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Agrément Certificate
09/4688
Product Sheet 2

IMPER ITALIA TOTAL ROOF WATERPROOFING SYSTEMS

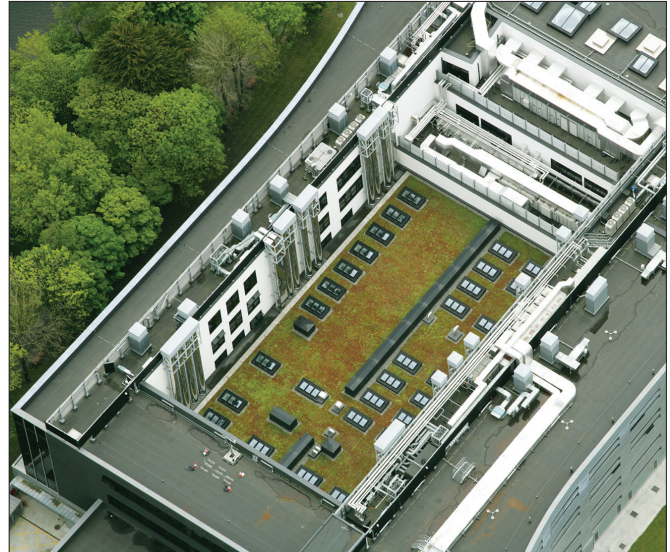
PARALON TOTAL GREEN ROOF SYSTEM

This Agrément Certificate Product Sheet⁽¹⁾ relates to the Paralon Total Green Roof System, a range of polymer-modified bitumen waterproofing membranes, insulation boards and a vapour control layer for use on flat and pitched roofs in extensive or intensive green roof specifications with limited or pedestrian access and with suitable protection.

(1) Hereinafter referred to as 'Certificate'.

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 system will resist the passage of moisture to the interior of the building (see section 6).

Thermal performance — the system can be used to improve the thermal performance of a roof (see section 7).

Condensation risk — roofs incorporating the system will adequately limit the risk of interstitial and surface condensation (see section 8).

Properties in relation to fire — in the opinion of the BBA, the system, when used in a suitable specification, will enable a roof to be unrestricted under the Building Regulations (see section 9).

Resistance to wind uplift — the system will enable a roof to be unrestricted under Building Regulations (see section 10).

Resistance to foot traffic — the system will accept, without damage, the limited foot traffic and loads associated with installation and maintenance (see section 11).

Resistance to penetration of roots — the system will resist the penetration of roots (see section 12).

Durability — under normal service conditions the system will provide a durable waterproof covering with a service life in excess of 30 years (see section 14).

The BBA has awarded this Certificate to the company named above for the system described herein. This system has been assessed by the BBA as being fit for its intended use provided it is installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of Second issue: 29 January 2016

John Albon — Head of Approvals

Claire Curtis-Thomas

Originally certificated on 12 April 2013

Construction Products

Chief Executive

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

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, the Paralon Total Green Roof System, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):



The Building Regulations 2010 (England and Wales) (as amended)

Requirement:	B4(2)	External fire spread
Comment:		On a suitable substructure, the use of the system will enable a roof to be unrestricted under this Requirement. See sections 9.1 to 9.3 of this Certificate.
Requirement:	C2(b)	Resistance to moisture
Comment:		The system, including joints, will enable a roof to meet this Requirement. See section 6.1 of this Certificate.
Requirement:	C2(c)	Resistance to moisture
Comment:		The vapour control layer component of the system can contribute to enabling a roof to satisfy this Requirement. See sections 8.1, 8.3 and 8.4 of this Certificate.
Requirement:	L1(a)(i)	Conservation of fuel and power
Comment:		The system is acceptable. See sections 7.2 and 7.3 of this Certificate.
Regulation:	7	Materials and workmanship
Comment:		The system is acceptable. See section 14 and the <i>Installation</i> part of this Certificate.
Regulation:	26	CO₂ emission rates for new buildings
Comment:		The system can enable a construction to meet the requirements of this Regulation. See sections 7.2 and 7.3 of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	Durability, workmanship and fitness of materials
Comment:		The use of the system satisfies the requirements of this Regulation. See sections 13 and 14.1 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	2.8	Spread from neighbouring buildings
Comment:		The system, when applied to a suitable substructure, is regarded as having low vulnerability under clause 2.8.1 ⁽¹⁾⁽²⁾ of this Standard. See sections 9.1 to 9.3 of this Certificate.
Standard:	3.10	Precipitation
Comment:		The use of the system, including joints, will enable a roof to meet the requirements of this Standard, with reference to clauses 3.10.1 ⁽¹⁾⁽²⁾ and 3.10.7 ⁽¹⁾⁽²⁾ . See section 6.1 of this Certificate.
Standard:	3.15	Condensation
Comment:		The vapour control layer component of the system will enable a roof to satisfy this Standard, with reference to clauses 3.15.1 ⁽¹⁾ , 3.15.3 ⁽¹⁾ , 3.15.5 ⁽¹⁾ and 3.15.6 ⁽¹⁾ . See sections 8.1, 8.3 and 8.5 of this Certificate.
Standard:	6.1	Carbon dioxide emissions
Standard:	6.2	Building insulation envelope
Comment:		The system can contribute to satisfying the requirements of these Standards, with reference to all or parts of clauses 6.1.2 ⁽²⁾ , 6.1.6 ⁽¹⁾ , 6.2.1 ⁽¹⁾⁽²⁾ , 6.2.3 ⁽¹⁾ , 6.2.4 ⁽²⁾ , 6.2.5 ⁽²⁾ , 6.2.6 ⁽¹⁾ , 6.2.7 ⁽¹⁾ , 6.2.8 ⁽¹⁾⁽²⁾ , 6.2.9 ⁽¹⁾⁽²⁾ , 6.2.10 ⁽¹⁾⁽²⁾ , 6.2.11 ⁽¹⁾⁽²⁾ , 6.2.12 ⁽²⁾ and 6.2.13 ⁽¹⁾⁽²⁾ . See sections 7.2 and 7.3 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The system can contribute to meeting the relevant requirements of Regulation 9, Standards 1 to 6 and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard. In addition, the system can contribute to a construction meeting a higher level of sustainability as defined in this Standard, with reference to clauses 7.1.4 ⁽¹⁾⁽²⁾ [Aspects 1 ⁽¹⁾⁽²⁾ and 2 ⁽¹⁾], 7.1.6 ⁽¹⁾⁽²⁾ [Aspects 1 ⁽¹⁾⁽²⁾ and 2 ⁽¹⁾] and 7.1.7 ⁽¹⁾⁽²⁾ [Aspect 1 ⁽¹⁾⁽²⁾]. See sections 7.2 and 7.3 of this Certificate.
Regulation:	12	Building standards applicable to conversions
Comment:		All comments given for the system under Regulation 9, Standards 1 to 6, also apply to this Regulation, with reference to clause 0.12.1 ⁽¹⁾⁽²⁾ and Schedule 6 ⁽¹⁾⁽²⁾ . (1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



The Building Regulations (Northern Ireland) 2012 (as amended)

Regulation:	23(a)(i)(iii)(b)	Fitness of materials and workmanship
Comment:		The system is acceptable. See section 14 and the <i>Installation</i> part of this Certificate.
Regulation:	28(b)	Resistance to moisture and weather
Comment:		Tests for water resistance indicate that the system membranes, including joints, meet the requirements of this Regulation. See section 6.1 of this Certificate.
Regulation:	29	Condensation
Comment:		The system can contribute to a roof meeting this Regulation. See sections 8.1 and 8.3 of this Certificate.

Regulation:	36(b)	External fire spread
Comment:	Tests indicates that, on suitable substructures, the use of the system will enable a roof to be unrestricted under the requirements of this Regulation. See section 9 of this Certificate.	
Regulation:	39(a)(i)	Conservation measures
Regulation:	40(2)	Target carbon dioxide Emissions Rate
Comment:	Roofs incorporating the system can satisfy or contribute to satisfying these Regulations. See sections 7.2 and 7.3 of this Certificate.	

Construction (Design and Management) Regulations 2015

Construction (Design and Management) Regulations (Northern Ireland) 2007

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

See section: 1 *Description* (1.2) and 3 *Delivery and site handling* (3.5 and 3.6) of this Certificate.

Additional Information

NHBC Standards 2016

NHBC accepts the use of the Paralon Total Green Roof System, provided it is installed, used and maintained in accordance with this Certificate, in relation to *NHBC Standards*, Chapter 7.1 *Flat roofs and balconies*.

CE marking

The Certificate holder has taken the responsibility of CE marking the system in accordance with harmonised European Standards EN 13165 : 2012, EN 13707 : 2013 and EN 13970 : 2011. An asterisk (*) appearing in this Certificate indicates that data shown are given in the manufacturer's Declaration of Performance.

Technical Specification

1 Description

1.1 The Paralon Total Green Roof System consists of:

- Paralon Antiroot – a non-woven, continuous, filament, polyester fabric reinforcing mat saturated with polymer-modified bitumen with added root-resistant chemicals, supplied with a lower surface finish of Termotene thermofusible film and an upper surface finish of talc or Textene
- Paralon ARD/HS Plus – a polyester-reinforced, polymer-modified bitumen membrane with a lower surface finish of thermofusible film and an upper surface finish of slate granules
- Paralon ARD/S Plus – a polyester-reinforced, polymer-modified bitumen membrane with a lower surface finish of thermofusible film and an upper surface finish of slate granules
- Paralon NT4 Plus – a polyester-reinforced, polymer-modified bitumen membrane with a lower surface finish of thermofusible film and an upper surface finish of talc or film
- Top Series 3 – a range of polymer-modified bitumen membranes reinforced with either polyester (Top S3) or glassfibre (Top N3), with a lower surface finish of thermofusible film and an upper surface finish of either talc or film
- Paratorch – a composite board consisting of a polyisocyanurate insulation faced with a bitumen-impregnated fibreboard, available in falls of 1:80, 1:60 and flat
- Paratherm T – a polyisocyanurate insulation board with bitumen glass-tissue facings on both sides, available in falls of 1:80, 1:60 and flat
- Imper Italia VCLs – a range of polymer-modified bitumen vapour control layers, reinforced with either polyester or glassfibre and a foil core, with a thickness range of 2 mm to 4 mm.

1.2 The membranes are supplied in rolls and are manufactured to the nominal characteristics given in Table 1.

Table 1 Nominal characteristics of membranes

Parameter (units)	Membrane						
	Paralon Antiroot	Paralon ARD/HS Plus	Paralon ARD/S Plus	Paralon NT4 Plus	Top S3	Top N3	Vapobar 1 ⁽¹⁾
Standard CE marked against	EN 13707	EN 13707	EN 13707	EN 13707	EN 13707	EN 13707	EN 13970
Thickness (mm)	4	4 ⁽²⁾	– ⁽³⁾	4	3	3	2
Length (m)	8, 10	8, 10	10	8, 10	10	10	20
Width (m)	1	1	1	1	1	1	1
Mass per unit area (kg·m ⁻²)	4	5.1	4.5	4	3	3	2
Roll weight (kg)	32, 40	40.8, 51	45	32, 40	30	30	40
Tensile strength* (N·50 mm ⁻¹)							
longitudinal	750	750	750	750	700	300	420
transverse	650	650	650	650	450	200	315
Elongation at break (%)							
longitudinal	50	50	50	50	40	2	2
transverse	50	50	50	50	45	2	2
Nail tear* (N)							
longitudinal	160	160	160	160	150	150	–
transverse	180	180	180	180	160	160	–
Dimensional stability (%)	≤0.5	≤0.5	≤0.5	≤0.5	≤0.25	–	–
Impact resistance* (mm)	1000	1000	1000	1000	–	–	–
Static indentation (kg)	20*	20*	20*	20*	–	–	10
Low temperature flexibility* (°C)	–20	–20	–20	–20	–10	–	–10
Heat resistance (°C)	130	130	130	130	120	120	120
Root resistance*	pass	–	–	–	–	–	–

(1) Thinnest of the vapour control layers used in the system.

(2) Excluding slate chippings.

(3) Thickness not declared.

1.3 The insulation boards are supplied to site with the nominal characteristics shown in Table 2.

Table 2 Nominal characteristics of insulation boards

Parameter (units)	Paratorch ⁽¹⁾	Paratherm T ⁽¹⁾
Standard CE marked against	EN 13165	EN 13165
Length (mm)	2400, 1200 and 600	1200
Width (mm)	1200	1200
Thickness (mm)	40 to 150 in 10 mm increments	25 to 145 in 10 mm increments
Compressive strength at 10% compression (kPa)	150	150
Density (kg·m ⁻³)	32	32
Thermal conductivity (W·m ⁻¹ ·K ⁻¹)	0.026 (<80 mm) 0.025 (80 – 119 mm) 0.024 (≥120 mm)	0.026 (<80 mm) 0.025 (80 – 119 mm) 0.024 (≥120 mm)

(1) Board sizes other than those shown may be available on request.

1.4 Other items or components which may be used with the system, but which are outside the scope of this Certificate, are:

- Impertene Primer — a solvent-based, bituminous primer for use on cementitious substrates, applied by either brush or roller
- Elastumul G — a water-based, solar reflective paint for use in protecting the waterproofing membranes from sunlight and other environmental factors
- various mechanical fasteners (including a countersunk plate) — for use in securing insulation boards to the substrate
- angle fillet — an insulated profile for use at upstands and kerbs above the insulation boards to aid formation of membrane edge details
- intensive substrate — vegetation base layer for multi-layered intensive plantings and planters
- extensive substrate — vegetation base layer for multi-layered extensive flat roof greening (0–5°), one layered sloping greening (≥5°) and lightweight planters
- sedum mix blanket⁽¹⁾ — sedum blanket produced on a coco mat consisting of a plant mix of 4–8 varieties of sedum
- sedum grass herbs blanket⁽¹⁾ — sedum blanket produced on a coco mat consisting of a plant mix of 4–8 varieties of sedum and 4–8 varieties of grasses and herbs

- wildflower blanket⁽¹⁾ — sedum blanket produced on a coco mat consisting of 6–8 varieties of sedum and about 30 species of wildflowers.

(1) Plug planting or plants can be used as an alternative.

2 Manufacture

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

2.2 As part of the assessment and ongoing surveillance of product quality, the BBA has:

- agreed with the manufacturer the quality control procedures and product testing to be undertaken
- assessed and agreed the quality control operated over batches of incoming materials
- monitored the production process and verified that it is in accordance with the documented process
- evaluated the process for management of nonconformities
- checked that equipment has been properly tested and calibrated
- undertaken to carry out the above measures on a regular basis through a surveillance process, to verify that the specifications and quality control operated by the manufacturer are being maintained.

2.3 The management system of Imper Italia SpA has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2008 by Bureau Veritas (Certificate 209130).

3 Delivery and site handling

3.1 The system 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 shrink-wrapped in UV-protective (white) polythene.

3.2 The insulation boards are delivered to site packaged shrink-wrapped in plastic.

3.3 Rolls must be stored upright on a clean, level surface, away from excessive heat and under cover.

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

3.5 The Certificate holder has taken the responsibility of classifying and labelling the system components under the *CLP Regulation (EC) No 1272/2008 on the classification, labelling and packaging of substances and mixtures*. Users must refer to the relevant Safety Data Sheet(s).

3.6 Impertene Primer containers must be kept tightly sealed and stored under cool and dry conditions, away from sources of ignition.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the Paralon Total Green Roof System.

Design Considerations

4 General

4.1 The Paralon Total Green Roof System is satisfactory for use as a partially or fully bonded, warm roof waterproofing system incorporating vapour control layers and thermal insulation in:

- green roof specifications on flat roofs with limited or pedestrian access or pitched roofs with limited access
- roof garden specifications on flat roofs.

4.2 Limited access roofs are defined for the purposes of this Certificate as those subjected only to pedestrian traffic for maintenance of the roof covering, cleaning of gutters, etc. Where traffic in excess of this is envisaged, such as pedestrian access roofs, additional protection must be provided (see sections 1.1 and 1.5.6 of this Certificate and the relevant clauses of the Certificate holder's installation instructions).

4.3 Pedestrian access roofs are defined for the purposes of this Certificate as those not subjected to vehicular traffic.

4.4 Flat roofs are defined for the purpose of this Certificate as those 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. 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.

4.5 Structural decks to which the system is to be applied must comply with the relevant requirements of BS 6229 : 2003, BS 8217 : 2005 and, where appropriate, *NHBC Standards 2016, Chapter 7.1 Flat roofs and balconies*.

4.6 Recommendations for the design of green roofs and roof garden specifications are available within the latest edition of *The GRO Green Roof Code – Green Roof Code of Best Practice for the UK*.

4.7 Structural decks to which the systems are to be applied must be suitable to transmit the dead and imposed loads experienced in service. Allowance needs to be made for loading deflections to ensure that the free drainage of water is maintained.

4.8 Imposed loads, dead loading and wind loads for green roof and roof garden specifications are calculated in accordance with BS EN 1991-1-1 : 2002, BS EN 1991-1-3 : 2003, BS EN 1991-1-4 : 2005 and their National Annexes.

4.9 The drainage system for the green roof or roof garden must be correctly designed, and provision made for access for maintenance purposes. Dead loads for green roofs and roof gardens can increase if the drains become partially or completely blocked causing waterlogging of the drainage layer.

5 Practicability of installation

The system must only be installed by contractors who have been trained and approved by the Certificate holder or their appointed agent.

6 Weathertightness



6.1 The waterproofing membranes, including joints, 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.

6.2 The membranes are impervious to water and will give a weathertight roofing capable of accepting minor structural movements without damage.

7 Thermal performance

7.1 Calculations of thermal transmittance (U value) must be carried out in accordance with BS EN ISO 6946 : 2007 and BRE Report (BR 443 : 2006) *Conventions for U-value calculations*, using the declared thermal conductivity ($\lambda_{90/90}$ value) of the insulation components as shown in Table 3.

Table 3 Thermal conductivity ($\lambda_{90/90}$ values)

Insulation thickness (mm)	Thermal conductivity ($W \cdot m^{-1} \cdot K^{-1}$)
< 80	0.026
≥ 80 < 120	0.025
≥ 120	0.024



7.2 The U value of a completed roof will depend on the thickness of insulation used, the number and type of fixings and the insulating value of other roof components/layers. Example U values of roofs incorporating the system are shown in Tables 4 and 5.

Table 4 Example U values — Paratherm T insulation boards

U value requirement ($W \cdot m^{-2} \cdot K^{-1}$)	Deck construction/insulation thickness (mm)		
	Concrete ⁽¹⁾⁽²⁾	Timber ⁽¹⁾⁽³⁾	Metal ⁽¹⁾⁽⁴⁾
0.13	210	200	220
0.16	170	160	175
0.18	150	140	155
0.20	130	125	140
0.25	105	100	115

(1) Includes 5.55 steel fixings per m² and 3.55 steel waterproofing fixings per m², with a 4.8 mm cross sectional head diameter and full insulation penetration depth.

(2) Concrete decking 2.0 $W \cdot m^{-1} \cdot K^{-1}$, 38 mm timber battens (15%), VCL, 7 mm waterproofing membranes, 12.5 mm plasterboard.

(3) 18 mm plywood decking, 150 mm timber joists (12.5%) with 150 mm airspace (87.5%), VCL, 7 mm waterproofing membranes, 12.5 mm plasterboard.

(4) Metal deck (not included in calculation), VCL, 7 mm waterproofing membranes.

Table 5 Example U values — Paratorch insulation boards

U value requirement ($W \cdot m^{-2} \cdot K^{-1}$)	Deck construction/insulation thickness (mm)		
	Concrete ⁽¹⁾⁽²⁾	Timber ⁽¹⁾⁽³⁾	Metal ⁽¹⁾⁽⁴⁾
0.13	215	205	225
0.16	175	165	185
0.18	155	145	160
0.20	135	130	145
0.25	110	105	120

(1) Includes 5.55 steel fixings per m² and 3.55 steel waterproofing fixings per m², with a 4.8 mm cross sectional head diameter and full insulation penetration depth.

(2) Concrete decking 2.0 $W \cdot m^{-1} \cdot K^{-1}$, 38 mm timber battens (15%), VCL, 7 mm waterproofing membranes, 12.5 mm plasterboard.

(3) 18 mm plywood decking, 150 mm timber joists (12.5%) with 150 mm airspace (87.5%), VCL, 7 mm waterproofing membranes, 12.5 mm plasterboard.

(4) Metal deck (not included in calculation), VCL, 7 mm waterproofing membranes.



7.3 The system can contribute to maintaining continuity of thermal insulation at junctions between elements and openings. For Accredited Construction Details, the corresponding psi values in BRE Information Paper IP1/06 *Assessing the effects of thermal bridging at junctions and around openings*, Table 6, may be used in carbon emission calculations in Scotland and Northern Ireland. Detailed guidance for other junctions and on limiting heat loss by air infiltration can be found in:

England and Wales — Approved Documents to Part L and for new thermal elements to existing buildings, Accredited Construction Details (version 1.0). See also SAP 2009, Appendix K, and the *iSBEM User Manual* for new-build

Scotland — Accredited Construction Details (Scotland)

Northern Ireland — Accredited Construction Details (version 1.0).

8 Condensation risk

Interstitial condensation



8.1 Roofs incorporating a VCL with a vapour resistance of at least $250 \text{ MN}\cdot\text{s}\cdot\text{g}^{-1}$ will adequately limit the risk of interstitial condensation when they are designed and constructed in accordance with BS 5250 : 2011, Section 8.4 and Appendix D, and BRE Report (BR 262 : 2002) *Thermal insulation: avoiding risks* in England and Wales.

8.2 For the purposes of assessing the risk of interstitial condensation, the boards' vapour resistivity may be taken as approximately $306 \text{ MN}\cdot\text{s}\cdot\text{g}^{-1}\cdot\text{m}^{-1}$.



8.3 Where an effective VCL cannot be guaranteed, eg owing to a large number of penetrations through the layer, the risk of condensation must be assessed in accordance with BS 6229 : 2003, Annex A.

Surface condensation



8.4 Roofs will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed $1.2 \text{ W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$ at any point. Guidance may be obtained from BS 5250 : 2011, Annex H. Further guidance may be obtained from BRE Report BR 262 : 2002 and section 7.3 of this Certificate.



8.5 Roofs will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed $1.2 \text{ W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$ at any point. Guidance may be obtained from BS 5250 : 2011, Section 8 and BRE Report (BR 262 : 2002).

8.6 Alternatively, a detailed assessment in accordance with BS 5250 : 2011, Annex D, and BS EN ISO 13788 : 2012, Section 5 can be carried out to show that surface condensation and mould growth are not predicted.

9 Properties in relation to fire



9.1 In the opinion of the BBA, use of the system in irrigated roof gardens or green roofs will be unrestricted under the national Requirements:

England and Wales — Requirement B4(2)

Scotland — Mandatory Standard 2.8, clause 2.8.1

Northern Ireland — Regulation 36(b).

9.2 Top S 3, when used in protected specifications, including an inorganic covering listed in the Annex of Commission Decision 2000/553/EC, can be considered to be unrestricted under the national Requirements.

9.3 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, clause 2.8.1

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

9.4 If allowed to dry, plants used in a roof garden may allow flame spread across a roof. This should be taken into consideration when selecting suitable plants for the roof. Appropriate planting irrigation and/or protection must be applied to ensure the overall fire-rating of the roof is not compromised.

10 Resistance to wind uplift

10.1 The system will resist the effects of wind suction likely to occur in service.

10.2 The soil used in roof gardens must not be of a type that will be removed or become delocalised owing to wind scour experienced on the roof.

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

11 Resistance to foot traffic

11.1 The system can accept the limited foot traffic and light concentrated loads associated with installation and maintenance. Where traffic in excess of this is envisaged, such as for maintenance of lift equipment, a walkway

must be provided (for example, using concrete slabs supported on bearing pads or manufacturer's walkway sheets). Reasonable care must be taken to avoid puncture of the membranes by sharp objects or concentrated loads.

11.2 For design purposes, the insulation boards may be assumed to have an allowable compressive strength of 150 kPa at 10% compression.

11.3 The insulation boards have not been assessed for use with permanent distributed or concentrated loads above those exerted by the upper layers of the green roof/roof garden system, such as air conditioning units, mechanical plants, water tanks, etc. Such loads must be supported directly on the roof construction or design support system.

11.4 When profiled decking is used, boards will need to span ribs. Maximum permissible spans between ribs for various board thicknesses are shown in Table 6.

Table 6 Maximum clear span


Maximum clear span (mm)	Minimum board 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

12 Resistance to penetration of roots

12.1 Results of tests on Paralon Antiroot indicate that it is suitable for use as a root-resistant membrane and, when used with the Paralon Total Green Roof System in roof garden applications, will provide adequate protection against penetration by roots.

12.2 Advice on suitable planting specifications can be obtained from the Certificate holder.

13 Maintenance

 Green roofs and roof gardens must be the subject of regular inspections, particularly in autumn after leaf fall and in the spring, to ensure that unwanted vegetation and other debris are cleared from the roof and drainage outlets (see section 4.9). Guidance is available in the latest edition of *The Green Roof Code — Green Roof Code of Best Practice for the UK*.

14 Durability

 Accelerated weathering tests and visits to existing exposed 30-year-old installations confirm that satisfactory retention of physical properties is achieved. Available evidence indicates that the system will have a service life in excess of 30 years.

Installation

15 General

15.1 Installation of the Paralon Total Green Roof System must be carried out by installers trained and approved by the Certificate holder in accordance with the relevant clauses of BS 8000-4 : 1989, BS 8217 : 2005, the Certificate holder or appointed agent's instructions and this Certificate.

15.2 Substrates to which the system is to be applied must be sound, dry and clean, and free from sharp projections such as nail heads and concrete nibs. Wet insulation boards must not be used. For the tapered boards to be effective in providing a uniform fall, it is essential that the structural deck is true and even. Any hollows, depressions or backfalls found in the roof deck must be rectified prior to laying the insulation.

15.3 Installation must not be carried out during inclement weather (eg rain, fog or snow). When the temperature is below 5°C, suitable precautions against surface condensation must be taken.

15.4 Detailing must be formed in accordance with the Certificate holder's instructions.

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

15.6 If the roof is likely to be subject to uncontrolled pedestrian access, the substructure must meet the requirements of BS 8217 : 2005, and to prevent damage to the roof covering one of the appropriate surface finishes referred to in clause 6.12 of the Standard must be used.

15.7 At falls in excess of 1:11, the provision for mechanical fixings as required by BS 8217 : 2005 should be observed.

15.8 On completion of the roof, the surface of the Paralon Antirroot membrane must always be protected when used as an exposed top layer.

15.9 The exposed surface of the membranes can be finished with a solar protective coating of Elastomul G. Such coatings must be the subject of regular checks to ensure their continued effectiveness.

15.10 Insulation boards can be cut to fit around projections through the roof, using either a sharp knife or a fine-toothed saw.

16 Procedure (vapour control layer)

16.1 Before adhering the VCL, the deck must be treated with Impertene Primer.

16.2 The VCL is fully torch-bonded to the deck with side laps of 100 mm and end laps of 150 mm.

16.3 At perimeters and penetrations the VCL is detailed to envelop the insulation boards.

17 Procedure (insulation)

17.1 The insulation boards are installed in a close-butted break-bonded pattern.

17.2 On metal decks the boards are laid either with the long axis at right angles to the corrugations of the metal deck or diagonally across the corrugations of the deck, ensuring that all end joints and corners are sufficiently supported on the crown flats of the decking. The thickness of the board to be used is dependent on the width of the trough openings of the metal deck as indicated in Table 6 in section 11.4.

Fully bonded

17.3 The installed boards are bonded to the VCL using hot bitumen (maximum temperature 240°C) or a polyurethane adhesive.

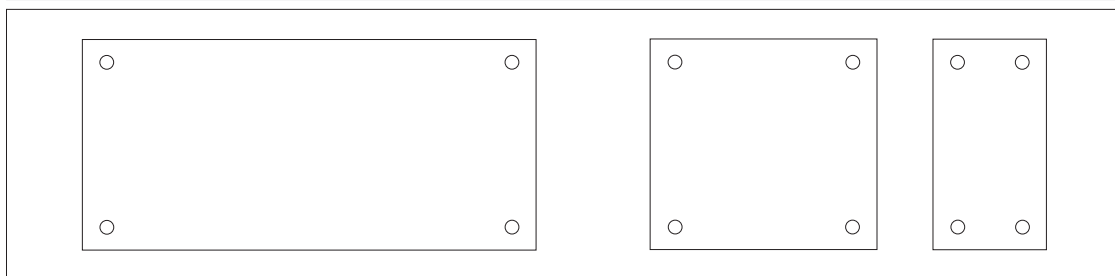
Mechanically-fastened

17.4 The boards are secured to the substrate by means of mechanical fastenings.

17.5 Each fixing must incorporate a minimum 50 mm by 50 mm square or 50 mm diameter circular plate countersunk washer, which must not restrain more than one board. The minimum number of fixings for each board size is given in Table 7 and fixing layouts are shown in Figure 1, with the requirement for additional fixings assessed in accordance with BS EN 1991-1-4 : 2005 and its UK National Annex. These are placed within the individual board area and sited more than 50 mm but less than 150 mm from the edges and corners of the board, giving a minimum fixing rate of 5.55 fixings per square metre for 1200 by 600 mm boards.

Board dimensions (mm)	Minimum number of fixings
2400 x 1200	6
1200 x 1200	4
1200 x 600	4

Figure 1 Fixing layouts — minimum fixing numbers (for solely mechanically-fixed specification)



18 Procedure (membrane)

Fully bonded

18.1 Bonding is achieved by melting the lower surface by torching and pressing the membrane down. Care must be taken not to overheat the coating.

18.2 Side laps must be a minimum of 100 mm and end laps must be a minimum of 150 mm. Where used partially-bonded, the membrane must be fully bonded to the substrate at least one metre immediately before and after the end lap. A bead of molten material must extrude from all laps to indicate a satisfactory seal and must be levelled out using a heated, rounded-tip trowel.

Partially bonded

18.3 A layer of 3G felt to BS 8747 : 2007 must be loose-laid edge to edge over the substrate.

18.4 The membrane is fully torch-welded onto the perforated layer, ensuring that the bitumen seeps evenly into the perforations.

Subsequent layers

18.5 Subsequent layers, such as separation layers, drainage layers and growing medium are installed in accordance with the Certificate holder's installation instructions.

19 Repair

In the event of accidental damage, repairs can be carried out by cleaning the area around the damage and applying a patch as described in the Certificate holder's instructions.

Technical Investigations

20 Tests

An assessment was made of data to EN 13707 : 2013 in relation to:

- characteristics of the membranes
 - thickness
 - width
 - length
 - mass per unit area
 - watertightness*
 - tensile force*
 - elongation at break
 - static indentation (soft support)*
 - dynamic indentation (rigid support)*
 - nail tear*
 - peel resistance of joint*
 - shear resistance of joints*
 - low temperature flexibility*
 - dimensional stability
 - heat resistance
 - adhesion of granules
- characteristics of the polyester reinforcements
 - mass
 - tensile strength and elongation
- physical properties of coating mass (as used in Paralon membranes)
 - softening point on unaged and heat aged samples
 - penetration
 - fines content
 - low temperature flexibility on unaged and heat aged samples
 - heat ageing for 180 days at 70°C
- physical properties of the sheets – directional
 - tensile strength and elongation
 - dimensional stability
 - tear strength
- physical properties of the membrane
 - water absorption
 - water pressure
 - low temperature flexibility on unaged, heat aged and water soaked samples
 - heat resistance on unaged and heat aged samples
 - heat ageing for 180 days at 70°C
 - water soaking for 7 days at 60°C
- joints
 - air pressure
 - resistance to peeling on unaged and aged samples
 - tensile strength of end laps and side laps on unaged, heat aged and water soaked samples

- heat ageing for 28 days at 80°C
- water soaking for 7 days at 60°C
- physical properties of the system
 - static indentation on soft substrates
 - dynamic indentation on soft substrates
 - slip resistance
 - unrolling at low temperature
 - thermal shock
 - fatigue cycling
 - heat ageing for 28 days at 70°C.

21 Investigations

- 21.1 A survey of known users of the membranes was carried out to assess performance in UK conditions.
- 21.2 Visits were made to existing sites in Italy and Dublin to assess the performance in use.
- 21.3 Data relating to the external fire performance of Paralon NT4 Plus were evaluated.
- 21.4 An assessment was made of the data leading to the issue of previous BBA Certificate 88/1983.
- 21.5 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

Bibliography

- BS 5250 : 2011 *Code of practice for control of condensation in buildings*
- BS 6229 : 2003 *Flat roofs with continuously supported coverings — Code of practice*
- 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 8747 : 2007 *Reinforced bitumen membranes (RBMs) for roofing — Guide to selection and specification*
- BS EN 1991-1-1 : 2002 *Eurocode 1 — Actions on structures — General actions — Densities, self-weight, imposed loads for buildings*
- NA to BS EN 1991-1-1 : 2002 *UK National Annex to Eurocode 1 — Actions on structures — General actions — Densities, self-weight, imposed loads for buildings*
- BS EN 1991-1-3 : 2003 *Eurocode 1 — Actions on structures — General actions — Snow loads*
- NA to BS EN 1991-1-3 : 2003 *UK National Annex to Eurocode 1 — Actions on structures — General actions — Snow loads*
- BS EN 1991-1-4 : 2005 + A1 : 2010 *Eurocode 1 — Actions on structures — General actions — Wind actions*
- NA to BS EN 1991-1-4 : 2005 + A1 : 2010 *UK National Annex to Eurocode 1 — Actions on structures — General actions — Wind actions*
- BS EN ISO 6946 : 2007 *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*
- BS EN ISO 9001 : 2008 *Quality management systems — Requirements*
- BS EN ISO 13788 : 2012 *Hygrothermal performance of building components and building elements — Internal surface temperature to avoid critical surface humidity and interstitial condensation — Calculation methods*
- EN 13165 : 2012 + A1 : 2015 *Thermal insulation products for buildings — Factory made rigid polyurethane foam (PU) products — Specification*
- EN 13707 : 2013 *Flexible sheets for waterproofing — Reinforced bitumen sheets for roof waterproofing — Definitions and characteristics*
- EN 13970 : 2011 *Flexible sheets for waterproofing — Bitumen water vapour control layers — Definitions and characteristics*

22 Conditions

22.1 This Certificate:

- relates only to the product/system that is named and described on the front page
- is issued only to the company, firm, organisation or person named on the front page — no other company, firm, organisation or person may hold or claim that this Certificate has been issued to them
- 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
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- is subject to English Law.

22.2 Publications, documents, specifications, legislation, regulations, standards and the like referenced in this Certificate are those that were current and/or deemed relevant by the BBA at the date of issue or reissue of this Certificate.

22.3 This Certificate will remain valid for an unlimited period provided that the product/system and its manufacture and/or fabrication, including all related and relevant parts and 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.

22.4 The BBA has used due skill, care and diligence in preparing this Certificate, but no warranty is provided.

22.5 In issuing this Certificate, the BBA is not responsible and is excluded from any liability to any company, firm, organisation or person, for any matters arising directly or indirectly from:

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- actual installations of the product/system, including their nature, design, methods, performance, workmanship and maintenance
- any works and constructions in which the product/system is installed, including their nature, design, methods, performance, workmanship and maintenance
- any loss or damage, including personal injury, howsoever caused by the product/system, including its manufacture, supply, installation, use, maintenance and removal
- any claims by the manufacturer relating to CE marking.

22.6 Any information relating to the manufacture, supply, installation, use, maintenance and removal 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, maintained and removed. It does not purport in any way to restate the requirements of the Health and Safety at Work etc. Act 1974, or of any other statutory, common law or other duty which may exist at the date of issue or reissue 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.