



WATERPROOFING

Sikaplan® WP/WT TAPES

HIGH PERFORMANCE, BONDED TERMINATION SOLUTIONS

BUILDING TRUST



CHALLENGING CROSS TUNNELS

FORMING WATERTIGHT TERMINATIONS and seals at the connections of cross tunnels and other shafts such as the transitions from precast elements to station boxes, onto precast tunnel lining segments that are produced using impermeable concrete, represents a technical challenge. The design and installation in situations with complex component geometry and high hydrostatic pressure is particularly difficult. To date, mechanically clamped watertight connection systems have predominantly been used for this purpose.

CROSS TUNNELS

Parallel twin tunnel tubes are generally connected every 200 – 500 m (according to function and local requirements) with a cross tunnel. These cross tunnels generally ensure an escape route from one tunnel to the other in case of a fire. In addition technical support and operational equipment such as the electrical switch rooms are often located in these passages and therefore they have to be watertight structures and “totally dry”, meaning also resistant to significant hydrostatic pressure.

This is easily achieved with Sikaplan® sheet membrane systems based on either polyvinylchloride (PVC), specifically the Sikaplan® WP 1100 series; or flexible polyolefin (FPO), the Sikaplan® WT 2200 series, depending on the ground conditions and project requirements. Historically, the watertight connections of the loose laid, welded Sikaplan® membranes to

the circular precast element shape are made by mechanically clamped systems, which can be difficult to correctly install in some conditions, and are sensitive for failures.

MAIN CHALLENGES IN CROSS SECTIONS

- Uneven surfaces (e.g. shotcrete)
- Damp/wet surfaces
- Ground freezing treatments
- Expansion/movement joints between segmental linings and cross-tunnels
- Offsets between segments of approx. <1.5 cm (tolerance)
- Location of the sealing gaskets and rebated grooves
- 3-dimensional water-flow paths
- Grease/dirt contamination inside the joint
- Conure/Connections as secure/equal to the watertight lining system



INNOVATIVE, HIGH PERFORMANCE BONDED TAPE SEALING SOLUTIONS

AS THE GLOBAL LEADER IN TUNNEL WATERPROOFING SOLUTIONS Sika has developed two high performance bonded tape sealing solutions that are both quick and easy to install, and with the same standard and level of watertightness as the whole cross section/transition waterproofing system (i.e. the Sikaplan Membrane Compartment System). Dependent on which membrane waterproofing system is selected for each project, Sika provides this bonded tape sealing solution based on a compatible formulation of either PVC – “The Sikaplan® WP Tape System”, or FPO – “The Sikaplan® WT Tape System”.

Uses:

- Watertight connection of crossings between parallel tunnels
- Watertight transitions between TBM driven tunnels to station boxes
- Forming compartment systems together with Sikaplan® tunnel membranes in Cut and Cover tunnels
- Watertight terminations of Sikaplan® WP/WT membrane systems

Main properties:

- The system cost is “highly” competitive in comparison to any clamped solution.
- No need for the costly mortar beds/build-ups required for mechanically clamped systems
- Proven durability:
 - The FPO based Sikaplan® WT Tape-200 has the same formulation as Sikaplan® WT 2200 Series with proven ageing behaviour >120 years and a well-documented track record
 - The PVC based Sikaplan® WP Tape-200 has the same formulation as Sikaplan® WP 1100 Series with proven ageing behaviour >100 years and a well-documented track record
- Full material/system compatibility and tested life expectancy
- Minimizes the risk of failures at critical details



Sikaplan® WP TAPE SYSTEM

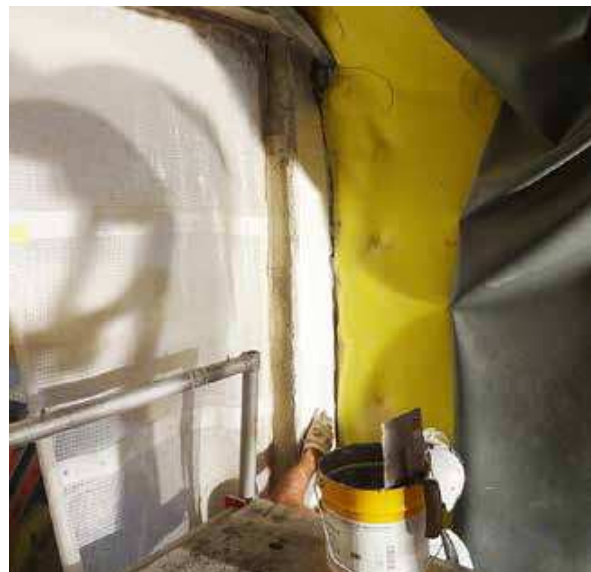
For PVC membranes

Sikaplan® WP TAPE-200 is a waterproof sealing tape for terminations and fixings of Sikaplan® WP membranes and is therefore also based on fully compatible modified PVC. The waterproof sealing tape is bonded and fully sealed by heat welding to the Sikaplan® WP waterproofing membranes – Including series WP 1100, 2101 and 2110 (all also based on the same PVC). The Sikaplan® WP Tape-200 is used to connect the Sikaplan® WP membranes to the substrate and itself at edges and terminations, thereby maintaining a high quality watertight seal that is exactly the same as the joints between the membrane sheets themselves. It can also therefore be used in Cross tunnels for all of the necessary special, high performance and secure terminations of the Sikaplan® WP Membrane System.

CHARACTERISTICS / ADVANTAGES

Sikaplan® WP Tape-200 is a white/black tape modified on the black side to provide excellent adhesive properties with the Sikadur®-31 CF adhesive, for bonding to concrete and steel surfaces.

- Very good bond characteristics
- Long-term water resistance
- Optimized workability, heat weldable
- Optimized flexibility with high tensile strength and multi-axial elongation
- Elastomeric behaviour
- Flexible in cold temperatures
- Bonds the membrane tape securely to the concrete substrate at terminations and fixings
- No lateral water underflow



Sikaplan® WT TAPE SYSTEM

For FPO membranes

SIKAPLAN® WT TAPE 200 is a high performance watertight sealing system based on modified polyolefin (FPO) membrane, with excellent bond characteristics with a range of special Sikadur® epoxy adhesives to ensure the optimum adhesion in different applications and conditions. The system allows direct watertight connections by heat welding to polyolefin (FPO) based waterproofing membranes from the Sikaplan® WT 1200, 2200, 5200 and 6200 ranges. The Sikaplan® WT Tape 200 is used to maintain a high quality watertight seal by connecting Sikaplan® WT membranes to the substrate at perimeter edges and terminations, plus it is also used for the creation of sealed compartments in the so-called compartment waterproofing systems.

CHARACTERISTICS / ADVANTAGES

Sikaplan® WT Tape is a grey/black tape modified on both sides. Both, black and grey sides have excellent bonding properties with Sikadur®-31 CF epoxy adhesives to concrete and steel.

- Excellent adhesion between the tape and adhesives means no solvent activation of the tape is required on site
- Fast and easy to install
- Suitable for installation on both dry and damp concrete surfaces
- Performs well within a wide range of temperatures
- Good adhesion to many different material substrates
- The adhesives are available in normal and rapid hardening grades to suit different conditions and requirements
- Root penetration resistant
- No lateral water underflow



COMPARISON

MECHANICALLY CLAMPED watertight connections are well known systems. Clamped solutions are also regulated by DIN Standard 18195 part 9. They have well known practical limitations and disadvantages in terms of their watertightness (particularly against high water pressure), together with high costs for tailor-made fabrication and time consuming specialist installation. The higher the water pressure gets, the higher the demands and also the necessary dimensions of the waterbar, including the flange system.



Comparison between clamped and bonded connection systems according to Tunnelling Manual 2014 / German Geotechnical Society

Criteria	Clamped type	Bonded type
Effect on the excavation geometry	High workspace requirement	Low workspace requirement
Substrate requirements	No difference	No difference
Surface characteristics requirements	High	Low
Number of (sub-) trades needed	Medium	Low
Time required for installation	High	Low
Inspection demands	High	Low
Susceptibility to defects	High	Medium
Effectiveness	Medium	High
Cost	High	Low



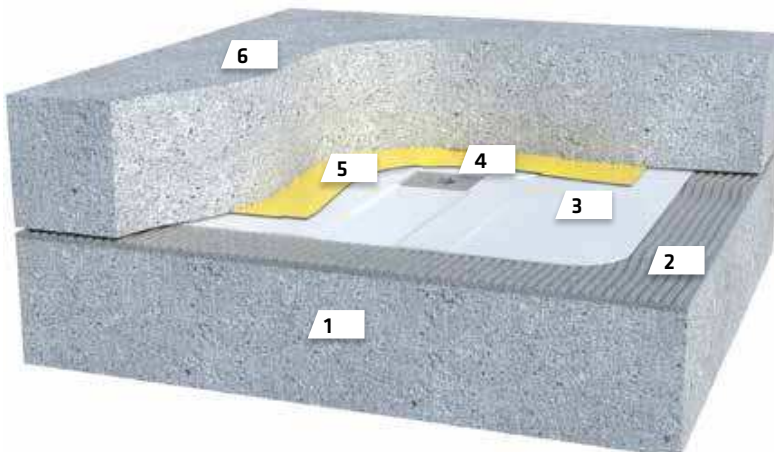
TESTING

SIKAPLAN® WP TAPE-200 AND SIKAPLAN WT TAPE-200 were tested for function and performance under high water pressure according to the Tunnelling Manual 2014. The purpose of the insitu water pressure test was functional validation of the watertightness of the specified sealed connection system and also to then determine the limits of the watertight sealing system. This testing was carried out using the system structure of Sikadur®-31 CF epoxy adhesive ('Normal' grade) with the Sikaplan® WP Tape welded to Sikaplan® WP 1100-21 HL2 membrane and a concrete structure. The build-up was as follows:

A watertightness test was carried out on this build-up of Sikaplan® WP Tape and sealing system (PVC based) welded to Sikaplan® WP 1100-21 HL membrane. The water pressure was increases step-by-step to failure to confirm the design and performance limitations. A similar build-up, but using FPO based Sikaplan® WT tape welded to Sikaplan® WT 2200-21 HL was tested in exactly the same way and at the same time. The insitu water pressure tests demonstrated a high performance watertightness was achieved with these systems.

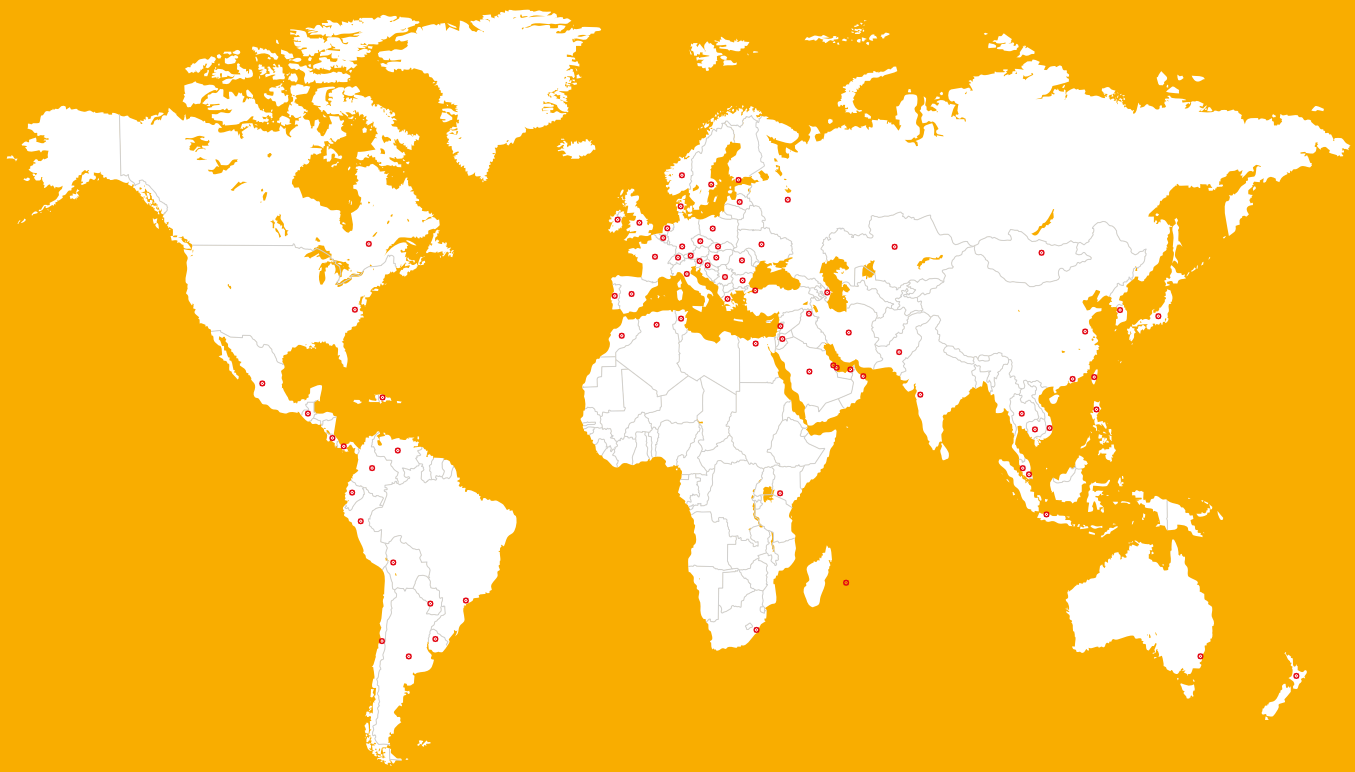


Sikaplan® WP/WT TAPE SYSTEM BUILD-UP:



1. Concrete substrate
2. Sikadur®-31 CF
3. Sikaplan® WP/WT Tape
4. Hole for Waterpressure
5. Sikaplan® WP 1100-21 HL2 or Sikaplan® WT 2200-22 HL
6. Crosshead installation of the test piece and concrete backing with grouting concrete

GLOBAL BUT LOCAL PARTNERSHIP



FOR MORE INFORMATION:



WE ARE SIKA

Sika is a specialty chemicals company with a leading position in the development and production of systems and products for bonding, sealing, damping, reinforcing and protecting in the building sector and the motor vehicle industry. Sika's product lines feature concrete admixtures, mortars, sealants and adhesives, structural strengthening systems, flooring as well as roofing and waterproofing systems.

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