

AS/NZS 2033:2024



Australian/New Zealand Standard™

Design and installation of polyolefin pipe systems



AS/NZS 2033:2024

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Australian/New Zealand Standard™

Design and installation of polyolefin pipe systems

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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee PL-006, Polyolefin Pipe Systems to supersede AS/NZS 2033:2008, *Installation of polyethylene pipe systems*.

The objective of this document is to specify requirements for the handling, storage, installation, testing and commissioning of above-ground and below-ground polyolefin pipe systems, for both pressure and non-pressure applications conveying fluids.

This revision updates the document with respect to current practice and new materials. It is intended to address the installation of polyolefin pipes and fittings for plumbing, industrial and irrigation applications. It is not intended to replace industry location-specific installation codes or regulations.

For plumbing applications, refer to AS/NZS 3500, *Plumbing and drainage* (all parts). For above-ground applications using structured wall pipes, refer to the manufacturer.

For installations conveying gaseous fluids, refer to AS/NZS 5601.1, *Gas installations, Part 1: General installations* and AS/NZS 4645.3, *Gas distribution networks, Part 3: Plastics pipe systems*, as appropriate and NZS 5258, *Gas distribution networks* in New Zealand.

For drinking and non-drinking water supply and wastewater network infrastructure involving the design and installation of polyolefin pipe systems, refer to the Water Services Association of Australia (WSAA) codes.

For electrical installations, refer to AS/NZS 3000, *Electrical installations (known as the Australian/New Zealand Wiring Rules)*.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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Australian/New Zealand Standard

Design and installation of polyolefin pipe systems

Section 1 Scope and general

1.1 Scope

This document specifies requirements for the design, handling, storage, installation, testing and commissioning of above-ground and below-ground polyolefin (PO) pipe systems, for pressure and non-pressure applications conveying fluids.

It is intended to address the installation of polyolefin pipes and fittings for plumbing, industrial and irrigation applications. It is not intended to replace industry location-specific installation codes or regulations.

This document applies to PO pipe systems that carry liquids under either pressure or gravity flow situations and the components of which conform to, but are not limited to, the following:

- (a) AS 2698.2 — PE rural pipe.
- (b) AS/NZS 4129 — Fittings for PE pipes for pressure applications.
- (c) AS/NZS 4130 — PE pipes for pressure applications.
- (d) AS 4176 — Polyethylene/aluminium and cross-linked polyethylene/aluminium macro-composite pipes for pressure applications.
- (e) AS/NZS 4401 — PE pipe for soil and waste discharge.
- (f) AS/NZS 5065 — PE and PP pipes for drainage and sewerage.
- (g) AS/NZS 2642.2 — Polybutylene (PB) plumbing pipe systems, Part 2: Polybutylene (PB) pipe for hot and cold water applications
- (h) AS 2492 — Cross-linked polyethylene (PE-X) pipes for pressure applications
- (i) AS/NZS 7671 — Plastics piping systems for soil and waste discharge (low and high temperature) inside buildings — Polypropylene (PP) (ISO 7671:2003, MOD)

1.2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

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

AS 1345, *Identification of the contents of pipes, conduits and ducts*

AS 1646 (all parts), *Elastomeric seals for waterworks purposes*

AS 2492, *Cross-linked polyethylene (PE-X) pipes for pressure applications*

AS 4176 (all parts), *Multilayer pipes for pressure applications*

AS 4793, *Mechanical tapping bands for waterworks purposes*

AS/NZS 2566.1, *Buried flexible pipelines, Part 1: Structural design*

AS/NZS 2566.2, *Buried flexible pipelines, Part 2: Installation*

AS/NZS 2642.2, *Polybutylene (PB) plumbing pipe systems, Part 2: Polybutylene (PB) pipe for hot and cold water applications*

AS/NZS 3500 (all parts), *Plumbing and drainage*

AS/NZS 4020, *Testing of products for use in contact with drinking water*

AS/NZS 4129, *Fittings for polyethylene (PE) pipes for pressure applications*

AS/NZS 4130, *Polyethylene (PE) pipes for pressure applications*

AS/NZS 4131, *Polyethylene (PE) compounds for pressure pipes and fittings*

AS/NZS 4645.3, *Gas distribution networks, Part 3: Plastics pipe systems*

AS/NZS 5065, *Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications*

Australian Pipelines and Gas Association (APGA). *Code of Practice for Upstream PE Gathering Lines in the CSG Industry*

ISO 4427-3, *Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) — Part 3: Fittings*

ISO 13953, *Polyethylene (PE) pipes and fittings — Determination of the tensile strength and failure mode of test pieces from a butt-fused joint*

ISO 15494, *Plastics piping systems for industrial applications — Polybutene (PB), polyethylene (PE), polyethylene of raised temperature resistance (PE-RT), crosslinked polyethylene (PE-X), polypropylene (PP) — Metric series for specifications for components and the system*

ISO 15874, *Plastics piping systems for hot and cold water installations — Polypropylene (PP)*

ISO 15875, *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X)*

ISO 15876, *Plastics piping systems for hot and cold water installations — Polybutene (PB)*

DIN - DVS 2203-5, *Testing of welded joints of thermoplastics plates and tubes - Technological bend test*

DIN - DVS 2207-1, *Welding of thermoplastics - Heated element welding of pipes, piping parts and panels made out of polyethylene*

EN 681-2, *Elastomeric seals - Material requirements for pipe joint seals used in water and drainage applications - Part 2: Thermoplastic elastomers*

Organisation Internationale de Metrologie Legale (OIML). *Water meters for cold potable water and hot water, Part 2: Test methods*

Plastics Industry Pipe Association. *PIPA POP10A – Part 1: Polyethylene Pressure Pipes Design for Dynamic Stresses*

Plastics Industry Pipe Association. *PIPA POP10B – Part 2: Fusion Fittings for Use with Polyethylene Pressure Pipes*

Plastics Industry Pipe Association. *PIPA POP017: Material Requirements for White PE Jacket Compounds Suitable for Long Term UV Exposure*

Plastics Industry Pipe Association. *PIPA POP018: Polyethylene Drinking Water Pipes in Contact with Chlorine and Chloramine*

WATER New Zealand Gravity Pipe Inspection Manual

WSA 05Conduit inspection reporting code of Australia

1.3 Terms and definitions

For the purposes of this document, the terms and definitions given in AS/NZS 3500.0 and the following apply.

1.3.1

competent person

person who has acquired, through education, training, qualification or experience or a combination of these, the knowledge and skill enabling that person to perform the required task correctly

1.3.2

embedment zone

zone around a pipe, including bedding, haunch support, side support and overlay zones

[SOURCE: AS/NZS 2566.2]

1.3.3

fixed point

point at which axial movement of a pipe or fitting is restrained

Note 1 to entry: The fixed point may be located, for example —

- (a) at the fixed (clipped) part of an expansion joint fitting;
- (b) at junctions and bends, except where alternative provision for expansion is made (see [Clause 7.4.3\(c\)](#));
or
- (c) at connections to fixtures, except where movement is accommodated at a trap [see [Clause 7.4.3\(d\)](#)],
and drains, except where movement is possible at the drain connection [see [Clause 7.4.3\(b\)](#)].

1.3.4

mechanical fittings

fittings for assembling plastics pipes with each other or with a metal pipe or fitting, that includes one or more compression zones to provide pressure integrity, leak tightness and resistance to end loads

[SOURCE: ISO 17885]

Note 1 to entry: Mechanical fittings include *compression* ([1.3.4.1](#)), *radial press* ([1.3.4.2](#)), *axial press* ([1.3.4.3](#)), *push-fit* ([1.3.4.4](#)) and *radial shrink fitting* ([1.3.4.5](#)).

1.3.4.1

compression

fitting in which the joint is made by screwing a union nut along a thread to compress a ring on the outside wall of a pipe

Note 1 to entry: An internal support providing permanent support against radial compressive forces may be applicable to some fittings.

[SOURCE: ISO 15875-3]

1.3.4.2

radial press

fitting with internal support in which the joint is made by a radial compression of a ring with a pressing tool on the outside wall of a pipe

Note 1 to entry: The fitting may be with or without a sealing element.

[SOURCE: ISO 15875-3]

1.3.4.3**axial press**

fitting with internal support in which the joint is made by an axial movement of a sleeve with a pressing tool

Note 1 to entry: The fitting may be with or without a sealing element.

[SOURCE: ISO 15875-3]

1.3.4.4**push-fit**

fitting which incorporates a sealing element, a gripping device and uses an internal support

Note 1 to entry: The joint is made by pushing the pipe into the fitting and a seal is achieved without the use of heat or tools.

Note 2 to entry: In some designs, push-fit joints can be disconnected and re-connected or disconnected and the fitting re-used elsewhere.

Note 3 to entry: The internal support can be an integrated part of the fitting or a separate part (supporting sleeve).

[SOURCE: ISO 15875-3]

1.3.4.5**radial shrink fitting**

fitting with internal support in which the joint is made by a radial shrinking of a pipe and a previously expanded ring made of viscoelastic plastics material on the outside wall of the pipe

Note 1 to entry: The fitting may be with or without sealing element.

Note 2 to entry: The internal support can be an integrated part of the fitting or a separate part (supporting sleeve).

[SOURCE: ISO 15875-3]

1.3.5**permeation**

passage or diffusion of a gas, vapour, liquid or solid through a material without the material being physically or chemically affected

1.3.6**polyolefin****PO**

polybutylene, polyethylene, polypropylene and cross-linked polyethylene

1.3.7**shall**

indicates a mandatory requirement

1.3.8**should**

indicates a recommendation

1.4 Abbreviations

The following abbreviations are used in this document.

MAOP Maximum allowable operating pressure

PB Polybutylene

PE	Polyethylene
PEX	Cross-linked polyethylene
PO	Polyolefin
PP	Polypropylene
SDR	Standard dimension ratio



Section 2 Products and materials

2.1 Scope of section

This section specifies requirements for products and materials used for the installation of PO pipe systems.

2.2 Pipe and fittings

2.2.1 Chemical resistance

For requirements relating to the suitability of PO pipes for the conveyance of chemicals, refer to ISO/TR 10358, USA PPI TR 19, or obtain advice from the manufacturer.

The effects of external chemical contamination on pipes and fittings shall be assessed as follows:

- (a) For installations in contaminated ground, the suitability of PO for that service shall be determined by the degree to which the material is degraded in a way that —
 - (i) affects the pipe system's structural integrity, or
 - (ii) permeates the pipes or fittings, not adversely affecting structural strength but potentially tainting pipe contents.

NOTE 1: Such permeation may not be an issue for pipes that do not convey drinking water (see [Clause 2.2.2](#)).

- (b) In drainage applications, the tables of chemical resistance shall be varied to take account of the concentration of the chemicals, temperature of the liquid, and the duration of contact (e.g. a laboratory drainage system).
- (c) For pipes joined with elastomeric seals, the chemical resistance of the seals shall be taken into account (see [Clause 2.2.3](#)).
- (d) Mechanical joint fittings and their components shall be in accordance with [Clause 5.3](#).

NOTE 2 See the chemical resistance data sheets in the Bibliography for further guidance. Alternatively, refer to the pipe and fitting manufacturer.

2.2.2 Permeation

Permeation of PO pipes and fittings by chemicals can be caused by the fluid being transported or by an external influence, such as ground contamination. The degree of permeation depends upon the concentration of the contaminant and its nature.

NOTE Permeation can affect pipes and fittings of any type or material, when used in any combination.

Expert advice should be sought if significant levels of contamination are present.

2.2.3 Elastomeric seals

Elastomeric seals for socketed pipes and fittings, not intended for drinking and recycled water applications, shall conform to the applicable parts of AS 1646.

For drinking and recycled water applications, elastomeric seals shall conform to AS/NZS 4020 and EN 681-2.

Elastomeric seals shall be installed in accordance with the manufacturer's specifications.

2.2.4 Lubricants for elastomeric seals and expansion joints

Elastomeric seals and expansion joints shall be fitted using the lubricants specified by the manufacturer of a socketed pipe or fitting. For drinking and recycled water applications, lubricants shall also conform to AS/NZS 4020.

2.2.5 UV resistance

For pipes exposed to direct sunlight for extended periods, UV stabilized pipes prescribed in the relevant product Standards listed in this clause shall be used.

PB and PP pressure pipes shall not be used in direct or indirect UV conditions, unless they are UV stabilized in accordance with AS/NZS 2642.2 or protected with a UV resistant material. PB and PP pressure pipes shall be protected from UV radiation during transportation and storage.

PEX pipes shall not be used in direct or indirect UV conditions, unless they have a black solid wall, or are protected with a UV resistant material. Pipes with a black solid wall shall have a carbon black content in accordance with AS 2492. PEX pipes shall be protected from UV radiation during transportation and storage.

NOTE 1 See [Clause 3.9.1](#) for guidance on heat build up due to the effect of sunlight on PO pipes.

PE and PP pipes used for drainage and sewerage applications shall not be used in direct or indirect UV conditions unless they contain, in solid wall or jacket, carbon black in accordance with AS/NZS 5065.

PE pressure pipes intended for extended continuous UV radiation shall contain carbon black in accordance with AS/NZS 4131.

Coloured pipes including jackets and stripes that are UV stabilized in accordance AS/NZS 4130 and AS/NZS 4131 may be used for UV exposures periods not exceeding two years.

Where white jacketed PE pipes are used to reduce external surface temperatures, the requirements specified in PIPA POP017 shall apply.

NOTE 2 The weathering tests included in the Standards cited in this clause provide assurance of resistance to weathering encountered during storage and transport of pipes. The tests do not provide assurance for installations with long-term exposure to elements. Refer to AS 1745.2 for typical incident energy at various sites around Australia.

2.3 Hangers and clips

Sliding joints, pipe hangers and clips shall be constructed so that, when fully tightened, the pipes can move longitudinally without damage to the pipes or fittings.

Anchor clips for fixed points shall be constructed so that, when fully tightened, the pipes or fittings are securely and evenly clamped to prevent movement. The pipes and fittings shall not be distorted by over-tightening.

2.4 Pipe embedment and trench-fill materials

Embedment and trench-fill materials shall conform to the AS/NZS 3500 series, AS/NZS 2566.1 and AS/NZS 2566.2, or applicable industry standards.

2.5 Tools and equipment

Specialized tools and equipment for the installation, repair, testing and commissioning of PO pipes and fittings shall be used in accordance with the manufacturer's specifications.

Section 3 Design

3.1 Scope of section

This section addresses the design of PO pipe systems in specific applications.

3.2 Calculation of maximum allowable operating pressures

PE 80B and PE 100 series 1 pipes shall conform to AS/NZS 4130 for below-ground applications. For the calculation of MAOP of other PO materials, the minimum required strength (MRS) shall conform to the appropriate product standard.

The design factors in [Table 3.1](#) shall be applied for below-ground applications.

For above ground applications, the design shall conform to the relevant ISO requirements for building applications. AS/NZS 3500 may be used, with the additional requirements of this document.

3.3 Design factors

When calculating the maximum allowable operating pressure (MAOP), the following minimum design factors (C_{min}) for various PO materials shall be used.

Table 3.1 — Design factors

PO material	C_{min}
PB	1.25
PE (PE 80B and PE 100)	1.25
PEX	1.25
PP copolymer	1.25
PP homopolymer	1.6

NOTE 1 Refer to ISO 12162 for further information.

NOTE 2 Refer to AS/NZS 4645.3 for design factors of PE pipes conveying gaseous fluids.

3.4 Material temperature ratings for pressure pipes

Where PO pipes under pressure are operated at temperatures greater than 20 °C, the MAOP shall be re-rated. PE 80B and PE 100 pipe materials conforming to AS/NZS 4131 shall be deemed to conform to the ratings listed in [Clause 4.7](#) of this document.

NOTE Refer to PIPA POP013 for further information on PE.

For other PO materials under pressure, the temperature ratings shall conform to the following —

- (a) *PP* — ISO 15874.
- (b) *PEX* — AS 2492 or ISO 15875.
- (c) *PB* — AS/NZS 2642.2 or ISO 15876.
- (d) *Multilayer pipes* — AS/NZS 4176

3.5 Surge and fatigue pressure ratings

3.5.1 Operating pressure

PO pipe pressure classes are a result of long-term hydrostatic pressure testing. It is assumed that the internal operating pressures are less than the pipe MAOP and act in a static manner.

Where the internal operating pressures behave dynamically, due to either surge or fatigue, then the design and selection of the pipe class shall be revised for these conditions.

NOTE 1 Surge is the condition where a pressure peak occurs, and decays rapidly over a short time (typically around 5 min).

NOTE 2 Fatigue is the condition where many repetitive pressure peaks occur. In this condition, the critical elements are the size and frequency of the repeat events.

For fatigue conditions, the maximum peak pressure shall be less than the pipe MAOP value.

For isolated surge conditions, the maximum peak pressure shall be less than $1.25 \times$ the pipe system MAOP value.

3.5.2 Design

For PE pipes conforming to AS/NZS 4130, design shall be as described in PIPA POP10A – Part 1.

For PE fusion fittings conforming to AS/NZS 4129, design shall be as described in PIPA POP10B – Part 2.

For other small diameter PO pipes used in above ground installations, design should conform to AS 3500. Additional information should be sought from the pipe manufacturer.

For other PE and PO fittings, advice should be sought from the fitting manufacturer.

3.6 Disinfection effects of polyolefin pipe system materials

3.6.1 General

PO pipes used for drinking water applications should be disinfected using either chlorine or chloramine to provide a residual disinfectant level in the water. Chlorine dioxide shall not be used for disinfection of plumbing, distribution and reticulation applications.

NOTE Refer to the Australian Drinking Water Guidelines, and Guidelines for Drinking Water Quality Management for New Zealand for the recommended limits for both aesthetic (0.6 mg/L) and health (5 mg/L) purposes.

Any effect of residual disinfection levels on PO pipe system materials is determined by the water temperature, pH, oxidation reduction potential (ORP), disinfectant type and concentration.

3.6.2 Polyethylene drinking water pipe systems

Where PE is used for drinking water applications with a continuous water temperature greater than 25 °C, the procedures in PIPA POP018 shall apply. Where the procedures in PIPA POP018 indicate higher risk of water disinfectant oxidation, mitigating actions shall apply.

3.6.3 Materials used in hot and cold water systems

Where cross-linked polyethylene (PEX), polybutylene (PB), polypropylene (PP) and multilayer pipes are used for hot and cold water applications in buildings, the risk of oxidative degradation due to the disinfection method shall be assessed and mitigating actions applied. Mitigating actions may include the following:

- (a) Reducing the level of disinfectant.
- (b) Raising the pH.
- (c) Reducing the operating temperature.
- (d) Using pipes with a lower SDR.

- (e) Selecting a different material.

Operating envelopes restrictions shall be as specified by the pipe system manufacturer.

NOTE ASTM F2023 and PPI TN-53 provide testing and evaluation procedures that can be applied to PO piping systems used for hot and cold water applications in buildings, in order to provide some guidance to users in the assessment of suitability for use.

3.6.4 Polypropylene hot and cold water systems

Where polypropylene (PP) pipes are used for hot and cold water systems, the operating envelope restrictions shall be as specified by the pipe system manufacturer.

The use of copper pipes and fittings in the system should be avoided where possible. Where this is not practicable, the water flow velocity in the copper components shall not exceed 0.5 m/sec.

NOTE Flow velocities in the PP pipe system sections are not restricted, however, a maximum velocity of 1.8 m/sec should be considered.

3.6.5 Secondary disinfection degradation effects

Where pipe systems use a mix of metallic and PO components, corrosion in the metallic components can cause secondary degradation in the PO components. The secondary disinfection degradation effect shall be mitigated by avoiding, where practicable, the use of mixed components within a pipe system.

3.7 Seismic risk area design

Where the pipe system is to be installed in an area subject to earthquakes or seismic risk, the resilient design principles outlined in [Appendix B](#) should be implemented.

Where practical, the jointing systems shown in [Table 3.2](#) should be used for above-ground and below-ground installations.

Table 3.2 — Jointing systems for seismic risk areas

Material	Jointing system
PE	Fully fusion welded joints such as butt welding or electrofusion, flanges or end load resistant mechanical fittings with internal bore support.
PEX, PB and multilayer	End load resistant mechanical joints.
PP for hot and cold water	Socket fusion flanges or end load resistant mechanical joints.

3.8 External load design

Where PO pipes are installed below ground, the selection of the pipe class, and the ability of the pipes to withstand any external loading, shall be evaluated using either the graphical design method outlined in [Clause 6.2.2](#) or AS/NZS 2566.1.

See [Clause 6.2](#) for more detail on structural design of below-ground pipes and fittings.

3.9 Effects of sunlight and fire

3.9.1 Effect of sunlight

Elevated pipe temperatures due to incidental sunlight will reduce the pressure capacity of PO pipes. The severity of the heating effect of sunlight on the temperature of pipes laid on-ground should be reduced by using light coloured pipes or pipes with a light-coloured, co-extruded jacket.

3.9.2 Effect of fire

PO is inherently flammable and pipes can be damaged if exposed to fire. The likelihood of encountering fire, and the consequences, shall be taken into account when installing PO pipes.

Section 4 General requirements

4.1 Scope of section

This section specifies general requirements for the installation of PO pipe systems and their handling, transport, storage and inspection.

4.2 Transport, handling and storage

4.2.1 Transport and handling

PO pipes and fittings shall be transported, handled and stored in a way which avoids the following physical damage that could adversely affect performance:

- (a) PO pipes and fittings shall not be gouged, scored, scratched; see [Clause 4.3.3](#).
- (b) PO pipes and fittings shall not have localized deformation, excessive ovalization or any impact damage.

NOTE Refer to PIPA POP005 for further information on transport handling and storage.

4.2.2 Storage

The storage area provided for pipes shall be —

- (a) a flat surface, free of any sharp stone or projection which may cause damage or localized deformation to the pipes; and
- (b) suitable for the use of the proposed loading and unloading equipment without the risk of accidental damage to the pipes.

For pipes conforming to AS/NZS 4130, if the total period of exposed storage outdoors is likely to exceed 24 months, pipes and fittings shall be covered.

EXCEPTION — The above requirement is not applicable to black pipes.

Pipes and fittings that are not UV stabilized shall be covered or stored indoors. Electrofusion fittings shall be stored in their original packaging.

Stacking of pipes during storage shall be in accordance with the manufacturer's specifications.

Joint lubricants shall be stored in sealed containers until ready for use.

4.3 Pre-installation inspection

4.3.1 Correct supply

Before installation, pipes and fittings shall be inspected to confirm that they are of the type, size and classification specified for the installation. Any components that are not in accordance with the specifications shall be replaced.

4.3.2 Cleanliness

Pipes and fittings shall also be inspected to confirm that they are free of obstructions and foreign materials which could interfere with the performance of the pipe system.

Pipes and fittings shall be cleaned if needed to remove obstructions and foreign materials.

4.3.3 Fitness for use

The outside surfaces of the pipes shall be visually checked for damage immediately before installation. The maximum damage to the external surface shall be no greater than 10 % of the pipe wall thickness. Sections with damage greater than 10 % shall be cut out and not used.

Before jointing, pipe ends shall be assessed for flat sections, toe-in, ovality and suitability of the jointing method.

NOTE Refer to PIPA POP001 for electrofusion jointing of PE, or manufacturer's instructions.

Pipes with kinks shall not be installed, re-rounded or repaired by reheating. Pipes should be cut to remove damaged sections, and the remaining sections may be used.

4.4 Protection against damage

4.4.1 General

Pipes installed in locations or operating under conditions where they may be subject to mechanical damage shall be protected, including during the construction stage.

NOTE Typical examples of protection include sleeving and jackets.

4.4.2 Protection from heat

Pipe systems shall not be installed adjacent to heat sources where the temperature of the pipework may exceed the design temperature of the pipe system.

NOTE Typical examples of heat sources include boilers, naked flame, hot water or steam lines.

4.5 Replacement of metallic water supply pipe systems

Any work on existing metallic pipes shall be conducted in accordance with the relevant section of AS/NZS 3500.1.

WARNING — Metallic water pipes often serve as an earth for electric systems within the property.

4.6 Static electricity

Static electric charges can be generated on the surface of PO pipes by the effects of friction during the handling, laying and operation of pipes.

Where the discharge of electricity from static electricity build-up is dangerous (e.g. in explosive atmospheres), static electricity shall either —

- (a) not be generated; or
- (b) be discharged in a safe manner.

4.7 Temperature considerations

4.7.1 Pressure re-rating due to thermal effects

4.7.1.1 Temperature of pipe wall

The nominal pressure (PN) rating of PO pressure pipes shall be based on the temperature of the pipe wall, which may be determined from one of the following:

- (a) An assumption of a constant pipe wall temperature typical for continuous service at a set temperature, e.g. cold water service.
- (b) An average service temperature, where temperature variations are likely to occur in a predictable pattern, e.g. in cavity walls or roof spaces.
- (c) 10 °C less than the maximum service temperature for installations where large unpredictable temperature variations occur up to a maximum of 80 °C, e.g. above-ground installations such as irrigation systems.

For PE pressure pipes applying to items (a) (b) and (c), the MAOP shall be in accordance with values in [Tables 4.1](#) and [Table 4.2](#).

NOTE The values specified in the tables are for PE materials typically used in Australia and New Zealand.

Table 4.1 — MAOP, metres head, PE 80B

Temperature °C	PN 3.2	PN 4	PN 6.3	PN 8	PN 10	PN 12.5	PN 16	PN 20
20	32	40	63	80	100	125	160	200
25	32	40	63	80	100	125	160	200
30	28	35	55	70	88	109	140	175
35	26	32	50	64	80	100	128	160
40	24	30	47	60	75	94	120	150
45	22	28	44	56	70	88	112	140
50 ^a	21	26	41	52	65	81	104	130
55 ^a	19	24	38	48	60	75	96	120

^a At 50 °C and 55 °C, the extrapolated performance of a pipe cannot be predicted beyond 36 years and 24 years, respectively, based on current data.

Table 4.2 — MAOP, metres head, PE 100

Temperature °C	PN 3.2	PN 4	PN 6.3	PN 8	PN 10	PN 12.5	PN 16	PN 20	PN 25
20	32	40	63	80	100	125	160	200	250
25	32	40	63	80	100	125	160	200	250
30	30	38	59	75	94	118	150	188	235
35	29	36	56	71	89	112	143	179	224
40	27	34	53	68	84	106	135	169	221
45	25	32	50	64	80	100	127	159	199
50 ^a	24	30	48	60	76	95	121	151	189
55 ^a	23	29	45	57	72	89	115	143	179

Table 4.2 (continued)

Temperature °C	PN 3.2	PN 4	PN 6.3	PN 8	PN 10	PN 12.5	PN 16	PN 20	PN 25
^a At 50 °C and 55 °C, the extrapolated performance of a pipe cannot be predicted beyond 36 years and 24 years, respectively, based on current data.									

4.7.1.2 Predictable temperature variations

For installations where predictable temperature variations occur, the average material temperature shall be determined from the following:

- (a) Across the wall of a pipe, the material temperature taken as the mean of the internal and external pipe surface temperatures, where a temperature differential exists between the fluid in the pipe and the external environmental.
- (c) With respect to time, the average temperature may be considered as the weighted average of temperatures for the proportion of time spent at each temperature under operational pressures. It shall be calculated from the following equation:

$$T_m = T_1 L_1 + T_2 L_2 + \dots + T_n L_n$$

where

NOTE 1 This approximation is reasonable provided the temperature variations from the mean do not exceed 10 °C, which is generally the case for pipes buried at depths 300 mm below finished surface level.

NOTE 2 The pressure and temperature condition, where flow is stopped for prolonged periods, should also be checked. In this event, fluid temperature and outside temperature may equalize.

T_m = average pipe material temperature for the time period under consideration, in °C

T_n = average pipe material temperature for a proportion of pipe life, in °C

L = proportion of life spent at temperature T_n

4.7.2 Provision for expansion and contraction

[Table 4.3](#) shows typical values for coefficient of thermal expansion.

Table 4.3 — Typical values for coefficient of thermal expansion

Material	Coefficient of expansion 10^{-4} /°C
PE 80B and PE 100	1.8
LDPE	2.0
PEX	1.5
Multilayer with aluminium	0.3
PPH	1.7
PPR PPB	2.0
PB	1.3

Where pipes are buried during hot or cold weather, expansion or contraction of the pipe system may take place as the pipes adjust to ground temperature during backfilling. In these cases, where no elastomeric seal joints are included, final connection and backfilling should not take place until the pipes are at the normal service temperature. In a pipe system using elastomeric seal joints, this precaution may not be necessary.

For above ground sanitary plumbing and drainage, the greatest thermal movements will usually be caused by variations in environmental temperature. This is because the duration of most waste discharges is short and the temperature response of the material is slow. Provision for expansion and contraction shall be in accordance with [Clause 7.4](#).

When a downpipe is connected to a stormwater pipe, or otherwise restrained at the discharge point, provisions shall be made to allow the pipe to expand and contract.

4.8 Effect of water hammer or pressure surges

Steps shall be taken to mitigate the effects of water hammer and pressure surges during the design phase (see [Clause 3.5.2](#)).

NOTE Information on surge and fatigue can be found in WSA 01, *Polyethylene Pipeline Code*, PIPA POP10A – Part 1 and 10B – Part 2, www.pipa.com.au, and other relevant documents.

4.9 Buckling under external load and vacuum

PO pipes and fittings subjected to negative pressure or installed below the water table may buckle due to external loads. The pipe class selected in the installation shall be high enough to ensure stability against —

- (a) the minimum (vacuum) design pressure; and
- (b) buckling failure when subjected to the maximum external hydrostatic pressure possible for the deepest pipe in the installation.

Typically, negative pressures for pipes with a SDR greater than SDR 13.6 shall be taken into account. In these circumstances, advice may be sought from the pipe manufacturer.

When grouting or concrete encasement of PO pipes is undertaken, the grouting pressures and temperatures should be determined in order to ensure that empty pipes do not deflect or buckle beyond acceptable criteria due to grout pressure and increased temperature due to the heat of hydration of the cementitious material. Where the contribution of grouting pressure to buckling forces on an empty pipe is of concern, grouting should be carried out with the pipe internally pressurized.

Section 5 Jointing methods

5.1 Scope of section

This section sets out requirements for the jointing of PO pipe and fittings in PO pipe systems.

5.2 Fusion joints

5.2.1 General

Acceptable methods for fusion jointing include the following:

- (a) Electrofusion.
- (b) Butt welding.
- (c) Socket-fusion.

Extrusion welding shall only be used for non-pressure applications.

Pipe spigot ends should be cut back to a point beyond evidence of toe-in and to where the outside diameter conforms to the appropriate Standard. Refer to AS/NZS 4130, AS 4176, AS/NZS 5065, AS 2492, AS/NZS 2642, AS 5082.1 or AS/NZS 7671.

Pipe fittings and spigot ends of cut pipe lengths used for butt welding and electrofusion shall be re-rounded during the jointing process.

5.2.2 Electrofusion

Electrofusion should be carried out in accordance with the manufacturer's instructions for each specific material, size and type of fitting. Electrofusion control boxes should conform to ISO 12176-2. Electrofusion shall be performed by competent persons.

NOTE 1 For more information about electrofusion of PE pipe systems, refer to PIPA POP001.

In Australia for the fusion of PE pipe systems, the competent person shall have completed PMBWELD 302 training within the last three years.

In New Zealand for the fusion of PE pipe systems, the competent person shall have completed PMBWELD 302, or other training approved by the relevant authority, within the last three years.

NOTE 2 In New Zealand this training can include Unit Standard 31532 and Unit Standard 31525.

When tested, electrofusion joints shall meet the requirements of AS/NZS 4129:2020 Clause 3.5.

A field fusion quality assurance (QA) plan shall be submitted and approved before commencing fusion jointing.

5.2.3 Butt welding

Butt welding should be carried out in accordance with the welding machine manufacturer's operating instructions for the specific machine, and each pipe diameter and wall thickness. Refer to ISO 21307, or other validated welding parameter systems.

Before butt welding commences on site, the fusion parameters shall be validated by test for the specified machine and operator, and each pipe diameter and wall thickness. Welding shall be performed by competent persons.

In Australia for the fusion of PE pipe systems, the competent person shall have completed PMBWELD 301 training within the last three years.

In New Zealand for the fusion of PE pipe systems, the competent person shall have completed PMBWELD 301, or other training approved by the relevant authority, within the last three years.

NOTE 1 In New Zealand this training can include Unit Standard 31532 and Unit Standard 31524.

Butt weld joints shall conform to either —

- (a) tensile fracture tests in accordance with ISO 13953, with a minimum 90 % parent pipe strength and ductile behaviour in all test coupons; or
- (b) flexural beam tests in accordance with DVS 2203-5, with no visible splits or cracks.

A field welding QA plan shall be submitted and approved before welding commences.

NOTE 2 For further information on butt welding of PE pipe systems, refer to PIPA POP003.

5.2.4 Socket fusion

Socket fusion should be carried out in accordance with the socket fusion machine manufacturer's operating instructions for the specific machine, and each pipe diameter and wall thickness. Socket fusion machines should conform to ISO 12176. Socket fusion shall be performed by competent persons.

Socket fusion products shall conform to ISO 15494 or ISO 4427-3. When tested, socket fusion joints shall conform to DVS 2207-1 (2015) [Clause 7](#).

A field fusion QA plan shall be submitted and approved before commencing fusion jointing.

5.2.5 Extrusion welding

Extrusion welding should be carried out in accordance with the extrusion weld machine manufacturer's operating instructions for the specific machine, and each pipe diameter and wall thickness. Refer to information regarding welding conditions or other validated condition systems in the machine supplier's instructions.

Extrusion welding conditions shall be validated by test before welding commences on site. Welding shall be performed by a competent person.

In Australia, the competent person shall have completed PMBWELD 309 training within the last three years.

In New Zealand, the competent person shall have completed PMBWELD 309, or other training approved by the relevant authority, within the last three years.

Extrusion welded joints shall conform to either –

- (a) tensile fracture tests in accordance with ISO 13953, with a minimum of 60 % of the parent pipe strength and ductile behaviour in all test coupons; or,
- (b) flexural beam tests in accordance with DVS 2203-5, with no visible splits or cracks.

A field welding QA plan shall be submitted and approved before welding commences.

5.3 Mechanical fittings

5.3.1 General

End load resistant mechanical fittings include compression, radial press, axial press, push-fit and radial shrink fittings. PO plumbing pipes shall be used with compatible fittings, as specified by the pipe or fitting manufacturer.

NOTE Some end-load resistant fittings can require a correctly fitted insert to provide long-term performance.

5.3.2 Radial and axial press fittings

In the case of radial and axial press fittings, only the specific compression tooling specified by the fitting manufacturer shall be used to make the joints.

5.4 Elastomeric seal joints

5.4.1 Application

Only elastomeric seals and lubricants specified by the pipe or fitting manufacturer shall be used.

NOTE Unrestrained elastomeric seal joints for use with PO are applicable only to low or non-pressure applications.

5.4.2 Procedures

5.4.2.1 Elastomeric seal incorporated in socket

The following procedure shall apply to joints where the elastomeric seal is incorporated in the socket:

NOTE 1 This procedure does not apply to expansion joints (see [Clause 7.4](#)).

- (a) Where pipes are required to be cut in the field, the following steps shall be taken:
 - (i) Cut the spigot end square and remove all burrs.
 - (ii) Chamfer the cut end of the pipe with a taper of approximately 15° to approximately half the wall thickness, or as specified by the pipe manufacturer.
 - (iii) At appropriate, witness mark the pipe at the distance specified by the manufacturer.

NOTE 2 A witness mark is normally positioned on the spigot by the manufacturer to show the optimum insertion depth.

NOTE 3 Where spigots and sockets are not made by the same manufacturer, reference should be made to the socket manufacturer for the correct marking depth.

- (b) Ensure that the inside of the socket is clean.
- (c) Where elastomeric seals are required to be fitted, clean and fit the seal. Check that the elastomeric seal sits evenly in the housing.
- (d) Apply the manufacturer's specified lubricant to the end of the spigot and chamfer of the pipe. Keep the elastomeric seal and its housing free of lubricant, unless otherwise specified by the manufacturer.
- (e) Align the pipes so that there is no deflection at the joints, then insert the spigot in the socket and push it home to the witness mark.
- (f) Hold the socket end firmly during the jointing to prevent previously assembled joints from moving.

NOTE 4 Similar procedures apply for making joints where the socket is pushed on to a spigot, e.g. socketed valves or fittings.

NOTE 5 After the joint is made, it may be deflected up to the limit specified by the socket manufacturer.