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**.

Download table of results
Download product test report (German)

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 suppliers installed their short liners. Each rig comprised a

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 **preparatory measures** undertaken by the installer, such as

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 Connections” has demonstrated that **short liners can renovate**

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.

Download table of results
Download product test report (German)

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.
At the core are **tests under realistic service life conditions**

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.