

# Derivados Asfálticos Normalizados SA (DANOSA)

Polígono Industrial Sector 9  
19290 Fontanar  
Guadalajara  
Spain  
Tel: 00 34 949 88 82 10  
e-mail: info@danosa.com  
website: www.danosa.com



**Agrément Certificate**

**19/5704**

Product Sheet 1

## DANOSA INVERTED ROOF SYSTEM

### DANOPREN TR AND DANOPREN 500 INVERTED ROOF INSULATION

This Agrément Certificate Product Sheet<sup>(1)</sup> relates to DANOPREN<sup>(2)</sup> TR and DANOPREN 500 Inverted Roof Insulation, extruded polystyrene (XPS) boards for use in inverted roofs (above the roof waterproofing) on new and existing domestic and non-domestic flat roofs, balconies and terraced roofs subject to pedestrian access only, with either zero pitch or slopes between 1:80 and 1:6. The products are used in conjunction with the DANOFLOW water-flow-reducing layer between the insulation and the ballast layer (forming the Danosa inverted roof system).

(1) Hereinafter referred to as 'Certificate'.

(2) DANOPREN is a registered trademark.

#### 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 design thermal conductivity ( $\lambda_d$ ), including moisture correction factor, of the products is  $0.036 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$  for 40 to 60 mm board thicknesses,  $0.038 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$  for 80 mm thickness and  $0.039 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$  for 100 mm thickness (see section 6).

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

**Resistance to foot traffic** — the products, when installed on appropriate decks finished with a gravel ballast layer or paving slabs, can be used on flat roofs, balconies and roof terraces with pedestrian access only (see section 8).

**Durability** — the products will remain effective as an insulant for at least 25 years, as long as the DANOFLOW water-flow-reducing layer is in place (see section 12).

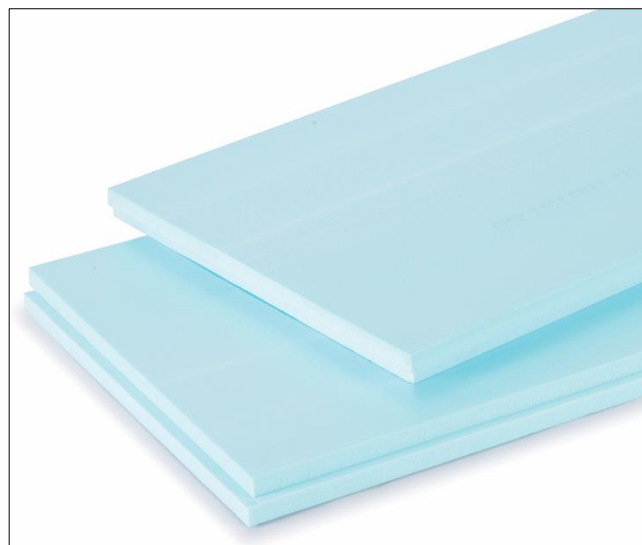
The BBA has awarded this Certificate to the company named above for the products described herein. These products have been assessed by the BBA as being fit for their intended use provided they are installed, used and maintained as set out in this Certificate.

On behalf of the British Board of Agrément

Date of First issue: 21 October 2019

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.*

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

#### British Board of Agrément

Bucknalls Lane  
Watford  
Herts WD25 9BA

©2019

tel: 01923 665300  
clientservices@bbacerts.co.uk  
www.bbacerts.co.uk

## Regulations

In the opinion of the BBA, DANOPREN TR and DANOPREN 500 Inverted Roof Insulation, 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)

<b>Requirement:</b> B4(2) Comment:	<b>External fire spread</b> The products, when used with suitable surface protection, can contribute to enabling a roof to be unrestricted under this Requirement. See sections 9.2 and 9.3 of this Certificate.
<b>Requirement:</b> C2(c) Comment:	<b>Resistance to moisture</b> The products can contribute to satisfying this Requirement. See sections 7.3 and 7.4 of this Certificate.
<b>Requirement:</b> L1(a)(i) Comment:	<b>Conservation of fuel and power</b> The products can contribute to satisfying this Requirement. See sections 6.1, 6.2 and 6.4 of this Certificate.
<b>Regulation:</b> 7 <b>Regulation:</b> 7(1) Comment:	<b>Materials and workmanship (applicable to Wales only)</b> <b>Materials and workmanship (applicable to England only)</b> The products are acceptable. See section 12.1 and the <i>Installation</i> part of this Certificate.
<b>Regulation:</b> 7(2) Comment:	<b>Materials and workmanship (applicable to England only)</b> The products are restricted under this Regulation in some cases. See sections 9.1 and 9.4 of this Certificate
<b>Regulation:</b> 26 <b>Regulation:</b> 26A <b>Regulation:</b> 26A <b>Regulation:</b> 26B Comment:	<b>CO<sub>2</sub> emission rates for new buildings</b> <b>Fabric energy efficiency rates for new dwellings (applicable to England only)</b> <b>Primary energy consumption rates for new buildings (applicable to Wales only)</b> <b>Fabric performance values for new dwellings (applicable to Wales only)</b> The products can contribute to satisfying these Regulations. See sections 6.1, 6.2 and 6.4 of this Certificate.



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

<b>Regulation:</b> 8(1)(2) Comment:	<b>Durability, workmanship and fitness of materials</b> The products are acceptable. See sections 11.1 and 12.1 and the <i>Installation</i> part of this Certificate.
<b>Regulation:</b> 9 Standard: 2.7 Comment:	<b>Building standards applicable to construction</b> Spread on external walls The products are restricted under this Standard, with reference to clause 2.7.2 <sup>(1)(2)</sup> . See sections 9.1 and 9.5 of this Certificate.
Standard: 2.8 Comment:	Spread from neighbouring buildings The products, when used with suitable surface protection, can be regarded as having low vulnerability and can contribute to enabling a roof to be unrestricted under clause 2.8.1 <sup>(1)(2)</sup> of this Standard. See sections 9.2 and 9.3 of this Certificate.

Standard:	3.15	Condensation
Comment:		The products can contribute to satisfying this Standard, with reference to clauses 3.15.1 <sup>(1)(2)</sup> , 3.15.3 <sup>(1)(2)</sup> , 3.15.4 <sup>(1)(2)</sup> , 3.15.5 <sup>(1)(2)</sup> and 3.15.6 <sup>(1)(2)</sup> . See sections 7.3 and 7.5 of this Certificate.
Standard:	6.1(b)	Carbon dioxide emissions
Standard:	6.2	Building insulation envelope
Comment:		The products can contribute to satisfying these Standards, with reference to clauses, or parts of, 6.1.1 <sup>(1)</sup> , 6.2.1 <sup>(1)(2)</sup> , 6.2.4 <sup>(1)(2)</sup> , 6.2.5 <sup>(2)</sup> , 6.2.6 <sup>(1)(2)</sup> to 6.2.11 <sup>(1)(2)</sup> , 6.2.12 <sup>(2)</sup> and 6.2.13 <sup>(1)(2)</sup> . See sections 6.1, 6.2 and 6.4 of this Certificate.
Standard:	7.1(a)(b)	Statement of sustainability
Comment:		The products 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 products can contribute to a construction meeting a higher level of sustainability as defined in this Standard, with reference to clauses 7.1.4 <sup>(1)(2)</sup> [Aspects 1 <sup>(1)(2)</sup> and 2 <sup>(1)</sup> ], 7.1.6 <sup>(1)(2)</sup> [Aspects 1 <sup>(1)(2)</sup> and 2 <sup>(1)</sup> ] and 7.1.7 <sup>(1)(2)</sup> [Aspect 1 <sup>(1)(2)</sup> ]. See sections 6.1, 6.2 and 6.4 of this Certificate.
Regulation:	12	<b>Building standards applicable to conversions</b>
Comment:		All comments given for the products under Regulation 9, Standards 1 to 6, also apply to this Regulation, with reference to clause 0.12.1 <sup>(1)(2)</sup> and Schedule 6 <sup>(1)(2)</sup> .
		(1) Technical Handbook (Domestic). (2) Technical Handbook (Non-Domestic).



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

Regulation:	23	<b>Fitness of materials and workmanship</b>
Comment:		The products are acceptable. See section 12.1 and the <i>Installation</i> part of this Certificate.
Regulation:	29	<b>Condensation</b>
Comment:		The products can contribute to satisfying this Regulation. See section 7.3 of this Certificate.
Regulation:	36(b)	<b>External fire spread</b>
Comment:		The system, when used with suitable surface protection, can contribute to enabling a roof to be unrestricted under the requirements of this Regulation. See sections 9.2 and 9.3 of this Certificate.
Regulation:	39(a)(i)	<b>Conservation measures</b>
Regulation:	40(2)	<b>Target carbon dioxide emission rate</b>
Comment:		The products can contribute to satisfying these Regulations. See sections 6.1, 6.2 and 6.4 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* (3.1 and 3.3), 4 *Use* (4.12) and 13 *Installation* (13.5) of this Certificate.

## Additional Information

### NHBC Standards 2019

In the opinion of the BBA, DANOPREN TR and DANOPREN 500 Inverted Roof Insulation, 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

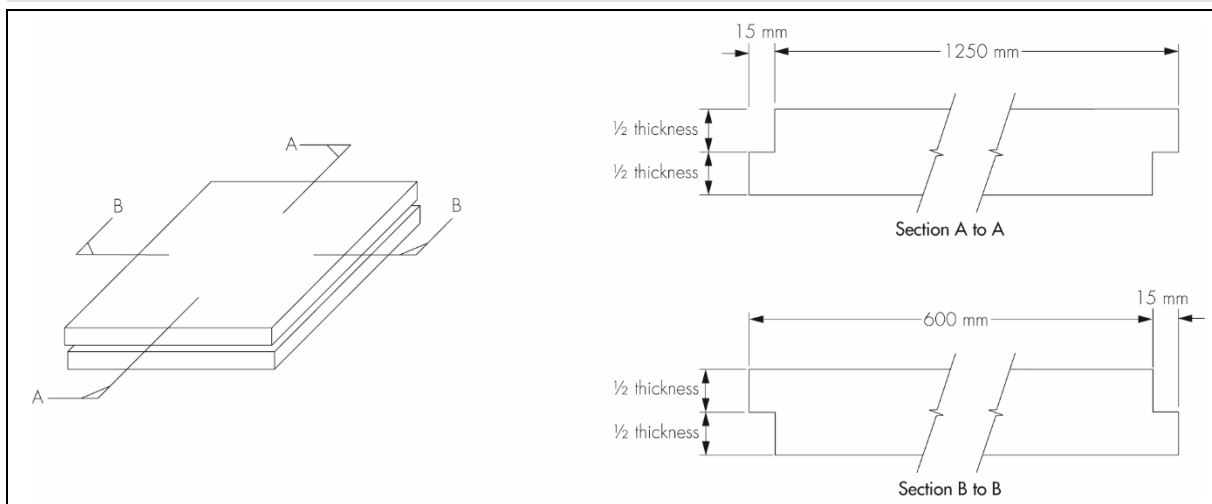
The Certificate holder has taken the responsibility of CE marking the products in accordance with harmonised European Standard BS EN 13164 : 2012. An asterisk (\*) appearing in this Certificate indicates that data shown is given in the manufacturer's Declaration of Performance.

## Technical Specification

### 1 Description

1.1 DANOPREN TR and DANOPREN 500 Inverted Roof Insulation comprises extruded polystyrene (XPS) foam boards, available in one standard size and rebated for lap jointing (see Figure 1). The boards are used in conjunction with the DANOFLOW water-flow-reducing layer and are for use with a gravel ballast or paving finish.

Figure 1 DANOPREN TR and DANOPREN 500 Inverted Roof Insulation boards



1.2 The products have the nominal characteristics shown in Table 1.

Table 1 Nominal characteristics of DANOPREN TR and DANOPREN 500 Inverted Roof Insulation

	DANOPREN TR	DANOPREN 500
Minimum compressive strength at 10% compression* (kPa)	300	500
Length x width (mm)	1250 x 600	1250 x 600
Thicknesses (mm)	40, 50, 60, 80, 100	50, 60, 80
Edge detail	Rebated (15 mm x half board thickness)	Rebated (15 mm x half board thickness)
Colour	Blue	Blue

1.3 The DANOFLOW water-flow-reducing layer acts as both a filter and water-flow-reducing layer between the insulation and the roof ballast. The nominal characteristics are shown in Table 2.

**Table 2 Nominal characteristics of the DANOFLOW water-flow-reducing layer**

Material type (vapour permeable membrane)	Thermally bonded polyolefin film laminate composite
Roll size (m)	50 x 1.5
Water vapour resistance (MN·s·g <sup>-1</sup> )	0.1
Head of water test (1.0 m)	No penetration
Mass per unit area (g·m <sup>-2</sup> )	100 (min)
Lap joints (mm) — unsealed	300
Colour	Black

1.4 Ancillary items outside the scope of this Certificate include:

- gravel ballast comprising a washed low-fines aggregate, rounded and a minimum of 19 mm in size, and laid to a minimum depth of 50 mm, OR paving ballast of minimum 40 mm thickness
- paving support/spacer pads
- DANOLOSA – paving slab incorporating extruded polystyrene insulation
- DANOFELT PY 300 – needle-punched polyester geotextile, for use as a separating layer
- DANOPREN UPSTAND BOARD (50 mm XPS insulation with a 6 mm fibre cement board facing)
- DANODREN JARDIN – HDPE drainage layer
- DANODREN R20 – HDPE drainage layer
- separating or cushion layers, if required (see section 4.11)
- rainwater outlet grilles
- dual-level rainwater outlets.

## 2 Manufacture

2.1 DANOPREN TR and DANOPREN 500 Inverted Roof Insulation boards are produced through a continuous extrusion process whereby the raw polystyrene is melted in an extruder machine together with additives (flame retardant, pigments, etc.), with other additives subsequently added which act as expansion or foaming agents. The fall of the pressure, once the end of the extruder is reached, makes the gel expand. This results in a continuous board, with a homogeneous closed-cellular structure.

2.2 The DANOFLOW water-flow-reducing layer is manufactured by a thermal-bonding process in which a polypropylene breathable micro-porous film is bonded to polypropylene non-woven membranes to form a flexible sheet.

2.3 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 being operated by the manufacturer are being maintained.

2.4 The management system of the manufacturer has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2015 by Bureau Veritas (Certificate ES083321-1).

## 3 Delivery and site handling

3.1 The DANOPREN TR and DANOPREN 500 Inverted Roof Insulation boards are shrink wrapped in polythene and delivered to site on pallets or bearers. Each pack shows the manufacturer's name, grade, type marking and BBA logo, incorporating the number of this Certificate.

3.2 Boards must be stored flat, off the ground on a clean, level surface and under cover to protect them from prolonged exposure to sunlight and high winds.

3.3 The boards must not be exposed to open flame or other ignition sources.

3.4 Care must be taken to avoid contact with solvents and materials containing organic components.

3.5 Damaged boards must not be used.

3.6 Rolls of the DANOFLOW water-flow-reducing layer are delivered to site in packages that carry a label bearing the marketing company's name, the grade identification and the BBA logo including the number of this Certificate.

3.7 The rolls should be stored flat on their sides, on a smooth, clean, dry 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 DANOPREN TR and DANOPREN 500 Inverted Roof Insulation.

## Design Considerations

### 4 Use

4.1 DANOPREN TR and DANOPREN 500 Inverted Roof Insulation are suitable for use as thermal insulation in inverted roof applications (above the roof waterproofing) on new and existing domestic and non-domestic flat roofs, balconies and terraced roofs subject to pedestrian access only, with either a zero pitch or slopes between 1:80 and 1:6, on a suitably designed timber, concrete or metal structural deck and appropriate fully supported waterproofing system.

4.2 The boards must always be overlaid with the water-flow-reducing layer, which acts both as a filter layer preventing fines and other debris from passing through and as a water-flow-reducing layer (minimising cold rainwater flowing between the insulation and the roof waterproofing, and thus consequent heat loss). This membrane must be laid with 300 mm laps (see section 14.3) and covered with a gravel ballast or paving finish.

4.3 For the purpose of this Certificate:

- flat roofs are defined as those roofs having either a minimum finished fall between 1:80 and 1:6, or a 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 Sheet No 4*).
- pedestrian access roofs are defined as roofs consisting of the structural deck and all the layers on it (including waterproofing, thermal insulation and a surface protective layer), which are designed for foot traffic and gathering of people greater than that required for maintenance.

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.

4.5 Care must be taken to ensure that upgraded roofs are capable of carrying the increased load and depth of the installed system.

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

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

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

4.8 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 drainage 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*, which generally requires surface drainage falls.

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 water-flow-reducing layer 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 Where there is a risk from plasticiser migration or other contaminants from the roof waterproofing (such as PVC single-ply membranes), a suitable 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. For mastic asphalt waterproofing membranes, a non-woven polyester fleece isolating membrane must be interposed in accordance with BS 8218 : 1998. Further details can be obtained from the Certificate holder.

4.12 A roof ballast layer must be installed as work progresses, to protect both the water-flow-reducing layer and the boards from the effects of wind uplift, UV degradation and foot traffic. The ballasted roof finish may be either gravel ballast or paving, which must be assessed by a suitably experienced and competent individual for its suitability according to region exposure and building height. In addition, the dead load imposed by the finish 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 washed, rounded and a minimum of 19 mm in size, and laid to a minimum thickness of 50 mm. The minimum size of ballast 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 sheltered regions, or buildings up to 10 storeys above the ground. 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 1991-1-2 : 2002. For other exposure conditions or tall buildings, specialist advice should be sought.

4.15 A paving ballast comprising a minimum 40 mm thickness of cast stone, mineral or 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. Paving slabs can be laid fully supported, or may be supported using proprietary support/spacer pads, in accordance with the Certificate holder's recommendations.

## 5 Practicability of installation

The products are designed to be installed by a competent general builder or contractor experienced with these types of products.

## 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 ( $\lambda U$ ) (including moisture correction factor) and the  $f_x$  drainage correction for the system, including DANOPREN TR and DANOPREN 500, as given below.

(See also *BBA Information Sheet No 4*).

- $0.036 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$  — for 40, 50 and 60 mm thicknesses
- $0.038 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$  — for an 80 mm thickness
- $0.039 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$  — for a 100 mm thickness
- $f_x = 0.005$  — drainage correction (incorporating the water-flow-reducing layer).

6.2 The value of a completed roof will depend on the insulation thickness, type of substrate and internal finish. 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 3 indicate that the products can contribute to a roof achieving typical U values referred to in those supporting documents.

*Table 3 Example U<sup>(1)</sup> values for flat roof and zero pitch applications (incorporating the DANOFLOW water-flow-reducing layer)*

Required U value (W·m <sup>-2</sup> ·K <sup>-1</sup> )	DANOPREN TR and DANOPREN 500 Inverted Roof Insulation thickness required <sup>(2)</sup> (mm)	
	<i>p</i> = 3 (mm·day <sup>-1</sup> )	<i>p</i> = 8 (mm·day <sup>-1</sup> )
0.13	100 + 100 + 80 + 40	100 + 100 + 100 + 100
0.15	100 + 100 + 80	100 + 100 + 80 + 40
0.16	100 + 100 + 50	100 + 100 + 100
0.18	100 + 80 + 40	100 + 100 + 50
0.20	100 + 100	100 + 80 + 40
0.25	100 + 50	100 + 80

(1) Deck taken as 200 mm dense reinforced concrete ( $\lambda = 2.5 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$ )  
 (2) Thinnest available insulation thickness or thickness combination to achieve the design U value. Note: thickest boards always used as bottom layer/s.


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 ( $\Delta U_r$ ) to the calculated roof U value in accordance with Annex F.4 of BS EN ISO 6946 : 2017, as follows:

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

- $\Delta U_r$  = correction to the calculated thermal transmittance of the roof element (W·m<sup>-2</sup>·K<sup>-1</sup>)
- p* = average rate of precipitation during the heating season (mm·day<sup>-1</sup>)<sup>(1)</sup>
- 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 (0.04 W·day·m<sup>-2</sup>·K<sup>-1</sup>·mm<sup>-1</sup>)
- R<sub>1</sub>* = thermal resistance of the layer of insulation above the waterproofing membrane (m<sup>2</sup>·K·W<sup>-1</sup>)
- R<sub>T</sub>* = total thermal resistance of the construction before application of the correction (m<sup>2</sup>·K·W<sup>-1</sup>)
- f<sub>x</sub>* = 0.005 drainage correction for the system incorporating the water-flow-reducing layer.

(1) Seasonal average rainfall can be found at <https://www.metoffice.gov.uk/public/weather/climate/> 'enter town, city or postcode' for the nearest of around 300 UK weather stations, select 'Averages table' and sum the monthly 'Rainfall' for October to May and divide by 243 to obtain '*p*' in mm·day<sup>-1</sup>.

**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 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, and disappear when the rain stops.

**Interstitial condensation**

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 Roofs will adequately limit the risk of interstitial condensation when they are designed and constructed in accordance with BS 5250 : 2011, Section 4 and Annexes D and H. Further guidance may be obtained from BRE Report BR 262 : 2002.

## Surface condensation



7.4 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 6.3 of this Certificate.



7.5 In Scotland, 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 6.3 of this Certificate.

## 8 Resistance to foot traffic

When covered with a ballast layer, as specified in section 4, the products can accept the pedestrian foot traffic and light concentrated loads likely to be encountered in service.

## 9 Behaviour in relation to fire



9.1 DANOPREN TR and DANOPREN 500 Inverted Roof Insulation boards have a reaction to fire classification\* of Class E to BS EN 13501-1 : 2007<sup>(1)</sup>.

(1) AFITI-LICOF Report No 3460T18-2, 6 July 2018. Copies can be obtained from the Certificate holder.



9.2 The use of the products, when used in protected or inverted roof specifications, including an inorganic covering listed in the Annex of Commission Decision 2000/553/EC, can be considered to be unrestricted under 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 products should not be used on balconies on buildings in England that have a storey at least 18 m above ground level and which contain: one or more dwellings, an institution, a room for residential purposes (excluding any room in a hostel, hotel or boarding house), student accommodation, care homes, sheltered housing, hospitals or dormitories in boarding schools.



9.5 The products should not be used on balconies in Scotland on buildings that have a storey more than 11 m above the ground.

9.6 DANOPREN TR and DANOPREN 500 Inverted Roof Insulation should not be laid over compartment walls.

## 10 Effect on roof coverings

10.1 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.

10.2 Separation or cushion layers between the insulation boards and the roof waterproofing may be needed in some circumstances (see section 4.11 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 insulation, water-flow-reducing layer and deck waterproofing layer. The Certificate holder can advise on the suitability of a particular product.

11.3 Should a leak occur in the waterproof membrane, it must be repaired following removal of the gravel ballast or paving ballast layer, water-flow-reducing layer and the insulation boards. Correct reinstatement of these layers must be carried out, taking care not to damage the water-flow-reducing layer.

## 12 Durability



12.1 DANOPREN TR and DANOPREN 500 Inverted Roof Insulation are rot resistant and, as long as the water-flow-reducing layer remains undamaged, will have a life of at least 25 years under normal service conditions.

12.2 To avoid the risk of UV degradation, care must be taken to ensure that the gravel ballast or paving, once installed, provides cover to the insulation and the water-flow-reducing layer at all times.

## Installation

## 13 General

13.1 DANOPREN TR and DANOPREN 500 Inverted Roof Insulation should be installed in accordance with the Certificate holder's instructions and this Certificate.

13.2 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.

13.3 DANOPREN TR and DANOPREN 500 Inverted Roof Insulation is laid in a brick bond pattern; it is essential that all joints between the boards are tight and that no gaps exist where they meet rooflights, edge details and other services which perforate the roof deck. The boards can be cut easily using a fine-tooth saw, sharp knife or a hot wire cutter.

13.4 When the products are to be placed over a loose-laid roof covering, they should be installed and ballasted as soon as possible to protect the covering from the effects of wind uplift (see sections 4.12 to 4.15) and installers must take care not to damage the existing roof waterproofing.

13.5 The insulation boards are light and may be installed in any weather but, due to their size, care will be needed in high winds. Installers must not carry them near to parapets or apertures in the deck and, once placed, they must be covered with the water-flow-reducing layer and ballasted as soon as possible.

13.6 The ballast loading layer should be installed in accordance with BS 6399-2 : 1997, 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-control layer from the effects of wind uplift, solar degradation and foot traffic.

## **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 made. 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 gravel to the top of the skirtings must be provided).

13.10 If upgrading involves laying the products 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 DANOPREN TR and DANOPREN 500 Inverted Roof Insulation and the water-flow-reducing layer are laid in accordance with the Certificate holder's instructions and this Certificate.

14.2 Single-layer roofing must be inspected carefully – this must include an examination for perforation and for the likelihood of subsequent perforation from beneath (by, for example, uneven decks and protruding nail heads).

14.3 The water-flow-reducing layer should be loose-laid over the insulation, at right angles to the slope, with 300 mm unsealed lap joints overlapping in the downward direction of the flat roof slope. At upstands and penetrations, the water-flow-reducing layer must be turned up to finish above the surface of the ballast layer (protected by a cover flashing) and turned down at drainage outlets.

14.4 The ballast layer must then be laid over the filter/water-flow-reducing layer as soon as possible, to prevent flotation, wind uplift, UV degradation and damage from foot traffic.

### **Gravel ballast finish**

14.5 The gravel ballast layer (see sections 4.13, 4.14 and 9.2) must be carefully placed directly over the water-flow-reducing layer to ensure complete depth and cover is achieved over the entire surface of the system.

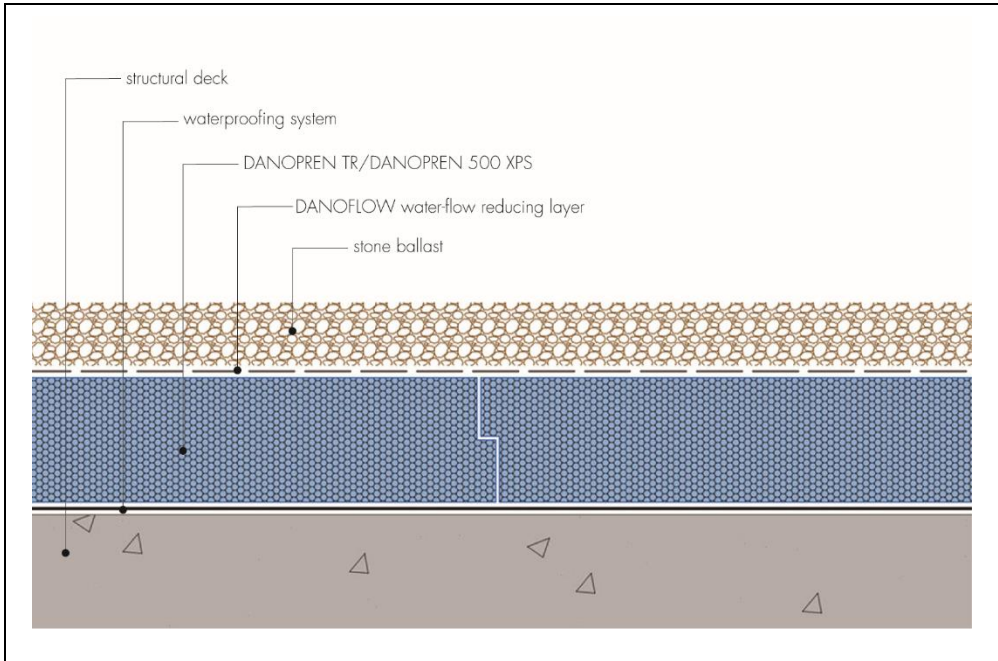
14.6 Gravel must not contain excessive fines in order to prevent clogging of gullies and outlets and to discourage organic growth.

### **Paving slab finish**

14.7 Standard pressed concrete, cast stone or mineral paving slabs of at least 40 mm thickness (see sections 4.15 and 9.2) must be carefully placed directly over the water-flow-reducing layer to ensure complete cover is achieved over the entire surface of the system. Paving slabs can either be laid fully supported, or may be supported using proprietary support/spacer pads.

14.8 Typical construction details are given in the following Figures:

**Figure 2 Typical installation detail – gravel ballast finish**



**Figure 3 Typical installation detail – paving ballast finish**

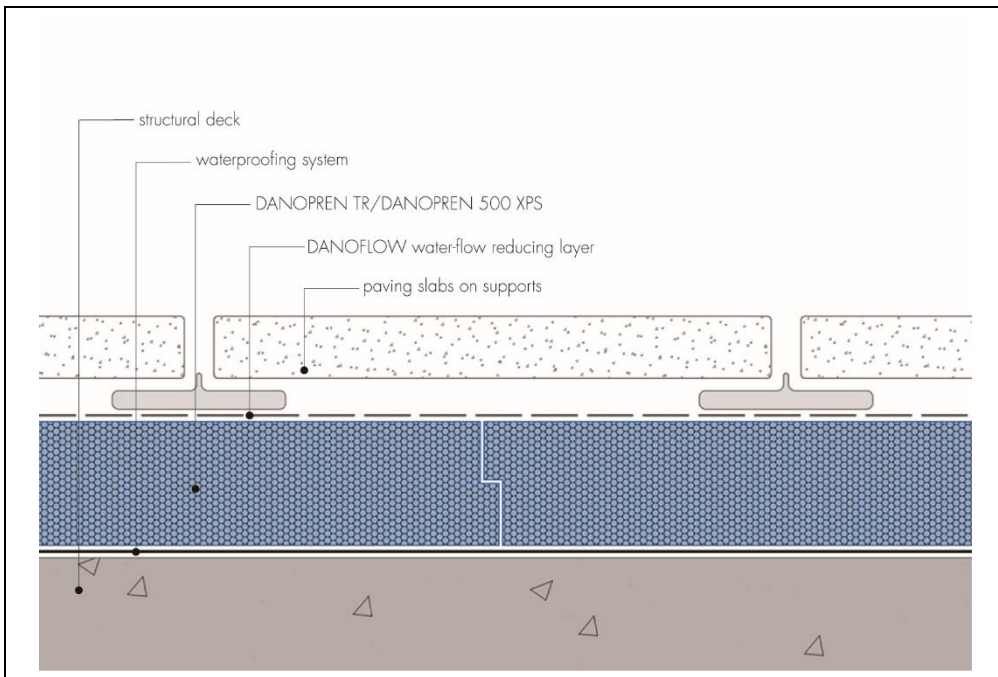


Figure 4 Water outlet detail – gravel ballast finish

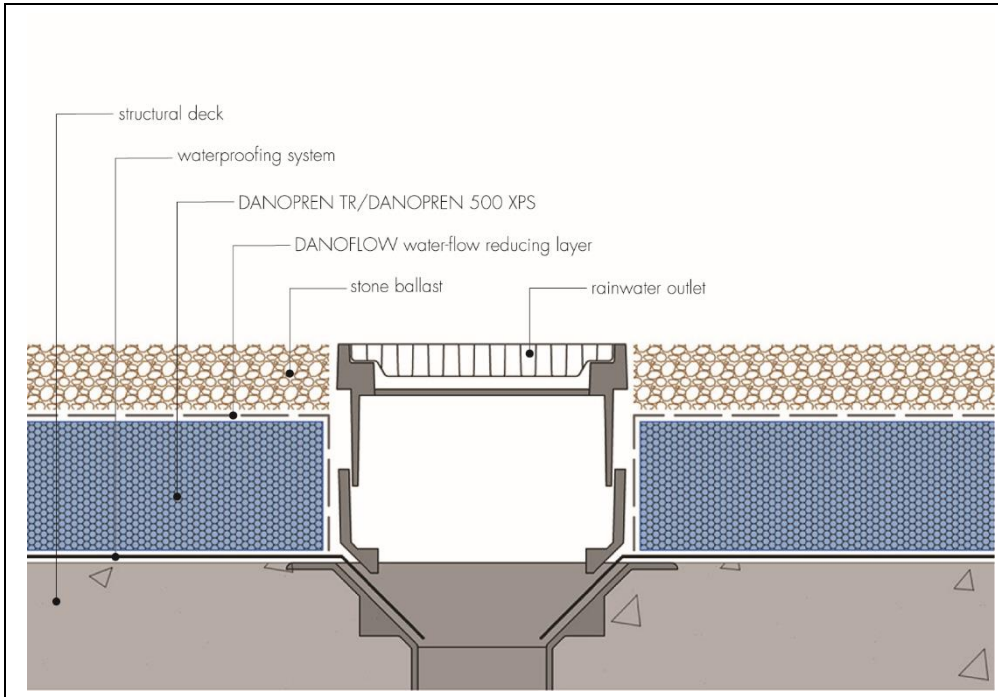


Figure 5 Water outlet detail – paving ballast finish

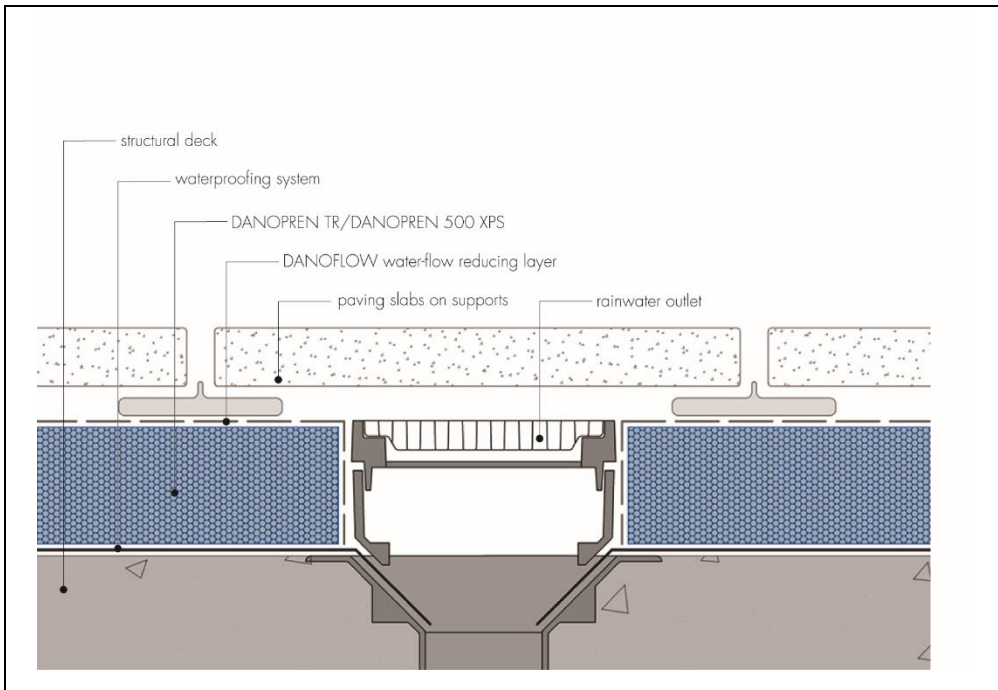
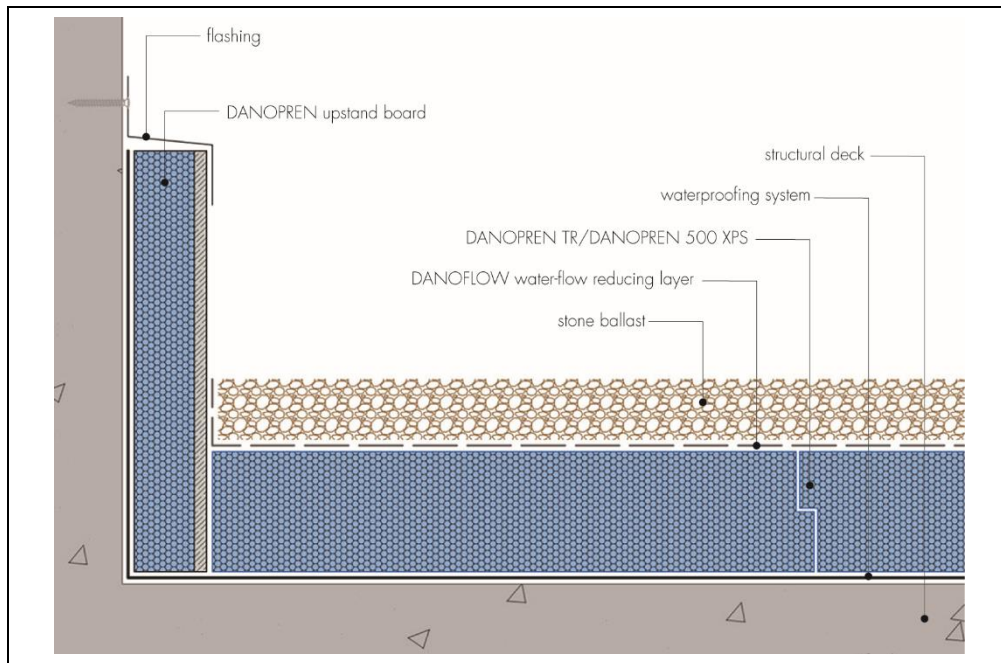


Figure 6 Typical upstand detail – gravel ballast finish



## Technical Investigations

### 15 Tests

15.1 Results of tests carried out on the DANOPREN TR and DANOPREN 500 Inverted Roof Insulation boards were assessed, to determine:

- thermal conductivity
- compressive strength
- water vapour permeability
- long-term water absorption by diffusion
- resistance to freeze-thaw of the thermal insulation
- water flow through an inverted roof kit
- deformation under specified compressive load and temperature
- dimensional stability
- reaction to fire classification.

15.2 Results of tests carried out on the DANOFLOW water-flow-reducing layer were assessed, to determine:

- tensile strength and elongation
- resistance to tear
- dimensional stability
- resistance to water penetration
- resistance to artificial ageing
- water vapour transmission
- resistance to penetration of air.

### 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 ( $\lambda_D$ ) and design ( $\lambda_U$ ) thermal conductivities.

16.3 A series of U value calculations was carried out.

16.4 A condensation risk analysis was carried out.

16.5 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

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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*

LRWA Guidance Note No.7 : 2012 — *Specifier Guidance for Flat Roof Falls*

### 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.