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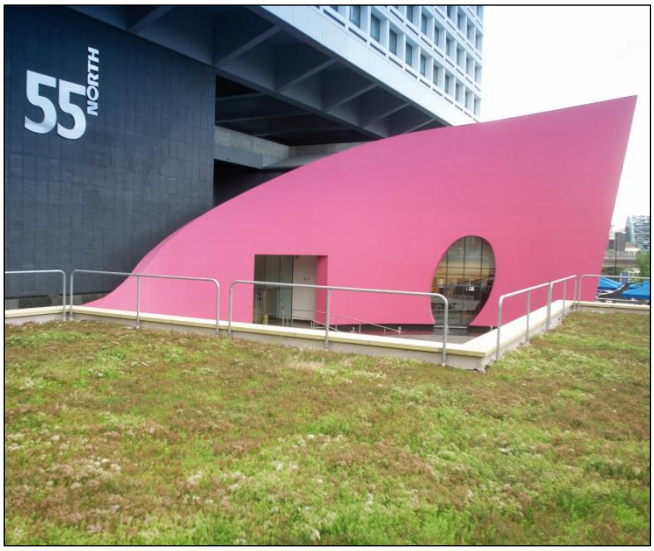
Agrément Certificate
08/4530
Product Sheet 1

SARNAFIL WATERPROOFING MEMBRANES

SARNAFIL PROTECTED ROOF WATERPROOFING MEMBRANES

This Agrément Certificate Product Sheet(1) relates to Sarnafil Protected Roof Waterproofing Membranes, comprising single-ply polymeric sheets for use in loose-laid and ballasted roof waterproofing applications on inverted roofs, green roofs, roof gardens and terraces on flat roofs.

(1) Hereinafter referred to as 'Certificate'.



CERTIFICATION INCLUDES:

- factors relating to compliance with Building Regulations where applicable
- factors relating to additional non-regulatory information where applicable
- independently verified technical specification
- assessment criteria and technical investigations
- design considerations
- installation guidance
- regular surveillance of production
- formal three-yearly review.

KEY FACTORS ASSESSED

Weathertightness — the products will resist the passage of moisture to the inside of the building (see section 6).

Properties in relation to fire — the products, when used in a suitable specification, will enable a roof to be unrestricted under the Building Regulations (see section 7).

Resistance to wind uplift — the products will enable a roof to be unrestricted under the Building Regulations (see section 8).

Resistance to foot traffic — the products will accept, without damage, regular foot traffic and associated loads (see section 9).

Resistance to penetration of roots — the products will adequately resist plant root penetration (see section 10).

Durability — under normal service conditions, Sarnafil G and Sarnafil TCG/TG66 roofing membranes will provide durable waterproof coverings with service lives in excess of 35 years and 25 years respectively (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 Agrement

Date of Third issue: 20 May 2015
Originally certificated on 27 March 2008

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.u

Regulations

In the opinion of the BBA, Sarnafil Protected Roof Waterproofing Membranes, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements of the following Building Regulations (the presence of a UK map indicates that the subject is related to the Building Regulations in the region or regions of the UK depicted):

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

Requirement:	**B4(2)**	**External fire spread**
Comment:		The use of the products in a suitable roof specification will be unrestricted under these Requirements. See sections 7.1 to 7.5 of this Certificate.
Requirement:	**C2(b)**	**Resistance to moisture**
Comment:		The products, including joints, will enable a roof to meet this Requirement. See section 6.1 of this Certificate.
Regulation:	**7**	**Materials and workmanship**
Comment:		The products are acceptable. See section 12 and the *Installation* part of this Certificate.

The Building (Scotland) Regulations 2004 (as amended)

Regulation:	**8(1)(2)**	**Durability, workmanship and fitness of materials**
Comment:		Use of the products satisfies the requirements of this Regulation. See sections 11 and 12 and the *Installation* part of this Certificate.
Regulation:	**9**	**Building standards applicable to construction**
Standard:	2.8	Spread from neighbouring buildings
Comment:		When used in a suitable roof specification, the products are classified as having low vulnerability under clause 2.8.1(1)(2) of this Standard, and will enable a roof to be unrestricted under this Standard with reference to clauses 2.8.1(1)(2) and 2.8.2(1)(2). See sections 7.1 to 7.5 of this Certificate.
Standard:	3.10	Precipitation
Comment:		The products, including joints, will enable a roof to satisfy the requirements of this Standard, with reference to clauses 3.10.1(1)(2) and 3.10.7(1)(2). See section 6.1 of this Certificate.
Standard:	7.1(a)	Statement of sustainability
Comment:		The products can contribute to meeting the relevant requirements of Regulation 9, Standards 1 to 6 and therefore will contribute to a construction meeting a bronze level of sustainability as defined in this Standard.
Regulation:	**12**	**Building standards applicable to conversions**
Comment:		Comments in relation to these products 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

Regulation:	**23(a)(i) (iii)(b)(i)**	**Fitness of materials and workmanship**
Comment:		The products are acceptable. See section 12 and the *Installation* part of this Certificate

Regulation:	**28(b)**	**Resistance to moisture and weather**
Comment:		The products, including joints, will enable a roof to meet the requirements of this Regulation. See section 6.1 of this Certificate.
Regulation:	**36(b)**	**External fire spread**
Comment		The use of the products in a suitable roof specification will be unrestricted by the requirements of this Regulation. See sections 7.1 to 7.5 of this Certificate.

Construction (Design and Management) Regulations 2015
Construction (Design and Management) Regulations (Northern Ireland) 2007

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

See sections: 1 *Description* (1.2) and 3 *Delivery and site handling* (3.3) of this Certificate.

Additional Information

NHBC Standards 2014

NHBC accepts the use of Sarnafil Protected Roof Waterproofing Membanes, provided they are installed, used and maintained in accordance with this Certificate, in relation to *NHBC Standards*, Part 7 *Roofs,* Chapter 7.1 *Flat roofs and balconies.*

CE marking

The Certificate holder has taken the responsibilty of CE marking the products in accordance with harmonised European Standard BS EN 13956 : 2005. An asterisk (*) appearing in this Certificate indicates that data shown are given in the manufacturer's Declaration of Performance.

Registered Contractors Scheme(1)

The Certificate holder operates a Registered Contractors Scheme for these products under which contractors are trained, registered and regularly reviewed by the Certificate holder to demonstrate that they are competent to carry out installation in accordance with this Certificate. Details of registered Contractors are available from the Certificate holder. Registered contractors are responsible for each installation of the products they undertake.

(1) The Certificate holder's records relating to their Registered Contractors Scheme will be audited annually by the BBA as part of its programme of surveillance.

Technical Specification

1 Description

1.1 Sarnafil Protected Roof Waterproofing Membranes comprise:

- Sarnafil G410 — a multi-layer roof waterproofing membrane based on plasticised PVC, incorporating UV- and flame-retardant stabilisers and non-woven glassfibre inlay
- Sarnafil G476 — a multi-layer synthetic roof waterproofing membrane based on PVC, incorporating a non-woven glassfibre inlay
- Sarnafil G476-SA — a multi-layer synthetic roof waterproofing membrane based on PVC, incorporating a non-woven glassfibre inlay and a self-adhesive PVC foam backing on the underside
- Sarnafil TCG — a multi-layer synthetic roof waterproofing membrane based on flexible polyolefins (FPO), incorporating UV-retardant stabilisers and a non-woven glassfibre inlay
- Sarnafil TG66 — a multi-layer synthetic roof waterproofing membrane based on flexible polyolefins (FPO), incorporating UV-retardant stabilisers and a non-woven glassfibre inlay.

1.2 The roofing membranes are manufactured to the nominal characteristics given in Tables 1 and 2.

Table 1 Nominal characteristics – PVC membranes

Characteristic (unit)	**Sarnafil G410**						**Sarnafil G476**	**Sarnafil G476-SA**
	Standard G410-EL			**Fleece backed G410-ELF**				
Roll length (m)	2	20	20	15	15	15	15	15
Roll width (m)	2	2	2	2	2	2	2	2
Thickness* (mm)	1.5	1.8	2.0	1.5(1)	1.8(1)	2.0(1)	2.0	1.5
Weight ($kg \cdot m^{-2}$)(1)	2.0	2.3	2.6	2.3	2.7	3.1	2.0	2.2
Roll weight (kg)	64	80	69	69	81	93	60	88
Colour								
upper face	A range of colours is available						Red	Red
lower face							Dark grey	Dark grey
Watertightness*	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Tensile strength* ($N \cdot mm^{-2}$)								
longitudinal	≥ 10	≥ 10	≥ 10	–	–	–	≥ 10	–
transverse	≥ 9	≥ 9	≥ 9	–	–	–	≥ 9	–
Elongation* (%)								
longitudinal	≥ 220	≥ 250	≥ 250	–	–	–	≥ 240	–
transverse	≥ 200	≥ 230	≥ 230	–	–	–	≥ 230	–
Tensile strength* [$N(50\ mm)^{-1}$]								
longitudinal	–	–	–	≥ 700	≥ 750	≥ 750	–	≥ 600
transverse	–	–	–	≥ 700	≥ 750	≥ 750	–	≥ 600
Elongation* (%)								
longitudinal	–	–	–	≥ 65	≥ 65	≥ 65	–	≥ 150
transverse	–	–	–	≥ 65	≥ 65	≥ 65	–	≥ 150
Dimensional stability* (%)								
longitudinal	≤0.2	≤0.2	≤0.2	–	–	–	≤0.2	–
transverse	≤0.1	≤0.1	≤0.1	–	–	–	≤0.1	–
Low temperature foldability* (°C)	≤ –25	≤ –25	≤ –25	≤ –25	≤ –25	≤ –25	≤ –25	≤ –25
Impact resistance*								
soft substrate	–	–	–	–	–	–	–	≥ 1250
hard substrate	–	–	–	–	–	–	–	≥ 700
Static load resistance*								
soft substrate	–	–	–	–	–	–	–	≥ 20
hard substrate	–	–	–	–	–	–	–	≥ 20
Resistance to root penetration*	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass

Table 2 Nominal characteristics – FPO membranes

Characteristic (unit)	**Sarnafil TCG**			**Sarnafil TG66**		
Roll length (m)	20	20	20	20	15	15
Roll width (m)	2	2	2	2	2	2
Thickness* (mm)	1.5	1.8	2.0	1.5	1.8	2.0
Weight ($kg \cdot m^{-2}$)(1)	2.0	2.3	2.6	1.5	1.8	2.0
Roll weight (kg)	64	80	69	60	54	60
Colour	Standard RAL 7040 Window Grey					
Watertightness*	Pass	Pass	Pass	Pass	Pass	Pass
Tensile strength* ($N \cdot mm^{-2}$)						
longitudinal	≥ 6	≥ 6	≥ 6	≥ 9	≥ 9	≥ 9
transverse	≥ 6	≥ 6	≥ 6	≥ 7	≥ 7	≥ 7
Elongation* (%)						
longitudinal	≥ 500	≥ 500	≥ 500	≥ 550	≥ 550	≥ 550
transverse	≥ 500	≥ 500	≥ 500	≥ 550	≥ 550	≥ 550
Dimensional stability* (%)						
longitudinal	–	–	–	≤ 0.2	≤ 0.2	≤ 0.2
transverse	–	–	–	≤ 0.1	≤ 0.1	≤ 0.1
Low temperature foldability* (°C)	≤ -35	≤ -40	≤ -40	≤ -30	≤ -30	≤ -30
Impact resistance* (mm)						
soft substrate	≥ 800	≥ 1000	≥ 1000	≥ 1000	≥ 1250	≥ 1250
hard substrate	≥ 600	≥ 800	≥ 900	≥ 800	≥ 1000	≥ 1000
Static load resistance*(kg)						
soft substrate	≥ 20	≥ 20	≥ 20	≥ 20	≥ 20	≥ 20
hard substrate	≥ 20	≥ 20	≥ 20	≥ 20	≥ 20	≥ 20
Resistance to root penetration*	Pass	Pass	Pass	Pass	Pass	Pass

1.3 Ancillary items necessary for installation of the products and included in this assessment are:

- Sarnacol 2170 — adhesive for bonding the G410 membrane to the substrate
- Sarnacol 2142S — adhesive for bonding G410-ELF membranes to the substrate.

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

- Sarnacol 2162UK — a one-component polyurethane adhesive for bonding insulation boards
- Sarnacol 2116 — adhesive for bonding ballast in areas of high winds
- Sarnafil T Clean — cleaning agent for TCG/TG66
- Sarnafil G445-13 — protection sheet for G410
- Sarnafil TG63-13 — protection sheet for TCG/TG66
- Sarnavap 500E, 1000E and 2000E — polyethylene vapour control layers
- Sarnavap double-sided jointing tape — for sealing Sarnavap vapour control layers
- Sarnavap 5000E SA — self-adhered bituminous vapour control layer
- Sarnafil Primer 600 — for use with Sarnacol 2162 and Sarnacol 5000E SA, and Sarnafil G476-SA subject to substrate requirements
- SarnaFelt Type T — polyester felt for use as a barrier to bitumen and polystyrene insulation boards
- SarnaFelt Type GK — polypropylene-based felts for use as cushion separation layers
- SarnaFelt VS 140 — polypropylene filter layer to be used with ballast in inverted roof applications
- Sarnafil Double L — insulated and sealable rainwater outlet for gravity and siphonic systems
- Sarnapad — paving support or levelling shim made of high-density polypropylene
- Sarnatherm — a range of thermal insulations comprising rigid urethane foam, expanded polystyrene and extruded polystyrene.

2 Manufacture

2.1 The products are manufactured by extrusion coating plasticised PVC and FPO into sheets which are then reinforced with a scrim.

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

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

2.3 The management system of Sika Limited has been assessed and registered as meeting the requirements of BS EN ISO 9001 : 2008 and BS EN ISO 14001 : 2004 by SQS (Certificate 31982).

2.4 The product is manufactured in Switzerland and marketed in UK by the Certificate holder.

3 Delivery and site handling

3.1 Membranes are delivered to site in rolls packaged in polythene bearing a label with the product identification, stock number, lot number, bulk roll number, area, date code and the BBA logo incorporating the number of this Certificate.

3.2 Rolls should be stored in a cool, dry area on a clean, level surface, and kept under cover. They should only be unwrapped from packaging at the time of installation, and unused membrane should be returned to its packaging until required.

3.3 The properties of the adhesives in relation to *The Chemicals (Hazard Information and Packaging for Supply) Regulations 2009* (CHIP4)/*Classification, Labelling and Packaging for Substances and Mixtures (CLP Regulation) 2009* are given in Table 2. These products should be stored in accordance with *The Dangerous Substances and Explosive Atmospheres Regulations 2002.*

Table 2 Adhesive and primer characteristics

Product	Flashpoint (°C)	Classification
Sarnacol 2142S	–18	Highly flammable/Harmful
Sarnafil T Clean	30	Flammable/Irritant
Sarnacol 2170	–4	Highly flammable/Irritant
Sarnacol 2162UK	—	Harmful
Sarnafil Primer 600	–20	Highly flammable/Irritant

Assessment and Technical Investigations

The following is a summary of the assessment and technical investigations carried out on Sarnafil Protected Roof Waterproofing Membranes.

Design Considerations

4 General

4.1 Sarnafil Protected Roof Waterproofing Membranes are satisfactory for use as a waterproofing on flat roofs with limited or pedestrian/amenity access on:

- loose-laid and ballasted roofs

- warm ballasted roofs
- inverted roofs
- green roofs and roof gardens.

4.2 The membranes must be mechanically fixed at upstands and edges.

4.3 Limited access roofs are defined for the purpose of this Certificate as those subjected only to pedestrian traffic for maintenance of the roof covering, cleaning of gutters etc. Where traffic in excess of this is envisaged, special precautions, such as additional protection to the membrane, must be taken (see section 9).

4.4 Flat roofs are defined for the purpose of this Certificate as those having a minimum finished fall of 1:80. Pitched roofs are defined as those having a fall in excess of 1:6. For design purposes, twice the minimum finished fall should be assumed, unless a detailed analysis of the roof is available, including overall and local deflection and direction of falls.

4.5 For the purposes of this Certificate the finished falls of the roof bearing the drainage layer should be between 1:80 and 1:20. The falls are provided by the substrate.

4.6 Decks to which the membranes are to be applied must comply with the relevant requirements of BS 6229 : 2003, BS 8217 : 2005 and, where appropriate, *NHBC Standards* 2014, Chapter 7.1.

4.7 Insulation systems or materials used in conjunction with the membranes must be either as described in the relevant clauses of BS 8217 : 2005 or be the subject of a current BBA Certificate and be used in accordance with, and within the limitations of, that Certificate.

4.8 Sarnafil G410 and G476 membranes can be adversely affected by contact with bituminous products and polystyrene insulation boards. In these cases, the G410 felt-backed version or a suitable separating layer such as SarnaFelt Type T must be used. Where doubt arises, the advice of the Certificate holder should be sought.

4.9 Sarnafil TCG and TG66 membranes should not come into direct contact with new bituminous or coal tar products or plasticised PVC. In these cases, a suitable separating layer such as SarnaFelt Type T must be used.

4.10 The membranes must not be laid directly onto timber substrates impregnated with substances containing solvents or oil (eg oil-based preservatives). In these cases, a felt-backed version or a suitable separating layer such as SarnaFelt Type T must be used.

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

4.12 For green and inverted roof gardens, structural decks to which the system is to be applied must be suitable to transmit the dead and imposed loads experienced in service.

4.13 Imposed loads, dead loading and wind load specifications are calculated in accordance with BS EN 1991-1 : 2002, BS EN 1991-1-4 : 2005 and their respective UK National Annexes.

4.14 The drainage system for green roofs or roof gardens must be correctly designed and provision made for access for maintenance purposes. Dead loads for green roofs and roof gardens can increase if the drains become partially or completely blocked, causing waterlogging of the drainage layer. Gravel guards should therefore be used on rainwater outlets and inspected annually.

4.15 For inverted roof specifications, the ballast requirements should be calculated in accordance with the relevant parts of BS EN 1991-1-4 : 2005 and its UK National Annex. Additional guidance for inverted roof specifications is given in BBA Information Bulletin No 4 *Inverted roofs — Drainage and U valued corrections.*

5 Practicability of installation

The membranes should only be installed by members of the Certificate holder's Registered Contractors Scheme (see the *Additional Information* part of this Certificate).

6 Weathertightness

6.1 Results of tests confirm that the membranes, including joints when completely sealed and consolidated, will adequately resist the passage of moisture into the building and enable a roof to comply with the requirements of the national Building Regulations.

6.2 The membranes are impervious to water and will adequately resist penetration by roots. When used in one of the systems described, they will provide a weathertight roof covering capable of accepting minor structural movement without damage.

7 Properties in relation to fire

7.1 The following applications will be unrestricted under the national Building Regulations:

- a loose-laid and ballasted specification, including a minimum surface finish of 50 mm of aggregate
- a roof garden covered with a drainage layer of gravel 100 mm thick and a soil layer of minimum 300 mm thick
- a green roof incorporating the membranes covered with an Aquadrain drainage layer and a growing medium of minimum 60 mm thick.

7.2 A system comprising an 18 mm plywood deck primed with Sarnafil Primer 600, a layer of Sarnafil G476-SA, a layer of Sarnafil S-T 300g polyester fleece, a 600 mm thickness of Sarnatherm Insulation board, a layer of Sarnafelt S-felt VS 140 filter layer and concrete pavers on Sarnapads with 20/40 mm gravel ballast margins, achieved a B_{ROOF}(t4) classification in accordance with EN 13501-5.

7.3 In the opinion of the BBA, the membranes, when used in irrigated roof gardens or green roofs, will be unrestricted under the national Building Regulations.

7.4 The membranes, 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 national Requirements.

7.5 The designation of other specifications should be confirmed by:

England and Wales — test or assessment in accordance with Approved Document B, Appendix A, clause 1
Scotland — test to conform to Mandatory Standard 2.8.1, clause 2.8.1
Northern Ireland — test or assessment by UKAS-accredited laboratory, or an independent consultant with appropriate experience.

7.6 If allowed to dry, plants used in roof gardens may allow flame spread across the roof. This should be taken into consideration when selecting plants for the garden. Appropriate protection should be applied to ensure the overall fire-rating of the roof is not compromised.

8 Resistance to wind uplift

8.1 In loose-laid and ballasted systems, the precise ballast requirements should be calculated in accordance with the relevant parts of BS EN 1991-1-4 : 2005 and its UK National Annex.

8.2 The use of concrete slabs on suitable supports should be considered in areas of high wind exposure, and the advice of the Certificate holder should be sought. In such areas, the gravel may be bonded at the edges for a distance of one metre using Sarnacol 2116. The membranes should always be ballasted with a minimum depth of 50 mm of aggregate. Soil used in green and garden roofs should be of a type that will not be removed or become localised by wind scour experienced on site.

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

9 Resistance to foot traffic

9.1 Where regular foot traffic is envisaged, such as for maintenance of lift equipment, a walkway must be provided by using concrete slabs on bearing pads. When paviours are used, a protective sheet such as Sarnafil G445-13 or TG63-13, or a filter layer such as SarnaFelt Type GK, must be laid over the waterproofing, prior to installation of the paviours on paving pad supports. For inverted applications, Sarnafil Type VS140 should be used on the insulation.

9.2 Once the green roof or roof garden is installed it can be regarded as a suitable protection for the membrane in use. However, it should be recognised that the membrane is taken up beyond the level of the soil (at least 150 mm) and therefore is vulnerable to damage in those areas.

10 Resistance to penetrations of roots

Results of tests on the membranes indicate that they are resistant to root penetration and can be used in a roof waterproofing system for roof gardens and green roofs.

11 Maintenance

11.1 The systems must be the subject of annual inspections and maintenance to ensure continued performance.

11.2 A planned maintenance cycle, including inspections by the Certificate holder at minimum intervals of five years, should be introduced if an extended service life is required. The Certificate holder can advise on methods of extending the service life. This could include the use of thicker membranes, specific maintenance requirements, or localised replacement and repair.

11.3 Any damage should be repaired in accordance with section 16 of this Certificate and the Certificate holder's instructions.

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

12 Durability

12.1 The durability of all roofing materials is dependent on the roof design, installation, immediate environment, maintenance and use. Other specific factors assessed by the BBA relating to the durability of individual products include formulation, thickness, and life to first maintenance.

Sarnafil G410, G476 and G476-SA

12.2 A Sarnafil G roofing system, used in the context of this Certificate, will have a service life in excess of 35 years.

12.3 The products have been in use in Switzerland and the UK since 1968 and 1980 respectively. The BBA has examined the oldest available sites where the material has been installed. Tests conducted on naturally-aged material taken from existing sites and on naturally-aged material which has been subjected to further ageing conditions confirm satisfactory retention of properties, indicating that a life in excess of 40 years can be achieved with periodic maintenance as stated in section 11.

Sarnafil TCG and Sarnafil TG66

12.4 Sarnafil TCG/TG66 will have a service life in excess of 25 years.

13 Reuse and recyclability

The products comprise polyvinyl chloride, flexible polyolefins, polyester and glass, which can be recycled.

Installation

14 General

14.1 Installation of Sarnafil Protected Roof Waterproofing Membranes (see Figure 1) must be carried out by trained and approved installers working in accordance with the relevant clauses of the Certificate holder's instructions and BS 8000-4 : 1989.

14.2 Conditions on site should be those for normal roof waterproofing work. Deck surfaces must be dry, clean, and free from sharp projections such as nail heads or concrete nibs. When used over a rough or bitumen substrate, a suitable protection layer must be laid first.

15 Procedure

15.1 Horizontal laps must be a minimum of 80 mm wide with all flashings raised a minimum of 150 mm above the finished roof level.

15.2 The membranes are mechanically fixed at perimeters, at all penetrations and at changes of level, and the laps welded together. Finally, the detail work is carried out.

15.3 The membranes must be covered with a protective sheet such as Sarnafil G445-13 or TG63-13, or a filter layer such as SarnaFelt Type GK. For inverted roof applications, SarnaFelt Type VS 140 should be used prior to the application of at least 50 mm of washed, well-rounded gravel. In areas of high wind exposure, a heavier gravel may be used and/or the gravel may be bonded at the edges for a distance of one metre using Sarnacol 2116. Alternatively, paving slabs set on suitable supports may be considered.

15.4 Sarnafil G410 membrane with SarnaFelt Type VS 140 filter layer is also suitable for use in an inverted roof construction.

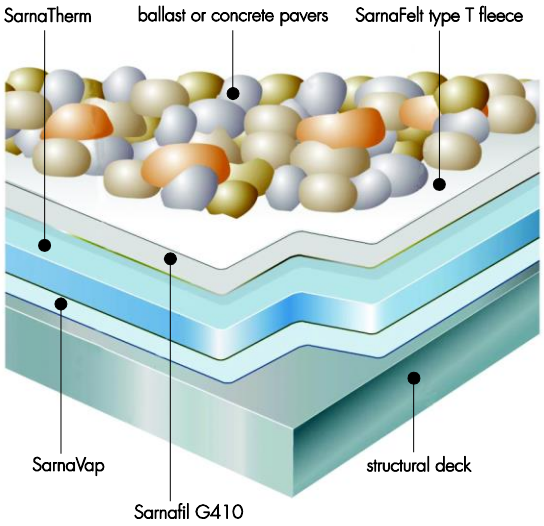
15.5 When using loose-laid application, normal account must be taken in the design of the deck of extra dead loading owing to the weight of the aggregate and/or paving.

15.6 When using Sarnafil G476-SA, the concrete deck should be primed with Sarnafil Primer 600 at approximately 200–500 $g \cdot m^{-2}$, depending on the smoothness and porosity of the surface. The membrane is unrolled flat without waves or creases and positioned to overlap by 80 mm. The membrane is pulled back and the release film peeled back. The membrane is laid back into position and the overlaps are welded immediately by hot air welding.

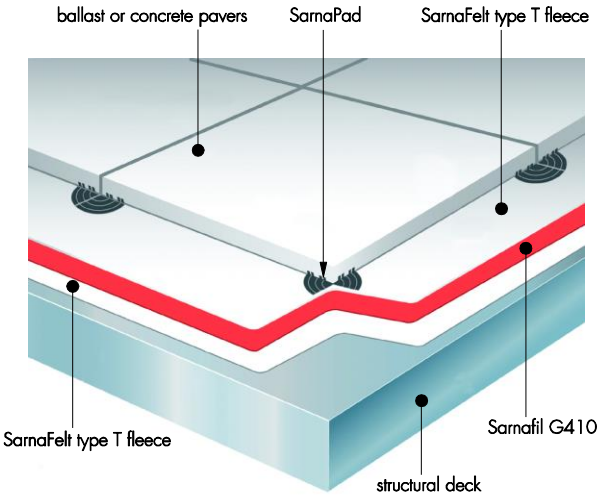
15.7 For green roof or garden roof applications, the Certificate holder's instructions must be strictly followed.

15.8 Flashing and detailing must be formed in accordance with the Certificate holder's instructions.

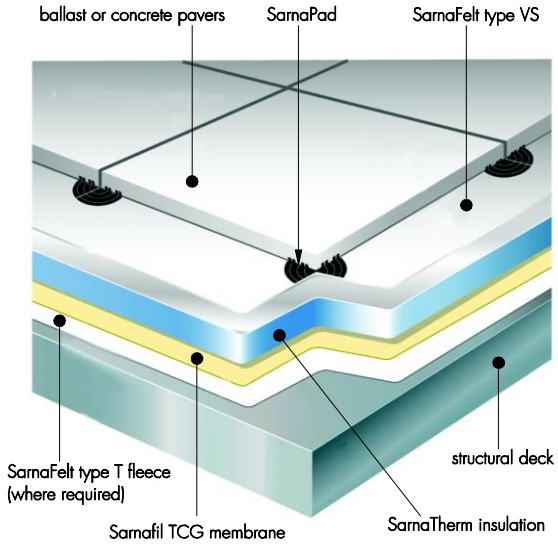
Figure 1 Typical installations



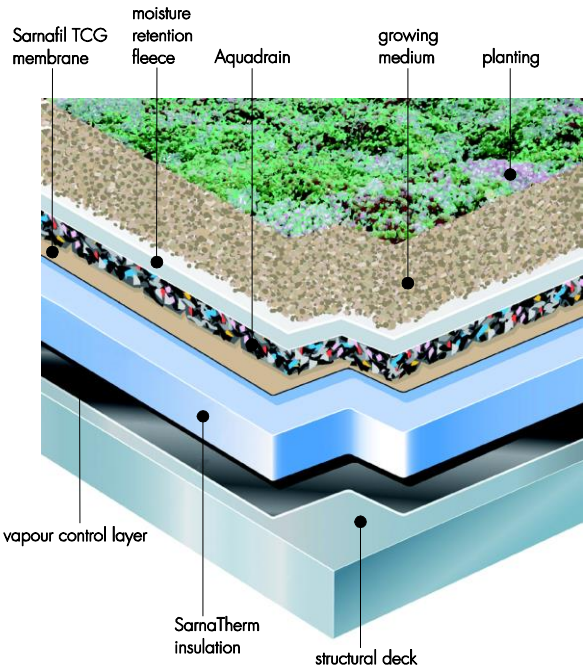
Sarnafil G410 – ballasted roof



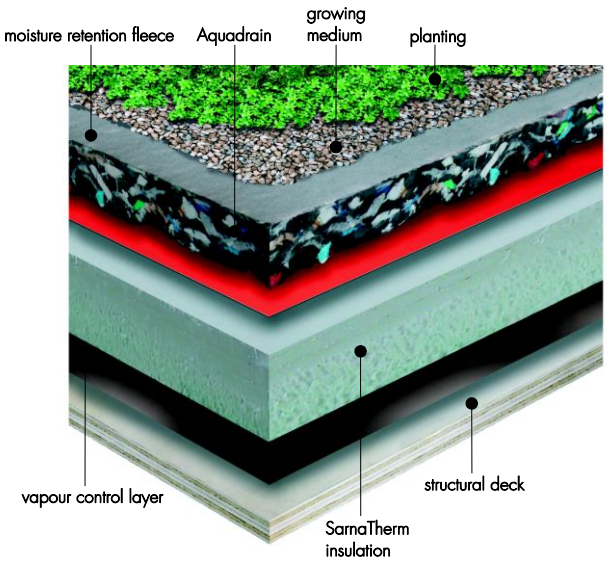
Sarnafil G410 – loose-laid



Sarnafil TCG – inverted roof



Sarnafil TCG – green roof



Sarnafil G410 – green roof

16 Repair

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

Technical Investigations

17 Tests

17.1 Tests were carried out on samples of Sarnafil G410 and the results assessed to determine:

- tensile strength*
- elongation at break*
- tear resistance
- dimensional stability*
- heat ageing (56 days at 80°C) followed by tensile strength and elongation
- UV ageing (500 light hours using UVB 313 lamps cycling 4 hours UV at 45°C and 4 hours condensation at 40°C) followed by tensile strength and elongation
- apparent density
- water vapour permeability
- ash content
- static indentation on hard and soft substrate*
- low temperature flexibility*
- thickness*
- resistance to root penetration*
- peel resistance of joints*
- shear resistance of joints*
- dynamic indentation on perlite board and expanded polystyrene*
- resistance to wind uplift
- thermal shock
- water vapour resistance
- resistance to sliding at 90°C
- resistance to water pressure (6 m head)
- peel resistance when applied to chipboard, concrete, perlite and polyisocyanurate (asbestos-faced) substrates (using Sarnacol 2170 adhesive applied to Sarnafil G410-12EL)
- peel resistance from a concrete substrate without ageing, after 56 days heat ageing at 80°C and after 28 days water soak at 20°C (using Sarnacol 2170 adhesive)
- resistance to cyclic movement
- air pressure resistance of joints
- tensile strength of welded joint after 28 days heat ageing at 80°C
- tensile strength of welded joint (longitudinal and transverse) after 7 days water soak at 60°C.

17.2 Tests were carried out on samples of Sarnafil G476 and the results assessed to determine:

- resistance to water pressure
- static indentation on concrete, fibre board and expanded polystyrene
- low temperature flexibility
- dynamic indentation on chipboard, perlite board and expanded polystyrene.

17.3 Tests were carried out on samples of Sarnafil TCG and the results assessed to determine:

- dynamic indentation on perlite board and expanded polystyrene
- static indentation on concrete and expanded polystyrene
- tensile strength of joints.

17.4 Tests were carried out on samples of Sarnafil TG66 and the results assessed to determine:

- tensile strength
- elongation at break
- 28 days water soak at 60°C followed by tensile strength and elongation
- dimensional stability
- tear strength (nail)
- static indentation on concrete and expanded polystyrene
- dynamic indentation on perlite board and expanded polystyrene
- water vapour permeability
- water vapour resistance.

18 Investigations

18.1 Tests were conducted on a material of similar formulation to the Sarnafil TG66/TCG material and the results assessed to determine:

- tensile strength and elongation
- resistance to water pressure
- resistance to nail tear
- resistance to folding at low temperature
- resistance to leakage at joints
- tensile strength of joints
- peel strength of joints.

18.2 Existing data relating to resistance of the membranes to root penetration and fire test data were evaluated.

18.3 The manufacturing process was evaluated, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

18.4 A survey of known users was carried out to assess the performance in use of the products.

18.5 A reassessment of the Durability statement was based on visits to existing sites in Switzerland and in the UK, and the results of tests conducted on Sarnafil G410 unaged, naturally-aged and accelerated-aged material, and on a material of similar formulation to Sarnafil TCG/TG66 unaged and naturally-aged material.

Bibliography

BS 6229 : 2003 *Flat roofs with continuously supported coverings — Code of practice*
BS 8000-4 : 1989 *Workmanship on building sites — Code of practice for waterproofing*
BS 8217 : 2005 *Reinforced bitumen membranes for roofing — Code of practice*
BS EN 1991-1-1 : 2002 *Eurocode 1 : Actions on structures — General actions — Densities, self-weight, imposed load for buildings*
NA to BS EN 1991-1-1 : 2002 UK National Annex to *Eurocode 1 : Actions on structures — General actions — Densities, self-weight, imposed loads for buildings*
BS EN 1991-1-3 : 2003 *Eurocode 1 : Actions on structures — General actions — Snow loads*
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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 13956 : 2005 *Flexible sheet for waterproofing — Plastic and rubber sheets for roof waterproofing — Definitions and characteristics*
BS EN ISO 9001 : 2008 *Quality management systems — Requirements*
BS EN ISO 14001 : 2004 *Environmental management systems — Requirements with guidance for use*

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