SINTEF Technical Approval

TG 20541

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Valid until 01.02.2027

Provided listed on
www.sintefcertification.no

SINTEF confirms that

Protan BlueProof Roofing System

has been found to be fit for use in Norway and to meet the provisions regarding product documentation given in the regulation relating to the marketing of products for construction works (DOK) and regulations on technical requirements for building works (TEK), with the properties, fields of application and conditions for use as stated in this document

1. Holder of the approval

Protan AS
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2. Product description

General on the roofing system

Protan BlueProof Roofing System includes Protan BP and Protan BPX roofing membranes installed as exposed roofing. The system will, in combination with specific accessories, provide rainwater retention as an additional function of the roof.

Protan BlueProof is a system that allows the water to accumulate and to be stored on a roof for a certain amount of time after the rainfall has ended, and by that operate as a rain-water retention system. The system is designed in a way that the water during strong precipitation will be accumulated gradually until a predefined maximum level. During the accumulation period the water run-off will be reduced, and designed not to exceed the specific maximum permitted discharge into the drainage system of the building or another recipient. Ref. fig. 4 on page 4.

If the water surface reaches a maximum defined water level, the outlet in the Protan BlueProof Roof System will operate as a traditional outlet, not allowing further water build-up on the rooftop. Additionally, at least one extra overflow in the parapet must be installed as extra protection.

Relevant requirements in TEK17 are assessed to be met on the basis of documentation of function, performance, product, solutions and execution. The following functional extension of the roof, hence the system and the roof covering, is documented:

- *Function*: Rainwater retention with peak water reduction
- *Performance*: Rainwater retention with documented storage
- capacity, run-off volume and run-off time
- *Product*: Documented enhanced quality with regard to intended performance and function as confirmation that the product meets the requirements in TEK17 and is suitable for use under the conditions specified in the approval.

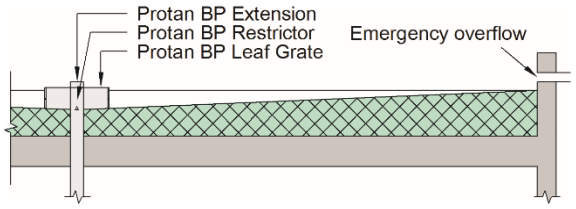

Fig. 1
Protan BlueProof roofing system. Principle drawing.

Protan BP and BPX roofing membrane

Protan BP and BPX are ca. 1.8 mm thick roofing membranes made of pliable PVC with a core of extra strong polyester reinforcement, which are used in Protan BlueProof Roofing System.

Protan BP and Protan BPX both have additional stabilizers to make the membranes resistant to high and low temperatures, ultra violet radiation and atmospheric contamination. Welding of joints is carried out by using hot air. The roofing membranes have an embossed surface that provides an anti-slip texture. The standard surface colour is dark grey. Measures and tolerances are shown in table 1.

Protan BP can be used as roofing on different kinds of substrates, but needs a separate migration barrier of the 120 g/m² glass fleece on polystyrene substrates.

Protan BPX has a polyester fleece laminated to the underside, and is specially adapted for reroofing directly on old bituminous roofing membrane.

Table 1
Measures and tolerances for Protan BP and BPX roofing membrane according to EN 1848-2, EN 1849-2

Property	Protan BP	Protan BPX	Unit	Tolerance
Thickness	1.8	1.8 + filt	mm	+10/-5 %
Area weight	2.1	2.1 + filt	kg/m²	+10/-5 %
Width	1.0 / 2.0 / On request		m	+1/-0.5 %
Length of roll	On request		m	+2/-0 %
Weight polyester core	ca. 100		g/m²	-
Weight polyester fleece	-	ca. 180	g/m²	-

SINTEF Certification
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Entreprise register: NO 919 303 808 MVA

Table 2
Product properties for fresh material of Protan BP and BPX roofing membrane

Property	Test method EN	DoP [1]	Control limit [2]	SINTEF's recommended minimum performance[3]	Unit
Foldability at low temperature	495-5	≤ -30	≤ -30	≤ -30 [4] ≤ -25 [4]	°C
Dimensional stability	1107-2	-	± 0.5	± 0.5	%
Water tightness 10 kPa/24 h	1928 (A)	Tight	Tight [8]	Tight	-
Tear resistance L T	12310-2	≥ 300 ≥450	≥ 300 ≥450	≥ 180	N
Tensile strength L T	12311-2 (A)	≥ 1800 ≥ 1400	≥ 1800 ≥ 1400	≥ 600	N/50 mm
Elongation at max. load L/T	12311-2 (A)	≥ 15	≥ 15	≥ 10	%
Peel resistance - Average - Maximum	12316-2	 ≥ 150 ≥ 250	 - [6] ≥ 250 [7]	 ≥ 150 ≥ 200	N/50 mm
Shear resistance joints	12317-2	≥ 1000	≥ 1000	≥ 600	N/50 mm
Resistance to puncture by - Impact at +23°C - Impact at +23°C - Impact at -10°C - Static load - Static load	 12691 (A) 12691:2001 [5] 12691:2001 [5] 12730 (A) 12730 (C)	 ≥ 600 - - - ≥ 30	 ≥ 600 ≤ 8 [8] ≤ 10 [8] ≥ 30 -	 ≥ 400 - ≤ 15 ≥ 20 -	 mm mm diam. mm diam. kg kg
Water vapour resistance, s_d value	ISO 12572	-	27 [8]	-	m

[1] The manufacturers Declaration of performance, DoP
[2] Control limit shows values (lowest permissible value) the product has to satisfy during internal factory production control and audit testing
[3] SINTEFs recommended minimum values for SINTEF Technical Approval for mechanically fastened membranes of PVC for use on ordinary roofs with a minimum slope of 1:40, and without the additional function for rainwater retention.
[4] SINTEFs recommended minimum value for membranes with thickness 1.2 mm is -30 °C
SINTEFs recommended minimum value for membranes with thickness ≥1.5 mm is -25 °C
[5] Soft substrate, EPS
[6] For failure mode A the average peel resistance has to be assessed towards SINTEF's recommended minimum value for average peel resistance
[7] The control limit applies for failure mode B and C
[8] Result from typetesting

L = Longitudinal T = Transversal

3. Fields of application

Protan BlueProof Roofing System is used for new roofing and reroofing with or without additional insulation. The system is primary used as exposed, mechanically fastened roofing on flat roofs, see fig. 1.

The roofing membranes in Protan BlueProof Roofing System, Protan BP and BPX, can be mechanically fastened as shown in fig. 2 or used in combination with Protan Vacuum Roofing System as shown in fig. 3.

Protan BlueProof Roofing System can be laid on roofs designed for slopes with minimum 1:100 towards the outlet.

4. Properties

Product properties
Product properties for fresh material are shown in table 2.

Properties related to fire
Protan BP and BPX roofing membrane fulfils the requirements of class B_{ROOF} (t2) according to EN 13501-5 regarding external fire performance on substrates shown in table 3. Testing is performed according to CEN/TS 1187, test 2.

Durability
Protan BP and BPX roofing membrane have shown satisfying properties after artificial ageing in connection with type-testing and audit testing performed by SINTEF.

Fastening capacity
The design capacity for different fasteners and premises are given in table 4. The capacity applies to the connection between the membrane and the fasteners.

For weak substrates the connection between the substrate and the fastener might limit the capacity. This must be considered, and only the lowest capacity for membrane or substrates must always be used.

Calculation of fasteners' spacing is carried out according to SINTEF Building Research Design Guide no. 544.206 *Mekanisk innfesting av asfalttakbelegg og takfolie på skrå og flate tak* and "TPF informerer nr. 5" published by Takprodusentenes Forskningsgruppe (TPF), see www.tpf-info.org.

Table 3
Protan BP and Protan BPX roofing membrane has fire classification B_{ROOF} (t2) on following substrates

Type of substrate – New building	BP	BPX
EPS [1]	No	No
EPS and ≥120 g/m² glass fleece [1]	Yes	No
PIR [1] [2]	Yes	No
30 mm stone wool on 50 mm EPS [1]	Yes	No
Stone wool	Yes	No
Wood particle board, ≥ 680 kg/m³	Yes	Yes
Concrete / calcium silicate plate	Yes	Yes
Type of substrate – Reroofing [3]	BP	BPX
Old bituminous roofing membrane on EPS [1] [3]	No	Yes
Old roofing membrane on EPS and ≥120 g/m² glass fleece [1] [3]	Yes	No
Old roofing membrane on PIR [1] [2] [3]	Yes	No
Old roofing membrane on 30 mm stone wool on 50 mm EPS [1] [3]	Yes	No
Old roofing membrane on stone wool [3]	Yes	No
Old roofing membrane on wood particle board, ≥ 680 kg/m³ [3]	Yes	Yes
Old roofing membrane on concrete / calcium silicate plate [3]	Yes	Yes

[1] In case of roofing on lightweight combustible insulation (e.g. EPS or PIR): See clause 6 *Special conditions for use and installation*, section *Substrate*, regarding requirements for replacement of combustible insulation to non-combustible around around bushings and against adjacent constructions.
[2] Fire technical classification on PIR applies only to the tested PIR product " Kingspan Therma TR26 LPC/FM ".
[3] See clause 6 *Special conditions for use and installation*, section *Substrate*, regarding requirements for the old roofing membrane.

Accessories and their properties
Main accessories for Protan BlueProof Roofing System include the Protan BP Restrictor with the Protan BP-Extention and the Protan BP-LeafGrate in dimensions matching the standard rain-water outlet.

The Protan BP-Restrictor reduces and delays the water flow during extreme rainfall. At a low precipitation intensity, the rain-water outlet with restrictor operates like an ordinary outlet. The discharge capacity of the restrictor(s) must be calculated for each roof. The restrictors will be dimensioned to meet different requirements.

If the rainfall exceeds the intensity of precipitation / precipitation amount for the chosen return period (or that the restrictors do not work as intended), the opening at the top of the restrictor is not restricted and will allow the water to flow freely and thus serve as a normal outlet. Additionally, the emergency overflow in the parapet will come operative, that the constructions bearing capacity will not be exceeded.

The selection of dimensions is part of the construction design and is done by the responsible engineer for heating, ventilation and sanitation (RIV) together with Protan, see item 6. The most common dimensions for the BP-Restrictor/overflow are 75 mm, 90 mm and 110 mm.

Table 4
Design capacity at ultimate limit state for the attachment of Protan BP and BPX with different fastening systems

Fastener/Fastening system	Design capacity N / fastener
SFS intec isotak RP48-3N plastic washer (Tested as Iso-Tak Plus 48 (PA/PP)) Distance between fasteners: 480 / 720 mm (soft substrate, attachment in steel plate)	1000 [1]
SFS intec isotak RP50 plastic washer (Tested as Iso-Tak Plus 45 PP) Distance between fasteners: 480 / 720 mm (soft substrate, attachment in steel plate)	700 [1]
Guardian SPA-40-F2B steel washer, Guardian S-Point Ph-2 Kop TS-5225 screw Distance between fasteners: 250 mm (firm substrate, attachment in plywood board)	650 [2]
Guardian R-45 plastic washer, Guardian BS 4,8 screw Distance between fasteners: 320 mm (soft substrate, attachment in steel plate)	700 [3]
Guardian RB-48 plastic washer, Guardian BS 4,8 screw Distance between fasteners: 320 mm (soft substrate, attachment in steel plate)	980 [3]
Guardian RBS-50 plastic washer, Guardian BS-4,8 screw Distance between fasteners: 320 mm (soft substrate, attachment in steel plate)	900 [3]
Koelner GOK-PLUS-N plastic washer Distance between fasteners: 240 mm (soft substrate, attachment in steel plate)	720 [2]

[1] Measured according to the Nordtest method NT BUILD 307.
[2] Measured according to method EOTA ETAG 006, and stated with safety factor used in Norway γ_m=1.3.
[3] Measured according to method EN 16002 and stated with safety factor used in Norway γ_m=1.3.

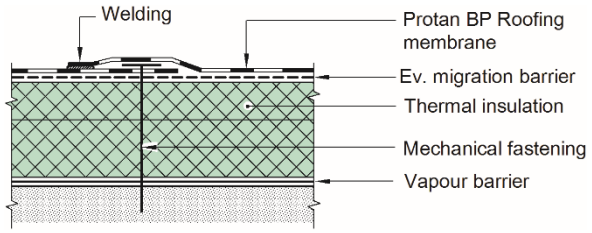

Fig. 2
Example for Protan BP or BPX roofing with mechanical fastening at the edge using the same principle as in SINTEF Techncial Approval no. 2010.

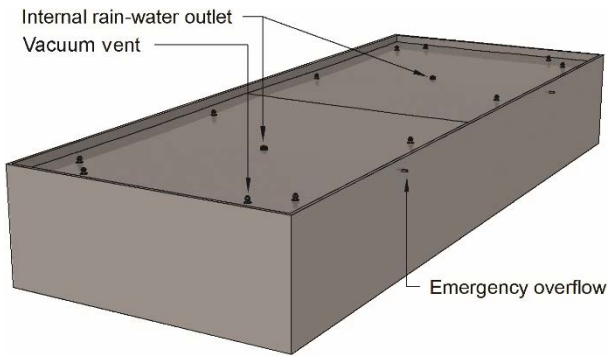

Fig. 3
Example of Protan BlueProof Roofing System installed as Vacuum Roofing System using the same principle as in SINTEF Technical Approval no. 2281.

The Protan BP-Extension is an elevation ring for the restrictor used to increase the roofs temporary water storage/retention capacity, if the dimensioning indicates that this is necessary.

The Protan BP LeafGrate is an additional grating, mounted on the outside of the outlet, to prevent natural contamination on the roof to block the BP-Restrictors. Protan BP LeafGrate is installed on all Protan BlueProof roofs.

Protan emergency overflows are overflows that are installed in the parapet. The lower edge of the emergency overflow is installed at the same height as the planned maximum water level.

5. Environmental aspects

Substances hazardous to health and environment

Protan BlueProof Roofing System contain no hazardous substances with priority in quantities that pose any increased risk for human health and environment. Chemicals with priority include CMR, PBT or vPvB substances.

Effect on soil, surface water and ground water

The leaching properties of Protan BlueProof Roofing System are evaluated to have no negative effects on soil or water.

Waste treatment/recycling

Protan BlueProof Roofing System shall be sorted as residual waste. The products shall be delivered to an authorized waste treatment plant for energy recycling.

Environmental declaration

An environmental declaration (EPD) has been worked out according to EN 15804 for Protan BlueProof. For complete documentation see EPD no. NEPD-1792-757-NO, www.epd-norge.no.

6. Special conditions for use and installation

Design considerations

In order to provide new buildings with good resilience it is recommended, on a general basis, that the building owner performs a risk evaluation regarding options for materials and solutions for the building.

The structural building design of the bearing constructions have to be performed by a responsible building engineer (RIB) according to EN 1990 *Eurocode*. When applying Protan BlueProof Roofing System for rehabilitation of roofs on existing buildings, load calculations and bearing capacity have to be verified by the responsible building engineer (RIB) as well.

The building design has to consider the relevant design situations with design values for loads and load combinations according to EN 1990 *Eurocode*. That includes, amongst other considerations, design snow load and actions due to heavy precipitation for the specific roof and the relevant combinations of such variable loads. For the action due to water, the load must be defined based on the water level when the water is running over the emergency overflow/ outlet. Consideration must be given to factors such as the slope of the roof, dimensional tolerances and deflection. In general, the characteristic value of a variable load has to correspond an upper value with 0.02 probability not to be exceeded (corresponding a return period of 50 years).

It is important to ensure that the internal rain-water outlets are positioned at locations where deflection is assumed to eventually occur, usually in the field zone of the roof.

For (high) buildings where swinging can occur, the effect of water on the roof must be taken into account for the design.

The calculation of the drainage from the roof including accessory products has to be done by Protan AS or an engineer authorized by Protan AS, by means of the calculation program BlueKalk. Protan BlueKalk calculates the rain-water retention, water height and accumulated water volume incl. mass per unit area on the roof, see fig. 4. The calculation takes into account the roof's design, slope and area, precipitation conditions and the specific maximum permitted flow rate from the building to the drainage system or another recipient.

The design must give full overview over all components included into the system.

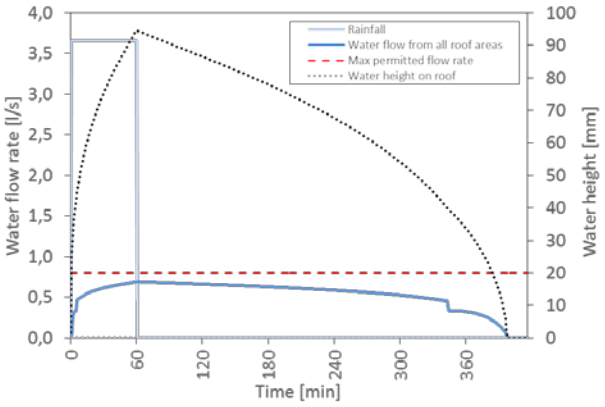

Fig. 4
Example for a BlueProof calculation for a given building and location.

Outlet and emergency overflow

The number of outlets and emergency overflows depends on the size of the roof and the requirements for rain-water retention. This is planned by Protan AS in each single case and provided to the responsible engineer for sanitation (RIV). Roofs smaller than 100 m^2 will have a limited retention effect, because the Restrictor would otherwise be too narrow. The suitability is verified by a calculation with Protan BlueKalk.

The number of primary outlets is calculated or chosen from the manufacturer's tables. To provide the best possible retention effect, the number of outlets must be limited. On roofs up to 200 - 300 m^2 typically one outlet with retention is installed plus minimum one emergency overflow in the parapet. After that the number of outlets is increased with increasing roof area.

Emergency overflow outlets shall have good capacity. It is recommended to use emergency overflows with a diameter of at least 75 mm.

On roofs with gutters it is recommended to install one emergency overflow at each end of the gutters.
In case of divided roof areas at least one emergency outlet has to be installed on each roof area. For a separate roof area with only one outlet, the emergency outlet must have minimum the same capacity as the outlet.

Termination of the roofing membrane must, where possible, be at least 150 mm higher than the overflow outlets.

Installation
The joints of the roofing membranes are welded by the use of hot air and the membranes shall be installed in accordance with the manufacturer's instructions. The roofing membrane shall generally be installed in accordance with the vendor's installation manual and the principles shown in SINTEF Building Research Design Guide no. 544.202 *Takfolie. Egenskaper og tekking*, 544.204 *Tekking med asfalttakbelegg eller takfolie. Detaljløsninger* and 544.206 *Mekanisk innfesting av asfalttakbelegg og takfolie på skrå og flate tak*, plus "TPF informerer nr. 5" published by Takprodusentenes Forskningsgruppe (TPF), see www.tpf-info.org.

Widths over 1 m should only be used at the field zone of the roof where the design peak of wind velocity pressure is less than 3.75 kN/m^2, with exception of vacuum roofing where rolls of 2 m must be places on the whole roof surface.

Quality assurance of installation
A Protan BlueProof Roofing System shall always be calculated and planned in detail by Protan AS. The roofing system must be installed by roofing contractors specially approved by Protan AS. Their roofers must have passed "Roofing school" (a certificate containing the relevant basic education in Protan's roofing handbook) and attended Protan BlueProof roofing training.

All roofs must be undertaken visual inspection done by a person especially appointed by Protan. During the inspection focus shall lie on good melt out along all welding joints on the roof area as well as around details and endings.

After completing the roof installation, a water flood / pressure test or another tightness test of the roof area has to be carried out.

Fasteners
Normal steel washers may be used in longitudinal overlapping joints on firm substrates such as wood-based roof sheathing or concrete.

On substrates of thermal insulation with compressive strength ≥ 80 kN/m2 (level CS(10)80 according to EN 13162/13163) steel washers with deep collars or plastic washers should be used.

Washers with integrated sleeves and good telescopic function must be used for installation on thermal insulation with lower compression strength, and the tightening of the fasteners must particularly be checked.

When using Protan BlueProof in combination with Protan Vacuum Roofing System the roofing membranes must be laid with airtight sealing at edges and penetrations. For more information see SINTEF Technical Approval No. 2281.

Substrate
When a fire classification is required the substrate must be in accordance with the provisions stated in clause 4 regarding *Properties related to fire*.

Substrates of combustible insulation as EPS or PIR must be covered or divided, and also replaced with non-combustible insulation around bushings and against adjacent constructions according to regulations in "Veiledning om tekniske krav til byggverk" § 11-9 and further description in SINTEF Building Research Design Guide no. 525.207 *Kompakte tak* and 520.339 *Bruk av brennbar isolasjon i bygninger* and "TPF informerer nr. 6 *Brannteknisk kostruksjoner for tak*" published by Takprodusentenes Forskningsgruppe (TPF), see www.tpf-info.org.

In connection with re-roofing, on old bituminous roofing membrane laid on insulation of EPS, the membrane in the old roofing must fulfil the requirements of class B_{ROOF} (t2) according to EN 13501-5 on EPS.

Traffic on the roof
Special precautionary measures should be taken to protect the roofing membrane if the roof is expected to have more traffic than is necessary for inspection and maintenance purposes only.

Cleaning and maintenance
For Protan BlueProof annual inspection is required to be in front of possible damages. All Protan BlueProof roofs require a maintenance agreement with the building owner. This will ensure qualified inspection and maintenance of the roof and its components up to two times a year during the roofs lifetime.

Before starting any welding, as a part of repair work, the roofing membrane must be cleaned locally, in accordance with the manufacturer's guidelines.

Storage
Protan BP and BPX roofing membranes shall be stored in a dry location at the building site, with the rolls placed on pallets protected by tarpaulins or similar.

7. Factory production control
Protan BP and BPX roofing membrane is produced by Protan AS, P.O. Box 420, NO-3002 Drammen, Norway.

The holder of the approval is responsible for the factory production control in order to ensure that the products are produced in accordance with the preconditions applying to this approval.

The manufacturing of Protan BlueProof Roofing System is subject to continuous surveillance of the factory production control in accordance with the contract regarding SINTEF Technical Approval.

Protan AS has a quality management system certified according to EN ISO 9001 and an environmental management system certified according to EN ISO 14001.

8. Basis for the approval
The evaluation of Protan BlueProof Roofing System is based on reports owned by the holder of the approval.

The evaluation of design and technical solutions are based on recommendations given in SINTEF Building Research Design Guides.

9. Marking

All rolls/pallets with roofing membrane are marked with product designation, production name, producer's product item number and production purchase order.

Accessory products Protan BP-Restrictor with Protan BP-Extention and Protan BP-LeafGrate are marked with article number.

Protan BP and BPX roofing membranes are CE marked in accordance with EN 13956.

The approval mark for SINTEF Technical Approval TG 20541 may also be used.

10. Liability

The holder/manufacturer has sole product responsibility according to existing law. Claims resulting from the use of the product cannot be brought against SINTEF beyond the provisions of Norwegian Standard NS 8402.

for SINTEF

Hans Boye Skogstad
Approval Manager