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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 vapour control layers (VCLs) for use on flat, zero fall and pitched roofs.

(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 waterproofing membranes will resist the passage of moisture to the interior of a 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 — the system, when used in a suitable specification, can enable a roof to be unrestricted under the national Building Regulations (see section 9).

Resistance to wind uplift — the system will resist the effects of any likely wind suction acting on the roof (see section 10).

Resistance to mechanical damage — 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 — the system will have a service life of at least 40 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 Third issue: 2 September 2019
Originally certificated on 14 October 2009

John Albon
Chief Scientific Officer

Claire Curtis-Thomas
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 suitable non-combustible substructures, the use of the system can be unrestricted under this Requirement. See sections 9.1 and 9.2 of this Certificate.
Requirement:	C2(b)	Resistance to moisture
Comment:		The system, including joints, will enable a roof to satisfy this Requirement. See section 6.1 of this Certificate.
Requirement:	C2(c)	Resistance to moisture
Comment:		The VCL can enable a roof to satisfy this Requirement. See sections 8.1 and 8.2 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 (applicable to Wales only)
Regulation:	7(1)	Materials and workmanship (applicable to England only)
Comment:		The system is acceptable. See section 14.1 and the <i>Installation</i> part of this Certificate.
Regulation:	26	CO₂ emission rates for new buildings
Regulation:	26A	Fabric energy efficiency rates for new dwellings (applicable to England only)
Regulation:	26A	Primary energy consumption rates for new buildings (applicable to Wales only)
Regulation:	26B	Fabric performance values for new dwellings (applicable to Wales only)
Comment:		The system can contribute to satisfying these Regulations; however, compensating fabric/services measures may be required. 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 13.1 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 and 9.2 of this Certificate.
Standard:	3.10	Precipitation
Comment:		The use of the system, including joints, will enable a roof to satisfy 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 VCL will enable a roof to satisfy this Standard, with reference to clauses 3.15.1 ⁽¹⁾⁽²⁾ , 3.15.3 ⁽¹⁾⁽²⁾ , 3.15.5 ⁽¹⁾⁽²⁾ and 3.15.6 ⁽¹⁾⁽²⁾ . See sections 8.1 and 8.3 of this Certificate.

Standard:	6.1(b)	Carbon dioxide emissions
Standard:	6.2	Building insulation envelope
Comment:		The system can contribute to satisfying the requirements of these Standards, with reference to clauses, or parts of, 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 satisfying 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:		Comments in relation to 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)	Fitness of materials and workmanship
Comment:	(iii)(b)(i)	The system is acceptable. See section 14.1 and the <i>Installation</i> part of this Certificate.
Regulation:	28(b)	Resistance to moisture and weather
Comment:		The system, including joints, satisfies the requirements of this Regulation. See section 6.1 of this Certificate.
Regulation:	29	Condensation
Comment:		The VCL can enable a roof to satisfy this Regulation. See section 8.1 of this Certificate.
Regulation:	36(b)	External fire spread
Comment:		On suitable non-combustible substructures, the use of the system will be unrestricted under the requirements of this Regulation. See sections 9.1 and 9.2 of this Certificate.
Regulation:	39(a)(i)	Conservation measures
Regulation:	40(2)	Target carbon dioxide Emissions Rate
Comment:		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) 2016

Information in this Certificate may assist the client, designer (including Principal Designer) and contractor (including Principal Contractor) to address their obligations under these Regulations.

See sections: 1 *Description* (1.2 and 1.3) and 3 *Delivery and site handling* (3.5 and 3.6) of this Certificate.

Additional Information

NHBC Standards 2019

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 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 : 2004. 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 Antirroot — 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 thermofusible film
- Paratorch — a composite board consisting of a polyisocyanurate insulation faced with a bitumen-impregnated fibreboard, available in falls of 1:80 or 1:60, or flat
- Paratherm T — a polyisocyanurate insulation board with bitumen glass-tissue facings on both sides, available in falls of 1:80 or 1:60, or flat
- Imper Italia VCLs (eg Vapobar 1) — a range of polymer-modified bitumen VCLs, reinforced with either polyester or glassfibre and a foil core, with a thickness range of 2 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

Characteristic (unit)	Membrane						
	Paralon Antiroot	Paralon ARD/HS Plus	Paralon ARD/S Plus	Paralon NT4 Plus	Top S3	Top N3	Vapobar 1
Standard against CE marking	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	8, 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
Watertightness*	pass	pass	pass	pass	pass	pass	pass
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	—	—
transverse	180	180	180	180	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	-10
Heat resistance* (°C)	130	130	130	130	120	120	120

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

(2) Excluding slate granules.

(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

Characteristic (unit)	Board	
	Paratorch ⁽¹⁾	Paratherm T ⁽¹⁾
Standard against CE marking	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)	0.026 (<80 mm)
	0.025 (80 – 119 mm)	0.025 (80 – 119 mm)
	0.024 (≥120 mm)	0.024 (≥120 mm)

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

1.4 An ancillary item for use with the system, and within the scope of this Certificate, is Impertene Primer, solvent- or water-based bituminous primer for use on cementitious, metal or timber substrates, applied by either brush or roller.

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

- solvent or water-based, solar reflective paint — for use in protecting the waterproofing membranes from sunlight and other environmental factors
- cementitious board — an optional insulation or deck coverboard, of a minimum thickness 12.5 mm, for improved construction, structural and fire performance of the system (contact the Certificate holder for suitable materials)
- various mechanical fasteners (including a countersunk plate) — minimum 50 by 50 mm square or 50 mm diameter circular plate countersunk washers, for use in securing insulation boards to the substrate
- an 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° or greater) and lightweight planters
- sedum mix blanket⁽¹⁾ — sedum blanket produced on a coco mat consisting of a plant mix of 4 to 8 varieties of sedum
- sedum grass herbs blanket⁽¹⁾ — sedum blanket produced on a coco mat consisting of a plant mix of 4 to 8 varieties of sedum and 4 to 8 varieties of grasses and herbs
- wildflower blanket⁽¹⁾ — sedum blanket produced on a coco mat consisting of 6 to 8 varieties of sedum and approximately 30 species of wildflowers.

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

2 Manufacture

2.1 The membranes are manufactured using conventional continuous bitumen coating techniques.

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 : 2015 by Bureau Veritas (Certificate 209130).

3 Delivery and site handling

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

3.2 The insulation boards are delivered to site 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 Impertene Primer containers must be kept tightly sealed and stored under cool and dry conditions, away from sources of ignition.

3.6 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).

Assessment and Technical Investigations

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

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, including zero fall, with limited or pedestrian access, or pitched roofs with limited access
- roof garden specifications on flat roofs, including zero fall
- blue roof specifications in combination with a storm water attenuation system⁽¹⁾.

(1) The storm water attenuation system is outside the scope of this Certificate.

4.2 The granular-finished membranes are satisfactory for use, where appropriate, as exposed capsheets or in detail work.

4.3 Decks to which the membranes are to be applied must comply with the relevant requirements of BS 6229 : 2018, BS 8217 : 2005 and, where appropriate, *NHBC Standards 2019*, Chapter 7.1.

4.4 The following terms are defined for the purpose of this Certificate as:

- roof garden (intensive) — a roof with a substantial layer of growing medium with planting that can include shrubs and trees, and generally accessible to pedestrians
- green roof (extensive) — a roof with a shallow layer of growing medium planted with low-maintenance plants such as mosses, sedums, grasses and some wild flower species
- blue roof — a flat roof designed to allow controlled attenuation of rain fall during heavy and storm events, as part of sustainable urban drainage systems (SUDS).

4.5 Limited access roofs are defined for the purpose 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 11 and 14.6 of this Certificate and the relevant clauses of the Certificate holder's installation instructions).

4.6

Pedestrian access roofs are defined for the purpose of this Certificate as those allowing unrestricted foot traffic but not subject to vehicular traffic.

4.7 Flat roofs are defined for the purpose of this Certificate as those having a minimum finished fall of 1:80⁽¹⁾. For design purposes, twice the minimum finished fall should be assumed, unless a detailed analysis of the roof is available, including overall and local deflection, direction of falls, etc.

(1) *NHBC Standards 2019* require a minimum fall of 1:60 for green roofs and roof gardens.

4.8 Pitched roofs are defined for the purpose of this Certificate as those having falls greater than 1:6.

4.9 Zero fall roofs are defined for the purpose of this Certificate as those having a finished fall of between 0 and 1:80⁽¹⁾.

(1) *NHBC Standards 2019* require a minimum fall of 1:60 for green roofs and roof gardens.

4.10 Structural decks to which the system is 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.

4.11 Imposed loads, dead loading and wind load specifications are calculated by a suitably competent and experienced individual in accordance with BS EN 1991-1-1 : 2002, BS EN 1991-1-3 : 2003 and BS EN 1991-1-4 : 2005, and their UK National Annexes.

4.12 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*.

4.13 The drainage systems for zero fall roofs, green roofs or roof gardens must be correctly designed, and the following points should be addressed:

- provision made for access for maintenance purposes
- for zero fall roofs, it is particularly important to identify the correct drainage points, to ensure that drainage is sufficient and effective. Reference should also be made to the appropriate clauses in Liquid Roofing and Waterproofing Association (LRWA) Note 7 – *Specifier Guidance for Flat Roof Falls*
- dead loads for green roof and roof gardens can increase if the drains become partially or completely blocked causing waterlogging of the drainage layer.

5 Practicability of installation

Installation of the Paralon Total Green Roof System must only be carried out by experienced roofing contractors.

6 Weathertightness



6.1 The waterproofing membranes, including joints, will adequately resist the passage of moisture to the interior of a building and enable a roof to comply with the requirements of the national Building Regulations.

6.2 The membranes are impervious to water and will achieve a weathertight roof capable of accepting minor structural movement without damage.

7 Thermal performance

7.1 Calculations of thermal transmittance (U value) must be carried out in accordance with BS EN ISO 6946 : 2017 and BRE Report BR 443 : 2006, using the declared thermal conductivity (λ_D value) of the insulation components as shown in Table 3.

Table 3 Thermal conductivity (λ_D values)

Insulation thickness (mm)	Thermal conductivity ($W \cdot m^{-1} \cdot K^{-1}$)
< 80	0.026
$\geq 80 < 120$	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·m ⁻² ·K ⁻¹)	Insulation thickness (mm) ⁽¹⁾		
	Concrete deck ⁽²⁾	Timber deck ⁽³⁾	Metal deck ⁽⁴⁾
0.13	— ⁽⁵⁾	— ⁽⁵⁾	— ⁽⁵⁾
0.16	— ⁽⁵⁾	— ⁽⁵⁾	— ⁽⁵⁾
0.18	— ⁽⁵⁾	— ⁽⁵⁾	— ⁽⁵⁾
0.20	150	140	150
0.25	120	110	120

- (1) Includes 5.55 steel ($\lambda = 50 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$) insulation fixings per m² and 3.55 steel ($\lambda = 50 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$) waterproofing fixings per m², with a 4.8 mm diameter and a subsequent cross-sectional area of 18.1 mm².
- (2) Suspended ceiling with no thermal performance, 150 mm concrete decking ($\lambda = 2.0 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$), VCL, Paratherm T insulation and 7 mm waterproofing membranes.
- (3) 12.5 mm plasterboard ($\lambda = 0.25 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$), 150 mm timber joists, 18 mm plywood decking ($\lambda = 0.17 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$), VCL, Paratherm T insulation and 7 mm waterproofing membranes.
- (4) Suspended ceiling with no thermal performance, 0.7 mm metal deck ($\lambda = 50 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$), VCL, Paratherm T insulation and 7 mm waterproofing membranes.
- (5) An additional layer of insulation boards is required to meet this U value requirement. The boards used for the additional layer are glass tissue faced.

Table 5 Example U values — Paratorch insulation boards

U value requirement (W·m ⁻² ·K ⁻¹)	Insulation requirement (mm) ⁽¹⁾⁽²⁾		
	Concrete deck ⁽³⁾	Timber deck ⁽⁴⁾	Metal deck ⁽⁵⁾
0.13	— ⁽⁶⁾	— ⁽⁶⁾	— ⁽⁶⁾
0.16	— ⁽⁶⁾	— ⁽⁶⁾	— ⁽⁶⁾
0.18	— ⁽⁶⁾	150	— ⁽⁶⁾
0.20	140	130	140
0.25	110	110	120

- (1) Includes 5.55 steel ($\lambda = 50 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$) insulation fixings per m² and 3.55 steel ($\lambda = 50 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$) waterproofing fixings per m², with a 4.8 mm diameter and a subsequent cross-sectional area of 18.1 mm².
- (2) Thickness of insulation excludes the 12 mm bitumen-impregnated fibre board ($\lambda = 0.05 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$).
- (3) Suspended ceiling with no thermal performance, 150 mm concrete decking ($\lambda = 2.0 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$), VCL, Paratorch insulation and 7 mm waterproofing membranes.
- (4) 12.5 mm plasterboard ($\lambda = 0.25 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$), 150 mm timber joists, 18 mm plywood decking ($\lambda = 0.17 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$), VCL, Paratorch insulation and 7 mm waterproofing membranes.
- (5) Suspended ceiling with no thermal performance, 0.7 mm metal deck ($\lambda = 50 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$), VCL, Paratorch insulation and 7 mm waterproofing membranes.
- (6) An additional layer of insulation boards is required to meet this U value requirement. The boards used for the additional layer are glass tissue faced.

Junctions



7.3 Care must be taken in the overall design and construction of junctions with other elements and openings to minimise thermal bridges and air infiltration. Detailed guidance can be found in the documents supporting the national Building Regulations.

8 Condensation risk

Interstitial condensation



8.1 The system will adequately reduce the risk of interstitial condensation when designed and constructed in accordance with BS 5250 : 2011, Appendix D and Appendix H Section H9, and BRE Report BR 262 : 2002, in England and Wales. When carrying out condensation risk analysis calculations to BS 5250 : 2011, the following vapour resistance values (in MN·s·g⁻¹) should be used:

- VCL⁽¹⁾ 5000
- individual bitumen layer of the boards 0.25
- individual tissue layer of the boards 1
- insulation core of the boards 300
- underlay 750
- capsheet 1000

(1) Based on a 2 mm VCL.

Surface condensation



8.2 Roofs will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed $0.35 \text{ W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$ at any point and the junctions with walls are designed in accordance with section 7.3.



8.3 For buildings in Scotland, constructions will be acceptable where the thermal transmittance (U value) does not exceed $1.2 \text{ W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$ at any point, and the junctions with other elements are designed in accordance with the guidance referred to in BS 5250 : 2011, Annex H. Further guidance may be obtained from BRE Report BR 262 : 2002 and section 7.3 of this Certificate.

9 Properties in relation to fire



9.1 in the opinion of the BBA, a roof incorporating the membranes will be unrestricted under the national Building Regulations when used in the following specifications:

- a roof garden covered with a drainage layer of gravel 100 mm thick and a soil layer 300 mm thick
- irrigated green roofs and roof gardens
- when protected by an inorganic covering (eg gravel or paving slabs) listed in the Annex of Commission Decision 2000/553/EC.

9.2 The designation of other specifications should be confirmed by reference to the requirements of the documents supporting the national Building Regulations.

9.3 If allowed to dry, plants used may allow the spread of flame across the roof. This must 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. Further guidance is available in the Department for Communities and Local Government publication, *Fire Performance of Green Roofs and Walls – August 2013*.

10 Resistance to wind uplift

10.1 The system, when used with a suitable roof garden or green-roof specification, will adequately resist the effects of wind uplift likely to occur in practice.

10.2 The ballast requirements for loose-laid systems should be calculated by a suitably experienced and competent individual in accordance with the relevant parts of BS EN 1991-1-4 : 2005 and its UK National Annex. The membrane should always be ballasted with a minimum depth of 50 mm of aggregate. In areas of high-wind exposure, the Certificate holder's advice should be sought. Alternatively, concrete slabs on suitable supports can be used.

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

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

11 Resistance to mechanical damage

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, 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 the boards will span the ribs. Maximum permissible spans between ribs for various board thicknesses are shown in Table 6.

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 Paralon Antiroot, including joints, will adequately resist penetration by plant roots.

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

12.3 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; this type of detail should therefore 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.

13 Maintenance



13.1 The system should be the subject of twice yearly inspections and maintenance in accordance with BS 6229 : 2018, Chapter 7, to ensure continued performance.

13.2 Guidance is available within the latest edition of *The GRO Green Roof Code – Green Roof Code of Best Practice for the UK*.

13.3 Where damage has occurred it should be repaired in accordance with section 19 and the Certificate holder's instructions.

14 Durability



14.1 The system, when subjected to normal conditions of use in a roof, will have a service life of at least 40 years.

14.2 When using Paralon ARD/HS Plus, it is possible that some localised loss of granular surfacing may occur after some years in areas where complex detailing of the roof design is incorporated.

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 8000-0 : 2014, BS 8000-4 : 1989 and 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 and 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 subjected to uncontrolled pedestrian access, the substructure must satisfy 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 this 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. Such coatings must be the subject of regular checks to ensure their continued effectiveness.

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

16 Procedure (VCL)

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, or loose-laid if used in conjunction with mechanically fastened insulation.

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 brick-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 section 11.4, Table 6.

Fully bonded

17.3 The insulation boards are bonded to the VCL using hot bitumen (maximum temperature 240°C) or a polyurethane adhesive. The Certificate holder can advise on suitable materials.

Mechanically fastened

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

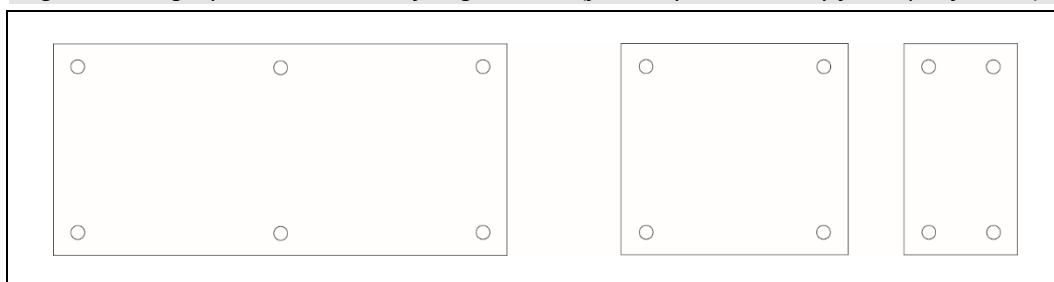
17.5 Each fixing must incorporate a minimum 50 by 50 mm square or 50 mm diameter circular plate countersunk washer, which must not restrain more than one board. The minimum number of fixings for each board size is given in Table 7 and fixing layouts are shown in Figure 1, with the requirement for additional fixings assessed by a suitably

experienced and competent individual 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 ⁽¹⁾	4

(1) Board cut in half during installation.

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 for Paralon NT 4 Plus and 80 mm for the mineral-faced capsheets, 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 perforated membrane 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.

20 Tests

An assessment was made of data in relation to:

the membranes

- thickness
- width
- length
- mass per unit area
- water absorption
- watertightness
- tensile force
- elongation at break
- static indentation (soft support)
- dynamic indentation (soft and rigid support)
- nail tear
- peel resistance of joint
- shear resistance of joints
- low temperature flexibility
- dimensional stability
- heat resistance
- root resistance
- slip resistance
- unrolling at low temperature
- peel resistance from primed asbestos, concrete, polyurethane insulation board and other substrates
- fatigue cycling
- heat ageing for 180 days at 70°C – low temperature flexibility and heat resistance
- heat ageing for 28 days at 70°C – peel resistance from substrates
- water soaking for 7 days at 60°C – low temperature flexibility
- adhesion of granules

polyester reinforcements

- mass
- tensile strength and elongation

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

membrane joints

- air pressure
- resistance to peeling
- tensile strength of end laps and side laps
- heat ageing for 28 days at 80°C – resistance to peeling and tensile strength laps
- water soaking for 7 days at 60°C – tensile strength laps

Insulation

- density
- dimensional stability with temperature
- water vapour resistance/resistivity
- dimensional changes due to variations
- effect of concentrated load under a free span
- fire rating
- compressive strength
- thermal conductivity (fresh and aged)
- dimensional accuracy
- dimensional variations in unrestrained panels
- behaviour under distributed load and increased temperatures
- effect of immersion and heat ageing on compressive and tensile strength.

21 Investigations

21.1 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.

21.2 Thermal and condensation risk assessments were carried out on the system.

21.3 Visits were made to existing sites in Italy and Dublin to assess the performance in use.

21.4 Data relating to the external fire performance were evaluated.

21.5 A survey of known users of the membranes was carried out to assess performance in UK conditions.

Bibliography

BRE Report BR 262 : 2002 *Thermal insulation : avoiding risks*

BRE Report BR 443 : 2006 *Conventions for U-value calculations*

BS 5250 : 2011 + A1 : 2016 *Code of practice for control of condensation in buildings*

BS 6229 : 2018 *Flat roofs with continuously supported flexible waterproof coverings — Code of practice*

BS 8000-0 : 2014 *Workmanship on construction sites — Introduction and general principles*

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 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 + A1 : 2015 *Eurocode 1 — Actions on structures — General actions — Snow loads*

NA to BS EN 1991-1-3 : 2003 + A1 : 2015 *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 : 2017 *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*

BS EN ISO 9001 : 2015 *Quality management systems — Requirements*

EN 13165 : 2012 + A2 : 2016 *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 : 2004 *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
- is copyright of the BBA
- 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:

- 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
- 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.