LICENCE

for

AS/NZS 4058:2007 Precast concrete pipes (pressure and non-pressure)

Licensee: Mr Nathan Kirk

Date: Tuesday, 8 December 2015 1:13 PM

Licence Agreement

This is an agreement between the end user of the Product ("Licensee") and SAI Global Limited, Level 37, 680 George Street, Sydney NSW 2000 AUSTRALIA, ABN 67 050 611 642.

1. Definitions and Interpretations

Australian Standards means Australian Standards and includes Joint ISO/Australian Standards, Joint NZ/Australian Standards, current Draft Australian Standards, and amendments to Australian Standards.

Concurrent Users means the maximum number of people able to access the Product at any one time, and is limited to the number of Licences purchased.

ISO Standards means Standards published by the International Organization for Standardization (ISO), for which SAI Global is an authorised distributor.

IEC Standards means Standards published by the International Electrotechnical Commission (IEC), for which SAI Global is an authorised distributor.

Internal use means use of the Product within the Licensee's organization.

Licence means the right to access and use the Product.

Licensee means the purchaser and user of the Product.

Product means Australian Standards, ISO Standards and IEC Standards ordered and purchased through the infostore, and

Click on the red box above to activate the Licence Agreement scroll bar.

AS/NZS 4058:2007

Australian/New Zealand Standard™

Precast concrete pipes (pressure and non-pressure)

STANDARDS Australia

STANDARDS NEW ZEALAND
PAEREWA AOTEAROA

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee WS-006, Concrete Pipes. It was approved on behalf of the Council of Standards Australia on 22 January 2007 and on behalf of the Council of Standards New Zealand on 19 December 2006.
This Standard was published on 18 April 2007.

The following are represented on Committee WS-006:

Australasian Railway Association
Australian Chamber of Commerce and Industry
Brisbane City Council
Business New Zealand
Concrete Pipe Association of Australasia
Engineers Australia
Main Roads Department, QLD
Master Builders Australia
New Zealand Water and Waste Association
Precast New Zealand
University of Tasmania
Water Services Association of Australia

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about joint Australian/New Zealand Standards can be found by visiting the Standards Web Shop at www.standards.com.au or Standards New Zealand web site at www.standards.co.nz and looking up the relevant Standard in the on-line catalogue.

Alternatively, both organizations publish an annual printed Catalogue with full details of all current Standards. For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update options. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of either Standards Australia or Standards New Zealand at the address shown on the back cover.

This Standard was issued in draft form for comment as DR 04237.

Australian/New Zealand Standard™

Precast concrete pipes (pressure and non-pressure)

Originated, in part, as AS A35—1957 and AS A124—1962.
AS A35 revised and designated AS 1342—1973,
AS A124 revised and designated AS 1392—1974.
AS 1342—1973 and AS 1392—1974 revised and designated AS 4058—1992.
AS 4058—1992 and NZS 3107:1978 jointly revised and designated AS/NZS 4058:2007.

Jointly published by Standards Australia, GPO Box 476, Sydney, NSW 2001 and Standards New Zealand, Private Bag 2439, Wellington 6020

ISBN 0 7337 8161 6

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee WS—006, Concrete Pipes, to supersede AS 4058—1992, *Precast concrete pipes (pressure and non-pressure)* and NZS 3107:1978, *Specification for precast concrete drainage and pressure pipes*.

The objective of this revision is to update the Standard for publication as a joint Australian/New Zealand Standard.

Where a choice is given between an Australian Standard and a New Zealand Standard (for example, Testing) the Australian Standard will apply in Australia and the New Zealand Standard in New Zealand.

Users of the Standard are reminded that the means for determining whether a pipe, manufactured in accordance with this Standard, is suitable for a particular loading application, are contained in AS/NZS 3725, *Design for installation of buried concrete pipes*.

The in-service life of a pipeline installation is dependent on the pipe's manufacture, application and installation conditions. Based on past experience of concrete pipe installations, a service life of 100 years could be expected when pipes are manufactured in accordance with this Standard and installed in accordance with AS/NZS 3725 in a 'normal environment' and 'marine environment', as defined in this Standard. Pipes subject to 'other environments' (i.e. more aggressive) should be assessed for suitability using appropriate engineering judgement. See Appendix E 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.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard. All other notes are for information only.

CONTENTS

Page

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Precast concrete pipes (pressure and non-pressure)

S E C T I O N 1 S C O P E A N D G E N E R A L

1.1 SCOPE

This Standard describes minimum requirements for materials and manufacture of controlled quality precast concrete pipes. It also describes minimum requirements for sampling, testing and classifying concrete pipes manufactured in accordance with this Standard.

This Standard applies to circular precast pipes manufactured from concrete, unreinforced or with circumferential steel reinforcement, that are intended for pressure or non-pressure water supply, drainage, sewerage or service duct applications.

This Standard does not apply to the following:

(a) Cast in situ pipes, box culverts, or structural members covered by other Australian Standards.

(b) Precast prestressed concrete pipe, embedded steel cylinder pipe, and fibre-reinforced concrete pipe or precast concrete cylindrical access chamber components, or pipes made of other materials.

Requirements for fittings fabricated from pipes complying with this Standard are not specified in this Standard.

Requirements for ordering and supplying concrete pipes are given in Section 6 (see Note 2).

NOTES:

1 This Standard does not cover the assessment of external service loads to which a pipe will be subjected in particular installation conditions. Therefore, purchasers should specify pipe design characteristics and routine testing requirements that are appropriate to the intended embedment and service conditions. Where a purchaser is not the concrete pipe asset owner, the purchaser should consult with the asset owner's designer or specifier to determine these requirements, prior to ordering.

2 AS/NZS 3725 should be referred to for the selection, design and specification of buried concrete pipe installations.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1379 Specification and supply of concrete

1478 Chemical admixtures for concrete, mortar and grout
1478.1 Part 1: Admixture for concrete

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 applications—Specifies by prescription formulation
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

AS
1726 Geotechnical site investigations

2758 Aggregates and rock for engineering purposes
2758.1 Part 1: Concrete aggregates

3582 Supplementary cementitious materials for use with portland and blended cement
3582.1 Part 1: Fly ash
3582.2 Part 2: Slag—Ground granulated iron blast-furnace
3582.3 Part 3: Amorphous silica

3610 Form for concrete

3972 Portland and blended cements

AS/NZS
3725 Design for installation of buried concrete pipes

4671 Steel reinforcing materials

NZS
3114 Specification for concrete surface finishes

3121 Specification for water and aggregate for concrete

3122 Specification for Portland and blended cements (General and special purpose)

1.3 DEFINITIONS

1.3.1 Administrative definitions

1.3.1.1 *Approved*

Approved by the purchaser or its nominated representative.

1.3.1.2 *Manufacturer*

The person(s) or corporate body responsible for the manufacture of the pipes.

1.3.1.3 *Purchaser*

The person(s), corporate body, or authorized agent thereof, with whom the manufacturer has contracted to manufacture or supply the pipes.

1.3.1.4 *Specified*

Stated in writing in any document (including an order, drawing and specification) that forms a part or the whole of a contract between the purchaser and the manufacturer.

1.3.2 Technical definitions

1.3.2.1 *Batch*

A group of pipes of the same class complying with a particular design and produced, under uniform conditions during a given production period, by the same process.

NOTE: A batch may be defined and identified by the pipe manufacturer.

1.3.2.2 *Class*

Pipes with common characteristics, classified in accordance with Clause 1.4.

1.3.2.3 *Concrete cover*

The thickness, in millimetres, of concrete between any surface of circumferential and longitudinal steel reinforcement, excluding nibs, end spacers and the ends of the longitudinal reinforcement, and the nearest concrete surface of the pipe.

1.3.2.4 *Diameter*

1 *Design diameter* The design internal diameter, nominated by the manufacturer for a specified nominal size load or pressure class of pipe to which specified tolerances are applied (see Note below).

2 *External diameter* The measured external diameter.

3 *Internal diameter* The measured internal diameter.

4 *Nominal diameter* (DN) The nominal internal diameter. Nominal diameter is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions.

NOTE: For a given nominal diameter, the design diameter usually decreases as the load or pressure class increases. The design diameter is normally the value used for hydraulic calculations.

1.3.2.5 *Deflection*

The maximum angle (of deviation) between two adjoining pipes that is quoted by the manufacturer as being able to be obtained without loss of joint performance for an appropriate service condition.

NOTE: Design deflections are normally only a proportion of the maximum deflection to allow for installation tolerances and future ground movement.

1.3.2.6 *Length*

1 *Effective length* The length (L_e) given in Figure 1.1, specified by the manufacturer and subject to the permissible tolerances.

2 *Laying length* The effective length plus the manufacturer's recommended laying gap.

1.3.2.7 *Lifting element*

A device cast into the pipe wall that is designed specifically to facilitate handling of the pipe.

1.3.2.8 *Normal environment*

An underground environment having negligible influence on the in-service life expectancy of pipe and having a minimum cover to reinforcement complying with this Standard.

NOTE: A guide to the concentration limits applicable to this environment is provided in Appendix E.

1.3.2.9 *Marine environment*

An underground environment for a pipe where the interior surface of the pipeline is also subject to tidal flow (i.e. not openly exposed to direct wave action or wind-driven salt-borne spray).

NOTE: A guide to the concentration limits applicable to some environment constituents is provided in Appendix E.

1.3.2.10 *Other environment*

An environment that does not comply with the definitions for either normal or marine environments.

NOTE: Includes environments in which one or more of the limits in Appendix E is exceeded.

1.3.2.11 *Splay ended pipe*

A pipe manufactured to have one or both ends at a specified non-perpendicular angle to the pipe axis.

1.3.2.12 *Standard feeler gauge*

A feeler gauge of the shape specified in Appendix C and of thickness given in Table C1, Appendix C.

1.3.2.13 *Test crack*

A crack developed in a pipe when the appropriate proof load has been applied and maintained in accordance with Appendix C.

1.3.2.14 *Proof load* (T_c)

The specified load applied to and sustained by a pipe without the appearance of cracks greater than the appropriate test crack.

1.3.2.15 *Test pressure* (P_t)

The hydrostatic pressure applied internally to pipes and fittings when factory-tested for strength and watertightness.

1.3.2.16 *Test ultimate load* (T_u)

The specified load that can be sustained by a pipe without loss of load.

1.3.2.17 *Test ultimate pressure* (P_u)

The specified factory hydrostatic pressure that can be sustained by a pipe without rapid loss of pressure.

1.3.2.18 *Allowable working pressure* (P_w)

The maximum internal hydraulic pressure, including surge pressure effects, that a pipe can sustain in continuous service with an appropriate design factor of safety.

1.3.2.19 *Routine test*

A test performed on a sample from a batch of pipes, to confirm conformance to the requirements of this Standard.

1.3.2.20 *Sample*

One or more pipes drawn from a batch selected at random irrespective of quality.

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

1.3.2.21 *Sampling scheme*

An overall system of sampling pipe production that comprises sampling plans for the tests to be carried out on finished pipes and includes related procedures.

1.3.2.22 *Sampling plan*

A specific plan or statement that gives the number, size and class of samples to be taken from a production batch of pipes, the frequency of inspection or testing and the associated acceptance or rejection criteria.

1.3.2.23 *Inspection*

An evaluation of the quality of pipe samples by inspection or examination.

1.4 CLASSIFICATION OF PIPES

1.4.1 Criteria

Concrete pipes shall be classified on the basis of the criteria given in Clauses 1.4.2 to 1.4.4. Pipes shall be considered to be of the same class if all the relevant classification criteria are the same.

1.4.2 Size class

The size class of a pipe shall be determined by the nominal diameter (DN) of the pipe in millimetres. Size classes for unreinforced concrete pipes are given in the first columns of Table 4.1. Size classes for reinforced concrete pipes are given in the first column of Table 4.2.

1.4.3 Load class

1.4.3.1 *General*

The load class of a pipe shall be determined in accordance with—

(a) Clause 1.4.3.2 for unreinforced pipes; or

(b) Clause 1.4.3.3 for reinforced pipe.

1.4.3.2 *Unreinforced pipes*

All unreinforced pipes shall be classified as light-duty load class in accordance with Table 4.1 and shall be designated by the size class followed by the letters 'LDU' (light duty unreinforced).

1.4.3.3 *Reinforced pipes*

Reinforced pipes shall be classified according to the size class and the corresponding test load(s) (proof and ultimate) given in the Table 4.2. The load class shall be designated by the size class followed by the class number specified at the top of the relevant column of Table 4.2.

1.4.3.4 *Jacking pipes*

This Standard does not provide data or criteria to design of concrete pipes for jacking loads. An appropriate engineering method shall be used.

1.4.4 Watertightness or pressure class

1.4.4.1 *General*

Where watertightness or pressure testing is specified in accordance with Clauses 4.4 or 4.5, as appropriate, a pipe and joint system shall be classified as either—

(a) watertight (90 kPa);

(b) pressure, where the specified test pressure (P_t) is ≥50 kPa.

Where no watertightness or pressure testing is specified for a pipe and joint system, it shall not be accorded a pressure classification.

Unreinforced (Load class LDU) pipes shall not be classified as pressure pipes.

1.4.4.2 *Watertightness class*

The watertightness class of a reinforced concrete non-pressure pipe shall be the verified by a 90 kPa watertightness test.

1.4.4.3 *Pressure class*

The pressure class of a reinforced concrete pressure pipe shall be the test pressure (P_t) (see Clause 4.5). The pressure class shall be designated by the value of P_t, (in kPa), and the maximum permissible proof load (T_{cp}) (in kN/m), determined in accordance with AS/NZS 3725, but not less than that given in Clause 4.2(c).

NOTE: Pressure class designations for pressure pipe are a P_t value ≥50 kPa.

1.4.4.4 *Joint selection*

Where a pipe joint system is accorded a pressure or watertightness class, the pipe joint shall incorporate an elastomeric seal in accordance with Clause 2.4.

NOTES:

1 Some non-pressure applications, where a watertightness class is not required, may involve the use of a pipe joint design that incorporates an elastomeric seal, which is intended to facilitate safe joint installation practices or to prevent soil or root migration into or through the joints.

2 Some flush or similar joint designs may have no watertightness or pressure class but may incorporate sealing elements including external bands to prevent soil migration into or through the joints

1.5 MARKING

1.5.1 Marking on each pipe

Each pipe shall have clearly and indelibly marked on it, in an easily visible location, the following information:

(a) The manufacturer's name or registered trademark and the location of manufacture.

(b) The date on which the pipe was cast.

(c) For pipes manufactured for—

(i) non-pressure or non-watertight applications, the nominal diameter and load class, e.g., DN 750/3 or DN 750/LDU

(ii) watertight applications (90 kPa), the nominal diameter and load class, e.g., DN 750/3/WT

(iii) pressure applications (e.g., pressure ≥50 kPa), the nominal diameter, the load class and the hydrostatic test pressure, e.g., DN 750/3/600 (750 nominal diameter, Class 3, 600 kPa hydrostatic pressure).

(d) For pipes manufactured for 'marine' or 'other' environments, in accordance with Item (c)(i), (c)(ii) or (c)(iii) above, as applicable, and the internal cover followed by the external cover, e.g., 10/20 or 20/10.

(e) Where an elliptical reinforcement cage has been incorporated in the pipe, the word 'TOP' indicating the correct laying position of the pipe with respect to the direction of vertical loading and the orientation of the reinforcement.

(f) The maximum mass in kilograms of pipe for the particular pipe class.

In New Zealand, for pipes with lifting elements in accordance with Clause 3.5.3, where the maximum mass that may be lifted using the lifting element has been marked on the lifting element, this requirement shall be deemed to have been met.

(g) For splay-ended pipes—

(i) markings 50 mm long on the outside of the pipe, at four locations on each end, to define the vertical and horizontal axes of the pipe; and

(ii) the specified curve identification for splay pipes, e.g., R 5 being for a 5 m radius curve, e.g., DN 750/3/R 5, or angle of splay in degrees, e.g., DN 750/3/2°.

(h) The number of this Standard, i.e., AS/NZS 4058.

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

1.5.2 Colour coding for load class

The pipe shall be indelibly marked, or a corrosion-resistant marker shall be securely fastened to the reinforcement, within 300 mm of the face of the pipe spigot end. The colour of the mark or marker for the appropriate load class shall be in accordance with Table 1.1. Markers shall not be employed with pipes for internal pressure applications.

For pipes having elliptical reinforcement, the mark or marker shall be fixed at the top of the pipe so that it will be clearly visible after the pipe is removed from the mould. Alternatively, marks or markers may be equally spaced each side of the top and in a plane perpendicular to the pipe length. Where marks or markers are located each side of the top of the pipe, a minimum of two sets (locations) are required. These marks or markers shall be in addition to the requirement of Clause 1.5.1(e).

TABLE 1.1

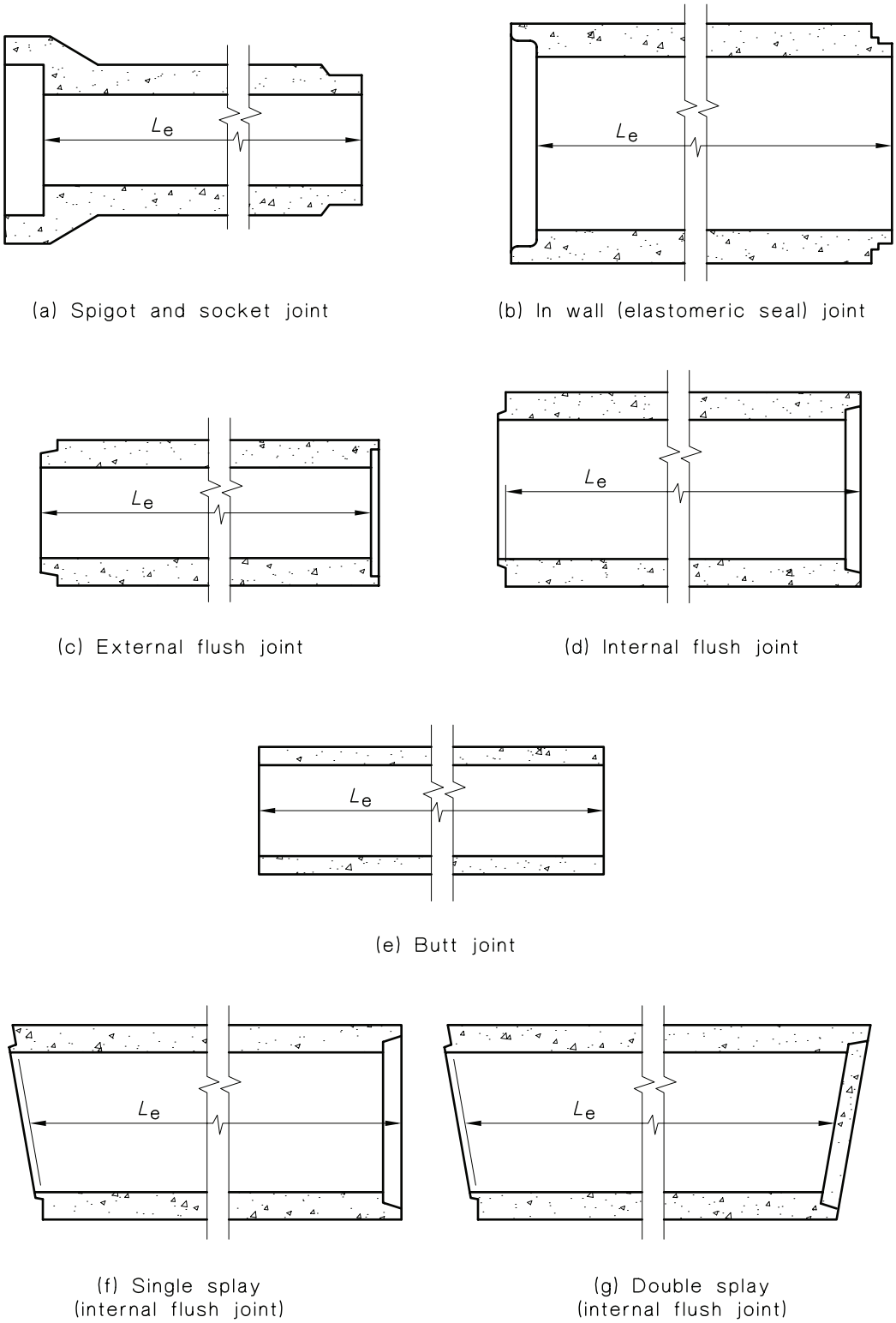
COLOUR CODING OF MARKERS

Load class designation of pipe (see Clause 1.4.3)	Marker colour	
	Australia	New Zealand
LDU	No marker	No marker
2	No marker	Yellow
3	Red	Blue
4	Yellow	Red
>4	Green	Red

NOTES:

1 In Australia, where elliptical reinforcement is used in Class 2 pipe, use white coloured markers to indicate top of pipe.

2 In New Zealand, where elliptical reinforcement is used in Class 2 pipe, a yellow marker shall be used to indicate top of pipe.



(a) Spigot and socket joint

(b) In wall (elastomeric seal) joint

(c) External flush joint

(d) Internal flush joint

(e) Butt joint

(f) Single splay
(internal flush joint)

(g) Double splay
(internal flush joint)

NOTES:

1 Joints depicted are schematic only and not intended to restrict the development of different joint designs.

2 For splay pipes L_e is the pipe centre-line dimension.

FIGURE 1.1 KEY PIPE ATTRIBUTES

SECTION 2 MATERIALS

2.1 VERIFICATION OF MATERIALS COMPLIANCE

The manufacturer shall have an auditable system of control that provides verification that concrete pipe materials comply with this Section.

2.2 CONCRETE MATERIALS

2.2.1 Cement

Cement shall comply with AS 3972 or NZS 3122, as applicable.

2.2.2 Supplementary cementitious materials

Supplementary cementitious materials shall comply with the relevant part(s) of AS 3582, as applicable.

2.2.3 Aggregates

Aggregates shall comply with AS 2758.1 or NZS 3121, as applicable, and with any additional requirements that may, according to that Standard, need to be separately specified for a particular usage or application of the pipes

Lightweight aggregates and non-ferrous metallurgical slag aggregates shall not be used in concrete for pipes.

NOTE: Attention is drawn to the fact that as AS 2758.1 and NZS 3121 include a number of options, they cannot be used on their own as a specification for contract purposes. The particular options selected as appropriate to the intended usage of the pipes will therefore need to be separately referred to by the purchaser. When not specified by the purchaser, the manufacturer should select the appropriate options in accordance with AS 2758.1 or NZS 3121.

2.2.4 Water

Water shall comply with the water requirements of AS 1379 or NZS 3121, as applicable.

2.2.5 Admixtures

Chemical admixtures shall comply with AS 1478.1. Chemical admixtures shall not contain nitrates, significant chlorides or other strongly ionized salts unless it can be shown that they do not adversely affect durability.

2.2.6 Restriction on chemical content

The materials shall not contain acid-soluble chloride or sulfate salts in excess of the values given in Table 2.1.

Other strongly ionized salts, such as nitrates, shall not be added to concrete unless it can be shown that they do not adversely affect durability.

TABLE 2.1

MAXIMUM VALUES OF ACID-SOLUBLE CHLORIDE AND SULFATE ION CONTENT IN CONCRETE AS CAST

Condition	Maximum acid-soluble chloride ion content (kg/m^3)	Maximum acid-soluble sulfate ion content percent (by mass of cement)
Concrete cured at ambient temperature	0.8	5.0
Steam-cured concrete	0.8	4.0

2.3 REINFORCEMENT

Reinforcement shall be steel bars, steel wire or welded-wire fabric complying with AS/NZS 4761.

2.4 JOINT MATERIALS

Where elastomeric seals or joint bands are used, they shall comply with AS 1646.1, and AS 1646.2 or AS 1646.3, as appropriate, and shall be supplied by the pipe manufacturer. When ordering elastomeric joint seals, the pipe manufacturer, as seal joint purchaser, shall document, as appropriate, the information described in Appendix B of AS 1646.1.

Other joint materials shall comply with the relevant Australian Standard or, where no such Standard exists, an appropriate current ISO, BS EN or ASTM Standard, by agreement between manufacturer and purchaser.

SECTION 3 MANUFACTURE, HANDLING AND STORAGE

3.1 VERIFICATION OF MANUFACTURING PROCESS COMPLIANCE

For each established and newly commissioned manufacturing facility, the manufacturer shall have an auditable system of control that verifies concrete pipe manufacturing, handling and storage comply with this Section.

3.2 DESIGN DETAILS

3.2.1 Joints

The ends of pipes shall be formed so that when pipes of the same nominal diameter and load class are laid together—

(a) for rigid joints, the diameters of the joined pipes shall be concentric in the plane of the joint; and

(b) for flexible joints, the axes of the joined pipes shall intersect in the plane of the joint.

Pipe ends intended for watertightness or pressure testing shall be designed to produce watertight pipeline joints in service (see Clause 5.2.3)

3.2.2 Structural continuity

Structural continuity shall be provided between the socket and pipe barrel.

NOTE: Barrel and socket reinforcement do not need to be interconnected.

3.2.3 Reinforcement

3.2.3.1 *General*

Where used, reinforcement shall be in the form of circular or elliptical cages concentric with the longitudinal axis of the pipe, and shall extend the length of the pipe barrel and socket.

At the time of placing concrete, the reinforcement shall be free of materials or coatings likely to impair its bond with the concrete.

3.2.3.2 *Fabrication*

Reinforcement shall be fabricated so that it can be easily placed and accurately held in the required position during pipe manufacture.

3.2.3.3 *Splicing of circumferential reinforcement*

Where it is necessary to splice the circumferential reinforcement, this shall be done by lapping the reinforcement not less than 50 diameters of the bar or wire, or by welding in a manner that will ensure that the ultimate strength of the reinforcement is developed by the splice. For lap splicing of welded wire fabric, the length of the lap shall be not less than the spacing of the transverse bars.

3.2.4 Concrete

Concrete shall be control batched and mechanically mixed. The batching and mixing shall be controlled to produce fresh concrete of uniform quality throughout each production run.

The fresh concrete shall be cast and cured to produce dense hardened concrete to a smoothness equivalent to a steel trowel finish and free from defects that would impair the strength or serviceability of the pipe. The interior or exterior concrete surfaces of pipes shall not be coated unless otherwise specified.

The manufacturer shall produce concrete with properties that provide a durability consistent with the water absorption limits specified in Clause 4.6 and strengths appropriate to the nominated load class and pressure class performance requirements.

NOTE: To achieve the required water absorption limits, typical concrete material requirements include the use of water/binder ratios (w/b) ≤0.4 and binder contents ≥330 kg/m^3.

3.3 DIMENSIONS AND TOLERANCES

3.3.1 General

The dimensions of pipes, including concrete cover to reinforcement, shall be determined in accordance with Clauses 3.3.2 to 3.3.7, at the place of manufacture. Where specified, sampling and testing shall be in accordance with Clause 5.2.

3.3.2 Concrete cover to reinforcement

The concrete cover to reinforcement, excluding radial nibs to circumferential reinforcement, end spacers, and longitudinal reinforcement ends, when measured in accordance with Appendix G shall be not less than the values given in Table 3.1.

TABLE 3.1

CONCRETE COVER TO STEEL REINFORCEMENT

millimetres

Method of manufacture	Minimum cover—Barrel and socket			Minimum cover—Mating surface of spigot		
	Environment					
	Normal	Marine	Other	Normal	Marine	Other
Machine made—						
Wall thickness						
≤25	6	N/A	(See	4	N/A	(See
>25, ≤35	8	N/A	Note 3)	5	N/A	Note 3)
>35	10	20		6	10	
Wet cast (50 MPa concrete)	25	35		25	35	

NOTES:

1 The minimum cover specifications apply to pipes with water absorption no greater than the values given in Clause 4.6.

2 Appendix E gives information on concentration limits applicable to some constituents of the buried environment when using concrete with water absorption in accordance with Clause 4.6.

3 'Other environment' refers to environments that do not comply with the definitions for either normal or marine environments. These include environments in which one or more of the limits in Appendix E is exceeded (e.g., above-ground salt-water exposure with severe wetting and drying). Specification of cover or other protective treatment for these situations requires an informed assessment drawing on information not available in this Standard.

4 Where pipes are loaded to less than 50% of the proof load for a marine environment, barrel cover for pipes with water absorption in accordance with Clause 4.6, may be reduced to 15 mm for machine made and 20 mm for wet cast.

5 Maximum 10 mm reinforcing bar or wire for nominated concrete covers to reinforcement.

6 N/A = Not applicable. Pipe wall geometry does not permit a pipe wall ≤35 mm to be specified for a marine environment.

3.3.3 Internal diameter

The internal diameter shall not vary from the design diameter nominated by the manufacturer by more than the tolerances given in Table 3.2.

No individual measurement of the internal diameter shall vary from the design diameter by more than—

(a) 10 mm for design diameters less than or equal to 1200 mm; or

(b) 15 mm for design diameters greater than 1200 mm.

The internal diameter shall be determined by taking two measurements, mutually at right angles, at 200 mm from each end and at the centre of the length. For socket and spigot joints, the distance from the socket end shall be measured from the point at which the socket meets the barrel. The internal diameter shall be taken as the mean of the six values.

TABLE 3.2

PERMISSIBLE TOLERANCES ON INTERNAL DIAMETER

millimetres

Design diameter	Permissible internal diameter tolerances	
	Drainage and sewerage pipes	Pressure pipes
≤600	±7	±5
>600, ≤1200	±8	±7
>1200, ≤1650	±10	±10
>1650	±13	±13

NOTE: Where specified, the tolerances in this Table may be applied to external diameter (see Clause 3.3.4).

3.3.4 External diameter

Where specified, the external diameter (D_e) shall be determined by taking two measurements mutually at right angles, at 200 mm from each end of the pipe barrel and at the centre of the length. For socket and spigot joints, the distance from the socket end shall be measured from the point at which the socket meets the barrel. The external diameter shall be taken as the mean of the six values.

3.3.5 Wall thickness

Wall thickness shall comply with the tolerances given in Table 3.3.

The wall thickness shall be determined by direct measurement. The wall thickness shall be determined by taking two measurements through the pipe barrel, mutually at right angles, at 200 mm from each end of the pipe. The wall thickness shall be taken as the mean of the four values.

TABLE 3.3

PERMISSIBLE TOLERANCES ON WALL THICKNESS

millimetres

Designated wall thickness *	Permissible tolerance
≤30	−2,+5
>30, ≤50	−3,+5
>50, ≤65	−4,+5
>65, ≤75	±5
>75, ≤95	±6
>95, ≤115	±7
>115, ≤135	±8
>135, ≤155	±9
>155	±10

* Refer to manufacturer's appropriate designated wall thickness for each pipe size class and load class.

3.3.6 Effective length

The effective length (L_e) shall not vary from the value nominated by the manufacturer by more than ±15 mm.

The lengths of the long and short sides of a splay-ended pipe shall not vary from the nominated values by more than ±7 mm.

The effective length (L_e) shall be determined by measuring along the barrel, at each of the one-third points of the internal circumference, and taken as the mean of the three values. For splay-ended pipes, L_e shall be determined by measuring along the barrel, at each of the one-quarter points of the internal circumference, and taken as the mean of the four values.

3.3.7 Straightness

For straight lengths of pipe, the total deviation from straightness of the inner surface when measured along the pipe axis from end to end shall not exceed 12 mm. In addition to this, the deviation from a straight line taken between any two points, one metre apart, along the pipe barrel shall not exceed 3 mm.

3.3.8 End squareness of pipes

End squareness of a pipe or jacking pipe shall comply with the tolerances given in Table 3.4.

The end squareness of a pipe shall be determined by measuring across three external end-diameters at 60 degrees to one another as shown in Figure 3.1.

TABLE 3.4

PERMISSIBLE TOLERANCE ON END SQUARENESS FOR PIPES

millimetres

Pipe		Jacking pipe	
Design diameter	**Permissible tolerance**	**Design diameter**	**Permissible tolerance**
≤450	±2	<900	±2
>450	*d*/200 or 10	≥900, ≤1500	±4
		>1500, ≤2400	±5.5
		>2400	±7

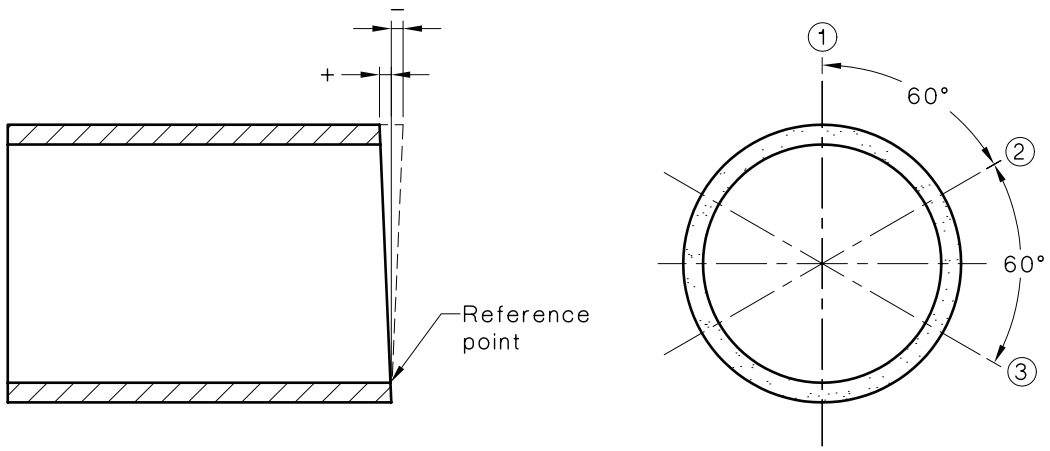


FIGURE 3.1 MEASUREMENT OF END SQUARENESS

3.4 WORKMANSHIP AND FINISH

3.4.1 Inspection and acceptance

Each pipe shall be inspected for defects in accordance with Clauses 3.4.2 and 3.4.4, and accepted in accordance with Clauses 3.4.3 and 3.4.4.

3.4.2 Defects in reinforced pipes

3.4.2.1 *Classification of defects by type*

Defects in untested reinforced pipes, or in such pipes after testing, shall be classified by type in accordance with Clause 3.4.2.2, and the acceptability or otherwise of pipes containing a particular type of defect shall be determined in accordance with Clause 3.4.3.

Surface craze cracks (usually of irregular pattern) and hairline cracks (cracks just visible to the naked eye) not extending through the pipe wall, shall not be classified as defects.

3.4.2.2 *Defect types*

Defects shall be classified as follows:

(a) *Type 1*—Clearly visible cracks not extending through the pipe wall and whose width as determined in accordance with Paragraph C4.3, Appendix C, at a depth of 3 mm is not greater than the relevant value given in Table 3.5, except that for sewerage pipes and pipes intended for use in marine environments, the maximum crack width for a Type 1 defect is 0.10 mm regardless of cover.

TABLE 3.5

MAXIMUM WIDTH OF TYPE 1 DEFECT CRACKS

millimetres

Cover	Maximum acceptable crack width
≤10	0.10
>10, ≤20	0.15
>20	0.20

(b) *Type 2*—Cracks not extending through the pipe wall, and whose width, at a depth of 3 mm, is greater than the value given in Table 3.5 but is less than the appropriate test crack width given in Table C2, Appendix C.

(c) *Type 3*—Cracks extending through the pipe wall or cracks whose width, as determined at a depth of 3 mm, is greater than the appropriate test crack width given in Table C2, Appendix C but is less than or equal to 0.5 mm.

(d) *Type 4*—Dents, bulges, chips and spalls of a depth or height not more than one quarter of the cover and extending in any direction not more than 50 mm. Surface blow holes not exceeding 4 mm in depth, or half the cover, whichever is the lesser, 10 mm in diameter and distribution not exceeding that shown in Appendix B of AS 3610 for Class 1 finish in Australia and NZS 3114 Class F5 finish in New Zealand.

NOTE: Where such defects, apart from those on socket back walls, extend to greater than 50 mm, arrangements should be made between the purchaser/asset owner/certifying body (as appropriate) and the manufacturer. This may be achieved by the provision of acceptable type samples or methods of test.

(e) *Type 5*—Dents, bulges, chips and spalls as for Type 4 but of a depth or height between one-quarter and one-half of the cover. Surface blowholes larger than Type 4 and bony patches of a depth not more than half of the cover and extending in any direction not more than 50 mm. On socket back walls, bony patches extending for a major portion of the circumference provided their depth is not more than one half of the cover.

NOTE: Where such defects, apart from those on socket back walls, extend to greater than 50 mm, arrangements should be made between the Purchaser, asset owner, certifying body (as appropriate) and the manufacturer. This may be achieved by the provision of acceptable type samples or methods of test.

Visible inclusions of foreign matter, with a total surface area less than 0.1% of the pipe surface area, either inside or outside and no individual inclusion greater than 400 mm^2 in area.

(f) *Type 6*—As for Type 5, but the depth or height of dents, bulges, chips, spalls and blowholes greater than one-half the cover.

(g) *Type* 7—Inclusions of foreign matter, in particular material of organic origin, greater than Type 5.

3.4.3 Acceptability of pipe wall and joint surface defects in reinforced pipes

The acceptability or otherwise of pipes with defects in the pipe wall or on the joint surfaces arising from manufacture or handling shall be determined in accordance with Table 3.6. Joint surface defects are those defects present in the mating parts of joint surfaces or in the surfaces in contact with elastomeric joint seals.

NOTE: Pipe wall defects 1, 2 and 3 apply to the pipe wall in all regions of the pipe.

3.4.4 Defects in unreinforced pipes

Cracks in unreinforced pipes shall not exceed 0.05 mm in width and shall not extend through the pipe wall nor extend for more than one-half of the barrel length.

Defects in untested unreinforced pipes, or in such pipes after testing, shall be classified by type (Types 4 to 7 only), in accordance with Clause 3.4.2.2, and the acceptability or otherwise of pipes containing a particular type of defect shall be determined in accordance with Clause 3.4.3.

Surface craze cracks (usually of irregular pattern) and hairline cracks (cracks just visible to the naked eye) that do not extend through the pipe wall shall not be classified as defects.

NOTE: Requirements relating to cover are not applicable to unreinforced pipes.

TABLE 3.6

ACCEPTABILITY OF PIPE WALL AND JOINT SURFACE DEFECTS

Defect type	Acceptability and conditions				
	Pipe wall		Joint surface		
	Drainage pipes	Sewerage and pressure pipes	Drainage pipes (not for water-tightness testing)[1]	Drainage pipes (for water-tightness testing)[2]	Sewerage and pressure pipes
1	Acceptable	Acceptable if pressure/load test passed	Not applicable	Not applicable	Not applicable
2	Acceptable after repair	Acceptable after repair if pressure/load tests passed	Not applicable	Not applicable	Not applicable
3	Acceptable after repair if load tests passed	Not acceptable	Not applicable	Not applicable	Not applicable
4	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable after repair if pressure test passed
5	Acceptable after repair	Acceptable after repair	Acceptable	Acceptable after repair	Acceptable after repair if pressure test passed
6	Acceptable after repair	Not acceptable	Acceptable after repair	Acceptable after repair	Acceptable after repair if load and pressure test passed for sewerage pipes. Not acceptable for pressure pipes.
7	Not acceptable	Not acceptable	Acceptable after repair	Acceptable after repair	Not acceptable

NOTES:

1 Refers to joint designs where pressure or watertightness testing is not specified.

2 Refers to all joint designs where pressure or watertightness testing is specified.

3.4.5 Finishing and repairs for pipes

Repairs to pipes shall be carried out using cement mortar, epoxy mortar, or other equivalent material that can be demonstrated to be suitable for the intended application. The tensile and bond strength of repair materials shall be not less than that of the concrete in the pipe. The pipe barrel shall not be finished by coating with cement wash or any other material before being tested.

NOTES:

1 The manufacturer may carry out repairs in accordance with standard documented practices unless otherwise requested by the purchaser (see Section 6).

2 Where pipes may be subject to elevated temperature service, a repair material should have a coefficient of thermal expansion that is compatible with that of the pipe concrete and will not produce additional defects by virtue of its thermal characteristics.

3 The finishing of the plastic concrete in the pipe during the manufacturing process is not covered by this Clause.

4 The cement washing-in of collar jointing surfaces to enhance the cosmetic appearance of the pipe is permitted provided it is carried out prior to any pressure or watertightness testing.

3.5 HANDLING, STORAGE AND TRANSPORTATION

3.5.1 General

Pipes shall be handled and, where required, stored and transported in a manner such that—

(a) neither pipe durability nor serviceability is impaired;

(b) pipe profile is not subjected to distortion that may adversely affect jointing, pressure tightness or watertightness characteristics; and

(c) pipe surface and edge finishes are not subjected to damage that may adversely affect pipe jointing or service performance. Defects arising from handling, storage and transportation shall be determined in accordance with Table 3.6.

3.5.2 Lifting holes

Lifting holes shall not be provided in pipes requiring watertightness or pressure testing.

Where lifting holes are provided for drainage applications, there shall be a hole in the top centre of mass of the pipe, of dimensions suitable for safe handling of the pipe. Lifting holes shall be positioned so that the pipe can be lifted without tilt or radial twisting and can be deposited with the structural top of the reinforcement in the designed position.

The lifting hole shall be filled with a plug of concrete, or other suitable material after placement. Plugs shall not impair pipe durability or serviceability.

3.5.3 Lifting elements

Where lifting elements are provided, they shall be designed to prevent any impairment of pipe durability or serviceability when installed in accordance with the element supplier's recommendations. The requirements of regulatory authorities shall apply, as appropriate.

SECTION 4 PERFORMANCE TESTS

4.1 VERIFICATION OF FINISHED PRODUCT COMPLIANCE

The tests specified in this Section shall be carried out in accordance with Section 5 to demonstrate compliance of finished concrete pipes with this Standard.

4.2 PROOF LOAD

When tested in accordance with Appendix C, the following criteria shall apply, as appropriate:

(a) *Unreinforced drainage and sewerage pipes* The pipe shall sustain the load corresponding to its size class given in Table 4.1 without developing a crack in the pipe wall that would be classed as a defect in terms of Clause 3.4.4.

TABLE 4.1

TEST LOADS FOR LOAD CLASS LDU (UNREINFORCED PIPES)

Nominal diameter (DN)	Test load kN/m
100	20
150	20
225	21
300	23
375	26
450	30
525	35
600	39

NOTE: The above test loads for unreinforced pipe have been developed from the ultimate values for a Load Class 2. Unreinforced pipe may be manufactured to sustain a higher Load Class subject to agreement between the manufacturer and purchaser.

(b) *Reinforced drainage and sewerage pipes* The pipe shall sustain the proof load (T_c) given in Table 4.2 for the corresponding size and load class, without developing a crack of width greater than the relevant test crack.

Upon removal of the test load, no crack in the pipe shall be greater in width than that given in Table C2, Appendix C.

(c) *Pressure pipes* The pipe shall sustain without developing a crack through the pipe wall of any width, or a crack of width greater than the relevant test crack, at least the greater of—

(i) the proof load (T_c) for load class 2; or

(ii) the proof load (T_{cp}) as calculated in accordance with AS/NZS 3725.

Upon removal of the test load, no crack in the pipe shall be greater in width than that given in Table C2, Appendix C.

TABLE 4.2

TEST LOADS FOR LOAD CLASSES 2 TO 10 (CIRCUMFERENTIALLY REINFORCED CONCRETE PIPES)

Pipe dia.	Proof or ultimate test load (see Note 1) kN/m											
	Load Class (see Note 2)											
	Class 2 (X)		Class 3 (Y)		Class 4 (Z)		Class 6		Class 8		Class 10	
DN	Proof	Ult.	Proof	Ult.	Proof	Ult.	Proof	Ult.	Proof	Ult.	Proof	Ult.
100	13	20	20	30	26	39	—	—	—	—	—	—
150	13	20	20	30	26	39	—	—	—	—	—	—
225	14	21	21	32	28	42	—	—	—	—	—	—
300	15	23	23	34	30	45	45	56	60	75	75	94
375	17	26	26	39	34	51	51	64	68	85	85	106
450	20	30	30	45	40	60	60	75	80	100	100	125
525	23	35	35	52	46	69	69	86	92	115	115	144
600	26	39	39	59	52	78	78	98	104	130	130	163
675	29	44	44	65	58	87	87	109	116	145	145	181
750	32	48	48	72	64	96	96	120	128	160	160	200
825	35	52	52	78	69	104	104	129	138	173	173	216
900	37	56	56	84	74	111	111	139	148	185	185	231
1050	42	63	63	95	84	126	126	158	168	210	210	263
1200	46	69	69	104	92	138	138	173	184	230	230	288
1350	50	75	75	113	100	150	150	188	200	250	250	313
1500	54	81	81	122	108	162	162	203	216	270	270	338
1650	58	87	87	131	116	174	174	218	232	290	290	363
1800	62	93	93	139	124	186	186	233	248	310	310	388
1950	66	99	99	149	132	198	198	248	264	330	330	413
2100	70	105	105	158	140	210	210	263	280	350	350	438
2400	78	117	117	176	156	234	234	293	312	390	390	488
2700	86	129	129	194	172	258	258	323	344	430	430	538
3000	94	141	141	212	188	282	282	353	376	470	470	588
3300	102	153	153	230	204	306	—	—	—	—	—	—
3600	110	165	165	248	220	330	—	—	—	—	—	—
3900	118	177	177	266	236	354	—	—	—	—	—	—
4200	126	189	189	284	252	378	—	—	—	—	—	—

NOTES:

1 The test load for a particular application should be determined in accordance with AS/NZS 3725.

2 The corresponding traditional alphabetical classes are shown in brackets (e.g., Class 4 = Class Z).

3 The proof load magnitude is proportional to the class number (e.g., Class 8 = Class 2 × 4).

4 Proof loads for intermediate classes may be obtained by linear interpolation between the closest tabulated values rounded upward to the nearest whole number, e.g., for a DN 300 size class pipe, the proof load for Class 7 is (45 + 60)/2 = 53 kN/m.

5 For pipe below Class 6, the ultimate load value is calculated to be 1.5 times the proof load and for Class 6 and above the ultimate load value is calculated to be 1.25 times the proof load.

4.3 ULTIMATE LOAD

When tested in accordance with Appendix C, the maximum load sustained by the pipe before loss of load shall be not less than the test ultimate load (T_u) given in Table 4.2 for the corresponding size and load class.

4.4 WATERTIGHTNESS 90 kPa TESTS

When hydrostatically pressure tested in accordance with Appendix D, Paragraphs D4.1 or D4.2**,** as appropriate, each pipe and joint shall be capable of sustaining the following pressures without failure:

(a) In Australia, for non-pressure sewerage pipe, and non-pressure drainage pipe where watertightness is specified, a test pressure of 90 kPa (see Paragaph D4.1, Appendix D).

(b) In New Zealand, for non-pressure sewerage pipe, and non-pressure drainage pipe where watertightness is specified, unless otherwise agreed by the purchaser, the manufacturer may elect to carry out either—

(i) a single pipe test (see Paragraph D4.1, Appendix D) with a test pressure of 90 kPa; or

(ii) a pipeline test comprising four (or more) test pipes assembled in a line (see Paragraph D4.2, Appendix D) with a test pressure of 90 kPa without exceeding a water loss rate of 0.6 mL/mm diameter/metre length/hour.

NOTE: The allowable water loss for field testing of pipelines is not covered by this Standard. It is generally higher than that given for this test.

4.5 SPECIFIED (≥50 kPa) AND ULTIMATE PRESSURE TESTS

When hydrostatically pressure tested in accordance with Appendix D, Paragraph D4.3, the pressure pipe and joint shall sustain the following pressures without failure:

(a) The specified test pressure (P_t) or, if not specified, a test pressure not less than 1.2 times the specified allowable working pressure (P_w).

(b) An ultimate test pressure (P_u), which shall be the lesser of—

(i) 1.5 times the allowable working pressure (P_w); or

(ii) 1.2 times the allowable working pressure (P_w) plus 75 kPa.

4.6 WATER ABSORPTION

When tested in accordance with Appendix F—

(a) the water absorption shall not exceed 6.0%; or

(b) the net water absorption shall not exceed 5.5%.

4.7 FLEXIBLE JOINT ASSEMBLY

When tested in accordance with Appendix H, the test assembly shall meet all of the manufacturer's specified joint performance characteristics based on the proposed pipe end use.

SECTION 5 COMPLIANCE WITH PERFORMANCE REQUIREMENTS

5.1 MEANS OF DEMONSTRATING COMPLIANCE WITH THE PERFORMANCE REQUIREMENTS

Compliance with the performance requirements of Section 4 shall be demonstrated by at least one of the following means:

(a) Sampling and testing in accordance with Clause 5.2.

(b) The use of a third party product certification scheme (by a certification body).

(c) The use of a second party product compliance audit (by the purchaser).

Clause 5.2 shall be the basis for demonstrating compliance with the sampling and testing requirements, except that, where the manufacturer can demonstrate adequate systems of process control in accordance with Clauses 2.1 and 3.1, the frequency of sampling and testing nominated in the manufacturer's quality plan and documented procedures shall take precedence.

NOTES:

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

2 Where a third party certification scheme is the specified means of compliance, it should meet the criteria described in SA HB18.28/ 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 quality. Product certification should 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-ANZ.

3 The use of a second party product compliance audit is at the sole discretion of the purchaser or asset owner and may be in combination with elements of a third party product certification scheme by agreement between purchaser or asset owner and manufacturer.

5.2 SAMPLING AND TESTING

5.2.1 Facilities for sampling and testing

The manufacturer shall provide all facilities, labour and equipment necessary for the sampling and testing of pipes, including any additional testing or retesting of non-compliant pipes.

5.2.2 Sampling and testing procedures

Procedures for the sampling and testing of pipes shall be as follows:

(a) Where a new design (including the verification of a newly commissioned manufacturing facility), or a significant departure from a proven design is proposed, type testing, appropriate to the design or design change, shall be carried out in accordance with Clause 5.2.4.

A significant change to an existing design shall be—

(i) decrease in the cement or supplementary cementitious materials of the concrete mix design by more than 10% or 40 kg/m^3, whichever is lesser;

(ii) decrease in the circumferential reinforcement design content by more than 10%;

(iii) decrease in the design wall thickness by 10% or 5 mm, whichever is greater; or

(iv) change in the pipe design joint profile or performance.

NOTE:

1 The manufacturer should define the minimum type test regime that is appropriate to assess the sensitivity of the design change.

2 For ultimate hydrostatic pressure testing, some limited testing may be required by the manufacturer to validate the departure from a proven design.

(b) Where it has been established that a design complies with the specified quality parameters, routine sampling and testing shall be carried out on each subsequent batch of pipes manufactured to the design, in accordance with Clause 5.2.5.

5.2.3 Test requirements

Type testing and routine testing shall be carried out in accordance with Table 5.1.

NOTE: See design and test information in Section 6.

TABLE 5.1

TEST REQUIREMENTS

Characteristic	Reference Clauses		Pipe Application/Test Purpose					
			Drainage (see note)		Sewerage		Pressure	
	Test method	Routine test frequency	Type testing	Routine testing	Type testing	Routine testing	Type testing	Routine testing
Proof load	App. C	Para. A4.1	Required	Required	Required	Required	Required	Required
Ultimate load	App. C	Para. A4.2	Required	Only if specified	Required	Only if specified	N/A	N/A
Hydrostatic pressure (only for elastomeric seal jointed pipes)								
(a) Watertightness (90 kPa)	App. D	Para. A4.3(b)	Only if specified	Only if specified	Required	Only if specified	N/A	N/A
(b) Specified pressure (≥50 kPa)	App. D	Para. A4.3(a)	N/A	N/A	N/A	N/A	Required	Required
(c) Ultimate pressure	App. D	Para. A4.3(a)	N/A	N/A	N/A	N/A	Required	Only if specified
Water absorption	App. F	Para. A4.4	Required	Required	Required	Required	Required	Required
Joint assembly test (Only for elastomeric seal jointed pipes)	App. H	Para. A4.5	Required	Only if specified	Required	Only if specified	Required	Only if specified
Cover (only for reinforced pipes)	App. G	Para. A4.6	Required	Required	Required	Required	Required	Required
Dimensional accuracy	Clause 3.3	Para. A4.7	Required	Only if specified	Required	Only if specified	Required	Only if specified
Workmanship and finish	Clause 3.4.2.2	Each pipe	Required	Required	Required	Required	Required	Required

LEGEND:
Required = test to be carried out whether specified or not
Only if specified = test to be carried out only if required by the specifier in accordance with Section 6
N/A = test is not applicable

NOTE: Refer to Clause 1.4.4 for information on the designation of appropriate pipe and joint pressure and watertightness classes.

5.2.4 Type testing

5.2.4.1 *General*

Pipes shall be manufactured to the proposed design and shall be sampled and tested in accordance with Clauses 5.2.4.2 and 5.2.4.3 to determine whether pipes manufactured under the same conditions, and to the same design, will satisfy the requirements of this Standard.

5.2.4.2 *Manufacture*

Pipes for type testing shall be manufactured as a continuous batch, and in sufficient numbers so that each required test can be carried out on a pipe that is unaffected by any previous testing.

The manufacture shall take into account the intended production processes, including methods and duration of curing, age at testing, and the quality of materials and workmanship to apply during routine pipe production.

5.2.4.3 *Testing*

Type tests shall be selected in accordance with Clause 5.2.3 and carried out in accordance with Clause 5.2.3 and Table 5.2.

TABLE 5.2

TYPE TESTS—MINIMUM NUMBER OF SPECIMENS TESTED

Test	Minimum number of specimens tested
Proof load	8
Ultimate load	4
Hydrostatic—watertightness (90 kPa)	8
Hydrostatic—specified (≥50 kPa)	8
Hydrostatic—ultimate	4
Water absorption	4 (see Note 1)
Cover	8
Dimensional accuracy	8
Joint assembly test	4

NOTES:

1 Each test specimen for water absorption testing shall be sourced from a separate pipe.

2 It shall be permissible to use a test pipe for more than one of the above tests. (For example, after passing the proof load test, a test specimen may be used for the ultimate load test.)

3 Where a pipe is to be subjected to both proof load and hydrostatic testing, hydrostatic testing shall be carried out after proof load testing and if necessary, subsequent curing of the pipe.

5.2.5 Routine sampling and testing

5.2.5.1 *General*

Routine pipe production shall be sampled and tested in accordance with Clauses 5.2.5.2 and 5.2.5.3.

Procedures for the assessment and acceptance or rejection of each routine test characteristic including disposal of non-conformances shall comply with the requirements of Appendix A.

5.2.5.2 *Sampling*

A representative sample in accordance with Appendix A shall be drawn at random from each batch of pipes manufactured to a particular design.

5.2.5.3 *Testing*

Routine tests shall be carried out in accordance with Clause 5.2.3 and Appendix A.

Where a pipe is subjected to both proof and hydrostatic testing, the hydrostatic test shall be carried out after proof load testing and, if necessary, after subsequent curing of the pipe.

NOTE: A sample check list for purchasing requirements is given in Appendix B.

SECTION 6 ORDERING AND SUPPLYING PIPES

6.1 PIPE DESIGN AND TEST INFORMATION

The purchaser and manufacturer shall agree on the following at the time of an enquiry and when a concrete pipe order is placed:

NOTES:

1 The minimum performance and testing requirements of the Standard apply to certain default concrete pipe load classes, joint design and hydrostatic pipe and joint capabilities. If additional requirements that may be essential to pipe performance, in particular embedment and service conditions are not specified prior to ordering, the pipe may be unsuitable for its intended service application and environment. Therefore, purchasers should specify the appropriate pipe design characteristics and routine testing requirements. The purchaser should seek advice from the pipe manufacturer as required.

2 Where a purchaser is not the concrete pipe asset owner, the purchaser should consult with the asset owner's designer or specifier to determine these requirements, prior to ordering.

(a) Intended service requirements:

  (i) Application (pressure or non-pressure water supply, drainage, sewerage or service ducts)—Clause 1.1

  (ii) Installation environment (normal, marine, other)—Clauses 1.3.2.8, 1.3.2.9 and 1.3.2.10, and Table 3.1

(b) Pipe size class or DN—Clause 1.4.2 and Tables 4.1 and 4.2.

(c) Pipe load class—Clause 1.4.3 and Tables 4.1 and 4.2.

(d) Pipe pressure or watertightness class, if applicable—Clauses 1.4.4, 4.4 and 4.5, and Table 5.1.

  (i) Non-pressure drainage and sewerage pipes:

    (A) Confirmation that watertightness testing is neither required nor specified.

    (B) Where watertightness tests are required or specified in New Zealand—

      (1) if the loss rate test is required or specified, and

      (2) the loss rate, if different to that specified in Clause 4.4(b)(ii).

    (C) Where specified, the nominated field test pressure and acceptance criteria.

  (ii) Pressure pipes (≥50 kPa):

    (A) The installation conditions (see AS/NZS 3725) and the allowable working pressure (P_w) including dynamic or surge effects.

    (B) The test pressure (P_t) where required to be in excess of $1.2P_w$.

    (C) The ultimate test pressure, if specified.

    (D) The minimum clear cover to reinforcement, if intended for other than the normal or marine conditions given in Table 3.1.

  NOTE: Refer to Table 5.1 for information on the default test provisions of the standard.

(e) Jacking loads if pipe is to be jacked—Clause 1.4.3.4.

(f) Pipe joint type, e.g., rigid or flexible, flush, socketed or other joint profile and if watertight, banded or other joint protection required—Clause 3.2.1 and Figure 1.1.

(g) Confirm effective pipe length with supplier—Clause 3.3.6 and Figure 1.1.

NOTE: The manufacturer usually nominates effective pipe length.

(h) Elastomer type for elastomeric seal joints, if other than natural rubber—Clause 2.4.

(i) Type and routine tests other than those 'required' by Table 5.1.

NOTE: Refer to Table 5.1 for the default test provisions of the Standard and thus guidance on the need for additional type and routine tests.

(j) Means of demonstrating finished product compliance with the performance requirements, if other than Clause 5.2—Clause 5.1.

(k) Place and rate of pipe delivery.

(l) Place of acceptance, if other than the place of manufacture.

(m) Specific requirements for cement, if any variation from Clause 2.2.1.

(n) Type of admixtures, if any variation from those permitted in Clause 2.2.5.

(o) Other specific material requirements, if any other variation from Clauses 2.2 to 2.4.

(p) Finishing and repair material specifications, if any variation from those permitted by Clause 3.4.5.

(q) Special pipe surface treatment or lining, if required.

(r) Marking requirements, if other than on the outside of the pipe—Clause 1.5.

6.2 INFORMATION TO BE SUPPLIED WITH EACH DELIVERY OF PIPE

The manufacturer shall supply the information listed in Clause 6.1, as appropriate, with each delivery of pipes.

6.3 MANUFACTURING INFORMATION TO BE SUPPLIED UPON REQUEST

The manufacturer shall record and maintain the following information as part of its system of control in accordance with Clauses 2.1 and 3.1:

(a) Drawings showing complete dimensions (including applicable tolerances) of—

  (i) pipes;

  (ii) joint profiles;

  (iii) joint seal dimensions and specifications in accordance with Clause 2.4; and

  (iv) maximum permissible joint deflection angle for elastomeric seal jointed pipes.

(b) The calculated mass of the pipe.

(c) The place of manufacture.

(d) The method of manufacture and testing.

NOTE: If requested by the purchaser, the manufacturer should be prepared to supply the above information.

APPENDIX A

SAMPLING SCHEME FOR ROUTINE TESTING

(Normative)

A1 SCOPE

This Appendix sets out sampling schemes whereby the manufacturer assures that the performance requirements of Sections 4 and 5 and, where specified, the dimensional requirements of Section 3 are satisfied for each of the test characteristics given in Table 5.1. A sampling plan is described for each test characteristic.

A2 SIZE OF BATCH

Subject to the requirements of the sampling plans described in this Appendix, the manufacturer may choose any size of batch provided that—

(a) batch sizes of 200 or more units be produced within one month; or

(b) batch sizes less than 200 units be manufactured within three consecutive months.

A3 INSPECTION MODES AND SWITCHING RULES

A3.1 Application

Where required by the sampling plans described in this Appendix, batches of 50 pipes or more shall be subjected to the inspection modes and switching rules, as specified in Paragraphs A3.2 and A3.3.

A3.2 Inspection modes

The sampling plan embraces the following inspection modes:

(a) *Normal inspection* Normal inspection shall be used when a process has been shown to be in a state of control. Normal inspection should also be used as the process is commenced.

(b) *Tightened inspection* Tightened inspection shall be used when two batches have been rejected in not more than five consecutive batches produced under normal inspection.

(c) *Reduced inspection* Reduced inspection shall only be substituted for normal inspection when permitted by the switching rules in Paragraph A3.3.

A3.3 Switching rules

Changes from one inspection mode to another are in accordance with the following switching rules:

(a) *Normal to tightened inspection* When normal inspection is operating, switch to tightened inspection if two in not more than five consecutive batches have been rejected.

(b) *Tightened to normal inspection* When tightened inspection is operating, switch to normal inspection only when five consecutive batches have been accepted.

(c) *Normal to reduced inspection* When normal inspection is operating, switch to reduced inspection only if 10 batches under normal inspection have all been accepted and the total number of non-conforming pipes in the samples of those batches was not greater than 4.

(d) *Reduced to normal inspection* When reduced inspection is operating, switch to normal inspection if—

(i) a batch is rejected;

(ii) production becomes irregular or delayed; or

(iii) a non-conforming pipe is found (after testing a random second sample), in which case the batch may be accepted but inspection reverts to normal mode.

(e) *Tightened inspection to stopping production* When tightened inspection is operating, stop production if it is not possible to switch to normal inspection (see Item (b)) after 10 consecutive batches.

Investigate the cause of failure and take remedial action. Resume production using tightened inspection.

A4 SAMPLING PLANS

A4.1 Sampling plan for proof load testing

The sampling plan for each batch shall be as follows:

(a) Select a batch size (see Paragraph A2).

(b) For batches of less than 50 pipes take a random sample of one pipe and subject it to the proof load test in accordance with Appendix C.

(c) For batches of 50 pipes or greater, take a random sample of size given in Table A1 according to the inspection mode and subject each pipe in the sample to the proof load test in accordance with Appendix C.

(d) Assess the acceptability of the batch as follows:

(i) If there are no non-conforming pipes in the sample, accept the batch.

(ii) For batches of less than 50 pipes, if the sample pipe fails the test, then select a random second sample of two additional pipes from the same batch and subject them to the same proof load test in accordance with Appendix C. If either pipe in the second sample fails, reject the batch. If no non-conforming pipes are found in the second sample, accept the batch.

(iii) For batches of 50 pipes or greater, either one of the following:

(A) If in the first sample two non-conforming pipes are found then reject the batch.

(B) If a single non-conforming pipe is found in the first sample, select a second random sample of the same size as the first and subject each pipe to the same proof load. If any pipe in the second sample fails the test, then reject the batch. When no further non-conforming pipes in the second sample are found, accept the batch. If reduced inspection is in operation it will be necessary to revert to normal inspection mode as a result of the first failure (see Paragraph A3.3(d)). Where normal inspection mode is in operation, it may be necessary to revert to tightened inspection mode (see Paragraph A3.3(a)).

(iv) Where a batch has been rejected the remaining pipes may—

(A) be assigned to an appropriate lower load class; or

(B) each be tested individually and appropriate action taken to improve the production procedures.

NOTE: Only those pipes that pass the test are acceptable. Switching rules do not apply to testing for individual acceptance.

(e) Record the results.

TABLE A1

SAMPLING PLAN FOR PROOF LOAD TEST (FOR BATCH SIZES 50 to 500)

Inspection mode (Paragraph A3.2)	Size of each Sample
Normal	5
Tightened	8
Reduced	2

A4.2 Sampling plan for ultimate load testing

Where ultimate load testing is specified or required, the sampling plan shall be as follows:

(a) Select one pipe at random from each population of 100 pipes or part thereof, made up from a batch or batches previously defined for the purpose of load testing.

(b) Subject the selected pipe to the ultimate load test in accordance with Appendix C.

(c) If the pipe fails to meet the test, select a second random sample of two additional pipes from the population represented by the first sample pipe and subject them to the same ultimate load in accordance with Appendix C. If any pipe in the second sample fails, reject the batch or group of batches. If no non-conforming pipes are found in the second sample, accept the batch or group of batches.

(d) Where a batch or a group of consecutive batches of pipes has been rejected, the sampling plan shall be as follows:

(i) The batch or group of consecutive batches may be assigned to an appropriate lower load class.

(ii) Select one random sample from each subsequent batch or group of consecutive batches with a maximum population of 100 pipes produced and repeat Steps (b) and (c).

(iii) Repeat Steps (i) and (ii) until three consecutive batches or group of batches pass the test.

(iv) If after five consecutive batches or group of batches have been tested, three consecutive batches or group of batches are not accepted as conforming, stop production and examine the manufacturing process to determine the reasons for failure. Initiate the necessary remedial action.

(v) After remedial action has been taken, test the first four pipes made and, if necessary, repeat Step (iv) until four consecutively made pipes pass the test.

(vi) Resume production using Step (a).

(e) Record the results.

A4.3 Sampling plan for hydrostatic pressure testing

The sampling plan for all pressure pipes, and where watertightness is specified for drainage and sewerage pipes, shall be as follows:

(a) Test each pressure pipe at the specified test pressure in accordance with Appendix D, Paragraph D4.1 or D4.2, as appropriate. Reject all non-conforming pipes.

Where an ultimate pressure test (see Paragraph D4.3) is specified, follow the sampling plan given in Paragraph A4.2.

(b) Where watertightness is specified for reinforced drainage or sewerage pipes, the test frequency shall be in accordance with Table A2.

TABLE A2

TEST FREQUENCY

Diameter	Test frequency
≤ DN 450	1 per 1000 per size class
>DN 450, ≤ DN 1200	1 per 500* per size class
> DN 1200	By agreement between manufacturer and purchaser

* Subject to a minimum of 4 pipes per annum.

Test the pipe in accordance with Appendix D, Paragraph D4.1 or D4.2, as appropriate, at the specified test pressure.

Assess the acceptability of the batch as follows:

(i) Subject each test pipe to the specified pressure in accordance with Appendix D, Paragraph D4.1 or D4.2, as appropriate, and accept the batch or group of batches if the pipes pass the test.

(ii) If the sample pipe fails the Appendix D, Paragraph D4.1 test, select a second random sample of two pipes from the same batch or group of batches and subject them to the same test in accordance with Appendix D, Paragraph D4.1. If either pipe fails the test, reject the batch or group of batches. Alternatively subject every pipe in the batch or group of batches to the test and accept or reject individual pipes within the batch or group of batches based on their performance in the test.

(iii) For the New Zealand loss rate test, Appendix D, Paragraph D4.2, accept the batch if the loss rate is not exceeded. If the loss rate exceeds double the allowable rate, the batch is rejected. For initial loss rates between allowable and double allowable a further test line from the same batch may be assembled. If the loss rate does not exceed the allowable on the second test, the batch is deemed to comply.

Where a batch has been rejected, the remaining pipes, other than those already sampled and tested, may—

(A) be assigned to an appropriate lower pressure class or watertightness class; or

(B) each pipe be tested individually for acceptability and appropriate action taken to improve production processes.

NOTE: Only pipe that individually passes the test is deemed acceptable. Switching rules do not apply to testing for individual pipe acceptance.

(c) Record the results.

A4.4 Sampling plan for water absorption testing

A4.4.1 *Standard sampling plan*

Unless otherwise specified, water absorption testing shall be carried out at a minimum frequency of one test per mix design per 6 months. The sampling plan for water absorption testing shall be as follows:

(a) Prepare and test an absorption specimen in accordance with Appendix F.

(b) Compare the results with the limits given in Clause 4.6 and—

(i) if the limits are not exceeded, repeat the testing at the frequency given above;

(ii) if the limits are exceeded, test a further 2 samples—

(A) if both samples pass, resume testing at the minimum frequency of one test per mix design per 6 months;

(B) if either sample fails, stop production and examine the manufacturing procedures to determine the reason for failure, and after remedial action has been taken, test the first four pipes made and, if necessary, repeat this Step (Step B) until 4 consecutive pipes pass the test.

(c) Record the results.

A4.4.2 *Alternative sampling plan*

When specified by the purchaser, the sampling plan shall be as follows:

(a) Select a pipe (other than one previously subjected to load or pressure testing) from one of the first two batches of the same size class.

(b) Prepare and test an absorption specimen in accordance with Appendix F.

(c) Compare the results with the limits given in Clause 4.6 and—

(i) if the limits are not exceeded, repeat Step (b) at a frequency of 1 sample per 1000 pipes, or part thereof, representing a consecutive series of batches produced for the same purpose; or

(ii) if the limits are exceeded, select a second test pipe and repeat Step (b).

When testing at a frequency described in Step (i), if a test pipe fails, repeat Steps (a), (b) and (c) as for the commencement of testing.

(d) If the second test pipe passes, continue sampling and testing at a frequency of 1 pipe per 250 pipes or part thereof representing a batch or a series of batches until 4 consecutive pipes pass, then revert to Step (c)(i).

(e) If the second pipe fails, stop production and examine the manufacturing procedures to determine the reasons for failure. Initiate necessary remedial action.

(f) After remedial action has been taken, test the first 4 pipes made and, if necessary, repeat Step (e) until 4 consecutively made pipes pass the test.

(g) Resume production using the tightened mode of inspection for proof load testing.

(h) Record the results.

A4.5 Sampling plan for joint assembly

Where specified for pipe, the sampling plan for joining assembly shall be as follows:

(a) Select three pipes at random from the first batch or the first group of consecutive batches of pipe, with a maximum population of 100 pipes or a maximum period or 3 months production.

(b) Subject the selected pipes to the test in accordance with Appendix H and, if the selected pipes pass the test, accept the batch or group of batches.

(c) If more than one of the sample pipes fail the test, identify the mould or moulds causing the problem. Reject product made from that mould or moulds from the batch or group of batches, or repair that product and leave within the batch or group of batches. Select a second random sample of three pipes and subject the selected pipes to the same test in accordance with Appendix H and if the selected pipes pass the test, accept the batch or group of batches.

(d) If in Step (c) any pipe fails the test, repeat Step (c).

(e) Record the results.

A4.6 Sampling plan for measurement of concrete cover to reinforcement

The sampling plan for measurement of concrete cover to reinforcement shall be as follows:

(a) Select, at random, one pipe for cover testing for each size class manufactured in any given 3 month period. Where a new reinforcement design is being introduced, select the pipe from the first batch or group of consecutive pipes produced.

(b) Subject the selected pipe to the test in accordance with Appendix G and, if the selected pipe passes the test, accept the batch or group of batches.

(c) If the sample pipe fails the test, select a second random sample of two pipes from the same population and subject them to the same test in accordance with Appendix G. If no non-conforming pipes are found in the second sample, accept the batch or group of batches as conforming.

(d) If in Step (c) either pipe fails the test, reject the batch or group of batches, or alternatively subject every pipe in the batch or group of batches to the test in accordance with Appendix G, Paragraph G3.2, and accept or reject individual pipes within the batches.

(e) Record the results.

A4.7 Sampling plan for measurement of dimensions other than concrete cover

Where specified, the sampling plan for measurement of dimensions other than concrete cover shall be as follows:

(a) Select one pipe at random from the first batch or the first group of consecutive batches of pipe, with a maximum population of 100 pipes or a maximum period of 3 months production.

(b) Take measurements of the selected pipe in accordance with Clause 3.3 and, where the measurements meet the requirements of Clause 3.3, or the specified requirements, for the application, accept the batch or group of batches.

(c) If the sample pipe fails the test, select a second random sample of two pipes from the same population and subject them to the same test in accordance with Clause 3.3 and acceptance requirements given in Clause 3.3, or the specified requirements, for the application. If no non-conforming pipes are found in the second sample, accept the batch or group of batches as conforming.

(d) If in Step (c) either pipe fails the test, reject the batch or group of batches, or alternatively subject every pipe in the batch or group of batches to that particular failed test and accept or reject individual pipes within the batches.

(e) Record the results.

APPENDIX B

CHECKLIST OF PURCHASING REQUIREMENTS

(Informative)

Purchaser and manufacturer to agree on the relevant AS/NZS 4058 requirements at the time of inquiry and when order placed.
Refer to Section 6

Section 1. Pipe details and application:

1a Pipe details
- Size class or nominal diameter DN : ……
- Pipe length: ……
- Type of joint: Rigid ☐ or
  Flexible ☐ with elastomeric seal: natural rubber ☐ other ☐ (details attached)
- Load class: ……

1b Application or Use:
- Drainage ☐ Proceed to Section 3 NOTE: If a watertightness test is specified, complete Sections **2a and 2b.**
- Sewer ☐ Proceed to Sections **2a and 2b.**
- Pressure ☐ Proceed to **Sections 2b.**

Section 2. Pressure requirements:

NOTE: Section 2 only applicable where a pipeline is to operate at a specified working pressure or is to be field-tested for acceptance, or where watertightness is specified.

2a Field acceptance tests:
- Is the installed line to be subjected to a field acceptance test? (see Note) NO ☐ YES ☐ ☐ kPa

2b – Watertightness requirements for non-pressure pipe:
- Has the watertightness test (90 kPa) been specified? (see Note) NO ☐ YES ☐

PROCEED TO SECTION 3

2c Pressure pipe requirements:
- Is allowable working pressure (including dynamic or surge effects) specified? NO ☐ YES ☐ ☐ kPa
- When establishing the working pressure has the specifier evaluated the installation conditions? NO ☐ YES ☐ See Note
- Is a factory test pressure specified NO ☐ YES ☐ ☐ kPa

NOTE: Refer purchaser/specifier to AS/NZS 3725 and AS/NZS 4058 to confirm the nominated tests are appropriate to the installation conditions and pipeline application.

PROCEED TO SECTION 3

Section 3. Special Requirements:
- Any special requirements? NO ☐ – Proceed to Section 4
  YES ☐ – Provide detail only when a requirement differs from normal manufacturing practice
- Jacking pipe YES ☐ – Marine conditions: YES ☐ – Minimum cover: ☐
- Cement type ☐ – Admixtures: ☐
- Finishing and repair materials: ☐ – Lining/surface treatments: ☐ – Markings: ☐
- Other: Refer to Section 6 of AS/NZS 4058 ☐
- Additional tests (i.e., other than AS/NZS 405 requirements): ☐

PROCEED TO SECTION 4

Section 4. Quantities and delivery advice:
- Quantities specified? NO ☐ YES ☐
- Delivery address specified? NO ☐ YES ☐
- Delivery program specified? NO ☐ YES ☐

APPENDIX C

LOAD TESTS FOR CONCRETE PIPES

(Normative)

C1 SCOPE

This Appendix sets out methods for determining the load-carrying capacity of concrete pipes under the action of externally applied compressive loads for the purpose of determining compliance with either the specified proof load capacity or the specified ultimate load capacity of a pipe.

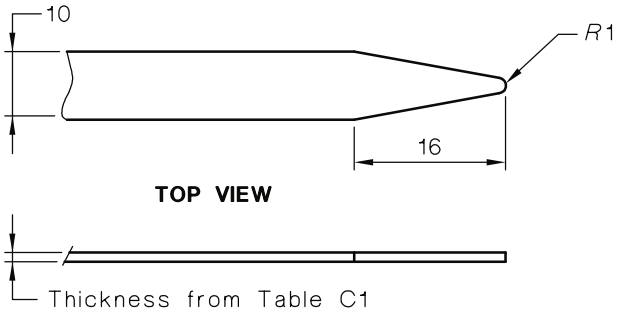
C2 APPARATUS

C2.1 Loading rig

The loading rig shall be either horizontal (see Figure C2) or vertical (see Figure C3) and of sufficient size and rigidity to apply the test load to the pipe specimen in the required manner without deformation in any of its parts, which would appreciably affect the validity or accuracy of the load measurement. It shall be capable of applying the test loads uniformly along the length of the pipe barrel at the specified rates. It shall be provided with a load-indicating device. Such a device shall be capable of measuring, either directly or indirectly, the total load being applied, to an accuracy of ±3% of its value, and be capable of recording a maximum load value.

C2.2 Standard feeler gauges

The standard feeler gauges used for determining crack widths shall be of the form shown in Figure C1 and of the thickness given in Table C1 within a tolerance of ±0.02 mm. The gauge shall be marked with either the gauge number or the thickness.



DIMENSIONS IN MILLIMETRES

FIGURE C1 STANDARD FEELER GAUGE

TABLE C1

THICKNESS OF STANDARD FEELER GAUGES

Gauge No.	Thickness mm
1	0.10
2	0.15
3	0.20
4	0.25

C2.3 Timber bearers

The timber bearers shall be of hardwood, of the cross-sectional dimensions shown in Figure C4 and of length not less than the external length of the barrel of the pipe being tested. The surfaces of the bearers in contact with the pipe shall be faced with rubber packing of hardness equivalent to Shore A of 55° and the bearers shall be firmly fixed in the testing rig to prevent their movement during a test.

C3 SAMPLE PREPARATION

Pipes to be tested shall be surface-dry and the surfaces of the barrel shall be free from—

(a) dust or any matter which might obscure a crack;

(b) cracks that would be classed as a Type 3 defect in terms of Item (c) of Clause 3.5.2.2; and

(c) any other type of defect deemed to be not acceptable for the intended use of the pipe before testing, in terms of Clause 3.5.3.

C4 GENERAL TEST CONSIDERATIONS

C4.1 Positioning of pipe (see Figure C4)

The pipe and the bearers shall be positioned in the loading rig so that—

(a) the longitudinal axes of the pipe and the bearers are parallel with one another and the bearers are symmetrically placed with respect to a diameter of the pipe cross-section;

(b) the line of action of the applied load lies in the plane of symmetry of the bearers;

(c) for elliptically reinforced pipes, the mark ‘Top’ is located at the centre-line of loading beams; and

(d) for bell-socketed pipe, the bearer shall be placed along the barrel only.

C4.2 Rate of loading

The test pipe shall be loaded at a minimum rate of 10 kN/min until the appropriate test load has been reached. The test load shall be maintained for sufficient time for the maximum crack width to be measured. The load shall then be released without shock to the pipe.

C4.3 Selection and measurement of crack width

The maximum crack width shall be selected visually by normal or corrected vision. The crack shall be measured by inserting the tip of the appropriate feeler gauge to refusal at a depth of greater than 3 mm, radially and perpendicular to the pipe surface, along the length of the crack at consecutive points spaced at 50 mm centres over a crack length of not less than 300 mm.

C4.4 Vertical loading rig

Where the pipe is to be tested using a vertical loading rig, the magnitude of the proof test load given in Table 4.4 shall be increased by an amount equal to the calculated pipe self weight and the ultimate test load determined based on the revised proof load.

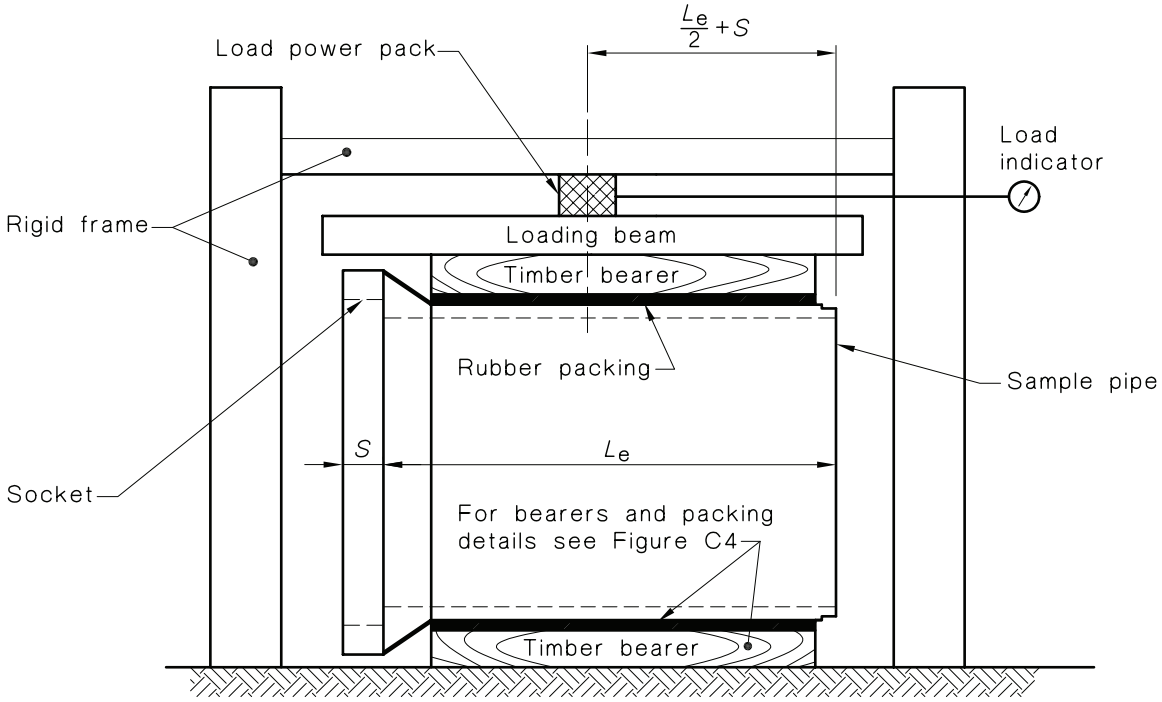
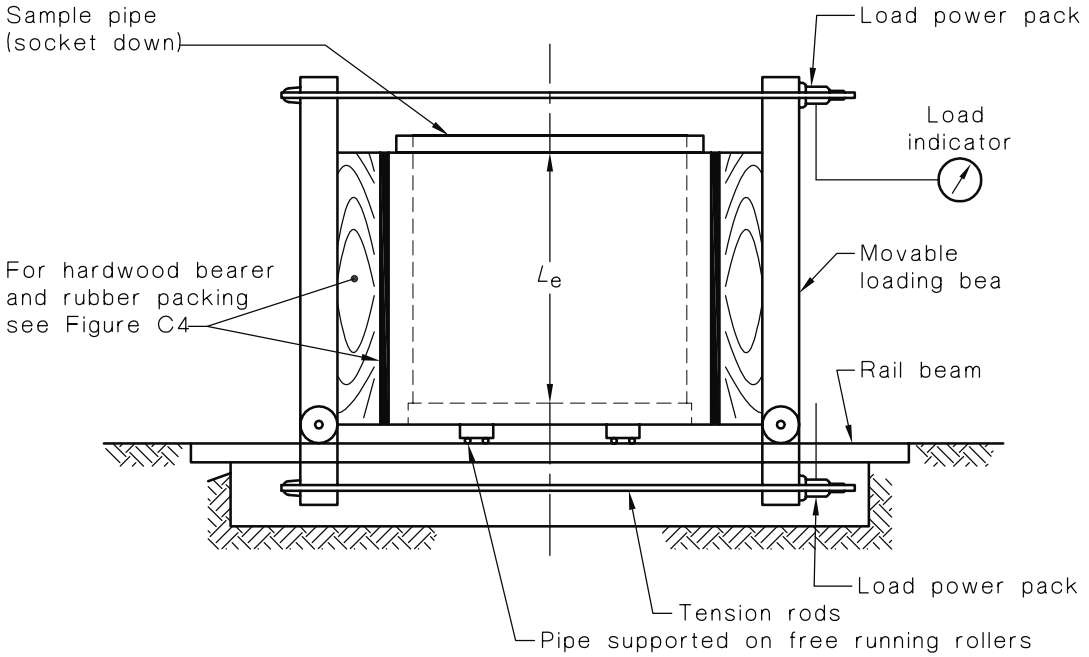


FIGURE C2 SCHEMATIC ARRANGEMENT OF HORIZONTAL LOADING RIG—TWO-EDGE AND THREE-EDGE METHOD

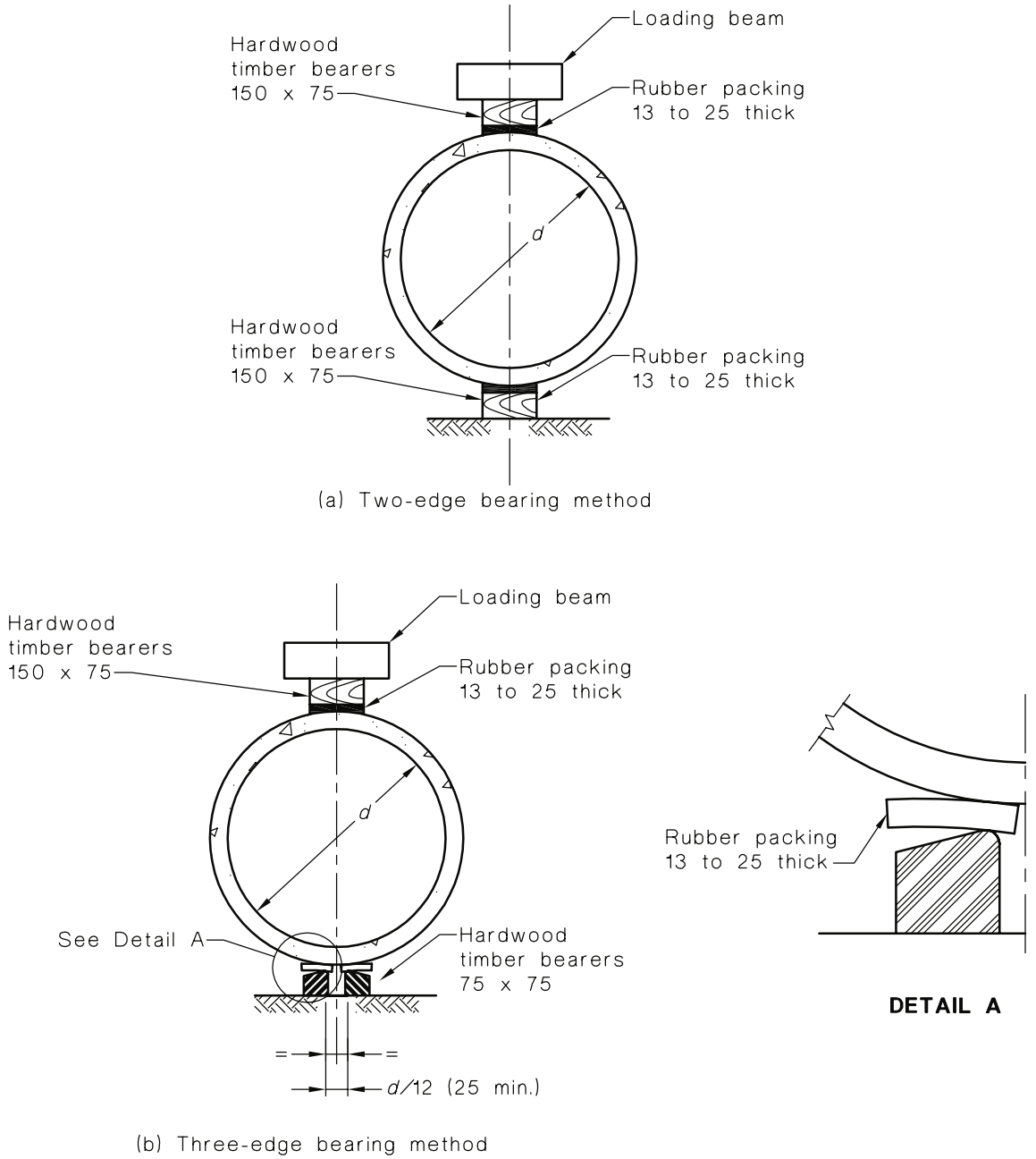


NOTES:

1 For flush-jointed and end-wall elastomeric seal joints only.

2 The magnitude of the proof load given in Table 4.2 is increased by an amount equal to the calculated pipe self weight and the ultimate load determined based on the revised proof load.

FIGURE C3 SCHEMATIC ARRANGEMENT OF VERTICAL LOADING RIG—TWO-EDGE METHOD



DIMENSIONS IN MILLIMETRES

FIGURE C4 SCHEMATIC ARRANGEMENT OF BEARERS—VERTICAL AND HORIZONTAL LOADING RIG

C5 PROCEDURE FOR PROOF LOAD TEST

C5.1 General

After positioning the pipe in the test rig, the load shall be increased to and maintained at the appropriate value determined in accordance with Paragraph C5.2. While the test load is being maintained, the pipe shall be inspected internally and externally for cracks and the maximum crack width measured. The test load shall then be removed and, for reinforced pipes, the width of any cracks remaining after complete removal of the load shall again be measured.

C5.2 Maximum test load

The maximum load that the pipe is to be subjected to shall be determined from the appropriate load per metre for the appropriate load class given in Table 4.1 or Table 4.2 multiplied by the effective length of the pipe (L_e).

C5.3 Determination of test crack width

C5.3.1 *Unreinforced pipes*

When examined under the test load, if any unreinforced pipe has developed a visible crack greater than 0.05 mm wide or greater than half the length of the pipe barrel or which passes entirely through the pipe wall, the pipe shall be reported as non-conforming.

C5.3.2 *Reinforced pipes*

The maximum crack in a reinforced pipe shall be selected and measured in accordance with Paragraph C4.3 both under the test load and after removal of the test load. If the tip of the feeler gauge (selected from Table C2 according to the specified cover and load condition)—

(a) meets refusal at less than 3 mm depth below the pipe surface, then the crack shall be taken as being of less width than the thickness of the feeler gauge and the pipe shall be reported as conforming; or

(b) meets refusal below the pipe surface at a depth greater than 3 mm at any six adjacent, consecutive measuring points, then the crack shall be taken as being greater than the test crack and the pipe shall be reported as non-conforming.

Except where pipes are manufactured with a specified sacrificial layer in addition to the specified minimum cover, in applying Table C2 all sewerage pipes and any pipe intended for use in a marine or aggressive environment shall be assumed to have a cover of less than or equal to 10 mm irrespective of the specified cover.

TABLE C2

THICKNESS OF FEELER GAUGE FOR CRACK WIDTH DETERMINATION

millimetres

Specified cover	Thickness of feeler gauge	
	Pipe loaded	Pipe after load removed
≤10	0.15	0.10
>10, ≤20	0.20	0.15
>20	0.25	0.20

C6 PROCEDURE FOR ULTIMATE LOAD TEST (Reinforced pipes only)

C6.1 General

After positioning the pipe in the test rig, the load shall be increased to the maximum value determined in accordance with Paragraph C6.2.

C6.2 Maximum test load

The maximum load that the pipe is to be subjected to shall be determined from the appropriate load per metre selected from Table 4.2, multiplied by the effective length of the pipe. If loss of load occurs before this load is attained, the maximum value attained shall be recorded.

If the load is attained without loss of load on the pipe, the pipe shall be taken as having satisfied the test and shall be reported as conforming, otherwise the pipe shall be taken as having failed the test and shall be reported as non-conforming.

C7 REPORTS

C7.1 General

For each pipe tested, the information specified in Paragraph C7.2 shall be recorded by the manufacturer and be kept available for inspection by the purchaser.

C7.2 Test report

The test report shall contain the following:

(a) The name of the manufacturer.

(b) The dates of casting and testing of the pipe.

(c) If the test is for type test or routine testing purposes and, if for routine testing, the batch identification.

(d) The specified class, and, if other than 10 mm, the specified cover.

(e) Whether the test was a proof load or an ultimate load test.

(f) For a proof load test, if the pipe is conforming or non-conforming and if non-conforming, the width, number and location of each crack.

(g) For an ultimate load test, if the pipe is conforming or non-conforming, and if non-conforming the maximum load attained.

(h) Reference to this test method, i.e. AS/NZS 4058, Appendix C.

APPENDIX D

PRESSURE TESTS FOR ELASTOMERIC SEAL JOINTED PIPES

(Normative)

D1 SCOPE

This Appendix sets out methods for determining the capacity of reinforced concrete pipes and their joints to resist internal hydrostatic pressure without failure.

NOTE: Refer to Clause 1.4.4 and Clause 4.4 for information on pressure and watertightness class designations, as appropriate, for the hydrostatic test pressures to be applied.

D2 APPARATUS

D2.1 Pressurizing equipment

Equipment capable of applying a controlled hydrostatic pressure to the interior of a pipe, varying from atmospheric to the maximum required pressure, and of maintaining a constant pressure within that range.

D2.2 End caps

Two impervious end caps shall be provided, each profiled to simulate the mating end of an adjoining pipe of the same size as the test pipe and fitted with the appropriate rubber sealing rings. One end cap shall have a pressure tapping located so that it will be close to the inside surface of the test pipe when assembled and the other end cap shall be fitted with a bleed pipe and stop valve (see Figures D1 and D2). Where the test pipe is orientated vertically, the bleed pipe and stop valve may be located on the same end cap as the pressure tapping.

D2.3 Pressure indicator

A pressure indicating device capable of measuring the pressure, over the full range required, with an accuracy of ±2% of the maximum value and capable of recording a peak value. The minimum scale division or increment shall be not greater than 5 kPa. The inlet end of the indicator shall be attached directly, or by an extension tube, to the pressure tapping of the end cap. For pipes tested in a vertical orientation, the pressure tapping shall be located in the top end cap.

D2.4 Pipe support

Rubber-faced adjustable bearers or supports shall be used to support the pipe between end caps.

D2.5 Elastomeric seals

Elastomeric seals shall be as specified by the manufacturer for the joint.

D2.6 New Zealand loss rate test

Means of accurately measuring the water loss during the test.

D3 SAMPLE PREPARATION

D3.1 General

Pipes to be tested shall be surface-dry at the time of test and the surfaces of the barrel shall be free from—

(a) dust or any matter that might hinder inspection of the finished surface of the pipe;

(b) cracks that are classed as Type 3 defects in terms of Item (c) of Clause 3.4.2.2; and

(c) any other type of defect deemed to be not acceptable for the intended use of the pipe before testing, in terms of Clause 3.4.3.

D3.2 Positioning of pipe and end caps

The pipe may be positioned either horizontally or vertically such that all parts of the pipe's external surfaces are clearly visible and can be readily examined.

Elliptically reinforced pipes when tested horizontally shall be positioned so that the top marker (see Clause 1.5.1(e)) is uppermost and vertically above the pipe axis.

A schematic arrangement of the test set-up is shown in Figures D1, D2 and D3.

D3.3 Preparations for testing

Fill the pipe with water. As required, bleed off any trapped air through the bleed pipe, then close the bleed pipe valve.

D3.4 New Zealand loss rate test

The test pipeline comprises four (or more) test pipes assembled with the joint sealing method and materials designed for the pipes. The pipeline ends shall be closed with end caps described in Paragraph D2.2.

The test pipeline axis shall be substantially horizontal.

D4 TEST PROCEDURES

D4.1 Procedure for a specified pressure and single pipe watertightness tests

D4.1.1 *Pressurization and inspection*

The procedure for specified pressure and watertightness tests shall be as follows:

(a) Determine the test pressure in accordance with Clauses 4.4 or 4.5, as appropriate;

(b) Position and prepare the test pipe in accordance with Paragraphs D2 and D3.

(c) Apply pressure at a gradual rate of increase until the test pressure is reached, or beads of water form on the pipe surface, whichever occurs first.

(d) Hold the pressure constant for 1 min plus 30 s for each 10 mm of wall thickness, or for twice that entire period if the application of pressure results in the formation of beads of water on the pipe surface.

(e) At the end of the holding period, release the pressure immediately if the test pressure has been reached. If the beads of water have not grown or run, increase the pressure slowly until the test pressure is reached or the beads of water grow or run (whichever occurs first).

(f) If the test pressure has been reached without the beads of water growing or running, hold the test pressure constant for 1 min plus 30 s for each 10 mm of wall thickness. At the end of the holding period release the pressure immediately.

(g) After releasing the pressure, drain the test pipe completely.

D4.1.2 *Pass or failure of pipe barrel*

Failure of the pipe barrel is defined as the appearance of beads of water on the pipe surface which have grown or run.

Failure of the joint is defined as the appearance of drops of water at each joint that fall from the joint at the rate of more than one drop per minute.

During the test, moisture appearing on the surface of the pipe in the form of damp patches shall not be considered leakage.

If the test pressure is reached before failure, the pipe shall be reported as conforming in that respect.

If failure of the pipe barrel occurs before the test pressure has been reached, the pressure at which failure occurred shall be recorded to the nearest 5 kPa and the pipe either—

(a) retested in the condition given in Paragraph D3.1 after further water curing; or

(b) reported as non-conforming.

D4.1.3 *Pass or failure of joint*

If failure of either joint occurs during the pressurization process or the time during which the pressure is maintained, the pipe shall be reported as non-conforming in terms of joint watertightness.

D4.2 Procedure for the New Zealand loss rate test

D4.2.1 *Procedure*

The procedure for the New Zealand loss rate test shall be as follows:

(a) Position and prepare the test pipe in accordance with Paragraphs D2 and D3.

(b) The test pipeline shall be filled with clean potable water and kept filled for a period ≤3 days, prior to commencement of the test. At no time shall the internal pressure be allowed to exceed the specified test pressure (90 ±5 kPa) as measured at the pipeline invert.

(c) The pipeline may be shielded from the direct rays of the sun and draped with sacking kept continuously wet throughout the test.

(d) Water pressure shall be applied in the pipeline gradually until the specified test pressure, as measured at the pipeline invert, is reached. The test pressure shall be maintained substantially constant, within a variation of ±5 kPa, for the duration of the specified test period.

(e) For measurement of rate of water loss, the test pressure shall be equal to 90 kPa above the pipeline invert, and the test period shall be at least one hour, or such longer period, or aggregate of period as agreed between purchaser and manufacturer.

D4.2.2 *Pass or failure of pipes*

The pipes shall be deemed to pass the test if the loss rate is less than that specified.

D4.3 Procedure for an ultimate pressure test

D4.3.1 *Procedure*

This test shall only be carried out on pipe designed and manufactured to carry pressures ≥50 kPa.

A test ultimate (P_u) shall be specified in accordance with Clause 4.5(b) and the test procedure carried out as follows:

(a) Position and prepare the test pipe in accordance with Paragraphs D2 and D3.

(b) Apply pressure at a gradual rate of increase until the test ultimate pressure is reached or there is a rapid loss of pressure, whichever occurs first.

(c) If the test ultimate pressure has been reached, hold the pressure at this level constant for 30 s.

(d) After releasing the pressure, drain the test pipe completely.

D4.3.2 *Pass or failure of pipe*

Failure is defined as the rapid loss of pressure. If the test ultimate pressure is reached without failure, the pipe shall be reported as conforming. If failure occurs during the pressurization process or the time during which the pressure is maintained, the pressure at which failure occurred shall be recorded to the nearest 5 kPa and the pipe reported as non-conforming.

D5 RECORDS

For each pipe tested, the following information shall be recorded by the manufacturer and maintained for compliance auditing or inspection by the purchaser:

(a) The name of the manufacturer.

(b) The dates of casting and testing the pipe.

(c) If the test is for type testing or routine testing purposes. If for routine testing purposes, the batch identification.

(d) Whether the test was for the determination of—

  (i) watertightness (single pipe or loss rate test);

  (ii) specified pressure; or

  (iii) ultimate pressure;

(e) Where specified and ultimate are given, as appropriate—

  (i) the test pressure (P_t); and

  (ii) the ultimate test pressure (P_u).

(f) Actual rate of water loss as compared with the specified or allowable loss rate, if applicable.

(g) Whether the test was a first test or a retest.

(h) Whether the pipe was conforming or non-conforming and if non-conforming, the relevant failure pressure, as applicable.

(i) Reference to this test method, i.e., AS/NZS 4058, Appendix D.

NOTE: The magnitude of the test pressure is to be increased by an amount calculated to provide concrete tension in the pipe wall equal to the concrete tension due to the calculated pipe self-weight when in the horizontal position.

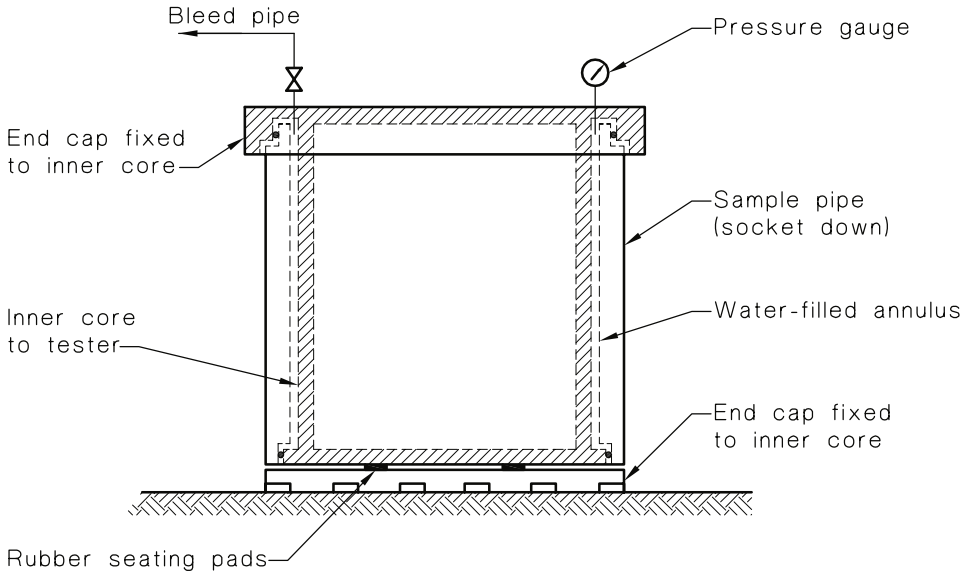


FIGURE D1 SCHEMATIC ARRANGEMENT OF PRESSURIZING EQUIPMENT FOR VERTICAL TESTING

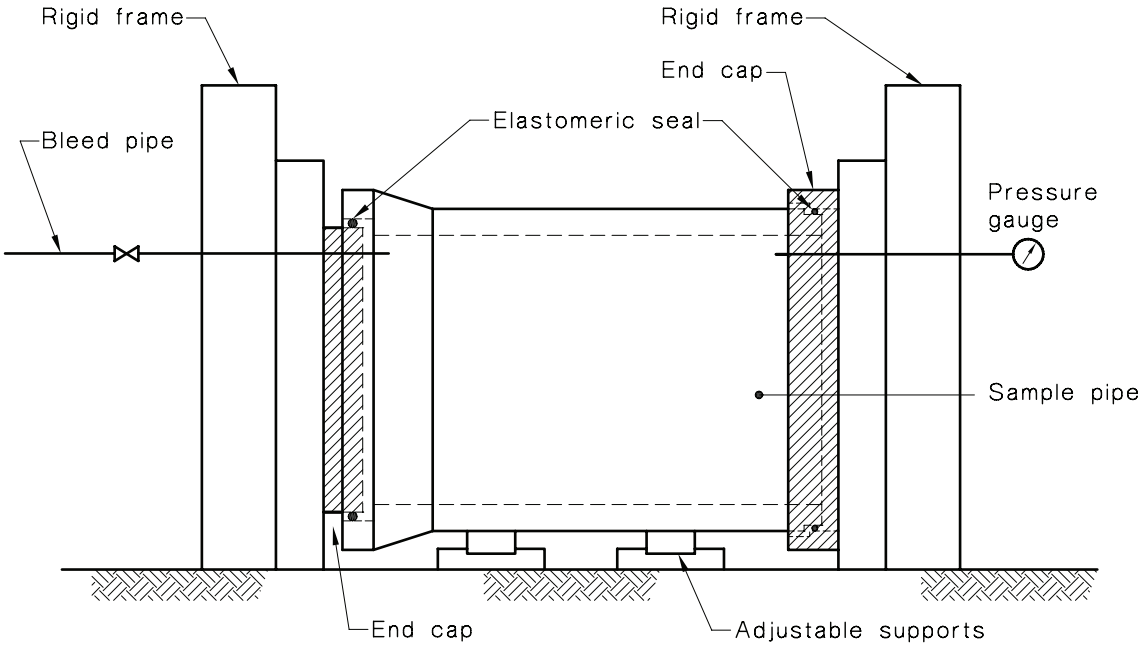


FIGURE D2 SCHEMATIC ARRANGEMENT OF PRESSURIZING EQUIPMENT FOR HORIZONTAL TESTING

APPENDIX E

GUIDE TO CONCENTRATION LIMITS APPLICABLE TO SOME CONSTITUENTS OF THE BURIED ENVIRONMENT

(Informative)

E1 SCOPE

The in-service performance of a pipeline is dependent on the time of continual exposure to the concentrations of the constituents of the buried environment.

This Appendix provides guidelines for concentration limits of some soil/terrain constituents of the buried environment when the concrete cover to barrel and socket reinforcement is in accordance with Table 3.1).

The defined ‘normal environment’ (see Clause 1.3.2.8) and ‘marine environment’ (see Clause 1.3.2.9) do not apply where one or more of the listed concentration limits are exceeded (refer to Note 3 of Table 3.1).

E2 CONCENTRATION GUIDE

E2.1 10 mm cover minimum

Table E1 gives guidelines for concentration of chloride and sulfate salts, acidity and dissolved carbon dioxide concentrations in broad groupings of soils.

Table E1 was developed from data first collated by the concrete pipe industry in 1977 for a variety of exposure conditions of the external concrete pipe surface and various soils/terrains. The limits were further defined in 1982 and reviewed in 1988 and 1999.

TABLE E1

CONCENTRATION OF IMPURITIES

Constituent	Soil classification (see Note 1)		
	Clay/stagnant	Medium	Sandy/flowing
Chloride (p.p.m. Cl^-) max.*			
Unreinforced concrete	No limit	No limit	No limit
Reinforced concrete (see Note 2)	20 000	20 000	20 000
Sulfate (p.p.m. SO^-_4) max*			
Type GP—general purpose type Portland cement	1 000	1 000	1 000
Type SR—sulfate-resisting type Portland cement or equivalent	10 000	10 000	10 000
Acidity			
Acid (pH) (min.)*	4.5	5.0	5.5
Exchangeable soil acid (mL of 0.1M NaOH consumed by 100 g air-dried soil, max.)	70	50	30
Aggressive CO_2(p.p.m.) max.*	150	50	15

* In groundwater or of soil extract (2:1 water to soil by mass)

NOTES:

1 The groupings used correspond to the classification adopted by AS 1726 as follows:

(a) Clay/stagnant—Practically impervious (that is impervious soils, for example, homogeneous clays).

(b) Medium—Poor drainage (for example, fine sands, organic and inorganic silt, mixtures of silt, sand and clay, glacial till, stratified clay).

(c) Sandy/flowing—Good drainage (for example, clean gravel, sands, mixtures of sand and gravel).

2 Continuously submerged in sea or groundwater. The limit of 20 000 p.p.m. corresponds to the concentration of chloride in sea water. Fluctuating saline groundwater conditions to be treated as separate individual cases often requiring additional protection.

E2.2 Covers less than 10 mm

Where the concrete cover to barrel and socket reinforcement is less than 10 mm, the concentration limits for acid or aggressive carbon dioxide are likely to be lower than those given in Table E1.

E2.3 Additional cover, coatings and protective treatments

Additional cover to reinforcement or other protective treatment can usually extend the service life of concrete pipe in aggressive conditions.

In conditions in which the concentration of acid or aggressive CO_2 is greater than the limit in Table E1, extra cover may in some situations provide life expectancies in excess of 100 years.

Coatings or keyed-in linings giving a long-term extension to service life may be appropriate in more severe conditions.

APPENDIX F

ABSORPTION TEST FOR CONCRETE PIPES

(Normative)

F1 SCOPE

This Appendix sets out a method for determining the relative potential of the concrete in the wall of a sample pipe to absorb water.

NOTE: The test provides an indicator of concrete quality and as such is used to predict durability.

F2 PRINCIPLE

The increase in weight of an oven-dried test specimen, caused by the absorption of water under specified conditions, is determined and expressed as a percentage of the initial oven-dry weight of the specimen.

F3 APPARATUS

F3.1 Drying oven

Of sufficient size to hold the test specimen and capable of maintaining a temperature of 105 ±3°C.

F3.2 Balance

Capable of weighing the mass of the saturated test specimen to an accuracy of ±0.05%.

F3.3 Desiccator

Of sufficient size to hold the test specimen.

F3.4 Urn

Of approximately 8.5 L capacity and capable of maintaining that volume of water at boiling point for at least 5 h at a time.

F3.5 Cutting and grinding equipment

For preparing the specimen.

F3.6 Absorbent paper or cloth

For drying the surface when determining saturated surface-dry mass.

F3.7 A rack or similar support

For suspending the specimen in the urn.

F4 CONDITION OF SAMPLE PIPES

The age of the sample pipes, from the time of casting to the time of preparation of the test specimens, shall be not less than 14 days nor greater than 28 days. The pipes shall not have been subjected to any previous testing that would affect the absorptive properties of the concrete in the pipe walls, and the area of the wall from which the test specimens are to be cut shall be free from cracks visible by normal or corrected vision.

F5 PREPARATION OF TEST SPECIMEN

From each sample pipe, extract from the wall of the barrel a core that extends through the entire thickness of the wall and which has faces (corresponding to the internal and external surfaces of the pipe) of area between 1.0×10^4 mm^2 and 1.5×10^4 mm^2.

NOTE: A cylindrical specimen, made by cutting radially through the pipe wall with a coring bit of 115 mm diameter, or 125 mm nominal diameter, would satisfy these area requirements.

The cut surfaces of the specimen shall be ground smooth and the specimen kept in a damp condition until tested.

F6 TEST PROCEDURES

F6.1 General

The test shall be carried out when the age of the concrete in the specimen is not greater than 28 days.

NOTE: The ability of concrete to absorb water diminishes with increasing time after casting and with increasing duration and quality of curing. Absorption tests made on 28 days old concrete will, therefore, yield lower percentage values than tests on concrete less than 28 days old. Hence if an early-age value is less than the permissible limiting value, no further test will be required, however, if this is not the case, a further test at 28 days would be required.

F6.2 Procedures

F6.2.1 *Determination of dry mass (m_1)*

The procedure shall be as follows:

(a) Weigh the damp specimen to the nearest 0.5 g and record the mass as m_0.

(b) Dry the specimen at 105 ±3°C in the drying oven until consecutive weighing of the specimen, when made at intervals of not less than 4 h, show a change in mass the lesser of 0.1% m_0 or 0.5 g. Record the lowest value determined at room temperature as the dry mass (m_1) to the nearest gram.

Each consecutive weighing required may be carried out either—

(i) by first allowing the specimen to cool from oven temperature to room temperature in the desiccator and then weighing; or

(ii) by weighing the hot specimen within 1 minute of its removal from the oven then, if no further drying is required, cooling it to room temperature in the desiccator and re-weighing it as soon as possible. The latter reading is recorded as the dry mass (m_1).

F6.2.2 *Immersion procedure*

Immediately following the determination of the dry mass, suspend the specimen in the urn so that no part of the specimen is closer to a direct source of heat than 50 mm. Introduce potable water into the urn at room temperature until all surfaces of the specimen are covered by at least 25 mm of water.

Once the specimen has been covered to the required depth, heat the water rapidly to 100°C and maintain it at that temperature for 5 h keeping the specimen covered with water throughout. At the end of this period, cool the specimen uniformly over 2 h to 20 ±5°C, by gradually replacing the hot water with colder water.

F6.2.3 *Determination of saturated surface-dry mass (m_2)*

At the end of the immersion procedure, remove the specimen from the urn, allow it to drain for not more than 1 min, then remove any remaining water on the surface with the absorbent paper or cloth.

Weigh the specimen in this saturated surface-dry condition and record the mass as (m_2), to the nearest 0.5 g.

If the specimen contains reinforcement, remove it from the concrete and clean off any adhering mortar. Weigh the reinforcement and record its mass as (m_3), to the nearest gram.

F7 CALCULATIONS

The absorption of each test specimen shall be calculated from the following equation:

$$\text{Absorption} = 100(m_2 - m_1)/(m_1 - m_3) \quad \ldots \text{F7(1)}$$

where

m_1 = dry mass, in grams

m_2 = saturated surface-dry mass, in grams

m_3 = mass of reinforcement, in grams

If required, the net absorption shall be calculated from the following equation:

$$\text{Net absorption} = A_s - (A_a \times m_4)/(m_1 - m_3) \quad \ldots \text{F7(2)}$$

where

A_s = absorption, calculated from Equation F7(1) above

m_4 = dry mass of coarse and fine aggregate in the test piece

A_a = percentage water absorption of the aggregate combination, using values for coarse and fine aggregate determined according to—

(a) in Australia, AS 2758.1, or

(b) in New Zealand, NZS 3121

NOTE: The quantities of the individual components of aggregate in the test piece are most readily determined from the concrete mix design.

F8 RECORDS AND REPORTS

F8.1 General

The information specified in Paragraph F8.2 shall be recorded by the manufacturer and shall be kept available for inspection by the purchaser.

F8.2 Records

The test report shall contain the following:

(a) The name of the manufacturer.

(b) The dates of casting and of testing the pipes.

(c) If the test is for type testing or routine testing purposes and, if for routine, the batch identification.

(d) The intended application of the pipe (drainage, sewerage, pressure) or the specified absorption value.

(e) The masses m_0, m_1, m_2 and m_3.

(f) The calculated percentage absorption, or net absorption, and if the test specimen is conforming or non-conforming.

(g) Any other relevant information about the tested specimen which might influence the measurements (e.g., duration of curing).

(h) Reference to this test method i.e. AS/NZS 4058, Appendix F.

APPENDIX G

MEASUREMENT OF CONCRETE COVER TO REINFORCEMENT

(Normative)

G1 GENERAL

This Appendix sets out two methods for determining the minimum thickness of concrete between the outside of the reinforcement and the nearest concrete surface of a test pipe. The methods are applicable to reinforced pipes containing circular or elliptical cages of circumferential reinforcement. While a number of methods are presented as alternatives, in the case of dispute the direct method shall be used.

G2 PRINCIPLE

The thickness of concrete cover is determined—

(a) directly, by cutting a chase along the barrel of the pipe;

(b) indirectly, using an electromagnetic cover meter, or similar device; or

(c) other means of cover checking implemented by the manufacturer as part of the process verification systems in accordance with Clause 5.1 (second paragraph).

G3 APPARATUS

G3.1 Cutting tools

Suitable manual or mechanical cutting or grinding tools capable of cutting the required depth and width of chase.

G3.2 Cover meter

Service capable of detecting the presence of reinforcement and indicating the depth from the concrete surface to the nearest point on the surface of the reinforcement with an accuracy of ±1 mm, at a depth of 20 mm.

G4 CONDITION OF SAMPLE PIPE

The surfaces of the pipe shall be clean and surface dry, and the surface areas on which measurements are to be made shall be smooth and free from surface defects, such as dents, bulges, spalls and blow holes.

G5 TEST PROCEDURE

G5.1 Direct method

G5.1.1 *Location of chases*

On each sample pipe, chases are randomly located between the parallel cross-sections containing the ends of the first cut chase. The number and position of the chases required is as follows:

(a) For single circularly reinforced pipes, one external and one internal chase spaced apart by one quarter of the external surface circumference. Where it is impractical to cut an internal chase because of the small diameter of the test pipe, two external chases shall be cut, spaced apart by one quarter of the external circumference.

(b) For double circularly reinforced pipe, two chases on the external surface and two chases on the internal surface spaced apart by one quarter of the surface circumference. The external and internal chases are to be on the same alignment as, but minimally offset clear of the chase in the opposite face of the pipe wall.

(c) For single elliptically or elliptically and circularly reinforced pipes, one internal chase, at the obvert or invert of the pipe, and one external chase on a diameter at 90° to the diameter containing the first chase.

G5.1.2 *Procedure*

At each location given in Paragraph G5.1.1, cut a chase parallel to the longitudinal axis of the pipe. The chase shall be of minimum width 25 mm, of depth equal to at least the applicable cover given in Table 3.1 or the specified cover, and of sufficient length to expose at least two circumferential bars or a single longitudinal bar, but in any case not less than 100 mm.

Remove and clean out the concrete from within the cut chase to expose any reinforcement at or within the required cover. Measure and record the minimum depth to any reinforcement encountered to the nearest millimetre.

G5.2 Indirect method

G5.2.1 *Calibration of meter*

Calibrate the meter in accordance with the manufacturer's instructions.

G5.2.2 *Procedure*

Move the meter in a line corresponding to the locations for chases given in Paragraph G5.1.1 and parallel to the longitudinal axis of the pipe, marking on the surface the position of two consecutive circumferential bars. Move the meter slowly backward and forward in the same line at each marked position and record the minimum value of cover indicated.

G6 RECORDS

G6.1 General

For each pipe tested in accordance with this Appendix, the information specified in Clause G6.2 shall be recorded by the manufacturer and kept available for inspection by the purchaser.

G6.2 Records

The test report shall contain the following:

(a) The name of the manufacturer.

(b) The dates of casting and testing of the pipe.

(c) The pipe class.

(d) The cover required in accordance with Clause 3.3.7 or the specified cover.

(e) The method adopted, whether direct or indirect.

(f) If the test is for type testing or specified routine testing purposes and, if for routine testing, the batch identification.

(g) If any reinforcement has a cover smaller than the required cover and, if so, the measured cover and the location at which it was measured.

(h) Reference to this test method, i.e. AS/NZS 4058, Appendix G.

APPENDIX H

JOINT ASSEMBLY TEST FOR CONCRETE PIPES WITH FLEXIBLE JOINTS

(Normative)

H1 SCOPE

This Appendix sets out a method for determining the ability of elastomeric seal joints to be assembled and deflected to the maximum recommended angle without damage or loss of joint seal.

H2 PRINCIPLE

Test pipes are assembled, deflected to the maximum recommended angle and the condition of the joint observed.

NOTE: Two test pipes are considered to constitute two test specimens by the reversal of pipes following the first test.

H3 PROCEDURE

The procedure shall be as follows:

(a) Support and assemble two test pipes in accordance with the manufacturer's instructions such that the longitudinal axis of one pipe intersects in the plane of the joint with the axis of the other pipe, and the angle of deflection is zero.

(b) Push the spigot of one pipe into the socket of the other until the gap between the spigot end and the socket back wall is zero or until there is a refusal of the spigot to proceed further.

(c) Deflect the pipes to the maximum inter-axial angle recommended by the manufacturer as being appropriate to the end use of the pipe.

(d) Using normal or corrected vision, inspect the joint at the spigot/socket interface. Record the following (see Figure H1):

  (i) Any damage to either pipe.

  (ii) Any lack of positive overlap of the socket inner face with the pipe spigot outside surface.

(e) Disassemble the pipes, reverse the position of each pipe and repeat the test procedure from Steps (a) to (d).

H4 RECORDS AND REPORTS

H4.1 General

For each pipe tested in accordance with this Appendix, the information specified in Paragraph H4.2 shall be recorded by the manufacturer and kept available for inspection by the purchaser.

H4.2 Records

The test report shall contain the following:

(a) The name of the manufacturer.

(b) The dates of casting and testing of the pipes.

(c) The identification marking of the pipes and the dimensions of the elastomeric seals used.

(d) Whether the joint failed the test and if so which of the test criteria caused the failure.

(e) Reference to this test method, i.e. AS/NZS 4058, Appendix H.

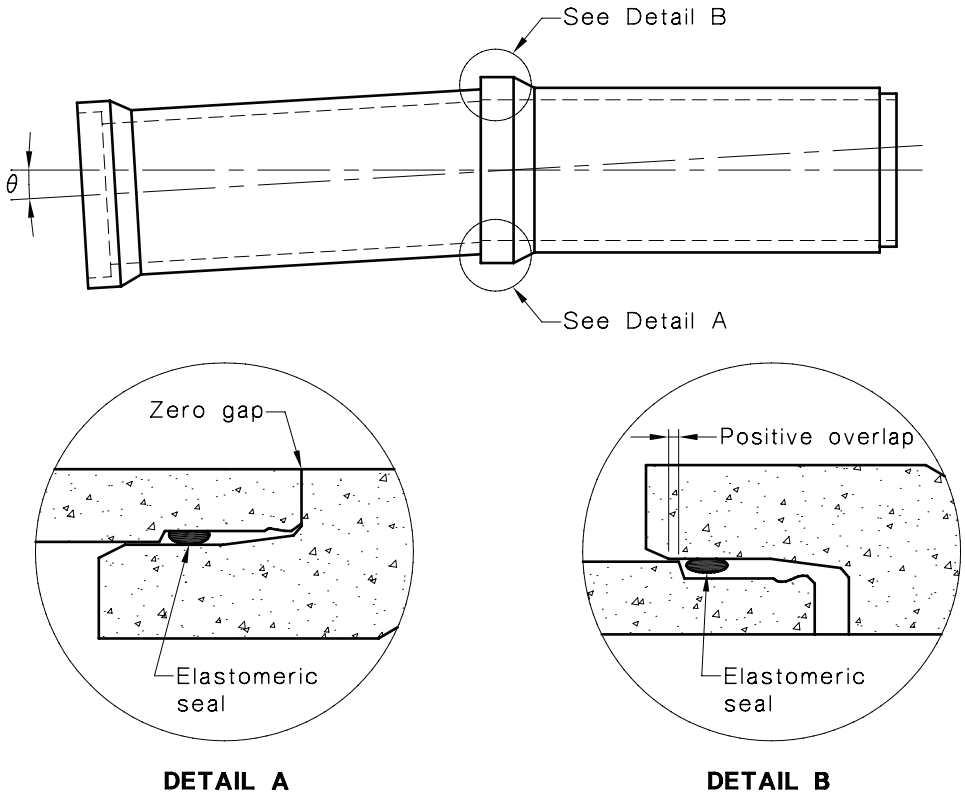


FIGURE H1 INSPECTION CRITERIA FOR JOINT ASSEMBLY TEST

NOTES

NOTES

NOTES

Standards Australia

Standards Australia is an independent company, limited by guarantee, which prepares and publishes most of the voluntary technical and commercial standards used in Australia. These standards are developed through an open process of consultation and consensus, in which all interested parties are invited to participate. Through a Memorandum of Understanding with the Commonwealth government, Standards Australia is recognized as Australia's peak national standards body.

Standards New Zealand

The first national Standards organization was created in New Zealand in 1932. The Standards Council of New Zealand is the national authority responsible for the production of Standards. Standards New Zealand is the trading arm of the Standards Council established under the Standards Act 1988.

Australian/New Zealand Standards

Under a Memorandum of Understanding between Standards Australia and Standards New Zealand, Australian/New Zealand Standards are prepared by committees of experts from industry, governments, consumers and other sectors. The requirements or recommendations contained in published Standards are a consensus of the views of representative interests and also take account of comments received from other sources. They reflect the latest scientific and industry experience. Australian/New Zealand Standards are kept under continuous review after publication and are updated regularly to take account of changing technology.

International Involvement

Standards Australia and Standards New Zealand are responsible for ensuring that the Australian and New Zealand viewpoints are considered in the formulation of international Standards and that the latest international experience is incorporated in national and Joint Standards. This role is vital in assisting local industry to compete in international markets. Both organizations are the national members of ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission).

Visit our web sites

www.standards.org.au www.standards.co.nz

www.standards.com.au

GPO Box 476 Sydney NSW 2001
Administration
Phone (02) 8206 6000
Fax (02) 8206 6001
Email mail@standards.com.au
Customer Service
Phone 1300 65 46 46
Fax 1300 65 49 49
Email sales@standards.com.au
Internet www.standards.org.au

Level 10 Radio New Zealand House
155 The Terrace Wellington 6001
(Private Bag 2439 Wellington 6020)
Phone (04) 498 5990
Fax (04) 498 5994
Customer Services (04) 498 5991
Information Service (04) 498 5992
Email snz@standards.co.nz
Internet www.standards.co.nz

ISBN 0 7337 8161 6

Printed in Australia