Roof waterproofing system

FATRAFOL-S

CONSTRUCTION AND TECHNOLOGICAL INSTRUCTIONS

for installation of waterproofing membranes
on roof decks

fatra

PN 5415/2011 **FATRAFOL-S**

Title:	Construction and technological Instructions for installation of FATRAFOL waterproofing membranes on roof decks
Prepared by:	Studio of insulations
Issued by:	FATRA, a.s., třída Tomáše Bati 1541, 763 61 Napajedla, Czech Republic
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INTRODUCTION

This Instructions must be followed when designing and installing FATRAFOL roof waterproofing membranes in new buildings and reconstructed roofs, and when refurbishing existing roof decks. The membranes are based on plasticised polyvinyl chloride (PVC-P) and thermoplastic polyolefin (TPO), and manufactured by FATRA, a.s. Napajedla.

The Instructions summarises theoretical and practical knowledge and expertise acquired through research, testing, design and installation of roof waterproofing membranes since 1982. The Instructions constitutes an integral part of the FATRAFOL-S roof waterproofing system. Any modifications to or deviations from the criteria, requirements and rules contained herein, whether on economic, performance or operational grounds, are only allowed with FATRA's prior review and approval.

This issue of the construction and technological Instructions supersedes its previous version.

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1 APPLICATION AND FEATURES OF FATRAFOL-S ROOF WATERPROOFING SYSTEM

1.1 Scope of application

The FATRAFOL-S waterproofing system is designed to create membrane roof coverings for all types of residential, public, administrative, industrial, agricultural, sports and similar buildings with a flat or pitched roof. The system is suitable for all roof designs, i.e. single-, two- and multi-ply roofs, ventilated and non-ventilated roofs, roofs with the standard arrangement of a thermal insulation layer, inverted or combined roofs, flat, pitched and steep roofs, roofs open or closed to pedestrian traffic, vehicular traffic roofs, roofs with aggregate or soil, green roofs and roof gardens, water roofs, photovoltaic roofs etc.

Subject to compliance with the instructions below, FATRAFOL-S roofing membranes may be laid on all conventional substrates (concrete, concrete prefabricated components, lightweight concrete, wood, polystyrene foam, polyurethane, polyisocyanurate, mineral fibre boards, asphalt covering etc), both in new buildings and in renovated, reconstructed and refurbished old buildings.

Highly versatile, the FATRAFOL-S system suits a wide range of applications.

1.2 Roof classification by waterproofing membrane location and fastening method

Depending on the waterproofing membrane location and attachment to the roof deck, the FATRAFOL-S roof waterproofing system is divided into four distinctive subsystems:

- Mechanically fastened waterproofing membranes
  - A FATRAFOL membrane is fastened mechanically to the substrate
  - Typical for lightweight roof structures
- Bonded waterproofing membranes
  - A FATRAFOL membrane is bonded to a suitable substrate
  - Usable for almost all structures, pitches and shapes
- Waterproofing membranes loaded with aggregate or a traffic layer
  - A FATRAFOL membrane is protected from direct weather conditions and secured against wind loads
  - The traffic layer provides protection from external fire
  - The system requires only minimum maintenance
- Waterproofing membranes loaded with a vegetation layer
  - A FATRAFOL membrane is protected from the weather and secured against wind uplift
  - The vegetation layer improves the interior climate and user comfort
  - Suitable only for roofs with a sufficient load-bearing capacity

1.3 Typical end-use properties of FATRAFOL-S roof covering system

- The roof covering typically includes a single membrane layer with a waterproofing layer thickness of 1.5 mm.
- The roof covering weight on the roof structure does not exceed 3.2 kg.m^{-2}.
- All joints within the roof covering are made of high-strength and watertight welds and may be additionally secured.
- The roof covering offers long-term resistance to weather-caused corrosion including UV radiation.
- The roof covering is highly resistant to aggressive chemicals in the air, industrial pollution, extracts from concrete and a number of other substances.

- The roof covering features great strength, elongation at break and elasticity and maintains its end-use properties at temperatures between -30°C and +80°C.
- The roof covering meets building fire safety requirements as prescribed by Czech and European standards.
- A good degree of waterproofing membrane permeability for water vapours allows continuous moisture diffusion from the roof deck into the atmosphere.
- The roof covering surface provides good reflection and minimum absorption of solar heat radiation.
- Based on existing long-term practical experience and laboratory tests, the roof covering offers at least 25 years of service life.
- The roof covering is fully compatible with all accessories and auxiliary items within the FATRAFOL-S system.
- The manufacturer provides a 10-year warranty on the functionality of FATRAFOL roof waterproofing membranes installed in accordance with this Instructions.

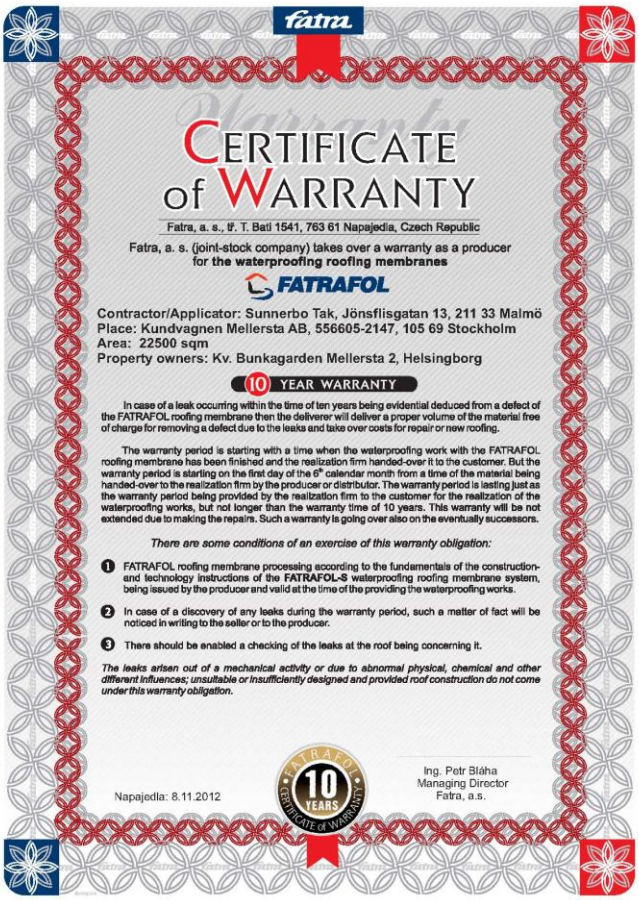
- Works can be carried out throughout the year, except rain, snow and temperatures below -5°C (below -10°C in case of TPO membranes). The roof covering may also be installed on a damp substrate.
- The roof covering is maintenance free throughout its service life except for regular recommended inspections of selected structures.
- If damaged, the roof covering is easy to repair.
- Easy renovation or removal of roof covering if required

CERTIFICATE

We hereby declare that company TVP-EKO d.o.o., is authorised to install PVC and TPO waterproofing membranes FATRAFOL, delivered by Fatra, a.s.Napajedla, Czech republic for the year 2012

Ing.Petr Bláha
Managing Director
Fatra, a.s.

FATRAFOL



CERTIFICATE of WARRANTY

Fatra, a. s., tř. T. Bati 1541, 763 61 Napajedla, Czech Republic

Fatra, a. s. (joint-stock company) takes over a warranty as a producer for **the waterproofing roofing membranes**

FATRAFOL

Contractor/Applicator: Sunnerbo Tak, Jönsflisgatan 13, 211 33 Malmö
Place: Kundvagnen Mellersta AB, 556605-2147, 105 69 Stockholm
Area: 22500 sqm
Property owners: Kv. Bunkagarden Mellersta 2, Helsingborg

10 YEAR WARRANTY

In case of a leak occurring within the time of ten years being evidential deduced from a defect of the FATRAFOL roofing membrane then the deliverer will deliver a proper volume of the material free of charge for removing a defect due to the leaks and take over costs for repair or new roofing.

The warranty period is starting with a time when the waterproofing work with the FATRAFOL roofing membrane has been finished and the realization firm handed-over it to the customer. But the warranty period is starting on the first day of the 6th calendar month from a time of the material being handed-over to the realization firm by the producer or distributor. The warranty period is lasting just as the warranty period being provided by the realization firm to the customer for the realization of the waterproofing works, but not longer than the warranty time of 10 years. This warranty will be not extended due to making the repairs. Such a warranty is going over also on the eventually successors.

There are some conditions of an exercise of this warranty obligation:

1. FATRAFOL roofing membrane processing according to the fundamentals of the construction- and technology instructions of the **FATRAFOL-S** waterproofing roofing membrane system, being issued by the producer and valid at the time of the providing the waterproofing works.
2. In case of a discovery of any leaks during the warranty period, such a matter of fact will be noticed in writing to the seller or to the producer.
3. There should be enabled a checking of the leaks at the roof being concerning it.

The leaks arisen out of a mechanical activity or due to abnormal physical, chemical and other different influences; unsuitable or insufficiently designed and provided roof construction do not come under this warranty obligation.

Napajedla: 8.11.2012

10 YEARS

Ing. Petr Bláha
Managing Director
Fatra, a.s.

2 FATRAFOL-S WATERPROOFING SYSTEM MATERIALS

The materials comprising the FATRAFOL-S system are divided as follows:

- FATRAFOL waterproofing membranes (a waterproofing layer as per CSN 73 1901)
- Supplementary waterproofing materials
- Auxiliary materials

The materials mentioned below are custom-designed and manufactured for their intended purpose. When installing the FATRAFOL-S system, waterproofing materials must be considered non-interchangeable.

2.1 FATRAFOL waterproofing membranes

FATRAFOL waterproofing membranes are the key material of the main waterproofing (water impermeable) layer.

2.1.1 Membrane manufacture and basic product classification

FATRAFOL membranes are manufactured only from raw materials of exactly defined properties. The composition and design of individual membrane types are such to give the membranes optimal technical parameters for their intended use.

Classification of FATRAFOL membranes by basic criteria:

a) By the manufacturing technology:

- Calendered and laminated
- Manufactured by the process of multiple extrusion

b) By the material base:

- Membranes from plasticised polyvinyl chloride (PVC-P)
- Membranes from thermoplastic polyolefins (TPO)

c) By intended use:

- Basic types (membranes for the main waterproofing layer)
- Additional types (for detailing as an accessory to basic membrane types)

Table 1 shows a detailed classification of the membrane range.

Table 1: FATRAFOL range classification

Reinforcement type	PVC-P membranes		TPO membranes
	Laminated	Extruded	
Basic types of waterproofing membranes			
High-strength PES grid	FATRAFOL 810 FATRAFOL 810 AA	FATRAFOL 810/V FATRAFOL 810/V AA	FATRAFOL P 916
Glass fibre fleece	FATRAFOL 814	FATRAFOL 818/V FATRAFOL 818/V-UV	FATRAFOL P 918
Base non-woven fleece	FATRAFOL 807 FATRAFOL 807/F FATRAFOL 807 AA	FATRAFOL 807/V	-
Combined reinforcement	-	-	FATRAFOL P 918/SG-PV
Additional types of waterproofing membranes			
Without reinforcement fleece	FATRAFOL 804	-	FATRAFOL P 918/H

2.1.2 Temperature resistance and welding temperatures

FATRAFOL roofing membranes offer long-term resistance to most types of corrosive loads including thermal loads. Their key performance properties remain basically stable at temperatures between -30°C and +80°C and the membranes can be installed at temperatures between -5°C (-10°C in case of TPO membranes) and +40°C. The membranes also withstand very sudden and recurring temperature changes without damage, even offer short-term resistance to extreme overheating*).

Recommended welding temperatures are 430°C up to 580°C for PVC-P based membranes and 380°C up to 520°C for TPO based membranes. The welding temperature depends on numerous factors such as membrane thickness and type, welding machine type, welding speed, substrate and ambient air temperature and humidity, wind speed etc. An on-site test must be performed to set the correct welding temperature. The manufacturer recommends making test welds with various welding machine settings before the start of work and adjusting the parameters to tensile test results.

*) *Note: Even brief exposure of TPO membranes to extreme overheating may cause thermal decomposition of polymer and have a negative impact on the quality of joints.*

2.1.3 Chemical resistance

With their excellent chemical resistance, FATRAFOL membranes may be used in environments with high chemical exposure. For a basic overview of chemical resistance at a standard temperature of 23°C, see Table 2 and Table 3 for PVC-P membranes and TPO membranes respectively. As chemical resistance depends largely on concentration and temperature of the substance and on exposure time, every case must be treated individually and a separate assessment must be made, in particular, of any substances not listed below and their combinations with respect to their estimated impact on the membrane.

Table 2: Chemical resistance of FATRAFOL PVC-P membranes

Inorganic acids	
Sulphuric acid 25%	+
Sulphuric acid 98%	Δ
Sulphurous acid 6%	+
Nitric acid 5%	+
Hydrochloric acid 10%	+
Concentrated hydrochloric acid	Δ
Organic acids	
Benzoic acid	+
Butyric acid	Δ
Acetic acid 10%	+
Citric acid	+
Tartaric acid	+
Oxalic acid	+
Oleic acid	Δ
Inorganic bases	
Sodium hydroxide	+
Potassium hydroxide	+
Ammonium hydroxide	+
Calcium hydroxide	+

Salt solutions	
Sulphates	+
Chlorides	+
Nitrates	+
Organic substances	
Acetone	–
Ethyl alcohol 10%	+
Ethylene glycol	Δ
Petrol	–
Diesel	–
Plant and animal oils	Δ
Motor and mineral oils	Δ
Tar	–
Toluene	–
Other	
Asphalt	–
Beer	+
Soap solutions	+
Sea water	+
Washing agents	+
Herbicides	+
Fertilisers	+

Chemical resistance rating: + *long-term resistance* Δ *limited resistance* - *not resistant*

Table 3: Chemical resistance of FATRAFOL TPO membranes

Inorganic acids	
Sulphuric acid 25%	+
Sulphuric acid 98%	Δ
Sulphurous acid 6%	+
Nitric acid 5%	+
Hydrochloric acid 10%	+
Concentrated hydrochloric acid	Δ
Organic acids	

Salt solutions	
Sulphates	+
Chlorides	+
Nitrates	+
Organic substances	
Acetone	Δ
Ethyl alcohol 10%	+
Ethylene glycol	+

Benzoic acid	+
Butyric acid	+
Acetic acid 10%	+
Citric acid	+
Tartaric acid	+
Oxalic acid	+
Oleic acid	Δ
Inorganic bases	
Sodium hydroxide	+
Potassium hydroxide	+
Ammonium hydroxide	+
Calcium hydroxide	+

Petrol	–
Diesel	Δ
Plant and animal oils	Δ
Motor and mineral oils	Δ
Tar	Δ
Toluene	–
Other	
Asphalt	+
Beer	+
Soap solutions	+
Sea water	+
Washing agents	+
Herbicides	+
Fertilisers	+

Chemical resistance rating: + *long-term resistance* Δ *limited resistance* - *not resistant*

2.1.4 Strength characteristics

FATRAFOL's mechanical properties include great tensile and compression strength and high elongation at break. Deformations of PVC-P membranes are largely reversible (elastic). FATRAFOL membranes also provide very good resistance to point stress (punctures, tears etc) and do not develop the so-called 'cold flow' when exposed to stress.

Some membrane types are reinforced with a high-strength fleece grid for added strength.

2.1.5 Packaging, transport and storage

Membranes are wound into rolls and wrapped; the rolls are placed on wooden pallets and secured in place with wrap film.

Typically, a pallet holds 19 rolls of 1,300 (1,200) mm wide membranes and 21 rolls of 2,000 (2,050) mm wide membranes.

Non-standard pallets hold 18 rolls of 2,000 (2,050) mm wide membranes, with the rolls having reduced length and weight and being block-stacked in 3 layers.

See figure 1 for basic packaging arrangements.

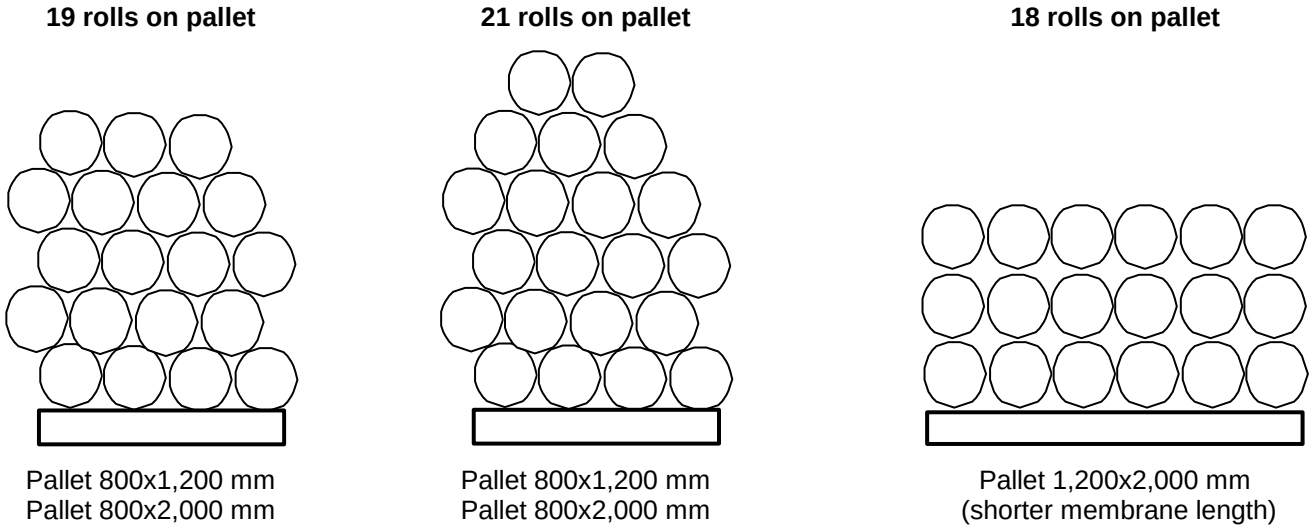


Figure 1: Handling and transport units – roll arrangement on pallet

Membranes must be transported in covered vehicles and stored in original closed packaging.

Membranes should be stored at between -5°C and +30°C. Membranes must be protected from dirt at the construction site. If possible, membranes should be protected from the weather until installed.

2.1.6 Membrane labelling and identification

Identification details are ink-printed on the top surface of FATRAFOL membranes, usually 100 mm from their edge, indicating membrane dimensions (width, thickness) in mm, date of manufacture and identification data. In addition, a '+' symbol is ink-printed at 150 mm intervals along the entire membrane length to allow easy adjustment of overlaps.

Each roll carries a label with a CE conformity mark. A unique production lot and production code are used for material identification in the manufacturing plant.

CE 01234	
FATRA a. s., Tomáše Bati 1541, 763 61 Napajedla **xx** 01234-CPD-xxxxx	
EN 13956	
Trade name	**FATRAFOL XXX**
Size	(t – w) mm
Quantity	xx m - xx m^2
Colour	
Product characteristics	
Production lot: XXXXX	Production code: XX-X

2.1.7 Safety regulations

FATRAFOL membranes are not classified as hazardous substances within the meaning of the Chemicals Act.

Waste disposal

Waste FATRAFOL membranes must be disposed of in accordance with current legislation (Waste Act 185/2001 Coll. as amended).

Clean waste is recyclable. Non-recyclable waste can be landfilled. Waste contaminated with hazardous substances must be disposed of in a hazardous waste incinerator.

Table 4 shows waste categories under Ministry of Environment Decree 381/2001 Coll. (Waste Catalogue) and possible reuse.

Table 4: FATRAFOL waste categories and reuse

Waste category	Catalogue number	Waste name as per catalogue number	Waste details, note	Waste hazardous property identification	Estimated waste use or disposal method
O	07 02 13	Waste plastic	**PVC-P membranes**	O	- Use as material - Disposal (thermal disposal*, landfill)
O	07 02 13	Waste plastic	**TPO membranes**	O	- Use as material - Use as energy - Disposal (thermal disposal*, landfill)
O	15 01 01	Paper and cardboard packaging	**Paper tubes**	O	- Use as material
O	15 01 02	Plastic packaging	**Wrap PE film and PE stretch film**	O	- Use as material

**) Waste incineration facility*

Occupational health and safety

All current safety, sanitary and fire regulations must be observed when installing and joining the membranes.

2.1.8 Legislative requirements

The quality management system for FATRAFOL development and manufacture is certified according to EN ISO 9001:2009.

The development and manufacture of waterproofing membranes are certified according to EN ISO 14001:2005 to demonstrate a commitment to the environment and adherence to environmental management standards.

In accordance with the Council Directive 89/106/EEC in conjunction with Directive 93/68/EEC, Act 22/1997 Coll. and Government Regulation 190/2002 Coll. as amended, all roofing membranes are certified, meet the requirements of the harmonised European standard EN 13956 and are issued with a CE declaration of conformity.

BUREAU VERITAS Certification

Certification

Awarded to

Fatra, a.s.
Head office and site: třída Tomáše Bati 1541, Napajedla
Site: Komenského 75, Chropyně
Czech Republic

Bureau Veritas certifies that the Management System of the above organisation has been audited and found to be in accordance with the requirements of the management system standard detailed below:

Standard

ČSN EN ISO 9001:2009

Scope of supply

DESIGN AND PRODUCTION OF PLASTIC FOILS, WATERPROOFING MEMBRANES, PLASTIC FLOOR COVERINGS, PRINTED SHEETS, INJECTION MOLDING AND PLASTIC MATERIALS BY TERMOFORMING. DESIGN AND PRODUCTION OF BREATHABLE FILMS AND LAMINATES. DESIGN AND PRODUCTION OF PVC GRANULES AND EXTRUDED PLASTIC PROFILES. DESIGN AND PRODUCTION OF BIAXIALLY-ORIENTED POLYETHYLENE TEREPHTHALATE FILMS AND MULTI-LAYER FILMS.

Original Approval Date: 23rd DECEMBER 1994

Subject to the continued satisfactory operation of the organisation's Management System, this certificate is valid until: 31st MAY 2015.

To check this certificate validity please call: +420 210 088 215

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organisation.

Date: 24th APRIL 2012

Certificate Number: 12000169

IAF

S 3100

BUREAU VERITAS Certification

Certification

Awarded to

Fatra, a.s.
Head office and site: třída Tomáše Bati 1541, Napajedla
Site: Komenského 75, Chropyně
Czech Republic

Bureau Veritas certifies that the Management System of the above organisation has been audited and found to be in accordance with the requirements of the management system standard detailed below:

Standard

ČSN EN ISO 14001:2005

Scope of supply

DESIGN AND PRODUCTION OF PLASTIC FOILS, WATERPROOFING MEMBRANES, PLASTIC FLOOR COVERINGS, PRINTED SHEETS, INJECTION MOLDING AND PLASTIC MATERIALS BY TERMOFORMING. DESIGN AND PRODUCTION OF BREATHABLE FILMS AND LAMINATES. DESIGN AND PRODUCTION OF PVC GRANULES AND EXTRUDED PLASTIC PROFILES. DESIGN AND PRODUCTION OF BIAXIALLY-ORIENTED POLYETHYLENE TEREPHTHALATE FILMS AND MULTI-LAYER FILMS.

Original Approval Date: 18th MAY 2000

Subject to the continued satisfactory operation of the organisation's Management System, this certificate is valid until: 31st MAY 2015.

To check this certificate validity please call: +420 210 088 215

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organisation.

Date: 24th APRIL 2012

Certificate Number: 12000170

IAF

S 3100

2.1.9 Description and technical specifications of waterproofing membrane types

2.1.9.1 PVC-P waterproofing membranes

2.1.9.1.1 FATRAFOL 807 waterproofing membrane

- **PRODUCT DESCRIPTION**

  FATRAFOL 807 (807/F, 807 AA) is a PVC-P based roofing membrane with the base layer made of non-woven PES fleece. The membrane is resistant to UV radiation and may be exposed directly to the weather.

  One of FATRAFOL 807 (807 AA) edges is without the non-woven fleece in order for the sheets to be joined longitudinally.

  The base non-woven fleece of FATRAFOL 807/F covers the entire sheet width.

  FATRAFOL 807 AA provides more fire resistance.

  All product versions are referred to below as FATRAFOL 807.

- **USE**

  The product is intended for bonded systems, in particular:

  - Refurbishment of old asphalt coverings on flat roofs,
  - Additional roof deck thermal insulation that cannot be loaded or mechanically fastened,
  - A bonded waterproofing system for sheds, light buildings etc.

  Covered with fleece with a surface density of 300 g/m^2, the membrane underside is suitable for contact with bitumens. If installed on an asphalt covering, the membrane should be bonded with PU adhesive.

- **APPLICATION**

  The membranes may only be installed by qualified and specially trained contractors.

  The membranes must be installed in accordance with this Instructions.

  Within the roof field, the membrane must be bonded or mechanically fastened to the substrate.

  The fixing method must ensure the membrane is secured against dimensional changes and wind uplift.

  The sheets are joined together in the overlap of the uncovered edge, using hand-operated or automatic hot-air welding machines. End joints must be made edge-to-edge and covered with a 120 mm wide strip of FATRAFOL 804, identically to side joints of FATRAFOL 807/F.

  When joining membrane sheets together, ambient air and substrate temperature should not drop below -5°C. Membranes should be bonded at temperatures and under conditions recommended by the adhesive (varnish) manufacturer.

- **PRODUCT DATA**

  - **Dimensions and packaging details**

Thickness [mm]	Width [mm]	Surface density*) [kg/m^2]	Roll length [m]	Roll length [m^2]	Roll weight *) [kg]	Pallet coverage Rolls	Pallet coverage [m^2]	Pallet weight *) [kg]
FATRAFOL 807, FATRAFOL 807 AA								
Effect.: 1.50 Total: 2.60	Total: 1,300 Free edge: 50	2.20	15.4	20	44	20	400	880
FATRAFOL 807/F								
Effect.: 1.50	1,300	2.20	17.7	23	51	19	437	960
Total: 2.60	1,000		17.7	17.7	39		336.3	740

**) Approximate figures*

- **Appearance and colours**
  - Smooth membrane with a matt surface
  - Top surface - Standard colour – light grey RAL 7040
    - Also available in colours shown in the table
    - Marks are printed 100 mm from the membrane edge for easier overlap adjustment and the positioning of fasteners
  - Underside - White non-woven fleece

Design	FATRAFOL 807 top surface colour	Colour tone	
		Fatra colour chart	RAL colour chart*)
	Light grey	2761	7040
	Dark grey	2003	7012
	Red	3104	3016
	Blue	9113	5015
	Green	7060B	6000

**) Some colours may differ slightly from the RAL colour chart, but no more than the 3rd degree of the grey scale under CSN EN 20105-A02.*

- **Technical parameters – guaranteed values**

Property	Test standard	Guaranteed values
Tensile strength	EN 12311-2 method A	≥ 800 N/50 mm
Elongation		≥ 60%
Watertightness	EN 1928/B	Pass
Reaction to fire	EN 13501-1	Class E
External fire performance	ENV 1187	B_{ROOF} (t1)
Peel resistance of joints	EN 12316-2	≥ 150 N/50 mm
Shear resistance of joints	EN 12317-2	≥ 650 N/50 mm
Resistance to impact	EN 12691/A	Pass, 1,250 mm
	EN 12691/B	Pass, 2,000 mm
Resistance to static loading	EN 12730/B	Pass, 20 kg
Resistance to tearing	EN 12310-2	≥ 250 N
Dimensional stability	EN 1107-2	Max. ± 1%
Foldability at low temperature	EN 495-5	≤ -35°C
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0
Water vapour permeability – diffusion resistance factor μ	EN 1931	8,200 ± 2,000
Equivalent diffusion thickness s_d		21.3 m
Thermal conductivity coefficient λ	EN 12667	0.068 W/m.K

- **RELATED TECHNICAL DOCUMENTATION**
  - Technical data sheet TL 5-1006-06, FATRAFOL 807 waterproofing membrane, issued by Fatra, a.s., Napajedla
  - Production management system certificate 1390-CPD-0028/07/Z for FATRAFOL 804, FATRAFOL 807, FATRAFOL 814 waterproofing membranes according to EN 13956:2006, issued by CSI, a.s., Prague, Zlín office

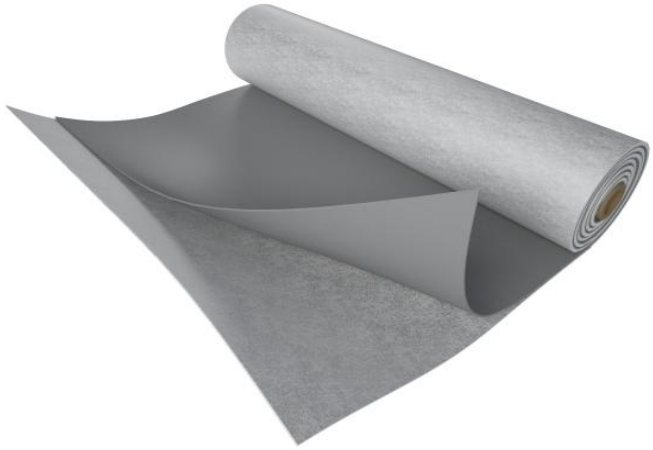
Documentation validity: Installation of the membrane requires using current product documentation (technical data sheet, declaration of conformity, certificate etc). This is available at www.fatrafol.cz.

2.1.9.1.2 FATRAFOL 807/V waterproofing membrane

PRODUCT DESCRIPTION

FATRAFOL 807/V is a PVC-P based roofing membrane with the base layer made of non-woven PES fleece with a surface density of 120 g/m^2. The membrane is resistant to UV radiation and may be exposed directly to the weather.

One edge of the membrane is without the non-woven fleece in order for the sheets to be joined longitudinally.



USE

The membrane is intended for bonded systems, in particular those using expansive polyurethane adhesives, for installation on:

- A suitable thermal insulation layer (e.g. PIR, EPS)
- A rigid roof deck that meets planarity requirements (Cetris boards, vibrated concrete etc)

The membrane should not be bonded to asphalt surfaces or fastened mechanically.

FATRAFOL 804 must be used for detailing.

APPLICATION

The membranes may only be installed by qualified and specially trained contractors.

The membranes must be installed in accordance with this Instructions.

Adhesives used for bonding the membrane must provide sufficient adhesion to the substrate, in line with a wind load calculation. Possible ways to secure the covering against internal forces are described below.

The sheets are joined together in the overlap of the uncovered edge, using hand-operated or automatic hot-air welding machines. End joints must be made edge-to-edge and covered with a 120 mm wide strip of FATRAFOL 804.

The membranes must be installed at temperatures recommended by the adhesive manufacturer. When joining the sheets together, ambient air and substrate temperature should not drop below -5°C.

PRODUCT DATA

Dimensions and packaging details

Thickness [mm]	Width [mm]	Surface density [kg/m^2]	Roll length		Roll weight *) [kg]	Pallet coverage		Pallet weight *) [kg]
			[m]	[m^2]		Rolls	[m^2]	
Effective: 1.20 Total: 1.60	Total: 2,050 Free edge: 70	1.67	19	38.95	66	21	817.95	1,400
Effective: 1.50 Total: 1.90		2.04	16	32.8	68	21	688.8	1,440
Effective: 2.00 Total: 2.40		2.52	13	26.65	68	21	559.65	1,440

**) Approximate figures*

Appearance and colours

- Smooth membrane with a matt surface
- Top surface - Standard colour – light grey RAL 7040
  - Also available in colours shown in the table
  - Marks are printed 100 mm from the membrane edge for easier overlap adjustment and the positioning of fasteners
- Underside - Greenish non-woven fleece

Design	FATRAFOL 807/V top surface colour	Colour tone	
		Fatra colour chart	RAL colour chart*)
	Light grey	2761	7040
	Dark grey	2003	7012
	White	1278	9010

*) *Some colours may differ slightly from the RAL colour chart, but no more than the 3rd degree of the grey scale under CSN EN 20105-A02.*

Technical parameters – guaranteed values

Property	Test standard	Guaranteed values for individual product thicknesses		
		1.60 mm	1.90 mm	2.40 mm
Tensile strength	EN 12311-2 method A	≥ 650 N/50 mm	≥ 800 N/50 mm	≥ 950 N/50 mm
Elongation		≥ 80%		
Watertightness	EN 1928/B	Pass		
Reaction to fire	EN 13501-1	Class E		
External fire performance	ENV 1187	B_{ROOF} (t1)		
Peel resistance of joints	EN 12316-2	≥ 200 N/50 mm	≥ 250 N/50 mm	≥ 280 N/50 mm
Shear resistance of joints	EN 12317-2	≥ 600 N/50 mm	≥ 720 N/50 mm	≥ 800 N/50 mm
Resistance to impact	EN 12691/A	Pass, 1,000 mm	Pass, 1,250 mm	Pass, 1,250 mm
	EN 12691/B	Pass, 1,500 mm	Pass, 2,000 mm	Pass, 2,000 mm
Resistance to static loading	EN 12730/B	Pass, 20 kg		
Resistance to tearing	EN 12310-2	≥ 180 N	≥ 220 N	≥ 240 N
Dimensional stability	EN 1107-2	Max. ± 0.3%		
Foldability at low temperature	EN 495-5	≤ -25°C		
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0		
Water vapour permeability – diffusion resistance factor μ	EN 1931	10,000 ± 3,000		
Equivalent diffusion thickness s_d		16 m	19 m	24 m

RELATED TECHNICAL DOCUMENTATION

- Technical data sheet TL 5-1016-09, FATRAFOL 807/V waterproofing membrane, issued by Fatra, a.s., Napajedla
- Production management system certificate 1390-CPD-0070/10/Z for FATRAFOL 807/V waterproofing membrane according to EN 13956:2006/AC 2006-06, issued by CSI, a.s., Prague, Zlín office

Documentation validity: Installation of the membrane requires using current product documentation (technical data sheet, declaration of conformity, certificate etc). This is available at www.fatrafol.cz.

2.1.9.1.3 FATRAFOL 810 (810/V, 810 AA, 810/V AA) waterproofing membranes

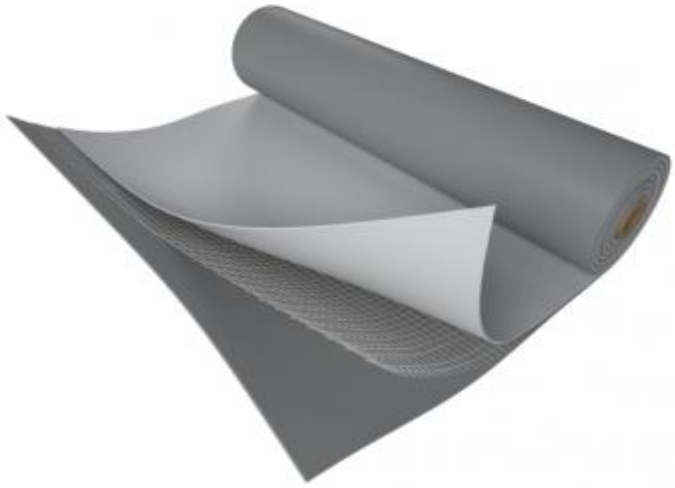
- **PRODUCT DESCRIPTION**

  FATRAFOL 810 (810/V, 810 AA, 810/V AA) is a PVC-P based roofing membrane reinforced with a polyester grid. The membrane is resistant to UV radiation and may be exposed directly to the weather.

  FATRAFOL 810 (810 AA) is manufactured by the process of calendering and lamination while FATRAFOL 810/V (810/V AA) is manufactured by the process of multiple extrusion.

  FATRAFOL 810 AA (810/V AA) offers more fire resistance.

  Unless otherwise stated, all product versions are referred to below as FATRAFOL 810.



- **USE**

  The membranes are intended for mechanically fastened systems where they are exposed to the weather without any protective and traffic layers:

  - With point fastening and linear fastening using plastic-coated metal profiles,
  - With fixing discs to which the membrane is bonded.

  The membranes are designed for roofs subjected only to occasional loads, e.g. when the installation is done in stages and the protective (traffic) layers are installed at a later stage.

  Membrane cut to strips:

  - Width 160 mm – used for covering fasteners in additional point fastening of the membrane
  - Width 215 mm – used for joining and fastening FATRAFOL 814 to the substrate
  - Width 650 mm, 1,000 mm and 1,025 mm – for additional fastening in perimeter and corner zones of roofs

- **APPLICATION**

  The membranes may only be installed by qualified and specially trained contractors.

  The membranes must be installed in accordance with this Instructions.

  The membrane must be properly attached to a stable part of the roof deck. The fixing method must ensure the membrane is secured against dimensional changes and wind uplift.

  Membrane sheets may be joined together using hand-operated or automatic hot-air welding machines or wedge welders (single-track weld).

  Ambient air and substrate temperature should not drop below -5°C during installation.

PRODUCT DATA

Dimensions and packaging details

Thickness [mm]	Width [mm]	Surface density *) [kg/m^2]	Roll length **) [m]	Roll length **) [m^2]	Roll weight *) [kg]	Pallet coverage Rolls	Pallet coverage [m^2]	Pallet weight *) [kg]
FATRAFOL 810								
1.20	1,300	1.52	20	26	41	19	494	780
	650			13	21	38	494	780
	215		40	8.6	13	36	309.6	490
	160			6.4	10	36	230.4	370
1.50	1,300	1.90	20	26	51	19	494	970
	650			13	26	38	494	970
	160		32	5.12	10	36	184.32	370
2.00	1,300	2.54	15.4	20	51	19	380	970
FATRAFOL 810/V								
1.20	2,050	1.52	25	51.25	78	21	1,076.25	1,650
	2,000			50	76		1,050	1,630
	1,600			40	61		840	1,290
	1,025			25.625	39	42	1,076.25	1,650
	1,000			25	38		1,050	1,630
1.50	2,050	1.90	20	41	78	21	861	1,650
	2,000			40	76		840	1,630
	1,600			32	61		672	1,290
	1,025			20.5	39	42	861	1,650
	1,000			20	38		840	1,630
1.80	2,050	2.28	16.5	33.825	77	21	710.325	1,650
	2,000			33	75		693	1,630
	1,025			16.912	39	42	710.304	1,650
	1,000			16.5	38		693	1,630
2.00	2,050	2.54	15	30.75	78	21	645.75	1,650
	2,000			30	76		630	1,630
2.40	2,000	3.05	13	26	79	21	546	1,690
FATRAFOL 810 AA								
1.50	1,300	1.93	20	26	52	19	494	990
FATRAFOL 810/V AA								
1.50	2,050	1.93	20	41	80	21	861	1,690
	2,000			40	78		840	1,650

**) Approximate figures*
***) Other roll lengths are available by arrangement between the manufacturer and the customer.*

Appearance and colours

- Smooth membrane with a matt surface gently textured by reinforcement fleece
- Top surface
  - Standard colour – light grey RAL 7040
  - Also available in colours shown in the table
  - Marks are printed 100 mm from the membrane edge for easier overlap adjustment and the positioning of fasteners
- Underside
  - Grey
  - White on white membranes

Design	FATRAFOL 810 top surface colour	Colour tone		Availability			
		Fatra colour chart	RAL colour chart*)	810	810/V	810 AA	810/V AA
	Light grey	2761	7040	●	●	●	●
	Dark grey	2003	7012	●	●	●	●
	Red	3104	3016	●	●		
	Blue	9113	5015	●	●		
	White	1278	9010	●	●		
	Green	7060B	6000	●	●		
	Copper brown	3503	8004	●			
	Grey-white	2732	7047		●		

*) *Some colours may differ slightly from the RAL colour chart, but no more than the 3rd degree of the grey scale under CSN EN 20105-A02.*

■ **Technical parameters – guaranteed values**

FATRAFOL 810, FATRAFOL 810 AA				
Property	**Test standard**	**Guaranteed values for individual product thicknesses**		
		1.20 mm	**1.50 mm**	**2.00 mm**
Tensile strength – L/T	EN 12311-2 method A	≥ 1,000/950 N/50 mm	≥ 1,000/950 N/50 mm	≥ 1,000/950 N/50 mm
Elongation		≥ 15%		
Watertightness (400 kPa)	EN 1928/B	Pass		
Reaction to fire	EN 13501-1	Class E		
External fire performance	ENV 1187	B_{ROOF} (t1), B_{ROOF} (t3), C_{ROOF} (t4)		
Peel resistance of joints	EN 12316-2	≥ 260 N/50 mm	≥ 260 N/50 mm	≥ 260 N/50 mm
Shear resistance of joints – L/T	EN 12317-2	≥ 900/850 N/50 mm	≥ 900/850 N/50 mm	≥ 900/850 N/50 mm
Resistance to impact	EN 12691/A	Pass, 1,000 mm	Pass, 1,250 mm	Pass, 1,250 mm
	EN 12691/B	Pass, 2,000 mm	Pass, 2,000 mm	Pass, 2,000 mm
Resistance to static loading	EN 12730/B	Pass, 20 kg		
Resistance to tearing	EN 12310-2	≥ 180 N		
Dimensional stability	EN 1107-2	Max. ± 0.3%		
Foldability at low temperature	EN 495-5	≤ -25°C		
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0		
Water vapour permeability – diffusion resistance factor μ	EN 1931	21,000 ± 3,000		
Equivalent diffusion thickness s_d		25.2 m	31.5 m	42 m
Thermal conductivity coefficient λ	EN 12667	0.141 W/(m.K)		

L – longitudinal direction, T – transverse direction

FATRAFOL 810/V, FATRAFOL 810/V AA				
Property	**Test standard**	**Guaranteed values for individual product thicknesses**		
		1.20 mm	**1.50-1.80-2.00 mm**	**2.40 mm**
Tensile strength – L/T	EN 12311-2 method A	≥ 1,000/1,000 N/50 mm	≥ 1,000/1,100 N/50 mm	≥ 1,100/1,200 N/50 mm
Elongation – L/T		≥ 15/20%		
Watertightness (400 kPa)	EN 1928/B	Pass		
Reaction to fire	EN 13501-1	Class E		
External fire performance	ENV 1187	B_{ROOF} (t1), B_{ROOF} (t2), B_{ROOF} (t3)		
Peel resistance of joints	EN 12316-2	≥ 260 N/50 mm	≥ 260 N/50 mm	≥ 260 N/50 mm
Shear resistance of joints – L/T	EN 12317-2	≥ 1,000 N/50 mm	≥ 1,000 N/50 mm	≥ 1,100 N/50 mm
Resistance to impact	EN 12691/A	Pass, 1,000 mm	Pass, 1,250 mm	Pass, 1,750 mm
	EN 12691/B	Pass, 2,000 mm	Pass, 2,000 mm	Pass, 2,000 mm

Resistance to static loading	EN 12730/B	Pass, 20 kg		
Resistance to tearing – L/T	EN 12310-2	≥ 200/220 N	≥ 200/220 N	≥ 250/270 N
Dimensional stability	EN 1107-2	Max. ± 0.3%		
Foldability at low temperature	EN 495-5	≤ -25°C		
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0		
Water vapour permeability – diffusion resistance factor μ	EN 1931	21,000 ± 3,000		
Equivalent diffusion thickness s_d		25.2 m	31.5-37.8-42 m	50.4 m
Thermal conductivity coefficient λ	EN 12667	0.141 W/(m.K)		
Resistance to root penetration	prEN 13948, FLL	Pass		
SRI index	ASTM E 1980-01	108 *(applies only to RAL 9010 white colour tone)*		

L – longitudinal direction, T – transverse direction

RELATED TECHNICAL DOCUMENTATION

- Technical data sheet TL 5-1008-06, FATRAFOL 810 waterproofing membrane, issued by Fatra, a.s., Napajedla
- Production management system certificate 1390-CPD-0026/06/Z for FATRAFOL 810 waterproofing membrane according to EN 13956:2006, issued by CSI, a.s., Prague, Zlín office
- Production management system certificate 1390-CPD-0033/06/Z for FATRAFOL 810/V waterproofing membrane according to EN 13956:2006, issued by CSI, a.s., Prague, Zlín office
- European Technical Approval ETA-12/0013 - FATRAFOL-S, Systems of mechanically fastened, flexible, roof waterproofing membranes

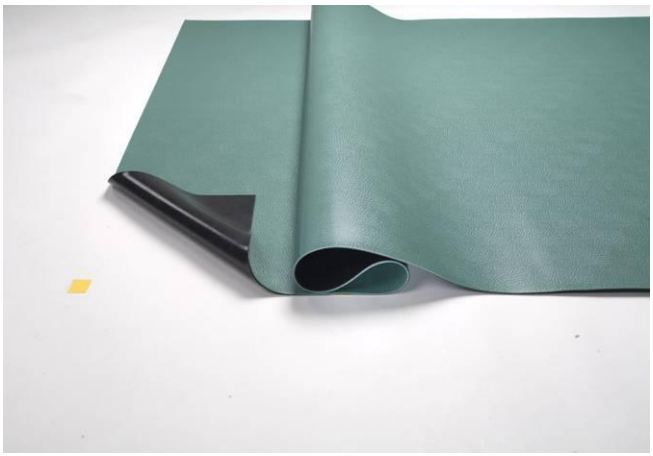
Documentation validity: Installation of the membrane requires using current product documentation (technical data sheet, declaration of conformity, certificate etc). This is available at www.fatrafol.cz.

2.1.9.1.4 FATRAFOL 814 waterproofing membrane

- **PRODUCT DESCRIPTION**

  FATRAFOL 814 is a PVC-P (plasticised polyvinyl chloride) based roofing membrane with glass fibre fleece. The membrane top surface features a special anti-slip texture.

  The membrane is resistant to UV radiation and may be exposed directly to the weather.



- **USE**

  Pedestrian traffic waterproofing layer for:

  - Open terraces and balconies of residential buildings
  - Walkways on flat roofs waterproofed with FATRAFOL PVC-P membranes

  FATRAFOL 814 meets the minimum shear friction coefficient of 0.5 required by CSN 74 4505 under both dry and wet conditions and as such is perfectly suitable to form a top layer subjected to pedestrian traffic.

- **APPLICATION**

  The membranes may only be installed by qualified and specially trained contractors.

  The membrane is generally used for horizontal surfaces only and must be installed in accordance with this Instructions. The substrate planarity and slope should prevent puddling on the membrane. No puddling usually occurs if the slope exceeds 3%.

  The membranes are typically installed edge-to-edge and their edges are hot-air welded, in a watertight manner, to a strip of an auxiliary membrane that is secured to a stable part of the substrate with special fasteners. The fixing method must ensure the membrane is secured against dimensional changes and wind uplift. To end the membrane on a wall or at the roof perimeter, weld the membrane to plastic-coated metal profiles. For complex detailing, penetrations, railing posts etc, the FATRAFOL 804 homogeneous detailing membrane should preferably be used.

  To install the membrane on walkways, hot-air weld the sheets to a finished FATRAFOL waterproofing layer on the roof deck.

  Ambient air and substrate temperature should not drop below 0°C during installation.

PRODUCT DATA

Dimensions and packaging details

Thickness [mm]	Width [mm]	Surface density *) [kg/m^2]	Roll length **) [m]	Roll length **) [m^2]	Roll weight *) [kg]	Pallet coverage Rolls	Pallet coverage [m^2]	Pallet weight *) [kg]
2.50	1,000	3.10	12	12	42	19	228	800

**) Approximate figures*

***) 1.5 m of the membrane (1.5 m^2) is added to each roll to compensate for the dents at the beginning of the roll. In result, the roll length is 13.5 m (13.5 m^2).*

Appearance and colours

- Embossed membrane with a shiny textured surface
- Top surface - Available in colours shown in the table
- Underside - Black

Design	FATRAFOL 814 top surface colour	Colour tone	
		Fatra colour chart	RAL colour chart *)
	Light grey	2761	7040
	Dark grey	2003	7012
	Green	7060B	6000
	Copper brown	3503	8004

**) Some colours may differ slightly from the RAL colour chart, but no more than the 3rd degree of the grey scale under CSN EN 20105-A02.*

Technical parameters – guaranteed values

Property	Test standard	Guaranteed values
Tensile strength	EN 12311-2 method B	≥ 8 MPa
Elongation		≥ 150%
Watertightness	EN 1928/B	Pass
Reaction to fire	EN 13501-1	Class E
External fire performance	ENV 1187	B_{ROOF} (t1)
Peel resistance of joints	EN 12316-2	≥ 250 N/50 mm
Shear resistance of joints	EN 12317-2	≥ 650 N/50 mm
Resistance to impact	EN 12691/A	Pass, 1,750 mm
	EN 12691/B	Pass, 2,000 mm
Resistance to static loading	EN 12730/B	Pass, 20 kg
Resistance to tearing	EN 12310-2	≥ 130 N
Dimensional stability	EN 1107-2	Max. ± 0.2%
Foldability at low temperature	EN 495-5	≤ -35°C
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0
Water vapour permeability – diffusion resistance factor μ	EN 1931	10,500 ± 2,500
Equivalent diffusion thickness s_d		26.3 m
Thermal conductivity coefficient λ	EN 12667	0.145 W/(m.K)
Shear friction coefficient in both dry and wet conditions	CSN 74 4507	Min. 0.6

RELATED TECHNICAL DOCUMENTATION

- Technical data sheet TL 5-1010-06, FATRAFOL 814 waterproofing membrane, issued by Fatra, a.s., Napajedla
- Production management system certificate 1390-CPD-0028/07/Z for FATRAFOL 804, FATRAFOL 807, FATRAFOL 814 waterproofing membranes according to EN 13956:2006, issued by CSI, a.s., Prague, Zlín office

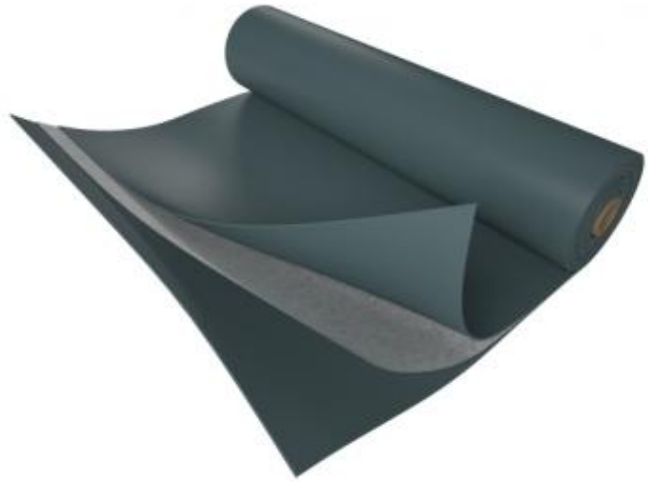
Documentation validity: Installation of the membrane requires using current product documentation (technical data sheet, declaration of conformity, certificate etc). This is available at www.fatrafol.cz.

2.1.9.1.5 FATRAFOL 818/V waterproofing membrane

- **PRODUCT DESCRIPTION**

  FATRAFOL 818/V (818/V-UV) is a PVC-P based roofing membrane with glass fibre fleece. The membrane is manufactured by the process of multiple extrusion.

  The 818/V-UV version is stabilised against UV radiation.



- **USE**

  The membrane is intended as a single-ply covering for flat roofs:

  - Loaded with aggregate
  - With a traffic layer – pavers on support pads or vehicular traffic surface
  - With vegetation layers

  FATRAFOL 818/V (818/V-UV) is unsuitable for mechanically fastened roof coverings without a loading layer.

  Since FATRAFOL 818/V does not offer long-term resistance to UV radiation, the loading layer must provide constant protection for the membrane from direct weather conditions. Use FATRAFOL 818/V-UV or FATRAFOL 810 for any areas where the membrane will be exposed to the weather.

  FATRAFOL 818/V-UV offers long-term resistance to UV radiation and as such is intended primarily for applications where not all of the roof deck can be protected from direct weather conditions, such as pavers on support pads. FATRAFOL 818/V-UV may also be used for parapets.

  For penetrations and other complex details projecting from the roof deck, the FATRAFOL 804 detailing membrane should preferably be used.

- **APPLICATION**

  The membranes may only be installed by qualified and specially trained contractors.

  The membrane must be installed in accordance with this Instructions.

  Within the roof field, lay the waterproofing membrane without fastening it to the substrate and ensure the sheets overlap by at least 50 mm. At the roof perimeter and at the point of sudden slope changes and details, the membrane must be fastened to the substrate using plastic-coated metal profiles.

  Membrane sheets may be joined together using hand-operated or automatic hot-air welding machines or wedge welders (single-track weld).

  Ambient air and substrate temperature should not drop below -5°C during installation.

- **PRODUCT DATA**

  - **Dimensions and packaging details**

Thickness [mm]	Width [mm]	Surface density *) [kg/m^2]	Roll length [m]	Roll length [m^2]	Roll weight *) [kg]	Pallet coverage Rolls	Pallet coverage [m^2]	Pallet weight *) [kg]
1.50	2,050	1.92	20	41	79	21	861	1,670
1.80	2,050	2.30	16.5	33.825	78	21	710.32	1,650
2.00	2,050	2.56	15	30.75	79	21	645.75	1,670

**) Approximate figures*

- **Appearance and colours**
  - Smooth membrane with a matt surface
  - Top surface - 818/V membrane – grey-green
    - 818/V-UV membrane - available in colours shown in the table
    - Identification details are printed 100 mm from the membrane edge.
  - Underside - 818/V membrane – grey-green
    - 818/V-UV membrane - grey

Design	FATRAFOL 818 top surface colour	Colour tone: Fatra colour chart	Colour tone: RAL colour chart *)	Availability: 818/V	Availability: 818/V-UV
	Grey-green	7646B	7033	•	
	Light grey	2761	7040		•

**) Some colours may differ slightly from the RAL colour chart, but no more than the 3rd degree of the grey scale under CSN EN 20105-A02.*

- **Technical parameters – guaranteed values**

Property	Test standard	Guaranteed values for individual product thicknesses: 1.50 mm	1.80 mm	2.00 mm
Tensile strength	EN 12311-2 method B	≥ 11 MPa		
Elongation		≥ 200%		
Watertightness	EN 1928/B	Pass		
Reaction to fire	EN 13501-1	Class E		
External fire performance	ENV 1187	B_{ROOF} (t1)		
Peel resistance of joints	EN 12316-2	≥ 250 N/50 mm	≥ 250 N/50 mm	≥ 250 N/50 mm
Shear resistance of joints	EN 12317-2	≥ 650 N/50 mm	≥ 800 N/50 mm	≥ 800 N/50 mm
Resistance to impact	EN 12691/A	Pass, 1,250 mm	Pass, 1,500 mm	Pass, 1,500 mm
	EN 12691/B	Pass, 2,000 mm	Pass, 2,000 mm	Pass, 2,000 mm
Resistance to static loading	EN 12730/B	Pass, 20 kg		
Resistance to tearing	EN 12310-2	≥ 120 N	≥ 150 N	≥ 150 N
Dimensional stability	EN 1107-2	Max. ± 0.1%		
Foldability at low temperature	EN 495-5	≤ -30°C		
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0		
Water vapour permeability – diffusion resistance factor μ	EN 1931	20,000 ± 4,000		
Equivalent diffusion thickness s_d		30 m	36 m	40 m
Thermal conductivity coefficient λ	EN 12667	0.145 W/(m.K)		
Resistance to root penetration	prEN 13948, FLL	Pass		

- **RELATED TECHNICAL DOCUMENTATION**
  - Technical data sheet TL 5-1017-09, FATRAFOL 818 waterproofing membrane, issued by Fatra, a.s., Napajedla
  - Production management system certificate 1390-CPD-0140/09/Z for FATRAFOL 818/V waterproofing membrane according to EN 13956:2006, issued by CSI, a.s., Prague, Zlín office

Documentation validity: Installation of the membrane requires using current product documentation (technical data sheet, declaration of conformity, certificate etc). This is available at www.fatrafol.cz.

2.1.9.1.6 EKOPLAN 819/V waterproofing membrane

PRODUCT DESCRIPTION

EKOPLAN 819/V is a PVC-P based roofing membrane reinforced with a polyester grid. The membrane is resistant to UV radiation and may be exposed directly to the weather.

EKOPLAN 819/V is manufactured by the process of multiple extrusion.

USE

The membrane is intended as a temporary single-ply covering for flat roofs, which is mechanically fastened to the substrate and does not have a loading layer.

APPLICATION

The membrane may only be installed by qualified and specially trained contractors.

The membranes must be installed in accordance with this Instructions.

The membrane must be properly secured to a stable part of the roof deck. The fixing method must ensure the membrane is secured against dimensional changes and wind uplift.

Membrane sheets may be joined together using hand-operated or automatic hot-air welding machines or wedge welders (single-track weld).

Ambient air and substrate temperature should not drop below 0°C during installation.

PRODUCT DATA

Dimensions and packaging details

Thickness [mm]	Width [mm]	Surface density*) [kg/m^2]	Roll length [m]	Roll length [m^2]	Roll weight *) [kg]	Pallet coverage Rolls	Pallet coverage [m^2]	Pallet weight *) [kg]
1.20	2,000	1.54	25	50	78	21	1,050	1,650
	1,600			40	62	21	840	1,320
	1,000			25	39	42	1,050	1,650
1.50	2,000	1.93	20	40	78	21	840	1,650
	1,600			32	62	21	672	1,320
	1,000			20	39	42	840	1,650
1.80	2,000	2.31	16.5	33	77	21	693	1,630
	1,000			16.5	39	42	693	1,630

*) *Approximate figures*

Appearance and colours

- Smooth membrane with a matt surface gently textured by reinforcement fleece
- Top surface - Standard colour – light grey RAL 7040
  - Also available in colours shown in the table
  - Marks are printed 100 mm from the membrane edge for easier overlap adjustment and the positioning of fasteners
- Underside - Black

Design	EKOPLAN 819/V top surface colour	Colour tone	
		Fatra colour chart	RAL colour chart *)
	Light grey	2761	7040
	Dark grey	2003	7012
	Red	3104	3016
	Blue	9113	5015
	Green	7060B	6000
	Grey-white	2732	7047

*) *Some colours may differ slightly from the RAL colour chart, but no more than the 3rd degree of the grey scale under CSN EN 20105-A02.*

■ **Technical parameters – guaranteed values**

Property	Test standard	Guaranteed values
Tensile strength	EN 12311-2 method A	≥ 1000 N/50 mm
Elongation		≥ 15%
Watertightness	EN 1928/B	Pass
Reaction to fire	EN 13501-1	Class E
External fire performance	ENV 1187	B_{ROOF} (t1)
Peel resistance of joints	EN 12316-2	≥ 150 N/50 mm
Shear resistance of joints	EN 12317-2	≥ 800 N/50 mm
Resistance to impact	EN 12691/A	Pass, 1,000 mm
	EN 12691/B	Pass, 1,500 mm
Resistance to static loading	EN 12730/B	Pass, 20 kg
Resistance to tearing – L/T	EN 12310-2	≥ 200/220 N
Dimensional stability	EN 1107-2	Max. ± 0.5%
Foldability at low temperature	EN 495-5	≤ -10°C
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0
Water vapour permeability – diffusion resistance factor μ	EN 1931	15,000 ± 5,000
Equivalent diffusion thickness s_d (thickness 1.2/1.5/1.8 mm)		18/23/27 m

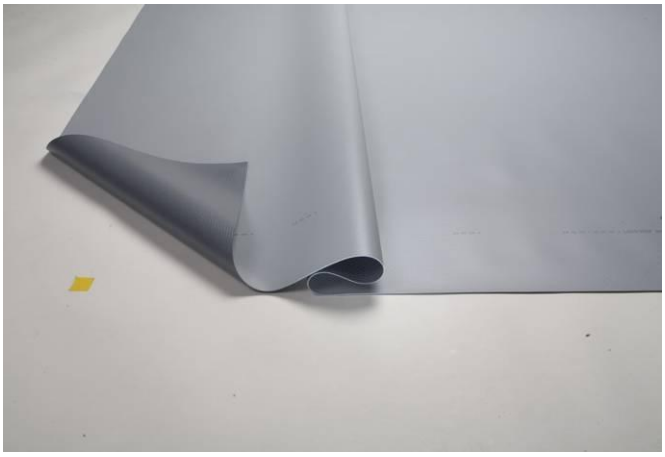
L – longitudinal direction, T – transverse direction

■ **RELATED TECHNICAL DOCUMENTATION**

- Technical data sheet TL 5-1026-11, EKOPLAN 819 waterproofing membrane, issued by Fatra, a.s., Napajedla
- Production management system certificate 1390-CPD-0161/11/Z for EKOPLAN 819/V waterproofing membrane according to EN 13956:2006/AC:2006, issued by CSI, a.s., Prague, Zlín office

Documentation validity: Installation of the membrane requires using current product documentation (technical data sheet, declaration of conformity, certificate etc). This is available at www.fatrafol.cz.

2.1.9.1.7 FATRAFOL 804 waterproofing membrane




- **PRODUCT DESCRIPTION**

  FATRAFOL 804 (804 AA) is a non-reinforced roofing membrane made on the basis of plasticised polyvinyl chloride (PVC-P). The membrane is resistant to UV radiation and may be exposed directly to the weather.

  The FATRAFOL 804 AA version offers more fire resistance.

  Both product versions are referred to below as FATRAFOL 804.

- **USE**

  The product is intended only as an accessory to FATRAFOL reinforced roofing membranes:

  - For detailing and complex parts of FATRAFOL-waterproofed roofs
  - For end joining of FATRAFOL 807 (807/V) joints

  The membrane is unsuitable for use as a mechanically fastened covering for entire roofs.

  The membrane should always be at least one degree thicker than the waterproofing membrane itself.

- **APPLICATION**

  The membrane may only be installed by qualified and specially trained contractors.

  The membrane must be installed in accordance with this Instructions.

  The membranes are joined together using hot-air welding machines. When making standard joints, keep a 50 mm sheet overlap and make the homogeneous joint at least 30 mm wide. In detailing (e.g. roof deck penetrations of unusual shape and size), maintaining the minimum membrane overlap and weld width is not always possible.

  Ambient air and substrate temperature should not drop below -5°C during installation.

- **PRODUCT DATA**

  - **Dimensions and packaging details**

Thickness [mm]	Width [mm]	Surface density *) [kg/m^2]	Roll length		Roll weight *) [kg]	Pallet coverage		Pallet weight *) [kg]
			[m]	[m^2]		Rolls	[m^2]	
1.50	1,300	1.90	20	26	50	19	494	940
1.80	1,200	2.28	15	18	41	19	342	780
2.00	1,200	2.54	15	18	46	19	342	870
2.00	120	2.54	35	4.2	11	32	134.4	340

**) Approximate figures*

Appearance and colours

- Smooth membrane with a matt surface
- Top surface
  - Standard colour – light grey RAL 7040
  - Also available in colours shown in the table
  - Identification details are printed 100 mm from the membrane edge.
- Underside
  - Grey
  - White on a white membrane
    MAKE SURE the membrane is placed correctly with respect to top surface UV stabilisation.

Design	FATRAFOL 804 top surface colour	Colour tone	
		Fatra colour chart	RAL colour chart *)
	Light grey	2761	7040
	Dark grey	2003	7012
	Red	3104	3016
	Blue	9113	5015
	White	1278	9010
	Green	7060B	6000
	Copper brown	3503	8004
	Grey-white	2732	7047

*) *Some colours may differ slightly from the RAL colour chart, but no more than the 3rd degree of the grey scale under CSN EN 20105-A02.*

Technical parameters – guaranteed values

Property	Test standard	Guaranteed values for individual product thicknesses		
		1.50 mm	1.80 mm	2.00 mm
Tensile strength	EN 12311-2 method B	≥ 13 MPa		
Elongation		≥ 220%		
Watertightness	EN 1928/B	Pass		
Reaction to fire	EN 13501-1	Class E		
External fire performance	ENV 1187	B_{ROOF} (t1)		
Peel resistance of joints	EN 12316-2	≥ 250 N/50 mm	≥ 250 N/50 mm	≥ 250 N/50 mm
Shear resistance of joints	EN 12317-2	≥ 720 N/50 mm	≥ 850 N/50 mm	≥ 960 N/50 mm
Resistance to impact	EN 12691/A	Pass, 1,000 mm	Pass, 1,000 mm	Pass, 1,000 mm
	EN 12691/B	Pass, 2,000 mm	Pass, 2,000 mm	Pass, 2,000 mm
Resistance to static loading	EN 12730/B	Pass, 20 kg	Pass, 20 kg	Pass, 20 kg
Resistance to tearing	EN 12310-2	≥ 100 N	≥ 115 N	≥ 130 N
Dimensional stability	EN 1107-2	Max. ± 2%		
Foldability at low temperature	EN 495-5	≤ -35°C		
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0		
Water vapour permeability – diffusion resistance factor μ	EN 1931	16,300 ± 3,000		
Equivalent diffusion thickness s_d		24.5 m	29.3 m	32.6 m
Thermal conductivity coefficient λ	EN 12667	0.145 W/(m.K)		

RELATED TECHNICAL DOCUMENTATION

- Technical data sheet TL 5-1005-06, FATRAFOL 804 waterproofing membrane, issued by Fatra, a.s., Napajedla
- Production management system certificate 1390-CPD-0028/07/Z for FATRAFOL 804, FATRAFOL 807, FATRAFOL 814 waterproofing membranes according to EN 13956:2006, issued by CSI, a.s., Prague, Zlín office

Documentation validity: Installation of the membrane requires using current product documentation (technical data sheet, declaration of conformity, certificate etc). This is available at www.fatrafol.cz.

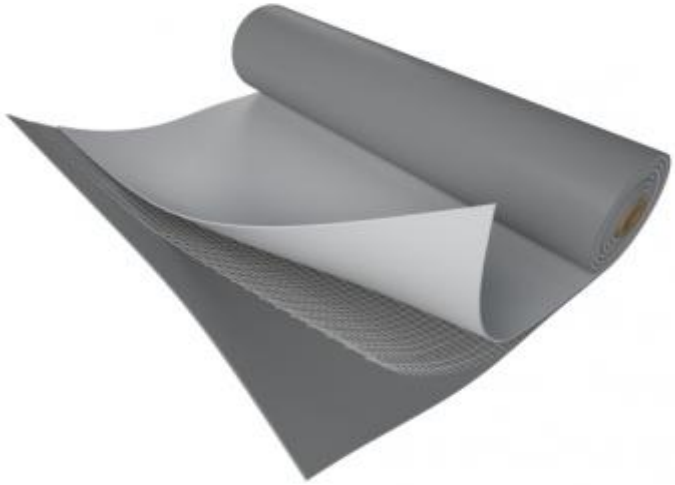
2.1.9.2 TPO waterproofing membranes

2.1.9.2.1 FATRAFOL P 916 waterproofing membrane

- **PRODUCT DESCRIPTION**

  FATRAFOL P 916 is a roof waterproofing membrane based on thermoplastic polyolefins (TPO) and reinforced with a PES grid. The membrane is manufactured by the process of extrusion.

  The membrane provides resistance to UV radiation and common chemicals, may be exposed to the weather and is compatible with asphalt and polystyrene.



- **USE**

  The membrane is intended as a single-ply roof covering of flat roofs, which is mechanically fastened to the substrate, without the presence of a loading layer.

- **APPLICATION**

  The membrane may only be installed by qualified and specially trained contractors.

  FATRAFOL P 916 must be installed in accordance with this Instructions.

  The fixing method must ensure the membrane is secured against dimensional changes and wind uplift.

  The membranes may be joined together by hot-air welding or a wedge welder with continuous temperature control. Welding temperature and speed must be set on the basis of on-site tests. No solvent need be applied at the point of weld to make a perfect joint.

  Use FATRAFOL P 918/H, an auxiliary homogeneous membrane, for complex detailing.

  Ambient air and substrate temperature should not drop below -10°C during installation.

- **PRODUCT DATA**

  - **Dimensions and packaging details**

Thickness [mm]	Width [mm]	Surface density *) [kg/m^2]	Roll length [m]	Roll length [m^2]	Roll weight *) [kg]	Pallet coverage Rolls	Pallet coverage [m^2]	Pallet weight *) [kg]
1.50	2,000	1.65	20	40	66	21	840	1,420
	1,000		20	20	33	42	840	1,420

**) Approximate figures*

- **Appearance and colours**
  - Smooth membrane with a matt surface
  - Top surface - Grey-white, RAL 7035
  - Underside - Grey, RAL 7037

Design	FATRAFOL P 916 top surface colour	Colour tone	
		Fatra colour chart	RAL colour chart
	Grey-white	-	7035

- **Technical parameters – guaranteed values**

Property	Test standard	Guaranteed values
Tensile strength	EN 12311-2 method A	≥ 1,000 N/50 mm
Elongation		≥ 15%
Watertightness	EN 1928/B	Pass
Reaction to fire	EN 13501-1	Class E
External fire performance	ENV 1187	B_{ROOF} (t1)
Peel resistance of joints	EN 12316-2	≥ 280 N/50 mm
Shear resistance of joints	EN 12317-2	≥ 800 N/50 mm
Resistance to impact	EN 12691/A	Pass, 1,250 mm
	EN 12691/B	Pass, 1,500 mm
Resistance to static loading	EN 12730/B	Pass, 20 kg
Resistance to tearing	EN 12310-2	≥ 250 N
Dimensional stability	EN 1107-2	Max. ± 1.5%
Foldability at low temperature	EN 495-5	≤ -40°C
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0
Water vapour permeability – diffusion resistance factor μ	EN 1931	90,000 ± 15,000
Equivalent diffusion thickness s_d		135 m

- **RELATED TECHNICAL DOCUMENTATION**
  - Technical data sheet TL 5-1013-11, FATRAFOL P 916 waterproofing membrane, issued by Fatra, a.s., Napajedla
  - Production management system certificate 1390-CPD-0013/11/Z for FATRAFOL P 916 waterproofing membrane according to EN 13956:2006/AC:2006, issued by CSI, a.s., Prague, Zlín office

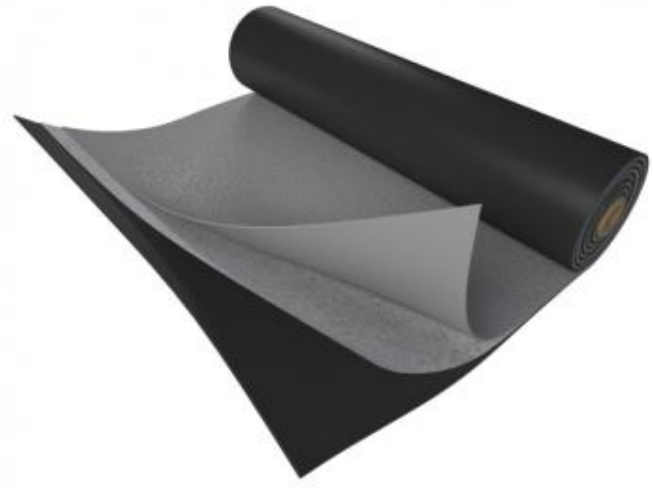
Documentation validity: Installation of the membrane requires using current product documentation (technical data sheet, declaration of conformity, certificate etc). This is available at *www.fatrafol.cz*.

2.1.9.2.2 FATRAFOL P 918 waterproofing membrane

PRODUCT DESCRIPTION

FATRAFOL P 918 is a roof waterproofing membrane based on thermoplastic polyolefins (TPO) and having glass fibre fleece. The membrane is manufactured by the process of multiple extrusion.

The membrane provides resistance to UV radiation and common chemicals, may be exposed to the weather and is compatible with asphalt and polystyrene.



USE

The membrane is intended as a single-ply covering for flat roofs:

- Loaded with aggregate
- With a traffic layer – pavers on support pads or vehicular traffic surface
- With vegetation layers
- That are mechanically fastened

APPLICATION

The membrane may only be installed by qualified and specially trained contractors.

FATRAFOL P 918 must be installed in accordance with this Instructions. The fixing method must ensure the membrane is secured against dimensional changes and wind uplift.

The membranes may be joined together by hot-air welding or a wedge welder with continuous temperature control. Welding temperature and speed must be set on the basis of on-site tests. No solvent need be applied at the point of weld to make a perfect joint.

Use FATRAFOL P 918/H, an auxiliary homogeneous membrane, for complex detailing.

Ambient air and substrate temperature should not drop below -10°C during installation.

PRODUCT DATA

Dimensions and packaging details

Thickness [mm]	Width [mm]	Surface density *) [kg/m^2]	Roll length [m]	Roll length [m^2]	Roll weight *) [kg]	Pallet coverage Rolls	Pallet coverage [m^2]	Pallet weight *) [kg]
1.50	2,050	1.50	20	41	62	21	861	1,320
1.80	2,050	1.80	16.5	33.825	61	21	710.325	1,300
2.00	2,050	2.00	15	30.75	62	21	645.75	1,320

**) Approximate figures*

- **Appearance and colours**
  - Smooth membrane with a matt surface
  - Top surface - Available in colours shown in the table
  - Underside - Black

Design	FATRAFOL P 918 top surface colour	Colour tone	
		Fatra colour chart	RAL colour chart
	Grey-white	-	7035
	Grey	-	7037

- **Technical parameters – guaranteed values**

Property	Test standard	Guaranteed values for individual product thicknesses		
		1.50 mm	1.80 mm	2.00 mm
Tensile strength	EN 12311-2 method A	≥ 400 N/50 mm	≥ 450 N/50 mm	≥ 500 N/50 mm
Elongation		≥ 500%		
Watertightness	EN 1928/B	Pass		
Reaction to fire	EN 13501-1	Class E		
External fire performance	ENV 1187	B_{ROOF} (t1)		
Peel resistance of joints	EN 12316-2	≥ 300 N/50 mm	≥ 300 N/50 mm	≥ 300 N/50 mm
Shear resistance of joints	EN 12317-2	≥ 400 N/50 mm	≥ 450 N/50 mm	≥ 500 N/50 mm
Resistance to impact	EN 12691/A	Pass, 800 mm	Pass, 800 mm	Pass, 1,000 mm
	EN 12691/B	Pass, 1,000 mm	Pass, 1,000 mm	Pass, 1,250 mm
Resistance to static loading	EN 12730/B	Pass, 20 kg	Pass, 20 kg	Pass, 20 kg
Resistance to tearing	EN 12310-2	≥ 150 N	≥ 170 N	≥ 200 N
Dimensional stability	EN 1107-2	Max. ± 0.5%		
Foldability at low temperature	EN 495-5	≤ -40°C		
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0		
Water vapour permeability – diffusion resistance factor μ	EN 1931	140,000 ± 20,000		
Equivalent diffusion thickness s_d		210 m	252 m	280 m

- **RELATED TECHNICAL DOCUMENTATION**
  - Technical data sheet TL 5-1012-07, FATRAFOL P 918 waterproofing membrane, issued by Fatra, a.s., Napajedla
  - Production management system certificate 1390-CPD-0265/07/Z for FATRAFOL P 918 waterproofing membrane according to EN 13956:2006, issued by CSI, a.s., Prague, Zlín office

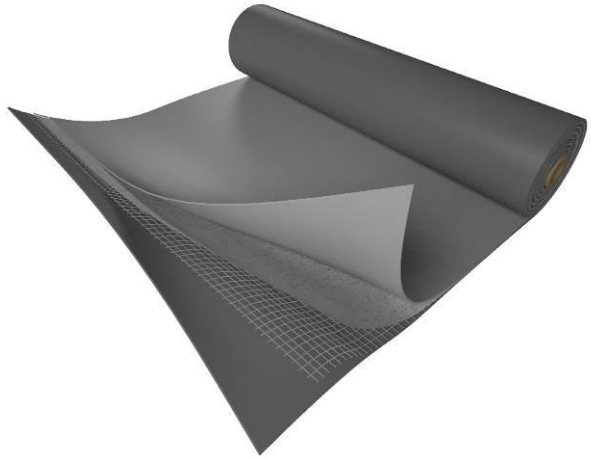
Documentation validity: Installation of the membrane requires using current product documentation (technical data sheet, declaration of conformity, certificate etc). This is available at www.fatrafol.cz.

2.1.9.2.3 FATRAFOL P 918/SG-PV waterproofing membrane

- **PRODUCT DESCRIPTION**

  FATRAFOL P 918/SG-PV is a roof waterproofing membrane based on thermoplastic polyolefins and having a combination of a polyester grid and glass fibre fleece for reinforcement. The membrane is manufactured by the process of multiple extrusion.

  The membrane features extremely high strength and excellent dimensional stability, offers great resistance to direct weather conditions including UV radiation, is resistant to common chemicals and compatible with asphalt and polystyrene.



- **USE**

  The membrane is intended as a single-ply roof covering for flat roofs where the most stringent requirements are placed on the performance and long service life of the roof deck waterproofing system:

  - For waterproofing photovoltaic power plants within the FATRASOL system
  - For a mechanically fastened roof covering without a loading layer
  - For loaded roofs with a traffic or vegetation layer

- **APPLICATION**

  The membrane may only be installed by qualified and specially trained contractors.

  FATRAFOL P 918/SG-PV must be installed in accordance with this Instructions.

  The fixing method must ensure the membrane is secured against dimensional changes and wind uplift.

  If the roof comprises the FATRASOL photovoltaic membrane, make sure to adhere to all specific requirements for the installation of the modules. The requirements are detailed in the FATRASOL PV module installation Instructions.

  The membranes may be joined together by hot-air welding or a wedge welder with continuous temperature control. Welding temperature and speed must be set on the basis of on-site tests. There is no need to treat the membrane with any solvent to make a perfect joint.

  Use FATRAFOL P 918/H, an additional homogeneous membrane, for complex detailing.

  Ambient air and substrate temperature should not drop below -10°C during installation.

- **PRODUCT DATA**

  - **Dimensions and packaging details**

Thickness	Width	Surface density *)	Roll length		Roll weight *)	Pallet coverage		Pallet weight *)
[mm]	[mm]	[kg/m^2]	[m]	[m^2]	[kg]	Rolls	[m^2]	[kg]
1.50	2,050	1.50	20	41	62	21	861	1,320
1.80	2,050	1.80	16.5	33.825	61	21	710.325	1,300
2.00	2,050	2.00	15	30.75	62	21	645.75	1,320

**) Approximate figures*

- **Appearance and colours**
  - Smooth membrane with a matt surface
  - Top surface - Grey-white, RAL 7035
  - Underside - Grey, RAL 7037

Design	FATRAFOL P 918/SG-PV top surface colour	Colour tone	
		Fatra colour chart	RAL colour chart
	Grey-white	-	7035

- **Technical parameters – guaranteed values**

Property	Test standard	Guaranteed values for individual product thicknesses		
		1.50 mm	1.80 mm	2.00 mm
Tensile strength	EN 12311-2 method A	≥ 1,100 N/50 mm	≥ 1,100 N/50 mm	≥ 1,250 N/50 mm
Elongation		≥ 15%	≥ 15%	≥ 20%
Watertightness	EN 1928/B	Pass		
Reaction to fire	EN 13501-1	Class E		
External fire performance	ENV 1187	B_{ROOF} (t1)		
Peel resistance of joints	EN 12316-2	≥ 300 N/50 mm	≥ 300 N/50 mm	≥ 300 N/50 mm
Shear resistance of joints	EN 12317-2	≥ 800 N/50 mm	≥ 800 N/50 mm	≥ 900 N/50 mm
Resistance to impact	EN 12691/A	Pass, 1,500 mm	Pass, 1,500 mm	Pass, 2,000 mm
	EN 12691/B	Pass, 2,000 mm	Pass, 2,000 mm	Pass, 2,000 mm
Resistance to static loading	EN 12730/B	Pass, 20 kg	Pass, 20 kg	Pass, 20 kg
Resistance to tearing	EN 12310-2	≥ 350 N	≥ 350 N	≥ 400 N
Dimensional stability	EN 1107-2	Max. ± 0.3%		
Foldability at low temperature	EN 495-5	≤ -40°C		
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0		
Water vapour permeability – diffusion resistance factor μ	EN 1931	95,000 ± 15,000		
Equivalent diffusion thickness s_d		143 m	171 m	190 m

- **RELATED TECHNICAL DOCUMENTATION**
  - Technical data sheet TL 5-1018-10, FATRAFOL P 918/SG-PV waterproofing membrane, issued by Fatra, a.s., Napajedla
  - Production management system certificate 1390-CPD-0129/11/Z for FATRAFOL P 918/SG and FATRAFOL P 918/SG-PV waterproofing membranes according to EN 13956:2006/AC 2006-06, issued by CSI, a.s., Prague, Zlín office

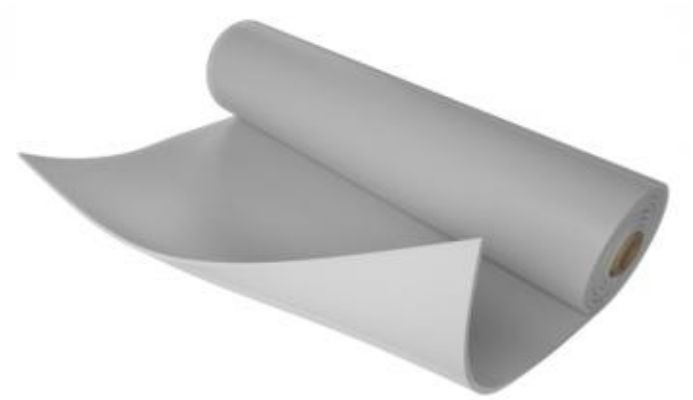
Documentation validity: Installation of the membrane requires using current product documentation (technical data sheet, declaration of conformity, certificate etc). This is available at www.fatrafol.cz.

2.1.9.2.4 FATRAFOL P 918/H waterproofing membrane

- **PRODUCT DESCRIPTION**

  FATRAFOL P 918/H is a homogeneous roof waterproofing membrane based on thermoplastic polyolefins (TPO). The membrane is manufactured by the process of extrusion.

  The membrane provides resistance to UV radiation and common chemicals, may be exposed to the weather and is compatible with asphalt and polystyrene.



- **USE**

  The membrane is only an accessory to FATRAFOL P TPO roofing membranes and is intended for detailing.

  The membrane is not suitable for use as a mechanically or otherwise fastened covering for large roof areas.

- **APPLICATION**

  The membrane may only be installed by qualified and specially trained contractors.

  FATRAFOL P 918/H must be installed in accordance with this Instructions.

  When making standard joints, keep a 50 mm sheet overlap and make the homogeneous joint at least 30 mm wide. In detailing (e.g. roof deck penetrations of unusual shape and size), maintaining the minimum membrane overlap and weld width is not always possible.

  The membranes may be joined together by hot-air welding or a wedge welder with continuous temperature control. Welding temperature and speed must be set on the basis of on-site tests. No solvent need be applied at the point of weld to make a perfect joint.

  Ambient air and substrate temperature should not drop below -10°C during installation.

- **PRODUCT DATA**

  - **Dimensions and packaging details**

Thickness [mm]	Width [mm]	Surface density *) [kg/m^2]	Roll length		Roll weight *) [kg]	Pallet coverage		Pallet weight *) [kg]
			[m]	[m^2]		Rolls	[m^2]	
2.00	2,050	2.00	15	30.75	62	21	645.75	1,320
	1,025		15	15.375	62	42	645.75	1,320

**) Approximate figures*

  - **Appearance and colours**
    - Smooth membrane with a matt surface
    - Available in colours shown in the table

Design	FATRAFOL P 918/H top surface colour	Colour tone	
		Fatra colour chart	RAL colour chart
	Grey-white	-	7035
	Grey	-	7037

■ **Technical parameters – guaranteed values**

Property	Test standard	Guaranteed values
Tensile strength	EN 12311-2 method A	≥ 750 N/50 mm
Elongation		≥ 800%
Watertightness	EN 1928/B	Pass
Reaction to fire	EN 13501-1	Class E
External fire performance	ENV 1187	B_{ROOF} (t1)
Peel resistance of joints	EN 12316-2	≥ 250 N/50 mm
Shear resistance of joints	EN 12317-2	≥ 450 N/50 mm
Resistance to impact	EN 12691/A	Pass, 1,250 mm
	EN 12691/B	Pass, 1,750 mm
Resistance to static loading	EN 12730/B	Pass, 20 kg
Resistance to tearing	EN 12310-2	≥ 180 N
Dimensional stability	EN 1107-2	Max. ± 2%
Foldability at low temperature	EN 495-5	≤ -40°C
Exposure to UV radiation, elevated temperature and water (5,000 hours)	EN 1297	Pass, degree 0
Water vapour permeability – diffusion resistance factor μ	EN 1931	100,000 ± 20,000
Equivalent diffusion thickness s_d		200 m

■ **RELATED TECHNICAL DOCUMENTATION**

- Technical data sheet TL 5-1022-10, FATRAFOL P 918/H waterproofing membrane, issued by Fatra, a.s., Napajedla
- Production management system certificate 1390-CPD-0010/11/Z for FATRAFOL P 918/H waterproofing membrane according to EN 13956:2006, issued by CSI, a.s., Prague, Zlín office

Documentation validity: Installation of the membrane requires using current product documentation (technical data sheet, declaration of conformity, certificate etc). This is available at *www.fatrafol.cz*.

2.2 Supplementary waterproofing materials

Supplementary waterproofing materials are components of the FATRAFOL-S roof waterproofing system that help build a perfectly watertight roof covering and details. The materials include vacuum-shaped non-reinforced membrane components for detailing (internal corner, external corner), flat membrane cuttings, rainwater outlets, vent outlets, plastic-coated metal profiles and sealants with great adhesion to membranes. All of these materials (except polyurethane sealer) are based on individual types of the waterproofing membranes manufactured by FATRA Napajedla. This guarantees their compatibility and material uniformity within the FATRAFOL-S roof waterproofing system.

2.2.1 Accessories for PVC-P membranes

2.2.1.1 Shaped piece – internal corner

A vacuum-shaped FATRAFOL 804 component

Manufacturer: FATRA, a.s., 763 61 Napajedla

Documentation: Company standard PND 5-101-97, material data sheet 1/1997

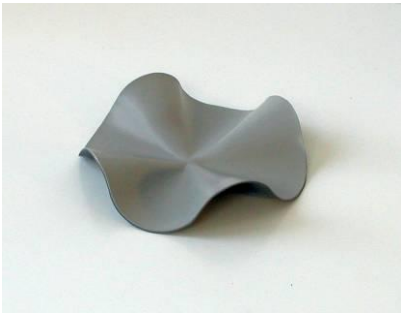
Colour: FATRAFOL 804 colours

Dimensions: Height 50 mm, diameter 120 mm

Packaging: 40-piece bag, 400-piece cardboard box

Use: Finishing and sealing of internal corners

2.2.1.2 Shaped piece – external corner



A vacuum-shaped FATRAFOL 804 component

Manufacturer: Fatra, a.s., 763 61 Napajedla

Documentation: Company standard PND 5-101-97, material data sheet 2/1997

Colour: FATRAFOL 804 colours

Dimensions: Height 25 mm, diameter 160 mm

Packaging: 30-piece bag, 240-piece cardboard box

Use: Finishing and sealing of external corners

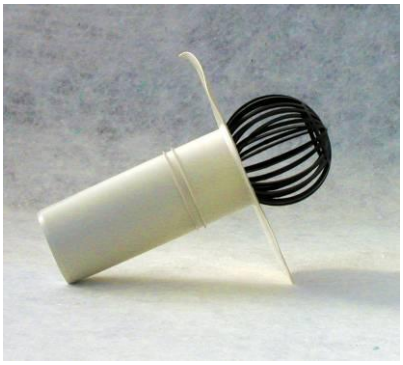
2.2.1.3 Vent outlets

Vent outlets with a PVC-P based collar for hot-air welding to a membrane

Dimensions: Minimum height 300 mm, opening diameter approx. 100 mm

Use: Removal of entrapped moisture from all types of roofs. Recommended quantity – 3 pieces per 100 m^2.

2.2.1.4 Rainwater outlets



Rainwater outlets with a PVC-P based collar for hot-air welding to a membrane

Dimensions: Neck diameters from 60 to 110 mm (in 10 mm increments), 125 mm, 150 mm

Use: Designed for finishing downpipes. Built-in outlets must be fitted with a leaf or stone trap.

2.2.1.5 Spouts and overflow outlets

Shaped drains with a PVC-based collar for hot-air welding to a membrane

Dimensions: Neck diameters 40 mm, 50 mm, 75 mm, 110 mm, 125 mm, square-shaped opening 50x100 mm up to 100x300 mm

Use: Finishing downpipes on a vertical wall, e.g. parapet.

2.2.1.6 Penetration components

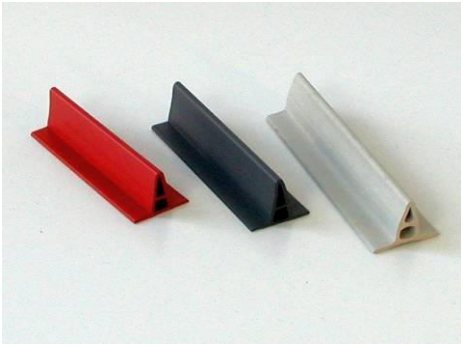
Suitably shaped pieces with a PVC-P based collar for hot-air welding to a membrane.

Dimensions: Wide range of dimensions, depending on type.

Use: Used for sealing TV aerials, cables, round and square-shaped closed profiles penetrating the roof.

2.2.1.7 'A' profile Novoplast 1871

An auxiliary profile for FATRAFOL roofing membranes – (type 1871, nozzle number 2291).



Use: Designed to optically divide roof coverings into smaller sections to imitate a sheet metal roof. The profiles must be applied on a finished covering; they do not have a waterproofing function.

Benefits: Division of roof planes into segments, better rainwater drainage, appealing to the eye

Composition: Plasticised PVC – extruded profile, UV stabilisation

Colour: Light grey (2761), dark grey (2003)

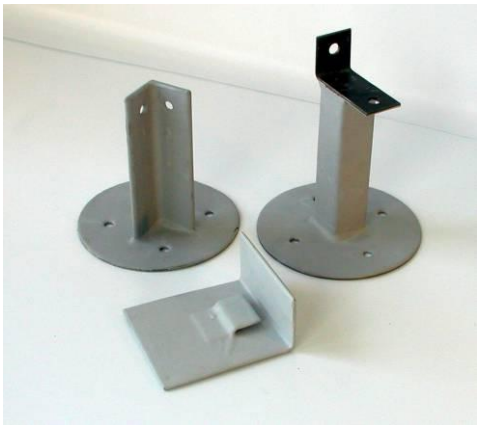
Dimensions: Width 31.5 mm; height 24.5 mm; length 2.5 m

Packaging: In boxes, in full length

Note: The profiles cannot be used as a snow barrier!

2.2.1.8 Plastic-coated installation components

PVC-coated steel components made to order (e.g. shingle flashing holder, air-conditioner support etc)

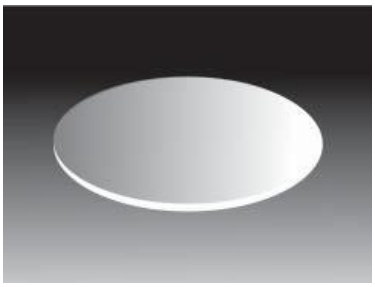


Dimensions: Any dimensions, limited by coating machine capabilities

Use: Fastening and installation of rooftop structures

2.2.1.9 Flat component - patch

A round cutting of the FATRAFOL 804 waterproofing membrane.



Manufacturer: FATRA, a.s., 763 61 Napajedla

Documentation: Company standard PND 5-101-97, material data sheet 3/1997

Colour: FATRAFOL 804 colours

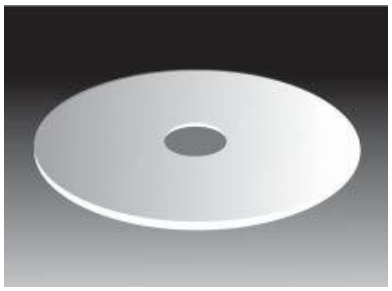
Dimensions: Diameter: 160 mm

Packaging: 25-piece bag, 300-piece cardboard box

Use: Used to cover fasteners or damaged spots of a waterproofing membrane.

2.2.1.10 Flat component – fixing disc, collar

A ring-shaped cutting of the FATRAFOL 804 and FATRAFOL 810 waterproofing membranes.



Manufacturer: FATRA, a.s., 763 61 Napajedla

Documentation: Company standard PND 5-101-97, material data sheet 4/1997

Colour: FATRAFOL 804 colours

Dimensions: Outer/inner diameter

- 400/20 mm if made of FATRAFOL 804
- 183/14 mm if made of FATRAFOL 810

Packaging: 10-piece PE bags or 140-piece cardboard box

Use: Collars made of FATRAFOL 804 are used to create shaped pieces for circular penetrations through the waterproofing membrane.

Collars made of FATRAFOL 810 (fixing disc) are used to fix the FATRAFOL 810 (810/V) membrane in a mechanically fastened system where the membrane is bonded to the discs.

2.2.1.11 Z-01 sealant

A solution of PVC and additives in organic solvents.

Colour: Dark grey, light grey, green

Packaging: 0.5 l and 2.5 l tins

Use: Used to secure the strength of PVC-P FATRAFOL welds. The sealant is applied using a PE bottle with a nozzle in the lid. The sealant takes about 2 hours to dry after application. To dilute the sealant, the manufacturer supplies diluent that is marketed under the L-494 name. If treating the entire weld area, approximately 1 tinful of the diluent is necessary for 300m^2.

Warning: The fumes are harmful to health! Class I flammable. Shake the tin well before use!

2.2.1.12 L-494 diluent

A colourless liquid.

Packaging: 2.5 l tins

Use: Designed for preparing and diluting sealants used to secure the strength of PVC-P FATRAFOL welds. Component ratio – 20% crushed membrane, 80% diluent Subject to compliance with specific conditions, the diluent may exceptionally be used to cold-join PVC-P waterproofing membranes.

Warning: The L-494 diluent contains tetrahydrofuran (THF), which is a volatile, highly flammable, poisonous and colourless liquid. The fumes are harmful to health! Class I flammable.

2.2.1.13 Polyurethane sealer

Highly elastic and flexible sealer with great adhesion to membranes and building materials. Has a long-service life even if exposed to direct weather conditions including UV radiation.

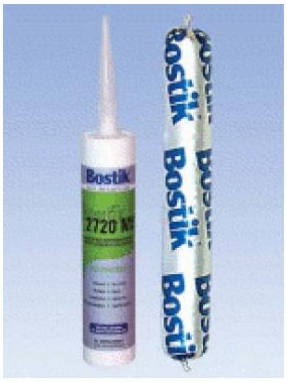
Packaging: - 310 ml cartridge – 25 Sh A
- 600 ml bag – 40 Sh A
- 5 kg buckets – 15 Sh A

Use: Applied to provide long-term elastic sealing at point of contact between a waterproofing membrane and metals, plastics and building materials. The surfaces to be sealed must be dry and clean. Not to be diluted. The sealer is applied using a sealing gun or spatula.

Application temperature: +5°C up to +40°C

2.2.1.14 Polymer sealer

One-component elastic hybrid sealer based on MS-polymers. A highly versatile product, the sealer dries by air humidity and creates softly elastic and watertight joints with excellent resistance to the weather and chemicals. The sealer is free of solvents, isocyanates and silicon. It contracts slightly after application.



Packaging: - cartridge - 20 x 290 ml (while, light grey, black) – 25 Sh A
- bag - 20 x 600 ml (white, black, dark brown, anthracite, tones of grey) – 25 Sh A

Use: The sealer is used for sealing and filling connection and expansion joints both indoors and outdoors. Sealed surfaces must be dry and clean.

Application temperature: +5°C up to +40°C

2.2.1.15 FATRANYL plastic-coated metal profiles

Description: FATRANYL is hot-dip galvanised sheet metal coated on both sides with a protective varnish layer and with a plasticised PVC layer on the top surface.

The plastic-coated sheet metal acquires its properties primarily from the high-quality sheet metal suitable for building applications and from the PVC layer composition that guarantees high UV resistance as well as resistance to thermal degradation during the hot-air welding process. FATRANYL requires no maintenance or PVC layer renovation during its life cycle.

FATRANYL meets the requirements of EN 14783.

Use: The plastic-coated sheet metal is used:

- For linear fastening and perimeter end pieces for PVC-P based waterproofing membranes
- As a sheet metal component – for plating roofs, terraces, balconies, recessed balconies, ledges, sills etc.

Application: Work with FATRANYL (cutting, bending, shaping etc) is similar to work with sheet metal without a PVC-P layer, differing in that FATRANYL sheets cannot be soldered or welded together. The sheets may be joined edge-to-edge, keeping an expansion joint, or overlapped and then covered.

If hot-air welding machines are used, FATRANYL is weldable to all FATRAFOL-S waterproofing membranes based on PVC-P.

Dimensions and packaging details:

- Sheet thickness: 0.6 mm, minimum PVC-P layer thickness: 0.6 mm
- Standard size: 2 x 1 m
- Shaped profiles – for shapes and dimensions see table 5.

Appearance and colours:

- Standard colour – light grey
- Also available in colours shown in the table

Design	FATRANYL top surface colour	Colour tone	
		Fatra colour chart	RAL colour chart *)
	Light grey	2761	7040
	Dark grey	2003	7012
	Red	3104	3016
	Blue	9113	5015
	Green	7060B	6000
	Copper brown	3503	8004

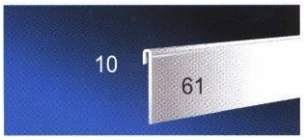
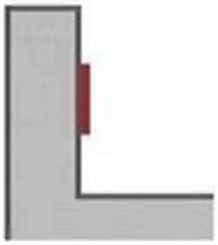
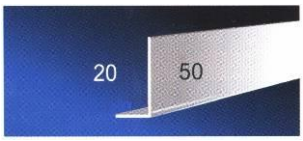
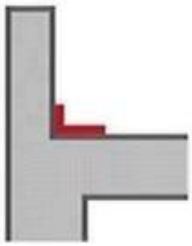
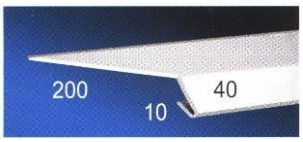
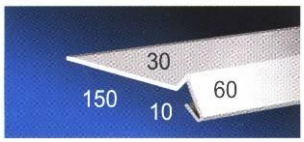
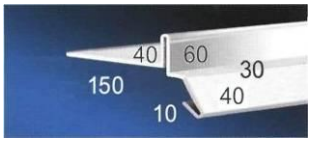
*) *Some colours may differ slightly from the RAL colour chart, but no more than the 3rd degree of the grey scale under CSN EN 20105-A02.*

Technical parameters – guaranteed values:

Property	Test standard	Guaranteed values
Resistance to weather	EN ISO 4892-3	Pass
PVC layer adhesion to sheet metal	Manufacturer's standard 1005-11	Pass
Welded joint strength after ageing in water and air	Manufacturer's standard 1001-11	Tearing outside of joint
External fire performance	ENV 1187	B_{ROOF} (t3)

Technical documentation: FATRANYL technical data sheet, issued by 3VH Plastics, Uherský Brod
EC declaration of conformity according to EN 14783:2006 – report on initial type examination 1020-CPD-060034118, issued by TZÚS Prague, Brno Branch

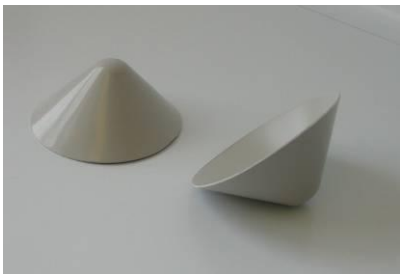
Table 5: Recommended basic shapes and dimensions of plastic-coated metal profiles

Type	Recommended shape and dimensions [mm]	Name	Unfolded width [mm]	Use	
1		Curved strip	71	Ending of vertical extension	
2		Internal and external corner flashing	70	Fastening on internal and external edges	
3		Drip mould, wide	200-250	Ending next to gutter and on parapet	
4		Gravel stop	250	Lateral ending of ledge	
5		Gravel stop, curved	330	Lateral ending on wall	
For a complete range of plastic-coated metal profiles visit www.fatrafol.cz.					

2.2.2 Accessories for TPO membranes

2.2.2.1 Shaped piece – internal corner

A vacuum-shaped FATRAFOL P 918/H component



Manufacturer: FATRA, a.s., 763 61 Napajedla

Documentation: Company standard PND 5-101-97, material data sheet 1/1997

Colour: FATRAFOL P 918/H colours

Dimensions: Height 50 mm, diameter 120 mm

Packaging: 40-piece bag, 400-piece cardboard box

Use: Finishing and sealing of internal corners

2.2.2.2 Shaped piece – external corner

A vacuum-shaped FATRAFOL P 918/H component

Manufacturer: Fatra, a.s., 763 61 Napajedla

Documentation: Company standard PND 5-101-97, material data sheet 2/1997

Colour: FATRAFOL P 918/H colours

Dimensions: Height 25 mm, diameter 160 mm

Packaging: 30-piece bag, 240-piece cardboard box

Use: Finishing and sealing of external corners

2.2.2.3 Vent outlets

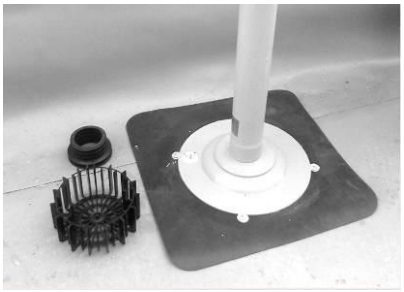
Vent outlets with a TPO based collar for hot-air welding to a membrane

Dimensions: Height 225 mm and 270 mm, opening diameter 50, 75, 110 and 125 mm

Use: Removal of entrapped moisture from all types of roofs. Recommended quantity – 3 pieces per 100 m^2.

2.2.2.4 Rainwater outlets

Rainwater outlets with a TPO based collar for hot-air welding to a membrane



Dimensions: Neck diameters: 70 mm, 110 mm, 125 mm

Use: Designed for finishing downpipes. Built-in outlets must be fitted with a leaf or stone trap.

2.2.2.5 Spouts and overflow outlets

Shaped drains with an integrated TPO-based collar for hot-air welding to a membrane

Dimensions: Neck diameters 40 mm, 50 mm, 75 mm, 110 mm, 125 mm, square-shaped opening 50x100 mm up to 100x300 mm

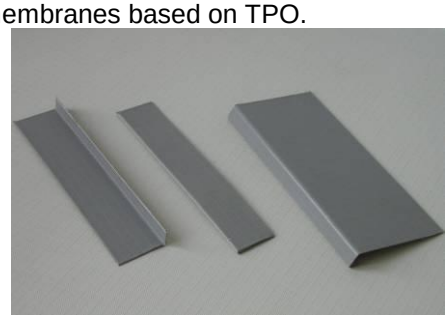
Use: Finishing downpipes on a vertical wall, e.g. parapet.

2.2.2.6 Penetration components

Given the limited range of products in the market, we recommend making penetration components for TPO membranes from the FATRAFOL P 918/H detailing membrane.

2.2.2.7 TPO-coated metal profiles

Plates, flat cuttings or shaped profiles of galvanised steel sheet metal (0.6 mm in thickness) with a single-sided coating of a 1.0 mm thick TPO membrane. The profiles are weldable to FATRAFOL-S membranes based on TPO.



Dimensions: Plates 2x1 m**,** shaped profiles – shapes and dimensions identical to Fatranyl sheet metal – see table 5.

Use: Designed for linear fastening of waterproofing membranes to a substrate. Fasteners are used to secure the membrane in place. TPO membranes are hot-air weldable to FATRAFOL P membranes. Uncovered edges require no maintenance or coating with protective paint.

2.3 AUXILIARY MATERIALS

Auxiliary materials are products whose primary function is to secure the contact between a waterproofing membrane and other structural components of the roof. They include separation and protective fleece and other materials necessary for a complete roof deck. The products below were tested and verified for their intended purpose but are interchangeable with products of other manufacturers that provide identical properties. Please see our current price list for an up-to-date range of auxiliary and supplementary materials.

If your application requires the use of a material not contained in this Instructions, please consult FATRA for its suitability.

2.3.1 Vapour barriers

2.3.1.1 FATRAPAR

Description: FATRAPAR is a vapour barrier based on a PE membrane and available in thicknesses of 0.15, 0.20 and 0.30 mm.

Use: A vapour control layer preventing the migration of water vapour and moisture through the roof and other structures. FATRAPAR may be used on flat and pitched roofs, walls, ceilings and floors.

Application: FATRAPAR must be installed in accordance with this Instructions.
The vapour control membrane is usually placed under the thermal insulation layer, close to the inner surface of the roof structure. It should preferably be installed in the direction of slope. To join the membranes, use double-sided adhesive butyl-rubber or Al tape and follow the tape manufacturer's instructions.

Dimensions and packaging details:

Thickness [mm]	Width [mm]	Surface density *) [kg/m^2]	Roll length [m]	Roll length [m^2]	Roll weight *) [kg]
0.15	2,000	0.14	50	100	15
	4,000		25		
0.20	2,000	0.19	50		20
	4,000		25		
0.30	2,000	0.28	50		30
	4,000		25		

**) Approximate figures*

Colour: yellow

Technical parameters – guaranteed values:

Property	Test standard	Guaranteed values
Tensile strength	EN 12311-2 method B	≥ 15 MPa
Elongation (L/T)		≥ 300/350%
Watertightness	EN 1928/A	Pass
Reaction to fire	EN 13501-1	Class F
Resistance to tearing (0.15 / 0.20 / 0.30 mm)	EN 12310-1	≥ 40 N / 70 N / 100 N
Effect of artificial ageing on water vapour permeability	EN 1296, EN 1931	Pass
Water vapour permeability – diffusion resistance factor μ	EN 1931	600,000
Equivalent diffusion thickness s_d (0.15 / 0.20 / 0.30 mm)		90 m / 120 m / 180 m

L – longitudinal direction
T – transverse direction

Technical documentation: Technical data sheet issued by Eurosystem, Polska Sp. z o.o.
Declaration of conformity with PN EN 13984:2006 and PR EN 13984:2006/A1:2007

2.3.1.2 SK VAP 108

Description: **SK VAP 108** is a self-adhesive bitumen vapour barrier with an aluminium insert and polyester reinforcement. The barrier features great adhesion to the substrate, chemical resistance, UV stability and flexibility.

Use: The self-adhesive vapour barrier is suitable for both pitched and flat roofs including application on trapezoidal sheet metal.

Application: The vapour barrier must be installed on a flat, clean, dry and grease-free surface. If installing the barrier on a highly absorbing substrate, such as concrete, the VERNIS ANTAC primer must be used. For installation instructions refer to the technical data sheet or the manufacturer's installation Instructions.

Application temperature: +5°C up to +40°C

Dimensions: Thickness: 1.2 mm
Width: 1,080 mm

Technical parameters – guaranteed values:

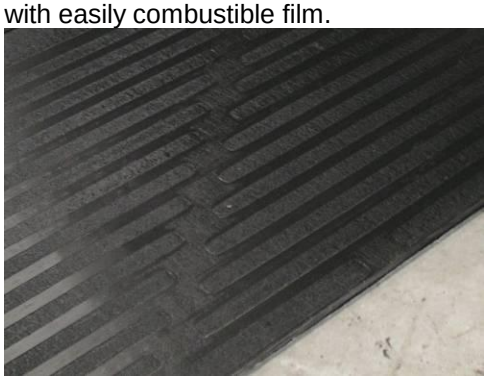
Property	Test standard	Guaranteed values
Tensile strength	EN 12311-1	≥ 200 N/50 mm
Elongation		≥ 20%
Reaction to fire	EN 13501-1	Class E
Resistance to tearing	EN 12310-1	≥ 20 N
Water vapour permeability – diffusion resistance factor μ	EN 1931	1,250,000
Equivalent diffusion thickness s_d		1,500 m
Effect of artificial ageing on water vapour permeability: Water vapour permeability – diffusion resistance factor μ	EN 1296, EN 1931	625,000
Equivalent diffusion thickness s_d (after ageing)		750 m

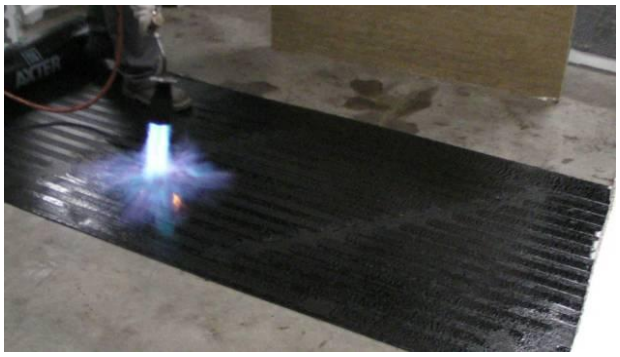
Packaging: The vapour barrier is packed in 25-m long rolls placed upright on a pallet and protected against high temperatures and humidity. Do not stack the pallets.

Technical documentation: Technical data sheet issued by AXTER, France.

2.3.1.3 VAP AL THERM

Description: **VAP AL THERM** is an SBS-modified asphalt thermofusible sheet with composite aluminium and glass fibre reinforcement. The top surface has a THERM system while the underside is protected with easily combustible film.





Use: A vapour barrier sheet that is suitable for melting onto any type of substrate.

Application: The vapour barrier must be installed on a smooth, clean, dry and grease-free surface. The substrate must be treated with the VERNIS ANTAC primer. The THERM system on the top surface allows direct installation of a thermal insulation layer consisting of EPS boards without adding any adhesive. For installation instructions refer to the technical data sheet or the manufacturer's installation Instructions.

Packaging: The vapour barrier is packed in 8-m long rolls placed upright on a pallet and protected against high temperatures and humidity.

Dimensions: Thickness: 3.0 mm
Width: 1,000 mm

Technical parameters – guaranteed values:

Property	Test standard	Guaranteed values
Tensile strength – L/T	EN 12311-1	≥ 500/350 N/50 mm
Elongation – L/T		≥ 15/40%
Reaction to fire	EN 13501-1	Class E
Resistance to tearing – L/T	EN 12310-1	≥ 160/150 N
Effect of artificial ageing on water vapour permeability	EN 1296, EN 1931	Pass
Water vapour permeability – diffusion resistance factor μ	EN 1931	500,000
Equivalent diffusion thickness s_d		1,500 m

L – longitudinal direction
T – transverse direction

Technical documentation: Technical data sheet issued by AXTER, France.

2.3.2 Thermal insulation

2.3.2.1 Mineral wool thermal insulation

Advantages:

- Incombustibility – protection from the spread of flames and fire
- Excellent thermal resistance and dimensional stability
- Great sound absorption
- High vapour permeability
- Compatibility with PVC-P membranes, no separation fleece required

Disadvantages:

- High water absorption
- Significantly heavier – i.e. added load on the roof structure
- Relatively low point load capacity of standard product types

Description: A rigid heavy hydrophobic board of stone wool (mineral wool) bonded with organic resin.

Use: Designed for thermal, fire and acoustic insulation of buildings. In combined insulation systems, mineral wool is used mostly as an upper layer under the covering to give the roof better fire protection. Mineral wool is suitable for mechanically fastened systems or roofs loaded with shingles or pavers.

Application: Mineral wool is installed in one or more layers; the maximum width of open joints is 5 mm. Minimum recommended thickness for single-layer installation: 60 mm.

Packaging: In blocks or on pallets covered with wrap film.

Dimensions: Width x length: 600 x 1,000 mm, 1,200 x 2,000 mm
Thickness: 30 mm up to 120 mm

Technical parameters – usual values:

Property	Test standard	Value
Thermal conductivity coefficient λD	EN 12667	0.040 W/m.K
Compressive strength at 10% compression	EN 826	≥ 60 kPa
Reaction to fire	EN 13501-1	Class A1
Long-term water absorption by immersion	EN 12087	≤ 3 kg/m^2
Point load	EN 12430	≥ 500 N
Apparent density	EN 1602	Approx. 220 kg/m^3

Technical documentation: EC Certificate of Conformity

2.3.2.2 Expanded polystyrene foam (EPS)

Advantages:

- Low apparent density
- Cheaper than other insulation boards

Disadvantages:

- Poorer fire performance
- Higher water absorption
- Unwanted interaction with a PVC-P membrane (120 g/m^2 glass fibre fleece must be used for separation)
- Low thermal resistance (e.g. volume changes may occur while membranes are hot-air welded on the boards)
- Higher thermal expansion

Description: Thermal insulation boards, dimensionally stabilised, sufficient thermal insulation performance for flat roofs.

Use: For all roof types except inverted ones.

Application: From EPS 70 S (for base waterproofing layers) up to EPS 200 S (for waterproofing layers exposed to heavy load).

EPS 100 S or higher for the top insulation layer (roofs without traffic).

Packaging: In blocks covered with wrap film.

Dimensions: Width x length: 500 x 1,000 mm, max. 1,000 x 6,000 mm
Thickness: up to 250 mm in 10 mm increments

Technical parameters – usual values:

Property	Test standard	Value
Thermal conductivity coefficient λD	EN 12667	0.033 W/m.K
Compressive strength at 10% compression	EN 826	≥ 70 up to 200 kPa
Reaction to fire	EN 13501-1	Class E
Long-term water absorption by immersion	EN 12087	≤ 5%
Point load	EN 12430	NA
Apparent density	EN 1602	Approx. 15 up to 30 kg/m^3

Technical documentation: EC Certificate of Conformity

2.3.2.3 Extruded polystyrene foam (XPS)

Advantages:

- Low apparent density
- Very low water absorption
- High compressive strength

Disadvantages:

- Poorer fire performance
- Unwanted interaction with a PVC-P membrane (120 g/m^2 glass fibre fleece must be used for separation)
- Low thermal resistance (e.g. volume changes may occur while membranes are hot-air welded on the boards)
- Higher thermal expansion

Description: Thermal insulation boards with a closed cell structure, manufactured by the process of extrusion, sufficient thermal insulation performance for flat roofs.

Use: For inverted roofs, roofs exposed to heavy traffic or green roofs.

Application: Boards with a perimeter half-groove or upright edges are typically installed in a single layer, edge-to-edge.

Packaging: In blocks covered with wrap film.

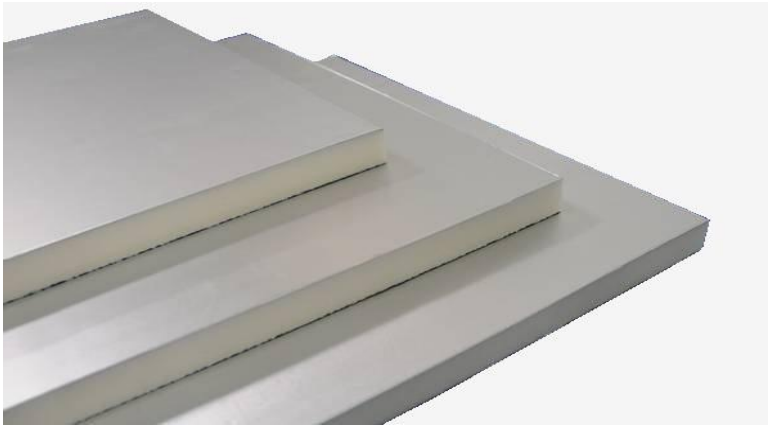
Dimensions: Width x length: 600 x 1,250 mm
Thickness: 20 mm up to 200 mm

Technical parameters – usual values:

Property	Test standard	Value
Thermal conductivity coefficient λ_D	EN 12667	0.035 W/m.K
Compressive strength at 10% compression	EN 826	≥ 300 kPa
Reaction to fire	EN 13501-1	Class E
Long-term water absorption by immersion	EN 12087	≤ 0.5%
Point load	EN 12430	NA
Apparent density	EN 1602	Approx. 30 kg/m^3

Technical documentation: EC Certificate of Conformity

2.3.2.4 Polyisocyanurate (PIR) insulation boards



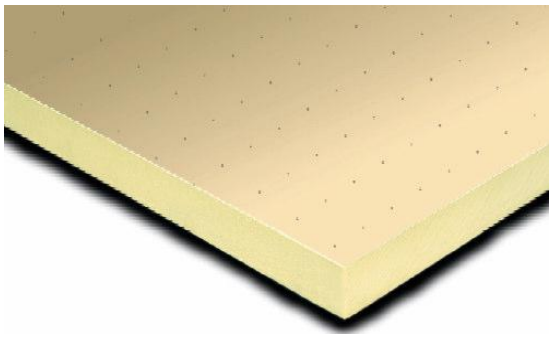
Advantages:

- Low apparent density
- High compressive strength
- Low water absorption due to closed structure
- Dimensional stability as the boards are not subject to sublimation caused by increasing surface temperature due to the Sun
- Premium thermal insulation properties that provide, despite thinner insulation, the same thermal resistance as standard materials
- Compatible with PVC-P membranes that are installed directly on the thermal insulation boards, no need to use separation fleece

Disadvantages:

- A higher price
- Cannot be used for inverted roofs

2.3.2.4.1 Powerdeck F



Description: POWERDECK F is a thermal insulation board with a core of rigid polyisocyanurate foam with a specific cell structure called *TAUfoam by Recticel*. It is faced on both sides with mineral-coated glass fibre fleece.

Use: Roof thermal insulating material suitable for both mechanically fastened and bonded systems. In a bonded system, Powerdeck F may only be used in combination with FATRAFOL 807/V.

Application: Only the 1,200x600 mm boards are used for a bonded system or a waterproofing system loaded with shingles. 1,200x1,000 mm or 1,200x2,500 mm boards are used for mechanically fastened systems.

Packaging: In blocks covered with wrap film.

Dimensions: Width: 1,200 mm
Length: 600 mm; 1,000 mm; 2,500 mm
Thickness: 30 mm up to 120 mm

Technical parameters – guaranteed values:

Property	Test standard	Guaranteed value
Thermal conductivity coefficient λ_D	EN 12667	0.026 W/m.K
Compressive strength at 10% compression	EN 826	≥ 120 kPa
Reaction to fire	EN 13501-1	Class E
Long-term water absorption by immersion	EN 12087	≤ 2%
Point load	EN 12430	NA
Apparent density	EN 1602	Approx. 30 kg/m^3

Technical documentation: EC Certificate of Conformity BC1-514-0004-0019-W002

2.3.3 Separation and protective fleece

2.3.3.1 FATRATEX

Needle-punched non-woven fleece based on 100% regenerated synthetic fibres, white colour.

Dimensions: - Width: 2,000 mm
- Surface density: 200 - 500g/m²

Use: Protective and separation layer for waterproofing membranes on flat and pitched roofs

Advantages: Surface thermal treatment = trouble-free fastening, the geotextile does not get wound around drill bits

Packaging: Rolls are covered with bright yellow PE film

2.3.3.2 FATRATEX S

Needle-punched non-woven fleece based on 100% regenerated synthetic fibres, white colour.

Dimensions: - Width: 2,800 mm
- Surface density: 200 - 1,300g/m²

Use: Protection of waterproofing membranes on flat and low-pitched roofs with aggregate, traffic layer or vegetation layers

Advantages: Enhanced resistance to biological corrosion

Packaging: Rolls are covered with high-visibility green PE film

2.3.3.3 Glass fibre fleece

Non-woven fleece made of glass fibres, white colour

Dimensions: - Width: 2,000 mm
- Square density: 120 g/m²

Use: Separation layer for FATRAFOL membranes/EPS-based thermal insulation

Advantages: Slows the spread of fire through the roof deck

Packaging: Rolls with 100 m^2 coverage

2.3.4 Adhesives

2.3.4.1 PUK

One-component expansive polyurethane adhesive, green colour

Use: For one-sided bonding of fleece-backed membranes to all types of materials except mineral wool boards.

Application: The bonded surface must be dry, flat and free of dust. Pour the adhesive onto the substrate directly from the can or using a PUK-KOBOLD cart. Immediately put the membrane on the adhesive and press the entire area of the joint. If the substrate is uneven, make sure to load the membrane for the reaction time (2-24 hours).

Application temperature: +5°C up to +50°C

Consumption: At least 120 g/m² (3-4 bonding beads of 8 mm in width per 1 m^2 of roof field).

Packaging: 2 kg or 6.5 kg cans

Cleaner: Acetone

2.3.4.2 ISOLEMFI 50119 D MONO

One-component reactive polyurethane adhesive, creamy transparent colour

Use: For bonding fleece-backed membranes to all types of materials including polystyrene and mineral wool thermal insulation boards.

Application: The bonded surface must be dry, flat and free of dust. To apply the adhesive on the substrate, use a toothed spatula, roller, applicator or a spray gun. Before unrolling the roll, moisten the adhesive film with water spray (approx. 10 g of water per 100 of adhesive).

Application temperature: +5°C up to +35°C

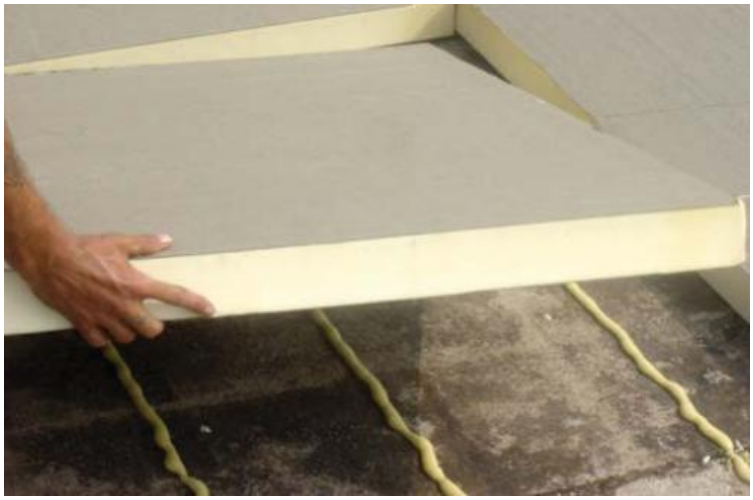
Consumption: 120 – 250 g/m² depending on application method and substrate type

Packaging: 8 kg and 40 kg cans

Cleaner: EMFI 683

2.3.4.3 Millennium One Step

Universal two-component polyurethane foamable solvent-free adhesive



Use: For bonding approved types of thermal insulation to the structural roof deck, asphalt vapour barriers, other types of thermal insulation and asphalt sheets with gravel or a smooth surface.

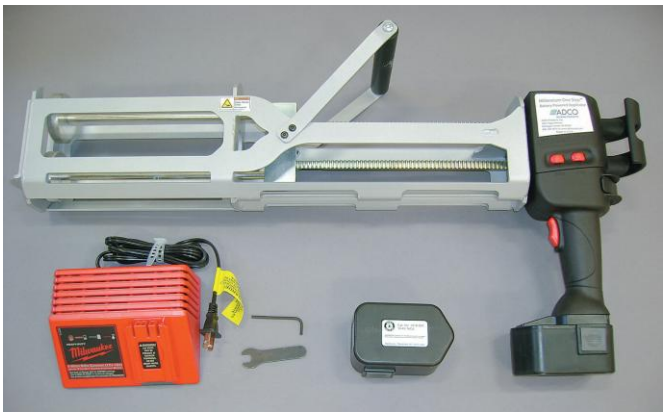
Approved thermal insulation and substrate types:

- Polyisocyanurate (PIR)
- Polystyrene (EPS, XPS)
- Asphalt cover boards
- Wood fibre boards, wood cement boards
- Perlite boards – min. 20 mm
- Gypsum boards, gypsum, DensDeck boards
- Concrete and lightweight concrete
- Wood or steel
- Modified asphalt sheets with gravel or sanded base sheets
- Approved thermal insulation – multi-layer roof composition
- Existing asphalt roof

Application: All substrates must be clean, dry, free of dust, oil, loose or embedded gravel, un-adhered coatings, deteriorated waterproofing membranes and other contaminants that may result in a surface that is not sound or even. If applying the product on new or non-oxidised asphalt, first treat the surface with the Millennium Surface Treatment solution. If using the product on existing deteriorated asphalt, first apply a layer of Millennium Universal Primer.

The insulation boards must lay flat on the substrate and must not be warped or curled; the adhesive is not recommended for boards larger than 1.2 x 1.2 m.

The adhesive is applied using a mechanical or handheld cartridge gun or a special multiple-cartridge cart.



Application temperature: +5°C up to +35°C

Coverage: Approx. 12 m^2 per double cartridge at 300 mm of centre-to-centre distance and 6-13 mm of adhesive bead width.

Packaging: 4 double cartridges (1.5 l) per paper case

Storage: Keep cartridges at between 18°C and 30°C for 24 hours before use. Do not store in direct sunlight or at temperatures above 32°C.

Cleaner: Acetone

2.3.4.4 Millennium PG1

Two-component polyurethane low-rise foamable adhesive that contains no solvents and sets in minutes. Compared to Millennium One Step, it has a longer application time.

Use: For bonding the FATRAFOL 807/V (807) roofing membrane to the structural roof deck, thermal insulation and smooth asphalt sheets (applies only to FATRAFOL 807). The adhesive may also be used for bonding thermal insulation.

Approved thermal insulation and substrate types:

- Polyisocyanurate (PIR)
- Polystyrene (EPS, XPS)
- Asphalt cover boards
- Wood fibre boards, wood cement boards
- Perlite boards – min. 20 mm
- Gypsum boards, gypsum
- Concrete and lightweight concrete
- Wood or steel
- Modified asphalt sheets with gravel or sanded base sheets
- Approved thermal insulation – multi-layer roof composition
- Existing asphalt roof

Application: All substrates must be clean, dry, free of dust, oil, loose or embedded gravel, un-adhered coatings, deteriorated waterproofing membranes and other contaminants that may result in a surface that is not sound or even. If applying the product on new or non-oxidised asphalt, first treat the surface with the Millennium Surface Treatment solution. If using the product on existing deteriorated asphalt, first apply a layer of Millennium Universal Primer.

The insulation boards must lay flat on the substrate and must not be warped or curled; the adhesive is not recommended for boards larger than 1.2 x 1.2 m.

The adhesive is applied directly onto the substrate using a mechanical or handheld cartridge gun or a special multiple-cartridge cart.

Under standard conditions, the membrane must be laid and pressed with a roller within approx. 6 minutes. The application time is shorter on very hot and humid days and longer on cold days.

Application temperature: +5°C up to +35°C

Coverage: Approx. 12 m^2 per double cartridge at 300 mm of centre-to-centre distance and 15-20 mm of adhesive bead width.

Packaging: 4 double cartridges (1.5 l) per paper case

Storage: Store the product valve side up at temperatures between 7°C and 35°C. Do not store in direct sunlight or at temperatures above 35°C. Keep from freezing.

Cleaner: Acetone

2.3.4.5 FF855 (C/88) polyurethane adhesive

Low-viscosity solvent-based polyurethane adhesive custom-developed for reinforced PVC-P roofing membranes.

Use: For bonding FATRAFOL 810 to fixing discs (collar – see article 2.2.1.10). The adhesive is unsuitable for bonding membranes at the point of joints.

Application: The bonded surface must be dry and free of dust, grease and dirt. If necessary, clean the dirty surface, preferably with the MEK solvent or acetone. Use a brush to apply the adhesive on fixing discs. BEWARE: the adhesive has a very short application time. Make sure that the bonded joint is loaded with a roller and air is pushed out of it between 30 and 60 seconds after adhesive application. Protect the adhesive from contamination by moisture and water.

Joints achieve their design strength only after complete solvent aeration, which takes approx. 7 days under standard weather conditions.

If the adhesive is applied at low temperatures or at high air humidity, moisture may occur on its surface, having a negative effect on joint strength.

Application temperature: +13°C up to +30°C

Consumption: 1 litre of adhesive per 3 up to 4 m^2 of surface

Packaging: 5 l tin

Cleaner: MEK or acetone

Warning: Highly flammable substance

2.3.5 Fasteners for waterproofing membranes and thermal insulation

The roof must be designed and checked for structural soundness in accordance with the below regulations and standards. Fasteners must secure the roof deck layers against internal and external forces.

The load capacity of roofs and roof supporting structures must be determined according to CSN EN 1991-1-1.

Snow loading of roof supporting structures and load-bearing layers must be determined according to CSN EN 1991-1-3.

Wind loading of roof supporting structures and of joints of individual roof layers and parts must be determined according to CSN EN 1991-1-4.

2.3.5.1 Fasteners for trapezoidal steel sheet metal

- **Substrate quality requirements:**

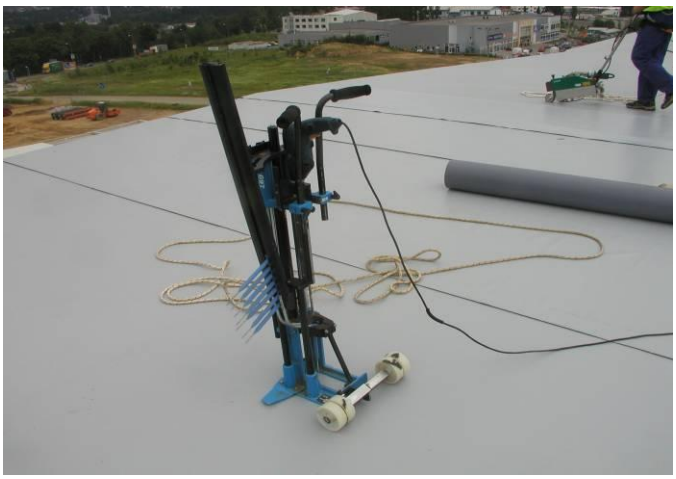
  Roof supporting structures made of trapezoidal sheet metal must withstand the loads specified in applicable standards. Bending and any other shape or dimensional changes caused by mechanical loads on the roof, temperature, and shape and dimensional changes of roof layers must not have an adverse effect on the roof function or on related structures. Bending must not exceed limits set by applicable standards. The supporting structure design must take into account the interaction of some metals (see CSN 73 3610).

  The smallest permissible longitudinal slope of roof valleys is 0.5% for water draining.

  The roof supporting structure slope must be such to prevent puddling on the roof. When choosing the membrane thickness, take the risk of puddling into account.

  Waterproofing membranes must not be placed directly on trapezoidal sheet metal without a suitable cushioning layer that can withstand the pressure during the hot-air welding process (minimum compressive strength: 60 kPa).

  Waves in trapezoidal steel sheet metal must not be filled with lightweight concrete.



- **Material:**
  - Screws made of refined carbon steel with anti-corrosion coating (e.g. Durocoat)
  - Screws made of austenitic stainless steel
  - Telescopes made of high-quality polypropylene or polyamide
  - Plate washers made of steel sheet with suitable finish (e.g. Al/Zn)

- **Use:**
  - To fasten a waterproofing layer combined with thermal insulation boards, use screws and plastic telescopes or plate washers.
  - To fasten linear profiles made of plastic- or film-coated sheet metal, use only screws.

- **Application:**
  - Combining a telescope with a screw provides a grip thickness of up to 700 mm. If using screws only, the maximum grip thickness is typically 300 mm or less.
  - Basic types of plate washers are available for both soft and hard substrates.
  - Fasteners are delivered separately in standard packaging or strapped for automatic installation machines.
  - Screws without a top thread combined with a plate washer are only suitable for thermal insulation with a minimum point load of 500 N.
  - Screw length shall be determined as the total thickness of all layers above trapezoidal sheet metal + 20 mm. If using a telescope and screw combination, make sure to add the screw length lost in the telescope shaft (approx. 15 mm).
  - Fasteners used for fastening roof structures and layers must withstand the estimated corrosive load in the roof composition.
  - Lines of fasteners must run perpendicularly or diagonally to trapezoidal sheet waves and must always be placed in upper waves. The minimum centre-to-centre distance between two adjacent fasteners is 150 mm.

2.3.5.2 Fasteners for concrete and reinforced concrete

- **Substrate quality requirements:**

  The substrate must be unbroken and sufficiently strong (at least 14 days old). Tensile tests must be performed for renovated flat roofs. The substrate must be free of any impurities and unevenness. The surface may be damp but it must be free of puddles, snow and ice.

Dilatation must be in accordance with CSN 731901.

The slope of the roof structure pitched layer must be such to prevent puddling on the covering (≥ 3%). When choosing the membrane thickness, take the risk of puddling into account.

The waterproofing membrane must be separated from the concrete base layer with non-woven fleece having a minimum surface density of 300 $g.m^{-2}$. Any use of separation fleece with a lower surface density (e.g. for machine-finished concrete) requires the technical supervisor's prior approval.

- **Material:**
  - Nails made of refined carbon steel with anti-corrosion coating (e.g. Durocoat)
  - Screws and blind rivets made of light metal alloys
  - Plate washers made of steel sheet with suitable finish (e.g. Al/Zn)
  - Telescopes made of high-quality polypropylene or polyamide

- **Use:**
  - To fasten a waterproofing layer combined with thermal insulation boards to massive concrete or concrete prefabricates, use screws and plastic telescopes.
  - Nails and blind rivets combined with a plate washer may be used to fasten a waterproofing layer with a thermal insulation layer to concrete of quality B 25 or higher. A tensile test is necessary for renovation projects.
  - To fasten linear profiles made of plastic- or film-coated sheet metal, use only screws, nails or blind rivets.

- **Application:**
  - Combining a telescope with a screw provides a grip length of up to 530 mm. If using screws only, the maximum grip length is typically 250 mm or less.
  - Steel nails with plate washers may be used for grip thicknesses up to 300 mm, longer nails are available on request (max. 800 mm).
  - Fasteners are delivered separately, in standard packaging.
  - To pre-drill holes for nails and screws in concrete, use a suitable concrete drill bit as recommended by manufacturers.
  - The thermal insulating material must have a point load capacity of no less than 500 N.
  - Screw length shall be determined as the total thickness of all layers above the concrete + 25 mm (+32 mm for nails). If using a telescope and screw combination, make sure to add the screw length lost in the telescope shaft (approx. 15 mm).
  - Fasteners used for fastening roof structures and layers must withstand the estimated higher corrosive load in the fixing layer. Fasteners are not reusable.

2.3.5.3 Fasteners for thin concrete prefabricates

- **Substrate quality requirements:**

  The substrate – prefabricate – surface must be unbroken and free of sharp edges and nibs. Open joints must be filled with suitable material. The substrate must be free of any impurities and unevenness. The surface may be damp but it must be free of puddles, snow and ice.

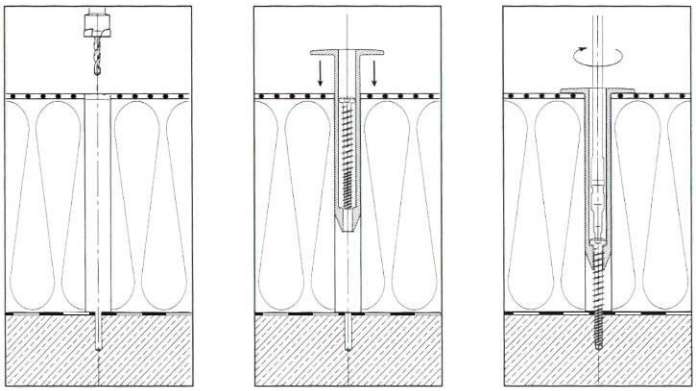
  The slope of the roof structure must be such to prevent puddling on the roof (≥ 3%). When choosing the membrane thickness, take the risk of puddling into account.

  The waterproofing membrane must be separated from the substrate with non-woven fleece having a minimum surface density of 300 $g.m^{-2}$.

- **Material:**
  - Screws made of refined carbon steel with anti-corrosion coating, e.g. Durocoat
  - Telescopes made of high-quality polypropylene or polyamide
  - Plate washers made of steel sheet with suitable finish (e.g. Al/Zn)

- **Use:**
  - To fasten a waterproofing layer combined with thermal insulation boards, use screws and plastic telescopes or plate washers.
  - To fasten linear profiles made of plastic- or film-coated sheet metal, use only screws.

- **Application:**
  - Combining a telescope with a screw provides a grip thickness of up to 515 mm. If using screws only, the maximum grip thickness is typically 125 mm or less.
  - Fasteners are delivered separately, in standard packaging.
  - Screw length shall be determined as the total thickness of all layers above the prefabricate + 25 mm. Usually add 15 mm for the screw length lost in the telescope shaft.
  - The minimum recommended pre-drill depth is 25 mm for thin prefabricates; the minimum recommended screw driving depth is 18 mm.
  - Fasteners used for fastening roof structures and layers must withstand the estimated higher corrosive load in the fixing layer.
  - To pre-drill screw holes, use suitable concrete drill bits as recommended by their manufacturers – see below.
  - The thermal insulating material must have a point load capacity of no less than 500 N.



2.3.5.4 Fasteners for porous concrete

- **Substrate quality requirements:**

  The porous concrete substrate (glass concrete, foam concrete and gas concrete) must be unbroken. If the apparent density is less than 500 kg/m^3, reinforce the surface with cement screed of a minimum thickness of 30 mm.

  Dilatation must be in accordance with CSN 731901.

  The slope of the roof structure must be such to prevent puddling on the roof (≥ 3%). When choosing the membrane thickness, take the risk of puddling into account.

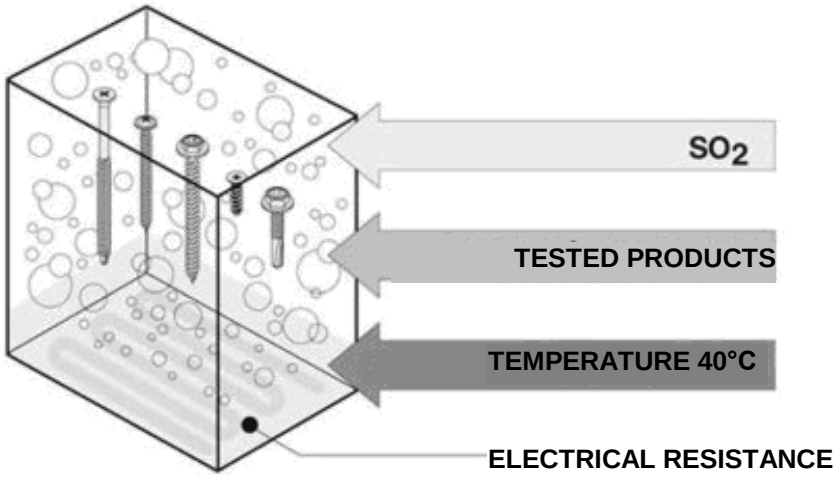
  The waterproofing membrane must be separated from the substrate with non-woven fleece having a minimum surface density of 300 g.m^{-2}.

- **Material:**
  - Screws made of refined carbon steel with anti-corrosion coating, e.g. Durocoat
  - Screws made of austenitic stainless steel
  - Telescopes made of high-quality polypropylene or polyamide
  - Plate washers (convex/concave) made of steel sheet with suitable finish (e.g. Al/Zn)

- **Use:**
  - To fasten a waterproofing layer combined with thermal insulation boards, use screws and plastic telescopes or plate washers.
  - To fasten linear profiles made of plastic- or film-coated sheet metal, use only screws.

- **Application:**
  - First of all, make sure to conduct tensile tests to help you choose a suitable fastener for this substrate type.
  - Combining a telescope with a screw provides a grip thickness of up to 455 mm. If using screws only, the maximum grip thickness is typically 240 mm or less.
  - For hard substrates, use convex washers. For soft substrates, use concave washers.
  - Fasteners are delivered separately, in standard packaging.
  - Screw length shall be determined as the total thickness of all layers above the porous concrete + 60 mm. Usually add 15 mm for the screw length lost in the telescope shaft.
  - The thermal insulating material must have a point load capacity of no less than 500 N.
  - Fasteners used for fastening roof structures and layers must withstand the estimated higher corrosive load in the fixing layer (moisture, aggressive chemicals etc).

Conducting the Kesternich test



KESTERNICH TEST: Fasteners are placed into a wet chamber filled with sulphur dioxide. No red corrosion may appear when the tested product is exposed to 2 litres of SO_2. The test cycle consists of 8 hours of exposure and 16 hours of rest. The resistance depends on the number of cycles the tested product goes through without showing signs of red corrosion.

2.3.5.5 Fasteners for wooden substrates

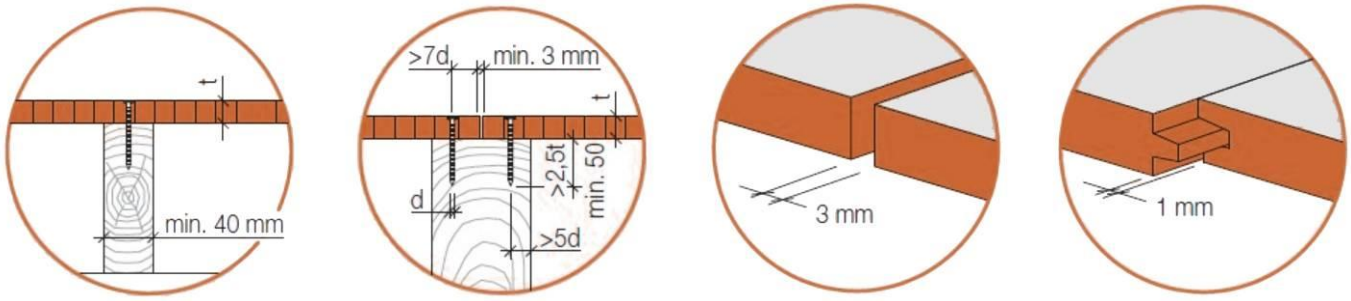
- **Substrate quality requirements:**

All components of the wooden structure (solid timber, large boards with added wood substance) except for cementitious boards must be treated against pests. An appropriate structural measure must be taken to ensure the service life of wooden components that are integrated into a structure with humidity exceeding 16% or that may be subject to additional exposure to water in the structure (e.g. due to condensation). Possible measures include building a two-ply roof with a ventilated air layer, adding a safety waterproofing layer etc. Even with a well ventilated air layer, water vapour may condense on the underside of the top ply in result of the so-called 'clear night factor'. The roof deck design must take this phenomenon into account. Wooden load-bearing components should be accessible for inspection, repair or renovation of the wood chemical protection throughout the structure's service life.

Planks must be joined tightly edge-to-edge; the minimum plank thickness is 25 mm. If the centre-to-centre distance of supports is 900 mm or greater, the minimum plank thickness is 30 mm.

Rigid roof boards pressed using wood substances and plywood panels must be installed keeping expansion joints recommended by the manufacturer. Expansion joints are necessary due to dimensional changes (humidity, temperature).

OSB boards – recommended fastening and expansion joints:



The minimum recommended width of an expansion joint at a point of penetration (roof opening, HVAC equipment, drain etc) is 3 mm. Expansion joints at a point of an adjacent structure (parapet, above-roof wall etc) should be approx. 15 mm wide.

The waterproofing layer must be separated from the substrate with non-woven biocide textile having a minimum surface density of 500 g/m^2 (300 g/m^2 for large-format components).

The slope of the roof structure pitched layer must be such to prevent puddling on the roof (typically ≥ 3%). When choosing the membrane thickness, take the risk of puddling into account.

- **Material:**
  - Screws made of refined carbon steel with anti-corrosion coating, e.g. Durocoat (at least 12 Kesternich cycles)
  - Screws made of austenitic stainless steel
  - Telescopes made of high-quality polypropylene or polyamide
  - Plate washers made of steel sheet with suitable finish, e.g. Al/Zn

- **Use:**
  - To fasten a waterproofing layer and a thermal insulation layer to massive wood or large-format boards, use countersunk head screws (lens-shaped head) and plastic telescopes. To fasten linear profiles to be later covered with a waterproofing layer, use only screws.
  - To fasten a waterproofing layer and a thermal insulation layer, hexagonal head screws and plate washers may be used. A tensile test is necessary for renovation projects.

- **Application:**
  - Combining a telescope with a screw provides a grip length of up to 490 mm. If using screws only, the maximum grip thickness is typically 130 mm or less.
  - Fasteners are delivered separately in standard packaging or strapped for automatic installation machines.
  - If using a screw and plate washer combination, the thermal insulating material must have a point load capacity of no less than 500 N.
  - The screw length required shall be determined as the total thickness of all layers above the fixing layer + 30 mm. If using a telescope and screw combination, add the screw length lost in the telescope shaft (approx. 15 mm).
  - Wood-cement particle boards, oriented strand boards, plywood boards and other large-format components must be at least 22 mm thick. Tensile tests are necessary for renovation projects.
  - Fasteners used for fastening roof structures and layers must withstand the estimated higher corrosive load in the fixing layer.

2.3.5.6 Problematic substrates

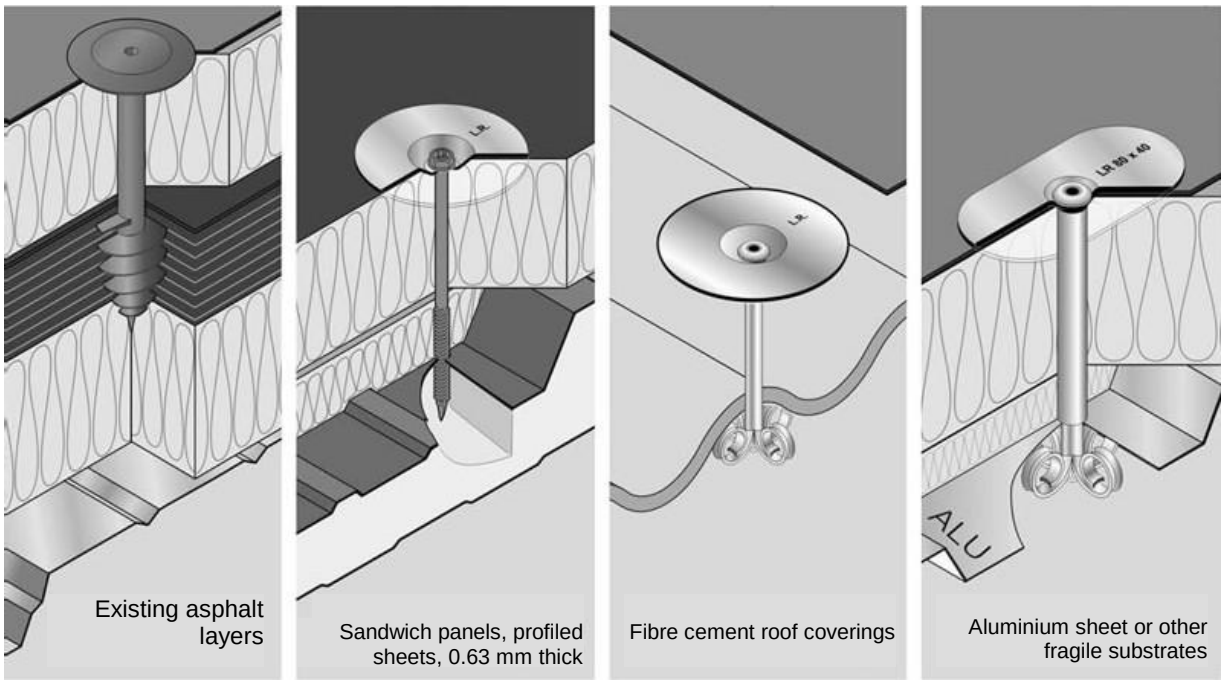
- **Substrate quality requirements:**

  Problematic substrates for mechanically fastened roof waterproofing membranes include, in particular, profiled aluminium sheets, roof panels with an integrated thermal insulation layer, thin-walled concrete shells, wood-cement boards, original asphalt sheets on a thermal insulation layer of EPS panels etc.

  It is recommended to conduct pull-out resistance tests for all of these substrates and to verify that their point load capacity is at least 500 N.

  Based on experience, the minimum recommended thickness of problematic thin-walled materials is generally as follows:

Steel sheet	> 0.5 mm
Aluminium sheet	> 0.6 mm
Concrete panel	> 13.0 mm
Wood-cement board	> 13.0 mm



Existing asphalt layers

Sandwich panels, profiled sheets, 0.63 mm thick

Fibre cement roof coverings

Aluminium sheet or other fragile substrates

The waterproofing layer must be separated from the substrate with non-woven biocide textile having a minimum surface density of 300 g/m^2.

The slope of the roof structure pitched layer must be such to prevent puddling on the roof (typically ≥ 3%). When choosing the membrane thickness, take the risk of puddling into account.

- **Material:**
  - Screws made of refined carbon steel with anti-corrosion coating, e.g. Durocoat (at least 15 Kesternich cycles)
  - Telescopes made of high-quality polypropylene or polyamide
  - Peel rivets made of hardened magnesium-aluminium alloy with a galvanised steel spindle
  - Drill wood screws with a plate head of polypropylene or polyamide reinforced with fibre glass
  - Plate washers made of steel sheet with suitable finish, e.g. Al/Zn

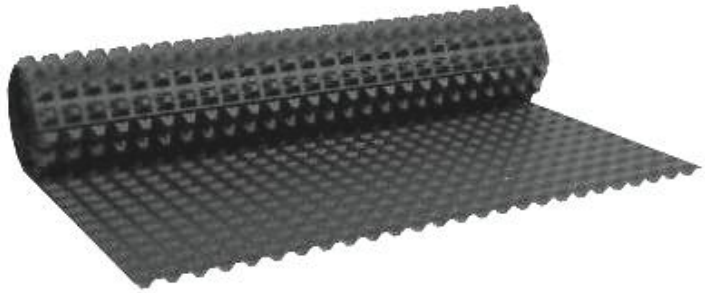
- **Use:**
  - To fasten a waterproofing layer and a thermal insulation layer to thin concrete boards, use countersunk head screws and plastic telescopes. To fasten linear profiles, use only screws.
  - To fasten a waterproofing layer and a thermal insulation layer to original asphalt coverings on EPS panels, lightweight PU material and wood-fibre boards, use plastic screws with a plate head.
  - To fasten waterproofing sheets and thermal insulation material to aluminium sheet metal, thin concrete boards, wood-cement boards and other problematic substrates use peel rivets and a plate washer for waterproofing sheets and peel rivets and a square washer for thermal insulation material.

- **Application:**
  - Combining a telescope with a screw provides a grip thickness of up to 515 mm. If using screws only, the maximum grip thickness is typically 130 mm or less.
  - Combining peel rivets with plate washers provides a grip thickness of up to 222 mm.
  - Plastic screws with a plate head are usable for a total grip thickness of up to 290 mm.
  - Fasteners are delivered separately in standard packaging. If a screw and plate washer combination is used, the thermal insulation material must have a point load capacity of no less than 500 N.

- The total screw length required is calculated as follows: (total thickness of all layers above the fixing layer + manufacturer-recommended driving depth in mm). If using a telescope and screw combination, add the screw length lost in the telescope shaft (approx. 15 mm).
- Fasteners used for fastening roof structures and layers must withstand the estimated higher corrosive load in the fixing layer.
- If using sandwich panels, e.g. KINGSPAN, place the fasteners into the lower wave of the upper sheet metal.

2.3.6 Drainage layer

A drainage layer removes water from layers located above the waterproofing layer. A drainage layer may consist of inert bulk material, woven or non-woven fleece, mats made of space-oriented plastic fibres, profiled plastic boards or membranes and other water permeable material. The layer is usually installed as part of traffic and green roofs.



A drainage layer placed above the main waterproofing layer must be resistant to biological corrosion.

A drainage layer must be drained. If not drained, a drainage layer may perform a separation or water retention function.

Special types designed for green roofs perform both a drainage and water retention function.

2.3.6.1 LITHOPLAST DREN drainage and water retention membrane

Description: A shaped perforated membrane designed for roof gardens.

Use: A water retention and drainage layer to retain and drain excessive rainwater on green roofs.

Some water that passes through the retention layer flows on the waterproofing layer into rainwater outlets. Place a filtration layer of biological corrosion resistant fleece above the drainage layer to prevent it from being clogged with soil.

Application: Install LITHOPLAST DREN directly on the roof waterproofing layer.

Unroll the membrane sheets within the roof field, next to each other, overlapping them by one line of cups, and bond them in the overlap using double-sided adhesive tape for polyethylene. Then place filtration fleece on the membrane and additional layers (lightweight aggregate, soil etc) on the fleece.

The minimum recommended roof slope for LITHOPLAST DREN is 2%.

Dimensions: LITHOPLAST DREN is available with a cup height of 10, 20, 40 and 60 mm. Water retention membrane dimensions are to be chosen by a garden architect, depending on the roof garden design.

Packaging: Rolls or boards

2.3.6.2 Petexdren drainage membrane

Description: Geosynthetic mat made of polyethylene fibres. Maintains high water permeability even when loaded by other structural layers. Available in black or white.

Available separately or as a sandwich combined with PE-based non-woven fleece.



Use: A drainage and separation layer in traffic, green, aggregate-loaded flat roofs and in roofs with a control and refurbishment system.

Application: Place Petexdren edge-to-edge, directly on the waterproofing membrane. If using Petexdren without non-woven fleece, place the fleece separately on the mat. Since Petexdren has limited resistance to direct weather conditions, the subsequent layer must be placed as soon as possible after its installation.

Dimensions:

- Petexdren 400 – thickness 3.0 mm
- Petexdren 900 – thickness 6.0 mm
- Petexdren 600 + 300 (composite) – thickness 7.0 mm

Packaging: 1,500 mm wide rolls

2.3.7 Other

2.3.7.1 MIRELON sealing cord

A round profile of expanded PE, featuring reduced flammability. Available in grey-black.

Dimensions: Ø 6, 8, 10, 12, - 70 mm

Application: Additional sealing of perimeter plastic-coated metal profiles, flashings and expansion joints in reconstruction projects

Advantages: Low apparent density, thermal resistance from -65°C to +90°C, low thermal conductivity coefficient λ=0.038W/m.K

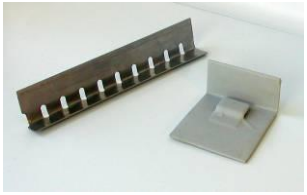
Packaging: Coils

2.3.7.2 Shingle flashing

Perforated stainless L-shaped flashing with bent edges for added strength.

Dimensions: 50 (100) x 30 x 2.500 mm

Application: Securing and ending stabilisation layers of roof decks loaded with bulk material or pavers on support pads at the roof perimeter.



2.3.7.3 Lightning rod holders

Supporting components with a steel, plastic or concrete base and a lightning rod fastener. Alternatively available as an all-plastic support with a sleeve.

Dimensions: Depending on approved type
Type - Ø 80 -100 mm, height 55 – 100 mm – steel/plastic
- Ø 165 (140) mm, height 100 (70 mm) – plastic/concrete
- 65 x 105 mm, height 135 mm – all-plastic type

Application: Supports lightning rods on flat roofs as well as on perimeter structures.

2.3.7.4 SAFEPOINT fall protection system

Stainless, permanent eyebolt anchor designed for temporary attachment of fall arrestors. Various versions are available, allowing installation in reinforced concrete, wooden substrate, steel beams and trapezoidal sheet metal.

Use: Eyebolt anchors are designed for installation on flat roofs with a free fall height and depth of at least 1.5 m. Eyebolt anchors allow safe movement of fitters and persons inspecting, maintaining and repairing the roof. Must not be used for lifting purposes.

Application: Drill a hole in reinforced concrete and wood and widen its upper end. Put a special screw into the hole, screw a tube on it and then the eyebolt anchor. Fix the anchor with a fan washer. Use a hexagonal head screw with a metric thread to fix the tube in holes drilled in steel beams. If installing the system in trapezoidal sheet metal, use a two-layer sheet base that must be fixed to the upper wave of the trapezoidal sheet metal with stainless screws.

Dimensions: Tube outer diameter for all versions: 20 mm, length: 300 – 600 mm.

Packaging: Includes suitable fasteners, depending on a product version

Technical documentation: SAFEPOINT technical data sheet, issued by TOPWET s.r.o.

2.3.7.5 Butyl-rubber tape

Double-sided butyl-rubber adhesive tape, UV stable, black colour

Application: Gas-tight joining of vapour control membranes, sealing of details, penetrations and connections to perimeter structures

Advantages: Extreme resistance to ageing, high tensile strength, dimensional stability, processing temperature from +5°C to +40°C, thermal resistance from -30°C to +80°C

Dimensions: Width: 15 mm, roll length: 45 m (other lengths available)

Packaging: Paper boxes

2.3.7.6 Liquid waterproofing products

2.3.7.6.1 Triflex ProDetail

Triflex ProDetail is a liquid-applied waterproofing system based on two-component polymethyl acrylate resin and reinforced with Triflex Special Fleece 110g/m². Standard colours: RAL 7032 (pebble grey), RAL 7035 (light grey) and RAL 7043 (traffic grey).

Technical parameters:

- European Technical Approval ETA-06/0269 according to ETAG 005
- Weather resistant
- Resistant to root penetration
- Resistant to hydrolysis and permanent water exposure
- Resistant to fire spread through the roof deck – classification Broof (t3)

Use: Designed for unusual, complex detailing. When combined with a FATRAFOL PVC-P membrane, Triflex ProDetail is suitable for almost every substrate. Use a brush or a special roller for application.

Approved substrates:

- Asphalt, bitumen, SBS and APP modified asphalt sheets
- Concrete, polymer concrete, levelling compound, lightweight concrete, plaster
- Steel, stainless steel, aluminium, copper, zinc, lead
- Glass, wood
- PVC-P based waterproofing membranes
- Plastic surfaces (films, coatings, panels) - PVC-P, PU, PMMA, epoxy and polyester resins, EPDM

Application: The product may only be installed by qualified contractors.

All substrates must be clean, dry and free of dust, oil, grease, deteriorated paint and other contamination. The substrate must be treated (usually roughened, sanded etc) as recommended by the manufacturer.

General rule: suitable bonding primer + double coating with reinforcement fleece

The waterproofing layer is watertight after 30 minutes and may be walked on after 45 minutes.

Note: To prepare the application substance, mix the product with Triflex Katalysator (100 g of catalyser per 5 kg of product). The mixture must be used within approx. 30 minutes.

Application temperature: - 5°C up to +40°C

Consumption: Approx. 3 kg/1 m^2

Packaging: - Triflex ProDetail – 15.0 kg tin
- Triflex Katalysator – 0.10 kg plastic bag
- Triflex Specialvlies – reinforcement fleece, width: 20 cm, 52.5 cm, 105 cm; length: 50 m
- Triflex Cryl Primer 222 and 276 – 10 kg tin

Cleaner: Triflex Cleaner (9 l tin)

Note: For sales and application of Triflex products outside of Czech Republic please contact directly company Triflex GmbH & Co. KG

2.3.7.6.2 Triflex ProFibre

Triflex ProFibre is a liquid-applied waterproofing system based on two-component polymethyl acrylate resin and reinforced with fibres.

Use: Designed for unusual, complex detailing. When combined with a FATRAFOL PVC-P membrane, Triflex ProFibre is suitable for almost every substrate. Use a brush or a special roller for application.

For approved substrates and their treatment see Triflex ProDetail.

Technical parameters:

- Resistance to weather
- Resistance to root penetration
- Resistance to hydrolysis and permanent water exposure
- Resistance to fire spread through the roof deck – classification Broof (t1)

Application: All substrates must be clean, dry and free of dust, oil, grease, deteriorated paint and other contamination. The substrate must be treated (i.e. roughened, sanded etc) as recommended by the manufacturer.

After treating the substrate and coating it with a bonding primer, use a wool roller or a brush to apply at least 3.0 kg of Triflex ProFibre per m^2.

The waterproofing layer is watertight after 30 minutes and may be walked on after 45 minutes.

Application temperature: 0°C up to +40°C

Consumption: Approx. 3 kg/1 m^2

Packaging: - Triflex ProFibre – 15.0 kg tin
- Triflex Katalysator – 0.10 kg plastic bag
- Triflex Cryl Primer 222 and 276 – 10 kg tin

Cleaner: Triflex Cleaner (9 l tin)

Note: For sales and application of Triflex products outside of Czech Republic please contact directly company Triflex GmbH & Co. KG

2.3.7.7 Thermoperl levelling compound for flat roofs

A levelling compound for flat roofs, made of natural perlite and coated in asphalt.

Use: Levelling of flat roofs, mostly during renovations of asphalt coverings, creating slopes

Application: Mix the matrix with Perlmix emulsion, use a lath to spread it on the surface and compact the material (approx. 30% compaction).

Advantages: Easy to process

Technical parameters:

- Consumption: approx. 13 l per m^2 and 10 mm of thickness
- Thermal conductivity: 0.07 W/(m.K)
- Apparent density: 300 kg/m^3

Packaging: 100 l/bag

3 BASIC CONSTRUCTION PRINCIPLES

3.1 General roof design requirements

Essential requirements for roof deck composition:

- Mechanical resistance and stability
- Fire safety
- Hygiene, health and environmental protection
- Protection against noise
- Safety of use
- Energy savings and thermal protection
- Other requirements (appearance, durability, reliability of the roof and its parts etc) as specified by the owner

Roof design must be such that the roof, throughout its service life, is resistant to mechanical and dynamic loads, corrosive, chemical, biological, electromagnetic and atmospheric effects and does not allow water or moisture to migrate into the roof structure. Roofs must meet thermal insulation requirements under CSN 73 0540-2 and sound insulation requirements as determined by a sound insulation calculation.

The roof project must give a full and clear description of roofing materials, technology, structure and roof use. The roof structure must withstand loads specified in applicable standards.

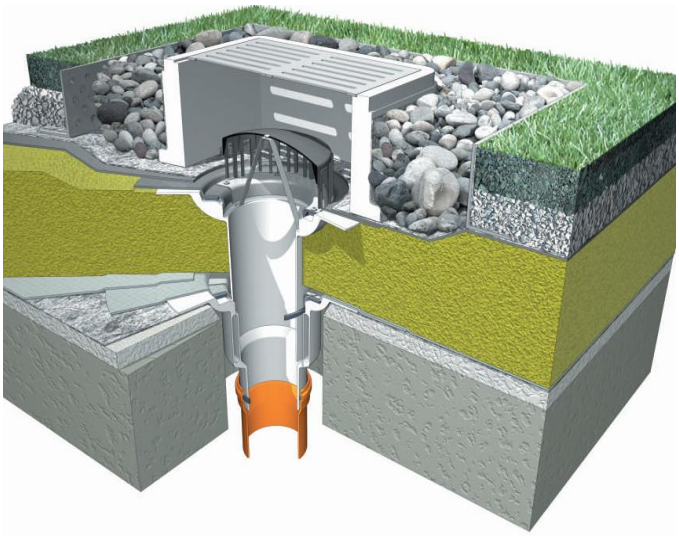
Throughout its service life, the roof deck must withstand all actual and estimated loads caused, in particular, by its self-weight, traffic and stabilisation layers, rooftop equipment, snow, water and ice including their mechanical effects, wind uplift and pressure, temperature changes and by roof deck use and maintenance.

None of the loads may cause the roof, its layers or components to lose its/their function, suffer damage or become less durable or reliable.

When using the FATRAFOL-S waterproofing system, pay attention to some specifics typical for installation of roof plastic waterproofing membranes.

This chapter describes the required quality, design and securing of individual roof deck layers with regard to the use of FATRAFOL waterproofing membranes in these constructions:

- Mechanically fastened, flexible roof waterproofing coverings,
- Bonded waterproofing coverings,
- Waterproofing coverings with an aggregate or traffic layer,
- Waterproofing coverings with a green layer.



3.2 Substrate structure

3.2.1 Requirements for substrate of new roof decks

The substrate of the main and, where applicable, of the securing waterproofing layer may be made of cement screed or concrete overcoat, ceiling or roof concrete slabs or panels, steel trapezoidal sheet metal, planks or boards made of wood-based materials, foam silicate, plastics and elastomers, rigid boards made of mineral fibres and other materials. The substrate top surface must be unbroken and sufficiently firm (compressive strength of no less than 60 KPa at 10% compression). The substrate strength of traffic roofs is determined by the loads they are exposed to and by the structure of the traffic layers. The substrate must be free of any impurities and unevenness.

The quality of substrates for mechanically fastened plastic waterproofing membranes with regard to recommended fasteners is described in more detail in article 2.3.5 ‘Fasteners for waterproofing membranes and thermal insulation’.

Since CSN 73 1901 does not give a definition of substrate planarity, make sure to always take into account what technical standards and the owner require and, if possible, note this in the site handover and acceptance report. Although a substrate may be damp, it must be free of puddles, snow and ice.

If the roof covering is to consist of a FATRAFOL membrane, no roof deck layer beneath the covering may contain tar or substances from which organic solvents evaporate.

Impregnation agents for wooden substrates for FATRAFOL membranes must not contain oils or highly volatile organic solvents.

Wooden load-bearing components should be accessible for inspection, repair or renovation of the wood chemical protection throughout the structure’s service life.

The structural protection of wood is primarily designed to ensure such moisture of wooden components in the building that prevents the growth and activity of fungi and insects harmful to wood. Central European species of insects and fungi harmful to wood cease being active when wood moisture drops below 10% and 20% respectively. The only exception is dry rot fungus, which is active at wood moisture as low as 16%.

3.2.2 Requirements for substrate of refurbished roofs

Essential substrate requirements are specified in article 3.2.1.

If proper separation is used, a new waterproofing layer may be laid on asphalt roofing sheets, sheet metal, levelling compound, sprayed polyurethane, old covering of rubber and plastics, traffic layer etc. Always make sure to thoroughly check the quality and cohesion of the substrate as well as its wear. A thermo-technical calculation should be made to determine the roof moisture and moisture regime. It is essential to assess the effect of shape and dimensional changes of installed roof materials, review the slope ratios and functionality of the existing roof drainage, to check if any additional safety components are necessary for roof inspections and maintenance etc.

It is of prime importance to check the structural effectiveness of the planned fixing layer and to document the pull-out force of the fasteners to be used. The minimum pull-out force per fixing point should be at least 1,000 N. If the pull-out force is lower than that, make sure to take this into account in the fixing plan (use more fasteners, combine various methods to secure the roof covering).

Roofing materials must be so placed and combined that there is no unwanted interaction between them at the point of contact or through a water layer or water flow. A separation layer may be used to keep materials apart.

If the roof load capacity and the condition of existing materials so permit, you should keep as many of the original materials as possible on the roof. Materials removed during renovation projects should be recycled or landfilled.

The surface must be sufficiently flat, free of bulges and big undulations. Any major unevenness must be removed or filled with a suitable material, e.g. Thermoperl.

When refurbishing single-ply bitumen roofs with a negative water vapour balance where no additional thermal insulation is required, it is necessary to perforate the asphalt waterproofing layer with at least five 50 mm big holes per square meter of the roof (1% of the area). This will allow an unobstructed discharge of water vapours through the asphalt covering. In refurbishment projects that include installing additional thermal insulation, the original asphalt waterproofing membrane functions as a vapour barrier. To remove entrapped moisture, use vent outlets with an asphalt sleeve – see detailing.

For substrate humidity requirements refer to table 6; the recommendation also applies to new roof decks. If a probe test shows a negative moisture regime in the roof, measures must be taken to reduce the moisture in the base layers.

Table 6: Recommended maximum moisture of materials integrated into roof structures

Material	Maximum weight content of moisture [%]
Lightweight concrete, apparent density: 450 to 700 kg.m^{-3}	35
Lightweight concrete, apparent density: less than 450 kg.m^{-3}	40
Expanded plastics (EPS, PU, PE, PVC, phenolic materials), apparent density: up to 40 kg.m^{-3}	25
Expanded plastics (EPS, PU, PE, PVC, phenolic materials), apparent density: over 40 kg.m^{-3}	20
Special expanded plastics (XPS, PU sprayed on outside roof surface), apparent density: up to 40 kg.m^{-3}	10
Special expanded plastics (XPS, PU sprayed on outside roof surface), apparent density: over 40 kg.m^{-3}	8
Mats and products made of mineral and glass fibres, apparent density: up to 110 kg.m^{-3}	10
Foam glass	5
Wood-cement boards	15
Wood (timber)	16
Gravel-sand	4
Gravel, grading 7-30 mm	2
Expanded clay (keramzite)	8
Foamed slag	7
Pumice sand	7
Aggloporite	8
Slag	15
Glass concrete, apparent density: 400 to 700 kg.m^{-3}	35

3.3 Vapour control layer

Vapour control layers are integrated into roof decks to reduce water vapour diffusion flow from the interior into the roof deck and thus to avoid the condensation of water vapour and its related negative impacts.

Vapour control layers are made of materials with high diffusion resistance. Materials that may be joined homogeneously should preferably be used; all joints with penetrations and end structures must be airtight.

The original intact asphalt covering may also function as a vapour control layer as part of installation of additional thermal insulation on the roof deck.

A vapour control layer made of a vapour control membrane, which is joined gastight, is placed under the thermal insulation layer, towards the inner surface of the roof structure. If a silicate pitched layer is used in the roof deck, the vapour control layer is placed on it. Vapour permeability of layers must increase towards the roof deck surface to ensure gradual removal of water vapour that migrates through the vapour control layer.

Placing a vapour control layer under a monolithic pitched or thermal insulation layer is not recommended unless moisture removal is provided for this layer from the above.

A protective or separation layer of suitable fleece should be placed on a monolithic or prefabricated base or pitched layer of silicate materials, under the vapour control layer made of lightweight membranes.

To dimension the vapour control layer, make a moisture calculation. If FATRAFOL open-diffusion membranes are used and if the roof deck does not have old coverings made of asphalt sheets or another closed-diffusion layer under the waterproofing membrane, a vapour control membrane with a diffusion length of 50 m is suitable for most applications.

If a thermal insulation layer of foam glass is used, no vapour control layer need be installed. However, always check if a vapour control layer may be omitted by making a thermo-technical calculation, assessing the water vapour balance in the roof structure and arranging the roof deck layers properly with respect to heat transfer coefficient and diffusion resistance.

Joints must remain fully functional on the entire layer throughout the roof service life or the design calculation must reflect their potential lack of tightness.

In order to function properly, a vapour control layer must be unbroken on the entire roof. If leaking points account for as little as 0.1% of the surface, its diffusion resistance drops to approx. 30% of the original value. If leaking points account for 1% of the surface, the vapour control layer has become totally ineffective.

Perforation caused by fasteners does not have an effect on the overall functionality. The actual perforation in PE membranes is negligible since openings are filled by fastener shafts. In asphalt vapour control layers, the perforation value is even lower.

A vapour control layer may also function as an airtight layer or a securing waterproofing layer. If a vapour control layer also functions as a securing waterproofing layer, it must be drained. Outlets should be connected to a separate downpipe, known as ‘dry riser’ or, via a separate connection with a non-return flap, to a shared downpipe of the drainage system of the main waterproofing layer.

3.4 Thermal insulation

Thermal insulation must meet requirements placed on flat roofs, be heat-resistant and dimensionally stable, must not be subject to volume and shape changes, must be made of materials with reduced absorption of water and humidity and must be resistant to biological attack.

Thermal insulation materials must be consistently resistant to the loads they are exposed to in roofs.

Thermal insulation layers made of panels must be unbroken. Where the warping or dimensional and shape changes of the substrate or thermal insulation boards are likely to create gaps between thermal insulation boards, then boards with a half-groove should be used. Boards should be placed in a brick pattern.

If a thermal insulation layer includes more boards placed atop each other, gaps of the upper layers should not align with gaps of the bottom layers.

A thermal insulation layer for inverted roofs must be made of a water resistant material that is guaranteed by the manufacturer to maintain its thermal insulation properties when exposed to water. Low water absorption materials should be used.

In order to ensure sufficient substrate rigidity, which is necessary also for joining roof waterproofing membranes, thermal insulation boards must meet the following requirements:

- Compressive strength at 10% compression according to EN 826 ≥ 0.06 N/mm^2 (60 kPa). This requirement applies either to homogeneous materials or to the top layer of multi-layered or composite products.
- Behaviour under point load according to EN 12430 ≥ 500 N at 5 mm deformation.

3.5 Protective and separation layer

Protective and separation layers protect waterproofing membranes and separate them from any layers that may, in case of direct contact, interact negatively with them.

FATRAFOL waterproofing membranes without non-woven fleece must be fully separated from all types of substrates using non-woven fleece with a minimum surface density of 300 g/m^2.

Listed below are the exceptions to the requirement, i.e. substrates that need a different or no separation layer:

- Wooden substrates made of slabs and planks are to be separated with non-woven fleece with a minimum square density of 500 g/m^2.
- Substrates made of expanded or extruded polystyrene are to be separated with glass fibre fleece with a minimum square density of 120 g/m^2 if the PVC-P membrane is the top uncovered roof deck layer.*)

- Substrates made of expanded or extruded polystyrene are to be separated with non-woven fleece with a minimum square density of 200 g/m^2 if the PVC-P waterproofing membrane is protected by other layers. The use of glass fibre fleece with a square density of 120 g/m^2 is also possible in this application.*)
- Substrates consisting of rigid thermal insulation boards of mineral fibres and expanded polyurethane or PIR do not require a protective and separation layer and the membrane may be laid directly on the thermal insulation.

**) No separation required for TPO membranes.*

3.6 Main waterproofing layer

The main waterproofing layer is a watertight structure that prevents the ingress of atmospheric, service or technological water into or under the roof. This layer or its part has the crucial waterproofing function in the roof deck.

The position of the layer depends on the required roof structure performance. In inverted roofs, the layers above the waterproofing layer should preferably be removable to allow its repair, maintenance or replacement.

The design of the main waterproofing layer must reflect the water exposure, installation process and accessibility for repairs. Attention should also be paid to its reliability, durability and ease of installation. The choice of fasteners for the waterproofing layer must be based on the required load capacity during the roof service life.

The main waterproofing layer of the FATRAFOL-S system is suitable also for zero-slope roofs. Although standing water and puddles on a roof covering do not have a negative impact on the performance and service life of FATRAFOL waterproofing membranes, it is recommended to slope the roof covering for structural reasons. The recommended slope depends on the roof structure use (see CSN 73 1901).

The main waterproofing layer of the FATRAFOL-S system usually consists of a single layer of the specified roofing membrane type.

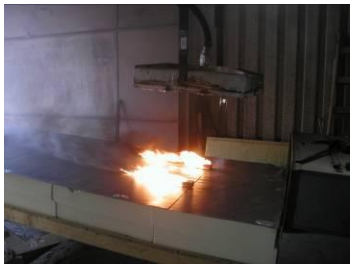
3.6.1 Choosing a suitable membrane type for the main waterproofing layer

A manufacturer of PVC-P and TPO based waterproofing membranes, Fatra, a.s., Napajedla offers 5 types of PVC-P and 3 types of TPO waterproofing membranes within the FATRAFOL-S system. Their suitability for use as the main waterproofing layer in roof decks depends on their technical specifications. To choose the most suitable membrane type for your application, refer to the recommendations in table 7. In practice, it is possible and usually also beneficial to combine some types of membranes on the roof, taking into account their typical technical properties and performance.

Waterproofing membranes for the top layer must be resistant to UV radiation. Membranes with limited resistance to UV radiation must be so installed that no direct or reflected solar radiation may fall on them during their service life. Protection against UV radiation must also be provided during the construction process. Any materials with limited resistance to weather must be installed within the time specified by their manufacturer.

The required fire performance depends on whether the roof structure is to bear loads or not. A load-bearing structure must have the fire resistance required for the specific type of structural part (DP1, DP2 or DP3). No fire resistance assessment is necessary for non-load-bearing structures and you may proceed to the next articles. The roof deck

composition in a fire hazard area must meet the requirements of the B_{ROOF}(t3) class of external fire performance for roofs. In a fire safe area, the requirements of the B_{ROOF}(t1) class must be met.



Surface temperature is one of the many factors to consider when choosing a membrane type. This depends on the membrane surface colour and structure and on the base layer thermal conductivity. Dark membranes increase the covering surface temperature, which may reach up to 85°C. Take this into account when choosing your thermal insulation material. On the other hand, light-coloured membranes reflect solar radiation and are used, for example, for some types of photovoltaic panels.

On flat roofs and in protection and traffic layers of roofs, water accumulates during rain and snow thaw, exerting hydrostatic pressure on the roof. For such conditions, the minimum membrane thickness is 1.5 mm (recommended under CSN P 73 0606).

Another criterion to consider when choosing a waterproofing membrane is the estimated corrosive load and the interaction of materials. Corrosive load on a roof is largely due to chemical, thermal, biological, electromagnetic or atmospheric effects, the surrounding environment and the use of and environment in the building. Corrosive load is higher in those roof covering parts where puddling occurs. In some cases, a continuous water layer may have a positive effect on the covering service life as it absorbs thermal radiation and reflects UV radiation. However, for practical reasons, water should be drained from the roof deck.

Typical examples of interaction of materials include a direct contact between expanded polystyrene and a PVC-P membrane. If not separated sufficiently, both materials may have a significantly shorter service life.

Table 7: Possible use of FATRAFOL roof waterproofing membranes

Roof system type/waterproofing membrane type	**Unprotected membrane, exposed directly to weather**			**Membrane protected by a loading or service layer**		**Recommended primary use of membrane**
	Mechanically fastened		**Bonded**	**Loaded with aggregate, pavers**	**With green layers**	
	In fire hazard areas	Outside fire hazard areas				
FATRAFOL 807	–	+	+ +	–	–	Renovation of asphalt roofs
FATRAFOL 807 AA	+	+	+ +	–	–	Renovation of asphalt roofs in fire hazard areas
FATRAFOL 807/V	–	–	+ +	–	–	Bonded systems
FATRAFOL 810 **FATRAFOL 810/V**	+	+ +	–	+ *)	+ *)	Standard roofs with mechanically fastened covering
FATRAFOL 810 AA **FATRAFOL 810/V AA**	+ +	+	–	–	–	Fire hazard sections of roofs
FATRAFOL 814	–	+ +	–	–	–	Top, pedestrian traffic layers of balconies and terraces
FATRAFOL 818/V	–	–	–	+	+ +	Green roofs
FATRAFOL 818/V-UV	–	–	–	+ +	+	Roofs with loading layer and traffic layer
EKOPLAN 819	–	+	–	–	–	Temporary waterproofing coverings
FATRAFOL P 916	–	+ +	–	–	–	Roofs with mechanically fastened covering
FATRAFOL P 918	–	+	–	+ +	+ +	Roofs with loading layer and green roofs
FATRAFOL P 918/SG-PV	–	+ +	–	+	+	Photovoltaic roofs

+ + *Primary use* + *Suitable for use* – *Unsuitable for use*

*) *Suitability for use in a specific application should be consulted with the manufacturer.*

3.6.2 Securing waterproofing membranes

3.6.2.1 Protecting membranes from internal forces

All membranes made of plasticised PVC and TPO are subject to dimensional changes depending on temperature and exposure time. The causes of this phenomenon lie in the production technology, thermal expansion and long-term structural changes in the membrane material.

While dimensional changes take place throughout membrane service life, the biggest ones (mostly contraction) occur just after membranes are unrolled from a tightly wound roll and when freely lying membranes are first warmed by sunshine or another source of heat. Therefore, after unrolling membrane sheets on the roof, you should leave them lie unconnected and unfastened for some time. In warm and sunny weather, the process takes a few minutes only, otherwise allow approximately half an hour.

To avoid further effects of internal forces, the covering must be fastened to a solid substrate at the perimeter or in the structure base, in accordance with applicable specifications. Likewise, a membrane must be fastened in roof valleys, when waterproofing valley and parapet gutters, at the perimeter of projecting structures, along all roof deck penetrations as well as in places where roof contraction may negatively affect the performance and stability of the covering (creation of fillets and 'trampolines'). Such fastening is necessary also when the covering is later loaded with a stabilisation, protection or traffic layer or with green layers. In this case, the membrane is laid entirely loose in the roof field, between protection layers that react to its movement as sliding layers, only with negligible resistance to internal forces of the membrane. In roofs with the standard arrangement of layers and a mechanically fastened waterproofing membrane, additional membrane contraction has also a positive effect on the planarity of the roof external surface by eliminating the undulations that cannot usually be avoided during the waterproofing layer installation.

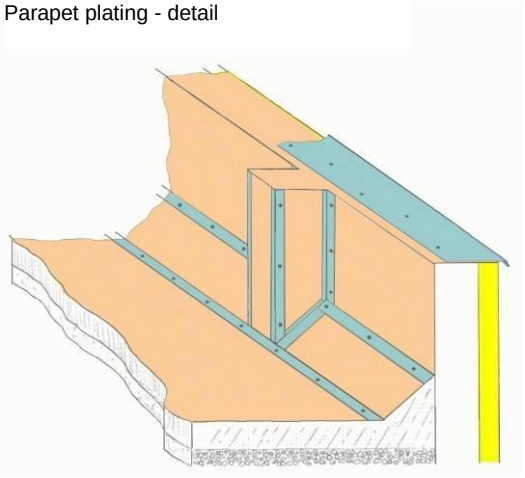
From a structural point of view, dimensional changes result from forces acting, with varying intensity, inside the membrane in all directions at the level at which the membrane is unfolded. Tension generated in any point of the covering depends on the dimensions and shape of the surface being waterproofed and on the position of fixed elements (fasteners, protruding structures, penetrations, rainwater outlets etc). Fasteners in the roof deck structure should preferably be tensioned in a manner that guarantees a better transfer of active forces, i.e. subjected to pull rather than bending stresses. Fasteners are not dimensioned to withstand bending forces.

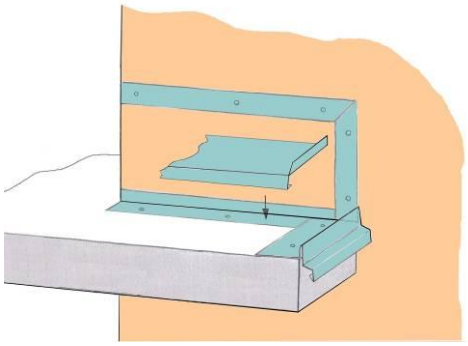
To meet the above requirements, use linear plastic-coated metal profiles to which the membrane may be welded homogeneously. Basic shapes of plastic-coated metal profiles are given in table 5. Use at least 4 fasteners per metre of profile length. Blind rivets, dowels, wood screws, screws, nails etc may be used as fasteners, depending on the substrate. Adjacent fasteners must be spaced at a minimum of 150 mm. If using fasteners of a greater width, place them in two lines, following a zigzag pattern. Fasteners for perimeter profiles are not included in the total number of fasteners used for securing the covering against external forces.

When fastening perimeter profiles, make sure their length expansion is possible. Under CSN 73 3610, the maximum length of an expansion section is 6 m. If using plastic-coated and film-coated sheet metal, standard sheet metal joints and expansion modifications are not possible.

In addition to perimeter fastening, all PVC-P membranes designed for mechanical fastening as well as FATRAFOL P 916 must be secured against internal forces also within the roof field, using at least 2 point fasteners per square metre.

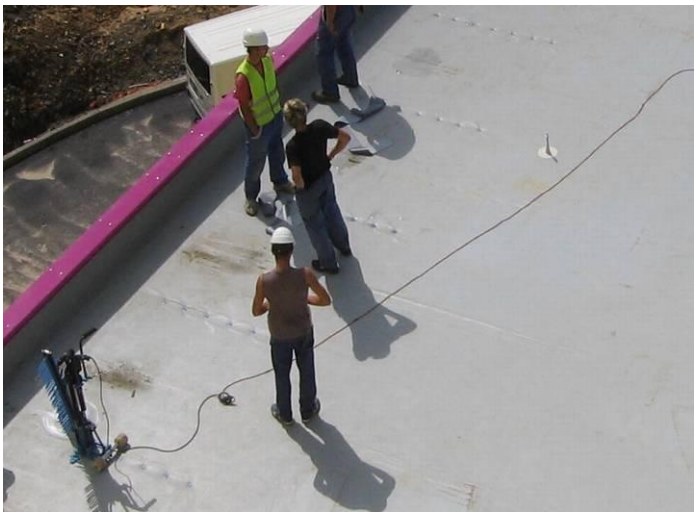
Parapet plating - detail





3.6.2.2 Protecting membranes from external forces

Negative wind pressure (uplift) is the biggest external force acting on each roof covering. Its intensity depends on the building position (orography, adjacent structure height, density of other structures and obstacles), terrain category, reference building height above the terrain, building shape and slope, reference wind speed and other factors, and varies in various roof sections. To eliminate the adverse effects of wind uplift, it is always necessary to protect the membrane covering with a stabilisation or traffic layer, green layers, with mechanical fastening to a solid and sufficiently cohesive substrate, by bonding or with a vacuum fastening system.



The possible ways to secure a roof deck against the adverse effects of negative wind pressure are limited mostly by the roof type and the material composition of the load-bearing structure and the substrate. To determine the wind action in individual roof deck zones, make a wind load calculation. Then assess the proposed fastening method and have a fixing plan prepared by an authorised structural engineer. The calculation method is described in CSN EN 1991-1-4 – Actions on structures – Part 1-4: General actions – Wind actions. The proposed method of securing the roof covering must correspond to the calculated results.

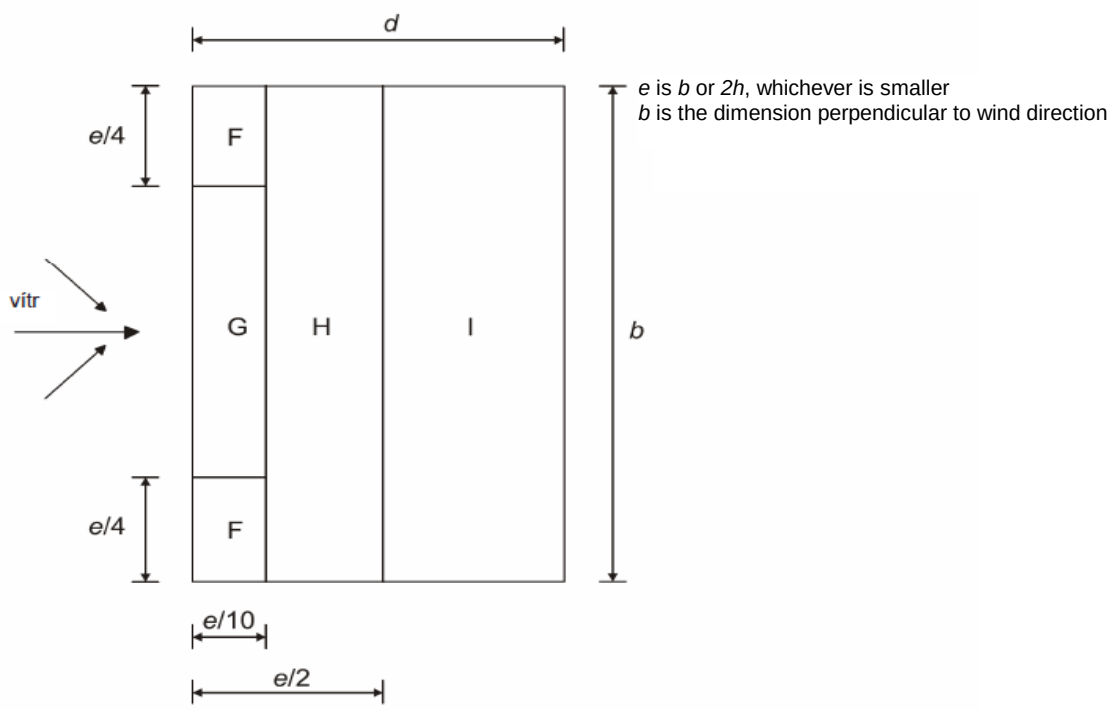


Figure 2: Dividing a roof into zones exposed to different wind loads

In order to determine wind areas on flat roofs in accordance with CSN EN 1991-1-4, the roof plane should be divided into 4 basic zones – see figure 2. Flat roofs are defined as having a slope α at |-5° ≤ α ≤ +5°|. Wind areas of roofs of other shapes (monopitch, duopitch, hipped and vaulted roofs and domes) must be determined in accordance with the above standard.

3.6.2.2.1 A simpler way to define stabilisation measures

In buildings having a flat roof with a reference roof height of no more than 30 m above the surrounding terrain, it is to some extent possible to use the following simpler method to define the necessary stabilisation measures (applies to an altitude of 700 m, open terrain, unprotected detached building):

1) Divide the reference roof area into three zones exposed to different wind loads:

   a) **A perimeter zone** delineated by a belt along the roof perimeter (excluding a corner zone) the width of which is 1/10 of the smaller dimension (the ground plan length of the building side perpendicular to wind direction or twice the building height)

   b) **A corner zone** delineated by the perimeter belt under a), having a length of 1/4 of the smaller dimension (the ground plan length of the building side perpendicular to wind direction or twice the building height) from the building corners

   c) **A central zone** of the roof outside the perimeter belts

   See figure 3 for roof division into zones and table 8 for a calculation of dimensions.

Table 8: Determining the dimensions of perimeter and corner zones

Dimensions of perimeter and corner zones	$a < 2 \cdot h$	$a > 2 \cdot h$	$b < 2 \cdot h$	$b > 2 \cdot h$
s_a – perimeter belt width on shorter building side	a/10	h/5	-	-
s_b – perimeter belt width on longer building side	-	-	b/10	h/5
d_a – corner zone length on shorter building side	a/4	h/2	-	-
d_b – corner zone length on longer building side	-	-	b/4	h/2

a – shorter ground plan dimension of building
b – longer ground plan dimension of building
h – building height (if the building is located on a slope, the height is measured from the slope base)

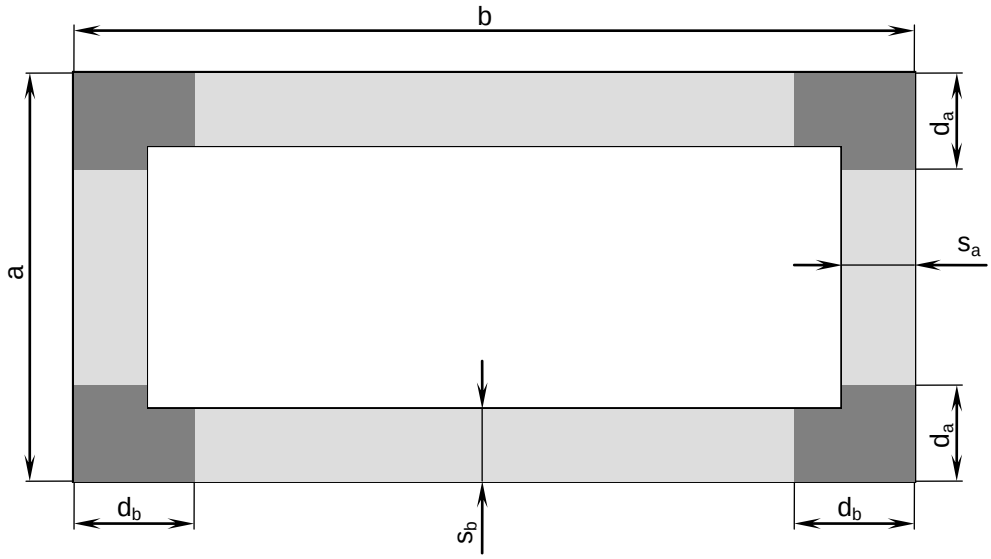


Figure 3: Dividing a flat roof into zones according to wind loads

Table 9 shows the maximum possible negative wind pressure, depending on the roof height above the terrain, which must be eliminated in individual zones by adopting an appropriate stabilisation measure.

Table 9: Approximate values of negative wind pressure (uplift) on roof coverings

Roof height above terrain [m]	Wind pressure in roof zone [N.m^{-2}]		
	Central zone	Perimeter zone	Corner zone
Max. 10	-440	-1,100	-1,650
Max. 20	-530	-1,320	-1,980
Max. 30	-590	-1,460	-2,190

2) Determine approximate values of stabilisation measures in individual wind zones of the reference roof for the elimination of identified wind pressure and for the chosen covering protection method - see table 10 (for a description and limiting factors see chapters 3.6.2.2.2 and 3.6.2.2.3).

Table 10: Simpler dimensioning of stabilisation measures for roofs up to 30 m in height

Roof area height above surrounding terrain	Dimensioning for roof zones		
	Central zone	Perimeter belt	Corner zone
Membrane covering secured with mechanical fasteners *)			
Max. 10 m	2 pcs/m^{-2} **)	5 pcs/m^{-2}	7 pcs/m^{-2}
Max. 20 m	2 pcs/m^{-2} **)	5 pcs/m^{-2}	8 pcs/m^{-2}
Max. 30 m	2 pcs/m^{-2} **)	6 pcs/m^{-2}	9 pcs/m^{-2}
Membrane covering secured with loading layer			
Max. 10 m	66 kg/m^{-2}	165 kg/m^{-2}	248 kg/m^{-2}
Max. 20 m	80 kg/m^{-2}	198 kg/m^{-2}	297 kg/m^{-2}
Max. 30 m	89 kg/m^{-2}	219 kg/m^{-2}	329 kg/m^{-2}
Membrane covering secured by bonding (only FATRAFOL 807 and 807/V) ***)			
0 - 30 m	200 g/m^{-2}	400 g/m^{-2}	600 g/m^{-2}

*) *The number of fasteners for mechanical fastening applies if a minimum pull-out force of over 1,000 N per fastener was determined in a tensile test, i.e. this corresponds to dynamic loading of the fastener with force of 400 N.*

**) *If a 1,300 mm wide membrane is used, the maximum centre-to-centre distance of fasteners in line is 417 mm. If a 2,000 (2,050) mm wide membrane is used, this distance is 263 (256) mm.*

***) *The figures apply to the PUK PU adhesive. For adhesive quantity in individual zones, refer to the manufacturer's technical data sheet.*

3.6.2.2.2 Securing membranes with mechanical fasteners

Mechanical fastening is the primary method of securing the FATRAFOL-S system against external forces unless its use is impossible due to the roof structure, arrangement and quality of layers in a roof deck where a membrane covering does not have stabilisation layers (see chapter 3.6.2.2.3).

In order to ensure adequate preparation for each installation, it is essential to obtain, in a timely manner, technical, professional, verified and guaranteed documentation regarding the state and position of the planned fixing layer. In terms of new buildings, this usually includes explicit and clear information in project documentation drawings or additional written information in a technical report. It is strongly recommended to verify this information on-site and well in advance of the installation.

When refurbishing an existing waterproofing layer, it is absolutely essential to obtain reliable data about the fixing layer by using probes and performing pull-out tests. In order to obtain reliable data, you should, in each separate roof zone, insert at least three probes as far in as the bearing layer of the roof deck, make a professional assessment of the firmness and moisture of all layers and use a tension meter to determine the pull-out force of the fasteners planned in the fixing layer. The minimum pull-out force determined in those 3 measurements in individual roof zones must be 1,000 N per fixing point. Otherwise, mechanical fastening alone is insufficient for the substrate, requiring another securing method or a combination of such methods.

For mechanical fastening of the covering, use the fasteners recommended for your substrate type (see article 2.3.5). Fasteners must be placed on the roof in a pattern that is as regular as practicable to ensure maximum possible uniformity of membrane and substrate loading. Fasteners are usually installed on the roof in direct lines, at the perimeter of membrane sheets and, if necessary, also inside the sheets. The number of fasteners per m^2 of the covering is determined through a calculation. In exceptional circumstances, the approximate figures shown in table 10 may be used for roofs of up to 30 m in height. A minimum of 2 fasteners per m^2 must be used in the central zone even if a structural calculation (fixing plan) requires a lower number. See figure 4 for an example of a proposed fastening method and roof division into zones.

If simultaneously fastening both waterproofing and thermal insulation layers of a roof with the standard arrangement of layers, make sure to also take into account the dimensions of the thermal insulation boards. In central roof zones where fewer fasteners are often used, it is sometimes necessary to fasten thermal insulation material separately. Two fasteners per m^2 are recommended for separate fastening of thermal insulation boards. Fasteners for thermal insulation layers are not included in the number of structural fasteners.

When fastening a waterproofing layer to a wooden substrate, you should drive the fasteners into bearing components (e.g. rafters). Dynamic loading makes it impossible to use nails for this fastening. The waterproofing layer must be fastened with suitably dimensioned wood screws with sufficient anti-corrosion treatment, i.e. **at least 12 Kesternich cycles**. Fastener manufacturers usually specify the method of installation for their products (minimum fixing layer thickness, minimum fastener length, overlap etc). In large-format wooden panels, the fastener thread must overlap the inside face of the fixing layer by 10-20 mm. Fixing lines must run perpendicular or diagonal to the direction of formwork planks. Individual planks must not be exposed to any load that exceeds the load-carrying capacity of its fastener to the bearing structure.

When fastening a layer to trapezoidal sheet metal, fasteners must always be placed in the upper wave, with a minimum centre-to-centre distance of 150 mm. The fastener thread must exceed the inside face of the sheet metal by 10 up to 20 mm. Fixing lines must run perpendicular or diagonal to the direction of the trapezoidal sheet metal waves.

For point fastening of membranes, fasteners with round or oval washers having a minimum diameter of 40 mm must be used. Each washer must firmly press the waterproofing membrane to the substrate with its entire area; the minimum distance between membrane and washer edges is 10 mm. When fastening a waterproofing layer through soft substrates (mineral fibre, EPS, PUR, PIR boards), make sure to use washers with a recessed centre in combination with screws with an upper thread, or a plastic telescope with a steel screw. The minimum compressive strength of substrate layers for hot-air fusion welding must be 60 kPa and the substrate must be unbroken and sufficiently cured.

For linear fastening, use plastic-coated metal profiles – see table 5. There should be four fixing points per running meter. The membrane is then fully welded to the installed profiles, using hot-air fusion.

Mechanical fastening must not affect the integrity of the waterproofing layer. Therefore, it is essential to additionally waterproof fasteners. This is done by overlapping them with an adjacent sheet if the fasteners are located at the perimeter of membrane sheets or by covering them with patches or a suitably wide membrane strip if they are located inside a membrane sheet. To avoid fastening inside a membrane sheet, a half-wide membrane may be used. Alternatively, fixing discs may be used. These are ring-shaped cuttings with a diameter of 183 mm (collar, type 13). The cuttings are made of a membrane identical in quality to the main membrane and fastened with mechanical fasteners into the fixing layer. Membrane sheets are then bonded to the discs with a PU adhesive. No membrane perforation occurs in this mechanical fastening method.

Prepared by a chartered structural engineer, a roof fixing plan typically defines the centre-to-centre distance of fasteners and the distances of individual fixing lines (according to membrane width and whether fasteners are only installed at the perimeter of a membrane sheet or also inside it). See figure 5 for an example. The minimum centre-to-centre distance of fasteners in a single line is 150 mm. If the calculated centre-to-centre distance of fasteners is less than 150 mm, the membrane must be fastened in its centre or narrower membrane sheets must be used. If the distance between two adjacent fasteners is less than 150 mm, they must be included in the calculation as a single fastener.

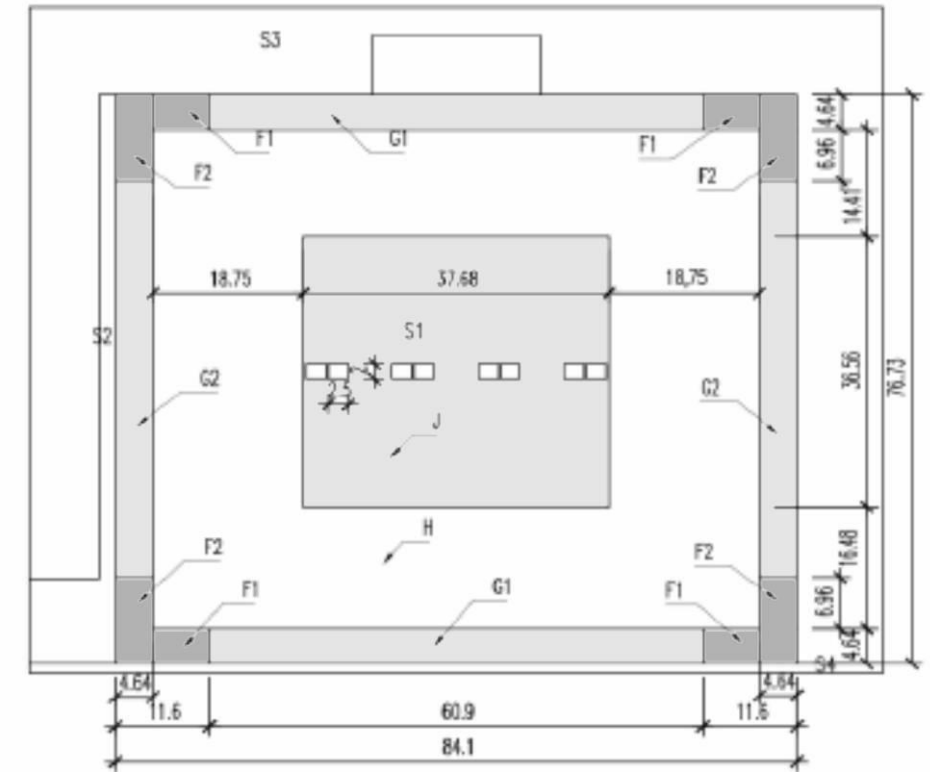


Figure 4: Example of roof layout

Area:	Min. number	Spacing of fixing lines (cm) R	Max. avg. spacing of fasteners (cm) D_{max}	Designed spacing (cm) D0,D1,D2,D3	Designed number per m²	Total area	Total number (pcs)	Usage rate (%)	Basic width of sheet (cm)
F1:	5.4	63.3	29.1		5.6	129.2	730	96	205
	Main line:		D0:	28	Spacing of main fixing lines (cm):				190
	Inner line 1:		D1:	28	Number of inner fixing lines:				2
	Inner line 2:		D2:	28					
F2:	6.0	47.5	35.2		6.6	215.3	1,418	91	205
	Main line:		D0:	28	Spacing of main fixing lines (cm):				190
	Inner line 1:		D1:	28	Number of inner fixing lines:				3
	Inner line 2:		D2:	28					
	Inner line 3:		D3:	56					
G1:	4.1	63.3	38.7		4.7	565.2	2,656	87	205
	Main line:		D0:	28	Spacing of main fixing lines (cm):				190
	Inner line 1:		D1:	28	Number of inner fixing lines:				2
	Inner line 2:		D2:	56					
G2:	5.4	63.3	29.1		5.6	497.0	2,804	96	205
	Main line:		D0:	28	Spacing of main fixing lines (cm):				190
	Inner line 1:		D1:	28	Number of inner fixing lines:				2
	Inner line 2:		D2:	28					
H:	3.3	95.0	32.3		3.8	3,668.7	13,794	87	205
	Main line:		D0:	28	Spacing of main fixing lines (cm):				190
	Inner line 1:		D1:	28	Number of inner fixing lines:				1
J:	2.0	95.0	52.6		2.8	1,377.6	3,886	71	205
	Main line:		D0:	28	Spacing of main fixing lines (cm):				190
	Inner line 1:		D1:	56	Number of inner fixing lines:				1
Number of fasteners on waterproofing layer (excluding details) (pcs):							Approx.	23,870	
Number of fasteners in details (pcs):							Approx.	1,582	
Number of fasteners on thermal insulation layer (excluding details) (pcs):							Approx.	12,906	
Total number of fasteners (pcs):							Approx.	**38,358**	
	Total area (m²):							6,453.0	

Figure 5: Proposed fastener layout within sheets in roof zones

3.6.2.2.3 Securing membranes with aggregate, traffic layer or a green layer

For approximate specifications of protection layers for roofs with a reference height of up to 30 m see table 10. If the roof deck composition prevents inspecting the functionality of the waterproofing layer or, as the case may be, the securing waterproofing structure placed under the stabilisation layer, you should use a failure alarm system or a double-layered system that will allow inspection and repair, in particular of inverted roofs, roofs open to traffic and green roofs.

Waterproofing and other structural layers of the roof deck without UV stabilisation must, throughout their service life, be effectively protected with a stabilisation layer against negative weather effects. The stabilisation layer quality must correspond with the planned roof traffic.

Since loading the roof deck with bulk material or loose pavers fails to fully eliminate internal forces in the membrane (contraction), it is essential to install suitable linear plastic-coated metal profiles at points where the roof suddenly changes its slope and to hot-air weld the membrane to the profiles.

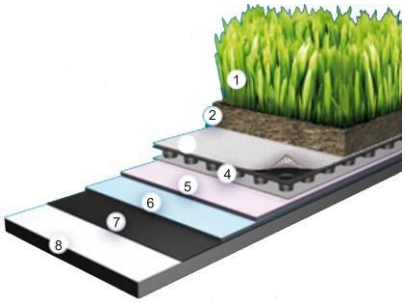
The following options are possible to secure roof layers against negative wind pressure and also meet other performance requirements:

- **Ballast** – usually contains mined and sorted aggregate of grading 16-32 mm (shingles), thickness as per a structural calculation or, in exceptional circumstances, as per table 10. In perimeter and corner zones of the roof, ballast should be combined with concrete pavers or other measures should be taken to secure both the membrane covering and the ballast against negative wind pressure. In order to secure ballast on a slope of over 6°, reinforce the surface layer, e.g. by bonding, with cement primer or an alternative technical measure, e.g. by using the NEOCEL honeycomb plastic membrane.
- **Pavers**
  - *Pavers on support pads, known as 'dry paving', concrete pavers with minimum recommended dimensions of 400x400x40 mm. PE- or PP-based support pads may be placed directly on the membrane without separation. Correction pads should be used to ensure the required flatness of the paver surface.*
  - *If placed on a mortar bed, pavers* are usually put on frost-resistant bonding sealer on a reinforced base concrete layer. The base layer must have expansion joints in a 2x2 m grid or as determined by a structural assessment.
  - *Sub-base for pavers* – usually a bed of sand or crushed aggregate of grading 2-4 mm, minimum layer thickness 20 mm. If the base layer is made of compressible material, e.g. thermal insulation boards of mineral wool or expanded plastics, the sub-base should be thicker due to paver compaction.
  - *Pavers of elastomeric or plastic panels* are typically used to create walkways or as temporary protection of the waterproofing membrane.

- **Stabilisation concrete layers** – these are usually made of reinforced oversite concrete, plastic concrete or asphalt concrete with expansion joints.
  Silicate materials in an unprotected position in the roof deck should have expansion gaps and be separated from adjacent structures with a suitable expansion, separation and drainage layer.
  The determination of the minimum thickness of stabilisation concrete layers is based primarily on the structural assessment of wind pressure in individual roof deck zones. The typical minimum thickness of these layers is 50 mm for silicate structures and 30 mm for other types of stabilisation layers.
- **Wooden slats** – protecting a waterproofing membrane with wooden slats does not usually meet the specifications required by the structural calculation, making it necessary to combine the slats with other protective measures. The materials must have constant resistance to biological corrosion and be separated

from the waterproofing membrane with point or linear components. Such components must not pose an obstruction to smooth removal of rainwater.

- **Vegetation layer (soil) –** the layer thickness depends on the proposed maintenance method and requirements of the plants. A vegetation layer should have a thickness of 80 mm to 150 mm for extensive maintenance and of 150 mm to 1,000 mm for intensive maintenance. The overall thickness of vegetation layers depends on the load-bearing capacity of the underlying roof structure and on the plants to be grown there.



In order to protect roof layers against negative wind pressure, the main protective means must usually be combined with additional ones in perimeter and corner roof zones.

See table 11 for approximate surface density of the most common types of stabilisation layers.

Table 11: Approximate surface density of selected loading layers

Stabilisation layer	Grading	Density, bulk weight [kg.m^{-3}]
Plain cement concrete, pavers, terrace pavers		2,300
Tile flooring		2,000
Mined aggregate (shingle)	8 - 22	1,800
	16 - 32	1,750
Expanded clay (keramzite)	8 - 16	500
	16 - 22	450
Aggloporite		800
Soil (peat)		500
Sand		1,600

When covering a FATRAFOL membrane with any traffic layer, the membrane top surface must always be protected fully from mechanical damage by using synthetic fibre textile with a minimum square density of 300 g.m^{-2}. The textile need not be used for traffic layers made of concrete pavers on plastic support pads.

3.6.2.2.4 Securing membranes with adhesives

Within the FATRAFOL-S system, FATRAFOL 807 and FATRAFOL 807/V may be secured against wind uplift with adhesives. Use reactive polyurethane, one- or multi-component adhesives for bonding. Secure the membrane covering with adhesives in applications where the roof structure must be perfectly airtight, where the waterproofing, vapour control and auxiliary waterproofing layers of the roof structure must not be perforated, and where the roof deck composition and structure do not allow using a different method to secure the covering.

Possible bonding methods include:

- Applying PU adhesives in accordance with manufacturers' technological specifications
- Cold-bonding with solvent-free asphalt varnish (suitable only for FATRAFOL 807)

Except for roof corner and perimeter zones, a membrane covering must never be fully-bonded to the substrate. For the bonding method and scope, follow the manufacturer's technological specifications.

The substrate to which the membrane covering is to be bonded must be strong enough to constantly transfer forces acting on the covering (see table 9). Without prior surface treatment, asphalt adhesives must not be used on substrates with reflective or acrylic paint, on laminates and aluminium membranes. Bonded substrates must be clean, dry, free of dust, oil, loose or embedded gravel, un-adhered coatings, deteriorated waterproofing membranes and any other materials that reduce the strength of the bonded layers. If using PU expansive adhesives to bond a membrane to a deteriorated asphalt substrate, treat the surface with a bonding primer recommended by the manufacturer.

A PU adhesive must be applied in regular beads to achieve the coverage recommended by the manufacturer.

Linear fasteners placed in roof perimeter or corner zones cannot be fully substituted with bonding or fusing. Linear fasteners must be installed everywhere there is a risk of peeling of the membrane covering, i.e. at the perimeter of bounding structures, protruding structures, around all penetrations etc – see article 3.6.2.1.

3.6.2.2.5 Securing membranes with a vacuum fastening system

The principle of vacuum fastening is based on a one-way air flow in the roof deck that is separated in an airtight manner from the building interior. Vacuum is created by using vacuum valves placed on the roof covering, mostly at the roof perimeter. The number and position of valves are determined by a calculation.

This fastening method is suitable for nearly all FATRAFOL-S membranes except FATRAFOL 818/V and FATRAFOL 814.

In general, airtight layers (monolithic concrete, original airtight asphalt covering etc) are a suitable substrate for this method of securing membranes. All perimeter, end and penetrating structures must ensure the roof deck is perfectly airtight. This may also be achieved by installing an additional airtight layer; a vapour control layer not perforated by fasteners may provide an airtight solution. If installing a separate airtight layer, make sure to assess its impact on thermal and technical properties of the roof.

Thermal insulation and separation layers must be secured (e.g. bonded) against movement in the structure.

3.6.3 Joining waterproofing membranes

When installing a membrane covering, the key task is to make entirely watertight and firm joints between waterproofing membrane sheets, membranes and linear plastic-coated metal profiles at the perimeter, and between membranes and accessories (rainwater outlets, vent outlets etc) in order to create a single unit. Two technologies are available to make these structural joints:

- **Hot-air welding** – this method is based on the so-called fusion welding, which involves heat-melting contact surfaces of membrane overlaps and their simultaneous compression. This is achieved by hot air flowing out of a slot nozzle of a welding machine with continuous temperature control. Move the welding machine gently in the direction of an open joint (with the slot nozzle projecting 3 to 5 mm over the upper membrane edge). Heated contact surfaces must be pressed down immediately behind the nozzle, using a rubber or Teflon roller.
  This joining method may be used at temperatures from -5°C for PVC-P/-10°C for TPO up to +40°C, and also on damp substrates.



- **Wedge welding** – this method is similar to hot-air welding, differing only in that the welded surfaces are heated by thermal transfer from a wedge welder. Heated contact surfaces must be pressed down immediately behind the wedge welder, using a roller. This system is used only for automatic welding machines and is suitable for materials with lower thermal oxidation stability (e.g. some types of TPO membranes).

If a proper working process is followed, both methods can create joints with shear resistance of at least 80% of the waterproofing membrane shear resistance indicated by the manufacturer. Hot-air welding must be considered the primary method of joining FATRAFOL membranes. Membrane sheets are welded at their overlaps. If using a hand-operated welding machine, the weld must be at least **30 mm** wide. Most automatic welding machines have a 40 mm wide welding nozzle.

Where membrane sheets are fastened mechanically, fixing washers must be positioned at least **10 mm** from the edge of the lower fastened membrane sheet. The overlap of the upper membrane sheet behind the washer must be 10 mm greater than the weld width – see figure 7. Oval washers must always be aligned lengthwise with the joint axis. Hot-air welding may be performed using a hand-operated welding machine or an automatic welding machine [1)], subject to adherence to this Instructions and applicable standards.

In case of membrane coverings with zero slope, roofs with a stabilisation or traffic layer, with green layers – green roofs, and in case of roofs where the membrane covering is not the top roof surface, all joints should be treated with a joint sealant. This recommendation is optional for other structural types of roofs. [2)]

Welds may be treated with a joint sealant only after they are checked with a testing needle or another penetrating method, not earlier than 1 hour after welding. To apply the joint sealant, use a PE bottle with a 3 mm wide delivery nozzle for horizontal welds and a 1 mm wide delivery nozzle for sloping and vertical welds.

Mix the joint sealant and, if necessary, adjust its consistency before use.

In addition to the above, treating welds with a joint sealant is recommended in:

- All detailing work where shaped pieces are used,
- Making T-joints (approx. 150 long)

The joint sealant is not a substitute for PU sealer – see the Construction Details.

Notes:

1) FATRAFOL 807 and 807/V membranes may only be welded using selected types of automatic welding machines that are capable of making the weld in the limited width area of the loose edge (collar).

2) Most structural types of flat roofs can be categorised by hydro-physical loads caused by pressure water (snow thaw, heavy rain, vacuum method of water drainage, water flooding in case of drainage system failure etc).

3.6.4 Ending a roof covering at the roof perimeter

The roof perimeter may include a parapet, ledge, wall, gutter edge etc. The design should meet the following performance requirements:

- Ensuring that wind uplift does not tear off the membrane edge from the substrate and that wind does not get under a non-loaded waterproofing membrane layer.
- Eliminating the ingress of rainwater under the covering, even in extreme conditions such as wind-driven rain and snow, a thick layer of thawing snow on the roof, roof flooding when downpipes are clogged with dirt, ice etc.
- Securing the covering against internal forces in the waterproofing membrane.
- Enabling fluent removal of water vapour from the roof layers.

To end the covering, use perimeter plastic-coated metal profiles (details 208, 301, 302, 303, 501 – 507). When joining the membranes to these profiles, follow the instructions for membrane joining within the roof field.

On a vertical wall, the covering may, depending on circumstances, be ended either directly on the masonry and then plastered to a height above the end of the waterproofing layer, or it may be ended on the surface of existing plasterwork and sealed with permanently elastic sealer. With this type of ending, you must take into account the risk that flowing water may seep through the wall. The height of the upper membrane edge above the covering of the adjacent area must be at least 150 mm (detail 303, 304, 305). A waterproofing membrane must be ended watertight on the edge of a roof opening if its height above the adjacent area level is less than 150 mm. To ensure the membrane covering is well ended, the edge of the roof opening and the structures below the edge must be sufficiently firm and, if possible, positioned in a single vertical line. When installing additional thermal insulation on a vertical wall, water ingress to the bottom of the thermal insulation must be prevented by welding an additional membrane sheet to the original covering and ending it on the new thermal insulation, as described above.

3.6.5 Additional sealing of details

When creating a waterproofing covering at a point where three waterproofed planes intersect (internal corner and external corner), and when waterproofing roof penetrations, follow the two methods described below.

When waterproofing 3D details, first cover the detail with suitable flat cuttings of the membrane. Once prepared (without undulations and stretching), the detail is finished by welding to it a vacuum-shaped piece of suitable kind that will make the entire detail completely watertight. Shaped pieces must always be joined to the base membrane by hot-air welding – they must be welded fully or along their entire perimeter, with the weld being at least 30 mm wide (detail 211, 212).

For circular roof penetrations (vent outlets, pipes etc), use is usually made of shaped pieces, either prefabricated (if the required dimension is available) or made on-site from a homogeneous roofing membrane. The homogeneous membrane should always be at least one degree thicker than the waterproofing membrane. Both types of shaped pieces must be fully hot-air welded to the waterproofing membrane. The upper edge of the shaped piece or of the adjacent vertical sheet on a penetrating PVC pipe is to be welded to the pipe. If the pipe is made of any other material, the upper edge is to be sealed with PU sealer and secured in place with corrosion-proof tape.
All joints of waterproofing membranes described in this chapter should be treated with a joint sealant.

3.6.6 Roof drainage

Rainwater may be drained from the surface of flat roofs either by external drainage components – gutters – or by internal drainage components – rainwater outlets and gutters within the roof field. Drainage components must be designed and dimensioned in accordance with CSN 73 1901 and CSN 73 3610 ‘Design of Sheet Metal Constructions’. The design must take into account snow, frost and ice loads on the roof, according to CSN EN 1991-1-3.

3.6.6.1 Linear drainage from roof

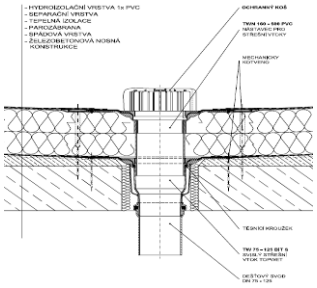
Linear drainage means removal of water using eaves, ledge, rooftop or parapet gutters. With this type of drainage, the roof covering is welded at its end to a perimeter plastic-coated metal profile (detail 503, 504, 508, 601, 602). It is not recommended to drain water from roofs using parapet and valley gutters.

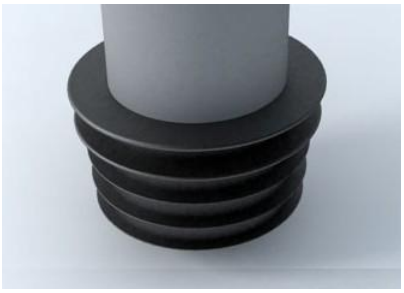
The minimum permissible slope of all gutters is 0.5%. If a smaller longitudinal slope is provided, dirt may deposit in the gutter, reducing its capacity.

Downpipes installed outside the building or in unheated areas must be sufficiently protected against freezing, e.g. by heating. Heating cables used for this purpose do not affect the roof covering with their temperature.

The maximum distance of rainwater outlets in gutters or valleys from their ends or the dividing crest in the gutters or valleys should not exceed 15 m.

3.6.6.2 Point drainage from roof





Two basic options are available for point drainage using rainwater outlets:

- Using a PVC-P or TPO rainwater outlet to which the membrane is welded at the roof plane or using a rainwater outlet made of a different plastic with a PVC or TPO collar to which the membrane is weldable (detail 603, 604).
- Using a PVC-P or TPO corner insert to drain water through a parapet (detail 605). This roof drainage method requires installing overflow outlets to address the risk of ice formation in rainwater outlets in the parapet wall.

For safety reasons, we recommend installing at least two separate rainwater outlets on each roof having internal drainage elements. Where only one rainwater outlet is provided to drain water from the roof, you should install an overflow outlet for added reliability.

If the covering includes a vapour control membrane, a two-stage rainwater outlet should be used.

To drain the securing waterproofing structure, follow the instructions for the main waterproofing layer. A securing waterproofing layer should be drained using a separate pipe or at least a separate rainwater outlet. That pipe should also indicate failures of the main waterproofing layer (e.g. transparent plastic, electric alarm).

For smooth finishing, roof rainwater outlets should be at least 0.5 m from adjacent structures (parapets, roof penetrations etc).

Refer to table 12 for dimensioning of rainwater outlets in the Czech Republic.

Connection collars or shaped pieces of rainwater outlets must always be firmly fastened at their perimeter at the roof plane to the substrate, or the underlying waterproofing layer must be fastened. Otherwise, there is a risk of them being displaced or deformed by internal and external forces.

The membrane must be joined in accordance with relevant instructions. A rainwater outlet should be recessed below the adjacent area to allow smooth drainage of water from the covering even during the maximum expected bending of the load-bearing structure.

If electric heating is not provided to protect a rainwater outlet from freezing, pay attention to the risk of water vapour condensation on the outlet inside the roof and ensure removal of all condensate. The same measure must be taken also for multi-ply roofs or, alternatively, the downpipe must be thermally insulated at the point of penetration through the ventilation and thermal insulation layer.

In case of roofs with a stabilisation layer of bulk material, rainwater outlets must always be protected from being clogged with the material; other outlets must be fitted with a leaf and dirt trap. Rainwater outlets should be so positioned and designed to allow easy inspection and cleaning.

Overflow outlets located in a parapet as protection in case rainwater outlets get clogged must be treated, at the point of penetration through the roof covering, similarly to rainwater outlets. The overflow outlet collar must also be fixed firmly to the substrate. The overflow outlet must be located next to the drained valley, at the lowest point of the waterproofing membrane on the parapet, keeping the required slope.

Table 12: Rainwater outlets – dimensioning for roof types and required safety coefficients

Pipe diameter [mm] (vertical)	Flow rate [l/s]	Green roofs with vegetation layer thickness		Other roofs
		Up to 100 mm	Over 100 mm	
DN 70	5.7	380 m^2	663 m^2	190 m^2
DN 100	6.3	420 m^2	700 m^2	210 m^2
DN 125	9.0	600 m^2	1,000 m^2	300 m^2
DN 150	10.0	667 m^2	1,110 m^2	333 m^2

Note: A safety coefficient of 0.5 applies in cases where strong precipitation or a clogged rainwater outlet may cause water ingress into the building. A safety coefficient of 0.3 applies to buildings requiring extra protection (hospitals, museums, theatres etc).

3.7 Traffic layer

A traffic layer or layers on the roof surface allow using the roof for pedestrian or vehicular traffic, as a roof garden, playground, swimming pool, relaxation area etc. A limited traffic layer is provided also on roofs not open to the public to allow their inspections and maintenance.

1. Vapour control membrane
2. Thermal insulation
3. Geotextile
4. FATRAFOL 818 waterproofing membrane
5. Drainage layer (Fatradren)
6. Loop mat
7. Fatratex geotextile
8. Soil
9. Vegetation layer

Within the FATRAFOL-S system, FATRAFOL 814 with an anti-slip texture may be used as a traffic layer.

The traffic layer surface must be so sloped to allow rainwater to flow smoothly to the drainage system.

Special attention must be paid to balconies and terraces. No puddling may occur on these surfaces. Sloping the roof at more than 3% usually prevents puddling.

A waterproofing layer covered with other layers or not accessible for cleaning should be resistant to root penetration. This is a mandatory requirement for vegetation roofs and roof gardens.

Traffic layers located above a waterproofing layer and consisting of ballast, pavers on support pads or pavers in ballast, layers with a reinforced concrete slab or with bonded pavers, vegetation layers etc that also serve as stabilisation against external forces are described in article 3.6.2.2.3.

Additional components:

- Reinforced concrete or plastic containers for soil and plants
- Special structures, shades, visual or protective structures
- Combinations of above layers and structures

4 Technical preparation for installation

4.1 Documentation for installation preparation

Preparatory works for installation may be based on project documentation (usually available for new buildings or general renovations) or survey results.

If project documentation is available, especially the following is necessary to get ready for roof covering installation:

- Technical report
- Structural assessment of roof load-bearing capacity
- Drawings - Roof plan with dimensions and slopes of roof areas
  - Characteristic roof cross-sections
  - Detailed design of roof structures including their thicknesses
  - Drainage method
  - Expansion joints
- Fastening method
- Bill of quantities
- Planned use and maintenance of the roof

If project documentation is unavailable or incomplete (e.g. 'building permit documentation') and in case of any refurbishment, it is necessary to conduct a roof survey, measure the roof, consult the details with the designer and customer, probe the roof and perform tensile tests of the proposed fasteners in order to establish:

- The composition, dimensioning and condition of individual roof deck layers, in particular the fixing and thermal insulation ones (thermal and technical assessment),
- Roof dimensions and shape,
- Roof height above the ground,
- Lengths of plastic-coated metal profiles,
- Height, shape and composition of parapets,
- Quantity and dimensions of roof penetrations including dimensions of rainwater outlets and their connection to downpipes,
- Additional adjustments to the roof covering,
- Any other requirements (thermal insulation of penetrations, substrate ventilation, positioning of rainwater outlets, expansion joints between traffic layers, slope etc) ,
- The maximum possible load on the roof and the positioning of safety components.

4.2 Getting ready for installation

The preparation for installation includes:

- Choosing the right waterproofing membrane for the main area and supplementary membrane types,
- Determining the method to secure the covering against external and internal forces,

- Specifying the required substrate treatment (see article 3.2.1),
- Determining the roof deck composition,
- Calculating the area of individual roof deck zones (based on known or established dimensions),
- Determining the types and dimensions of perimeter profiles (see article 3.6.4),
- Determining the types, positions and density of fasteners if mechanical fastening is used (see article 3.6.2.2.2),
- Determining the type, thickness and position of the stabilisation layer within the roof field,
- Choosing the adhesive depending on the substrate structure quality, and positions and coverage in individual roof zones,
- Determining the types and quantity of shaped pieces, rainwater outlets and vent outlets,
- Specifying the overall material consumption (see table 13),
- Calculating the quantities or costs, or drawing up a budget if necessary, based on the labour required, installation time and all relevant costs associated with the installation (based on the contractor's experience and the calculation formula shown in Decree 21/1990 Coll. as amended).

QUOTATION (prices excl. VAT)

MATERIAL SPECIFICATIONS

Item	Material description	Quantity	Unit	Unit price	Total [CZK]	Note
1	FATRAFOL 810 membrane, thickness 1.5 mm	4.500,00	m²	205,00	922.500	
2	FATRAFOL 804 membrane, thickness 2.0 mm	522,00	m²	239,00	124.758	
3	FATRAFOL 803 membrane, thickness 1.5 mm	80,00	m²	145,00	11.600	
4	FATRAFOL 814 membrane, thickness 2.5 mm	154,00	m²	349,00	53.746	
5	Shaped piece, type 10, internal corner	108,00	pc	30,00	3.240	
6	Shaped piece, type 11, external corner	260,00	pc	30,00	7.800	
7	Shaped piece, type 13, collar, Ø 400 mm	120,00	pc	60,00	7.200	
8	FATRATEX-S, non-woven textile 300 g/m²	4.800,00	m²	19,00	91.200	
9	VIPLANYL 60 plastic-coated sheet metal (as per list)	342,81	m²	368,00	126.154	
10	TWE 128 PVC S rainwater outlet	29,00	pc	2370,00	68.730	
11	TWPP 512 PVC 100/100 overflow outlet	10,00	pc	1770,00	17.700	
12	AL 6x30 mm blind rivet	4.500,00	pc	2,18	9.810	
13	AL 6x40 mm blind rivet	200,00	pc	3,10	620	
14	GBS 6x 60 mm self-drilling screw, countersunk head	21.300,00	pc	5,50	117.150	
15	SMZ 4,8 x19 mm self-drilling screw, sheet metal	1.150,00	pc	0,75	863	
16	UV 5x40 mm wood screw	200,00	pc	0,50	100	
17	HZ 6x50 mm hollow brick dowel	2.500,00	pc	1,10	2.750	
18	VIP 50 washer	14.300,00	pc	2,60	37.180	
19	Z-01 joint sealant, grey colour	37,00	kg	250,00	9.250	
20	Emfimastic 25 PU sealer (310 ml cartridge)	64,00	pc	110,00	7.040	
21	PP lightning rod holder – Techplast	620,00	pc	26,00	16.120	
22	Patch for lightning rod support	620,00	pc	5,00	3.100	
23	MIRELON sealing profile	650,00	m	15,00	9.750	
MATERIAL TOTAL:					**1.648.361**	

HANDLING OF MATERIAL

24	On-site transport of material	1,87%			30.824	
25	Extra charge for extensive transport	0,57%			9.396	
MATERIAL TRANSPORT TOTAL:					**40.220**	

INSTALLATION

Item	Activity description	Quantity	Unit	Unit price	Total [CZK]	Note
1	Installation of roof deck waterproofing system	4.402,00	m²	161,00	708.722	
INSTALLATION TOTAL:					**708.722**	

MATERIAL:	**1.688.581**	
INSTALLATION:	708.722	
TOTAL:	**2.397.303**	

EXTRA COSTS

Site preparation	1,20%			8.505	
Operational effects	0,80%			5.670	
Logistics	2,50%			42.215	
EXTRA COSTS TOTAL:				**56.389**	

TOTAL

PRICE EXCL VAT:	2.453.692	CZK
VAT (at 19%)	466.201	CZK
GRAND TOTAL:	**2.919.893**	**CZK**

The result of preparatory works for installation is a quotation.

Table 13: Approximate material consumption

Material	Installation method	Consumption per m^2 of roof	Note
FATRAFOL membrane Width 1,200 mm and 1,300 mm	50 mm overlap	1.10 m^2	
	100 mm overlap	1.15 m^2	
FATRAFOL membrane Width 2,000 mm and 2,050 mm	50 mm overlap	1.05 m^2	
	100 mm overlap	1.10 m^2	
FATRAFOL membrane Width 600 mm and 650 mm	50 mm overlap	1.15 m^2	
	100 mm overlap	1.25 m^2	
Protective fleece, width 2,000 mm	50 mm overlap	1.05 m^2	
Bonding with liquid asphalt	40% of area (corner zone)	1.00 kg	
	20% of area (perimeter belt)	0.50 kg	
	10% of area (central zone)	0.30 kg	
Bonding with PU adhesives	Corner zone	0.60 kg	Exact consumption as per manufacturer's instructions or structural assessment
	Perimeter belt	0.40 kg	
	Central zone	0.20 kg	
Joint sealant	Securing of all joints (3 mm wide delivery nozzle)	0.008 kg	1 kg per approx. 130 m^2 of roof
Fasteners for point fastening of membrane	Depending on density of fasteners in individual roof zones	$(1.03(\Sigma h_n.P_n)/P)$ pc	See table 10.
Fasteners for plastic-coated sheet metal	~5 pcs/1 running metre	-	Typical centre-to-centre distance of fasteners: 20 - 25 cm
Sealers	Depending on length sealed	(0.031.d/P) kg	1 cartridge per 13 running meters

d - Length sealed [m]
h_n – Density of fasteners in the nth roof section [pieces.m^{-2}]
P_n - Area of the nth roof section [m^2]
P - Roof area [m^2]

5 TECHNOLOGICAL PROCEDURES

5.1 EXTERNAL CONDITIONS FOR WATERPROOFING WORKS

5.1.1 Site readiness

Site takeover, i.e. typically a takeover of a delineated site under **Government Regulation 591/2006 Coll.**, on minimum occupational health safety requirements at construction sites, and of completed load-bearing structures, all end, perimeter and penetrating structures and other firmly attached components, is made by the contractor's authorised representative (site manager, shift supervisor) in the presence of a site manager representing a superior contractor, the investor's technical supervisor and other authorised persons.

As part of site takeover, a visual inspection must be made of completeness and slope of base structures and parapets, of skylights and all roof penetrations. Make sure the situation on site corresponds to the current project documentation and the fixing plan.

Works should not commence until the owner's technical supervisor accepts the base structures. Site takeover must be noted in the construction log, together with the following:

- Date and time of site takeover
- Exact site description using layout axes (map or sketch)
- Site conditions in terms of OH&S, fire prevention and EMS
- Number of skylights and steel supports for technological equipment and their conformity with current project documentation
- Defects and outstanding works, if any
- Signatures of those handing over and taking over the site

Images should be taken of the site at the time of takeover.

Key items to be provided and determined as part of a site takeover process:

- A material storage location and protection of materials from mechanical damage, weather and theft
- Safe access to the site and place of installation
- A safe and cost-effective method of horizontal and vertical transport
- Space for materials on the load-bearing or base structure, subject to permissible load
- 230/400 V connections in accordance with current regulations, including electricity meters
- A waste management system (sorting, environmentally friendly disposal, certificates)
- Necessary measures in accordance with the site rules and safety, legal and sanitary regulations and standards
- Methods to coordinate simultaneous and related construction works and other operations on the roof deck (considering the traffic on complete roof deck sections that have not been handed over to the client as yet)
- Performing tightness tests and demonstrating work quality – handover of roof sections

5.1.2 Working conditions

PVC-P and TPO membranes may be installed at an ambient temperature of no less than -5°C *) and -10°C respectively. At temperatures below +5°C, you should first warm unwound waterproofing membranes in a heated room as close to the place of installation as practicable. Works must not be carried out in rain, snow, frost and strong wind.

Fitters may only step on laid waterproofing membranes if wearing soft-soled shoes that prevent mechanical damage to the membrane, ensure safe treading on the membrane without the danger of slipping and meet the safety requirements regarding personal protective equipment.

Access by any other persons to laid membranes must be reduced to a minimum. No movement of light construction equipment and no transport and storage of heavy loads is allowed on an unprotected membrane.

Transport routes for people, construction materials and equipment on a finished roof covering, especially on single-ply roofs with the standard arrangement of layers and rigid mineral wool boards for thermal insulation, must be covered with firm material (e.g. OSB boards) to prevent destruction of the thermal insulation. The same protection must be provided where technical equipment is installed and heavy loads temporarily stored.

**) The lowest application temperature for FATRAFOL 814 is +5°C.*

5.2 Installing a roof covering

The installation of a FATRAFOL-S system roof covering includes the following sequence of steps:

- A visual inspection and, if necessary, levelling and sweeping the substrate
- Installing a suitable vapour control layer
- Laying a thermal insulation layer (usually two layers with overlapped joints)
- Fastening thermal insulation boards to the substrate
- Laying base, protective and separation layers of non-woven biocide textile
- Installing perimeter profiles of FATRANYL plastic-coated sheet metal or TPO-coated sheet metal
- Laying a FATRAFOL waterproofing membrane – dimensional stabilisation
- Fastening the membrane to the substrate (mechanical fastening, bonding)
- Joining the membranes at overlaps (by a hot-air welding machine or wedge welder)
- Waterproofing roof penetrations
- Installing end elements
- Treating joints with a joint sealant
- Treating the roof covering end components, on projecting structures, with permanently elastic PU sealer

Depending on specific on-site conditions, some jobs may be skipped or the tasks below may follow:

- Testing the covering tightness (submersion test, vacuum test of welds known as 'bubble emission technique' under EN 1593 + Amendment A1, high-frequency voltage, coloured smoke, impedance defectoscopy etc)
- Applying an upper protective layer (aggregate etc)
- Applying a traffic layer (pedestrian or vehicular traffic roofs or roofs having another specific function)
- Applying vegetation layers for roof gardens
- Installing a lightning conductor, TV aerials etc

5.2.1 Installing a vapour control layer

A vapour control layer should be installed on an unbroken substrate. If installed on a broken substrate, joints of the layer must be placed on a firm surface.

If using a PE membrane as a vapour control layer, lay it loose on the base layer, keeping both side and end overlaps with the width recommended by the manufacturer, usually at least 100 mm. Use specific tape to join, in a vapour-tight manner, the overlaps of neighbouring sheets to each other and to all penetrating and end structures and structural components. The surface of joined areas must be clean, dry and free of dust and impurities.

Before installation of a vapour control layer of bitumen sheets, the substrate is usually treated with an adhesion primer. Follow the manufacturer's instructions to connect the layer to all penetrating and end structures and structural components. Bitumen sheets are usually used as a vapour control layer for concrete substrates where holes for fasteners must be pre-drilled, and for bonded systems.

On parapets and projecting structures, a vapour control layer must reach at least to the level of the upper surface of the thermal insulation layer.

If a vapour control layer functions simultaneously as an airtight layer, it must not be perforated by roof fasteners.

5.2.2 Installing a thermal insulation layer

Thermal insulation boards are to be installed on a prepared, sufficiently firm and planar substrate that has the required or recommended slope. Bear in mind that if the substrate does not have the required slope, this will have a negative impact on the waterproofing layer surface (risk of puddling). The boards must always be installed in accordance with the manufacturer's instructions.

Thermal insulation layers made of rigid pressed boards must be joined tightly edge-to-edge or in a brick-like manner. Some types of thermal insulation boards are joined using a half-groove. In case of single-layer mineral fibre insulation, all boards must have an identical direction. If trapezoidal sheet metal is used as a substrate, you should place the boards with their longer side perpendicularly to the profiles in the sheet metal.

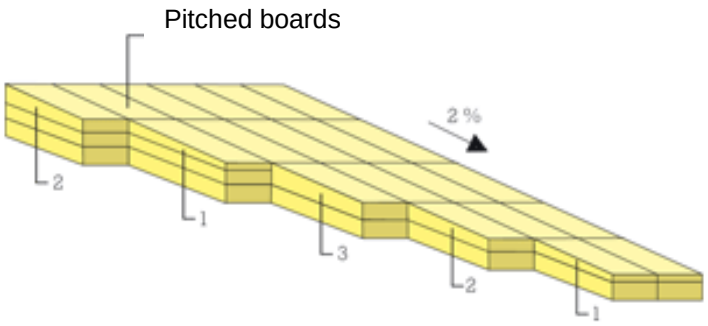
If the substrate has a zero slope, pitched thermal insulation boards may be used for sloping. These boards are installed on the first thermal insulation layer, having the minimum design dimensions.

Make sure gaps are sufficiently covered if installing two layers of thermal insulation boards. Gaps between thermal insulation boards and/or perimeter and penetrating structures may be up to 5 mm wide as this width usually has no effect on their thermal insulation properties.

If thermal insulation boards are not sufficiently secured with waterproofing membrane fasteners or a loading or traffic layer, they must be secured and fastened to the substrate mechanically or by bonding. In case of single-ply roofs with the standard arrangement of layers, thermal insulation boards must be fastened separately, using at least 2 fasteners per m². These fasteners are not included in the number of structural fasteners, i.e. the covering still needs to be secured against internal forces (at least 2 fasteners per m²).

Thermal insulation boards made of foam glass feature zero absorption but they must not be fastened mechanically to the substrate and no waterproofing layer may be fastened through them.

In justified cases, e.g. multi-ply roofs or a bonded system, thermal insulation boards are bonded using organic PU-based adhesives, cold asphalt varnishes, or alternatively fixed on special self-adhesive or easily fused asphalt sheets. The boards may be bonded in points or lines, and the adhesive must cover an area specified by the adhesive manufacturer (the bonded surface must provide stabilisation against external forces).



The top surface of the thermal insulation layer must provide a firm and unbroken substrate for the waterproofing membrane with constant compressive strength (at least 60 kPa) that is necessary to transfer active pressure while the sheets are being joined.

5.2.3 Installing a base, protective and separation layer

Sheets of base and protective fleece as well as glass fibre mats are to be placed on the substrate loosely while keeping side and end overlaps of at least 50 mm in width. Overlaps of fleece sheets are only point-joined by hot-air welding and pressing. Instead of being welded, fibreglass mats are bonded together with self-adhesive tape. Overlaps of a protective layer made of non-woven fleece should be welded fully when applying protective or traffic layers on the waterproofing membrane that may cause displacement of the protective fleece.

If concrete is to be placed over the protective fleece, you should use an open-diffusion membrane ($S_d \leq 3$ m) for separation to provide protection from the ingress of cement milk. The easiest method of dividing (cutting) the fleece is by means of hot air. If possible, the materials must be installed dry. Unfastened fleece should be temporarily loaded (with membrane rolls, boards etc) during windy conditions. A protective and separation layer placed on vertical surfaces is to be fastened using perimeter plastic-coated metal profiles and/or bonded with PU adhesives. The adhesive must not have any negative impact on the micro-ventilation function of this layer.

5.2.4 Installing perimeter profiles

Perimeter profiles, i.e. bent plastic-coated metal profiles of various shapes and sizes, are usually installed immediately after the placement of a base or separation fleece layer since they also secure the layer against wind uplift. If fleece-backed membranes (FATRAFOL 807 and 807/V) are used, perimeter profiles are usually installed only after the placement of a waterproofing membrane on the horizontal surface.

The profiles are installed along the entire roof perimeter (eaves, parapet, backing) as well as at points of sudden changes in the base slope (roof valley), at stairs and projecting substrate edges, along gutter edges and at the perimeter of most roof deck penetrations.

Suitable fasteners (blind rivets, wood screws, rivets, self-tapping screws, self-drilling screws etc) are used for fixing perimeter profiles. The fasteners must not be spaced more than 250 mm apart (minimum density: 4 fasteners per running meter). Unless the fasteners are specified in a list of sheet metal components in the project documentation, the responsibility for choosing and dimensioning them lies with the contractor.

If wide perimeter profiles are used, they should be fixed alternately in two lines. If the perimeter profile and the substrate so permit, this fastening method is always preferred to single-line fastening. Fasteners must always reach as far in as a solid and structurally sound layer of the roof deck (concrete, masonry, wood, trapezoidal sheet metal etc).

2 metre long perimeter profiles are installed with open joints (minimum width: 2 mm) according to CSN 73 3610 or must be overlapped and their joint must be riveted in a single line. CSN 73 3610 requires that a perimeter end component joined this way has expansion joints at no more than 6 m intervals and the gaps must be finished as specified in the standard. If necessary, use metal shears to adjust the length and shape of sheet metal components; avoid using an angle disc grinder.

When installing perimeter profiles, structural expansion joints must be respected. At points of structural expansion joints on a horizontal plane as well as on vertical structures, the perimeter plastic-coated metal profiles must also have an expansion joint.

Make sure the waterproofing layer is so ended at the roof perimeter that no wind, wind-driven rain or snow can get under the covering, e.g. install a sealing profile for this purpose. This is of special importance in reconstructions and refurbishment of old roof coverings.

After positioning and fastening perimeter profiles, cover open or expansion joints with self-adhesive paper tape with a minimum width of 20 mm. The joints are covered with a strip of an auxiliary homogeneous membrane of a suitable type and a minimum width of 80 mm and the strip is hot-air welded to both pieces of the plastic-coated metal profiles. The minimum weld width is 30 mm. It is essential to prevent any leakage at a point where 3 layers intersect. Increase the welding pressure and time for this purpose.

5.2.5 Installing a waterproofing membrane

Installing any type of a waterproofing membrane requires unrolling the roll, putting it in the right position, correctly fastening the membrane to the substrate and making watertight joints.

To avoid installing any damaged material, check all materials in advance. First of all, check if the packaging of the entire pallet as well as of individual rolls is intact. Unroll the rolls and refer to the label to make a visual check of key parameters such as membrane type, dimensions, thickness, number of rolls on pallet. Also check if the product is free of any visible defects such as mechanical damage, colour deviations, inhomogeneities, deviations from straightness, undulated edges, contamination etc. If any major defects are discovered, do not install the membrane. Keep the label, note the details printed on the sheet edge and contact the distributor for further arrangements. If you fail to do so, the manufacturer disclaims liability for damage caused by deliberate installation of any material that had visible defects and flaws before installation.

5.2.5.1 FATRAFOL 810, 810 AA, 810/V and 810/V AA (mechanically fastened covering)

With their structure, technical parameters and end-use properties, the FATRAFOL 810, 810 AA, 810/V and 810/V AA membranes (referred to below as ‘FATRAFOL 810’) are the primary type of a waterproofing membrane designed for mechanical fastening.

The membrane is laid on a substrate covered fully with protective and separation fleece, usually after the placement of perimeter profiles. An exception to the rule is a substrate of rigid thermal insulation mineral fibre boards or of rigid PUR and PIR boards on which the membrane may be laid without non-woven separation fleece.

Sheets are laid with side and end overlaps. Side overlap width may differ depending on the fasteners used but must not be less than 90 mm. The minimum overlap width for membranes not fastened mechanically is 50 mm. To determine the overlap, refer to the printed identification strip on the membrane face, located 100 mm from its edge. If necessary, cut the sheet length and width with a knife or scissors.

Do not tear membrane sheets. This causes major damage to the reinforcing layer and affects the membrane strength during mechanical fastening.

After putting the membrane to the desired position, fasten it mechanically as per the fixing plan, using fasteners designed for that roof section.

Subject to adherence to basic conditions, a simpler method of dimensioning may be used for buildings with a flat roof not higher than 30 m above the ground – see article 3.6.2.2.1.

If the building is exposed to heavy wind loads, each zone must be assessed individually through a structural calculation under CSN EN 1991-1-4 , ‘Eurocode 1: Actions on structures - Part 1-4: General actions – Wind actions’ and the fasteners must be chosen based on system tests conducted according to ETAG 006 on the basis of which the ‘European Technical Approval’ (ETA) was issued.

Central zone membrane sheets with a width of 1,300 mm and 2,000 mm (2,050 mm) are usually fastened at their perimeter only.

In perimeter and corner zones where, as demonstrated by a structural design and assessment, perimeter fastening alone fails to secure the covering against negative wind pressure, additional measures must be taken:

- Installing sheets of a smaller width,
- Point fastening in the sheet centre and then covering the fasteners,
- Using pre-installed strips for fastening and welding or bonding the membrane to them,
- Using fixing discs for fastening and welding or bonding the membrane to them.

For fastener spacing for various sheet widths and for fastener density see figure 6.

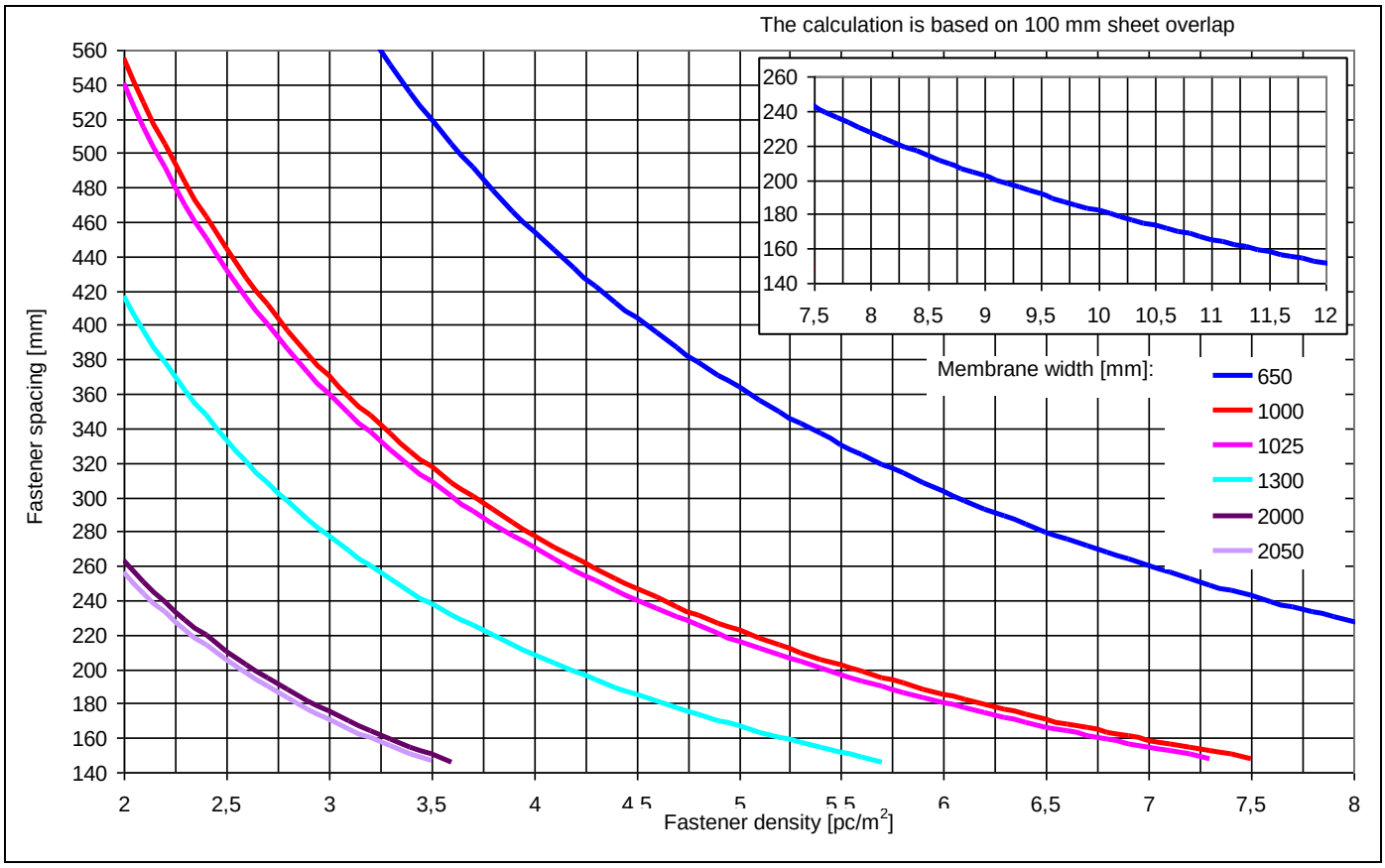


Figure 6: Fastener spacing for various sheet widths and fastener density

5.2.5.1.1 Fastening a membrane at its perimeter

Fasteners must be so positioned that the washer edge is at least 10 mm from the sheet edge; for finishing of a hot-air welded joint see figure 7. The minimum and maximum permissible linear spacing of fasteners is 150 and 500 mm respectively (exceptionally 560 mm for trapezoidal sheet metal with waves spaced at 280 mm).

Fasteners must be fixed to the substrate in accordance with manufacturer's instructions.

Previously used fasteners must not be reused.

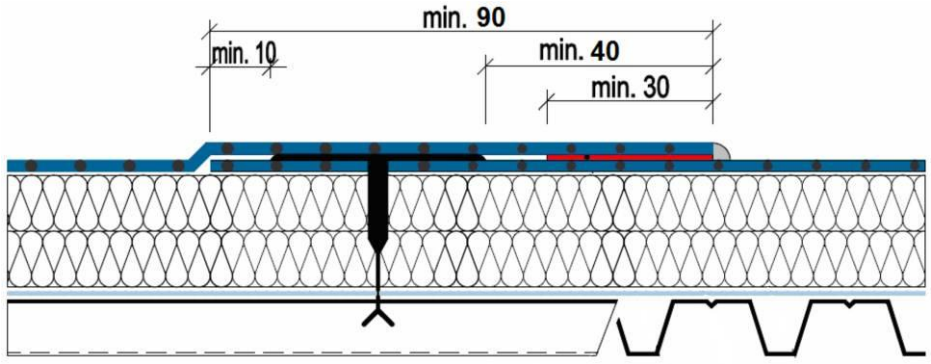


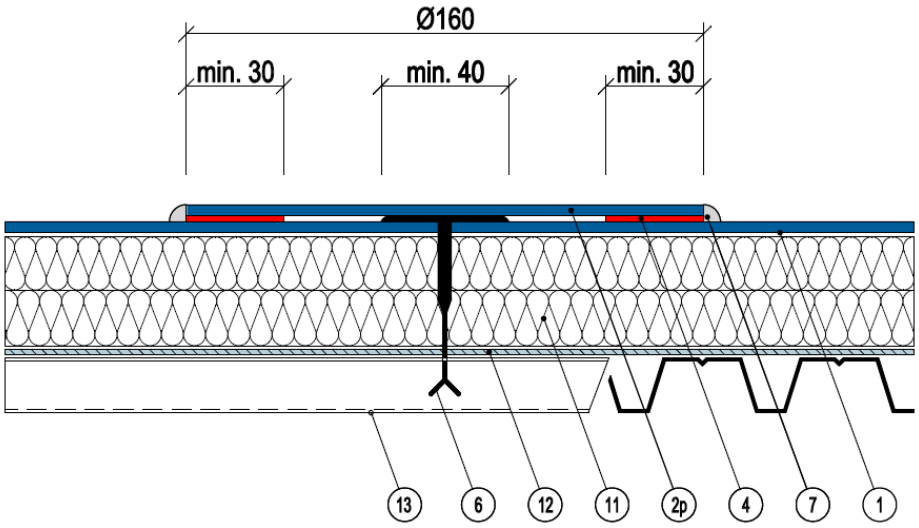
Figure 7: FATRAFOL 810 joint in overlap of sheets fastened to substrate

5.2.5.1.2 Point-fastening a membrane in centre of sheets

Sheets are fastened in a line in their centre, using the same fasteners as for perimeter fastening. A round patch or a 160 mm wide FATRAFOL 810 strip is then welded over the line of fasteners.

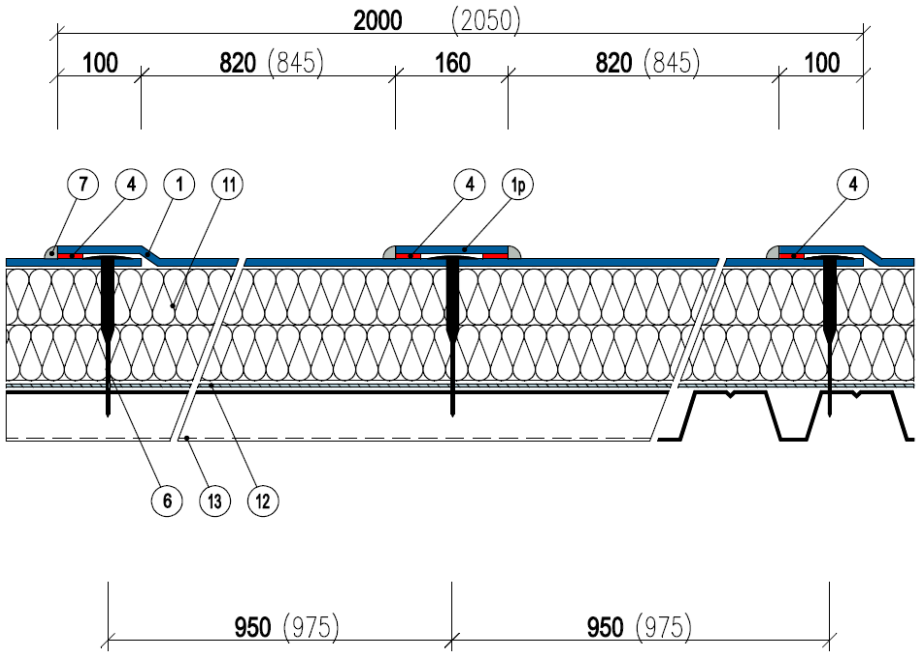
See figure 8 for the waterproofing of a centre-located fastener with a round patch. See figure 9 for the fastening of a 2,000 (2,050) mm wide waterproofing membrane, fastener layout and minimum membrane overlaps.

Centre-located fasteners must be aligned along the entire length of the sheet/roof deck zone and oval washers for fasteners must have a uniform direction. A marking string with powder paint may be used to mark the position of a fastener line.



1	FATRAFOL 810 membrane	7	Z-01 joint sealant
2p	Round patch ø 160 mm	11	Thermal insulation board
4	Membrane joint – hot-air welded	12	Vapour control membrane
6	Fastener	13	Trapezoidal sheet metal

Figure 8: Covering of additional fasteners of FATRAFOL 810 in centre of sheets

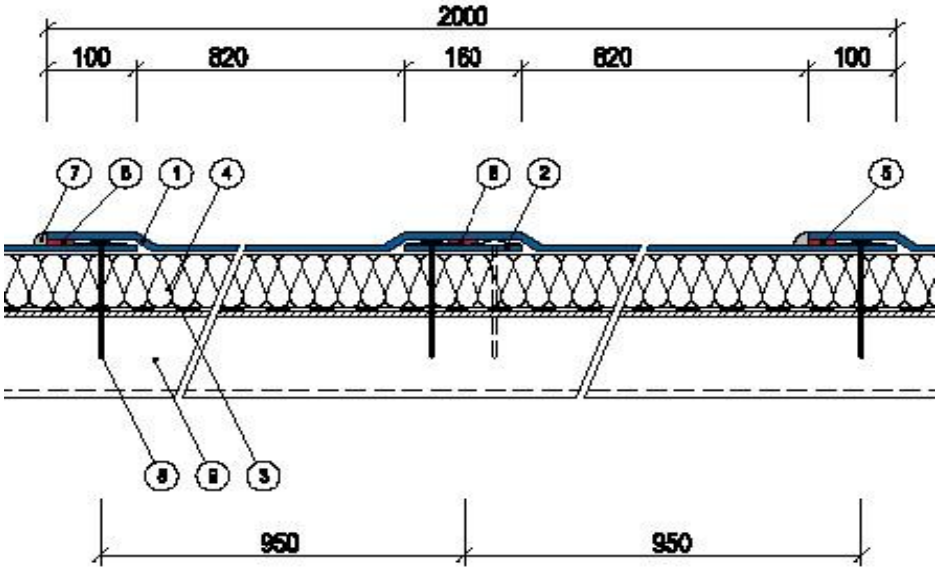


1	FATRAFOL 810/V membrane, width: 2,000 (2,050) mm	7	Z-01 joint sealant
1p	FATRAFOL 810 strip	11	Thermal insulation board
4	Membrane joint – hot-air welded	12	Vapour control membrane
6	Fastener	13	Trapezoidal sheet metal

Figure 9: Fastening of FATRAFOL 810 in centre of sheet and covering it with membrane strip

5.2.5.1.3 Fastening with pre-installed strips, to which the membrane underside is bonded

Install 160 mm wide FATRAFOL 810 fastening strips on the roof as per the fixing plan. Pay special attention when unrolling and fastening a cut strip to ensure that its axis aligns with the axis of the fastened membrane sheet and with the axes of fasteners.



1	FATRAFOL 810/V membrane, width: 2,000 (2,050) mm	5	Membrane joint – hot-air welded
2	FATRAFOL 810 strip	6	PU adhesive FF 855
3	Vapour control membrane	7	Z-01 joint sealant
4	Thermal insulation board	8	Fastener
		9	Trapezoidal sheet metal

Figure 10: Fastening of FATRAFOL 810/V in centre of sheet with membrane strip

Put the membrane roll in the correct position. While unrolling the roll, bond the sheet with the PU adhesive FF 855 (C/88), continuously along its entire length. The substrate and ambient temperature must be above +13°C at the time of installation and the bonded joint must be loaded within 30 up to 60 seconds after adhesive application.

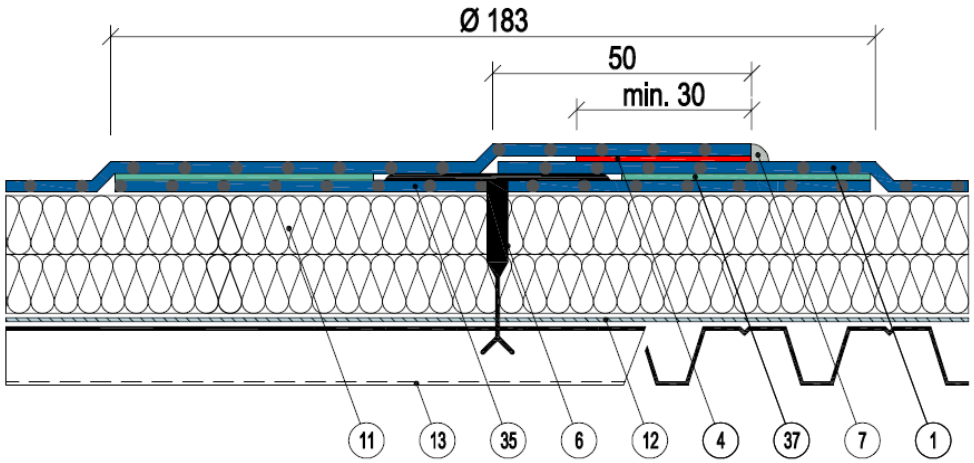
Edges of membrane sheets are hot-air welded together after the adhesive dries partly.

See figure 10 for an example of additional fastening of a 2,000 mm wide waterproofing membrane.

5.2.5.1.4 Fastening with fixing discs, to which the membrane underside is bonded

This system may be used as the main method of fastening a membrane within the roof field or as an auxiliary method for perimeter and corner zones. Its advantages include achieving a high-load bearing capacity per fastener, reducing an overlap width to the width necessary for welding, and having no fasteners that penetrate the membrane (including in areas with additional fasteners).

The fixing discs (collar, type 13) have a diameter of 183 mm and are fastened to the deck using suitable fasteners with a round plate washer. Fastener spacing in longitudinal rows is chosen according to the sheet width to create a joint between the fixing disc and the membrane where each membrane reaches the middle of the fixing disc – see figure 11. The membrane is then bonded to the disc using the PU adhesive FF 855 (C/88) as specified by the adhesive manufacturer.



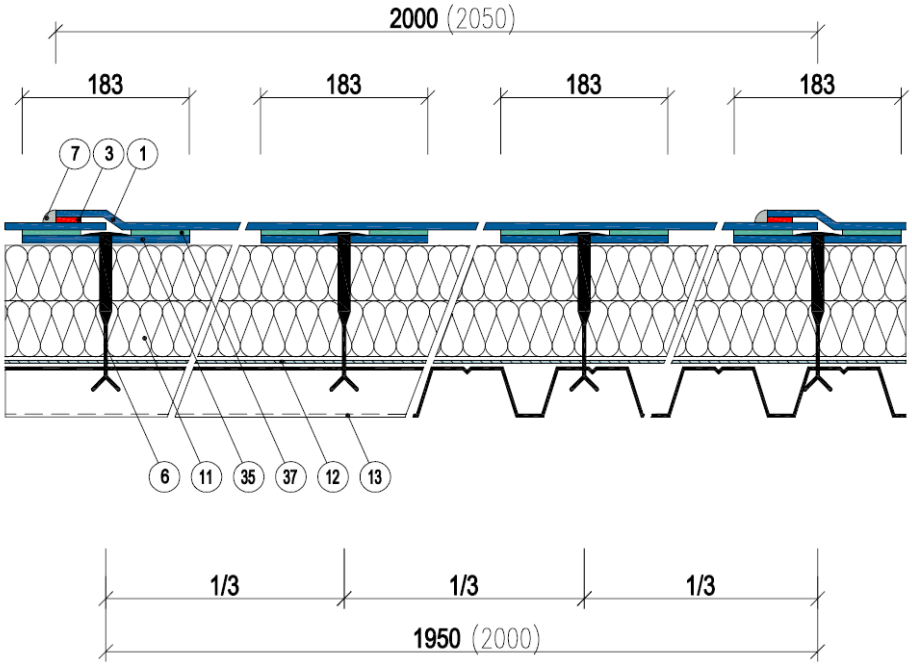
1	FATRAFOL 810 membrane	12	Vapour control membrane
4	Membrane joint – hot-air welded	13	Trapezoidal sheet metal
6	Fastener	35	Collar, type 13 – 183 mm (fixing disc)
7	Z-01 joint sealant	37	PU adhesive FF 855
11	Thermal insulation board		

Figure 11: FATRAFOL 810 joint in overlap of sheets fastened to substrate with fixing discs

The substrate and ambient temperature must be above +13°C at the time of installation and the bonded joint must be loaded within 30 up to 60 seconds after adhesive application.

Edges of membrane sheets are hot-air welded together after the adhesive dries partly.

Figure 12 shows the fastening of a 2,000 (2,050) mm wide waterproofing membrane.



1	FATRAFOL 810/V membrane, width: 2,000 (2,050) mm	11	Thermal insulation board
4	Membrane joint – hot-air welded	12	Vapour control membrane
6	Fastener	13	Trapezoidal sheet metal
7	Z-01 joint sealant	35	Collar, type 13 – 183 mm (fixing disc)
		37	PU adhesive FF 855

Figure 12: Fastening of FATRAFOL 810/V with fixing discs

5.2.5.2 FATRAFOL 807 and 807/V membranes (bonded covering)

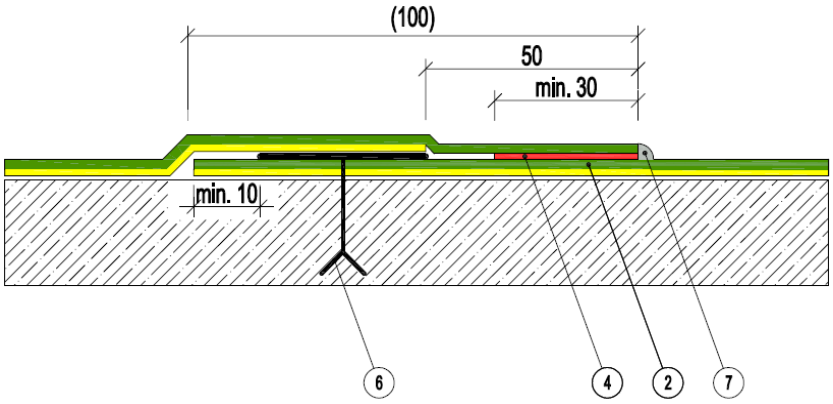
The FATRAFOL 807 and 807/V waterproofing membranes are laid directly on the substrate (without a protective or separation layer) and bonded to the base layer with a suitable adhesive. If the base layer is made of thermal insulation boards, it must be bonded or mechanically fastened to the substrate to ensure that it can transmit wind loads to the load-bearing structure.

FATRAFOL 807 may be bonded using polyurethane adhesives or asphalt varnishes, whether hot or cold, or the bonding may be combined with mechanical fastening.

FATRAFOL 807/V is designed only for bonding with expansive polyurethane adhesives.

The bonding method, conditions, consumption and coverage in individual roof zones depend on the adhesive type. The membranes must always be bonded in strict accordance with the adhesive manufacturer's specifications and instructions.

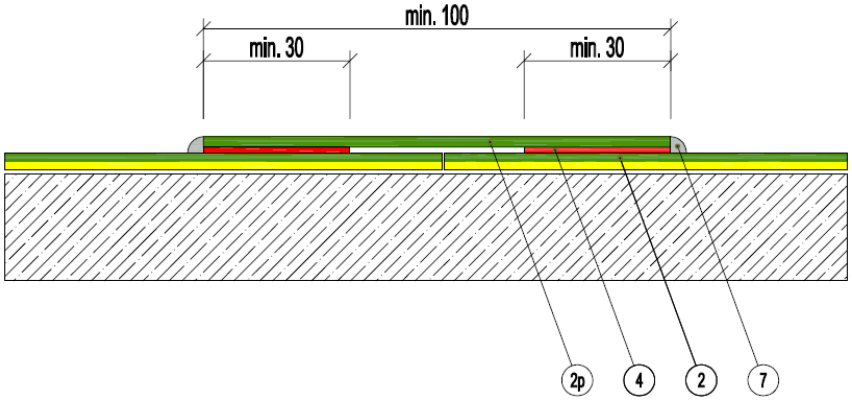
Membrane sheets are laid with side overlaps that must be at least 50 mm wide. The sheets are overlapped along the edge where there is no layer of non-woven fleece to allow them to be welded together – see figure 13.



2 – FATRAFOL 807 (807/V) membrane
4 – Membrane joint – hot-air welded
6 – Fastener
7 – Joint sealant

Figure 13: Side joint of FATRAFOL 807 (807/V) sheets

In transverse direction, membrane sheets are joined edge-to-edge and then covered with a strip of the FATRAFOL 804 auxiliary homogeneous membrane – see figure 14.



2 – FATRAFOL 807 (807/V) membrane
2p – FATRAFOL 804 membrane
4 – Membrane joint – hot-air welded
7 – Joint sealant

Figure 14: End joint of FATRAFOL 807 (807/V)

At the roof perimeter where the membrane is joined to perimeter profiles, the membrane is usually installed before the perimeter profiles. Perimeter plastic-coated metal profiles are installed afterwards and fastened together with the membrane to the deck with suitable fasteners. For detailing, use FATRAFOL 804.

5.2.5.3 FATRAFOL 818/V and 818/V-UV membranes (loaded covering)

The FATRAFOL 818/V and 818/V-UV waterproofing membranes with glass fibre fleece feature excellent dimensional stability, minimum contraction and other benefits that make them an ideal product for the so-called loose installation without point fastening in the roof field. Linear fastening to plastic-coated sheet metal is still necessary at points where the roof plane changes suddenly. A suitable stabilisation layer must be applied immediately after membrane installation to provide protection from external forces.

FATRAFOL 818/V-UV, a membrane stabilised against direct weather conditions, is to be used where there is a risk of the membrane being exposed to solar radiation. This usually includes roofs with pavers on support pads or aggregate-covered roofs with a higher pitch. For other applications, use FATRAFOL 818/V for a protected roof covering. Both membranes may be combined together on the roof.

The membrane is laid on a substrate covered fully with protective and separation fleece and lined at the perimeter with plastic-coated metal profiles. An exception to the rule is a substrate of rigid thermal insulation mineral fibre boards or of rigid PUR and PIR boards on which the membrane may be laid without separation non-woven fleece. When fastening plastic-coated metal profiles, maintain the maximum fastener spacing of 250 mm (at least 4 fasteners per metre).

Sheets are laid with side and end overlaps. Side overlaps must be at least 50 mm wide.

Since the covering is fastened to the substrate only at the roof perimeter and around all penetrations, it must be secured against wind loads immediately after installation. Subject to adherence to basic conditions, a simpler method of dimensioning may be used for buildings with a flat roof not higher than 30 m above the ground – see article 3.6.2.2.1.

If the building is exposed to heavy wind loads, each zone must be assessed individually through a structural calculation under CSN EN 1991-1-4. For approximate apparent density of selected loading layers, see table 11.

5.2.5.4 FATRAFOL 814 membrane (pedestrian traffic covering)

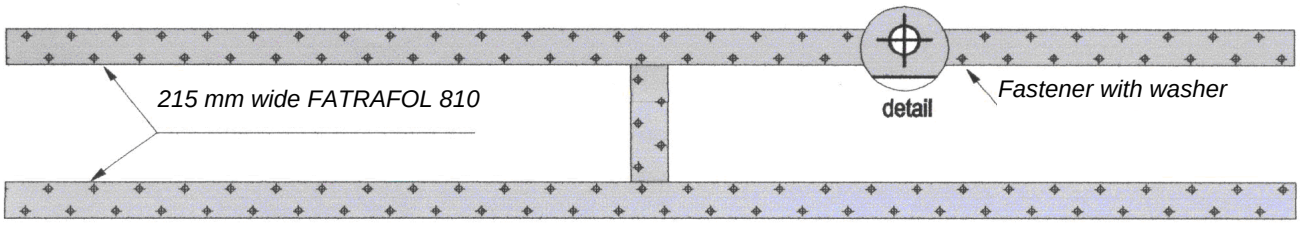
FATRAFOL 814 is a pedestrian traffic membrane for terraces and balconies. The membrane installation method, i.e. no overlapping at joints, reflects this purpose. In conventional installation, the membrane thickness is doubled at overlaps (2.5 mm), which may cause puddling on the surface during rainy weather and affect the function of the anti-slip texture. In addition, conventional joints between a membrane and the perimeter components on the eaves edge may obstruct smooth rainwater drainage from the surface. In result, the drip mould should be recessed approx. 5 mm below the adjacent base structure (by cutting an approximately 150 mm wide edge, reducing the pitched concrete layer or cement levelling compound etc).

There are several ways to extend the traffic layer onto vertical end structures (detail 304, 305). Before the installation, the method of finishing details should be agreed to meet the owner's conditions and requirements. This agreement should be made in writing and signed by both parties.

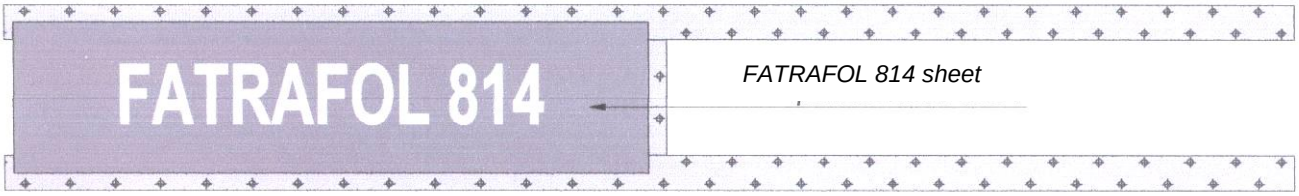
Sheets may also be laid similarly to conventional types of FATRAFOL waterproofing membranes, i.e. with side and end overlaps. However, this method is only used occasionally, mainly to create walkways on a finished waterproofing layer made of PVC-P based membranes for the purpose of inspecting and operating rooftop technical equipment.

Installation process:

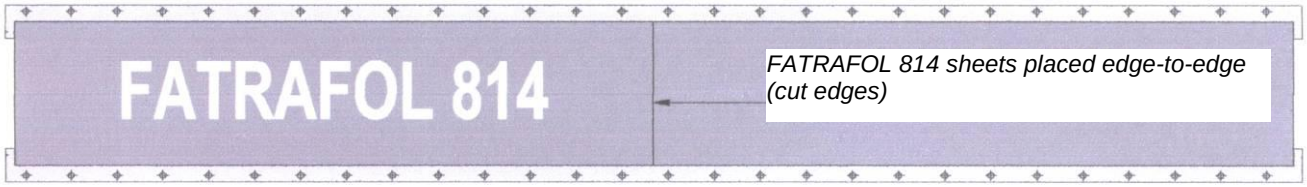
1. The substrate must be covered with non-woven separation fleece having a minimum surface density of 200 g/m². Before FATRAFOL 814 installation, fasten perimeter plastic-coated metal profiles and fastening strips made of the reinforced FATRAFOL 810 membrane (1.20 mm in thickness and 215 mm in width) to the substrate. The fastening strips of FATRAFOL 810 are installed in the longitudinal axis of joints of membrane sheets as well as at the point of end joints of sheets. Fasten the strips to the substrate alternately at both edges, ensuring that the washer edge is at least 10 mm from the strip edge.



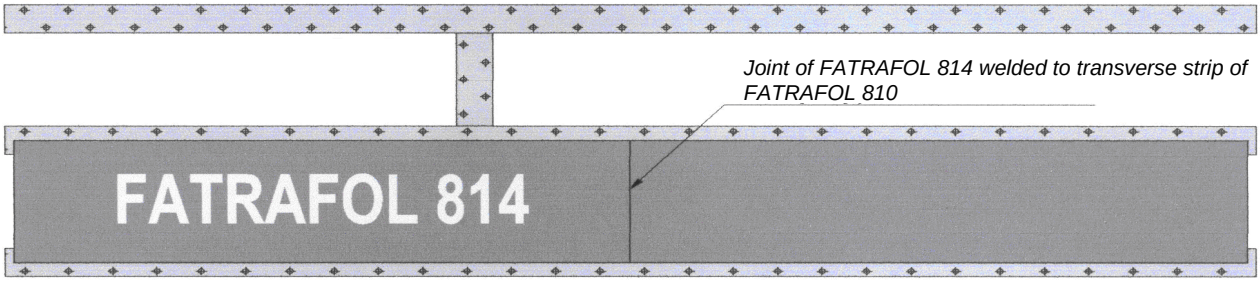
2. Lay the first sheet of FATRAFOL 814 on the prepared substrate.



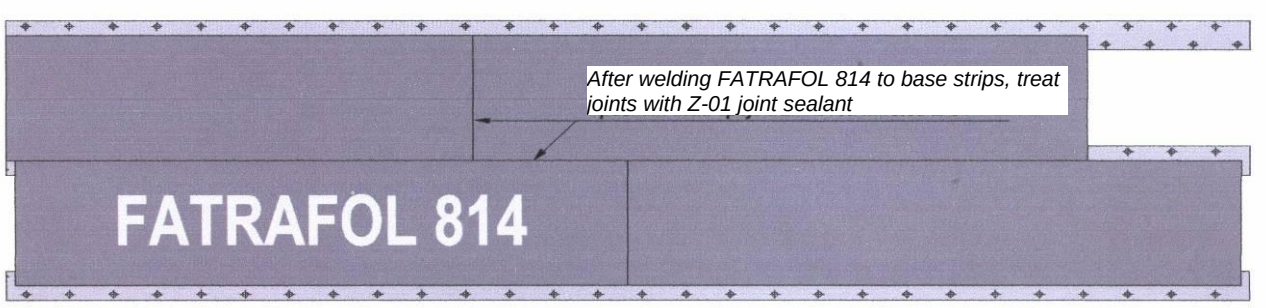
3. After positioning and welding the sheet at its entire perimeter, lay another sheet of FATRAFOL 814. Lay the sheets edge-to-edge, without side or end overlaps. You should keep an approximately 1 mm wide gap between welds for easier application of the joint sealant.



4. Repeat the procedure under points 1 to 3 for each additional sheet of FATRAFOL 814. Lay a transverse fastening strip under a longitudinal one, keeping a 50 mm overlap, and hot-air weld it to the longitudinal strips. To make the joints as even as possible, you should overlap the sheets by approx. 30 mm and cut them with a steel blade.



5. After covering the entire area, treat all FATRAFOL 814 joints with a joint sealant in the membrane colour.



For detailing, use FATRAFOL 804 or, if necessary, FATRAFOL 810 of the same colour. Shaped pieces for additional sealing of 3D details must be chosen with consideration to the overall appearance of the traffic layer. If such pieces are first welded to the L-profiles of plastic-coated sheet metal and then covered with FATRAFOL 814, the textured layer will not be interrupted with the smooth surface of the shaped piece.

5.2.5.5 FATRAFOL P 916 and 918 SG-PV membranes (mechanically fastened covering)

The basic principles of installing TPO-based FATRAFOL P 916 and 918 SG-PV membranes are identical to PVC-P membranes. The waterproofing membranes may be installed on all types of substrates covered with a separation layer of non-woven fleece which primarily protects the membrane from mechanical damage. No separation layer is required for substrates of rigid thermal insulation made of mineral fibre boards, EPS, XPS, PUR and PIR materials.

Perimeter end components of TPO-coated sheet metal are usually installed before the membrane, which is then hot-air welded to the components with a weld at least 30 mm wide. If mechanical fastening is used to secure the membrane against internal and external forces, the minimum overlap width along the sheet edge is 90 mm.

Use a knife or scissors to cut membrane sheets to size.

The choice of fasteners for individual roof zones depends fully on the fixing layer quality, its position in the roof structure, building use, building surroundings, orography, roof deck composition, building height, position in the terrain etc. A structural assessment of the fastener layout should be given preference over an empirical fixing plan.

FATRAFOL P membranes based on TPO polymer cannot be fastened mechanically using pre-installed strips or fixing discs to which the membrane is bonded. Therefore, extra fastening in perimeter and corner zones must be provided by using narrower membrane sheets or additional fasteners. The remaining principles of fastening the membrane to the substrate and positioning the fixing lines and fasteners within the sheet are identical to PVC-P based membranes – see article 5.2.5.1.

5.2.5.6 FATRAFOL P 918 membrane (loaded covering)

The basic principles of installing FATRAFOL P 918 are identical to the FATRAFOL 818/V PVC-P membrane – see article 5.2.5.3.

The waterproofing membrane may be installed on all types of substrates covered with a separation layer of non-woven fleece which primarily protects the membrane from mechanical damage. No separation layer is required for substrates of rigid thermal insulation made of mineral fibre boards, EPS, XPS, PUR and PIR materials.

Membrane sheets are installed with side and end overlaps at least 50 mm wide and immediately covered with a suitable load to protect them from wind forces.

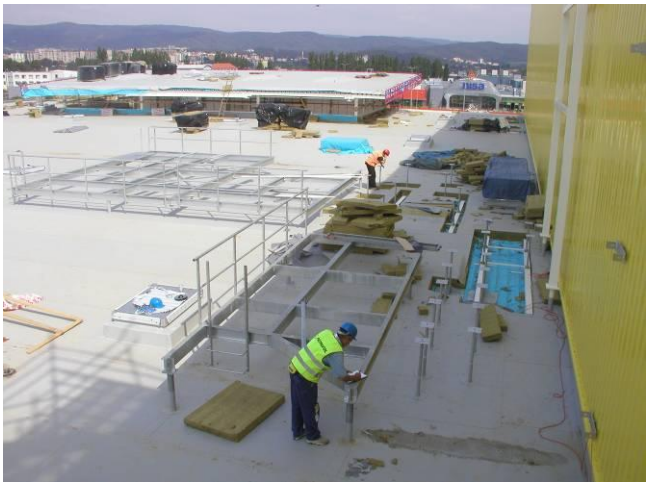
5.2.6 Roof detailing

5.2.6.1 Ending waterproofing membranes on vertical structures

If the installation includes end, perimeter and penetrating structures (parapets, above-roof masonry, damping chambers, skylight edges, pipes etc), the waterproofing membrane must always extend to the vertical part of such structures, at least to a height of 150 mm above the outside surface of the adjacent roof area (detail 303). The joining gap of the waterproofing covering must not be exposed to water under pressure; it may only be exposed to water flowing down the surface of the structures. The height of the waterproofing layer extension to the end or penetrating structure must be chosen with consideration to local weather conditions, possible snow accumulation, snow dynamic effects and other factors. The upper edge of the membrane must be hot-air welded to pre-installed perimeter plastic-coated metal profiles (detail 301, 302).

In case of round penetrations, bond the membrane with a PU or polymeric adhesive and secure it in place with a corrosion-proof binding strap. This loose extension of the membrane to penetrations where the membrane is puttied and secured with a binding strap is possible for small-sized circular penetrations. If any of the penetrations, in particular bars and pipes, are likely to be exposed to dynamic loads (impact), the connection to the waterproofing membrane must withstand such loads. The roof deck structure adjoining the bottom part of a penetration must be sufficiently strong and unbroken to allow proper detailing. Pipes and bars penetrating the roof deck must be attached to the load-bearing structure of the roof deck or fixing layer.

Penetrating bar structures (support, auxiliary, technological) should be shaped as closed profiles and allow smooth finishing and ending of the waterproofing membrane on the structure. The shape of open rolled or thin-walled profiles is absolutely unsuitable.



At the point of contact with the waterproofing membrane, pipes with a surface temperature exceeding 40°C must be equipped with protection and thermal insulation at least to the height of the upper waterproofing membrane edge. The gap between the upper waterproofing membrane edge and the penetration must be sealed with permanently elastic sealer resistant to the surface temperature and fitted with a sleeve or a cap that must be joined watertight to the penetration.

If the waterproofing membrane is ended on a vertical surface with an end component of plastic-coated sheet metal that covers the full height of the extension, the waterproofing membrane may be ended on the horizontal arm of the sheet metal components, at the height of the adjacent roof plane. Open horizontal joints between perimeter plastic-coated metal profiles and the adjacent roof structure must always be sealed with permanently elastic sealer to prevent water ingress under the membrane and wind uplift.

5.2.6.2 Transition from vertical to horizontal waterproofing layers

Transition from vertical to horizontal waterproofing layers is done by hot-air welding a vertical membrane to attached perimeter plastic-coated metal profiles or directly to a membrane of the adjacent horizontal surface, at first at the base of the vertical structure and then to the horizontal waterproofing layer in the field. The way to fasten the profiles and weld the waterproofing membrane depends on membrane type and roof deck composition (details 401 to 408).

5.2.6.3 Parapets and ending of waterproofing membranes at roof plane

5.2.6.3.1 Ending a parapet with plastic-coated metal profiles

For added transverse strength, perimeter plastic-coated metal profiles must be fastened alternately in two lines (zigzag pattern). To prevent wind from blowing through the joining gap under the profiles (especially in reconstruction projects), use a permeable profile to seal the profiles (removal of entrapped moisture through fleece installed over the entire area must be possible). In new buildings, it is usually sufficient to extend the separation layer to the outer edge of the parapet wall coping.

The upper outer surface of the parapet should slope at least 5% towards the building and the perimeter profiles through which rainwater is not drained via the exposed face of the adjacent vertical structure should have an overlap of

at least 30 mm (CSN 73 3610). FATRAFOL membranes must be hot-air welded to perimeter plastic-coated metal profiles and the weld must be at least 30 mm wide (detail 501, 502).

5.2.6.3.2 Ending membranes under parapet flashing

If the parapet has a standard flashing made of galvanised, titan-zinc or copper sheet metal or in case of lightweight roof decks, a FATRAFOL membrane is usually ended by being welded to a fixed perimeter plastic-coated metal profile on the inner upper edge of the parapet (detail 502). If parapet height exceeds 500 mm, the loose waterproofing membrane must be properly fastened to the parapet structure (point fastening, linear fastening, bonding) or must be ended as on a wall structure.

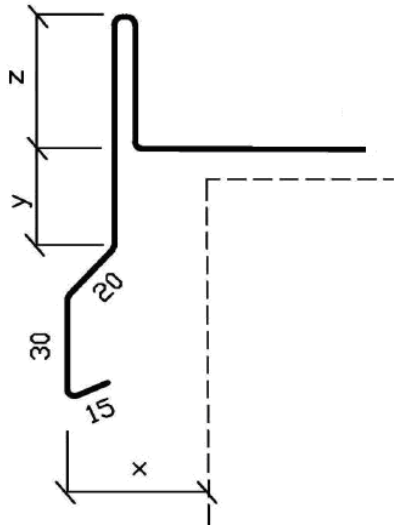
5.2.6.3.3 Ending membranes at roof plane with drip mould of plastic-coated sheet metal

The detailing work is similar to article 5.2.6.3.1. Before detailing, attach brackets for the eaves gutter. Detailing work for roofs without thermal insulation is shown in detail 503. The drip mould extension over the edge of the eaves base structure depends on the gutter dimension and structure shape and must also reflect any loads the extended edge may be exposed to, e.g. snow or ice. If the drip mould edge extends more than 30 mm, you should support the edge with a suitable profile of galvanised sheet metal or steel strips. If ice is likely to accumulate on the edge of the roof or gutter, additional extension over the façade surface is recommended. In hilly and mountainous locations, it is highly recommended to provide complete protection to roof overhangs, e.g. by thermally insulating the soffit, installing electric heating cables etc. Sheet metal components must be fastened in accordance with CSN 73 3610. The durability of fasteners must correspond to that of the sheet metal components. You should only use fasteners whose pull-out strength is certified by their manufacturer or you should make on-site pull-out tests. If direct fastening to the substrate is used, fasteners should not be spaced at more than 250 mm in line.

If the roof is loaded with a stabilisation, traffic or protective layer of loose aggregate or if it is a green roof, attach a bracket for the ‘shingle strip’ to the drip mould of plastic-coated sheet metal. After attaching the bracket, insert a stainless perforated shingle strip into it. For an example of eaves of a thermally insulated roof with aggregate see detail 504.

5.2.6.3.4 Ending membranes at roof plane with gravel stop

The main steps of the detailing work are identical to article 5.2.6.3.1. The gravel stop must be fastened on the sealing profile of expanded PE to prevent wind from blowing under the waterproofing covering. Gravel stops are usually fastened in two lines, in a zigzag pattern. If rainwater must be prevented from flowing down the wall, the height of the ‘z’ perimeter component must be at least 50 mm above the adjacent section of the roof plane.



If the façade is thermally insulated or the gravel stop width **y+z** ≥ 100 mm, the gravel stop must be fastened to a pre-installed steel clip (detail 505, 506) for added rigidity. The same applies if the façade is to be thermally insulated at a later time. In this case, the gravel stop must extend beyond the exposed face of the wall by the necessary length (i.e. thickness of the future thermal insulation). Under CSN 73 3610, the recommended extension length **x** is 50 mm.

One of the ways to end the roof covering in case of additional roof thermal insulation is shown in detail 507.

5.2.6.4 Valley and parapet gutters, recessed valleys

Valley and parapet gutters as well as recessed valleys should be kept to a minimum in roof structures. Under 73 3610, the recommended longitudinal slope of all such gutters is at least 0.5%. Make sure that water flow is unobstructed and that waste does not deposit on the roof. When choosing the gutter slope, pay attention to gutter material and distances between gutter outlets.

Gutters and downpipes may be blocked by ice in winter, especially if the downpipes are installed in unheated parts of the building. Therefore, it is advisable to keep gutter bottoms and relevant downpipe sections warm. If gutter outlets and downpipes are to be kept warm only by inside air, pay attention to water vapour condensation on the cold surface of these components and make suitable structural arrangements to avoid its negative effects, e.g. by controlled condensate removal or by installing a water retention or thermal insulation layer.

The method of finishing valley and parapet gutters and recessed valleys depends on their shapes and dimensions. If the gutter is not deeper than 150 mm and is wide enough (at least 300 mm), it is sufficient to waterproof it with a single continuous membrane sheet. In this case, the membrane is hot-air welded to attached perimeter plastic-coated metal profiles.

If the gutter is deeper or narrower, it must be waterproofed in phases by joining membranes at its bottom (see detail 601, 602).

In both of the above applications, the gutter may be finished with shaped plastic-coated sheet metal to which the membrane is joined only on the upper edge. However, for better waterproofing performance, you should line the entire gutter profile with a waterproofing layer. To join gutter sections, follow the instructions for perimeter plastic-coated metal profiles, i.e. keep a 2 mm wide gap between the metal sheets, cover it with 20 mm wide self-adhesive tape, or overlap the gutter sections and rivet them together, or fasten both sections to the substrate and weld a homogeneous membrane strip (minimum width: 80 mm) on their edges (minimum weld width: 30 mm). When finishing gutters in this manner, make sure to take into account the maximum expansion length of the sheet metal components, as specified in CSN 73 3610.

If gutter dimensions, in particular limited width, make it impossible to create perfectly watertight and strong joints, an individual approach will be necessary, which usually involves making relevant structural modifications.

5.2.6.5 Rainwater outlets

Rainwater outlets and downpipes are part of the base structure and as such they should be installed before the installation of the membrane covering begins and as close to the drained surface as possible. In this respect, pay attention to the surface slope and possible changes to the roof surface shape due to loads (snow, ice or occasional loading). Rainwater outlets must allow smooth connection of the membranes and a tight connection to the downpipe. If the structure and use of the roof so permit, rainwater outlets should be recessed slightly under the adjacent surface of the drained roof.

If the roof is intended for pedestrian or vehicular traffic, rainwater outlets must withstand related stresses. Rainwater outlets must always be attached to the roof structure with suitable fasteners to secure them against external and internal forces acting in the waterproofing layer. Rainwater outlets must always be fastened to the substrate in at least three points at their perimeter. The method of finishing rainwater outlets and fastening the waterproofing membrane to the load-bearing roof structure of trapezoidal sheet metal and to a roof deck with a concrete load-bearing structure is shown in detail 603. The method of joining the covering to a rainwater outlet on a concrete roof is shown in detail 605.

For PVC-P or TPO roofing membranes, use rainwater outlets made of materials that are easy to weld to these membranes. If rainwater outlets of other suitable materials are used, the membrane is connected using a flange or is welded to the PVC collar, which is an integral part of the rainwater outlet (detail 603).

Rainwater outlets must be sealed to the downpipe they are joined to. Sealing prevents the ingress of water under the covering in case the downpipe is blocked or full, and the ingress of warm humid air from sewers to the roof layers. Use a properly sized rubber sealing ring for reliable sealing of the rainwater outlet and the downpipe. If the downpipe has an unconventional shape or when renovating coverings made of asphalt sheets, use a special outlet with a flexible sleeve or seal the joint with permanently elastic PU sealer.

Depending on the roof composition, rainwater outlets must have a suitable dirt and stone trap. It is not recommended to discharge rainwater from the roof deck via parapets into outside drain pipes since there is a risk of freezing in winter. If no alternative solution is available, water should be drained using a PVC or TPO corner insert (detail 605) which usually leads into a gutter. The insert is fastened mechanically to the substrate and hot-air welded to the membrane. An electrically heated outlet should be used for this type of drainage.

5.2.6.6 Circular pipe penetrations and vent outlets

5.2.6.6.1 PVC or TPO pipe penetrations

All bars and pipes penetrating the roof must be securely fastened to the roof deck bearing structure. The fastening method is specified in project documentation, structural assessment and design or by the manufacturer of the penetration. Unless otherwise specified, there must be at least 3 fixing points per penetration.

To finish a pipe penetration onto which a shaped piece may be slid, use a PVC-P or TPO collar, type 13, made of 2.0 mm thick FATRAFOL 804 or 2.0 mm thick FATRAFOL P 918/H. Use scissors to enlarge the round hole in the collar centre to give it a diameter that is approx. a third up to a half smaller than the pipe outer diameter. Heat both sides of the area around the collar hole with hot air and slide the collar while hot onto the penetrating pipe. This way, the originally flat component is shaped into a sleeve that tightly encloses the penetrating pipe.

The horizontal part of the shaped piece is then hot-air welded to the waterproofing membrane around the penetrating pipe. The shaped piece collar should be welded fully to the membrane of the adjoining main waterproofing layer.

A rectangular cutting of a homogeneous membrane must then be wound around the vertical part of the penetrating pipe and may be ended at least 150 mm above the surrounding surface of the waterproofing covering. While winding the cutting around the penetrating pipe, hot-air weld the cutting bottom to the sleeve of the shaped piece and the upper part to the penetrating pipe. Finally, weld the beginning and the end of the rectangular cutting together. All joints must be secured with a joint sealant (detail 606).

If the pipe penetration does not allow a shaped piece to be slid onto it from the top (fixed head or another obstruction), use a circular shaped piece the diameter of which is sufficient to cover the installed fasteners and project at least 50 mm beyond their perimeter line. Use the FATRAFOL 804 homogeneous membrane and cut an inner hole with a diameter approx. a third or up to a half smaller than the pipe diameter to create a ring. Cut the ring in one place and put it on the penetrating pipe from the side. Gently pull the inner edge of the ring on the vertical part of the penetrating pipe and weld it at the same time. Overlap both ends of the shaped piece and weld them together. To finish the vertical part of the penetrating pipe, use a rectangular cutting and proceed as specified above.

5.2.6.6.2 Pipe penetrations of materials not weldable to membranes

To finish such penetrations, follow the instructions for PVC-P or TPO penetrations – see article 5.2.6.6.1. The upper edge of the homogeneous membrane cutting is secured on the penetrating pipe with a corrosion-proof strap and sealed with permanently elastic PU sealer (detail 605, 608).

If the sealer is the only barrier preventing the ingress of water into the roof structure, the sealed areas should be properly protected from UV radiation and weather effects by using, for example, a cap or sheet metal sleeve (detail 607).

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5.2.6.6.3 Installing vent outlets

Vent outlets must be so positioned on the roof that their ventilation capacity is fully used. This means positioning them on the ridge of individual roof planes and at the perimeter of end structures to maximise air flow. When choosing the right position, you should consider the possibility of the outlets being covered with snow.

Where vent outlets will be installed, strip the original membrane covering down to the underside of the thermal insulation layer. The stripped area must not be smaller than the diameter of the vent outlet shaft. This is aimed to maximise contact between outside air and the material with entrapped moisture. This opening must be filled with a suitable thermal insulation material to prevent the ingress of cold air and humidity into the roof structure and to avoid thermal bridges. For vent outlet installation methods see detail 609 (new building) and detail 610 (renovation with thermal insulation). Fasten the membrane mechanically under the vent outlet collar to the substrate at no fewer than 3 fixing points and then hot-air weld the collar to the waterproofing membrane. Alternatively, a turbine vent may be used to remove entrapped moisture. To finish a turbine vent, follow the instructions for circular pipe penetrations.

5.2.6.7 Non-circular penetrations

The way to finish non-circular penetrations (chimneys, access holes, skylights, HVAC ducts, supporting structures, bars etc) must be chosen depending on penetration material and shape. For ease of detailing, these penetrations should preferably have a closed shape (circle, square or rectangle) at the waterproofing layer level. If making any changes to their shape, always remember that the membrane covering must extend at least 150 mm above the external surface of the adjacent roof area. If supporting components of metal or highly heat conductive materials penetrate the entire roof deck (from the interior to the exterior), suitable structural arrangements must be made to prevent water vapour condensation on their surface or to reliably remove the condensed vapour.

A wall flashing may be used for ending a membrane covering on a vertical surface, according to article 5.2.6.1. Alternatively, the membrane must be joined, in a watertight manner, to the penetration with a waterproof material, i.e. by being welded directly to a rigid PVC penetration or by being sealed with PU sealer if the penetration is made of materials not weldable to PVC or TPO.

When finishing non-circular penetrations, you should make relevant structural modifications to give the penetration as uniform a geometrical shape as possible, at least to the height covered by the membrane. The membrane covering of the adjacent area must end immediately next to the penetration and be always ended with perimeter plastic-coated metal profiles that must be fastened to the base structure or the penetration if its structure and other aspects so permit. In terms of fastener strength, fasteners should not be exposed to any tensile stress higher than the stress they are dimensioned for.

5.2.6.8 Dividing roof area with Novoplast profile

When waterproofing pitched or steep roofs, it is sometimes required that their covering imitates the appearance of a smooth or profiled sheet covering. For PVC-P membranes, a Novoplast profile, type 1871, nozzle number 2291, serves this purpose, imitating joints of individual panels of a profiled or smooth sheet covering.

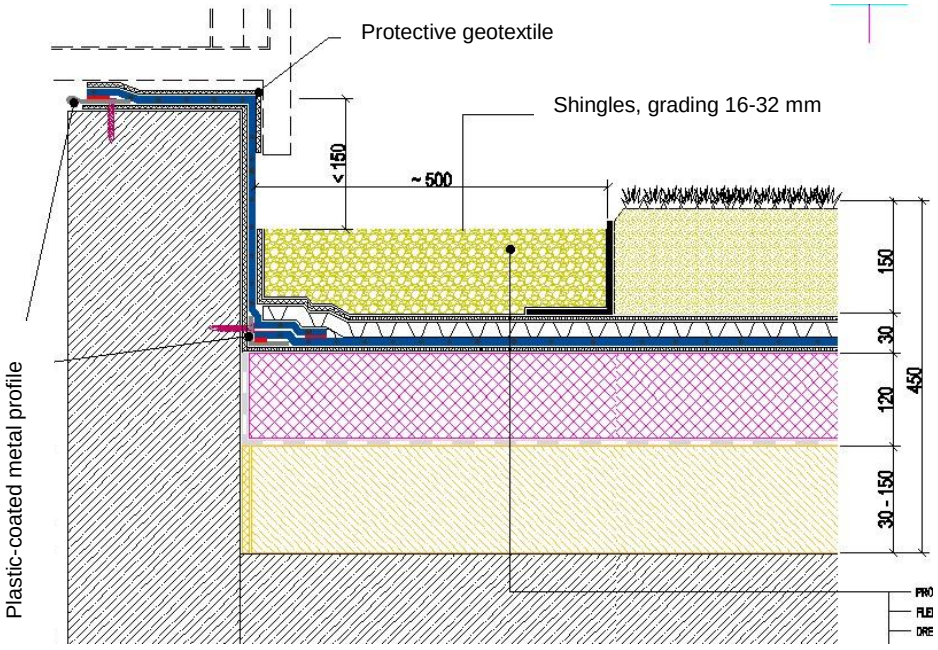
The profile must always be laid on a finished membrane covering that was installed in full accordance with the instructions contained herein. Novoplast profiles are available in a length of 2,500 mm. They must be hot-air welded on both sides to the membrane, at the required centre-to-centre distances. To weld the profile in a straight line, put a steel T-square ruler from the opposite side to keep the profile in the desired position during the welding process. Alternatively, the profile may be welded to the membrane with a LEISTER-Varimat welding machine, which considerably cuts welding time and delivers a more precise weld.

A Novoplast profile, type 1871, must always be laid in the direction of the roof slope or diagonally to ensure rainwater flow from the membrane covering. Novoplast profiles are installed only for aesthetic purposes and as such they are not designed to and must never be used to join two membrane sheets!

5.2.7 Protecting the roof surface from mechanical damage

A roof deck of single- or multi-ply roofs with the standard arrangement of layers that is likely to be exposed to stress during installation works, traffic or storage of equipment and materials during installation must be properly protected to avoid damage to or deterioration of individual layers, or the loss or reduction of designed performance. Unless specified in the project documentation, the method of protection must be proposed and agreed before the start of works. Suitable measures include dividing the installation into stages or providing protection to finished roof deck layers. In addition, placing the main waterproofing layer under a traffic layer or layers reduces the risk of its mechanical damage.

Where intense mechanical stress on the roof covering is envisaged (clips for lighting conductors, TV aerials and pipes, access areas, walkways to allow inspection and maintenance of rooftop equipment and other rooftop structures having an effect on the roof), it is advisable to protect the waterproofing membrane from damage by a protective layer, e.g. by doubling the membrane or placing it on a rigid material with a separation layer made of non-woven fleece etc. Such protective layers also tend to enhance the roof deck resistance to external fire.



If the substrate is sufficiently firm, large-format concrete pavers (typical dimensions 500x500x50 mm, known as ‘dry paving‘) on support pads may be used to create a pedestrian traffic layer (over the entire area or walkways only).

Walkways may also be created using the FATRAFOL 814 membrane that must be hot-air welded at its perimeter to the finished membrane covering.

5.2.8 Installing top protective fleece

Where the membrane covering is not the top surface of the roof deck, i.e. in case of roofs with a stabilisation, protective or traffic layer, green roofs and inverted roofs, individual layers must be fully separated with a separation and protective layer of non-woven fleece to avoid interaction between some of the materials and reduce the risk of mechanical damage. It is usually sufficient to use fleece with a surface density of 200 or 300 $g.m^{-2}$. Fleece with a higher surface density is necessary only if the waterproofing layer is likely to be exposed to great mechanical stress during later works. When installing the top protective fleece, follow the instructions for base layers. In order to prevent the ingress of particles of aggregate, concrete etc under the protective layer and to avoid protective layer displacement, fleece sheets must be welded together along the entire length of the joint, not only in points.

5.2.9 Installing loading layer on roof covering

If installing any additional layers on a finished membrane covering, give consideration to pedestrian and equipment traffic and avoid any risks of mechanical or chemical damage to the covering (membrane punctures or cuts during installation and material handling, storage and handling of chemicals and other substances that may damage the waterproofing layer).

When unfolding stabilisation, protective or traffic layers, the material must be spread over the roof area immediately, in accordance with the approved layout. In this respect, observe the permissible load of the roof-bearing structure so that its sections are not overloaded. Also assess the need to secure the loading layers against wind pressure and displacement if the roof slope exceeds 6°, e.g. by bonding aggregate to the surface, loading the roof edges and corners with concrete pavers or stabilisation mats, e.g. GEOCEL.

Loading and traffic layers should always be removable to allow inspection and repair of the main waterproofing layer or any underlying layer.

It is recommended to create well secured walkways (e.g. using planks or rubber boards) and avoid using vehicles with steel wheels (wheelbarrows, carts) and sharp-pointed or sharp-edged tools.

5.2.10 Repairing damaged roof covering

The durability of the entire roof deck depends on the durability of structural components with the shortest renewal or replacement interval. These usually are the sealed joints of structural details within the roof deck. When a finished roof deck is handed over to the client, make sure to schedule inspections and, if necessary, renewal of selected roof components. For example, sealed joints should be inspected once a year and renewed once per 2 to 3 years. If the roof is open to public use (parks, playgrounds, sports grounds etc), give consideration to the risk of intentional damage to or theft of roof deck structural parts or components and adopt suitable measures to minimise such risk.

If roof covering integrity is damaged locally (mechanically, by high temperature or chemicals), the damaged spot must be covered with a suitably-sized patch, made of an identical membrane type and width, that will be hot-air welded at its perimeter to the roof covering. For minor local damage, use circular PVC-P or TPO ready-made patches, type 12. When applying square or rectangular patches, round their corners to give them a radius of approx. 40 mm. Before applying a patch, make sure to clean the membrane thoroughly of all dirt (wash it using water with detergent; alcohol, benzine). If the membrane cannot be cleaned thoroughly, it is best to insert a patch under the original membrane being

repaired and to weld the patch to the clean bottom surface of the covering (applies only to membranes without fleece backing). Once welded, the joints should be treated with a joint sealant.

This process allows for easy repair of a FATRAFOL membrane covering throughout its service life.

6 OCCUPATIONAL HEALTH & SAFETY, FIRE PREVENTION

6.1 Occupational health & safety at construction site

The essential legal regulations that lay down the requirements for occupational health and safety include **Act 309/2006 Coll.** (further conditions for occupational health and safety), **Act 262/2006 Coll.** (Labour Code as amended), **Government Regulation 101/2005 Coll.** on detailed requirements for workplaces and work environments, **Government Regulation 591/2006 Coll.** on essential requirements for occupational health and safety at construction sites, and **Government Regulation 362/2005 Coll.** on detailed requirements for occupational health and safety for works involving the risk of a fall from a height or into a depth.

The contractor's general obligations regarding project preparation and implementation are laid down in Act 309/2006 Coll.

Detailed requirements for construction site safety, and safe operation and use of machines, equipment, devices and tools are laid down in Government Regulation 378/2001 Coll. Construction site specific requirements are given in Government Regulation 591/2006 Coll., including requirements related to the organisation of works and construction works (e.g. material storage and handling, groundwork, concreting, installation works etc).

Government Regulation 362/2005 Coll. specifies the requirements for the organisation of works and work procedures that the contractor must provide at sites where staff are exposed to the risk of falling from a height or into a depth.

Act 262/2006 Coll., Labour Code, applies to the provision of personal protective equipment (PPE). Detailed requirements for PPE are given in Government Regulation 495/2001 Coll.

6.2 Fire prevention

Act 133/1985 Coll. on fire prevention, is the essential framework for creating conditions that effectively protect human life, health and property from fire, and for providing first aid during natural disasters and emergencies.

The act is implemented through Decree 246/2001 Coll. on fire prevention, which defines basic terms related to fire safety.

Other regulations that lay down specific requirements for building fire safety include Ministry of Interior Decree 202/1999 Coll. on technical requirements for fire doors, Act 102/2001 Coll. and Act 59/1998 Coll. on general requirements for building product safety.

6.3 Installation-related safety risks

When installing FATRAFOL-S membranes, follow the above safety, sanitary and fire regulations, as most recently amended, regarding work at construction sites, in particular work at heights.

Electrical equipment (welding machines, drills etc) must be connected and operated in accordance with current regulations, in particular Government Regulation 378/2001 Coll. Connection cables for handheld electrical equipment and construction equipment must be maintained in accordance with manufacturer's instructions and inspected at regular intervals.

Take extra care when handling adhesives, joint sealant (a solution of PVC in an organic solvent) and the L-494 thinner (tetrahydrofuran) for the joint sealant. These products are class I flammables and their handling requires adherence to common safety precautions for this category: storage only in a proper and designated flammables store, no smoking and no naked flames during work, no use in closed spaces. Burning THF may be extinguished with conventional extinguishers or plenty of water.

Inhaling THF fumes results in vertigo, headache and overall discomfort. The above symptoms disappear quickly in fresh air. Splashes on the skin cause irritation that will disappear when washed with plenty of water.

If THF splashes into the eye, it must be rinsed thoroughly with plenty of water for 10 to 15 minutes. Then seek advice of an eye specialist. If THF is swallowed, induce vomiting immediately and always seek medical advice as soon as possible.

Membrane fitters and all persons entering the roof must be advised in advance that the membrane surface is very slippery when wet or icy and that walk on the membrane requires extra caution under such conditions (also after morning dew).

A written system of OHS risk prevention is required for most new construction projects. Such documentation is usually part of site takeover documents. Compliance with safety precautions is reviewed by site supervisors and by occupational safety inspectors at larger construction sites.

TEMPLATE: RISK FACTORS AND MITIGATION MEASURES

SITE:

CONTRACTOR **Fatra, a.s. Napajedla, Třída Tomáše Bati 1541, 763 61**

WORK TYPE: **Roof deck membrane covering**

Place	Hazard type	Risk	Precautions
Fatra, a.s., Napajedla	Risk of falling from a height or into a depth	**1**	Protective structures must be erected at the site (scaffolding, protective barriers, fall arrests etc, Decree 362/2005 Coll.). Employees must have personal protective equipment against falls from a height according to EN 358 and EN 361. Employees must be trained in OHS and have a current medical examination.
	Damage to health or risk to life due to inappropriate storage and handling of materials	**1**	Materials must be stored and placed in such a manner to ensure their stability and avoid damage to employee health; do not exceed the permissible load of the substrate. An employee must not handle loads heavier than 50 kg.
	Tripping, sprains, hitting obstructions and penetrations at the site or getting caught by them	**1**	Remove obstructions, keep routes safe and clear, create transport routes for employees.
	Slipping, stepping on a stair edge with the foot in an unstable position upon the stair	**1**	Keep an anti-slip surface on vertical routes, walk carefully on staircases, use prescribed safety footwear.
	Knife cuts, sliding and/or cracking of blade ⇒ cuts on hands, legs and front part of the body	**1**	Take extra care when cutting and splitting material. Use OEM cutting tools and replaceable knife blades, use manufacturer-recommended cutting tools for the material, work with care and do not apply excessive force on the tools, use PPE – Kevlar gloves.
	Eye injury caused by flying debris or chips (material cutting, concrete or metal drilling etc)	**1**	Follow safe working practices, make sure there are no chips and cracks on the tools, use suitable eye and face protection.
	Employee being hit by a loose tool or component (hammer, cutter, drill bit etc)	**1**	Follow proper working practices and use proper tools, fasten the tools to your belt or working platform, use required PPE (hard hat, goggles, gloves, footwear, work clothing).
	Clothes or their loose parts getting caught in rotating equipment (typically a drill bit of an electric drill, grinding disc, fastener etc)	**1**	Wear suitable, closely fitting clothes and cap. Do not wear gloves close to rotating equipment. Concentrate on the work.
	Irritation to airways and mucous membranes when handling and cutting mineral wool	**1**	Follow safe working practices, wear breathing masks, protective clothing, cap and protective goggles. Make sure fine dust is removed from the workplace.
	Operator injury by electric shock	**1**	Do not use any damaged power tools, keep connection cables, distribution boards and connection points in full working order and protect them from damage by construction works. Advise all employees of occupational safety rules – only persons familiar with the rules may use power tools. Provide the protection class required by the tool or equipment manufacturer.
	Limb bruises caused by load handling (membrane rolls)	**1**	Use PPE for hand protection and work footwear with toe protection, take extra care when laying material on rigid support.

6.4 Roof safety during use

Safe access to the roof deck must be provided in line with the intended use of the roof. Access to roofs open to traffic is usually described in project documentation. Access to other types of roofs must be provided to allow inspection, maintenance and repair of rooftop equipment. Under CSN 73 1901 – Designing of roofs – Basic provisions, access openings to roofs open to traffic must be at least 600x1,800 mm in size.

Walkways to rooftop equipment must have an anti-slip surface. Materials placed under the traffic layer should provide long-term resistance to the estimated traffic volume.

Roof decks must incorporate a fall arrest system to allow inspection, maintenance and repair of the traffic layer and all equipment placed on it. Under CSN 74 3305 – Safety railings, a safety railing may be used instead of a fall arrest system. The roof Instructions must include safety instructions regarding movement on the roof deck under various weather conditions. The Instructions should also contain a list of informed persons who are allowed access to the roof.

Roofs not open to traffic that may only be accessed by informed persons must have an access opening with minimum clear dimensions of 600x600 mm that may pass through the roof deck. Access openings in adjacent walls must have minimum dimensions of 600x1,200 mm.

Lightning conductors placed on rooftop walkways must not cause an obstruction and safety passages must be built to cross them.

The roof deck perimeter must be so designed that roof deck structural parts and components or rooftop equipment cannot fall over the edge.

7 INSPECTIONS AND ACCEPTANCE OF INSTALLED FATRAFOL-S SYSTEM

7.1 Quality inspection

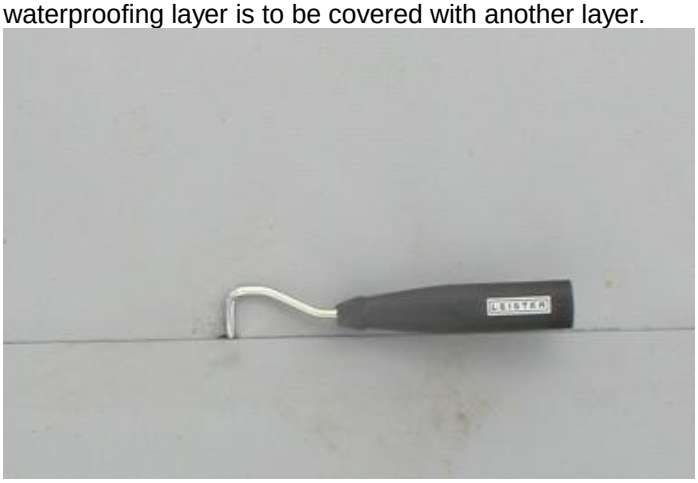
As part of its production management system, Fatra, a.s., Napajedla, the manufacturer of waterproofing membranes, formulated and maintains the '*Inspection Instructions for FATRAFOL Waterproofing Membranes*' that specifies general rules, responsibility for and methods of inspections of membrane coverings and of data processing.

1. The quality of the base structure must be checked before installation of a vapour control layer. The inspection should focus primarily on the structure completeness within the main field, detailing of penetrations, adherence to process times, on whether the surface is planar and free of dirt, debris, puddles, ice and snow etc, on the required slope angle, connection to perimeter and end structures, completeness of rooftop equipment and connecting pipes, certificate of acceptance by the owner's technical supervisor of documentation etc.
2. An inspection of the vapour control layer covers its quality in terms of technical parameters as well as the quality of its installation in the roof structure. Check, in particular, the layer integrity, joints of individual sheets, the way the membrane is joined to perimeter, end and penetrating structures, moisture trapped under the membrane and dirt on the membrane.
3. The thermal insulation layer must be inspected before installation of the main waterproofing layer. i.e. in particular the project-specific quality of thermal insulation, its thickness and slope, gap width, gap filling if appropriate, the way the boards are fastened mechanically or bonded to the substrate, recesses around rainwater outlets, installation of vertical structures according to project documentation, entrapped moisture, deformation of boards, surface strength etc. Before being covered, the thermal insulation layer must be approved in writing by the owner's technical supervisor.
4. Before installing the main waterproofing layer, check the membrane quality and its conformity with the approved project documentation and specifications contained in the manufacturer's technical documentation, in particular its type, thickness, straightness, undulating and other aspects that allow for visual inspection.
5. Check the following during the installation process: correct installation of the base and separation layer, if necessary, the position of perimeter plastic-coated metal profiles and their fastening to the load-bearing structure, placement of membrane sheets in accordance with the fixing plan, method of membrane sheet cutting, side and end overlaps, position of fixing lines, fastener type and quality, distance of fasteners from sheet edges and their required centre-to-centre distances in line, welding method, weld quality and geometry, detailing within the roof field and membrane ending on perimeter, end and penetrating structures, position of fire stop strips, correct installation and detailing of rainwater outlets, compulsory or recommended application of joint sealant on welds etc.
6. These inspections are to be made by a contractor's engineer or an authorised representative. Within a handover process, complete sections of the membrane covering are inspected, in accordance with contract terms and conditions, by the contractor's engineer, construction site representative, the owner's technical supervisor and other authorised persons as necessary. Details of the handover process are noted in the construction log or constitute a separate report.
7. The work handover and acceptance process is governed by current legislation, owner's requirements, approved terms and conditions and requirements of other stakeholders. In addition to other documents demonstrating the work quality, the handover documentation must also include the so-called 'roof Instructions' and an inspection and renewal schedule for selected structural parts of the roof. It is highly important to schedule inspections of rainwater outlets to ensure they are in full working order. (When drafting this part of documentation, reference may be made to Annex H to current CSN 73 1901 – Designing of roofs – Basic provisions, Renewal and inspection schedule, Table H.1 and Table H.2). A handover report must be prepared in connection with the work handover and acceptance, indicating all relevant matters such as obvious defects, outstanding works, deadlines for corrective action, conditions for later works on the finished roof deck surface etc.

7.2 Tightness tests

Several methods or a combination thereof are available to test the tightness of a membrane covering, or more precisely of the waterproofing layer of a completed part or of the entire roof. Mechanical, vacuum and submersion tests are preferred for the FATRAFOL-S system. Other methods detailed below are used only exceptionally and require appropriate equipment.

1. **Mechanical test** – use a testing needle to check all types of welds (continuous and detail welds including T-joints) no earlier than 1 hour after welding. A testing needle used for this test is usually included in the welder's essential kit and delivered by the welding equipment manufacturer (Leister, Herz etc). Drive the needle in the direction of the weld axis and apply gentle side pressure on the joint to easily detect any non-welded or separated points in the weld. This test should be performed before securing the welds with a joint sealant for roofs with a stabilisation layer, inverted roofs, traffic roofs, green roofs and in all places where the waterproofing layer is to be covered with another layer.



2. **Vacuum test** – based on EN 1593, this test checks selected critical points of the waterproofing layer (T-joints, 3D details, valleys, rainwater outlets etc) using shaped bells of organic glass and a vacuum pump. The test is limited by the size of the testing bell (approx. 600 mm), which makes it costly and time consuming to test the entire length of all welds. A detection liquid (soap solution) is applied on the tested surface and a testing bell is attached. If no bubbles appear on the tested surface during 15 seconds, the tested spot is tight.

3. **Submersion test** – the method specified by CSN 75 0905 - Water supply and sewerage tanks. Testing of water-tightness - may to some extent be used for this test. The use of this method is limited by roof deck specifications, in particular the permissible load of the load-bearing structure, maximum water level and the roof deck area. Typically, roof decks up to 100 m^2 in area are covered with a continuous water layer while larger roofs are only partly covered, e.g. in valleys between roof planes or in individual tested sectors. The maximum water column height should be determined by a structural engineer, with consideration being given to dynamic load of the roof deck.

4. **Coloured smoke test** – this method involves pressurising the area under the waterproofing layer with coloured inert smoke that makes a coloured trace on the membrane surface, detecting any leaks. Another air-tight layer should be installed; a vapour control layer, among others, may perform this function in the roof deck structure.
5. **Other methods** – for example high-frequency voltage or ultrasound. These tests are less suited for roof deck inspections and require special measures to be conclusive.
6. **Impedance defectoscopy** – a testing method to detect moisture in the roof deck. While this test does not detect leaks in the waterproofing layer, it detects moisture under the layer, helping to localise potential defects in the waterproofing membrane.

All of the above tests must be agreed upon in advance with the site management and owner's technical supervisor, and must be approved by the project documentation author. Also bear in mind that testing costs, e.g. for an immersion test, may run up to thousands of euros.

Technical documentation must be kept for all performed tests and a test report must be issued. Test reports for some tests are specified by standards while other tests allow for using an own test report. For some types of tests, the inspectors should be qualified in accordance with special regulations or at least authorised by the roofing contractor.

8 FITTER'S QUALIFICATIONS AND EQUIPMENT

8.1 Qualifications

Fitters installing the FATRAFOL-S waterproofing system must be trained in this work. Regular and special training for new contractors is provided by Fatra's Insulation Studio and a 'Certificate of qualifications for installation of FATRAFOL waterproofing membranes' is issued after successful completion of a 2-day training course. The certificate is currently valid for 5 years. In accordance with its sustainable development programme, Fatra, a.s., Napajedla provides regular training courses in product innovations, advanced technologies and legislative changes. These training courses are an opportunity to share technical information and enhance contractors' expertise.

The fitters' supervisor should submit the above 'Certificate of qualifications for installation of FATRAFOL waterproofing membranes' at request. The certificate is a guarantee by FATRA, a.s. Napajedla, the FATRAFOL manufacturer, that the fitters received training and are qualified for the works indicated therein. Team members not holding this certificate may only do unskilled work.

This certificate is not a substitute for technical education (e.g. certificate of apprenticeship in insulation) and does not lead to obtaining a trade licence in the field of insulations.

8.2 Fitters' equipment

8.2.1 Electrical equipment

- Hot-air welding machine with 40 mm and 20 mm wide slot nozzle (recommended type: LEISTER TRIAC S or TRIAC PID, TRIAC AT, HERZ – Rion)
- Hot-air mobile automatic welding machine (recommended type: LEISTER VARIMAT, HERZ – Laron etc)
- Impact drill with set of drill bits for concrete and other materials
- Water extractor
- Vacuum pump and bells for vacuum tightness test
- Cordless screwdriver
- Angle grinder with metal cutting disc
- Other electrical equipment and devices such as automatic fastening machines, sealing guns, PU adhesive applicators etc
- Electrical extension cord



8.2.2 Work tools

- Tension meter
- Levelling instrument
- Folding ruler
- Steel ruler
- Thermometer
- Greasy chalk
- Carpenter's pencil
- Knife with hook
- Scissors
- Membrane cutting pad
- Handheld rubber and Teflon rollers
- Pressing roller (if membrane is bonded to substrate)
- Tool for driving blind rivets (steel pipe Js 4÷5 mm, approximate length 150 mm)

- Hammer
- Rivet pliers
- Sealant cartridge gun
- Combination pliers
- Joint testing needle
- Puncher set
- PE bottles with delivery tube
- Steel cutter
- Cleaning cloths
- Flat and crosshead screwdrivers

- Rubber spatulas for cleaning membrane surface
- Hacksaw
- Sponges for removing puddles
- Hand metal shears
- PE waste bags
- Brass brush for cleaning slot nozzles
- Broom
- Spatulas for sealant
- Dustpan

8.2.3 Essential hand tools – installation kit

Essential protective equipment:

- Work clothing
- Soft-soled shoes with a safety toe cap for summer/winter use
- Protective gloves made of chrome tanned leather
- Protective goggles or face shield
- Knee guards
- Cap with shield
- Sun glasses with UV filter
- Ear protectors
- Dust mask (not necessary)

9 NORMATIVE REFERENCES

Standard	Czech title	English title
CSN 73 0540-2	Tepelná ochrana budov - Část 2: Požadavky	Thermal protection of buildings - Part 2: Requirements
CSN P 73 0606	Hydroizolace staveb - Povlakové hydroizolace - Základní ustanovení	Waterproofing of buildings - Continuous sheet water proofing - Basic provisions
CSN 73 1901	Navrhování střech - Základní ustanovení	Designing of roofs - Basic provisions
CSN 73 3610	Navrhování klempířských konstrukcí	Design of sheet metal constructions
CSN 74 3305	Ochranná zábradlí	Protective railings
CSN 74 4505	Podlahy – Společná ustanovení	Floors – Common Regulations
CSN 75 0905	Zkoušky vodotěsnosti vodárenských a kanalizačních nádrží	Water supply and sewerage tanks. Testing of water-tightness
EN 13956	Hydroizolační pásy a fólie - Plastové a pryžové pásy a fólie pro hydroizolaci střech - Definice a charakteristiky	Flexible sheet for waterproofing - Plastic and rubber sheets for roof waterproofing - Definitions and characteristics
EN 13984	Hydroizolační pásy a fólie - Plastové a pryžové parozábrany - Definice a charakteristiky	Flexible sheets for waterproofing - Plastic and rubber vapour control layers - Definitions and characteristics
EN 14783	Celoplošně podepřené plechové výrobky pro střešní krytiny a vnější a vnitřní obklady - Specifikace výrobku a požadavky	Fully supported metal sheet and strip for roofing, external cladding and internal lining - Product specification and requirements
EN 1593	Nedestruktivní zkoušení - Zkoušení těsnosti - Bublinková metoda	Non-destructive testing - Leak testing - Bubble emission techniques
CSN EN 1991-1-1	Eurokód 1: Zatížení konstrukcí - Část 1-1: Obecná zatížení - Objemové tíhy, vlastní tíha a užitná zatížení pozemních staveb	Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings
CSN EN 1991-1-3	Eurokód 1: Zatížení konstrukcí - Část 1-3: Obecná zatížení - Zatížení sněhem	Eurocode 1: Actions on structures - Part 1-3: General actions - Snow loads
CSN EN 1991-1-4	Eurokód 1: Zatížení konstrukcí - Část 1-4: Obecná zatížení - Zatížení větrem	Eurocode 1: Actions on structures - Part 1-4: General actions - Wind loads
EN 358	Osobní ochranné prostředky pro pracovní polohování a prevenci pádů z výšky - Pásy pro pracovní polohování a zadržení a pracovní polohovací spojovací prostředky	Personal protective equipment for work positioning and prevention of falls from a height - Belts for work positioning and restraint and work positioning lanyards
EN 361	Osobní ochranné prostředky proti pádům z výšky - Zachycovací postroje	Personal protective equipment against falls from a height - Full body harnesses
EN ISO 14001	Systémy environmentálního managementu - Požadavky s návodem pro použití	Environmental management systems - Requirements with guidance for use
EN ISO 9001	Systémy managementu kvality - Požadavky	Quality management systems - Requirements

10 Principles of finishing typical details

10.1 Overview of details

10.1.1 Joining FATRAFOL- mutually and with supplementary materials

Detail 201: Joining FATRAFOL membrane at overlaps without mechanical fastening and at crosswise joints

Detail 202: FATRAFOL membrane joint at overlaps when fixed by adhesion

Detail 203: Joining FATRAFOL membrane at overlaps when mechanically fixed

Detail 204: Joining FATRAFOL membrane on long side when mechanically fixed

Detail 205: FATRAFOL 807, 807/V membrane cross joint when fixed by adhesion

Detail 206: Joining FATRAFOL 814 membrane when mechanically fixed

Detail 207: Joining FATRAFOL membrane with roof perimeter edging profiles

Detail 208: Joining FATRAFOL 807, 807/V membrane with roof perimeter edging profiles

Detail 209: Joining FARAFOL membrane with linear fixing components from plastic coated sheet metal profiles

Detail 210: FATRAFOL membrane - additional fixing

Detail 211: Additional insulation of internal corner by shaped piece

Detail 212: Additional insulation of external corner by shaped piece

Detail 213: Mechanical fixing of FATRAFOL membrane in center (with patch)

Detail 214: Fixing of FATRAFOL 810/V membrane by adhesion on prefixed patches

10.1.2 Ending roof covering on vertical surface

Detail 301: Ending FATRAFOL membrane on vertical surface without additional covering strip

Detail 302: Ending FATRAFOL membrane on vertical surface with additional covering strip

Detail 303: Ending FATRAFOL membrane on thermal insulated vertical surface

Detail 304: Ending FATRAFOL 814 membrane on vertical surface – metod 1

Detail 305: Ending FATRAFOL 814 membrane on vertical surface – metod 2

10.1.3 Transition of roofing membrane from vertical to horizontal position

Detail 401: Transition of FATRAFOL membrane from horizontal to vertical position at wall (parapet) corner - roof covering without thermal insulation

Detail 402: Transition of FATRAFOL membrane from horizontal to vertical position - roof with typical order of layers on trapezoidal sheet metal

Detail 403: Transition of FATRAFOL membrane from horizontal to vertical position - restoration of roof covering

Detail 404: Transition of FATRAFOL membrane from horizontal to vertical position - roof with typical order of layers

Detail 405: Transition of FATRAFOL membrane from horizontal to vertical position – roof covering with tiles installed on spacers

Detail 406: Transition of FATRAFOL membrane from horizontal to vertical position – ballasted roof by gravel with typical order of layers

Detail 407: Transition of FATRAFOL membrane from horizontal to vertical position – inverse roof

Detail 408: Transition of FATRAFOL membrane from horizontal to vertical position – roof with vegetative layer

10.1.4 Detailing of parapets and ending of roof covering at roof plane

Detail 501: Detailing of parapets with plastic coated sheet metal profiles

Detail 502: Detailing of parapets on sandwich panels

Detail 503: Ending FATRAFOL membrane with plastic coated sheet metal drip mold in roof plane

Detail 504: Ending FATRAFOL membrane with plastic coated sheet metal drip mold, ballasted layer secured by pea gravel stop profile

Detail 505: Ending FATRAFOL membrane with plastic coated flashing component

Detail 506: Ending FATRAFOL membrane with drip mold on wall (parapet) with system ETICS

Detail 507: Ending FATRAFOL membrane with plastic coated sheet flashing component

Detail 508: Ending FATRAFOL membrane with plastic coated sheet metal drip mold

10.1.5 Gutters, rainwater outlets and penetrations

Detail 601: Detailing of thermal insulated rainwater gutter with FATRAFOL membrane

Detail 602: Detailing of rainwater gutter behind parapet with FATRAFOL membrane

Detail 603: Joining FATRAFOL membrane with PVC rainwater outlet - ballasted roof on trapezoidal sheet metal

Detail 604: Joining FATRAFOL membrane with doubled rainwater outlet

Detail 605: Joining FATRAFOL membrane with horizontal rainwater outlet

Detail 606: Detailing of railing pole with FATRAFOL membrane

Detail 607a: Detailing of thermal insulated pipe penetration

Detail 607b: Detailing of thermal insulated pipe penetration

Detail 608: Detailing of non insulated pipe penetration

Detail 609: Vent outlet on thermal insulated roof

Detail 610: Vent outlet on thermal insulated roof with original roof composition

Drawings of details

The following drawings show how standard details are finished. The method of fastening membranes to the substrate is only indicative in the cross sections. Fasteners and their layout must always be chosen in accordance with the above construction specifications.

Key:

1 FATRAFOL waterproofing membrane
2 FATRAFOL 807 (807/V) fleece-backed waterproofing membrane
3 Protective fleece
4 Membrane joint
5 Plastic-coated metal profile
6 Fastener
7 Z-01 joint sealant
8 PU sealer
9 Asphalt waterproofing layer
10 Thermal insulation board of expanded plastic
11 Thermal insulation board of mineral fibres
12 Vapour control membrane
13 Trapezoidal sheet metal
14 Plastic pad
15 Pavers
16 Aggregate loading layer
17 Drainage membrane
18 Loose soil
19 Vegetation layer
20 Plaster ended with aluminium flashing
21 Steel sheet metal
22 Wood screw
23 Wood
24 Shaped piece – Internal corner, type 10
25 Shaped piece – External corner, type 11
26 Rainwater outlet
27 PVC membrane collar
28 PVC outlet insert
29 PVC pipe
30 Sealing profile of expanded PE
31 PVC vent outlet
32 Lightning conductor wire
33 Concrete filling
34 Plastic holder
35 Bonding
36 Cast-iron pipe
37 Steel binding strap
38 Sheet metal
39 Single-sided rivet