

Australian/New Zealand Standard™

PVC pipes and fittings for pressure applications



AS/NZS 1477:2017

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee PL-021, PVC, ABS and Polyamide Pipe Systems. It was approved on behalf of the Council of Standards Australia on 24 April 2017 and by the New Zealand Standards Approval Board on 10 May 2017. This Standard was published on 1 June 2017.

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Australian/New Zealand Standard™

PVC pipes and fittings for pressure applications

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee PL-021, PVC, ABS and Polyamide Pipe Systems, to supersede AS/NZS 1477:2006.

The objective of this Standard is to provide a standard specification for manufacturers and purchasers of PVC pipe and fittings for pressure applications.

This Standard provides for injection-moulded fittings with main diameters greater than DN 150 with parallel solvent-welded sockets. These fittings are predominantly imported fittings and have no specific requirements for colour or titanium dioxide to provide UV protection.

Additional marking requirements have been specified for these fittings to highlight the parallel sockets, the need for gap-filling solvent cements and additional UV protection when used outdoors.

The test criteria specified in this Standard apply to pipes and fittings at the time of manufacture. They are not to be used to assess the results from tests on pipes or fittings that have already been in service.

Appendix B sets out the provisions for best environmental practice PVC for PVC-U pressure pipe. These provisions are in accordance with the credit criteria established by the Green Building Council of Australia in their Green Star rating program.

For best environmental practice PVC satisfying the provisions of Appendix B, an attestation of compliance for upstream materials such as chlorine and vinyl chloride, is necessary. Such attestations can take the form of a declaration of conformity prepared and maintained in accordance with ISO/IEC 17050, *Conformity assessment—Supplier's declaration of conformity*, Part 1: *General requirements*, and Part 2: *Supporting documentation*. Part 1 addresses the contents of the declaration of conformity and the procedures necessary to ensure ongoing compliance. Part 2 addresses the documentation required to support a declaration of conformity including the contents, traceability, availability and retention period.

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

The term 'normative' has been used in this Standard to define the application of the appendix to which it applies. A 'normative' appendix is an integral part of a Standard.

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FOREWORD

This Standard contains dimensions for two ranges of pipe sizes, Series 1 and Series 2. Series 1 pipes are a metric pipe size and Series 2 pipes have dimensions that are compatible with cast iron pressure pipe and fittings.

Pipe dimensions are determined using maximum hoop stresses according to nominal size as follows:

- (a) A hydrostatic design stress of 11.0 MPa under static hydrostatic conditions for calculating the minimum wall thickness of pipes of nominal sizes up to and including DN 150.
- (b) A hydrostatic design stress of 12.3 MPa under static hydrostatic conditions for pipes of nominal size greater than DN 150. The higher hydrostatic design stress for larger diameter pipes is based on test results obtained by the manufacturers and is in accordance with international practice.

The maximum out-of-roundness on outside diameters is applicable to Classes PN 9, PN 12, PN 15, PN 16, PN 18 and PN 20. No such tolerance is placed on sizes in Classes PN 4.5 and PN 6 because the thinner walled pipes may easily be re-rounded when inserted into sockets.

The minimum and maximum wall thicknesses are calculated as follows:

$$T_{\min} = \frac{PD_{\min}}{2S + P}$$

$$T_{\max} = 1.10T_{\min} + 0.20$$

where

$T_{\min}$ = minimum wall thickness, in millimetres

P = maximum allowable working pressure at 20°C, in megapascals

$D_{\min}$ = minimum mean outside diameter, in millimetres

S = hydrostatic design stress, in megapascals, in the static condition at 20°C:

11.0 MPa for nominal sizes DN 10 to DN 150 mm

12.3 MPa for nominal sizes DN 175 to DN 575 mm

$T_{\max}$ = maximum wall thickness, in millimetres

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PVC pipes and fittings for pressure applications

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for PVC pipes and fittings for pressure applications for use below ground or above ground, where they are not exposed to direct sunlight.

Appendix B sets out additional requirements for pipes and fittings classed as best environmental practice PVC-U for pressure applications.

NOTE: Requirements for the installation and use of pipes and fittings manufactured to this Standard are set out in AS/NZS 2032 and AS/NZS 2566.1, as applicable.

1.2 APPLICATION

Appendix A specifies a means of demonstrating conformance with this Standard. Appendix A defines the minimum requirements for a sampling and testing plan. Where variations to this plan are made, demonstrations of conformance with the minimum requirements may be necessary.

1.3 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard:

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS

1199 Sampling procedures for inspection by attributes
 1199.1 Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

1646 Elastomeric seals for waterworks purposes

1722 Pipe threads of Whitworth form
 1722.2 Part 2: Fastening pipe threads

2888 Methods of testing plastics waste fittings
 2888.1 Method 1: Method of determining the suitability of connection threads of BSP form

681 Elastomeric seals—Material requirements for pipe joint seals used in water and drainage applications
 681.1 Part 1: Vulcanized rubber

AS ISO

7 Pipe threads where pressure-tight joints are made on the threads
 7.1 Part 1: Dimensions, tolerances and designation
 7.2 Part 2: Verification by means of limit gauges

AS ISO/IEC

- 17025 General requirements for the competence of testing and calibration laboratories
- 17050 Conformity assessment—Supplier's declaration of conformity
- 17050.1 Part 1: General requirements
- 17050.2 Part 2: Supporting documentation

AS/NZS

- 1462 Methods of test for plastics pipes and fittings
- 1462.1 Method 1: Method for determining the dimensions of pipes and fittings
- 1462.3 Method 3: Method for determining the impact characteristics of pipes
- 1462.4 Method 4: Method for determining reversion of UPVC pipes
- 1462.6 Method 6: Thermoplastics pipes, fittings and assemblies for the transport of fluids under pressure—Resistance to internal pressure
- 1462.8 Method 8: Method of testing the leaktightness of assemblies

AS/NZS

- 1462.11 Method 11: Method for high temperature stress-relief testing of fittings
- 1462.15 Method 15: Method for determination of vinyl chloride monomer content
- 1462.16 Method 16: Method for high temperature testing of pipe
- 1462.19 Method 19: C-ring test for fracture toughness of PVC pipes
- 1462.20 Method 20: Method for the determination of long-term failure stress of PVC moulding compounds
- 2032 Installation of PVC pipe systems
- 3500 Plumbing and drainage
- 3500.0 Part 0: Glossary of terms
- 4020 Testing of products for use in contact with drinking water

AS ISO/IEC

- 17050 Conformity assessment—Supplier's declaration of conformity
- 17050.1 Part 1: General requirements
- 17050.2 Part 2: Supporting documentation

1.4 DEFINITIONS

For the purpose of this Standard, the definitions given in AS/NZS 3500.0 and those below apply.

1.4.1 Best environmental practice PVC pipes and fittings

Pipes or fittings produced by a manufacturer meeting both the requirements of the credit criteria prescribed in Appendix B and this Standard.

1.4.2 Hoop stress

The stress in a pipe or fitting under pressure, acting tangentially to the perimeter of a transverse section.

1.4.3 Hydrostatic design stress

The hoop stress due to internal hydrostatic pressure, which can be applied continuously at a specified temperature. It is obtained by the application of a safety factor to the extrapolated 50 year long-term hydrostatic stress value.

1.4.4 Long-term hydrostatic stress

The continuously applied hoop stress that is estimated to cause failure at a specified time and temperature.

1.4.5 Moulded fittings

A fitting manufactured entirely by injection moulding.

1.4.6 Out-of-roundness (sometimes referred to as ‘ovality’)

The difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-section of the pipe.

1.4.7 Post-formed bend

A bend produced from pipe conforming to this Standard.

1.4.8 Test pressure

The pressure applied internally to pipes or fittings when being tested for strength and watertightness.

1.4.9 Working pressure

The maximum pressure that can be sustained by the type and class of pipe or fitting for its estimated useful life under the expected working conditions.

1.5 NOTATION

The following symbols are used in this Standard:

$A_{\min}$ = minimum socket depth, in millimetres

d = maximum internal dimension of fitting (see Clause 5.3.2), in millimetres

DN = nominal size (based on nominal bore), in millimetres

D_m = mean outside diameter, in millimetres

D_i = socket mouth mean inside diameter, in millimetres

D_r = socket root mean diameter, in millimetres

ε_d = maximum diametral strain, in megapascals

F = extrapolated 50 year failure stress, in megapascals

K_{Ic} = fracture toughness, in megapascals square root metre (MPa $\sqrt{m}$)

L = socket length, in millimetres

P = maximum static working pressure of the fitting, in megapascals

PN = The nominal working pressure designated in bar, but normally referenced in megapascals. The conversion of units is as follows:

$$\left(\frac{PN(\text{in bar})}{10} = \text{MPa} \right)$$

S = hydrostatic design stress, in megapascals

t = pipe material temperature range, in degrees

T = wall thickness, in millimetres

1.6 CLASSIFICATION

Pipe and fittings shall be classified by nominal pressure as follows:

PN 4.5—for a nominal working pressure of 0.45 MPa at 20°C.

PN 6—for a nominal working pressure of 0.6 MPa at 20°C.

PN 9—for a nominal working pressure of 0.9 MPa at 20°C.

PN 12—for a nominal working pressure of 1.2 MPa at 20°C.

PN 15—for a nominal working pressure of 1.5 MPa at 20°C.

PN 16—for a nominal working pressure of 1.6 MPa at 20°C.

PN 18—for a nominal working pressure of 1.8 MPa at 20°C.

PN 20—for a nominal working pressure of 2.0 MPa at 20°C.

NOTE: Selection of class should be based on consideration of all factors that may affect the operation of the pipe, e.g. temperature of operation, fluctuating pressure, and external loading. Reference should be made to AS/NZS 2032 for the design and installation of PVC systems.

SECTION 2 GENERAL REQUIREMENTS

2.1 SCOPE OF SECTION

This Section specifies the minimum general requirements applicable to PVC pressure pipes and fittings.

2.2 COMPOSITION

The material from which the pipes and fittings are produced shall consist of polyvinyl chloride (PVC) together with additives necessary for the manufacture and performance requirements of this Standard. Such additives shall include a minimum of 1.5 parts of rutile titanium dioxide (TiO_2) per 100 parts per mass of PVC. This requirement does not apply to fittings greater than DN 150 with non-interference fit parallel sockets. The PVC content of the pipe or fitting shall be not less than 83.3%. Establishment of the TiO_2 and PVC content shall be achieved by the use of process control methods. Rework material of the same composition, regenerated from the manufacturer's own production of pipes and fittings made to this Standard may be used. Additives containing compounds based on lead (Pb), cadmium (Cd) or mercury (Hg) shall not be used.

2.3 DIMENSIONS

The dimensions of the pipes and fittings, measured in accordance with AS/NZS 1462.1, shall conform to the dimensions given in this Standard.

Out-of-roundness of the outside diameter shall be measured within 24 h from the time of manufacture.

Out-of-roundness tolerances apply to Classes PN 9, PN 12, PN 15, PN 16, PN 18 and PN 20 only.

2.4 COLOUR

2.4.1 Series 1

Series 1 pipes for drinking water application shall be white.

2.4.2 Series 2

Series 2 pipes for drinking water applications shall be light blue and neither lighter than RAL 200 90 10 or RAL 210 90 10 nor darker than RAL 200 80 25 or RAL 210 80 25.

2.4.3 Recycled water

Series 1 and Series 2 pipes specified for recycled water applications shall be purple. The colour shall be neither lighter than RAL 310 70 15 nor darker than RAL 330 40 40 or RAL 310 50 30.

2.4.4 Sewer

Pipes intended for pressure sewerage applications shall be cream. The colour shall be neither lighter than RAL 080 90 20, nor darker than RAL 075 80 20.

2.4.5 Other colours

Other colours may be supplied by agreement between the purchaser and manufacturer.

NOTE: Information on the RAL colour range may be obtained from RAL Deutsches Institut für Gütesicherung und Kennzeichnung e.V., www.ral.de.

2.5 FREEDOM FROM DEFECTS

2.5.1 General

Defects shall not affect the performance or function of the pipes and fittings in service.

Pipes shall not have any blisters and heat marks. When grooves, wrinkles, rippling, dents or projections are present, the pipe shall comply with the dimensional requirements of Table 4.1 or Table 4.2 as appropriate.

2.5.2 Cleanliness

Pipes and fittings shall be clean and free from any manufacturing debris.

2.5.3 Ends

Pipe and fitting ends shall not have any chips and rough edges. Jointing surfaces shall be smooth. The axis of sockets formed on the ends of pipes and fittings shall be parallel within 2° to the axis of the fitting.

The jointing surfaces of sockets on pipes and fittings for solvent cement jointing shall taper uniformly from the mouth to the root of the socket.

NOTE: The defects described in Clauses 2.5.1 and 2.5.3 cannot be completely quantified. Where the presence, size or frequency of any such defects are considered to be of concern, arrangements for acceptable product quality should be made by agreements between relevant parties to confirm acceptance of the product. This may be achieved by the provision of acceptable type samples. Where defects are present and the product is submitted for acceptance, the manufacturer should be able to demonstrate fitness for purpose.

2.6 REQUIREMENTS FOR ELASTOMERIC JOINTING RINGS

The elastomeric jointing rings shall comply with AS 1646 and AS 681.1.

NOTE: Elastomeric jointing rings, for use with pipes and fittings manufactured to this Standard, should be obtained only from the pipe or fittings manufacturer.

2.7 WITNESS MARK

Pipes with a socket for elastomeric seal joints shall carry a witness mark on the spigot end to delineate the insertion length (see Figure 4.1(b)).

2.8 ADDITIONAL REQUIREMENTS FOR BEST ENVIRONMENTAL PRACTICE PVC PIPES AND FITTINGS

For pipes and fittings that are to be classified as 'best environmental practice PVC', the additional requirements set out in Appendix B shall apply.

SECTION 3 PERFORMANCE REQUIREMENTS

3.1 SCOPE OF SECTION

This Section specifies the minimum performance requirements applicable to PVC pressure pipes and fittings at the time of manufacture.

NOTE: Test requirements given in this Section relate to product performance only and are not intended to relate to field performance.

3.2 COMMON TESTS

3.2.1 Effect on water

Pipes, fittings, post-formed bends, couplings, lubricants and elastomeric seals shall comply with AS/NZS 4020. A scaling factor of 1 shall be applied to pipes. For fittings, a scaling factor of 0.01 shall be applied.

NOTE: This applies to all applications including recycled water.

3.2.2 Vinyl chloride monomer test

When determined in accordance with AS/NZS 1462.15, the vinyl chloride monomer level shall not exceed 1 mg/kg. Where a pipe or fitting manufacturer uses a resin with a residual vinyl chloride monomer content of less than 1 mg/kg, this requirement shall be considered to be met.

3.3 PIPE TESTS

3.3.1 Long-term hydrostatic pressure test

When determined in accordance with the AS/NZS 1462.29 long-term hydrostatic pressure test, the extrapolated mean hoop stress values at 50 years (σ_{50}) and the extrapolated 97.5% lower confidence limit (LCL_{σ}) of failure time shall be not less than the values specified in Table 3.1.

In addition, the compound shall sustain a hoop stress of 12.5 MPa at 60°C for 1000 h without failure in accordance with AS/NZS 1462.6. Prior to the establishment of a test point beyond 10 000 h in the 20°C test, provisional approval of a PVC-U compound may be obtained by meeting the 60°C requirement.

TABLE 3.1
LONG-TERM HYDROSTATIC PRESSURE TEST

Nominal size DN	Mean hoop stress 20°C, 50 years (σ_{50}) MPa	LCL ₂₀ years	LCL ₂₃ years
Up to 150	23.6	50	—
175 and above	26	—	50

3.3.2 Impact characteristics at 20°C

When tested in accordance with the 20°C impact test procedure of AS/NZS 1462.3, the pipe shall have a true impact rate (TIR) below 10% at a confidence level of 90%.

The testing parameters employed shall be as follows:

- Mass—as specified in Table 3.2.
- Maximum number of impacts per specimen—as specified in Table 3.3.
- Drop height—2 +0.1, –0.0 m.