

The logo for KÖSTER, featuring the word in a bold, blue, sans-serif font. The letter 'O' is stylized with a blue outline and a white center, and the letter 'E' has a blue outline and a white center. The background of the entire page is a close-up photograph of a grey, textured waterproofing membrane with a grid-like pattern of raised rectangular cells.

Waterproofing Membranes

# KÖSTER TPO TF for Tunnels and Foundations

Issued: 05/2026





The KÖSTER TPO TF is a thermoplastic polyolefin PE-based reinforced membrane for the waterproofing of tunnels and foundations

## KÖSTER TPO TF Membranes

For over 35 years, KÖSTER has been manufacturing waterproofing membranes in Aurich, Germany. These waterproofing membranes have proven their effectiveness over time in multiple structural waterproofing applications.

KÖSTER TPO TF membranes were specially designed for the waterproofing of all types of underground structures including basements, foundations, and tunnels.

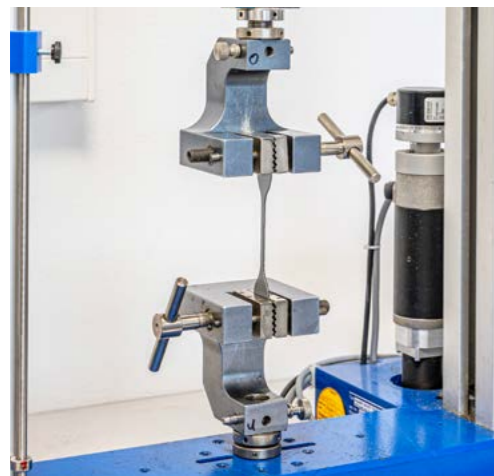
<b>Product name</b>	KÖSTER TPO TF
<b>Type</b>	FPO / TPO – PE base
<b>Construction</b>	Double layer FPO-PE with central reinforcement in between layers
<b>Reinforcement</b>	Yes – glass fleece
<b>Signal layer</b>	Yes – silver top signal layer for visual damage control
<b>Thicknesses available</b>	1.5 mm (standard availability) 2.0 mm (standard availability) 2.5 mm (available upon special request)
<b>Rolls Width</b>	1.75 meters wide 2.10 meters wide
<b>Fields of application</b>	<p><b>Tunnel construction</b></p> <ul style="list-style-type: none"> <li>• Cut-and-cover construction</li> <li>• Drained mining tunnels</li> <li>• Pressurized mining tunnels</li> <li>• Cross passages in segmental linings</li> </ul> <p><b>Underground structures</b></p> <ul style="list-style-type: none"> <li>• Foundations and basements</li> <li>• Watertight compartment systems</li> <li>• Ground-Contact Floors on Moist Substrates</li> <li>• Podium decks</li> </ul>
<b>Application technique</b>	Overlap the sheets and weld seams with hot air welding equipment Single or double seam welding
<b>Advantages</b>	<p>High elongation and tear resistance</p> <p>High crack-bridging ability</p> <p>Superior mechanical impact resistance</p> <p>Resistant to permanent contact with water – does not rot over time</p> <p>Seams homogeneously welded (not glued or bonded)</p> <p>No chemical activation of the seam needed during application</p> <p>Signal layer for visual damage control</p> <p>Immediate waterproofing effect</p> <p>Fast and clean installation</p> <p>Free of volatile plasticizers and other VOC's</p>



A superior performing membrane for wider waterproofing fields of application.



## KÖSTER TPO TF Performance



To ensure performance integrity, the KÖSTER TPO TF membrane is designed and tested in accordance with mechanical, hydraulic, and thermal requirements. These requirements include elongation capability, tear and impact resistance, membrane rigidity, and water-tightness.

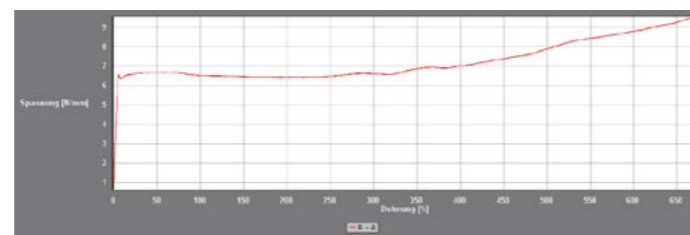
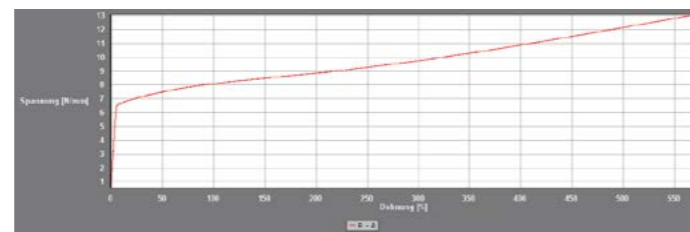
Our membranes also provide excellent chemical resistance and durability. In addition, KÖSTER TPO TF is equipped with a silver signal layer for visual damage control. The waterproofing membrane is capable of deforming without rupture or deterioration during its life expectancy.

Below we can see the results of the elongation test, confirming the high flexibility and mechanical performance of the KÖSTER TPO TF membrane.



Machine Direction

Cross Direction



## Welding KÖSTER TPO TF

Automatic Welding



Details and pile heads



To ensure a watertight installation and long service life, the KÖSTER TPO TF membrane seams are welded homogeneously with hot air, using single or double seam welding machines.

To achieve full waterproofing, manual welding with the help of a pressure roller is carried out on detail areas and pile heads.

KÖSTER TPO TF membranes can be welded within a wide temperature window between +400 °C to +600 °C, depending on the local environmental conditions.

Hot air welding in comparison to fully bonding or cold applied adhesives provides a faster and cleaner installation process with an immediate waterproofing effect, without relying on curing times or surface preparation. The welded seams offer consistent, high mechanical strength and can be easily inspected and tested on site, ensuring reliable quality.

## Comparison between loose-laid hot-air welded membrane systems and other methods



### Fully bonded membrane

This application method has many disadvantages compared to our membrane installation using a hot air welded system. Fully bonding is sensitive to external factors such as substrate condition, irregular surfaces, complex details, and protrusions, which can affect proper adhesion of the membrane. These factors can create weak points in the system and make the application more expensive.



### Cold-applied adhesive

Using the cold-applied adhesive method could have the disadvantages of long curing times, temperature limitations, moisture sensitivity, and limiting breathability which can increase the risk of trapped moisture. Welding seams avoids these issues and offers several other advantages.

### Chemically bonded / moisture activated

The effectiveness of the bond between pre-applied membranes and green/fresh concrete is highly dependent on site conditions and concrete quality, making long-term adhesion performance somewhat unpredictable.

The unpredictability of the adhesion/bonding reaction between the membrane and freshly poured concrete can potentially lead to incomplete bonding or localized debonding, resulting in water leakages into the structure.

## Waterproofing solution

The differentiation of the application methods for waterproofing membranes is based on the project design, excavation system, required water control system, soil and substrate conditions surrounding the structure, and its intended use.

## Water Control Systems: Drainage Solutions and Barrier Techniques

Drainage System	Waterproofing against damp soil and percolating water using a single layer membrane. The waterproofing membrane protects the concrete while channeling water into the drainage system.
Barrier System	Waterproofing against hydrostatic pressure using a single layer membrane and a compartment system composed of waterbars, injection flanges, and control ports. The membrane ensures comprehensive protection of the concrete structure from moisture and chemical exposure, with options for integrated monitoring and injection systems for backup protection.



## Membrane thickness selection

Moisture and water ingress	1.5 mm
Hydrostatic pressure 0 m - 10 m	1.5 mm
Hydrostatic pressure 10 m - 20 m	2.0 mm

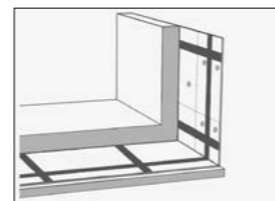
## Tunnels

Tunnel waterproofing systems need to perform under difficult construction conditions, heavy structural loads, cost restrictions, and exposure over time.

Tunnels



Basements



## Basements and Foundations

Basement waterproofing systems must be designed to remain in constant ground contact, under variable groundwater pressure and site construction limitations, and ensure long-term protection against moisture infiltration and structural loads. For this reason, different system solutions are applied depending on the project parameters.

## KÖSTER TPO TF in Construction Waterproofing

Basements and tunnels are subjected to varying water exposure, pressure conditions, and biological factors. Complete waterproofing of all basement and tunnel components in ground contact is required to prevent water ingress and protect against chemical attack.

## Tunnels



Vehicular Tunnels



Underground Railways



Pressurized water tunnels



Rock protection gallery



Shafts



Interconnecting passages

## Underground structures



Commercial basements



Sub-level parking areas



Metro stations



Residential basements



Containment facilities



Leisure centers



Archives



Warehouses



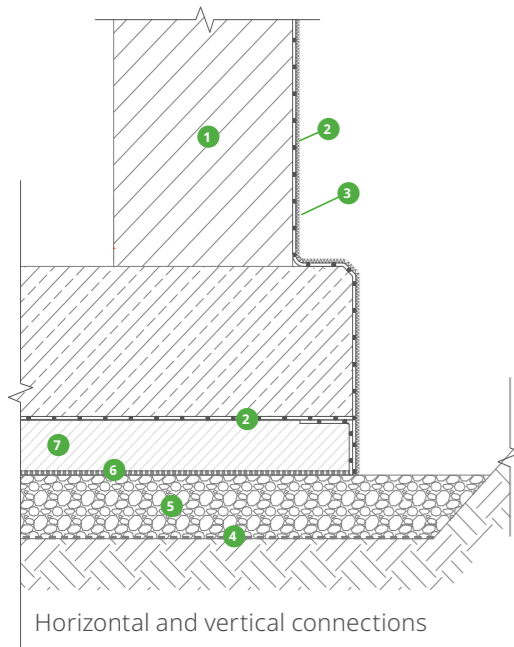
Utility Rooms

## Application Methods

The application of our KÖSTER TPO TF is carried out depending on the project and the location where it will be installed. However, it is important to consider some important characteristics. In applications where a primary lining of shotcrete is used, the surface must be smoothed before the geomembrane is installed. Tension in the membrane should be minimized, and all reinforcement and waterstop anchors should be fully embedded during concrete pouring.

The KÖSTER Method constitutes a series of application steps ensuring a secure installation of the KÖSTER TPO TF, while guaranteeing a better connection between the horizontal and vertical surfaces.

A strip with a minimum width of 20 cm is securely fastened as a transition to the inside of the formwork, and the cleanliness layer poured half way up the membrane. The strip is then folded over the slab and the horizontal waterproofing welded to it. Then the structural slab can be poured. When the formwork is removed and the walls built, the vertical waterproofing can be easily welded to it.



### Vertical surfaces

The vertical waterproofing membranes are mechanically fastened along the upper edge and secured with a finishing profile to avoid water infiltration behind the membrane.

### Horizontal surfaces

KÖSTER TPO TF Membranes are placed over the horizontal surface and the overlaps are connected by hot air welding, which creates a homogenous, watertight, and durable connection.

- 1 Structural concrete wall
- 2 KÖSTER TPO TF
- 3 KÖSTER SD Protection and Drainage Sheet 3-250
- 4 Geotextile separation layer
- 5 Filter bed with gravel (optional)
- 6 PE Foil
- 7 Cleanliness layer

The following sections present the application methods in different scenarios. For further details, please consult our KÖSTER TPO TF Method Statement.

## Tunnels

### Mined tunnel



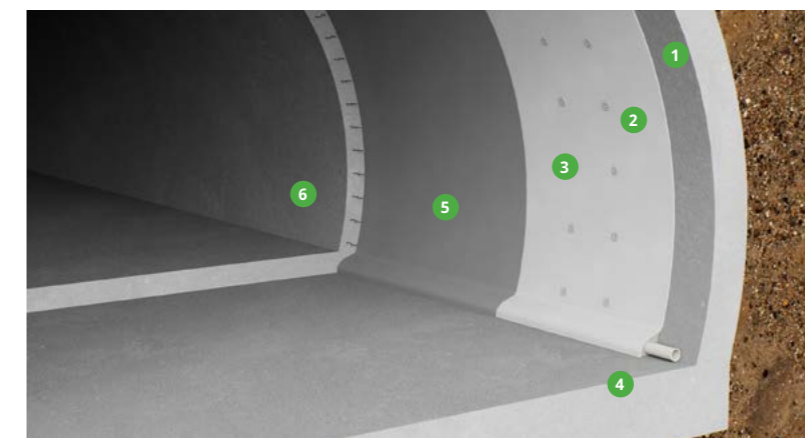
Drainage Umbrella System

### Description

Umbrella tunnels are waterproofed only in the vault area and are not designed to resist water pressure. Any infiltrating or temporary water must be collected and discharged through a drainage installed at the bottom of the tunnel.

KÖSTER Technology	KOSTER TPO TF 2.0
<b>Type of construction</b>	TBM Shield TBM Drill and Blast
<b>Waterproofing system</b>	Drainage layer + loose-laid KÖSTER TPO TF membrane
<b>Installation method</b>	Pre-installed waterproofing systems: Loose-laid prefabricated KÖSTER TPO TF membrane systems.
<b>Performance</b>	Durability: High Crack-bridging: High Water vapor tightness: High Chemical resistance: Very High Concrete Protection: High
<b>Advantages</b>	Full waterproofing arch Drainage system Seamless waterproofing layer
<b>Typical application fields</b>	Railway tunnels and road tunnels with complex geology
<b>Repair method</b>	Local injection in the event of leakages on determined segments

### Application



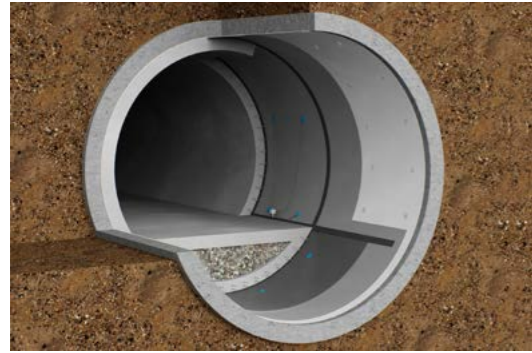
- 1 Substrate
- 2 Geotextile protection layer
- 3 PE Discs
- 4 Drainage system
- 5 KÖSTER TPO TF
- 6 Concrete

Substrate is prepared, Geotextile is applied and after attached with the PE discs.

The substrate is prepared. A geotextile layer is installed and fixed in place using polyethylene (PE) discs. The KÖSTER TPO TF membrane is then attached by welding it to the discs, with all overlaps sealed using hot-air welding to ensure continuous waterproofing. The installation also includes a drainage system to prevent water ingress and direct it safely to outlets.

## Tunnels

### Mined tunnel



Hydrostatic membrane barrier  
Compartment System

### Description

In tunnels designed as a hydrostatic barrier, the waterproofing forms a closed system around the entire tunnel cross-section. The structure is protected against permanent groundwater pressure. Drainage is normally not part of the concept, so all joints, penetrations, and connections must be watertight and pressure-resistant.

### Application

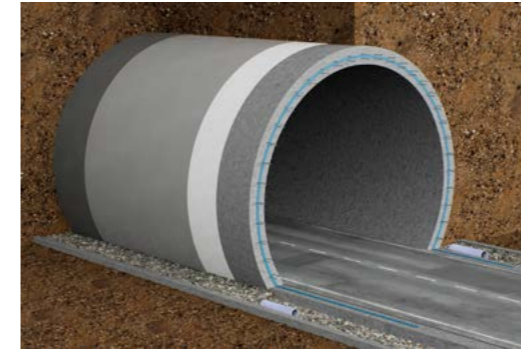


- 1 Substrate
- 2 Geotextile protection layer
- 3 PE Discs
- 4 KÖSTER TPO TF
- 5 Waterbar
- 6 Injection flange
- 7 Injection hose
- 8 Control Port
- 9 Concrete

The substrate is prepared. The geotextile layer is fixed with PE discs. The KÖSTER TPO TF is welded to the discs, with overlaps sealed by hot-air welding. To localize potential leaks the system is divided into independent compartments using waterstops welded to the membrane. Injection valves and control ports are installed to permit inspection and targeted repair where needed.

KÖSTER Technology	KÖSTER TPO TF 2.0
<b>Type of construction</b>	TBM Shield TBM Drill and blast
<b>Waterproofing system</b>	Loose-laid KÖSTER TPO TF membrane + Compartment system
<b>Typical application fields</b>	Railway tunnels and road tunnels in complex geology
<b>Performance</b>	Durability: High Crack-bridging: High Water vapor tightness: High Chemical resistance: Very High Concrete Protection: High
<b>Installation method</b>	Loose laid membrane system made of KÖSTER TPO TF with compartments and integrated injection back-up. Membrane application in one layer
<b>Advantages</b>	High waterproofing security Built-in redundant protection by compartment injection
<b>Repair method</b>	Injection of leaking compartments through injection ports inside of structure

### Cut and cover

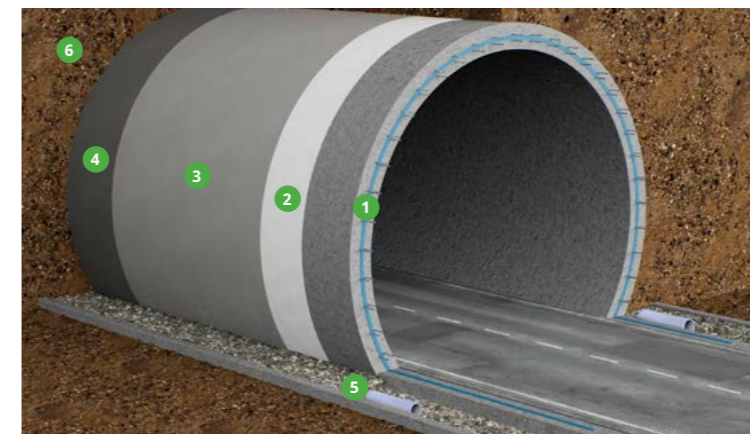


Drainage System

### Description

Cut-and-cover tunnels with a drainage system are designed to relieve water pressure around the structure. Water is collected by drainage layers and led to drainage pipes for controlled discharge. The waterproofing protects the structure, while the drainage prevents the build-up of hydrostatic pressure.

### Application



- 1 Reinforced Concrete
- 2 Geotextile protection layer
- 3 KÖSTER TPO TF
- 4 KÖSTER SD Protection and Drainage Sheet
- 5 Drainage system
- 6 Backfill

The reinforced concrete tunnel is constructed. A geotextile layer is installed followed by the waterproofing membrane with overlaps sealed by hot-air welding. The KÖSTER TPO TF membranes are positioned so that seepage can run off into a drainage system.

KÖSTER Technology	KÖSTER TPO TF 2.0
<b>Type of construction</b>	Cut-and-cover
<b>Waterproofing system</b>	Mechanically fastened KÖSTER TPO TF membrane + Drainage layer + back-fill
<b>Typical application fields</b>	Road tunnels, road galleries, metro stations, railway tunnels.
<b>Performance</b>	Durability: High Crack-bridging: High Water vapor tightness: High Chemical resistance: Very High Concrete Protection: Very High
<b>Installation method</b>	Mechanically fastened membrane system made of KÖSTER TPO TF. Membrane application in one layer + drainage and protection sheet
<b>Advantages</b>	Positive side waterproofing with drainage system Seamless waterproofing layer
<b>Repair method</b>	Injection in the event of leakages in the affected areas

## Basements and Foundations

### External waterproofing



### Description

With external waterproofing, the waterproofing layer is applied to the outside of the basement walls and slab before backfilling. It protects the structure against ground moisture, seepage and groundwater, depending on the selected system. Particular care is required at joints, pipe penetrations, and wall/floor transitions.

KÖSTER Technology	KOSTER TPO TF 1.5 KOSTER TPO TF 2.0
<b>Type of construction</b>	External waterproofing Sandwiched waterproofing
<b>Waterproofing system</b>	Drainage layer + loose-laid KÖSTER TPO TF membrane
<b>Typical application fields</b>	Commercial and residential buildings, storage areas, metro stations
<b>Performance</b>	Durability: High Crack-bridging: High Water vapor tightness: High Chemical resistance: Very High Concrete Protection: High
<b>Installation method</b>	Loose-laid mechanically fastened membrane system: Loose-laid prefabricated KÖSTER TPO TF membrane systems.
<b>Advantages</b>	It offers excellent durability, allows for simple and rapid construction, requires no additional wall protection, and is a cost-efficient solution.
<b>Repair method</b>	Local injection in the event of leakages in the affected areas

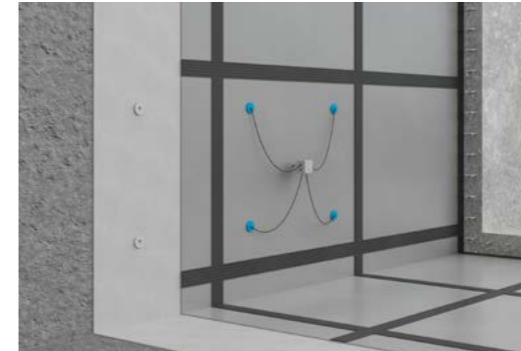
### Application



- 1 Substrate
- 2 Geotextile protection layer
- 3 KÖSTER TPO TF
- 4 KÖSTER SD Protection and Drainage Sheet

The membranes are hung down from the top edge and mechanically fixed with fasteners or a bar for mechanical fixation. The bottom of the membranes are welded to the exposed horizontal waterproofing.

### Compartment System

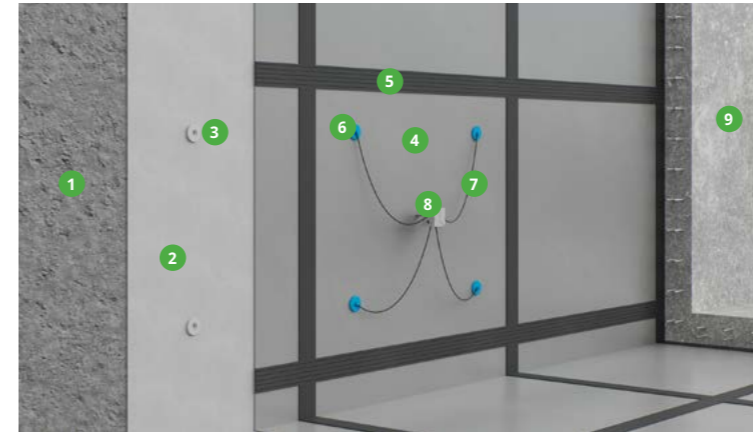


### Description

A compartment system divides the waterproofing into separate watertight sections. If a leakage occurs, water migration is limited to one defined area, making the defect easier to locate and repair. This system is commonly used for basements or underground structures exposed to pressurized water.

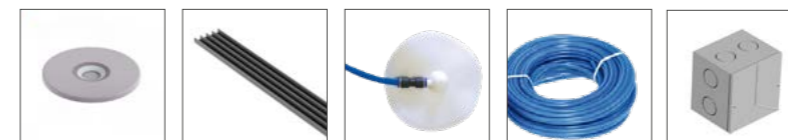
KÖSTER Technology	KOSTER TPO TF 1.5 KOSTER TPO TF 2.0
<b>Type of construction</b>	Compartment System
<b>Waterproofing system</b>	Mechanically fixated KÖSTER TPO TF membrane and controlled injection segments
<b>Typical application fields</b>	Large underground engineering projects, in which controlled sections are required for leak detection.
<b>Performance</b>	Durability: High Crack-bridging: High Water vapor tightness: High Chemical resistance: Very High Concrete Protection: High
<b>Installation method</b>	Loose laid membrane system made of KÖSTER TPO TF with compartments and integrated injection back-up. Membrane application in one layer.
<b>Advantages</b>	High waterproofing security. Built-in redundant protection by compartment injection. No excavation required to repair localized leaks.
<b>Repair method</b>	Injection of leaking compartments through injection ports inside of structure.

### Application



- 1 Substrate
- 2 Geotextile protection layer
- 3 PE Discs
- 4 KÖSTER TPO TF
- 5 Waterbar
- 6 Injection flange
- 7 Injection hose
- 8 Control Port
- 9 Concrete

The substrate is prepared. A geotextile layer is fixed with PE discs. The KÖSTER TPO TF is welded to the discs, with overlaps sealed by hot-air welding: To limit local leaks the system is divided into independent compartments using waterstops welded to the membrane. Injection valves and control ports are installed to permit inspection and targeted repair if needed.



## Repair System

When localized damage to a waterproofing system leads to water ingress, the affected areas must be properly sealed. In tunnels and underground structures, direct access to the membrane is often limited, making injection methods the most practical repair approach.

Repairs can be performed using localized injection. In this method, low-viscosity resins are injected directly into the point of water ingress to seal specific defects.

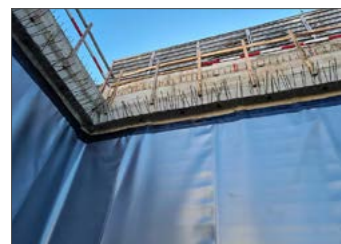
In compartments systems, injection is carried out through the pre-installed valves and control ports. This method repairs the waterproofing system by sealing the area between the KÖSTER TPO TF membrane and the concrete.

## Control System

Weld samples must be taken daily on site to determine the correct welding parameters. If conditions change, the settings must be checked and readjusted if necessary.

In addition, the following inspections shall be carried out:

<b>Visual Inspection</b>	After welding, all seams are visually inspected, especially at connections.
<b>Manual Testing</b>	Once the welded seams have completely cooled, they are mechanically tested with a test needle.
<b>Vacuum Bell Test</b>	A soap solution is applied to the seam edges and subsequently the vacuum bell is pressed over the area. In case of leaks, bubbling is observed.
<b>Compressed air test – double welding</b>	Double seam welding machines create two welds at the same time, creating an enclosed channel between them. The weld is tested by compressing air into the void created by the two welds. In case of leaks, the pressure drops.



## Radon retardant

Radon is a colorless, odorless and tasteless gas, which makes it very difficult to detect. Possible entry points of Radon in buildings include areas in ground contact and foundations with potential cracks or potential points which the gas could enter.



KÖSTER TPO TF is a waterproof membrane designed to retard radon ingress into the structure. A radon diffusion coefficient was determined according to the method A of the ISO/TS 11665-13. Concentrations on both sides of tested samples were measured continuously by radon detectors (TSR-4 of the TERA System) and current mode ionization chambers.

Exposure to radon represents a health hazard and is addressed with the amendment to the Radiation Protection Act of May 12, 2017 to protect against radon in buildings. The specified reference value should not exceed 100 becquerels per cubic meter of room air, otherwise suitable protective measures must be taken.

86  
**Rn**  
Radon  
222

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Order No.: 862803A217	
<b>TEST REPORT No. 124026/2026</b> upon the test: Determination of the radon diffusion coefficient of KÖSTER TPO TF carried out in accordance with the ISO/TS 11665-13	
Client's name and address: KÖSTER BALACHEMIE AG Dierstraße 1-10 D-26607 Aurich Germany	
Date of issue: 18.4.2025	
Approved by:	
prof. Ing. Martin Jirasek, CSc. Technical head of OÜ 124 laboratory	
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Always adhere to the specifications in the respective Technical Data Sheets.