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Australian Standard 2492—1981

CROSSLINKED POLYETHYLENE (XLPE) PIPE FOR HOT AND COLD WATER APPLICATIONS

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STANDARDS ASSOCIATION OF AUSTRALIA
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THE FOLLOWING SCIENTIFIC, INDUSTRIAL AND GOVERNMENTAL ORGANIZATIONS and departments were officially represented on the committee entrusted with the preparation of this standard:

Confederation of Australian Industry

Department of Housing and Construction

Department of Local Government, Queensland

Engineering and Water Supply Department, S.A.

Federated Master Plumbers of Australia

Hunter District Water Board

Melbourne and Metropolitan Board of Works

Metal Trades Industry Association of Australia

Metropolitan Water Sewerage and Drainage Board, Sydney

Plastics Institute of Australia Inc.

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AUSTRALIAN STANDARD

CROSSLINKED POLYETHYLENE (XLPE) PIPE FOR HOT AND COLD WATER APPLICATIONS

AS 2492—1981

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PREFACE

This standard was prepared by the Association's Committee on Crosslinked Polyethylene (XLPE) Pipe under the authority of the Plastics Standards Board. It sets out requirements for hoop stress, temperature rating, dimensions, degree of crosslinking, pressure and leakage tests and toxicity of XLPE pipe for use in water supply.

In the preparation of this standard, the committee took cognizance of overseas experience including draft DIN standard 7728 (Feb. 1977)—Pipes made of High Density Crosslinked Polyethylene.

The requirements herein have been drawn up in the light of present experience of the properties of crosslinked polyethylene from one source. Studies are still required in order to further existing knowledge regarding the properties of the material and the test criteria suitable for describing its behaviour. For example, the committee was unable to include specific criteria for resistance against ultraviolet degradation owing to the lack of a proven accelerated method of test.

With regard to the toxicity requirements specified in the standard, the committee has presented these requirements in this form because the issues involved are so complex that it is not possible to be more precise. Information on toxicity was sought from world-wide sources and at the time of publication, no evidence has been forthcoming to indicate that XLPE would present a health hazard.

In Australia, consultation has been taking place with the National Health and Medical Research Council (NHMRC) and advice has been received that the Food Science and Technology Subcommittee and the Water Quality (Reference) Subcommittee have indicated no objection on toxicological grounds to the use of XLPE with potable water.

Crosslinked polyethylene pipe can be used with either plastics or metallic fittings, provided that they are in accordance with AS . . . ., Mechanical Jointing Fittings for use with Crosslinked Polyethylene (XLPE) Pipes for Hot and Cold Water Applications.* Requirements set out therein cover compatibility with pipe, toxicity, resistance to leakage and pull-out, as well as thermal tests and pressure cycling tests. In the latter case, this test has been included because pressure pipes directly connected to mains are subject to cyclic loadings due to fluctuating pressures. As the area in which failure is most likely to occur is at the junction of the fitting and pipe, it was considered that this test was more appropriate to the fittings standard.

During the preparation of the standard for XLPE pipe the matter of catalytic degradation was raised. This can occur when certain plastics materials are in contact with copper or copper alloys, e.g. brass fittings. It was considered to be relatively easy to stabilize this degradation by the inclusion of a metal deactivator in the pipe material; however, this could lead to difficulties with the conveyance of potable water. In order to check whether catalytic degradation is likely to occur, copper or copper alloy fittings have been specified in the strength characteristics test.

This standard may require reference to the following standards.

AS 1199	Sampling Procedures and Tables for Inspection by Attributes
AS 1349	Bourdon Tube Pressure and Vacuum Gauges
AS 1399	Guide to AS 1199
AS 1463	Polyethylene Pipe Extrusion Compounds
AS 1821-1823	Suppliers Quality Control Systems
AS 2000	Guide to AS 1821-1823,Suppliers Quality Control Systems
BS 1972	Polyethylene Pipe (Type 32) for Cold Water Services
BS 2537	Ethanediol (Ethylene Glycol)
BS 2782	Methods of Testing Plastics
ASTM D 297	Rubber Products—Chemical Analysis
ASTM D 1603	Test for Carbon Black in Olefin Plastics

*In course of preparation.

CONTENTS

STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard

for

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FOREWORD

In the determination of hydrostatic design hoop stress of crosslinked polyethylene specified herein, the ultimate hoop stress of the material at 95° C has been extrapolated to the 50-year point and a safety factor of 1.3 applied. This safety factor is one commonly applied to polyolefin materials. This extrapolation has been supported (at the time of publication) by the results of continuous testing at the ultimate hoop stress and a temperature of 95°C for 69 000 h (8 years). Testing is still continuing.

The minimum wall thicknesses for the pipes specified have been calculated from the Lamé formula* which takes into account the maximum working hoop stress of the material and the working pressure and diameter of the pipes.

The Lame′ formula and the formula used for calculating the maximum wall thickness are as follows:

$$T_{min} = \frac{D_{m\ max}}{2}\left(1 - \sqrt{\frac{S/P - 1}{S/P + 1}}\right)$$

$$T_{max} = 1.10\ T_{min} + 0.1$$

where

T_{min} = minimum wall thickness, in millimetres

T_{max} = maximum wall thickness, in millimetres

$D_{m\ max}$ = maximum mean OD, in millimetres

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

S = maximum hydrostatic design hoop stress of 6.9 MPa at 20° C.

In the interests of serviceability of the pipe, and irrespective of the calculated minimum wall thickness, this standard does not provide for a wall thickness of less than 2.0 mm.

*Popov E.P., Mechanics of Materials, Prentice Hall, Englewood-Cliffs New Jersey, 2nd Ed. 1976.

SPECIFICATION

1 SCOPE. This standard specifies requirements for crosslinked polyethylene pipe for use in water supplies. This includes domestic, industrial, agricultural and other hot and cold water applications.

NOTES:

1. Crosslinked polyethylene pipe manufactured in accordance with this standard is considered suitable for use in direct or indirect sunlight only if it is stabilized against ultraviolet degradation. One effective method of stabilization is by the addition of not less than 2.5 percent carbon black. Natural coloured crosslinked polyethlene pipe not containing ultraviolet stabilizers is not considered suitable for use in either direct of indirect sunlight.
2. Crosslinked polyethylene pipe is intended to be used with fittings complying with AS . . . ., Mechanical Jointing Fittings for Use with XLPE Pipe.* Joining crosslinked polyethylene pipe by means of solvent cement or heat fusion is not satisfactory.
3. Advisory information on the determination of compliance of a 'lot' with this standard is given in Appendix A.

2 DEFINITIONS. For the purpose of this standard, the following definitions relating to stress and pressure apply:

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

Ultimate hoop stress—the stress in a pipe or fitting under pressure acting tangentially to the perimeter of a transverse section at which failure occurs, at a specific time and a specific temperature.

Hydrostatic design hoop stress—the particular hoop stress that is defined by the application of a safety factor to the value of the extrapolated 50-year ultimate hoop stress.

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

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

Pipe material temperature—the average temperature estimated as applying through the full wall thickness.

Standard dimension ratio (SDR)—the maximum mean outside diameter ($D_{m\ max}$) divided by the minimum wall thickness (T_{min}).

3 NOTATION. The following notation shall apply in this standard:

D_e = nominal outside diameter, in millimetres
D_m = mean outside diameter, in millimetres
D_i = mean inside diameter, in millimetres
D_o = outside diameter including ovality, in millimetres
T = wall thickness, in millimetres

4 HOOP STRESS. Crosslinked polyethylene pipe shall be designed for the hoop stress specified in Table 1 according to the pipe material temperature.

TABLE 1
HOOP STRESS

Pipe material temperature °C	Extrapolated 50-year ultimate hoop stress MPa	Hydrostatic design hoop stress MPa
20	9.0	6.9
40	7.8	6.0
60	6.6	5.1
80	5.5	4.2
95	4.1	3.2
100	3.6	2.8

NOTES:

1. The hydrostatic design hoop stress has been based upon an extrapolated 50-year ultimate hoop stress, but this should not be taken as the life of the material under service conditions at elevated temperatures. However, on the basis of information presently available, tests have indicated satisfactory performance for 8 years while operating continuously at the ultimate hoop stress and at a temperature of 95°C. These tests are ongoing and a longer working life is possible under these maximum conditions; however, sufficient test data as to the extent of this, are not yet available.
2. As hot water systems are not normally designed to operate at boiling point, the stress levels at 100°C have been included for guidance only.

5 CLASSIFICATION. Crosslinked polyethylene pipe shall be classified according to maximum continuous working pressure at a pipe material temperature of 20°C, as follows:

(a) Class 10—maximum continuous working pressure of 1.0 MPa.
(b) Class 16—maximum continuous working pressure of 1.6 MPa.
(c) Class 20—maximum continuous working pressure of 2.0 MPa.
(d) Class 25—maximum continuous working pressure of 2.5 MPa.
(e) Class 32—maximum continuous working pressure of 3.2 MPa.
(f) Class 40—maximum continuous working pressure of 4.0 MPa.

6 WORKING PRESSURE ACCORDING TO TEMPERATURE RATING. The working pressure in the pipe shall be as specified in Table 2 according to the pipe material temperature.

TABLE 2
PRESSURE DERATING OF PIPES ACCORDING TO PIPE MATERIAL TEMPERATURE

Class	Working pressure, MPa					
	20°C	40°C	60°C	80°C	95°C	100°C
10	1.0	0.87	0.74	0.61	0.46	0.40
16	1.60	1.39	1.18	0.98	0.73	0.64
20	2.00	1.74	1.47	1.23	0.92	0.80
25	2.50	2.17	1.84	1.54	1.15	1.01
32	3.20	2.78	2.36	1.97	1.47	1.29
40	4.00	3.48	2.95	2.46	1.83	1.61

*In course of preparation.