Technical Approval

SINTEF Building and Infrastructure confirms that

Protan SE, T, SE Titanium, SE Titanium+, EX and EXG roofing membranes

meets the provisions regarding product documentation given in Norwegian building regulations, with properties, fields of application and conditions as stated in this document

1. Holder of the approval

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2. Manufacturer

Protan AS, Drammen.

3. Product description

Protan SE, group of membranes are roofing membranes made of pliable PVC with a core of woven polyester. Stabilizers have been added to make the roofing resistant to high and low temperatures, ultra violet radiation, and to limit spread of flames. Welding is carried out by using hot air.

Protan SE, T[1], SE Titanium, SE Titanium+, EX and EXG are available in several thicknesses, and with specifications as shown in Table 1. Protan EX has a layer of polyester felt, and Protan EXG a layer of glass felt, fixed to the underside. Protan SE Titanium has a lacquered surface and Protan SE Titanium+ is also added chemicals to reduce microbes in a larger degree.

Standard widths are 1 m and 2 m. Standard length is 20 m per roll. Other dimensions are available on request.

The membranes are manufactured with several surface colours. The underside is dark grey.

4. Field of application

Protan SE, SE Titanium, SE Titanium+, EX and EXG are primary used as exposed, mechanically fastened roofing membranes on flat and sloping roofs, see Fig. 1.
Protan SE can be used as roofing on all types of underlay, but needs a separate migration barrier/levelling layer on polystyrene underlay and for re-roofing applications.

Protan SE Titanium can be used under same conditions as Protan SE. It has a lacquered surface which gives an extra benefit on visible surfaces where the aesthetical appearance is important. White Protan SE Titanium is marketed under the name Protan Cool Roof.

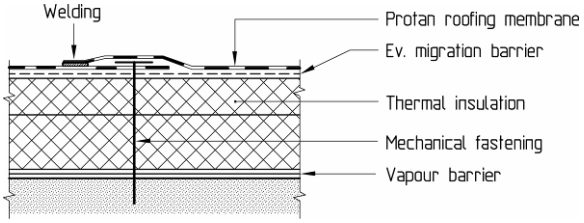

Fig. 1
Protan SE, EX and EXG roofing, mechanically fastened at the edge

Protan EX has a laminated felt, and can be laid directly on old roofing underlay of bitumen. The membrane can also be used under turf roofing. An additional loose felt must be used on liquid applied asphalt roofing.

Protan EXG is laminated with glass felt and can be laid directly on polystyrene.

Protan SE Titanium+ can be used under same conditions as Protan SE, but the main purpose is to be a roofing membrane in an extensive green roof application, fig. 2.

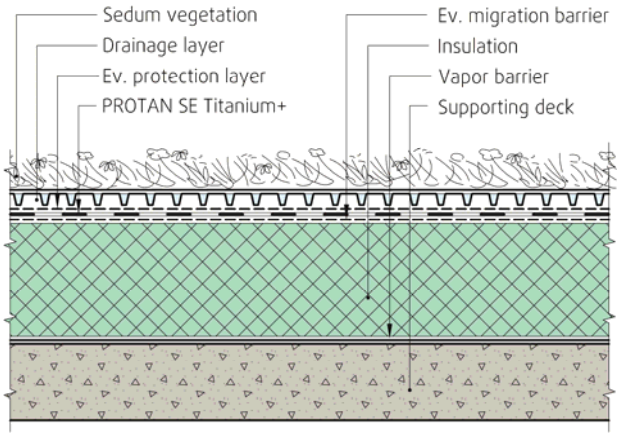

Fig. 2
Protan SE Titanium+ composed for extensive green roofs

Roofs must have adequate slope to drain water from rain and melting snow. SINTEF Building and Infrastructure recommends that all roofs have an inclination of minimum 1:40.

[1] Protan T is delivered with tichkness of only 2.0 mm

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5. Properties

Material properties

Product properties for fresh material are shown in Table 2.

Properties related to fire

Protan SE, T, SE Titanium and SE Titanium+ fulfils the requirements of class B_{ROOF} (t1) and (t2) according to EN 13501-5 for all underlay except EPS/XPS-insulation. When using a migration barrier of at least 120 g/m² glass felt, Protan SE, SE Titanium and SE Titanium+ fulfils class B_{ROOF} (t1) and (t2) also on EPS/XPS-insulation.

Protan EX satisfies the requirements of class B_{ROOF} (t2) and (t1) in accordance with EN 13501-5 on underlay of old roofing membranes.

Protan EXG fulfils class B_{ROOF} (t2) and (t1) according to EN 13501-5 for all underlay. The testing is carried out in accordance with ENV 1187-2 and ENV 1187-1.

Table 1
Measures and tolerances for Protan SE, T[1)], SE Titanium[*)], SE Titanium+[**)], EX and EXG roofing membranes

Property	Protan SE, SE Titanium[*)], SE Titanium+[**)]					Protan EXG		Protan EX		
Thickness (mm)	1.2 +0.2/-0.1	1.6 +0.2/-0.15	1.8 +0.2/-0.15	2.0 +0.2/-0.15	2.4 +0.2/-0.15	1.2 + felt +0.2/-0.10	1.6 + felt +0.2/-0.15	1.2 + felt +0.2/-0.1	1.6 + felt +0.2/-0.15	1.8 + felt +0.2/-0.15
Weight (kg/m²)	1.4 +0.2/-0.1	1.8 +0.2/-0.1	2.1 +0.2/-0.1	2.4 +0.2/-0.1	2.9 +0.2/-0.1	1.4+ felt +0.2/-0.1	1.8+ felt +0.2/-0.1	1.4 + felt +0.2/-0.1	1.8 + felt +0.2/-0.1	2.1 + felt +0.2/-0.1
Width	1 m / 2 m ± 2 %	1 m / 2 m ± 2 %	1 m / 2 m ± 2 %	1 m / 2 m ± 2 %	1 m / 2 m ± 2 %	1 m / 2 m ± 2 %	1 m / 2 m ± 2 %	1 m / 2 m ± 2 %	1 m / 2 m ± 2 %	1 m / 2 m ± 2 %
Roll length	20 m +2/-0 %	20 m +2/-0 %	20 m +2/-0 %	20 m +2/-0 %	20 m +2/-0 %	20 m +2/-0 %	20 m +2/-0 %	20 m +2/-0 %	20 m +2/-0 %	20 m +2/-0 %
Weight. Polyester core (impr.)	80 g/m²	80 g/m²	80 g/m²	80 g/m²	80 g/m²	80 g/m²	80 g/m²	80 g/m²	80 g/m²	80 g/m²
Weight. Polyester felt	-	-	-	-	-	-	-	180 g/m²	180 g/m²	180 g/m²
Weight. Glass felt	-	-	-	-	-	55 g/m²	55 g/m²	-	-	-

*) White Protan SE Titanium is marketed under the name Protan Cool Roof
**) Protan SE Titanium+ exists only with thickness of 1.6 mm
1) Protan T are only delivered in thickness of t = 2.0 +0.2/-0.1

Table 2
Product properties for fresh material of Protan SE, SE Titanium, SE Titanium+[*)], EX and EXG roofing membranes

Property	Test method EN	Control limit[1)]										Unit
		Protan SE, T[1)], SE Titanium[*)], SE Titanium+[**)]					Protan EXG		Protan EX			
		1.2 mm	1.6 mm	1.8 mm	2.0 mm	2.4 mm	1.2 mm w/felt	1.6 mm w/felt	1.2 mm w/felt	1.6 mm w/felt	1.8 mm w/felt	
Foldability at low temperature	495-5:2001	≤ -30	≤ -25	≤ -25	≤ -25	≤ -25	≤ -30	≤ -25	≤ -30	≤ -25	≤ -25	°C
Dimensional stability L/T	1107-2:2001	± 0.5	± 0.5	± 0.5	± 0.5	± 0.5	± 0.5	± 0.5	± 0.5	± 0.5	± 0.5	%
Water tightness (10 kPa)	1928:2000 (A)	Tight	Tight	Tight	Tight	Tight	Tight	Tight	Tight	Tight	Tight	-
Tear resistance L/T	12310-2:2000	≥ 210	≥ 210	≥ 210	≥ 210	≥ 210	≥ 210	≥ 210	≥ 300	≥ 300	≥ 300	N
Tensile strength L/T	12311-2:2000 (A)	≥ 1050	≥ 1050	≥ 1050	≥ 1050	≥ 1050	≥ 1050	≥ 1050	≥ 1100	≥ 1100	≥ 1100	N/50 mm
Elongation L/T	12311-2:2000 (A)	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	≥ 15	%
Average peel resistance of joints	12316-2:2000	≥ 150	≥ 150	≥ 150	≥ 150	≥ 150	≥ 150	≥ 150	≥ 150	≥ 150	≥ 150	N/50 mm
Shear resistance of joints	12317-2:2000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥ 1000	≥1000	≥ 1000	N/50 mm
Resistance to puncture												
- by impact at +23°C	12691:2006 (A)	≥ 500	≥ 700	≥ 800	≥ 800	≥ 900	≥ 500	≥ 600	≥ 500	≥ 700	≥ 800	mm
- by impact at -10°C	12691:2001	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 10	≤ 10	≤ 8	≤ 8	≤ 8	mm diam
- by static loading	12730:2001(A)	≥ 20	≥ 20	≥ 20	≥ 20	≥ 20	≥ 20	≥ 20	≥ 20	≥ 20	≥ 20	kg
Water vapour resistance as equivalent air layer thickness	ISO 12572:2001	16	22	24.5	27	32	16	22	16	22	24.5	m

1) The stated values are existing control limits for internal control at the producer and supervising control
*) White Protan SE Titanium is marketed under the name Protan Cool Roof
**) Protan SE Titanium+ exists only with thickness of 1.6 mm

Table 3
Product properties for aged material of Protan SE, EX and EXG roofing membranes

Property	Test method EN	Measured value								Unit
		Protan SE			Protan EXG		Protan EX			
		1.2	1.6	1.8	1.2	1.6	1.2	1.6	1.8	mm
Foldability at low temperature - Artificial ageing [1)]	495-5:2001	≤ -25	≤ -25		≤ -25		≤ -25			°C

1) Aged according to method NS-EN 1297 with specimen exposed to UV light, heat radiation, water and laboratory climate

Durability
Some properties after artificial ageing are given in Table 3. The products have shown satisfying properties after artificial ageing in connection with type-testing and audit testing performed by SINTEF Building and Infrastructure.

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 hold to 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 Sheet 544.206 and "TPF Informs No. 5" published by Takprodusentenes Forskningsgruppe.

6. Environmental aspects

Environmental declaration
Specific environmental declaration according to ISO 21930 has been worked out for Protan SE. Environmental indicators are given in Table 4. For complete documentation see environmental declaration document NEPD No. 0032 on http://www.epd-norge.no/ (see "EPD-register"). No environmental declarations have been worked out for the other membranes.

Table 4
Environmental declaration for Protan SE 1.2 mm

Environmental indicators	
Global warming	5.7 kg CO_2 ekv.
Energy use	28.6 kWh
Recycled materials	0 %
Indoor air classification (Classification according to EN 15251:2007)	Not relevant

Substances hazardous to health and environment
The products contain no hazardous substances with priority in quantities that pose any 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, ground water or drinking water.

Waste treatment/recycling
The products shall be sorted as mixed waste on the building/demolition site. The materials in Protan SE, SE Titanium, SE Titanium+, EX and EXG can be recycled, and a system for recycling has been established. The products shall be delivered to an authorized waste treatment plant for energy recovery.

7. Special conditions for use and installation

Storage
Protan roofing membranes should be stored in a dry place, with the rolls placed on pallets at the building site and protected by a covering.

Installation
The joints of Protan SE, EX and EXG are welded by the use of hot air, and the membranes shall be installed in accordance with the manufacturer's instructions. The products shall otherwise be used in accordance with the principles shown in SINTEF Building Research Design Sheet 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 velocity pressure is less than 3.75 kN/m² with exception of vacuum roofing where rolls of 2 m widths must be placed on the whole roof surface.

Table 5
Design capacities at ultimate limit state for mechanical fasteners in Protan SE, SE Titanium, SE Titanium+, EX and EXG [2)]

Fastening system/Fastener	Capacity, N per fastener [1)]
Placed at lane edge, Protan SE, SE Titanium, **SE Titanium+, EXG**	
Roofing nail 2,8–25	100
Staples (2 x 20 mm)	130
Eurofast TLK Ø45 fastener	620
SFS intec MW-40-F washer	650
SFS intec MW-40-R washer	650
Guardian SP 40-F washer	650
SFS IR-82x40 washer	650
Guardian SPA 8240-D washer	700
SFS Iso-Tak R45/RP45 fastener	700
Guardian R(P) 45 fastener	700
SFS Iso-Tak LB45 light weight concrete plug	700
Koelner GOK-Plus fastener with studs	720
Ecotek50 IH-P fastener with studs	720
Milletech Quatro-T fastener with studs	750
Guardian CBF/CP concrete plug	800
SFS IG8-C 82x40 washer	900
Guardian RB(P) 48 fastener with studs	900
Guardian SPBA 8240 washer	1000
SFS Iso-Tak R(P) 48–3N fastener with studs	1000
SFS Iso-Tak TPS/TPP fastener with studs	1100
Placed at the edge, Protan EX	
SFS Iso-Tak R45/RP45 fastener	725
SFS intec MW-40-F/ MW-40-R washer	900
Iso-Tak TPP fastener with studs	1100
Placed in roll flip X-335	
SFS Iso-Tak R45/RP45 fastener	950
SFS Iso-Tak TPP fastener with studs	1100
Pull through resistance	
SFS Iso-Tak R45/RP45 fastener	1000
SFS intec MW-40-F/ MW-40-R washer	1100

1) The values given in table 5 are for use i Norway with safety factor 1.3. For use in other countries their actual safety factor have to be used.
2) Other fasteners than those given in table 5 can be used if they are documented with ETA or SINTEF Technical Approval.

Fasteners
Fastening with normal steel washers can be used in longitudinal overlap joints on stiff underlay, i.e. on wood-based roof sheathing or on concrete.

On underlay of insulation material with good compression strength like EPS with compression strength of ≥ 80 kPa (class CS (10) 80 according to NS-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.

On rolls with 2 m widths, fasteners of ≥ 900 N/fastener capacities shall always be used.

Underlay
When a fire classification is required the underlay must be in accordance with the provisions stated in section 5 "Safety in case of fire".

Protan EXG or a separate migration barrier must be used when the roofing is installed directly on old, aged PVC, or on EPS or XPS insulation.
When the membrane is installed on old asphalt roofing without additional insulation, Protan SE with a separate barrier or Protan EX shall be used.

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

Inspections and maintenance
The roofing membranes must be cleaned locally before starting any welding of joints as a part of repair work.

Roof traffic
When it should be expected that roof traffic may exceed what is required for normal inspection visits and maintenance, special measures should be taken to protect the roofing membrane.

8. Factory production control

Protan SE, SE Titanium, SE Titanium+, EX and EXG are subject to supervisory factory production control and product control according to con-tract between SINTEF Building and Infrastructure and Protan AS concerning SINTEF Technical Approval.

The manufacturer Protan AS has a quality system which is certified by Det Norske Veritas according to ISO 9001:2000, certificate no. 95-OSL-AQ-6343.

9. Basis for the approval

Material- and design data have been verified by type testing and audit testing is performed by SINTEF Building and Infrastructure during the years 1975–2012.

Resistance against spread of flames have been verified by type testing and audit testing performed during the years 1975–2012.
The data in Table 5 is based on system 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.

The durability of Protan PVC roofing membranes against humus attacks from roots in the turf roofing has been verified according to DIN 16734 par. 5.16, see report 31224/96 and 33354/97 from Süddeutsches Kunststoff-Zentrum, and in accordance with FLL-Verfahren (1999), see report dated 12.10.1999 from Institut für Bodenkunde und Pflanzenernährung.

10. Marking

All rolls/packages shall be marked with the manufacturer's product code, product name and date of production. The approval mark for SINTEF Technical Approval No. 2010 may also be used.

Approval marrk

11. 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.

12. Technical management

Project manager for this approval is Knut Noreng,
SINTEF Building and Infrastructure, Trondheim.

for SINTEF Building and Infrastructure

Tore H. Erichsen
Approval manager