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# WATER INDUSTRY SPECIFICATION

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UK Water Industry

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## SPECIFICATION FOR THERMOPLASTICS STRUCTURED WALL PIPES – SUPPLEMENTARY TEST REQUIREMENTS

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### FOREWORD

This specification supplements the *National Annex (informative) to BS EN 13476-1:2007 Additional Guidance for UK Users* with details on the performance testing requirements.

The original specification was prepared by the "Steering Group for Structured Wall Gravity Sewer and Drainage" under the direction of Water UK in consultation with the Water Industry, the British Plastics Federation Pipes Group and WRc plc.

It gives the testing requirements for structured wall pipes made from thermoplastics materials suitable for the construction of gravity sewers. These are currently defined as Poly(Vinyl Chloride) (PVC-U), Polypropylene (PP), and Polyethylene (PE).

The specification does not purport to include all the necessary provisions of a contract. Users of this specification are responsible for its correct application.

Reference to a British Standard, Water Industry Specification or any other specification applies equally to any equivalent specification.

Compliance with this specification does not itself confer immunity from legal obligations.

This specification calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

It has been assumed in the drafting of this specification that the execution of its provisions is

entrusted to appropriately qualified and experienced people.

Information contained in this specification is given in good faith. Neither the UK Water Industry Research Ltd., Water UK, WRc plc nor the British Plastics Federation can accept any responsibility for actions taken as a result.

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# 1. SCOPE

This Specification specifies the materials, performance and test requirements for thermoplastics structured wall pipe and joints having a smooth bore for gravity sewers in nominal sizes of 150 to 900.

It covers pipes jointed using separate moulded or formed couplers, formed integral sockets and factory fitted moulded couplers forming sockets which are an integral part of the supplied pipe.

# 2. DEFINITIONS

For the purposes of this standard, the definitions given in BS EN ISO 472, BS EN 476, and BS EN ISO 1043-1 apply. In addition the following definitions apply.

**2.1 Thermoplastics structured wall pipes:** products which have an optimised design with regard to material usage to achieve the relevant performance requirements.

**2.2 Nominal size DN:** a numerical designation of size of a component, which is a convenient round number approximately equal to the manufacturing dimension in millimetres. This can apply to the internal diameter (DN/ID) or external diameter (DN/OD).

**2.3 Intermediate layer**  
The layer sandwiched between solid skins produced by a multi-extrusion process.

# 3. PERFORMANCE TESTS

## 3.1 General Requirements

The requirements of this section shall be met before compliance with this specification can be claimed. If there is a change in design, in material and/or in the production method other than routine in-process adjustments and extensions to the product range it will be necessary to demonstrate that the requirements of this specification are still satisfied.

The type tests as listed in Table 1 shall be carried out on samples from each diameter in the manufacturer's product range unless specified otherwise in this specification

**Table 1 - Test requirements applicable for different construction materials**

Test	Clause	Material of Construction		
		PVC-U	PP	PE
Internal puncture	3.2	√	√	√
Water jetting	3.3	√	√	√
Longitudinal bending	3.4	√	√	√

## 3.2 Resistance to internal puncture

Note: This test is intended to assess the toughness/general robustness of the internal wall of the product.

The test shall be carried out on a 150 DN pipe (or the pipe within the product range with the minimum internal wall thickness).

When tested in accordance with Appendix A, the pipe shall be capable of withstanding without damage (as defined in Appendix A) a minimum impact energy equivalent to 250 g from a 1m drop height (2.45 Joules).

## 3.3 Resistance to water jetting (only required for diameters ≤ DN300)

When tested in accordance with Appendix B of this specification, the pipe shall withstand a jetting pressure of 180 bar without damage as defined below (Note A).

Note A: Damage is defined as penetration through:

- the wall of the pipe for solid wall pipe and multi layer pipe where all the layers are of solid construction;
- the inside wall for twin wall pipe. Penetration through the first inside layer of multi layer pipe where the intermediate layer is of foam or hollow construction.

NOTE B: Small diameters are generally unblocked using high pressure/low volume jetting machines. These can lead to high forces on the pipe wall.

## 3.4 Longitudinal bending

When tested in accordance with Appendix C of this specification, the pipe shall not sag by more than 5% of the overall length of the pipe.

The pipe shall be deemed to have failed if:

- (a) the difference in dimensions when measured in the vertical axis is greater than 5% of the pipe length;
- (b) during the test the pipe incurs local permanent deformation.

## 4. TEST CONDITIONS

### 4.1 Test Conditions

Unless otherwise specified the tests shall be conducted at a standard laboratory temperature of  $(23 \pm 5)^{\circ}\text{C}$ .

### 4.2 Conditioning During Type Testing or in cases of disagreement

In the case of tests in air, test pieces shall be conditioned prior to test by being kept at  $(23 \pm 2)^{\circ}\text{C}$  in air, for not less than 12 hours for pipes of wall thickness up to and including 12.7 mm, or not less than 24 hours for pipes of wall thickness greater than 12.7 mm, unless otherwise specified.

## 5. REFERENCES

This specification makes reference to the latest edition of the following publications (except where otherwise indicated) including all addenda and revisions.

### European standards

BS EN ISO 472	Plastics. Vocabulary.
BS EN ISO 1043-1	Plastics. Symbols and abbreviated terms. Basic polymers and their special characteristics.
BS EN 476	General requirements for components used in discharge pipes, drains and sewers for gravity systems.
EN 13476-1	Plastic piping systems for non-pressure underground drainage and sewerage. Structured-wall piping systems of uPVC, PP, PE. Part 1: General requirements and performance characteristics

# APPENDIX A – RESISTANCE TO INTERNAL PUNCTURE TEST

## A.1 Principle

A segment of pipe is subjected to impact on its internal surface whilst fully supported by its external surface.

## A.2 Apparatus

**A.2.1** Standard drop weight pipe testing apparatus capable of dropping a tup from a height of 1 metre.

**A.2.2** A 250 g tup which can be varied by 25 g multiples with a striker consisting of a steel rod at least 25 mm in length, 5 mm in diameter and with a 2.5 mm radiused hemispherical end.

**A.2.3** A 250 mm x 250 mm box containing dry Leighton Buzzard sand (Garside quarry) such that there is at least 100 mm of sand beneath the test specimen when bedded down.

Typically:

Class	Lower Greensand
Specific Gravity	2.65 Mg/m <sup>3</sup>
Uncompacted bulk density	1560 kg/m <sup>3</sup>
Nominal size	1-2 mm
Coefficient of uniformity	<1.4

**A.2.4** A 5.5 kg hemispherical bar (max length 246 mm).

**A.2.5** Vibration apparatus upon which the box containing sand, specimen and 5.5 kg weight can be placed.

## A.3 Test pieces

Twenty specimens shall be cut from a sample of structured wall pipe. The specimen shall be 243 ± 3 mm long with a chord length across the cut section of 140 mm min. and 246 mm max. It shall be cut at right angles to the longitudinal axis. Mark the intended point of impact on the inside of the pipe at the intersection of the centre lines.

Note: With profiled pipes the point of impact may have to be moved slightly from the intersection to ensure that it is mid way between the ribs or in the middle of a hollow corrugation.

## A.4 Procedure

**A.4.1** The test pieces shall be conditioned in air at a temperature of (23 ± 5)°C for a period of at least 30 minutes before the test.

**A.4.2** The test piece shall be bedded into the sand using the vibration apparatus with the inner surface of the test piece exposed and facing upwards.

**A.4.3** Place the 5.5 kg weight on top of the test piece.

**A.4.4** Vibrate the box until the sample is buried so that the inside wall of the pipe is level with the surface of the sand.

**A.4.5** Locate the box under the drop tube of the impact apparatus such that the marked point of impact is under the striker in line with the centre line of the tup.

**A.4.6** Drop the tup from a height of 1m onto the inner surface of the specimen.

**A.4.7** Examine the specimen for damage.

Note A: Damage is defined as a puncture or crack of the inside wall for twin wall pipe or multi-layer pipe where the intermediate layer is of foam or hollow construction. Ductile bending or “whitening” is not considered to be damage.

Note B: Damage is defined as a puncture or crack of the wall for solid wall pipe or multi-layer pipe where all the layers are of solid construction. Ductile bending or “whitening” is not considered to be damage.

**A.4.8** If the specimen exhibits a ‘pass’, the next test shall be tested using the next highest tup of 25 g greater weight. If the specimen fails reduce the tup weight by 25 g.

## A.5 Test report

The test report shall include:

- identification of the samples;
- test weight used for each sample;
- whether or not damage occurred for each sample;
- the average of the impact weights for all passes;
- if any individual failure below 250 g occurred.

## **APPENDIX B – RESISTANCE TO WATER JETTING TEST**

### **B.1 Apparatus**

#### **B.1.1 Pump Unit**

The pump shall be a reciprocating piston pump capable of delivering at least 350 bar at 9 gallons per minute of water pressure e.g. Neolith Super Series 6. The hose length shall be approximately 90 m and of 15 mm (half inch) internal diameter. There shall be no sign of leakage from any part of hose or fittings.

#### **B.1.2 Jetting nozzle**

The jetting nozzle shall be manufactured from stainless steel. The orifice diameter shall be 1.5 mm. All dimensions and material shall be as stated in Figure B.1.

#### **B.1.3 Pressure gauge**

The pressure gauge shall be calibrated and capable of measuring to at least 350 bar to an accuracy of  $\pm 5$  bar. The gauge should be connected to the water supply immediately before the nozzle.

#### **B.1.4 Test rig**

The test rig shall be capable of withstanding pressures of at least 350 bar (5000 psi).

It shall also be capable of:

- clamping the nozzle at a constant vertical stand off distance of 5 mm ( $\pm 0.5$ ) mm from the inside surface of the pipe sample (Figure B.2);
- holding the nozzle at an angle of  $(30 \pm 1)^\circ$  to the inside surface of the pipe sample as shown in Figure B.2;
- maintaining a fixed jet of water throughout the test period;
- holding the test piece stationary throughout the test period

#### **B.1.5 Measuring equipment**

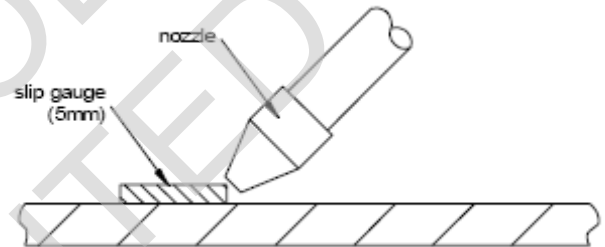
Suitable means of checking the vertical stand off distance between the internal pipe surface and the jet orifice (e.g. slips – with radiused bottom – Figure B.3).

Suitable means of measuring the orifice diameter in the jet nozzle to an accuracy of 0.002 mm.

Suitable means of measuring the angle of the nozzle to the pipe wall to an accuracy of  $0.1^\circ$ .

### **B.2 Test piece**

The test piece shall be a 300 mm long section of pipe of the pipe size to be tested. The test piece shall be marked off longitudinally along the pipe into 8 equidistant sections and numbered. The marking shall be waterproof.



**Figure B.3 – Measurement of stand-off distance**

### **B.3 Procedure to identify the pressure limit**

**B.3.1** Run the pump for a period of approximately 5 minutes at full pressure or until all air has been purged from the supply and the pump is stabilised. The temperature of the water shall be  $(15 \pm 10)^\circ\text{C}$ .

**B.3.2** Stop the pump, place the test piece in the rig and secure so that the sample can not move when under test. Align the pipe with one of the marked sections in the jetting area. Record the segment number.

**B.3.3** Start the pump and increase the pressure to the test pressure uniformly over a time period of not less than 10 seconds and not more than 15 seconds.

**B.3.4** The test pressure shall be applied to the pipe surface for 120 seconds. Record the test pressure. If there is evidence to suggest the test pressure was not within the required tolerance ( $\pm 5$  bar) then the test shall be aborted.

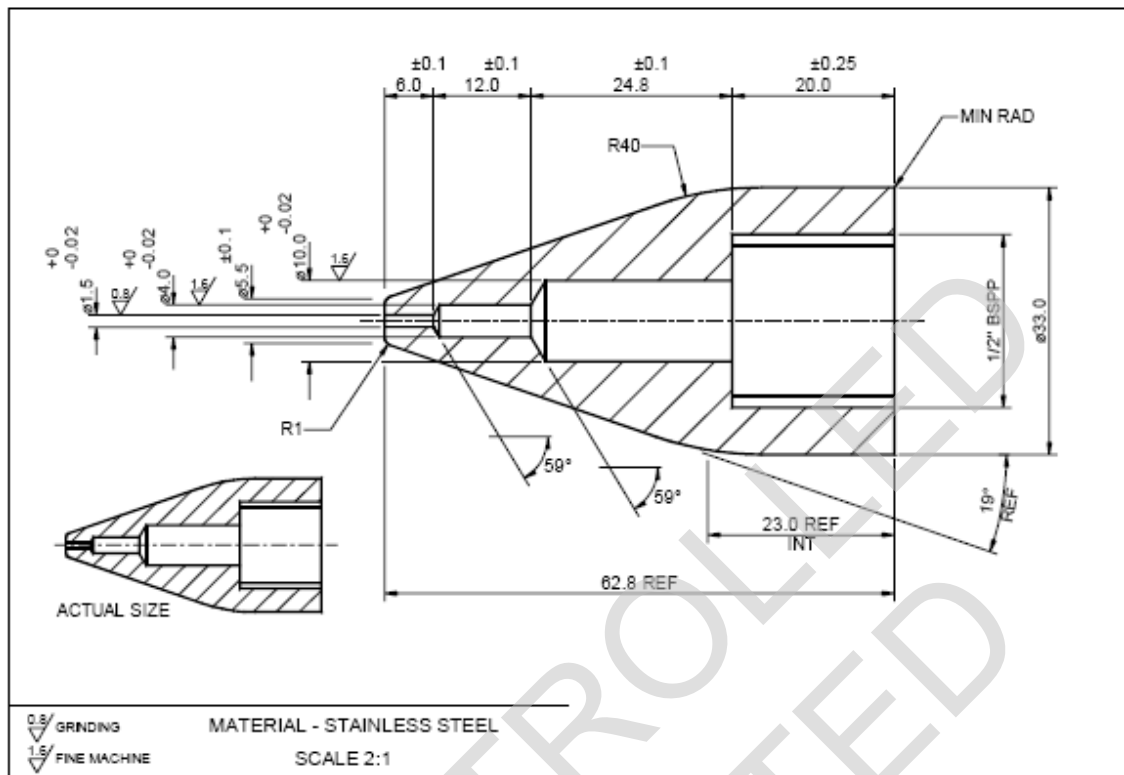


Figure B.1 – Nozzle for jetting rig

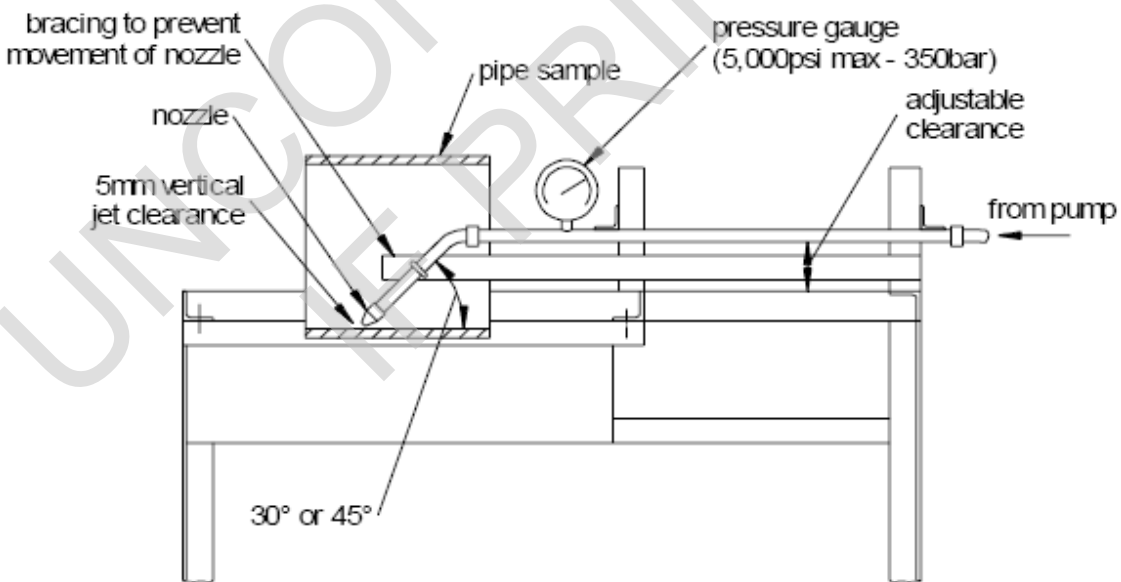


Figure B.2 – Schematic of test rig

**B.3.5** After 120 seconds stop the water jet. Remove the test piece from the rig, inspect for signs of damage, and record pass or fail in accordance with Clause 3.3.

**B.3.6** The test shall be repeated 5 times in succession at the test pressure. The pipe sample shall be turned to an untested segment for each test. If there is no unacceptable damage from these five consecutive tests then the pipe is considered to have passed at that pressure.

**B.3.7** If unacceptable damage is apparent in one of the five consecutive tests the pipe is considered to have failed the test. A further 5 tests shall be carried out at a lower pressure. The five consecutive tests shall not be repeated at the same pressure.

**B.3.8** If all five of the further consecutive tests show no unacceptable damage, the pressure limit is confirmed.

#### **B.4 Test Report**

The test report shall include:

- identification of the sample;
- whether the requirements of Clause 3.3 are met.

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## **APPENDIX C – LONGITUDINAL BENDING TEST**

### **C.1 Principle**

The maximum length of pipe as sold by the manufacturer is placed on two end supports and the amount of sag measured.

The test is intended to eliminate very flexible pipe (e.g. coilable pipe) and pipe which is so weak that it might deform when being handled on site.

### **C.2 Apparatus**

Two support blocks at least 250 mm wide and of sufficient height to allow the pipe to sag over its length without touching the ground. Typically this could consist of standard building blocks stood on their ends.

A means of measuring the vertical distance between the pipe at the centre of the span and a fixed point of reference (ground) to an accuracy of  $\pm 5$  mm.

### **C.3 Test specimens**

The length of pipe shall be conditioned for at least 1 hour in accordance with 4.1.

### **C.4 Method**

The supports are set at a distance apart equal to the length of pipe minus 500 mm.

Place the pipe symmetrically on the supports.

Measure the distance between the top of the supports and the ground or to any fixed reference point in the vertical axis through the centre line of the pipe.

After a period of two minutes measure the distance between the centre line of the pipe at mid span and the fixed reference point. Record the difference in readings as a percentage of pipe length.