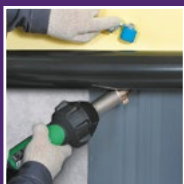




TECHNOLICOL



Manual

for installation of single-
ply polymer membranes for
underground waterproofing

KNOWLEDGE. EXPERIENCE. CRAFTSMANSHIP.



We are proud of what we produce and create. We enjoy seeing how new high-quality materials are produced from plain raw components with our up-to-date equipment, our work and efforts. We are continuously improving ourselves and strive to do the same for the environment. We prefer to address the comprehensive energy efficiency of buildings and structures. Our innovative solutions enable us to create high technology and energy-efficient buildings, improve the quality of buildings under construction, cut down operation and construction costs. We are glad to know that our materials are used in the construction of houses, plants, bridges, social infrastructure facilities and other objects, which improve the level and quality of life of people.

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1.

Introduction

1. Introduction

1.1. General information

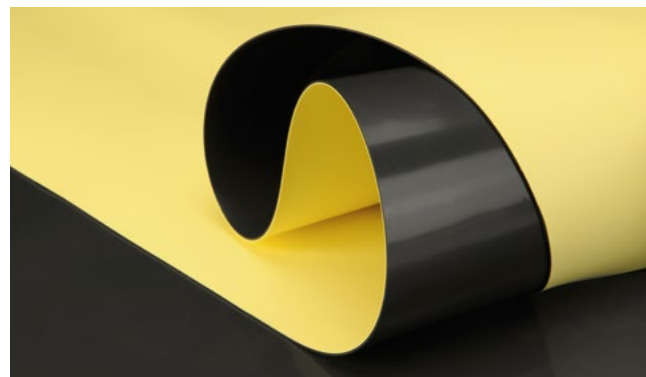
This manual was developed to be used at construction sites when waterproofing underground structures of buildings and facilities.

This manual includes recommendations for installing LOGICBASE V-SL PVC membrane. It is based on membrane laying technology and only contains general rules for installing the waterproofing layer, so should be considered as a short reference book.

TECHNONICOL LOGICBASE V-SL membrane is produced on a state-of-the-art AMUT line (Italy) from high-quality raw materials (PVC, plasticizer and specialized additives) using the extrusion method.

LOGICBASE V-SL membrane fully meets a number of requirements for strength, fire safety and resistance to external impacts (chemical aggressiveness of groundwater, other types of aggression and impact of microorganisms) and durability, and emit no toxic substances during construction and use of facilities.

The membrane has all the necessary certificates required by law confirming its high quality.



1.2. Designations and area of application

LOGICBASE V-SL waterproofing PVC membrane is produced in rolls with a standard width of **2.05 m**, length of **20 m** and thickness of **1.5** and **2.0 mm**. Rolls may be custom-made with a length up to **35 m** and thickness of up to **3.0 mm**.

An example of marking of a 1.5 mm-thick LOGICBASE waterproofing PVC membrane:

LOGICBASE V-SL 1.5 mm



1. Material name;
2. The V-SL index partially describes the base and specifications:
V – polyvinyl chloride (PVC); S – signal; L – layer;
3. Material thickness in millimeters.

LOGICBASE V-SL waterproofing PVC membrane is used for:

- Protecting bearing and retaining structures that are in contact with soil against the impact of ground and surface water, including water under pressure;
- Waterproofing underground structures, underground parking lots, basements and other underground parts of civil construction facilities;
- Waterproofing underground pedestrian crossings;
- Waterproofing subway stations;
- Waterproofing road and railway tunnels constructed by any method, including the trenchless method;
- Waterproofing underground tanks.

1.3. Features of LOGICBASE V-SL membrane

LOGICBASE V-SL waterproofing PVC membrane is a homogeneous, watertight sheet folded into rolls. The membrane has high performance parameters essential for waterproofing of both small low-risk structures constructed in simple geological conditions and highly critical buildings and facilities in complex geological conditions.

The use of LOGICBASE V-SL membrane for underground waterproofing is based on the following properties:

- Absolute water-tightness at a water pressure of up to **60 kPa**;
- Tensile strength over **16 MPa** in the longitudinal direction;
- Ability to stretch by over **320 %** without loss of water-tightness;
- Tear resistance over **150 N**;
- Foldability at a low temperature of **-30 °C**.

The material is classified as a thermoplastic polymer, membrane sheets are easily welded with hot air, without using an open flame. Welded seams have a high tensile strength and are absolutely watertight.

Advantages of LOGICBASE V-SL membrane:

- High durability;
- High resistance to mechanical impact;
- High strength and flexibility;
- High elasticity at low temperatures;
- Possibility of use in aggressive or acidic environment;
- Resistance to root penetration;
- Microbiological stability;
- High chemical resistance;
- Possibility of laying on a damp underground structure;
- High speed installation;
- Loose laying without gluing to the base, which allows easy compensation of movements and deformations of structures and soil due to the strength and elasticity of the membrane;
- Possibility of instrumental quality control of performed work;
- Easy quality control of complete waterproofing.

1.4. Marking, rules of membrane storage and transportation

LOGICBASE V-SL PVC membrane is supplied on wooden pallets; rolls are stockpiled on pallets in three rows with one roll shift in each row.

Rolls are additionally wound with a polyethylene film and bound on a pallet with a polymer strip with lining.



Each roll is packed in a non-transparent polyethylene film for protection against contamination and UV light.

Each pallet with products has a properly marked packing list. The marking contains the following information:

- Manufacturer's name and address;
- Trademark;
- Product name;
- Designation of the polymer membrane;
- Number of the company standard;
- Product issue date;
- Type of upper and lower surfaces;
- Color of upper and lower surfaces.

The rolls shall be stored horizontally in one tier in height on pallets or without pallets, at least **1 m** away from any heating appliances.

The rolls at the construction site shall be protected against an impact of direct sunlight, rain, snow, ice, etc. If stored in dry, clean and moderately cold conditions, preparation for welding is minimized.

NOTE: Do not store pallets with rolls on surfaces with a slope greater than 3 %.

Rolls of material shall be transported in covered vehicles and stacked horizontally on pallets in no more than two rows. Other means of transportation that ensure the integrity of the material are possible with the customer's approval.

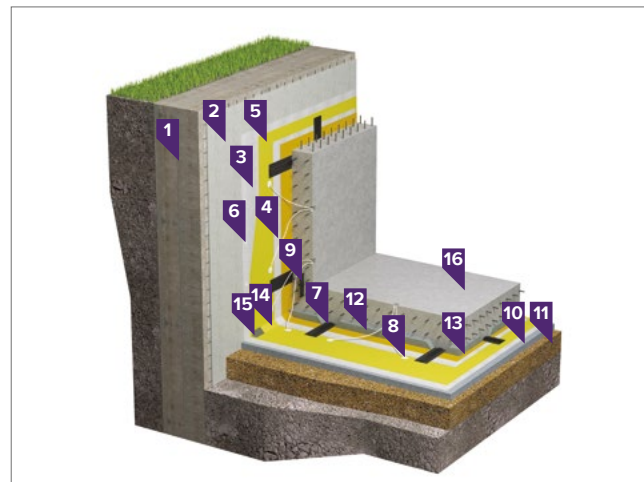
Material shall be loaded and transported in accordance with the Cargo Transportation Rules applicable to the means of transport used.

1.5. Description of waterproofing systems based on LOGICBASE V-SL membrane

1.5.1. Professional repairable waterproofing foundation system with a diaphragm wall

Apart from waterproofing, the system includes a repair system that allows easy and quick elimination of leaks if they appear.

In this system, a PVC membrane is loosely laid in one layer on the horizontal surface of the foundation slab and is attached mechanically with PVC rondels or strips of PVC membrane on a vertical retaining wall.



1. Diaphragm wall;
2. Leveling plaster;
3. Needle-punched geotextile, **500 g/m²**;
4. Needle-punched geotextile, **500 g/m²**;
5. LOGICBASE V-SL waterproofing PVC membrane;
6. PVC rondel TECHNICONICOL;
7. TECHNICONICOL EC-220-3 PVC waterstop;
8. PVC injection flange;
9. TECHNICONICOL IC-240-6 PVC waterstop;
10. Concrete blinding;
11. Sand;
12. Protective sand cement screed;
13. Polyethylene film;
14. Reinforcement element of LOGICBASE V-SL membrane;
15. Compensator made of XPS TECHNICONICOL CARBON PROF;
16. Reinforced concrete structure.

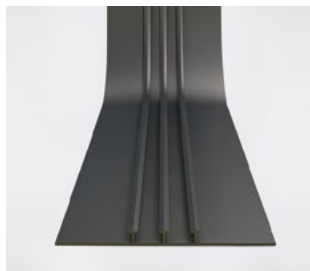
Concrete surfaces shall be covered with geotextile before laying of PVC membranes to prevent any possible damage.

If the removal of water coming through the retaining wall is required, a PLANTER geo drainage membrane should be placed between the diaphragm wall and the waterproofing system.

The waterproofing system must be compartmentalized into isolated sections to monitor its integrity and to enable its repair.

1.5.2. Compartmentalization of waterproofing system

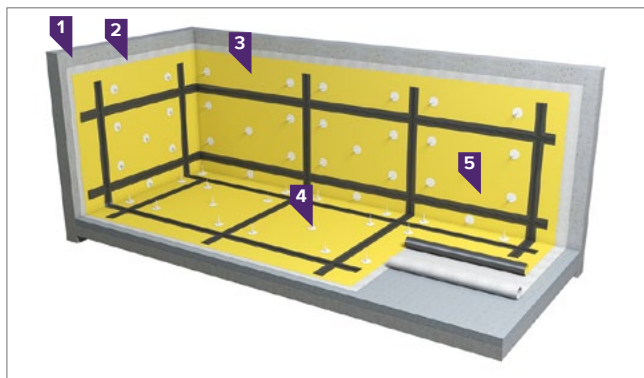
The waterproofing system with PVC membrane is loose laid, i.e. it is not attached to the base. So, it should be compartmentalized into isolated sections to avoid water spreading along the entire structure in case of damage of the waterproofing layer.



One of the waterstop surfaces has anchor elements along its entire length. Waterstops are welded using hot air, with the smooth side facing towards the waterproofing membrane, thereby forming closed rectangular outlines. The maximum recommended size of one section is **150 m²**.

Waterstop anchors are embedded in concrete during its casting. Having such a system means that if waterproofing is damaged, water penetrating under the membrane does not spread along the whole structure, but is confined to a section bounded by waterstops.

The design includes a repair injection system to eliminate the leak in the waterproofing system with the diaphragm wall.



1. Diaphragm wall;
2. Geotextile with a density of **500 g/m²**;
3. LOGICBASE V-SL membrane;
4. Injection flange;
5. Isolated section bounded by waterstops.

1.5.3. Injection system

The injection system serves both for monitoring of the waterproofing condition and for its repair. The injection system consists of injection flanges and injection hoses connected to them by fittings.



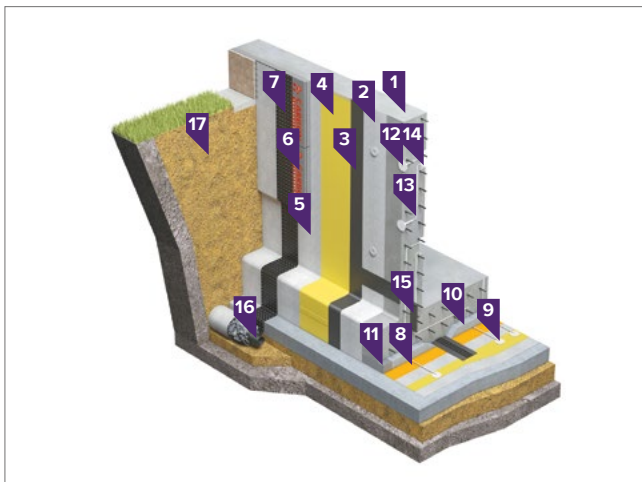
Each standard section has **5** injection flanges installed – **4** in the corners and **1** in the center. When calculating the number of injection flanges, use the following recommendation: **1** flange for a maximum area of **30 m²**, at least **2** flanges per **1** section.

The flange is spot-welded to the membrane. Injection hoses are connected to flanges and routed through the reinforcement cage inside the structure directly or get collected in special injection niches. Each hose is marked according to the section it relates to.

If waterproofing is damaged and a leak appears, water normally starts coming through the injection hose, which allows precisely defining the damaged section. After the damaged section is identified, special injection polymer compounds are pumped through the injection system in liquid form and fill the damaged section by filling the space between the waterproofing membrane and the structure, and then are polymerized forming a dense watertight gel. In this way, the integrity of the waterproofing system is restored.

1.5.4. Professional reparable waterproofing system for foundation with backfilling

The system is used both for an excavation pit with a retaining structure where the diaphragm wall serves as an external formwork, and in the case of excavation with backfilling.



1. Reinforced concrete structure;
2. Needle-punched geotextile, **500 g/m²**;
3. TECHNONICOL EC-220-3 PVC waterstop;
4. LOGICBASE V-SL waterproofing PVC membrane;
5. Needle-punched geotextile, **500 g/m²**;
6. XPS TECHNONICOL CARBON PROF;
7. Drainage membrane with geotextile PLANTER geo;
8. Polyethylene film;
9. Angular PVC injection flange;
10. Protective sand cement screed;
11. Compensator made of XPS TECHNONICOL CARBON PROF;
12. PVC injection flange;
13. Injection hose;
14. Niche for injection hoses;
15. TECHNONICOL IC-240-6 PVC waterstop;
16. Drainage pipe;
17. Backfill soil.

1.6. General guidelines

Always follow the procedures specified in this guidebook. Carefully plan the procedure for installation of LOGICBASE V-SL waterproofing membrane. Always consider the weather conditions at the construction site, both current and future.

Clearly define the scope of work for the current day. It is desirable to have a completed section of waterproofing covered by protective layers by the end of a working day, including geotextile, polyethylene film and a protective screed. If a protective screed cannot be installed on the same day, it is preferable to leave the membrane unprotected, but fence off the completed work section and not admit any unauthorized persons to it. Before resuming the work, carefully check the unprotected section for any membrane damage.

Before commencement of work, perform trial welding on site to determine optimum welding modes for specific weather conditions.

Seam quality control needs special attention. All seams made using automatic equipment with formation of a double seam should be checked instrumentally using the overpressure method, for details see section 4.2. Seams made with manual equipment should be spot checked with the destructive method.

Carefully check for possible mechanical damage of the laid membrane (through punctures, cuts, ruptures).

NOTE: Before starting waterproofing work, LOGICBASE V-SL membrane shall undergo incoming control that consists in checking for compliance of the material's quality with regulatory documents and the data sheet.

1.7. Safety

Materials and equipment must be stored in areas designated in the project execution plan.

The following is prohibited during the work:

- Use of faulty equipment and working without personal protection equipment;
- Allowing unauthorized individuals to perform work;
- Waterproofing works at wind speeds over **15 m/s**, in case of icing, rain, snowfall or fog, affecting visibility in the work area and at ambient air temperatures below **-10 °C** or above **+45 °C**.

The waterproofing site must be provided with fire extinguishers, a sand box and fire-fighting equipment.

Waterproofing works should be performed by trained personnel, who have passed an exam for minimum technical requirements for waterproofing, using PVC membranes and work safety. Welding must be performed by skilled workers with experience of working with welding machines, including those manufactured by Leister.

Before commencement of work, the workers must be familiarized with the project execution plan and safety rules. Work management and quality control must be performed by persons with experience in waterproofing of underground structures.

Workers must be provided with work clothes, work shoes and personal protection equipment. Put on your goggles when using liquid detergents and compounds for seam surface preparation. These recommendations must be observed before welding of membranes and waterstops as well as rondels.

Welding equipment can be connected only to the electrical outlet with a grounding wire. An extension cable with protective ground may be used. When operating the equipment, use a circuit breaker with differential protection for safety. In order to ensure a continuous and stable welding process, it is recommended to connect the welding machine to a separate network or use a separate **220/380 V** generator set. Do not operate electrical equipment if the power cable is damaged or reeled. Always completely unroll the reel before starting the work.

Do not change nozzles when the heating element is on, especially using tools (pliers). In case of incorrect clamping, this will cause nozzle deformation and, consequently, a poor quality seam, even if work is performed correctly.

Upon completion of the work and during replacement or cleaning of nozzles, keep the machine turned on for at least **5 minutes** with the heating element deactivated in order to avoid its overheating.

Upon completion of work with electrical equipment, disconnect the power supply points from power sources and remove them to a closed room or cover with watertight material. Tools must be removed upon completion of each shift.

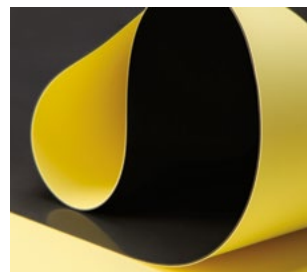
2.

Materials and equipment

2. Materials and equipment

2.1. Main materials for system installation

Unreinforced waterproofing PVC membrane LOGICBASE V-SL based on plasticized polyvinyl chloride (PVC) with a signal layer is used as the main waterproofing material. Follow the provided list of required components – it will help install the repairable waterproofing system quickly and with proper quality.



LOGICBASE V-SL waterproofing PVC membrane

Roll size: width **2.05 m**, length **20 m**.

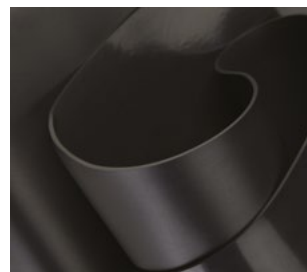
Membrane thickness:

1.5/2.0 mm.

Color: top layer – yellow, bottom layer – black.

Material: membrane of plasticized PVC, unreinforced.

Application area: protection of underground structures against groundwater.



LOGICBASE V-PT protective PVC membrane

Roll size: width **2.05 m**, length **20 m**.

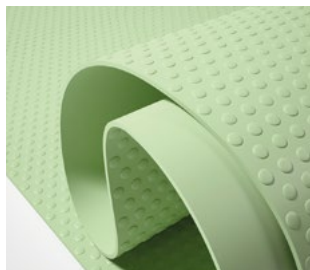
Membrane thickness:

1.5/2.0 mm.

Color: black.

Material: membrane of plasticized PVC, unreinforced.

Application area: protection of LOGICBASE V-SL PVC membrane from mechanical damages.



**LOGICBASE V-ST
waterproofing PVC membrane**

Roll size: width **2.05 m**, length **20 m**.

Membrane thickness: **1.6 mm**.
Color: green.

Material: membrane of plasticized PVC, unreinforced, with textured surface.

Application area: used as the second layer in double-layer PVC waterproofing systems with vacuum quality control.



TECHNICOL needle-punched geotextile

Roll size: width **2.15 m**, length **45 m**.

Color: white/grey/brown.

Material: unwoven, thermally bounded, needle-punched synthetic geotextile based on polypropylene fibers with **500 g/m²** density.

Application area: protection of LOGICBASE V-SL PVC membrane against mechanical damage and drainage function.



Polyethylene film

Roll size: width **3 m**, length **100 m**.

Thickness: **0.2 mm**.

Color: orange/transparent.

Material: polyethylene.

Application area: separation of protective sand-cement screed and geotextile layers.



PLANTER geo drainage membrane

Roll size: width **2 m**, length **15 m**.

Color: black.

Material: HDPE + geotextile.

Application area: construction of vertical and horizontal drainage for foundations.



PLANTER standard protective membrane

Roll size: width **2 m**, length **20 m**.

Color: black.

Material: HDPE.

Application area: protection of LOGICBASE V-SL PVC membrane during backfilling.



TECHNICOL PVC rondel

Dimensions: diameter **75 mm**, thickness **10 mm**.

Color: grey.

Material: PVC.

Application area: mechanical fixation of geotextile and LOGICBASE V-SL membrane to tunnel arches and vertical surfaces.



Internal waterstops: IC-240-2, IC-240-6, IM-240/20, IM-260/50

Dimensions: the first digit in the index means the waterstop width in millimetres; length – **10 to 20 m** depending on the type of waterstop.

Color: black.

Material: PVC.

Application area: sealing of construction concrete joints and expansion joints.



External waterstops: EC-220-3, EC-320-4, EM-260/20, EM-260/50

Dimensions: the first digit in the index means the waterstop width in millimetres; length – **10 to 30 m** depending on the type of waterstop.

Color: black.

Material: PVC.

Application area: compartmentalization of the waterproofing system, protection of construction concrete joints and expansion joints against water penetration.



TECHNICOL PVC tape

Dimensions: width **220 or 300 mm**, length **30 m**.

Color: grey.

Application area: compartmentalization of the waterproofing system, protection of construction concrete joints and expansion joints against water penetration.



Epoxy glue TECHNICAL

Package: components **A+B**, **10+5 kg**.

Color: grey / dark grey.

Material: two-component glue based on epoxy resins.

Application area: glueing of TECHNICAL PVC tapes, repair of concrete elements, filling of voids, joints and fractures, connection of structural elements and repaired concrete elements.



Injection flanges

Color: grey.

Material: PVC.

Application area: injection system element used for supply of the repair injection compound to a damaged section of the waterproofing system.



Injection hose

Color: red, blue, black.

Application area: injection system element used for supply of the repair compound to an injection flange.



Connection fittings

Color: black + blue.

Application area: connection of injection hoses to injection flanges and interconnection of injection hoses.

2.2. Auxiliary materials for system installation

Use auxiliary system elements for the improvement of its reliability, operability, convenience and simplicity of installation.



TECHNINICOL polyurethane sealant

Color: grey.
Material: one-component, high modulus, quick-drying polyurethane-based compound.
Application area: sealing of waterproofing ends, compensation and expansion joints in concrete structures, etc.



TECHNINICOL cleaner for PVC membranes

Volume: **3 liters**.
Color: colorless.
Application area: removal of local contamination on PVC membranes and for preparation of membrane surfaces for welding.



Double-sided adhesive tape

Dimensions: width **50 mm**, length **25 m**.
Application area: glueing of PE film seams and connection of geotextile overlaps.



NICOBAND self-adhesive sealant tape

Dimensions: width **150 mm**, length **10 m**.
Material: self-adhesive sealant tape on the base of the polymer-bitumen compound.
Application area: sealing of joints of PLANTER profiled HDPE membranes.



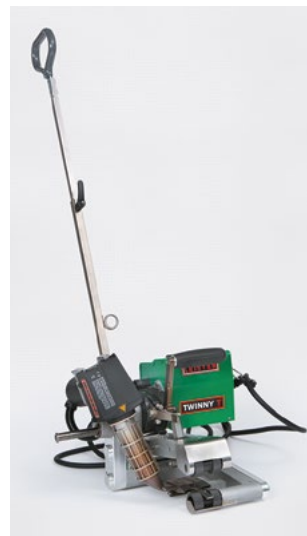
Disk elements and self-tapping screws with polyamide anchor sleeve

Dimensions: **4.8×50 mm**.
Application area: fastening of the waterproofing membrane to concrete building structures.

2.3. Welding equipment

Use welding equipment by Leister, models Twinni-T and Twinni-S (automatic tools), Triac Drive (semi-automatic tool), Triac PID and Triac S (hot air hand tools) for welding LOGICBASE V-SL waterproofing PVC membrane.

Other models of welding equipment, including more modern ones, and those designed for welding of membranes (materials) of other types may be used if required welding parameters are ensured.



Use Twinni-T and Twinni-S automatic welding machines by Leister for membrane welding on horizontal, slanted and vertical surfaces.



Use Triac Drive semi-automatic welding machines for welding in difficult areas of joints and welding waterstops to the PVC membrane.



Use Triac PID and Triac S manual welding machines with a set of nozzles and hold-down rollers for membrane welding in difficult to access areas where automatic equipment cannot be used.

Also, use manual welding machines for welding the membrane to PVC rondels, as well as for welding injection flanges and profiled elements of waterstops to the membrane.

The list of recommended accessories for hot air hand tools

WORK DESCRIPTION	SLOT NOZZLE SIZE, MM	TYPE OF ROLLER
Regular seam welding	40	Silicone / teflon
Seam welding in difficult to access areas	20	Narrow brass roller
Welding the membrane to a PVC rondel	40	Silicone / teflon
Welding an injection flange to the membrane	20	Teflon / brass
Execution of junctions	20-40	Teflon / brass

2.4. Tools and devices

Use the recommended standard tools for convenient, high quality and quick installation of waterproofing system with LOGICBASE V-SL PVC membrane.



1. Slot nozzle **40 mm**;
2. Slot nozzle **20 mm**;
3. Silicone and teflon rollers **40 and 20 mm**;
4. Narrow brass roller **8 mm**;
5. Soft brush for cleaning welding machine nozzles;
6. Probe for weld quality testing (seam probe);
7. Knife with replaceable blades for membrane cutting;
8. Special knife for cutting the chamfer at membrane edges (required for cross-shaped or T-shaped seams of proper quality);
9. Hook roofing knife;
10. Tape measure;
11. Marker;
12. Screwdrivers of different sizes;
13. TECHNOMICOL cleaner for PVC membranes;
14. Special needle for double seam quality check;
15. Roofing clamp;
16. Membrane cutters;
17. Vacuum compressor, control hoses / connecting tubes, vacuum cap (see section 4.2.);
18. Gloves (cotton or leather);
19. Cotton rag.

3.

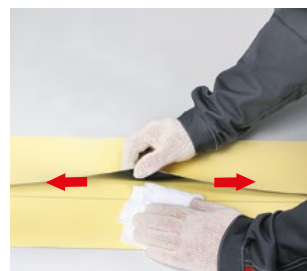
Hot air welding of membranes

3. Hot air welding of membranes

3.1. Seam preparation



Perform all welding operations on clean and dry membrane surfaces only. Remove dirt and dust from welded surfaces using wet cloth moistened with TECHNOMICOL cleaning liquid for PVC membranes.



Replace the cleaning cloth as often as possible, as it will make the process more effective.



Use only clean cloth for seam area cleaning. White cloth is the most suitable for this purpose, since it leaves no paint stains on the membrane.

NOTE: Before working with the PVC membrane cleaner, always study the safety guidelines on the package.

3.2. Manual welding

Manual welding of membranes is performed with a special hand tool (hot air heat gun). Air operating temperature values can be adjusted in the range of **50-600 °C** using a controller.

NOTE: A regular construction heat gun cannot be used for welding of polymer membranes due to an instability of air temperature at the nozzle outlet.

3.2.1. Equipment preparation



Before commencing welding operations, check equipment:

- Machine housing and display must be clean; all icons must be clearly visible. This will enable a selection of the required welding temperature;
- Air suction holes must be clean and unobstructed. If required, clean air intakes with a soft brush;
- The power cable must not be damaged.



Fix the slot nozzle on the heating element tube using a retaining screw and a screwdriver. For details on nozzle selection, see the table in section 2.3.

NOTE: The opening of the slot nozzle must be straight and clean.



To turn the heat gun on, press the ON button and hold it for several seconds.

For LOGICBASE V-SL membrane welding, select a temperature of **400-510 °C**, depending on weather conditions and welding speed.

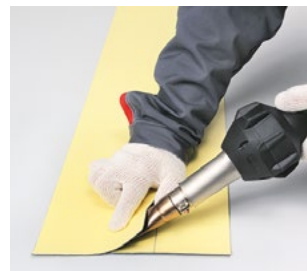
After the heat gun is activated for heating, wait for **2-3 minutes** until air gets heated.

NOTE: Always start work with trial welding to adjust equipment to specific site conditions.

3.2.2. Seam forming

A seam is formed by overlapping edges of the sheets with a width of minimum **80 mm**. Proceed with manual welding in three steps.

Step 1. Spot welding



To avoid displacement of the membrane sheets relative to each other, fix them with spot welding. To do this, place a heated nozzle between the sheets to a depth of over **40 mm** and quickly press the membrane against the heat gun nozzle base with a finger.

NOTE: Insertion time of the heated nozzle and pressing must be short, no more than 2-3 seconds.

The number of spot welds per running meter of a seam – **6 pcs**. Correct spot welding must be easily detachable leaving virtually no traces on the membrane.

The number of spot welds may vary, depending on the created joint.

Step 2. Forming a thermal pocket



Carry out preliminary welding of membrane sheets. To do this, quickly move the heat gun along the seam, rolling the membrane down with one edge of the roller and pressing it against the nozzle edge. This will prevent hot air leaking during main welding.

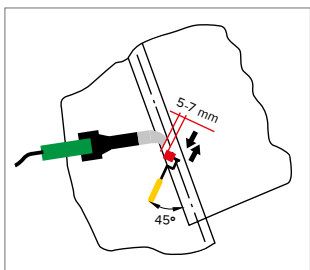


After preliminary welding, the front part of an overlap must remain free for final welding.

Step 3. Final welding



Insert the hot heat gun into the thermal pocket at an angle of approximately **45°**. The nozzle end must protrude from overlap by **3-4 mm**.



Move the heat gun along the seam smoothly and at constant speed (if held in the left hand, the direction is to the left, if in the right hand – the direction is to the right). Maintain a distance of **5-7 mm** while rolling the roller down parallel to the nozzle edge. Do not let the roller catch up with the nozzle.

Move the roller in parallel to the nozzle exit creating amplitude of its movement that should exceed the seam width.

The width of the weld (the place of homogeneous connection of two layers of the membrane) must be at least **30 mm**.

NOTE: The three-step manual welding procedure is valid for all manual welds.

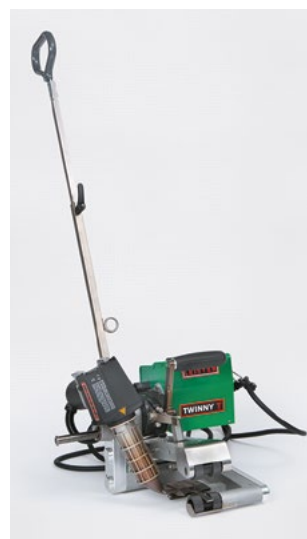


Continuously check for accumulation of scaling on the nozzle surface. After it appears, always clean the nozzle with a metallic brush.

3.3. Automatic welding

To weld long seams of the main membrane sheets, use special automatic hot air welding machines.

NOTE: Prior to starting a job, review the manufacturer's automatic welding machine manual.



To create a double seam with a test channel, use the Twinni-T and Twinni-S models.

These models have the advantage of being used on horizontal, slanted and vertical surfaces. Their operation is unaffected by surface unevenness.



Before starting welding operations, set the required parameters (air temperature, welding machine movement rate and pressure of pressure rollers). For details on selection of parameters, see section 3.3.1.

3.3.1. Selection of welding parameters

The best strength and air-tightness of seams are achieved by selecting optimum welding parameters.

The main welding parameters include air stream temperature, welding machine movement speed and pressure of rollers. These parameters are not constant and depend on a variety of factors, such as the membrane thickness, base surface temperature and material surface temperature, wind speed and humidity, and technical condition of welding equipment.



First, set the pressure of the rollers on the seam. It is calculated based on the membrane thickness. A force of **150 N** must be applied to each millimeter of membrane thickness. For example, when two membrane sheets with a thickness of **2 mm** are welded together, the force must be **$2 \times 2 \times 150 = 600 \text{ N}$** .

The force is adjusted as follows:

- While the machine is turned off, two layers of material are inserted between the machine rollers;
- Move the clamp lever down to lightly press two layers of the membrane between rollers;
- Turn the adjusting coupling (polygon) to achieve such a pressure on the membrane when turning the adjusting coupling manually becomes difficult;
- After that, raise the clamp lever upwards to release the rollers and turn the adjusting coupling to achieve the required pressure. A coupling turn by one facet (**60°**) corresponds to the hold-down force of **100 N**. If a pressure of **600 N** has to be achieved, the collar shall be turned by **6 facets**, i.e. by one full turn.

After such an adjustment is made, the required pressure of **600 N** will be applied to the material for clamping of two membrane layers between rollers during welding.

Then, select the optimal temperature and speed of machine movement. To achieve this, perform trial welding.

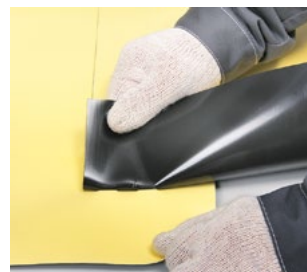


Prepare strips of material with a width of minimum **30 cm** and a length of minimum **1 m**.



Weld membrane strips while changing the speed of welding machine movement on sections of at least **10 cm**. For convenience, strips can be preliminarily marked with a marker and cut according to markings after cooling.

After the completed welded seam is fully cooled to the ambient temperature, or at least **30 minutes** after welding, check the quality.



Non-destructive examination
Apply force to the upper sheet at the beginning or the end of the test section to tear it away from the lower sheet. This test shows how uniform the welded seam is.



Destructive examination

Cut out a **20-30 mm** wide strip perpendicular to the welded seam and rip it by hand.

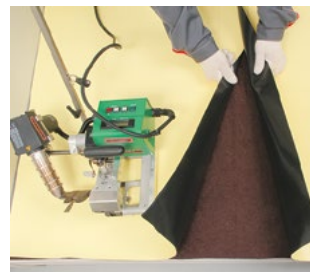


The welded section must not come loose along the seam. A seam of proper quality will tear along the sheet.

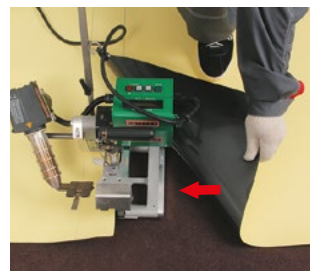
Optimal welding parameter selection algorithm

OPTIONS	AIR STREAM TEMPERATURE	SPEED
Option 1	Increase	No change
Option 2	No change	Decrease
Option 3	Decrease	No change
Option 4	No change	Increase

3.3.2. Seam forming



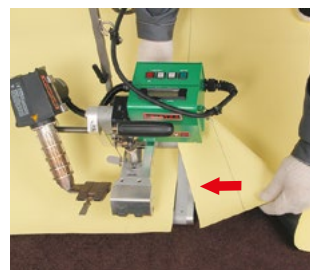
After optimal parameters are selected, welding can start.



Lay two rolls with an overlap of at least **10 cm**.



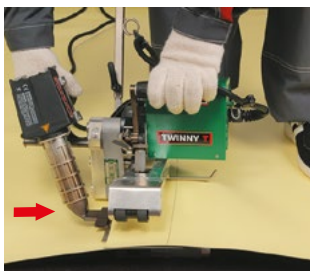
Place the welding machine at the weld starting point.



Guide the lower membrane sheet into the lower arm of the welding machine.



Guide the upper membrane sheet into the upper arm of the welding machine.



Insert the machine nozzle into the overlap area.



Move the clamp lever down until complete closure of leading pressure rollers. Activate leading pressure rollers by pressing the "M" button.



Make sure the machine moves in the correct direction and adjust it with the handle as required.



When approaching the end of the overlap, turn the clamp lever to the topmost position.



Take out the machine nozzle from the overlap area by slightly pulling it sideways along the guideway. Stop the movement of the leading rollers by pressing the "M" button.

NOTE: Do not allow any movement of the leading pressure rollers in a clamped position without the sheet.

NOTE: It is prohibited to weld PVC membranes by an open flame or by using any other non-recommended method.

4.

Seam quality control

4. Seam quality control

4.1. Visual quality inspection

Visual quality inspection involves identification of the following features:

- A trace from pressure rollers is clearly visible;
- Light melting of the heated material (bead) between the membrane layers;
- No folds on the seam surface;
- No signs of sheet overheating (change of the membrane color, burnt areas).

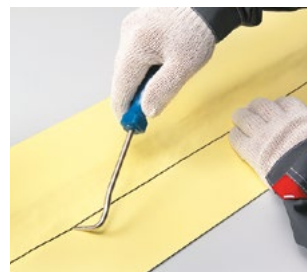
Also visually check the condition of the completed waterproofing and note the following defects:

- Swelling;
- Folds;
- Ruptures;
- Cracks, etc.

Promptly rectify any revealed defects.

Seams made with a manual or semi-automatic tool must be checked for lack of interruptions, air-tightness and presence of a bead along the seam.

To do this, use a weld quality probe or a thin flat blade screwdriver (with rounded tip edges).



Move the probe along the seam while slightly pressing on it – the tip of the probe shall not penetrate into the seam.

NOTE: Try not to apply excessive force on the probe to prevent seam damage during the examination.

4.2. Instrumental quality control

Air-tightness of all welds made both with automatic tools and manual equipment should be monitored using specialized equipment and tools.

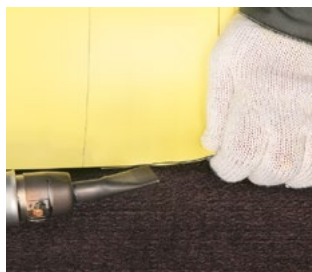
Air-tightness of seams made with Twinni-T or Twinni-S automatic tools with formation of a double seam with a test channel should be checked using the excessive pressure method.

The following equipment is required to check air-tightness of a double seam using the excessive pressure method:

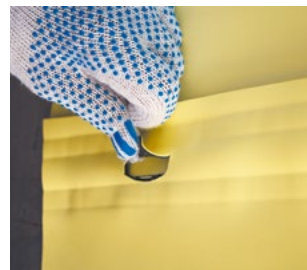
- Hollow needle with a pressure gauge;
- Connecting hose;
- Compressor.



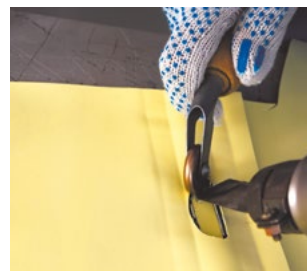
A foot pump for vehicle tires may be used instead of a compressor. In that case, the needle for quality inspection may be used without an integrated pressure gauge.



After two membrane sheets are welded, the seam should be sealed at both ends. To do this, weld both ends with a manual welding machine and roll the edges with a teflon roller or clamp them with a special clamp.



Another method of sealing a seam. At the end of the seam, open the test channel formed during welding with a hook shaped knife.



Weld the test channel using a narrow nozzle and a brass roller.



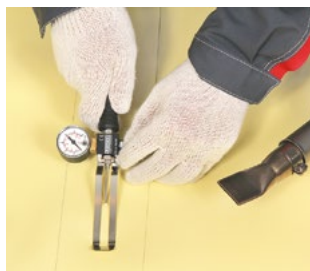
After the test channel is plugged by welding, remove the non-welded part of the overlap for subsequent patching.



Place a patch so as to make sure that it covers the width of the seam and the hole cut in the test channel. Start welding the patch from the test channel moving towards the patch edges.



Seal the test channel at the opposite end of the seam and apply a patch. Next, perform the air pressure test.



To check seam air-tightness, insert the needle with a pressure gauge into the space of the air channel. To do this, lightly heat the surface of the seam at the site of planned needle insertion with a manual welding device.

NOTE: Insert the needle with extreme care, since it must not damage the opposite side of the air channel.

Connect the connecting hoses to the compressor. Turn the compressor on and start feeding air to a pressure of **1.5 atm** for **1.5 mm** membrane thickness, and up to **2 atm** – for **2 mm** membrane thickness.



After the preset pressure value is reached, turn off the compressor and check the pressure gauge readings. If the pressure in the seam falls by not more than **20 %** in **3 min**, the seam is air-tight. If the pressure in the seam falls by more than **20 %**, this is the evidence of poor quality welding. Such a seam must be redone or repaired.



After seam air-tightness is checked, extract the needle from the test channel. Patch the membrane puncture point.



Seams made with manual equipment or with automatic tools, but without forming a double seam, should be checked using the vacuum method after the visual examination with the weld quality probe.

Required set of equipment:

- Vacuum compressor;
- Connecting tubes;
- Vacuum cap with a soft rubber gasket along the perimeter.



Apply soapy water to a cleaned seam and then place a vacuum cap on the moistened section of the seam, ensuring tight adherence of the cap frame to the surface of the membrane by strongly pressing on the handles.



After turning on the vacuum compressor, depressurize the vacuum chamber to **2.0 MPa** for least **15 seconds**, and then turn the compressor off. Soap bubbles will appear in poorly welded places.



Mark the places where soap bubbles appear as defective. The seam in these areas must be repaired.

Then perform inspection at an adjacent seam area. To do this, move the vacuum cap further along the seam with overlapping of the already checked section by **10-20 mm** and repeat the attempt. Check the seam along its whole length in this way.



Apart from the above methods, the seam strength could be spot-checked on a stationary rupture machine or on a portable rupture machine of a Leister Examo type, regardless of the seam forming method.

The proper quality of the seam is confirmed by a rupture along the membrane and not along the membrane junction.

5.

Waterproofing system installation

5. Waterproofing system installation

5.1. Foundation slab waterproofing

The waterproofing system should be installed on a prepared foundation. The quality of the concrete foundation has a significant impact on the uniformity and quality of the seam and on preservation of membrane integrity during installation.

All system layers on a horizontal surface are laid loosely in a single layer without mechanical fixation or gluing to the base.

5.1.1. Base preparation

The base humidity requirements:

- The base must be dry or matte wet, but without any water on the surface (humidity is not standardized).

Required base evenness:

- The surface of the concrete base must be even and smooth. Unevenness of the base must be rounded without abrupt rises, drops or sharp edges;
- Protruding sharp elements (concrete chips, stones) must be removed mechanically (cut or ground off);
- Reinforcing bars must be cut at a depth of at least **1 cm** from the concrete surface. The resulting cavities must be filled with a rigid concrete mix with a minimum grade of **M150**;
- Defects in concrete with a depth over **20 mm** (fractures, cavities, indents) must be filled with cement-sand mortar with a minimum grade of **M150**;
- When the membrane is laid directly on the retaining structure (diaphragm wall, secant pile walls, etc.), remove the remaining soil and bentonite from its surface, chop off protruding parts and level the surface with a cement-sand mortar on a wire mesh.

Required strength of the base:

- At the beginning of the waterproofing work, the concrete base of the supporting structures must have a strength of at least **75 %** of the graded, but not less than **50 kg/cm²**;
- Installation of the waterproofing layer on the surface of concrete blinding should be carried out after the concrete reaches a strength of at least **2.5 MPa**;
- The base must be free of fragile and low-strength layers. Concrete swells must be removed.

Required base cleanliness:

- There must be no construction debris, dirt, dust, mold or oil on the base surface.

Structural requirements:

- Leave space in areas of expansion joints (a cavity with rounded edges) sufficient for a compensator, ensuring required elongation of the waterproofing material during deformation (shrinkage, settling) of the structures.

The following is prohibited:

- Use of reinforcing bars as guides on the concrete bed for waterproofing of the foundation slab;
- Leaving of inserts, used to tie the formwork, after concrete casting in retaining structural walls;
- Direct contact of PVC membranes with foamed and porous polymer materials (XPS, EPS, PIR).

5.1.2. Geotextile laying

Place geotextile on a prepared surface before installation of a waterproofing membrane.

Geotextile will help avoiding mechanical damage of the membrane caused by unevenness of concrete and will prevent undesirable contact with contaminants.



Place geotextile on a prepared concrete surface with an overlap of **100 mm**. Geotextile density should be not less than **500 g/m²**.



In order to avoid displacement of sheets, fasten the overlaps with spot welding using a manual welding heat gun.

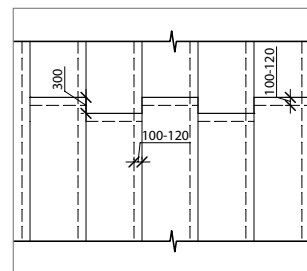


Select a temperature of **250-300 °C** for spot welding of sheets.

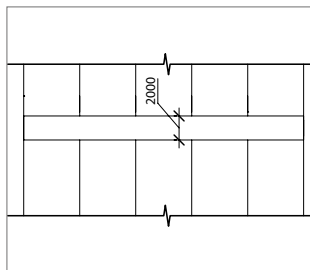
5.1.3. Installation of LOGICBASE V-SL waterproofing membrane

When a waterproofing membrane is installed on a horizontal surface, create **300-500 mm** wide membrane extensions protruding beyond the foundation slab for subsequent joining with vertical waterproofing.

NOTE: Membrane extension beyond the slab outline (300-500 mm) must be protected with fiber boards and a layer of cement-sand screed at least 50 mm thick. This will protect the membranes against mechanical damage during construction of walls.



Place membrane sheets on geotextile with **100-120 mm** overlap both in longitudinal and transverse areas of their joining.



If the installation of membrane sheets with a displacement of butt ends is impossible, place the assembled strip perpendicular to the main sheets.

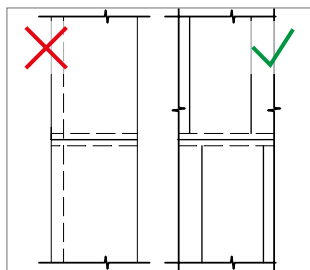


For convenience of overlap width control, LOGICBASE V-SL membranes have marking on longitudinal edges. Align the edge of the adjacent sheet with the marking strip and make sure that the rolled surface is even.



Create longitudinal and transverse seams with an automatic welding tool, producing a test channel.

NOTE: Rolls must be laid down so as to ensure that four rolls do not join at a single point. The correct option is when four rolls are joined with a displacement, forming T-shaped seams.



A T-shaped seam is formed as follows: two rolls are welded together as usual with an automatic tool. The free edge of the membrane should be cut off on both sides of the double seam at the point of intersection with the third roll where a transverse seam will be positioned.



The free edge is cut off with a hook-shaped or a paper knife for a length of **120-140 mm**.



Remove the chamfer on the seam section, where the free edge has been cut off to form a smooth transition and to avoid a "step" at this point that would be hard to weld through.

NOTE: Check the depth of chamfer removal, do not cut welded sections.



Weld the T-shaped seam with an automatic tool.



Reinforce all T-shaped seams of membranes by patching. To do this, cut out a **120×120 mm** patch from a LOGICBASE V-SL membrane. Weld the reinforcing patch over the junction and roll it down with a roller.

NOTE: Before installation of the reinforcing patch, crimp the membrane edge with a brass roller while heating the membrane surface with a hot air hand tool.



After the seam cools down, check its quality using a weld quality probe.



In case of a spot mechanical damage of the membrane, its tightness should be restored with patches with the minimum diameter of **120 mm**. The distance from the place of damage to all edges should be not less than **50 mm**.

5.1.4. Waterproofing compartmentalization

After the installation of the membrane, compartmentalize the waterproofing layer by welding the waterstops to the material. The map of surface compartmentalization into tightly isolated sections (areas) is defined by the project. The size of the sections should not exceed **150 m²**.



At first, lay down TECHNICAL EC-220-3 or EC-320-4 waterstop with the flat side facing the membrane surface and anchoring ribs facing the concrete. Then weld the edges of the waterstop to the membrane with manual or semi-automatic equipment.

Installation of waterstops with the manual welding equipment

Waterstops shall be welded with the hot air hand tool according to section 3.2.

Select optimal temperature between **450-500 °C** depending on membrane thickness and weather conditions.

Perform spot welding of the waterstop every **20-30 cm** to temporarily fix it to the membrane surface. This will prevent displacement of the waterstop and wave formation during the main welding.



Place a **40 mm** wide nozzle between the membrane and the waterstop. Make sure that the end of the nozzle extends beyond the outer edge of the welded seam by **3-4 mm**. Move the heat gun continuously along the seam, evenly heating both surfaces.

NOTE: Use the silicone roller to achieve the required pressure.



After the seam cools down, check its integrity. Move the probe or the flat screwdriver along the seam. If any sections are not sealed properly, re-weld them.

Installation of waterstops with the semi-automatic Triac Drive machine

The process of selecting welding parameters for waterstops and waterproofing membrane using semi-automatic Triac Drive implies determining the optimal ratio of its movement speed to the air stream temperature.

Set the air stream temperature between **450-500 °C**.

NOTE: Adjust the temperature based on trial welding.

Place the machine on the membrane surface. Put the edge of the waterstop into the special slot nozzle. According to the trial welding results, set the machine movement speed. The machine then starts moving automatically.



Apply the necessary pressure to the handle and smoothly move the machine along the seam. Make sure that the edges of waterstop are evenly welded to the membrane surface.

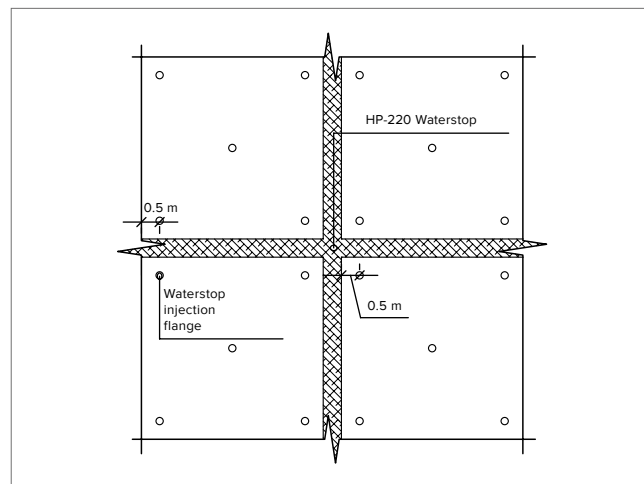
Possible mistakes during the welding of waterstops to the waterproofing membrane

DEFECT	CAUSE	RESULT	SOLUTION
Carbonization (overheating)	Welding temperature too high or machine movement too slow	Seam not sealed properly	Reduce the air temperature or increase machine movement speed
Detachment (shallow weld)	Welding temperature too low or machine movement speed too fast	Materials are not welded	Increase air temperature or decrease machine movement speed

5.1.5. Installation of an injection system

After the waterproofing is compartmentalized, install an injection system consisting of injection flanges and hoses that are designed to repair waterproofing in case any leaks appear.

It is recommended to install **5** injection flanges into each section of a standard size (**150 m²**). Normally, one out of five flanges is installed in the center of a section, and the remaining ones – in corners at a maximum distance of **1.5 m** from the edges.



Clean the flange and the membrane surface in the place of flange installation.



Perform the spot welding of the flange to the membrane surface with the hot air hand tool.



Mark the flange according to the number on the section map.



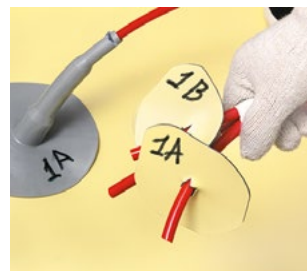
Connect an injection hose to the flange through connecting fitting. Install a stainless steel clamp at the point of hose and flange connection.



Elbow fittings are used to change the direction of the injection hose at a right angle, e.g. when approaching an injection niche.



To make installation of hoses more convenient, fix them on the membrane surface with a small membrane strip.



Mark the hoses according to the marking of flanges they are connected to.



Install distribution boxes for hoses in the reinforcement cage. Bring hose ends from the flanges in each section into the installed box.

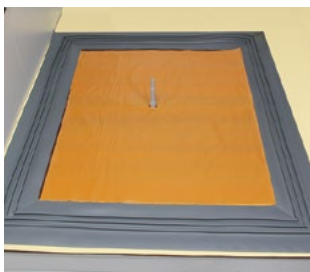
5.1.6. Installation of protective layers

After the injection system is installed, start laying a protective layer of geotextile with a minimum density of **500 g/m²**. This will prevent mechanical damage to the membrane.



Lay geotextile within one section limited by waterstops.

NOTE: Do not lay geotextile on waterstops; their anchors must be open for subsequent concrete casting.

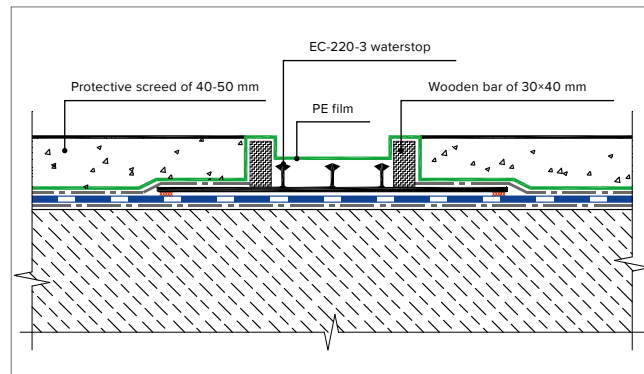


In order to prevent geotextile saturation with bleeding cement, place **0.2 mm** thick polyethylene film over the geotextile. The film, as well as geotextile, should be laid within the limits of one section.

In order to connect film overlaps, use double-sided masking tape or single-sided foil-covered adhesive tape.

Install the protective screed of at least **50 mm** on the film to prevent the membrane from mechanical damage during reinforcement installation. Before installation of the protective screed, place the formwork that will limit contamination of the waterstop with the cement-sand mortar.

NOTE: Keep protective screed away from the waterstop ribs. To do this, first cover all waterproofing, including waterstops, with polyethylene film, and after the protective screed is placed, cut off PE film above the waterstop.



A special protective membrane LOGICBASE V-PT can be used instead of geotextiles and polyethylene film. On horizontal surfaces, the protective membrane is installed on top of the main waterproofing membrane LOGICBASE V-SL using the free-laying method (except for the locations of the waterstops). On vertical surfaces, it is spot welded to LOGICBASE V-SL membrane.

Installation of the protective membrane can be carried out with the formation of longitudinal and transverse overlaps or without them. However, in order to increase the efficiency of the whole system, it is recommended to install LOGICBASE V-PT protective membrane with the formation of overlaps and their subsequent welding. Thus, a second waterproofing and protective layer is formed.

When forming overlaps, it is not necessary to organize their spacing relative to each other and relative to overlaps of the first layer of LOGICBASE V-SL membrane. Welding of overlaps of the protective membrane can be performed using both manual and automatic equipment with the formation of single and double seams.



5.2. Installation of the waterproofing system on the diaphragm wall

5.2.1. Geotextile laying



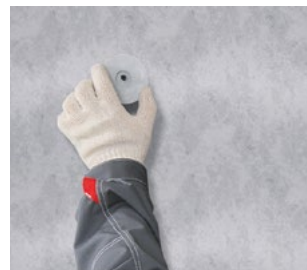
Unroll geotextile rolls onto the concrete surface of the wall from the top downwards with the minimum overlap of **100 mm**.



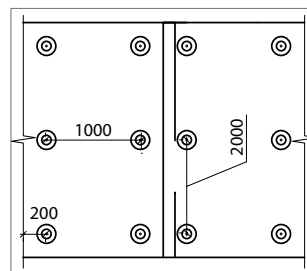
Geotextile is mechanically fastened with the disk fasteners or PVC disc fixing elements (rondels).



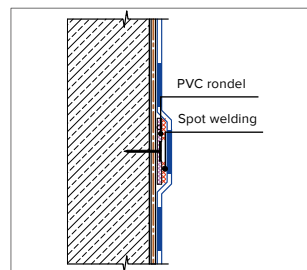
Use TECHNOMICOL PVC rondels with **75 mm** diameter and **10 mm** thickness for fastening membrane sheets on the retaining structure.



Fasten the rondels with self-tapping screws through geotextile on a vertical surface.



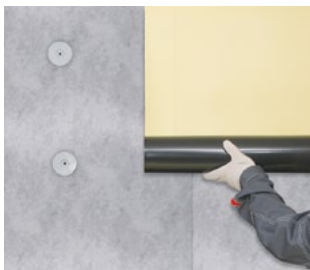
Fix PVC rondels at a distance of **1 m** horizontally and **2 m** vertically from one another, leaving minimum **200 mm** from the geotextile sheet edges for further joining of sheets.



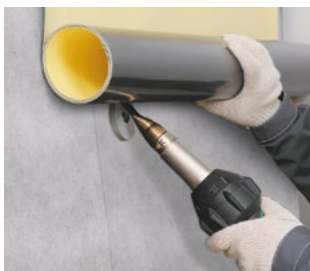
Afterwards, the waterproofing membrane is held on a vertical surface by welding to these PVC rondels.

NOTE: The further fixation of the membrane should be spot welding: this will ensure membrane separation from the fixing element surface without loss of integrity in case of the structure shifts.

5.2.2. Installation of LOGICBASE V-SL waterproofing membrane



Unroll waterproofing membrane rolls from the top downwards with an overlap of adjacent sheets of **100-120 mm**.



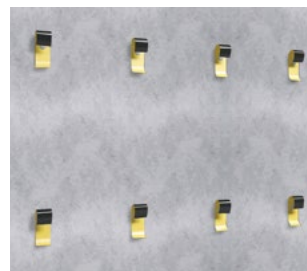
While unrolling the membrane, spot weld it to rondels used for fastening of the first layer of geotextile.



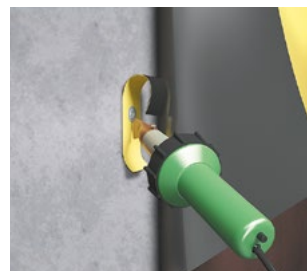
Weld the waterproofing membrane rolls to each other with an automatic welding machine.



5 cm wide and **20 cm** long strips cut out of PVC membrane can be used instead of rondels.



Fasten the strips mechanically through geotextile on a vertical wall surface, leaving **7 cm** from the strip edge with the free end of the strip directed upwards.



The fixation span is similar to the fixation span of the rondels. Bend the free end of the strip downwards and weld the membrane to it.

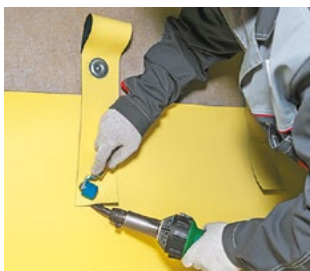
Waterproofing membrane may also be attached based on a temporary pattern with temporary fixations. Such fastening method is the most convenient for the horizontal installation of rolls on the walls.



Temporarily attach the roll of the membrane to the vertical surface using the mechanical method. For this purpose, make **5×30 cm** strips of LOGICBASE V-SL membrane.



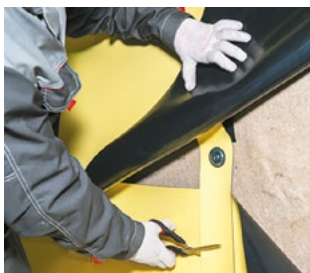
Mechanically fasten the strips on the wall **10-15 cm** above the top edge of the membrane.



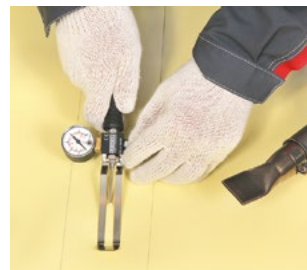
Spot weld the membrane to the strips with the hot air hand tool.



When installing the next row of the membrane, ensure overlap between the lower and upper rows of the membrane of at least **100 mm**. Weld the overlap with an automatic welding machine.



Remove the temporary fastening strips along with the machine movement, cutting them off from the mechanical attachment and in the spot-weld area.



Check the welded seams with compressed air. For details, see section 4.2. After checking seam airtightness, compartmentalize the waterproofing and install an injection system. For details, see sections 5.1.4 and 5.1.5.

5.2.3. Installation of protective layers

For the protection of the waterproofing membrane from mechanical damage during the installation of the reinforcement, use geotextile with **500 g/m²** surface density and polyethylene film with **200 µm** thickness.

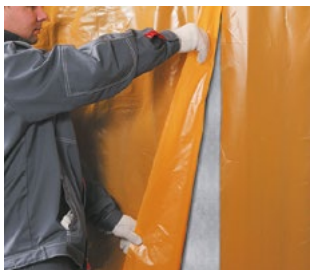


Unroll the geotextile from the top downwards with a minimum overlap of **100 mm**. If it is required to fasten the geotextile to the membrane surface, use spot welding with small strips. The fixation methods for membranes are described in details in section 5.3.7. – they are also applicable to the geotextile.

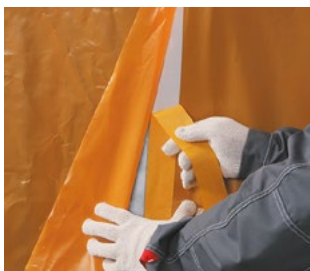
NOTE: Lay geotextile by sections, without covering waterstops.



Spot weld geotextile overlaps with Leister hot air hand tool, Triac PID or Triac S models.



After the geotextile is fastened, protect it against the alkaline concrete environment with the polyethylene film. Unroll the film from the top downwards with the minimum overlap of **100 mm**.



Use double-sided masking tape on the overlaps of the film. Film overlaps may also be sealed with the manual heat gun at the low-temperature mode.

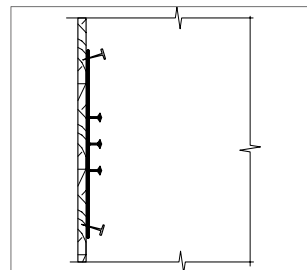
After installing the protective layers, mount the reinforcing cage of the concreting grips and cast the concrete mixture. End clamps of the protective layer of concrete should provide protection for the waterproofing membrane from mechanical damage by reinforcing bars. When mounting formwork panels, they are not allowed to be attached to the enclosing structure of the pit with a violation of the integrity of the membrane. To increase the reliability of the protection of the waterproofing layer from mechanical damage by reinforcing bars, it is allowed to use sheet materials (plywood, hardboard, etc.).

5.3. Installation of the waterproofing system on the foundation wall with backfilling

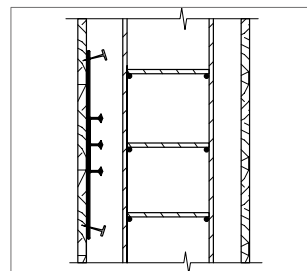
Installation of the waterproofing system on the foundation wall with backfilling starts with the installation of waterstops and injection system into the formwork.

5.3.1. Compartmentalization of waterproofing system with profiled waterstops

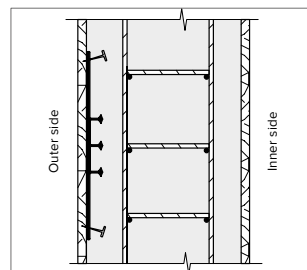
The layout of waterstops in the formwork is defined by the project. Waterstops must form sections with a maximum area of **150 m²**.



Fasten waterstop to the formwork with short nails every **250-350 mm**. Nails must be driven between the waterstop edge and first anchor from the edge and not for their full length.



Then the nails should be bent by **40-50°** from the vertical position. After the waterstop is fastened, install the reinforcement cage and cast concrete.



After the formwork is dismantled, all nails protruding from the concrete surface must be removed: extracted from concrete or cut off.

The waterproofing membrane is then welded to the waterstop embedded in the foundation wall, thus ensuring waterproofing compartmentalization into closed sections.

5.3.2. Compartmentalization of waterproofing system with PVC tapes

TECHNONICOL PVC tapes may be used for compartmentalization of the waterproofing system instead of TECHNONICOL EC-220-3 embedded waterstops.



The geotextile-edged PVC tape is attached to a surface with TECHNOMICOL two-component epoxy glue.

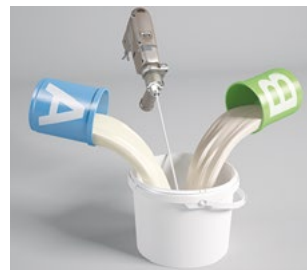


Concrete, brick and natural stone foundations must be clean, even, smooth and strong. Protruding sharp elements (concrete flows, coarse aggregate edges) must be eliminated (chopped or smoothed). To remove deteriorating parts, traces of paint, oils and bleeding cement, machine the surface. Then clean the surface of dust using compressed air.

The humidity of the concrete surface at the places of glueing PVC tapes TECHNOMICOL should not exceed **5 %**, while the application of glue on a wet surface with traces of water is unacceptable. Before applying to fresh concrete, let it mature.

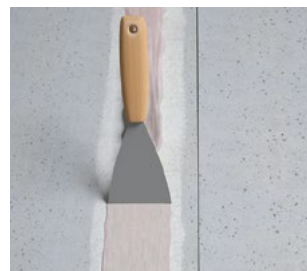
Metallic surfaces must also be cleaned of traces of corrosion, oils and paint using sandblasting, preferably to a clean metal state.

The temperature during application must be at least **+5 °C**, and three aspects must be considered: foundation temperature, air temperature and material temperature – and the minimum temperature should be used as a guide. For highly porous foundations, it is recommended to use an epoxy primer prior to applying glue.



The glue is prepared as follows: mix components A and B for at least **3 min.** using a mixer (**100-150 RPM**) until a uniform grey color mixture is created.

NOTE: The prepared mix must be used within **40 minutes**.



The PVC tape is then glued by geotextile edges to the epoxy glue. For this purpose, the glue is applied to the substrate in two parallel lines of **1-3 mm** thick so as to ensure that geotextile edges are aligned with glue strips during PVC tape installation. The glue must extend beyond tape edges by **20-30 mm**.



Press geotextile tape edges into the glue. Then apply a second layer of epoxy glue over geotextile edges of the tape.

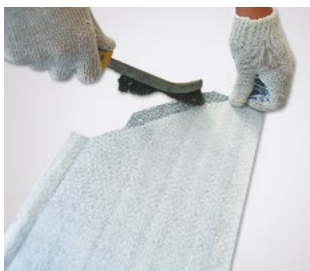
Overlap of flexible tapes in the junction area must be at least **40 mm**. Waterproofing tapes are welded to each other with a Leister Triac PID machine and silicone roller, similar to membranes.

The consumption of epoxy glue is **1.0-1.2 kg** per **1 linear m** of PVC tape.

5.3.3. Installation of TECHNOMICOL PVC tapes



Before overlap welding of tapes, when angular, T-shaped or cross-shaped elements are created, melt the fleece layer on their backside with a manual heat gun at **300 °C**.

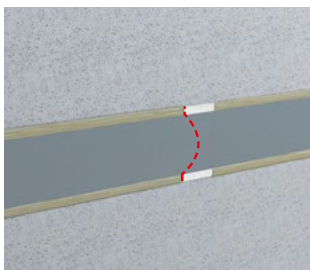


Remove the melted fleece with a metal brush to ensure improved reliability of joints.

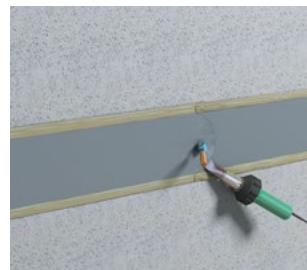
Joining of tapes length-wise with an overlap



When installing the tape, do not apply glue at its end at a distance of a minimum of **10 cm** from the edge.



Form an overlap of the following tape to the already installed one for at least **10 cm**. Mark and cut the formed overlap, as shown in the figure. This will enable maximum sealing of the welded seam.

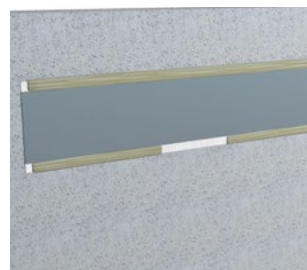


Weld the overlap with the hot air hand tool.

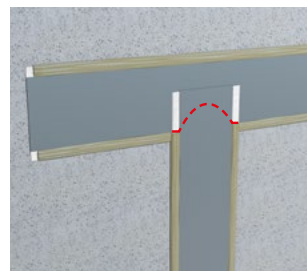


Apply epoxy glue to the tape ends at the point of welded overlap so as to ensure that newly applied tape goes over the already applied one.

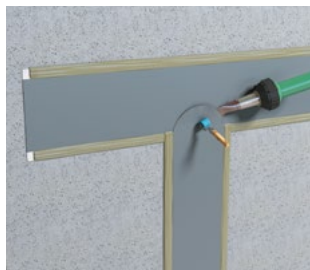
T-shaped connection



When installing a tape, do not apply epoxy glue on its edges at the point of a planned T-shaped connection.



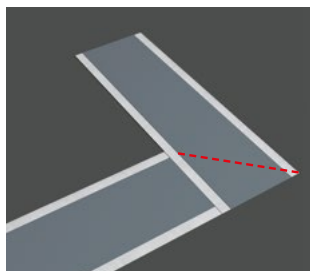
Install the second tape on the already installed one with a minimum overlap of **10 cm**. Pay special attention to the quality of adhesion at the point where glue has not been applied to the edge of the bottom tape. Mark and cut the formed overlap, as shown in the Figure.



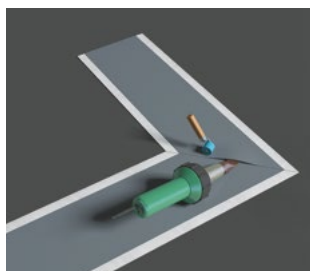
Weld the resulting overlap with the hot air hand tool. When welding PVC tapes, take care not to melt free edges of the fleece with hot air.

Cross-shaped elements are made as two T-shaped connections.

Corner elements



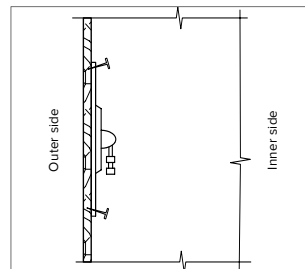
Form an overlap of tapes at the points of their crossing. Mark and cut the overlap at **45°** angle.



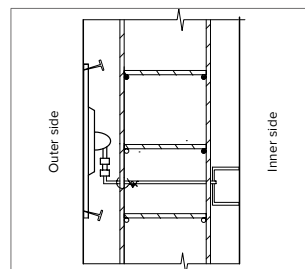
Weld the resulting overlap with the hot air hand tool.

5.3.4. Installation of an injection system

When using the method of excavation with backfilling, injection flanges are installed into the foundation walls by fastening to formwork and reinforcement cage before concrete casting.

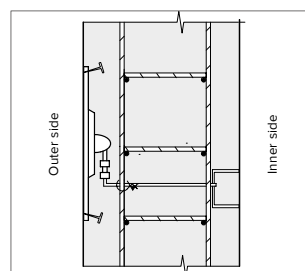


Install **5** injection flanges into each section bounded by waterstops. There must be a maximum of **4 nails** per flange. Bend the driven nails by **40-50°** from the vertical position.



Connect injection hoses to injection flanges with fittings. Hoses are fastened with wire on the reinforcement cage and extended inside the structure.

Install injection boxes for collection of injection hoses and place injection hoses from each injection flange into these boxes. Hoses from different waterproofing sections may be in the same box.



After injection flanges and hoses are reliably fixed on formwork surface and in the reinforcement cage, cast concrete in this section according to design.

NOTE: The inlet hole of the flange must be temporarily glued or plugged so as to prevent the ingress of cement mortar into flanges during concrete casting.



After the concrete casting is completed and the formwork is dismantled, carefully clean the surface of embedded waterstops and injection flanges for further welding of the membrane to them.

NOTE: All nails protruding from the concrete surface must be removed.

Before further installation of the waterproofing, make sure that the surfaces of the embedded outer waterstops and injection flanges are undamaged and clean.

5.3.5. Laying of geotextile on walls

Before starting PVC membrane installation, lay a protective geotextile layer with a minimum density of **500 g/m²**.

NOTE: Lay geotextile in sections, i.e. within the limits of one section bounded by waterstops. It should not cover the waterstops embedded in concrete.



For convenience reasons, geotextile sheets may be placed on a wall both vertically and horizontally.



Attach geotextile to the foundation wall with disk fasteners and **4.8×50 mm** self-tapping screws with polyamide **8.2×45 mm** anchor sleeves.

5.3.6. Installation of LOGICBASE V-SL waterproofing membrane

After the preparatory layer of geotextile is fastened on a vertical surface, start installing LOGICBASE V-SL membrane. For convenience reasons, the waterproofing membrane may be installed both in vertical and horizontal directions.

Do not create too many intermediate fixations of the membrane. The fixations may be limited to welding the membrane to the waterstop embedded in the foundation wall.



Weld the membrane edge to the installed PVC waterstop.

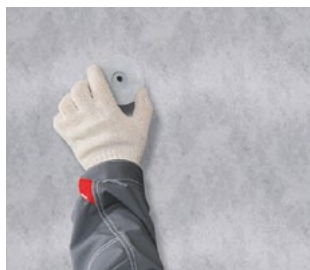


Gradually unroll the membrane downwards towards the wall base.

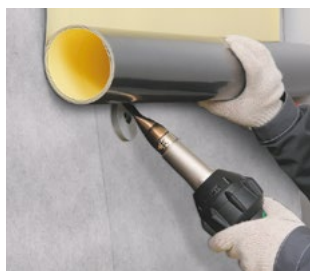


Provide the minimum overlap of **100 mm** between the adjacent rolls. Weld the membrane rolls to each other with an automatic welding machine.

Check the quality of all welds with compressed air. For details, see section 4.2.



The membrane may be also fixed to a foundation wall with PVC disc fixing elements (rondels). Mechanically attach rondels through geotextile to the wall surface.



Weld the membrane to rondels.



The membrane may be also fastened to the foundation wall based on a temporary pattern. If a roll is unrolled along the wall, rather than from the top downwards, it is recommended to create temporary attachments of the membrane to the wall from the strips cut out of the PVC membrane. These strips must be cut off before the next row is welded to the membrane from the top.

5.3.7. Top fixation of the waterproofing membrane

Mechanical fixation with the bar

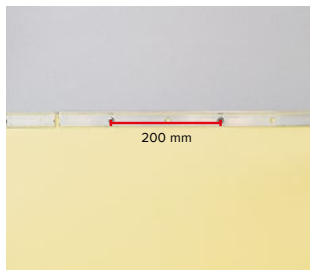
NOTE: Use the termination bar with an edge bend.



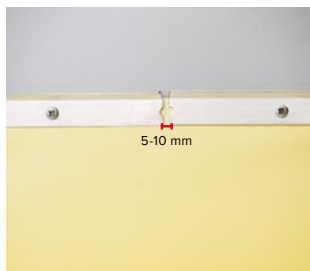
Fasten all layers of the waterproofing system mechanically using pointed self-tapping screws with a polyamide shell.



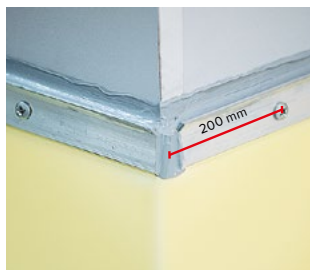
The edge bend of the bar must be oriented away from the wall.



The fastening span is **200 mm**.



Cut the bar at the points of outer and inner corners and leave a gap of **5-10 mm** at the point of joining of two bars.

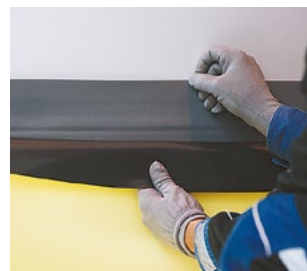


Fasten the bar edge in outer corners by installing the first self-tapping screw at a maximum distance of **50 mm** from the corner edge.

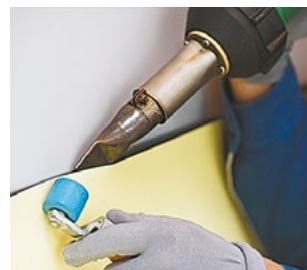
Fill the gap between the bar bend and the wall with polyurethane sealant.



Fixation with EC-220-3 or EC-320-4 outer waterstops or TECHNOMICOL PVC tape



If waterproofing is fixed non-mechanically, fasten it by welding to the surface of a pre-installed EC-220-3 or EC 320-4 outer waterstops.



For this purpose, weld LOGICBASE V-SL membrane to the waterstop using the hot air hand tool and the pressure roller.

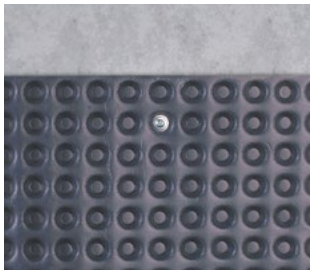
NOTE: Pay special attention to the quality of welding in the area of inner and outer corners. The welded joint must be sealed carefully.

TECHNOMICOL PVC tape may also be applied instead of the pre-installed EC-220-3 or EC-320-4 waterstops for the fixation of the waterproofing membrane. After the tape is installed on the concrete surface, tightly weld LOGICBASE V-SL membrane to it.

5.3.8. Protection of the waterproofing layer

After the complete installation of LOGICBASE V-SL waterproofing membrane, install PLANter geo protective and drainage membrane. This will prevent possible mechanical damage of waterproofing on the foundation walls during backfilling.

If any other drainage material is used for protection, e.g. PLANter eco, it is recommended to additionally protect the waterproofing membrane with geotextile with a density of **500 g/m²** before its installation.



Mechanically fix PLANTER geo membrane above the waterproofing level.



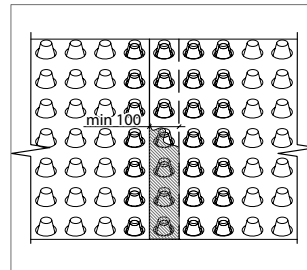
After the top end of PLANTER geo membrane is fastened, unroll it from the top downwards. Install the following rolls with a minimum overlap of **120-150 mm** over already installed ones.



On the place of rolls overlap separate the geotextile from the bottom membrane studs by **120-150 mm**.



Ensure an overlap of membranes edges "stud to stud" where no geotextile is present. Seal the overlap with the self-adhesive butyl rubber tape.



Make sure that the middle of the tape is aligned with the edge of the top sheet.



Direct the free end of the geotextile over the adjacent roll at the connection point between two rolls of the profiled membrane.



Apply double-sided adhesive tape to the point of geotextile connection. Geotextile overlaps may also be attached with a manual heat gun at a low-temperature mode.



Geotextile from two adjacent rolls must be interconnected immediately after membranes are completely unrolled.

NOTE: This procedure is required to prevent possible separation of geotextile under the influence of natural and technological factors. It also prevents silting of the membrane drainage intake.



Install the edge profile above the waterproofing level to prevent soil ingress into the gap between the waterproofing and drainage membrane.

6.

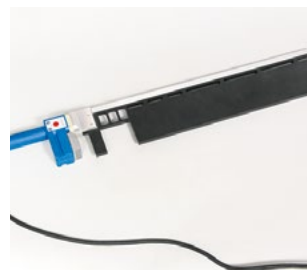
Welding of waterstops

6. Welding of waterstops

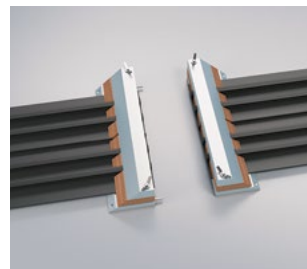
All connections could be made with the use of special equipment (an electromagnetic plate and pressure conductor) or the hot air hand tool.

6.1. End connections

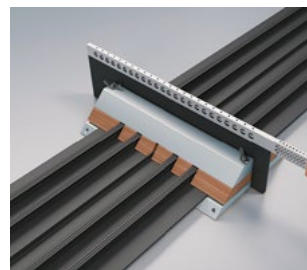
6.1.1. Welding of end connections with special equipment



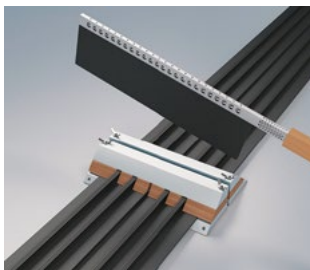
Before starting the work, preheat the heating element to the required temperature of **450 °C**.



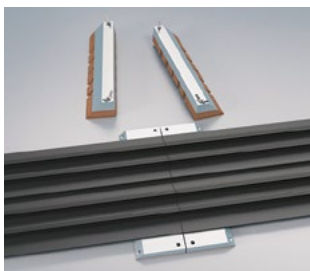
Fasten the connected ends of waterstops in the conductor. Evenly cut the ends of waterstops to be welded. Next, open the conductor and move the waterstop a little forward from the conductor and clamp again.



Place a heating element into the operating position between the waterstop ends. Gently close the conductor bringing the waterstop ends to the heating element. This causes formation of a bead of molten material along the whole perimeter of the waterstop cut area. Make sure that melting is uniform.



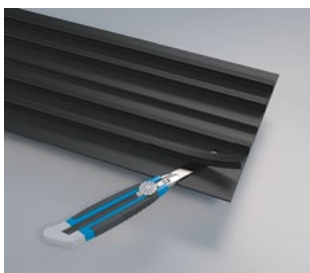
Next, open the conductor, take out the heating element and close it again. Molten edges of the waterstop will close and fuse.



Let the new seam cool down and dismantle the conductor. The bead of molten material formed along the perimeter of the welded joint should be cut with a paper knife.

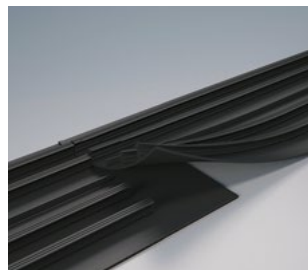
6.1.2. Welding of end connections with the hot air hand tool

End connections of waterstops may also be made using a hot air hand tool.



Clean and even out the edges of waterstops being connected. Cut off anchoring ribs at one of the waterstops being connected to a width of **6-8 cm** minimum.

NOTE: Always remove the chamfer from the end of the waterstop where the ribs were removed.



After the ribs are cut, remove the chamfer from the waterstop end to ensure the better connection of waterstops. Place the second waterstop on the waterstop with cut-off ribs so as to ensure that cuts of waterstop anchors on both sides are tightly pressed against each other.



Insert the nozzle into the created overlap and weld the waterstops by pressing the top waterstop against the bottom one with a teflon roller. Move the heat gun across the waterstop along the seam.

Using a heat gun with a narrow nozzle, alternately preheat the ends of anchor elements and manually press them against each other. They will form a strong seam after cooling.

6.2. Angular and cross-shaped elements

6.2.1. Welding of corner elements with special equipment



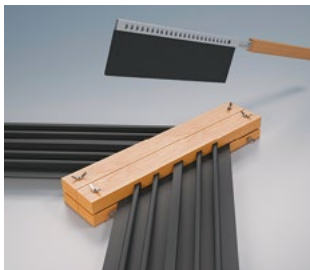
Position and fasten the waterstops being connected in the conductor for corner connections and cut them along the conductor at a **45°** angle.



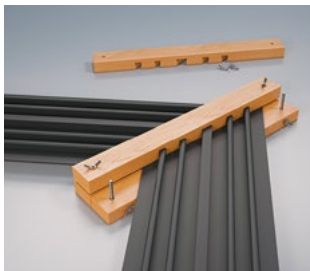
Open the conductor and insert the waterstop, ensuring that it extends from conductor and clamp it again.



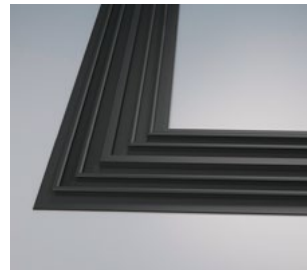
Place the heating element into the operating position between the waterstop ends. Gently close the conductor, bringing the waterstop ends to the heating element. This causes formation of a bead of molten material along the whole perimeter of the waterstop cut area. Make sure that melting is uniform.



After the waterstop ends are uniformly melted, take out the heating element and firmly press the clamps against each other.

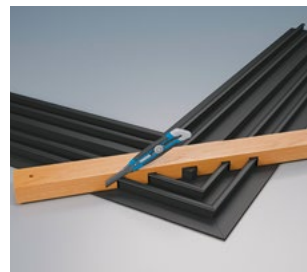


Remove the clamp after cooling. A bead of molten material formed along perimeter of welded joint should be cut with a knife.



Angular element is ready.

6.2.2. Welding of cross-shaped elements with special equipment



To create a cross-shaped element, weld **2** angular elements.



Cut the apex off both angular elements, as shown in the figure.



Fasten the parts in a special X-conductor. Place a heating element into the operating position between the waterstop ends. Gently close the conductor, bringing the waterstop ends to the heating element. This causes formation of a bead of molten material along the whole perimeter of the waterstop cut area. Make sure that melting is uniform. After the waterstop ends are uniformly melted, take out the heating element and firmly press the clamps against each other.



Remove the conductor after cooling. A bead of molten material formed along the perimeter of the welded joint should be cut with a paper knife.



The cross-shaped element is ready.

6.2.3. Welding of corner elements with the hot air hand tool

90° angles are formed when the direction of waterstop installation is changed and in case of transition from the horizontal surface to the vertical one.



To make a **90°** turn, follow recommendations below. Form an overlap between the waterstops being connected.



To ensure further convenience of work, cut the flat part of the waterstop, which is on top.



Do not remove the cut part completely.



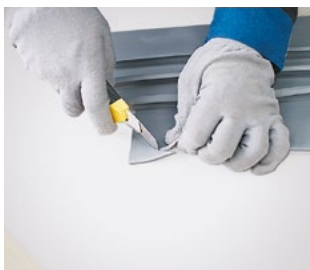
After the overlap is formed, cut the top waterstop at a **45°** angle.



Lightly cut only the ribs of the waterstop first, and place a waterstop on an even and strong surface for cutting of the flat part.



Always round off the corners formed during cutting.



Do this at both sides. This will ensure the convenience of welding of flat parts and will increase joint reliability.



Then form an overlap again to prepare the bottom element.

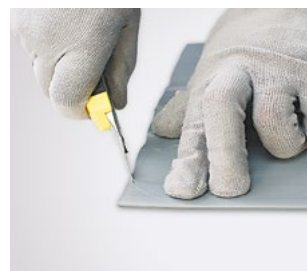


Mark and then slightly cut waterstop ribs at **45°**.

NOTE: Do not cut through the flat part of the waterstop, only its ribs.



Remove the ribs of the lower waterstop for a width corresponding to the overlap width.



After the ribs are removed, round off sharp corners.



Weld edges of the bottom element to the waterproofing membrane surface.



Place the upper element on the welded bottom element.



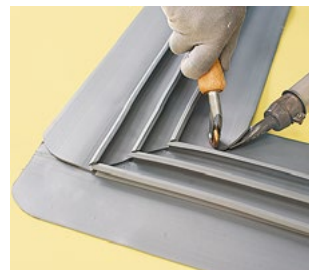
Mark the overlap on the bottom element.



Remove the chamfer along the waterstop edge from the mark to the end of the waterstop cut.



Crimp the waterstop edge along the whole distance where the chamfer was removed.



Next, form an overlap. Precisely align waterstop ribs.

Weld flat edges of waterstops to one another, using a brass roller.



Weld the top part of the overlap to the waterproofing membrane surface, using the teflon roller.

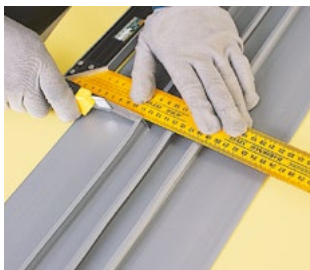


After flat parts of waterstops are welded to each other and to the waterproofing membrane, weld the ribs of waterstops.

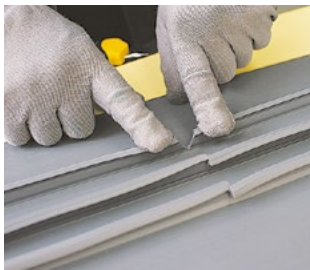


90° corner element is ready. Check the quality of welded joints.

6.2.4. Welding of a 90° corner at the point of transition from the horizontal surface to the vertical one with the hot air hand tool



Cut waterstop ribs at the expected bend point.



Make V-cuts at each cut point with a width equal to the rib height.



Bend the waterstop and weld the cut point.

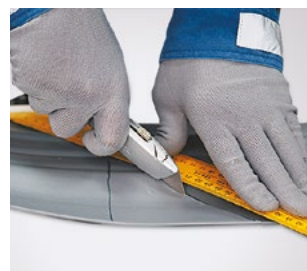
6.2.5. Welding of T-shaped elements with the hot air hand tool



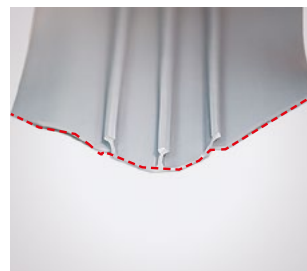
T-shaped connections may be made on site by fabrication of individual elements with their further installation at the crossing points.



Mark the element for subsequent cutting of its edges at **45°**.



Cut the element as marked.



After the element is cut at **45°**, turn it over and cut **1 cm** inwards and to the sides, near the outer ribs, as shown in the figure.



Start preparing another element. At first, make sure the junction between two elements is uniform, using a measuring tool.

NOTE: The angle between the elements must be 90°.



Remove the part of the rib of the second element, which prevents joining.



Place the first element at the site, where a part of the rib of the second element was removed for further welding. If required, cut the element on site.

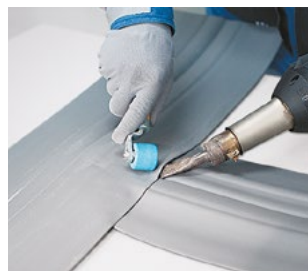


Weld the elements starting with ribs. Place the nozzle in the area of the junction between two ribs, wait for uniform melting of edges for **2-4 seconds**, remove the nozzle and attach rib edges by tightly pressing them against each other.

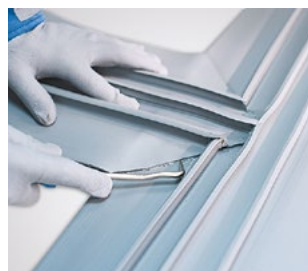
NOTE: Always use heat-resistant gloves.



Use a brass roller when welding flat parts of elements.



After all rib junctions and flat parts of the elements are welded, turn it over and weld the overlap on the reverse side.



A T-shaped element is ready. Check the quality of the welded joint.

7.

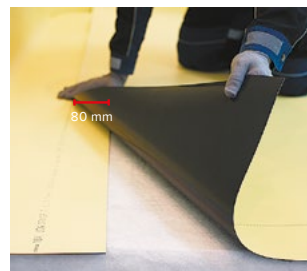
Connection of vertical and horizontal waterproofing layers

7. Connection of vertical and horizontal waterproofing layers

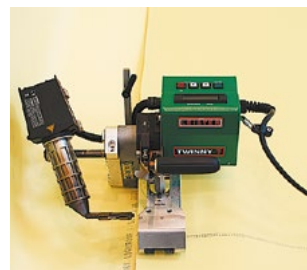
7.1. Membrane transition from the foundation slab to the diaphragm wall



The connection is made on the horizontal surface. To do this, provide an overlap of at least **300 mm** for the membrane installed on the vertical surface to the horizontal surface of the concrete bed.



When installing the membrane on the horizontal surface of the concrete bed, form an overlap to the vertical membrane of at least **80 mm**.

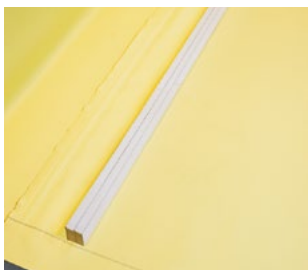


Weld the formed overlap with the automatic welding machine.

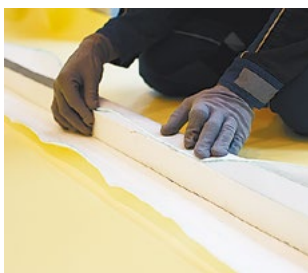
The connection may be also made on the vertical surface of the retaining structure.

To do this, make sure that the horizontal membrane extends to the surface of the retaining structure by at least **300 mm**. When installing the membrane on the vertical surface of the retaining structure, create a surplus over the already provided extension of the horizontal membrane to form an overlap of at least **80 mm**. Weld the formed overlap with an automatic welding machine.

Regardless of the surface where the connection between the vertical and horizontal waterproofing layers was made, one must provide an expansion joint of a stress compensator (foamed polyethylene cord or extruded polystyrene) and a reinforcing layer of LOGICBASE V-SL membrane at the point of transition from the concrete bed to the retaining structure.



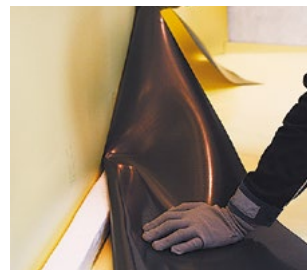
After the connection of horizontal and vertical waterproofing layers is made, start installing the stress compensator on the membrane surface. To do this, prepare a **50×50 mm** bar of extruded polystyrene.



Always wrap the prepared bar with geotextile or polyethylene film.



Use double-sided self-adhesive tape to attach the geotextile or film. When a foamed polyethylene cord is used as a compensator, wrapping is not needed.



Prepare a **1 m** wide strip from LOGICBASE V-SL membrane. Place the prepared reinforcing strip on the spot where the stress compensator is installed so that one half of it is located vertically and the other horizontally.



Weld the reinforcing strip so as to precisely replicate the outline of installed stress compensator.

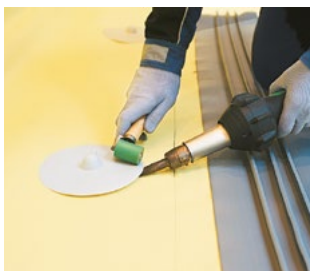


The connection is ready.

Since the transition from the concrete bed to the retaining structure is a vulnerable place, we recommend allocating it in an individual watertight section bounded by waterstops and installing a repair injection system.



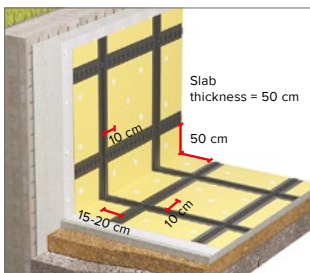
To do so, install EC-220-3 waterstop by welding it to the surface of the main membrane layer at the point of transition from the horizontal surface to the vertical one.



Install injection flanges in the created section.



Use spot welding to attach the flanges. The flange skirt must not be welded around the complete circumference.



The installation scheme for waterstops and flanges is shown on the figure.

7.2. Membrane transition to the foundation wall with backfilling



A stress compensator (foamed polyethylene cord or **50×50 mm** bar of extruded polystyrene pre-wrapped in a non-woven fabric or plastic film) should be installed on the surface of the waterproofing membrane along the edge perimeter of the foundation slab.



The stress compensator is fixed with the strips from LOGICBASE V-SL membrane that are welded to the surface of the main waterproofing layer.

After installing the compensator, one should arrange the additional reinforcing layer of the waterproofing membrane with the width of at least **300 mm**. The reinforcing layer should be installed around the entire perimeter of the edge of the foundation slab, and its width should be evenly distributed relative to the edge of the slab in both directions.

The transition of the membrane from under the foundation slab to the foundation walls is made on the vertical surface by welding of vertical waterproofing layer to the extension of the horizontal waterproofing layer.



When installing the system on the horizontal surface of the concrete bed, make sure all of its layers (except the PE film) extend beyond the limits of the bottom outline of the foundation slab by at least **300 mm**.

NOTE: Always protect the membrane extensions with plywood or cement-sand screed.

After reinforcement and concrete works are completed and foundation walls are ready, dismantle the protective layers and release the membrane extensions.



Raise the horizontal extension of the membrane upwards, joining it with the membrane being installed vertically and forming an overlap of at least **80 mm** for welding with the manual hot air tool and at least **100 mm** when using the automatic one.



For convenience, make spot welds of the overlap between the horizontal and vertical waterproofing layers with the manual heat gun. Keep in mind that spot welding is a temporary fixation of the membranes and is only made for the convenience of further automatic welding.



Weld the membranes with the automatic welding machine. When the machine moves along the overlap, temporary spot welds should be destroyed.



The transition from the horizontal surface to the vertical one is ready.

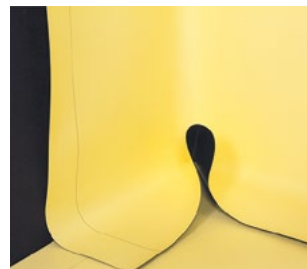
8.

Execution of corners

8. Execution of corners

8.1. Execution of an inner corner with a “pocket”

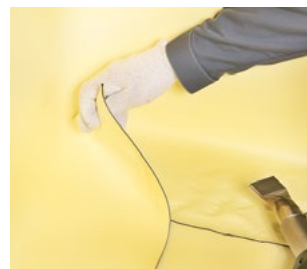
An inner corner shall be made with the hot air hand tool.



Form a “pocket” from the membrane along the inner corner and carefully press it into the corner base.



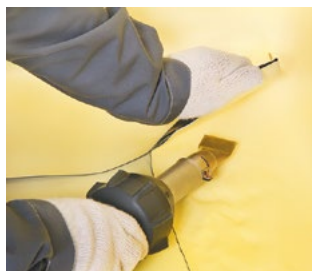
Fold a loop at **45°**.



Weld the horizontal overlap from one side of the corner to the main membrane.



Weld the “pocket” inside, moving from the corner base (“pocket tip”) to the center.



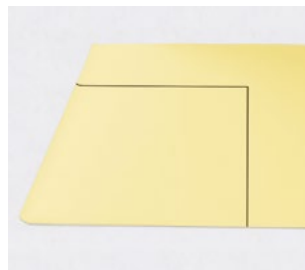
Fold the welded “pocket” and weld it to the horizontal overlap (welded earlier) using a narrow brass roller.



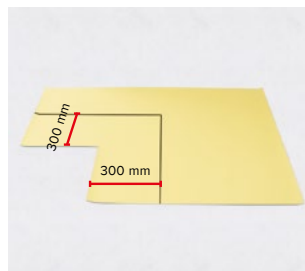
Weld the horizontal overlap from the other side of the corner to the main membrane starting from the “pocket” weld base.

8.2. Execution of an inner corner on the foundation with backfilling

In this case, an inner corner is made by fabrication of an individual element consisting of two parts (straight angle).



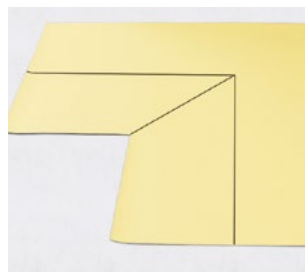
To fabricate the element, prepare a cut-off piece of LOGICBASE V-SL membrane with the minimum dimensions of **1×1 m**. Place it on the concrete bed at the point of the waterproofing, where the inner corner of the walls will be located. Mark the outlines of future foundation walls.



Measure **300 mm** from the outlines of each foundation wall as shown in the figure. This is required to form extensions for subsequent joining with the vertical waterproofing membrane. Remove the part of the element as shown in the figure. It can be used later as a second part of the element.



Mark the element, connecting the corner base to its edge.



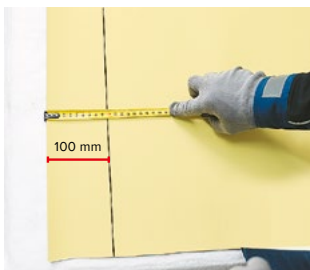
An intermediate look of the element.



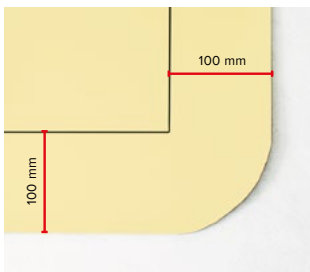
Cut the element as marked.



Start making the second part of the element. To do this, prepare a square workpiece with sides determined by measurement of the main part cut length **+100 mm**.



Mark it, leaving **100 mm** from the edge.



Always round off one of the workpiece corners, as the ultimate quality of the element depends on it.



Preheat a small area of the workpiece at the rounding point with the manual heat gun. When the membrane becomes soft, stretch it with hands.



Follow the same procedure for the adjacent section, until a significant length increase is obtained at the point of the rounded corner.

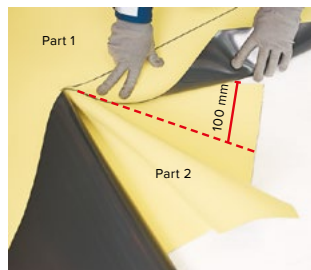
NOTE: Do not pull the workpiece with excessive force or overheat it.



Start connecting two parts for the fabrication of the element to be used for waterproofing of an inner corner. To do this, place the prepared second part of the element into the area of the cut of the first part.



Place it, positioning the rounded corner of the second part at the base of the cut of the first part of the element.



Align the edge of the cut of the first part with the marks on the second part of the element, forming an overlap for welding.



Spot weld the formed overlap.



Then weld both parts of the element, starting from the corner base both ways.



Turn over the element. Weld extensions of part 2 to part 1 starting from the edge of the first part and move towards the corner base.



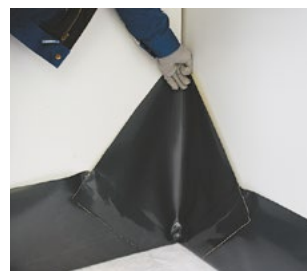
Pay special attention to the quality of welding of the stretched corner. An element (straight angle) is ready. Turn it over again and install it at the point where the inner corner will be located. Weld it to the main waterproofing membrane on the foundation slab.



After the walls are ready and protection of waterproofing extensions is dismantled, raise the extensions of the waterproofing membrane.

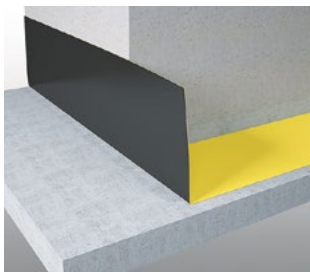


Unfold the prepared element that seals the inner corner. The extensions should be now welded to the vertical membrane.

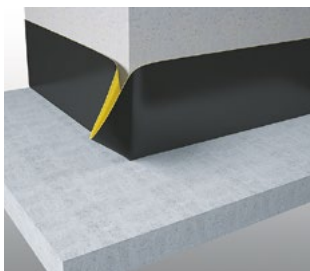


Unfold the prepared element that seals the inner corner. The extensions should be now welded to the vertical membrane.

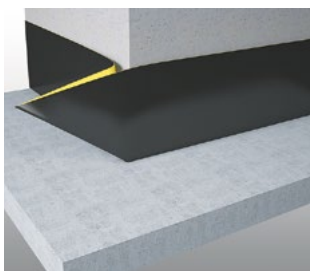
8.3. Execution of an outer corner



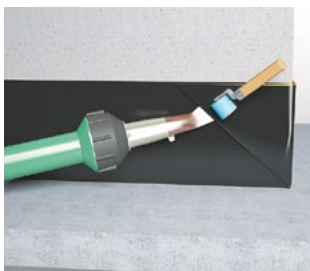
Successively bend the membranes in the left and right horizontal corner planes.



Spot weld the "pocket".



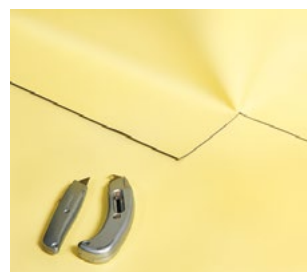
Bend the formed "pocket" across the corner line to any vertical plane.



Weld the "pocket" to the membrane lifted to the vertical surface.

When joining the extension of the horizontal waterproofing membrane lifted to the vertical surface with the vertical waterproofing membrane, ensure the overlap of at least **10 cm**. Special attention must be paid to the sealing of welding at the crossing point between the "pocket" welded to the vertical surface and the lower edge of the vertical waterproofing membrane. There must be no non-welded channel left at this site, through which water may penetrate underneath the waterproofing layer.

In some cases, the connection between the horizontal and the vertical waterproofing membranes is made without extension of the horizontal waterproofing membrane to the vertical surface. In this case, the membrane extension from under the foundation slab is left on the horizontal surface, while the vertical membrane is lowered to the horizontal membrane with an overlap of **10 cm**. Then the area of the corner should be additionally reinforced as followed.



Cut the membrane opposite to the corner, stopping at least **5 mm** from the corner base. Always round off sharp corners formed during cutting.



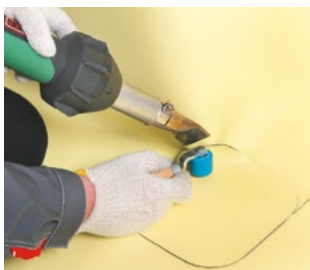
Weld the overlap to the horizontal membrane along the corner direction.



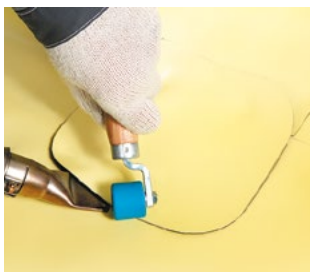
Cut out a reinforcing element from LOGICBASE V-SL membrane with dimensions ensuring that it overlaps the cut point by at least **50 mm**.



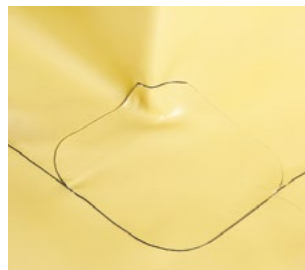
Round off the corner of the element to be located in the vertical corner. Using the manual heat gun, preheat and stretch the rounded corner of the element.



Weld the rounded element corner from the top downwards, starting from the corner base and sideways away from corner base.



Carefully weld the remaining area of the element using the wide silicone roller.



The outer corner is ready.

9.

Waterproofing of expansion joints

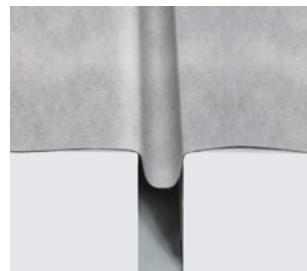
9. Waterproofing of expansion joints

Use TECHNONICOL waterstops of EM and IM types for reliable waterproofing of expansion joints.

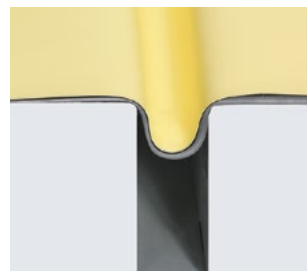
The composition of the waterproofing system in the area of expansion joints matches the layers installed on the main surface.

Leave space at the sites of expansion joints (a groove with rounded edges) sufficient for a compensator, ensuring required elongation of the waterproofing material during deformation (shrinkage, settling) of the structures.

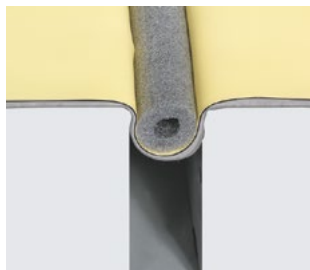
9.1. Waterproofing of an expansion joint on the foundation slab



Place the first layer of geotextile with a loop extension into the groove.



Place LOGICBASE V-SL membrane over geotextile, forming a compensation loop for reduction of tension stresses.

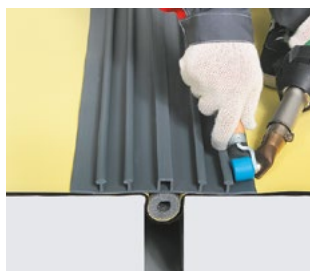


Place a foamed polyethylene cord of the corresponding diameter into the created loop to serve as the compensator.



Place the EM-type waterstop for expansion joints over the compensator.

NOTE: The middle of the waterstop must match the center of the expansion joint.



Weld the edges of the waterstop to the membrane with manual or automatic equipment.



After the waterstop and the membrane are welded together, continue installation of the other layers.



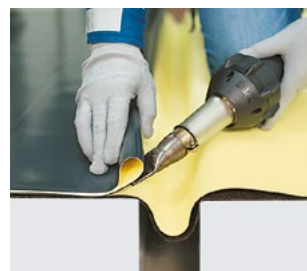
Place the top layer of geotextile and polyethylene film.

NOTE: Do not cover the waterstop anchors with geotextile and film. Anchors must be open for subsequent concrete casting.

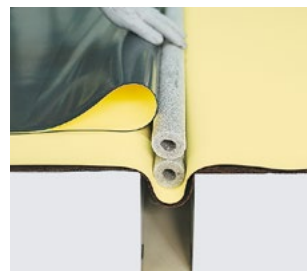
9.1.1. An alternative method for waterproofing of an expansion joint

The most reliable method of expansion joint waterproofing in terms of waterproofing serviceability is the method of creating a repair section in the seam area.

After the underlying layer of geotextile and the main layer of the membrane are laid in the seam area forming a compensation loop, start applying the strengthening layer.



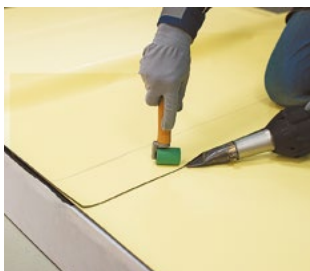
To do this, prepare a strengthening strip of LOGICBASE V-SL membrane with the width that must cover the **500 mm** distance from the seam centerline both ways. Place the prepared strip in the seam area and spot weld it at one edge for convenience of future work.



To form a loop of the material, use additional foamed polyethylene cord of a suitable diameter.

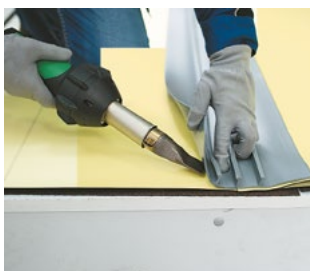


Cover the installed cord with the strengthening strip.

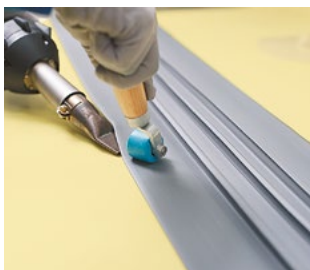


Weld its edges to the main waterproofing membrane.

After the strengthening strip is installed, start installing EC-220-3 waterstops.



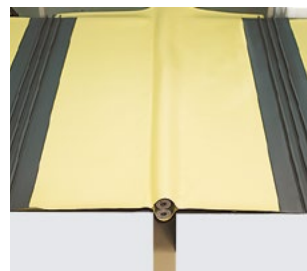
Weld the flat edge of the waterstop to the membrane surface on both sides of the seam. Distance from the waterstop centerline to the seam centerline is **500 mm** minimum. At first, spot weld the waterstop edge closer to center.



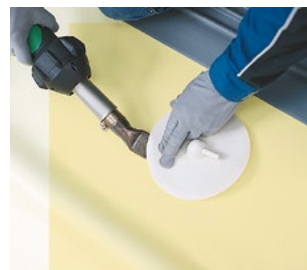
Then tightly weld the waterstop edge using the roller and the hot air hand tool.



Use Varimat welding machine for flat waterstop edge welding to the membrane, if the seam is long.



The intermediate look of the isolated section.

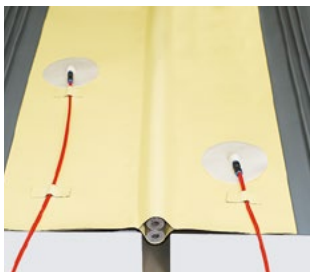


Install injection flanges into the formed section at a minimum distance of **200 mm** from the waterstop. The relative displacement of the centerlines of adjacent flanges must be at least **2 m**.

Use spot welding to attach the flanges. The flange skirt must not be welded around the complete circumference.

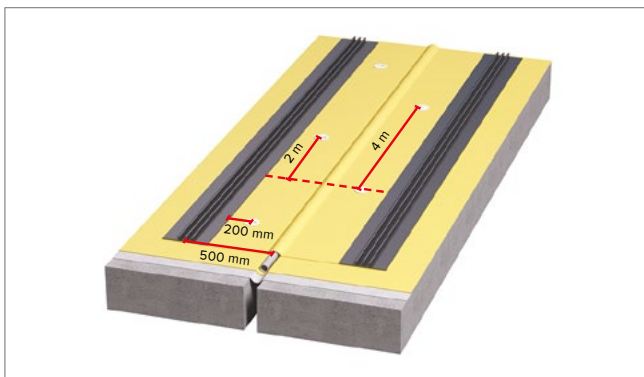


Connect injection hoses to flanges using connection fittings.

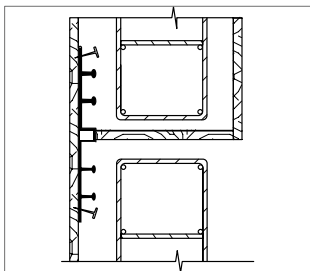


Waterproofing in the area of an expansion joint is complete.

The installation diagram for waterstops and flanges is given in the figure below.

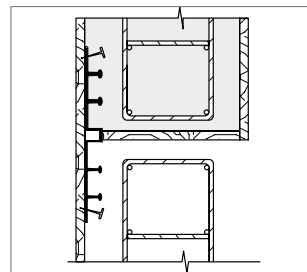


9.2. Waterproofing of an expansion joint on the foundation wall

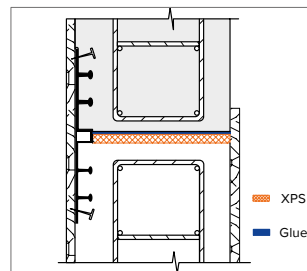


Install waterstops at the casting stage.

Prepare a site for waterstop installation, clean dirt and contaminants from it, mount and fasten the waterstop on the formwork.

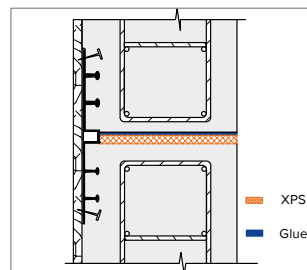


Cast concrete to the relevant part of the structure. Remove the formwork and visually check the quality of waterstop installation. Clean the exposed part of the waterstop before casting concrete in an adjacent structure section.



Install and fasten the seam cavity filler – a bar of XPS thermal insulation – with epoxy glue.

Install formwork at an adjacent structure section.



Cast concrete in an adjacent part of the structure. Visually check the quality of performed work.

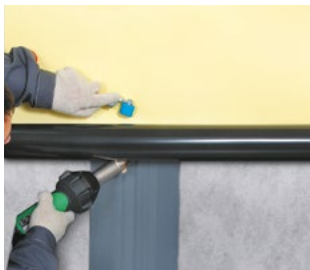
NOTE: After formwork is dismantled, all nails protruding from the concrete surface must be removed.

9.2.1. An alternative method of foundation wall joint waterproofing



Install TECHNICONICOL EC-220-3 waterstops in the area of the vertical expansion joint at the concrete casting stage (see section 5.3.1. for details).

After formwork is removed and concrete surface is prepared, install the first layer of geotextile.



During the installation of the waterproofing membrane, weld it to the surface of the installed waterstops.



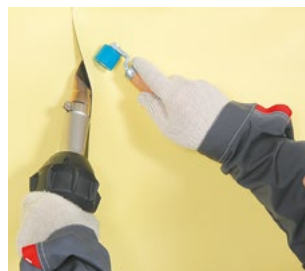
Create a membrane loop in the expansion joint.



Place a foamed polyethylene cord in the created loop as a compensator.



Install a strip of LOGICBASE V-SL membrane with a width exceeding the width of the seam by **150-200 mm** on each side.



Lightly weld the membrane strip in the area of the seam.

10.

Waterproofing of utility passageways

10. Waterproofing of utility passageways

10.1. Membrane installation at pipe passageways



Mark the place of membrane connection to a pipe with and cut the membrane after tightly pushing it against the pipe.



Cut a hole of the appropriate diameter.



Weld a patch on the cut area.

Check the quality of completed seams with the probe.

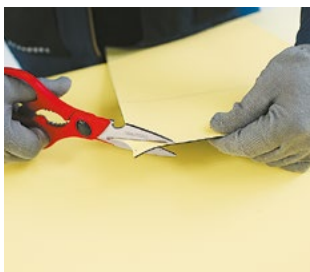
10.2. Connection to a pipe



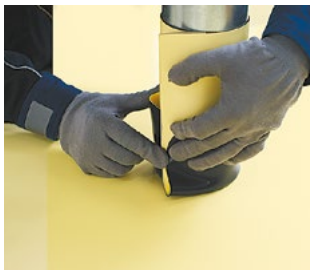
After the main waterproofing layer is installed at a pipe passageway location, start waterproofing the joint. For that one will need a patch of the rectangular shape.



One side of this rectangle is equal to length of pipe circumference **+50 mm**, and the other one is equal to the sleeve length **+100 mm**. Make the required measurements and cut out the material for the workpiece.



Always round off two corners of the workpiece located on its long side.



Wrap the workpiece around the pipe, forming a bend at its base.

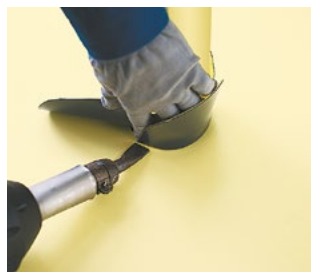


Spot weld the formed overlap on the vertical part of the pipe.

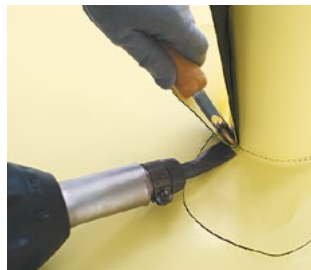


Cut the created bend to let the parts formed during cutting would move down to the pipe base.

NOTE: Always round off sharp corners formed during the cutting.

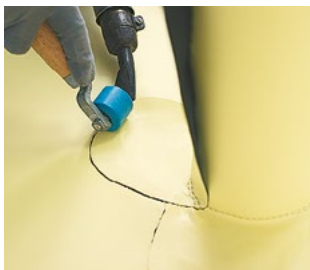


Carefully preheat the base of the bent parts and lower them to the main waterproofing membrane.



Weld the bent parts starting from the base and moving towards the edge.

NOTE: Use a brass roller for base welding.



Use the teflon roller for welding the edges.

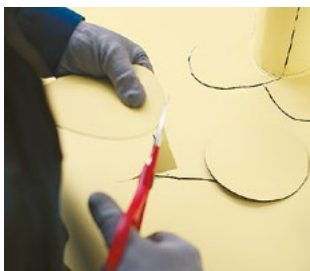
NOTE: Always preheat the bent parts before starting welding.



After the bent parts are welded to the main membrane, weld the formed overlap on the pipe.



Weld the overlap in two runs to weld through the overlap uniformly through the whole thickness. Weld the overlap from the depth first and then at an edge.



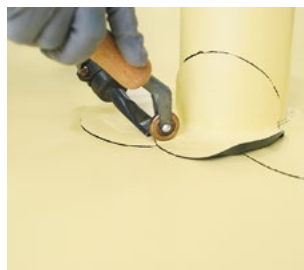
After the overlap on the pipe and all the bent parts are welded, prepare patches with a minimum size of **50 mm** in diameter. The number of such patches should correspond to the number of workpiece cuts.



Always preheat patches before installation, measuring them against the site and giving them the required shape.



This will make the patch welding process significantly easier and will improve joint reliability.



Weld the prepared patches with the brass roller, starting from the pipe base and moving towards the edges. Pay special attention to the quality of welding at the point of overlap between a bent part and a patch.

After all patches are reliably welded to the bent parts and the main membrane, start final waterproofing of the completed element.



To do this, install the clamp of a corresponding diameter that must reliably fasten the membrane on the pipe at least **50 mm** below the membrane end.



Fill the formed cavity with sealant along the whole pipe outline until a visible swelling is formed.



After the cavity is filled with sealant, install a second clamp at a distance of at least **10 mm** from the membrane edge.



Apply an additional amount of sealant to the section from the pipe to the clamp. Make sure that the sealant layer contacts the clamp and the metal pipe.

10.3. Connection to a pipe using a prefabricated element



Cut the top part of the prefabricated element according to the pipe's diameter.



Place the element on the pipe and lightly spot weld it to the base in several spots. Remove the chamfer from the element edges along the whole seam width (at least **30 mm**).



Weld the base edge of the prefabricated element all around using the teflon or silicon roller.



Tighten the joint with a metal clamp and fill it with the sealant.

11.

Waterproofing of piles

11. Waterproofing of piles

11.1. Waterproofing of piles using waterstops

Waterproofing of piles is performed by grouting of a pile cap with cement non-shrink grout with the installation of an outer waterstop on the inner surface of pile cap formwork.



To do this, prepare formwork for installation of the EC-220-3 waterstop on its inner side.



Install the waterstop fixing it to the formwork with its flat side (see section 5.3.1. for details).



Install the prepared formwork with the attached waterstop around the pile cap and fill it with non-shrink grout with a waterproof grade of at least **W 12**.



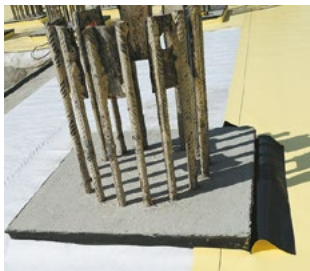
After the waterproof grout hardens, dismantle the formwork.



Always clean the waterstop surface to remove mortar after concrete grouting.



Place a sub-layer of geotextile on the concrete grouting surface. The edge of the geotextile should not cover the waterstop surface.



Lay the main waterproofing membrane covering the installed waterstop and cutting the material on site.



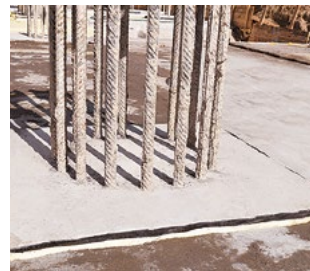
Weld the membrane to the waterstop surface. Pay special attention to the quality of welding on uneven surfaces.



Install reinforcing patches in the membrane cutting areas at the pile cap corners.



Pay special attention to the quality of welding in the areas of patch installation.



After the second geotextile layer and PE film are laid, waterproofing must always be protected with cement-sand screed.

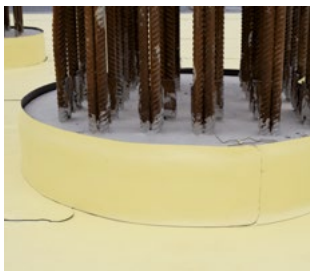
11.2. Waterproofing of piles using PVC tapes

Connection of the waterproofing membrane to piles may also be made with PVC tapes. In this case, the waterstop is not installed into the formwork. After casting of a pile cap around the pile and removal of formwork, TECHNOMICOL PVC tape should be attached to the waterproof concrete surface using TECHNOMICOL epoxy glue. The membrane is then welded to the PVC tape as described below.



Apply epoxy glue to the surface of the pile cap prepared in accordance with section 5.3.2. The glue is recommended to be applied in a continuous layer with a width equal to the width of the tape used. Then install TECHNOMICOL PVC tape on it.

NOTE: After installing the tape, form a second layer of glue over geotextile edge of the tape for reliable sealing.

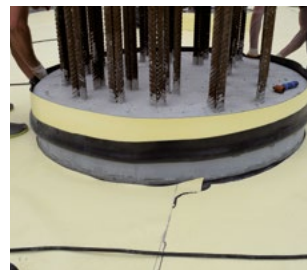


Prepare a strip from LOGICBASE V-SL membrane with the length equal to the pile circumference **+100 mm** and the width equal to the height of the pile cap **+100 mm**.

Weld the overlap with the manual welding machine.



It is recommended to install a reinforcing patch at the overlap weld site.



Fold the bottom edge of the strip, it will form an overlap on the main horizontal membrane.



Align and carefully weld the top edge of the strip to TECHNOMICOL PVC tape installed earlier.



Then unfold and weld the bottom edge of the strip to the horizontal waterproofing membrane.



This method of pile caps waterproofing requires careful alignment and drying of the base for glueing the tapes.

12.

Waterproofing of pits

12. Waterproofing of pits



Lay LOGICBASE V-SL membrane in the pits, cutting the corners along the corner line.



The intermediate look of the pit.



Prepare membrane strips of the length enough to cover the membrane cut, extending to the horizontal surface.



Weld all formed overlaps.



Pay special attention to welding of corners rounded in advance.



The pit waterproofing is ready.

13.

Installation of double-layer waterproofing system

13. Installation of double-layer waterproofing system

13.1. General information about the system and materials used

A double-layer reparable waterproofing system with vacuum quality control is based on the use of LOGICBASE PVC membranes with an additional set of equipment to restore the waterproofing properties during the operation of the structure. Another feature of this system is the ability of instrumental control of the waterproofing layer integrity over the entire area.

The system consists of double-layer sections with an area of up to **150 m²**. Each section consists of the main waterproofing PVC membrane with a signal layer LOGICBASE V-SL and the textured PVC membrane LOGICBASE V-ST. Compartmentalization of the system allows localizing the leaks in case of their occurrence and perform local repairs using injection technologies.

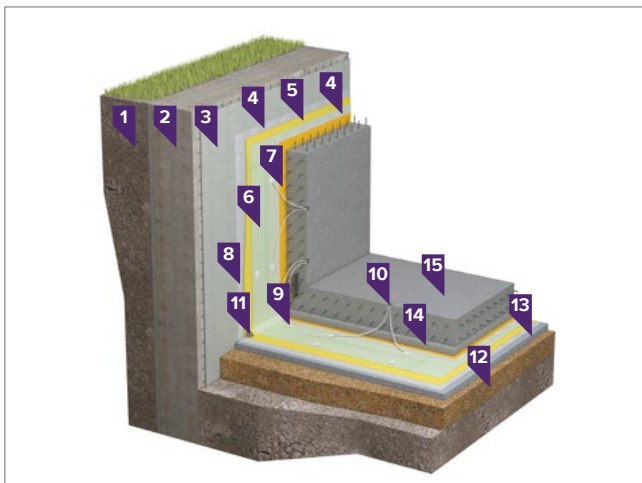
In each waterproofing section, one should cut the holes in LOGICBASE V-ST textured membrane with the following complete welding of injection flanges to them. One section can contain from **2 to 5** or more flanges, depending on the area and geometry. The flanges are then connected with fittings to injection hoses that are grouped into the injection boxes.

In the need of repair, a special polymeric compound LOGICBASE INJECT is injected through the system of hoses and flanges. It fills the section and polymerizes with the formation of a waterproof gel, thus restoring the integrity of the waterproofing layer.

To check the watertightness of the section, the injection hoses are connected to the vacuum pump and the air is evacuated from the section. The ability of the section to hold a vacuum indicates its watertightness. Such a test can be carried out at any stage of the construction and operation of the building.

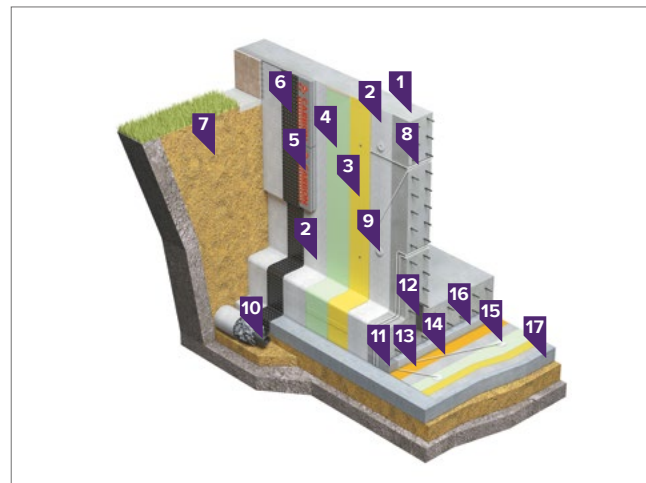
The double-layer reparable waterproofing system can be installed on the foundations of any type.

Double-layer reparable waterproofing system for the foundation with the diaphragm wall



1. Soil;
2. Diaphragm wall;
3. Leveling plaster;
4. Needle-punched geotextile, **500 g/m²**;
5. LOGICBASE V-SL waterproofing PVC membrane;
6. LOGICBASE V-ST waterproofing and protective PVC membrane;
7. Polyethylene film;
8. PVC rondel TECHNOMICOL;
9. PVC injection flange;
10. Niche for injection hoses;
11. Compensator made of XPS TECHNOMICOL CARBON PROF;
12. Sand;
13. Concrete blinding;
14. Protective sand cement screed;
15. Reinforced concrete structure.

Double-layer reparable waterproofing system for the foundation with backfilling



1. Reinforced concrete structure;
2. Needle-punched geotextile, **500 g/m²**;
3. LOGICBASE V-SL waterproofing PVC membrane;
4. LOGICBASE V-ST waterproofing and protective PVC membrane;
5. XPS TECHNOMICOL CARBON PROF;
6. Drainage membrane with geotextile PLANTER geo;
7. Backfill soil;
8. Metal tube for injection hoses;
9. PVC rondel TECHNOMICOL;
10. Drainage pipe;
11. Compensator made of XPS TECHNOMICOL CARBON PROF;
12. TECHNOMICOL IC-240-6 PVC waterstop;
13. Polyethylene film;
14. Injection hose;
15. Angular PVC injection flange;
16. Protective sand cement screed;
17. Concrete blinding.

13.2. General principles of installation, equipment used



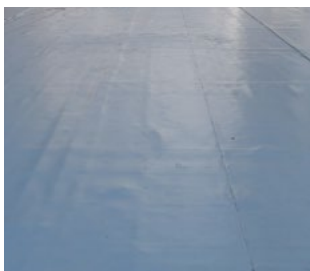
Lay the geotextile on the concrete blinding (for details, see section 5.1.2.).



Install the first waterproofing layer from PVC membrane LOGICBASE V-SL (for details, see sections 3, 4 and 5.1.3.).



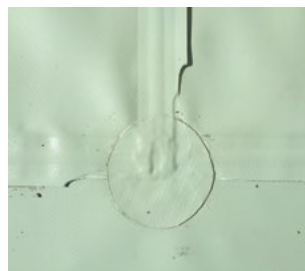
Then install the second waterproofing layer from PVC membrane LOGICBASE V-ST with its textured surface facing the first layer of LOGICBASE V-SL membrane.



During the installation, always shift the seams of the second layer from the seams of the first layer.



Weld the overlaps of the second layer from LOGICBASE V-ST membrane with automatic welding equipment using the same principles as for the main waterproofing layer.



T-shaped seams of the second layer from LOGICBASE V-ST membrane must be additionally reinforced with the patches.



Check the integrity of welded seams with the air pressure method (for details, see section 4.2.).

In order to compartmentalize the waterproofing system into separate sections, weld the first layer of LOGICBASE V-SL membrane with the second layer of LOGICBASE V-ST membrane.



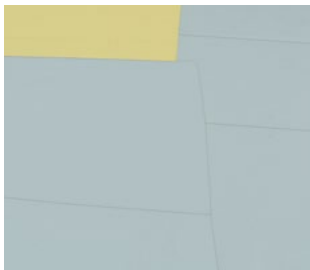
The welding of layers should be carried out around the perimeter of the section with the continuous seam made by automatic welding machine Varimat or manual welding equipment.



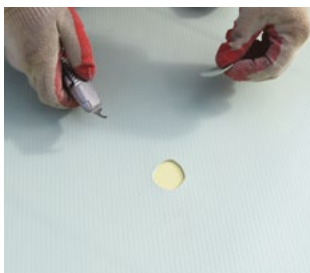
Before welding of layers, it is necessary to cut off the free edge on the seams of LOGICBASE V-ST membrane in the welding zone of the layers.



After the seam between the layers cools down, check its quality with the probe.



Always offset the seams forming adjacent sections for at least **100 mm**.



Install injection flanges according to the designed project.

At first, cut a hole in the top waterproofing membrane (LOGICBASE V-ST) with the diameter corresponding to the passage channel of the flange.



Then the flange should be welded to the surface of the membrane with the continuous seam on its circumference.



This provides access to space between two layers of waterproofing within the isolated section.



Connect an injection hose to the flange with the use of fitting.

For more details on the installation of the injection system, see section 5.1.5.

Now the watertightness of the section can be checked with the vacuum test. Connect all injection hoses from an isolated section to the vacuum pump and turn it on. The ability of the section to hold a vacuum indicates its watertightness. Such a test can be carried out at any stage of the construction and operation of the building.

14.

Other installation requirements

14. Other installation requirements

14.1. General requirements

The following is prohibited during the works with LOGICBASE membranes:

- Storing tools, construction equipment or materials on an unprotected waterproofing membrane;
- Perform geodetic works with the use of instruments on tripods with sharp ends or laser instruments with pins for insertion into the soil (levelling instruments and theodolites) on the waterproofing membrane surface not protected with a screed;
- Conduct arc and gas welding and cutting of the reinforcement above unprotected sections of the waterproofing membrane on the main surface and near expansion joints;
- Use of transport in the area of waterproofing works (even covered with the protective screed).

14.2. Recommendations on backfilling of the foundation pit

Local sandy or clayey soils shall be used for backfilling. The soil for backfilling shall not contain solid inclusions, wood, fibrous materials, construction debris, snow or ice.

Backfilling of foundation pit should be performed in layers after installing the material that protects the waterproofing PVC membrane LOGICBASE (TECHNONICOL needle-punched thermobonded geotextile with a density of **500 g/m²**, or PLANTER geo protective and drainage membrane) and after signing a certificate for concealed works and receiving a permit for backfilling.

Hollows shall be backfilled with a gradual movement of soil into cavities. Soil compaction during backfilling shall be performed with plate compactors or electric rammers at the minimum distance of **50 mm** from waterproofing and protective drainage layers. During the works, always take into account the safety precautions against damage or displacement of these layers. The average thickness of the backfilled sand layer shall be at least **70 cm**.

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