British Precast
Drainage Association

Concrete Pipeline Systems

Testing of pipe materials' resistance to high-pressure water jetting (Report 1)

The British Precast Drainage Association (BPDA) conducted a series of jetting-resistance tests with a stationary water jet at around 4,000 psi (280 BAR) on a number of concrete and plastic drainage pipe products. The tests were originally carried out in accordance with a new stationary jetting test which will be introduced to concrete pipe standard BS 5911. However, many elements of that test methodology are identical to those employed in jetting tests in accordance with EN 295-3 (clay pipes) and WIS 4-35-01 (plastic pipes ≤ DN300). While all concrete pipe specimen passed the test, all plastic pipes specimen failed. Most plastic pipe units experienced piercing within 3 to 5 seconds (test duration is 3 minutes) except for two specimens (Samples 3 and 8) which failed after a longer period despite being advertised as resistant to water jetting pressure exceeding 4,000 psi.

First issued: March 2021
V.2: August 2021

1. Introduction

Resistance to cleaning and water jetting pressure is included in most pipeline product standards. The main standard for components used in drains and sewers, EN 476, stresses that product standards need to provide justifying statements in regard to sewerage components resistance to cleaning operations. It is therefore vital for all types of pipeline standards to incorporate tests with sufficient information on the likely jetting resistance of different pipeline materials. The British concrete pipe standard, BS 5911, is being revised to incorporate a new jetting test for concrete pipeline products. A testing rig was developed to help member companies perform the new tests. In November 2019, BPDA conducted a series of jetting resistance tests with a stationary water jet at 4,000 psi. Two specimens of concrete pipe (Samples 1 & 2) were tested, followed by six samples for plastic pipes with different levels of jetting resistance.

This report is a re-production of the original test report, which remains confidential. Names of any companies, locations or product brands were removed for privacy purposes and to serve the main objective of this report, which is educational.

2. Test Methodology

The test procedure aligned with most stationary nozzle test requirements at BS 5911, EN 295-3 and WIS 4-35-01.However, the draft BS 5911-1: 2020 guidance was the main method followed:

Water source	Drinking quality standard water
Pressure at nozzle	280 Bar (approx. 4,000 Psi)
Angle of nozzle to test surface	30°C ±1
Vertical distance from nozzle to specimen surface	5mm
Test procedure	Nozzle is kept in stationary position for a duration of 3 minutes

Table 1. Test specifications.

3. Test procedure

The test was carried out on 27th November 2019 at the testing facility of a BPDA member company using the BPDA test rig. The test assembly was inspected prior to testing and no imperfections were detected. All specimens were inspected prior to testing for any defects and none were detected.

4. Results

Results for each of the eight samples are described below:

4.1 Sample 1 (DN 450 concrete pipe)

A BPDA member company DN 450 concrete pipe with wall thickness >60mm was tested. After 3 minutes of testing, surface damage was detected at all jetting sites, varying in depth from 3.3mm to 6.8mm. All sites would still pass gauging for maximum surface void size as specified in Draft BS 5911-1:2020.

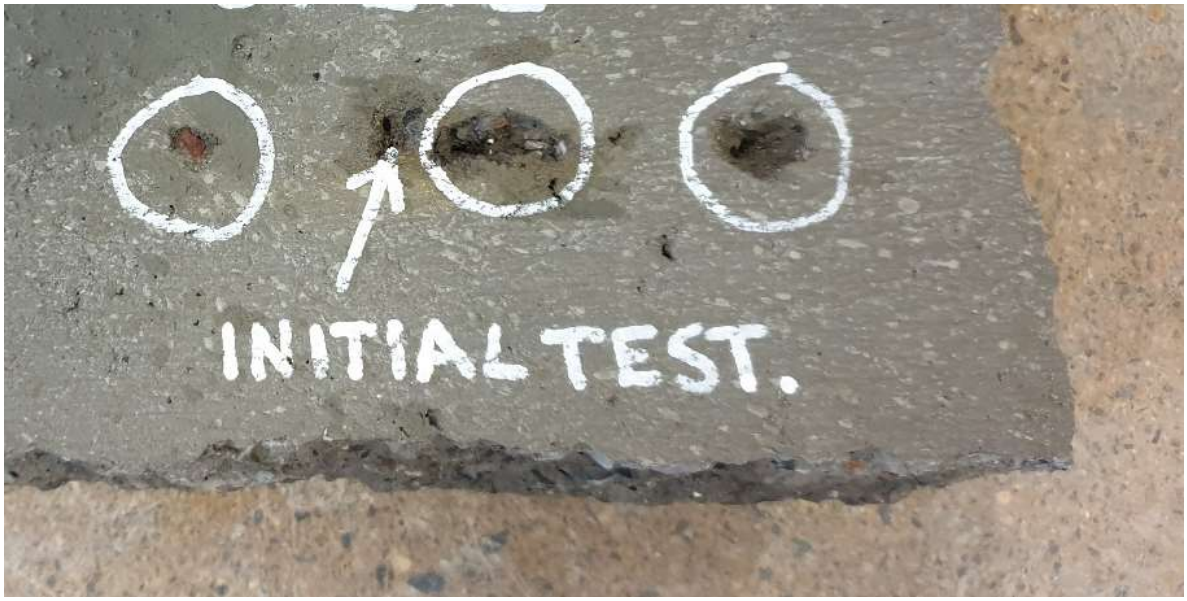


Figure 1. Sample 1 after testing.

4.2 Sample 2 (DN 450 concrete pipe repaired with mortar)

A BPDA member company DN 450 concrete pipe with a repaired 10mm deep x 10mm wide channel[1] was tested. No visible damage was caused by the water jet at any of the jetting sites tested.

Figure 2. Sample 2 after testing.

4.3 Sample 3 (DN150 uPVC multi-wall type pipe)

One uPVC pipe type DN150 was tested. The jetting water pierced the surface of all three sites tested after only 5 to 10 seconds.

The jetting water then dispersed through the core material within the wall and raised blisters on the inner surface, allowing the jetting water to escape internally. But water did not pierce

[1] Repair material used: Sika-Dur 31 Rapid, two-part repair mortar.

the full wall depth of the pipe after three minutes of test duration. Blister size approximately 50mm in diameter.

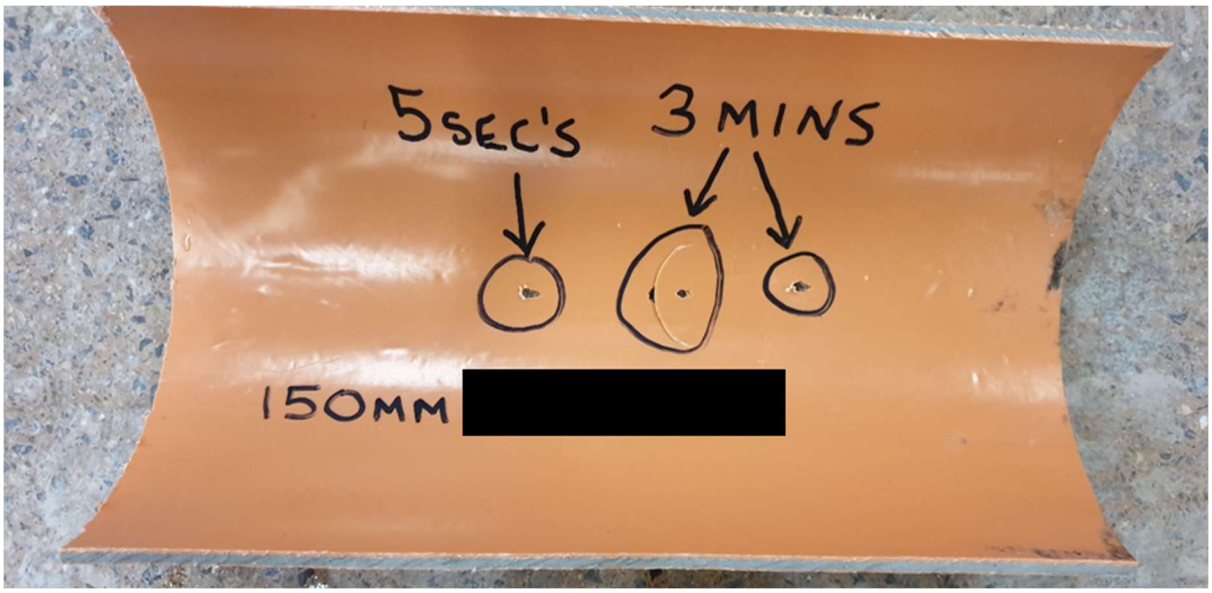
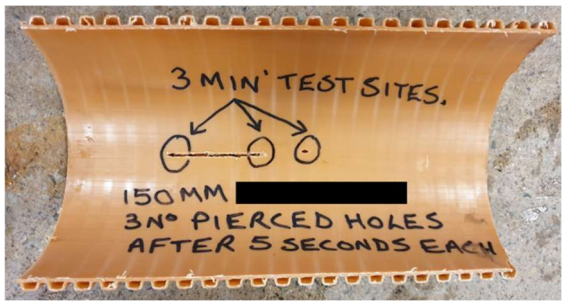


Figure 3. Sample 3 after testing.

4.4 Sample 4 (double-wall type plastic pipe)

One Double-wall type DN150 plastic pipe was tested. All three jetting test sites pierced the inner surface after 5 seconds and quickly continued to pierce through the full wall depth.



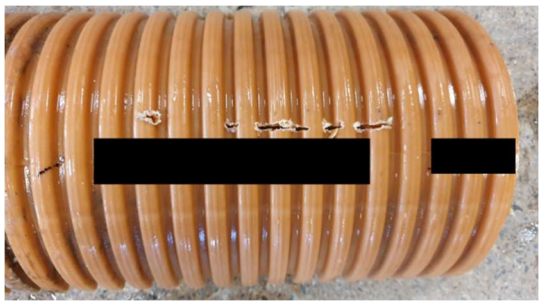


Figure 4. Sample 4 after testing.

4.5 Sample 5 (double-wall type uPVC pipe)

One double-wall type DN225 pipe was tested. All three jetting sites tested pierced the full wall depth of the product after approximately 5 seconds.

Figure 5. Sample 5 after testing.

4.6 Sample 6 (PVC DN225 pipe)

PVC pipe with smooth external & internal surface was tested. All three jetting sites tested pierced the inner surface after approximately 5 seconds and two out of the three sites pieced the full wall depth of the product a few seconds after.

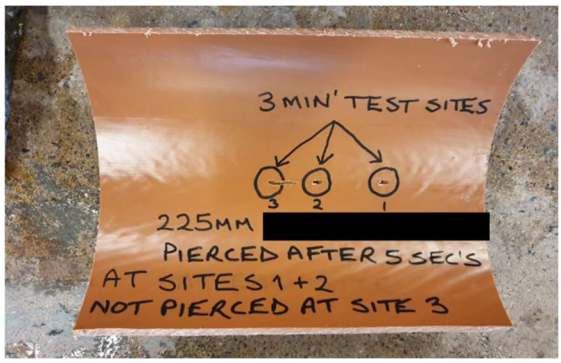


Figure 6. Sample 6 after testing.

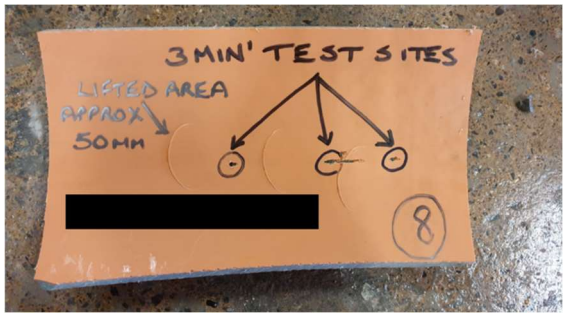
4.7 Sample 7 (uPVC DN150 pipe)

uPVC type DN150 plastic pipe was tested. All three sites tested pierced the inner surface after approximately three seconds and continued to pierce the full wall thickness after several more seconds under the test.

Figure 7. Sample 7 after testing.

4.8 Sample 8 (DN375 uPVC multi-wall type pipe)

uPVC pipe type DN375 was tested. All three jetting sites tested pierced the inner surface after several seconds. The water jet then dispersed into the inner recycled core material until after approximately one minute of testing. The inner surface material blistered adjacent to each test site, allowing the water jet to escape internally. The blister sizes were approximately 50mm in diameter. No damage was detected in the outer surface of pipe.



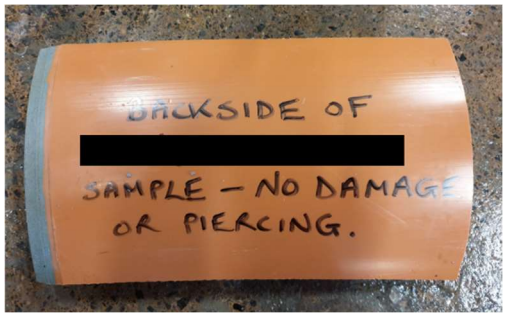


Figure 8. Sample 8 after testing.

5. Conclusions

While all concrete pipe specimens passed the 4,000 psi stationary nozzle jetting test. All plastic pipes tested started experiencing piercing damage within 3 seconds to ~1 minute and ultimately failed a few seconds after. The overall results are as expected as the Manual of Drain and Sewer Cleaning sets the maximum jetting pressure for concrete and plastic pipes at 5,000 psi and 2,600 psi respectively. However, the tests reveal two important findings that may require further investigation by research bodies and water authorities:

- Two of the plastic samples tested have been advertised as resistant to water jetting pressure exceeding 4,000 psi. In all tests conducted, it was not possible to prove this as the pipes' inner surface was penetrated and core material was breached, exposing potentially hazardous recycled material in the core. One pipe sample lasted for around 1 minute (suggesting resistance that might be very close to 4,000 psi). But the other failed within 5-10 seconds. If WIS 4-35-01 allowed for equivalent 4,000 psi (275-280 Bar) tests then this could have failed the test passing requirements.
- All other samples started experiencing irreversible inner surface layer piercing damage only 3-5 seconds after the start of testing. The pipes were fully penetrated a few seconds afterwards. This is a major concern as 3-5 seconds is a very short period for a blockage clearance team dealing with a blockage or fatberg to realise that the pipe is irreversibly damaged, making it very difficult to clear some blockages within such types of plastic pipe without causing damage that may require pipe replacement or rehabilitation after the blockage clearance operation.

For product information, please contact BPDA members

British Precast Drainage Association (BPDA)
The Old Rectory, Main Street, Glenfield, LE3 5DG
Tel: 0116 232 5170
email@precastdrainage.co.uk
www.precastdrainage.co.uk

Marshalls Civils & Drainage
Marshalls Civils & Drainage
Tel: 01179 814 500

F P McCann
Tel: 01530 240 000

Stanton Precast Concrete
Tel: 01159 441 448