal performance

6.1 Calculations of the thermal transmittance (U value) of specific roof constructions should be carried out in accordance with BS EN ISO 6946 : 1997 and BRE<sup>(1)</sup> report (BR 443 : 2006) Conventions for U-value calculations, using the declared thermal conductivity ( $\lambda_{90/90}$  value) of the boards as shown in Table 2.

(1) Building Research Establishment.



6.2 The roof systems contribute to meeting the requirements of the national Building Regulations.

### England and Wales and Northern Ireland

- 0.16 W·m<sup>-2</sup>·K<sup>-1</sup> required for 'notional' dwellings in SAP 2005 (see section 6.3)
- 0.25 W·m<sup>-2</sup>·K<sup>-1</sup> required for buildings other than dwellings in SBEM
- 0.25 W·m<sup>-2</sup>·K<sup>-1</sup> limit average U value specified in Approved Documents L1A (Table 2) and L2A (Table 4) and Technical Booklets F1 (Table 2.2) and F2 (Table 2.4).

### Scotland

- 0.16 W·m<sup>-2</sup>·K<sup>-1</sup> U value required for the 'notional' dwellings in SAP 2005 and the 'simplified approach — all fuel packages' in Mandatory Standard 6.1, clauses 6.1.2<sup>(1)</sup> and 6.1.6<sup>(1)</sup> (see section 6.3)
- 0.20 W·m<sup>-2</sup>·K<sup>-1</sup> maximum average U value specified Mandatory Standard 6.2, in clause 6.2.1<sup>(1)</sup> (see section 6.3)
- 0.25 W·m<sup>-2</sup>·K<sup>-1</sup> U value required for 'notional' building in SBEM in Mandatory Standard 6.1, clause 6.1.3<sup>(2)</sup>
- 0.25 W·m<sup>-2</sup>·K<sup>-1</sup> maximum U value specified for the insulation and
- 0.35 W·m<sup>-2</sup>·K<sup>-1</sup> limit value for the individual elements as per Mandatory Standard 6.2, clause 6.2.1<sup>(1)(2)</sup>.

(1) Technical Handbook (Domestic).

(2) Technical Handbook (Non Domestic).

6.3 Where a proposed roof U value is greater than the 'notional' value specified in section 6.2, additional energy saving measures will be required in the building envelope and/or services to achieve the required overall carbon dioxide emission rate reduction to about 20% in dwellings (18% to 25% in Scotland) and 23% to 28% for buildings other than dwellings.

6.4 Compliance with the guidance referred to in section 6.5 will allow the use of the default psi values from Table 3 of BRE Information Paper IP 1/06 *Assessing the effects of thermal bridging at junctions and around openings* and Table K1 of *The Government's Standard Assessment Procedure for Energy Rating of Dwellings* (SAP 2005), in Target Emission Rate calculations to SAP 2005 or the Simplified Building Energy Model (SBEM) (use 'simplified approach' for Scotland).

6.5 The insulation component of the systems can maintain, or contribute to maintaining, continuity of thermal insulation at junctions between roof and other building elements. Guidance in this respect and on limiting heat loss by air infiltration, can be found in:

**England and Wales** — *Limiting thermal bridging and air leakage : Robust construction details for dwellings and similar buildings* TSO 2002 or Accredited Construction Details (version 1.0)

**Scotland** — Accredited Construction Details (Scotland)

**Northern Ireland** — Accredited Construction Details (version 1.0).

## 7 Condensation risk

### Surface condensation



7.1 Roofs will adequately limit the risk of surface condensation when the U value of the roof does not exceed 0.35 W·m<sup>-2</sup>·K<sup>-1</sup> at any point and junctions and openings are designed in accordance with the relevant requirements of *Limiting thermal bridging and air leakage : Robust construction details for dwellings and similar buildings*, TSO 2002, Accredited Construction Details — June 2007 (1st Edition) or BRE Information Paper IP 1/06.

7.2 Roofs will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed 1.2 W·m<sup>-2</sup>·K<sup>-1</sup> at any point. Guidance may be obtained from section 8 of BS 5250 : 2002 and BRE report (BR 262 : 2002) *Thermal insulation : avoiding risks*.

7.3 The vapour control layers provide effective control to the passage of liquid water and water vapour. See Table for *Physical properties — general*.

### Interstitial condensation

7.4 Roofs will adequately limit the risk of interstitial condensation when they are designed and constructed in accordance with BS 5250 : 2002, Section 8.4 and Annex D.

## 8 Properties in relation to fire



8.1 In the opinion of the BBA when used in irrigated roof gardens or green roofs, the use of the systems will be unrestricted under the national Requirements:

**England and Wales** — Requirement B4(2)

**Scotland** — Mandatory Standard 2.8, with reference to clause 2.8.1

**Northern Ireland** — Regulation E5(b).

8.2 When tested in accordance with BS 476-3 : 2004, a system comprising an 19 mm exterior plywood substrate, a fully bonded layer of Bauder VB4 Expal Vapour Barrier, a 100 mm thick BauderPIR insulation board bitumen bonded, a fully bonded layer of Bauder G4E, a fully bonded layer of Bauder Plant E, and Bauder Xeroflor XF301 Sedum Blanket achieved an EXT.S.AA rating.

8.3 When tested in accordance with BS 476-3 : 1958, a system comprising an 18 mm plywood substrate, a fully bonded layer of Bauder VB4 Expal Vapour Barrier, a Bauder 50 mm thick Eurotherm V EF polyurethane insulation board bitumen bonded, a fully bonded layer of Bauder G4E, a fully bonded layer of Bauder Plant E, and Bauder Xeroflor XF301 Sedum Blanket achieved an EXT.F.AA rating.

8.4 When tested in accordance with ENV 1187 : 2002 test 4, a system comprising an 19 mm exterior plywood substrate, a fully bonded layer of Bauder VB4 Expal Vapour Barrier, a 100 mm thick BauderPIR insulation board bitumen bonded, a fully bonded layer of Bauder G4E, a fully bonded layer of Bauder Plant E, and Bauder Xeroflor XF301 Sedum Blanket achieved a classification to BS EN 13501-5 : 2005 of B<sub>ROOF(t4)</sub>.

8.5 The designation of other specifications (eg on combustible substrates) should be confirmed by:

**England and Wales** — Test or assessment in accordance with Approved Document B, Appendix A, Clause 1

**Scotland** — Tests to confirm compliance with Mandatory Standard 2.8, with reference to clause 2.8.1

**Northern Ireland** — Test or assessment by a UKAS accredited laboratory, or an independent consultant with appropriate experience.

## 9 Resistance to wind uplift

9.1 The adhesion of the bonded membranes is sufficient to resist the effects of wind suction, elevated temperature and thermal shock conditions likely to occur in practice. See Table for *Physical properties — general*.

9.2 The soil used in intensive planting should not be of a type that will be removed, or become localised due to wind scour experienced on site.

9.3 It should be recognised that the type of plants used could significantly affect the expected wind loads experienced in service.

## 10 Resistance to foot traffic

10.1 Prior to installation of the upper layers of the system the waterproofing can accept the limited foot traffic and light concentrated loads associated with installation operations. See Table for *Physical properties — general*.

10.2 Where regular foot traffic is envisaged, paving on bearer pads or similar suitable pedestrian surfaces should be used.

## 11 Resistance to plant growth

11.1 Results of test data indicate that the waterproofing membrane will adequately resist penetration by plant roots.

11.2 Where there is a run-off from a large sill or gully onto the roof surface, the build-up of silt may allow the germination of seeds, therefore this type of detail should be avoided. Any growth occurring will be restricted and will not normally affect the performance of the roof and will be no worse than that occurring on normal flat roofs.

## 12 Maintenance



12.1 Roofs should be inspected annually in autumn after leaf fall and in the spring to ensure vegetation and other debris are cleared from the roof and drainage outlets cleared. Guidance is available within the latest edition of *Guidelines to Green Roofing* The Green Roof Organisation (GRO).

12.2 It is imperative that the drainage system of the green roof or roof garden is designed correctly, and provision is made for access for maintenance purposes. Inspection of the drains should be carried out regularly to avoid waterlogging of the garden and the subsequent increase in dead weight load.

## 13 Durability



13.1 The systems have been used since 1982 in Germany, and evidence from tests confirm that exposed waterproofing membranes will have a life in excess of 30 years. When fully protected and subject to normal service conditions in roof garden and green roof specifications, the system can provide an effective barrier to the transmission of liquid water and water vapour for the design life of the roof in which it is incorporated. See Table for *Physical properties — directional* and Table for *Physical properties — general*.

13.2 Bauder PLANT E, when exposed, will suffer some localised loss of mineral surfacing in areas where complex detailing of the roof design is incorporated.

## 14 General

14.1 Installation of Bauder Total Green Roof Waterproofing Systems is carried out in accordance with the Certificate holder's instructions and the relevant Clauses of BS 8000-4 : 1989 and BS 8217 : 2005

### Waterproofing

14.2 Deck surfaces must be dry, clean and free from sharp projections such as nail heads and concrete nibs. The substrate should be prepared using Bitumen Primer or Fast Drying Bitumen Primer at the recommended rate prior to installation of the vapour control layer.

14.3 Systems may be laid in conditions normal to roofing work and must not be laid in rain, snow or heavy fog, nor if the surface temperature falls below 5°C.

14.4 The waterproofing layers must always be installed with staggered overlaps and in such a manner that no counter-seams in the direction of the outlets are made.

14.5 At falls in excess of 5° (1:11) precautions against slippage, and requirements for mechanical fixing as required by BS 8217: 2005, should be observed. For slopes above 10° (1:5.7) the Certificate holder's Technical Service Department should be contacted for advice.

14.6 Soil or other bulk material should not be stored on one area of the roof prior to installation, to ensure that localised overloading does not occur.

### Insulation

14.7 Where required, insulation boards can be cut easily using a handsaw or knife.

14.8 It is essential that all joints between the boards are tight and gaps do not exist where they meet rooflights, edge details and other services which perforate the roof deck.

14.9 Boards must be installed in dry weather, Due to their light weight, care must be taken in high winds. Installers must not carry boards near to parapets or apertures in the deck and, once placed, the boards must be loaded immediately.

## 15 Procedure

15.1 The vapour control layer is rolled out onto the primed substrate, positioned and cut to length. The vapour control layer must extend up all upstands a sufficient height to ensure the thermal break insulation is encapsulated. The vapour control layer is installed in accordance with the appropriate method for the product.

15.2 BauderPIR FA-TE insulation board, is partially bonded using the heat activated adhesive strips of the BauderTherm DS1 DUO vapour control layer. The other insulation boards are fully bonded to the vapour control layer using hot 95/25 bitumen or an approved insulation adhesive. The bitumen should be poured and not mopped to ensure minimum heat loss.

15.3 The underlays are installed either by partially torch bonding for Bauder G4E and fully bonding for the BauderTEC KSA DUO using self-adhesive application method. The Bauder G4E membrane should be fully torch bonded for a distance of 400 mm at perimeters and penetrations such as roof lights, outlets and pipes.

15.4 Head and side laps for the underlays are 100 mm wide and fully bonded ensuring that a continuous bead of bitumen exudes from the lap.

15.5 The underlay must be taken up all upstands and protrusions a sufficient distance to ensure a secure lap with the vapour control layer and should be a minimum height of 150 mm above the roof surface.

15.6 Bonding of the cap sheets is achieved by melting the lower surface by torching and pressing the membrane down. Care must be taken not to overheat the membrane.

15.7 Head and side laps for the cap sheets are 100 mm wide and fully bonded ensuring that a continuous bead of bitumen exudes from the lap. Laps between the membrane and any base sheets should be offset by a minimum of 300 mm.

15.8 Detailing should be carried out in accordance with the Certificate holder's instructions.

15.9 The subsequent layers, such as separation layers, drainage layers, growing medium, are installed in accordance with the Certificate holder's installation instructions.

## 16 Repair

In the event of damage the cap sheet can be effectively repaired with a patch of the appropriate cap sheet torch-bonded over the damaged area.

## 17 Tests

17.1 Samples of the membranes used in Bauder Total Green Roof Waterproofing Systems were obtained from the Certificate holder for testing. The results of the tests carried out by the BBA are summarised in Tables 3 and 4.

*Table 3 Physical properties (directional)*

Tests (units)	Mean results		Method <sup>(1)</sup>
	Longitudinal	Transverse	
Tensile strength (N per 50 mm)			BS EN 12311-1
BauderTherm DS1 DUO	760	510	
Bauder VB4-Expal	755	530	
BauderTEC KSA DUO	1215	1085	
Bauder G4E	1405	1895	
Bauder K5E	1260	1115	
Bauder PLANT E	1385	1105	
Bauder Rootbar	1020	905	
Elongation at maximum load (%)			BS EN 12311-1
BauderTherm DS1 DUO	5	6	
Bauder VB4-Expal	4	3	
BauderTEC KSA DUO	10	9	
Bauder G4E	8	13	
Bauder K5E	52	56	
Bauder PLANT E	51	63	
Bauder Rootbar	7	7	
Nail tear (N)			BS EN 12310-1
BauderTherm DS1 DUO	220	250	
Bauder VB4-Expal	190	210	
Bauder TEC KSA DUO	200	360	
Bauder G4E	480	335	
Bauder K5E	325	325	
Bauder PLANT E	325	355	
Bauder Rootbar	275	335	
Dimensional stability (%)	-0.7	+0.3	MOAT 64 : 4.3.7
Low temperature flexibility (°C) <sup>(2)</sup> unaged			MOAT 64 : 4.2.5
BauderTherm DS1 DUO	-20	-20	
Bauder VB4-Expal	-20	-20	
BauderTEC KSA DUO	-20	-20	
Bauder G4E	-20	-20	
Bauder K5E	-20	-20	
Bauder PLANT E	-20	-20	
Bauder Rootbar	-20	-20	
water exposure <sup>(3)</sup>			
Bauder Rootbar	-15	-15	
Fatigue cycling			MOAT 64 : 4.3.5
BauderTherm DS1 DUO	pass	pass	
BauderTEC KSA DUO	pass	pass	

(1) The test documents are detailed in the *Bibliography*. Numbers in the table refer to sections/parts of the various documents.

(2) Lowest temperature tested for control sample was -20°C and for water exposure -15°C.

(3) Water exposure 180 days at 60°C in accordance with EOTA TR 012.

*Table 4 Physical properties (general)*

Tests (units)	Mean results	Method <sup>(1)</sup>
Static loading		MOAT 64 : 4.3.9
Bauder PLANT E <sup>(2)</sup>		
EPS substrate	L <sub>25</sub>	
Concrete substrate	L <sub>25</sub>	
Dynamic impact		MOAT 64 : 4.3.10
Bauder PLANT E <sup>(2)</sup>		
EPS substrate	I <sub>10</sub>	
Perlite substrate	I <sub>10</sub>	
Watertightness		MOAT 64 : 4.3.6
Bauder Rootbar	pass	
Water vapour transmission (g·m <sup>-2</sup> ·day <sup>-1</sup> )		BS 3177 (25°C/75% RH)
BauderTherm DS1 DUO	<0.1	
Bauder VB4-Expal	0.1	
BauderTEC KSA DUO	0.3	
Bauder G4E	0.2	
Bauder K5E	0.2	
Bauder PLANT E	0.3	
Bauder Rootbar	0.1	
Water vapour resistance (MN·s·g <sup>-1</sup> )		BS 3177 (25°C/75% RH)
BauderTherm DS1 DUO	<2054	
Bauder VB4-Expal	2054	
BauderTEC KSA DUO	685	
Bauder G4E	1027	
Bauder K5E	1027	
Bauder PLANT E	685	
Bauder Rootbar	2054	
Shear resistance of joints (N per 50 mm)		BS EN 12317-1
Bauder Rootbar		
water exposure <sup>(3)</sup>	739	
Peel from primed concrete (N)		MOAT 64 : 4.3.3
BauderTEC KSA DUO		
unaged	50.6	
heat aged <sup>(4)</sup>	56.0	
Air pressure on joints		MOAT 27 : 5.2.1
Bauder Rootbar		
water exposure <sup>(3)</sup>	pass	

(1) The test documents are detailed in the *Bibliography*. Numbers in the table refer to sections/parts of the various documents.

(2) Bauder PLANT E tested with BauderTEC KSA DUO.

(3) Water surface exposure for 180 days at 60°C.

(4) Heat aged 28 days at 80°C.

16.2 The following tests were also carried out on the membranes:

- thickness
- mass per unit area
- width
- heat resistance
- slippage.

## 18 Investigations

18.1 The manufacturing process was examined, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

18.2 Data on fire performance to BS 476-3 : 1958, 2004 and ENV 1187 : 2002 test 4 were examined.

18.3 Data examined on rain generated impact sound transmission for a standard Bauder roofing specification and the the same specification with the addition of the Bauder Xeroflor Sedum Blanket (saturated), showed a reduction in transmitted noise for the system with the sedum blanket.

18.4 Visits to sites using Bauder SBS modified bitumen membranes in exposed specifications installed in 1983, 1985 and 1986 were carried out to assess the durability of the systems.

## Bibliography

- BS 476-3 : 1958 *Fire tests on building materials and structures — External fire exposure roof test*
- BS 476-3 : 2004 *Fire tests on building materials and structures — Classification and method of test for external fire exposure to roofs*
- BS 3177 : 1959 *Method for determining the permeability to water vapour of flexible sheet materials used for packaging*
- BS 5250 : 2002 *Code of practice for control of condensation in buildings*
- BS 6229 : 2003 *Flat roofs with continuously supported coverings — Code of practice*
- BS 6399-1 : 1996 *Loading for buildings — Code of practice for dead and imposed loads*
- BS 6399-2 : 1997 *Loading for buildings — Code of practice for wind loads*
- BS 6399-3 : 1988 *Loading for buildings — Code of practice for imposed roof loads*
- BS 8000-4 : 1989 *Workmanship on building sites — Code of practice for waterproofing*
- BS 8217 : 2005 *Reinforced bitumen membranes for roofing — Code of practice*
- BS EN 12310-1 : 2000 *Flexible sheets for waterproofing — Determination of resistance to tearing (nail shank)— Part 1 — Bitumen sheets for roof waterproofing*
- BS EN 12311-1 : 2000 *Flexible sheets for waterproofing — Determination of tensile properties — Part 1 — Bitumen sheets for roof waterproofing*
- BS EN 12317-1 : 2000 *Flexible sheets for waterproofing — Bitumen sheets for roof waterproofing — Determination of shear resistance of joints*
- BS EN 13165 : 2008 *Thermal insulation products for buildings — Factory made rigid polyurethane foam (PUR) products — Specification*
- BS EN 13501-5 : 2005 *Fire classification of construction products and building elements — Classification using data from external fire exposure to roof tests*
- BS EN ISO 6946 : 1997 *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*
- DD ENV 1187 : 2002 *Test methods for external fire exposure to roofs*
- EOTA Technical Report TR 012 (May 2004), *Exposure procedure for accelerated ageing by hot water [Liquid Applied Roof Waterproofing Kits (LARWK)]*
- MOAT No 27 : 1983 *General Directive for the Assessment of Roof Waterproofing Systems*
- MOAT No 64 : 2001 *UEAtc Technical Guide for the assessment of Roof Waterproofing Systems made of Reinforced APP or SBS Polymer Modified Bitumen Sheets*

## 19 Conditions

19.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is granted only to the company, firm or person named on the front page — no other company, firm or person may hold or claim any entitlement to this Certificate
- is valid only within the UK
- has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective
- is copyright of the BBA
- is subject to English law.

19.2 Publications and documents referred to in this Certificate are those that the BBA deems to be relevant at the date of issue or re-issue of this Certificate and include any: Act of Parliament; Statutory Instrument; Directive; Regulation; British, European or International Standard; Code of Practice; manufacturers' instructions; or any other publication or document similar or related to the aforementioned.

19.3 This Certificate will remain valid for an unlimited period provided that the product/system and the manufacture and/or fabrication including all related and relevant processes thereof:

- are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA
- continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine
- are reviewed by the BBA as and when it considers appropriate.

19.4 In granting this Certificate, the BBA is not responsible for:

- the presence or absence of any patent, intellectual property or similar rights subsisting in the product/system or any other product/system
- the right of the Certificate holder to manufacture, supply, install, maintain or market the product/system
- individual installations of the product/system, including the nature, design, methods and workmanship of or related to the installation
- the actual works in which the product/system is installed, used and maintained, including the nature, design, methods and workmanship of such works.

19.5 Any information relating to the manufacture, supply, installation, use and maintenance of this product/system which is contained or referred to in this Certificate is the minimum required to be met when the product/system is manufactured, supplied, installed, used and maintained. It does not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate; nor is conformity with such information to be taken as satisfying the requirements of the 1974 Act or of any statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the manufacture, supply, installation, use and maintenance of this product/system.