TECHNONICOL






MANUAL
for the waterproofing of flat roofs by using polymer-bitumen membranes

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Annotation

The manual is intended for employees of outsourcing companies who carry out roofing works, and may also be useful for technical supervision officers who monitor the quality of a complete work.

In this manual a structure of single- and two-ply roofing is observed with the following fastening types:

- torch-on application
- mechanical fastening to bearing decking
- self-adhesive materials installation

This document is based on more than 25 years of experience of the company TECHNONICOL in the field of production and application of polymer-bitumen materials for roofing. The manual step-by-step outlines the process of roofing arrangement, including junctions to roofing elements.

Considering these recommendations, You would reduce the probability of roof leaking and therefore increase the inter-repair lifetime of the entire roofing system.

We hope, that this document would be useful in your everyday work.

Contents

1.
Introduction

1. Introduction

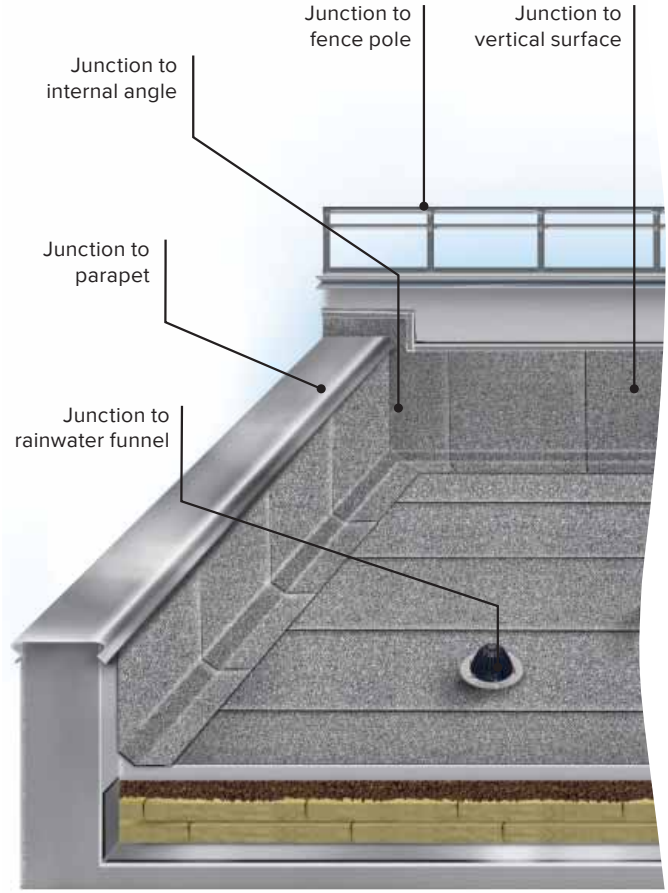
1.1. General information

- Roof protects buildings from impacts of atmospheric precipitations.
- Only utilization of present-day materials and qualitative installation work performance can provide reliability of a roof. It is commonly known, that roof leaking occurs mostly due to mistakes in project solutions and erroneous installation of roofing materials.
- The manual may be used when working with TECHNONICOL materials, fastened by torch-on application or mechanical fastening, or self-adhesive ones.
- It is recommended to remove a current roofing during repair of an entire roofing.
- In case new materials are being fastened over old roofing without complete removal of an old roofing, the current roofing must be completely removed from vertical surfaces and upstands*

Pocket Manual Symbology

IMPORTANT! Please, pay attention.

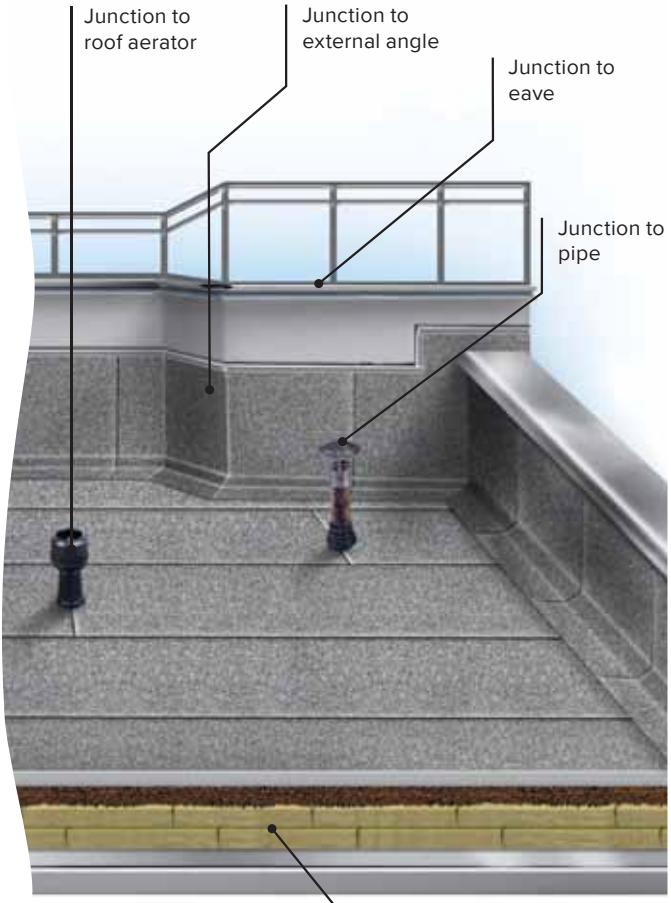
General information, description.

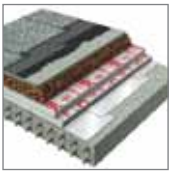


Additional:

Expansion joints performing

Lightning protection





Description of roofing systems

Roofing structure:

- Bitumen waterproofing membrane 2 layers
- Deck arrangement and preparation for roofing
- Roof sloping
- Thermal insulation
- Vapor barrier

1.2. Description and selection of roofing systems

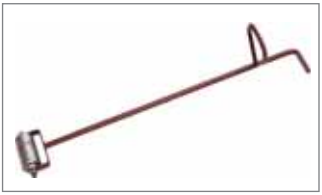
This manual considers following roofing systems:

1. Two-ply roofing on a timber deck with mechanical fastening of a base layer and torch-on application of a top layer.
2. Two-ply roofing on stone wool with mechanical fastening of a base layer and torch-on application of a top layer.
3. Single-ply roofing with mechanical fastening on stone wool.
4. Two-ply roofing on a concrete deck on both - inverted accessible and ballasted roofs.

1.3. Equipment

1.3.1. Set of gas equipment for roofing

Standard TECHNONICOL gas torch and shortened TECHNONICOL gas torch are used for seam gluing and torch-on application of bitumen materials.



Roller for seam rolling for total and hermetically sealed adhesion.

Hook for unrolling - a tool used for unrolling polymer-bitumen roll materials during torch-on application.

Seam torch with a roller - this equipment set is used for gluing polymer-bitumen materials seams.

TECHNONICOL Electrical Heater for gas cylinders maintains stable pressure and provides effective blowdown inside of a cylinder.

Professional gas pressure regulator with a manometer - a tool for gas pressure regulation.

Gas hose is used for connecting propane roofing gas torchs to a gas-pressure reducer.

1.3.2. Automatic equipment set for roofing

The set is intended for single-ply roofing on a horizontal roof surface.

BITUMAT - a powerfull machine for polymer-bitumen materials seam gluing (Technoelast K-MS 170/4000 and Technoelast K-YS 5500).

Cap on VARIMAT with a roller for hot air gluing of bitumen materials seams.

Brush for metal surfaces is used to clean the caps of portable fans and automatic equipment (BITUMAT, VARIMAT) of bitumen after the work.

Portable hot-air fan of LEISTERTRIACS type with a 80 mm crevice nozzle for polymer-bitumen sheet materials overlaps welding (Technoelast K-MS 170/4000 and Technoelast K-YS 5500).

Portable hot-air fan of LEISTERTRIACS type with a 75 mm crevice nozzle for polymer-bitumen sheet materials overlaps welding (Technoelast K-MS 170/4000 and Technoelast K-YS 5500).

Silicone roller 80 mm wide for manual torch-on application.

1.3.3. Equipment for mechanical fastening

- For mechanical fastening of roofing on corrugated steel sheets a screwdriver with a cross slot is needed.
- Mechanical fastening of roofing on concrete deck (sand cement screeds) requires a perforator, a concrete drill and a screwdriver with a cross slot.

Screwdriver with a cross slot.

Perforator with a concrete driller.

IMPORTANT! Tool misalignment must be not more than 2° to the decking surface. Do not fasten the fasteners too tight, so that tightened areas do not occur around a seam.

2.
Materials
and Components

2. Materials and Components

2.1. Materials

For roofing with mechanical fastening materials with certain physical and mechanical characteristics are used, which in association with the fasteners are able to hold wind loading.

Tab. 1 Use classes of bitumen membranes

Roofing systems	VE20 (1:20)	VE40 (1:40)	VE80 (1:80)	VE80R (1:80)
TL1	•	•		
TL4 + TL3	•			
TL4 + TL2	•	•		
TL4 + TL1	•	•		
TL3 + TL3	•	•		
TL3 + TL2	•	•		
TL2 + TL2	•	•	•	
TL2 + TL1	•	•	•	
TL2 + TL2 + TL2	•	•	•	•
TL2 + TL2 + TL1	•	•	•	•

• a reccomendable roofing system in each use class

- On heavily trafficked decks and/or on those that are not easily repaired after construction, it is recommended that a roofing system complying with the standards of VE80R be used.
- On terraces and balconies with only light pedestrian traffic waterproofing can be specified to comply with use class VE80 if the structure can be easily inspected/opened.
- In mineral wool roofing systems, the base membrane must be at least of product class TL3.
- If membranes of different product class are used in a roofing system it is recommended that the cap sheet be of a higher standard. Only for justifiable reasons may the order be changed.

Tab. 2 Product class requirements for modified bitumen membranes

				PRODUCT CLASS			
	Testting method	Requirement	Unit	TL1 [1]	TL2	TL3	TL4
Tensile strength, 23 °C logit. / transversal	EN 12311-1	min	N/50mm	750 500	500 400	500 400	250 200
Elongation, 23 °C logit. / transversal	EN 12311-1	min	%	15	30	20	2
Elongation, -20 °C logit. / transversal	EN 12311-1	min	%	15	30	10	2
Tear resistance at nail shank, logit. / transversal	EN 12310-1	min	N	300	130	100	40
Puncture resistance [6] dynamic (impact), -10 °C	EN 12691	max	ø mm	20			
Joint tensile strength [6]	EN 12317-1	min	N/50mm	500			
Resistance to water penetration	EN 1928 B	min	kPa	500	300	200	100
Adhesion of granules [7]	EN 12039	max	%	30	30	30	30
Heat resistance	EN 1110	min	°C	80	80	80	80
Flexibility Bonded membrane, base and top torch on membrane, top torch on membrane, base	EN 1109	max max	°C / ø 30mm	 -25 -20 -10	 -25 -20 -10	 -15 -10 0	 -25 -20 -10
Long therm durability [4] [8] Heat resistance (aging) Flexibility (aging) Bonded membrane, base and top torch on membrane, top torch on membrane, base	EN 1269 (EN 1110) (EN 1109)	- min max	 °C °C / ø 30mm	 80 -15 -10 0	 80 -15 -10 0	 80 -5 0 +10	 80 -15 -10 0
Nominal weight [2] [5] Bonded top sheet Torch-on top sheet Underlay sheet Torch-on underlay sheet	EN 1849-1	nom	g/m²	 4500 5500 3500 4500	 4000 5000 3000 4000	 4000 5000 3000 4000	 3800 4800 2200 3200
Dimensions Length and width [3] Straightness, 10 m	EN 1848-1	dec max	mm mm	dec 20	dec 20	dec 20	dec 20

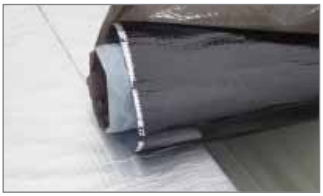
1. TL Class 1 membranes are generally used for single-ply systems, hence they have more stringent strength and stability requirements than the others. TL 1 class products may also be used as part of a two-ply system.

2. The requirement for minimum weight is designed to ensure the workability and water resistance of membranes. Exceptions to the values may be accepted, provided that with preliminary tests, work samples and other acceptable methods are used to verify the workability and water resistance of the product. However, other class standards are still applicable.
3. The manufacturer/supplier shall provide product dimensions.
4. The product is aged in a +70°C autoclave for 12 weeks, after which the properties of the product are reassessed.
5. The manufacturer/supplier shall provide the nominal weight of the product (MDV). A maximum of 5% deviation (tolerance) of the declared value is permissible.
6. Applies only to single-ply roofing membranes.
7. Deviating from the standard method, the assessment is made in a one-hour-test.
8. Applies only to cap sheets.

TECHNONICOL has produced special brands, which correspond with the required characteristics - Technoelast K-MS 170/4000 and Technoelast K-YS 5500.

Wind tests in Sweden (Constructech Sweden AB laboratory) have shown, that Technoelast K-MS 170/4000 and Technoelast K-YS 5500 materials are able to hold significant wind loading.

2.1.1. Vapor barrier materials



Technoelast VB 500 Self – is used in public and industrial buildings with normal temperature and humidity conditions (shopping centers, warehouse complexes, sport centers etc.).

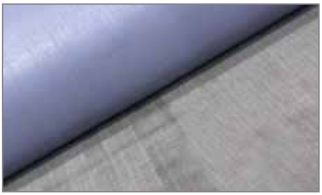
Unifleks EPP 4.0, Unifleks K-MS 170/4000 Technoelast K-MS 170/3000, Technoelast K-MS 170/4000 – roofing materials, which can be used as a vapor barrier layer in roofs with bearing deck from reinforced concrete.

2.1.2. Materials for two-ply roofing

Unifleks EPP 4,0, Unifleks K-MS 170/4000, Unifleks EMP, Technoelast K-MS 170/3000, Technoelast K-MS 170/4000 – materials for a base layer on a main (horizontal) roof plane.

Technoelast K-TMS 170/3400 - material for a base layer on a main (horizontal) roof plane. The material contains bitumen stripes on a reverse side, placed randomly. When torch-on applied, ventilated channels occur, which allow to remove moisture from under the material, which in turn prevents the roof from bulging.

Technoelast K-PS 170/5000, Unifleks K-PS 170/5000, Unifleks EKP 5.0 slate - materials with coarse-grained slate for a top layer of a roof.



MIDA SELF EPS – polymer-bitumen self-adhesive fiberglass-reinforced material, which is used as a base layer of a waterproofing system.

MIDA SELF BASE GV S3 – polymer-bitumen self-adhesive fiberglass-reinforced material, which is used as a base layer of a waterproofing system.

MIDA SELF PV S2.0s – polymer-bitumen self-adhesive polyester-reinforced material; is used as a base layer of a waterproofing system in the junction areas and for reinforcing of a main layer of a waterproofing system.

2.1.3. Materials for single-ply roofing

Technoelast K-YS 5500 – polymer-bitumen material for single-ply roofing. May be fastened either by torch-on application or by mechanical fastening with seam gluing.

IMPORTANT! Depending on a roof deck and fixing type, on the main (horizontal) plane Technoelast K-YS 5500 materials can be fastened mechanically or by torch-on application. On vertical constructions of a roof materials are fixed by torch-on application.

2.1.4. Selection of materials for waterproofing membrane

Tab. 3 TECHNONICOL materials used for layers of a roofing

Material	Class	Dimensions, m	Basis material	Fixing type	Application
Technoelast K-YS 5500	TL1	8x1	polyester	Mechanical fastening with seam gluing or welding with a gas torch	Single-ply roofing
Technoelast K-PS 170/5000	TL2	10x1	polyester	Welding with a gas torch	Top layer in two-ply roofing
Unifleks EKP 5.0	TL2	10x1	polyester	Welding with a gas torch	Top layer in two-ply roofing
Technoelast K-MS 170/4000	TL2	10x1	polyester	Mechanical fastening with seam gluing or welding with a gas torch	Base layer in two-ply roofing
Technoelast K-MS 170/3000	TL2	10x1	polyester	Mechanical fastening with seam gluing or welding with a gas torch	Base layer in two-ply roofing
Unifleks EPP 4.0	TL2	10x1	polyester	Welding with a gas torch	Base layer in two-ply roofing
Technoelast K-TMS 170/3400	TL3	10x1	polyester	Welding with a gas torch	Base layer in two-ply roofing
Unifleks EMP	-	10x1	polyester	Welding with a gas torch	Base layer in two-ply roofing
MIDA SELF EPS	-	10x1	fiberglass	Self-adhesive	Base layer in two-ply roofing
MIDA SELF BASE GV S3	-	10x1	fiberglass	Self-adhesive	Base layer in two-ply roofing
MIDA SELF PV S2.0s	-	10x1	polyester	Self-adhesive	Base layer in two-ply roofing

Tab. 4 Applying of combinations of TECHNONICOL roofing materials for different roofing types

Roof decking	Roofing system	VE20 (1:20)	VE40 (1:40)	VE80 (1:80)	VE80R (1:80)
Timber	Technoelast K-YS 5500	+	+		
	Technoelast K-MS 170/4000 + Technoelast K-PS 170/5000	+	+	+	
	Unifleks EPP 4.0 + Unifleks EKP 5.0	+	+	+	
Mineral wool	Technoelast K-YS 5500	+	+		
	Technoelast K-MS 170/4000 + Technoelast K-PS 170/5000	+	+	+	
	Unifleks EPP 4.0 + Unifleks EKP 5.0	+	+	+	
Concrete	Technoelast K-YS 5500	+	+		
	Technoelast K-MS 170/4000 + Technoelast K-PS 170/5000	+	+	+	
	Unifleks EPP 4.0 + Unifleks EKP 5.0	+	+	+	
	Technoelast K-MS 170/4000 + Technoelast K-MS 170/4000 + Technoelast K-PS 170/5000	+	+	+	+
	Unifleks EPP 4.0 + Unifleks EPP 4.0 + Unifleks EKP 5.0				+
	Unifleks EPP 4.0 + Unifleks EPP 4.0 + Unifleks EPP 4.0				+

+ recommended solution
+ permissible to apply

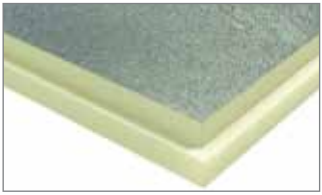
2.1.4. Thermal insulation materials

TECHNOROOF N is used as a base layer for two-ply thermal insulation in roofing made of reinforced concrete or corrugated steel sheets. It is recommended to be used together with the TECHNOROOF V slabs.

TECHNOROOF V is used as a top thermal insulation layer in roofing made of reinforced concrete or corrugated steel sheets. The roof cladding is installed without an additional protective coupler.

TECHNONICOL CARBON PROF is thermal insulation for ballasted, multipurpose, and traditional roofs.

- It is used in loggia and balcony structures; are thermal insulation for foundations and basements of premises, under-floor heating, floors on ground, and also for insulation of cold bridges in precast panel construction;



LOGICPIR is a thermal insulation based on foam polyurethane (PIR), on both sides laminated with aluminium foil or fiberglass. PIR slabs have straight or formed L-shaped ends for better material junction and creation of a continuous thermal insulation contour without thermal bypass.

2.2. Peculiarities of works at low temperatures

A serious factor, which influences quality of roofing materials installation, are climate (weather) conditions.

- Torch-on application should be carried out in no precipitation conditions. In other cases it is necessary to arrange sheds, and at subzero temperatures - a cold protection enclosure.
- When working with polymer-bitumen materials, environmental air temperature and temperature of a material itself should be higher than the flexibility temperature of the material.
- Self-adhesive materials are fastened at temperatures not lower than +5˚C. At temperatures lower than +15˚C the adhered surface is heated by industrial fans. Before fastening, materials should be stored at not lower than +20˚C for 24 hours.

IMPORTANT! In case of works being carried out at subzero temperatures, roofing material should be stored in a warm place for not less than 24 hours at temperatures not lower than +15 °C. At the working site should the material be transferred directly before torch-on application.

- To increase the effectiveness and safety during works with the gas equipment use a cylinder heater.
- The heater provides stable gas pressure in a cylinder, which allows to spend gas effectively (gas save may reach 30%).

2.3. Components

TECHNONICOL Funnel with Clamping Flange for internal water drain. In roofs with no thermal insulation it is recommended to use heated funnels.

Put-on element with a clamping flange is used together with a funnel to create a two-layer funnel.

Seal (element) Ø 100-140 mm (Ø 10.50 mm) - for junctions of a roofing to pipes.

Roofing Aerator 160×460 mm is intended for steam removal in «breathing» roofing.

Parapet Funnel and Parapet Funnel for water transferring are intended to remove water over the parapet of a flat roof.

TECHNONICOL sealing mastic N°23 is used for sealing the edge of a roofing on vertical junctions in the area of an edge strip, for sealing roofing elements (pipe seals, funnels, aerators etc.), and can also be used for repair of a protective layer of a roofing material.

TECHNONICOL BITUMEN PRIME COATING bitumen primer is a solution of high-quality oil bitumens with a softening temperature of no lower than 80°C in specially selected organic solvents.

- It has an enhanced penetrability and short drying time. Ready primer is applied to the foundation at once, which provides additional convenience and enhanced performance for carrying out work.

TECHNONICOL BITUMEN PRIMER N° 03 polymer-bitumen primer consists of a solution of oil bitumen, polymers and adhesive additives in organic solvents.

- The material has a short drying time and provides reliably protection of the metal surface against corrosion before installation of the waterproofing layer. It's increases the adhesive strength of the material to the base.

TECHNONICOL BITUMEN PRIMER N° 04 bitumen emulsion primer is produced on the basis of bitumen dispersion in water. The material does not contain solvents, it has a neutral smell and is ideally suited for work in doors.

TECHNONICOL N° 41: a hot-applied polymer-bitumen mastic.

TECHNOROOF N30 SLOPE, TECHNONICOL CARBON ECO SLOPE, LOGICPIR SLOPE is intended as an easy and fast way of creating roof slopes

Edge strip (metal rod with an enlarged upturn*) is used to fasten the edge of a roofing on vertical constructions.

TECHNONICOL Telescopic fastener is used for mechanical fastening of thermal insulation and roofing materials to the bearing roof decking from reinforced concrete and corrugated steel sheet.

Self-tapping screw EDS-B 4.8 is used for fastening of the roofing to the bearing deck from corrugated steel sheets.

Round-shaped Metal Cup Lock is used for mechanical fastening of roofing materials to the decks from reinforced concrete and sand cement screeds.

Self-drilling screw EDS-B 4.8 with an anchor element is used for fastening the roofing to the deck from reinforced concrete and sand cement screeds.

2.4. Material storage

Roll materials should be stored vertically on pallets in one row heightwise, protected from humidity and direct sunlight (under sheds).

Short-term outdoor storage of pallets with roll materials is allowed providing that original package is not damaged.

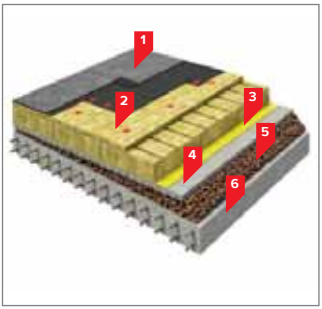
While stored, bitumen materials should not directly contact with heat sources (heaters) with the constant surface temperature of more than 45°C. The distance from heat sources (heaters) should be more than 1 m.

3.
Preparation Works

3. Preparation works

3.1. General information

Roof - is a multi-layer system consisting of:



1. waterproofing membranes
2. thermal insulation
3. vapour barrier
4. reinforced concrete layer
5. sloping layer
6. reinforced concrete decking

IMPORTANT! Installation of roofing is a final step in roofing works, install previous layers attentively. Mistakes are be difficult to correct.

3.2. Work safety

3.2.1. General information

The fundamental issues in safety at work on roofing sites are protection against falling and the ascent routes.

Additionally to be noted as part of safety at work are the scheduling of the work, the placement of materials and equipment on the roof, tidiness of the site, protection of access routes into the building and the need to reserve a sufficient safety zone around the building.

The principle is that along edge areas where there a risk of falling, railings complying with safety at work regulations must be built. Exceptions to this may be made if the free fall is less than three metres and there is even ground below. If there is water, rocks or other similar terrain, fall protection is mandatory. The working area may be delimited, for example, with a caution line that prevents access closer than 1.5 metres to the edge (does not obviate the need for a railing).

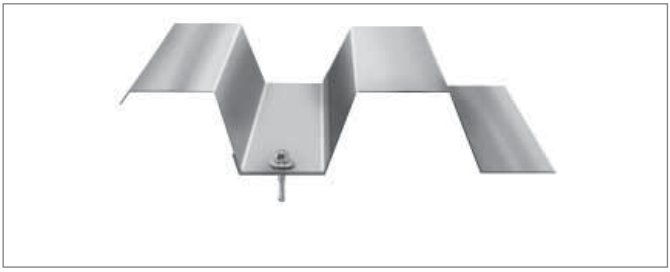
If necessary, a fall protection plan must be drawn up. Any openings must also be protected, either by covering them securely and marking them or by building railings or other protection against falling around them. Stepping or sitting on any covers over openings should always be avoided.

Access to the roof should primarily be arranged from inside or outside utilising the permanent access routes existing in the building. If there are no such routes, a temporary access route must be constructed for the work period. In most cases this means a site stair tower complying with safety at work regulations. A house ladder does not usually constitute a safe access route as intended in safety at work regulations.

IMPORTANT! Be careful! Before works, make sure that bearing constructions (roof framing) from corrugated steel sheets are installed over entire roof plane with no through cavities and gaps.

Corrugated steel sheets should be fastened to each other with fasteners:

- Self-tapping screw:



- Aluminum rivet:

3.2.2. Hot work regulations

In roofing and waterproofing work the entire currently applicable Hot Work Guideline must be followed. Below are listed some of the basic obligations of the safety guideline. (Hot Work Standard 5900 dating from 2002 and the Fire and Rescue Services Act of 2003).

3.2.3. Hot work permit

Every worker carrying out hot work is required to have a valid "roofing and waterproofing sector" hot work permit (valid for 5 years). There is a specific hot work permit for the sector, for which the permit holder must pass the hot work examination required by the Federation of Finnish Insurance Companies and organised by the Finnish National Rescue Association. Completing the hot work examination indicates that a person understands the risks involved in using a naked flame, and knows the basic procedures and work methods to avoid unnecessary risks and to carry out hot work as safely as possible.

3.2.4. Hot Work Permission / Checklist for Hot Work

The Checklist for Hot Work / Hot Work Permission must be completed before commencing hot work. The objective of the checklist is that the possible risks at a work site are mapped out before commencing work so as to avoid unnecessary damage is. The procedure ensures that the necessary safety equipment can be found at a temporary hot work site and that the workers have the roofing and waterproofing sector hot work permits.

The checklist/permission defines who is responsible for fire watch after completion of the work and its duration. At some sites it is advisable to extend the fire watch beyond the minimum time (1 hour). The permission/checklist must be updated according to site requirements but at least fortnightly.

It should be noted that it is the contractor's obligation to acquire regular extinguishers for a roofing site. However, the acquisition of special equipment should be agreed upon separately.

Roofing works during atmospheric ice, fog, ceasing visibility within working area, thunderstorm, wind with the speed of more than 15 mps are prohibited.

Working site should be provided with the following fire-extinguishing and medical aid equipment:

- Fire extinguisher - not less than 2 per 500 m^2 of roof.
- Asbestos cloth - 3 m^2
- First-aid kit with a set of medicaments - 1 pc.
- Sand box with capacity of 0,05 m^3 - 1 pc.
- Shovel - 2 pcs.

3.2.5. Safety regulations for works with gas torchs

When working with gas cylinders (working gas - propane) it is necessary to consider «Temporary Instruction on Safe Exploitation of Sites, Storage and Transportation of Gas Cylinders with Propane-Butane During Waterproofing Works».

- Polymer-bitumen materials are fastened with the open flame, thus safety regulations during works with gas torchs must be obeyed.
- It is absolutely forbidden to transfer filled gas cylinders on a roof with the cap down.
- During works with the gas specially intended regulators must be used: reducing, regulating and automatically maintaining working gas pressure ones.
- Domestic regulators are forbidden.
- When igniting a hand gas torch* (working gas - propane), a valve should be cracked open for 1/4.1/2 of a turn and after a short-term hose venting gas mixture should be ignited, whereupon flame may be regulated.
- Gas torch ignition should be carried out with a match or a special silicic lighter*.
- With an ignited gas torch do not move away from the working site, do not climb up the stairs and scaffolds, do not make sudden movements.

- To turn off a gas torch, block a gas-supply valve and then lower a blocking lever. Gas in a hose must be entirely burned.
- During breaks flame should be put out and valves should be tightly blocked.
- During breaks (meal breaks etc.) valves on cylinders and regulators must be turned off.
- In case of a gas torch being overheated, works should be suspended and a gas torch should be turned off and cooled down to the temperature of the environmental air in a container with clean water.
- Flame works should be carried out at the distance of not less than 10 m from a group of cylinders (more than 2), intended for flame works; not less than 5 m from single cylinders with the gas; not less than 3 m from gas pipelines.
- If gas leaking from a cylinder is detected, the works must be immediately stopped. Cylinders or any other equipment must not be repaired at the flame working site.
- In case of a regulator or a block valve being frozen, should they be warmed up only with clean warm water.
- Gas cylinders must be not less than 1 m away from heaters and 5 m from heating furnaces and other strong heat sources. Do not take off a cap with a hit of a hammer, chisel or any other tool, which can produce a spark. A cap must be taken off with a special wrench.
- Hoses should be protected from damaging; during laying avoid flattening, twisting, folding; do not use oil hoses, prevent sparks and heavy objects falling on hoses, avoid exposure to high temperatures; do not use gas hoses for liquid fuel supply.
- In case of a fire occurring at a working site, it should be extinguished with extinguishers and dry sand, covering the fires with an asbestos cloth.
- At the end of the roofing works with a gas torch, a roofing worker must turn a fuel-supply valve off, block a valve on a cylinder. Gas in a hose must be entirely burned. Then hoses should be taken off of regulators and cylinders, wound and put in a special storage place.
- Carrying out roofing works at the same time with installation and construction roofing works with the use of open fire (torch-on application etc.) is prohibited.

3.2.6. First aid for burns with hot bitumen

For Burns:

- Cool bitumen with water (preferably with cold water) to avoid deep damage of tissues.
- Cooling with water must be carried out immediately until bitumen hardens and cools. To avoid hypothermia, cool for not longer than 5 minutes.
- It is prohibited to remove bitumen from a burnt area. Qualified medical assistance must be provided as soon as possible.

For Severe Burns:

- Bitumen on burn blisters is removed together with the skin at the same time with lavage* and removal of dead tissues.
- Bitumen on non-exfoliated skin is not removed. Skin is treated with petrolatum or medicaments on animal fats, similar to petrolatum or lanoline, antibacterial cream.
- Subsequent cream treatment and bandaging should be carried out until bitumen dissolves completely and can be removed - usually 24-72 hours.
- After removal of bitumen a burn is treated conventionally.
- It is prohibited to use solvents for bitumen removal, because they can aggravate tissue damage.

3.3. Bearing roof decking

The decking underneath waterproofing must be stable and even. Harmful gaps and sharp upturns are to be avoided. The structure must be rigid enough to avoid depressions of the roof surface that could damage the roofing or prevent drainage of water from the roof. The decking must have a sufficient fall. It is advisable to incorporate the angle already in the loadbearing structure.

The actual roofing cannot be used to make the falls. Roofing membranes should be chosen according to the slope. The requirements for the roofing are the more stringent the lower the pitch of the roof. A sufficient slope ensures a good and economic result. When choosing a decking material the functioning of the entire system must be considered and attention must also be paid to the requirement for ventilation and a vapour barrier.

3.3.1. Timber substructure

- The substructure must be even and rigid. The substructure is usually cross ventilated. The ventilation gap must be sufficient (min. 100 mm). The exhaust air vent is situated as high as possible and the air inlet vent as low as possible, so as also to allow gravitational ventilation of the structure.

3.3.2. Board decking

- The decking is constructed of roughsawn T&G boards with a max. width of 95 mm.
- The minimum thickness is 20 mm when the support spacing is 600 mm (see table). The boards must be square edged and dry. The moisture content may not be over 20% of the dry weight. Lengthwise joints are to coincide with supports and the minimum board length is 2x support spacing. Allowance for moisture and thermal expansion of boards should be made by leaving a sufficient gap between them.
- Each board is nailed to each roof truss with two HDG nails of no less than 70 mm in length. The board deck is stiffened e.g. with crosswise band steel braces, which will stabilise it against possible lateral forces caused by wind or snow loads.

3.3.3. Timber panel decking

- Appropriate building board (e.g. exterior quality plywood) may be used to construct the roof deck.

- The boards should be fixed according to the manufacturer's instructions.
- The minimum board thicknesses are given in the table below.

Tab. 5 Minimum thicknesses for timber product decking

Support spacing c-to-c/mm	Thickness of rough sawn T&G boards mm	Thickness of plywood mm
600	20	12
900	23	15
1200	28	19

Snow load 1.8 kN/m^2, point load 1.0 kN

- The joints in the direction of the supporting members should coincide with the supports. The joints perpendicular to the supports should be tongued and grooved to prevent either edge from protruding /sagging or this should be prevented by other practicable construction.
- The panels should be installed so that the perpendicular joints do not coincide with one another. The panels should span at least two support spacings.
- At the joints expansion in width and length due to moisture and thermal movement should be taken into account. When using a panel product decking, comply with the manufacturer's instructions.

3.3.4. Concrete decking

- Bearing concrete decking may be made of a monolithic reinforced concrete or precast concrete slabs*.
- Unsmooth surfaces of slabs or a monolithic decking are finished with a sand cement solution of a brand not lower than M150. Bulges of coarse aggregate of more than 3 mm in height should be cut off or knocked down.
- Joints of precast concrete slabs are grouted with a solution of a mark not lower than M150.
- In case of a significant amount of roughnesses on a reinforced concrete deck for a vapor barrier, it is recommended to carry out an equalizing sand cement screed.

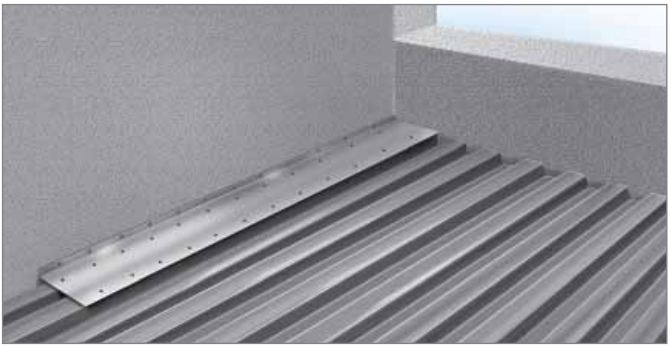
3.3.5. Corrugated steel sheets

- Corrugated steel sheets used for roofing should comply with the requirements, applicable in Finland.
- Thickness of a corrugated steel sheet must be not less than 0.7 mm. Corrugated steel sheets must be installed with a wide flange* up.

IMPORTANT! Check out whether fastening of corrugated steel sheets to a bearing construction on the entire roof area coincide with the project. Lateral corrugated steel sheets junctions must be riveted or connected by self-tapping screws.

In the areas where corrugated steel sheets adjoin vertical constructions, installation of L-shaped elements from galvanized steel not less than 0.8 mm thick should be provided.

The L-shaped element must overlap 2 corrugations of a corrugated steel sheet in horizontal direction and be placed on a vertical surface for a height of at least 50 mm.



- L-shaped elements are fastened with self-tapping screws. Span* of fastening to vertical constructions - 200-250 mm. Fastening to corrugated steel sheets is performed to the upper flanges of the two nearest corrugations in staggered order with a span of 200-300 mm.
- The upper edge of the L-shaped element should be sealed with butyl-rubber sealant in roofing of premises with (moist)

humidity conditions and in cases when the flange of the L-shaped element, adjacent with vertical constructions, is more than 50 mm high.

In the areas where rainwater funnels go through a corrugated steel sheet covering, reinforcement of a corrugated steel sheet covering with a galvanized sheet steel at least 0.8 mm thick should be provided.

- Dimensions of a sheet depend on a cutting point and should be fastened to at least 3-4 corrugations of a corrugated steel sheet.
- In the areas where pipes, bundles of pipes, cables and other elements go through a covering, sleeves should be installed. A sleeve can be made of metal or in the shape of a box from plain cement sheets or cement-shavings slabs. Height of a sleeve should be chosen with consideration, that a sleeve should rise above a waterproofing membrane for at least 150 mm. The gap between a wall of a sleeve and a pipe should be not less than 25 mm.
- In the areas of expansion joints of a building compensators* made of galvanized steel at least 0.8 mm thick should be provided. Compensators* must be fastened to the both sides of a joint and ensure mobility of a unit.

3.4. Vapor barriers

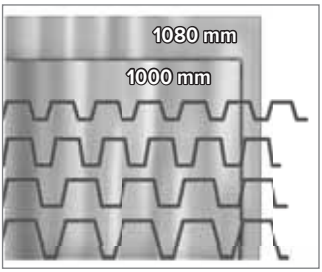
Vapor barriers protect constructive layers (thermal insulation, roof decking, slope) from saturation of moisture from interiors. When there are no vapor barriers or they are damaged, thermal insulation becomes saturated with moisture, which leads to decreasing of heat insulating ability and freezing of a roof construction.

- Selection of vapor barriers in roofing is a very responsible process. Vapor barriers in such systems are leaking due to mechanical fasteners being fastened to a roof decking (corrugated steel sheets) directly through vapor barrier.
- Because of special properties of a bitumen binder, fastening area and bitumen vapor barrier tighten and seal. That is why we recommend bitumen-containing materials as vapor barriers: Technoelast VB 500 Self (on corrugated steel sheets), Unifleks EPP 4.0, Unifleks K-MS 170/4000, Technoelast K-MS 170/3000, Technoelast K-MS 170/4000 (on reinforced concrete decks).

3.4.1. Vapor barrier on corrugated steel sheets

Technoelast VB 500 Self – foil-laminated self-adhesive bitumen-containing vapor barrier material. High tearing characteristics of the material allow to hold a weight of a human standing between corrugations of a corrugated steel sheet on a vapor barrier. The material does not tear or stretch in such conditions.

Technoelast VB 500 Self 1.08 m wide is suitable for all types of corrugated steel sheets and is installed without overspending:



- H-75-750
- H-114-600
- H-114-750
- H-158-750

Preparation works before vapor barrier installation

Clear the surface of a corrugated steel sheet on site from dust, debris, snow, ice, shavings, oil.

In the areas of expansion joints, junctions of corrugated steel sheets to walls, ventilation shafts, roof exits fill the corrugation gaps with stone wool materials of non-flammable flammability class.

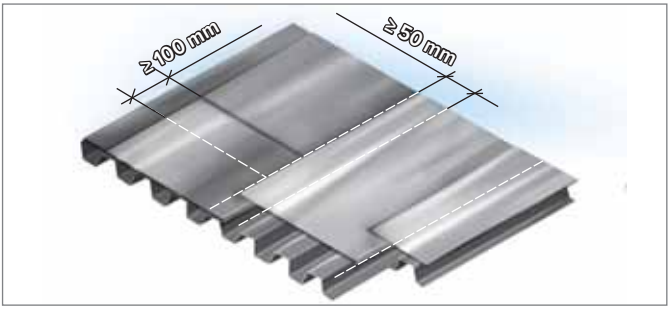
Gaps filling is carried out with slab thermal insulation not less than 250 mm from the edge of a corrugated steel sheet. It is also performed in the areas of cuttings and non-overlapped junctions of corrugated steel sheets (in the points of pipes installation, funnels installation, ridge and valley).

IMPORTANT! Corrugation gaps should not be filled with filled-up thermal insulation.

Vapor barriers on general plane

Install the material along upper flanges of a corrugated steel sheet.

IMPORTANT! In case of greasing of a corrugated steel sheet surface or bad adhesion to the decking, cover upper flanges of corrugations with TECHNONICOL BITUMEN PRIMER N°03.



- Lateral overlaps of adjacent sheets should be at least 50 mm wide and be located on the upper flange of a corrugated steel sheet. End overlaps should be at least 100 mm. Adjacent sheets should be installed with spacing between end seams.

Before installation, unroll the roll material by 2 m, form all the necessary overlaps and stick the beginning of the roll:

Using a roofing knife, cut the protective film from the bottom of the material 30-40 cm from the edge of the roll. Carefully take off the protective film and stick the beginning of the roll.

Roll the gluing area with a silicone roller.

Stick Technoelast VB 500 Self to the decking: One worker pulls the protective film, another one smoothens the material with a brush. Smoothening of the material to the foundation should be performed from the middle of the roll to the edges of the material.

In case the lateral side of vapor barrier covers the upper flange of a corrugated steel sheet for less than 50 mm, stick the material to the corrugated steel sheet as shown in the picture.

- Lateral overlap of the next roll should be located on the upper flange of a corrugated steel sheet.

Vapor barrier junction to an internal angle

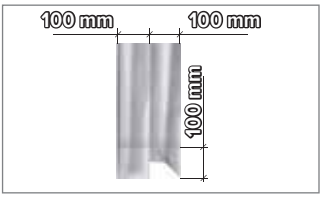
When unrolling the roll along vertical constructions (walls, parapets, ventilation shafts etc.), place Technoelast VB 500 Self closely to the vertical surface.

When placing the material to a vertical construction, stick the material directly to the vertical surface. The material is placed 25 mm above the thermal insulation layer.

In the places where it was impossible to place the material directly to the vertical surface, stick an additional reinforcement layer.

- On horizontal surfaces the additional layer should overlap the edge of a vapor barrier material for 100 mm.

Prepare a patch as shown in the picture and stick it to the internal angle.



A strip is 200 mm wide.

Vapor barrier junction to an external angle

When installing the material on a horizontal surface, place it also on a vertical one, where possible. The material should be placed on the vertical surface 25 mm above the thermal insulation layer.

In the places where it was impossible to place the material directly on the vertical surface, stick an additional reinforcement layer.

- On horizontal surfaces the additional layer should overlap the edge of the installed material for at least 100 mm. In the angle bind the material of the additional layer to another side and make an overlap for at least 100 mm.

Seam the cut place of the material with a patch in the angle.

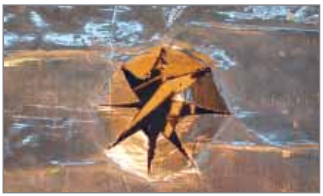
Vapor barrier junction to pipe penetrations

The pipe lining with the vapor barrier material described below, can be performed only providing that the pipe is rigidly connected to the bearing construction elements (joists* or purlins*) and corrugated steel sheets are installed on those elements. It is intended for cold pipes with the temperature of pumped liquid or gas less than +45°C. In other cases it is necessary to mount around a pipe a closing sleeve with a flange and perform vapor barrier junction to the sleeve according to the method described below.

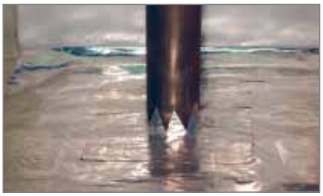
Install a vapor barrier on the decking, cutting the vapor barrier material around the pipe.

Prepare a reinforcement layer from Technoelast VB 500 Self in a shape of a square:
A side of the square should be 300 mm bigger than the diameter of the pipe.

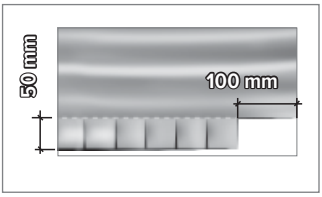
- In the middle of the reinforcement layer draw a circle with a diameter equal to the external diameter of the pipe.



Cut the material from the edge of the circle to the center.



Stick the reinforcement layer, the pinks occurred stick to the pipe.



Prepare a strip from Technoelast VB 500 Self: the length of the strip should be 100 mm longer than the circumference of the pipe.

The width of the strip considers that the material should be stick to the pipe 25 mm above the thermal insulation layer and be placed on 50 mm of the horizontal surface of the decking.

- Cut in stripes a part of the material, which is going to be stick to the horizontal surface of the decking.
- Stick the piece to the pipe.

Peculiarities of works with Technoelast VB 500 Self membrane at subzero temperatures

- Environmental air temperature and temperature of the material itself should be higher than the flexibility temperature of Technoelast VB 500 Self (-25° C).
- Technoelast VB 500 Self must be stored for at least 24 hours in a warm place at a temperature of +15°C. From the warm place to the working site should the material be transferred directly before installation on a corrugated steel sheet.
- For better adhesion of the material to a corrugated steel sheet additionally warm up the decking (corrugated steel sheet) with a gas torch before unrolling the material. Damage of galvanized layer of the corrugated steel sheet should be avoided.

3.4.2. Vapor barrier on reinforced concrete decking

Polyester- or fiberglass-reinforced polymer-bitumen materials are recommended as vapor barrier on reinforced concrete decking - Unifleks EPP 4.0, Unifleks K-MS 170/4000 Technoelast K-MS 170/3000, Technoelast K-MS 170/4000. These materials obtain vaporproofing properties and are resistant to probable mechanical damaging during fastening.

Preparation of decking for vapor barrier installation

Seal up roughnesses and junctions of bearing reinforced concrete slabs with a sand cement solution of a brand not lower than M150.

Align the surface of an irregular monolithic reinforced concrete decking with a sand cement solution of a brand not lower than M150 at least 30 mm thick.

Clean the surface of the decking from dirt, dust, foreign objects, ice crust and snow.

Free installation with seam guing

Bitumen vapor barrier can be entirely stick or installed without sticking, but seams must be glued.

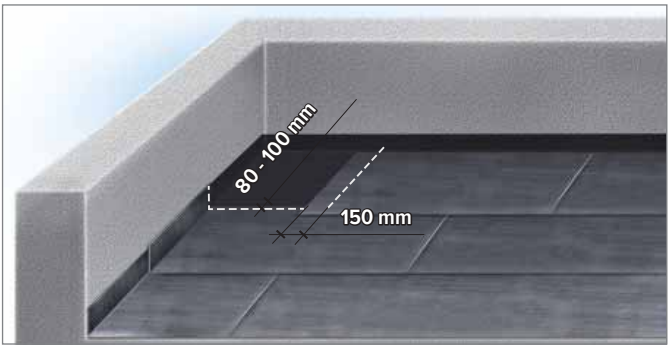
- On vertical constructions vapor barrier should be placed on the vertical surface and welded with a gas torch above the thermal insulation layer.

Continuous Torch-On application on the decking

All the surfaces, on which the material is going to be welded with a gas torch (vertical surfaces till the level of the material placement and vapor barrier decking in case of continuous adhesion), should be treated with cold priming solutions (primers). As a primer applied on dry surfaces, TECHNONICOL BITUMEN PRIME COATING is recommended.

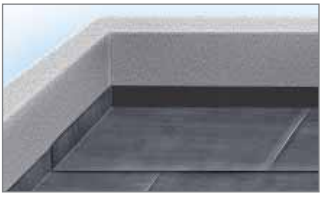
IMPORTANT! On buildings more than 75 m high due to increased wind loading vapor barrier materials are recommended to be entirely stick to the bearing deck.

General rules of vapor barrier installation



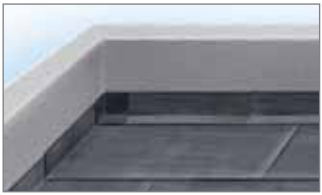
- Install the material with 80-100 mm overlaps in lateral seams and 150 mm overlaps in end seams.
- Adjacent sheets install with spaces between end seams.

When placing a side end of a vapor barrier to a vertical construction, place and weld the material with a torch on the vertical surface above the thermal insulation layer.



When placing a lateral end of a vapor barrier to a vertical construction, place the material closely to the vertical surface.

Stick an additional layer to the vertical surface from the side of a roll, which is installed closely to the vertical construction.



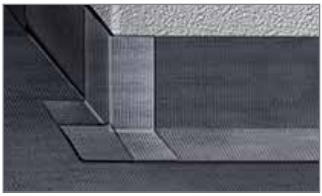
The additional layer should be installed on the vertical surface above the thermal insulation layer and angle fillet and placed 80-100 mm on the horizontal surface of the decking.

Cut out a patch and weld it with a torch on the internal angle.

Vapor barrier installation to an external angle

Stick the vapor barrier material to a vertical surface (walls, parapets, ventilation shafts etc.).

Cut out the patches and weld them on the external angle.



IMPORTANT! Vapor barrier junctions to the pipes are carried out according to the technology, similar to the arrangement of alike junctions in a waterproofing system.

3.5. Thermal insulation Installation

Thermal insulation is a layer of insulation system of an exterior construction, including roofs, which provides warmth preservation inside a building.

Thermal insulation surface may serve as a roof decking, providing that the materials used are with at least 0.06 MPa (60 kPa) compressive strength - stone wool slabs TECHNOROOF with compressive strength of not less than 60 kPa in 10% deformation conditions and polyisocyanurate foam slabs TECHNONICOL (PIR).

3.5.1. Mineral wool

Two to three mineral wool layers, where the top layer is harder and stiffer, are generally used. The top layer is also a thinner layer (20 - 70 mm). It is recommended to use grooved slabs so that the grooving is as close to the surface of the insulation (20 – 70 mm from the top surface) as possible.

Tab. 6 Insulation slab stress classes and compressive strength

Use of structure	Bottom and intermediate layers	Top layer
Stress class R1: (light) -ordinary storage building	≥ 20 kPa	≥ 40 kPa
Stress class R2: (normal) - ordinary residential or office building	≥ 30 kPa	≥ 50 kPa
Stress class R3: (heavy) - ordinary industrial building	≥ 50 kPa or > 60 kPa	≥ 70kPa > 60kPa *
Stress class R4: (extreme) - demanding industrial building	≥ 60 kPa or ≥ 60 kPa	≥ 80kPa > 70kPa *

* the values may be applied when the thickness of the top slab of a layered insulation system is > 30 mm and the long sides of the slabs are tongued and grooved.

- With the insulation thicknesses applicable in Finland, only short term max. 20 mm depressions of limited area that do not damage the insulation are permissible.

3.5.2. Plastic insulation slabs

Plastic based insulation slabs used on roofs, e.g. PIR, must be products specifically manufactured for this purpose. The compression strengths of PIR roof insulation slabs are 120 kPa. The long-term shrinkage of plastic based insulation slabs must be less than 0.2%. To prevent long-term shrinkage, the slabs should be heat treated during manufacture or they should be stored for over 6 weeks in a warm (over 15°C) storage facility.

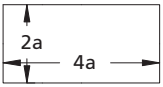
IMPORTANT! Installation of thermal insulation slabs should be carried out on a ready vapor barrier layer. Vapor barrier surface should be dry.

Installation of thermal insulation slabs on corrugated steel sheets should be performed so that the longer side of a slab is placed perpendicular to corrugations of a sheet.

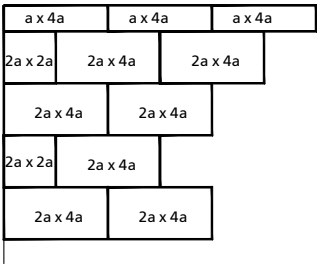
When installing thermal insulation of two and more insulation slabs, orient the seams in a staggered order to provide close adjoining of slabs.

- Seams of more than 5 mm between thermal insulation slabs fill with thermal insulation material.

Thermal insulation slab:



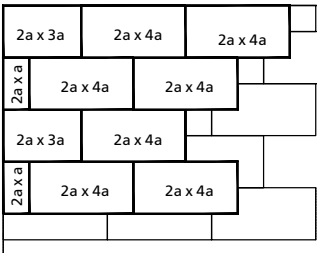
Installation of the first (base) layer:



Installation of thermal insulation starts from the corner of the roof.

Install the slabs towards yourself. This will reduce slab damage during the works.

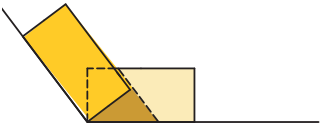
Installation of the second (top) layer:



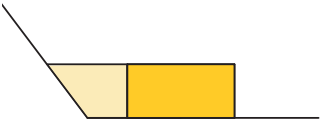
When installing, the thermal insulation slabs are being cut in the way so that the junctions of the first and the second layers do not coincide.

To simplify the installation of the thermal insulation slabs in unstraight angles, it is recommended to apply the following method of slab cutting:

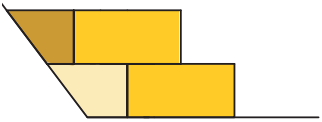
Install the thermal insulation slab in the angle of the roof. The longer side of the slab should be parallel to one of the sides of the angle.



Install the second slab above the first one so that the longer side of the slab coincides with the second side of the angle. Slit the lower slab as shown in the picture.



Assemble the first and the second layers of thermal insulation slabs from the elements.

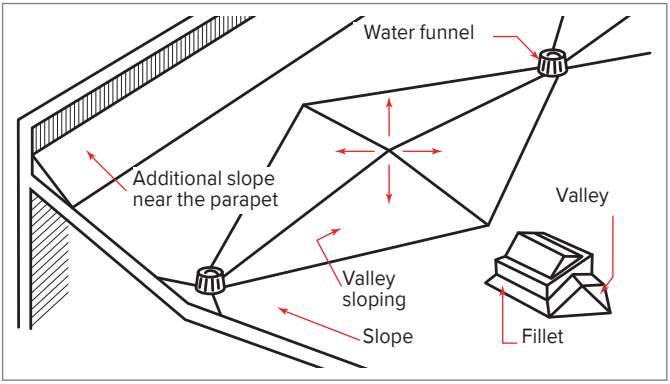


Fasten the top thermal insulation slab to the bearing decking with fasteners.

- Fastening of the 1000×500 mm and 1200×600 mm slabs is carried out in consideration of 2 fasteners per top slab, fastening of the 2400×1200 mm slabs - 6 fixtures per slab.

3.6. Slope formation on a roof

Slopes are used to remove water from the roof. For total water removal from the surface of the roofing with external and internal piped drainage systems* a slope of at least 1.5% is recommended.



IMPORTANT! Sloping layer can be formed with the bearing covering slabs during roof projecting or with the sloping layer.

In case decking slope is specified by the bearing constructions, counter slopes can be made of a sloping layer.

Slopes are used to remove water from the roof. For total water removal from the surface of the roofing with external and internal piped drainage systems a slope of at least 1.5% is recommended.

As a sloping layer the following can be used:

- V-shaped TECHNONICOL slabs;
- filled-up materials (keramzite gravel, perlite and others);
- light concrete mixtures (foamed concrete, polystyrene foam concrete, keramzite concrete, perlite concrete);
- sand cement compositions.

IMPORTANT! Filled-up materials, concrete and sand cement compositions are prohibited to be used as sloping layers on bearing decks from corrugated steel sheets.

3.6.1. Sloping layer from filled-up thermal insulation

Traditional way to make a slope from filled-up materials:

Before starting the works it is recommended to make a separating layer (e.g. from ruberoid*, asphalt roofing paper*) on thermal insulation slabs.

Works should be performed in dry weather conditions. During precipitations (rain, snow etc.) the works are prohibited.
Set the guide rods on the level-checked marks with a span of 2-3 m on the decking.

Spread and smooth out the material according to the guide rods. Bulk material should be dry.

- Place a reinforced net from Bp3 wire and 150x150 mm mesh width on the sloping layer. The reinforced net helps to carry out further works with bulk material without damaging the slope.

IMPORTANT! Main disadvantages of slopes from filled-up thermal insulation:

- Damage of projected slopes due to filled-up material displacement during installation.
- Additional loadings on the bearing roof construction.

3.6.2. Sloping layer from V-shaped thermal insulation

V-shaped TECHNONICOL slabs for roof slope formation are produced from stone wool, extruded polystyrene foam or polyisocyanurate foam.

- Direct installation of V-shaped thermal insulation slabs from stone wool on steel profiled sheeting is prohibited.
- Fastening of V-shaped slabs is carried out together with the main thermal insulation layer. Recommended amount of fasteners is at least two per one 1200x600 mm slab. The length of a fastener is increased by a corresponding thickness of a V-shaved insulation.
- Sloping layer from filled-up materials (keramzite, vermiculite, perlite and others) is installed on the roofs with the bearing deck from prefabricated* or monolithic reinforced concrete.
- Sloping layer from light concrete is installed on the roofs with high operation loads, e.g. roofs used for car loads.
- Sloping layer strength depends on loading rate on a roof.

IMPORTANT! Advantages of V-shaped thermal insulation slabs:

- roof load reduction;
- economy of labor costs of sloping works;
- shortening of the duration of works.

V-shaped slabs for main slope of the roof

For the main slope of the roof are used:

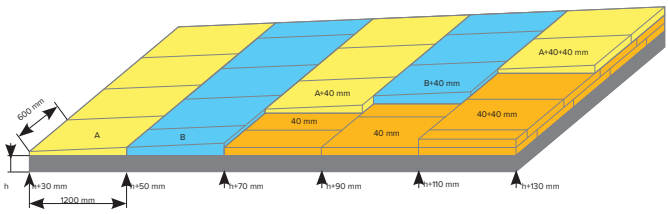
- Stone wool slabs TECHNOROOF N30 SLOPE 1.7%
- Extruded polystyrene foam slabs TECHNONICOL CARBON ECO SLOPE 1.7 % (XPS CARBON ECO SLOPE 1.7 %)
- Polyisocyanurate foam slabs LOGICPIR SLOPE 1.7%

Slabs from the «A» and «B» sets make the main slope of 1.7% on the roof from the valley to the ridge.

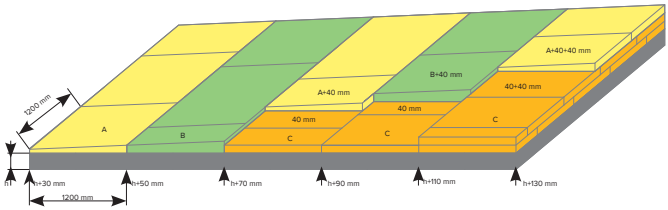
- TECHNONICOL CARBON ECO SLOPE 1.7 % and LOGICPIR SLOPE 1.7% slabs are installed on the top layer of the main thermal insulation.
- TECHNOROOF N30 SLOPE 1.7 % slabs are installed as a base layer of thermal insulation.

- Start assembling the slope from the lowest point of the roof - from the funnel, valley or eave.
- As an extension slab in sloping TECHNOROOF SLOPE, XPS CARBON ECO SLOPE or LOGICPIR SLOPE 40 mm thick slabs can be used.

An example of CARBON ECO SLOPE 1.7 % and LOGICPIR SLOPE 1.7% slabs layout:



An example of TECHNOROOF N30 SLOPE 1.7% slabs layout:

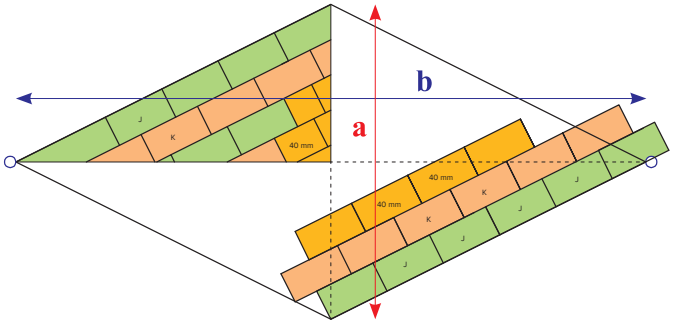


V-shaped slabs for valley sloping and counter slope

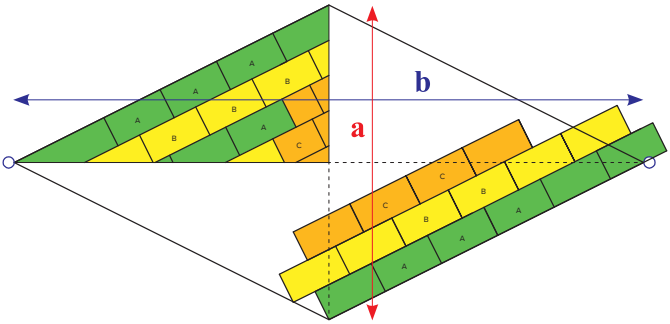
For sloping in the valley and a counter slope are used:

- Stone wool slabs TECHNOROOF N30 SLOPE 3.4%
- Extruded polystyrene foam slabs TECHNONICOL CARBON ECO SLOPE 3.4 % (XPS CARBON ECO SLOPE 3.4 %)
- Polyisocyanurate slabs LOGIC PIR SLOPE 3.4%
- The slabs create a 3.4% slope between funnels in valley, counter slope from eave, clerestory*, venting shafts and other elements.
- Slabs with 8.3% sloping (XPS CARBON ECO SLOPE 8.3 %) are intended for slopes between funnels in valleys, counter slopes on the roofs with the main slope of more than 3%.
- The first row is made of the slabs with 3.4% sloping with the ends 10 and 30 mm high, the second one - of the slabs with 3.4% sloping with the dimensions of the ends 30 and 50 mm. Then, if necessary, install an extension slab from extruded polystyrene foam 40 mm thick and repeat the slabs lay out.
- Ratio of a longer (b) diagonal of the rhomb to a shorter one (a) should be a/b≤5. Recommended ratio: a/b=3

An example of counter slopes layout from TECHNONICOL CARBON ECO SLOPE 1.7 % and LOGIC PIR SLOPE 3.4% slabs:



An example of counter slopes layout from TECHNOROOF N30 SLOPE 3.4% slabs:



3.7. Mechanical fastening. General deck and fastening elements requirements

3.7.1. Deck requirements

Mechanical fastening of the roof is possible to the following types of decking:

- bearing decking from corrugated steel sheets. In accordance with Building Standard for coverings corrugated steel sheets certified H are used. Sheet should be at least 0.7 mm thick;
- reinforced sand-cement screed at least 50 mm thick and of at least 5 MPa compression strength;
- monolithic and prefabricated reinforced concrete slabs at least 120 mm thick.

IMPORTANT! Mechanical fastening to hollow and ribbed slabs is not recommended. This can lead to weakening of the bearing ability of the slab, thus when selecting a solution for a roof with mechanical fastening, a roofing deck from sand cement screed should be performed or self-adhesive materials should be used.

Before starting the works, it is necessary to identify the resistance to withdrawal of fasteners from the deck, using the table.

Tab. 7

The deck for installing the fastener	Resistance to withdrawal of the fastener, N, not less than
Reinforced sand cement screed of a brand not lower than M150 not less than 50 mm thick	800
Heavy-weight concrete M200, M200, fine aggregate, grain fraction 0,63-5,0 mm	850
Heavy-weight concrete M300, M200, fine aggregate, grain fraction 0.63-5.0 мм	850
Heavy-weight concrete of B15 class (M200), coarse aggregate, grain fraction 10-20 mm	900
Heavy-weight concrete of B20 class (M250), coarse aggregate, grain fraction 10-20 mm	900
Cold rolled thin sheet steel 0.7 mm	900
Cold rolled thin sheet steel 0.7-2.5 mm	950

3.7.2. How to choose fasteners for mechanical fastening

Elements of mechanical fastening for thermal insulation and roofing materials fixation constitute an important part in the roof construction. Inteslatey and lifetime of a roof depend on chosen fasteners, necessary amount and fastening span calculations, quality of the installation works performed.

Fastening of the waterproofing covering to the bearing deck through the thermal insulation layer is carried out with plastic telescopic fasteners TECHNONICOL (1) and special self-tapping screws:

- For fastening to the corrugated steel sheet deck, roofing self reaming tapping screws TECHNONICOL 4.8 mm in diameter are used (2).
- For fastening to the decking from concrete of B15-B25 class or sand cement screed at least 50 mm thick from a solution of a brand not lower than M150, roofing pointed screws* TECHNONICOL 4.8 mm in diameter and 45 or 60 mm long (3, 5) are used.
- For fastening to the decking from concrete of B25 class, drop-in anchors with polyamide anchor sleeves* 45 or 60 mm long (4) are used.

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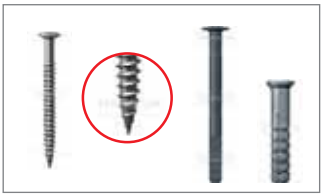
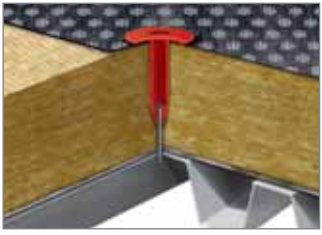
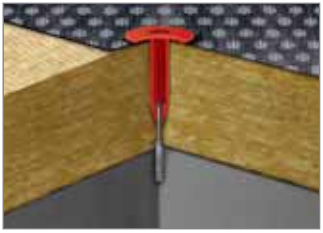


3 4 5

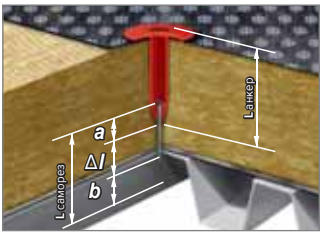




* Plastic telescopic elements are used in slopes under 10%. In slopes more than 10% instead of telescopic fixture steel self-tapping screws with steel plates are used. A screw used for such fixation should have thread on the upper part to prevent a plate from displacement down the screw during operation.

- The length of a telescopic element should be 15% and at least 20 mm less than the thickness of the thermal insulation layer. This value is explained by the insulation deformation due to mechanical load application.
- The length of a screw is chosen so that it can be screwed in the concrete of sand cement decking for at least 45 mm and for at least 15 mm in the corrugated steel sheet decking.

Let us consider an example of selection of fasteners



Initial data:
Thermal insulation thickness
- 150 mm
Bearing deck
- corrugated steel sheet.

Computing:
1. Identify the length of an anchor:
Δl = 150 × 0,15 = 22,5 mm > 20 mm, which is acceptable.
L_{anch} = 150-22,5 = 127,5 mm, select the length of an anchor according to the table - 120 mm.

Tab. 8

Anchor length, mm	Diameter of a plate element, mm	Diameter of a sleeve, mm	Diameter of a spool hole, mm	
20	50	14	5.5	
50	50	14	5.5	
60	50	14	5.5	
80	50	14	5.5	
100	50	14	5.5	
120	50	14	5.5	
130	50	14	5.5	
140	50	14	5.5	
150	50	14	5.5	
170	50	14	5.5	
180	50	14	5.5	
200	50	14	5.5	
220	50	14	5.5	
240	50	14	5.5	

2. Identify the length of a screw:
L_{screw} = a + Δl + b = 15 mm + (150 . 120) + 15 mm = 60 mm.
According to the table select the length of a screw with a small allowance - 70 mm.

Tab. 9

Diameter/ length, mm	Drill capacity	Rotation speed of a drill, rpm	
4.8*50	2.5	1500	
4.8*60			
4.8*70			
4.8*80			
4.8*100			
4.8*120			
4.8*160			
4.8*200			

For easier selection of the length of a fastener depending on the thickness of the thermal insulation use the table below.

Tab. 10

Thermal insulation thickness, mm	Fastener length, mm				
	Concrete decking				
	Telescopic fastener TECHNONICOL, mm	Self reaming tapping screws TECHNONICOL 4.8	Anchor element 8*45	Telescopic fastener TECHNONICOL, mm	Self reaming tapping screws TECHNONICOL 4.8 mm
40	20	80	45	20	60
50	20	90	45	20	70
60	20	100	45	20	80
70	50	80	45	50	60
80	50	80	45	50	60
90	60	90	45	60	70
100	80	80	45	80	60
110	80	90	45	80	70
120	100	80	45	100	60
130	100	90	45	100	70
140	120	80	45	120	60
150	130	80	45	120	70

Thermal insulation thickness, mm	Fastener length, mm				
	Concrete decking				
	Telescopic fastener TECHNONICOL, mm	Self reaming tapping screws TECHNONICOL 4.8	Anchor element 8*45	Telescopic fastener TECHNONICOL, mm	Self reaming tapping screws TECHNONICOL 4.8 mm
160	140	80	45	130	70
170	150	80	45	140	70
180	150	90	45	150	70
190	150	100	45	150	80
200	180	80	45	170	70
210	180	90	45	180	70
220	180	100	45	180	80
230	200	100	45	200	70
240	200	100	45	200	80
250	150	160	45	200	100
260	170	160	45	220	80
270	170	160	45	220	100
280	180	160	45	220	100
290	200	160	45	170	160
300	200	160	45	180	160
310	170	200	45	200	160
320	180	200	45	200	160
330	200	200	45	220	160
340	200	200	45	220	160
350	220	200	45	200	200
360	220	200	45	200	200
370	--	--	--	220	200
380	--	--	--	220	200

When installing a roof on a rigid deck, fastening is carried out with round metal cup locks 50 mm in diameter (1) and special screws:

- for fastening to a decking from concrete of B15-B25 class or sand cement screed at least 50 mm thick from a solution of a brand not lower than M150, roofing pointed screws TECHNONICOL 4.8 mm in diameter together with a polyamide anchor sleeve 45 or 60 mm long (2, 4) are used;
- for fastening to a B25 concrete decking drive anchors are used (3).

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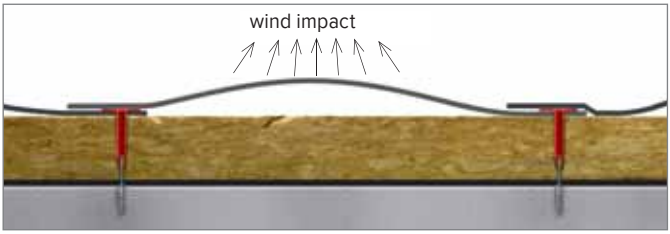
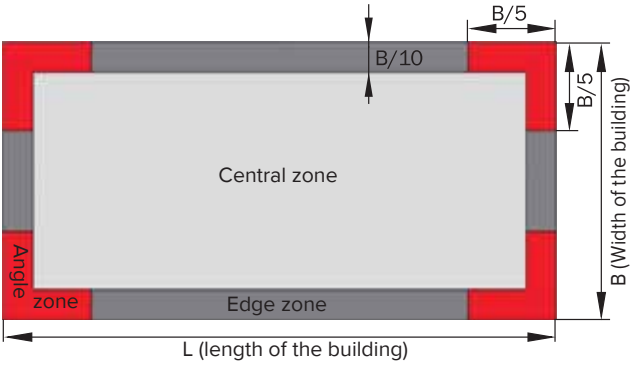
3.7.3. General requirements to calculations of number and span of fasteners

Number of fasteners is determined according to the wind loading design.



IMPORTANT! Calculation errors can lead to irreversible consequences

Depending on the intensity of wind loading, a roof is conditionally divided in three zones: angle, edge and central. Wind loading is the biggest in the angle zones, that is why the number of fasteners in these zones should also be larger.



TECHNONICOL Company released the Roofing Calculator. This calculator allows You to calculate the needed number of fasteners according to Eurocode 1991-1-4 requirements.
http://www.technonicol.com/about/o_tehnonikol/servisy/programmy_rascheta/

IMPORTANT! These calculations are of a test character. The number of fasteners used on roofing must be not less than the value obtained from the Roofing Calculator.

3.7.4. Recommendations on calculations of fasteners span during fastening to corrugated steel sheets

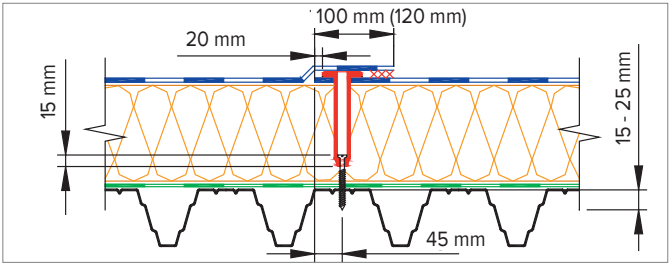
- To decrease the amount of materials install the roofing perpendicular to the corrugations of steel sheets.
- Fastening should be carried out to the upper wave of a corrugated steel shee.
- Fastening span must be limited to the distance between the upper waves of corrugated steel sheets.

3.7.5. Recommendations on rigid decking (sand cement screed, monolithic slabs) fasteners span calculations

- The direction of the roofing depends on the angle of the slope;
- The distance between fasteners should be not less than 150 mm.

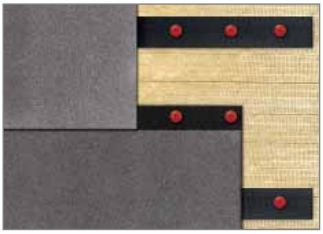
3.7.6. Peculiarities of mechanical fastening of roofing material

1. Fasteners in a lateral overlap should be installed 45 mm from the edge of a roll. When installing Technoelast K-YS 5500 material, the lateral overlap should be not less than 120 mm, when installing Technoelast K-MS 170/4000 membrane - not less than 100 mm.



2. It is allowed to install a fastener in the end overlap, but only in cases of stretching of the roll (this fastener is not considered in wind loading design) and on roofing slopes more than 10%.
3. On roofing slopes more than 10% regardless of the results of wind loading calculations fasteners in a lateral seam must be installed in every wave of a corrugated steel sheet.
4. In case the calculations show a span of fasteners installation less than 150 mm (when fastened to a rigid decking) or less than the distance between corrugations of a sheet (when installed to a corrugated steel sheet decking), it is allowed to install the fasteners in the ways described below.

Fastening in single-ply roofs:

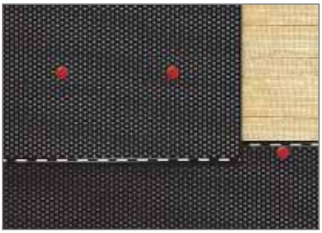


Install additional strips of 200 mm wide from Unifleks EPP 4.0 or Technoelast K-YS 5500 with the slate down to the decking.

- Fasten the strip to the decking according to the calculated span, providing needed amount of fasteners per square meter.

- During further roofing install Technoelast K-YS 5500 material with a torch on the fastened strips.

Technoelast K-MS 170/4000 fastening in two-ply roofs:



Install the fasteners in the middle of the material. Such fastening scheme is not a defect.

- Extra fasteners are installed on perimeter of the entire roof along parapets, eaves, utilities (ventilation and lift shafts, roof ventilators etc.). Extra fastening span should be 150-250 mm.

IMPORTANT! Mechanical fastening of a roof is prohibited on vertical constructions (walls, parapets, ventilation shafts etc.). Roofing should be entirely stick to the decking.

4.
Installation of Roofing Materials

4. Installation of roofing materials

4.1. Preparation of roof decking

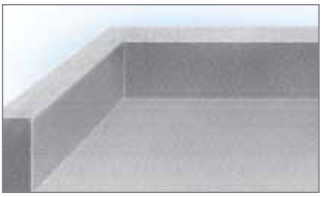
- The general requirements to the roof decking from thermal insulation are outlined in 3.5.

The general requirements to the roof decking from sand cement screeds:

- Fill with the M150 sand cement solution all the probable cavities, cracks, roughnesses.
- Check the slope of the decking. The formed slopes should be not less than 1.5%. The slope can be measured with a level and a rod or with a level and a measuring tape.
- Check the evenness of the decking with a two-meter rod. Carry out the measurements at least 5 times per every 70-100 m^2 of a roof. Maximum gap must not exceed 5 mm along the slope and 10 mm across the slope.
- In case of bleeding cement, corrosion or oil spots, remove them by abrasive treatment, then rinse and dry the decking. When the defect lies deeper, it should be removed and replaced with a new concrete or filled with a sand cement solution. Clear the surface of the decking from dirt, dust, foreign objects, ice, snow, puddles.

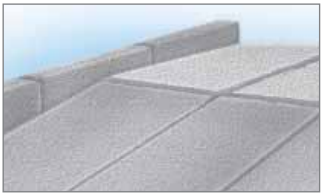
On vertical constructions roofing must be stick to a smooth decking, that is why as a decking the following materials can be used: monolithic and precast reinforced concrete, plastered vertical construction from masonry units and precast sheets from plain cement sheets or cement-shavings slabs.

Vertical surface from monolithic reinforced concrete:



Level the surface of the monolithic reinforced concrete decking (walls, parapets) with the sand cement solution of a brand not lower than M150.

Vertical surface from precast reinforced concrete constructions:



Fill the junctions of the vertical reinforced concrete constructions (walls, parapets) with polyurethane sealant.

- Level the surface of the reinforced concrete decking (walls, parapets) with the sand cement solution of a brand not lower than M150.

Vertical surface from masonry units:

Vertical construction surfaces from masonry units (bricks, breeze blocks) should be plastered with M150 sand cement solution over the entire surface of placement of the additional waterproofing layer.

Vertical surface from plain cement sheets and cement-shavings slabs:

Vertical construction surfaces, protruding above the roof and made of masonry units (bricks, breeze blocks) and "sandwich"-panels, may be coated with plain cement sheets or cement-shavings slabs over the entire surface of placement of the additional waterproofing layer.

IMPORTANT! On horizontal plane of the eave a 4% slope in the direction of the roofing must be created.

Vertical surface of a decking from sand cement solution, precast screeds (both sides of the sheets should be treated) and concrete should be treated with primers to provide the necessary adhesion of roofing materials with the decking.

- As primer for dry surfaces TECHNONICOL BITUMEN PRIME COATING is recommended.

(!) IMPORTANT! TECHNONICOL BITUMEN PRIME COATING is applied to the surface with mass humidity of not more than 5%.

4.2. How to choose the direction of unrolling of the roll

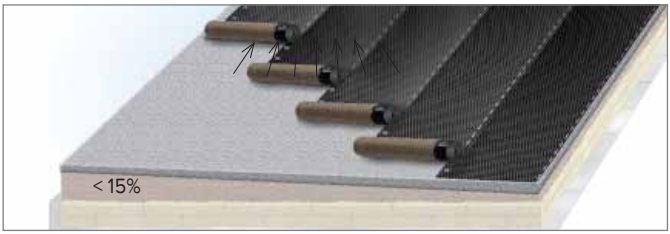
Selection of the direction of installation depends on the type of the decking, to which the roofing is going to be fastened mechanically.

Bearing deck of a roof - corrugated steel sheets.

The rolls of polymer-bitumen materials (Technoelast K-MS 170/4000, Technoelast K-YS 5500) should be unrolled in one direction across the waves of corrugated steel sheets.

Rigid deck - reinforced concrete, sand cement screeds.

With the slopes more than 15% the rolls should be unrolled along the slope, with the slopes less than 15% - along as well as across the slope.



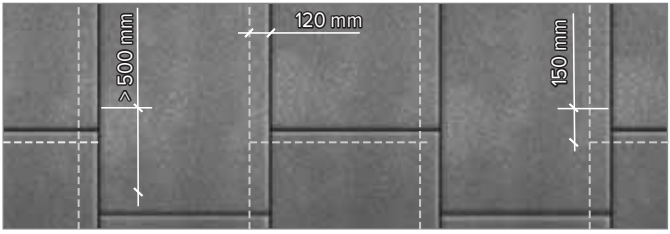
4.3. Single-ply waterproofing covering with mechanical fastening to the deck

4.3.1. Installation on the main (horizontal) plane of the roof

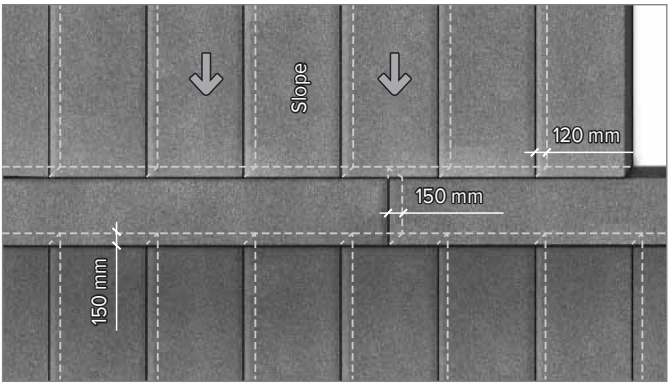
There are two methods of installation of a single-ply roof:

- solution with built-up strip* without spacing between end seams (roof slope less than 15%);
- traditional solution with spacing between end seams.

Traditional solution with spacing between end seams:



Solution with a built-up strip:



IMPORTANT! When installing with automatic equipment, performing of a built-up strip is recommended. This will increase convenience and speed of work.

Let us consider installation of a built-up strip on a low area with a funnel.

Unroll the first roll on the low area; the funnel should be in the middle of the roll.

- Roll the roll back till the funnel reinforcement layer.
- In the funnel area stick the material to the funnel reinforcement layer.
- Temporarily fill the funnel with a non-flammable material so it will not be damaged during works with a torch.

Fasten the roll to the deck in the lateral seam and from another side in accordance with the calculated span.

Unroll the next roll, try it on the plane, align, form an end overlap with the first roll installed.

- The end overlap of adjacent rolls should be at least 150 mm.

To increase the reliability and tightness of the end overlap it is recommended to cut the corner of the material, which is a lower one in the overlap.
Cut at an angle of 45°.

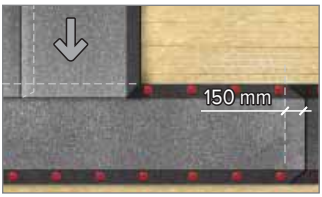
Undercut of a built-up strip roll is performed from the both sides.

Fasten the roll to the deck in the lateral seam from the both sides of a cloth in accordance with the calculated span.

- After installation of fasteners, glue the end seam with the chosen equipment and continue the installation of a built-up strip.

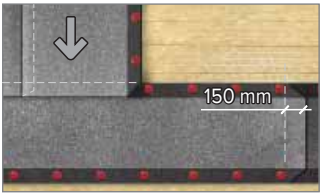
IMPORTANT! To avoid the occurrence of counter seams, keep the right overlap of the end seam. Water should flow from the seam towards the water funnel:

Placement of the rolls to the built-up strip

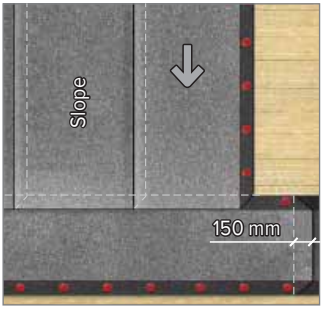


Unroll the roll perpendicular to the built-up strip, try it on the plane, align, form an end overlap to the built-up strip.

- The end overlap of the roll, formed on the built-up strip, should be at least 150 mm.



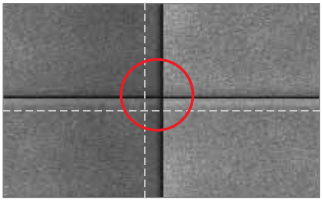
Fasten the roll in the lateral seam along the entire length in accordance with the calculated span.
Do not fasten in the end overlap.



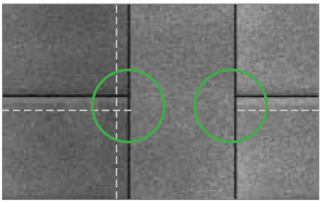
Install the adjacent material.
Lateral overlap of adjacent rolls should be not less than 120 mm.
When forming overlaps, fastening in the lateral seam is performed on the material, which is a lower one in the overlap. Glue the lateral seam with the chosen equipment and continue the installation of the next roll.

IMPORTANT! Avoid X-shaped crossings of the seams, where 4 layers of a roll material occur. Form T-shaped and lineal seams.

Wrong:



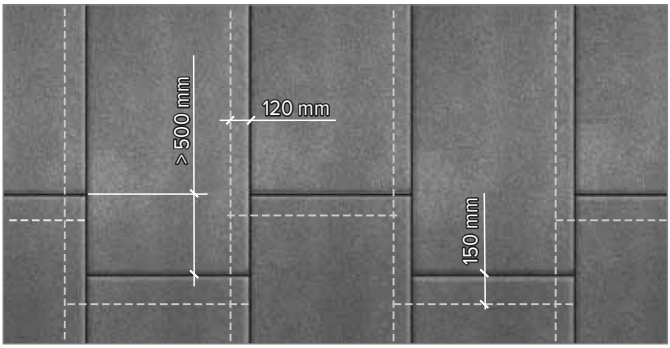
Right:



After installation of all the rolls to the built-up strip, glue all the end seams with the chosen equipment.

IMPORTANT! Continue the roof installation, performing built-up strips and placing the rolls to the strip. Follow the rule of counter seams - water should flow from the seam towards a water funnel.

Traditional solution with spacing between end seams



- Traditional solution considers parallel installation of the rolls with end (at least 150 mm overlap) and lateral (at least 120 mm overlap) seams.
- Rolls are fastened in accordance with the calculated span.

- The first roll is formed similar to the built-up strip on a low area.
- Displacement of the end overlaps of the adjacent sheets should be not less than 500 mm.

IMPORTANT! To avoid the occurrence of counter seams, keep the right overlap of the end seam. Water should flow from the seam towards the water funnel.

4.4. Two-ply covering with mechanical fastening of the base waterproofing layer to the bearing deck and torch-on application of the top waterproofing layer

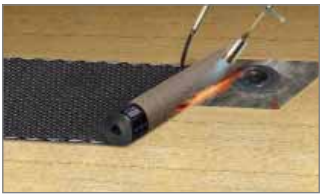
In this type of waterproofing covering installation as a bearing deck can serve the following:

- Monolithic timber deck
- Stone wool slabs

4.4.1. Installation of the base layer on the main (horizontal) roof plane

Begin the installation of a roll material from the low area (eaves, valley, places of funnel installation etc.).

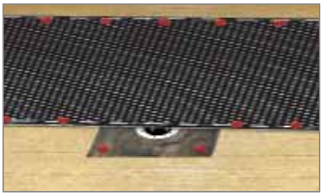
Place the first cloth of the roofing material Technoelast K-MS 170/4000 so that the lateral edge lies on the axis of the water funnel.



Roll the roll till the funnel reinforcement layer.

Stick the material to the funnel reinforcement layer near the funnel.

- Temporarily fill the vertical funnel pipe with a non-flammable material so it will not be damaged during works with a torch.



Fasten the roll to the deck in the lateral seam from the both sides of a cloth in accordance with the calculated span.

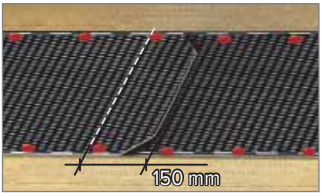
IMPORTANT! Do not install mechanical fasteners in the place of funnel installation

Unroll the next roll, try it on a plane, align, form an end overlap with the installed first roll.

- The end overlap of adjacent rolls should be at least 150 mm.

Fasten the roll to the decking in the lateral seam from the both sides of a cloth in accordance with the calculated span.

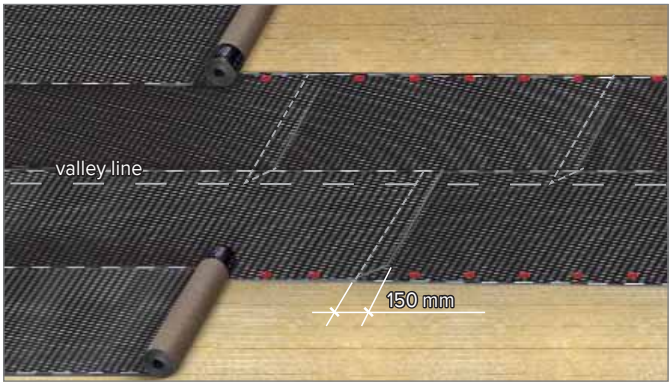
IMPORTANT! To avoid the occurrence of counter seams, keep the right overlap of the end seams of the next rolls. Water should flow from the seam towards the water funnel.



To increase the reliability and tightness of the end overlap it is recommended to cut the corner of the material, which is a lower one in the overlap. Cut at an angle of 45°.

Glue the end overlap with the chosen equipment.

IMPORTANT! When installing next rolls, keep rolling the materials in the lateral overlaps from the lowest points to the highest one to avoid the occurrence of counter seams. Water should flow from the seam towards counter seams.

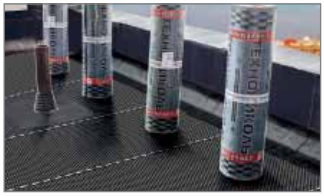


- Lateral overlap of the sheets should be at least 100 mm.
- Displacement of the adjacent rolls should be not less than 500 mm.
- In the lateral seams should the next rolls be fastened to the material, which is a lower one in the overlap.
- Glue the lateral seam with the chosen equipment.

4.4.2. Installation of the top layer on the main (horizontal) roof plane

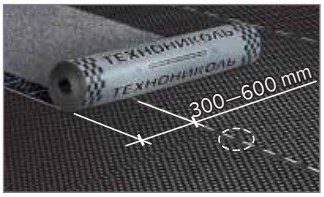
Installation of the top waterproofing layer from Technoelast K-PS 170/5000 is performed after installation of the base layer of Technoelast K-MS 170/4000.

It is prohibited to stick the sheets of the rolls of the top and the base layers of the roofing crosswise.



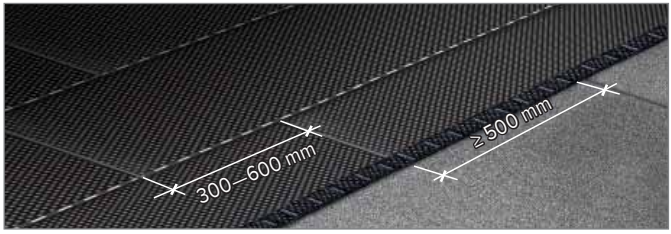
Put the rolls of Technoelast K-PS 170/5000 vertically. At a working site the amount of the materials should not exceed the needs of one working shift.

IMPORTANT! Begin the installation of a roll material from a lower area (water funnels, eave).



The distance between the lateral junctions of roofing sheets in adjacent layers should be 300-600 mm. For convenience shift the upper roll by half the width, i.e. 500 mm.

- End overlaps of materials of adjacent layers should not coincide. It is recommended to shift the end overlaps of adjacent layers to a distance of at least 500 mm.

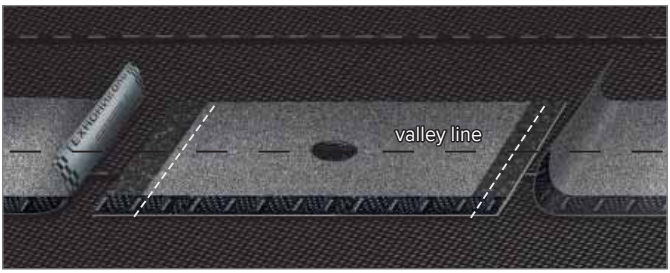


Lateral overlap of adjacent rolls should be 80-100 mm. Specially for a lateral overlap on Technoelast K-PS 170/5000 there is a strip without coarse-grained slate.

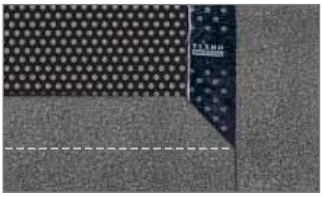
- Keep installing the material in the lateral overlaps from the lowest points of the roof to the highest one to avoid the occurrence of counter seams. Water should flow from the seam towards drainage divide line.

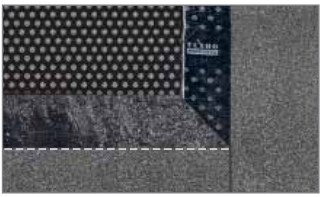
IMPORTANT! The very first roll installed on the lower area of a water funnel should be overlapped with adjacent sheets for 80-100 mm from each side. To provide a lateral overlap from another side of the roll imbed the slate.

To avoid the occurrence of counter seams, keep the right way of overlapping the end seam. Water should flow from the seam towards a water funnel.



- To increase the reliability and tightness of the end overlap it is recommended to cut the corner of the material, which is a lower one in the overlap. Cut at an angle of 45°.





- End overlaps of adjacent sheets of the roofing material Technoelast K-PS 170/5000 should be shifted relative to each other for not less than 500 mm:

4.4.3. Works with equipment during installation of two-ply roofs with mechanical fastening

When installing a two-ply roofing, the top layer should be entirely stick to the base one, that is why gluing of the seams of the base layer and adhesion of the top layer to the base layer are carried out with standard gas torchs.

- In case of special requirements to the installation of the base layer to inflammable decks, it is recommended to use automatic welding equipment.

Performing of a seam on the base layer from Technoelast K-MS 170/4000

Before seam gluing works, all the necessary overlaps should be prepared and the material, which is a lower one in the overlap, should be mechanically fastened .

To place a standard torch under the seam in the overlap conveniently, fold the lateral edge of the top material and put Your leg on the lateral edge of the mechanically fastened material.

- Aim the flame of a torch under the seam.
- For qualitative torch-on application of the material it is necessary to achieve even flowing-out of a polymer-bitumen binder from under the edge of the material.
- Torch-on application is performed towards Yourself.

Immediately after application, when the material is not cooled yet, roll the glued seam with a roller for total sealing of the overlap.

A sign of good, proper material heating is the flowing-out of the polymer-bitumen binder from under the side edge of the material to 25 mm.

IMPORTANT! Flowing-out of more than 25 mm indicates overheating of the material. Overheating during torch-on application impairs the operational properties of the roof.

Installation of the top roofing layer from Technoelast K-PS 170/5000

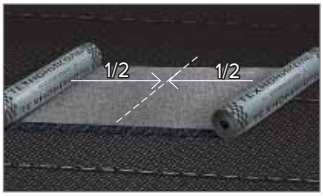
Torch-on application of the top roofing layer from Technoelast K-PS 170/5000 is carried out after installation of the base layer from Technoelast K-MS 170/4000.

Unroll and try the roll.

IMPORTANT! Depending on the roof sloping, there are two methods of winding and unrolling of the roll during torch-on application.

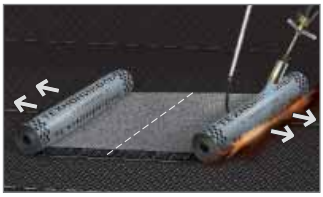
Method N°1

At low slopes of the roof



Roll the aligned cloth until the middle.
Rolling is better to be performed round a metal or a cardboard reel.

- Ensure that the material is rolled evenly (the edge of the roll should be straight).

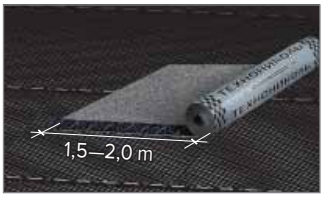


The material should be welded from the middle to the both sides.

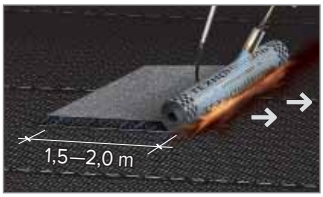
When installing the material, unroll the roll towards yourself. For convenient unrolling use a hook.

Method N°2

Used at significant roof sloping (more than 8%) to avoid probable displacement of the roll during torch-on application.



Roll the aligned cloth almost to the end: leave 1.5-2 m.



Weld the roll to the deck. When installing, roll the material towards yourself.
After installation of the roll, weld the left part of the roll.

Basic rules of torch-on application of a roll:

Warm the material with smooth movements of a gas torch. When welding the first roll in the low area, provide equal warming of the material and the surface of the decking.

When welding adjacent rolls, a gas torch should move in L-shaped trajectory to provide additional warming of the part of the overlapping material.

For qualitative welding of the material to the decking it is necessary to get (during welding) a small bulge of a polymer-bitumen binder in the place where the material touches the surface.

In case of welding to the coarse-grained slate (end, lateral overlaps etc.), imbed the slate in the area of seam formation:

- warm up the material with a gas torch;
- imbed the slate into bitumen with a spatula.

IMPORTANT! Welding of the material to the coarse-grained slate can lead to roof leaking.

A sign of a good and right material warming is flowing-out of a polymer-bitumen binder from under the lateral edge of the material for not more than 15 mm.

IMPORTANT! Flowing-out for more than 25 mm along the entire lengthwise (lateral) overlap means overheating of the material. Overheating during torch-on application impairs the operational properties of the roof.

IMPORTANT! It is forbidden to walk on still hot material. The slate will imbed into the bitumen binder layer, causing the occurrence of footprints or areas with exfoliated upper layer of the material, which will lead to worse appearance, accelerated aging under the influence of sun radiation or mechanical damaging of the roof.

4.4.4. Works with equipment during roof installation on vertical surfaces

On a vertical surface should the roofing (two- and single-ply) be entirely stick (welded) to the decking. When installing a two-ply roof on vertical surfaces, Unifleks EPP 4.0 and Technoelast K-PS 170/5000 materials are used, in case of a single-ply roof use Technoelast K-YS 5500.

Weld the material, unrolling the roll from the bottom upwards from the upper edge of the angle fillet.

- For qualitative welding of the material to the decking it is necessary to get (during welding) a small bulge of a polymer-bitumen binder in the place where the material touches the surface.

The stick material should be additionally smoothened and pressed from the center to the edges of the roll, extruding bitumen binder and air.

After smoothening, pull the unstick part of the material and continue welding.

After vertical installation, weld the material on the angle fillet and a horizontal area.

- Thoroughly press or roll the material in the areas of deck curving.
- To provide an overlap with an additional top layer, warm up the material and imbed the slate.

4.5. Two-ply covering on a concrete decking

4.5.1. Deck preparation

Installation of a concrete decking on a horizontal surface

Installation of a decking from sand cement screed is carried out on a prepared sloping layer from filled-up materials or thermal insulation slabs. Before installation of a roof decking on V-shaped slabs of thermal insulation, it is recommended to create a separating layer (e.g. from ruberoid, asphalt roofing paper).

Place a reinforced net 150x150 mm mesh width on the sloping layer. Install the nets with an overlap of at least one mesh. In overlaps tie the nets with a tying wire with a span of 300 mm (3 meshes).

Set the guide battens on the level-checked marks at a span of 1.5-3 m. To keep the slope and a screed thickness, set the guide rods at spots, checked with a level. For convenience use rods with a profile height of a necessary screed thickness.

Fill the strips formed by rods with sand cement solution. Even the solution with a screed board, moving along the guide rods.

- After screed strength development, demount the rods and fill the holes left from the rods with the sand cement solution.

For work convenience You may fill with the sand cement solution the strips next but one. Then even the solution with a screed board, moving along the guide rods. After screed strength development, demount the rods and fill the holes left from the rods with the sand cement solution. Even the solution with a screed board.

IMPORTANT! Form expansion joints in new sand cement screeds.

It is useful to form expansion joints in the drainage divide line, while the width of every joint should be calculated separately:

$$\Delta L = L_0 * \alpha * \Delta t,$$
$$\Delta t = t_2 - t_1$$

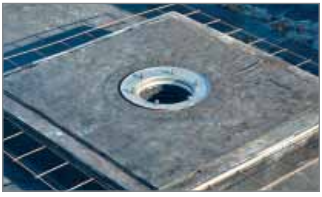
where ΔL – minimal width of an expansion joint, mm;
L_0 - distance between joints, mm;
α – decking thermal expansion coefficient (sand cement screeds, bitumen concrete), 1/°C.
Thermal expansion coefficient of a sand cement screed - 0.00001 $°C^{-1}$
t_2 – «working» temperature, i.e. deck installation temperature;
t_1 – maximal temperature, to which the deck may be exposed, °C

Forming of a Local Subsiding in the Area of Funnel Installation

IMPORTANT! Local roof subsiding in the areas of installation of internal drainage funnels should be 20-30 mm 500 mm away from the centre of a funnel. This can be achieved in several ways.

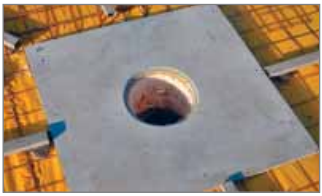
Method N°1

Install a timber box on a vapor barrier layer.
Height of the wall should be equal to the thermal insulation thickness.



Install thermal insulation in the box and cover with two plain cement sheets.

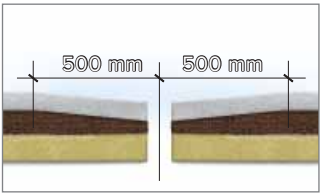
Between the sheets install a reinforced net.



After installation of the thermal insulation layer, install a sloping layer so that the lowest point of a slope coincides with the level of the plain cement sheet.

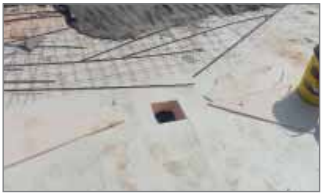
Then flow sand cement screed till the level of plain cement sheets.

Method N°2



Local subsiding can be achieved by decreasing of the thickness of a sloping layer from filled-up material.
Then flow sand cement screed.

Method N°3



When forming a sloping towards a funnel, subsiding is formed with V-shaped thermal insulation slabs.
Then flow sand cement screed.

Preparation of a roofing material deck on a vertical surface

Vertical surfaces of monolithic reinforced concrete constructions:

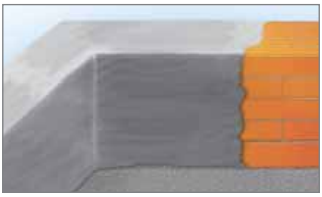
Even the surface of a monolithic reinforced concrete decking (walls, parapets) with a sand cement solution of a brand not lower than M150.

Vertical surfaces of precast reinforced concrete constructions:

Fill the junctions of vertical reinforced concrete constructions (walls, parapets) with Polyurethane sealant.

- Even the surface of a reinforced concrete decking (walls, parapets) with a sand cement solution of a brand not lower than M150.

Vertical constructions from masonry units:



Vertical surfaces of constructions from masonry units (bricks, breeze blocks) should be plastered with an M150 sand cement solution over entire surface of placement of an additional waterproofing layer.

Vertical surfaces of constructions protruding over the roof and made of masonry units (bricks, breeze blocks) can be covered with pressed flat cement sheets or cement-shavings slabs over the entire surface of placement of an additional waterproofing layer.

On a horizontal surface of a parapet create a 4% slope towards the roof.

Cleaning of a surface of a waterproof covering deck

- Fill all the probable cavities, cracks, roughnesses with M150 sand cement solution.
- Remove oil contaminations from the surface of the deck.
- Check the sloping of the deck. Formed slopes should be not less than 1.5%. A slope can be measured with a level and a leveling rod or a level and a tape.
- Check the evenness of the deck with a two-meter rod. Carry out at least 5 measurements per every 70-100 m^2. Maximal gap must not exceed 5 mm along the slope and 10 mm across the slope.
- In case of bleeding cement, corrosion or oil spots, remove them by abrasive treatment, then rinse and dry the deck. When the defect lies deeper, it should be removed and replaced with a new concrete or filled with a sand cement solution.
- Clear the surface from dirt, dust, ice and snow.
- Check the humidity of the decking. Humidity of sand cement screeds should not exceed 5% in mass, bitumen concrete screeds - 2.5%. Concrete humidity is usually measured with an aquameter apparatus.

Decking Surface Priming

Surface of a decking from sand cement solution and concrete should be treated with primers to provide necessary adhesion of roofing materials to the decking. As primers for dry surfaces, TECHNONICOL BITUMEN PRIME COATING and TECHNONICOL BITUMEN PRIMER N°04 are recommended.

IMPORTANT! TECHNONICOL BITUMEN PRIME COATING is applied to the surfaces with not more than 5% humidity by mass, and TECHNONICOL BITUMEN PRIMER N°04 can be applied till occurrence of surface-condensed moisture.

Apply setup to prime the entire surface of placement of the material to the vertical surface (wall, parapet).

Apply primer to the surface. Use a paint roller.
On vertical surfaces for accurate primer applying use painter's tape, stick according to a setup.

Apply primer on the parapet from the facade side for 50 mm to place the waterproofing material.
In hard-to-reach places, use a brush with stiff bristles.

IMPORTANT! Wait until primer is completely dry. Drying time depends on the brand of the primer and climate conditions during the works.

To identify whether the primer is dry, one can attach a cotton wool to it: on the cotton wool attached to a dry primer there should be no bitumen traces.

IMPORTANT! It is prohibited to carry out priming works at the same time with torch-on application of roofing.

4.5.2. Installation of waterproofing

Torch-on application of the base layer

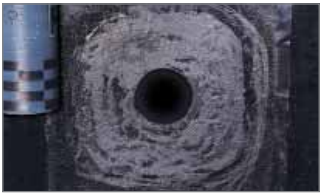
As a base layer of waterproofing covering can be used continuously torch-on applied material Unifleks EPP 4.0 and partially torch-on applied material Technoelast K-TMS 170/3400, which allows to avoid bulging of the waterproofing.

- Decide the direction of unrolling:
- At slopes more than 15% the rolls should be unrolled along the slope, at slopes less than 15% the rolls can be unrolled across as well as along the slope.

It is a good practice to setup the rolls on the prepared deck. Setup will provide aligned adhesion, help to avoid displacement of the rolls and decrease material consumption.

Put the rolls of Unifleks EPP 4.0 vertically. At a working site the amount of the materials should not exceed the needs of one working shift.

IMPORTANT! Start installing roll materials from the low area (water funnels, eaves etc.).

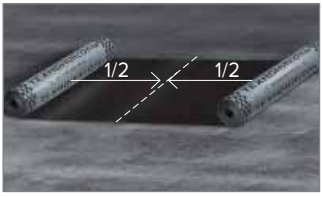


Unroll the entire roll of Unifleks EPP 4.0 so that the lateral edge lies on the axis of the water funnel.

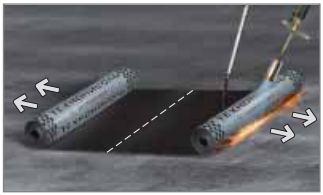
Align the roll according to the setup. To avoid displacement of the roll in the process of alignment and occurrence of corrugations on the roll, it is necessary that one roofing worker stands on one edge of the roll and another aligns the roll.

IMPORTANT! Depending on the roof sloping, there are two methods of rolling and unrolling of the membrane during torch-on application.

Method N°1 used at low slopes of the roof

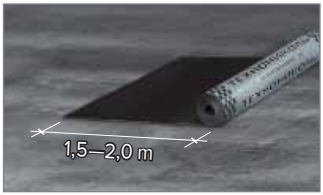


Roll the aligned membrane until the middle. Rolling is better to be performed round a metal or a cardboard reel. Ensure that the edge of the roll is straight.

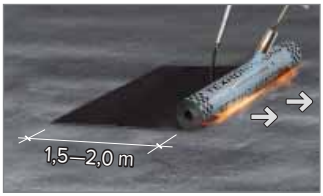


The material should be welded from the middle to the both sides.
When welding the material, unroll the roll towards yourself. For convenient unrolling use a hook.

Method N°2 used at significant slopes of the roof (more than 8%) to avoid probable displacement of the roll during torch-on application.



Roll the aligned membrane almost to the end: leave 1.5-2 m.



Weld the roll to the deck. When welding, unroll the material towards yourself.
After welding of the roll, weld the left part of the roll (1.5-2 m).

Basic rules of torch-on application of a roll:

Warm the material with smooth movements of a gas torch.
When welding the first roll in the low area, provide equal warming of the material and the surface of the decking.

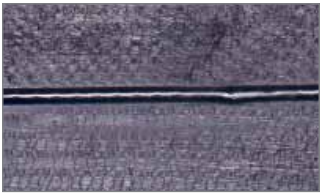
When welding adjacent rolls, a gas torch should move in L-shaped trajectory to provide additional warming of the part of the overlapping material (dimensions of overlaps are listed below).

IMPORTANT! When using materials with partial adhesion, from the bottom side of the roll where vapor strips are, the film is burned with the flame of a gas torch, avoiding drowning of sand in polymer-bitumen binder. Lateral overlap is additionally warmed during torch-on application so that a roll of a polymer-bitumen binder occurs; it should flow out for 0.5-1.5 cm from a lateral seam.

Print deformation means right warming of polymer-bitumen binder from the bottom side of a roll material.

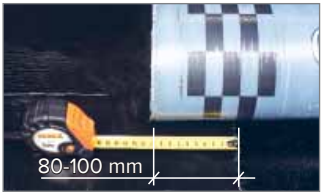
- For qualitative torch-on application to the decking it is necessary to achieve a small roll of a polymer-bitumen binder in the area of material adhesion to the surface.

IMPORTANT! It is forbidden to walk on still warm material !!!



A sign of a good and right material warming is a flowing-out of a polymer-bitumen binder from under the lateral edge of the material till 25 mm.

IMPORTANT! Flowing-out for more than 30 mm along the entire lengthwise (lateral) overlap means material overheating. Overheating during torch-on application impairs operational properties of the roof.

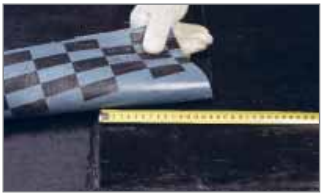


Lateral overlap of adjacent rolls should be 80-100 mm.

IMPORTANT! Width of a lateral overlap for material with partial torch-on application should be at least 90 mm.

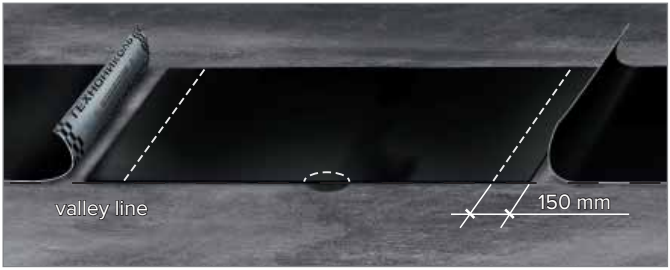
Keep the order of material installation in lateral overlaps from the lowest points of the roof to the top one to avoid the occurrence of counter seams. Water should flow from the seam towards drainage divide line.

IMPORTANT! The very first roll installed on a low area of a water funnel should be overlapped from both sides with adjacent sheets for 80-100 mm.

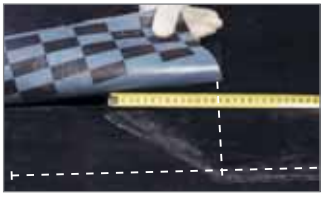


End overlap of adjacent rolls should be not less than 150 mm.

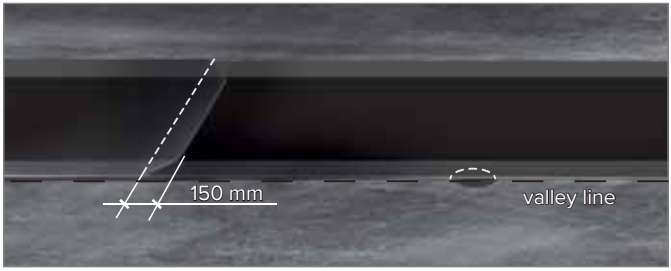
- To avoid the occurrence of counter seams, keep the right overlap of the end seam. Water should flow from the seam towards the water funnel.



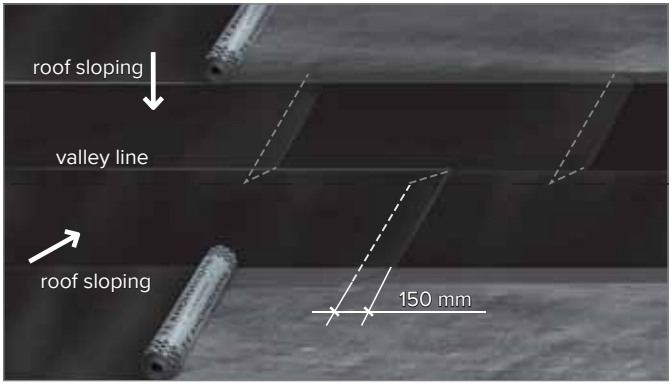
- To increase the reliability and tightness of the end overlap it is recommended to cut the corner of the material, which is a lower one in the overlap. Cut at an angle of 45°.

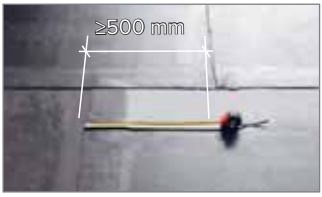


- The very first roll on the low area is recommended to be cut from both sides.



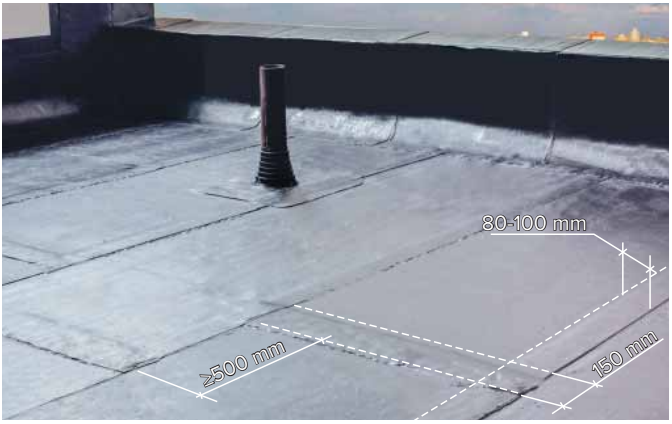
Subsequent installation and edge cutting of the rolls:





End overlaps of adjacent sheets of roofing material should be shifted relatively one another for not less than 500 mm.

General view of a flat roof after torch-on application of a base layer of Unifleks EPP 4.0.



IMPORTANT! For installation of roofing elements and torch-on application of the base roofing layer on vertical constructions see "Elements Performing".

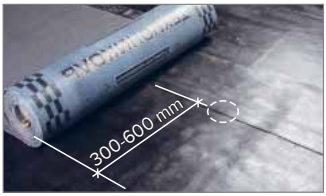
Torch-on application of the top layer

IMPORTANT! Cross adhesion of sheets of the rolls of top and base layers of the main roofing is prohibited!

It is a good practice to setup the rolls on a prepared decking.
Setup will provide aligned adhesion, help to avoid displacement of the rolls and decrease material consumption.

Put the rolls of Unifleks EPP 4.0 vertically. At a working site the amount of the materials should not exceed the needs of one working shift.

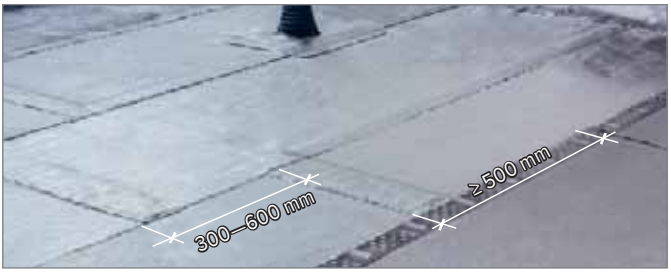
IMPORTANT! Start installing roll materials from the low area (water funnels, eave etc.).



Distance between lateral junctions of roofing sheets in adjacent layers should be 300 - 600 mm. For convenience, shift the upper roll half the width, i.e. 500 mm.

IMPORTANT! End overlaps of the base and the top layers should not coincide.

Junctions of end overlaps of adjacent layers materials should not coincide. It is recommended to shift end overlaps of adjacent layers for not less than 500 mm.

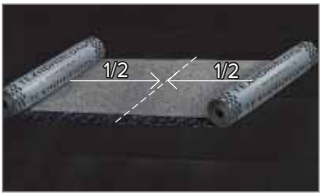


Unroll the roll, considering necessary shift of the sheets of the base and the top layers relatively one another.

To avoid roll displacement during the process of alignment and occurrence of corrugations on the roll, it is necessary that one roofing worker stands on one edge of the roll and another one aligns the roll, controlling overlaps.

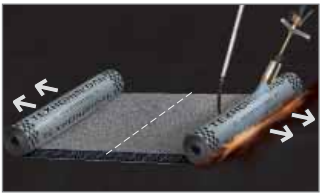
IMPORTANT! Depending on the roof sloping, there are two methods of rolling and unrolling of the rolls during torch-on application.

Method N°1 used at low slopes of the roof



Roll the aligned cloth until the middle.
Rolling is better to be performed round a metal or a cardboard reel.

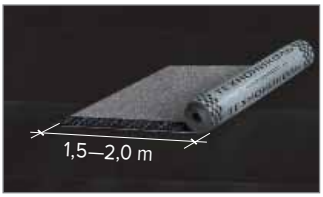
- Ensure that the material is rolled aligned (the edge of the roll should be straight).



The material should be welded from the middle to the both sides.

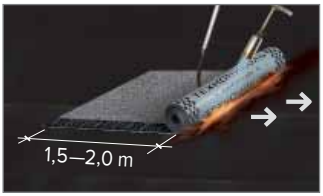
When welding the material, unroll the roll towards yourself. For convenient unrolling use a hook.

Method N°2 used at significant slopes of the roof (more than 8%) to avoid probable displacement of the roll during torch-on application.



Roll the aligned cloth almost to the end: leave 1.5-2 m.

Weld the roll to the deck.



When welding, unroll the material towards yourself.

After welding of the roll, weld the left part of the roll (1.5-2 m).

Basic rules of torch-on application of a roll:

Warm the material with smooth movements of a gas torch. When welding the first roll in the low area, provide equal warming of the material and the surface of the decking.

When welding adjacent rolls, a gas torch should move in L-shaped trajectory to provide additional warming of the part of the overlapping material.

For qualitative welding of the material to the decking it is necessary to get (during welding) a small bulge of a polymer-bitumen binder in the place where the material touches the surface.

In case of welding to the coarse-grained slate (end, lateral overlaps etc.), remove the slate from the welding area:

- warm up the material with a gas torch;
- imbed the slate into bitumen with a spatula.

IMPORTANT! Welding of the material to the coarse-grained slate can lead to roof leaking.

A sign of a good and right material warming is flowingout of a polymer-bitumen binder from under the lateral edge of the material for not more than 25 mm.

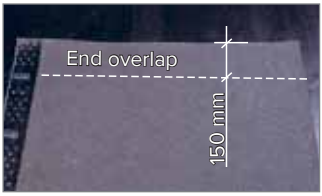
IMPORTANT! Flowing-out for more than 30 mm along the entire lengthwise (lateral) overlap means overheating of the material. Overheating during torch-on application impairs the operational properties of the roof.

IMPORTANT! It is forbidden to walk on still hot material. The slate will imbed into the bitumen binder layer, causing the occurrence of footprints or areas with exfoliated upper layer of the material, which will lead to worse appearance, accelerated aging under the influence of sun radiation or mechanical damaging of the roof.

Lateral overlap of adjacent rolls should be 80-100 mm. Specially for lateral overlaps on each Technoelast K-PS 170/5000 material there is a strip without coarse-grained slate.

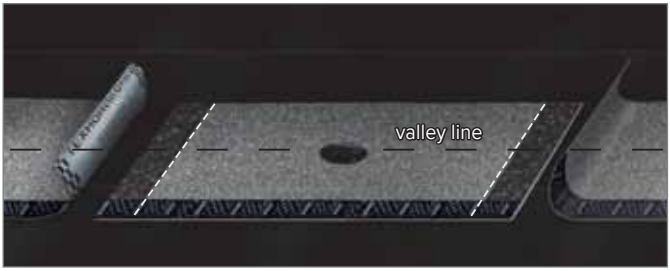
- Keep the order of material installation in lateral overlaps from the lowest roof points to the top one to avoid the occurrence of counter seams. Water should flow from the seam towards drainage divide.

IMPORTANT! The very first roll installed on a low area of a water funnel should be covered with adjacent sheets from the both sides for 80-100 mm. To provide a lateral overlap, remove slate from another side of a roll.

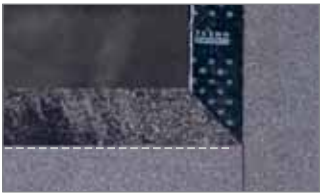


End overlap of adjacent rolls should be not less than 150 mm.

- To avoid the occurrence of counter seams, keep the right overlap of an end seam. Water should flow from the seam towards a water funnel.



- To increase the reliability and tightness of the end overlap it is recommended to cut the corner of the material, which is a lower one in the overlap, and then remove the coarse-grained slate. Cut at an angle of 45°.



- End overlaps of adjacent sheets of Technoelast K-PS 170/5000 roofing material should be shifted relatively one another for not less than 500 mm:

4.5.3. Accessible Roofs

Accessible roofs are only installed on bearing reinforced concrete deck.

- As a rule, accessible roofs are performed with inverted location of layers. In this case thermal insulation lies above waterproofing covering and acts as a protective layer.
- As thermal insulation in accessible roofs extruded polystyrene foam XPS is used. It possesses low water absorption (less than 1%), which allows to use it in constantly humid conditions. Moreover, XPS slabs have high compression strength in 10% deformation conditions - from 200 to 1000 kPa. It is enough to handle weight of lorries.
- Waterproofing covering not only exhibits waterproofing functions, but also acts as a vapor barrier.
- As a waterproofing covering in such roofs polymer-bitumen materials of a class not lower than TL2 are used, with performing of 2 or 3 layers. See "Material Selection".
- Rules of installation of waterproofing covering in accessible roofs are similar to those in "Two-ply Covering On Concrete Decking". When needed, a third layer can be installed according to the same rules.

4.5.4. Green Roofs

Green roofs are a particular type of accessible roofs.

- As a rule, green roofs are inverted.
- In roofs with a soil layer and a vegetation system the top layer of a waterproofing covering should be performed with polymer-bitumen roll material Technoelast K-MS 170/4000 GREEN. This material is installed by torch-on application and contains special additives, which prevent roots of plants from damaging the waterproofing layer.
- Rules of installation of waterproofing covering in accessible roofs are similar to those in "Two-ply Covering On Concrete Decking". When needed, a third layer can be installed according to the same rules.

4.5.5. Ballasted Roofs

In this ballasted system the roofing is withheld by dead weight of ballast.

- As a ballast use ballast gravel of 20-40 mm fraction.
- Necessary amount of ballast gravel should be calculated according to Eurocode 1991-1-4.
- Ballasted roofs can be performed with traditional location of layers as well as with inverted one.
- Rules of installation of waterproofing covering in accessible roofs are similar to those in "Two-ply Covering On Concrete Decking".

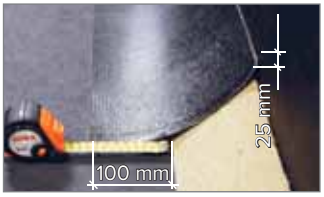
4.5.6. Installation of assembly components and imbedded items

Before installation of the base roof layer, install reinforcement layers, water funnels, angle fillets, strips of expansion joints. Reinforcement layers are necessary to increase reliability, tightness and durability of a roof in the areas of installation of water funnels, ridge, valley, junctions to vertical surfaces (parapets, walls) and other elements.

Installation of reinforcement layers in the junctions to vertical constructions (walls, parapets)

Install angle fillet from TECHNOROOF stone wool on hot-applied roofing mastic TECHNONICOL N° 41 in the junctions with parapets, walls and other vertical constructions.

Angle fillet can also be of M150 sand cement solution with legs 100x100 mm. In this case, inclined surface of a fillet should be treated with a primer.



Prepare reinforcement strips from Unifleks EPP 4.0. Reinforcement layer should entirely cover the fillet and be placed on a horizontal surface 100 mm from the fillet and on a vertical surface 25 mm from the fillet.

IMPORTANT! In the areas of junctions with vertical surfaces the bottom layer of a roofing from material with partial torch-on application is installed till the fillet, but should not be placed on it. Then reinforcement layers are performed from Unifleks EPP 4.0.

Weld reinforcement strips from the chosen material on angle fillet. Warm the material with smooth movements of a gas torch; provide equal warming of the material and the surface of the decking.

For qualitative welding of the material to the decking it is necessary to get (during welding) a small bulge of a polymer-bitumen binder in the place where the material touches the surface.

A sign of a good and right material warming is flowing-out of a polymer-bitumen binder from under the lateral edge of the material for not more than 25 mm.

IMPORTANT! To avoid occurrence of counter seams, installation of reinforcement layers from Unifleks EPP 4.0 should be carried out starting with low areas of the roof.

Lateral overlaps of adjacent reinforcement layers should be 80-100 mm.

Installation of reinforcement layers in the area of a water funnel

Cut out an additional reinforcement layer from Unifleks EPP 4.0 500x500 mm. It is recommended to round off the corners of the additional layer.

Weld the reinforcement layer in the area of local subsiding of a water funnel (in accordance with a project). Warm the material with smooth movements of a gas torch; provide equal warming of the material and the surface of the decking.

For qualitative welding of the material to the decking it is necessary to get (during welding) a small bulge of a polymer-bitumen binder in the place where the material touches the surface.

A sign of a good and right material warming is flowing-out of a polymer-bitumen binder from under the lateral edge of the material for not more than 25 mm.

In the reinforcement layer installed cut out a round hole for a water funnel pipe and outline the contours of a funnel bell.

Installation of water funnel

Burn down the film on the surface of the material in the area of water funnel installation.

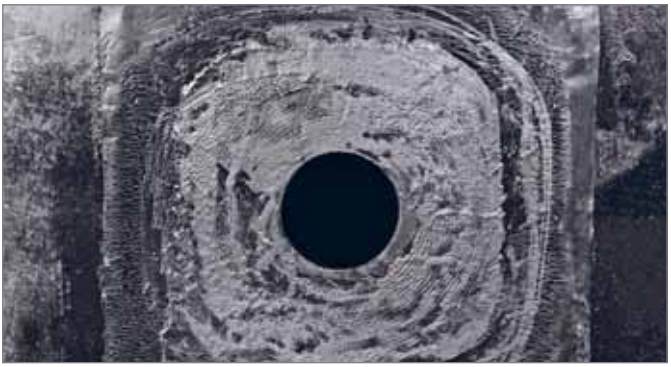
- When using thin torch-on applied materials as a material for a base layer, before installation of a funnel flange it is necessary to burn the film on the material and pour a layer of hot roofing mastic TECHNONICOL N° 41 or apply TECHNONICOL N° 23 (Fixer) mastic with a spatula.

Install the funnel and imbed the bell of the water funnel into warmed up area or into a mastic layer. Ensure that the polymer-bitumen binder is flowing out from under the funnel bell evenly.

- Flowing-out provides total tightness of a junction.

For a tight junction with a funnel, it is necessary to cover the funnel flange with a bitumen-binder. There are several ways of applying a bitumen binder:

1. "Hot" applying with roofing mastic TECHNONICOL N°41
2. "Hot" applying with cuttings of Technoelast material
3. "Cold" applying with sealing mastic TECHONICOL N°23



The first "hot" method of applying - applying with hot roofing mastic TECHNONICOL N°41:

Pour the hot mastic over the entire funnel flange.

The second "hot" method of applying - applying with cuttings of Technoelast material:

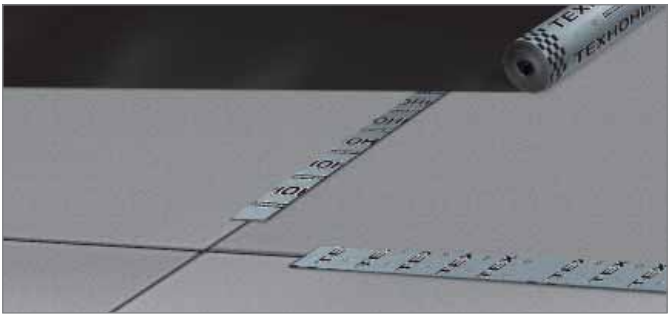
Take the cuttings of Technoelast material.
Warm up the reverse side of the material and put the warmed polymer-bitumen binder on the water funnel flange with a spatula.

Spread the binder evenly over the entire surface of the flange of the funnel.

The third "cold" method of applying - applying with the sealing mastic TECHNONICOL N°23.

- Cover the funnel flange with the sealing mastic TECHNONICOL N°23 directly before installation of a roofing layer.
- Burn down the film on the reverse side of the area of Technoelast material, which is going to be installed on the funnel flange.
- Install the burned-film area of the material on the mastic-covered flange without torch-on application.

Expansion Joints Performing

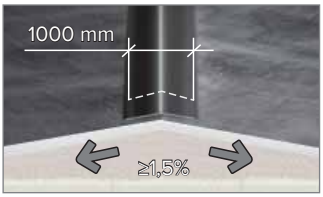


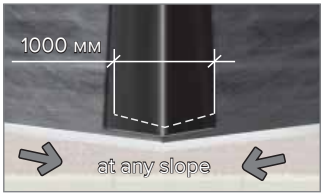
Expansion joints are important to avoid damages of screeds and monolithic thermal insulation (occurrence of cracks), caused by thermal deformation, which can lead to damaging of the roofing.

Overlap expansion joints performed in 2.5.1 with the 100-150 mm wide strips of a roll material with the slate down.

IMPORTANT! Weld the strip pointwise from one side of the joint to avoid displacements during the process of roofing material installation.

Installation of reinforcement layers on ridge and in valley





When the roof sloping is 3% or more, the ridge of a roof should be reinforced for 250 mm from the both sides and the valley for 500 mm from the inflection line* with one layer of a roll roofing material.

4.6. Works with equipment at installation of single-ply roofs with mechanical fastening

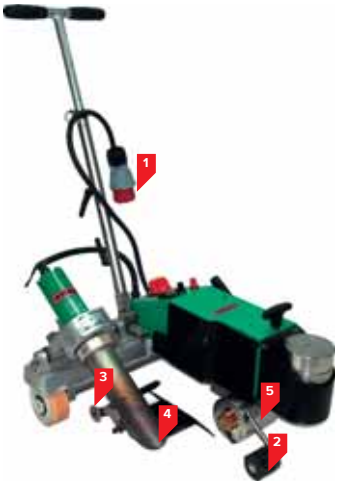
Seams of a single-ply roof can be glued with hot air of automatic equipment and industrial fan or with flame of a seam or a standard gas torch.

- In case of special requirements to the installation of the base layer to inflammable decks, it is recommended to use automatic welding equipment.

4.6.1. Performing of a Seam with Automatic Equipment

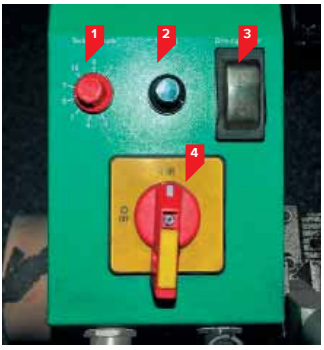
Automatic equipment is used for installation of single-ply roofs. The advantage of automatic equipment welding is absence of human factor when forming a qualitative seam.

- Before starting the works, get acquainted with the recommendations of automatic welding equipment producer.
- As an example, let us consider automatic equipment BITUMAT.



1. Cable plug, 400 V power supply
2. Lifting device
3. Metal guide roller
4. 100 mm wide welding attachment
5 . 100 mm wide roller

Device dashboard:



1. Temperature regulator
2. Speed regulator
3. On/Off motion tumbler
4. On/Off tumbler

IMPORTANT! BITUMAT operates from a 400 V grid.

Firstly, lay down parameters (air temperature (550-600 ˚C) and speed) of the welding equipment.

- After turning off the equipment, wait till the air and nozzles warm up. Warming up duration depends on the environmental temperature; it takes from 7 to 10 minutes in average.

IMPORTANT! At a working site always start the works with test welding to set the welding equipment correctly. Welding parameters, such as temperature and speed of the equipment, are not constant and depend on external weather conditions (environmental temperature, wind speed etc.).

Take two pieces of a material for a test and glue a seam.

The main requirement to the seam is an even flowing-out of a bitumen binder for not more than 25 mm. A flowing-out for 5-10 mm is recommended.

- On a first step flowing-out can be richer than during further steps, but should not exceed 25 mm. It is so because of preparation for starting the equipment motion.

After total cooling of the seam, cut out a 50 mm wide strip from the test welding area and check the quality of adhesion and the width of the seam (it should be not less than 90 mm wide).

In case the seam is torn easily, it is necessary to reduce welding speed or increase welding temperature.

IMPORTANT! At qualitative seam gluing cohesive failure* occurs, i.e. it is not the seam, which is torn, but the material itself. It is rather difficult to perform cohesive failure of a qualitative seam of a bitumen-material.

After setting the necessary parameters, start roofing welding.

Install the equipment in the place, where welding is going to be performed.

Place the metal guide roller along the edge of the seam. It is necessary for positioning of the equipment along the seam during the process of welding.

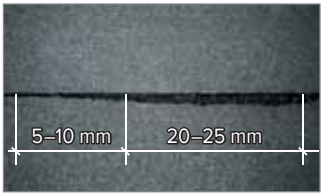
Roller should be placed 5 mm away from the edge of the material.

Lift the roller with the lifting device.

For convenient placement of the nozzle under the seam, fold the lateral edge of the above installed material and put Your leg on the lateral edge of the mechanically fastened material.

Put the nozzle under the seam and remove the lifting device.

As soon as the smoke appears (1.2 sec), turn the motion on, and the equipment will start moving.



Flowing-out should be controlled with the speed regulator - in case of large flowing-out, increase motion speed, and vice versa.

In cases of placing the equipment in hard-to-reach areas, manually place the equipment, lift the nozzle and turn off the motion of the equipment.
After that glue the seam to the end with a manual fan (see below).

IMPORTANT! To use automatic equipment intended for PVC-membranes seam gluing, e.g. VARIMAT, it is necessary to use a special nozzle and a roller.

After works, set the lowest temperature, let the equipment cool down. Then the equipment can be switched off.

4.6.2. Manual seam performing

Manual welding is carried out with a special hot-air fan. It is mainly used in hard-to-reach areas, where automatic welding equipment does not manage with the task.

IMPORTANT! Before starting the works, get acquainted with the manuals and recommendations of automatic welding equipment producer.

Manual hot-air fan Leister Triac S with an 80 mm crevice nozzle

Manual hot-air fan Leister Electron ST with a 75 mm crevice nozzle

1. Temperature regulator
2. On/Off tumbler

Before starting the works, check up the equipment:

Nozzle should be fixed to the neck of the welding equipment.
Nozzle crevice should be clean and be of an even width. Burned deposits are recommended to be removed with a metal copper brush.

IMPORTANT! Before seam gluing it is recommended to perform a test seam on the material strips to set the temperature of the equipment and the speed of manual motions of a fan.

With the regulator set the necessary temperature of the air on exit from the nozzle. For welding choose the working temperature of about 550-600 °C, depending on weather conditions and individual welding speed.

- After turning on the fan, wait for about 7-10 min till the equipment warms up to the necessary temperature.

When the fan is prepared for work, one can start gluing seams:

Insert the nozzle of the fan in the seam at an angle of about 45°. The edge of the nozzle should protrude from the overlap for 2-3 mm.
Wait for several seconds and start moving the fan along the seam.

While moving the fan, additionally roll the seam with a silicone roller 4-5 cm away from the nozzle.
When rolling with a silicone roller, control the flowing-out of a bitumen binder.

IMPORTANT! Burned deposits, as they accumulate, are recommended to be removed with a metal copper brush.

4.6.3. Seam gluing with a special gas torch and a roller

Before starting the seam gluing works form all the necessary overlaps and mechanically fasten the material, which is a lower one in the overlap.

It is not needed to fold the material with Your leg, as it was recommended at seam gluing with a standard gas torch. The necessary fold is formed by a gas torch nozzle.

Insert the nozzle of the seam gas torch and glue the overlap.

- For qualitative welding of the material it is necessary to achieve an even flowing-out of a polymer-bitumen binder from under the edge of the material.
- Welding is carried out towards Yourself.

Directly after the gluing, when the material is still hot, roll the glued seam with the roller for total tightening of the overlap.

A sign of right material warming up is a flowing-out of a polymer-bitumen binder from under the lateral edge of the material till 25 mm.

IMPORTANT! Instead of a special gas torch standard gas torchs can be used.

4.7. Works with equipment in forming of junctions to vertical surfaces

On a vertical surface roofing (two- and single-ply) should be entirely stick (applied with a torch) to the decking.

- At two-ply roofing installation on vertical surfaces Unifleks EPP 4.0 and Technoelast K-PS 170/5000 materials are used, at single-ply roofing installation - Technoelast K-YS 5500.
- Weld the material, unrolling the roll from the bottom upwards from the upper edge of an angle fillet.
- For qualitative welding of the material to the decking it is necessary to get (during welding) a small bulge of a polymer-bitumen binder in the place where the material touches the surface.
- The stick material should be additionally smoothened and pressed from the center to the edges of the roll, extruding bitumen binder and air.
- After smoothening, pull the unstick part of the material and continue welding.

After vertical installation, weld the material on the fillet and a horizontal area.
Thoroughly press or roll the material in the areas of deck curving.

- To provide an overlap with an additional top layer, warm up the material and imbed the slate.

5.
Junction Elements Performing

5. Junction elements performing

On vertical constructions of traditional roofs it is recommended to use the materials mentioned in the table 1 except for Technoelast K-TMS 170/3400.

5.1. Single-ply waterproofing covering with mechanical fastening

5.1.1. Junction to water funnel

Water funnel in the roof construction can be performed with a two- or a single-level funnel.

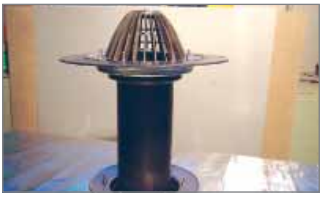
Junctions of two- and single-level funnels to bitumen roofing are performed according to the same rules, with differences in preparation works before installation of the funnels on the roofing. Let us consider both options

Option N°1
Preparation works at two-level funnel installation

Two-level funnel consists of a bottom part with a flange (Fig. 1), which is installed on the vapor barrier layer, and a put-on element (Fig. 2), which is inserted in the funnel. Tightness between the parts is provided by a rubber gland and a locking ring.

Fig. 1

Fig. 2



In photo 1 general view of the put-on element and the funnel, installed on the vapor barrier layer without thermal insulation layer, is depicted.

Install the funnel in accordance with the project and fasten the funnel to the reinforcement sheet from galvanized steel.

Stick vapor barrier to the entire surface of bearing deck.

Imbed bolt joints of the funnel through the vapor barrier.

Cut the vapor barrier to the internal diameter of the funnel.

Firstly, install the rubber gland, and then the locking ring in the funnel.

To increase tightness of a flange and a vapor barrier material junction, apply sealing mastic TECHNONICOL N°23. The mastic is easier to apply in an S-shaped way directly from the cartridge.

Insert the flange and fasten it with screws.

Install thermal insulation on the vapor barrier layer in accordance with 3.4.1.

In the place of funnel installation on an area of at least 500×500 mm, entirely replace TECHNOROOF stone wool thermal insulation with extruded polystyrene TECHNONICOL CARBON PROF (henceforth referred as XPS).

- To subside the level of the roof in the funnel area, the XPS patch thickness should be 20 mm less than the thickness of the top thermal insulation slab.
- In XPS cut a round hole of 10 mm more than the funnel pipe diameter.

Install a plain cement screed or a sheet from cement-shavings slab in the size of the XPS patch and not less than 10 mm thick. Treat the screed with TECHNONICOL BITUMEN PRIME COATING.

- In the sheet cut a round hole, 10 mm more than the funnel pipe diameter.
- Insert a put-on element in the hole all the way in and measure the height from the sheet to the bottom part of the flange. Shorten the bottom part of the put-on element so that its upper flange touches the decking over the entire surface.

Option N°2

Preparation works at installation of a single-level funnel (TECHNONICOL funnel with a crimp flange)

Stick vapor barrier to the entire surface of bearing deck.

Cut the vapor barrier to the diameter of the funnel pipe.

Install thermal insulation on the vapor barrier layer in accordance with 3.4.1.

In the place of funnel installation on an area of at least 500×500 mm, entirely replace TECHNOROOF stone wool thermal insulation with extruded polystyrene.

- To subside the level of the roof in the funnel area, the XPS patch thickness should be 20 mm less than the thickness of the top thermal insulation slab. Cut the XPS to the diameter of the funnel pipe.

IMPORTANT! For a tight junction stick the XPS to the vapor barrier with butyl-rubber sealant TECHNONICOL N°45. In case several layers of XPS are used for a patch, it is necessary to stick the slabs to one another with a sealant.

Install a plain cement sheet or a sheet from cement-shavings slab in the size of the XPS patch and not less than 10 mm thick. Treat the sheet with TECHNONICOL BITUMEN PRIME COATING.

- For a tight junction, stick the reinforcement sheet to the XPS with butyl-rubber sealant TECHNONICOL N°45.

5.1.2. Performing of a junction of the roofing to the funnel

Weld a reinforcement layer from Unifleks EPP 4.0 to the plain cement sheet.
Fasten the plain cement sheet to the bearing deck. The sheet should be fastened with at least 4 telescopic fasteners.

- Warm up with a gas torch flame the area of the reinforcement layer, on which the funnel is going to be installed.
- Imbed the bell of the funnel (TECHNONICOL funnel with a crimp flange) in the warmed up area.
- Fasten the funnel to the plain cement sheet.

For a tight junction with the funnel, it is necessary to cover the flange of the funnel with a bitumen binder.

Install the Technoelast K-YS 5500 material. The roll should be welded to the funnel reinforcement layer.

- Temporarily fill the funnel with a non-flammable material so it will not be damaged during works with a torch.

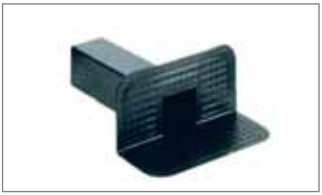
While the material is still hot, imbed the bolt joints of the funnel through the Technoelast K-YS 5500 material.

Cut the roofing to the diameter of the water funnel pipe.

To increase reliability of the flange junction with the roofing, apply sealing mastic TECHNONICOL N°23 on the reverse side of the flange.

Insert the flange and fasten it with screws.
Install leaf catcher.

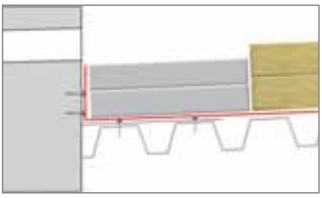
5.1.3. Installation of a parapet funnel (parapet spillover)



Parapet funnel 100×100 (see photo N°1) - a funnel for external water drain over balconies and parapets on low areas of a roof.

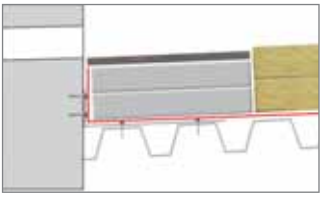
Parapet funnel ULTRA 110 (see photo N°2) is a parapet spillover, which is installed in cases of emergency water discharge when the main internal water drain funnel is clogged.

Junctions of eave funnels TECHNONICOL to the roof are carried out according to identical technologies. In this manual junction of a parapet funnel ULTRA 110 is considered.



In the place of funnel installation on an area of at least 500×500 mm, entirely replace TECHNOROOF stone wool thermal insulation with XPS.

- To subside the level of the roof in the funnel area, the XPS patch thickness should be 20 mm less than the thickness of the top thermal insulation slab.



Install a plain cement sheet or a sheet from cement-shavings slab in the size of the XPS patch and not less than 10 mm thick. Treat the sheet with TECHNONICOL BITUMEN PRIME COATING.

Cut out a reinforcement layer from Unifleks EPP 4.0 and weld it to the area of a local subsiding of the water funnel.

- The reinforcement layer should be 100 mm more than the parapet funnel flange from each side.

In the installed reinforcement layer cut a round hole for a water funnel pipe.
Warm up with a gas torch flame the area of the reinforcement layer, on which the funnel is going to be installed.

Install the funnel.
Imbed the bell of the funnel in the warmed up polymer-bitumen binder or mastic.

- Make sure, that the binder is flowing out from under the funnel flange evenly. Flowing-out provides total tightness of a junction.

Fasten the water funnel to the decking, using at least 6 fasteners (4 on the vertical surface, 2 on the horizontal decking).

- As fasteners use pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve.

For a tight junction with the funnel, it is necessary to cover the funnel flange with bitumen binder.

Install angle fillet from TECHNOROOF stone wool to the parapet funnel on a hot mastic. Change the direction smoothly from the inclined surface of the fillet to the vertical surface of the additional layer.

Install Technoelast K-YS 5500 on the main plane. The material should not be placed on the inclined surface of the fillet.

- Weld the material to the reinforcement layer and the binder-covered funnel flange.

Weld Technoelast K-YS 5500 on the parapet.

- For qualitative torch-on application over coarse-grained slate in the seam forming area, remove the slate from the welding area.
- Cut the roofing to the hole of the water funnel pipe.
- Insert a leaf catcher in the created round hole.

5.1.4. Junction to parapet up to 450 mm high

Parapets up to 450 mm high can be entirely covered (this option is considered below). It is recommended to entirely cover the parapets, which are not more than 700 mm high.

In the areas of junction to vertical constructions install TECHNOROOF stone wool angle fillet.

Place the roll of Technoelast K-YS 5500 to the vertical construction and place the material on the inclined surface of the fillet.

- In the area, where the material is placed on the fillet, carry out mechanical fastening along the entire vertical construction with a span of not more than 250 mm.

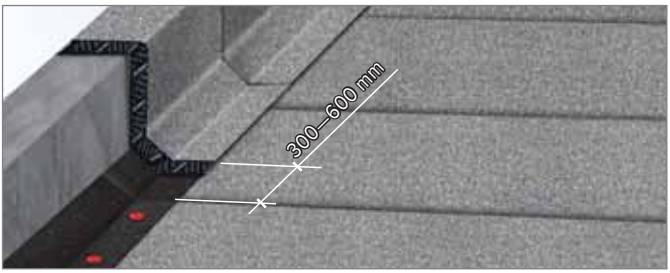
For qualitative torch-on application over coarse-grained slate, remove the slate from the welding area. To do this, warm the surface of the material with the flame of a gas torch and imbed the slate in the bitumen binder with a spatula.

The additional layer should be placed on a vertical surface of the parapet on a height of not less than 250 mm and on a horizontal surface of the decking 150 mm away from the angle fillet.

IMPORTANT! Installation of Technoelast K-YS 5500 on a vertical surface should start from low areas of a roof. Water should flow from the seam towards the valley.

The roll installed on the low area (valley) should be overlapped with adjacent sheets for 120 mm. Imbed the slate from the lateral side of the material to form a lateral overlap:

The distance between lateral junctions of roofing sheets in adjacent layers on the parapet should be 300-600 mm.

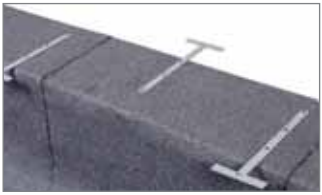


IMPORTANT! It is recommended to protect the upper part of the parapet with roofing galvanized steel or parapet slabs with seam sealing.

Let us consider an option of covering the parapet with roofing steel. To do this, a T-shaped roofing metal piece and a galvanized steel parapet apron are needed.

T-shaped roofing metal piece is intended for fastening galvanized steel drip edges and aprons to the parapets. The metal piece should be not less than 4 mm thick and be covered with anticorrosive solutions.

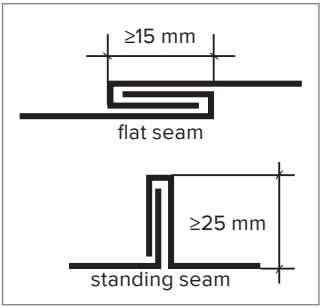
Parapet apron from galvanized steel is intended for protection of the parapet from atmospheric precipitations and mechanical damaging.



Install metal pieces from the both sides of the parapet with a span of not more than 750 mm.

- The row of the metal pieces from one side of the parapet should be shifted relatively another row for a half. T-shaped metal pieces should protrude beyond the parapet for 80-120 mm.

Install the galvanized apron on the metal pieces.
The apron will protect the parapet from impacts of atmospheric precipitations and mechanical damaging.

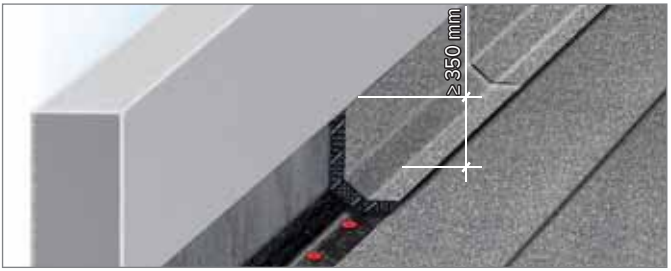


Galvanized parapet aprons should be connected to one another with a flat or a standing seam.

5.1.5. Junctions to vertical constructions of a roof

Junction to a vertical surface is carried out according to the technology, described above. The only difference in this case is that it is enough to place the roofing material on a height of not less than 350 mm and additionally fasten it with an edge strip.

Place the material on the vertical surface for not less than 350 mm.



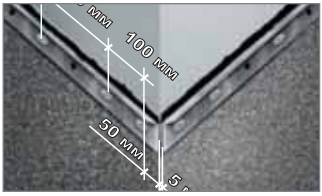
Depending on the type of the deck of the vertical surface, two options of fastening of the roofing material edge are possible.

Option N°1
The vertical construction is made of precast and monolithic reinforced concrete constructions and from masonry units, which are entirely plastered:

The material welded on the vertical surface fasten with an edge strip with pointed self-tapping screws EDS-S 4.8 with a polyamide sleeve.

Cut the strip in the areas of internal or external angles. It is forbidden to bend the strip in the angles.

Fasten the edge strip not less than 50 mm away from the angle of the wall. In an external angle this will prevent the wall from chipping.



In the angles the distance between the first and the second screws (counting from the angle) should be 100 mm; all the next screws are installed with a span of 200 mm.

Leave 5-10 mm expansion gap between adjacent fasteners.

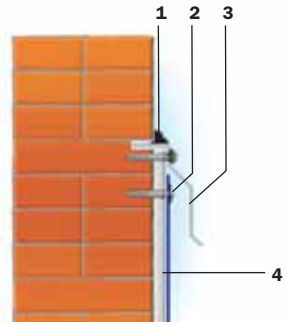
Fill the gap between the wall and the bent of the edge strip with sealing mastic TECHNONICOL N°23.

When there are vertical changes of direction, place the edge rod vertically. Leave 5-10 mm gap between adjacent fasteners.

- Apply sealing mastic TECHNONICOL N°23 on both sides of the vertical strip.

Option N°2

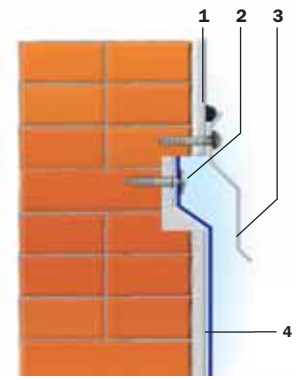
The vertical surface is made of masonry units and is not plastered. Plaster the wall with M150 sand cement solution over the metal net over the entire surface of placement of the additional waterproofing layer (not less than 350 mm).



1. Sealing mastic TECHNONICOL N°23
2. Mechanical fastening of the roof with a metal washer 50 mm in diameter and pointed self-tapping screws TECHNONICOL
3. Drip edge from galvanized steel
4. Technoelast K-YS 5500

- Weld the material on the vertical surface.
- Fasten the roofing with metal washers D=50 mm with pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve.
- Make a chase in the wall above the plastered area not less than 50 mm deep.
- Install the galvanized steel apron in the chase. The apron should overlap the edge of the roofing for at least 100 mm. The bottom edge of the apron should be not less than 150 mm above the roofing.
- Fasten the apron with roofing self-tapping rubber-sealed screws with a span of 200 mm.
- The length of one apron should not exceed 2500 mm.
- An overlap in the apron junctions – 30-50 mm. Do not install fasteners in the overlaps.
- Apply sealing mastic TECHNONICOL N°23 atop.

In case of oversailing courses on the vertical surface of the wall

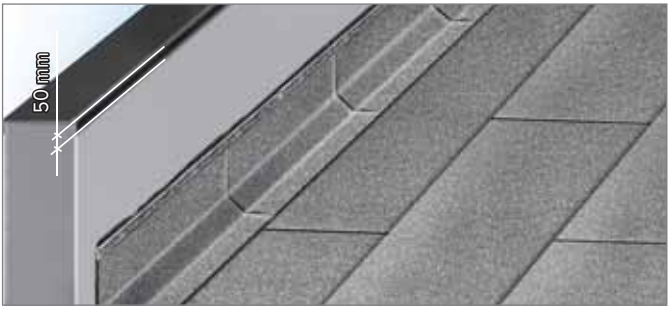


1. Sealing mastic TECHNONICOL N°23
2. Mechanical fastening of the roof with a metal washer 50 mm in diameter and pointed self-tapping screws TECHNONICOL
3. Drip edge from galvanized steel
4. Technoelast K-YS 5500

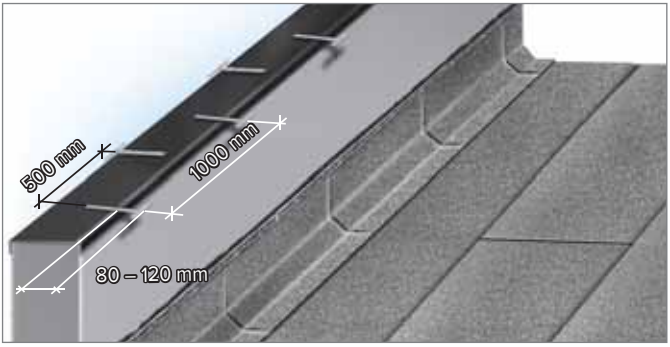
- Weld the material on the vertical surface. Place the material in the oversailing course.
- Fasten the roofing with metal washers D=50 mm with pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve.
- Install the galvanized steel apron in the chase. The apron should overlap the edge of the roofing for at least 100 mm. The bottom edge of the apron should be not less than 150 mm above the roofing.
- Fasten the apron with roofing self-tapping rubber-sealed screws with a span of 200 mm.
- The length of one apron should not exceed 2500 mm.
- An overlap in the apron junctions – 30-50 mm. Do not install fasteners in the overlaps.
- Apply sealing mastic TECHNONICOL N°23 atop.

IMPORTANT! The upper part of the parapet on the roof should be protected with roofing steel or be covered with parapet slabs with seam sealing.

Let us consider an option of covering the parapet with roofing steel. Weld Unifleks EPP 4.0 on the horizontal part of the parapet and place the material on the vertical part (from the facade side and the side of the roof) for 50 mm.

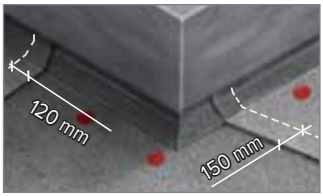


- Install T-shaped metal roofing pieces from the both sides of the parapet with a span of 1000 mm.
- The row of metal roofing pieces from one side of the parapet should be shifted for 500 mm relatively another row. T-shaped metal pieces should protrude beyond the parapet for 80-120 mm.



Install the galvanized apron on the metal roofing pieces. The apron will protect the parapet from impacts of atmospheric precipitations and mechanical damaging.

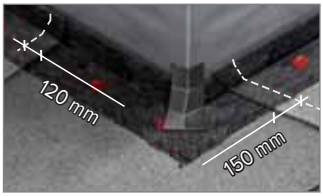
5.1.6. Junction to external angle



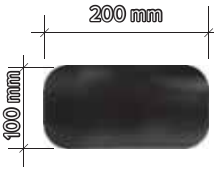
Install the roofing from Technoelast K-YS 5500 on the main plane of the roof .
Place the material on the angle fillet closely to the parapet.

- Fasten the material near the angle fillet with the calculated span.

For qualitative welding on the material with coarse-grained slate, imbed the slate in the welding area.



Weld a patch on the angle junction with the fillet.



Weld the material over the entire plane of the parapet from one side of the parapet angle.

- The material should cover the other side of the parapet for 120 mm, be placed on the horizontal plane of the roof for 150 mm and on the facade part of the parapet for 50 mm.

Imbed coarse-grained slate in the overlap area.

Weld the material over the entire plane of the parapet from another side of the parapet angle.

IMPORTANT! The upper part of the parapet on the roof should be protected with roofing steel or be covered with parapet slabs with seam sealing.

Peculiarities of performing external angle to vertical surfaces (walls, high parapets etc.)

The principle of performing external angle to vertical construction is almost the same with the method described above.

- In this case the top layer of the material is recommended to be placed on a height of not less than 350 mm.

IMPORTANT! The upper part of the parapet on the roof should be protected with roofing steel or be covered with parapet slabs with seam sealing.

5.1.7. Junction to Internal Angle

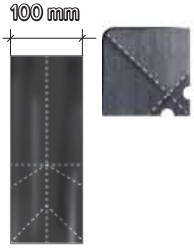
Install the material closely to the angle fillet.

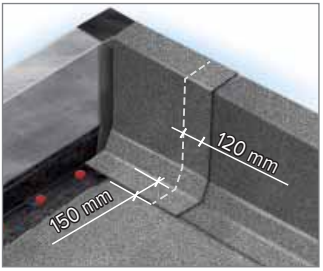
Cut the material in the area of the angle fillet.

In the area where the material is placed on the fillet, along the entire vertical construction carry out mechanical fastening with a span of not more than 250 mm.

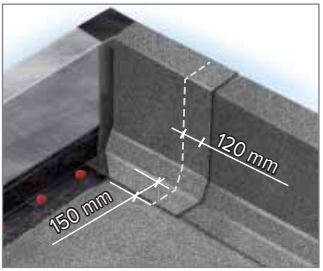
For qualitative welding on the material with coarse-grained slate, imbed the slate in the welding area.

Weld patches from Unifleks EPP 4.0 on the angle on the entire height and the horizontal plane of the parapet to seal the seam.

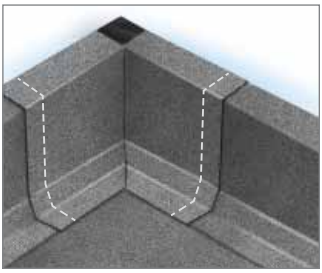




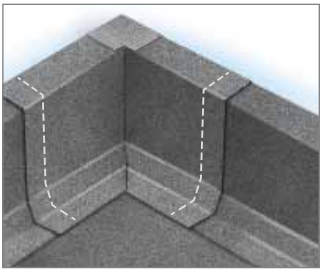
Weld the material on the entire plane of the parapet from one side of the parapet angle.
Place the material on the facade part of the parapet for 50 mm.



For qualitative welding on the material with coarse-grained slate, imbed the slate in the welding area.



Weld the material on the entire plane of the parapet from another side of the parapet angle.



Weld the patch from coarse-grained slate material on the left horizontal plane of the parapet.
Imbed coarse-grained slate in the area of an overlap with the patch.

IMPORTANT! Protect the parapet from impacts of atmospheric precipitations and mechanical damaging with a galvanized apron.

Peculiarities of performing internal angle to vertical surfaces (walls, high parapets etc.)

The principle of performing external angle to vertical constructions is almost identical to the method described above.

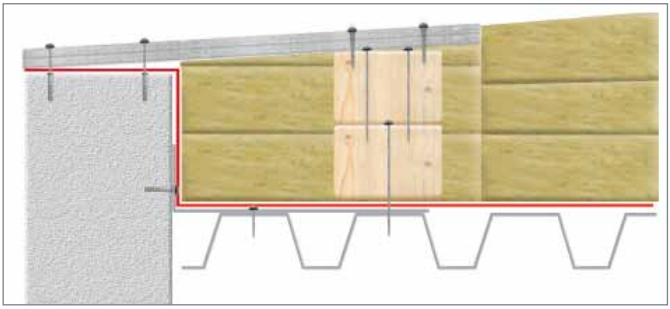
- The difference is, that the material is recommended to be placed on a height of not less than 350 mm.

5.1.8. Junction to Eave

Before installation of an eave, it is necessary to carry out preparation works:

- In case the wall is made of a sandwich-panel, it is necessary to cut it, keeping the slope of the roof. The cut part protruding above a corrugated steel sheet should not be less than the height of the main thermal insulation layer. The cut part should be covered with a metal sheet.
- In case the wall is made of masonry units or reinforced concrete panels, it is necessary to lay masonry units till the necessary level of the roof sloping. The height of the protruding part of the wall should not be less than the height of the main thermal insulation layer.
- Prepare a rigid frame for eave installation.

Let us consider an example of performing a rigid frame from antiseptic timber strips:



- Start assembling the rigid frame after installation of an L-shaped element and installation of the vapor barrier layer;
- Then fasten timber strip to the upper waves of a corrugated steel sheet. Install the strip on the second wave of a corrugated steel sheet. Select the height of a strip, considering the thickness of the thermal insulation layer and sloping of the roof;
- Install thermal insulation;
- Install plain cement sheets or sheets from cement-shavings slabs on perimeter of the roof eave in two layers with seam spacing. One sheet should be not less than 10 mm thick and not less than 500 mm wide. Fasten the sheets to the timber strips, external wall and between one another.

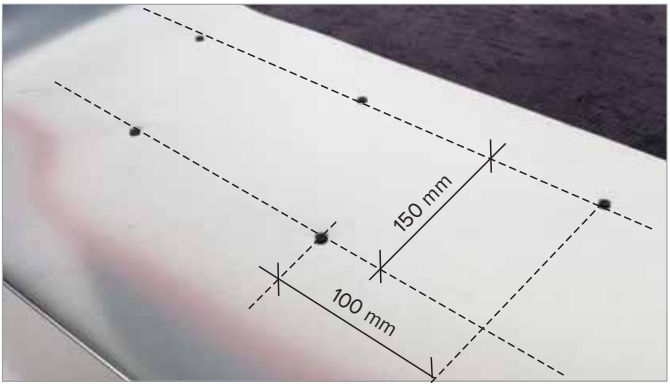
Weld on the plain cement (cement-shavings slabs) sheets the reinforcement layers from Unifleks EPP 4.0.

Install the eave:

- Eave should be fastened 30 mm away from the wall.
- Minimal width of an eave flange should be 350 mm.

IMPORTANT! Welted metal sheets of an eave should be installed with overlaps of 150-200 mm.

- Fasten the eave with a span of 200 mm in two rows. The distance between the rows should be 150 mm.
- Self-tapping screws in the rows should be shifted one relatively another for 100 mm.



Install a single-ply roofing from Technoelast K-YS 5500.

Technoelast K-YS 5500 is necessary to be welded on the reinforcement layer and the eave.

5.1.9. Junctions to anchors and pipes of small diameter

Prepare a metal sleeve:

- Flange of the metal sleeve should cover the horizontal surface 150 mm from the sleeve walls.
- The sleeve should be at least 100 mm high.
- The distance between the edge of the pipe and the wall of the sleeve should be not less than 25 mm.

In the pipe area replace the TECHNOROOF stone wool thermal insulation with extruded polystyrene (henceforth referred as XPS).

- An XPS patch should be 200 mm more than the flange of the sleeve.
- Before installation of XPS, cut a round hole in the patch, 10 mm larger than the diameter of the funnel pipe.

Install a plain cement screed or a sheet from cement-shavings slab to the dimensions the XPS patch and not less than 10 mm thick.
Before installation of the screed, cut a round hole in the patch, 10 mm larger than the diameter of the funnel pipe.

- Treat the sheet with bitumen primer TECHNONICOL BITUMEN PRIME COATING.
- Fasten the sheet to the bearing deck with 4 fasteners.

Weld a reinforcement layer from Unifleks EPP 4.0 to the screed.

Warm up with the flame of a gas torch the reinforcement layer for installation of the sleeve flange.

Install the sleeve and imbed the flange in the warmed material. Make sure, that the flowing-out of a polymer-bitumen binder from under the sleeve flange is even. Flowing-out will provide total tightness of a junction.

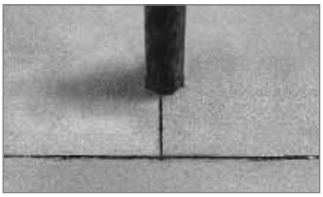
Fasten the metal sleeve to the plain cement sheet (or a sheet from cement-shavings slabs) with at least 4 fasteners.

For a tight junction, it is necessary to cover the flange of the sleeve with a bitumen binder.

Install Technoelast K-YS 5500 over the entire surface of the roof. In the area of the reinforcement layer and the sleeve flange the material is necessary to be applied with a torch.

Gap between a pipe and sleeve walls should be filled with sealant or hot mastic.

5.1.10. Junction to pipes



Install Technoelast K-YS 5500 membrane over the entire surface of the roof.

Imbed the slate in the area of installation of the skirt of a seal. Put the seal on the pipe and select the necessary diameter.

Cut the seal to the chosen pipe diameter.

Warm up the surface of the material and imbed the skirt in the warmed material.
Make sure, that the flowing-out of a polymer-bitumen binder from under the bell of the seal is even. Flowing-out will provide total tightness of a junction.

Seal skirt can be installed on the hot mastic TECHNONICOL N° 41 preliminarily poured over the material surface or on the sealing mastic TECHNONICOL N°23 applied with a spatula.

For a tight junction, it is necessary to cover the seal skirt with a bitumen binder.

Prepare and weld a reinforcement layer.
The reinforcement layer should overlap the seal bell for 150 mm.

To tighten the junction between the pipe and the seal, apply sealing mastic TECHNONICOL N°23.

Install a hose clamp on the seal and tighten.

5.1.11. Junction to roofing aerator

Roofing aerator (roof cowl) - a device intended for removing water vapors and moisture from roof space.

- Roofing aerator is used at installation of "breathing" roofing and also at repairs of local bulges of a roof and, if needed, in the roofs with a sloping layer from keramzite gravel. When installing a roof in cold seasons, aerators are especially recommended to be installed.
- Roofing aerators are installed on the roof at the rate of 1 pc. (1 aerator Ø110 mm) per 100 m^2 of the roof. For optimal removal of vapor from under the roofing the distance between the aerators should not exceed 12 m.
- In the valley aerators are installed every 10-12 m, in the ridges - 6-8 m.
- Start installing aerators, when the roofing is installed over the entire plane of the roof.

Cut a round hole in the place of aerator installation. In case the roofing is installed on sand cement screeds, cut the hole to the sloping layer. Diameter of the hole should be equal to the internal diameter of the aerator pipe.

Imbed the slate in the area of aerator flange installation.

Warm the surface of the material and imbed the skirt in the warmed material.

Make sure, that the flowing out of a polymer-bitumen binder from under the seal skirt is even. Flowing out provides total tightness of a junction.

Seal skirt can be installed on the hot mastic TECHNONICOL N° 41 preliminarily poured over the material surface or on the sealing mastic TECHNONICOL N°23 applied with a spatula.

Fasten the roofing aerator to the bearing deck with at least 4 fasteners:

- When installing the roof on a sand cement decking, use pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve (this type of fasteners is depicted in the photo).
- When installing the roof directly on thermal insulation on bearing deck from corrugated steel sheets, use telescopic fasteners and drill-tipped screws TECHNONICOL Ø 4.8 mm.

For a tight junction, it is necessary to cover the skirt with a bitumen binder.

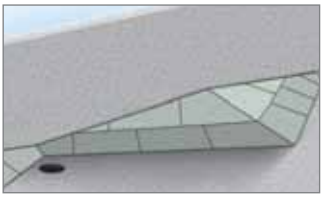
Prepare and weld a reinforcement layer. The reinforcement layer should overlap the aerator flange for 150 mm.

5.2. Two-ply torch-on applied waterproofing covering

5.2.1. Junction to a water funnel

IMPORTANT! Local subsiding of the roof in the areas of internal water drainage funnels installation should be 20-30 mm within a radius of 500 mm.

Water funnels installed along the parapets and other protruding parts of buildings should be placed not less than 600 mm away from them.



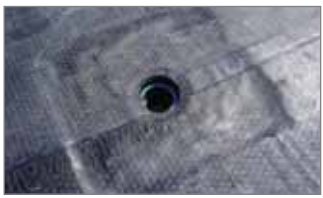
Form an additional counter slope from vertical constructions (walls, parapets etc.) to a water funnel.

IMPORTANT! It is forbidden to install rainwater pipes inside the walls.

Installation of a TECHNONICOL funnel

In 3.1.2. "Installation of Reinforcement Layers in the Area of a Water Funnel" and 3.1.3 "Installation of a Water Funnel" preparation step before torch-on application of a top and a base layer is considered. Below the junction to a funnel is described.

Unroll the roll of the base layer from Unifleks EPP 4.0 so that the lateral edge lies on the funnel.



Weld the base layer from Unifleks EPP 4.0.

Lateral overlap should lie on the axis of the funnel.

- Temporarily fill the vertical pipe of the funnel with a non-flammable material so it will not be damaged during works with a torch.

Install the top layer from Technoelast K-PS 170/5000.

Cut the roofing to the diameter of the water funnel pipe.

Insert a leaf catcher into the created round hole.

General view of the water funnel.

Installation of a TECHNONICOL funnel with a crimp flange

Remove the flange from the funnel.

Cut an additional reinforcement layer from Unifleks EPP 4.0 with dimensions 500x500 mm. It is recommended to round the angles of the created reinforcement layer.

Weld the additional reinforcement layer in the area of local subsiding of the water funnel according to the project.

In the installed additional reinforcement layer cut a round hole to the edge of the water funnel.

Warm up with the flame of a torch a part of the reinforcement layer, on which the funnel is going to be installed.

- Imbed the bell of the water funnel in the warmed area. Make sure, that the flowing-out of a polymer-bitumen binder from under the flange of the funnel is even.
- Flowing-out provides total tightness of a junction.

Fasten the water funnel to the deck with at least 4 fasteners.

- Fastening will prevent the funnel from probable displacement during further roofing installation.

- As fasteners use pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve.

For a tight junction with the funnel, it is necessary to cover the flange of the funnel with a bitumen binder.

Weld the base layer from Unifleks EPP 4.0. Lateral overlap of the sheets should lie on the axis of the funnel.

- Temporarily fill the vertical pipe of a funnel with a non-flammable material so it will not be damaged during works with a torch.

Cut the roofing to the hole of the water funnel pipe.

Weld the top layer from Technoelast K-PS 170/5000.

While the material is still warm, imbed bolt joints of the funnel through Technoelast K-PS 170/5000.

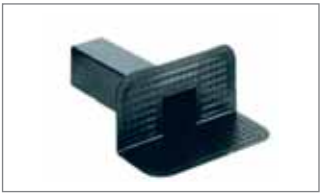
Cut the roofing to the diameter of the water funnel.

To increase reliability of the junction between the flange and the roofing, apply sealing mastic TECHNONICOL N°23 on the reverse side of the flange.

Install the flange and fasten it with screws.

Install a leaf catcher.

5.2.2. Installation of a Parapet Funnel (Parapet Spillover)



Parapet funnel 100 x 100 (see photo 1) – funnel for external water drainage over balconies and parapets on low areas of a roof.

Parapet funnel ULTRA 110 (see photo 2) is a parapet spillover, which is installed in cases of emergency water discharge when the main funnel of internal water drainage is clogged.

Junctions of parapet funnels TECHNONICOL to the roof are carried out according to identical technologies. In this manual junction of a parapet funnel ULTRA 110 is considered.

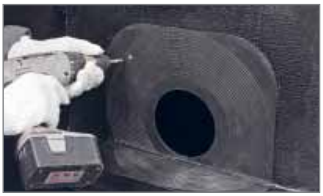
Cut out a reinforcement layer from Unifleks EPP 4.0 and weld it to the area of a local subsiding of the water funnel. The reinforcement layer should be 100 mm more than the parapet funnel flange from each side.

In the installed reinforcement layer cut a round hole for the water funnel pipe.
Warm up with the flame of a torch a part of the reinforcement layer, on which the funnel is going to be installed.

- When using thin torch-on applied materials as the materials for a base layer, apply sealing mastic TECHNONICOL N°23 with a spatula.

Install the funnel.
Imbed the bell of the water funnel in the warmed polymer-bitumen binder or mastic.

- Make sure, that the flowing-out of a binder from under the flange of the funnel is even. Flowing-out provides total tightness of a junction.



Fasten the water funnel to the decking with at least 6 fasteners (4 on the vertical surface, 2 on the horizontal decking). As fasteners use pointed self-tapping screws EDS-S 4.8 with a polyamide sleeve.

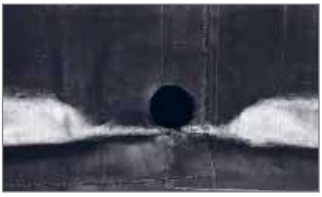
For a tight junction with the funnel, it is necessary to cover the flange of the funnel with a bitumen binder.

Install angle fillet from TECHNOROOF stone wool to the parapet funnel on a hot mastic. Change the direction smoothly from the inclined surface of the fillet to the vertical surface of the additional layer.

Weld strips of the reinforcement layer from Unifleks EPP 4.0 on the fillet.

Weld the base layer from Unifleks EPP 4.0.

Weld the base additional layer of Unifleks EPP 4.0 on the parapet so that the lateral edge lies on the axis of the funnel.



Cut the roofing to the diameter of the pipe of the water funnel.

Weld the top layer from Technoelast K-PS 170/5000.

Weld the additional top layer from Technoelast K-PS 170/5000 on the parapet.

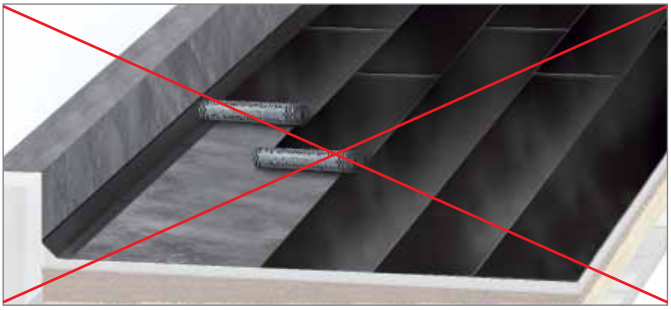
- Cut the roofing to the diameter of the pipe of the water funnel.
- Install a leaf catcher in the created round hole.

5.2.3. Junction to the Parapet Up To 450 mm High

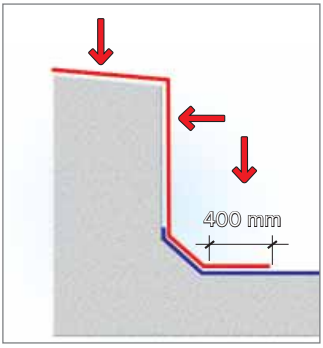
Install angle fillet in accordance with 3.1.1.
Weld the strips of the reinforcement layer Unifleks EPP 4.0 in accordance with 3.1.1.

Weld the base layer from Unifleks EPP 4.0. Place the material close to the angle fillet, but not on the fillet.

- End overlaps of materials of the base and the reinforcement layers should better not coincide.

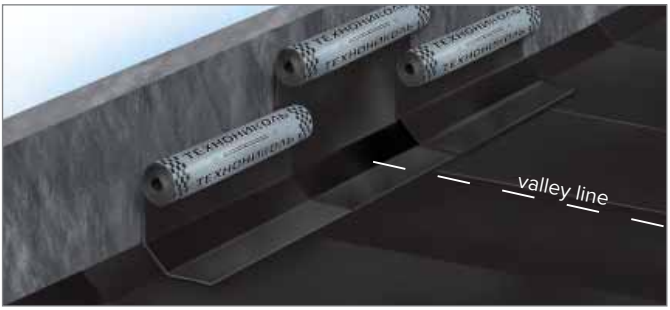


- The end part of the roll can be placed on the angle fillet without reinforcement. It is possible only when the end part of the roll is placed to the vertical surface: on the vertical surface should the end part of the roll be placed 25 mm above the angle fillet.

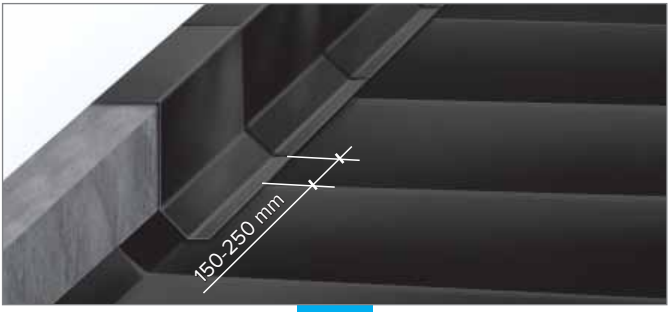


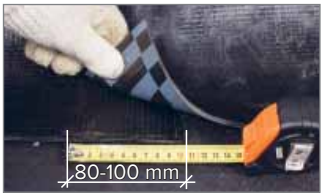
Prepare the additional base layer from Unifleks EPP 4.0 for placement on the plane of the parapet.
The additional base layer should be placed on the vertical surface of the parapet for not less than 250 mm in height and on the horizontal surface of the decking 150 mm from the angle fillet. Parapets up to 450 mm high can be entirely covered (in the Manual this type of junction to the parapet is considered).

- Begin the installation of the additional base layer of Unifleks EPP 4.0 on the parapet from the low parts of the roof - valleys - to avoid occurrence of counter seams. Water should flow from the seam towards the valley. The roll installed on the low part of the roof (valley) should be overlapped with adjacent sheets for 80-100 mm.



- Spacing of the seam of the additional base layer installed on the parapet and the seam of the base layer on the main plane of the roof should be 150-250 mm.





When installing next rolls, form lateral overlaps of 80-100 mm.

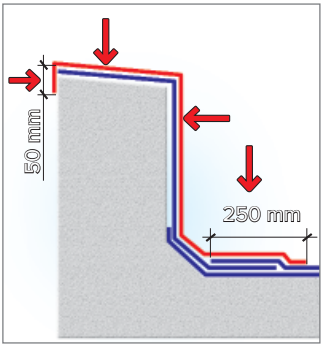
Roll the prepared part. Rolling is better to be performed round a cardboard reel in case of manual feed.

- Weld the additional base layer from Unifleks EPP 4.0.
- Unroll the rolls from the bottom upwards, starting from the fillet.
- For qualitative welding of the material to the decking it is necessary to get (during welding) a small bulge of a polymer-bitumen binder in the place where the material touches the surface.

To complete the torch-on application, weld the bottom part of the roll and place it on the horizontal area.

Weld the top layer from Technoelast K-PS 170/5000 .

Place the material close to the angle fillet, but not on the fillet.



Prepare the additional top layer from Technoelast K-PS 170/5000 for placement on the plane of the parapet:

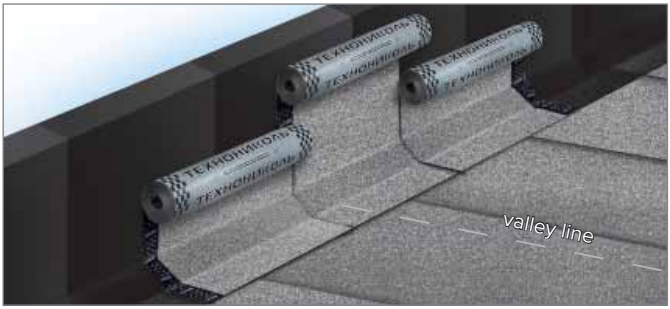
- The material should be placed on the facade part of the parapet for 50 mm;
- On a horizontal surface should the material overlap the angle fillet totally and be placed on the plane for 200 mm.

To provide an overlap with the additional top layer, warm up the material and imbed the slate of the top layer of Technoelast K-PS 170/5000.

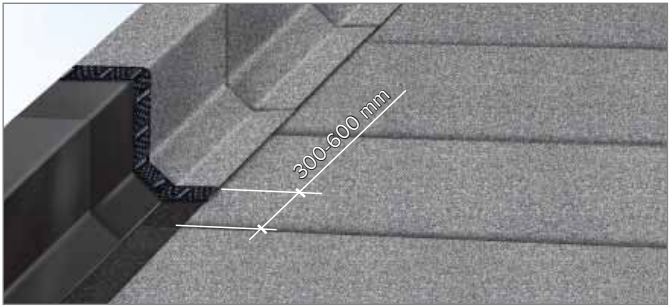
The slate should be removed from 200 mm from the edge of the angle fillet and Technoelast K-PS 170/5000.

IMPORTANT! Installation of the additional top layer of Technoelast K-PS 170/5000 on a vertical surface should start from the low parts of the roof. Water should flow from the seam towards the valley.

- The roll installed on the low area (valley) should be overlapped with adjacent sheets for 80-100 mm
- Remove coarse-grained slate from the surface of the material to form a lateral overlap.



- The distance between lateral junctions of roofing sheets in adjacent layers on the parapet should be 300-600 mm.



Roll the prepared part. Rolling is better to be performed round a tube or a cardboard reel in case of manual feed.

- Weld the additional top layer from Technoelast K-PS 170/5000.
- Unroll the rolls from the bottom upwards, starting from the fillet.
- For qualitative welding of the material to the decking it is necessary to get (during welding) a small bulge of a polymer-bitumen binder in the place where the material touches the surface.

To complete the torch-on application, weld the bottom part of the roll and place it on the horizontal area and on the facade part of the parapet for 50 mm.

IMPORTANT! It is recommended to protect the upper part of the parapet with galvanized roofing steel or parapet slabs with seam gluing.

To do that, use T-shaped metal pieces and a galvanized steel parapet apron.

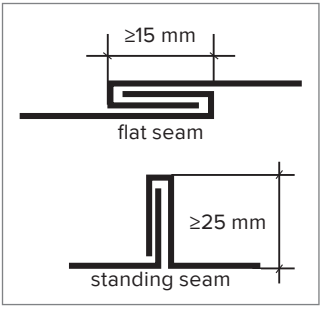
T-Shaped metal piece – is intended for fastening galvanized drip edges and aprons to the parapets.

Parapet apron from galvanized steel – is intended for protection of the parapet from atmospheric precipitations and mechanical damaging.

Install T-shaped metal pieces from the both sides of the parapet with a span of not more than 750 mm.

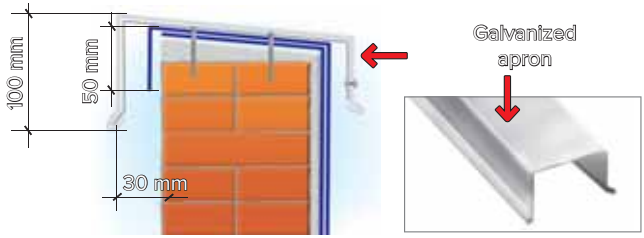
- The row of metal pieces on one side should be shifted to half relatively another row. T-shaped metal pieces should protrude beyond the edge of the parapet for 80-120 mm.

Install the galvanized apron on the metal pieces.
The apron will protect the parapet from impacts of atmospheric precipitations and mechanical damaging.



Galvanized parapet aprons should be connected to one another with a flat or a standing seam.

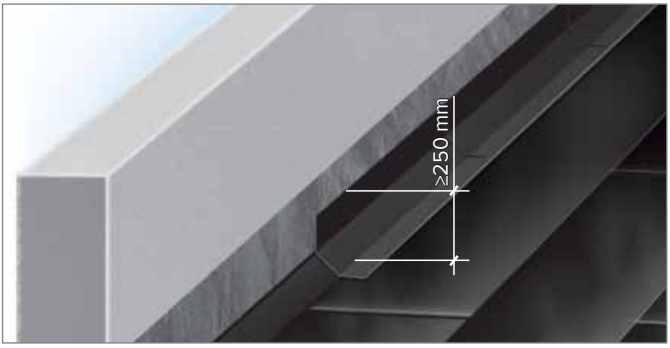
For parapet protection different types of parapet aprons are used. Profile of fasteners (metal pieces) depends on the form of the galvanized apron itself (see below).



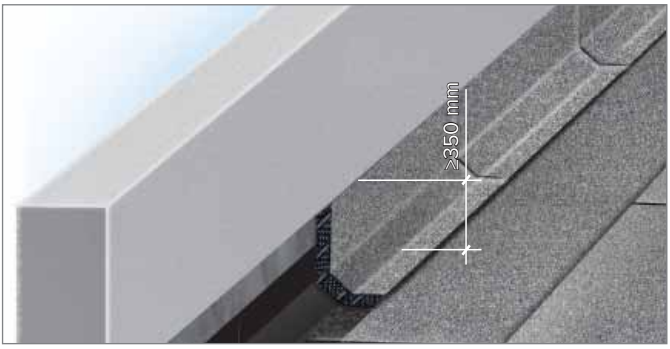
5.2.4. Junction to Vertical Surfaces (walls, high parapets, venting shafts, clerestory etc.)

Junction to a vertical surface is carried out according to the technology, considered in 4.2. The only difference is that the roofing material should be placed on a height of not less than 350 mm and additionally fastened with an edge strip.

- The height of placement of the additional base layer on a vertical surface should be not less than 250 mm.



- The additional top layer is recommended to be placed on a vertical surface on a height of not less than 350 mm.



Depending on the type of a decking of the vertical surface, two options of fastening of the roofing material edge are possible.

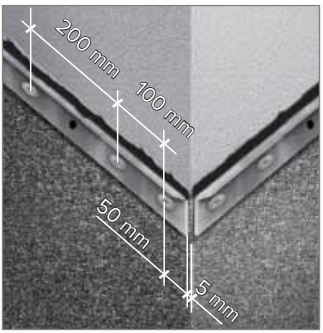
Option N°1

The vertical construction is made of precast and monolithic reinforced concrete constructions and from masonry units, which are entirely plastered.

The material welded on the vertical surface fasten with an edge strip with pointed self-tapping screws EDS-S 4.8 with a polyamide sleeve.

Cut the strip in the areas of internal or external angles. It is forbidden to bend the strip in the angles.

Fasten the edge strip not less than 50 mm away from the angle of the wall. In an external angle this will prevent the wall from chipping.



In the angles the distance between the first and the second screws (counting from the angle) should be 100 mm; all the next screws are installed with a span of 200 mm.

Leave 5-10 mm expansion gap between adjacent fasteners.

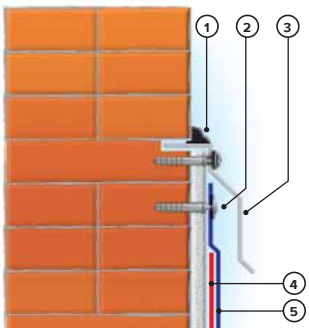
Fill the gap between the wall and the bent of the edge strip with sealing mastic TECHNONICOL N°23.

In case of vertical changes of directions, place the strip vertically. Leave 5-10 mm gaps between adjacent fasteners.

- Apply sealing mastic TECHNONICOL N°23 on the both sides of the vertical edge strip.

Option N°2

The vertical surface is made of masonry units and is not plastered. Plaster the wall with M150 sand cement solution over the metal net over the entire surface of placement of the additional waterproofing layer (not less than 350 mm).

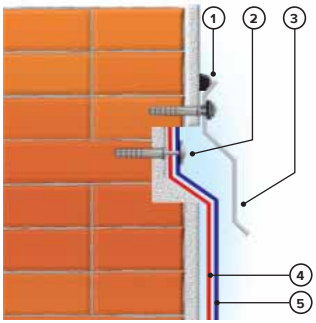


1. Sealing mastic TECHNONICOL N°23
2. Mechanical fastening of the roof with a metal washer 50 mm in diameter and pointed self-tapping screws TECHNONICOL
3. Drip edge from galvanized steel
4. Technoelast K-MS 170/4000
5. Technoelast K-PS 170/5000

- Weld the material on the vertical surface.
- Fasten the roofing with metal washers D=50 mm with pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve.
- Make a chase in the wall above the plastered area not less than 50 mm deep.
- Install the galvanized steel apron in the chase. The apron should overlap the edge of the roofing for at least 100 mm. The bottom edge of the apron should be not less than 150 mm above the roofing.
- Fasten the apron with roofing self-tapping rubber-sealed screws with a span of 200 mm.
- The length of one apron should not exceed 2500 mm.

- An overlap in the apron junctions – 30-50 mm. Do not install fasteners in the overlaps.
- Apply sealing mastic TECHNONICOL N°23 atop.

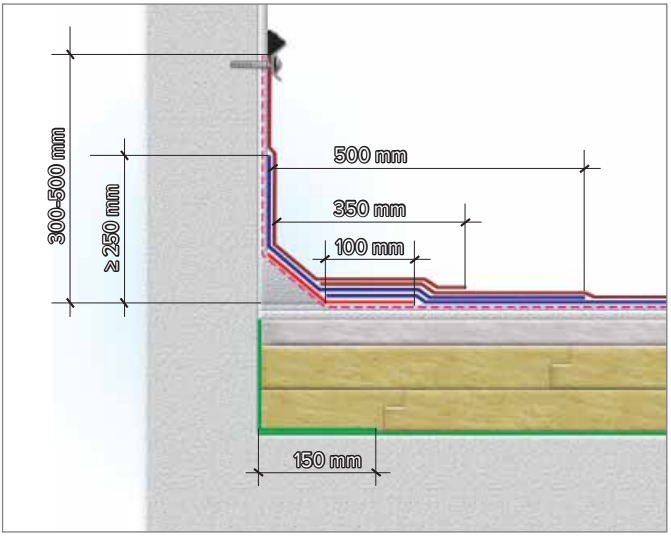
In case of oversailing courses on the vertical surface of the wall



1. Sealing mastic TECHNONICOL N°23
2. Mechanical fastening of the roof with a metal washer 50 mm in diameter and pointed self-tapping screws TECHNONICOL
3. Drip edge from galvanized steel
4. Technoelast K-MS 170/4000
5. Technoelast K-PS 170/5000

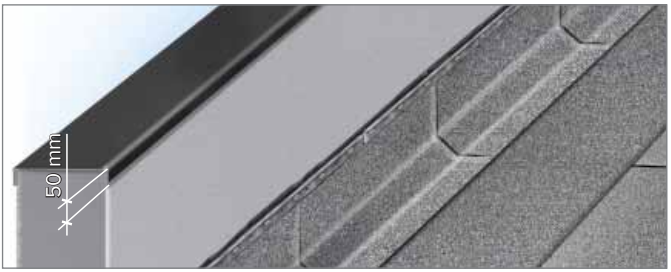
- Weld the material on the vertical surface. Place the material in the oversailing course.
- Fasten the roofing with metal washers D=50 mm with pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve.
- Install the galvanized steel apron in the chase. The apron should overlap the edge of the roofing for at least 100 mm. The bottom edge of the apron should be not less than 150 mm above the roofing.
- Fasten the apron with roofing self-tapping rubber-sealed screws with a span of 200 mm. The length of one apron should not exceed 2500 mm.
- An overlap in the apron junctions – 30-50 mm. Do not install fasteners in the overlaps.
- Apply sealing mastic TECHNONICOL N°23 atop.

When placing the material on a height of more than 700 mm, it is necessary to carry out interposing fastening of the roofing material:

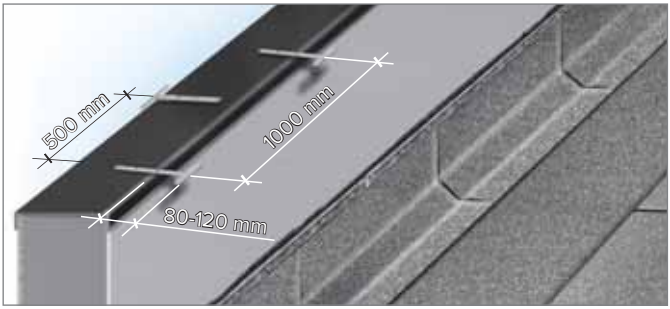


IMPORTANT! The upper part of the parapet on the roof should be protected with roofing steel or covered with parapet slabs with seam gluing.

Let us consider an option of covering of the parapet with roofing steel.



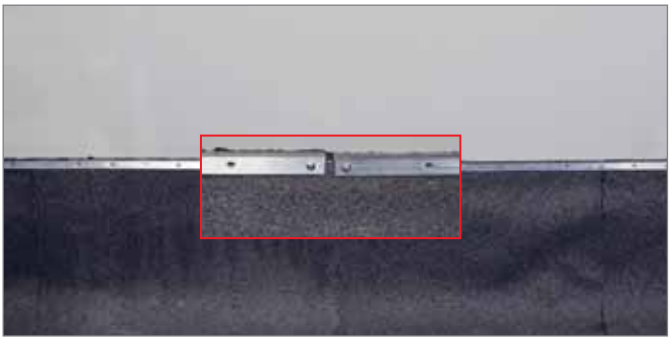
- Weld Technoelast K-PS 170/5000 on the horizontal part of the parapet and place it on the vertical part (from the facade side and the side of the roofing) for 50 mm.
- Install T-shaped metal pieces from each side of the parapet with a span of 1000 mm.



- The row of metal pieces from one side of the parapet should be shifted for 500 mm relatively another row. T-shaped metal pieces should protrude beyond the edge of the parapet for 80-120 mm.

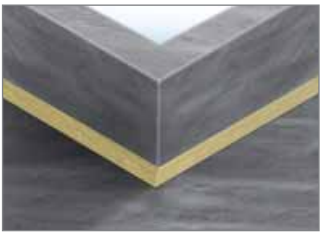
- Install the galvanized apron on metal pieces.
- The apron will protect the parapet from impacts of atmospheric precipitations and mechanical damaging.

General view of the junction to a high parapet:

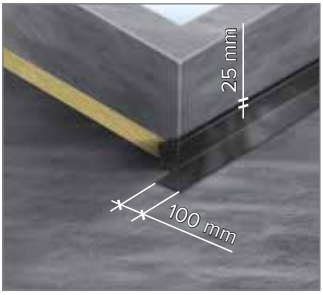


5.2.5. Junction to an External Angle

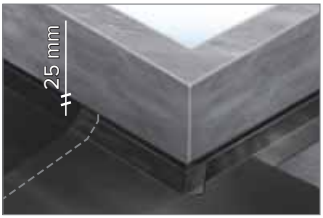
Let us consider the arrangement of an external angle of a parapet up to 450 mm high.



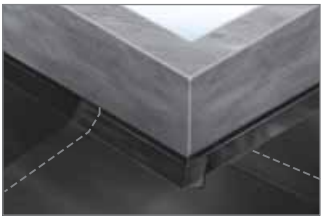
Install angle fillet from TECHNOROOF stone wool in the areas of junction with the parapet on a hot roofing mastic.



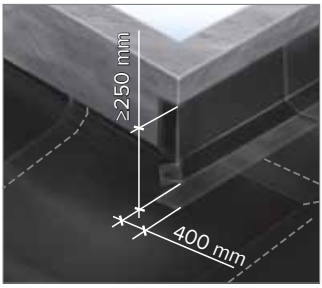
Install and weld the strips of the reinforcement layer from Unifleks EPP 4.0 on the angle fillet from the side of the parapet, where the material is going to be placed with its lateral part.
The reinforcement layer should totally cover the fillet, be placed on the horizontal surface of the fillet for 100 mm and on the vertical surface 25 mm from the fillet.



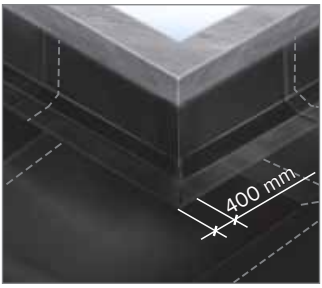
Weld the base layer of the material, the end part of which is placed to the parapet.
The material should totally cover the fillet and be placed on the vertical surface 25 mm from the fillet.



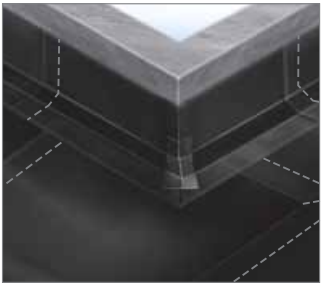
Weld the base layer from Unifleks EPP 4.0 over the entire surface of the roofing.



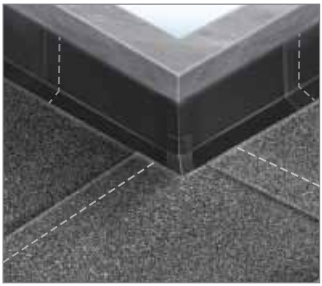
Weld the additional base layer on one side of the external angle.
The material should cover 100 mm of another side of the parapet, be placed on the horizontal plane of the roof for 150 mm and on the parapet of not less than 250 mm.



Weld the additional base layer on another side of the external angle.

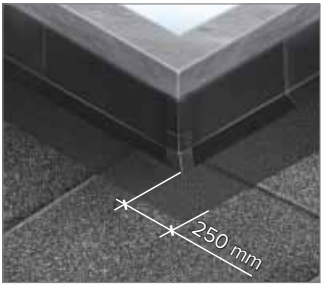


Weld a patch on the corner junction with the fillet.



Weld the top layer from Technoelast K-PS 170/5000.

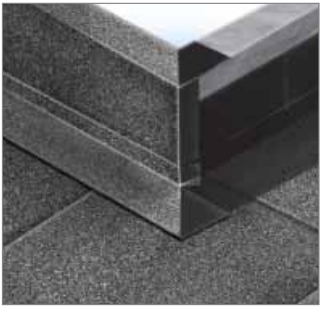
Place the material close to the angle fillet, but do not place it on the inclined surface of the fillet.



For qualitative welding on the coarse-slate material, remove the slate from the welding area.

To remove the slate:

- Warm up the material with the flame of a torch.
- Imbed the slate in bitumen with a spatula 200 mm from the edge of the angle fillet and Technoelast K-PS 170/5000.



Weld the additional top layer over the entire plane of the parapet on one side of the angle of the parapet.

- The material should cover another side of the parapet for 100 mm, be placed on the horizontal plane of the roof for 200 mm and on the facade part of the parapet for 50 mm.
- Remove coarse-grained slate from the area of an overlap.

Weld the additional top layer from Technoelast K-PS 170/5000 over the entire plane of the parapet on another side of the angle of the parapet.

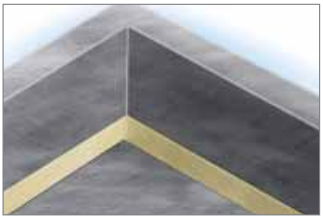
IMPORTANT! Protect the parapet with a galvanized apron from the impacts of atmospheric precipitations and mechanical damaging.

Peculiarities of performing external angle to vertical surfaces (walls, high parapets etc.)

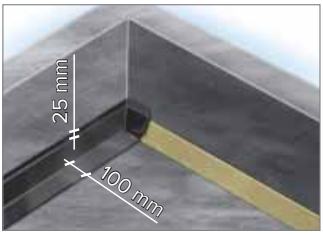
The principle of performing an external angle to walls, high parapets and other vertical constructions is almost the same as the method described above.

- The difference is that the top layer of the material is recommended to be placed on a height of not less than 350 mm.
- The material welded on the vertical surface is necessary to be fastened with an edge strip with pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve.
- The gap between the wall and the upturn of the strip is to be filled with sealing mastic TECHNONICOL N°23.

5.2.6. Junction to an internal angle

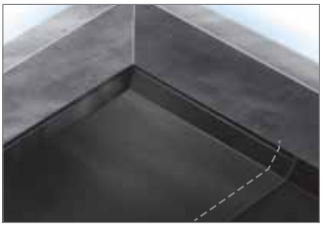


Install angle fillet from TECHNOROOF stone wool on the hot roofing mastic TECHNONICOL N°41 in the junctions with the parapet.

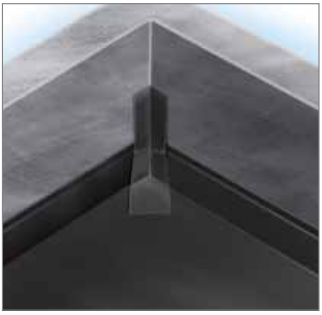


Install and weld the strips of the reinforcement layer from Unifleks EPP 4.0 on the angle fillet from the side of the parapet, where the material is going to be placed with its lateral part.

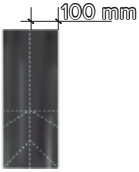
- The reinforcement layer should totally cover the fillet, be placed on the horizontal surface of the fillet for 100 mm and on the vertical surface 25 mm from the fillet.

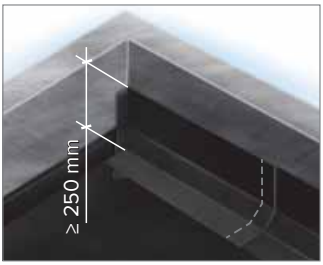


Weld the base layer of the material, which is placed to the parapet with its end part:
The material should totally cover the fillet and be placed on the vertical surface 25 mm from the fillet.



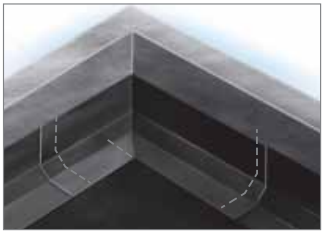
Weld a patch on the angle to seal the seam. Place the patch on the height of the additional base layer (not less than 250 mm).



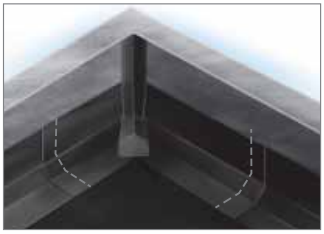


Weld the additional base layer on one side of the external* angle on a height of not less than 250 mm.

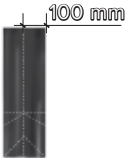
The material should be placed on the horizontal surface of the roof for 150 mm.

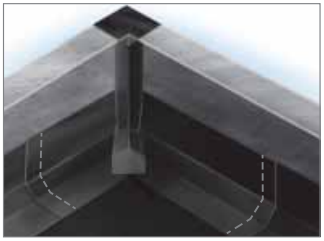


Weld the additional base layer from another side of the external* angle.

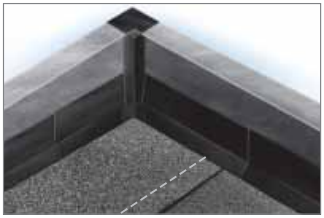


Weld the patch on the angle over the entire height of the parapet to seal the seam.

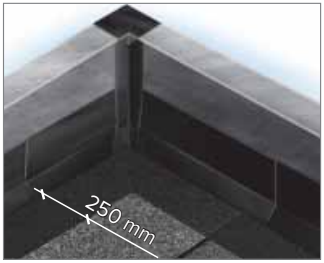




Weld the patch on the horizontal plane of the parapet to seal the seam.



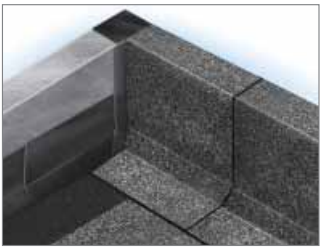
Weld the top layer from Technoelast K-PS 170/5000. Place the material closely to the fillet, but do not place it on the inclined surface of the fillet.



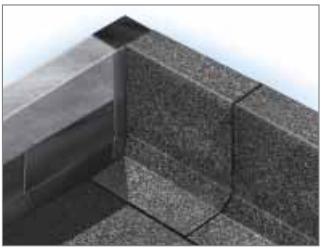
For qualitative welding on the coarse-grained slate material, remove the slate from the welding area.

To remove the slate:

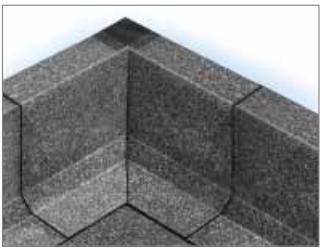
- Warm up the material with the flame of a torch.
- Imbed the slate in bitumen with a spatula 200 mm from the edge of the angle fillet and Technoelast K-PS 170/5000.



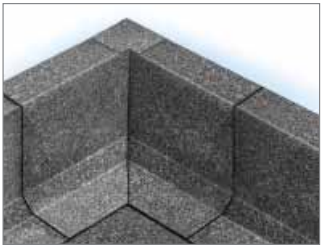
Weld the additional top layer on the entire plane of the parapet from one side of the angle of the parapet.
Place the material on the facade part of the parapet for 50 mm.



For qualitative welding on the coarse-grained slate material, remove the slate from the welding area.



Weld the additional top waterproofing layer over the entire plane of the parapet from the other side of the angle of the parapet.



Weld the patch from coarse-grained slate material on the left horizontal plane of the parapet.
Remove the coarse-grained slate from the additional top layer in the overlap with the patch.

IMPORTANT! Protect the parapet with a galvanized apron from the impacts of atmospheric precipitations and mechanical damaging.

Peculiarities of performing internal angle to vertical surfaces (walls, high parapets etc.)

The principle of performing internal angle to vertical constructions is almost identical to the method described above.

- The difference is, that the material is recommended to be placed on a height of not less than 350 mm.
- The material welded on the vertical surface is to be fastened with an edge strip with pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve.
- The gap between the wall and the upturn of the strip is to be filled with the sealing mastic TECHNONICOL N°23.

5.2.7. Junction to eave

IMPORTANT! To install an eave, T-shaped metal pieces and a galvanized steel apron are required.

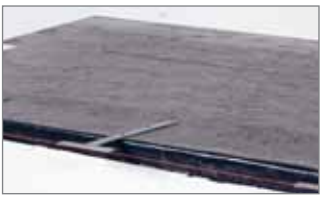
T-shaped metal piece – is intended for fastening of galvanized drip edges and aprons to the parapets. A metal piece should be not less than 4 mm thick.

Galvanized steel overhang – protects the wall from pouring rain- and melt-water.

Weld the first roofing layer from Unifleks EPP 4.0 on the eave.

Place the material on the facade part of the building for 50 mm.

After welding the material on the eave, continue installing the first layer over the entire surface of the roof .



Install and fasten T-shaped metal pieces with a span of not more than 700 mm.

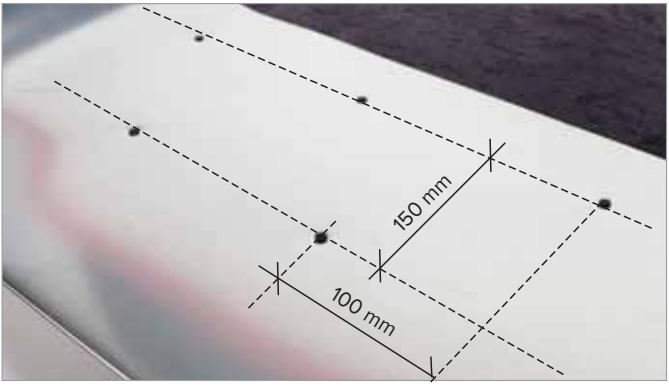
T-shaped metal pieces should protrude beyond the edge of the eave for 80-120 mm.

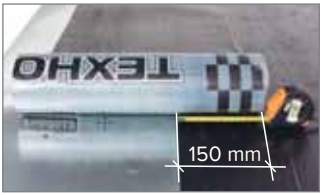
Install the eave:

- Eave should be installed on the metal piece tightly.
- The flange of the eave should be at least 350 mm wide.

IMPORTANT! Welted metal sheets of the eave should be installed with overlaps.

- Fasten the eave with pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve with a 200 mm span in two rows. The distance between the rows should be 150 mm.
- Self-tapping screws should be shifted one relatively another in the rows for 100 mm.





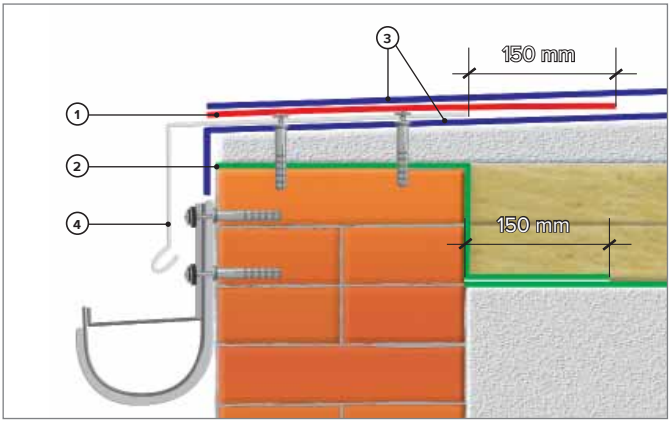
Weld the reinforcement layer from Unifleks EPP 4.0. The reinforcement layer should cover the eave for 150 mm.

Weld the top waterproofing layer from Technoelast K-PS 170/5000 .

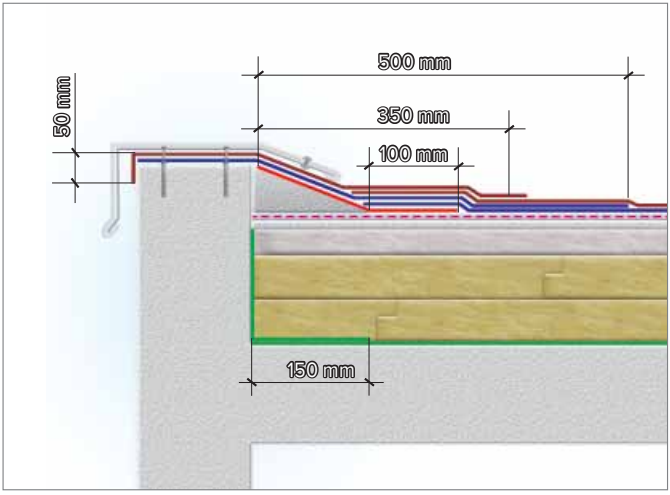
If the works are carried out correctly and all the recommendations are followed, the following layout should be obtained:

1. base layer (Unifleks EPP 4.0)
2. eave
3. reinforcement layer (Unifleks EPP 4.0)
4. top layer (Technoelast K-PS 170/5000)

There are various types of galvanized eaves, which differ in shape. Profile of a fixture element (metal piece) depends on the shape of the galvanized apron itself.



1. Reinforcement layer (Unifleks EPP 4.0)
2. Vapor barrier (Unifleks EPP 4.0, Unifleks K-MS 170/4000 Technoelast K-MS 170/3000, Technoelast K-MS 170/4000)
3. Roofing membrane (Technoelast K-PS 170/5000)
4. Galvanized apron
5. Metal piece



5.2.8. Junction to fence pole (equipment support and other elements) fastened to the deck with a flange

To protect people from falling during operation, repair and service of the roof, fences are installed.

Installation of the fence directly on the ready roofing:

Carry out setup of the fence poles on the plane of the roof according to the project solution.

- Bases of poles should be installed before the eave and should not be placed on the galvanized steel element.

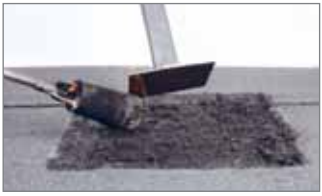
Prepare the reinforcement layer from Unifleks EPP 4.0:

- The length of the side of the layer should cover the base of the pole for 150 mm from each side.
- Cut a hole in the centre for the profile of the pole.

Delineate the contour of the reinforcement layer on the top waterproofing layer of Technoelast K-PS 170/5000 in the area of installation of the pole.

Warm up the material within the contour and imbed the slate with a spatula on Technoelast K-PS 170/5000.

There should be no slate on the prepared area.



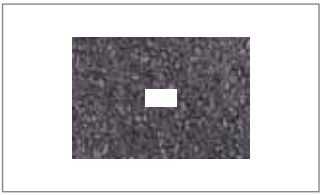
Warm up the base for the pole flange with the flame of a torch, then install the pole. Make sure, that the lowing-out of polymer-bitumen binder from under the base of the pole is even.

- Flowing-out will provide total tightness of a junction.

Fasten the pole to the deck. Roofing fence of a building must hold the load of not less than 0.54 kN (54 kgf).

For a tight junction, it is necessary to cover the base of a pole with a bitumen binder.

Weld the reinforcement layer from Unifleks EPP 4.0.



Prepare the additional layer from Technoelast K-PS 170/5000:

- The length of the side of the layer should cover the base of the pole for 200 mm from each side.
- Cut a hole in the centre for the profile of the pole.
- The angles of the created additional layer are recommended to be rounded.

Remove the slate from the material to weld the additional top layer.

Weld the additional top layer from Technoelast K-PS 170/5000.

Install the rails of the fence.

5.2.9. Installation of a pipe through the roofing

Installation of a pipe through the roofing with a seal

Put the seal on the pipe and select necessary diameter.

Cut the seal to the chosen diameter of the pipe.

Burn the film on the surface of the material.

- When using thin torch-on applied materials as the materials for the base layer, before installation of the flange of the funnel it is necessary to burn the film on the material and pour a layer of hot mastic TECHNONICOL N°41 or apply mastic TECHNONICOL N°23 (Fixer) with a spatula.

Imbed the skirt in the warmed material. Make sure, that the flowing-out of the polymer-bitumen binder from under the skirt of the seal is even. Flowing-out will provide total tightness of a junction.

For a tight junction, it is necessary to cover the seal skirt with a bitumen binder.

Weld the top layer from Technoelast K-PS 170/5000.

To seal the junction between the pipe and the seal, apply sealing mastic TECHNONICOL N°23.

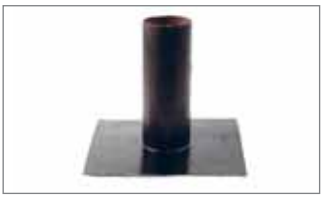
Install a hose clamp on the seal and tighten.

Galvanized steel hose clamp will provide tight junction of fitting with the pipe.

For extra sealing of the seal with the roofing, cover the seal and Technoelast K-PS 170/5000 on the perimeter of the junction with sealing mastic TECHNONICOL N°23.

To complete the junction to the pipe, install a galvanized boot on the pipe. Diameter of the boot should be at least 60 mm more than the diameter of the pipe.

Installation of a pipe through the roofing with a metal sleeve



Installation of a metal sleeve:

- The flange of the metal sleeve should be placed on the horizontal surface for 150 mm from the walls of the sleeve.
- The sleeve should be at least 350 mm high,
- Diameter of the sleeve tube should be 10 mm more than the insulated pipe.

Weld the base layer from Unifleks EPP 4.0.

Warm up with the flame of a gas torch a part of the material, on which the flange of the sleeve is going to be installed.

Install the sleeve and imbed the flange in the warmed material. Make sure, that the flowing-out of a polymer-bitumen binder from under the flange of the sleeve is even. Flowing-out will provide total tightness of a junction.

Fasten the metal sleeve to the decking with at least 4 fasteners. As fasteners use pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve.

For a tight junction, it is necessary to cover the flange of the sleeve with a bitumen binder. All methods of bitumen binder applying are considered in 3.1.3 with the example of covering the flange of a funnel.

Prepare the reinforcement layer from Unifleks EPP 4.0 in the shape of a square:

- The sides of the square should cover the flange of the metal sleeve for 150 from each side.
- Cut a round hole in the middle of the square with a diameter of the pipe of the sleeve.

Weld the additional reinforcement layer. Pay attention to the flowing-out of bitumen from under the edge of the material.

Weld the top layer from Technoelast K-PS 170/5000.

Install a galvanized steel bell on the pipe and tighten it with a hose clamp.

The galvanized steel skirt will protect the space between the pipe and the sleeve from atmospheric precipitations.
The skirt should cover 75 mm of the height of the sleeve.

To tighten the junction between the pipe and the skirt, apply sealing mastic TECHNONICOL N°23 and tighten the hose clamp.

The galvanized steel hose clamp will provide tighten junction between the bell and the pipe.

To complete the junction to the pipe, install a galvanized steel boot on it. Diameter of the boot should be at least 60 mm more than the diameter of the pipe.

Installation of the small diameter pipe through the roofing, junction to anchors and other small elements

Manufacture a metal sleeve:

- The flange of the metal sleeve should be placed on the horizontal surface for 150 mm from the walls of the sleeve.
- The sleeve should be at least 100 mm high.
- Distance between the edge of the pipe and the sleeve wall should be not less than 25 mm.

This type of a metal sleeve can be also used when performing a junction to anchors and other small elements.

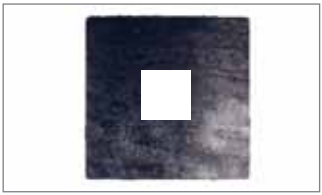
Weld the base layer of the roofing material.

Warm up with the flame of a torch a part of the material, where the flange of the sleeve is going to be installed.

Install the sleeve and imbed the flange in the warmed material. Make sure, that the flowing-out of a polymer-bitumen binder from under the flange of the sleeve is even. Flowing-out will provide total tightness of a junction.

Fasten the metal sleeve to the decking with at least 4 fasteners. As fasteners use pointer self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve.

For a tight junction, it is necessary to cover the flange of the sleeve with a bitumen binder.



Prepare the reinforcement layer from the base layer material in the shape of a square:

- The sides of the square should cover the flange of the metal sleeve for 100 from each side.
- Cut a round hole to the dimensions of the sleeve in the middle of the square.

Install and weld the additional reinforcement layer. Pay attention to the flowing-out of bitumen from under the edge of the material.

Weld the top layer of a roofing material.

Fill the space between the pipe and the walls of the sleeve with a Polyurethane sealant.

Instead of a polyurethane sealant, hot roofing mastic TECHNONICOL N°41 can be used - fill the sleeve with the mastic and apply shale slate atop.

5.2.10. Expansion Joints Performing

Expansion joints are performed to divide a building or its certain parts to, first of all, prevent the destruction of constructions of a building, caused by different deformations. To decrease the probability of expansion joint leaking, the slopes on the roof should be formed in the way so that water would flow in different directions from the expansion joint.

Weld the base waterproofing layer of Unifleks EPP 4.0 from the both sides of an expansion joint. Place the material closely to the expansion joint.

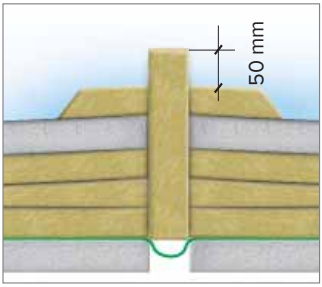
Warm up with the flame of a torch the surface of the decking from the both sides of the expansion joint.

- Install TECHNNOROOF thermal insulation 100 mm thick and not less than 200 mm wide from the both sides on the warmed decking.
- Create angle fillet from TECHNOROOF stone wool (cut the longer edge of the thermal insulation at 45° or install ready-made fillet from TECHNOROOF stone wool).
- Insert squeezable TECHNOLITE stone wool thermal insulation in the expansion joint till the vapor barrier layer.

TECHNOLITE – stone wool material, based on rocks of the basalt group and intended for using as heat and sound insulation of building constructions of civil and industrial buildings and buildings, in which thermal insulation does not hold external loads.

Install Unifleks EPP 4.0 rolled in a tube on the squeezable thermal insulation. The tube should be 50-70 mm in diameter.

Material rolled in a tube is used to form an expansion loop of a roof. Instead of a wound tube, a Ø 50 mm rubber cord can be used:



Install the reinforcement layer. The reinforcement layer should cover the stone wool thermal insulation (TECHNOROOF) and a tube from Unifleks EPP 4.0. End overlaps of the reinforcement layer should be glued.

IMPORTANT! Reinforcement layer should be installed without welding on the stone wool. To avoid displacement of the reinforcement layer during the process of the further assembling of an expansion joint, warm up the material pointwise and install it on the stone wool. The flame of a torch should not touch stone wool.

Weld the base layer from Unifleks EPP 4.0. The material should cover the expansion joint and be placed on the horizontal part of the decking for 50 mm from each side of the joint.

Weld the top layer from Technoelast K-PS 170/5000. Place the material close to the angle fillet without placing it on the expansion joint.

For qualitative torch-on application on the coarse-grained slate material, remove the slate from the welding area:

- Warm up the material with the flame of a torch.
- Imbed the slate in bitumen with a spatula 200 mm from the edge of the angle fillet and Technoelast K-PS 170/5000.

Weld the top layer from Technoelast K-PS 170/5000.

- The material should cover the expansion joint and be placed on the horizontal surface of the decking for 200 mm from each side of the joint.
- Lateral overlaps should be 100 mm.

5.2.11. Junction to roofing aerator

Roofing aerator (roof cowl) - a device intended for removing water vapors and moisture from roof space. Roofing aerator is used at installation of "breathing" roofing and also at repairs of local bulges of a roof and, if needed, in the roofs with a sloping layer from keramzite gravel. When installing a roof in cold seasons, aerators are especially recommended to be installed.

- Roofing aerators are installed on the roof at the rate of 1 pc. (1 aerator Ø110 mm) per 100 m^2 of the roof. For optimal removal of vapor from under the roofing the distance between the aerators should not exceed 12 m.
- In the valley aerators are installed every 10-12 m, in the ridges - 6-8 m.

Weld the base layer from Unifleks EPP 4.0 on the roof.

Cut a round hole in the place of aerator installation till the sloping layer from filled-up thermal insulation. Diameter of the hole should be equal to the inner diameter of the aerator pipe.

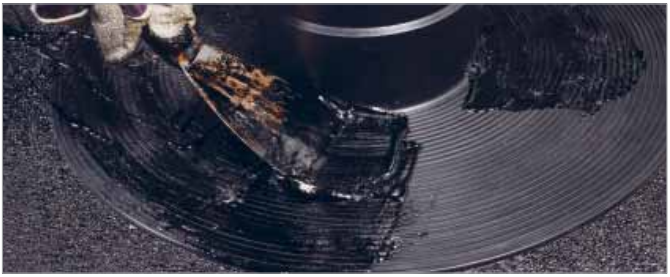
IMPORTANT! When repairing leaking roofs, in the places of roofing aerators installation a hole is cut till the vapor barrier layer.

Warm up with the flame of a torch a part of Unifleks EPP 4.0, on which the aerator is going to be installed.

Install the aerator and imbed the skirt in the warmed material. Make sure, that the flowing-out of a polymer-bitumen binder from under the flange of the aerator is even. Flowing-out will provide total tightness of a junction.

Fasten the roofing aerator to the decking with at least 4 fasteners. As fasteners use pointed self-tapping screws TECHNONICOL EDS-S 4.8 with a polyamide sleeve.

For a tight junction, it is necessary to cover the flange of the aerator with a bitumen binder.



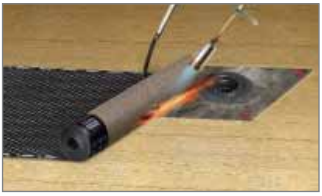
Weld the top layer from Technoelast K-PS 170/5000.

- Fill the aerator with keramzite gravel so that the level of the gravel is 1/3 aerator's height higher than the level of the roof.
- To complete the aerator, install the boot.

For extra sealing of the aerator with the roofing, apply sealing mastic TECHNONICOL N°23 on the perimeter of the junction between the aerator and Technoelast K-PS 170/5000.

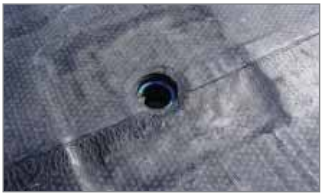
5.3. Two-ply waterproofing covering with mechanical fastening of the first layer

5.3.1. Junction to water funnel



Install the base layer of the roofing from Technoelast K-MS 170/4000.

- The base roofing layer should be welded to the reinforcement layer of the funnel.
- Temporarily fill the funnel with a non-flammable material so it will not be damaged during works with a torch.



Cut the installed material to the hole of the water funnel pipe.

Weld the top roofing layer from Technoelast K-PS 170/5000.

While the material is still hot, imbed bolt junctions of the funnel through Technoelast K-PS 170/5000.

Cut the roofing to the diameter of the water funnel pipe.

To increase reliability of a junction between the flange and the roofing, apply sealing mastic TECHNONICOL N°23 on the reverse side of the flange.

Install the flange and fasten it with screws.

Install a leaf catcher.

5.3.2. Installation of a parapet funnel (parapet spillover)

Junction of the roofing to the parapet funnel is carried out in accordance with the technology considered in 6.3.4. Preparation of the junction before installation of roofing material is similar with that described in 6.3.4. Below the junction of the roofing to the parapet funnel is considered.

Install the base layer from Technoelast K-MS 170/4000 on the main plane of the roof.

- The material should be welded to the reinforcement layer of the funnel.

Install angle fillet from TECHNOROOF stone wool on a hot mastic to the parapet funnel. Change the direction smoothly from the inclined surface of the fillet to the vertical surface of the additional layer.

Weld strips of the reinforcement layer from Unifleks EPP 4.0 on the fillet.

- Reinforcement layer should totally cover the fillet and be placed on the horizontal surface 100 mm from the fillet and on the vertical surface 25 mm from the fillet.

Weld the base layer from Unifleks EPP 4.0 on the parapet so that the lateral edge lies on the axis of the funnel.

Cut the roofing to the hole of the water funnel pipe.

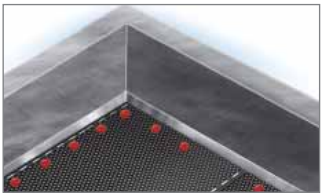
Weld the top layer from Technoelast K-PS 170/5000 on the main plane of the roof.

Stick Technoelast K-PS 170/5000 to the parapet.

- Cut the roofing to the hole of the water funnel pipe.
- Install a leaf catcher in the obtained round hole.

5.3.3. Junction to a parapet up to 450 mm.

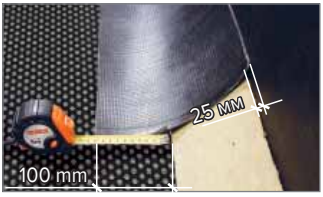
Parapets up to 450 mm high can be entirely covered (this type of a junction to the parapet is considered below). It is recommended to entirely cover the parapets up to 700 mm high.



Install the base layer from Technoelast K-MS 170/4000 on the main plane of the roof.

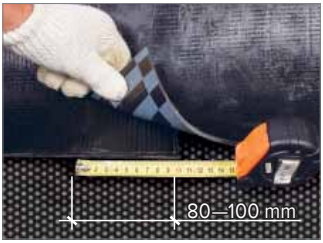
- Place Technoelast K-MS 170/4000 close to vertical constructions.
- Fasten the base layer with a chosen span on the entire perimeter of the roof.

In the places of junctions to vertical constructions install angle fillet from TECHNOROOF stone wool on the material, preliminarily warmed with the flame of a torch.

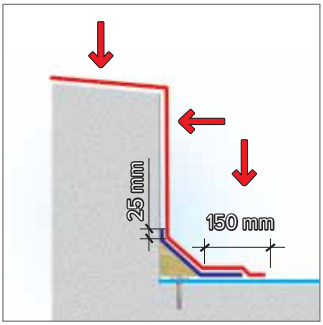


Prepare strips of the reinforcement layer from Unifleks EPP 4.0. Reinforcement layer should totally cover the fillet and be placed on the horizontal surface 100 mm from the fillet and on the vertical surface 25 mm from the fillet.

IMPORTANT! Installation of reinforcement layers from Unifleks EPP 4.0 should begin from the low areas of the roof, avoiding the occurrence of counter seams.



Lateral overlaps of adjacent reinforcement layers should be 80-100 mm.

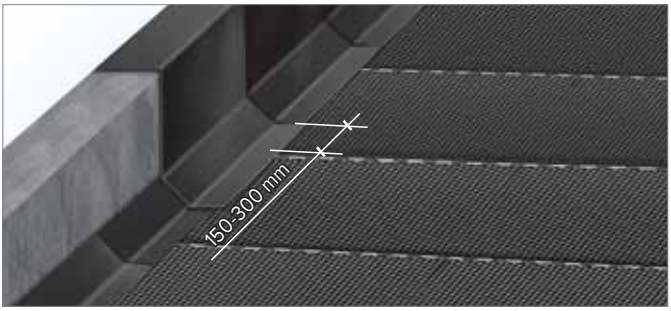


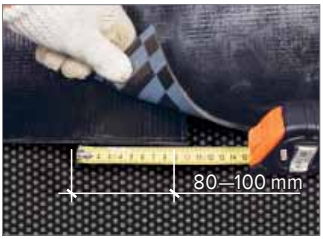
Prepare the base layer from Unifleks EPP 4.0 for placement on the plane of the parapet.

The material should be placed on the vertical surface of the parapet for a height of at least 250 mm and on the horizontal surface of the decking 150 mm from the angle fillet.

IMPORTANT! Installation of the base layer of Unifleks EPP 4.0 on the parapet should begin from the low areas of the roof - valleys - to avoid the occurrence of counter seams. Water should flow from the seam towards the valley. The roll installed on the low area (valley) should be overlapped with adjacent ones for 80-100 mm.

Spacing between the seam of the additional base layer installed on the parapet and the seam of the base layer on the main plane of the roof should be 150-250 mm.

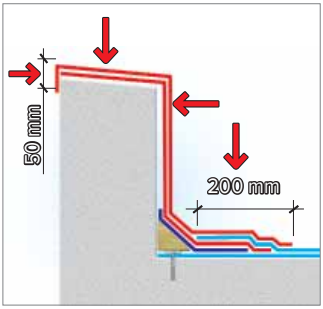




When installing next rolls, keep lateral overlaps of 80-100 mm.

Weld the top layer from Technoelast K-PS 170/5000 on the main plane of the roof.

- Place the material close to the angle fillet without placing it on the stone wool fillet.



Prepare the top layer from Technoelast K-PS 170/5000 for placement of the plane of the parapet:

The material should be placed on the facade part of the parapet for 50 mm;

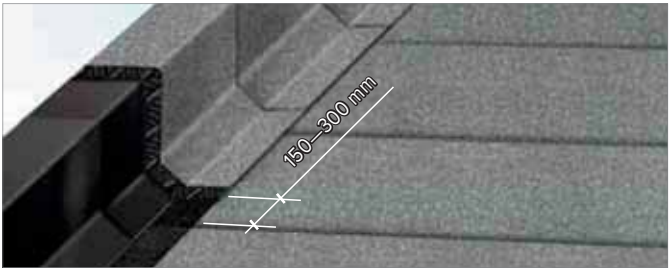
- On the horizontal surface should the material totally cover the angle fillet and be placed on the plane for 200 mm.

To provide an overlap with the additional top layer, warm up the material and imbed the slate in the welding area.

The slate should be removed from 200 mm from the edge of the angle fillet and Technoelast K-PS 170/5000.

IMPORTANT! Installation of the top layer of Technoelast K-PS 170/5000 on the vertical surface should begin from the low areas. Water should flow from the seam towards the valley.

- The roll installed on the low area (valley) should be overlapped with adjacent sheets for 80-100 mm.
- Remove coarse-grained slate from the surface of the material to form a lateral overlap.
- The distance between lateral junctions of the roofing sheets in adjacent layers on the parapet should be 300-600 mm.

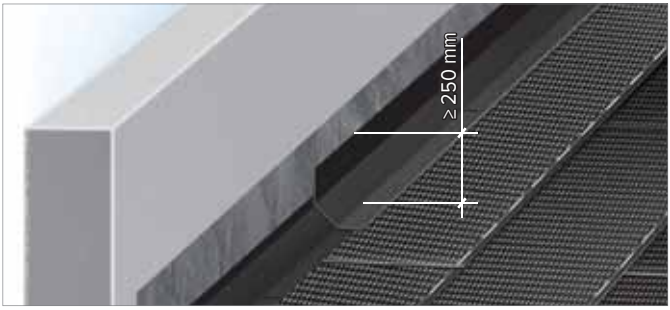


IMPORTANT! It is recommended to protect the upper part of the parapet with galvanized roofing steel or parapet slabs with seam gluing.

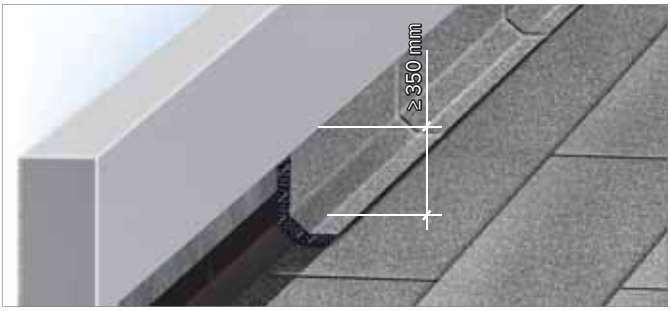
5.3.4. Junction to vertical constructions

Junction to a vertical surface is carried out according to the technology described in the paragraph above. The only difference is that the roofing material is necessary to be placed on a height of at least 350 mm and extra fastened with an edge strip.

- The additional base layer should be placed on the vertical surface for at least 250 mm.



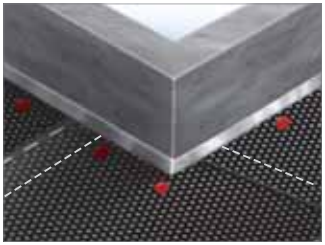
- The additional top layer is recommended to be placed on the vertical surface for at least 350 mm.



- Depending on the type of the decking of the vertical surface two types of fastening of the edge of the roofing material are possible.

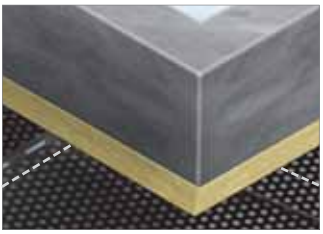
5.3.5. Junction to an External Edge

Parapets up to 450 mm high can be entirely covered (this type of junction to the parapet is considered below). It is recommended to entirely cover parapets up to 700 mm high.



Install the base roofing layer from Technoelast K-MS 170/4000 on the main plane of the roof.

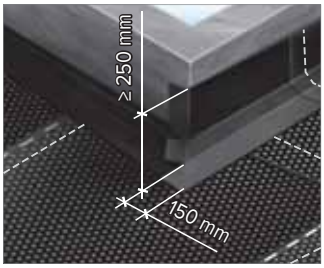
- Place the material close to the parapet and additionally fasten the edge of the material with a chosen span.



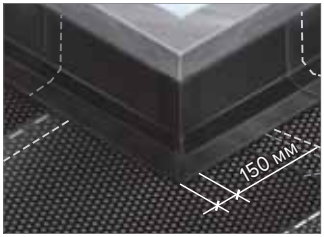
Install angle fillet on the material preliminarily warmed in the areas of junction with the parapet.

Install and weld the reinforcement layer strips from Unifleks EPP 4.0.

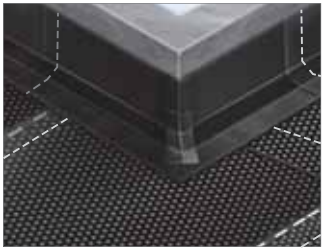
- Reinforcement layer should totally cover the fillet, be placed on the horizontal surface 100 mm from the fillet and on the vertical surface 25 mm from the fillet.



Weld the additional base layer on one side of the external angle.
The material should cover 100 mm of another side of the parapet, be placed on the horizontal surface of the roof for 150 mm and placed on the parapet on a height of not less than 250 mm.



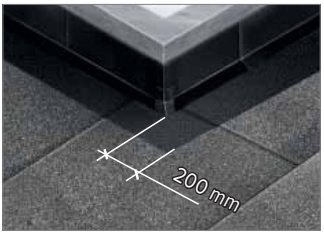
Weld the additional base layer on another side of the external angle.



Weld a patch on the corner junction with the fillet.

Weld the top layer from Technoelast K-PS 170/5000.

Place the material close to the angle fillet without placing it on the inclined surface of a fillet.



For qualitative welding on the coarse-grained slate material, remove the slate from the welding area.

Weld the additional top layer over the entire plane of the parapet from one side of the angle of the parapet.

- The material should cover 100 mm of another side of the parapet, be placed on the horizontal plane of the roof for 200 mm and on the facade part of the parapet for 50 mm.
- Remove coarse-grained slate from the overlapping area.

Weld the additional top layer from Technoelast K-PS 170/5000 over the entire plane of the parapet from another side of the angle of the parapet.

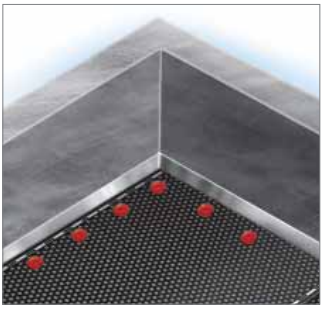
IMPORTANT! Protect the parapet from impacts of atmospheric precipitations and mechanical damaging with a galvanized steel apron.

Peculiarities of performing external angle to vertical surfaces (walls, high parapets etc.)

The principle of performing an external angle to vertical constructions is almost identical to the method described above.

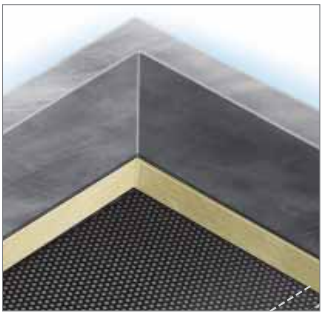
- The difference is, that the top layer of the material is recommended to be placed on a height of not less than 350 mm.

5.3.6. Junction to an internal angle

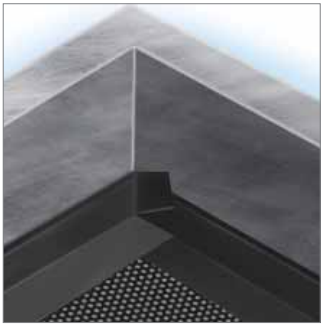


Install the base roofing layer from Technoelast K-MS 170/4000 on the main plane of the roof.

Place the material close to the parapet and additionally fasten the edge of the material with a calculated span.

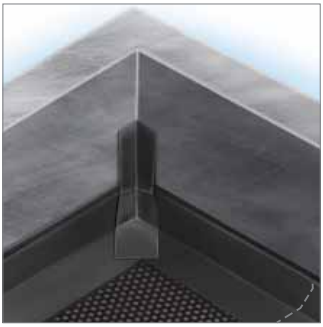


Install angle fillet on the material preliminarily warmed in the areas of junctions to the parapet.

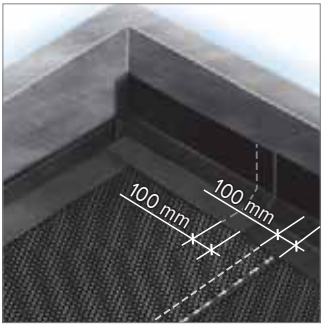


Install and weld the strips of the reinforcement layer from Unifleks EPP 4.0.

Reinforcement layer should totally cover the fillet and be placed on the horizontal surface 100 mm from the fillet and on the vertical surface 25 mm from the fillet.

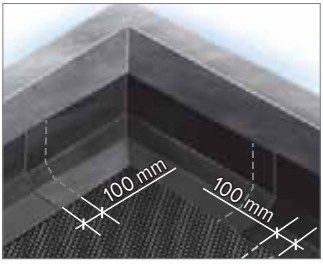


Weld a patch on the angle to seal the seam. Place the patch on the height of the additional base layer (not less than 250 mm).

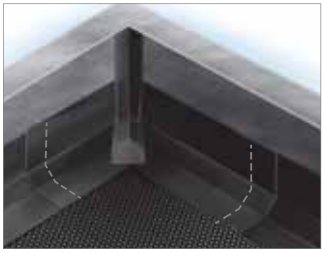


Weld the additional base layer from one side of the internal angle on a height of not less than 250 mm.

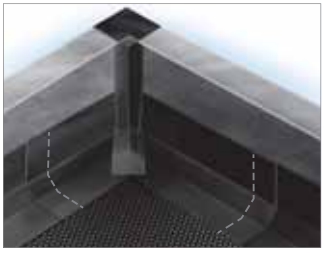
The material should be placed on the horizontal surface of the roofing for 150 mm.



Weld the additional base layer from another side of the internal angle.

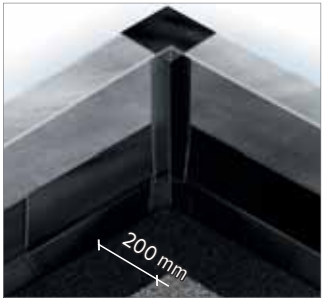


Weld the patch on the angle over the entire height of the parapet to seal the seam.



Weld the patch on the horizontal plane of the parapet to seal the seam.

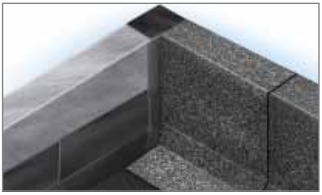
Weld the top layer from Technoelast K-PS 170/5000. Place the material close to the angle fillet without placing it on the inclined surface of a fillet.



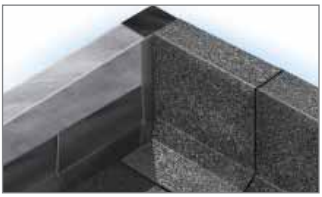
For qualitative welding on the coarse-grained slate material, remove the slate from the welding area.

To remove the slate, warm up the material with the flame of a gas torch.

Imbed the slate in the bitumen with a spatula 200 mm from the edge of the angle fillet and Technoelast K-PS 170/5000.



Weld the additional top layer over the entire plane of the parapet on one side of the angle of the parapet.
Place the material on 50 mm of the facade part of the parapet.



For qualitative welding on the coarse-grained slate material, remove the slate from the welding area.

Weld the additional top waterproofing layer over the entire plane of the parapet from another side of the angle of the parapet.

- Weld a patch from a coarse-grained slate material on the left horizontal plane of the parapet.

Remove the coarse-grained slate from the additional top layer in the area of an overlap with the patch.

IMPORTANT! Protect the parapet from impacts of atmospheric precipitations and mechanical damaging with a galvanized steel apron.

Peculiarities of performing internal angle to vertical surfaces (walls, high parapets etc.)

- Roofing material fastening is considered in 5.2.3. The difference is, that the top layer is recommended to be placed on a height of not less than 350 mm.

5.3.7. Installation of an Eave

Installation of an eave is carried out according to the technology considered in 5.2.7.
Technoelast K-MS 170/4000 should be welded to the reinforcement layer and the eave.

5.3.8. Junction to Pipes

Junction of the roofing to a pipe with a seal is carried out according to the technology considered in 5.2.8.

5.3.9. Junction to Roofing Aerator

Junction of the roofing to an aerator is carried out according to the technology considered in 5.2.11.

5.3.10. Junction to Anchors and Small Diameter Pipes

Junction of the roofing to small diameter pipes is carried out according to the technology considered in 5.2.9.

5.4. Lightning protection

Lightning protection - is a strategy run for people, building and equipment protection from negative impacts of lightning. In this manual examples of roofing lightning protection devices are depicted.

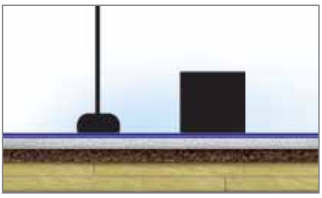
To install lightning protection use the following:

Lightning rope – is intended for installation of a lightning protection grid.

Concrete base – is used for installation of interception rods on flat roofs.

Lightning rods and sticks – are used for installation of separately standing interception rods.

Lightning diverter holder – is intended for fastening of the lightning diverter wire.



To protect the equipment on the roofing (ventilation, conditioning, antennas etc.) separately standing lightning rods are used.

- Lightning rods are installed on a concrete base beneath the protected object. Concrete base is installed on the roofing freely.

Lightning protection grid is installed in accordance with the project. The grid is fastened to plastic holders.

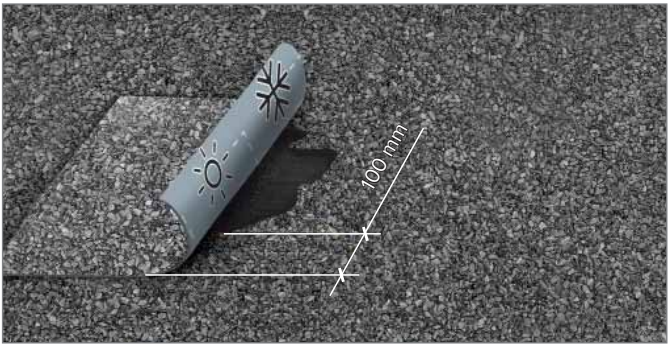
- To create a ballast holding the lightning protection grid, plastic holders are to be filled with sand or sand cement solution. An installation span should not exceed 1 m.

All elements of lightning protection should be interconnected with the lightning protection grid. Lightning protection grid is to be connected to current conductors. Current conductors head over the facade of the building to the ground wire.

6.
Roofing Repair

6. Roofing repair

Repair of the roofing with mechanical damage:



- Clear the damaged area from debris and dust.
- Cut out a patch, which overlaps 100 mm of the damaged area of the roofing for 100 mm.
- Warm up the place of the patch installation with the flame of a torch and imbed the slate with a spatula in the top layer of polymer-bitumen binder.
- Weld the patch on the damaged area.

Slate recovery in cases of protection bitumen binder layer damage:

Apply sealing mastic TECHNONICOL N°23 on the damaged area.

Apply shale slate on the mastic.

With a brush spread the slate evenly over the entire area.

7.
General Rules of Roof Operation

7. General rules of roof operation

- The general principles of roof service are regular monitoring of the roof condition and timely elimination of the occurred defects. Scrutiny of technical condition consists of scheduled and occasional surveys.

To general roll roof operation rules refer the following:

1. Do not allow accumulation of debris and dust on the roofing.
2. Do not expose the roofing to organic solvents, benzene and oils.
3. When a bulging on the roofing occurs, should it be removed in short time.
4. Eliminate the defects of the roofing at an early stage.
5. Placement and installation of the equipment on the roof should be carried out in accordance with the project.
6. Do not allow clogging of the roof drainage elements and occurrence of large areas of water accumulation on the roof.

Removing snow buildups from roof should be done carefully, without damaging the roof structure and waterproofing layers.

During a survey condition of units and elements of the roof, temperature and humidity conditions of a premise located under the roof construction are monitored. In a scheduled order the roofs are examined in spring, summer, autumn and winter. Occasional surveys of the roof should be carried out after heavy downpours, winds, heavy snowfalls, complaints of residents.

- The results of the survey of the roof should be kept in a special registration book.

7.1. Seasonal surveys

During spring surveys the following is carried out:

- examination of the inner surface of the roof slab to identify wet spots from leaks;
- checkup of the condition of the protection layer of the roof;
- evaluation of condition of the roofing in the junctions to vertical surfaces (occurrence of bulges, exfoliations, damage of the roofing fastening);
- checkup of the correctness of the eave and elements of the external water drainage system fastening;
- checkup of fastening of the parapet fences.

During summer surveys the following is carried out:

- checkup of the occurrence of cracks on the top layer of the roofing;
- checkup of the occurrence of bulges on the roofing;
- evaluation of the condition of the roofing in junctions to vertical surfaces (occurrence of bulges, exfoliations, damage of roofing fastening);

During autumn surveys the following is carried out:

- checkup of fastening of the parapet fences;
- cleaning of the roof from debris, dirt and leaves with a broom or scraping devices from polymer materials;
- water drainage systems checkup:
- compliance with the project values of the roof sloping in general and sloping to the water drainage system elements in particular;

- in case of inner water drainage system - condition of the inner water drainage funnels checkup;
- in case of external drainage system - condition of valleys, water gutters, eaves and water funnels checkup;
- in case of free roof drainage - condition of eave overhangs checkup.

Funnels of external downpipes should be covered with special caps during winter - boots from galvanized steel sheets. This helps to prevent accumulations of snow in the funnels, provide runoff of melted waters during snowbreak avoiding downpipes, and decrease their icing. When the environmental temperature becomes steadily positive, the boots shout be taken off of the funnels.

During winter surveys the following is carried out:

- checkup of snow accumulation on the roof and occurrence of iced areas, especially in the eave part of the roof;
- checkup of occurrence of icicles, places of their origin and their absolute length in case of a roof with controlled external roof drainage;
- grade of icing of venting shafts and their hoods checkup;
- occurrence of ice dams along the gutters, near water funnels and downpipes checkup;
- checkup of defects of inner water removal funnels;
- occurrence of frost penetrations and dampen areas on the ceilings of open roofs at external temperatures lower than -25 °C.

7.2. Occasional surveys

After heavy winds and downpours the following is carried out:

- checkup of condition of the protection layer of the roof;
- evaluation of condition of the roofing in junctions to vertical surfaces (occurrence of bulges, exfoliations, damage of roofing fastening);
- checkup of inteslatey of fastening of metal protection aprons and eaves;
- checkup of roof drainage systems.

After heavy snowfalls the following is carried out:

- evaluation of the level of snow cover on the roof.

If there is a threat of collapse of the roof, a decision may be made to clean the roof of the snow. To protect the roofing from damage, snow is not removed from the roof totally, but a layer of at least 5 cm is left. It is forbidden to remove the snow neat vertical walls and parapets within 50 cm from the vertical surface. The roofing can be cleaned only with wooden or plastic shovels. It is forbidden to use metal shovels, digging bars and axes.

After complaints on leaks the following is carried out:

- examination of the roof to identify the defect;
- performing of an emergency repair of the roofing in the damaged area.

Particular areas of roll roofs are allowed to be cleaned from snow in winter season for emergency repair in case of leaking occurrence in those areas.

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