

Australian Standard[®]

Multilayer pipes for pressure applications

**Part 8: Multilayer pipe systems for consumer gas installations with a maximum operating pressure up to and including 5 bar (500 kPa)—
Specifications for systems
(ISO 17484-1:2006, MOD)**



This Australian Standard® was prepared by Committee PL-006, Polyolefin Pipe Systems. It was approved on behalf of the Council of Standards Australia on 3 March 2010. This Standard was published on 30 March 2010.

The following are represented on Committee PL-006:

- Certification Interests (Australia)
 - Energy Networks Association
 - Engineers Australia
 - Master Plumbers, Gasfitters and Drainlayers New Zealand
 - National Plumbing Regulators Forum
 - New Zealand Water and Waste Association
 - Plastics Industry Pipe Association of Australia
 - Plastics New Zealand
 - Plumbing Products Industry Group
 - Water Services Association of Australia
-

This Standard was issued in draft form for comment as DR AS 4176.8.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

Keeping Standards up-to-date

Australian Standards® are living documents that 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Standards may also be withdrawn.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 that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting www.standards.org.au

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at mail@standards.org.au, or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

Australian Standard[®]

Multilayer pipes for pressure applications

Part 8: Multilayer pipe systems for consumer gas installations with a maximum operating pressure up to and including 5 bar (500 kPa)— Specifications for systems (ISO 17484-1:2006, MOD)

Originated as AS 4176—1994.
Revised in part as AS 4176.8—2010.

COPYRIGHT

© Standards Australia

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher.

Published by Standards Australia GPO Box 476, Sydney, NSW 2001, Australia

ISBN 978 0 7337 9451 3

PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee PL-006, Polyolefin Pipe Systems to supersede, in part, AS 4176—1994, *Polyethylene/aluminium and cross-linked polyethylene/aluminium macro-composite pipe systems for pressure applications*.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this Standard is to specify the general requirements and performance requirements of pipes and joints made of multilayer construction intended to be used for consumer gas installations with a maximum operating pressure up to and including 5 bar (500 kPa).

PE-X and PE pipes composed of one stress-designed layer, adhesive and a barrier layer are also covered by this part of AS 4176.

This Standard is an adoption with national modifications and has been reproduced from ISO 17484-1:2006, *Plastics piping systems—Multilayer pipe systems for indoor gas installations with a maximum operating pressure up to and including 5 (500 kPa)*, Part 1: *Specifications for systems* and its corrigendum ISO 17484-1:2006 Cor.1:2008 which has been added following the source text. The modifications and additional requirements are set out in Appendix ZZ. Appendix ZA has been included to specify requirements on means of demonstrating compliance with this Standard.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number does not appear on each page of text and its title appears only on the cover page.
- (b) In the source text ‘this part of ISO 17484’ should read ‘this part of AS 4176’.
- (c) A full point substitutes for a comma when referring to a decimal marker.

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

Statements expressed in normative terms in footnotes to tables are deemed to be requirements of this Standard.

None of the normative references listed in Clause 2 have been adopted as Australian or Australian/New Zealand Standards.

CONTENTS

	<i>Page</i>
1	Scope 1
2	Normative references 2
3	Terms, definitions and symbols 3
3.1	Structural definitions 3
3.2	Geometrical definitions 3
3.3	Definitions related to pressure 4
3.4	Materials definitions 4
3.5	Definitions related to material characteristics 5
3.6	Terms related to service conditions 5
4	Requirements for the system 6
4.1	Pressure drop 6
4.2	Bending 6
4.3	Corrosive conditions 6
5	Pipes 6
5.1	Material 6
5.2	General characteristics 7
5.3	Dimensions of pipes 7
5.4	Mechanical properties 8
5.5	Physical properties 9
6	Fittings 10
6.1	General 10
6.2	Materials 11
6.3	Dimensions 11
6.4	Transition fittings 11
6.5	Rubber rings 11
7	Fitness for purpose 11
7.1	Diameter classes 11
7.2	Relation between maximum operating pressure and qualification test pressure 11
7.3	Requirements 12
8	Marking and documentation 13
8.1	Legibility 13
8.2	Damage 13
8.3	Minimum marking requirements 13
Annex A (normative)	List of the reference product standards 15
Annex B (normative)	Test for delamination and strength of the joint line 16
Annex C (normative)	Resistance to gas constituents 18
Annex D (normative)	Thermal durability of the outer layer of M-pipes 19
Annex E (normative)	Adhesion test 21
Annex F (normative)	Odour permeability 22
Annex G (normative)	Resistance to tensile load on joints 23
Annex H (normative)	Crush test on joints 25
Annex I (normative)	Impact resistance test on joints 27
Annex J (normative)	Thermal cycling test on joints 29
Annex K (normative)	Repeated bending test 31
Bibliography	 33

INTRODUCTION

This part of ISO 17484 was developed in response to worldwide demand for minimum specification for multi-layered pipes for indoor gas applications.

Multi-layered pipes are delivered generally as a complete system. Pipes, fittings, tools, etc., are not compatible with components of another brand, generally. An advantage is that all components are perfectly geared to one another, but for repairing, the lack of compatibility might be problematic in the future.

Fire safety of systems

Depending on the construction of the house, pipework layout and other local circumstances, it is possible that additional safety devices are required to fulfill the demands of fire safety. Safety aspects of the system will be described in the planned Part 2.

Code of practice

The planned second part of ISO 17484 will be the code of practice for installation.

Recommendations on design, construction and protection in case of fire of the gas indoor installation are given in EN 1775).

References to ISO/TC 138/SC5 work

Test methods referred to in this part of ISO 17484 have been developed by SC 5 as far as possible. However, not all test methods needed are in the working programme of SC 5. These test methods are placed in Annexes B to K of this part of ISO 17484. It is planned that these tests will be developed as International Standards in the future.

For multilayer pipe construction, consisting of a layer of a reference standard material, an adhesive and a non-stress-designed layer, procedure I and the relevant product standards are followed for all aspects, excluding the aspects of delamination and, if applicable, oxygen permeation.

For example, layers can have the following purposes:

- ability to withstand the pressure;
- ability to realize interlayer adhesion;
- ability to block or greatly diminish incoming UV and/or sunlight;
- ability to mechanically protect the outside layer;
- ability to control the longitudinal expansion;
- ability to give the multilayer pipe a colour (inside layer or outside layer).

Some characteristics can be combined in one layer.

AUSTRALIAN STANDARD

Multilayer pipes for pressure applications**Part 8:**

Multilayer pipe systems for consumer gas installations with a maximum operating pressure up to and including 5 bar (500 kPa)—Specification for systems (ISO 17484-1:2006, MOD)

1 Scope

This part of ISO 17484 specifies the general requirements and the performance requirements for multilayer pipe systems based on pipes, fittings and their joints intended to be used for gas supply within buildings.

PE-X and PE pipes composed of one stress-designed layer, adhesive and a barrier layer are also covered by this part of ISO 17484.

This part of ISO 17484 gives guidance for the design of piping systems consisting of multilayer pipes based on thermoplastics, for which at least 60 % of the wall thickness is polymeric material. Polymeric materials intended for stress-designed layers and all inner layers are required to be polyethylene (PE) and/or crosslinked polyethylene (PE-X) in accordance with Annex A of this part of ISO 17484. The outer layer of a metal multilayer is required to be PE or PE-X. PE-RT is considered as PE but with specific properties concerning hoop-stress performance (see 5.4.2.).

This part of ISO 17484 applies to systems that operate at temperatures of – 20 °C up to 60 °C.

For the purpose of this part of ISO 17484, crosslinked polyethylene (PE-X) and adhesive layers are considered as thermoplastic materials.

For sizes greater than 63 mm the requirements of ISO 18225 have to be fulfilled in addition.

This part of ISO 17484 is applicable for piping systems used in buildings to supply gas with a maximum operating pressure up to and including 500 kPa (5 bar)¹⁾.

This standard applies to the following fuels:

- Category D gaseous fuel: natural gas; see ISO 13623;
- Category E gaseous fuel: LPG vapour, and natural gas or LPG vapour; see ISO 13623.

1) 1 bar = 0,1 MPa = 105 Pa; 1 MPa = 1 N/mm²

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3:1973, *Preferred numbers — Series of preferred numbers*

ISO 161-1, *Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures — Part 1: Metric series*

ISO 497:1973, *Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers*

ISO 1167 (all parts), *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure*

ISO 3126, *Plastics piping systems — Plastics components — Determination of dimensions*

ISO 3503, *Assembled joints between fittings and polyethylene (PE) pressure pipes — Test of leakproofness under internal pressure when subjected to bending*

ISO 8085-3:2001, *Polyethylene fittings for use with polyethylene pipes for the supply of gaseous fuels — Metric series — Specifications — Part 3: Electrofusion fittings*

ISO 9080, *Plastics piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation*

ISO 10838 (all parts), *Mechanical fittings for polyethylene piping systems for the supply of gaseous fuels*

ISO 11357-6, *Plastics — Differential scanning calorimetry (DSC) — Part 6: Determination of oxidation induction time*

ISO 12162:1995, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (design) coefficient*

ISO 13480, *Polyethylene pipes — Resistance to slow crack growth — Cone test method*

ISO 13623:2000, *Petroleum and natural gas industries — Pipeline transportation systems*

ISO 14531-1, *Plastics pipes and fittings — Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications — Part 1: Pipes*

ISO 17454:2006, *Plastics piping systems — Multilayer pipes — Test method for the adhesion of the different layers using a pulling rig*

ISO 17456:—, *Plastics piping systems — Multilayer pipes — Determination of long-term strength*

ISO 18225, *Plastic piping systems — Multilayer piping systems for outdoor gas installations — Specifications for systems*

EN 713, *Plastics piping systems — Mechanical joints between fittings and polyolefin pressure pipes — Test method for leaktightness under internal pressure of assemblies subjected to bending*

EN 1555-3, *Plastics piping systems for the supply of gaseous fuels — Polyethylene(PE) — Part 3: Fittings*

3 Terms, definitions and symbols

For the purposes of this document, the following terms, definitions and symbols apply.

3.1 Structural definitions

3.1.1

construction group A

group composed of multilayer pipes in which all the layers considered to be designed for stress bearing are made of polymeric materials selected from the list of reference product standards (see Annex A)

3.1.2

construction group B

group composed of multilayer pipes in which all the layers considered to be designed for stress bearing are made of polymeric materials selected from the list of reference product standards (see Annex A) and including a stress bearing metallic layer

3.1.3

multilayer pipe

pipe comprising of several stress-designed layers

3.1.4

multilayer M-pipe

multilayer pipe comprising of polymers and one metallic layer of which thickness of the pipe consists of at least 60 % of polymer layers

3.1.5

multilayer P-pipe

pipe comprised of more than one stress-designed polymeric layer (e.g. PE/PE-X)

3.1.6

layer

homogeneous circumferential section of pipe wall that has chemical and/or mechanical and/or physical characteristics different from those of its immediate neighbours

3.1.7

inner layer

layer in contact with the conveyed fluid

3.1.8

outer layer

layer exposed to the external environment

3.2 Geometrical definitions

3.2.1

nominal diameter

d_n

specified diameter, assigned to a nominal size (DN/OD or DN/ID)

NOTE The nominal diameter is expressed in units of millimetres.

3.2.2

outside diameter

d_e

diameter, measured through its cross section at any point of a pipe or the fitting end of a fitting, rounded to the next greater 0,1 mm

3.2.3**mean outside diameter**

measured length of the outer circumference of the pipe divided by π , rounded up to the nearest 0,1 mm

NOTE The value for π is taken to be 3,142.

3.2.4**inside diameter**

value of the measurement of the diameter through its cross section at any point of a pipe, rounded to the next greater 0,1 mm

3.2.5

SDR_m

metal layer standard dimension ratio, the nominal outside diameter (DN or OD) divided by the nominal wall thickness of the metal layer

3.2.6**wall thickness**

difference between the pipe outside diameter used for joining and the pipe bore divided by 2

3.2.7**nominal wall thickness**

e_n

wall thickness, corresponding to the minimum wall thickness at any point

NOTE The nominal wall thickness is expressed in units of millimetres.

3.2.8**mean wall thickness**

e_m

arithmetic mean of at least four measurements regularly spaced around the same cross-sectional plane of the pipe, including the measured minimum and maximum values obtained, rounded up to the nearest 0,1 mm

3.3 Definitions related to pressure**3.3.1****design pressure**

p_D

highest pressure related to the circumstances for which the system has been designed and intended to be used

3.3.2**predicted design pressure**

p_{CD}

pressure that represents the predicted design pressure after a lifetime of 50 years, using the 97,5 % reference line

NOTE The predicted design pressure is expressed in units of kilopascals (bars).

3.4 Materials definitions**3.4.1****virgin material**

material in a form such as granules or powder that has not been subjected to use or processing other than that required for its manufacture and to which no reprocessible or recyclable material has been added

3.4.2**own reprocessible material**

material prepared from rejected unused pipes and fittings, including trimmings from the production of pipes and fittings that can be reprocessed in a manufacturer's plant after having been previously processed by the same manufacturer by a process such as moulding or extrusion and for which the complete formulation is known

3.4.3**reference product standard**

International Standard or draft International Standard prepared by Technical Committee ISO/TC 138/SC 4, applicable for non-multilayer pipes, to which this part of ISO 17484 can refer for clauses related to the materials, components (e.g. fittings), and fitness for purpose of the system

3.4.4**stress-designed layer**

plastics materials used for layers intended to be stress bearing shall be restricted to the reference material standards

3.5 Definitions related to material characteristics**3.5.1****long-term hydrostatic strength****long-term pressure strength**

quantity with the dimensions of stress, which represents the predicted mean strength at a temperature T and a time t

NOTE The long-term hydrostatic strength is expressed in units of megapascals.

3.5.2 P_{LPL}

lower confidence limit of the predicted hydrostatic pressure, which represents the 97,5 % (one-sided) lower confidence limit of the predicted hydrostatic pressure at a temperature T and a time t

NOTE The lower confidence limit of the predicted hydrostatic pressure is expressed in units of kilopascals (bars).

3.5.3**MRP**

minimum required pressure, equal to the estimated long-term pressure resistance of a pipe at a temperature of 20 °C and a time 50 years, rounded to the nearest lower value of the R10 series of ISO 3:1973 and ISO 497:1973

3.5.4**overall service (design) coefficient** C factor

overall coefficient with a value greater than 1, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confidence limit

NOTE The minimum value of C for various materials is given in 5.2.3.

3.6 Terms related to service conditions**3.6.1****gaseous fuel**

any fuel which is in the gaseous state at a temperature of 15 °C and a pressure of 100 kPa (1 bar)

3.6.2**category D gaseous fuels**

natural gas

NOTE Categories of gaseous fuels and liquid fuel are defined in detail in ISO 13623:2000.

3.6.3**category E gaseous fuels**

LPG vapour

NOTE Categories of gaseous fuels and liquid fuel are defined in detail in ISO 13623:2000.

3.6.4**maximum operating pressure****MOP**

maximum pressure at which a system can be operated continuously under normal conditions

4 Requirements for the system**4.1 Pressure drop**

The manufacturer shall provide information on the pressure drop in the system.

4.2 Bending

Special attention shall be paid to the pressure drop of bends. Bending properties of the pipe shall be stated by the manufacturer.

4.3 Corrosive conditions

Components exposed to corrosive conditions shall be manufactured from a corrosion-resistant material or protected against corrosion.

5 Pipes**5.1 Material****5.1.1 General**

All stress-designed and polymeric inner layers shall be composed of reference materials in accordance with the reference product standards specified in Annex A. It is not necessary for the outer layer to be made of a reference material.

Materials intended for the stress-bearing layers shall conform to the material requirements of the reference product standard(s) specified in Annex A. The pipe manufacturer shall declare the reference material standard applicable to his product, as listed in Annex A.

5.1.2 Reprocessable materials

Clean own reprocessable material (except PE-X) of the same polymer type from products manufactured to the reference product standard may be added to the virgin material.

5.1.3 Metallic materials

Aluminium materials used shall be in accordance with EN 573-3.

5.1.4 Product classification and construction group

Multilayer pipes may include polymeric or metallic layers that have several purposes, including the ability to withstand the pressure.

For the purpose of this part of ISO 17484, multilayer pipes are classified in two groups: construction group A and construction group B as defined in 3.1. For these definitions, adhesives are not considered as stress-bearing layers.

The pipe manufacturer shall declare the construction group of the multilayer pipe.

5.2 General characteristics

5.2.1 General

When viewed without magnification, the internal and external surfaces of pipes shall be smooth, clean and free from scoring, cavities and other surface defects to an extent that would prevent conformance with this part of ISO 17484. The ends of the pipe shall be cut cleanly and square to the axis of the pipe.

The following information shall be provided:

- outside diameter;
- wall thickness;
- thickness of the inner layer;
- thickness of the metal layer;
- thickness of the outer layer;
- tolerances.

Dimensions shall be measured in accordance with ISO 3126.

5.2.2 Multilayer pipe construction

The joint line of the metallic layer shall be continuously welded.

5.2.3 Minimum overall service (design) coefficient

The minimum overall service (design) coefficient (C factor) is 2, as used to calculate the design pressure, p_D , taking into account the maximum operating temperature.

5.3 Dimensions of pipes

The outside diameter shall be in accordance with ISO 161-1.

All layers shall be of sufficient thickness so that the composite pipe fulfills the requirements of this part of ISO 17484.

5.4 Mechanical properties

5.4.1 Long-term pressure strength

5.4.1.1 General

The long-term pressure strength of the multilayer pipes shall be measured or calculated, as applicable. Consequently, two procedures for the determination of long-term pressure strength of multilayer pipes are defined in this part of ISO 17484: procedure I and procedure II.

Requirement for the predicted design pressure: P_{CD} shall be equal to or greater than the relevant MOP.

The operating temperature shall be taken into account.

The viscoelastic behaviour of PE-X and PE are similar; therefore, procedure I may be applied to P-pipes using layers of both materials. It shall be taken into account that the results of procedure I are generally rather conservative. Reference lines for PE-X can be found in ISO 10146.

NOTE The minimum overall service (design) coefficients for each material can be found in the relevant product standard (see Annex A).

5.4.1.2 Procedure I — Calculation method

This method shall only be used for P-pipes.

The long-term pressure strength shall be calculated using the reference lines of each individual pressure-bearing polymer layer according to of ISO 17456:—, Annex A. The addition rule related to each pressure-bearing layer assumes similar elastic behaviour of each material used and that complete interlayer adhesion exists, with design coefficients coming from the reference product standards.

The cumulative P_D shall be equal to or greater than the relevant MOP.

For details of confirmation testing, see 5.4.1.4.

5.4.1.3 Procedure II — Testing method

This method can be used for both multilayer P- and multilayer M-pipes.

At least one diameter of every “similar construction type” shall be tested in accordance with ISO 9080. For M-pipes, the diameter with the highest SDR_m of the metal layer shall be tested.

The parameters p_{CD} and MRP for each pipe construction shall be determined in accordance with ISO 17456.

For the determination of multilayer M-pipes, the design coefficient of the inner layer shall be used. For multilayer P-pipes, the design coefficients of each layer shall be taken in account (see Annex A).

NOTE To determine the weakest diameter within a construction group, a burst test on each diameter can be performed.

5.4.1.4 Pressure strength of all diameters

All diameters of the similar construction type, excluding the diameter tested in accordance with 5.4.1.3, shall undergo the confirmation testing in accordance with ISO 17456. If the SDR_m for a metal layer having a diameter smaller than the completed tested diameter is less than 90 % of the SDR_m of the completed tested diameter, the smaller diameter may be tested in accordance with the confirmation testing of ISO 17456.

5.4.1.5 Calculation of the control points

5.4.1.5.1 Procedure I for P-pipes

Failure control points for each diameter for 22 h, 165 h and 1 000 h shall be calculated using Equation (A.2) of ISO 17456:—.

5.4.1.5.2 Procedure II for P-pipes and M-pipes

Failure control points for each diameter for 22 h, 165 h and 1 000 h (or other requested testing time) shall be calculated using the 95 % value of the P_{LPL} line of the fully tested diameter.

5.4.2 Strength of the joint line of M-pipe

When the outside diameter of the pipe is increased by 10 %, no failures relative to the joint line of the metal layer shall occur. The test shall be carried out in accordance with Annex B.

5.4.3 Resistance to slow crack growth of the outer layer (cone test) for M-pipes

When tested in accordance with ISO 13480, the crack growth rate of the outer layer shall be less than 10 mm/day.

The test shall be carried out on pipe produced from material used for the outer layer.

5.5 Physical properties

5.5.1 General

The applicable physical characteristics of each stress-designed and inner layer shall be checked in accordance with the corresponding clause of the reference product standard.

5.5.2 Additional requirements

The requirements for the physical properties are listed in Table 1.

Table 1 — Physical properties

Characteristic	Requirements	Tests		
		Parameter	Value	Reference
Resistance to gas constituents	≥ 20 h No delamination	Conditioning	1 500 h/23 °C	Annex C
		Temperature	80 °C	
		Pressure	0,4 p_D	
		Cone test	10 % expansion	
Thermal durability of the outer layer of M-pipes	No visual cracks in outer layer	PE or PE-X		Annex D
		At 100° or	0,5 year	
		at 110°C	0,25 year	
		Strain	3 %	
Oxidation induction time (OIT)	≥ 20 min	Temperature	200 °C ^a	ISO 11357-6
Delamination: P-pipes	No cracks or delamination	Expansion	10 % (by cone with 15 % slope)	Annex B
		Temperature	23 °C	
Delamination: M-pipes	Peel strength ≥ 15 N/cm	Temperature	23 °C	Annex E
		Cycling test	– 20 °C/+ 60 °C	
		Number of cycles	10	
Odorant permeability	No perception of THT smell by experienced observer	Odorant Exposure time Temperature	THT 60 days 23 °C	Annex F

^a Test may be carried out at 210 °C providing that there is clear correlation with the results at 200 °C. In case of dispute, the reference temperature shall be 200 °C.

6 Fittings

6.1 General

6.1.1 Fitting reference standards

Fittings shall comply with the performance requirements the following International Standards:

- mechanical fittings: ISO 10838 (all parts);
- electrofusion fittings: ISO 8085-3;
- PE-X electrofusion fittings: ISO 14531-2;
- mechanical fittings for PE-X: ISO 14531-3.

6.1.2 Installation

During installation of the fitting on the pipe, the aluminium layer, and in particular the welded seam, shall not be torn.

Tools and aids used for installation of the fitting shall not damage the pipe or fitting.