Guide to leaktightness testing of gravity drains and sewers

Introduction

New drains, sewers and ancillary structures, other than those specifically for infiltration drainage, are designed to be watertight. This prevents escape (exfiltration) of raw sewage into the surrounding environment and the ingress (infiltration) of groundwater into the sewer which would increase the volumes of wastewater requiring treatment. After completion, drain and sewer systems can be tested to provide confidence that the watertightness offered by the individual components has been delivered in the built network. In this context 'leaktight' and 'watertight' are interchangeably used to mean the same.

This guide summarises the procedures for undertaking site tests on gravity systems to demonstrate watertightness against infiltration and exfiltration and provides practical guidance on using the tests for plastic piping systems.

Leaktightness (watertightness) assessment

Best practice is described in British Standard BS EN 752[1] as "New drains, sewers and ancillary structures shall be watertight in accordance with the testing requirements of BS EN 1610[2]."

For adoptable drains and sewers, all key documents (see Table 1) require leaktightness testing to demonstrate watertightness against infiltration and exfiltration. These tests are conducted after pipeline construction, but before backfilling (other than any necessary for structural stability whilst under test), to allow for any defects to be located and remedied.

For private drains and sewers, all key guidance documents (see Table 1) recommend testing new pipelines up to 300mm diameter for watertightness. Visual tests are generally completed before backfilling (Source: NHBC Standards 2021) and where required by pipeline / property owner, leaktightness tests are undertaken after backfilling.

In line with BS EN 1610: 2015[2], BPF Pipes Group members recommend that testing should be undertaken prior to backfilling so that any adjustments to the constructed pipeline highlighted by the test can be made. There is no restriction on the number of corrections and tests which can be undertaken at this stage and reduces the likelihood of test failures after backfilling.

Table 1: Key documents for construction of drains and sewers in the UK

	Private Drain and Sewers	Public Sewer
England	Building Regulations: Part H Approved Document H	Design and Construction Guidance (for current version see Water UK website), referred to as DCG
Northern Ireland	Building Regulations: Part N	Sewers for Adoption – Northern Ireland (1st edition), referred to as SFA-NI
Scotland	Building Standards: Part M Technical Handbook – Domestic: Environment Technical Handbook - Non-Domestic: Environment	Sewers for Scotland (4th edition), referred to as SfS4
Wales	Building Regulations: Part H Approved Document H	Sewers for Adoption (7th Edition), referred to as SFA7

Which tests should be used for new pipelines or new sections of pipeline?

The test should be performed according to the methods listed in Table 2.

There are two primary test methods:

- Testing with air
- Testing with water

The quickest and simplest to complete is the air test. BPF Pipes Group members recommend that in most instances, this should be used as the default test. If a satisfactory result is achieved, then the pipeline is considered watertight. If not, Figure 1 shows how adjustment and repeat testing may be used in accordance with BS EN 1610 to assess the watertightness of the pipeline.

Note: Alternative or additional testing might be required if groundwater is above the crown of the pipeline during testing. This should be specified when the system is being designed.

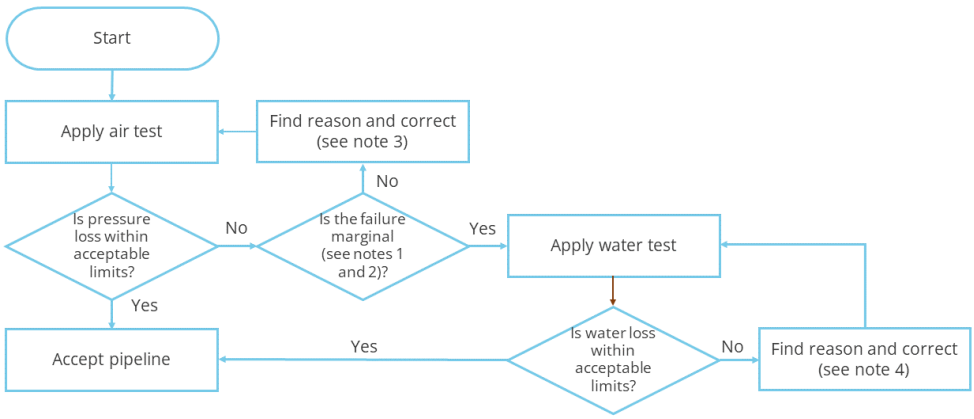
Table 2: Leaktightness methods for new drains and sewers in the UK

	Private Drain and Sewer [a]	Public Sewer [a]
England	Up to 300mm, air or water test to Approved Document H[b]	Up to 1000mm diameter, air or water test to DCG
Northern Ireland	Up to 300mm, air or water test to Building Regulations: Part N	Up to 750mm diameter, air or water test to SFA-NI
Scotland	Air or water test to BS EN 1610	Up to 750mm diameter, air or water test to SfS4
Wales	Up to 300mm, air or water test to Approved Document H[b]	Up to 750mm diameter, air or water test to SFA7

a) For all pipe sizes greater than listed here, BS EN 1610 should be used.

b) The 2002 edition of Approved Document H contained an error in the published figures. This is corrected in the 2015 edition and aligned to BS EN 1610. The 2002 edition should not be

Figure 1: Selection of test method



Notes to Figure 1:

1) A marginal failure indicates that the pipeline may pass the water test. A more severe failure indicates that there is a problem with the installation which needs to be rectified before continuing.

2) If the failure is marginal and the testing is being undertaken before backfilling, BPF Pipes Group members recommend that the installer checks and rectifies any potential problems and repeats the air test at least once before moving on to a water test.

3) Reasons for test failure might also include problems with test equipment, change of temperature during the test period requiring shelter or protection from sun.

4) The installer may wish to undertake an air test first to check that any potential problems have been rectified.

Which tests should be used for existing pipelines?

When checking for leakage from existing drains and sewers, care needs to be taken not to damage the existing system. Applying an internal pressure could dislodge joints or pipework in poor structural condition. The air test uses lower pressures than the water test and should be used as the default test. In England and Wales, Section 114 of the Water Industry Act 1991 does not permit the undertaker to use a water test for investigation of defective sewers. For private drains and sewers, guidance on testing for leaks can be found in The Drain Repair Book[3].

Testing with air

The section of pipeline to be tested is sealed with stoppers and connected by a tube to a manometer (water gauge) and a tube to a small hand bellows pump.

The air is pumped into pipeline for a period of 5 minutes to a value of 110 mm head of water on the gauge for a section containing pipes only or 55 mm for a section containing pipes and gullies.

The pressure is then reduced to a value of 100 mm head on the water gauge for a section containing pipes only or 50 mm head for a section containing pipes and gullies for a period of 7 minutes. The maximum loss over the 7-minute period should be no more than 25 mm on the water gauge.

For pipes greater than 300 mm diameter, the air test described in BS EN 1610: 2015 should be used.

Testing with water

The section of pipeline to be tested is sealed with stoppers and connected by a tube to a water container placed at the highest point of the test section.

The section is filled with water to achieve a specified level in the water container and the water topped up to maintain the level over a 30-minute test period.

In general, the specified level in the container should be a minimum of one metre, and no more than five metres, to ensure that the test pressure in the section of pipeline is equivalent to one metre head of water above the invert level of the downstream pipe.

A conditioning time of 1 hour should be allowed prior to commencement of the test and the container kept topped up to the water level during this period.

The amount of water added to maintain the level during the 30-minute test period is recorded. This is compared to the maximum acceptable water loss.

Table 3 provides a quick look-up of maximum water loss over 3-minute test period for the most common diameters of plastic pipes.

Table 3: Maximum water loss over 30-minute test period

Nominal size (DN/ OD)	Allowable water loss (l/m^2)	Maximum water loss per metre test section (l) [a, c]
110	0.15	0.042
125	0.15	0.049
160	0.15	0.063
200	0.15	0.079
250	0.15	0.098
315	0.15	0.124
355	0.15	*0.158*[b]
400	0.15	0.158
450	0.15	*0.200*[b]
500	0.15	0.197
630	0.15	0.248
710	0.15	*0.316*[b]
800	0.15	0.315
900	0.15	*0.401*[b]
1000	0.15	0.394

Notes to Table 3:

a) The method provided in BS EN 1610: 2015 was used to calculate water loss for solid wall PVC-U (to BS EN 1401-1[4]) and structured wall plastic pipes (to BS EN 13476 Parts 2[5] and 3[6]) and the most conservative values for each diameter presented in the table. In case of dispute or for sizes not shown in the table, BS EN 1610 should be consulted.

b) Values for DN/OD 355, 450, 710, 900 are based on the dimensions of SN4 pipe to BS EN 1401-1.

c) The value of water loss per metre length of pipeline can be multiplied up for the actual test section length.

References

1. BS EN 752: Drain and sewer systems outside buildings. Sewer system management (incorporating corrigenda October 2019) BSI, October 2019.

2. BS EN 1610: Construction and testing of drains and sewers . BSI, 2015.

3. The Drain Repair Book, 4th edition, WRc plc, 2017.

4. BS EN 1401-1: Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticized poly(vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system. BSI, July 2019.

5. BS EN 13476-2:2018+A1:2020: Plastics piping systems for non-pressure underground drainage and sewerage. Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE). Specifications for pipes and fittings with smooth internal and external surface and the system, Type A .

6. BS EN 13476-3:2018+A1:2020: Plastics piping systems for non-pressure underground drainage and sewerage. Structured-wall piping systems of unplasticized poly(vinyl chloride) (PVC-U), polypropylene (PP) and polyethylene (PE). Specifications for pipes and fittings with smooth internal and profiled external surface and the system, Type B. BSI, June 2018.