

Radmat Building Products Ltd

Esha House
St Mary's Business Park
Albany Road
Market Harborough
Leicestershire LE16 7EB

Tel: 01858 410372 Fax: 01858 410572
e-mail: techenquiries@radmat.com
website: www.radmat.com



Agrément Certificate
16/5347
Product Sheet 2

PROTHERM QUANTUM INVERTED ROOF INSULATION SYSTEM FOR FLAT ROOFS

PROTHERM QUANTUM HYBRID INVERTED ROOF INSULATION SYSTEM

This Agrément Certificate Product Sheet⁽¹⁾ relates to the ProTherm Quantum Hybrid Inverted Roof Insulation System, which comprises ProTherm Quantum (VIP — vacuum insulation panels) for use as inverted roof insulation, used in conjunction with both XPS Layer and XPS Infill (inverted roof insulations), Regupol RCM (rubber crumb protection mat) and Grey Thermal Sheet (water-reducing layer). The system is finished with a gravel ballast or paving protection, and is for use on untrafficked inverted flat roofs, and balconies and terraced roofs subject to pedestrian access only. The system may be used with zero pitch and slopes between 1:80 and 1:6.

(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.

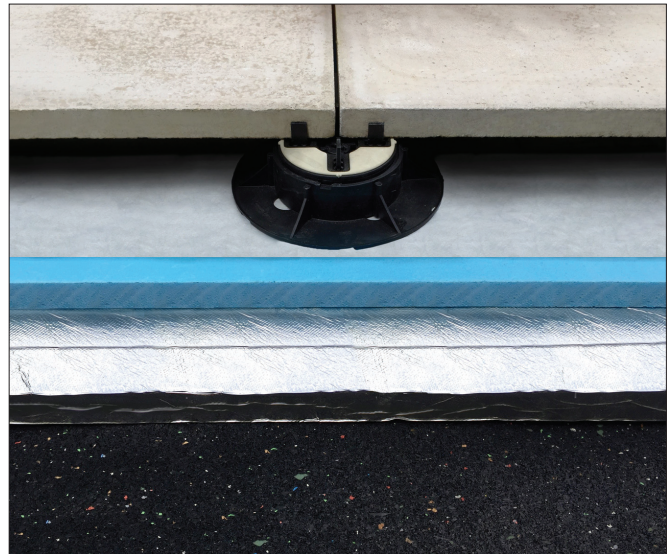
KEY FACTORS ASSESSED

Thermal performance — the insulation components of the system have design thermal conductivity values (λ_{10}) (including a moisture correction factor) of $0.008 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ for ProTherm Quantum, and $0.035 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ for the XPS Layer and XPS Infill (inverted roof insulations) (see section 6).

Condensation risk — the system can contribute to limiting the risk of surface and interstitial condensation (see section 7).

Resistance to foot traffic — when installed on appropriate decks finished with a gravel ballast layer or paving slabs, the system can be used on untrafficked roofs with limited pedestrian access associated with maintenance operations, and pedestrian access roofs (on balconies and roof terraces) subject to foot traffic only provided the panels are suitably protected (see section 8).

Durability — the system will remain effective as an insulant for at least 25 years, provided the Grey Thermal Sheet and the ProTherm Quantum remain undamaged (see section 12).



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

A handwritten signature in black ink, appearing to read 'John Albon'.

A handwritten signature in black ink, appearing to read 'Claire Curtis-Thomas'.

Date of First issue: 7 September 2016

John Albon — Head of Approvals
Construction Products

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.

British Board of Agrément
Bucknalls Lane
Watford
Herts WD25 9BA

©2016

tel: 01923 665300
fax: 01923 665301
clientservices@bba.star.co.uk
www.bbacerts.co.uk

Regulations

In the opinion of the BBA, the ProTherm Quantum Hybrid Inverted Roof Insulation 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:	C2(c)	Resistance to moisture
Comment:		The system can contribute to satisfying this Requirement. See sections 7.4 and 7.5 of this Certificate.
Requirement:	L1(a)(i)	Conservation of fuel and power
Comment:		The system can contribute to satisfying this Requirement. See sections 6.1 and 6.3 of this Certificate.
Regulation:	7	Materials and workmanship
Comment:		The system is acceptable. See section 12.1 and the <i>Installation</i> part of this Certificate.
Regulation:	26	CO ₂ 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. See sections 6.1 and 6.3 of this Certificate.



The Building (Scotland) Regulations 2004 (as amended)

Regulation:	8(1)(2)	Durability, workmanship and fitness of materials
Comment:		The system is acceptable. See sections 11.1 and 12.1 and the <i>Installation</i> part of this Certificate.
Regulation:	9	Building standards applicable to construction
Standard:	3.15	Condensation
Comment:		The system can contribute to satisfying this Standard, with reference to clauses 3.15.1 ⁽¹⁾⁽²⁾ , 3.15.3 ⁽¹⁾⁽²⁾ , 3.15.4 ⁽¹⁾⁽²⁾ , 3.15.5 ⁽¹⁾⁽²⁾ and 3.15.6 ⁽¹⁾⁽²⁾ . See sections 7.4 and 7.6 of this Certificate.
Standard:	6.1(b)	Carbon dioxide emissions
Standard:	6.2	Building insulation envelope
Comment:		The system can contribute to satisfying these Standards, with reference to clauses, or parts of, 6.1.1 ⁽¹⁾ , 6.1.2 ⁽¹⁾⁽²⁾ , 6.1.4 ⁽¹⁾⁽²⁾ , 6.1.5 ⁽¹⁾ , 6.1.6 ⁽¹⁾⁽²⁾ , 6.1.7 ⁽²⁾ , 6.1.8 ⁽²⁾ to 6.1.10 ⁽²⁾ , 6.2.1 ⁽¹⁾⁽²⁾ , 6.2.2 ⁽¹⁾ , 6.2.3 ⁽¹⁾⁽²⁾ , 6.2.4 ⁽¹⁾⁽²⁾ , 6.2.5 ⁽²⁾ , 6.2.6 ⁽¹⁾⁽²⁾ to 6.2.11 ⁽¹⁾⁽²⁾ , 6.2.12 ⁽²⁾ and 6.2.13 ⁽¹⁾⁽²⁾ . See sections 6.1 and 6.3 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 section 6.1 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	Fitness of materials and workmanship
Comment:		The system is acceptable. See section 12.1 and the <i>Installation</i> part of this Certificate.
Regulation:	29	Condensation
Comment:		The system can contribute to satisfying this Regulation. See section 7.4 of this Certificate.
Regulation:	39(a)(i)	Conservation measures
Comment:		The system can contribute to satisfying this Regulation. See sections 6.1 and 6.3 of this Certificate.
Regulation:	40(2)	Target carbon dioxide emission rate
Comment:		The system can contribute to satisfying this Regulation. See sections 6.1 and 6.3 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 section: 3 *Delivery and site handling* (3.1 and 3.3) of this Certificate.

Additional Information

NHBC Standards 2016

NHBC accepts the use of ProTherm Quantum Hybrid Inverted Roof Insulation 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 XPS Layer, XPS Infill and Grey Thermal Sheet components of this system in accordance with harmonised European Standards BS EN 13164 : 2012 (XPS Layer and XPS Infill) and BS EN 13859-2 : 2014 (Grey Thermal Sheet). An asterisk (*) appearing in this Certificate indicates that data shown is given in the manufacturer's Declaration of Performance.

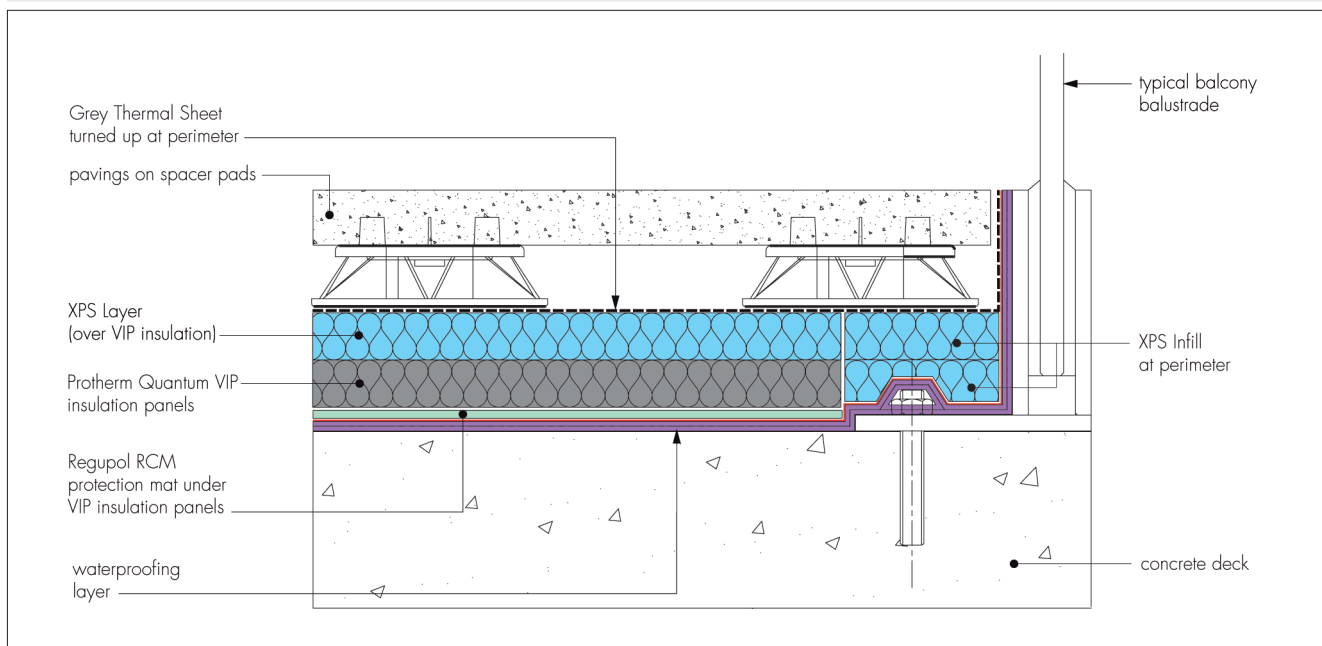
Technical Specification

1 Description

1.1 ProTherm Quantum Hybrid Inverted Roof Insulation System consists of the following components (see Figure 1):

- ProTherm Quantum — (VIP — vacuum insulation panels) inverted roof insulation (lower layer)
- XPS Layer — (XPS — extruded polystyrene) inverted roof insulation (upper layer)
- XPS Infill — (XPS — extruded polystyrene) inverted roof insulation (at perimeter and service details)
- Regupol RCM — rubber crumb protection mat (below the lower VIP insulation layer)
- Grey Thermal Sheet — water-reducing layer (above the upper XPS layer).

Figure 1 ProTherm Quantum Hybrid Inverted Roof Insulation System — typical balcony detail



1.2 ProTherm Quantum (VIP inverted roof insulation) comprises rigid insulation boards of micro-porous fumed silica, vacuum-sealed in a multi-layer aluminium foil outer wrapper. The nominal characteristics are shown in Table 1.

Length (mm) x width (mm)	Standard board sizes ⁽¹⁾ 300 x 300, 400 x 300, 600 x 400, 600 x 600 1200 x 300, 1200 x 400 1200 x 600
Thicknesses (mm)	20, 25, 30, 40 and 50
Edge detail	Straight edge – butt jointed
Minimum compressive strength at 10% compression (kPa)	160
Tensile strength (kPa)	> 80
Density (kg·m ⁻³)	170 – 210

(1) Other board sizes can be manufactured to order subject to quantities.

1.3 The XPS Layer and XPS Infill (inverted roof insulations) comprise rigid extruded polystyrene (XPS) insulation boards with rebated edges on all four sides. The nominal characteristics are shown in Table 2.

Length (mm) x width (mm)	1250 x 600 board
Thicknesses (mm)	30, 40, 50, 80 and 100
Edge detail	15 mm shiplap edge rebated on all 4 sides ⁽¹⁾
Minimum compressive strength at 10% compression* (kPa)	300
Minimum density (kg·m ⁻³)	33
Colour	Blue

(1) Board to be cut to required infill size with straight butt edges.

1.4 Regupol RCM (rubber crumb protection mat) comprises a flexible rubber crumb mat used as a protection layer below the inverted roof insulation layers. The nominal characteristics are shown in Table 3.

Length (mm) x width (mm)	2250 x 1150
Thickness (mm)	5
Edge detail	Straight edge – butt jointed
Density (kg·m ⁻³)	720
Colour	Black

1.5 Grey Thermal Sheet (water-reducing layer) comprises a high-density polyethylene (HDPE) breathable membrane used as a water control layer between the rubber crumb protection mat and the roof ballast/paving layer. The nominal properties are shown in Table 4.

Roll length (m) x width (m)	100 x 3
Thickness (mm)	0.17
Water vapour transmission* S_d (m)	0.01
Mass per unit area (g·m ⁻²)	60
Lap joints (mm) – unsealed	300
Colour	Light grey

1.6 Ancillary items used with the system but outside the scope of this Certificate include:

- roof waterproofing membrane. See section 4.4
- roof waterproofing protection/isolation sheet. See section 4.9
- rain water outlet grilles and dual-level rainwater outlets. See section 4.7
- gravel ballast comprising a washed low fines aggregate, rounded and 16 mm to 32 mm in size (nominal), laid to a minimum depth of 50 mm. See section 13.9.

or

- paving of minimum 40 mm thickness. See sections 4.15, 9.2 and 13.12.

2 Manufacture

2.1 ProTherm Quantum is manufactured in a vacuum process, with a compressed silica sand microporous core from which air and moisture have been removed, and encased in a sealed gas-tight hybrid aluminium foil envelope.

2.2 XPS Layer and XPS Infill are manufactured by a continuous extrusion process allowing a skin to form on the surfaces. Boards are then cut to size and rebates formed.

2.3 Regupol RCM is manufactured by processing recycled rubber granules and polyurethane binders into a rubber matting sheet.

2.4 Grey Thermal Sheet is manufactured by spinning strands of HDPE and bonding them together with heat and pressure to form a flexible sheet.

2.5 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.

3 Delivery and site handling

3.1 ProTherm Quantum is delivered to site in compartmentalised boxes. Each box bears the manufacturer's and product names, including project name, roof area and board dimensions, and the BBA logo incorporating the number of this Certificate. The box also contains guidance on the installation layout of the boards. The boards are to be stored in their boxes, inside a building and raised off the floor until ready for installation, and must be handled with care to prevent contact with sharp objects, solvents and other chemicals. The boards must not be walked on, cut or penetrated. Damaged/punctured boards must not be used.

3.2 XPS Layer and XPS Infill are shrink wrapped in polythene and delivered to site on pallets. Each pack is labelled with the manufacturer's name, product name and the BBA logo. The products must be protected from prolonged exposure to sunlight and stored under cover or protected with light-coloured opaque polythene sheeting. Care must be taken to prevent contact with solvents and materials containing organic components or exposure to open flame or other ignition sources. Damaged boards must not be used.

3.3 Where large volumes of insulation boards are stored, especially indoors, flammable material and ignition sources should not be permitted in the vicinity and adequate ventilation (at least two air changes per hour) should be ensured.

3.4 Regupol RCM is delivered to site in sheets (see Table 3).

3.5 Grey Thermal Sheet is delivered to site in rolls wrapped in polythene bearing the Certificate holder's name, product name and the BBA logo. Rolls should be stored on their side, on a smooth, clean surface under cover and protected from sunlight.

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on the ProTherm Quantum Hybrid Inverted Roof Insulation System.

Design Considerations

4 Use

4.1 The ProTherm Quantum Hybrid Inverted Roof Insulation System is suitable for use on untrafficked inverted flat or zero pitch roofs, and balconies and terraced roofs subject to pedestrian access only, with a gravel ballast or paved finish and a suitably designed concrete, metal or timber structural deck and appropriate fully supported waterproofing system.

4.2 For the purpose of this Certificate:

- flat roofs are defined as those roofs having either a finished fall between 1:80 and 1:6, or zero pitch with finished falls from 0 to 1:80. For design purposes on sloping flat roofs, 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. See also *BBA Information Bulletin No 4*
- untrafficked roofs are defined as those roofs subject only to pedestrian traffic during installation of the system and to carry out maintenance of the roof covering and cleaning of gutters. Pedestrian access roofs (balconies and terraced roofs only) are defined for the purpose of this Certificate as those roofs subject only to foot traffic and gathering of people no greater than that required for maintenance. Traffic in excess of the above criteria is outside the scope of this Certificate.

4.3 Concrete, metal or timber roofs should be designed in accordance with the relevant provisions of BS 6229 : 2003, BS 8217 : 2005 and BS 8218 : 1998, in particular to accommodate the weight of the ballast layer, and the maximum height of rain water should the roof outlet(s) become blocked.

4.4 Decks should be covered with one or more of the following roof waterproofing specifications:

- built-up specifications using reinforced bitumen membranes in accordance with the recommendations of Table 5 of BS 8747 : 2007 and installed to the relevant clauses of BS 8217: 2005
- mastic asphalt laid in accordance with BS 8218 : 1998
- other waterproofing systems for inverted roof applications which are the subject of a current Agrément Certificate, laid in accordance with, and within the limitations imposed by, that Certificate.

4.5 The roof must be designed with adequate falls unless the roof waterproofing system has been specifically designed and covered by a valid BBA Certificate for use in a zero pitch roof application. For zero pitch roofs it is particularly important to identify the correct drainage points, to ensure that the drainage provided is sufficient and effective. Reference should be made to the appropriate clauses of the LRWA Guidance Note No 7 — *Specifier guidance for flat roof falls*.

4.6 It is essential that roof falls and drainage paths are correctly designed to avoid ponding and subsequent risk of silt build up, stresses in freezing conditions and to reduce water entry in the event of a failure in the waterproofing layer.

4.7 Dual level roof drainage should be provided in accordance with BS 6299 : 2003 and BS EN 12056-3 : 2000 to drain water off at the level of the Grey Thermal Sheet and also at the level of the roof waterproofing.

4.8 Drainage points need to be located at the lowest point of the roof, to facilitate the effective removal of rainwater. Care is needed to identify these locations. For example, precast concrete decks will deflect between spans, and mid-span may be the lowest point of the roof rather than roof edges or column supports.

4.9 Regupol RCM is manufactured from recycled rubber granules and compatibility with the roof waterproofing system should be checked prior to installation. Where there is a risk from plasticiser migration or other contaminants from the roof waterproofing (such as PVC single ply membranes), a suitable plastic fibre or similar isolating sheet must be interposed between the roof waterproofing and the insulation boards. For loose-laid single-layer roof waterproofing membranes, a cushion layer should be interposed.

4.10 The ProTherm Quantum boards are laid as the bottom insulation layer, protected underneath by the Regupol RCM crumb mat, and protected on top by the upper XPS Layer. The ProTherm Quantum must never be directly walked upon: a protective foot or crawl board must be used on top until the upper XPS Layer is in place. See section 8.5 of this Certificate.

4.11 The Grey Thermal Sheet is to be laid directly on top of the upper XPS Layer, and acts as a filter layer preventing fines and other debris from passing through, and also as a water-flow-reducing layer minimising cold rainwater flowing between the insulation and the roof waterproofing with consequent heat loss. This membrane is laid with 300 mm laps, overlapping in the downward direction of the roof slope. At upstands and penetrations, the membrane must be turned up to finish above the surface of the ballast layer and turned down at drainage outlets. The membrane is then covered with either a gravel ballast or paving finish.

4.12 A roof ballast layer must be installed as work progresses, to protect the insulation boards and the Grey Thermal Sheet from the effects of wind uplift and UV degradation. The ballasted roof finish may be either gravel ballast or paving, which must be assessed by a suitably qualified and experienced individual for its suitability according to region exposure and building height. In addition, the dead load imposed by the finish (and the potential height of water. See 4.3) must be allowed for in calculating the total acceptable load on the deck. Care must be taken to ensure that upgraded roofs are capable of carrying the increased load and depth of the installed system. Ballast must not be stacked in one place on the roof unless the roof is capable of supporting it.

4.13 Gravel ballast should be a washed low fines aggregate, rounded and 16 mm to 32 mm in size (nominal), and laid to a minimum thickness of 50 mm. The minimum size of aggregate depends on the wind loads and parapet height to prevent wind scour of the ballast. The ballast should be installed in accordance with BS EN 1991-1-4 : 2005 and its UK National Annex.

4.14 The gravel ballast specification given in section 4.13 is suitable for use in sheltered regions, or buildings up to 10 storeys. On buildings up to 15 storeys, this specification may be used, but the perimeter must be loaded with paving determined by reference to BS EN 1991-1-4 : 2005. For other exposure conditions or tall buildings, specialist advice should be sought.

4.15 A paving finish ballast comprising a minimum 40 mm of standard pressed concrete paving slabs is suitable in sheltered regions and in buildings up to 15 storeys. For other exposure conditions or tall buildings, specialist advice should be sought.

5 Practicability of installation

The products are designed to be installed by a competent general builder or contractor experienced with these types of products. Further installation support including an on-site 'toolbox talk' is available from the Certificate holder upon request.

6 Thermal performance



6.1 Calculations of the thermal transmittance (U value) of a specific roof construction should be carried out in accordance with BS EN ISO 6946 : 2007 and BRE Report BR 443 : 2006, using the design thermal conductivity (λ_{ij}) and the f_x drainage factor for the system as given below. See also *BBA Information Bulletin No 4*.

- ProTherm Quantum — design thermal conductivity (λ_{ij}) $0.008 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ (including a moisture correction factor)
- XPS Layer and XPS Infill — design thermal conductivity (λ_{ij}) $0.035 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ (including a moisture correction factor) for 30 mm, 40 mm, 50 mm, 80 mm and 100 mm thickness
- $f_x = 0.001$ — drainage factor (system incorporates water-reducing layer).

The value of a completed roof will depend on the insulation thickness, and type of substrate and internal finish, and is to be determined for the completed roof installation as a whole, taking into account all areas of VIP and XPS insulation as installed. When considering insulation requirements, designers should refer to the detailed guidance contained in the documents supporting the national Building Regulations. The U values shown in Table 5 of this Certificate indicate that the product can contribute to a roof achieving typical U values referred to in those supporting documents.

Table 5 Example U values⁽¹⁾ for flat roof and zero pitch applications (incorporating the Grey Thermal Sheet)

Required U value (W·m ⁻² ·K ⁻¹)	Insulation thickness required
	XPS Layer (upper insulation layer) ⁽²⁾
	ProTherm Quantum (VIP insulation) ⁽³⁾ (mm)
	$p^{(4)} = 8$
0.13	50 ⁽³⁾ + 50 ⁽²⁾
0.15	50 ⁽³⁾ + 30 ⁽²⁾
0.16	40 ⁽³⁾ + 40 ⁽²⁾
0.18	40 ⁽³⁾ + 30 ⁽²⁾
0.20	30 ⁽³⁾ + 40 ⁽²⁾
0.25	25 ⁽³⁾ + 30 ⁽²⁾

- (1) 200 mm dense concrete deck with 3 mm plaster skim.
- (2) XPS Layer is laid as upper insulation layer.
- (3) ProTherm Quantum (VIP insulation) laid as bottom layer.
- (4) Value for p taken as worst case for all UK locations.

6.2 Rainfall reaching the roof waterproofing membrane will temporarily affect the rate of heat loss from the roof and should be accounted for by adding a correction (ΔU_r) to the calculated roof U value in accordance with Annex D.4 of BS EN ISO 6946 : 2007, as follows:

$\Delta U_r = pfx (R_1/R_T)^2$ where:

ΔU_r = correction to the calculated thermal transmittance of the roof element (W·m⁻²·K⁻¹)

$p^{(1)}$ = average rate of precipitation during the heating season (mm·day⁻¹)

f = drainage factor giving the fraction of p reaching the waterproof membrane

x = factor for increased heat loss caused by rainwater flowing on the membrane (W·day·m⁻²·K⁻¹·mm⁻¹)

R_1 = thermal resistance of the layer of the insulation above the waterproofing membrane (m²·K·W⁻¹)

R_T = total thermal resistance of the construction before application of the correction (m²·K·W⁻¹)

fx = 0.001 (system incorporates water-reducing layer).

- (1) Values for average rainfall during the heating season for different UK locations can be found at www.metoffice.gov.uk/climate/uk/averages/19611990/images/RainOctMar6190.gif and divided by 182 days to obtain ' p ' in mm·day⁻¹.

Junctions



6.3 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.

7 Condensation risk

7.1 Warm water trapped under the boards is likely to be replaced by colder water during rainfall. Therefore, during heavy or continuous rainfall the roof waterproofing and the deck will be cooled. If condensation does occur it will be short-term, disappearing when the rain stops.

7.2 The risk of interstitial condensation will be minimal with concrete decks.

7.3 For systems using paving, a condensation risk analysis may be necessary using dynamic software in accordance with BS EN 15026 : 2007, depending on the climatic conditions in the location where it is installed.

Interstitial condensation



7.4 Roofs will adequately limit the risk of interstitial condensation when they are designed and constructed in accordance with BS 5250 : 2011, Annexes D and H. Further guidance may be obtained from BRE Report BR 262 : 2002.

Surface condensation



7.5 Roofs will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed 0.35 W·m⁻²·K⁻¹ at any point and the junctions with walls are designed in accordance with section 6.3 of this Certificate.



7.6 Roofs will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed 1.2 W·m⁻²·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 6.3 of this Certificate.

8 Strength and stability

8.1 The inverted roof insulation boards have a compressive strength at 10% compression* as given below:

- ProTherm Quantum (VIP inverted roof insulation) — 160 kPa
- XPS Layer (Inverted roof insulation) — 300 kPa
- XPS Infill (Inverted roof insulation) — 300 kPa.

8.2 The structural strength and deformation of both the roof structure and the inverted roof insulation boards must be assessed by a suitably experienced and qualified individual, to resist actions due to the combination of the dead load imposed by the paving and gravel ballast finish, and the imposed load from foot traffic, snow and the possible weight of rain water (should the roof outlet(s) become blocked).

8.3 The ProTherm Quantum (VIP insulation) and XPS Layer (XPS insulation) inverted roof insulation boards have been assessed for compressive creep, and are suitable for use in the inverted roof application when installed with the system components described in this Certificate, subject to a maximum overall insulation thickness of 100 mm, comprising 1 layer of XPS Layer insulation on top of 1 layer of VIP insulation panels (maximum 50 mm VIP thickness).

8.4 The ballast layer required to prevent wind uplift of the inverted roof insulation system should be assessed by a suitably experienced and qualified individual, according to region exposure and building height. See sections 4.12 to 4.15 of this Certificate.

Resistance to foot traffic

8.5 The completed system has adequate resistance to the loads associated with light maintenance traffic on roofs, and to pedestrian foot traffic on balconies and roof terraces, provided the ProTherm Quantum panels are protected at all times, underneath using Regupol RCM mat, and on top with either XPS Layer or XPS Infill. The ProTherm Quantum panels must not be walked on at any time, and a protective foot or crawl board should be used during the installation process until the protection layer is in place above and below the VIP panels.

9 Behaviour in relation to fire

9.1 ProTherm has a reaction to fire classification* of Class C-s1, d2 to BS EN 13501-1 : 2007. XPS Layer, XPS Infill and Grey Thermal Sheet all have a reaction to fire classification* of Class E to BS EN 13501-1 : 2007.

9.2 When ballasted with aggregate (minimum depth of 50 mm), or fully-supported cast stone or mineral slabs of at least 40 mm thickness, the roof may be considered to be of designation AA (low vulnerability in Scotland) and so is unrestricted by the national Building Regulations.


9.3 The designation of other roof covering specifications should be confirmed as required by the national Building Regulations.

9.4 The insulation boards should not be laid over compartment walls.

10 Effect on roof coverings

The protected inverted roof system will provide solar protection and also limit the range of temperatures to which the waterproofing membrane will be subjected. Placing the insulation on top of the roof covering will normally lead to an extended life of the waterproof membrane. See also section 4.9 of this Certificate.

11 Maintenance

 11.1 The inverted roof concept should require little or no maintenance, other than annual removal of any plants (in the case of gravel/paving finish), cleaning/checking of water outlets and gutters if necessary and checking that the gravel ballast is still in place and not interfering with or blocking gullies or outlets. Any displaced ballast, for example by wind scouring, should be promptly returned to its original state.

11.2 The use of chemicals (eg weed killers) should be checked for compatibility with the various system components and the deck waterproofing layer. The Certificate holder can advise on the suitability of a particular product.


11.3 Leaks in the waterproof membrane can be accessed by removal of the gravel ballast or paving, Grey Thermal Sheet, Regupol RCM and insulation boards, taking care not to damage the Grey Thermal Sheet and the ProTherm Quantum panels.

11.4 Protected inverted roofs can be upgraded by the addition of insulation if there is sufficient height in the parapets and roof lights. As this may also require additional ballast, the structural deck must be able to support the extra loading from the increase in weight.

11.5 The Certificate holder must approve any upgrading using a loose layer of insulation on top of the existing insulation.

11.6 If the ProTherm Quantum panels become damaged or punctured during their working life, they must be removed and bespoke replacement panels obtained and installed.

12 Durability

 12.1 The system is rot resistant and, as long as the Grey Thermal Sheet, the ProTherm Quantum and XPS Layer/XPS Infill panels remain undamaged, will have a life of at least 25 years under normal circumstances.

12.2 The ProTherm Quantum VIP insulation panels must be protected at all times against puncture damage, by the use of the Regupol RCM mat underneath, and above by the XPS Layer. See section 4.10.

12.3 Care must be taken to ensure that the gravel ballast or paving, once installed, provides cover to the Grey Thermal Sheet at all times, to avoid UV degradation of that membrane.

Installation

13 Procedure

13.1 A roof insulation layout drawing is supplied with the ProTherm Quantum panels to illustrate the installation layout pattern.

13.2 The system is to be installed above a waterproofing membrane (see section 4.4 of this Certificate) and the surface should be clean, dry, level and free from projections.

13.3 The Regupol RCM is laid over the completed waterproofing layer (with isolating sheet/cushion layer if applicable, as noted in 4.9) with the long edges running perpendicular to the ProTherm Quantum panels, and closely butted together without overlaps.

13.4 The ProTherm Quantum panels are laid on top of the Regupol RCM in accordance with the layout drawing supplied, lightly butting the boards together without gaps. The ProTherm Quantum panels are to be handled with great care and must never be directly walked on during installation. Protective crawl boards should be used until the upper XPS Layer has been laid on top of the ProTherm Quantum panels.

13.5 The XPS Infill board is cut accurately to the required size using a fine-toothed saw or knife, to ensure close-butting joints and continuity of insulation, to fit around the perimeter, penetrations, rainwater outlets etc in accordance with the layout drawing.

13.6 The upper XPS Layer is laid over the ProTherm Quantum panels, using protective crawl boards for installation access and taking care not to walk on the VIP panels. The joints between XPS Layer insulation panels should be laid staggered to the joints in the ProTherm Quantum panels.

13.7 The Grey Thermal Sheet is then laid with 300 mm unsealed laps overlapping in the downward direction of the roof slope, directly on top of the upper XPS Layer. At upstands and penetrations, the Grey Thermal Sheet must be turned up to finish above the surface of the ballast layer, and turned down at drainage outlets. See Figures 2 and 3 in this Certificate.

13.8 The finished surface of ballast or pavings should be installed as soon as possible to retain and protect the Grey Thermal Sheet and the overall system.

Figure 2 Parapet upstand detail — paving/gravel finish

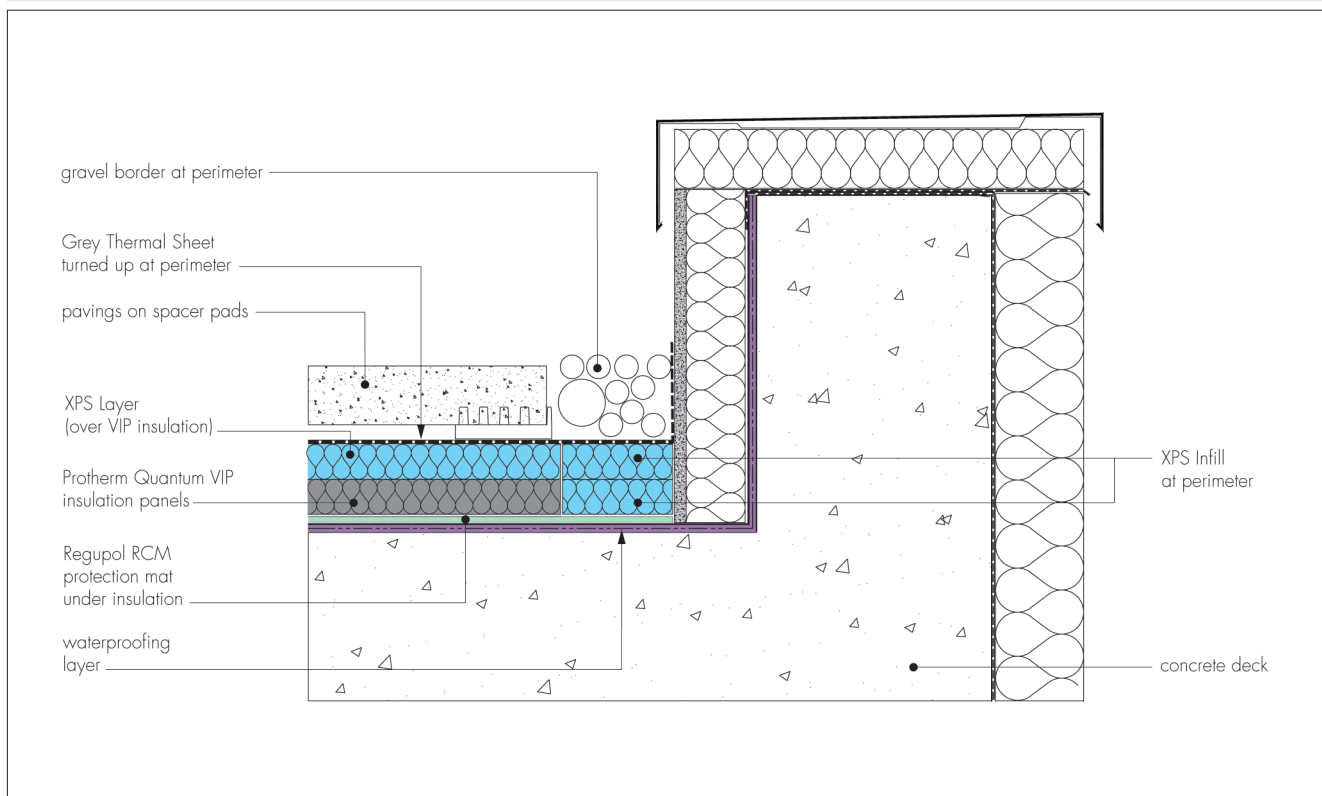
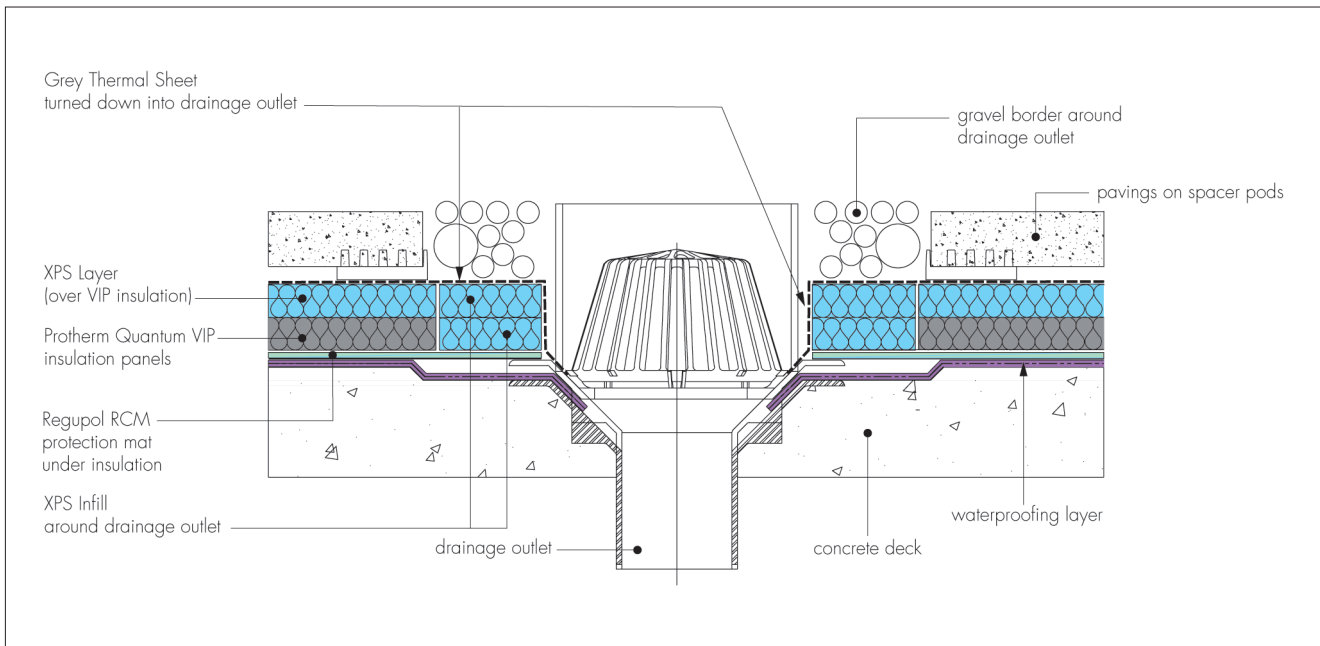


Figure 3 Drainage outlet detail — paving/gravel finish



Gravel ballast finish

13.9 In order to prevent flotation, wind uplift and UV degradation, the system must be covered with gravel ballast as the work proceeds, to a minimum thickness of 50 mm.

13.10 It is essential that the ballast is carefully placed directly over the Grey Thermal Sheet, and that complete depth and cover is achieved over the entire surface of the system.

13.11 Gravel must not contain excessive fines in order to prevent clogging of gullies and outlets and to discourage organic growth.

Paving slab finish

13.12 Cast stone or mineral slab pavings of at least 40 mm thickness must meet the requirements of sections 4.15 and 9.2 of this Certificate. The paving slab finish is laid directly over the Grey Thermal Sheet, and slabs can either be laid fully supported, or may be supported using proprietary spacer pads in accordance with the manufacturer's instructions.

Technical Investigations

14 Tests

An examination was made of data relating to:

VIP and XPS insulations

- fire performance
- thermal conductivity
- compressive strength
- deformation under specified compressive load and temperature
- long-term water absorption by diffusion
- long-term water absorption by partial immersion
- resistance to freeze-thaw of the thermal insulation
- water vapour permeability
- dimensional stability.

Rubber crumb protection layer

- resistance to static loading
- resistance to impact
- exposure to liquid chemicals.

Water-reducing layer

- water flow through an inverted roof kit.

15 Investigations

15.1 A series of U value calculations was carried out.

15.2 A site visit was undertaken to witness the practicality of installation of the system.

15.3 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of 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 8217 : 2005 *Reinforced bitumen membranes for roofing — Code of practice*

BS 8218 : 1998 *Code of practice for mastic asphalt roofing*

BS 8747 : 2007 *Reinforced bitumen membranes (RBMs) for roofing — Guide to selection and specification*

BS EN 1991-1-4 : 2005 *Eurocode 1 — Actions on structures — General actions — Wind actions*

NA to BS EN 1991-1-4 : 2005 *UK National Annex to Eurocode 1 : Actions on structures — General actions — Wind actions*

BS EN 12056-3 : 2000 *Gravity drainage systems inside buildings — Roof drainage, layout and calculation*

BS EN 13164 : 2012 *Thermal insulation products for buildings — Factory made extruded polystyrene foam (XPS) products - Specification*

BS EN 13501-1 : 2007 *Fire classification of construction products and building elements — Classification using test data from reaction to fire tests*

BS EN 13859-2 : 2014 *Flexible sheets for waterproofing — Definitions and characteristics of underlays — Underlays for walls*

BS EN 15026 : 2007 *Hygrothermal performance of building components and building elements — Assessment of moisture transfer by numerical simulation*

BS EN ISO 6946 : 2007 *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*

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

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

LRWA Guidance Note No. 7 : 2012 *Specifier guidance for flat roof falls.*

16 Conditions

16.1 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.

16.2 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.

16.3 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.

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

16.5 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.

16.6 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.