

Australian Standard<sup>®</sup>

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**Polyethylene/aluminium and  
cross-linked polyethylene/  
aluminium macro-composite pipe  
systems for pressure applications**

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This Australian Standard was prepared by Committee PL/6, Polyethylene Pipe. It was approved on behalf of the Council of Standards Australia on 16 November 1993 and published on 17 January 1994.

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The following interests are represented on Committee PL/6:

Australian Chamber of Commerce and Industry  
Brisbane City Council  
Engineering and Water Supply Department, S.A.  
Hunter Water Corporation  
Melbourne Water  
Public Works Department, N.S.W.  
Rural Water Corporation, Vic.  
The Plastics Industry Association  
Water Authority of Western Australia  
Water Board, Sydney—Illawarra—Blue Mountains  
Water Resources Commission Queensland

Additional interests participating in preparation of Standard:

Aluminium Development Council  
AGL Sydney

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*This Standard was issued in draft form for comment as DR 93003.*

## PREFACE

This Standard was prepared by the Joint Australia/New Zealand Standards Committee PL/6, on Polyethylene Pipe, under the direction of the Building Standards Policy Board.

The following documents were considered during the preparation of this Standard:

## ASTM

F1281—90 Crosslinked Polyethylene/Aluminium/Crosslinked Polyethylene (PEX-AL-PEX) pressure pipe

F1282—90 Polyethylene/Aluminium/Polyethylene (PE-AL-PE) composite pressure pipe

The Committee decided to use the terminology macro-composite to better describe the pipe structure. The term 'macro' reflects the three separate component layers working together in the pipe wall as opposed to the more common fibre-reinforced composite pipe structures.

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.

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## FOREWORD

Polyethylene/aluminium macro-composite pipes are intended for applications with continuous working pressures not exceeding 1.4 MPa at 20°C and operating temperatures not exceeding 60°C. Cross-linked polyethylene/aluminium macro-composite pipes may be used at continuous operating temperatures up to 80°C with short exposures up to 100°C and continuous working pressures not exceeding 1.4 MPa. Polyethylene or cross-linked polyethylene macro-composite pipes which are either natural or of colours other than black are not suitable for use or extended storage where exposed to direct sunlight.

## STANDARDS AUSTRALIA

## Australian Standard

**Polyethylene/aluminium and cross-linked polyethylene/aluminium  
macro-composite pipe systems for pressure applications**

## SECTION 1 SCOPE AND GENERAL

**1.1 SCOPE** This Standard specifies requirements for macro-composite pipes and associated fittings for the conveyance of fluids including compressed air, gaseous fuels and water in agricultural, industrial, domestic and other applications in sizes ranging from 14 to 25 mm outside diameter.

The macro-composite pipes covered by this Standard consist of an aluminium core encapsulated in, and bonded to, an inner and an outer layer of polyethylene or cross-linked polyethylene.

NOTE: Advisory information on the determination of compliance with this Standard is given in Appendix A.

**1.2 REFERENCED DOCUMENTS** The following documents are referred to in this Standard:

AS	
1199	Sampling procedures and tables for inspection by attributes
1349	Bourdon tube pressure and vacuum gauges
1399	Guide to AS 1199—Sampling procedures and tables for inspection by attributes
1460	Fittings for use with polyethylene pipes
1460.1	Part 1: Mechanical jointing fittings
1685	Plastic pipes and fittings for gas reticulation—Polyethylene compound for manufacturing
1984	Vernier callipers (metric series)
2102	Micrometer callipers for external measurement
2345	Dezincification resistance of copper alloys
2492	Crosslinked polyethylene (PE-X) pipe for hot and cold water applications
2642	Polybutylene pipe systems
2642.3	Part 3: Mechanical jointing fittings for use with polybutylene (PB) pipes for hot and cold water applications
3500	National Plumbing and Drainage Code
3500.0	Part 0: Glossary of terms
3688	Water supply—Copper and copper alloy compression and capillary fittings and threaded end connectors
3707	Method for testing pressure cycling resistance of pipes and fittings
3855*	Suitability of plumbing products for contact with potable water

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\* First published as an Interim Standard.

AS	
3900	Quality management and quality assurance standards
3900.1	Part 1: Guidelines for selection and use
3904	Quality management and quality system elements
3904.1	Part 1: Guidelines
4131*	PE pipe compounds
SAA	
HB18	Guidelines for third-party certification and accreditation
HB18.44	Guide 44—General rules for ISO or IEC international third-party certification schemes for products
ASTM	
D1513	Test method for carbon black, pelleted—Pour density
D1603	Test method for carbon black in olefin plastics
D3849	Test method for carbon black primary aggregate dimensions from electron microscope image analysis
ISO/DIS	
11420	Method of test for carbon black dispersion in polyethylene pipes and fittings
12162	Thermoplastics materials for pipes and fittings for pressure applications—Classification and designation—Overall service (design) coefficient

**1.3 DEFINITIONS** For the purpose of this Standard, the definitions given in AS 3500.0 and those below apply.

**1.3.1 Component** A part, or a subassembly of parts, contributing to a total assembly.

**1.3.2 PE/AL/PE pipe** A macro-composite pipe structure comprising an inner and an outer layer of polyethylene bonded to an aluminium core (see Figure 1).

**1.3.3 PE-X/AL/PE-X pipe** A macro-composite pipe structure comprising an inner and an outer layer of polyethylene bonded to an aluminium core and cross-linked in accordance with AS 2492 (see Figure 1).

**1.4 NOTATION** The following notation applies in this Standard:

$D_m$	= mean outside diameter
$D_o$	= ovality outside diameter
$D_i$	= mean inside diameter
$T$	= total wall thickness
$T_o$	= thickness of the outer polymer layer
$T_i$	= thickness of the inner polymer layer

## 1.5 CLASSIFICATION

**1.5.1 PE/AL/PE macro-composite pipe** PE/AL/PE macro-composite pipe shall be classified as PN 14. This corresponds to a maximum static working pressure of 1.4 MPa at a nominal pipe material temperature of 20°C for a working life of not less than 50 years.

NOTE: PE/AL/PE macro-composite pipe is not intended for use in hot water supply systems.

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\* First published as an Interim Standard.

**1.5.2 PE-X/AL/PE-X macro-composite pipe** PE-X/AL/PE-X macro-composite pipe shall be classified as PN 14. This corresponds to a maximum static working pressure of 1.4 MPa at a continuous pipe material temperature not exceeding 80°C for a working life of not less than 50 years.

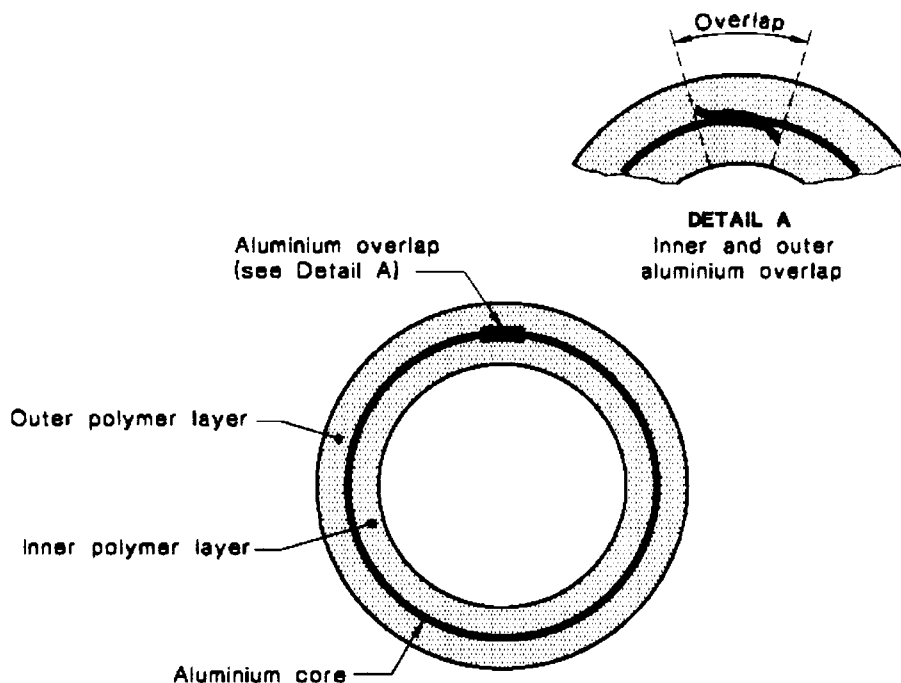


FIGURE 1 CROSS-SECTION OF PIPE STRUCTURE

**1.5.3 Gas applications** Macro-composite pipe used in gas applications shall be classified as Class 500. This corresponds to a service pressure not exceeding 500 kPa at pipe material temperatures in the range  $-20^{\circ}\text{C}$  to  $+35^{\circ}\text{C}$ .

## 1.6 MATERIALS

**1.6.1 Carbon black** Black pipe extrusion compounds shall contain  $2.25 \pm 0.25\%$  by mass of carbon black, when determined in accordance with ASTM D1603. Other methods of determining the carbon black content may be used, e.g. thermogravimetric analysis, provided that they have been demonstrated to give an accuracy of the same or higher degree than that in ASTM D1603. In the event of a dispute, the method of ASTM D1603 shall be the referee method. Carbon black shall comply with the following requirements:

- (a) Average particle size of 10 to 25 nanometres (nm) when determined in accordance with ASTM D3849.
- (b) Density of 1.5 to 2.0 g/mL when determined in accordance with ASTM D1513.
- (c) Maximum volatile content of 2% when determined in accordance with AS 4131, Appendix B\*.
- (d) Maximum toluene extract of 0.1% when determined in accordance with AS 4131, Appendix C\*.

Non-black polyethylene shall comply with the weathering resistance requirements of AS 4131\*.

\* First published as an Interim Standard.

**1.6.2 Dispersion of additives** Anti-oxidants, ultraviolet stabilizers, carbon black and other pigments shall be evenly dispersed in the compounds and, when tested in accordance with ISO/DIS 11420, the diameter of carbon black agglomerates or alternative pigment agglomerates as well as bubbles, voids or foreign bodies shall not exceed 100 µm corresponding to Grade 5 of ISO/DIS 11420.

NOTE: Because the dispersion of anti-oxidants and ultraviolet stabilizers is difficult to assess, it is assumed that if the pigment is evenly dispersed, the other additives will also be evenly dispersed.

**1.6.3 Fittings** Fittings shall be manufactured from materials which are compatible with the pipe material and the fluid to be transported.

Copper alloy fittings shall comply with AS 2345.

**1.6.4 Effect on water** For potable water applications, all materials in contact with water shall comply with AS 3855\*.

**1.6.5 Effect of chemicals** Where fluids other than water or air are to be conveyed, the effect of the fluid on the pipe and fitting materials may be established by reference to the manufacturer.

**1.6.6 Effect on chemicals** Where fluids other than water or air are to be conveyed, the effect of the pipe and fitting materials on the fluid may be established by reference to the manufacturer.

**1.6.7 Chemical resistance for gas applications** The polyethylene or cross-linked polyethylene used in pipes for gas applications shall meet the chemical resistance requirements of AS 1685.

**1.7 PACKAGING** Pipe may be supplied either coiled or in straight lengths as agreed with the customer. If the pipe is coiled, the coiling shall be carried out at a temperature that will ensure that the difference between the minimum and maximum outside pipe diameters at any cross-section does not exceed 10% of the maximum outside diameter of the pipe.

The minimum coil diameter shall be not less than 15 times the mean outside diameter of the pipe with a minimum of 350 mm.

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\* First published as an Interim Standard.

## SECTION 2 PIPES

## 2.1 GENERAL REQUIREMENTS

**2.1.1 Diameter and wall thickness** When measured in accordance with Appendix B, the pipe shall conform with the dimensions given in Table 1. In the area covering the overlap of the aluminium core (see Figure 1), the wall thicknesses  $T_i$  and  $T_o$  may be up to 0.2 mm less than the values given in Table 1, however the minimum total wall thickness shall be maintained. Ovality diameter measurements shall apply to straight lengths only.

TABLE 1  
PIPE DIMENSIONS

millimetres

Nominal size	Designation	Mean outside diameter $D_m$		Ovality outside diameter $D_o$		Mean inside diameter $D_i$	Wall thickness		
		min.	max.	min.	max.		min.	Inner $T_{i \text{ min.}}$	Outer $T_{o \text{ min.}}$
14	10-14	14.0	14.4	13.6	14.7	10.0	0.6	0.4	1.6
16	12-16	16.0	16.4	15.6	16.8	12.0	0.6	0.4	1.6
20	16-20	20.5	21.0	19.9	21.6	16.0	0.7	0.6	2.0
25	20-25	25.0	25.5	24.3	26.2	20.0	0.9	0.6	2.2

**2.1.2 Length** Straight pipe shall be supplied in nominated lengths with a tolerance of +0.15, -0 m. In coils, the length shall be not less than that designated by the manufacturer. All measurements shall be adjusted to an equivalent length at 20°C.

**2.1.3 Adhesion** When tested in accordance with Appendix C, there shall be no separation of the inner or outer polyethylene or cross-linked polyethylene layers from the aluminium core.

**2.1.4 Freedom from defects** Defects shall not affect the performance or function of the pipe in service. Pipes shall be free from blisters, foreign matter and heat marks. Where grooves, wrinkles, rippling, dents or projections are present, the pipe shall comply with the dimensional requirements of Table 1.

NOTE: The defects described in this Clause cannot be completely quantified. Where the presence, size or frequency of any of these are considered to be of concern, arrangements should be made between the purchaser/approving authority/certifying body (as appropriate), and the manufacturer. This may be achieved by the provision of acceptable type samples or methods of test. Where defects are present and the product is submitted for acceptance, the manufacturer should be able to demonstrate fitness for purpose.

**2.1.5 Marking** All pipes shall be legibly and indelibly marked with letters of a minimum height of 3 mm. Such marking shall be repeated at intervals such that the length of any unmarked pipe shall not exceed 1 m. The marking shall show the following:

- (a) Manufacturer's name or registered trademark, or both.
- (b) Nominal size (DN) and designation in the form 12-16, as appropriate.
- (c) The class of the pipe in the form 'PN 14' or 'Class 500', as appropriate.
- (d) The words 'COLD WATER/GAS PE/AL' or 'WATER PE-X/AL', or as appropriate.
- (e) The date of manufacture in the form 940112, i.e. 12th January 1994, as appropriate.

- (f) The place of manufacture. The manufacturer's code is acceptable, e.g. P1.

Example of mandatory marking.

'Tradename' DN 16 (12-16) PN 14 COLD WATER/CLASS 500 GAS PE/AL  
940112 P1.

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

## 2.2 TEST REQUIREMENTS FOR PE/AL/PE PIPE

**2.2.1 Burst test\*** When tested in accordance with Appendix D, at 20°C, so that the burst occurs within 60 to 70 s of commencement of pressurization, the burst pressure shall be not less than the values shown in Table 2.

**TABLE 2**  
**PE/AL/PE PIPE MINIMUM**  
**BURST PRESSURES AT 20°C**

Nominal size	Min. burst pressure
DN	MPa
14	7.0
16	6.0
20	5.0
25	4.0

**2.2.2 Pressure resistance test†** When tested in accordance with Appendix E, the pipe shall withstand the pressures shown in Table 3 at a temperature of 60°C for not less than 10 h and 500 h, as appropriate.

**TABLE 3**  
**PE/AL/PE PIPE TEST PRESSURES**

Nominal size	Test pressure, MPa	
	Test duration	
	10 h	500 h
DN		
14	3.0	2.5
16	3.0	2.5
20	3.0	2.5
25	2.5	2.0

**2.2.3 Long-term rupture test†** When tested at 60°C in accordance with Appendix F, the pipe shall have a minimum 97.5% lower confidence limit (LCL) of not less than 438 000 h at a pressure of 1.56 MPa.

NOTE: (Long-term pressure rating, at elevated temperature: 1.2 MPa)  $\times$  1.3 = 1.56.

Where 1.3 is an overall service (design) coefficient, see ISO/DIS 12162.

\* These tests are short-term quality control tests which are carried out to confirm the quality of the production run prior to release of the pipes.

† These tests are long-term destructive tests which assist in monitoring the absolute quality of the product and need not be completed prior to release of the pipes.