
WATER INDUSTRY SPECIFICATION

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UK Water Industry

SPECIFICATION FOR LEAK TIGHTNESS TESTING OF CURED-IN-PLACE-PIPE LINING SYSTEMS FOR GRAVITY SEWER REHABILITATION

FOREWORD

Infiltration of groundwater into sewers through defective joints and other defects in the pipes, is a major cause of untreated discharges from sewer systems. Cured-in-place-pipe (CIPP) lining systems are one of the principal methods for sealing pipes to reduce discharges to the environment.

Following a high groundwater event in 2001 Thames Water produced a draft test method to establish the leak tightness of CIPP liners to be used in its subsequent renovation programme. Following some further development in 2004 Thames Water asked WRc to take on the management of a process witnessing testing of various liner systems as part of a collaborative research project CP308 which was undertaken between 2005 and 2007 during which time five systems were tested. The CP308 project was supported by four UK water companies. In 2011 a reference to the CP308 test was included in the *Civil Engineering Specification for the Water Industry* (7th Edition).

In 2024 Thames Water, who were planning significant expenditure on reducing infiltration through CIPP lining in AMP8, approached WRc to promote a project to update the CP308 test and produce a specification. This resulted in WRc project CP655 which was supported by five UK water companies and eight suppliers, whose products were tested as part of the validation of the test method.

With the Board's approval, development was undertaken by a Task and Finish Group chaired

by a representative of Thames Water. The Group contained representatives from five other UK water companies, the Government of Jersey and eight CIPP lining system suppliers. The draft WIS was open for three-months public comment on the WUK Standards Board website before finalisation and publication in its present form.

This specification does not purport to include all the necessary provisions of a contract and users are responsible for its correct application. 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 the technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

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

Information contained in this specification is given in good faith. Neither Water UK nor the members of its Standards Board can accept any responsibility for actions taken as a result.

It has been assumed in the drafting of this specification that the execution of its provisions is entrusted to appropriately qualified and experienced people, for whose guidance it has been prepared.

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1. SCOPE

This specification is a supplementary requirement for cured-in-place-pipe lining systems complying with BS EN ISO 11296-4.

It specifies test apparatus and a test method for use as a reference test by which the leak tightness of a CIPP lining system can be demonstrated for compliance with the functional requirements of BS EN 752.

It is applicable to full length CIPP lining systems complying with the requirements of BS EN ISO 11296-4 with or without lateral connection collars.

Note: Although a pipe diameter of 225mm has been selected for the test, this is not intended to limit the application of these products to any particular diameter or range of diameters, though thicker liners may be required in larger pipes.

2. TERMS AND DEFINITIONS

For the purposes of this specification the terms and definitions given in BS EN ISO 11296-1 and BS EN ISO 11296-4 apply together with the following.

Lining system

lining pipe and all relevant fittings for insertion into an existing pipeline for the purposes of renovation including where appropriate, any membrane, lateral connection collars, and end seal arrangements such as cured-in-place patch repairs or other end seals

Type A lining system

lining system intended to be used in host pipes with lateral connections and not requiring a lateral connection collar.

Type B lining system

lining system intended to be used in host pipes with lateral connections using a lateral connection collar.

Type C lining system

lining system intended only to be used in host pipes without lateral connections.

Type AB lining system

lining system intended to meet the requirements of both a Type A system and a Type B system.

3. TYPE TEST REQUIREMENTS

3.1 The system tested shall be as supplied (with any additional components to meet the leak tightness requirement) and installed in accordance with the supplier's installation manual in the conditions described in the test method under an external hydrostatic pressure of 30 kPa.

3.2 When tested in accordance with the method described in this document at an external hydrostatic pressure of 50 kPa and at the stages indicated in Table 1 for each type of lining system, the measured infiltration shall not exceed the appropriate maximum permissible infiltration rate in all three tests given in Table 2 for the appropriate class.

3.3 For Type A or B lining systems the reported class is based on the highest infiltration rate from the two tests required. For Type AB lining systems, the reported class is based on the highest infiltration rate from the three tests required.

Table 1 - Test requirements for each type of lining system

Test stage	Type of lining system		
	A	B	C
Test 1 - Liner with closed lateral connection	✓	✓	✓
Test 2 - Liner with open lateral with no lateral connection collar	✓		
Test 3 - Liner with open lateral after installation of a connection collar		✓	
✓ = test required			

Note: 50 kPa is the test pressure specified in BS EN 13380 *General requirements for components used for renovation and repair of drain and sewer systems outside buildings*, though it does not specify a requirement.

Table 2 - Reference levels for acceptable infiltration

Class	Maximum permissible infiltration (I_{lim}) over 30 mins [ml]
1	$I_{lim} = 0$
2	$I_{lim} = 506$ based on $I_{lim} = 500 * D * L$ Where: D is the internal diameter of the host pipe (0.225) [m] L the length of the pipeline (4.5) [m] For Class 2 liners the measured infiltration as a percentage of the limit specified above shall be stated with the class in the test report (e.g. Class 2 [40%])

Note: The limit for Class 1 is in accordance with the requirements for new drain and sewer pipe product standards. The limit for Class 2 is derived from the infiltration test requirement for new pipelines in Civil Engineering Specification for the Water Industry 8th Edition, clause 7.8.

4. CERTIFICATE OF CONFORMITY

A certificate of conformity with this WIS shall contain the information specified in section A.8 of Appendix A of this WIS.

5. REFERENCES

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

BS EN 295-4 *Vitrified clay pipe systems for drains and sewers - Part 4: Requirements for adaptors, connectors and flexible couplings*

BS EN 752 *Drain and sewer systems outside buildings - Sewer system management*.

BS EN ISO 11296-1 *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks — Part 1: General*.

BS EN ISO 11296-4 *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks - Lining with cured-in-place pipes*.

Note: BS EN ISO 11296-1 and BS EN ISO 11296-4 are likely to be superseded by ISO 11300-2 during 2025.

BS EN 13380 *General requirements for components used for renovation and repair of drain and sewer systems outside buildings*

Civil Engineering Specification for the Water Industry 8th Edition, UKWIR/WRc 2023

APPENDIX A – TEST METHOD

A.1 Apparatus

A.1.1 The test apparatus shall comprise the following.

- 1) Vitrified clay pipes conforming to BS EN 295-1 as follows:
 - a) one DN 225 x 150 plain ended unequal 45° oblique junction fitting with a length along the main pipe of 450 mm;
 - b) four DN 225 plain ended pipes 1.0 m in length;
 - c) one DN 150 plain ended pipe at least 1.0 m in length.

Note: The range of lengths allow use of standard pipes cut in half.

- 2) The tolerances of any cut pipes shall conform to BS EN 295-1.
- 3) Metal banded flexible couplings conforming to BS EN 295-4 for vitrified clay pipes modified to have two tappings and test ferrules (minimum bore 6 mm) longitudinally at the centre of the coupling and circumferentially 90° apart:
 - a) four of these shall be DN 225;
 - b) one of these shall be DN 150 with a single inlet ferrule.
- 4) Two DN 225 pipe stoppers with bleed valves in them.
- 5) One DN 150 pipe stopper with a bleed valve in it.

A.1.2 The DN 225 pipes shall be laid out on a suitable support structure with a constant fall of 50 mm ± 5 mm towards the downstream end. The junction pipe shall be at the centre. The pipes shall be connected together with the flexible couplings with the test ferrules at the top and one side of the pipes. The DN 150 pipe shall be connected to the branch of the junction with the branch at 45° to the vertical (see Figure A.1). The spacing between the ends of the pipes shall be in accordance with Table A.1.

A.1.3 The ferrules on the top of the pipes (A1, B1, D1 and E1) shall be connected by flexible

pipes to valves on a manifold which is connected to a fixed head water supply that is able to supply and maintain water pressures of 50 kPa ± 1 kPa and 30 kPa ± 1 kPa. A further flexible pipe from the manifold shall be connected to a ferrule (C) of the coupling on the DN 150 branch. The flow rate at 50 kPa through each ferrule shall be 0.12 l/s when all inlet valves are open.

A.1.4 Flexible pipes shall also be connected to the ferrules at the sides of couplings on the DN 225 couplings (A2, B2, D2 and E2). An isolation valve shall be fitted to each of these flexible pipes.

Table A.1 – Joint spacings

Joint reference	Location	Spacing
A	Pipes 1 - 2	25 mm ± 6 mm
B	Pipes 2 - 3	Maximum 3 mm
C	Junction to lateral	25 mm ± 6 mm
D	Pipes 3 - 4	25 mm ± 6 mm
E	Pipes 4 - 5	Maximum 3 mm

A1.5 The water supply shall be maintained at a temperature of 20°C ± 10°C throughout the installation and testing.

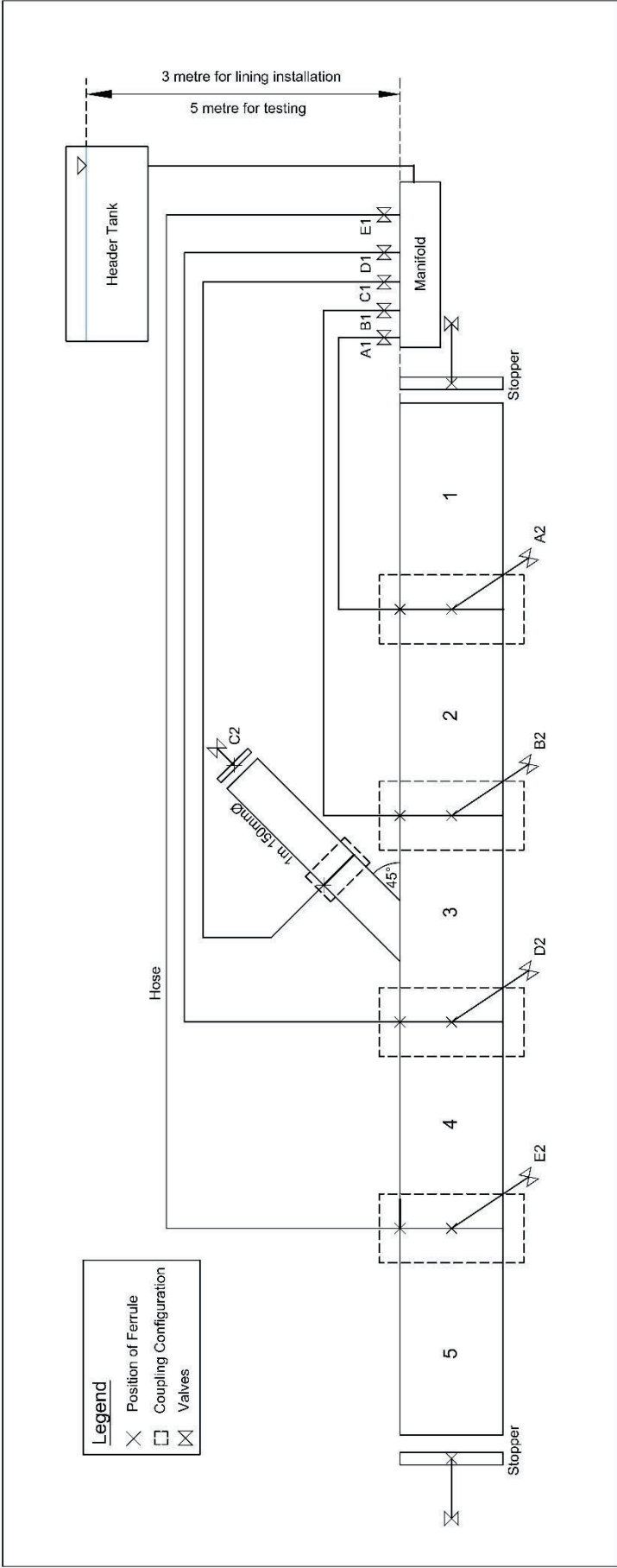
A.2 Installation of the liner

A.2.1 Prior to installation, the apparatus shall be checked to ensure that all the inlet ferrules (A1, B1, C1, D1 and E1) are discharging water through the ferrules.

A.2.2 All valves shall then be closed; stoppers shall be placed in each end and the pipe filled with water to ensure that the pipes are wet.

A.2.3 After draining down the pipe, and with all the inlet valves (A1, B1, C1, D1 and E1) open, the lining shall be installed in the DN 225 pipeline while it is still wet, and against a water pressure of 30 kPa. The lining system shall then be cured, and any end seals installed and cured or conditioned, in accordance with the supplier's instruction manual.

Figure A.1 Test Apparatus



A.2.4 The 30 kPa pressure shall be maintained until the liner is cured and any end seals have been conditioned in accordance with the supplier's instruction manual.

A.2.5 Both ends of the liner shall be trimmed so that they project at least 50 mm out of the ends of the host pipe. The protruding sections shall be formed into a spout so that any flow in the liner can be collected in a measuring vessel as shown in Figure A.2. A separate vessel shall be provided at each end to collect any flow from the annulus between the pipe and the liner (see Figure A.2).

A.2.6 After installation and curing of the liner (and any hydrophilic seals have conditioned in accordance with the supplier's instruction manual), ensure that none of the ferrules have become blocked by flushing water through from the inlet on each coupling to the corresponding outlet valve (A2, B2, D2 or E2 respectively). If any of the ferrules are blocked these should be drilled out, being careful that the drill does not project beyond the depth of the ferrule. If there is still no flow between inlet and corresponding outlet ferrules this shall be noted in the test report.

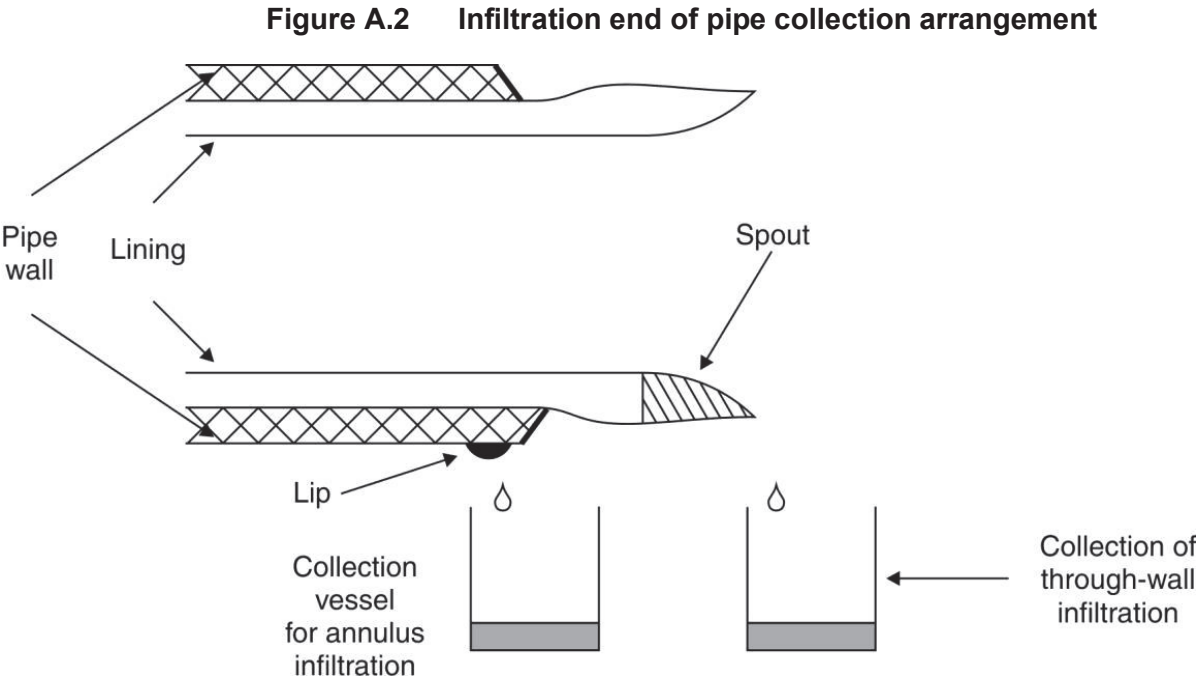
A.3 Test 1 - Liner test

A.3.1 The valves shall be set as indicated in Table A.2 and the water pressure increased to 50 kPa.

A.3.2 With the valves in these positions, the liner shall then be conditioned for a minimum period of 12 hours

Table A.2 Valve positions for Liner test

Valve Ref	Between Pipes	Valve position	Function
A1	1-2	O	PA
A2	1-2	X	
B1	2-3	O	PA
B2	2-3	X	
C1	Junction lateral	O	PA
C2	Lateral stopper	X	
D1	3-4	O	PA
D2	3-4	X	
E1	4-5	O	PA
E2	4-5	X	
O – Valve open X – Valve closed PA – Pressure applied			



A.3.3 The liner shall then be tested in accordance with the procedure set out A.7.

A.4 Test 2 - Liner test with open lateral

A.4.1 This test is only required where indicated in Table 1.

A.4.2 The lateral shall be opened by cutting through the liner in accordance with the supplier's instruction manual.

A.4.3 The valves shall be set as indicated in Table A.3.

Table A.3 Valve positions for test with open lateral

Valve Ref	Between Pipes	Valve position	Function
A1	1-2	O	PA
A2	1-2	X	
B1	2-3	O	PA
B2	2-3	X	
C1	Junction-lateral	X	
C2	Lateral Stopper	O	Vent
D1	3-4	O	PA
D2	3-4	X	
E1	4-5	O	PA
E2	4-5	X	
O – Valve open X – Valve closed PA – Pressure applied			

A.4.4 The lining system shall then be tested in accordance with the procedure set out A.7.

A.5 Installation of the lateral connection collar (where applicable)

A.5.1 Where the lining system includes a lateral connection collar, all the inlet valves (A1, B1, C1,

D1 and E1) shall be opened and a water pressure of 30 kPa shall be applied as indicated in Table A.3. The valve in the stopper (C2) shall also be opened.

A.5.2 The lateral connection collar shall then be installed and cured in accordance with the supplier's instruction manual.

A.6 Test 3 - Liner test with lateral connection collar

A.6.1 This test is only required where indicated in Table 1.

A.6.2 Where the lateral connection collar is Class A or B in accordance with ISO 11296-4, the valves shall be set as indicated for in Table A.4.

A.6.3 Where the lateral connection collar is Class C in accordance with ISO 11296-4, the valves shall be set as indicated for in Table A.3.

A.6.4 The water pressure shall be increased to 50 kPa.

Table A.4 Valve positions for test with lateral connection collar

Valve Ref	Between Pipes	Valve position	Function
A1	1-2	O	PA
A2	1-2	X	
B1	2-3	O	PA
B2	2-3	X	
C1	Junction-Lateral	O	PA
C2	Lateral stopper	O*	Vent
D1	3-4	O	PA
D2	3-4	X	
E1	4-5	O	PA
E2	4-5	X	
O – Valve open X – Valve closed PA – Pressure applied * Or stopper removed			

A.6.5 The lining system shall then be tested in accordance with the procedure set out A.7.

A.7 Test Procedure

A.7.1 The test procedure for tests 1, 2 and 3 is as follows:

- a) Ensure the temperature of the liner is the same as the temperature of the clay pipes to within $\pm 2^{\circ}\text{C}$. and that it is within $20^{\circ}\text{C} \pm 10^{\circ}\text{C}$.
- b) The valve positions shall be set to the required positions shown in Table A.2, A.3, or A.4 as appropriate.
- c) The water pressure at the manifold shall be set to 50 kPa.
- d) The test assembly shall be allowed to stabilise for 5 minutes.
- e) The test period shall be 30 minutes.
- f) Two empty, dry measuring vessels capable of measuring to the nearest ml, shall be placed at each end of the assembly to collect any water flowing from the liner or from the annulus between the liner and the host pipe (see Figure A.2).
- g) The water pressure shall be maintained at 50 kPa for the 30-minute test period.
- h) The volume of infiltrating water collected at each test monitoring point shall be measured and the total volume from all four measuring vessels shall be recorded at the end of the test period.
- i) The volume calculated in accordance with paragraph (h) above shall be compared to the value in Table 2.

A.8 Test Report

A.8.1 The following information shall be recorded in the test report:

- 1) Details of the system:
 - a) The name of the supplier of the system;
 - b) The product name of the system;

- c) The type of system (Type A, B, C or AB).

2) Details of the liner:

- a) The name(s) of the manufacturer(s) of the component materials and their respective product names;
- b) The type of resin, the carrier material (including any reinforcement) and any membrane (see ISO 11296-4:2018+A1:2021 Table 1);
- c) The volume or mass of resin used per square metre of internal surface of the host pipe or the spacing of the impregnation rollers;
- d) The curing method;
- e) The nominal “I” stage thickness of the liner in accordance with ISO 11296-4;

3) Where a separate end-seal is used:

- a) The type of end-seal used (e.g. cured-in-place patch repair, mechanical seals, or hydrophilic end seal);
- b) The name of the manufacturer or supplier of the end seal system;
- c) The product name of the end seal system;
- d) For cured-in-place patch repair systems the type of resin and the carrier material.

4) Details of the lateral connection collar (Type B and Type AB systems):

- a) The name of the manufacturer of the lateral connection collar;
- b) The type of resin and the carrier material in the lateral connection collar;
- c) The type of lateral connection collar (Top-hat or Tee piece) in accordance with ISO 11296-4:2018+A1-2021 Figure 3;
- d) The class of lateral connection collar in accordance with ISO 11296-4:2018+A1-2021 Table 3.

- 5) The results of the tests:
- a) The total volume of water collected in each of the tests carried out (see A.3, A.4 and A.6) in ml in 30 minutes
 - b) The total volume of water collected in each test as a percentage of the limit specified in Table 2 .
 - c) The class of the system in accordance with Table 2, based on the worst case of the tests carried out.
- 6) The organisation carrying out the test.
- 7) The dates on which the test was carried out.