SA Water

Engineering

Technical Standard

TS 0900 – Pressure testing of pipelines

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Government of South Australia

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Documents superseded by this standard

The following documents are superseded by TS 0900:

a. TS 0210, Version 1.0.

Significant/major changes incorporated in this edition

Updates in this version of the Technical Standard include:

a. Updated in accordance with the SA Water Technical Standard Template Version 8.0 and the SA Water Style and Writing Standard Version 2.0, including revised disclaimers.
b. Internal references updated.
c. Section 2.1 and 2.1.2 updated
d. Removal of section 2.1.4
e. Addition of section 3.
f. Section 4 replaced with reference to TS 0105.
g. Section 6.1.2 updated
h. 200mm gauge replaced with 160mm gauge in section 6.1.10.

Updated text throughout is provided with dotted underline, excepting minor formatting or grammatical changes.

Document controls

Version history

Version	Date	Author	Comments
1.0	10-02-2022	J. Skirrow G. Holmes	First version
2.0	08-08-2024	S. Perveen	Technical Standard Template changed to 8.0. Internal references updated.

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Approvers

Approver Name	Approver Role	Signature
Shazia Perveen	Principal Engineer, Hydraulics (Acting)	11/09/2024 X Signed by: PE1972
Matthew Davis	Manager Engineering Quality and Innovation	12/09/2024 X Signed by: DA003681
Sofia Chouli	Senior Manager Engineering	12/09/2024 X Signed by: CH005288

Reviewers

Name	Role	Version	Review Date

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1 Introduction

SA Water is responsible for the construction and commissioning of an extensive amount of engineering infrastructure.

This standard has been developed to assist in the design, maintenance, construction, and management of this infrastructure such that it is safe and functional.

1.1 Purpose

The purpose of this standard is to detail minimum requirements to ensure that assets covered by the scope of this standard are constructed and maintained to consistent standards and attain the required asset life.

1.2 Glossary

The following glossary items are used in this document:

Term	Description
ABS	Acrylonitrile Butadiene Styrene
AHD	Australian Height Datum
AOP	Allowable Operating Pressure
ASTP	Allowable Site Test Pressure
CCTV	Closed Circuit Television
DAFI	SA Water – Development Agreement Formal Instrument
DICL	Ductile Iron Cement Lined
DIPL	Ductile Iron Polyurethane Lined
DN	Diameter Nominal
FoS	Factor of Safety
FRCP	Fibre Reinforced Concrete Pipes
GRP	Glass Reinforced Pipe
H	Hour
HDD	Horizontal Directional Drilling
HDP	Hydraulic Design Pressure
HTP	Hydrostatic Test Pressure
IP	Inspection Point
ITP	Inspection and Test Plan
Km	Kilometre
L	Litre
m	Metre
MH	Maintenance Hole
MSCL	Mild Steel Cement Lined
MSEL	Mild Steel Epoxy Lined
MSPL	Mild Steel Polyurethane Lined
NATA	National Association of Testing Authorities
PE	Polyethylene

Term	Description
PN	Pressure Nominal
PP	Polypropylene
PVC-M	Polyvinyl Chloride Type M
PVC-O	Polyvinyl Chloride Type O
PVC-U	Polyvinyl Chloride Type U
RCP	Reinforced Concrete Pipes
RRJ	Rubber Ringed Joints
SA Water	South Australian Water Corporation
SS	Stainless Steel
TDRF	Technical Dispensation Request Form
TG	SA Water Technical Guideline
TS	SA Water Technical Standard
WSA/WSAA	Water Services Association/Water Services Association of Australia

1.3 References

1.3.1 Australian and international

The following table identifies Australian and International standards and other similar documents referenced in this document:

Reference	Title
AS 1210	Pressure Vessels
AS/NZS 2033	Installation of polyethylene pipe systems
AS 2124	General Conditions of Contract (AS 2124-1992)
AS 2280	Ductile Iron Pressure Pipes and Fittings
AS/NZS 2566.2	Buried Flexible Pipelines – Installation
AS/NZS 2638.1	Gate Valves for Waterworks Purposes – Metal-Seated
AS 4037	Pressure Equipment – Examination and Testing
AS 4041	Pressure Piping
AS 4087	Metallic Flanges for Waterworks Purposes
AS/NZS 4129	Fittings for Polyethylene (PE) Pipes for Pressure Applications
AS 4300	General Conditions of Contract for Design and Construct
AS 5081	Hydraulically Operated Automatic Control Valves for Waterworks Purposes
WSA 01	Polyethylene Pipeline Code
WSA 02	Gravity Sewerage Code of Australia
WSA 03	Water Supply Code of Australia
WSA 04	Sewer Pumping Station Code of Australia
WSA 07	Pressure Sewer Code of Australia

1.3.2 SA Water documents

The following table identifies the SA Water standards and other similar documents referenced in this document:

Reference	Title
TS 0101	Safety in design standard
TS 0105	Quality requirements
TS 0109	Infrastructure design
TS 0230	Gate and butterfly valve requirements
TS 0460	Liners and floating covers for earth bank storages for potable or recycled water
TS 0502	Authorised products - gravity and pressure sewer systems
TS 0503	Authorised products - water systems
TS 0506	Authorised products - vacuum sewer systems
TS 0507	Authorised products - pressure sewer systems
TS 0526	Water tightness testing of liquid retaining structures
TS 0531	CCTV inspection of gravity sewer infrastructure
TS 0710	Concrete
TS 0800	Materials in contact with drinking water
SAWO-OPS-0026	Spray disinfection INSTACHLOR PR1000 tablets
SAWP-WQ-0039	Mains – cleaning or flushing
SAWP-WQ-0047	Disinfection c.*t* requirements
SAWS-WQ-0004	New assets – water quality and monitoring requirements for commissioning
SAWS-WQ-0010	Distribution system – water quality guideline for design and construction
SAWS-WQ-0011	Distribution system – water quality guideline for operation and maintenance
WSCM	Water supply construction manual (SA Water standard drawing set)
SCM	Sewer construction manual (SA Water standard drawing set)

1.4 Definitions

The following definitions are applicable to this document:

Term	Description
Accepted	Determined to be satisfactory by SA Water's Representative.
Accuracy	The level of closeness of an estimated value – measured or computed – of a quantity to its true or accepted value.
Allowable Operating Pressure	Maximum pressure at which a piping system can sustain in continuous use under given service conditions without pressure surge. For plastic piping systems, the value is specified at a temperature of 20°C.
Allowable Site Test Pressure	Maximum pressure applied on-site in a newly installed pipeline (includes a safety factor and allowances for surge).
Constructor	The organisation responsible for constructing and installing infrastructure for SA Water whether it be a third party under contract to SA Water or an in-house entity.
Contract	A set of documents supplied to Constructor as the basis for construction; these documents contain contract forms, contract conditions, specifications, drawings, addenda, and contract changes.

Term	Description
Designer	The organisation responsible for designing infrastructure for SA Water, whether it be a third party under contract to SA Water or a Constructor, or an in-house entity. A Designer is a person who effects design, produces designs or undertakes design activities as defined in the *Work Health and Safety Act 2012 (SA)*.
Accredited Superintendent	For works delivered under a Development Agreement Formal Instrument (DAFI), is the person accountable for the design (or their representative).
Hydraulic Design Pressure	The maximum system pressure at a point in the pipeline considering all hydraulic scenarios including, but not limited to, future developments, static pressures, pump shut-off head, dynamic pressures, and transients from surge.
Hydrostatic Test Pressure	The maximum hydrostatic pressure applied to a pipeline being assessed for leakage and water tightness. The test pressure, at any point in the pipeline section being tested, is not less than the Hydraulic Design Pressure, and not more than 25% above the rated pressure of any pipeline component.
Inspection	Measuring, testing or examining Works, materials, goods or services (including raw materials, components and intermediate assemblies) for determining conformity with the Requirements.
Inspection and Test Plans	The planned inspections and tests for individual work processes or activities.
kPa or MPa	Kilopascals or Megapascals; unit of measurement, typically used to denote pressures.
Manufacturer	A person, group, or company that owns and operates a manufacturing facility that provides materials for use in SA Water infrastructure.
Rated (or class) pressure	A long-term (i.e. design life) internal pressure capacity for a pipe, fitting or valve. The PN 'number' is used as a pressure rating for pipeline components. The number is 10 times the rated pressure in MPa not accounting for derating factors, e.g. PN 12 rating means the allowable long-term internal pressure is 1.2 MPa.
Representative	The Representative shall be either one of the following: a. For Works delivered under a Developer Agreement Formal Instrument (DAFI), this shall be the Accredited Superintendent. i. Where witness or hold points on site are required under this standard, SA Water's Representative shall also be provided with notice to attend at their discretion. b. For works delivered directly for SA Water under a Contract or engagement, this shall be SA Water's Representative.
Requirement	Need or expectation that is stated within the Contract.
Responsible Discipline Lead	The engineering discipline expert identified in the 'Approvers' table (via SA Water's Representative).
SA Water Representative	The SA Water representative with delegated authority under a Contract or engagement, including (as applicable): a. Superintendent's Representative (e.g. AS 4300 and AS 2124 etc.) b. SA Water Project Manager. c. SA Water nominated contact person.
Sewer Chamber	Typically referring to pumping station wet-well chambers. Whilst not always 'water retaining,' these structures are required to be watertight and must be tested as such in accordance with this Standard.
Sewer Maintenance Holes	Inspection/access points located on sewer mains/plants, typically referred to simply as Maintenance Holes (MHs). Whilst not always 'water retaining,' these structures are required to be watertight and must be tested as such in accordance with this Standard.
Shall and should	In this Standard the word "shall" indicates a requirement that is to be adopted in order to comply with the Standard. The word "should" indicates practices which are advised or recommended.

Term	Description
Supplier	A person, group or company that provides goods for use in SA Water infrastructure.
Technical Dispensation Request Form	This form is part of SA Water's Technical Dispensation Request Procedure which details the process by which those required to comply, or ensure compliance, with SA Water's technical requirements may seek dispensation from those requirements.
Terminology	a. Where an obligation is given, and it is not stated who is to undertake these obligations, they are to be undertaken by the Constructor. b. Directions, instructions, and the like, whether or not they include the expression "the Constructor shall" or equivalent, shall be directions to the Constructor, unless otherwise specifically stated. c. Where a submission, request, proposal is required, and it is not stated who the recipient should be, it is to be provided to SA Water's Representative for review. d. Each word imparting the plural shall be construed as if the said word were preceded by the word "all". e. Each word implying persons shall, where appropriate, also be construed as including corporations. f. "Authorised", "approval", "approved", "selected", "directed" and similar words shall be construed as referring to the authorisation, approval, selection, or direction of SA Water's Representative in writing. g. "Allow" shall mean that the cost of the item referred to is the responsibility of the Constructor. h. "Provide" shall mean "supply and install". i. "Submit" shall mean "submit to the SA Water Representative or their nominated delegate." j. Submissions, requests, proposals are to be provided at least 10 business days prior to work commencing or material ordering (unless noted otherwise). k. "Informative" shall mean "provided for information and guidance."
Tolerance	The required degree of accuracy. The amount by which a measurement or calculation might change and still be acceptable. In this document Accuracy and Tolerance can be interchangeable.
Trade Waste Discharge(s)	Commercial or Industrial wastewater discharge(s) for which an SA Water trade waste discharge authorisation is required.
Work	Elements of a project which require design and/or construction.

2 Scope

2.1 Scope and application of this Technical Standard

This Technical Standard covers the on-site/fabrication workshop-based pressure testing and/or site hydrostatic testing of the following infrastructure – constructed, commissioned, and put into service for SA Water by its Constructors:

a. Pressure Pipelines – Water.

b. Pressure Pipelines – Wastewater (both pressurised and gravity).

c. Pressure Pipe – Spools (Workshop-based hydro-static testing is also included).

Requirements for the testing of liquid retaining structures (in addition to this standard) are further described in TS 0526.

This Technical Standard has been written to conform to the relevant provisions of WSA 02, WSA-03, WSA-04 and WSA-07, as a minimum, whilst also establishing SA Water specific requirements. As such, this Technical Standard, in conjunction with TS 0526, shall supersede the following test provisions of WSA-02, WSA-03, WSA-04 and WSA-07 (including SA Water's current supplements to these):

a. WSA 02-2014 Part 2, Section 21.4.

b. WSA 03-2011 Part 2, Section 19.4.

c. WSA 04-2005 Part 3, Section 36.4.

d. WSA 04-2005 Part 3, Section 36.5.

e. WSA 07-2007 Part 3, Section 21.4.

f. WSA 07-2007 Part 3, Section 21.5.

g. WSA 07-2007 Part 3, Section 21.6.

2.1.1 Pressure pipelines – water

This standard covers the pressure testing of all pipeline systems designed for both drinking and non-drinking water, as well as new pipelines laid at water treatment or water storage sites, generally greater than DN63.

2.1.2 Pressure pipelines – wastewater

This standard covers the pressure testing of pipeline systems containing wastewater (both pressurised (typically rising mains) and gravity).

In addition, the requirements of this standard includes pressure testing of pipelines laid at wastewater treatment sites (generally greater than DN100) as well as chambers and maintenance holes (to be tested in accordance with TS 0526, subject to the requirements of this standard).

2.1.3 Pressure pipelines – workshop testing of spools and assemblies

This standard covers the pressure testing of pipework spools and valving arrangements that are manufactured bespoke in workshop facilities – for both water (drinking and non-drinking) and wastewater systems. They are generally used in pressure applications, at treatment or pumping sites (as manifolds for instance), but may be used at other locations, such as at isolation valve sites in the network.

These items are generally flanged or designed to allow all open ends to be blanked. If not, then it may be difficult to pressure test them in the workshop, and they shall subsequently be tested in place with the rest of the pipework on site. Where this is impractical for operational reasons, the Constructor shall provide details of how risks of not undertaking pressure testing will be managed as part of a TDRF submissions for SA Water approval.

It is possible that flanged spools will also be pressure tested on-site once installed in the Works. Yet, this does not preclude them from the Requirement to be pressure tested in the workshop.

2.2 Works not in scope

This Technical Standard does not cover the pressure testing and/or hydrostatic testing of the following infrastructure nor the following systems or processes:

2.2.1 General

a. Commissioning procedures are generally different from those commissioning tasks in the scope herein.

b. Small bore or high-pressure process pipework for water, sewage, desalination, chemicals, gases, membranes, filters, etc.

c. High-pressure piping or associated pressure vessels covered by AS 1210.

d. Copper pipe up to and including DN50.

e. Surge vessels.

f. Testing of pipes associated with building roof drainage, surface water or road drainage systems, and treatment plants, for instance.

g. Structural tests, such as testing of welds or testing of coatings and spool linings, etc.

h. Deflection testing of pipes and spools.

i. Sewer chambers and maintenance holes (to be tested in accordance with TS 0526).

2.2.2 Water system pressure pipes

Disinfection procedures, applicable for both drinking water and non-drinking water networks.

2.2.3 Pressure systems – sewer

The following are not in scope:

a. Systems associated with products authorised under TS 0506 – Vacuum Sewer Systems.

b. Systems associated with products authorised under TS 0507 – Pressure Sewer Systems.

2.2.4 Pipe spools

The following are not in scope:

a. Systems associated with products authorised under TS 0506 – Vacuum Sewer Systems.

b. Systems associated with products authorised under TS 0507 – Pressure Sewer Systems.

c. Type testing or product testing of 'off the shelf' items such as DI bends to AS 2280 or HDPE bends to AS 4129, etc. Items such as these, however, will be tested, such as pipeline components, in-site or workshop-based pressure tests covered by this TS.

d. Type testing or product testing 'off the shelf' items such as gate valves to AS 2638.1 and TS 0230 or control valves to AS 5081, etc. Items such as these, however, may be tested, being pipeline components, in the site or workshop-based pressure tests covered by this TS – subject to conditions described elsewhere in this document.

2.3 Technical dispensation

Departure from any requirement of this Technical Standard shall require the submission of Technical Dispensation Request Form (TDRF) for the review and approval (or otherwise) of SA Water Principal Engineer listed on Page 3, on a case-by-case basis.

The Designer shall not proceed to document/incorporate the non-conforming work before the Principal Engineer has approved of the proposed action in writing via the Technical Dispensation Request Form (TDRF).

SA Water requires sufficient information to assess dispensation requests and their potential impact. The onus is, therefore, on the proponent to justify dispensation request submissions and provide suitable evidence to support them.

Design works that are carried out without being appropriately sanctioned by SA Water shall be liable to rejection by SA Water and retrospective rectification by the Designer/Constructor.

2.4 Hazards

SA Water has provided known hazards associated with the testing activities nominated in this Technical Standard below for reference by users of this document.

Specific hazards/risks and their proposed controls relating to testing shall be included within the project Quality Plan and Work Method Statement submission (section 4).

Hazards/risks may include, but are not limited to, the following:

a. Insufficient anchorage, resulting in unexpected and uncontrolled movement of material/pipe under test.
    i. Before testing, the pipe spool shall be anchored adequately so that thrusts from bends, branch outlets, pipeline ends, etc., shall be transmitted to solid ground or to a suitable temporary anchorage, as appropriate.
        a. The Constructor shall be responsible for the design and installation of any additional/temporary anchors/thrust blocks, etc., necessary to restrain the pipe.
    ii. Certain pipelines designed to use restrained leg lengths to provide thrust resistance via friction will require the trench to be backfilled to a minimum cover prior to pressure testing (the Designer shall advise under these circumstances).
    iii. Thrust blocks shall be allowed to develop adequate strength before any internal pressure is applied to the pipeline. Refer to TS 0710.
b. Uncontrolled energy release from incorrectly secured opening.
    i. Before testing opening shall be restrained with plugs, caps, or blank flanges, properly jointed, anchored and supported.
c. Safe access to fitting plugs, caps or flanges as described in point b) above as may be required by the construction type and location.

Compacted embedment and backfill shall generally be placed, but excluding wearing courses, to leave exposed joints, service connections and valves wherever practicable. SA Water's Representative may direct the testing to be done at an earlier stage of trench backfill.

3 Hold points and witness points

3.1 Hold points

Hold points applicable to this Technical Standard can be found in Appendix A. Please refer to TS 0105 for further detail on hold points.

3.2 Witness points

Please refer to TS 0105 for further detail on witness points.

3.3 Non-conformance

Please refer to TS 0105 for the requirements relating to non-conformance.

4 Quality requirements

Please refer to TS 0105 for details of SA Water's quality management, documentation and hold/witness point requirements.

5 Site/workshop pressure testing

5.1 General

The aim of this section is to specify SA Water's parameters for hydrostatic pressure required during testing, whether on-site or in a Workshop – for spools. This tests the pipeline/spool in question and its components for acceptability against leaking.

5.2 Definitions

This section is to be read in conjunction with section 1.3. The definitions used in this standard generally align with AS/NZS 2566.2. The Allowable Operating Pressure (AOP) is typically the same as, or less than, the rated pressure, and the Allowable Site Test Pressure (ASTP) generally is 1.25 times the AOP or rated pressure.

5.3 SA Water reticulation systems

5.3.1 Default hydrostatic test pressure

The minimum Hydrostatic Test Pressure (HTP) for SA Water's infrastructure (both potable and non-potable) is 1600 kPa. As such, the rated pressure of all equipment, pipe and fittings shall be PN16 minimum. For example, the maximum of all current and future static and dynamic pressures and transient pressures set up by surges and acting within the pipeline is to be less than 1600 kPa (equating to the Hydraulic Design Pressure (HDP)).

The relationship between the HTP and the HDP shall be as follows:

(HDP <1600 kPa, then HTP shall be the max. of either 1600 kPa **OR** (HDP x FOS), with FOS=1.25)

(HDP ≥ 1600 kPa, then HTP x FOS, with FOS=1)

As noted in AS 2566, the HTP at any point in the pipeline shall be no more than 25 percent above the rated pressure (PN rating) of any pipeline component.

5.3.2 Higher hydrostatic test pressures

It should be noted that there are areas in the reticulation system, such as at the interfaces between the various Zones, for instance, where the HTP may need to be greater than 1600 kPa, i.e. 2100 kPa or 3500 kPa. As such, the rated pressure of all equipment, pipe and fittings within these Zones shall be PN21 or PN35 minimum, respectively. This, consequently, implies that the maximum of all current and future static and dynamic pressures, and transient pressures set up by surges, i.e. the HDP, is correspondingly less than 2100 kPa or 3500 kPa, as appropriate.

The relationship between the HTP and the HDP shall be as stated in 5.3.1.

Where the HTP is anticipated to be higher than 1600 kPa, the Designer shall:

a. Confirm current flows and any future flows with SA Water and check static and dynamic pressures associated with them.

b. Undertake design checks and/or modelling to estimate current and future transient pressures.

c. Nominate the HDP and confirm it with SA Water. To ensure compatibility with the design, checks shall also be made of existing pressures and ratings within the existing or neighbouring hydraulic system(s), that is, those not in the scope of the design.

5.3.3 Locations not requiring hydrostatic testing

There are locations in the reticulation and non-reticulation systems that do not require hydrostatic pressure testing. Such locations include:

a. Pipe downstream of the final isolation valve in a scour line, the latter leading to a location at/of nominal atmospheric pressure.

b. Pipe downstream of the final isolation valve in a pressure relief line, the latter leading to a location at/of nominal atmospheric pressure/low pressure.

c. Pipe downstream of the final isolation valve in a tank inlet line, the latter leading to a location at/of nominal atmospheric pressure/low pressure.

d. Tank overflow and/or scour/drain lines.

Pipes in these locations shall be subject to visual inspection during commissioning, and any leakage shall be repaired.

The Constructor may choose to pressure test such locations but must ensure that they are properly designed as such.

If the Designer and or Constructor feels that there is a location in their design, not mentioned above, that does not warrant a hydrostatic pressure test, a Technical Dispensation Request Form (TDRF) is to be sent to SA Water by the Designer, and approval obtained, prior to making such changes to the standard.

5.3.4 Location of the application of the hydrostatic test pressure (HTP)

The Constructor shall apply the Hydrostatic Test Pressure (HTP) to the point in the test section with the lowest elevation (in m - AHD). This means that pipe sections at a higher elevation will see a test pressure less than the HTP. A check shall be made to confirm that such sections are still subject to a local hydrostatic test pressure greater than the HDP. If not, the pressure test will require re-designing such that all pipeline sections are tested to a pressure greater than the HDP and at an upper limit equal to the HTP.

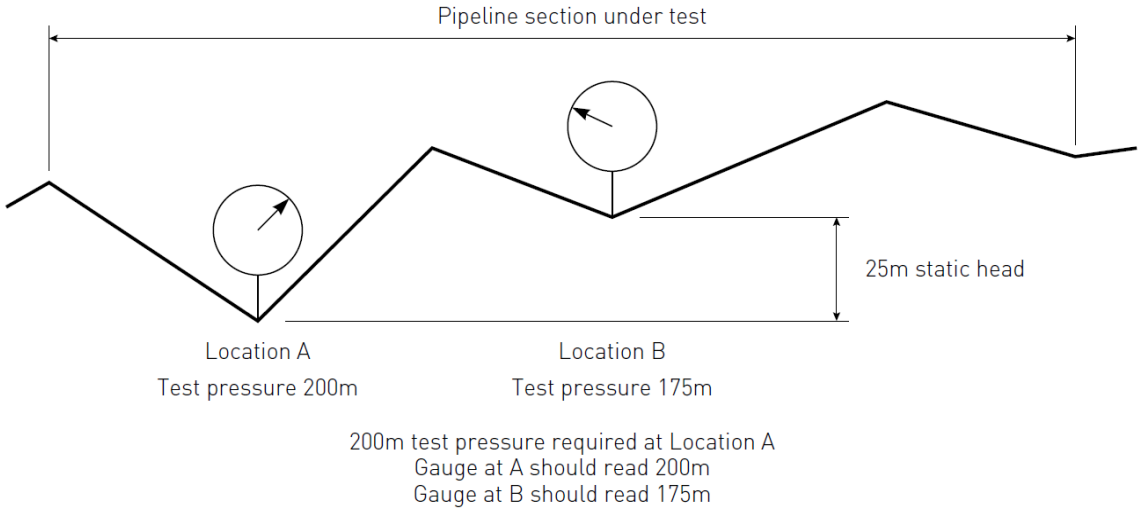


Figure 1: Application of the hydrostatic test

For non-reticulation systems, alternatively, the pipeline to be tested may be subdivided into smaller test sections, and this test methodology is applied so that local test pressure is always greater than the HDP and is less than or equal to the HTP.

A check shall also be made to confirm that no sections of the pipe will be tested to pressures greater than 1.25 times the lowest PN rating of any element of the section under test.

5.3.5 Non-reticulation systems

Lesser pressure ratings than the standard PN16 for pipework when required for non-reticulation systems may only be used after gaining project-specific approval from SA Water using the Technical Dispensation Request Process. If approval is granted, a note shall be included on the relevant drawings explaining the justification.

For non-reticulation systems, the pressure rating can also be PN21 or PN35, where relevant. The Designer shall consult with SA Water to determine the pressure rating for the system being designed and tested and/or check the static/dynamic pressures of the system as per section 5.3.2.

It shall be noted that in some instances, a pipe material is required to be de-rated such that a PN20 pipe, as an example only, is required in the PN16 rated system. In this case, the infrastructure shall still be nominated as being rated as PN16 – with an explanatory note added to the design and as-built drawing(s) to avoid any confusion. Likewise, this also applies to higher-rated systems.

6 On-site testing of pressure pipe systems

6.1 Scope and application

6.1.1 Scope

The scope for the testing of pressure pipelines is described in sections 2.1.1 and 2.1.2. The Constructor shall be responsible for carrying out hydrostatic testing of pressure pipe systems, and for the supply of all necessary equipment to undertake this.

For testing of spools and piping arrangements in workshop conditions refer to section 7.

6.1.2 Application

Acceptance testing is required to test the capability of the pipeline assembly to satisfy design Requirements as specified. It is not intended to test the material's capability. Testing is intended to:

a. Reveal the existence of any assembly and structural faults.

b. Ensure the water main can sustain pressures greater than the HDP without leakage.

Based on these objectives, acceptance testing shall be conducted when all network components (valves, fire plugs, etc.) within the area to be tested have been installed.

While the Constructor may choose to undertake testing prior to this milestone for their own internal quality assurance, this **shall not** be considered as final acceptance testing in accordance with this Technical Standard.

6.1.3 Compressed air testing

Compressed air testing is not permitted for pressure pipe systems.

6.1.4 Testing against valves

Testing against closed valves connected to a live network is generally discouraged due to the additional risks posed to water quality and network integrity by these tests. However, where on-site pressure testing of installed pipe systems against a valve needs to occur, the following measures shall be implemented, with confirmation of these requirements being satisfied representing a **HOLD POINT** to be released by the Representative **prior to testing**:

a. For Trunk Mains (>DN375), testing against a closed valve at HDP is only permitted:

   i. If it is possible to check for leakage past the valve seat in accordance with AS/NZS 2566.2.

   ii. If there is evidence to show that the risks of a water quality incident are acceptably low (i.e. leakage past the wedge of a gate valve).

   iii. For existing valves, if there are recent valve closure testing, pressure testing, installation records, etc. available to show that the associated risk of testing against this valve is acceptably low.

   iv. Valves are fully restrained.

Testing to HTP shall only occur as a workshop test – refer to section 7.1.4.

b. For Reticulation mains (≤ DN375), testing against a closed valve at HTP is only permitted where the Constructor can demonstrate the following to the Representative:

   i. If it is possible to check for leakage past the valve seat in accordance with AS/NZS 2566.2.

   ii. If there is evidence to show that the risks of a water quality incident are acceptably low (i.e. leakage past the wedge of a gate valve).

   iii. For existing valves, recent valve closure testing, pressure testing, installation records, etc. are available to show that the associated risk of testing against this valve is acceptably low.

   iv. A pressure relief mechanism is installed to protect the existing pipe systems from the HTP.

   v. Valves are fully restrained.

Where hydrostatic testing against valves is acceptable, it is preferred that the valve being tested against is a resilient seated gate valve in accordance with AS/NZS 2638.2. Metal seated gate valves, in accordance with AS/NZS 2638.1, have a permissible leakage rate and are unlikely to hold system pressure and, therefore, are not suitable for this particular application.

Testing against valves not connected to a live network shall be at the Constructor's risk due to the potential for leakage through the valve (new or existing), causing failure of the test.

6.1.5 Selecting test lengths

The pipeline length tested shall be either the whole or a section (capable of being isolated) of the pipeline, depending on the length and diameter, the availability of water and the spacing between sectioning valves or blank ends.

The pipeline shall be divided into test sections such that at any point in the section under test:

a. The local hydrostatic test pressure is not less than the Hydraulic Design Pressure, and not more than the Hydrostatic Test Pressure, nor 25 per cent above the rated pressure of any pipeline component.

b. Water is available for the test together with facilities for its disposal, in accordance with SA Water's requirements, after the test.

Pipelines longer than 1000 metres may need to be tested in several sections. Where long lengths are to be tested, radio or other means of communication between test operatives to coordinate test procedures and thus minimise the test duration is desirable.

Long test sections may incorporate many mechanical (i.e. flanged) joints, which should be checked for leakage. The longer the test section, the harder it is to locate a leak or discriminate between a leak and the other effects, such as the absorption of air into solution under pressure.

6.1.6 CCTV inspection

CCTV recording is only required at the discretion of the SA Water Representative for all newly installed pressure mains in potable water or sewer rising main systems greater than DN375. For gravity systems, refer to section 8.1.6

If debris is discovered the Constructor will be responsible for the removal and cleaning of the affected pipeline, prior to arranging a subsequent CCTV recording. Provision for the launch and retrieval of CCTV equipment shall be included in the design of the pipeline.

CCTV equipment is to be approved for potable water use, shall be appropriately disinfected, and shall never have been used in a sewer inspection. During CCTV inspection, any joint misalignment, homing of pipe concerns, or internal lining damage of internal coatings, including coatings heat affected by welding, shall be noted and provided to SA Water for review prior to hydrostatic testing in accordance with TS 0531.

6.1.7 Test water

For potable water mains pressure testing, use mains water for pressure testing where practical, ensuring no cross-contamination between the drinking water supply and the section of pipeline under test. Mains shall be filled via a metered hydrant, water tanker or similar approved by SA Water for potable water use at a controlled flow rate to prevent air entrainment and surge damage to the system. The fill flow rate is to be calculated using the specific test methods noted within this Technical Standard. For large volume tests, a meter should be installed to record make-up water.

a. For the Water Carting procedure, refer to document SAWO-OPS-0025 for further details (available upon request from the Manager of Water Quality Improvement and Compliance).

For all other pipeline pressure testing, alternative sources of water (e.g. recycled water, secondary treated effluent) may be used, with the SA Water Representative's approval.

6.1.8 Cleaning

Pipelines shall be cleaned before any test is performed in accordance with the following procedures (available upon request from the Manager of Water Quality Improvement and Compliance):

Document number	Document title
SAWO-OPS-0026	Spray Disinfection INSTACHLOR PR1000 tablets
SAWP-WQ-0039	Mains – Cleaning or Flushing
SAWP-WQ-0047	Disinfection C.t Requirements
SAWS-WQ-0004	New Assets – Water Quality and Monitoring Requirements for Commissioning
SAWS-WQ-0010	Distribution System – Water Quality Guideline for Design & Construction
SAWS-WQ-0011	Distribution System – Water Quality Guideline for Operation & Maintenance

The Constructor shall take due note of any Requirement under the Contract for cleaning and/or swabbing prior to disinfection. Should there be any concerns raised by SA Water Representative or water quality results arise, additional cleaning maybe requested before or after pressure testing.

6.1.9 Visual inspection

Visually inspect all water mains and their component markers to ensure the pipeline assembly and the type and location of markers are as specified.

Verify by inspection of purchasing records and/or visual examination and/or other appropriate means that all products and materials used are approved by SA Water.

6.1.10 Pressure gauges

Pressure gauges used for testing pressure pipelines shall either be of the conventional circular type, of not less than 160 mm diameter, calibrated in kPa, or shall have a digital indicator capable of reading increments of 1 kPa, and shall have a pressure range that places the test pressure within the range 35 per cent to 70 per cent of the gauge's full scale.

Two calibrated test gauges shall be used, in testing, to cross check gauge accuracy. They shall each have a certificate of calibration issued within the last twelve (12) months by an approved NATA registered laboratory.

A dated certificate of its accuracy shall be provided as a **HOLD POINT** and shall be included within the inspection and test plan.

The two calibrated gauges shall read within ±5 per cent of each other. If they disagree with this tolerance, the equipment shall be re-calibrated or replaced with other equipment meeting this standard.

6.1.11 Pumps

The pump shall be of adequate size to raise and maintain the test pressure.

A pump that is too small may increase the test duration, or if too large, it may be difficult to control the pressure.

Service records are to be provided to the Representative, which show details on the pump maintenance, including maintenance and testing of seals.

6.1.12 Disposal of water from cleansing, testing or disinfection

The provisions for the removal and disposal of water used for disinfection, swabbing or testing shall be stated in the project specification. Discharges to sewers or through overflow pipework shall not take place without the consent of SA Water.

Water used in the cleansing, testing or disinfection of pipelines shall be rendered safe prior to discharge to the environment.

A Trade Waste Discharge application, including a description of the proposed methodology, shall be submitted to SA Water for authorisation prior to discharging test water to the environment where volumes exceed 50kL per day.

6.1.13 Final connection

Where a new pipeline or other tested element is to connect to an operational pipeline, the final connection shall be inspected visually as a **WITNESS POINT** under normal operating pressure, and there shall be no visible leakage; pressure testing as per this standard need not be undertaken.

All components shall be disinfected for all potable and non-potable water systems prior to final connection.

The Designer shall consider the condition of the existing/operational pipeline such that forces imparted from the new pipeline during testing do not adversely affect the structural adequacy of the pipe system as a whole.

6.1.14 Property and fire services

Hydrostatically pressure test property services and fire services in conjunction with the reticulation mains.

Along with the process of pressure testing the reticulation main, open the main tap (ball valve) or electrofusion tapping saddle (with integral cutter and service isolation valve) at the reticulation main for each water service and close the ball valve at the lot boundary or meter isolation valve, as applicable, to pressure test each service. Entrapped air release on large dead-end branches or dog-legged branches may need to be considered.

To ensure the escape of entrapped air and as part of checking that services are connected to the correct water supply main (drinking or non-drinking), temporarily open ball valves at each lot boundary until water flows through the service free of air. Rectify any faults that are found.

If services are required to be tested separately from mains testing, ensure the main's service taps at each connection are opened following the pressure test.

In some instances, SA Water may approve a Constructor's request to lay services after successful pressure testing of the water main and when all other utilities' assets have been installed to prevent interference and damage.

6.1.15 Under pressure cut-in connections

Prior to undertaking any activity associated with under pressure cut-ins for pipe sizes DN375 and larger, an ITP shall be submitted to the Representative for review and acceptance.

Test the connection assembly on the host pipe prior to drilling in accordance with this clause. Care shall be taken where brittle pipe materials are encountered (for example, asbestos-cement and cast iron) and connections not attempted in areas with visible cracking and/or corrosion (noting that for cast iron pipework, this corrosion can also be internal).

It is not permitted to undertake an under pressure cut in at the same size as the host pipe in any material, e.g. DN375 under-pressure connection into a DN375 reticulation pipe. If this is required, a Technical Dispensation Request Form (TDRF) is to be sent to SA Water by the Designer, presenting the design for review and acceptance.

Before cutting-in to the host pipe, pressure test the assembly by applying a pressure that is equal to the HTP for a period not less than three (3) minutes.

Visually inspect the assembly for leaks as a **WITNESS POINT**.

Accept the pressure test on the assembly if there is:

a. No visible leakage.

b. No failure of any pipe, off-take, valve, joint or any other assembly component.

In the event of a failure, detect and rectify the fault and re-test. If a satisfactory test cannot be achieved, use an alternative method of connection, such as an inserted tee.

Visually inspect the completed connection assembly for leaks.

In the event of a leak, detect and rectify the fault, and test the completed connection assembly and associated connecting pipework.

6.1.16 Mains constructed using trenchless technology

For mains constructed using trenchless technology, if practical and feasible, the pressure testing should occur before connecting to open trench construction or to a new section of water main installed using open trench construction.

The design and construction methodology should consider requirements for pressure testing, especially if using a pipe type that differs from adjoining pipework. This may include temporary arrangements constructed for testing purposes.

6.2 Pre-test procedures

The pre-test procedures are as follows:

a. All required temporary and permanent thrust blocks shall be in place, and all concrete shall be adequately cured, as determined by test results or confirmed by a suitably qualified Engineer. This constitutes a **WITNESS POINT** before testing may be undertaken.

b. Blank flanges, removable spades or caps shall be installed at the beginning and end of the test section. Mechanical ends that are not end load resistant shall be temporarily strutted or anchored, to withstand the test pressures without movement.

   i. Temporary supports **should not be removed** until the pipeline has been depressurised. All test personnel should be informed of the loading limits on temporary fittings and supports.

   ii. Testing shall not take place against closed valves without prior approval, refer to section 6.1.4.

c. Where practicable, all bolted joints shall be left exposed to allow for visual inspection and re-tensioning during or after testing.

d. Compacted embedment and fill material shall be placed to leave joints, service connections and ball valves exposed wherever practical.

e. For PE pipelines, the pressurising time shall not exceed 45 min.

   i. Pressurising time affects the duration of the test.

f. The test equipment shall be placed in position and checked for satisfactory operation.

g. The pump shall be of adequate size to raise and maintain the test pressure. Refer also to section 6.1.11.

h. Two calibrated test gauges shall be used to cross check gauge accuracy. Refer also to section 6.1.10.

i. All hydrants or fire plugs should be opened prior to filling. Close all hydrants and fire plugs when no more air is being expelled.

j. Slowly fill the test length of pipeline with water, preferably from the lowest point, ensuring air is vented at the high point valves. Allow a period, within the range of 3 h to 24 h, for the temperature of the test length and the test water to stabilise and for dissolved air to exit the system. The recommended rate of filling shall be based on a flow velocity of 0.05 m/s, calculated from the following equation:[1]

$$Q_f \leq 12.5pD^2$$

where Q_f = filling rate (litres per second), and D = pipe diameter (metres)

k. The period of stabilisation will depend upon pipe dimensions, length, material, longitudinal profile, and air exit points. For a cement-mortar-lined pipe, the pipeline shall be filled at least twenty (24) hours before the commencement of the test to allow the lining to become saturated. For PE and PVC pipes, the test section shall be left to stabilise for at least three (3) hours.

   i. A firm foam swab may be used ahead of the fill water to assist air removal, especially where the pipeline undulates. Extract the swab at a high-point wash-out.

   ii. Concrete lined pipe may require soaking or pre-pressure applied for soaking of the lining. PE pipe may also require pre-pressure testing to stretch the pipe.

[1] The slow rate of 0.05 m/s avoids air entrainment when the filling water is cascading through downward gradients along the pipeline.

6.3 Test procedures

The hydrostatic test procedures (refer to sections 6.5, 6.6 and 6.7) described in this standard are primarily drawn from AS/NZS 2566.2. Further information may be obtained from the Australian Standard.

The Hydrostatic Test Pressure shall be calculated as described in section 5.3.1.

Once a test has commenced, the procedure shall not be changed to another applicable procedure until the test is completed.

6.4 Post-test procedures

After testing, pipelines shall be depressurised **slowly**. All air venting facilities shall be open when emptying pipelines. The test water shall be drained to an approved location (refer to section 6.1.13), and all connection points shall be reinstated. Depressurising should commence at the highest point, working down and ensuring adequate venting if draining the main.

For Land Division installation, the opening of inlet risers in multiple locations is required to ensure that all water mains have been tested and that there are no closed valves within the stage.

6.5 Polyethylene systems – hydrostatic testing

6.5.1 General

Pressure testing polyethylene (PE) pipes may require special processes since they may continue to expand significantly throughout the test period. When a PE pipe is sealed under a test pressure, there may be decay, even in a leak-free system, due to the creep response and stress relaxation of the PE material. Due to this material behaviour, standard pipe testing procedures used for other pipe materials, such as DI and steel, may not be suitable for PE pipe. Refer to WSA 01 – Polyethylene Pipeline Code, Testing and Commissioning for further information.

The following factors can affect a PE pipe pressure test:

a. Length of section and pipe diameter.

b. Test pressure, rate of pressurisation and duration of the test.

c. Presence of air.

d. Relative movement of mechanical fittings.

e. Level of support from pipe embedment.

f. Accuracy of test equipment.

g. Ambient temperature changes during testing.

h. Presence of fittings and other materials in the test section.

i. The presence of leaks.

Long test sections may incorporate many joints that should be checked for leakage. The longer the test section, the harder it is to locate a leak. Pipes above DN250 cause additional effects to further complicate the test process. Where site or production reasons require longer lengths to be tested, radio links between test operatives to minimise the test duration should be employed.

6.5.2 Test principles

For plastic pipes that are subjected to internal pressure, there will be a progressive drop in that pressure due to stress relaxation. Accordingly, it may be difficult to assess whether a pipeline is leaking or simply subject to stress relaxation.

To overcome this difficulty, this method is based on the principle that if the pressure is held constant, there will be a linear relationship between hoop strain and logarithmic time. Variables such as pipe stiffness and soil compaction are irrelevant, as the test result is based on actual performance during the test.

Temperature may be considered constant, as with other test methods, unless special conditions exist.

6.5.3 Constant pressure method for visco-elastic pressure pipelines

6.5.3.1 Application

This test is drawn from AS 2566.2 and is suitable for PE, PP and ABS pipelines (noting that both PP and ABS pipe are not approved for SA Water's pressure pipe systems per TS 0109).

6.5.3.2 Acceptance

The test length shall be acceptable where:

a. There is no failure of any thrust block, pipe, fitting, joint or any other pipeline component.

b. There is no visible leakage; and

c. $V_2 \leq 0.55V_1 + Q$

Where $V_{1/2}$ = volume in litres and Q = allowable make-up water (litres per hour).

6.5.3.3 Procedure

The procedure shall be as follows:

a. Purge the air from the pipeline (refer section 6.2).

b. Apply the specified test pressure to the test length (refer section 6.1.12 and 6.1.14).

c. Shut off the main and allow pressure to settle for twelve (12) hours (pressure will drop significantly).

d. Re-apply and maintain the test pressure constant for five (5) hours by pumping water into the pipeline.

e. Measure and record the water volume (V_1 in litres) required to maintain the test pressure constant between hour 2 and hour 3.

f. Measure and record the water volume (V_2 in litres) required to maintain the test pressure constant between hour 4 and hour 5.

g. Calculate:

$$0.55V_1 + Q$$

Where Q is the allowable make-up volume obtained from:

$$Q \leq 0.14LDH$$

Where:

V_1 = volume (L)

Q = allowable make-up water (L/h).

D = nominal diameter of the test length (m).

L = length of the test length (km).

H = average test head over length of pipeline under test (m).

6.5.3.4 Report

The following shall be reported:

a. Full details of the pipeline tested, including a vertical elevation of the test section showing heights and locations of air valves, gauges, and filling points.
b. Failure of any thrust block, pipe, fitting, joint or any other pipeline component.
c. Location and nature of leaks repaired.
d. Whether there is visible leakage.
e. Water and ambient temperatures.
f. Test pressure.
g. Test duration.
h. Q, the allowable make-up volume.
i. The values of V1 and V2.
j. Whether the pipeline was acceptable.
k. The date of the test.
l. Reference to this test method.

6.6 Other pipe materials – hydrostatic testing

6.6.1 General

These tests apply to DI, steel, and PVC systems.

6.6.2 Constant pressure (water loss) method

This test is drawn from AS 2566.2.

6.6.2.1 Acceptance

The test length shall be acceptable where:

a. There is no failure of any thrust block, pipe, fitting, joint or any other pipeline component.
b. There is no visible leakage.
c. The quantity of make-up water necessary to maintain the test pressure shall comply with the following equation:

$$Q \leq 0.14LDH$$

Where:

Q = allowable make-up water (L/h).

L = length of the test length (km).

D = nominal diameter of the test length (m).

H = average test head over length of pipeline under test (m).

The test shall also last for a minimum of two (2) hours.

The make-up water is **not a leakage allowance**, but is an allowance to cover the effects of the test head forcing small quantities of entrapped air into the solution. Normally, the test should last for a minimum of two (2) hours and be concluded within five (5) hours to eight (8) hours. The makeup water requirement should be reduced with time as air goes into the solution. Where, after twelve (12) hours, the makeup water still exceeds the allowable limit, testing should cease, and the cause of loss investigated.

6.6.2.2 Procedure

The procedure shall be as follows:

a. Close all valves apart from the test pump input and pressurise the test length to the specified test pressure.

b. Apply and then maintain the test pressure by adding measured and recorded quantities of make-up water at regular intervals over a period of one (1) hour to twelve (12) hours.

c. Where pressure measurements are not made at the lowest part of the test length, make an allowance for the static head between the lowest point of the pipeline and the point of measurement to ensure that the test pressure is not exceeded at the lowest point.

d. The allowable quantity of make-up water, Q, shall be calculated.

6.6.2.3 Report

The following shall be reported:

a. Full details of the pipeline tested, including a vertical elevation of the test section showing heights and locations of air valves, gauges, and filling points.

b. Failure of any thrust block, pipe, fitting, joint or any other pipeline component.

c. Location and nature of leaks repaired.

d. Whether there is visible leakage.

e. Water and ambient temperatures.

f. Test pressure.

g. Test duration.

h. The maximum allowable make-up volume.

i. Actual volume of makeup water.

j. Whether the pipeline was acceptable.

k. The date of the test.

l. Reference to this test method.

6.6.3 Alternative test procedure

This test procedure may be used as an alternative to the procedure detailed in section 6.6.2 for Developer works only (i.e. small-bore reticulation).

6.6.3.1 Procedure

The Hydrostatic Test Pressure (HTP) is a minimum of 1600 kPa, or 1200 kPa in the case of non-potable reticulation systems (refer 5.3.1)[2], shall be maintained for a minimum of:

a. Two (2) hours for DICL and MSCL (not including any pre-conditioning requirements for cement lining).

b. One (1) hour for PVC.

c. Between fifteen (15) to forty-five (45) minutes for PE, PP and ABS.

In cases of dispute, the test method shall revert to the procedure detailed in section 6.6.2.

[2] The HTP may be higher as per section 4.

The water reticulation system tested will be accepted as being satisfactory by the SA Water Representative if there are no leaks after the full test pressure has been held for the above testing period.

The Constructor shall repair all leaks, and following the repairs, the testing shall be repeated until approved as satisfactory by the SA Water Representative.

6.6.3.2 Report

The following shall be reported:

a. Full details of the pipeline tested, including a vertical elevation of the test section showing heights and locations of air valves, gauges, and filling points.
b. Failure of any thrust block, pipe, fitting, joint or any other pipeline component.
c. Location and nature of leaks repaired.
d. Whether there is visible leakage.
e. Water and ambient temperatures.
f. Test pressure.
g. Test duration.
h. Whether the pipeline was acceptable.
i. The date of the test.
j. Reference to this test method.

6.7 Visual test method for minor pipelines

This test is applicable for small pipelines of all materials (less than 200 metres in length) and pipelines where pipeline joints have been safely left exposed for the test operation and can be easily inspected visually for leaks.

The test is drawn from AS 2566.2.

6.7.1.1 Acceptance

The test length shall be acceptable where:

a. There is no failure of any thrust block, pipe, fitting, joint or any other pipeline component.
b. There is no visible leakage.
c. There is no pressure loss indicative of a leak.

6.7.1.2 Procedure

The procedure shall be as follows:

a. The Hydrostatic Test Pressure shall be applied for a minimum of thirty (30) minutes, and the test section should be isolated by closing the high point air release valves and the pump feed valve.
b. The test section shall be visually inspected for leakage at all joints, especially bolted joints, all fittings, service connections and ball valves.
c. Pressure gauges shall be checked to ensure that pressure has not fallen significantly, indicating an undetected leak.
d. Any detected leak shall be repaired, and the section shall be retested.
e. Where no leak is detected, high point air release valves shall be opened, the pipeline shall be depressurised to slowly drain the line into an approved waterway, and all connection points shall be reinstated.

6.7.1.3 Report

The following shall be reported:

a. Full details of the pipeline tested, including a vertical elevation of the test section showing heights and locations of air valves, gauges, and filling points.

b. Failure of any thrust block, pipe, fitting, joint or any other pipeline component.

c. Location and nature of leaks repaired.

d. Whether there is visible leakage.

e. Water and ambient temperatures.

f. Test pressure.

g. Test duration.

h. Whether the pipeline was acceptable.

i. The date of the test.

j. Reference to this test method.

7 Workshop testing of spools and assemblies

7.1 Scope and application

7.1.1 Scope

The scope for hydrostatic testing of bespoke fabricated pressure pipe spools is described in section 2.1.3. The following testing is applicable to workshop testing; otherwise, testing is to be in accordance with the relevant pipeline testing method.

7.1.2 Application

Acceptance testing is required to test the capability of the pressure pipe spool assembly to satisfy design requirements as specified. It is not intended to test the material capability of the pipe spool. Testing is intended to:

a. Reveal the existence of any assembly and structural faults.

b. Ensure the pipe spool can sustain pressures greater than the Hydraulic Design Pressure without leakage.

c. Prove the sealing function of valves, consistent with relevant clauses stated in TS 0230 – Gate and butterfly valve requirements.

In certain instances, acceptance testing is also required to test the material capability of the valves integrated within the pipe spool assembly. In this case, refer to section 7.1.4.

7.1.3 Compressed air testing

Compressed air testing shall not be permitted for pipe spools.

7.1.4 Valves

The valves being used in the pipe spools and assemblies shall have undergone successful Factory testing in accordance with the requirements and nature of the tests in TS 0230.

Factory testing of valves is required where the valve diameter is greater than 375 mm.

Workshop testing against closed valves is required where isolation of the valve is of a critical nature related to a High-Risk activity (identified via risk assessment), as agreed with SA Water's Representative and in accordance with TS 0230. This is required to test that the leakage amount is within tolerance, as per the manufacturer's standards, TS 0230 – Gate and butterfly valve requirements, and the relevant Australian Standards.

Valves shall be tested in both directions.

7.1.4.1 Test method for valves incorporated within spools

a. Sealing test for both directions in accordance with the Production Tests specified in the relevant Australian Standards for specific valve types such as AS/NZS 2638.2 for resilient seated gate valves and AS 4795.2 for double flanged butterfly valves.

b. Valves >DN375 (bi-directional).

c. Valves >DN375 (uni-directional).

d. Sealing test, for preferred direction in accordance with the Production Tests specified in the relevant Australian Standards for specific valve types, such as, AS/NZS 2638.2 for resilient seated gate valves and AS 4795.2 for double flanged butterfly valves).

7.1.5 Final connection

Refer section 6.1.14.

7.1.6 Test method for pipe spools

a. Bring to the Hydrostatic Test Pressure and hold for thirty (30) minutes (AS 4041, AS 4037).

b. The Constructor/Designer is to confirm the Hydraulic Test Pressure and the Hydraulic Design Pressure with SA Water.

c. The test shall pass if there is no drop in pressure or failure of any element or leak.

7.1.7 Cleaning

Clean spools before any test is performed in accordance with the following procedures:

a. SAWO-OPS-0026 (available upon request from the Manager of Water Quality Improvement and Compliance).

The Constructor shall take due note of any Requirements under the Contract for cleaning and/or swabbing prior to disinfection.

7.1.8 Visual inspection

Visually inspect all spools and their components to ensure the pipeline assembly is as specified.

Verify by inspection of purchasing records and/or visual examination and/or other appropriate means that all products and materials used are approved by SA Water and, where required, comply with TS 0800 when used in drinking water applications.

7.1.9 Disposal of water from cleansing, testing or disinfection

The provisions for the removal and disposal of water used for disinfection, swabbing or testing shall be stated in the project specification. Discharges to sewers or through overflow pipework shall not take place without the consent of SA Water.

Water used in the cleansing, testing or disinfection of pipelines shall be rendered safe prior to discharge to the environment.

A Trade Waste Discharge application, including a description of the proposed methodology, shall be submitted to SA Water for authorisation prior to discharging test water to the environment where volumes exceed 50kL per day.

8 Testing of sewer gravity systems

8.1 Scope and application

8.1.1 Scope

The scope for the testing of non-pressure pipelines is described in section 2.1.2 The Constructor shall be responsible for carrying out leak testing of sewers, including the sewer service connections.

8.1.2 Application

The tests specified in this section refer to the low-pressure testing, whether by vacuum or by positive pressure, on infrastructure associated with the gravity sewerage network.

Pressure testing, either low-pressure air testing or vacuum testing, is only qualitative as pressure losses do not directly reflect water leakage rates. It is used to identify points of leakage and potential pipeline infiltration and exfiltration due to damaged pipe seals and joints.

Vacuum or air pressure test all sewers ≤DN 1500 in accordance with this section, including external MH drops, property connection sewers, vertical risers, maintenance chambers, maintenance shafts and inspection shafts and fittings.

Undertake vacuum tests where the Specification does not specify the test method.

Test after placement and compaction of pipe embedment, including overlay.

Provide calibration certificates for all air pressure and vacuum testing equipment to the Representative upon request.

Sewers ≥DN 750 should be inspected and tested during construction and before the construction of MHs. The test may be conducted after trench filling, but repair /rectification costs would almost certainly be greater.

Requirements, in addition to this specification, for the cleaning, leakage testing, and CCTV inspection of mains apply and are further described in TS 0531 – CCTV inspection of gravity sewer infrastructure.

8.1.3 Cleaning

Clean sewers and structures before any test is performed and dispose of debris in accordance with the requirements described in TS 0531 – CCTV inspection of gravity sewer infrastructure.

8.1.4 Visual inspection – above ground

Visually inspect all sewers, maintenance structures, and vents to ensure their assembly and that the type and locations of maintenance structures, including access covers and vents, are specified and installed correctly.

Verify by inspection of purchasing records and/or visual examination and/or other appropriate means that all products and materials used are approved by the SA Water Superintendent's Representative.

8.1.5 Disposal of water from cleansing, testing or disinfection

The provisions for the removal and disposal of water used for disinfection, swabbing or testing shall be stated in the project specification. Discharges to sewers or through overflow pipework shall not take place without the consent of SA Water.

Water used in the cleansing, testing or disinfection of pipelines shall be rendered safe prior to discharge to the environment.

A Trade Waste Discharge application, including a description of the proposed methodology, shall be submitted to SA Water for authorisation prior to discharging test water to the environment where volumes exceed 50kL per day.

Further requirements on mains cleansing are found in TS 0531 – CCTV inspection of gravity sewer infrastructure.

8.1.6 CCTV inspection

CCTV recording is required for all newly installed gravity sewers. It should be the last action undertaken for acceptance testing.

If debris is discovered the Constructor will be responsible for the removal and cleaning of the affected sewer, prior to arranging a subsequent CCTV recording.

Details of CCTV requirements are to be found in TS 0531 – CCTV Inspection of Gravity Sewer Infrastructure.

8.2 Air testing of sewers

This section applies to low air pressure Testing of sewers, inclusive of Maintenance Holes and Inspection Points. All small-sized submersible packaged pumping stations (Wet-well Chambers) and all newly constructed concrete/non-concrete Maintenance Holes shall be hydrostatically tested, separately from the sewer system, as per TS 0526.

Where it is impractical to undertake hydrostatic testing, the Constructor shall submit a Technical Dispensation Request Form (TDRF), in accordance with the Technical Dispensation Procedure, to alternatively undertake Air Vacuum Testing (TS 0526) or Low Air Pressure Testing (section 8.2).

8.2.1 General

There are several options available to use:

a. 8.2.2 Low-Pressure Air Testing Method.

b. 8.2.3 Alternative Low-Pressure Air Testing Method.

c. 8.2.4 Vacuum Testing Method.

d. 8.2.5 Testing of Non-Pressure PE Sewers.

Once the selected test procedure has been commenced, it is not permissible to swap it for an alternate test procedure.

Test after placement and compaction of pipe embedment, including overlay. Enough embedment and trench fill material shall be placed around the pipes to ensure they are restrained. Where specifically directed in writing by the SA Water Representative, the Constructor shall leave joints exposed to facilitate visual inspection for leakage.

The Constructor shall supply all pumping and test equipment for air testing. Pressure gauges shall each have a certificate of calibration issued within the last twelve (12) months by an approved NATA-registered testing facility. Provide calibration certificates for all air pressure and vacuum testing equipment to the Representative upon request.

8.2.2 Low-pressure air testing method

Testing shall be limited to sewers ≤DN 1500 and to runs between MHs and/or MSs/IPs of ≤250 m. For sewers greater than DN 1500, refer to the SA Water Representative.

The test method to be undertaken is as follows:

a. Plug all sewer inlets and outlets and cap and seal all MS and IP risers in the test length of the sewer.

b. Slowly apply an initial test pressure of approximately 27 kPa since rapid pressurisation can cause significant air temperature changes that may affect testing accuracy. Where the sewer is below the water table, increase the stated pressure to achieve a differential pressure of 27 kPa, but do not exceed 50 kPa actual test pressure.

c. Close the valve on the air pressure line and shut off the pump. Allow the air pressure to stabilise for at least three (3) minutes to identify any initial leakage.

d. When the pressure has stabilised and is at or above the starting test pressure of 24 kPa, commence the test by allowing the gauge pressure to drop to 24 kPa, at which point initiate the time recording. Record the drop-in pressure over the test period.

e. Accept the length of sewer under test if the test pressure loss is ≤7 kPa for the relevant time interval specified in Table 8.1. Table 8.1 is drawn from WSA 02.

f. If the sewer fails the test, re-apply the test pressure to identify any leaks.

g. Rectify all defects prior to conducting any further testing.

h. Rectify any visible or audible faults even if the pressure testing is satisfactory.

It is recommended that a relief valve with a 50 kPa maximum setting be installed on all pressurising equipment.

Table 8.1: Pressure and vacuum air testing acceptance times for 7 kPa pressure change

Pipe size DN	Test length m					
	50	100	150	200	250	300
	Minimum test duration minutes					
100	2	2	2	2	3	3
150	3	3	3	5	6	6
225	4	5	8	10	13	15
300	6	9	14	18	23	29
375	7	14	22	29	36	43
450	10	21	31	41	52	66
525	14	28	42	56	70	86
600	18	37	55	73	92	106
675	23	46	70	93	116	144
750	29	57	86	115	143	168
900	41	83	124	165	207	243
1000	51	102	153	204	255	300
1050	56	112	169	225	281	319
1200	73	147	220	294	367	460
1500	115	230	344	459	574	700

Note: Timing of the test duration to commence after the 3 minutes initial period

8.2.3 Alternative low-pressure air testing method

This test procedure may be used as an alternative to the procedure detailed in section 8.2.2 as applicable to works delivered via a DAFI agreement only. It is not applicable for the testing of PE pipe.

Once all sewer and connection openings are sealed, air shall be introduced slowly until a pressure of 50 kPa gauge is reached. This pressure shall be maintained for a minimum of three (3) minutes using a pressure regulator, that is, not by use of additional pressure top-ups. Should no leaks be detected at the end of the three (3) minutes, the air supply shall be shut off – if the 50 kPa pressure is maintained for a further (3) minutes, that section of sewer and connections will be accepted as satisfactory by the SA Water Representative.

If within the (3) minutes, a decrease in pressure is observed, then, provided the pressure of the air contained in the section of sewer under test does not fall below 35 kPa gauge within fifteen (15) minutes, that section of sewer and connections will be accepted as satisfactory by the Representative.

If the sewer and/or connections fail the tests, any leaks shall be repaired by the Constructor, and following the repairs, the testing shall be repeated at the Constructor's expense until approved as satisfactory by the SA Water Representative.

8.2.4 Vacuum testing method

The test method to be undertaken is as follows:

a. Plug all sewer inlets and outlets and cap and seal all MS and IP risers in the test length of the sewer.

b. Apply an initial test vacuum pressure (negative pressure) of approximately 27 kPa. Close the valve on the vacuum line and shut off the vacuum pump. Allow the air pressure to stabilise for at least three (3) minutes to identify any initial leakage.

c. When the pressure has stabilised and is at or below the starting test vacuum of 24 kPa, commence the test by allowing the gauge pressure to drop to 24 kPa, at which point initiate time recording. Record the drop-in vacuum over the test period.

d. Accept the length of sewer under test if the test vacuum loss is ≤7 kPa for the relevant time interval specified in Table 8.1.

e. If the sewer fails the test, re-apply the vacuum to identify any leaks.

f. Rectify all defects prior to conducting any further testing.

g. Rectify any visible or audible faults even if the vacuum testing is satisfactory.

8.2.5 Testing of non-pressure polyethylene sewers

PE sewers require a different test procedure than other non-pressure pipelines to compensate for the material's tendency to strain during pressure testing.

Perform all acceptance testing after backfilling.

The test method to be undertaken is as follows:

a. All inlets and outlets shall be plugged, and any other access points in the test length of the pipeline shall be capped and sealed.

b. An initial test vacuum pressure (negative pressure) of approximately 27 kPa shall be applied. The valve on the vacuum line shall be closed and the vacuum pump shut off. The air pressure shall be allowed to stabilize for at least 3 minutes to identify any initial leakage.

c. When the pressure has stabilized and is at or below the starting test vacuum of 23.6 kPa, the test shall commence by allowing the gauge pressure to drop to 23.6 kPa, at which point time recording shall be initiated. The drop-in vacuum over the test period shall be recorded.

d. The length of pipeline under test shall be accepted if the test vacuum loss is ≤7 kPa for the relevant time interval specified in Table 8.1.

e. If the pipeline fails the test, the vacuum shall be reapplied to identify any leaks.

f. All defects shall be rectified prior to conducting any further testing.

g. Any visible or audible faults shall be rectified even if the vacuum testing is satisfactory.

Appendix A - Schedules of hold points, witness points and identified records

A1 Schedule of hold points, witness points and approvals

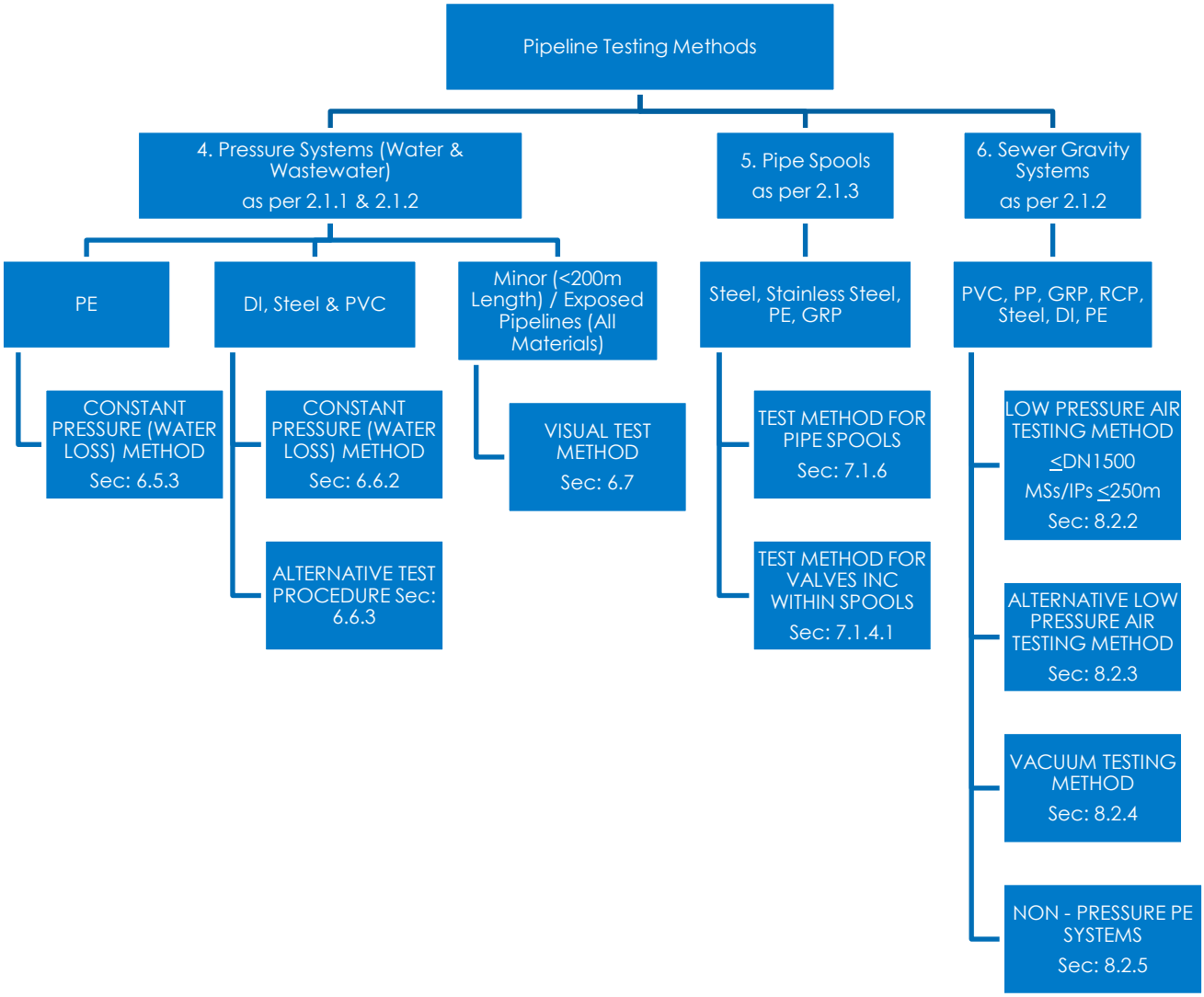
Section	Type	Description
6.1.10	Hold	Before any gauge is used, it shall be checked independently, and a dated certificate of its accuracy shall be provided. Certificate of calibrations issued within the last 12 months by an approved NATA registered laboratory.
6.2	Witness	Thrust blocks shall have reached the minimum design strength required, as determined in consultation with the Designer, the mix design (trial mix test results) and TS 0710
6.1.13	Witness	Where a new pipeline or other tested element is to connect to an operational pipeline, the final connection shall be inspected visually under normal operating pressure and there shall be no visible leakage.
6.1.15	Hold	All repairs carried out by the Constructor shall be inspected and passed by SA Water's Owners Engineer or Superintendent's Representative before backfilling is continued.
6.1.4	Hold	Confirmation of requirements to test against a closed valve.
6.1.12, 7.1.9 and 8.1.5	Approval	The provisions for the removal and disposal of water used for disinfection, swabbing or testing shall be stated in the project specification. Discharges to sewers or through overflow pipework shall not take place without the authorisation of SA Water.
6.1.15, 6.2, 6.7, 7.1.8 and 8.1.4	Witness	Visual inspection during commissioning, and any leakage repaired.

A2 Schedule of identified records

Section	Description of Identified Record
6.1.10	Certificate of calibration issued within the last 12 months by an approved NATA Registered laboratory.
6.1.11	Pump maintenance records.
8.1.2	Calibration certificate for all air pressure and vacuum testing equipment.
8.2.1	Pressure gauges shall each have a certificate of calibration issued within the last 12 months by an approved NATA registered testing facility
8.2.1	Calibration certificate for all air pressure and vacuum testing equipment.

Appendix B - Test methods

B1 Pipeline testing methods



Appendix C - Example inspection and test plans

C1 Constant pressure method for visco-elastic pressure pipelines

To be used as required.

Company Name		**Project No.**	
Constructor Name		**Pipe Under Test**	
Signature		**Date**	
Test Method	TS 0900: Section 6.5.3: CONSTANT PRESSURE (WATER LOSS) METHOD FOR VISCO-ELASTIC PRESSURE PIPELINES		
Hydraulic Design Pressure		**Hydraulic Test Pressure**	
Pipe Material		**Size**	
Start Time / Date		**End Time / date**	
Water Temperature		**Ambient Temperature**	
Start Pressure / Volume		**End Pressure / Volume**	

Description / Parameter	Initial	Comment / Value
Vertical elevation of test section sketched (to be attached to this document). Including details of heights, location of air valves, gauges and fill points.		
Battery limits of the test (e.g. starting and finishing points/chainages). Record in sketch.		
Visual inspection of pipe section under test ensuring all pre-test checks have been done.		
Exclusion zone set up, and all parties are aware that a pressure test is underway.		
Thrust restrains (temporary or otherwise) in place & cured.		
Calibrated pressure gauges installed at appropriate locations.		
Calibration certificates approved and in date.		
Test source water approval obtained.		
Pipeline cleaned.		
Air purged from pipeline.		
Failure of any thrust block, pipe, fitting, joint or any other pipeline component. Record locations on sketch.		
Location and nature of leaks repaired identified. Record in sketch.		
Any visible leakage identified. Record in sketch.		
Allowable Makeup Volume (Q1). Record here.		
Release approved (EPA Permit etc approved).		
Test pressure safely de-pressurised.		
Insert as required.		

SAMPLE

Time		Pressure (kPa)	Makeup Water (litres)		Ambient Temp. (°C)	Initial
Hour	Time / Date		Added	Total		
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Pass / Fail		Signature	
Client Witness Name		Company	
		Signature	
Remarks / Defects			

C2 Constant pressure (water loss) method

Company Name		**Project No.**	
Constructor Name		**Pipe Under Test**	
Signature		**Date**	
Test Method	TS 0900: Section 6.6.2: CONSTANT PRESSURE (WATER LOSS) METHOD		
Hydraulic Design Pressure		**Hydraulic Test Pressure**	
Pipe Material		**Length**	
Start Time / Date		**End Time / date**	
Water Temperature		**Ambient Temperature**	
Start Pressure / Volume		**End Pressure / Volume**	

Description / Parameter	**Initial**	**Comment / Value**
Vertical elevation of test section sketched (to be attached to this document). **Including details of heights, location of air valves, gauges and fill points.**		
Battery limits of the test (e.g. starting and finishing points/chainages). Record in sketch.		
Visual inspection of pipe section under test ensuring all pre-test checks have been done.		
Exclusion zone set up and all parties are aware that a pressure test is underway.		
Thrust restrains (temporary or otherwise) in place & cured		
Calibrated pressure gauges installed at appropriate locations		
Calibration certificates approved and in date.		
Test source water approval obtained.		
Pipeline cleaned.		
Air purged from pipeline.		
Failure of any thrust block, pipe, fitting, joint or any other pipeline component. Record locations on sketch.		
Location and nature of leaks repaired identified. Record in sketch.		
Any visible leakage identified. Record in sketch.		
Allowable Makeup Volume (Q1). Record here.		
Actual volume of Makeup Water.		
Release approved (EPA Permit, etc. approved)		
Test pressure safely de-pressurised		
Insert as required.		

SAMPLE

Time		Pressure (kPa)	Makeup Water (litres)		Ambient Temp. (°C)	Initial
Hour	Time / Date		Added	Total		
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

Pass / Fail	Signature	
Client Witness Name	Company	
	Signature	
Remarks / Defects		

C3 Alternative test procedure and visual test for minor pipelines

Company Name		**Project No.**	
Constructor Name		**Pipe Under Test**	
Signature		**Date**	
Test Method	TS 0900: Section 6.6.3: ALTERNATIVE TEST PROCEDURE **OR** TS 0900: Section 6.7: VISUAL TEST FOR MINOR PIPELINES		
Hydraulic Design Pressure		**Hydraulic Test Pressure**	
Pipe Material		**Length**	
Start Time / Date		**End Time / date**	
Water Temperature		**Ambient Temperature**	
Start Pressure / Volume		**End Pressure / Volume**	

Description / Parameter	Initial	Comment / Value
Vertical elevation of test section sketched (to be attached to this document). Including details of heights, location of air valves, gauges and fill points.		
Battery limits of the test (e.g. starting and finishing points/chainages). Record in sketch.		
Visual inspection of pipe section under test ensuring all pre-test checks have been done.		
Exclusion zone set up and all parties are aware that a pressure test is underway.		
Thrust restrains (temporary or otherwise) in place & cured		
Calibrated pressure gauges installed at appropriate locations		
Calibration certificates approved and in date.		
Test source water approval obtained		
Pipeline cleaned		
Air purged from pipeline		
Failure of any thrust block, pipe, fitting, joint or any other pipeline component. Record in sketch.		
Location and nature of leaks repaired identified. Record in sketch.		
Any visible leakage identified. Record in sketch.		
Release approved (EPA Permit, etc. approved)		
Test pressure safely de-pressurised		
Insert as required.		

Pass / Fail	**Signature**	
Client Witness Name	**Company**	
	Signature	
Remarks / Defects		

SAMPLE