

WOOLF Newsletter

11th Pilot project

Retro-sealing
expansion joints
in record time!



Main station, Vienna, Austria
Source: Architekten24 Photo © Unger Steel Group, Renée Del Missier

The large-scale Austrian Rail infrastructure project, begun in June 2009, was completed in only 5 years – and the retro-sealing of a 27 m long expansion joint, the 11th pilot project of Wolf Kabeltechnik, Stuttgart, Germany, was also carried out there in record-breaking time.

- **Wolf GmbH, Stuttgart**, manufacturer of a patented reusable expansion-joint sealing system, was given the opportunity of demonstrating the advantages of their system in the context of a pilot project in Austria.

In the pilot project, the swelling-material coated sealing cushions with a valve, manufactured with new technology, were installed for the very first time. The new technology now makes it possible to produce the sealing cushions in lengths of up to 23 m instead of the previous 10 m limit. The sealing of the 27-metre long expansion joint was sealed in only 45 minutes.

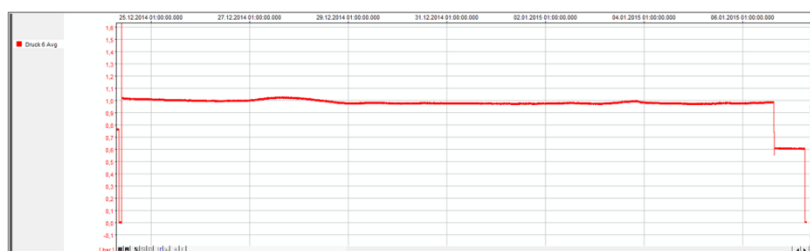
Advantages of Wolf GmbH sealing technology



1. Optimum permanent adaptation of the closed compressed-air system to the expansion-joint movement (for expansions joints with a parallel structure)
2. Can be subjected to load immediately after inflation
3. No interruption of trains during installation – bridges are sealed from below
4. The lightweight sealing cushions (7.5 kg/23 m) make installation easy and quick (≤ 10 min/m), using a sealing-cushion unwinder from Ziehl, Vienna
5. Very few components required for installation
6. Installation is practically independent of the state of the joint and can also be carried out in damp or wet weather conditions
7. No mess in the work area due to adhesives etc.
8. No special safety precautions necessary when using or storing the work materials
9. Useful in the course of inspections or renovation work e.g. for leakages around joint offsets, cross-shaped joints or joints at right angles
10. Easy, quick removal. No unwanted adhesion of the sealing element to the surrounding construction, with a consequent reduction of labour and material costs.

Tested technology!

Similar sealing cushions (valve) have been successfully employed for years for cable sealing. Their suitability for expansion joints is regularly tested in the Fibre Optics CT GmbH testing laboratory. The tests are carried out under real-life conditions e.g. with overpressure fluctuation due to expansion joint movement.



Test setup:
Expansion joint width 80 mm

Temperature:
18°C to 26°C (storage near a night storage heater)

Sample length: 5000 mm

Specified overpressure:
0.5 ± 0.1 bar 20°C/ 7 days

Actual overpressure:
1.0 bar 20°C/ 13 days

Result:

Test passed

- **Dr. Heinz Zoebl, engineer, Ein- und Ausfuhrhandelsges.m.b.H. (Export & Import), Vienna**
Sales partner of Wolf GmbH, Stuttgart, in Vienna. Mr. Salzer (from the Zoebl company) organised the "Sealing of expansion joints" project from December 2014, in cooperation with ARGE HBF Vienna BL01. Thanks to the active collaboration of those who took part in planning the project and giving expert assistance in its execution, it was possible to fit the joint tape in only 45 minutes.



- **Fibre Optics CT GmbH, Stuttgart**

held an informative session prior to the installation, on the universal applications of the reusable sealing systems (valve) from Wolf Kabeltechnik GmbH, Stuttgart. The sealing technology was illustrated by means of numerous samples and practical tests. (The relevant scripts, E-FO11.1 Applications for reusable sealing elements, and E-FO11.2 Test and measurement results are available on request.)

There were so many participants from ÖBB Infrastruktur AG, ARGE HBF Wien BL01 (Strabag, Porr, Pittel and Brausewetter), ARGE ÖBA Wien Hauptbahnhof (Metz + Partner, FCP, Tecton Consult), ITB Gary, OAT, etc., that there was not always sufficient space in the site office was not sufficient.



Clarification of technical details

During the training session, the participants' questions about sealing technology were gone into in detail. The answers included information on the range of sealing applications and which wet duty classes the sealing cushions (valve) types L and S can be used for.

For example: Type L fulfils the wet duty class 1 (pressing water) requirements for joint widths and/or uneven places varying between 2 and 5 cm. In the case of joint-width unevenness and/or joint movement up to 9 cm, it only fulfils the requirements for wet duty class 2 (non-accumulating water seepage).

Extract from the information session, taken from FO11.1 Applications for reusable sealing elements

	Standard			
Sealing cushion type	L		S	
Sealing cushion width / depth [cm]	13,5		28,5	
Actual joint width [cm]	Sealing area / sealing depth [cm]			
		Class		Class
2,0 ± 0,5	10	1.1	26	1.1
3,0 ± 0,5	9		24	
4,0 ± 0,5	7		23	
5,0 ± 0,5	6		21	
6,0 ± 0,5	4	1.2	20	1.2
7,0 ± 0,5	3		18	
8,0 ± 0,5	1		17	
9,0 ± 0,5	0	2.1	14	2.1
10,0 ± 0,5	/		13	
11,0 ± 0,5			11	
12,0 ± 0,5			9	
13,0 ± 0,5			7	
14,0 ± 0,5		6	1.2	
15,0 ± 0,5		4		
16,0 ± 0,5		3		
17,0 ± 0,5		1	2.1	
18,0 ± 0,5		0		
Ground humidity	≥8.6		18.1	

Water duty classes:

- 1.1 **Pressing water:** Ground water, strata water, flood water or any other water that exerts hydrostatic pressure, (even if only temporarily)
- 1.2 **Non-pressing water:** Water in dripping liquid form that exerts little or no hydrostatic pressure (water column 100 mm); temporary build-ups of water seepage that may collect on fairly impermeable surfaces if there is no drainage. The floor of the building lies at least 30 cm above the design-basis water level.
- 2.1 **Non-accumulating water seepage:** Water that can drain away without accumulating, if the ground is extremely permeable ($k_f > 10^{-4}$ m/s); water that is permanently removed from an impermeable surface by a permanently functioning draining system in accordance with DIN 4095.

Ground humidity: Water that is capillary-bound in the ground

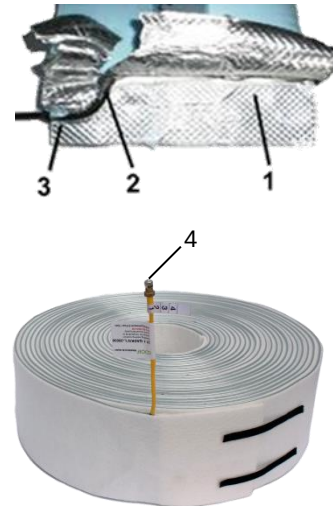
Participants' questions:

1. How is it possible to give such a long service life guarantee for the sealing system (valve), whereas car and bike tyres lose air over time and other well-known sealing systems are no longer tight after 2-3 years?

Answer:

The reason for the long service life of the seal lies in the design and in the materials used. The patented 5-layered sealing cushion design from Fibre Optics CT GmbH, consisting of an aluminium laminate (1) with a diffusion barrier, is heat-seal welded.

Furthermore, the PE-coated valve extension at the edge of the wide side (3) of the sealing cushion is also fitted to the cushion (2) by a heat-seal welding process. After inflation, a valve end-cap (4) is screwed on by hand.



The seal between the sealing cushion and the duct or cables etc. is effected by means of the 4.2 mm thick swelling sealing tape (480 g/m²) that coats the cushion on both sides. For sealing cushion type L (width 135 mm), a swelling sealing tape of width ≥ 135 mm is used. There is no unwanted adhesion of the sealing tape to the surrounding construction, so that easy removal of the sealing cushion is ensured.

Test result: Total seal rate of the sealing cushion (with valve end cap)

Sample No. 1: 5.5×10^{-8} mbarl/sec = 1,5 mbarl/year

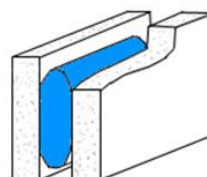
Sample No. 2: $6,2 \times 10^{-8}$ mbarl/sec = 2,7 mbarl/ year

..../ Participants' questions:

2. What factors affect the durability of the sealing/valve?

Answer:

Durability is influenced by the width of the expansion joint, the length of the sealing cushion and optimum compressibility.



Purely theoretically, the seal created by our sealing cushions would last forever, thanks to their design and the materials from which they are made.

Length l of sealing cushion QADK/V L-	[cm]	100	200	500	1000	2000
Width b of sealing cushion in the joint	[cm]	3	3	3	3	3
Height h of sealing cushion in the joint	[cm]	10	10	10	10	10
Volume (V) (area of diffusion) $V = l \times b \times h$	[cm ³]	3 000	6 000	15 000	30 000	60 000
Quantity of compressed air in the QADK/V [mbarl]						
...for filling quantity p = 0.5 bar (on installation)	[mbarl]	1500	3000	7500	15000	30 000
...for diffusion up to p = 0.2 bar (still tight!!)	[mbarl]	600	1200	3000	6000	12 000
...Δ diffusion of the joint seal	[mbarl]	900	1800	4500	9000	18 000
Theoretical durability calculated on the basis of a yearly diffusion of 2.7 mbarl/year	[years]	333	666	1666	3333	6666
Verified duration of service lifetime	[years]	>20				

In practice, however, changes in the surrounding environment, such as movement and the resulting changes in volume, affect durability.

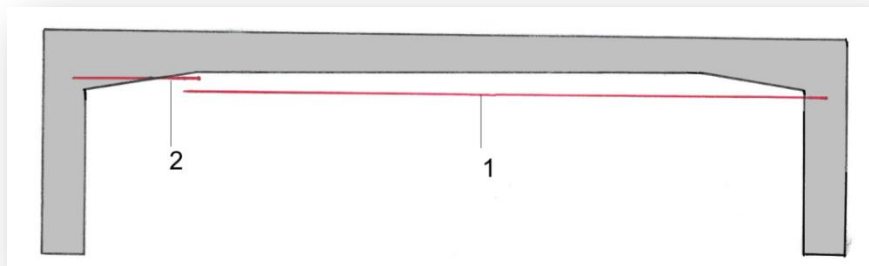
Lab tests have verified a service lifetime of over 20 years. If environmental conditions are extreme and there is a noticeable drop in the pressure of the shortest sealing cushion, it cushion can be re-inflated in the course of maintenance work.

..../ Participants' questions:

3. How will the expansion joint retrosealing of the main station bridge in Vienna be carried out?

Answer: The procedure is as follows:

- Removal of the previous sealing material in the expansion joint as far as possible. The expansion joint tapes must not be damaged in the process.
- Insert the sealing cushions No. 1 length 23 m and No. 2 length 4 m into the bridge support, ends first. Lay the valve ends of the cushions in the joint with an overlap of about 25 to 50 cm. Inflate the sealing cushions to installation pressure as follows:
Sealing cushion No. 1: approx. 0.5 bar overpressure
Sealing cushion No. 2: approx. 0.5 bar overpressure



Installation planning of the construction management team, ARGE HBF, Wien

Thanks to prior planning, it was possible to seal the 27 m long expansion joint in a record time of only 45 minutes.



Photo left: All previous sealing material was removed from the expansion joint up to a depth of 80 cm

Photo right: Mobile working platform



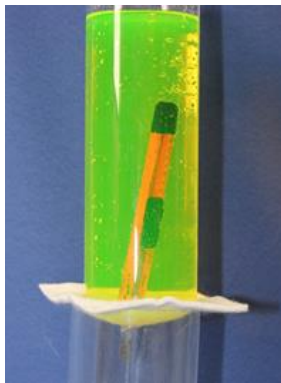
Make up your own mind!

In the course of our information session in Vienna on 20th and 21st January 2015, our materials were tested by the participants. We would be glad to send you samples you can test for yourself.



Testing carried out by several participants on the swelling-material coating of the sealing system for cables, ducts, gaps and expansion joints.

Test of water penetration, including on damaged swelling material



- A piece of swelling sealing tape (480 g/m²) 100 x 100 mm was laid between two tubes
- **An incision was made in the swelling material with a cutter**
- The top tube was filled with fluorescent water to test the tightness of the swelling material
- **Test result: passed**
Water penetration $\leq$ 10 ml

Test of mechanical resistance (notch resistance)



- A piece of swelling-material coated sealing cushion laminate was laid on a slab with stones and subjected to load on both sides alternately.
Slab 1: Stone layer ~ 10-20 mm/swelling material
Platte 2: Basalt grit size 5 - 8 mm/cushion laminate
Weight of the participant $\leq$ 110 kg
- **Test result: passed**
The sealing cushion laminate was not damaged by the load

Demonstration model

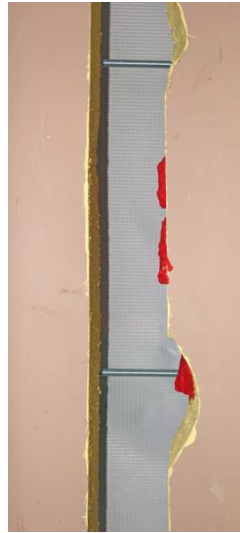
Before the information session started, the participants were able to examine the three expansion joint functional models and discuss their breadth of applications.



Model 1
Joint unevenness
2 to 8 cm over
a length of
~ 40 cm



Model 2
Joint width 6 cm,
vertical shear



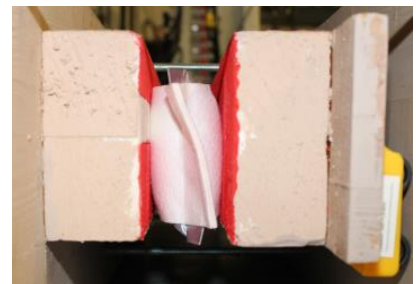
Model 3
Joint width 12 cm, uneven places, concrete chipped with/out residue

Solutions:

- a.) 2 sealing cushions, type L b.) 1 sealing cushion, type S
- c.) Fill chips with repair mortar. Uneven sections < 40 cm



The position of the sealing cushion in functional model 2 (vertical shear) attracted particular attention during repeated tests of "3 cm unevenness in a joint surface" and a lot of photos were taken of it.



Installation procedure and briefing

Start at 08:00 on 21st January 2015, at a temperature of ~ 5°C

Start: 08:00

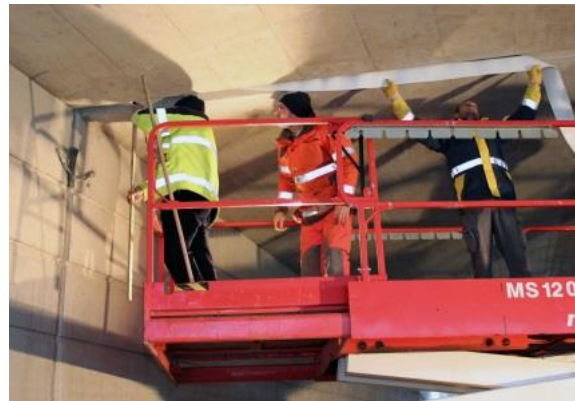
- Preparation for installation
- Short briefing on installation procedure.
The cushion was positioned ~ 80 cm in the joint and in the bridge support, and fixed to the joint approx. every 2 m with PE round cord.

Approx. 08:10

- Pull the end of the 23 m long-QADK/V L 23 sealing cushion from the installation reel and lay it in the joint.



- With the aid of a stick etc., push the sealing cushion about 80 cm upwards

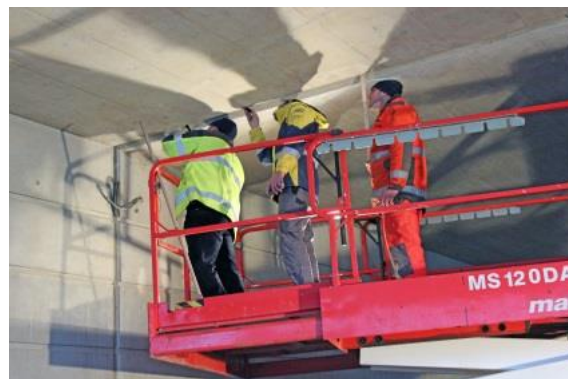


- Insert the sealing cushion into the bridge support

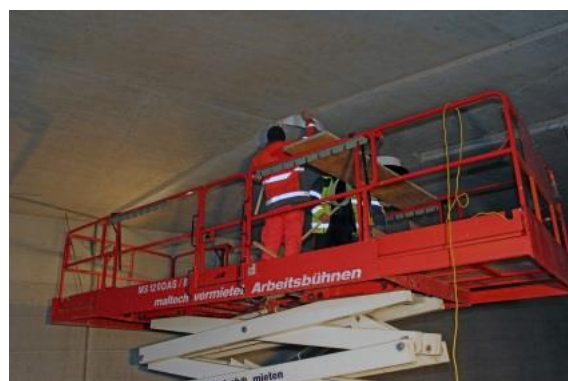


.../ Installation of the expansion joint sealing

- Checking the depth of the sealing cushion and attaching it with PE-round cord.



- Approx. 08:20
After 4 m of the sealing cushion is installed, the joint depth goes from 80 cm to about 20 cm



- Approx. 08:30
23 m sealing cushion (weight ~ 7.5 kg) installed!
- Lay the second sealing cushion with a length of 4 m in the bridge support, in such a way that the valve ends of both cushions overlap in the joint by about 50 cm



- Inflate the sealing cushions, first the long one, then the short one.
- 08:45
End of the installation.
- At the end, to protect the sealing cushion against vandalism, a rope Ø 8 - 10 mm is fixed at 1 m from the cushion ends and then every 4 m.



The urgent need for sealing expansion joints

Leaking expansion joints in bridges are problematic because they lead to

- the formation of icicles or black ice in winter, with the risk of harm to people and damage to property
- chemical changes that can result in the concrete covering cracking. Moreover, the concrete loses its alkalinity and consequently its protective function.



Formation of icicles
on the bridge deck overhead



The bridge deck has cracked



NEW! A way approach to prevent the penetration of water seepage:



Our latest approach to a solution:

13.3 QV-PER swelling material-PE round cord

6 diameters, lengths up to 30 m

Applying PE round cord coated in swelling material (480 g/m²) above the joint could reduce the amount of water seeping through.

Supplier

Your local sales partner

National sales

WOLF GmbH

Zazenhäuser Str. 52, 70437 Stuttgart, Germany

Tel. ++49 (0) 711 87 39 41

Fax ++49 (0) 711 87 12 30

Email: service@wolf-systems.com

Internet: www.wolf-systems.com

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