SINTEF

SINTEF Certification

Technical Approval

No. 20541

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Revised:
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Valid until: 01.10.2021
Provided listed on www.sintefcertification.no

SINTEF Building and Infrastructure 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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NO-3002 Drammen
www.protan.com

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 roofing 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 restricted, and designed not to exceed the specific maximum permitted discharge into the drainage system of the building. 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.

Roofing

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 can be used as roofing on different kinds of substrate, but needs a separate migration barrier of the quality 120 g/m^3 on polystyrene substrates.

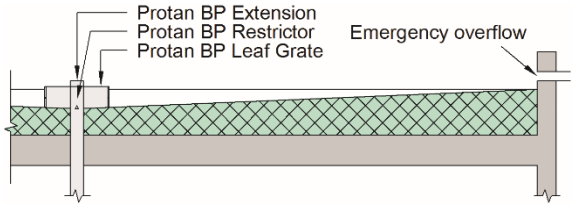

Fig. 1
Protan BlueProof roofing system. Principle drawing.

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 and to improve safety in case of fire. Welding of joints is carried out by using hot air. The roofing membranes have an embossed surface that provides an anti-slip texture.

Measures and tolerances are shown in Table 1. Other widths are available on request. The standard surface colour is dark grey.

Table 1
Dimensions and tolerances for Protan BP and BPX roofing membranes

Property	Protan BP	Protan BPX	Tolerance
Weight (kg/m²)	≥ 2.1	≥ 2.1+fleece	+10 %/-5 %
Width (m)	1.0 and 2.0	1.0 and 2.0	± 2 %
Roll length (m)	On request		+2/-0 %
Weight. Polyester core (g/m²)	100	100	-
Weight polyester fleece (g/m²)	-	180	-

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Table 2
Product properties for fresh material of Protan BP and BPX roofing membranes according to EN 13956

Property	Test method	DoP[1)]	Control limit [2)] BP og BPX	SINTEF's recommended minimum performance[3)]	Unit
Foldability at low temperature	NS-EN 495-5	≤ – 30	≤ – 30	≤ – 30	°C
Dimensional stability	NS-EN 1107-2	-	≥ - 0,5 and ≤ +0,5	≥ - 0,5 and ≤ +0,5	%
Water tightness (10 kPa)	NS-EN 1928	Pass	Pass	Pass	-
Resistance to tearing L/T	NS-EN 12310-2	≥ 450/300	≥ 450/300	≥ 180	N
Tensile strength L/T	NS-EN 12311-2	≥ 1800/1400	≥ 1800/1400	≥ 600	N/50 mm
Elongation	NS-EN 12311-2	≥ 15	≥ 15	≥ 10	%
Peel resistance of joints (T-peel) Average value Maximum value	 NS-EN 12316-2 NS-EN 12316-2	 ≥ 150 ≥ 300	 ≥ 150 ≥ 300	 ≥ 150 -	 N/50 mm N/50 mm
Shear resistance of joints	NS-EN 12317-2	≥ 1000	≥ 1000	≥ 600	N/50 mm
Resistance to puncture - by impact at +23˚C - by impact at +23˚C - by impact at -10˚C - by static loading	 NS-EN 12691:2006 (A) NS-EN 12691:2001 [4)] NS-EN 12691:2001 NS-EN 12730	 ≥ 600 ≥ 8 - ≥ 30	 ≥ 600 ≥ 8 ≤ 10 ≥ 30	 ≥ 400 - ≤ 15 ≥ 20	 mm mm/diam. mm/diam. kg
Water vapour resistance as equivalent air layer thickness; s_d – value	NS-EN ISO 12572		27	-	m

1) Declaration of performance (DoP)

2) The stated values are existing control limits for internal control at the producer and supervising control. If nothing else is mentioned, the control limits concern both directions of the product, where relevant.

3) SINTEFs recommended minimum performance in SINTEF Technical Approval for mechanically fastened roofing membrane for the use on ordinary roofs with slope 1:40 and without the additional function of rain-water retention.

4) Soft underlay, EPS.

3. Fields of application

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

Protan BP and BPX roofing membranes can be mechanically fastened as shown in fig. 2.

Protan BlueProof Roofing System can be used in combination with Protan Vacuum Roofing System, fig. 3.

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

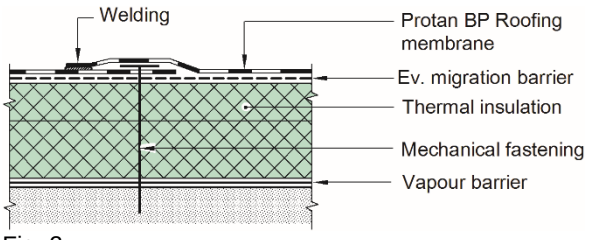

Fig. 2
Example for Protan BP or BPX roofing with mechanical fastening at the edge using the same principle as in SINTEF Techncial Approval no. 2010.

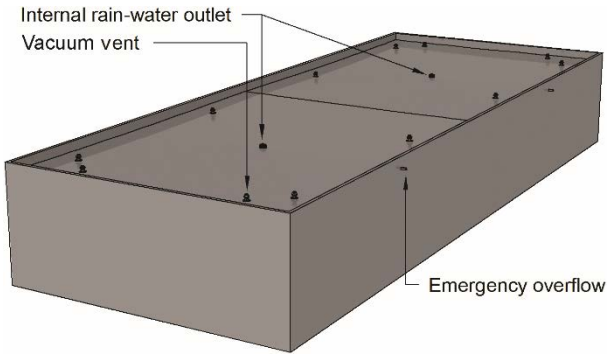

Fig. 3
Example of Protan BlueProof Roofing System installed as Vacuum Roofing System using the same principle as in SINTEF Technical Approval no. 2281.

4. Properties

Material properties
Product properties for fresh material are shown in Table 2.

Safety in case of fire
Protan BlueProof fulfils the requirements of fire resistance class B_{ROOF} (t2) according to EN 13501-5 on underlays shown in Table 3.

Table 3
Protan BP and Protan BPX roofing membrane achieve reaction-to-fire classification class B_{ROOF} (t2) on following underlays

New roofing on type of underlay	BP	BPX
EPS	No	No
EPS and ≥ 120 g/m² glass felt	Yes	No
PIR	Yes	No
Rock wool	Yes	No
Wooden sheeting	Yes	Yes
Concrete / silica plate	Yes	Yes
Reroofing on old roofing and underlay	BP	BPX
Old plastic/rubber coating on EPS	No	No
Old plastic/rubber coating on EPS / PIR / rock wool / wooden sheeting / concrete or silica plate **under the condition of a** ≥ 120 g/m² glass felt between new and old roofing membrane	Yes	No
Old roofing underlay of bitumen on EPS / PIR / rock wool / wooden sheeting / concrete or silica plate	No	Yes
Old roofing underlay of bitumen on EPS / PIR / rock wool / wooden sheeting / concrete or silica plate **under the condition of a** ≥ 140 g/m² polyester- or polypropylene felt between the new and the old roofing membrane	Yes	Yes

Durability

Properties after artificial ageing are given in Table 4. The products have shown satisfying properties after artificial ageing during type-testing and audit testing performed by SINTEF Building and Infrastructure.

Table 4
Product properties for aged material of Protan BP and Protan BPX roofing membrane

Property	Test method	Value	Unit
Foldability at low temperature after artificial ageing[1)]	EN 495-5 :2001	≤ -30	°C

1) Aged according to method NS-EN 1297 where exposure comprises UV-radiation, heat, sprayed-on water and laboratory climate

Calculation of fasteners

Load capacities for fastening the roofing membrane with various types of fasteners are shown in Table 5. The capacities relate to the fastening of the membrane itself. The strength of the fastening to a weak underlay may limit the overall capacity of the fixing points. The lowest value for membrane/foundation must always be used.

Calculation of fastener spacing is carried out according to SINTEF Building Research Design Guide 544.206 and "TPF Informs No. 5" published by Takprodusentenes Forskningsgruppe (TPF).

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

Table 5
Design capacities at ultimate limit state for mechanical fastenings when fastening Protan BP and BPX [1)]

Fastening system / fastener fastening at the edge	Capacity, N/fastener [2)]
SFS intec MW-40-F/R washer	650
SFS Iso-Tak R45/RP45 tube washer	700
SFS Iso-Tak R(P) 48–3N tube washer (with studs)	1000
Guardian SP 40-F washer	650
Guardian R(P) 45 tube washer	700
Guardian RB(P) 48 tube washer (with studs)	900

1) Other fastening systems than those given in Table 5 can be used provided that they have documented wind resistance with ETA or SINTEF Technical Approval together with Protan roofing.

2) The values given in Table 5 are for use in Norway with safety factor 1.3. For use in other countries their actual safety factors have to be used.

outlet with restrictor operate like an ordinary outlet. The discharge capacity of the restrictor(s) must be calculated for each roof. The restrictors will be delivered 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.

The Protan BP-Extension is a ring elevating the outlet used to increase the roofs temporary water storage/retention capacity.

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 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

The product contains 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 the product are evaluated to have no negative effects on soil or water.

Waste treatment/recycling

The product shall be sorted as residual waste. The product shall be delivered to an authorized waste treatment plant for energy recovery.

Environmental declaration

No environmental declaration (EPD) has been worked out for the product.

6. Special conditions for use and installation

Design considerations

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.

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 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 a 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.

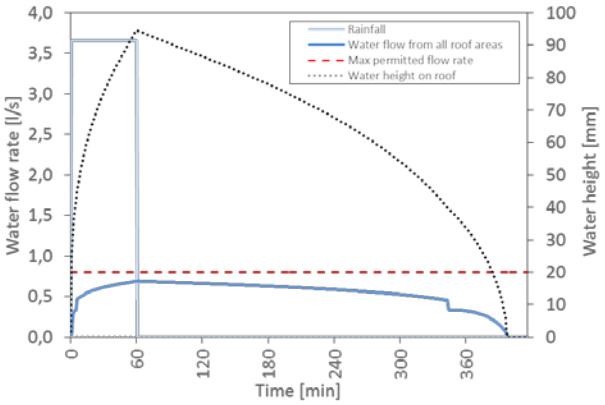

Fig. 4
Example for a BlueProof calculation for a given building and location.

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

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 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. Protan BP and BPX roofing membranes shall otherwise be used in accordance with the principles shown in SINTEF Building Research Design Guide 544.202, 544.204 and 544.206, as well as in "TPF Informs No. 5".

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 of the roof area has to be carried out, alternatively, verification using electronic leak testing.

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.

Fasteners

Ordinary steel washers may be used in longitudinal overlapping joints on firm underlays such as wood-based roof sheeting or concrete.

On underlay of insulation material with good compression strength like EPS with compression strength of ≥ 80 kPa (class CS (10) 80 according to EN 13162/13163), plastic fasteners with integrated sleeve are preferably used.

When roofing membranes are installed on insulation material with lower compression strength, the tightening of the fasteners must be controlled and fasteners with good telescopic action must be used.

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.

Underlay

When a fire classification is required the underlay must be in accordance with the provisions stated in section 4 "Safety in case of fire".

On underlays of combustible insulation as for instance EPX/XPS the combustible insulation must be replaced by non-combustible insulation at all penetrations, parapets and adjacent walls. For more information see VTEK § 13 or "TPF Informs No. 6" at www.tpf-info.org.

When reroofing on old bituminous roofing without additional insulation, Protan BP shall be used with a separate levelling layer, alternatively Protan BPX.

Repairs

In the case of repairs, the roofing must be cleaned locally before any welding work is undertaken.

Traffic on the roof

When roof traffic may be expected to exceed what is required for normal inspection visits and maintenance, special measures should be taken to protect the roofing membrane by establishing marked pathways.

Storage

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

7. Factory production control

The product 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 product is produced in accordance with the preconditions applying to this approval.

The 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 system certified by Det Norske Veritas according to ISO 9001:2000, Certificate No. 95-OSL-AQ-6343.

8. Basis for the approval

Hydraulic evaluation

Asplan Viak report "Hydraulisk vurdering av fordrøyning av overvann på tak", 01. July 2016 (rain water retention).

Product properties

SINTEF report 102013682-3, 21.06.2016.
Material properties and durability for the Protan SE product series have been verified by initial type testing and audit testing performed by SINTEF Building and Infrastructure during the years 1975-2016. Protan BP and BPX roofing membranes are versions of SE with strengthened core and beyond that the same recipe and production method.

Properties related to fire according to CEN/TS 1187 test 2.: SP-Fire Research test report 6P06167, 12.08.2016 and classification report 6P06167-1, 15.08.2016.
Resistance against spread of flames for the SE product series have been verified by type testing and audit testing performed on the different underlays during the years 1975-2012.

Design capacities in Table 5 are based on wind load resistance tests in accordance with the test methods NT Build 307 and NBI 162/90, supplemented by comparable results from simplified tests in accordance with NBI 163/91, plus on tests according to ETAG 006 and NS-EN 16002 for the Protan SE product series. Protan BP and BPX roofing membranes are versions of SE with strengthened core and beyond that the same recipe and production method.

SINTEF report 2018:00310, dated 2018.03.14 regarding flexibility at low temperature.

9. Marking

All pallets/packs with roofing membranes must be marked with product designation and date of production. The approval mark for SINTEF Technical Approval No. 20541 may also be used.

Approval mark

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 Building and Infrastructure

Hans Boye Skogstad
Approval Manager