

Australian Standard[®]

**POLYETHYLENE PIPE
EXTRUSION COMPOUNDS**

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Department of Public Works, N.S.W.
Engineering and Water Supply Department, S.A.
Federated Master Plumbers of Australia
Melbourne and Metropolitan Board of Works
Metropolitan Water Authority, W.A.
Rural Water Commission, Vic.
The Plastics Institute of Australia Inc.
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POLYETHYLENE PIPE EXTRUSION COMPOUNDS

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PREFACE

This Standard was prepared by the Association's Committee on Polyethylene Pipe under the direction of the Plastics Standards Board.

In this edition the specification of antioxidant and ultraviolet absorbent limits has been deleted. Other changes are the inclusion of more realistic tolerances on test conditions to make the tests more practical.

In the type rating test three alternative end connections may now be used. These conform to those specified in ISO 1167—1973, *Plastics pipes for the transport of fluids—Determination of the resistance to internal pressure*. The requirements for the effect of polyethylene compounds on potable water follow those of the previous Standard; however a new Standard is in preparation, which will provide a method of determining the extractability of toxic and undesirable substances from materials used in water supply applications, when exposed to water intended for human consumption, and will be applicable to all types of piping materials, including the range of plastics materials.

The various test methods provided in the appendices should be used to determine matters in dispute.

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Australian Standard

POLYETHYLENE PIPE EXTRUSION COMPOUNDS

1 SCOPE. This Standard specifies requirements for polyethylene extrusion compounds for use in the manufacture of polyethylene pipe.

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

2 REFERENCED DOCUMENTS. The following Standards are referred to in this Standard:

AS	
1199	Sampling procedures and tables for inspection by attributes
1399	Guide to AS 1199, Sampling procedures and tables for inspection by attributes
1821-1823	Suppliers quality systems
1984	Vernier callipers
2000	Guide to AS 1821-1823, Suppliers quality systems
2102	External micrometers
2164	One-mark volumetric flasks
2166	One-mark pipettes
2167	Straight-pipettes
2490	Sampling procedures and charts for inspection by variables for percent defective
BS	
2782	Methods of testing plastics Part 8: Methods 823A and 823B—Methods for the assessment of carbon black dispersion in polyethylene using a microscope (BS 2782: Part 8)
ASTM	
D 1510	Test method for carbon black—Iodine absorption number
WHO	
	Guidelines for drinking water quality (Vol. 1) (WHO 1984)

3 DEFINITIONS. For the purpose of this Standard, the definitions below apply:

3.1 Hoop stress—the stress in a pipe or fitting under pressure acting tangentially to the perimeter of a transverse section.

3.2 Long-term hydrostatic stress—the continuously applied hoop stress which is estimated will cause failure at a specified time and temperature.

3.3 Hydrostatic design stress—the hoop stress due to internal hydrostatic pressure that 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.

3.4 Test pressure—the pressure applied internally to pipes and fittings when being tested for strength and water-tightness.

3.5 Type test—a test intended to prove the suitability and performance of a new composition, a new compounding or processing technique, or a new design or

size of pipe, joint or fitting. Type tests are generally carried out when a change is made in compound composition or method of manufacture.

4 CLASSIFICATION. Polyethylene pipe extrusion compounds shall be classified into the following types according to the properties determined in accordance with Clause 6:

Type 30

Type 50

The type number, when divided by 10, gives the hydrostatic design stress in megapascals (MPa) of the material in pipe form over a period of at least 50 years at 20°C.

The type classification may be extended using the techniques detailed in Clauses 6.1 and 6.2, but the interval between the hydrostatic design stress of the types shall not be less than 0.5 MPa.

5 COMPOSITION.

5.1 General. Polyethylene pipe extrusion compounds shall consist only of ethylene homopolymers or copolymers of ethylene with 1-alkenes together with additives as described in Clause 5.2. Polyethylene pipe extrusion compounds may be black, natural or any other colour. Black polyethylene pipe extrusion compounds shall contain carbon black as specified in Clause 5.2.2.

NOTE: Polyethylene pipe extrusion compounds which are natural or of colours other than black are not suitable for storage or use where exposed to direct sunlight.

5.2 Additives.

5.2.1 Antioxidants. Polyethylene pipe extrusion compounds shall contain antioxidants either singly or in combination so that when determined in accordance with Appendix B, the oxidation induction temperature for any test specimen shall be not less than 230°C.

5.2.2 Carbon black. Black polyethylene pipe extrusion compounds shall contain 2.5 ± 0.5 percent by mass of carbon black, when determined in accordance with Appendix C. 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 a higher degree than that of the method in Appendix C. In the event of a dispute, the method of Appendix C shall be the referee method.

Carbon black shall comply with the following requirements:

- Iodine absorption: not less than 140 mg/g when determined according to the method described in ASTM D 1510.
- Maximum volatile content: 2 percent when determined in accordance with Appendix D.
- Maximum free sulphur content: 0.1 percent by weight when determined in accordance with Appendix E.
- Maximum toluene extract: 0.10 percent when determined in accordance with Appendix F.

5.2.3 Other stabilizers. Ultraviolet stabilizers other than carbon black may be used in pipe compounds coloured other than black.

5.2.4 Pigments. Polyethylene pipe extrusion compounds, other than black or natural, may be coloured using appropriate pigments.

5.2.5 Dispersion of additives (not applicable to unpigmented compounds). Antioxidants, pigments and ultraviolet stabilizers shall be evenly dispersed in the compounds, and when tested in accordance with Appendix G, the pigment shall show a satisfactory dispersion.

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

6 TYPE RATING TEST.

6.1 Long-term test.

6.1.1 Type 50 material. When tested in accordance with Appendix H, Section 2, the extrapolated hoop stress value at 50 years shall be not less than 8.3 MPa.

NOTE: Experience has shown that, if linear extrapolation of the long term pressure test data results in a 50 year hoop stress greater than 8.3 MPa, the actual 50 year failure hoop stress in pipe specimens will be greater than 6.5 MPa.

6.1.2 Type 30 material. When tested in accordance with Appendix H, Section 2, the extrapolated hoop stress value at 50 years shall not be less than 3.9 MPa.

6.1.3 New formulations. A new long term type rating test is required for each new formulation of compound. While variations in formulation within the normal range of manufacturing tolerance are not considered new formulations, a change in composition or raw materials shall be treated as a new formulation where it causes either of the following:

- a change in the melt (flow) index of the compound to move outside the manufacturer's specified range.
- the density of the compound to move outside the manufacturer's specified range.

NOTES:

- Information on the allowable ranges of melt (flow) index and compound density for a particular compound may be confidential. The compound manufacturer should provide this information to the pipe manufacturer on the understanding that it should not be transmitted to any third party.

- Provisional approval of a new formulation, prior to establishment of the data required for calculation of the extrapolated hoop stress at 50 years, should be sought provided the material meets the requirements of the short run test in Clause 6.2. Such provisional material will only apply for a period of 18 months following the introduction of the new formulation.

6.2 Short-term test. Three test specimens shall be tested at the higher stress and three test specimens at the lower stress, in accordance with Appendix H, Section 3, using the appropriate test conditions as set out in Table 1. Failure is defined as leaking, weeping or rupturing of the test specimen. Failure of any two of the six test specimens before the minimum period stated in Table 1 shall constitute a failure of the test. Should one of the six test specimens fail, a further six test specimens shall be selected, and both the three short-term and the three long-term tests repeated. Failure of any one of these specimens in the repeat test shall constitute a failure of the test.

7 EFFECT ON WATER. (Applicable to pipe extrusion compounds for potable water applications.) Polyethylene pipe extrusion compounds, when extruded into pipe, shall not impart to water any objectionable taste, colour, odour or any constituent known to be hazardous to health. When tested according to the method described in Appendix J the amount of any toxic ingredients shall not exceed guideline values specified in the World Health Organisation Guidelines for Drinking Water Quality (Vol. 1) (WHO, 1984).

NOTES:

- The Statutory Authority may require that the manufacturer disclose the constituents of the compound.
- An Australian Standard method for determining the extractability of toxic and undesirable substances from materials in water supply applications when exposed to water intended for human consumption is in course of preparation.
- When required, levels of contaminants may be agreed between supplier and purchaser.

8 MARKING. All packages of polyethylene pipe extrusion compounds complying with this Standard shall be marked with the following information:

- Manufacturer's name and/or registered trademark.
- Type in the form 'TYPE 50', as applicable.
- Batch identification.

The colour of the compound shall be readily identifiable by wording on the package or by the use of a robust transparent package through which the colour of the contents is readily discernible.

NOTE: Manufacturers who place the number of this Australian Standard on products, or on packaging or literature related thereto, should ensure that the products are manufactured to comply with the Standard.

TABLE 1
TEST CONDITIONS FOR SHORT-TERM TESTS

Type	Test conditions		
	Test temperature °C	Hoop stress MPa	Duration of test h
50	80 ± 2	4.19	44 + 2, – 0
		3.02	165 + 2, – 0
30	70 ± 2	3.50	1 + 0.25, – 0
		3.00	100 + 2, – 0

NOTE: Where other type materials are proposed, methods of rating need to be established between the manufacturer and the user.

Attention is particularly drawn to the scheme for independent assurance provided by the StandardsMark which is a registered certification trademark owned by the Standards Association of Australia and which is available for use with suitable Australian Standards.

The presence of the StandardsMark on or in relation to a product is an assurance that the goods have been produced under a system of supervision, control and testing applied during manufacture and including periodical inspections at the manufacturer's works in accordance with the certification mark scheme of the SAA.

The StandardsMark can be used only by manufacturers licensed under the certification mark scheme operated by SAA, and only when accompanied by the number of the relevant Australian Standard. It will usually be a requirement that the words 'Manufactured to Australian Standard' accompany the number of the

Standard and enclose the Mark as shown below; however, this is a matter for negotiation with the Association.

Further particulars of the terms of licence and suitability of this Standard for certification purposes may be obtained from the Quality Assurance and Certification Department, Standards Association of Australia, 1 The Crescent, Homebush, NSW 2140.



APPENDIX A

DETERMINATION OF COMPLIANCE OF A LOT

(This Appendix does not form an integral part of this Standard.)

A1 STANDARDSMARK. The general purpose of the ‘StandardsMark’ is to provide an independent assurance reinforcing the claim by the manufacturer that articles comply with an Australian Standard.

An essential feature of the scheme is that it does not rely merely upon initial type tests and subsequent check tests, but places on the manufacturer the onus of maintaining an effective system of quality control. Its aim is to ensure that the manufacturer makes his product ‘right first time’, so that faulty production is avoided and the interest of the consumer in obtaining reliable products, fit for their purpose in terms of the Standard, is safeguarded.

A2 ASSESSMENT OF COMPLIANCE ON THE BASIS OF STATISTICAL SAMPLING. Where compliance with this Standard is to be assessed on the basis of statistical sampling and inspection, the sampling plan should be in accordance with either AS 1199, account being taken of the guidance given in AS 1399, or AS 2490. The designation of an acceptable quality level does not imply that the supplier has the right to supply knowingly any defective item or unit of product.

A3 ASSURANCE OF COMPLIANCE ON THE BASIS OF SUPPLIER’S QUALITY SYSTEMS. Where compliance with this Standard is to be assured on the basis of a supplier’s quality system, the acceptance procedures should include provision for—

- (a) type testing, type approval and maintenance of type approval; and
- (b) the customer to specify the level of the system in accordance with the requirements of AS 1821-23, as appropriate, account being taken of the guidance given in AS 2000.

A4 OTHER MEANS OF ASSESSMENT. Where the above approaches are not considered practicable in their entirety and some other method coupled with the manufacturer’s guarantee of compliance is desired, then consideration may be given to the results of testing, in accordance with Table A1, in the assessment of compliance.

NOTE: The designation of an acceptable quality level or a low test frequency does not imply that the supplier has the right to supply knowingly any defective items or units of production.

TABLE A1
ALTERNATIVE SAMPLING AND TESTING SCHEDULE FOR ASSESSMENT OF COMPLIANCE

Clause	Test method	Requirement	Minimum frequency
5.2.1	Appendix B	Presence of antioxidants	Type test
5.2.2	Appendix C	Carbon black content	Fortnightly during production, or if this is more than 200 t, in 200 t lots.
5.2.2	Appendix D	Volatile content of carbon black	Type test
5.2.2	Appendix E	Free sulphur content of carbon black	Type test
5.2.2	Appendix F	Toluene extract of carbon black	Type test
5.2.5	Appendix G	Dispersion of additives	Fortnightly during production, or if this is more than 200 t, in 200 t lots.
6.1	Appendix H	Type rating test—long term	Type test
6.2	Appendix H	Short term test	Fortnightly during production, or, if this is more than 200 t, in 200 t lots
7	Appendix K	Effect on water	Type test