SINTEF Technical Approval

TG 2010

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Provided listed on
www.sintefcertification.no

SINTEF confirms that

Protan SE, T, SE-L and EX roofing membranes

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
P.O. Box 420
NO 3002 DRAMMEN
www.protan.com

2. Product description

Protan SE, T, SE-L and EX are roofing membranes made of pliable PVC reinforced with a core of a polyester textile. Stabilizers have been added to make the roofing resistant to high and low temperatures, UV radiation and atmospheric contaminations, and to limit spread of flames. Welding is carried out by using hot air.

The membranes are manufactured with several surface colours. The bottom side is dark grey. The membranes with white surface colour are specially designed for solar panels and are marketed as Protan Cool Roof. Standard measures and tolerances are stated in table 1. Other lengths and widths can be supplied if required.

Protan SE-L has a lacquered surface.

Protan EX has a layer of polyester felt laminated to the bottom side.

3. Fields of application

Protan SE and *Protan SE-L* are primarily used as exposed, mechanically fastened roofing membranes on flat and sloping roofs, see fig. 1. The roofing membranes can be used on all types of substrates but need a separate migration barrier/levelling layer on substrates of polystyrene and for re-roofing applications.

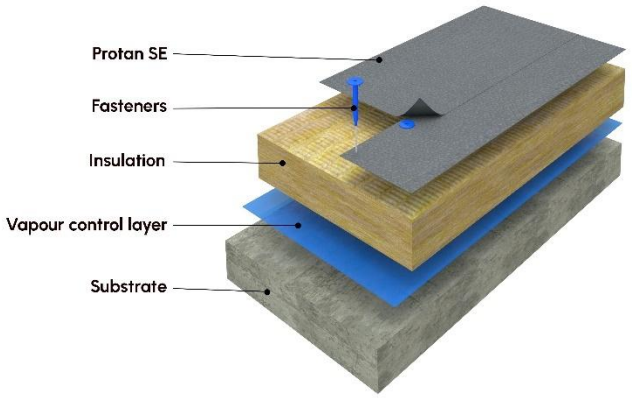


Fig.1
Protan SE mechanically fastened at the edge.
Figur: Protan AS

Protan SE 1,8 can be as roofing membrane in extensive, green roof applications, see fig. 2.

Protan SE-L has a lacquered surface which gives a beneficial aesthetic appearance on visible surfaces.

Protan T can be used as exposed, mechanically fastened membrane for terraces.

Table1
Measures and tolerances for Protan SE, T, SE-L and EX roofing membranes according EN 1848-2 and EN 1849-2

Property	Protan SE / Protan SE-L				Protan SE	Protan T	Protan EX				Unit	Tolerance
Thickness	1.2	1.6	1.8	2.0	2.4	2.0	1.2[1)]	1.6[1)]	1.8[1)]	2.0[1)]	mm	+10 % / -5 %
Area weight	1.4	1.8	2.1	2.4	2.9	2.4	1.4[1)]	1.8[1)]	2.1[1)]	2.4[1)]	kg/m²	+10 % / -5 %
Width	1.0 2.0	1.0 2.0	1.0 2.0	1.0 2.0	1.0 2.0	1.0 2.0	1.0 2.0	1.0 2.0	1.0 2.0	1.0 2.0	m	+1 % / -0.5 %
Length of roll	20	20	15	15	10	15	20	20	15	15	m	+5 % / -0 %
Weight of polyester reinforcement	80	80	80	80	80	80	80	80	80	80	g/m²	-
Weight of polyester felt	-	-	-	-	-	-	180	180	180	180	g/m²	-

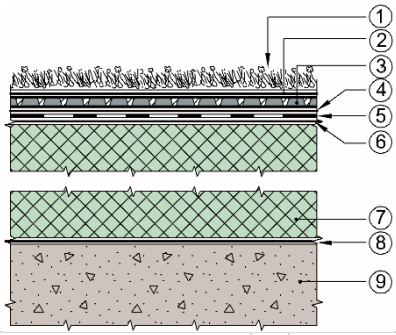
[1)] Measured without polyester felt

Table 2
Product properties for fresh material of Protan SE, T, SE-L and EX roofing membranes

Property	Protan	SE 1,2 SE-L 1,2		SE 1,6 SE-L 1,6		SE 1,8 SE-L 1,8		SE 2,0 SE-L 2,0		SE 2,4		SINTEF's recommended. minimum values[3]	Unit
	Test method EN	DoP[1]	Control-limit[2]	Control-limit[2]	Control-limit[2]	DoP[1]	Control-limit[2]	DoP[1]	Control-limit[2]	DoP[1]	Control-limit[2]		
Foldability at low temperature [4]	495-5	≤ -30	≤ -30	≤ -30	≤ -30	≤ -25	≤ -25	≤ -25	≤ -25	≤ -25	≤ -25	≤ -30 [4] ≤ -25 [4]	°C
Dimensional stability	1107-2	-	± 0.5	-	± 0.5	-	± 0.5	-	± 0.5	-	± 0.5	± 0.5	%
Water tightness 10 kPa/24 h	1928 (A)	Tight	Tight [5]	Tight	Tight [5]	Tight	Tight [5]	Tight	Tight [5]	Tight	Tight [5]	Tight	-
Tear resistance L/T	12310-2	≥ 210	≥ 210	≥ 210	≥ 210	≥ 210	≥ 210	≥ 210	≥ 210	≥ 210	≥ 210	≥ 180	N
Tensile strength L T	12311-2 (A)	≥ 1100 ≥ 1050	≥ 1100 ≥ 1050	≥ 1100 ≥ 1100	≥ 1100 ≥ 1100	≥ 1100 ≥ 1100	≥ 1100 ≥ 1100	≥ 1100 ≥ 1100	≥ 1100 ≥ 1100	≥ 1100 ≥ 1100	≥ 1100 ≥ 1100	≥ 600	N/50mm
Elongation at max. load L/T	12311-2 (A)	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 10	%
Peel resistance Average Maximum	12316-2	- ≥ 200 [8]	- [6] ≥ 200 [7]	- ≥ 200 [8]	- [6] ≥ 200 [7]	- ≥ 200 [8]	- [6] ≥ 200 [7]	- ≥ 200 [8]	- [6] ≥ 200 [7]	- - [8]	- [6] ≥ 200 [7]	≥ 150 ≥ 200	N/50mm
Shear resistance joints	12317-2	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 600	N/50mm
Resistance to punctere - Impact at +23°C - Impact at -10°C - Static load - Static load	 12691 (A) 12691 12730 (A) 12730 (C)	 ≥ 400 - - ≥ 20	 ≥ 400 ≤ 10 [5] ≥ 20 -	 ≥ 600 - - ≥ 20	 ≥600 ≤ 10 [5] ≥ 20 -	 ≥ 700 - - ≥ 20	 ≥ 700 ≤ 10 [5] ≥ 20 -	 ≥ 800 - - ≥ 20	 ≥ 800 ≤ 10 [5] ≥ 20 -	 ≥ 900 - - ≥ 20	 ≥ 900 ≤ 10 [5] ≥ 20 -	 ≥ 400 ≤ 15 ≥ 20 -	 mm mm diam. kg kg
Root resistance	FLL	-	-	Passed	Passed [5]	-	Passed [5]	-	Passed [5]	-	Passed [5]	-	-
Property	Protan	T		EX 1,2		EX 1,6		EX 1,8		EX 2,0		SINTEF's recommended minimum values[3]	Unit
	Test method EN	DoP[1]	Control-limit[2]	DoP[1]	Control-limit[2]	DoP[1]	Control-limit[2]	DoP[1]	Control-limit[2]	DoP[1]	Control-limit[2]		
Foldability at low temperature [4]	495-5	≤ -25	≤ -25	≤ -30	≤ -30	≤ -30	≤ -30	≤ -25	≤ -25	≤ -25	≤ -25	≤ -30 [4] ≤ -25 [4]	°C
Dimensional stability	1107-2	-	± 0.5	-	± 0.5	-	± 0.5	-	± 0.5	-	± 0.5	± 0.5	%
Water tightness 10 kPa/24 h	1928 (A)	Pass	Tight [5]	Pass	Tight [5]	Pass	Tight [5]	Pass	Tight [5]	Pass	Tight [5]	Tight	-
Tear resistance L/T	12310-2	≥ 210	≥ 210	≥ 300	≥ 300	≥ 300	≥ 300	≥ 300	≥ 300	≥ 300	≥ 300	≥ 180	N
Tensile strength L/T	12311-2 (A)	≥ 1100	≥ 1100	≥ 1100	≥ 1100	≥ 1100	≥ 1100	≥ 1100	≥ 1100	≥ 1100	≥ 1100	≥ 600	N/50mm
Elongation at max. load L/T	12311-2 (A)	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 10	%
Peel resistance Average Maximum	12316-2	- ≥ 200 [8]	- [6] ≥ 200 [7]	- ≥ 200 [8]	- [6] ≥ 200 [7]	- ≥ 200 [8]	- [6] ≥ 200 [7]	- ≥ 200 [8]	- [6] ≥ 200 [7]	- ≥ 200 [8]	- [6] ≥ 200 [7]	≥ 150 ≥ 200	N/50mm
Shear resistance joints	12317-2	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 600	N/50mm
Resistance to punctere - Impact at +23°C - Impact at -10°C - Static load - Static load	 12691 (A) 12691:2001 12730 (A) 12730 (C)	 ≥ 800 - - ≥ 20	 ≥ 800 ≤ 10 [5] ≥ 20 -	 ≥ 400 - - ≥ 20	 ≥ 400 ≤ 10 [5] ≥ 20 -	 ≥ 600 - - ≥ 20	 ≥ 600 ≤ 10 [5] ≥ 20 -	 ≥ 700 - - ≥ 20	 ≥ 700 ≤ 10 [5] ≥ 20 -	 ≥ 800 - - ≥ 20	 ≥ 800 ≤ 10 [5] ≥ 20 -	 ≥ 400 ≤ 15 ≥ 20 -	 mm mm diam. kg kg
Root resistance	FLL	-	Passed [5]	-	-	-	Passed [5]	-	Passed [5]	-	Passed [5]	-	-

[1] The manufacturers Declaration of performance, DoP
[2] Control limit shows the value the product must satisfy during internal factory production control and audit testing.
[3] SINTEFs recommended minimum values for SINTEF Technical Approval for mechanically fastened membranes
[4] Minimum performance for thickness 1.2 mm is -30 °C / Minimum performance for thickness ≥1.5 mm is -25 °C
[5] Result from type testing
[6] For failure mode A the average peel resistance must be assessed towards SINTEF's recommended minimum value for average peel resistance
[7] The control limit applies for failure mode B and C
[8] Requirement for failure mode C

L = Longitudinal T = Transversal



1	Sedum vegetation	6	Optional migration layer if insulation of EPS/XPS
2	Optional filtering layer of geotextile	7	Insulation
3	Drainage layer	8	Vapour barrier
4	Optional protection layer / felt	9	Structural deck
5	Protan SE 1,8, mechanically fastened		

Fig. 2
Protan SE 1,8 (mechanically fastened) used in extensive green roof

Protan EX has a felt laminated to the bottom side and can be laid directly on old bituminous roofing. The membrane can also be used under turf roofing. An additional loose felt must be used on liquid applied bituminous roofing.

Roofs must have adequate slope to drain water from rain and melted snow. SINTEF recommends in general a minimum slope of 1:40 for all roofs.

4. Properties

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

Properties related to fire
Protan SE, T, SE-L and EX fulfil the requirements of fire class B_{ROOF} (t2) according to EN 13501-5 regarding external fire performance on substrates shown in table 3 and 4. Testing is performed according to CEN/TS 1187, test 2.

For more information regarding fire property requirements for the roofing, see TPF Informerer no. 6 *Branntekniske løsninger for kompakte tak og terrasser* published by Takprodusentenes Forskningsgruppe (TPF), see www.tpf-info.org.

Durability
The products have shown satisfying properties after artificial ageing in connection with type-testing and audit testing performed by SINTEF.

Fastening capacity
The design capacity for the fastening of the membranes with different fasteners and premises is given in table 5 - 7. The capacity applies to the connection between the membrane and the fasteners.

Table 3
Protan SE, SE-L and T has fire classification B_{ROOF} (t2) on following substrates

Type of substrate	Protan SE / SE-L [1.2 mm]	Protan SE / SE-L / T [1.6-2.4 mm]
EPS [1) 2)]	No	No
EPS [1)] + min. 120 g/m² glass felt [2)]	No	Yes
PIR [2) 3)]	Yes	Yes
Mineral wool [1)]	Yes	Yes
Wood particle board [1)]	Yes	Yes
Concrete / calcium silicate plate [1)]	Yes	Yes
Old roofing membrane on EPS [2) 4)]	No	No
Old roofing membrane on EPS [1)] + min. 120 g/m² glass felt [2)]	No	Yes
Old roofing membrane on PIR [2) 3)]	Yes	Yes
Old roofing membrane on mineral wool	Yes	Yes
Old roofing membrane on wood particle board	Yes	Yes
Old roofing membrane on concrete / calcium silicate plates	Yes	Yes

1) Standard substrate according to CEN/TS 1187, test 2.
2) In case of roofing on 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 passages and against adjacent structures.
3) Fire classification on PIR applies only to the tested PIR product "PIR Kingspan Therma TR26".
4) See clause 6 *Special conditions for use and installation*, section *Substrate*, regarding requirements for the old roofing membrane.

Table 4
Protan EX has fire classification B_{ROOF} (t2) on following substrates

Type of substrate	Protan EX
EPS [1)]	No
Mineral wool [1)]	Yes
Wood particle board [1)]	Yes
Concrete / calcium silicate plate [1)]	Yes
Old roofing membrane on EPS [2) 3)]	Yes
Old roofing membrane on mineral wool	Yes
Old roofing membrane on wood particle board	Yes
Old roofing membrane on concrete / calcium silicate plates	Yes

1) Standard substrate according to CEN/TS 1187, test 2.
2) In case of roofing on 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 passages and against adjacent structures.
3) See clause 6 *Special conditions for use and installation*, section *Substrate*, regarding requirements for the old roofing membrane.

Table 5
Design capacity at ultimate limit state for the attachment of Protan SE 1,2 with different fastening systems

Fastener/Fastening system	Design capacity N / fastener
Guardian SPA-40-F2B steel washer and S-Point, Ph-2 Kop screw Tested on firm substrate, attachment in 18 mm plywood board Distance between fasteners: C/C 250 mm Width of overlap and weld not specified in report	849 [1]
Guardian R-45 plastic washer and BS 4.8 screw Tested on soft substrate, attachment in 0.75 mm steel plate, f_y = 320 N/mm^2 Distance between fasteners: C/C 320 mm Fastening in 130 mm overlaps with 40 mm weld	684 [2]
Guardian R48 plastic washer and BS 4.8 screw Tested on soft substrate, attachment in 0.75 mm steel plate, f_y = 320 N/mm^2 Distance between fasteners: C/C 320 mm Fastening in 130 mm overlaps with 40 mm weld	684 [2]
Guardian RB-48 plastic washer and BS 4.8 screw Tested on soft substrate, attachment in 0.75 mm steel plate, f_y = 320 N/mm^2 Distance between fasteners: C/C 320 mm Fastening in 130 mm overlaps with 40 mm weld	912 [2]
EJOT Eco-Tek T 50 plastic washer and TKR-4.8 screw Tested on soft substrate, attachment in 0.75 mm steel plate, f_y = 320 N/mm^2 Distance between fasteners: C/C 320 mm Fastening in 130 mm overlaps with 40 mm weld	627 [1]

[1] Measured according to method EOTA ETAG 006 and the safety factor γ_m=1.5.
[2] Measured according to method EN 16002 and the safety factor used in Norway γ_m=1.5.

Table 6
Design capacity at ultimate limit state for the attachment of Protan SE 1,6

Fastener/Fastening system	Design capacity N / fastener
EJOT Eco-Tek T 50 plastic washer and TKR-4.8 screw Tested on soft substrate, attachment in 0.75 mm steel plate, f_y = 320 N/mm^2 Distance between fasteners: C/C 320 mm Fastening in 130 mm overlaps with 40 mm weld	798 [1]

[1] Measured according to method EN 16002 and the safety factor used in Norway γ_m=1.5.

For weak substrates the connection between the substrate and the fastener might limit the capacity. This must be considered.

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 *Innfesting av fleksible takbelegg, dimensjonering og utførelse*" published by Takprodusentenes Forskningsgruppe (TPF), see www.tpf-info.org. It is not possible to assume increased wind load capacity by decreasing the distance between the fasteners; due to uncertainty in the type of failure, ref. EAD 030351-00-0402 Annex 1. The lowest capacity for attachment in the membrane / substrate must always be used for the calculation.

5. Environmental aspects

Substances hazardous to health and environment
The products 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 the products are evaluated to have no negative effects on soil or water.
Waste treatment/recycling
The products shall be sorted 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 SE and Protan EX*. For complete documentation see www.epd-norge.no / www.ibu-epd.com, EPD no:

- NEPD-2036-909-NO, Protan SE 1,2
- NEPD-1920-845-NO, Protan SE 1,6
- NEPD-2051-921-NO, Protan EX 1,6

6. Special conditions for use and installation

Installation
The joints are welded with hot air. TPF Informerer no. 6 *Branntekniske løsninger for kompakte tak og terrasser* describes which roofing methods can be used on various roof structures. When roofing with hot air or open flame, all combustible insulation must in principle be protected with non-combustible insulation. However, TPF Informerer no. 6 describes exceptions for hot air welding of roofing membranes with fire class B_{ROOF} (t2).

The membranes shall be installed in accordance with the manufacturer's installation manual and the principles shown in SINTEF Building Research Design Guide no.:

- 525.207 *Kompakte tak*
- *544.202 Takfolie. Egenskaper og tekking*
- *544.204 Tekking med asfalttakbelegg eller takfolie. Detaljløsninger*
- *544.206 Mekanisk feste av asfalttakbelegg og takfolie på flate tak*

plus information sheets issued by Takprodusentenes Forskningsgruppe (TPF), see www.tpf-info.org:

- TPF informerer nr. 5 *Innfesting av fleksible takbelegg, dimensjonering og utførelse*
- TPF informerer nr. 6 *Branntekniske løsninger for kompakte tak og terrasser*
- TPF informerer *nr. 13 Tak under oppføring – forholdsregler og tiltak ved bruk*

There are special requirements and restrictions when using the product under "green roofs", see TPF informerer nr. 10 *Bygningsmessige aspekter ved prosjektering og bygging av grønne tak*.

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.

Membrane widths above 1 m must only be used on the mid field of the roof surface and where the design wind gust pressure is less than 3.75 kN/m²; with the exception of vacuum roofs where a membrane width of 2 m is laid on the entire roof surface. When using widths above 1 m, the number and spacing of fasteners must be designed accurately.

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, such as EPS, must be covered or divided into areas, and replaced with non-combustible insulation around bushings and adjacent constructions, such as parapets and walls, according to pre-accepted performances given in the guidance to *Forskrift om tekniske krav til byggverk § 11-9* and in TPF informerer nr. 6 *Branntekniske løsninger for kompakte tak og terrasser*.

When 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. When the membrane is installed on old bituminous roofing without additional insulation, Protan SE with a separation layer or Protan EX shall be used.

When the membranes are installed on old bituminous roofing membrane, on old and rigid PVC roofing or directly on EPS or XPS insulation, a separate migration barrier/separation layer shall be used in accordance with the manufacturer's installation manual. See SINTEF Building Research Design Guide no. 544.202 *Takfolie. Egenskaper og tekking*. for additional requirements for migration barriers and protective layers.

Protan EX is recommended for installation on wood-based roof sheathing.

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

Transport and storage
Protan roofing membranes must be transported in a manner that does not damage the product and be stored in a dry location, placed on pallets and protected at the building site.

7. Factory production control

The membranes are produced by Protan AS, Baches vei 1, 3413 Lier, Norway.

The holder of the approval is responsible for maintaining the factory production control to ensure that "the product" is manufactured in compliance with the preconditions upon which this approval is based.

The manufacturing of the products and the manufacturer's system for factory production control (FPC) is subject to continuous surveillance 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 ISO14001.

8. Basis for the approval

The product's characteristics are documented in reports issued by independent bodies. The technical documentation serves as the basis for SINTEF's product assessment with respect to the product standard EN 13956, the guidelines for SINTEF Technical Approval, and recommendations as outlined in SINTEF Building Research Design Guides.

9. Marking

All pallets/ packages/rolls shall be marked with the manufacturers name, product name and production number. All rolls are also marked with week number and year.

The roofing membranes are CE marked in accordance with EN 13956.

The approval mark for SINTEF Technical Approval TG 2010 may also be used.

10. Liability

The holder/manufacturer has sole product liability according to current law. Claims can only be made against SINTEF under general law or other special grounds.

for SINTEF

Ola Asphaug

Ola Asphaug
Approval Manager