TECHNONICOL

PREMIUM






INSTALLATION MANUAL

of an Underground Waterproofing System
Based on PVC Membrane LOGICBASE V-SL

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Moscow City Business Centre,
Moscow
Underground Waterproofing
Area 32,600 m²
LOGICBASE V–SL 2.0 mm
2008–2012

The tunnel of Federal Highway M27 Dzhubga–Sochi to the border with Georgia on the Adler–Veseloye section, Sochi
Waterproofing of tunnel
Area 8,500 m²
LOGICBASE V–SL 2.0 mm
2010

FOREWORD

This instruction manual was developed to improve the skills of contractors involved in waterproofing the PVC membranes for underground structures.

Objectives:

- describe waterproofing processes;
- provide visual aids for installing PVC membranes;
- improve the design quality and waterproofing constructions for underground structures, buildings and facilities;
- provide support for compliance with the requirements of technical regulations

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1. INTRODUCTION

Roki Road Tunnel, Republic of North Ossetia–Alania
Tunnel Waterproofing
Area 40,000 m²
LOGICBASE V–SL 1.5 mm
2015

Museum Complex of the State Tretyakov Gallery, Moscow
Basement Waterproofing
Area 10,000 m²
LOGICBASE V–SL 2.0 mm
2015

1. INTRODUCTION

1.1 GENERAL

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

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

TechnoNICOL LOGICBASE V-SL membranes are 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 membranes fully meet 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 membranes have all the necessary certificates required by law confirming their high quality.

1.2 DESIGNATIONS AND SCOPE

Designation

LOGICBASE V-SL waterproofing PVC membranes are 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.

The designation of membranes includes:

—material name
—V-SL index
—thickness in millimeters
—number of the company standard for material production

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

LOGICBASE	V–SL	1.5 mm	STO 72746455-3.4.3-2015
1	2	3	4

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
4 Regulatory document reference number for production of the material.

Field of application

LOGICBASE V–SL Waterproofing PVC Membranes are used for:
— rotecting 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 SPECIFICATIONS OF LOGICBASE V–SL MEMBRANES

LOGICBASE V–SL waterproofing PVC membrane is a homogeneous, watertight sheet folded into rolls.

The membranes have 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 membranes for underground waterproofing is based on the following properties:
— absolute water-tightness at water pressure of up to 1.0 MPa;
— tensile strength over 16 MPa;
— ability to stretch by over 400 % without loss of water-tightness;
— resistance to rupture by a nail over 150 N;
— cold-bending at -35 °C max;
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 Membranes
— 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 membranes are 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.

Membranes 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.

IMPORTANT! DO NOT store pallets with membrane 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.

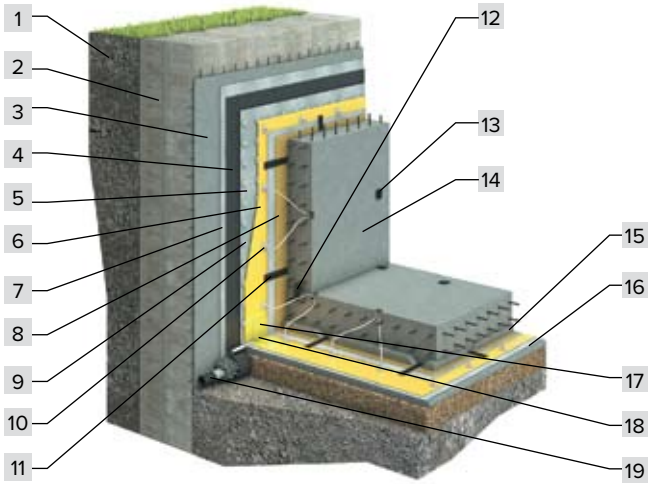
Material shall be loaded and transported in accordance with the Cargo Transportation Rules applicable to the means of transport used.

1.5 DESCRIPTION OF A WATERPROOFING SYSTEM BASED ON THE LOGICBASE V-SL PVC MEMBRANE

TN-Foundation Prof Diaphragm Wall – Reparable Waterproofing System

Apart from waterproofing, TN-Foundation Prof Diaphragm Wall 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 disk fixing elements or strips of PVC membrane on a vertical retaining wall.



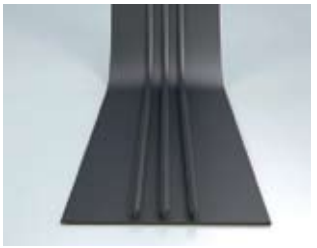
1. Soil
2. Excavation pit enclosure – diaphragm wall
3. Leveling plaster
4. PLANTER geo drainage membrane
5. TechnoNICOL needle-punched geotextile
6. LOGICBASE V–SL waterproofing PVC membrane
7. TechnoNICOL needle-punched geotextile
8. Polyethylene film
9. PVC disk fixing element
10. PVC injection flange
11. TechnoNICOL EC-220-3 PVC Waterstop
12. TechnoNICOL IC-240-2 PVC Waterstop
13. Niche for collection of injection hoses
14. A reinforced concrete structure
15. Protective screed
16. Concrete bed
17. Strengthening layer
18. Compensator
19. Drainage pipe

PVC membranes shall be covered with geotextile before laying them on concrete surfaces to prevent any possible damage.

If the removal of water, coming through the retaining wall is required, a Planter Geo dimpled membrane should be placed between the diaphragm wall and the waterproofing system.

The waterproofing is compartmentalized into isolated sections to monitor its integrity and to enable its repair.

Compartmentalization of Waterproofing

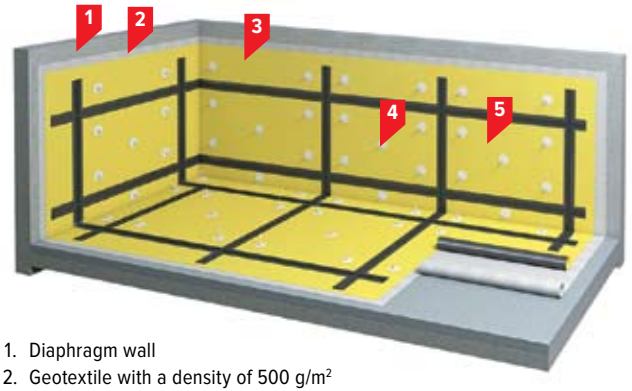


The PVC membrane waterproofing system is loose-laid, i.e. it is not attached to a base. In the event of damage to the waterproofing, it can be compartmentalized into isolated sections to avoid water spreading along the entire structure. Profiled PVC strips, waterstops, are used for compartmentalization.

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 m^2. Waterstop anchors are embedded in concrete during concrete 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 a leak in the TN-FOUNDATION–Diaphragm Wall waterproofing system.



1. Diaphragm wall
2. Geotextile with a density of 500 g/m²
3. LOGICBASE V–SL Membrane
4. Injection flange
5. Waterproofed section bounded by waterstops

The Injection System

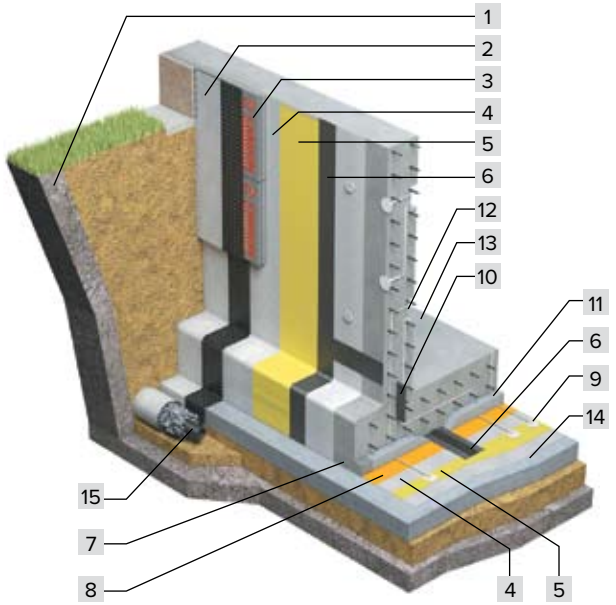
The injection system serves both for monitoring of the waterproofing condition and for its repair. The injection system consists of injection flanges and injection hoses connected to them by fittings.

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 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, water-tightness of the waterproofing system is restored.

The TN FOUNDATION Prof waterproofing 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. Soil
2. PLANTER geo drainage membrane
3. TechnoNICOL CARBON PROF 300 extruded polystyrene
4. TechnoNICOL needle-punched geotextile
5. LOGICBASE V–SL waterproofing PVC membrane
6. TechnoNICOL EC-220-3 PVC Waterstop
7. Corner compensator made of extruded polystyrene TechnoNICOL CARBON PROF 300
8. Polyethylene film TechnoNICOL 200 µm
9. PVC injection flange
10. TechnoNICOL IC-240-2 PVC Waterstop
11. Protective sand-cement screed
12. Niche for injection of the repair compound
13. Foundation slab
14. Concrete bed
15. Drainage pipe

1.6 GENERAL GUIDELINES

—Always follow the procedures specified in this guidebook;
—Carefully plan the procedure for installation of LOGICBASE V–SL waterproofing membranes;
—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;
—Seam quality control needs special attention;
—Before commencement of work, perform trial welding on site to determine optimum welding modes for specific weather conditions;
—All seams made using automatic equipment with formation of a double seam should be checked instrumentally using the overpressure method (see Section 4);
—Seams made with manual equipment should be spot checked by the destructive method (see Section 4);
—Carefully check for possible mechanical damage of the laid membrane (through punctures, cuts, ruptures).

IMPORTANT! Preparation for Work

Before starting waterproofing work, the 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

During waterproofing work using polymer membranes, adhere to the following requirements:
—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 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 disc fixing elements;
— Welding equipment can be connected only to an earthed electrical outlet. 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 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;
— Do not operate electrical equipment if the power cable is damaged or reeled. Always completely unroll the reel before starting the work.
— 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

The Worker and Collective Farm Girl Monument, Moscow
Pavilion Waterproofing
Area 10,000 m²
LOGICBASE V–SL 1.5 mm
2009

Tunnel complexes 6, 7, 8
Sochi, Adler-Tuapse railway
Tunnel Waterproofing
Area 35,000 m²
LOGICBASE V–SL, 2.0 mm
2011–2012

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	Protection of underground structures against groundwater.

TechnoNICOL needle-punched geotextile, density of 500 g/m²

Roll size	Width 2.15 m., Length 45.0 m
Color	White/grey/brown
Material	Unwoven, thermally treated, needle-punched synthetic geotextile based on polypropylene fibers with 500 g/m² density.
Application	Intended for protection of LOGICBASE V–SL PVC membrane against mechanical damage and functions as drainage.

Polyethylene film

Roll size	Width 3.0 m., Length 100 m., Thickness 0.2 mm
Color	Orange/transparent
Material	Polyethylene
Application	Separation of geotextile layers and protective sand-cement screed.

PLANTER extra, PLANTER standard protective membrane

Roll size	Width 2.0 m., Length 20.0 m
Color	Black
Material	HDPE
Application	Protection of LOGICBASE V–SL PVC membrane during backfilling.

TechnoNICOL disc fixing element

Dimensions	Diameter 75 mm., Thickness 10 mm
Color	Grey
Material	PVC
Application	Mechanical attachment of geotextile and LOGICBASE V–SL membranes 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 millimeters. Unrolled length: 10 to 20 m depending on the type of waterstop.
Color	Black
Material	PVC
Application	Waterproofing of construction concrete joints and expansion joints

TechnoNICOL PVC strip

Note. Subject to agreement, rolls of individual length may be supplied.

Dimensions	Width 220 mm. Length 30 m
Color	Grey
Application	TechnoNICOL PVC strip is used for compartmentalization of the waterproofing system based on LOGICBASE V–SL PVC membranes, for waterproofing 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 millimeters. Unrolled length: 10 to 20 m depending on the type of waterstop.
Color	Black
Material	PVC
Application	Compartmentalization of the waterproofing, protection of construction concrete joints and expansion joints against water passageway.
Application	Compartmentalization of the waterproofing, protection of construction concrete joints and expansion joints against water passageway.

TechnoNICOL epoxy glue

Package	Components A+B 10+5 kg
Color	Grey/dark grey
Material	Two-component glue based on epoxy resins
Application	Gluing of TechnoNICOL PVC strips, 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	Flange is an element of the injection system and is designed for supply of the repair injection compound to a damaged section of the waterproofing system.

Injection hose

Color	Red, blue, black.
Application	Injection system element used for supply of the repair compound to an injection flange.

Connection fittings

Color	Black, blue
Application	Connection of injection hoses to injection flanges and interconnection of injection hoses.

Pipe (utility) passageway element

Dimensions	Nominal diameter 50–90 mm and 75–125 mm
Color	Grey
Material	PVC
Application	Waterproofing of pipe (utility) passageways. Attached by welding to the waterproofing membrane on one end and by mechanical crimping on the pipe.

2.2 AUXILIARY MATERIALS FOR SYSTEM INSTALLATION

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

PLANTER geo drainage membrane

Dimensions	Width 2.0 m., Length 20 m
Color	Black
Material	Polyethylene + Geotextile
Application	Wall drainage and drainage in the underground substructure

TechnoNICOL polyurethane sealant

Color	Grey
Material	One-component, high modulus quick-drying polyurethane-based material.
Application	Used for waterproofing termination, compensation and expansion joints in concrete structures, etc.

TechnoNICOL contact adhesive for PVC membranes

Volume	5 liters
Color	Brown
Material	Based on nitrile rubber and synthetic resins.
Application	Used for gluing of a PVC membrane to brick, concrete, wooden and metallic surfaces and for spot attachment of geotextile to a LOGICBASE V–SL PVC membrane.

TechnoNICOL cleaner for PVC membranes

Volume	3 liters
Color	Colorless
Application	Intended for 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
Color	Yellow
Application	Gluing of PE film seams and connection of geotextile overlaps.

PLANTERBAND adhesive tape

Dimensions	12.5×10 m
Color	Black
Application	Connection of PLANTER membrane seams

2.3 EQUIPMENT FOR MEMBRANE INSTALLATION

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 for welding waterstops to a 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 disc fixing elements, welding injection flanges to the membrane and welding profiled elements of waterstops to the membrane.

Seam quality control equipment.

Table 2.1. The list of recommended accessories for hot air hand tools

Work description	Slot nozzle size, mm	Type of roller
Regular seam welding	40	Silicone
Seam welding in difficult to access areas	20	Narrow brass roller
Welding a membrane to a PVC disc fixing element	40	Silicone
Welding an injection flange to the membrane	20	Silicone

2.4 TOOLS AND DEVICES

Use the recommended standard tools for convenient, high quality and quick installation of waterproofing system from LOGICBASE V–SL PVC membranes.

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. "Bat" roof knife
10. Tape measure;
11. Markers and pencils;
12. Screwdrivers of different sizes;
13. TechnoNICOL cleaner for PVC membranes;
14. Special needle for double seam quality check, air compressor, connecting hoses (see Section 4);
15. Roof clamp;
16. Membrane cutters;
17. Vacuum compressor, control hoses / connecting tubes, vacuum cap (see Section 4);
18. Gloves (cotton or leather);
19. Cotton rags.

3.
HOT-AIR WELDING OF MEMBRANES

City of the River Tushino – 2018, Moscow
Underground Waterproofing
Area 30,000 m²
LOGICBASE V–SL 2.0 mm
2015 – Expected completion in 2018

Butovo Mall Shopping Centre, Moscow
Underground Waterproofing
Area 60,000 m²
LOGICBASE V–SL 1.5 mm
2014

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 TechnoNICOL cleaning fluid 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.

IMPORTANT! 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.

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

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 **Table 2.1**.

IMPORTANT! The opening of the slot nozzle must be straight and clean.

To turn the machine 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.

IMPORTANT! Always start work with trial welding to adjust equipment to specific site conditions.

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.

IMPORTANT! 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.

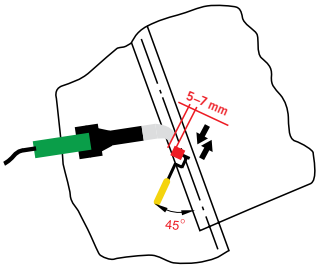
Step 2. Forming a Thermal Pocket

• 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.

IMPORTANT! 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.

IMPORTANT! 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 rate and pressure of pressure 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 pressure 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 2×2×150=600 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 travel. 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 travel 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.

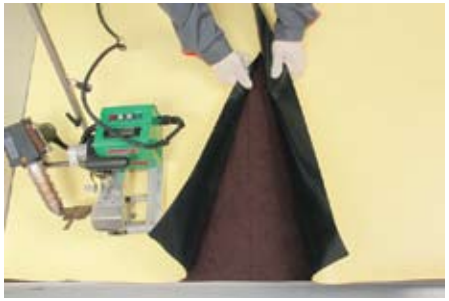
Destructive Examination
Cut out a 20–30 mm wide strip perpendicular to the welded seam and rip it by hand.

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

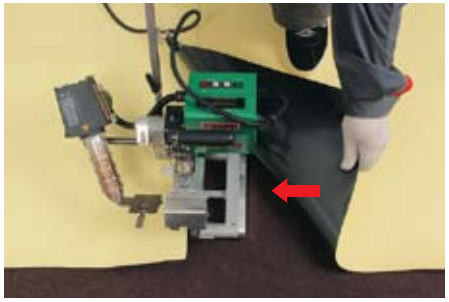
Table 3.1. Optimal welding parameter selection algorithm. Measured variable and Type of change.

	Air stream T	Machine travel rate
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

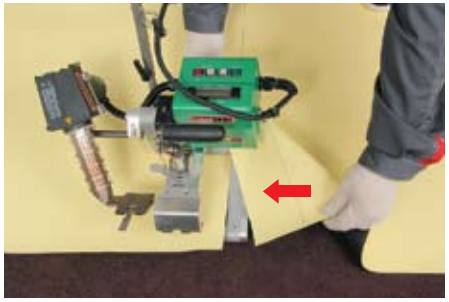


After optimal parameters are selected, welding can start.



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

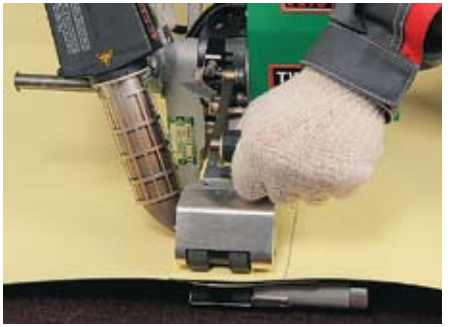
Place the welding machine at the weld starting point.



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.

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

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

4. SEAM QUALITY CONTROL

Vinogradny Residential Complex, Moscow
Underground Waterproofing
Area 30,000 m²
LOGICBASE V–SL 2.0 mm
2012

Business Centre Moscow, Krylatskoye
Underground Waterproofing
Area 8,000 m²
LOGICBASE V–SL 2.0 mm
2010

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.

IMPORTANT! 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:

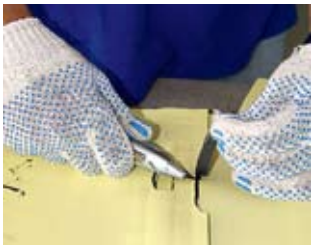
- a hollow needle with a pressure gauge;
- a connecting hose;
- compressor.

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 closed, 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 welding machine.

IMPORTANT! 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 5 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.

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

Seams made with manual equipment or automatic tools, without forming a double seam, should be checked using the vacuum method.

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 sec., 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 should be spot-checked on a stationary rupture machine, e. g. H10KT 0238 or on a portable rupture machine, 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

Khrunichev Plant, Moscow
Underground Waterproofing
Area 4,000 m²
LOGICBASE V–SL 2.0 mm
2012

Residential Complex 1147,
Moscow
Underground Waterproofing
Area 100,000 m²
LOGICBASE V–SL 2.0 mm
LOGICBASE V–ST 1.6 mm
2015

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 attachment or gluing to the base.

5.1.1 Base Preparation

General requirements:

— The concrete surface being waterproofed must correspond to the requirements of SNiP 3.04.01, SNiP 3.04.03 or category A4 per GOST 13015.

— The foundation humidity requirements:
- The foundation must be dry or matte wet, but without water on the surface (humidity is not standardized).

— Required foundation evenness:
- The surface of the concrete foundation must be even and smooth. Unevenness of the foundation must be rounded without abrupt rises, drops or sharp edges;
- Protruding sharp elements (concrete chips, stones) must be removed mechanically (cut or ground off);
- Rebars 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 foundation strength:
- At the beginning of the waterproofing work, the concrete foundation for waterproofing must have a strength of at least 75% of the graded, but not less than 50 kg/cm2;
- The foundation must be free of fragile and low-strength layers. Concrete swells must be removed.

— Required foundation cleanliness:
- There must be no construction debris, dirt, dust, mold or oil on the foundation surface;
- Concrete surfaces, previously subjected to impact of aggressive media, must be flushed with clean water, neutralized with

an alkaline solution or a 4 or 5% sodium carbonate solution and flushed again.

— Structural requirements:
- Leave space at the sites 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 rebars 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 LOGICBASE V-SL PVC membranes with foamed and porous polymer materials (XPS, EPS, PIR).

5

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. Geotextile density is minimum 500 g/m^2 with an overlap of 100 mm.

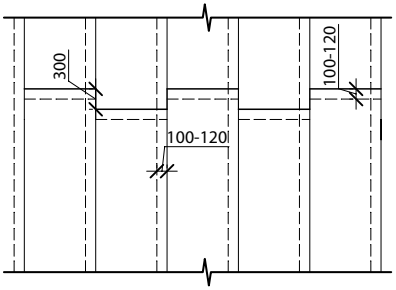
In order to avoid displacement of sheets, fasten the overlaps with spot welding using a manual welding heat gun.

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

5.1.3 Installation of LOGICBASE V–SL Waterproofing Membrane

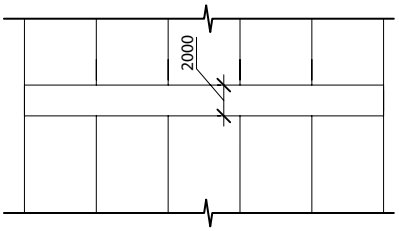
When a waterproofing membrane is installed on a horizontal surface, create 300–500 mm wide membrane extensions protruding beyond the foundation slab for subsequent joining with vertical waterproofing.

IMPORTANT! 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.

5

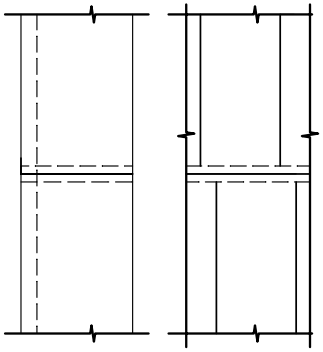


If installation of membrane sheets is impossible without displacement of butt ends, place the assembled strip perpendicular to the main sheets.

IMPORTANT! Make sure that the installed membrane has no folds or waves.

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.

5

IMPORTANT! 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 the where 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.

IMPORTANT! Check the depth of chamfer removal, do not cut welded sections.

Weld the T-shaped seam with an automatic tool.

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

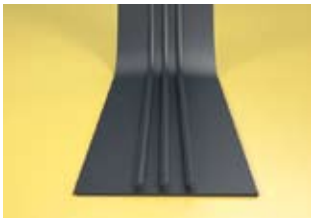
5

IMPORTANT! Before installation of a 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 it for air-tightness with air pressure.

5.1.4 Waterproofing Compartmentalization

After a waterproofing membrane is installed, compartmentalize the waterproofing by welding waterstops to the laid membrane. The map of membrane surface compartmentalization into tightly isolated sections (areas) is defined in the project. The size of sections should not exceed 150 m^2.



Waterproofing is compartmentalized as follows: lay down a TechnoNICOL EC-220-3 or EC-320-4 waterstop with the flat side facing the membrane surface and anchoring ribs facing the concrete.

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

Installation of Waterstops with a Hot Air hand Tool

Waterstops shall be welded with a hot air hand tool according to Section 3.1.

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

Spot weld a waterstop every 20–30 cm to temporarily affix it to the membrane surface. This will prevent displacement of the waterstop and wave formation during welding.

Place a 40 mm wide nozzle between the membrane and waterstop surfaces being welded.

Make sure that the end of the nozzle extends beyond the outer edge of the welded seam by 3–4 mm.

Move the machine continuously along the seam, evenly heating both surfaces.

IMPORTANT! Use a silicone roller to achieve the required pressure.

After the seam cools down, check its air-tightness. Move a probe of flat screwdriver along the seam.

If any sections are not tight, 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 air stream temperature between 450–500 °C.

IMPORTANT! Adjust the temperature based on trial welding.

Place the machine on the membrane surface. Guide its edge and 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 force to the machine handle and smoothly move the machine along the seam. Make sure that the edges of waterstop are evenly welded to membrane surfaces.

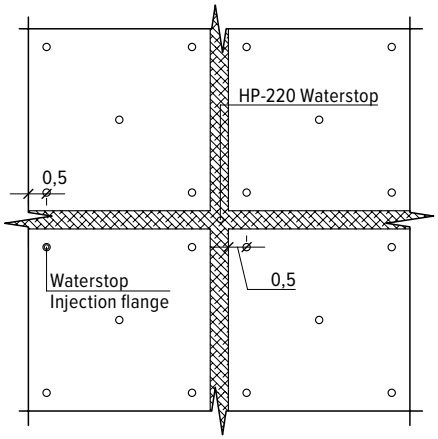
Possible mistakes during welding of waterstops and waterproofing membranes:

Defect	Coking (overburn)	Detachment (shallow weld)
Cause	Welding temperature too high or machine movement too slow	Welding temperature too low or machine movement speed too fast
Effect	Non-air-tight, weak seam	Materials are not fused
Remedy	Reduce the air temperature or increase machine movement speed	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 designed to repair waterproofing, if any leaks appear.

It is recommended to install 5 injection flanges into each section of a standard size (150 m^2). 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.

Clean the membrane surface in the place of flange installation.

Spot weld the flange to the membrane surface with a hot air hand tool.

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

Connect an injection hose to the flanges through connecting fittings.

Install a stainless steel clamp at the point of tube and flange connection.

To connect the injection hose to the flange, use straight fittings. 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.

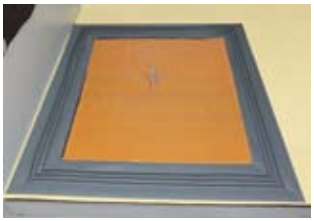
Install distribution boxes for hoses in the reinforcement cage. Bring hose ends from the flanges in each section into the installed box.

After the injection system is installed, start laying a protective geotextile layer with a minimum density of 500 g/ m^2: this will prevent mechanical damage to the membrane.

5.1.6 Installation of Protective Layers

Lay geotextile within one section limited by waterstops.

IMPORTANT! 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.

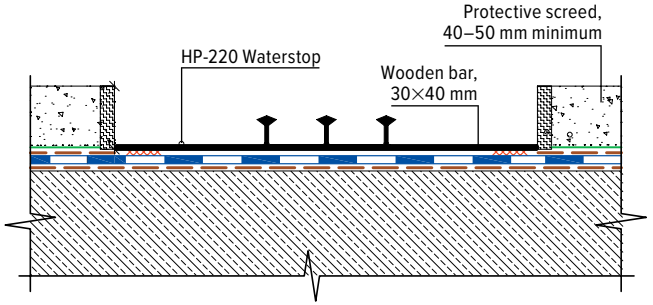
To connect film overlaps, use double-sided painter's tape or single sided foil covered adhesive tape.

IMPORTANT! Do not lay film on waterstops; their anchors must be open for subsequent concrete casting.

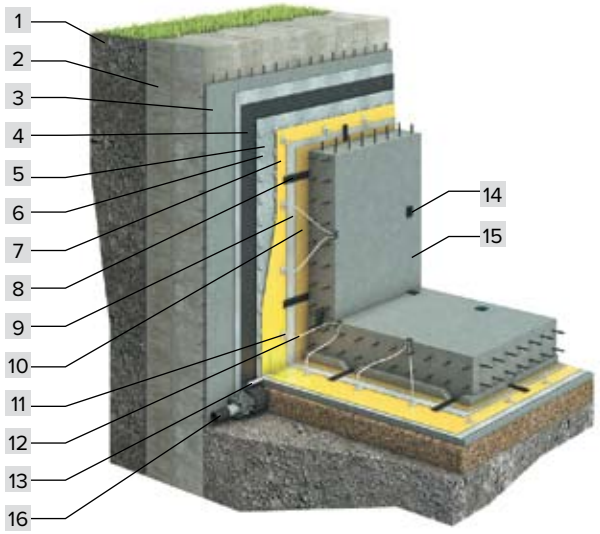
Laying of protective screed on geotextile and film is required to protect the membrane against mechanical damage during rebar installation. Protective screed thickness must be at least 50 mm.

Before laying the protective screed, install formwork that will limit contamination of the waterstop with the cement-sand mortar.

IMPORTANT! 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.



5.2. INSTALLATION OF A WATERPROOFING SYSTEM ON A DIAPHRAGM WALL



1. Soil
2. Diaphragm wall
3. Smoothing plaster
4. PLANTER geo dimpled membrane with geotextile (optional)
5. Geotextile with 500 g/m^2 density
6. PVC disc fixing elements
7. LOGICBASE V–SL PVC membrane
8. PVC Waterstop TechnoNICOL EC-220-3
9. Geotextile with 500 g/m^2 density
10. Polyethylene film, 200 µm
11. PVC flanges
12. Injection hoses
13. Corner compensator
14. Injection niche
15. Foundation wall
16. Drainage pipe

5.2.1 Geotextile Laying

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

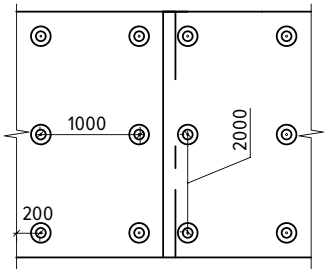
Geotextile is mechanically fastened with dish fasteners or PVC disc fixing elements.

Use TechnoNICOL disc fixing elements for fastening membrane sheets on a retaining structure.

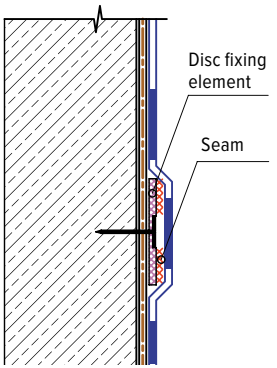
The disc fixing elements are disk-shaped and made of PVC with 75 mm diameter and 10 mm thickness.

The disc fixing elements are attached to the foundation surface mechanically with self-tapping screws through geotextile.

Fasten the disc fixing elements mechanically through geotextile on a vertical surface.



Install disc fixing elements at a distance of 1 m horizontally and 2 m vertically from one another, leaving a minimum margin of 200 mm from the geotextile sheet edges for further joining of sheets.



Membrane is held on a vertical surface by welding to the disc fixing elements.

IMPORTANT! Tack weld the membrane to the disc fixing element: this will ensure membrane separation from the fixing element surface without loss of integrity in case of structure shifts.

5.2.2 Installation of LOGICBASE V–SL Waterproofing Membrane

Place LOGICBASE V-SL waterproofing membrane on the structures of retaining walls as follows:

Unroll waterproofing membrane rolls from top down with an overlap of adjacent sheets of 100–120 mm.

As the membrane gets unrolled, weld it to disc fixing elements used for preliminary fastening of the first layer of geotextile.

Weld the waterproofing membrane sheets 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 disc fixing elements.

Fasten the strips mechanically through geotextile on a vertical wall surface, leaving 7 cm margin from the strip edge.

The free end of the strip, in this case, faces upwards.

The attachment frequency is similar to the attachment frequency of the disc fixing elements.

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 attachments. Such a fastening method is the most convenient for horizontal laying of rolls on walls.

Temporarily attach a membrane roll to a 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 a hot air hand tool.

When installing the next row of membrane, ensure an 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 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 protection of the waterproofing membrane against mechanical damage, during installation of the load-bearing structure rebars, use geotextile with 500 g/m² surface density and polyethylene film with 200 µm thickness.

Unroll geotextile from top down with a minimum overlap of 100 mm.

If it is required to fasten geotextile to the membrane surface, use spot attachment with small strips. The fastening method for protective membranes is described in detail in Section 5.3.7. It is also applicable to geotextile.

IMPORTANT! Lay geotextile by section, without covering waterstops.

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

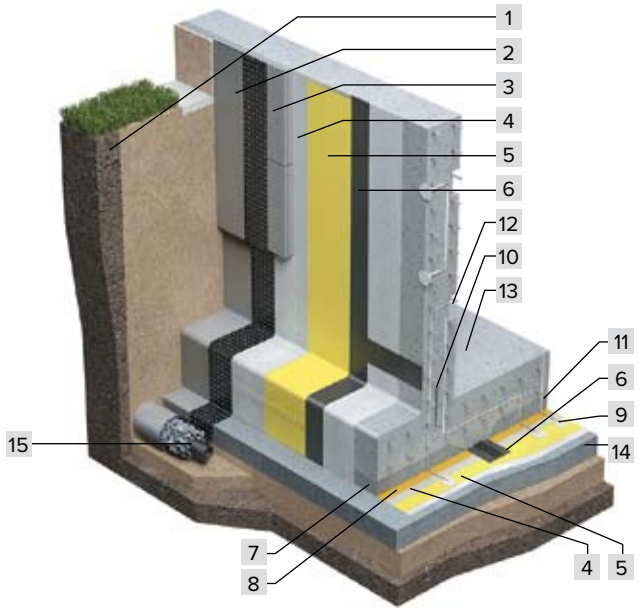
After the geotextile is fastened, protect it against the alkaline concrete environment with a polyethylene film.

Unroll the film from the top down with an overlap of 100 mm minimum.

To connect film sheets, use double-sided painter's tape.

Film overlaps may also be attached with a manual heat gun at a low temperature mode.

5.3 VERTICAL INSTALLATION OF WATERPROOFING FOR EXCAVATION WITH BACKFILLING

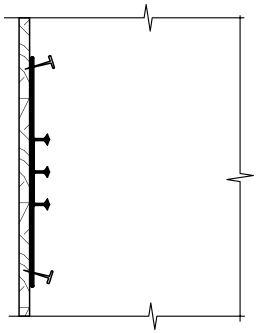


1. Soil
2. PLANTER geo drainage membrane
3. TechnoNICOL CARBON PROF 300 extruded polystyrene
4. TechnoNICOL needle-punched geotextile
5. LOGICBASE V–SL waterproofing PVC membrane
6. TechnoNICOL EC-220-3 PVC Waterstop
7. Corner compensator made of extruded polystyrene TechnoNICOL CARBON PROF 300
8. Polyethylene film TechnoNICOL 200 µm
9. PVC injection flange
10. TechnoNICOL IC-240-2 PVC Waterstop
11. Protective sand-cement screed
12. Niche for injection of the repair compound
13. Foundation slab
14. Concrete bed
15. Drainage pipe

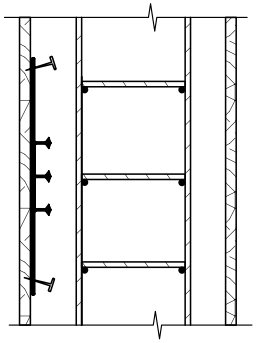
Installation of a waterproofing system on foundation walls in an excavation with backfilling starts with installation of waterstops and an injection system into the formwork.

5.3.1 Compartmentalization of Waterproofing with Profiled Waterstops

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

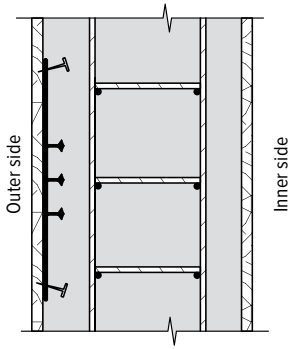


Fasten waterstop to the formwork with short nails every 250–350 mm.
Nails must not be driven along the entire length between the waterstop edge and first anchor from the edge.



After this, nails should be bent by 40–50° from the vertical position.

After the waterstop is fastened, install a 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 Waterproofing Compartmentalization with an Adhesive Waterstop

TechnoNICOL adhesive waterstop may be used for compartmentalization of the waterproofing instead of TechnoNICOL EC-220-3 embedded waterstops.

An adhesive waterstop is created with geotextile-edged PVC tape, which is attached to a surface with TechnoNICOL two-component epoxy glue.

Concrete and brick foundations and natural stone foundations must be clean and strong. To remove deteriorating parts, traces of paint, oils and bleeding cement, machine the surface. Then clean the surface of dust using compressed air.

Metallic surfaces must also be cleaned of traces of corrosion, oils and paint using sand blasting, preferably to a clean metal state. Before applying to fresh concrete, let it mature.

Temperature of materials during application must be at least +5 °C minimum, 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 epoxy primer prior to applying glue.

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

IMPORTANT! Prepared mix must be used within 40 minutes.

PVC tape is glued by geotextile edges using epoxy glue. For this purpose, the glue is applied to substrate in two parallel lines (1–3 mm layer thickness) so as to ensure that geotextile edges are aligned with glue strips during PVC tape laying. 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.

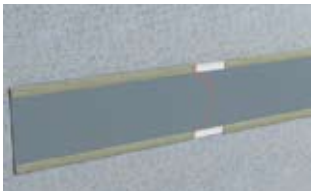
5.3.3 Installation of TechnoNICOL PVC Strips

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

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

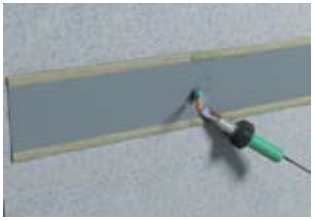
Joining of tapes length-wise with an overlap

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

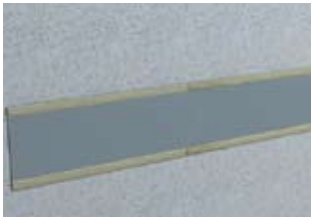


When the next tape is installed, form an overlap of the newly installed tape with the already installed one for a minimum length of 10 cm.

Mark and cut the formed overlap, as shown in the Figure. This will enable maximum air-tightness of the welded seam.

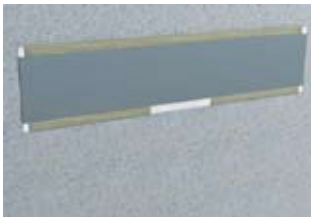


Weld the overlap with a manual welding machine.

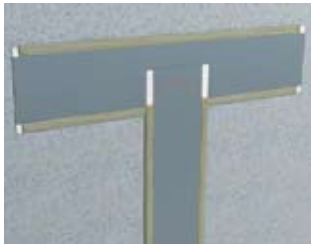


Apply epoxy glue to the tape ends at the point of welded overlap so as to ensure that newly applied layer goes over the already applied one.

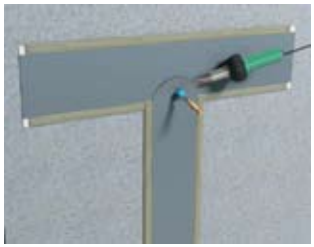
T-Shaped Connection



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



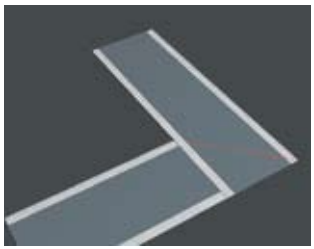
Install a second tape on the already installed one with a minimum overlap of 10 cm. Pay special attention to the quality of adhesion at the point where glue has not been applied to the edge of the bottom tape. Mark and cut the formed overlap, as shown in the Figure.



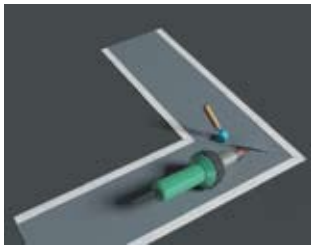
Weld the resulting overlap with a manual welding machine. When welding PVC tapes, take care not to melt free edges of the fleece with hot air.

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

Corner Elements



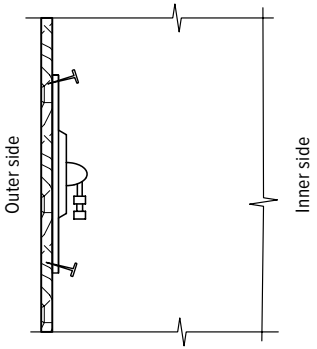
Form an overlap of tapes at the points of their crossing. Mark and cut the overlap at 45° angle.



Weld the resulting overlap with a hot air hand tool.

5.3.4 Installation of an Injection System

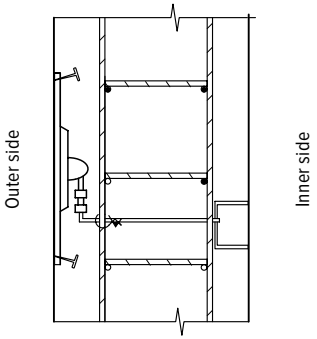
When using an excavation with backfilling, injection flanges are installed into the foundation walls by fastening to formwork and reinforcement cage before concrete casting.



Install 5 injection flanges into each section bounded by waterstops.

There must be a maximum of 4 nails per one flange.

Bend the driven nails by 40–50° from the vertical position.

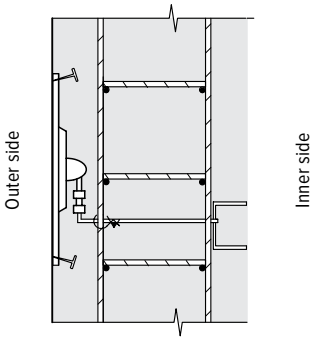


Connect injection hoses to injection flanges with fittings.

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 fastened on formwork surface and in the reinforcement cage, cast concrete in this section according to design.

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

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

IMPORTANT! All nails protruding from the concrete surface must be removed.

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

5

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/m^2.

IMPORTANT! 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 sheets to a foundation wall with dish fasteners and 4.8×50 mm self-tapping screws with a polyamide 8.2×45 mm anchor sleeve.

5.3.6 Installation of LOGICBASE V–SL Waterproofing Membrane

After a preparatory layer of geotextile is fastened on a vertical surface, start installing LOGICBASE V-SL membranes. For convenience reasons, a waterproofing membrane may be placed both vertically and horizontally.

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

Weld the membrane edge to the installed PVC waterstop.

Gradually unroll the membrane downwards towards the wall base.

5

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

Check the quality of all welds with compressed air. For details, see Section 4.

Membrane may be also attached to a foundation wall with PVC disc fixing elements.

Mechanically attach disc fixing elements through geotextile to the wall surface.

Weld the membrane to the disc fixing elements.

Membrane may be also fastened to the at foundation wall based on a temporary pattern:

If a roll is unrolled along the wall, rather than from top down, it is recommended to create temporary attachments of membrane to the wall from 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.

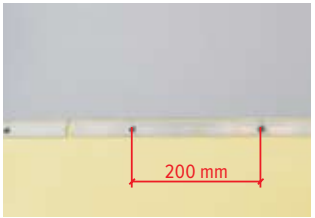
5.3.7 Waterproofing Membrane Termination Options

Termination by Mechanical Attachment Via a Bar

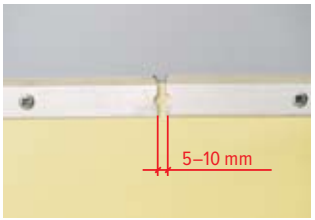
IMPORTANT! Use a termination bar with an edge bend.

Fasten all layers of the waterproofing system mechanically using TechnoNICOL EDS-S 4.8 pointed self-tapping screws with a polyamide shell.

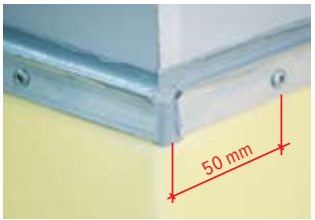
The edge bend of the bar must be oriented away from the wall.



Spacing of self-tapping screws 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 TechnoNICOL Sealant No. 70.

Termination by Joining with an EC-220-3 or EC-320-4 Outer Waterstop or TECHNONICOL PVC Tape

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

For this purpose, weld the LOGICBASE V-SL membrane to the waterstop using a manual welding machine and a pressure roller.

IMPORTANT! Pay special attention to the quality of welding in the area of inner and outer corners. The welded joint must be air-tight.

TECHNONICOL PVC tape may be applied instead of a pre-installed EC-220-3 or EC-320-4 waterstop for air-tight termination of the waterproofing membrane (see Section 3.2). After the tape is installed on a concrete surface, tightly weld the LOGICBASE V-SL membrane to the surface.

After the end of the waterproofing membrane is tightly welded to the surface of the PVC tape or a EC-220-3 or EC-320-4 waterstop, fasten the protective layer of geotextile (or dimpled membrane) mechanically by installing an termination bar with self-tapping screws above the waterproofing termination level (see Section 3.6). In this case, application of sealant is not required.

5.3.8 Waterproofing Protection

After complete installation of geotextile and LOGICBASE V-SL waterproofing membrane, place a PLANTER geo protective and drainage membrane over them. This will prevent possible mechanical damage of waterproofing on the foundation walls during backfilling.

If any other drainage sheet instead of PLANTER geo 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/m^2 before its installation.

Mechanically attach the PLANTER membrane above the waterproofing level.

Another way of drainage sheet attachment is fastening it with strips cut from PVC membrane

Strips of PVC membrane with dimensions of 5×30 cm are inserted through cuts made in the drainage sheet.

The strip ends are welded together.

The resultant loop is welded to the membrane.

After PLANTER geo is fastened, unroll the roll from top down.

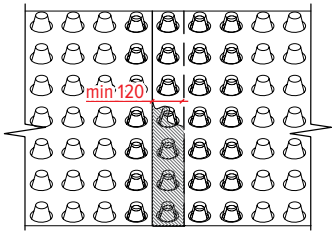
Install further rolls with an overlap over already installed ones. Overlap in this case must be a minimum of 120–150 mm.

Attachment of protective drainage sheets:

Separate geotextile from membrane "spikes" by 120–150 mm.

Ensure an overlap of membrane edges "spike to spike" where no geotextile is present.

Fasten the sheets with an adhesive butyl rubber tape.



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

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

Apply double-sided adhesive tape or sealant tape to the point of geotextile sheet connection.

Geotextile overlaps may also be attached with a manual heat gun at a low temperature mode.

IMPORTANT! This procedure is required to prevent possible separation of geotextile under the influence of natural and technological factors.

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

IMPORTANT! Fastening of geotextile sheets 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

Residential Complex Beskudnikovo, Moscow
Underground Waterproofing
Area 70,000 m²
LOGICBASE V–SL, 2.0 mm
2010

Leningrad NPP, St. Petersburg
Waterproofing of an Aeration Basin
Area 120,000 m²
LOGICBASE V–SL 2.0 mm
2011–2012

6. WELDING OF WATERSTOPS

6.1 END CONNECTIONS

End connections are made using special equipment: an electromagnetic plate and pressure conductor or a manual heat gun.

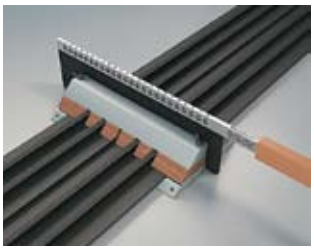
6.1.1 Welding with Special Equipment

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

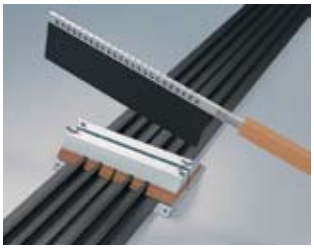
Fasten the connected ends of waterstops in the conductor.

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.



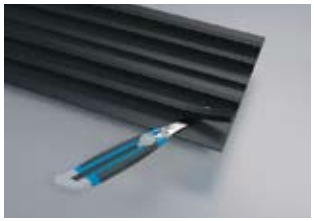
Place a heating element into the operating position between the waterstop ends. Gently close the conductor bringing the waterstop ends to the heating element. This causes formation of a bead of molten material along the whole perimeter of the waterstop cut area. Make sure that melting is uniform.



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 with a 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.

IMPORTANT! Always remove the chamfer from the end of the waterstop where the ribs were removed.

After ribs are removed, remove the chamfer from the waterstop end to ensure better connection of waterstops.

Place a second waterstop on the waterstop with cut-off ribs so as to ensure than 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 Fabrication of Corner Elements

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

Angular element is now ready.

6.2.2 Fabrication of Cross-Shaped Elements

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

Cut the apex off both arch elements forming, 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.

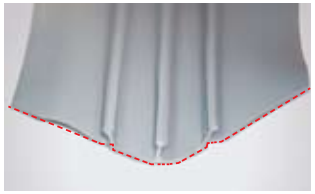
The cross-shaped element is now ready.

6.2.3 Fabrication of T-Shaped Elements

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

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

Cut the workpiece as marked.



After the workpiece 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.

Prepare another workpiece for the element.

Make sure the junction between two elements is uniform, using a measuring tool.

IMPORTANT! Angle between the workpieces must be 90°.

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

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

Weld the workpieces through, starting with ribs.

Place the nozzle in the area of the junction between two ribs, wait for uniform melting of edges for 2–4 sec, remove the nozzle and attach rib edges by tightly pressing them against each other.

IMPORTANT! Always use heat-resistant gloves.

Use a brass roller when welding flat parts of workpieces.

After all rib junctions and flat parts of a workpiece are welded through, rotate the element and weld the overlap on the reverse side.

A T-shaped element is now ready.

Check the quality of the welded joint.

6.2.4 Fabrication of a Right Angle

90° angles are formed, when the direction of waterstop laying is changed and in case of transition from a horizontal surface to a 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 completely remove the cut part.

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 convenience of welding flat parts and will increase joint air-tightness.

Workpiece 1 is now ready.

After workpiece 1 is ready, form an overlap again to complete workpiece 2.

Mark and then slightly cut waterstop ribs at 45°.

IMPORTANT! 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, always round off sharp corners. Workpiece 2 is now ready.

For further work, follow the rules for workpiece welding and installation on a waterproofing membrane.

Weld edges of workpiece 2 to the waterproofing membrane surface.

Place workpiece 1 onto welded workpiece 2.

Mark workpiece 1 start and end points on workpiece 2.

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

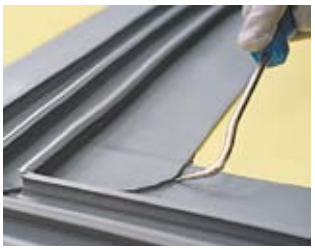
Crimp the waterstop edge along the whole distance where the chamfer was removed.

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 a Teflon roller.

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



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

6.2.5 A 90° Angle at the Point of Transition from a Horizontal Surface to a Vertical One

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.

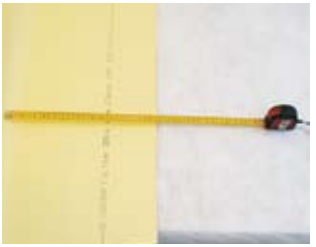
7.
CONNECTION OF VERTICAL AND HORIZONTAL WATERPROOFING

Volga Hotel Complex,
Moscow
Underground Waterproofing
Area 11,000 m²
LOGICBASE V–SL 2.0 mm
LOGICBASE V–ST 1.6 mm
2015

Spassky Most Residential Complex, Krasnogorsk
Underground Waterproofing
Area 16,000 m²
LOGICBASE V–SL 2.0 mm
2010–2011

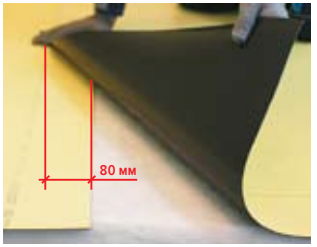
7. CONNECTION OF VERTICAL AND HORIZONTAL WATERPROOFING

7.1 MEMBRANE TRANSITION FROM THE FOUNDATION SLAB TO THE RETAINING WALLS IN EXCAVATION PITS WITH RETAINING STRUCTURES



The connection is made on a horizontal concrete grout surface.

To do this, provide a free margin of at least 300 mm for the membrane installed along a vertical surface to the horizontal surface of the concrete bed for convenience of work and creation of an overlap.



When mounting a membrane on a horizontal surface of the concrete bed, form an overlap with the free margin of vertical membrane of at least 80 mm.

Weld the formed overlap with an automatic welding machine.

The connection may be also made on a 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 mounting a membrane on a 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 was made, an expansion joint must be provided at the point of transition from the concrete bed to the retaining structure consisting of a stress compensator (foamed polyethylene cord or extruded polystyrene) and a strengthening layer made of LOGICBASE V-SL.

After the connection of the horizontal and vertical waterproofing is made, start laying 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 adhesive tape to attach the geotextile or film. When a foamed polyethylene cord is used as a compensator, wrapping is not needed.

Prepare a strip of LOGICBASE V-SL membrane, 1,000 mm wide.

Place the prepared strengthening strip on the spot where the stress compensator is laid so that one half of it is located vertically and the other horizontally.

Weld the strengthening strip so as to precisely replicate the outline of laid expansion device.

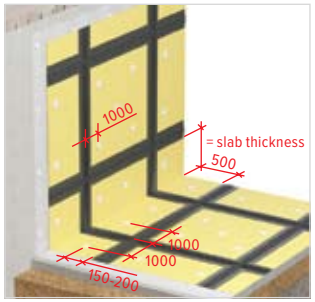
The strengthening is now ready; proceed with system installation.

Since 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.

Install an EC-220-3 waterstop for this purpose by welding it to the surface of the main membrane layer at the point of transition from a horizontal surface to a vertical one.

Install injection flanges in the created section.

Use spot welding to attach the flanges. The flange skirt must be welded around the complete circumference.



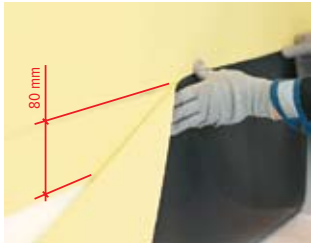
The installation parameters for waterstops and flanges are shown on the diagram.

7.2 MEMBRANE TRANSITION TO FOUNDATION WALLS IN AN EXCAVATION PIT WITH BACKFILLING

This transition is made by welding of vertical waterproofing to an extension of the horizontal waterproofing on a vertical surface.

When installing the system on a horizontal surface of a 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.

IMPORTANT! Always protect 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 mounted vertically and forming an overlap of at least 80 mm.

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

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

Transition from a horizontal surface to a vertical one is now ready.

8.
CORNERS

Molodezhny Residential Complex, Krasnogorsk
Underground Waterproofing
Area 10,000 m²
LOGICBASE V–SL 1.5 mm
2014

Right Bank Residential Complex, Khimki
Underground Waterproofing
Area 50,000 m²
LOGICBASE V–SL 1.5 mm
2012–2013

8. CORNERS

8.1 AN INNER CORNER WITH A "POCKET"

An inner corner shall be made with a hot air hand tool

Form a "pocket" of the membrane along the inner corner and carefully press it into the corner base.

Fold a loop at 45°.

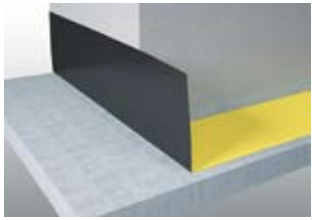
Weld the horizontal overlap to the main membrane.

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

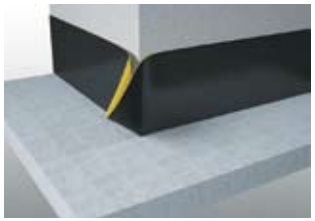
Adjust the welded "pocket" and weld it to the horizontal overlap using a narrow brass roller.

Weld the horizontal overlap to the main membrane starting from the "pocket" weld base.

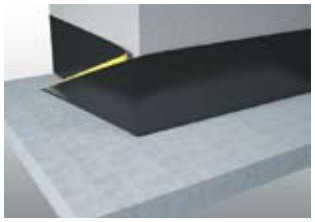
8.2 AN OUTER CORNER



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 horizontal waterproofing, raised to the vertical surface with vertical waterproofing, ensure there is an overlap of at least 10 cm. Special attention must be paid in this case to air-tightness of welding at the crossing point between the "pocket" welded to the vertical surface and the lower edge of the vertical waterproofing. There must be no non-welded channel left at this site, through which water may penetrate underneath the waterproofing.

In some cases, connection between the horizontal and vertical waterproofing is made without extension of the horizontal waterproofing to the vertical surface.

Membrane extension from under the foundation slab is left on the horizontal surface.

Membrane is lowered from the vertical surface to the horizontal membrane with an overlap of 10 cm.

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 horizontally laid membrane along the corner direction.

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

Round off the workpiece corner to be located in the vertical corner.

Using a manual heat gun, preheat and stretch the rounded corner of the workpiece.

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

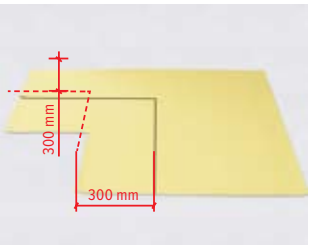
Carefully weld the remaining area of the workpiece, lifting the non-welded part.

Use a wide silicone roller.

8.3 INNER CORNER IN AN EXCAVATION WITH BACKFILLING

An inner corner is made by fabrication of an individual element consisting of two parts (straight angle).

To fabricate an element, prepare a cut-off piece of a LOGICBASE V-SL membrane with minimum dimensions of 1,000 x 1,000 mm. 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.



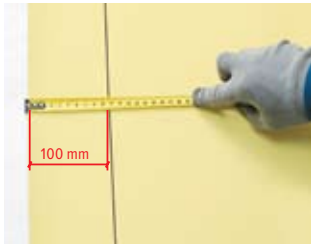
Measure 300 mm from the outlines of each foundation wall as shown in the photo. This is required to form extensions for subsequent joining with vertical waterproofing.

Remove part of the workpiece. It can be used later as a second part of the element.

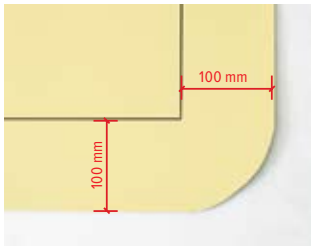
Mark the workpiece, connecting the corner base to its edge.

Cut the workpiece as marked.

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



Mark it, leaving 100 mm from the edge.

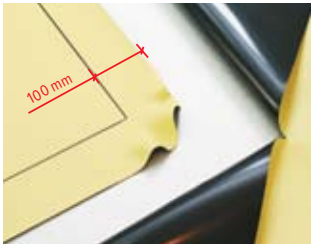


IMPORTANT! Always round off one of workpiece corners, as the ultimate quality of the element depends on it.

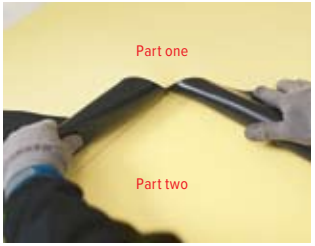
Preheat a small area of the workpiece at the rounding point with a construction heat gun. When the membrane becomes soft, stretch it with hands.

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

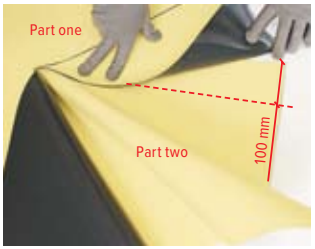
IMPORTANT! Do not pull the sheet with excessive force or overheat it.



Start connecting two parts for 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.

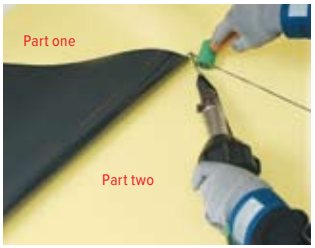


Place it, positioning the rounded corner of the second workpiece at the base of the cut of the first part of the element.



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

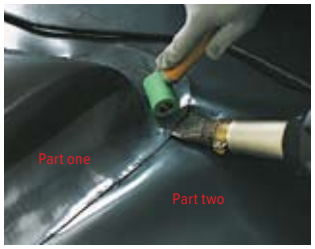
Spot weld the formed overlap.



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

Rotate 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 rounded and stretched corners.

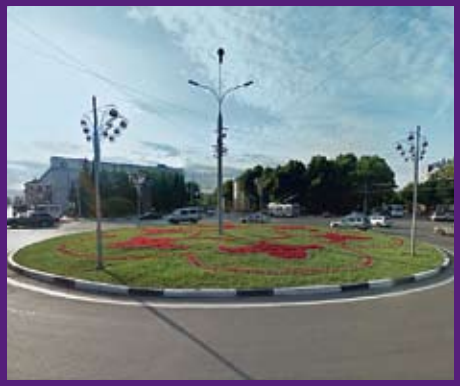
An element (straight angle) is now ready. Rotate and install it at the point where the inner corner is located and weld it to the main waterproofing felt of the foundation slab.

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

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

9.

WATERPROOFING OF EXPANSION JOINTS



Red Square, Yaroslavl
Stylobate Waterproofing
Area 5,600 m²
LOGICBASE V–SL 2.0 mm
2008

Mozaika Shopping Centre,
Moscow
Underground Waterproofing
Area 55,000 m²
LOGICBASE V–SL, 2.0 mm
2012

9. WATERPROOFING OF EXPANSION JOINTS

Use EM and IM-type TechnoNICOL waterstops for reliable waterproofing of expansion joints.

The composition of waterproofing layers in the area of expansion joints matches the layers installed on the surface outside of the seams.

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 A FOUNDATION SLAB

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

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

IMPORTANT! 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 semi-automatic equipment.

After the waterstop and membrane are welded together, continue installation of the other layers. Place the top layer of geotextile and polyethylene film.

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

9.2 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 material, width of which 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 a 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. To do this, first, spot-weld the waterstop edge closer to center.

Then tightly weld the waterstop edge using a roller and a manual welding machine.

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

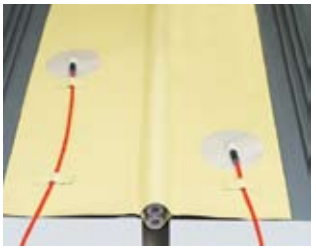
Install flanges into the formed watertight section.

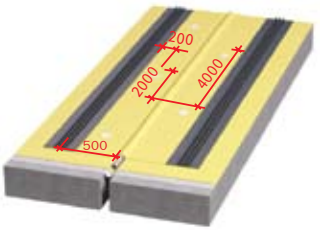
Install injection flanges into the formed section at a minimum distance of 200 mm from the waterstop. Relative displacement of the centerlines of adjacent flanges must be at least 2,000 mm.

Use spot welding to attach the flanges. The flange skirt must be welded around the complete circumference.

Connect injection hoses to flanges using connection fittings.

Waterproofing in the area of an expansion joint is now complete.

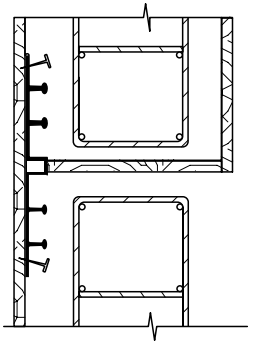




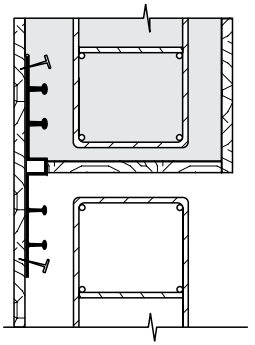
The installation diagram for waterstops and flanges.

9.3 WATERPROOFING OF AN EXPANSION JOINT ON THE FOUNDATION WALLS

Install waterstops at the casting stage.

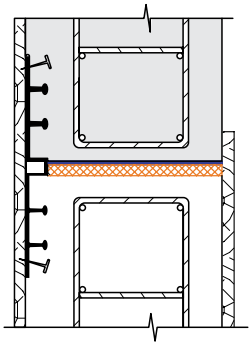


Prepare a site for waterstop installation, clean dirt and contaminants from it and mount and fasten the waterstop on the formwork.



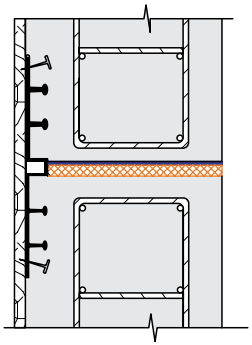
Cast concrete to the relevant part of the structure. Remove the formwork and visually check the quality of waterstop installation.

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 heat 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.

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

Another method of foundation wall joint waterproofing:

Install TechnoNICOL EC-220-3 formwork waterstops in the area of a vertical expansion joint at the concrete casting stage. For details on installation of waterstop, see Section 5.3.1.

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

As the waterproofing membrane is installed, weld it to the surface of the installed waterstops.

Create a membrane loop in the expansion joint.

Lay 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

Lokomotiv Stadium, Moscow
Waterproofing of Balconies and Passages
Area 12,000 m²
LOGICBASE V–SL 1.5 mm
2013–2014

Vodny Shopping Centre,
Moscow
Waterproofing of Foundation and Stylobate
Area 55,000 m²
LOGICBASE V–SL 2.0 mm
LOGICBASE V–ST 1.6 mm
2013–2015

10. WATERPROOFING OF UTILITY PASSAGEWAYS

10.1 MEMBRANE INSTALLATION AT PIPE PASSAGEWAYS

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

Weld a patch on the cut area. Check the quality of completed seams with a probe.

10.2 CONNECTION TO A PIPE

After the main waterproofing sheet is installed at a pipe passageway location, start waterproofing the joint.

10

This job will require preparation of rectangular-shaped material.

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 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.

Lightly cut the created bend (forming a "daisy") to let the parts formed during cutting ("daisy" petals) move down to the pipe base.

IMPORTANT! Always round off sharp corners formed during workpiece cutting.

Carefully preheat the base of the bend of the "petals" and lower them to the main waterproofing membrane.

Weld the "petals", starting from the base and moving towards the edge.

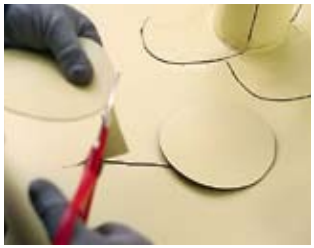
IMPORTANT! Use a brass roller for base welding.

Use a Teflon roller for welding "petal" edges.

IMPORTANT! Always preheat the "petals" before starting welding.

After the "petals" are welded to 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 "petals" are welded, prepare patches with a minimum size of 50 mm in diameter; the number of such patches should correspond to 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 workpieces with a 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 "petal" and a patch.

After all workpieces are reliably welded to the "petals" and the main membrane, start final waterproofing of the completed element.

To do this, install a worm gear clamp of a corresponding diameter that must reliably fasten the membrane on the pipe.

Install the clamp 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 additional amount of sealant to the section from the pipe to the clamp. "Pipe metal to clamp metal" sealant contact is mandatory.

10.3 CONNECTION TO A PIPE WITH A PREFABRICATED ELEMENT

Cut the top part 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 patch edges along the whole seam width (at least 30 mm).

Weld the "skirt" of the pre-made element all around using a Teflon or silicon roller.

Tighten the joint with a metal clamp.

11.
WATERPROOFING OF PILES

YE'S Multifunctional Complex Apartment Hotel, Moscow
Waterproofing of Foundation and Stylobate
Area 20,000 m²
LOGICBASE V–SL 2.0 mm
2014–2015

Moskovskaya Metro Station,
Almaty, Kazakhstan
Tunnel Waterproofing
Area 20,000 m²
LOGICBASE V–SL 2.0 mm
2013–2014

11. WATERPROOFING OF PILES

Waterproofing of piles is performed by grouting of a pile cap with hydraulic cement non-shrink grout with 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 surface.

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

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.

IMPORTANT! 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 a waterproofing membrane covering the installed waterstop and cutting the material on site.

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

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

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

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

Connection of the waterproofing membrane to piles may be made with an adhesive waterstop. In this case, the waterstop is not installed into the formwork. After casting of a pile cap around the pile and removal of formwork, TechnoNICOL PVC tape should be attached to the waterproof concrete surface using TechnoNICOL epoxy glue. The membrane is welded to an adhesive waterstop similarly to how it was described in the previous section.

11

12.
WELL WATERPROOFING

12

Victoria Residential Complex, Perm
Underground Waterproofing
Area 13,500 m²
LOGICBASE V–SL 2.0 mm
2010

Tunnel No. 1 Amirkhana/ Chistopolskaya, Kazan
Tunnel Waterproofing
Area 24,500 m²
LOGICBASE V–SL, 2.0 mm
2012

12. WELL WATERPROOFING

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

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

Weld strips in all corners, extending to the horizontal surface.

12

13.
GENERAL INSTALLATION REQUIREMENTS

A Multifunctional Complex with Underground Parking, Moscow, corner of Mosfilmovskaya and Minskaya Streets
Underground Waterproofing
Area 12,000 m²
LOGICBASE V–SL 2.0 mm
2014–2015

Aquamall Shopping Centre, Ulyanovsk
Underground Waterproofing
Area 42,200 m²
LOGICBASE V–SL 2.0 mm
2010

13. GENERAL INSTALLATION REQUIREMENTS

THE FOLLOWING IS PROHIBITED:

— walking, storing tools, construction instruments or materials on an unprotected waterproofing membrane when installing the protective layer;
— geodetic works associated with the use of instruments on tripods with sharp ends or laser instruments with sharp parts (levelling instruments and theodolites) with pins for insertion into soil on a waterproofing membrane surface not covered by a screed;
— arc-welding and gas-welding and cutting of rebars above unprotected sections of a waterproofing membrane on the main surface and near an expansion joint;
— use of transport in the area of waterproofing works and on the protective screed.

Technical Recommendations on Compaction Methods and Soil Quality during an Excavation with Backfilling

— Backfilling should be performed in strict compliance with the design project and the rules defined in SP 45.13330.2012.
— Requirements for backfilling soil are adopted according to Appendix M to SP 45.13330.2012.
— The soil designed for backfilling shall not contain solid inclusions, wood, fibrous materials, or construction debris.
— The soil designed for backfilling shall not contain snow or ice.
— Local, sandy or clayey soils shall be used for backfilling.
— Backfilling of excavation pit hollows should be performed in layers after installing material that protects LOGICBASE V-SL waterproofing membrane (TechnoNICOL needle-punched thermobonded geotextile with a density of 500 g/m², or PLANTER protective drainage membrane) and after preparing a certificate for concealed works and receiving a permit for backfilling.
— Hollows shall be backfilled with gradual movement of soil into cavities with safety precautions against damage or displacement of waterproofing or protective drainage materials.
— Soil compaction during backfilling for a distance of at least 300 mm from the waterproofing and protective drainage materials shall be performed with plate compactors or electric rammers in accordance with safety precautions against their displacement and damage.
— When plate compactors or electric rammers are used, the average thickness of backfilled sand layer shall be at least 70 cm.
— The minimum distance from the plate compactors or electric rammers to waterproofing and protective drainage materials during soil compaction shall be 50 mm.
— Backfilling shall be performed after installation of waterproofing and protective drainage materials.

Contractor Training

If you wish to gain practical skills in working with polymer membranes, learn the secrets and nuances not covered by this publication, welcome to TechnoNICOL Training Centers!

A Specialized Training Centre was established at the Logicroof plant in Ryazan, where full training in handling the LOGICBASE PVC membrane is available. Course duration – 4 days.

Training benefits:

— improved performance and quality of the work;
— acquisition of the skills for working with modern cutting-edge materials;
— minimization of complaints from customers and supervisory authorities during work acceptance;
— working according to quality requirements of the modern construction market.

Administrator of the Training Centers Direction:
Ph.: +7 (347) 291-25-02,
Toll-free line: 8 800 200-05-65 (Russia only)
E-mail: seminar@tn.ru
All information on a single portal www.academy.tn.ru

Please send your feedback on this Manual to:
LOGICROOF@TN.RU

TECHNONICOL QUALITY ASSURANCE

Ensuring Proper Quality of Installation is the Task of our Quality

Assurance Department

Focusing on the reliability and durability of waterproofing systems created using TechnoNICOL materials, our Company uses a systemic approach and offers not only underground waterproofing, but also a unique service for the Russian market assuring our clients of proper parameters of selected products. We established the Quality Assurance Department, a team of highly skilled engineers all throughout Russia and the CIS.

The Quality Assurance Department provides free support and assistance for your project at all stages of underground waterproofing. This includes manufacturer's support, a free examination of underground waterproofing that uses LOGICBASE polymer membranes and minimization of possible mistakes related to poor installation quality.

The objectives of the Quality Assurance Department engineers include creation of conditions for effective installation and easy and long-term operation of underground waterproofing systems made from modern LOGICBASE premium-class polymer membranes. Our specialists are ready to visit your site and promptly provide the required services to our customers.

TechnoNICOL Quality Assurance Department provides:

— free evaluation of the technical condition of the underground waterproofing system;
— qualified free technical support of LOGICBASE waterproofing installation on site with recommendations for rectification of defects;
— training in installation of systems using LOGICBASE polymer membranes.

Should you need any advice, please contact us by phone
8 800 200 05 65 (Russia only) or by email at **CK@TN.RU**
You can also request a free examination of a foundation, tunnel or other underground facility right now on our website **logicroof.ru/ck**

Life Volzhskaya Residential Complex, Moscow
Underground Waterproofing
Area 50,000 m²
LOGICBASE V–SL 2.0 mm
2012

Great Moscow State Circus on Vernadskogo Prospekt (Reconstruction), Moscow
Waterproofing of Stylobate
Vacuum Waterproofing System
Area 10,000 m²
LOGICBASE V–SL 2.0 mm
LOGICROOF T-PL 1.6 mm
2014

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