



TEST REPORT: PA 0446

Gelsenkirchen, 10 December 2003

Client: Epros Umweltschutztechnik GmbH
Dr.-Alfred-Herrhausen-Allee 20d
D-47228 Duisburg

Test Order No.: PA 0446

Test Order Name: High-pressure cleaning strength of the
epros patch liner

Description: Jetter test after the Hamburg model

Order Dated: 12 May 2003

This report covers 10 pages.

The test results refer to no objects other than the tested objects. It is not permitted to reproduce the test report in part unless with the written approval of the Institute for Underground Infrastructure – IKT.

Dipl.-Ing. D. Homann
(Head of Testing Institute)

Samples

| Sample Reference | | | Date received | Sample made by | Description of specimens |
|------------------|--|---|---------------|----------------|---|
| Srl. No. | IKT (Tester) | Client | | | |
| 1 | H 1263-1.1 H 1263-1.2 H 1263-2.1 H 1263-2.2 | epros patch liner - resin system: epros silicate resin - support material: CRF+ glass approx. 1050 gsm | 20 Aug 03 | Client | Test line made of DN 300 vitrified clay pipes with epros patch liners being installed inside the pipes at 25 cm from their ends. The patch liners, 4 in total, are composed of a CRF+ glass matting (3-layered) and the epros silicate resin. |

Samples

| Quantity | Testing mode | Test procedure | Specimen no. | Preparation of specimens |
|----------|--|-------------------------|--|--|
| 1 | Testing of high-pressure cleaning resistance | After the Hamburg model | H 1263-1.1 H 1263-1.2 H 1263-2.1 H 1263-2.2 | 4 patch liners in total were installed by epros GmbH in DN 300 vitrified clay pipes. |

1. Background

By order dated 12 May 2003, epros Umweltschutztechnik GmbH commissioned the Institute for Underground Infrastructure – IKT – in Gelsenkirchen to test the resistance of epros patch liners to high-pressure cleaning.

According to the data provided by the manufacturer, the epros patch liner is based on an epros silicate resin in conjunction with a bidirectional CRF+ glass at a basis weight of approximately 1050 gsm (g/m²). All of the DN 300 epros patch liners tested had three glass layers for reinforcement and a wall thickness of approximately 5 mm.

The long-term resistance of the epros patch liner to high-pressure cleaning runs is determined on the basis of the jetter test following the Hamburg model. The objective is to prove that the epros patch liner withstands without visual damage the loads from today's usual sewer cleaning methods.

2. Test Method

The long-term resistance of patch liners to high-pressure cleaning is determined according to the Hamburg model. The Hamburg Model Jetter Test was developed by the Municipal Sewage Department of the city of Hamburg in 1988 on the basis of realistic ambient conditions from daily cleaning practice. So when carrying out the test, it is very important to use common standard cleaning vehicles, jetter hoses and nozzles as applied in everyday practice. All operating materials used for the test are the current state of the art.

In accordance with the Hamburg model, 30 jetter runs were carried out to simulate a service of life of 30 years with annual cleaning. A cleaning cycle is made up of the introduction and removal of the jetter. The test is performed without adding test debris. During the course of the test, there shall be no damage impairing the functional safety of the patch liner.

3. Test procedure

On 23 August 2003, the test line was set up by staff of the IKT Institute for Underground Infrastructure using three DN 300 vitrified clay pipes, which contained installed epros patch liners made of epros silicate resin and CRF+ glass (3 layers). The patch liners were installed in the clay pipes beforehand by the company epros Umweltschutztechnik GmbH in the IKT institute.

First of all, 30 cleaning cycles are carried out in accordance with the Hamburg model and each cycle covers both a forward motion and a backward motion through the entire pipe run. The test is performed without adding any test debris.

Afterwards, the jetter is placed and stopped at the inner surfaces of the patch liners as well as at the patch-liner-to-clay-pipe transition zone to apply 3-minute punctual permanent loads to said points.

Prior to testing, the pressure and the mass flow were measured via a pressure sensor and a magnetic inductive flow metering system and monitored during the test. The pressure at the nozzle was 80 bars for a flow rate of approximately 270 litres per minute, as recommended by ATV-M 143, Part 7. The following outlines the major testing conditions:

Test pressure: 80 bar at nozzle

Diameter of nozzle inserts: 2.8 mm

Number of nozzle inserts: 8

Jet angle: 30°

Flow rate: approx. 270 l/m

Test rate: approx. 0.1 to 0.3 m/s

The patch liners underwent visual examinations for irregularities and damage prior to testing, after 30 cleaning cycles, and after stationary loads.

4. Test results

Prior to testing, the CRF+ glass of the epros patch liners showed several zones which were only slightly covered with resin. No visually detectable irregularities were found in the remaining regions.

After the 30 test cycles, the epros patch liners based on silicate resin showed no visually detectable damage. The slightly resin-covered regions already found before the test showed no changes from jetter loads.

Also, the 3-minute stationary permanent loads do not cause any damage to epros patch liners, neither in the liner wall region nor in the liner-to-pipe transitional zones. There were just several cases of excess resin removal (refer to picture 9).

The photo documentation in Chapter 7 show epros patch liners after 30 jetter cycles or after the stationary test loads, respectively.

5. Photo Documentation For Test Set-Up and Test Performance



Picture 1: *Set-up for the Hamburg Model Jetter Test*



Picture 2: *Punctual stationary load by jetter stop
(for 3 minutes)*

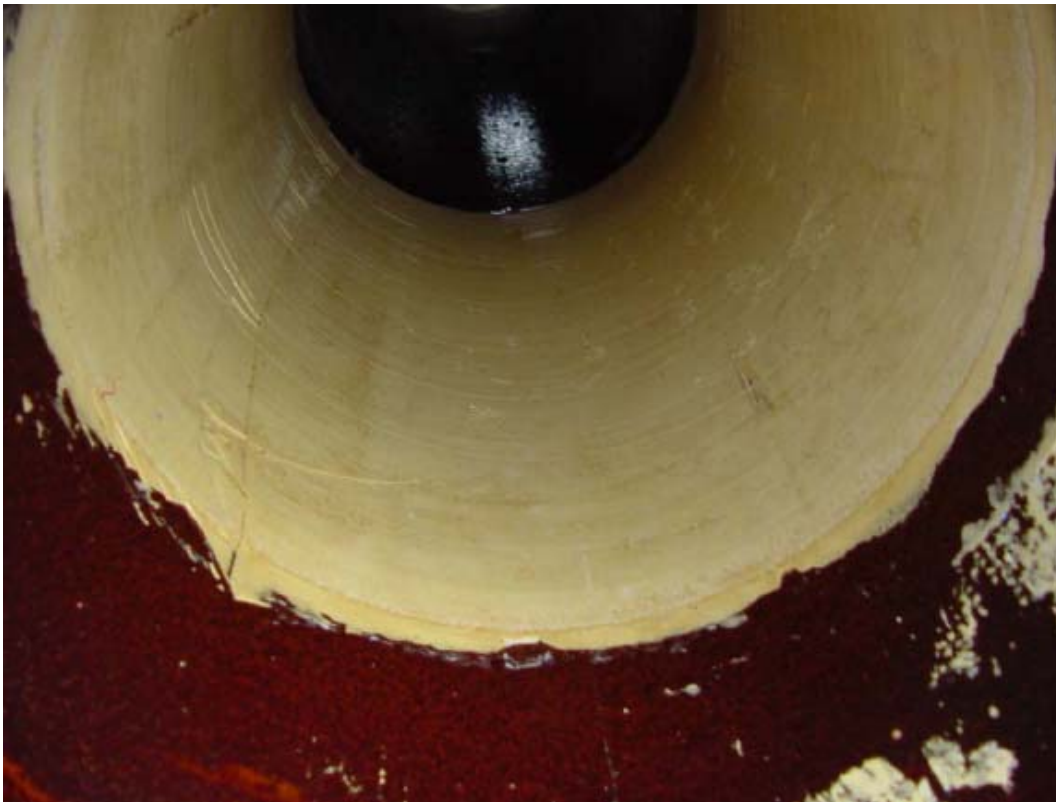


Picture 3: Pressure sensor for checking the water pressure at the nozzle



Picture 4: Magnetic inductive flow meter for monitoring the flow rate during testing

6. Photo Documentation For epros Patch Liner Prior To Testing



Picture 5: epros patch liner H1263-1.2 prior to jetter test



Picture 6: epros patch liner H1263-1.1 prior to jetter test

7. Photo Documentation For epros Patch Liner After Testing



Picture 7: epros patch liner H1263-2.2 after completion of 30 jetter cycles at 80 bar



Picture 8: epros patch liner H1263-2.1 after completion of 30 jetter cycles at 80 bar



Picture 9: epros patch liner H1263-1.2 after completion of 30 jetter cycles at 80 bar and after stationary load (3 minutes)



Picture 10: epros patch liner H1263-1.1 after completion of 30 jetter cycles at 80 bar and after stationary load (3 minutes)