

IKT Compare: Can Short Liners Repair House Connections?



How do short liners perform? IKT figured it out in its latest IKT Compare project.

Short liners are often the first choice for **repairing local damage** in house connections. But, can they deal with **seriously damaged pipes**? The results of the new **IKT-Compare project "Short Liner for House Connections"** are now available.

IKT institute has found in its most recent IKT-Compare project that in principle short liners (also referred to as patch or point repairs) can make **good quality repairs** to house connection pipes, even when the pipe is **severely damaged**. Eight short liner systems were tested and achieved scores ranging from **"VERY GOOD"** to **"SATISFACTORY"**. The evaluation did find significant **differences in performance** between the systems that were examined.

Twinbond Liner was the best performer with a score of **VERY GOOD (1.2)**. Second place went to **epros DrainPacker** (Trelleborg) also graded **VERY GOOD (1.4)**. Bodenbender Point-Liner-System (1.7), Berolina Repair System (2.5), Cosmic TopHat system (2.5) and MC Konudur LM-Liner (2.5) each received a **GOOD** grade. Alocit short liner (2.7) and I.S.T. Spot Repair System (2.9) were graded **SATISFACTORY**.

The project has been undertaken in co-operation with **twelve sewer network operators** which wanted to understand the **strengths and weaknesses** of this widely used technology. It has been **funded** by the North Rhine-Westphalian **Ministry of the Environment** and the **network operators**.

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Tough testing of short liners



Deliberate defects: IKT has installed eight test sections with a total of 64 cases of damages in its large test pit.

A rehabilitation using a short liner should be able to restore the **structural stability** of a pipe, secure its **hydraulic performance** and **seal a damaged area**. For this reason, the IKT Compare team and the network operators involved placed particular emphasis during testing on the **water tightness**, **operational reliability** and **structural stability** of the rehabilitation. The particular focus was **resilience external water pressure**.

Test set-up damage scenarios

For this project IKT built eight identical **1:1 scale rigs**, in its large-scale test pit (15m by 6m by 6m), into which

length of sewer to which were attached one **house connection pipe** on the same level as the sewer pipe and two house connection pipes from a higher level. The house connection pipes were prepared with **defined areas of damage**, including milled patterns of **cracks**, the removal of some or all of the **joint seals** and **broken sections**. A total of **64 damage patterns** were produced – eight in each of the eight test rig setups.



Two up, one down: the test set-up.

These **patterns of damage** were arranged as follows:

- **Test Setup I** (the lower house connection pipe, to which a 2m head of external groundwater was subsequently applied): cracks, a broken joint, a radially displaced joint and a joint displaced at an angle
- **Test Setup II** (the two higher house connection pipes, to which a 1m head of groundwater pressure was subsequently applied): a defective change of pipe material, defective change of pipe diameter and material from cast iron DN 150 to PVC DN 125, a defective change of pipe diameter and material from clay pipe DN 150 to PVC DN 125, and a break in the joint of a 45 degree bend

Following **installation** of the eight different short liner systems into separate test rigs, an **extensive testing programme** began, starting with initial **visual inspection** and **leak tests**. This was followed by short-term and long-term

external water pressure tests, high-pressure jetting at different pressures and using different types of nozzle, simulated **backing-up of water, changing groundwater levels,** and **cleaning** with rodding devices.

Frequent visual inspections and leak tests were undertaken as the programme progressed. Finally, when the test rigs were exhumed from the test-pit, the **cross-section reduction** was measured and the **adhesive tensile strength** and **ring stiffness** of the installed liners were assessed.

Grading of performance



In-situ tests: lab tests were validated through in-situ observation of the same systems being installed at actual construction sites.

In addition to physical tests, the **QA/QC procedures** were examined. The laboratory results were validated through **in-situ observation** of the same systems being installed at actual construction sites. The **final scores** in this IKT Compare test are based on these three evaluations. The **range of grades** applied is from VERY GOOD (score of 1.0) to INSUFFICIENT (score of 6.0).

Weighting of scores: Water Tightness counts for the most

To derive the final scores the results of the **1:1 scale testing system tests** were given a **85% weighting** and the results of the **QA/QC** evaluation **15%**. For the 1:1 scale test score, the three test criteria were weighted as follows: “water tightness” (60 percent), “operational reliability” (20 percent) and “structural stability” (20 percent).



Ongoing observation. IKT testers regularly check the installed short liners for leaks.

The assessment of QA/QC comprised **five criteria**: the installation manual, the available training courses, the system’s DIBt (German Government’s approval body) approval, external production monitoring, and a comparison between the installations observed in the laboratory and in the field. The results for each criteria were given a 20% weighting in the final QA/QC score.

In addition to the test criteria used to derive the comparative scores of the systems, **supplementary information** was collected and presented that would be of interest to the end user. These include results from **internal pressure tests** undertaken after the rigs were excavated and the **adhesive tensile strengths** of the liner bonding to the host pipe. The

initial inspection, substrate preparation and cleaning, were documented. Also presented are: the number of on-site working days, the number of installation staff, the time required for preparatory work and installation, and the costs.

The Steering Committee – twelve cities

Members of the Steering Committee for the IKT Compare project “Short Liner for House Connections” are the following German cities: Billerbeck, Burscheid, Dortmund, Duisburg, Düsseldorf, Gelsenkirchen, Göttingen, Hagen, Herne, Rheda-Wiedenbrück, Schwerte, and Arnhem from the Netherlands.

What the systems can do



Repair objective: to seal damaged house connections.

In this IKT Compare project, the system suppliers demonstrated that **serious damage** to house connections can be **reliably sealed** using short liners, including breaks, cracks, misalignments and deflections. In particular, the **Twinbond** and **Trelleborg** systems proved to be the **most reliable** under permanent groundwater load, jetting, simulated backflow events and changing groundwater levels. For this they were deservedly awarded the **score of 1.0** for water tightness.

Special Challenges

In principle, it was also shown to be **possible to seal** the changes in nominal diameter and pipe material in **Test Setup II**. However, four of the systems came up against their **performance limits** here, showing weak points, which led to **infiltration**. In one case, gushing water was visible immediately after installation. Therefore, changes in diameter and material require **special attention** during installation.

Results of Test Setup I

All eight short liners showed **very good to satisfactory** results for the four damage patterns in **Test Setup I**: cracks, broken joint, radially displaced joint and joint displaced at an angle. **No infiltration** was observed during the whole test period. However, about half of the systems showed **visual abnormalities** in the form of moisture and/or discoloration at some locations, but without the formation of droplets.

Structural stability assured



Adhesion test

The structural stability testing of the short liners showed that they basically have **reliable adhesive and load-bearing performance**. For products with full-surface bonding of the liner to the host pipe, hardly any abnormalities were observed. i.e. no crack formation. no excessive deformation.

no stability failure nor large-surface loosening of the adhesive bond. Five systems showed **partial loosening** of the adhesive bond at points of changing diameter or pipe material, albeit without any consequences.

The Cosmic system is not intended to bond over the full-surface, only at the start and end of the liner. However, the supplier was able to submit a **static proof** which confirmed the structural stability of the short liner observed in the test.

Operational activities



High-pressure jetting did not affect the short liners.

The test scenarios **simulating sewer operation**, such as high-pressure jetting, water backing-up in the pipe, and changing groundwater levels, had **no significant effects** on system performances.

Good QA/QC

There were **no issues** with quality assurance: seven out of the eight systems fulfil all the criteria for quality assurance and receive a grade of 1.0. The Cosmic system does not have a DIBt approval and so gets a grade of 2.0.

Conclusion

In conclusion the IKT Compare project "Short Liners for House

even severely damaged sewer pipes. However, changes in diameter and material require special attention during installation as they might cause serious problems. It is important to select the **right system for the task**, to understand the limitations of individual systems, and apply the necessary QA/QC before, during, and after installation.

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Contact

IKT - Institute for Underground Infrastructure, Germany

Serdar Ulutaş, MBA, Dipl.-Ing. (FH)

phone: +49 209 17806-32

email: ulutas@ikt.institute

IKT Compare: How good are products really?



Defined damages: preparing the test rigs

The objective of IKT Compare projects is to provide network operators with **reliable, neutral, and independent information** on the strengths and weaknesses of products and methods in sewer technology. IKT Compare projects are always undertaken **in collaboration with network operators**. Their representatives form a **steering committee** which takes all important decisions on how to test the products.

such as traffic and ground loads, groundwater pressure and high-pressure jetting.

Each IKT Compare project is accompanied by a steering committee set up of network operators. The committee meets regularly and takes decisions on:

- products to be tested
- scope of the test programme
- test criteria
- test set-up
- final grading and assessment of the test results

The actual testing and documentation of the results are carried out by IKT, as a neutral and independent institute. As a result, network operators are provided with **independent, practice-related, and technically well-founded information** on the strengths and weaknesses of products, their applications and limits.