Australian Standard™

Arc-welded steel pipes and fittings for water and wastewater

Standards Australia

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Australian Standard™

Arc-welded steel pipes and fittings for water and wastewater

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PREFACE

This Standard was prepared by the Standards Australia Committee WS-009, *Rolled and Welded Steel Pipes* to supersede AS 1579—1993.

The objective of this draft is to provide designers of rolled and welded steel pipe with requirements for design of steel pipe, and means of demonstrating compliance with the Standard.

The main changes in this revision are the following:

(a) The provision of design methods that do not require hydrostatic testing in order to demonstrate compliance.

(b) The inclusion of joints, joint dimensions and bends

(c) Details of testing for steel piling.

This Standard may be used in conjunction with Standards for the protection of pipes and piles, which are referred to in the document.

Statements expressed in mandatory terms in notes to tables are deemed to be requirements of this Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

CONTENTS

Page

STANDARDS AUSTRALIA

Australian Standard
Arc-welded steel pipes and fittings for water and wastewater

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for arc-welded steel pipes and fittings with butt-welded seams, having diameters equal to or greater than 114 mm outside diameter intended for the conveyance of water and wastewater at rated pressures up to 6.8 MPa, and for use as piles.

Methods of demonstrating compliance with this Standard are given in Appendix A.

NOTE: Purchasing guidelines are given in Appendix B.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard.

AS	
1199	Sampling procedures and tables for inspection by attributes
1281	Cement mortar lining of steel pipes and fittings
1349	Bourdon tube pressure and vacuum gauges
1399	Guide to AS 1199—Sampling procedures and tables for inspection by attributes
1646	Elastomeric seals for waterworks purposes
1646.1	Part 1: General requirements
1646.2	Part 2: Material requirements for pipe joint seals used in water and wastewater
1646.3	Part 3: Material requirements for pipe joint seals used in water and wastewater applications with the exception of natural rubber and polyisoprene compounds
1978	Pipelines—Gas and liquid petroleum—Field pressure testing
2812	Welding, brazing and cutting of metals—Glossary of terms
4087	Metallic flanges for waterworks purposes
4321	Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings
AS/NZS	
3500	National Plumbing and Drainage Code
3500.0	Part 0: Glossary of terms
1554	Structural steel welding
1554.1	Part 1: Welding of steel structures
1594	Hot-rolled steel flat products
3678	Structural Steel—Hot-rolled plates, floorplates and slabs
4020	Products for use in contact with drinking water
SAI	
HB18	Guidelines for third-party certification and accreditation
HB18.28	Guide 28: General rules for a model third-party certification system for products

ISO
559 Steel tubes for water and sewerage
2859 Sampling procedures for inspection by attributes
2859.1 Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
3951 Sampling procedures and charts for inspection by variables for percent nonconforming

API
5L Specification for Line Pipe (see Note)

NOTE: Available from American Petroleum Institute, 1801 K St. N. W., Washington, DC 20037

1.3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 1978, AS 2812, AS 3500.0 and those below apply. Where this Clause includes definitions of terms defined elsewhere, the definition provided herein apply.

1.3.1 Deflection angle

The acute angle formed between the axes of two adjacent pipes when a joint is completed between them.

1.3.2 Effective length

The overall length of the pipe minus the nominal joint entry, expressed in metres.

1.3.3 Hydrostatic test pressure

The pressure applied internally to the pipe or fitting during the hydrostatic test.

1.3.4 Layback

The angular distortion of a flange from its original plane due to welding the flange onto a pipe or fitting.

1.3.5 Nominal minimum yield strength (NMYS)

The anticipated minimum yield strength based on statistical records.

NOTE: This may be applied to analysis grades and by agreement with the purchaser to structural (mechanically tested) grades.

1.3.6 Non-destructive testing (NDT)

Testing of welds in accordance with AS/NZS 1554.1 Category SP.

1.3.7 Outside diameter (OD)

The specified outside diameter of the uncoated pipe or fitting expressed in millimetres.

NOTE: This is the preferred method of specifying pipe diameter.

1.3.8 Nominal size (DN)

A numerical designation of size, which is common to all components in a piping system other than components designated by outside diameters.

NOTE: Nominal size is loosely related to manufacturing dimensions, and is designated by DN followed by a number.

1.3.9 Ovality

The difference between maximum and minimum diameters after due allowance for sag.

1.3.10 Pile

A circular structural member that is driven into soil and is not used for internal pressure containment.

1.3.11 Specified minimum yield strength (SMYS)

The specified minimum yield strength when ordering a structural (mechanically tested) grade of steel.

1.3.12 Rated pressure (P_r)

The maximum internal hydrostatic pressure, at which the pipe is suitable for sustained operation.

1.3.13 Wall thickness (t)

The nominal thickness of the wall of a pipe or fitting, not including any lining or coating and not taking into account the effect of manufacturing tolerances.

1.3.14 Working pressure

The maximum operating internal hydrostatic pressure for the pipeline determined by the designer after considering the rated pressure of the pipe and fittings and taking into account the various factors such as external loads and transient hydrostatic conditions.

1.4 MARKING

Pipes and fittings shall be legibly and permanently marked on the external surface, no closer than 150 mm from an end, with the following information:

(a) A unique serial number that is maintained throughout the manufacturing operations.

(b) The place of manufacture.

NOTE: This is not required where the place of manufacture is readily traceable from the unique serial number.

(c) Outside diameter (pipes only).

(d) Wall thickness (pipes only).

(e) The number of this Australian Standard, i.e. AS 1579.

(f) The manufacturer's name or registered trademark.

(g) For hydrostatically tested pipes only, the rated pressure, in megapascals.

(h) For non-hydrostatically tested pipes only, the words 'Not hydrostatically tested'. Additionally where required for non-hydrostatically tested pipes, '100% NDT AS 1554.1 SP'.

(i) For pipes or fittings complying with AS/NZS 4020 'AS/NZS 4020'.

1.5 INFORMATION TO BE SUPPLIED BY THE PURCHASER

NOTE: Guidelines for information to be supplied by the purchaser at the time of inquiry are given in Appendix B.

1.6 COATING AND LINING

Pipes and fittings intended for the conveyance of water and sewage shall be protected from corrosion by a coating and lining, suitable for their intended purpose. Coatings shall be applied in accordance with AS 1281 and AS 4321. Other coatings and linings may be applied as specified by the purchaser.

1.7 HANDLING, LIFTING AND STORAGE

Pipes, piles and fittings shall be lifted and handled in a manner that is safe and avoids permanent distortion of the pipe, pile or fitting and damage to the coating and/or lining.

Pipes, piles and fittings shall be supported, both in storage and during transport, in a manner that is safe and avoids permanent distortion of the pipe, pile or fitting and damage to either the coating and/or lining.

1.8 EFFECT ON WATER

Pipes and fittings supplied to this Standard, which are for use in contact with water intended for human consumption, shall comply with AS/NZS 4020. Such compliance shall apply to the pipe and fittings in the finished condition taking into account all coatings and/or linings that come into contact with the water in the pipeline.

SECTION 2 RATED PRESSURE

2.1 HYDROSTATICALLY TESTED PIPE

The maximum internal hydrostatic pressure at which hydrostatically tested pipe is suitable for sustained operation is calculated from the following equations:

$$P_r = 0.72\frac{(2\times SMYS\times t)}{OD} \text{ or;} \qquad \ldots 2.1(1)$$

$$P_r = 0.72\frac{(2\times NMYS\times t)}{OD} \qquad \ldots 2.1(2)$$

The maximum rated pressure for pipes and fittings produced in accordance with this Standard is 6.8 MPa. This maximum is dictated by a pressure test equipment limit of 8.5 MPa.

In emergency situations transient pressures may lead to an increase in pipe stress. Under these conditions the maximum allowable combined stresses shall be determined by the designer, but shall not exceed 0.90 × SMYS.

2.2 NON-HYDROSTATICALLY TESTED PIPE

For pipe that is not hydrostatically tested in accordance with this Standard, the designer shall determine the design pressure rating of the pipe.

The wall thickness of all pipes that are non-hydrostatically tested shall be no less than 8.0 mm. All welds shall be 100 % non-destructively tested in accordance with AS 1554.1, Category SP.

The maximum hoop stress at the rated pressure shall not exceed 0.50 of the specified minimum yield stress of the steel.

2.3 FITTINGS

The rated pressure of fittings produced in accordance with this Standard shall be the responsibility of the designer.

SECTION 3 MANUFACTURE

3.1 PIPE AND PILES

3.1.1 Steel

Hydrostatically tested pipes shall be manufactured from an analysis or structural grade of hot rolled steel complying with AS/NZS 1594 or AS/NZS 3678. Piles and non-hydrostatically tested pipe shall be manufactured from a structural grade of steel complying with AS/NZS 1594 or AS/NZS 3678. Alternatively, piles may be manufactured from an analysis grade complying with AS/NZS 1594, in which case the steel shall be mechanically tested in accordance with AS 1391 to demonstrate that it meets the tensile requirements specified by the purchaser. The steel shall have a carbon equivalent (CE) not exceeding 0.40 when calculated using the following formula:

$$CE = \frac{\%Mn}{6} + \left(\frac{\%Cr + \%Mo + \%V}{5} \right) + \left(\frac{\%Ni + \%Cu}{15} \right) \quad \ldots 3.1$$

3.1.2 Welding

All welds shall be complete penetration butt welds carried out in accordance with AS 1554.1 Category SP.

Pipes for water and wastewater shall be produced using at least one internal pass and one external pass. Welds may be made by any combination of longitudinal, circumferential or spiral welding. The height of weld reinforcement shall not exceed 3 mm, and the maximum misalignment between plates of the same nominal thickness in butt welds shall be as follows:

(a) 1.5 mm where $t < 12$ mm.

(b) 3.0 mm where $t \geq 12$ mm.

Repair welds shall be carried out in accordance with AS 1554.1 Category SP.

3.1.3 Pipe and pile sizes

The minimum outside diameter shall be 114 mm.

NOTE: Whereas this Standard does not place any restrictions on pipe sizes, ISO pipe sizes shown in Appendix C are preferred.

3.1.4 Tolerances on dimensions

3.1.4.1 *General*

Tolerances in Clauses 3.1.4.1 to 3.1.4.4 shall apply to the finished pipe along the length of the barrel of the pipe (i.e. excluding the joint region, where relevant).

3.1.4.2 *Diameter*

The outside diameter of the pipe shall be measured by taping the circumference. It shall not deviate from the specified diameter by more than ±0.50%. The pipe dimension shall be measured at completion, unless the manufacturer can demonstrate that measurements recorded during manufacture are suitable.

3.1.4.3 *Ovality*

Ovality shall not exceed 1% of the specified outside diameter. Ovality shall be measured at the pipe ends.

3.1.4.4 *Length*

The following apply to the length of pipes:

(a) Where pipes are ordered without an exact length (i.e. as standard length), the measured length of any pipe shall not differ from the length ordered by more than ±75 mm.

NOTE: Pipes may be supplied with a maximum variation of ±300 mm, provided the number of pipes supplied to this wider tolerance does not exceed 5% of the total order and advice is given to the purchaser.

(b) Where pipes are ordered to be of exact length, the order shall show the word, 'exact', and the measured length of any pipe shall not differ from the length ordered by more than ±12 mm.

(c) Where pipes are ordered in random lengths, the average length and the minimum length shall be subject to agreement between the purchaser and the manufacturer.

3.1.4.5 *Straightness*

The deviation from straightness shall be not greater than 0.2% of the pipe length. Straightness shall be measured at the side of the pipe so that any sag does not influence the measurement.

NOTE: Pipes manufactured for cement mortar lining (in accordance with AS 1281) may need to be made to a tighter straightness tolerance to ensure uniformity of lining application.

3.2 FITTINGS

3.2.1 Manufacture

Fittings shall be made from pipe manufactured in accordance with this Standard, or shall be fabricated from structural steel complying with AS/NZS 1594 or AS/NZS 3678. The CE shall not exceed 0.40.

The use of pipe manufactured in accordance with API Specification 5L shall be acceptable for branches only (e.g. offtakes, scour valves, air valves, etc.). Where such pipe is used, the CE of the material shall not exceed 0.40.

NOTE: The use of fittings, incorporating pipe branches manufactured in accordance with API Specification 5L, shall be the responsibility of the fittings designer.

Fittings shall be supplied with joints as specified by the purchaser.

3.2.2 Welding

Welds shall be carried out in accordance with AS 1554.1 Category SP. Single-sided butt-welds are permissible provided full penetration is achieved. The height of weld reinforcement shall not exceed 3 mm, and the maximum misalignment between plates of the same nominal thickness in butt welds shall be as specified in Clause 3.1.2.

3.2.3 Dimensions and tolerances on fittings

Fittings may be manufactured in a range of outside diameters and wall thicknesses.

NOTE: See Appendix D for dimensions of a typical range of fittings.

The end faces of fittings shall be at right angles to the axis of the relevant leg of the fitting.

3.2.4 Tolerance on dimensions

Tolerances shall be as follows:

(a) The tolerance on diameter and ovality shall be the same as for pipe of the same size.

(b) The tolerance on leg lengths shall be ±50 mm, except where an exact leg length is specified then the tolerance shall be ±5 mm.

(c) The tolerance on the angle between end-faces shall be within one degree of the design value.

3.3 JOINTS

3.3.1 General

The dimensions and tolerances of elastomeric seal joints shall be included in the manufacturer's design for the purposes of inspection. Where angular deflection is required in field joints, the maximum allowable deflection shall be specified by the manufacturer.

NOTE: Typical examples of joints are illustrated in Appendix E.

3.3.2 Flanged joints

Flanged joints shall be in accordance with AS 4087. Other types of flanges may be supplied with the agreement of the purchaser.

Flanges shall be square to the pipe or fitting to which they are fitted within 0.25° or 2 mm, whichever is less, and the layback shall be within the range 0 to 0.75°.

3.3.3 Elastomeric joints

Elastomeric joint seals shall comply with AS 1646.1 and either AS 1646.2 or AS 1646.3, as applicable. The elastomeric material shall be EPDM, unless otherwise specified by the purchaser (see Appendix B).

3.3.4 Field butt welded joints

Where pipes are to be supplied with the ends prepared for butt welding in the field, the pipe ends shall be bevelled to an angle of 30 +5, −0°. This angle shall be measured from a line drawn perpendicular to the axis of the pipe, and with a root face of 2.0 ±1.0 mm, unless otherwise specified by the purchaser (see Appendix B).

3.3.5 Field fillet welded joints

The maximum gap in assembled ends that are designed for field fillet welding shall not exceed 3 mm.

Spherical slip in joints with diameters greater than 1000 mm may have a gap greater than 3.0 mm on the inside, when fully deflected, provided that the region where the excessive gap exists does not exceed 20% of the pipe circumference.

SECTION 4 TESTING

4.1 PIPE

4.1.1 General

Every pipe intended for the conveyance of water or wastewater, shall be —

(a) subjected to hydrostatic testing in accordance with Appendix F; or

(b) subject to approval of the relevant asset owner, 100% of the welds shall be non-destructively tested by ultrasonic or radiography methods in accordance with AS 1554.1 Category SP with acceptance standards as specified in AS 1554.1

Pipes that are to be hydrostatically tested shall be subjected to a strength test and a leak test in accordance with Clause 4.1.2 and 4.1.3, as applicable.

4.1.2 Strength test

Strength tests shall be conducted at a pressure in accordance with Equation 4.1(1) or 4.1(2), equivalent to 90% of the specified minimum yield strength (SMYS), or nominal minimum yield strength (NMYS), of the steel from which the pipe or fitting is manufactured, or 8.5 MPa, whichever is less.

The strength test hydrostatic pressure (P_t) is calculated as follows:

$$P_t = \frac{0.90(2 \times \text{SMYS} \times t)}{D} = 1.25\, P_r \qquad \ldots 4.1(1)$$

$$P_t = \frac{0.90(2 \times \text{NMYS} \times t)}{D} = 1.25\, P_r \qquad \ldots 4.1(2)$$

Upon strength testing, there shall be no rupture or leakage of the test pipes.

4.1.3 Leak test

A leak test shall be conducted on the pipe. The leak test hydrostatic pressure (P_l) is equivalent to the rated pressure, P_r.

Upon leak testing, there shall be no leakage observable on the pipe surface.

4.2 PILES

Non-destructive testing of a portion of pile welds shall be examined by ultrasonic or radiography methods in accordance with AS/NZS 1554.1 Category SP. The test results shall meet the requirements of AS/NZS 1554.1 Category SP. Where a spot examination discloses welding that does not comply with AS/NZS 1554.1 Category SP, then the entire length of weldment on that pile shall be examined. All unacceptable defects shall be repaired and re-examined to demonstrate compliance to AS/NZS 1554.1 Category SP.

NOTE: Steel piles do not require hydrostatic testing.

4.3 FITTINGS

4.3.1 General

The quality of welds shall be tested in accordance with Clauses 4.3.2 to 4.3.4, as appropriate.

4.3.2 Pressure retaining main butt welds

All pressure retaining butt welds (i.e. longitudinal, circumferential and spiral) in fittings shall satisfy either —

(a) a non-destructive test in which the full length of all pressure containing welds shall be examined by ultrasonic or radiography methods in accordance with AS/NZS 1554.1 Category SP with acceptance standards as specified in AS/NZS 1554.1; or,

(b) a pressure test in which welds shall be hydrostatically tested in accordance with Appendix F.

4.3.3 Branch welds and pressure containing fillet welds

Branch welds and pressure containing fillet welds, as shown in Figures D4 to D9, D12 and D13 of Appendix D, shall satisfy either—

(a) a dye penetrant or magnetic particle test on the full length of weldment, undertaken in accordance with the methods and requirements of AS 1554.1 Category SP; or,

(b) a pressure test in which welds will be hydrostatically tested in accordance with Appendix F.

4.3.4 Non-pressure retaining fillet welds

Fillet weldment shall be visually inspected for soundness according to the requirements of AS 1554.1 Category SP, and shall be measured to show conformance with the size specified in the design.

4.4 JOINTS

4.4.1 General

All butt-welded, fillet-welded, flanged and elastomeric seal joints shall be measured for dimensional conformance.

4.4.2 Assembly test

Spigot and socket type pipe joints shall be subjected to an assembly test, which includes elastomeric ring joints, spherical slip in joints, ball and socket joints, and the like. The assembly test excludes both flange and butt joints.

The test comprises two pipes being joined by entering the spigot into the socket to the manufacturer's recommended depth without causing damage to the pipe, coating, lining or seal. This test shall be applied to finished pipes that have been hydrostatically tested (see Section 3). If the pipes do not meet the test requirement, they shall be rejected and two additional joints shall be tested from the production shift. Failure of either of the retests shall require testing of each pipe in the batch for compliance.

4.4.3 Elastomeric seal joint type testing

Elastomeric ring joints shall be hydrostatically tested for watertightness in accordance with Appendix G over the range of permissible component tolerances and joint deflections as follows:

(a) The type test shall include a partial vacuum test of at least −80 kPa and a positive pressure test at least 1.25 times the rated pressure of the joint.

(b) A type test on any pipe within the size range 114–323 mm OD qualifies all pipes in that range. The same applies to the size range 324–1016 mm OD provided the pipe tested is in the range 711–1016 mm OD. For pipes above 1016 mm OD, a type test on any pipe size qualifies all sizes up to the pipe size tested.

No leakage shall occur in either the positive pressure or the partial vacuum test and the joint components shall remain within their dimensional tolerances after completion of the test.

Documentation of the type test(s) applicable to each joint design shall be maintained by the manufacturer, and shall be available to the purchaser upon request.

As an alternative to type testing it is acceptable for the manufacturer to provide documented evidence of satisfactory field performance of elastomeric seal joints for each of the diameter ranges specified above. Such documentation shall include a statement from the owner or operator of the pipeline attesting to the pipe diameter, joint design, wall thickness, successful installation and commissioning, together with at least one year of satisfactory service, of not less than 5 km of that sized pipeline.

APPENDIX A

MEANS FOR DEMONSTRATING COMPLIANCE WITH THIS STANDARD

(Normative)

A1 SCOPE

This Appendix sets out two means by which compliance with this Standard shall be demonstrated by a manufacturer:

The use of a product certification scheme.

The use of a minimum sampling and testing frequency plan.

A2 RELEVANCE

The long-term performance of pipeline systems is critical to the operating efficiency of water agencies in terms of operating licences and customer contracts. The long-term performance of plumbing systems is similarly critical to the durability of building infrastructure, protection of public health and safety and protection of the environment.

A3 DEFINITIONS

A3.1 Acceptable quality level (AQL)

Where a continuous series of lots or batches is considered, the quality level, which for the purpose of sampling inspection, is the limit of a satisfactory process average (see ISO 2859-1 and ISO 3951).

NOTE: The designation of an AQL does not imply that a manufacturer has the right to supply knowingly any non-conforming unit of product.

A3.2 Batch release test (BRT)

A test performed by the manufacturer on a batch of components, which has to be satisfactorily completed before the batch can be released.

A3.3 Inspection level

The relationship between the lot or batch size and the sample size (see ISO 2859-1).

A3.4 Lot

A clearly identifiable subdivision of a batch for inspection purposes.

A3.5 Production batch

A clearly identifiable collection of units, manufactured consecutively or continuously under the same conditions, using material or compound conforming to the same specification.

A3.6 Sample

One or more units of product drawn from a batch or lot, selected at random without regard to quality.

NOTE: The number of units of product in the sample is the sample size.

A3.7 Type test (TT)

Test intended to prove the suitability and performance of new materials, new manufacturing processes, new joint designs or new types of fittings.

NOTE: Type tests are generally carried out when a change is made to one of these aspects of the product.

A4 PRODUCT CERTIFICATION

The purpose of product certification is to provide independent assurance of the claim by the manufacturer that products comply with this Standard.

The certification scheme shall meet the criteria described in SAI HB 18.28/SANZ HB 18.28 (ISO/IEC Guide 28) in that, as well as full type testing from independently sampled production and subsequent verification of conformance, it requires the manufacturer to maintain effective planning to control production.

The certification scheme serves to indicate that the products consistently conform to the requirements of this Standard.

Product certification shall be conducted by a certification body accredited by the Joint Accreditation System for Australia and New Zealand (JAS-ANZ) or by another certification body that is acceptable to JAS-SNZ.

The frequency of the sampling and testing plan, as detailed in Paragraph A5, shall be used by the certifying body for product compliance auditing. However, where the manufacturer can demonstrate adequate process control to the certifying body, the frequency of sampling and testing nominated in the manufacturer's quality and/or documented procedures shall take precedence for the purpose of product certification.

A5 MINIMUM SAMPLING AND TESTING FREQUENCY PLAN

A5.1 General

Table A1 sets out the minimum sampling and testing frequency plan for a manufacturer to demonstrate compliance of product(s) to this Standard.

A5.2 Retesting

In the event of a test failure, the products manufactured since the previous test(s) conforming to the requirements outlined in Table A1 shall be quarantined as a batch. A further set of samples shall be selected randomly from the quarantined batch using a sampling plan to AS 1199 for an acceptable quality level (AQL) of 2.5 and an inspection level of S3, unless otherwise specified. If the retest requirements are met, the batch may be released and compliance with this Standard for the quarantined batch may be claimed.

Should a failure occur on retesting, then the quarantined batch shall be rejected and claims and/or marking indicating compliance to this Standard shall be suspended until the cause of the failure has been identified and corrected.

For assembly test, retesting shall be in accordance with Clause 4.4.2.

A5.3 Rejection after test

In the event of a quarantined batch being rejected after retesting in accordance with the procedures set out in Paragraph A4.2, it may be subjected to 100% testing for the failed requirement(s), and only those items found to comply may be claimed and/or marked as complying with this Standard.

A6 TEST REQUIREMENTS

Testing shall be undertaken as specified in Section 4 at a frequency not less than that specified in Table A1.

TABLE A1

TYPICAL TESTING SCHEDULE FOR THE ASSESSMENT OF COMPLIANCE

Characteristic	Clause	Requirement	Test Method	Frequency
Type tests (TT)				
Marking	1.4 (see Note 1)	Legible and permanent no closer than 150 mm from an end	Visual examination and measuring tape	At any change in marking process
Material properties—Pipes and fittings—Water supply and sewerage only	1.6	Coatings and linings shall comply with requirements of AS 1281 and AS 4321 or as specified by the purchaser	Refer to AS 1281 and AS 4321 or customer specification	As specified in AS 1281 and AS 4321 and customer specification
Handling, lifting and storage	1.7	No permanent distortion and damage to either lining and/or coating	Visual examination and measuring tape	At any change in handling, lifting and storage procedures, design or manufacturing process
Material properties—Pipes and fittings—Water supply only	1.8	Effect on water	AS/NZS 4020	At any change in material or every five years whichever occurs first
Material properties — Pipes, piles and fittings	3.1.1	Certificate of compliance Carbon equivalent <0.40	AS/NZS 1594 or AS/NZS 3678 and by calculation	At any change in material
Welding—Pipes, piles and fittings	3.1.2	Qualification of welding procedure	AS 1554.1 Category SP	At any change in material, or welding procedure
Dimensions—Pipes and piles	3.1.4.1 (see Note 1)	Diameter	Measuring tape	At any change in design or manufacturing process
	3.1.4.2 (see Note 1)	Ovality	Measuring tape	At any change in design or manufacturing process
	3.1.4.3 (see Note 1)	Length	Measuring tape	At any change in design or manufacturing process
	3.1.4.4 (see Note 1)	Straightness	As appropriate	At any change in design or manufacturing process
Dimensions—Fittings	3.2.4 (see Note 1)	General dimensions including diameter, leg length, fitting angle between end faces etc.	As appropriate	At any change in design or manufacturing process
Dimensions—Joints	3.3.2 (see Note 1)	Flange squareness and layback	As appropriate	At any change in joint design or joint manufacturing process

(*continued*)

TABLE A1 (*continued*)

Characteristic	Clause	Requirement	Test Method	Frequency
	3.3.4 (see Note 1)	General dimensions of bevel and root face	As appropriate	At any change in joint design or joint manufacturing process
	3.3.5 (see Note 1)	Tolerance on gap in assembled ends	As appropriate	At any change in joint design or joint manufacturing process
	4.4.1 (see Note 1)	Dimensional conformance to manufacturers' design	As appropriate	At any change in joint, design or joint manufacturing process
Material properties—Elastomeric seals	3.3.3	Certificate of compliance	AS 1646 and either AS 1646.2 or AS 1646.3	At any change in material
Design—Non-hydrostatically tested pipe	4.1.1(b) (see Note 1)	NDT of all welds	AS 1554.1 category SP	At any change in material or welding process
Design—Hydrostatically tested pipe	4.1.2 (see Note 1)	Strength test	Appendix F	At any change in design or manufacturing process
		Leak test	Appendix F	At any change in design or manufacturing process
Design—Piles	4.2 (see Note 1)	NDT of portion of welds	AS 1554.1 category SP	At any change in material or welding process
Design—Fittings	4.3.1(a) (see Note 1)	NDT of pressure retaining main butt welds	AS 1554.1 category SP	At any change in material or welding process
	4.3.1(b) (see Note 1)	Hydrostatic test	Appendix F	At any change in material or welding process
	4.3.2(a) (see Note 1)	NDT of pressure retaining fillet welds	AS 1554.1 category SP	At any change in material or welding process
	4.3.2(b) (see Note 1)	Hydrostatic test	Appendix F	At any change in material or welding process
	4.3.3 (see Note 1)	Visual examination and fillet size of non-pressure retaining fillet welds	AS 1554.1 category SP	At any change in material or welding process
Design—Joints	4.4.2 (see Note 1)	Assembly test	As appropriate	At any change in material, joint design or joint coatings.
	4.4.3	Hydrostatic test of 1 pipe per size range or documented evidence of satisfactory field performance.	Appendix G or service performance	At any change in elastomeric seal hardness or shape or joint design.

(*continued*)

TABLE A1 (*continued*)

Characteristic	Clause	Requirement	Test Method	Frequency
Batch release tests (BRT)				
Marking	1.4	Legible and permanent no closer than 300 mm from an end	Visual examination and measuring tape	Each pipe or once at the start of a production run
Material properties—Pipes, piles and fittings	3.1.1, 3.2.1	Certificate of compliance verification of carbon equivalent <0.40	AS/NZS 1594 or AS/NZS 3678 By calculation	Each heat of steel
Weld inspection—Pipes	3.1.2	Weld reinforcement misalignment ≤1.5mm for t < 12 mm ≤3.0 mm for $t \geq 12$ mm	By measurement	At the start of a run or at a change in procedure.
Dimensions—Pipes and piles	3.1.4.1 (see Note 2)	Diameter	Measuring tape	Each pipe or, once at the start of a production run then weekly.
	3.1.4.2	Ovality	Measuring tape	Each pipe end once per shift
	3.1.4.3	Length	Measuring tape	Every pipe where exact length is specified, otherwise one pipe per shift.
	3.1.4.4	Straightness	As appropriate	Once per shift
Dimensions—Fittings	3.2.4	Fitting leg length, ovality and diameter	Measuring tape	Each fitting
	3.2.4	Fitting angle between end faces	As appropriate	Each fitting
Joint inspection of pipes and fittings	3.3.2 3.3.4 4.4.1	Conformity with dimensional tolerances	As appropriate	Once per shift for butt-welded joints. Each flanged or elastomeric ring joint pipe end.
Material properties—Elastomeric seals	3.3.3	Not required if supplied product StandardsMark product certified. Otherwise, certificate of compliance required.	Manufacturer's specification	Not required or each batch as appropriate
Joint assembly of pipes and fittings	3.3.5	Tolerance on gap in assembled ends	As appropriate	One joint (two pipes) from the first 10 pipes manufactured and one joint per week of production thereafter
	4.4.2	Demonstrate satisfactory assembly.	As appropriate	One joint (two pipes) from the first 10 pipes manufactured and one joint per week of production thereafter

(*continued*)

TABLE A1 (*continued*)

Characteristic	Clause	Requirement	Test Method	Frequency
NDT—Pipes, piles and fittings	4.1.1(b) 4.2 4.3.1(a) 4.3.2(a) 4.3.3	Satisfactory defect level	AS 1554.1 Category SP ultrasonic, radiography, dye penetrant and MPI and visual examination as applicable	All weldments for pipes and fittings and 10% of weldment in the first 10 piles and 5% of pile weldment thereafter
Hydrostatic testing	4.1.1(a), 4.1.2, 4.1.3 4.3.1(b) 4.3.2(b)	No leakage	Appendix F	Each pipe and fitting (where applicable)

NOTES:

1 The applicable batch release test shall be sufficient to demonstrate compliance.

2 Where the manufacturing process is such that the diameter is determined by a non-adjustable process (e.g. a fixed cage), measurements shall be taken on one of the first ten pipes manufactured, then once every week.

APPENDIX B

PURCHASING GUIDELINES

(Informative)

B1 SCOPE

Joint Australian/New Zealand Standards are intended to include the technical provisions necessary for the supply of products referred to in a particular Standard, but do not purport to contain all the necessary provisions of a contract.

In a number of cases, the purchaser is either asked to specify requirements or is given a choice of optional requirements. These are contractual matters to be agreed upon between the purchaser and the manufacturer.

This Appendix contains advice and recommendations on the information to be supplied by the purchaser at the time of inquiry. Its aim is to avoid misunderstandings and to result in the purchaser receiving satisfactory products and service.

B2 INFORMATION TO BE SUPPLIED BY THE PURCHASER

A purchaser should supply the following information at the time of calling for tenders or quotations for pipes and fittings:

(a) The outside diameter of the pipes and fittings.

(b) The intended use of the pipe, particularly if intended for use in contact with drinking water

(c) The required rated pressure or the required wall thickness and yield strength.

(e) The total quantity of pipe

(f) Required effective length of individual pipes.

(g) Whether the pipes are to be supplied other than in standard lengths (see Clause 3.3.2.3).

(h) Type of joint to be provided.

(i) The type of coating or lining required

(j) If NDT is to be used in lieu of hydrostatic testing, written permission shall be obtained from the relevant asset owner.

(k) The type of field joint to be supplied and, if non-standard, the dimensions and tolerances for preparations intended for field butt welds (see Appendix E and Clause 3.3.4).

(l) The types of fittings to be supplied. Where the design is to be undertaken by the purchaser, a complete design for each type of fitting. Where the design is to be undertaken by the supplier, an instruction to that effect.

(m) Whether elastomeric jointing rings are to be included in the order and if a particular elastomeric seal material is required.

Whether provision for joint bonding cables is required on elastomeric ring jointed pipes.

B3 INFORMATION TO BE SUPPLIED BY THE MANUFACTURER

The manufactures should provide the maximum allowable deflection of the joint.

B4 MANUFACTURER'S CERTIFICATE

The manufacturer should, upon request, supply the purchaser with a signed certificate stating that the pipes, fittings, or both, have been manufactured in accordance with the requirements of the purchaser and this Standard.

NOTE: Manufacturers making a statement of compliance with this Australian Standard on a product, packaging, or promotional material related to that product are advised to ensure that such compliance is capable of being verified.

APPENDIX C

ISO STEEL PIPE SIZES

(Informative)

The diameters given in Table C1 are from ISO 559 (with the exception of DN 750).

TABLE C1

OUTSIDE DIAMETERS

Nominal size DN	Outside diameter (mm)
100	114
150	168
200	219
250	273
300	324
350	356
400	406
450	457
500	508
600	610
700	711
750	762
800	813
900	914
1000	1016
1200	1219
1400	1422
1600	1626
1800	1829
2000	2032
2200	2235

APPENDIX D

SUGGESTED DIMENSIONS OF BENDS AND DESCRIPTIONS OF FITTINGS

(Informative)

D1 SCOPE

This Appendix describes a selection of commonly used steel fitting configurations.

D2 GENERAL

Fittings are manufactured in a range of configurations to suit a wide variety of specific needs. Figures D1 to D14 depict commonly used fittings. Table D1 indicates sizes for elastomeric ring jointed bends. Some water agencies may have standard bend designs that may be used in preference to those described in this Appendix. The purchaser may request alternative bend dimensions. The design of the bend, including wall thickness, welding detail, pressure rating and bend anchorage remain the responsibility of the designer.

Common end configurations include plain end, slip-in-joint, ball and socket joint, flanged and elastomeric ring joints. With the exception of plain ended fittings, an additional length for the joint entry should be added to the fitting

D3 DIMENSIONS OF BENDS

An economical design of elastomeric ring-jointed bends is depicted in Figures D1 to D3. For bends with an angle in the range 0 to 22.5° (Figure D1) the economical leg length is equal to D, rounded to the nearest 100 mm, but no less than 200 mm. For bends with an angle above 22.5° the radius R, determines the optimum size. Table D1 specifies the minimum radius for different pipe diameters. On fittings with spigot and socket type joints (i.e. not plain end) the leg length of the socket should be increased by the joint entry length, Le.

D4 DESCRIPTION OF FITTINGS

The legend for symbols used in Figures D4 to D14 is as follows:

D_1 = outside diameter of pipe

D_2 = outside diameter of branch

L = leg length as measured at centre-line of fitting

L_1 = leg length of branch or offtake

L_2 = leg length to branch or change in diameter

$\theta°$ = angle of deflection

Le = joint entry length (typically 130 mm for elastomeric ring jointed pipe)

R = radius of bend

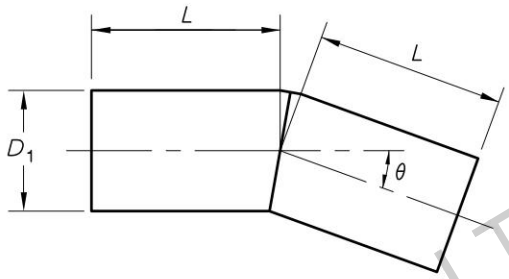


FIGURE D1 MITRED BEND 0° TO 22.5°

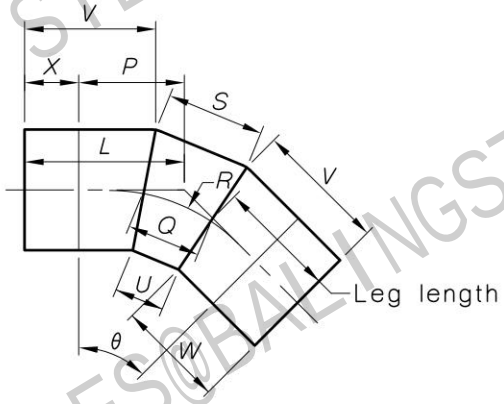


FIGURE D2 MITRED BEND 22.5° TO 45°

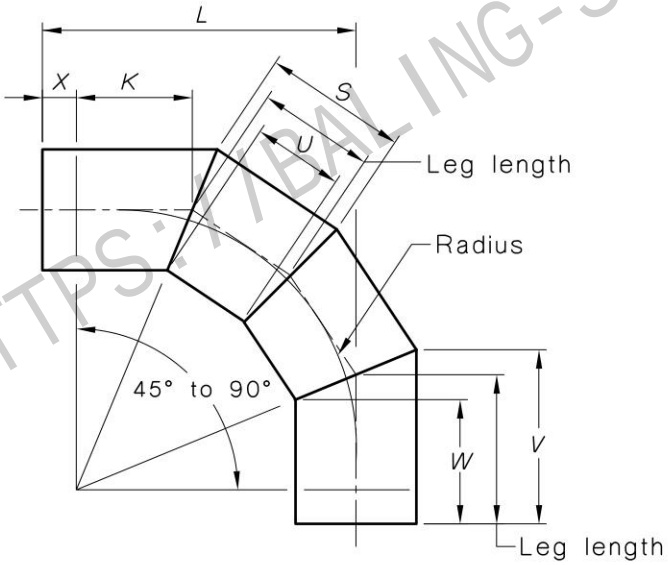


FIGURE D3 MITRED BEND 45° TO 90°

TABLE D1

SUGGESTED DIMENSIONS OF BENDS

millimetres

OD	Angle Degrees	Radius	No. of mitre cuts	X	K	L	S	U	V	W	Centre-line length
324	30	650	2	326	86	500	214	128	433	390	994
324	45	650	2	231	129	500	323	194	392	328	979
324	60	650	3	225	115	600	286	172	368	311	1137
324	90	650	3	150	174	800	435	262	368	281	1345
406	30	800	2	286	105	500	264	157	418	364	993
406	45	800	2	169	159	500	399	238	368	287	974
406	60	800	3	238	141	700	354	211	415	343	1323
406	90	800	3	200	214	1000	538	320	469	360	1686
508	30	1000	2	150	132	650	330	196	315	248	827
508	45	1000	2	150	199	650	499	297	399	298	1096
508	60	1000	3	150	176	800	442	263	371	282	1358
508	90	1000	3	150	268	1150	672	400	486	350	1908
610	30	1200	2	150	158	700	396	236	348	268	932
610	45	1200	2	150	239	700	599	356	449	328	1255
610	60	1200	3	150	212	950	531	316	415	308	1570
610	90	1200	3	150	322	1350	807	480	553	390	2229
711	30	1350	2	150	178	750	449	262	375	281	1011
711	45	1350	2	150	269	750	678	396	489	348	1374
711	60	1350	3	150	238	1050	601	351	451	325	1728
711	90	1350	3	150	362	1500	914	533	607	416	2470
813	30	1600	2	150	211	900	528	314	414	307	1143
813	45	1600	2	150	318	900	798	475	549	387	1573
813	60	1600	3	150	282	1200	708	421	504	360	1993
813	90	1600	3	150	429	1750	1075	640	688	470	2872
914	30	1800	2	150	237	1000	594	354	447	327	1248
914	45	1800	2	150	358	1000	898	534	599	417	1732
914	60	1800	3	150	317	1300	796	474	548	387	2204
914	90	1800	3	150	482	1950	1210	720	755	510	3194
1016	30	2000	2	150	263	1100	660	393	480	346	1353
1016	45	2000	2	150	398	1100	998	594	649	447	1891
1016	60	2000	3	150	353	1450	884	526	592	413	2416
1016	90	2000	3	150	536	2150	1344	800	822	550	3515

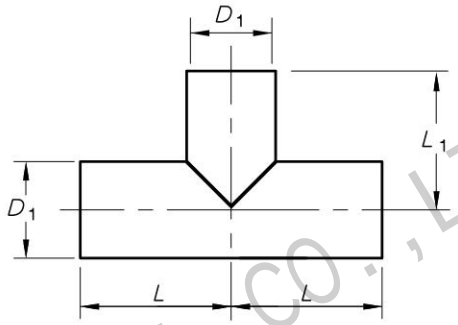


FIGURE D4 EQUAL TEE (UNREINFORCED)

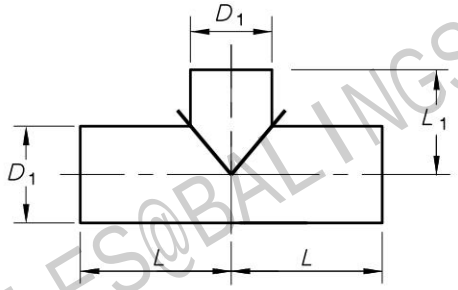


FIGURE D5 REINFORCED EQUAL TEE

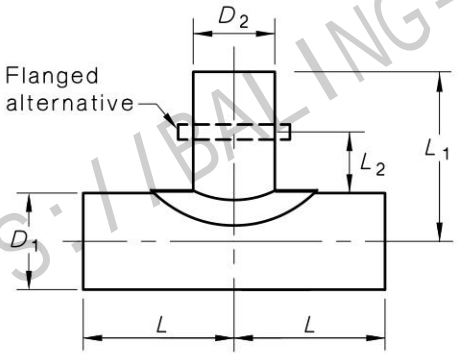


FIGURE D6 UNEQUAL TEE WITH REINFORCEMENT COLLAR

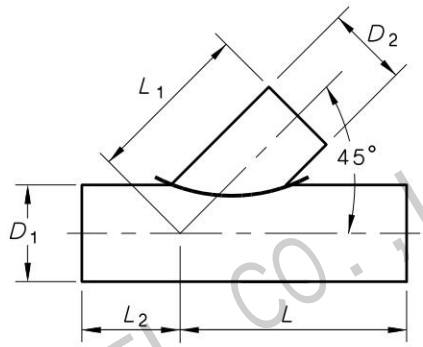


FIGURE D7 REINFORCED BRANCH

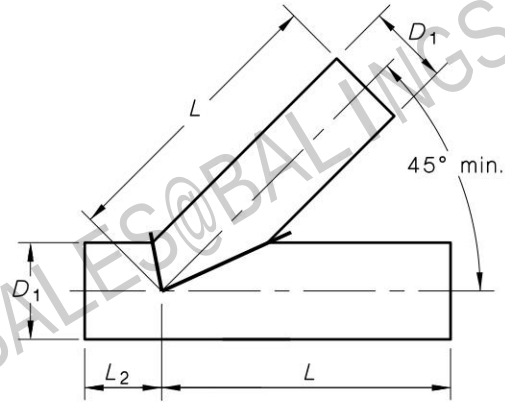


FIGURE D8 REINFORCED ANGLE BRANCH

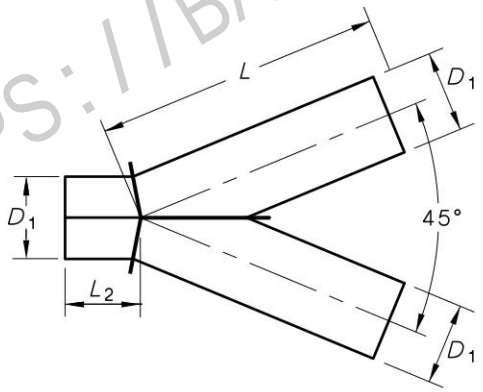
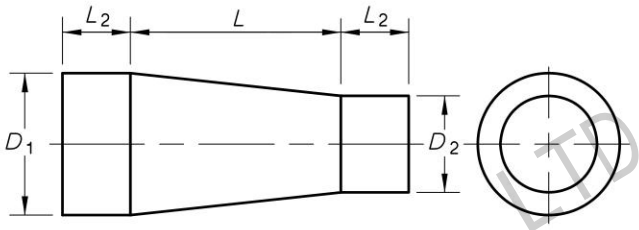
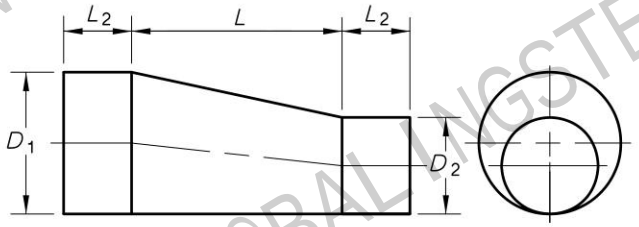


FIGURE D9 Y-PIECE



NOTE: A puddle flange may be required where elastomeric ring joints are used.

FIGURE D10 CONCENTRIC REDUCER



NOTE: A puddle flange may be required where elastomeric ring joints are used.

FIGURE D11 ECCENTRIC REDUCER

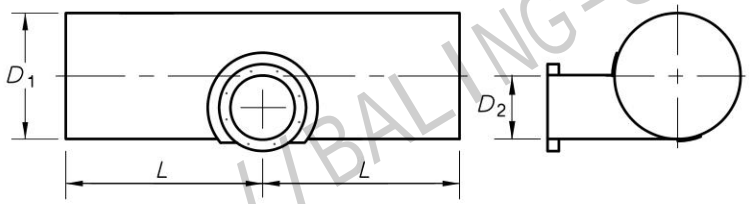


FIGURE D12 TANGENTIAL DRAIN OR SCOUR OUTLET

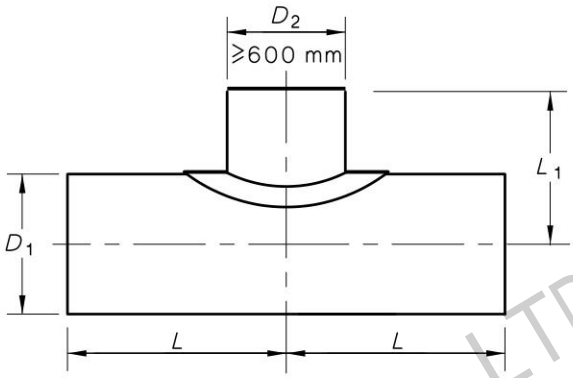


FIGURE D13 ACCESS HOLE

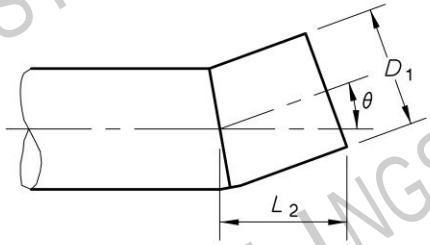
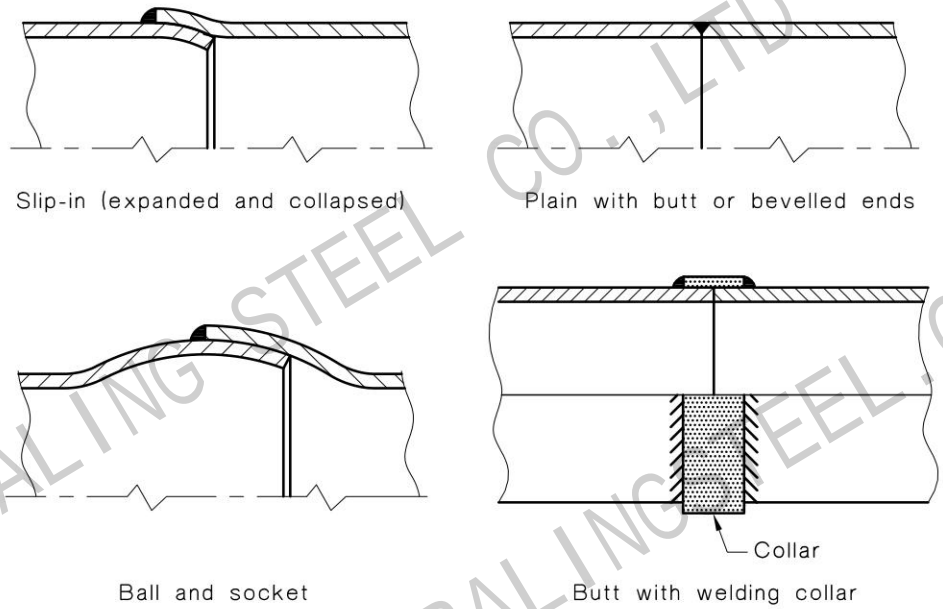


FIGURE D14 PIPE SUPPLIED WITH ANGLE DEVIATION

APPENDIX E
TYPICAL EXAMPLES OF JOINTS
(Informative)



NOTE: Weld preparation and location will depend upon pipe thickness and outside diameter.

FIGURE E1 WELDED JOINTS

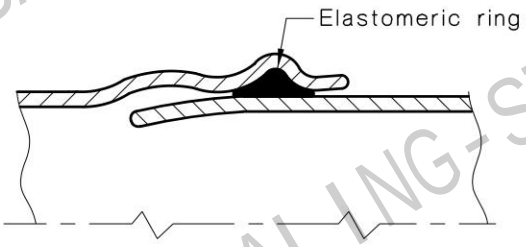


FIGURE E2 ELASTOMERIC RING JOINT

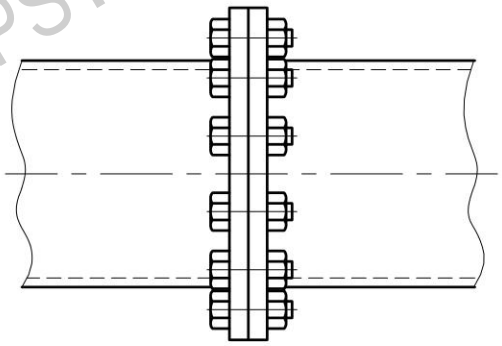


FIGURE E3 FLANGED JOINT

APPENDIX F

HYDROSTATIC TEST METHOD

(Normative)

F1 SCOPE

This Appendix sets out a method for hydrostatic testing of pipes for strength and leak tightness, for the purpose of type testing and batch release testing.

F2 PRINCIPLE

Pipe is sealed at each end and is pressurized hydrostatically. It is checked for strength at a pressure that represents the design pressure of the pipe. It is tested for leak tightness at the rated pressure of the pipe.

F3 RESIDUAL AIR

A vent shall be provided to permit the escape of air from the pipe as it is filled with water.

F4 PRESSURE MEASUREMENT

The pressure shall be measured by equipment complying with the installation, sensitivity and accuracy requirements of AS 1349 for test gauges. Where Bourdon tube pressure gauges are used, they shall be at least 150 mm diameter, and chosen so that the test pressure (P) is within 40% to 80% of the full scale range.

The pressure shall be recorded on equipment fulfilling the installation, sensitivity and accuracy requirements of AS 1349 for industrial gauges. Where a chart recorder is used, the scale shall contain at least 50 divisions.

Pressure measuring and recording equipment shall be checked at the test pressure against the indication of a deadweight tester at least once per week, or for each change of test pressure, whichever occurs first.

F5 STRENGTH TEST

The strength test shall be conducted at a test pressure P_t (MPa) calculated in accordance with Clause 4.1.2, and shall be held within the range of $P_t \pm 50$ kPa for at least 10 s.

NOTE: The tensile stress-strain behaviour of formed and welded pipes is not linear unless the pipe has been cold expanded or heated to temperatures above about 100°C after the forming process. For this reason, extreme care is required in the control of the hydrostatic test at pressures over about 80% SMYS. At pressures above the specified test pressure, the extent of yielding may increase rapidly. The application of pressures above the specified maximum of $P_t + 50$ kPa has to be avoided because of risks to personnel, product and plant (see AS 1978, Appendix D).

F6 LEAK TEST

Following completion of the strength test, each pipe shall be subjected to a leak test at a pressure equivalent to the rated pressure.

NOTE: The reduction in pressure below the strength test pressure is intended to provide for safe visual inspection.

Where the strength test is carried out at the maximum value of 8.5 MPa, the leak test shall be conducted at 6.8 MPa. Pipes that pass the leak test at 6.8 MPa shall be assigned a rated pressure of 6.8 MPa.

The duration of the leak test interval shall be sufficient to ensure, as far as practicable, complete visual inspection of the pipe surface. The surface of the pipe shall be adequately illuminated and kept dry during test.

F7 MEASUREMENT

Following hydrostatic testing, the pipe or fitting shall be measured to determine whether it complies with the dimensional requirements of this Standard.

F8 RECORDED INFORMATION

The following shall be recorded:

Pipe size and number.

The name of the manufacturer, and the OD of the pipe.

The pipe yield stress and wall thickness.

The test pressures.

Whether any leaks were evident at the test pressures.

APPENDIX G

METHOD FOR TYPE TESTING OF ELASTOMERIC SEAL JOINTS

(Normative)

G1 SCOPE

This Appendix sets out a method for type testing the design of elastomeric ring joints over the range of expected operating conditions by means of hydrostatic tests.

G2 PRINCIPLE

An elastomeric ring joint is assembled in a manner that—

(a) represents a worst-case mismatch of spigot and socket dimensional tolerances;

(b) simulates field stress conditions on the seal; and

(c) represents the maximum allowable deflection angle and maximum allowable radial deflection.

The assembly is then subjected to an internal hydrostatic pressure followed by a partial vacuum.

G3 DOCUMENTATION OF JOINT DESIGN

The design of an elastomeric ring joint that is to be type tested shall be documented. The documentation shall include the following information:

(a) The range of diameters.

(b) The maximum deflection angle.

(c) The design maximum operating temperature.

(d) The maximum radial deflection of the components.

(e) Dimensional tolerances for all components including coatings linings, or both, in the working region of the joint.

(f) The maximum and minimum (if other than −80 kPa) rated pressure for which the joint is designed.

(g) A description of the range of axial forces or stresses for which the joint is designed.

(h) A description of the method of assembly.

(i) Material property data upon which the joint design is based and upon which the joint depends over its working life.

G4 TEMPERATURE

Except where material property data for any component of the joint indicates otherwise, a type test conducted at any ambient temperature shall qualify the joint design for temperatures up to 30°C. If a higher design maximum operating temperature is required, it shall be qualified by a type test performed at the design maximum operating temperature.

G5 APPARATUS

Pressure measuring and recording equipment shall comply with the requirements of Paragraph F2 of Appendix F.

G6 TEST MEDIUM

The test medium shall be water, substantially free of air.

G7 JOINT CONFIGURATION

Each component, including any coatings or linings within the sealing area of the joint, shall be chosen such that the relevant dimensions are within 20% of the unfavourable tolerance limit. The unfavourable tolerance limit is defined in this context as being the worst case condition for the purposes of sealing.

G8 ASSEMBLY

The joint shall be assembled in accordance with the manufacturer's instructions as documented in the joint design. Pipe or fitting ends shall be sealed such that field stress conditions are simulated.

The joint shall be deflected axially and radially to the manufacturer's allowable limit as documented in the joint design.

G9 TEST PROCEDURE

The test procedure shall be as follows:

(a) Raise the pressure gradually to the test pressure of 1.25 times the rated pressure of the joint and hold it at that pressure for not less than one hour.

(b) Visually inspect the joint during pressurization, once the test pressure has been reached and after the holding period.

(c) Note the presence of moisture in the region of the joint.

(d) Following the release of pressure, apply a partial vacuum to the inside of the joint of −80 kPa or 1.25 times the design minimum rated pressure, if less than −60 kPa.

(e) Once the test negative pressure is reached and the pressurizing circuit sealed, hold the test pressure for at least one hour and note any reduction in vacuum as recorded by the test pressure gauges.

(f) Following negative pressure testing, disassemble the joint and determine whether the joint components have remained within their dimensional tolerances.

G10 REPORT

The following shall be reported:

(a) The name of the manufacturer, date of manufacture and size of the joint.

(b) The elastomeric joint ring material and dimensions.

(c) The angle of axial deflection and amount of radial deflection of joint components.

(d) The test pressure and partial vacuum applied.

(e) Whether any leakage was evident at the test pressure and whether any drop in vacuum was recorded at the test negative pressure.

(f) Any change in dimensions as a result of the test.

(g) A reference to this test method, i.e. AS 1579, Appendix G.

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