

SINTEF Building and Infrastructure confirms that

Protan Vacuum Roofing System

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

Protan A/S
 Postboks 420
 NO-3002 DRAMMEN
 Norway
 Tel.: +47 32 22 16 00 Fax: +47 32 22 17 00

2. Manufacturer

The roofing membrane is produced by Protan A/S, Drammen.
 Fixing bars and vents are supplied by authorized subcontractors to Protan's specifications.

3. Product description

General

Protan vacuum roofing system consists of Protan roofing membrane in combination with fixing bars, airtight seal and vacuum vents. The roofing system is based on the principle of anchoring the membrane by creating negative pressure in the layer between the membrane and the substrate when subjected to wind loading. The negative pressure causes the membrane to be held down against the substrate, and load transfer is achieved downwards to the supporting structures. The substrate may for example be an old bitumen membrane. The assumption to have a working roof system, a good airtightness of all connections between the top membrane and the substrate is essential.

The vent system functions as an extra security and consists of one-way vents which let air out to compensate for small unintentional air leakages between membrane and substrate. The vents are effective in the area of the roof where the wind suction at any given time is greatest, and they are positioned systematic in corners and along edges; see Fig. 1.

Membrane

The membrane must be a polyester reinforced roofing membrane like Protan SE, EX and EXG. The roofing membranes are documented in SINTEF Technical Approval No. 2010.

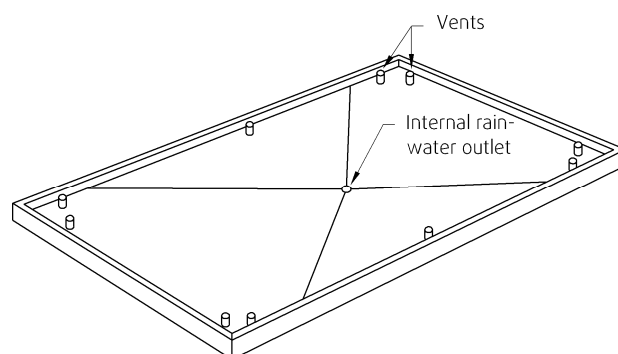


Fig. 1
 Principle of Protan vacuum roofing system. The membrane is laid with airtight seals along edges and penetrations.

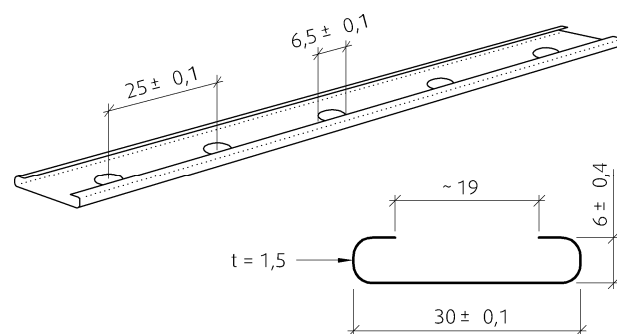


Fig. 2
 Protan steel bar. The bars are supplied in standard lengths of 2.1 m.

Fixing bars

Protan steel bars are shown in Fig. 2. The bars are made from galvanized steel with a zinc weight of 225 g/m³, which is equivalent to a thickness of approx. 20 µm. The primary task of Protan's steel bars is to ensure air tightness in the roofing system.

Vacuum-vent

Protan Vacuum-vent is a one-way vent with an external shell of aluminium and an internal ducting system of expanded polystyrene (EPS); see Fig. 3. The closing mechanism is an EPDM membrane attached to one of the partition walls in the EPS cross.

Supplementary products

Protan airtight seal made of PVC with a closed cell structure, and sealants approved by Protan AS, are delivered as supplementary products for the system.

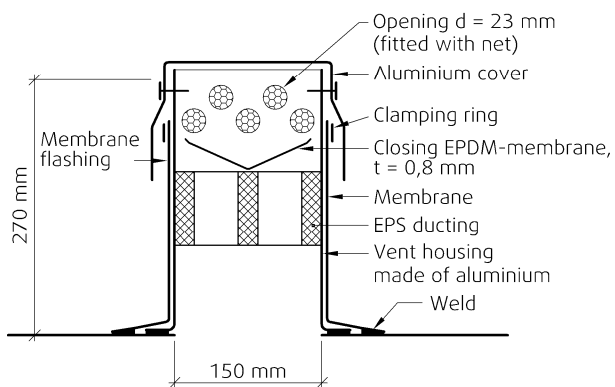
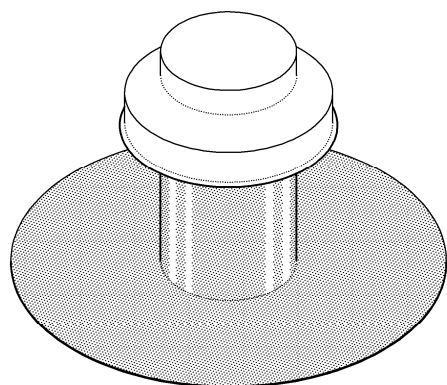


Fig. 3
Protan Vacuum-vent

4. Fields of application

Protan vacuum roofing system can be used for new roofing, plus for reroofing with and without additional insulation of roofs, provided that good air sealing can be established to prevent leaks from outside and inside.

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.

5. Properties

The properties of the roofing membranes concerned are set out in SINTEF Technical Approvals No. 2010.

The capacity of the roofing system is determined by the substrate capacity. The substrate must be designed for the relevant wind loads.

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, 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

Planning and application

Protan vacuum roofing system must always be dimensioned by Protan A/S, who must also carry out an initial survey of the roof in question and assess whether it is suitable for the system. Dimensioning mainly involves the number of vents, positioning, and, if required, calculation of the substrate capacity. The roofing system must be installed by installers with special approval by Protan A/S. All approved installers must have completed a compulsory training programme. On all roofs covered with Protan vacuum roofing system, a final control shall be reported.

The membrane must also be applied in accordance with Building Research Design Sheets 525.207, 544.202 and 544.204, and with Protan's design and application instructions.

Substrate and joints

A basic requirement for the system is that the substrate and connections of the membrane to the substrate have good air tightness. The substrate may be a lightweight roof structure with a vapour barrier having good mechanical strength and welded, airtight joints (see Fig. 4), a solid concrete roof deck or a roof with an existing roofing membrane.

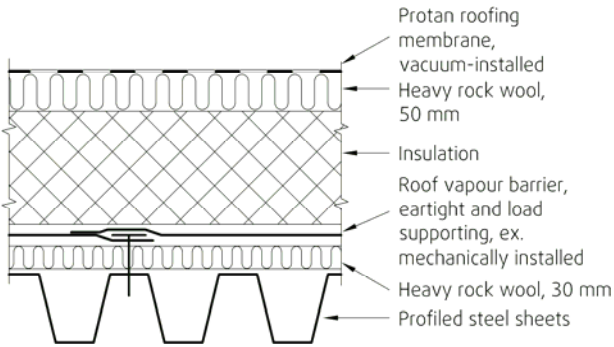


Fig. 4
Example of a new roof structure with supporting profiled steel sheets.

Inspection during reroofing

In conjunction with reroofing, any existing membrane must be inspected for leakage in the membrane and any weaknesses in the existing anchoring, and if necessary these must be repaired. The membrane is normally inspected visually using non-destructive equipment. In case of doubt, parts of the roof can be opened to investigate the air sealing and the condition of the existing anchoring.

Sealing at edges and penetrations

All edges and penetrations in the membrane must be performed with airtight construction details, using Protan steel bars, airtight seal and supplementary products. The steel bar shall be screwed to the substrate.

Figures 5 to 8 show examples of sealing principles at the connections with an external wall or a top edge/parapet with a maximum fastener range of 150 mm to ensure the air tightness. The distance is verified by an estimate of the wind pressure. Figure 9 shows sealing at a roof outlet.

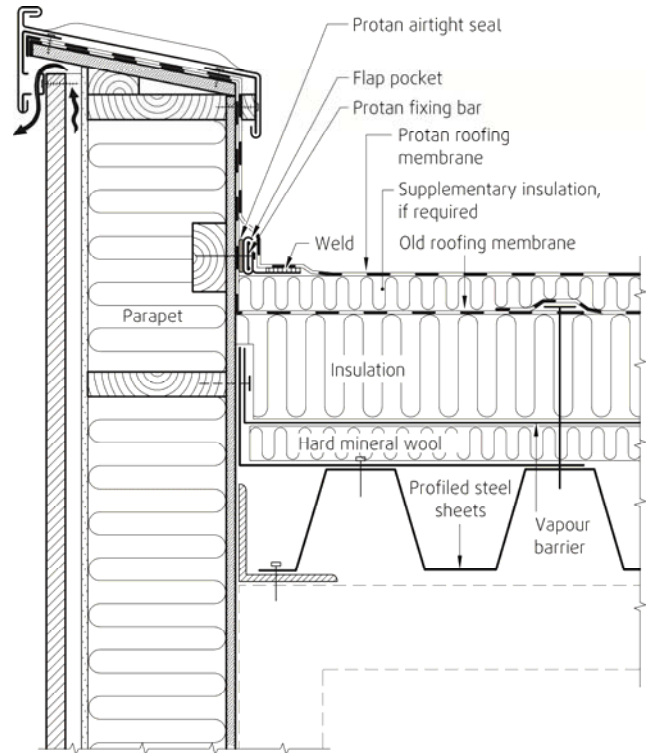


Fig. 5
Sealing principle for edges on a roof with supporting profiled steel sheets. Reroofing.

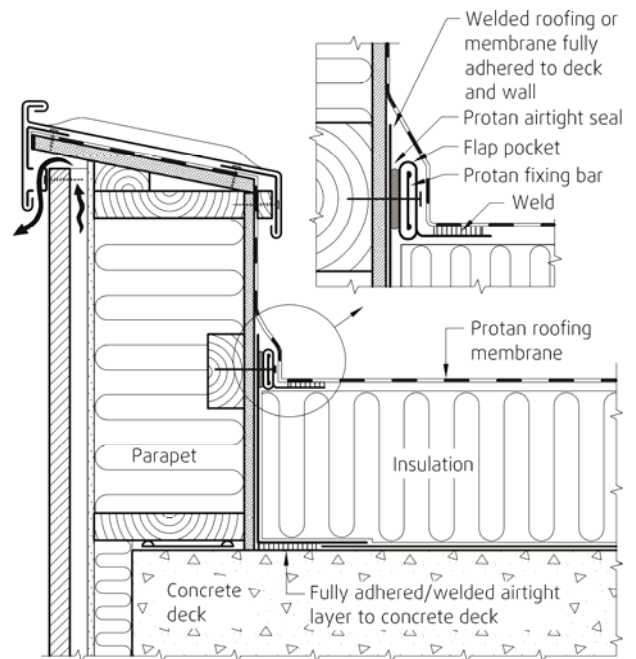


Fig. 6
Sealing principle for edges on a concrete roof deck. New building or reroofing.

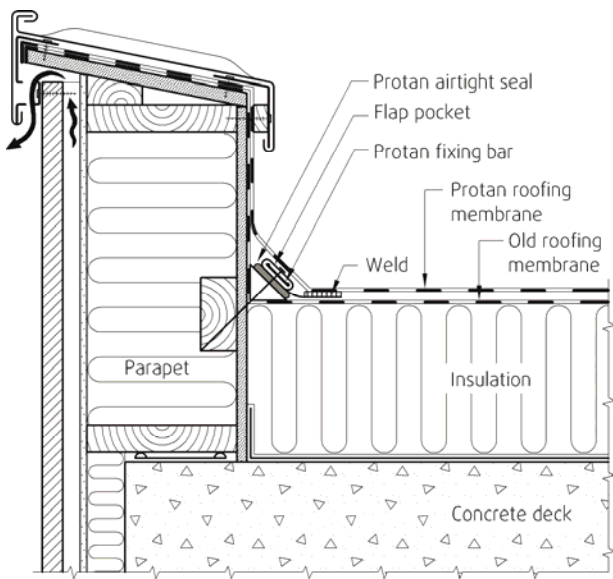


Fig. 7
Sealing principle for edges on roof with use of triangle lath. Reroofing.

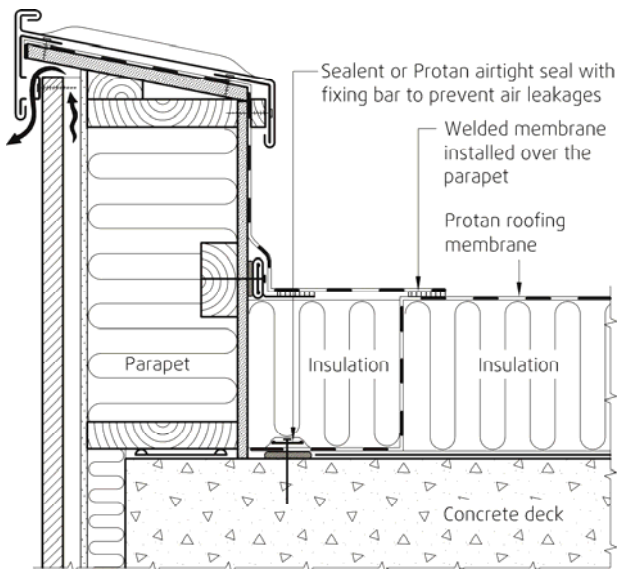


Fig. 8
Sealing principle for edges on a roof with an airtight concrete deck. New building. Suitable if movements are expected between the wall and the deck.

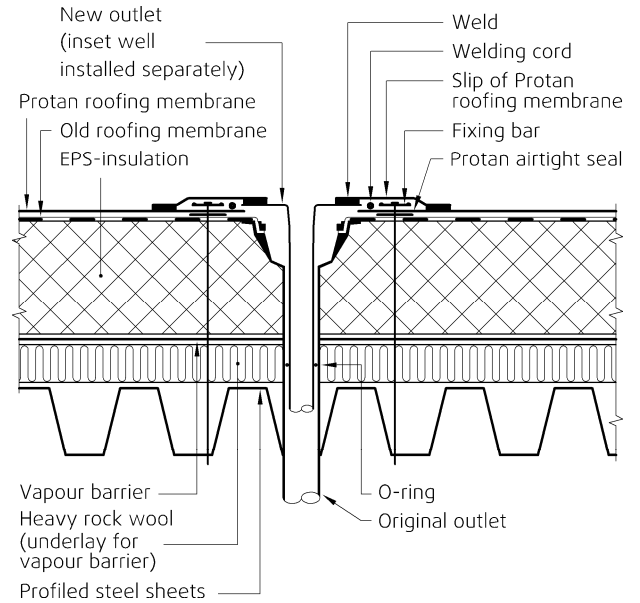


Fig. 9
Principle for sealing at an outlet

Positioning of vents

Vents are normally placed in the corners and the perimeter area and along free edges. Where the roof abuts against adjacent high walls, the membrane is attached as shown in Figs. 5, 6 or 7. The following general instructions are applicable when positioning and installing vents, see Fig. 10:

- two vents in external corners
- two vents in internal corners
- maximum distance between vents along free edges is 15 metres
- for pitched roofs with a fall > 1:6, vents should be used at the roof ridge, both close to gables and on the centre section.

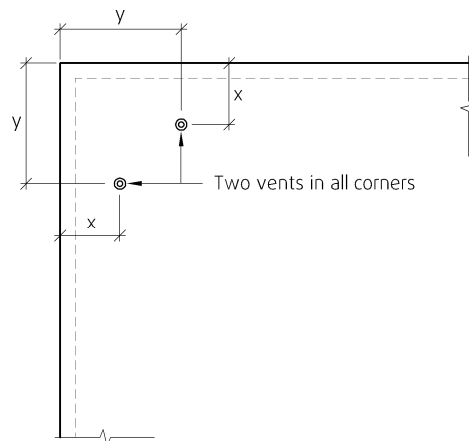


Fig. 10
Positioning of vents at external corners. Dimensions for x and y must be determined individually for each project and calculated by Protan.

Roof traffic

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.

Inspection and maintenance

When doing repair work, the roofing membrane must be cleaned locally before starting any welding of joints. Appropriate cleaning agent must be used.

8. Factory production control

Protan vacuum roofing system is subject to supervisory factory production control according to contract between SINTEF Building and Infrastructure and Protan A/S concerning SINTEF Technical Approval.

Protan A/S has a quality system certified by Det Norske Veritas according to ISO 9001:2000, Certificate No. 95-OSL-AQ-6343.

9. Basis for the approval

Material and performance data for the roofing membranes have been determined by type testing and regular audit testing performed by SINTEF Building and Infrastructure and the Norwegian Fire Research Laboratory during the years 1975 – 2006; see SINTEF Technical Approval Nos. 2010 and 2219.

The properties of the roofing system are based on type testing and pilot projects documented in the following reports from the Norwegian Building Research Institute:

- O 8346 dated 22.12.98
- N 8351-P3/P4 dated 14.04.2000
- O 8348 dated 30.06.2000.

10. Marking

All pallets/packs of roofing membranes must be marked with the manufacturer's name, product designation and date of production. All rolls must be marked with the manufacturer's production code. All pallets/packs of vents and bars must be marked with the manufacturer's name and product designation. The approval mark for SINTEF Technical Approval No. 2281 may also be used.



Approval mark

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 Henrik Erichsen
Approval Manager