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Agrément Certificate

20/5769

Product Sheet 2

QUANTUM PLUS+ INVERTED ROOF INSULATION SYSTEM FOR FLAT ROOFS

QUANTUM PLUS+ HYBRID INVERTED ROOF INSULATION SYSTEM

This Agrément Certificate Product Sheet⁽¹⁾ relates to the Quantum PLUS+ Hybrid Inverted Roof Insulation System, which comprises Quantum PLUS+ VIP (vacuum insulation panels with a factory sprayed protective coating) and ancillary items, for use as inverted roof insulation on new and existing domestic and non-domestic flat roofs, including zero fall. The system is finished with paving slabs or a gravel ballast, and is for use on untrafficked inverted flat roofs, and balconies and terraced roofs subject to pedestrian access only.

(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 system can contribute towards the thermal performance of a roof. The design thermal conductivity value (λ_u), including a moisture correction factor, is $0.007 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ for Quantum PLUS+ VIP, and $0.032 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ for single thicknesses $\leq 80 \text{ mm}$ of XPS Layer and XPS Infill (see section 6).

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

Strength and stability — when installed on appropriate decks finished with paving slabs or a gravel ballast layer, 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 XENERGY MK, Quantum PLUS+ VIP, XPS Layer and XPS Infill 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

Date of First issue: 6 July 2020



Hardy Giesler
Chief Executive Officer

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 MUST check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA directly.

Any photographs are for illustrative purposes only, do not constitute advice and should not be relied upon.

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Regulations

In the opinion of the BBA, the Quantum PLUS+ 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 6.2 of this Certificate.
Regulation:	7(1)	Materials and workmanship
Comment:		The system is acceptable. See section 12.1 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. See sections 6.1 and 6.2 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 6.2 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 6.1 and 6.2 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
Regulation:	40(2)	Target carbon dioxide emission rate
Comment:	The system can contribute to satisfying these Regulations. See sections 6.1 and 6.2 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: 3 *Delivery and site handling* (3.3 and 3.4) and 13 *General* (13.5) of this Certificate.

Additional Information

NHBC Standards 2020

In the opinion of the BBA, the use of Quantum PLUS+ Hybrid Inverted Roof Insulation 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 XPS Layer and XPS Infill products in accordance with harmonised European Standard BS EN 13164 : 2012. The manufacturer has taken the responsibility of CE marking the XENERGY MK product in accordance with harmonised European Standard BS EN 13859-2 : 2014.

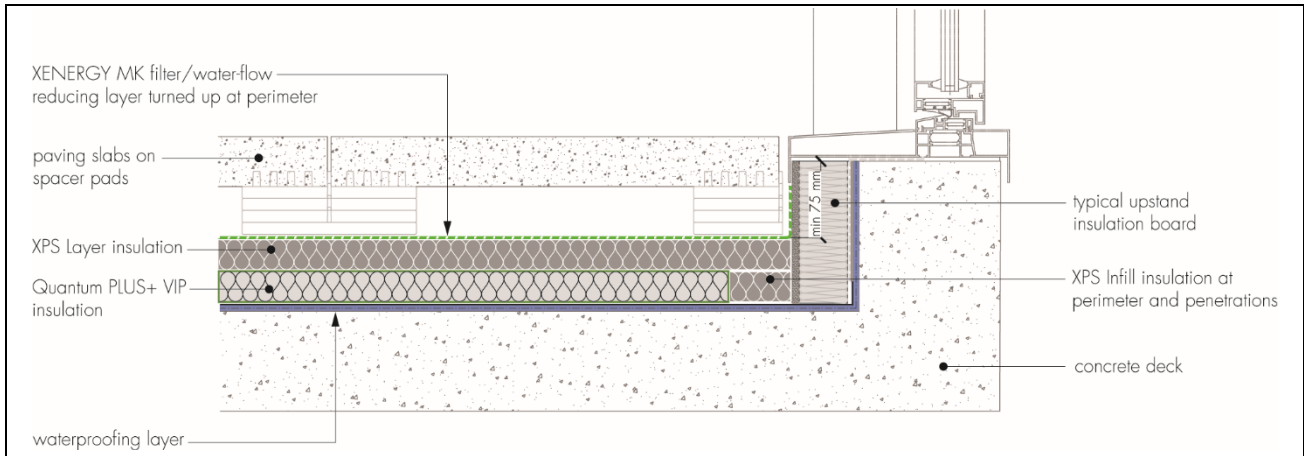
Technical Specification

1 Description

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

- Quantum PLUS+ VIP — vacuum insulation panels with a factory-sprayed protective coating, inverted roof insulation (lower layer) (comprising either single or double layer VIP panels inside external finished coating).
- XPS Layer — XPS (extruded polystyrene) inverted roof insulation (upper layer).
- XPS Infill — XPS (extruded polystyrene) inverted roof insulation (at perimeter and service details)
- XENERGY MK — filter/water-flow-reducing layer (on top of the upper XPS layer).

Figure 1 Quantum PLUS+ Hybrid Inverted Roof Insulation System – typical balcony detail



1.2 Quantum PLUS+ VIP (inverted roof insulation) comprises rigid insulation panels of micro-porous fumed silica, vacuum-sealed in a multi-layer aluminium foil outer wrapper, which is then factory sprayed with an outer protective coating. The nominal characteristics are shown in Table 1.

Table 1 Quantum PLUS+ VIP – nominal characteristics

Length (mm) x width (mm)	Standard panel sizes ⁽¹⁾ 300 x 300, 300 x 400, 300 x 1000, 400 x 400, 400 x 1000, 600 x 600, 600 x 1000
Finished thicknesses (mm) (thicknesses shown with brackets contain a double layer of VIP panels inside)	20, 25, 30, 40 and 50 45 (20 + 25), 55 (25 + 30), 60 (30 + 30), 70 (30 + 40)
Edge detail	Straight edge – butt jointed
Minimum compressive strength at 10% compression (kPa)	150

(1) Other panel 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 panels with rebated edges on all four sides. The nominal characteristics are shown in Table 2.

Table 2 XPS Layer and XPS Infill – nominal characteristics

Length (mm) x width (mm)	1250 x 600 panel
XPS Infill and XPS Layer - Single thicknesses (mm)	30, 40, 50, 80, 100, 120, 130, 140, 160, 180, 200 and 205
- Double layer thicknesses (mm)	60 (30 + 30), 70 (30 + 40)
Edge detail	15 mm shiplap edge rebated on all 4 sides ⁽¹⁾
Minimum compressive strength at 10% compression (kPa)	300
Colour	Grey

(1) Panel to be cut to required infill size.

1.4 XENERGY MK (filter/water-flow-reducing layer) comprises a high-density polyethylene (HDPE) breathable membrane used as a water control layer between the upper layer of inverted roof insulation (XPS Layer) and the roof ballast/paving layer. The nominal properties are shown in Table 3.

Table 3 XENERGY MK (filter/water-flow-reducing layer) – nominal characteristics

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 ($g \cdot m^{-2}$)	60
Lap joints (mm) – unsealed	300
Colour	Light grey

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

- roof waterproofing membrane (see section 4.5)
- roof waterproofing protection/isolation sheet (if necessary) (see section 4.6)
- rain water outlet grilles and dual-level rainwater outlets (see section 4.9)
- paving slabs of minimum 40 mm thickness, supported on proprietary support (spacer) pads where required (see sections 4.13, and 9.2) **or**
- gravel ballast comprising a washed low fines aggregate, rounded and 16 to 32 mm in size (nominal), laid to a minimum depth of 50 mm (see section 4.15).

2 Manufacture

2.1 Quantum PLUS+ VIP 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. It is then factory sprayed with an outer protective coating.

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

2.3 XENERGY MK is manufactured by spinning strands of HDPE and bonding them together with heat and pressure to form a flexible sheet.

2.4 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 Each Quantum PLUS+ VIP panel is individually wrapped in a wax paper, and the panels are delivered to site in boxes. Each box bears the Certificate holder'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 panels.

3.2 The Quantum PLUS+ VIP panels must 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. Panels must not be cut or penetrated; damaged/punctured panels must not be used (see sections 13.4 and 14.1).

3.3 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 panels must not be used.

3.4 Where large volumes of insulation panels 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.

3.5 XENERGY MK 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 Quantum PLUS+ Hybrid Inverted Roof Insulation System.

Design Considerations

4 Use

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

4.2 The maximum thickness combinations of inverted roof insulation to be used is given in Table 4 (also see section 8.2 of this Certificate). The Quantum PLUS+ VIP inverted roof insulation is only to be applied as a single layer, and should not be applied multi-layered on site. The XPS Layer and XPS Infill insulation may, however, be applied as either a single or double layer, to suit the overall thickness of Quantum PLUS+ VIP required.

Table 4 Quantum PLUS+ Hybrid Inverted Roof Insulation System – Maximum insulation thickness combinations

Quantum PLUS+ VIP insulation Thickness (mm)	XPS Layer on top of VIP insulation Maximum XPS thickness to be used (mm)
20, 25, 30, 40	205
45	180
50	160
55, 60	140
70	100

4.3 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 fall 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 Sheet 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 greater than that required for maintenance.
- traffic in excess of the above criteria is outside the scope of this Certificate.

4.4 Concrete, metal or timber roofs should be designed in accordance with the relevant provisions of BS 6229 : 2018, 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.

4.5 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.

4.6 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 panels. For loose-laid single-layer roof waterproofing membranes, a cushion layer should be interposed.

4.7 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 fall roof application. For zero fall 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*.

4.8 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.

4.9 Dual level roof drainage should be provided in accordance with BS 6229 : 2018 and BS EN 12056-3 : 2000 to drain water off at the level of the XENERGY MK and also at the level of the roof waterproofing.

4.10 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.

4.11 The XENERGY MK 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 paving finish or a gravel ballast. Further guidance on installation is given in LRWA Guidance Note No 14 – Best Practice for the Installation of Water Flow Reducing Layers in Inverted Roofs 2020.

4.12 The roof ballast layer must be installed as work progresses, to protect the insulation panels and XENERGY MK from the effects of wind uplift and UV degradation. The ballasted roof finish may be either paving (on proprietary support pads) or gravel ballast, 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 section 4.4) 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 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 taller buildings, specialist advice should be sought.

4.14 When installed with a gravel ballast finish (typically at perimeter margins or service penetrations), the top surface of Quantum PLUS+ VIP insulation bottom layer is protected against possible puncture damage from the gravel, by the upper XPS Layer (see Figures 2 and 3).

4.15 Gravel ballast should be a washed low fines aggregate, rounded and 16 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.

4.16 The gravel ballast specification given in section 4.15 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 taller buildings, specialist advice should be sought.

5 Practicability of installation

The system is designed to be installed by a competent general builder or contractor experienced with this type of system.

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 : 2017 and BRE Report BR 443 : 2006, using the design thermal conductivity (λ_U) and the fx factor for the system as given below. See also *BBA Information Sheet No. 4*.

- Quantum PLUS+ VIP — design thermal conductivity (λ_U) of $0.007 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ (including a moisture correction factor)
- XPS Layer and XPS Infill — design thermal conductivity (λ_U) of $0.032 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ (including a moisture correction factor) for single thicknesses $\leq 80 \text{ mm}$
- $fx = 0.001$ — the product of the water-flow-reducing-layer drainage factor ' f ' and the factor ' x ' for increased heat loss caused by rainwater flowing on the waterproof layer ($0.04 \text{ W}\cdot\text{day}\cdot\text{m}^{-2}\cdot\text{K}^{-1}\cdot\text{mm}^{-1}$). (system incorporates filter/water-flow-reducing layer).

6.2 The U 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 fall applications
(incorporating the XENERGY MK)*

Required U value ($\text{W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$)	Insulation thickness required
	XPS Layer (upper insulation layer) ⁽²⁾
	Quantum PLUS+ VIP ⁽³⁾ (mm)
	$p^{(4)} = 8$
0.13	$50^{(3)} + 30^{(2)}$
0.15	$40^{(3)} + 30^{(2)}$
0.16	$40^{(3)} + 30^{(2)}$
0.18	$30^{(3)} + 30^{(2)}$
0.20	$30^{(3)} + 30^{(2)}$
0.25	$20^{(3)} + 30^{(2)}$

(1) 200 mm dense concrete deck ($\lambda=0.25 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$) with suspended ceiling tiles.

(2) XPS Layer is laid as upper insulation layer.

(3) Quantum PLUS+ (VIP insulation) laid as bottom layer.

(4) Value for p taken as worst case for all UK locations.

6.3 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 F4 of BS EN ISO 6946 : 2017, as follows:

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

ΔU_r = correction to the calculated thermal transmittance of the roof element ($\text{W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$)

p = average rate of precipitation during the heating season ($\text{mm}\cdot\text{day}^{-1}$)

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 ($\text{W}\cdot\text{day}\cdot\text{m}^{-2}\cdot\text{K}^{-1}\cdot\text{mm}^{-1}$)

R_1 = thermal resistance of the layer of the insulation above the waterproofing membrane ($\text{m}^2\cdot\text{K}\cdot\text{W}^{-1}$)

R_T = total thermal resistance of the construction before application of the correction ($\text{m}^2\cdot\text{K}\cdot\text{W}^{-1}$)

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

Junctions

6.4 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 panels 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 but metal and timber decks will be subjected to short periods of moisture; therefore timber must be treated with a suitable preservative in accordance with BS 8417 : 2011

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 $0.35 \text{ W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$ at any point and the junctions with walls are designed in accordance with section 6.4 of this Certificate.



7.6 Roofs will adequately limit the risk of surface condensation when the thermal transmittance (U value) does not exceed $1.2 \text{ W}\cdot\text{m}^{-2}\cdot\text{K}^{-1}$ 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 6.4 of this Certificate.

8 Strength and stability

8.1 The structural strength and deformation of both the roof structure and the inverted roof insulation panels 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).

8.2 The Quantum PLUS+ VIP (inverted roof insulation) and XPS Layer (XPS insulation) inverted roof insulation panels 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 the maximum installed insulation thickness combinations given in section 4.2 (Table 4) of this Certificate.

8.3 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 Quantum PLUS+ VIP panels are protected above by the XENERGY MK membrane, and paving slabs or a gravel ballast finish. The lower layer of Quantum PLUS+ VIP panels are protected on top against possible puncture damage from gravel ballast (when used) by the upper XPS Layer. The outer sprayed coating of the Quantum PLUS+ VIP panels provides some degree of protection when handling; however, during the installation process, the VIP insulation panels must be protected with suitable walkway matting / covering or crawl boards, until covered by the XPS Layer, to safeguard against any physical/puncture damage.

9 Behaviour in relation to fire

9.1 Quantum PLUS+ VIP (inverted roof insulation), XPS Layer, XPS Infill, and XENERGY MK, are not classified as 'non-combustible' or 'of limited combustibility'.

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 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 panels 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 (also see section 4.6 of this Certificate).

11 Maintenance



11.1 The inverted roof concept should require little or no maintenance, other than annual removal of any plants, 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 Leaks in the waterproof membrane can be accessed by removal of the paving or gravel ballast, XENERGY MK, Quantum PLUS+ VIP and XPS layer insulation panels, taking care not to damage the XENERGY MK and the Quantum PLUS+ VIP panels.

11.3 If the Quantum PLUS+ VIP 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 XENERGY MK, the Quantum PLUS+ VIP and XPS Layer/XPS Infill panels remain undamaged, will have a life of at least 25 years under normal circumstances.

12.2 The Quantum PLUS+ VIP insulation panels must be protected at all times against puncture damage. See sections 4.14, 8.3 and 13.4.

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

Installation

13 General

13.1 The Quantum PLUS+ Hybrid Inverted Roof Insulation System should be installed above a waterproofing membrane in accordance with the Certificate holder's instructions, taking into account the relevant design guidance in section 4 of this Certificate, and providing adequate load-bearing capacity, falls, drainage, sound roof waterproofing and limited risk of condensation.

13.2 A roof insulation layout drawing is supplied with the Quantum PLUS+ VIP panels to illustrate the installation layout pattern. Further installation support including an on-site 'toolbox talk' is available from the Certificate holder upon request.

13.3 It is essential to establish that the roof waterproofing has been installed correctly and that it is weathertight, clean and free from any extraneous matter. Every joint between sheets, flashing and other details must be checked to ensure that the roof covering is suitable for an inverted roof specification.

13.4 Prior to installation of the Quantum PLUS+ Hybrid Inverted Roof Insulation System, the existing waterproofed deck must have a smooth surface, flat to within 5 mm when measured with a two-metre straight-edge. Irregularities

greater than this must be removed and re-waterproofed. Specific advice may be sought from the Certificate holder. The finished deck is to be swept clean of any debris and inspected to ensure no projecting or sharp objects exist which could damage the Quantum PLUS+ VIP insulation panels, before commencement of laying.

13.5 The Quantum PLUS+ Hybrid Inverted Roof Insulation System may be installed in any weather but, due to its size, care will be needed in high winds. Installers must not carry it near to parapets or apertures in the deck and, once placed, the product must be covered with the XENERGY MK filter/water-flow-reducing layer and ballasted as soon as possible.

13.6 The ballast loading layer should be installed in accordance with BS EN 1991-1-4 : 2005, BRE Digest 295 : 1985 and BRE Digest 311 : 1986.

13.7 The ballast loading layer must be applied as work progresses to protect the insulation and the water-flow-reducing layer from the effects of wind uplift, solar degradation and foot traffic. The ballast must not be stacked in one place on the roof unless the roof is strong enough to support it.

Upgrading roofs

13.8 In existing roofs, the requirements of sections 13.1 to 13.7 also apply. In addition, the existing roofing and substructure must be examined for degradation and, where necessary, repairs should be carried out. Particular consideration should be given to the condensation risk that the existing roof structure may present (see section 7 of this Certificate).

13.9 Where, for example, parapets, details and services have insufficient height to accommodate the increased depth of insulation/protection, due provision needs to be made (a minimum of 150 mm from the top of the roof finish to the top of the skirtings must be provided).

13.10 If upgrading involves laying the product on existing inverted roof insulation, the advice of the Certificate holder should be sought.

13.11 Rainwater outlets may need to be modified or replaced to suit, eg by the installation of gravel guards.

14 Procedure

14.1 The Quantum PLUS+ VIP inverted roof insulation panels have a factory applied external coating which provides some protection against damage when handled and installed with due care. The Quantum PLUS+ VIP panels are laid on top of the prepared existing roof waterproofing (or isolation membrane if required) in accordance with the layout drawing supplied, lightly butting the panels together without gaps. During installation the Quantum PLUS+ VIP panels must be protected on top against access damage, using suitable walkway matting / covering or crawl boards, until covered by the XPS Layer. Care must be taken at all times to ensure the Quantum PLUS+ VIP panels are not damaged or punctured by sharp tools or other objects. Panels that are damaged/punctured during handling or installation must not be used, and replacement panels must be substituted.

14.2 The XPS Infill panel 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. Where XPS Infill panels abut walls or Quantum PLUS+ VIP panels, any rebated edges in the XPS must be removed so that a close-butted joint is achieved, to limit any cold-bridging.

14.3 The upper XPS Layer is laid over the Quantum PLUS+ VIP panels. The joints between XPS Layer insulation panels should be laid staggered to the joints in the Quantum PLUS+ VIP panels. Where XPS Layer panels abut walls, any rebated edges in the XPS must be removed so that a close-butted joint is achieved, to limit any cold-bridging.

14.4 The XENERGY MK 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 XENERGY MK must be turned up to finish above the surface of the ballast layer, and turned down at drainage outlets (see Figures 2 and 3 of this Certificate).

14.5 The finished surface of pavings or ballast should be installed as soon as possible to retain and protect the XENERGY MK and the overall system.

Figure 2 Parapet upstand detail – paving/gravel finish

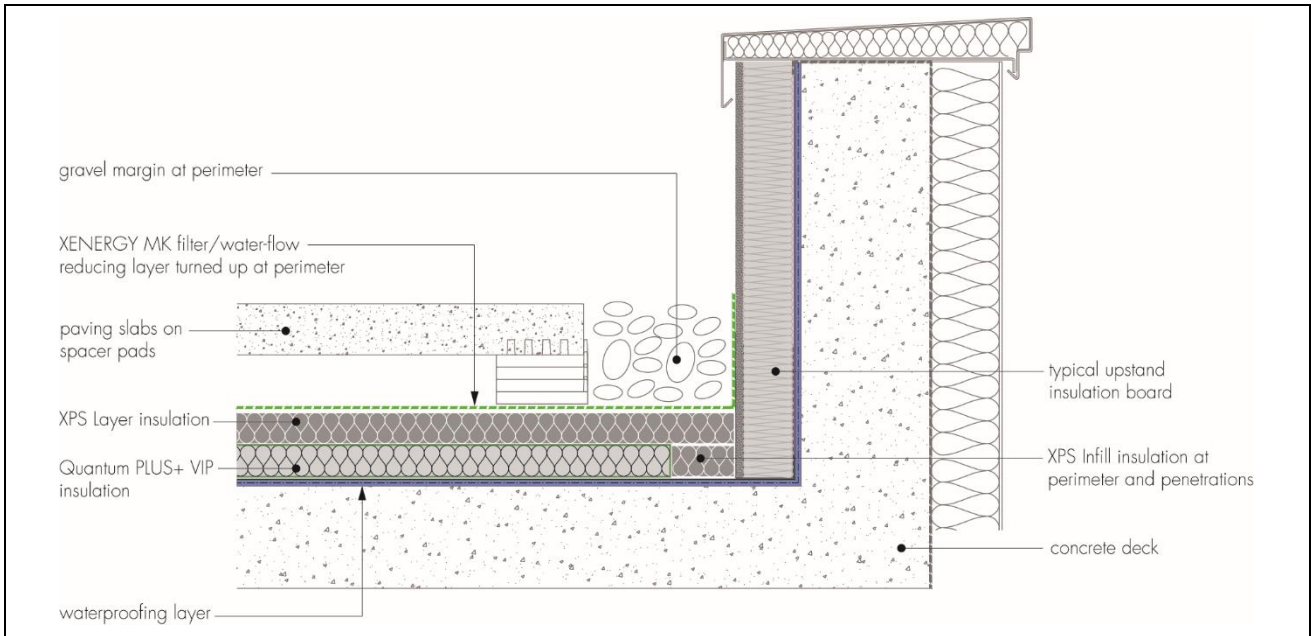
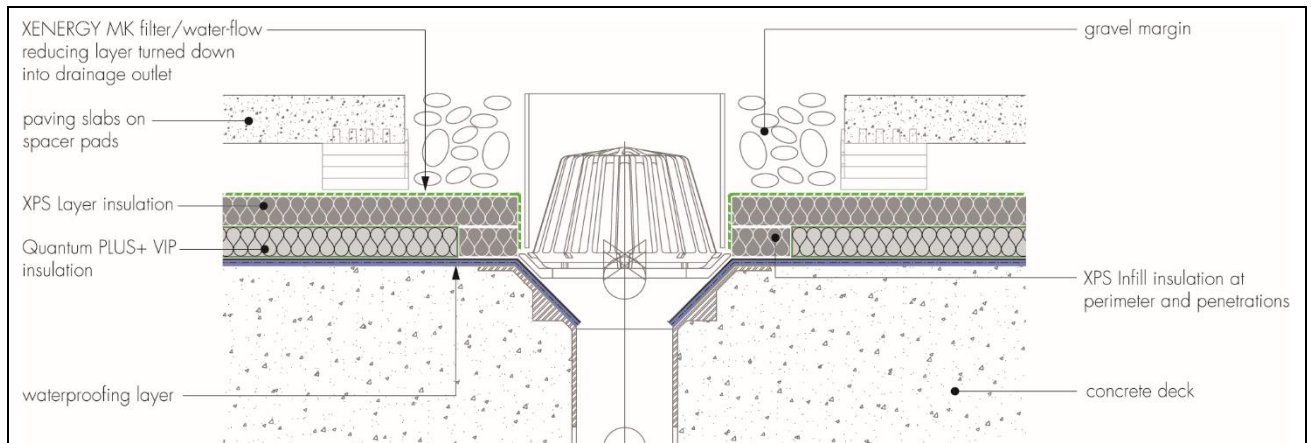


Figure 3 Drainage outlet detail – paving/gravel finish



Paving slab finish

14.6 In order to prevent flotation, wind uplift and UV degradation, the system must be covered with paving ballast as the work proceeds. Cast stone or mineral slab pavings of at least 40 mm thickness must meet the requirements of sections 4.13 and 9.2 of this Certificate. The paving slab finish is laid directly over the XENERGY MK, and slabs can either be laid fully supported, or may be supported using proprietary support pads in accordance with the manufacturer’s instructions.

Gravel ballast finish

14.7 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.

14.8 It is essential that the ballast is carefully placed directly over the XENERGY MK, and that complete depth and cover is achieved over the entire surface of the system.

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

15 Tests

Results of tests were assessed to determine:

- design thermal conductivity
- compressive strength
- compressive creep
- deformation under specified compressive load and temperature
- oxygen permeability of the VIP insulation outer foil facing
- reaction to fire
- dimensional stability
- resistance to static loading
- resistance to impact
- exposure to liquid chemicals
- filter/water-flow-reducing layer
- water flow through an inverted roof kit.

16 Investigations

16.1 Existing data on durability and properties in relation to fire were evaluated.

16.2 A calculation was undertaken to confirm the declared and design thermal conductivity.

16.3 A series of U value calculations was carried out.

16.4 A condensation risk analysis was carried out.

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

16.6 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 + A1 : 2016 *Code of practice for control of condensation in buildings*
- BS 6229 : 2018 *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 8417 : 2011 + A1 : 2014 *Preservation of wood - Code of practice*
- BS 8747 : 2007 *Reinforced bitumen membranes (RBMs) for roofing — Guide to selection and specification*
- 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 12056-3 : 2000 *Gravity drainage systems inside buildings — Roof drainage, layout and calculation*
- BS EN 13164 : 2012 + A1 : 2015 *Thermal insulation products for buildings. Factory made products of extruded polystyrene foam (XPS). Specification*
- 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 : 2017 *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*
- BBA Information Sheet No. 4 : *Inverted roofs – Drainage and U value corrections*
- BRE Digest 295 : 1985 *Stability under wind load of loose-laid external roof insulation boards*
- BRE Digest 311 : 1986 *Flat roof design: the technical options*
- 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.*
- LRWA Guidance Note No. 14 : 2020 *Best practice for the installation of water flow reducing layers in inverted roofs.*

17 Conditions

17.1 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.

17.2 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.

17.3 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.

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

17.5 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.

17.6 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.