

1. SCOPE

Specification for POLYETHYLENE PIPES AND FITTINGS FOR GAS RETICULATION

UDC [621.643.2+4]:678.742.2:696.2

PR DD

Approved for publication by the New Zealand Standards Board

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Declared on 21 July 1978 by the Standards Council to be a standard specification pursuant to the provisions of section 23 of the Standards Act 1965.

First published
Reprinted

July 1978
March 1987

The following SANZ references relate to this standard:

Project No. P949C
Draft for comment No. DZ 7646
Printing code: 300 1986/2030/23272

AMENDMENTS

<i>No.</i>	<i>Date of issue</i>	<i>Description</i>	<i>Entered by, and date</i>

MILNE PRINTERS LTD
WELLINGTON, NEW ZEALAND

NEW ZEALAND STANDARD

Specification for
**POLYETHYLENE PIPES AND FITTINGS
 FOR GAS RETICULATION**

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COMMITTEE REPRESENTATION

This standard was prepared under the supervision of the Plastics Industry Sectional Committee (76/—) for the Standards Council, established under the Standards Act 1965. The committee consisted of representatives of the following:

Department of Education
 Department of Health
 Department of Labour
 *Department of Scientific and Industrial Research
 *Ministry of Works and Development
 New Zealand Institution of Engineers
 New Zealand Society of Master Plumbers
 *Plastics Institute of New Zealand

The Polythene Gas Pipes Committee (76/5) was responsible for the preparation of the standard, and consisted of representatives from the following organizations in addition to those marked with an asterisk (*) above:

Auckland Gas Company
 Natural Gas Corporation of New Zealand
 Palmerston North City Corporation Gas Department.

RELATED DOCUMENTS

Reference is made in this standard to the following documents:

NEW ZEALAND STANDARDS

		<i>Clause reference herein</i>
NZS 1021 : 1965	<i>Methods for the load verification of testing machines</i>	E1
NZS 1050 : 1969	<i>Colours for specific purposes</i>	105.1; 203.1
NZS 7647 : —	<i>Code of practice for the installation of polyethylene gas pipes (In course of preparation)</i>	Foreword; 102.1
MP 3801 : 1972	<i>A guide to the adoption of the model building bylaw (NZS 1900) by local authorities using the standard adoption and annual updating procedures</i>	103.1

OVERSEAS STANDARDS

AS 1685 : 1974	<i>Polyethylene compounds for the manufacture of gas pipes and fittings</i>	101.2; 105.1; 203.1
ASTM D 2290	<i>Standard method of test for apparent tensile strength of ring or tubular plastics by split disk method</i>	E5.2
BS 1780 : —	<i>Bourdon tube pressure and vacuum gauges Part 2 : 1971 Metric units</i>	B1; F1

ACKNOWLEDGEMENT

The committee responsible for the preparation of this standard acknowledges the use made of Australian Standard AS 1667 : 1974 *Polyethylene pipes and fittings for gas reticulation*.

FOREWORD

This standard was prepared under the supervision of the SANZ Plastics Industry Sectional Committee at the request of the gas industry and polyethylene pipe manufacturers; it sets out dimensional and performance requirements for polyethylene pipe in gas reticulation systems.

Creep rupture strength of the material has been used as the basis for deriving wall thickness. Experimental data for creep rupture strength against time for a range of temperatures were extrapolated to obtain a value corresponding to a service life of 50 years at 20 °C.

A code of practice for the installation of polyethylene pipe for gas reticulation is now in preparation and will be published as NZS 7647*.

Throughout this standard the name "polyethylene" is used; it should be noted that this is equivalent to the name "polythene".

* See list of related documents.

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NEW ZEALAND STANDARD

Specification for
POLYETHYLENE PIPES AND FITTINGS FOR
GAS RETICULATION

PART 1 PIPES

101 SCOPE

101.1 Part 1 of this standard applies to polyethylene pipe for use in gas mains and services for direct burial and reliner applications. Such pipe is intended for use in the distribution of natural gas at pressures up to 4.2 bar (420 kPa). It also applies to pipe for use with gas produced from liquefied petroleum gas (LPG) and mixtures of LPG and air where the partial pressure of the LPG component does not exceed 2 bar (200 kPa).

101.2 The pipe shall be formed from compound complying with AS 1685* which provides only for a high density polyethylene, coloured yellow.

101.3 This standard does not apply to pipe for use with petroleum liquids, including liquid LPG and liquid pentane, or with manufactured or mixed gas distribution systems or systems which may contain more than 1 percent aromatics.

NOTE – The suitability of the pipe in these latter cases is to be determined by the purchaser.

102 APPLICATION

102.1 Pipes installed in accordance with NZS 7647* may be installed to work at the pressures stated in clause 104.1. The wall thickness of pipes for special applications shall be calculated by the method given in clause 104.2

103 INTERPRETATION

103.1 General. Where any other standard named in this standard has been declared or endorsed in terms of the Standards Act 1965, then –

- (a) Reference to the named standard shall be taken to include any current amendments declared or endorsed in terms of the Standards Act 1965; or
- (b) Reference to the named standard shall be read as reference to any standard currently declared or endorsed in terms of the Standards Act 1965 as superseding the named standard, including any current

amendments to the superseding standard declared or endorsed in terms of the Standards Act 1965.

NOTE – The date at which amendments or superseding standards are regarded as “current” is a matter of law depending upon the particular method by which this standard becomes legally enforceable in the case concerned. In general, if this is by contract the relevant date is the date on which the contract is created, but if it is by Act, regulation, or bylaw then the relevant date is that on which the Act, regulation, or bylaw is promulgated; for bylaws, promulgation includes updating by the procedure set out in MP 3801*.

103.2 Definitions. For the purpose of this standard the following definitions shall apply:

LPG. Liquefied petroleum gas which is composed predominantly of any of the following hydrocarbons or mixtures of all or any of them: propane, propylenes, butanes and butylenes.

STANDARD DIMENSION RATIO (SDR). The maximum mean outside pipe diameter divided by the corresponding minimum wall thickness.

104 CLASSIFICATION

104.1 Standard pipe. The classification of standard pipe shall be by SDR as follows:

- SDR 32: for operating pressures up to and including 1.0 bar (100 kPa)
- SDR 26: for operating pressures up to and including 1.6 bar (160 kPa)
- SDR 21: for operating pressures up to and including 2.0 bar (200 kPa)
- SDR 17: for operating pressures up to and including 2.45 bar (245 kPa)
- SDR 11: for operating pressures up to and including 4.2 bar (420 kPa)

NOTE – These operating pressures apply to ground temperatures in the range -20 to $+20$ °C. Manufacturers' data should be consulted for ground temperatures outside this range.

104.2 Special sizes of pipe. The wall thickness of special sizes of pipe shall be calculated using the following formula. The formula applies for operating pressures up to and including 4.2 bar (420 kPa):

*See list of related documents.

$$t_{min} = \frac{fPD_{max}}{20S + P}$$

where P = maximum operating pressure of pipe, in bar

D_{max} = maximum mean outside diameter of pipe, in millimetres (column 2, table 1)

t_{min} = minimum wall thickness of pipe, in millimetres

S = hoop stress of 5.0 MPa

f = safety factor of 2.25

105 GENERAL REQUIREMENTS

105.1 Composition. Polyethylene pipe shall be manufactured from polyethylene extrusion compound complying with AS 1685*. The addition of not more than 10 per cent of the manufacturer's own rework material resulting from the manufacture of pipe to this specification shall be permitted.

NOTE -

- (1) The colour specified in AS 1685* for the extrusion compound corresponds to colour No. 309 of NZS 1050*.
- (2) The ultraviolet stabilizer specified in AS 1685* should ensure that there is no deterioration in the physical properties of pipe exposed to direct sunlight for a period of two months.

105.2 Freedom from defects. The pipe shall be homogeneous throughout and the internal and external surfaces shall be clean, smooth and free from grooves, blisters, wrinkles, dents and heat marks.

105.3 Pipe ends. Pipe shall be supplied with ends cut square. They shall be smoothly cut, and free from chips and rough edges. The ends of pipes shall be capped or plugged against the ingress of foreign materials.

105.4 Dimensions

105.4.1 Standard pipe shall conform to the dimensions given in table 1. The pipe shall be measured by the method described in Appendix A.

105.4.2 Unless otherwise specified, pipe shall be supplied in straight lengths of 6 m with a tolerance of +50 -0 mm.

105.4.3 Pipes of nominal bore not greater than 50 mm may be supplied in coils. The length shall be not less than that designated by the manufacturer, and the inside diameter of the coil shall comply with the requirements of table 2. If the pipe is coiled, the difference between the major and minor axes of a cross-section shall not exceed 5 percent of the mean outside diameter as measured when the pipe is subsequently straightened. All measurements shall be adjusted to an equivalent length at 20 °C.

Table 1
DIMENSIONS OF POLYETHYLENE GAS PIPES

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nominal bore	Mean outside diameter (D)		Outside diameter including ovality		Wall thickness (t)									
					SDR 11		SDR 17		SDR 21		SDR 26		SDR 32	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	16.0	15.7	16.1	15.6	2.5	2.3*								
15	21.7	21.4	21.8	21.3	2.5	2.3*								
20	27.1	26.7	27.2	26.6	2.7	2.4	2.5	2.3†						
25	33.7	33.4	33.8	33.3	3.4	3.1	2.5	2.3†						
32	42.4	42.0	42.6	41.9	4.2	3.9	2.5	2.3†						
40	48.6	48.0	48.7	47.9	4.8	4.4	2.9	2.7†						
50	60.7	60.3	60.8	60.2	6.0	5.5	3.9	3.6						
65	76.7	76.0	76.9	75.8	7.6	6.9	4.9	4.5						
80	89.2	88.7	89.3	88.5	8.9	8.1	5.8	5.2						
100	114.7	114.1	114.9	113.9	11.4	10.4	7.4	6.7	6.0	5.4				
150	168.9	168.0	169.3	167.6	16.8	15.3	10.9	9.9	8.8	8.0	7.1	6.5		
200	219.9	218.8	221.0	217.7	21.9	19.9	14.3	13.0	11.5	10.4	9.3	8.4	7.5	6.8
250	274.0	272.6	275.2	271.4	27.3	24.9	17.7	16.1	14.3	13.0	11.6	10.5	9.4	8.5
300	325.0	323.4	326.7	322.0	32.4	29.5	21.0	19.1	17.0	15.4	13.7	12.5	11.1	10.1

* The minimum wall thickness for socket fusion is 2.3 mm.

† These pipes are not recommended for butt fusion jointing.

* See list of related documents.

Table 2

COIL DIMENSIONS	
Nominal bore	Minimum inside diameter of coil
mm	m
10 to 25	0.90
32 and 40	1.25
50	To be agreed between purchaser and supplier.

106 TESTING

106.1 Frequency of sampling for testing. The manufacturer shall select samples for testing at the frequency stated in table 3 and when there is a change of formulation.

106.2 Hydrostatic pressure test

106.2.1 Six representative specimens shall be selected for testing. The length of each specimen shall be at least ten times the nominal diameter, but not less than 250 mm nor greater than 1 m. Each specimen shall include any pipe markings as required by section 108.

106.2.2 The pipe shall be tested by the method described in Appendix B, at a pressure equal to six times the rated operating pressure of the pipe for 1 h at $20 \pm 5 - 0^\circ\text{C}$. The pipe shall not rupture nor exhibit other evidence of failure.

106.3 Squeeze-off properties

106.3.1 Three lengths approximately 600 mm long shall be cut from the pipe at random points, and shall be tested by the method described in Appendix C. The pipe shall show no evidence of splitting, cracking or breaking.

106.4 Heat reversion

106.4.1 Three specimens, representative of the batch, lot or extrusion run, shall be selected for testing. Each test specimen shall consist of a complete pipe section approximately 300 mm long.

106.4.2 The specimens shall be tested by the method described in Appendix D. The pipe shall show no alteration in length greater than 3 percent, and shall show no sign of cracks, cavities or blisters.

106.5 Chemical resistance

106.5.1 Sufficient pipe shall be taken to prepare 25 test specimens which conform to the dimensions given in fig. 4, Appendix E.

106.5.2 Each specimen shall be subjected to the treatment described in Appendix E. The pipe shall not increase

in mass by more than 0.5 percent nor change in tensile stress at yield by more than 12 percent.

106.6 Resistance to internal pressure at elevated temperature

106.6.1 For type tests six representative specimens shall be selected for testing. The length of each specimen shall be at least ten times the nominal diameter, but not less than 250 mm nor greater than 1 m. Each specimen shall include any pipe markings. The specimens shall be tested by the method described in Appendix F. Three specimens shall withstand an internal pressure equivalent to a circumferential stress of 3.00 MPa for a period of 170 h at $80 \pm 1^\circ\text{C}$, and the other three specimens shall withstand an internal pressure equivalent to a circumferential stress of 4.19 MPa for a period of 44 h at $80 \pm 1^\circ\text{C}$.

106.6.2 For production testing one specimen shall be selected. The length of the specimen shall be at least ten times the nominal diameter, but not less than 250 mm nor greater than 1 m. The specimen shall include any pipe markings. The specimen shall be tested by the method described in Appendix F, and shall withstand an internal pressure equivalent to a circumferential stress of 4.19 MPa for a period of 44 h at $80 \pm 1^\circ\text{C}$. The test procedure shall be repeated immediately and continuously with a fresh test specimen.

106.7 Certificate of compliance. When requested by the purchaser, the manufacturer shall supply the results of the tests carried out to determine compliance of the pipe and material with this specification.

106.8 Inspection. When placing his order the purchaser shall notify the manufacturer of his request for a certificate of compliance and whether it is his intention to inspect the pipes at the manufacturer's works. The manufacturer shall afford the purchaser all reasonable facilities to inspect the pipes and to witness the tests being carried out.

106.9 Independent tests. Should there be a dispute about compliance of the pipes with the requirements of this specification, the manufacturer or the purchaser shall have the right to have independent tests made by a mutually acceptable testing authority. Such independent testing shall be carried out according to the appropriate clauses of this specification, and the results so obtained shall be accepted as final.

NOTE — Facilities for such testing are afforded by laboratories registered by the Testing Laboratory Registration Council of New Zealand for the field and class of testing concerned.

106.10 Cost of tests

106.10.1 The manufacturer shall bear the cost of all testing carried out to meet the requirements of this standard. Should the purchaser require that additional specimens be tested, he shall bear the cost except that, in the event of the tests indicating that the pipes do not comply with the

specification, the cost shall be borne by the manufacturer. In the case of independent testing, if the pipes are found not to comply with this standard, the cost of the independent testing shall be borne by the manufacturer; if the pipes are found to comply with this standard, the cost shall be borne by the purchaser.

Table 3

FREQUENCY OF SAMPLING OF PIPES FOR TESTING

Test	Minimum sampling frequency	Test method	Clause No.
Freedom from defects	Every coil and length of pipe	Visual	105.2
Dimensions	Every coil and length of pipe	Appendix A	105.4
Hydrostatic pressure test	Specimens shall be selected representing each size of pipe from each machine. They shall be selected to be representative of each 8 h production, or of each 300 m of pipe if this takes a longer period, and at the beginning and end of each continuous production run. Specimens shall be selected from each end only from continuous lengths requiring in excess of 8 h to produce. Testing shall be carried out continuously during production.	Appendix B	106.2
Squeeze-off properties	Type test only	Appendix C	106.3
Heat reversion	Specimens shall be selected representing each size of pipe from each machine. They shall be selected to be representative of each 8 h production, or of each 300 m of pipe if this takes a longer period, and at the beginning and end of each continuous production run	Appendix D	106.4
Chemical resistance	Type test only	Appendix E	106.5
Resistance to internal pressure at elevated temperature	Continuous test using samples from each machine representative of the range of products currently in production.	Appendix F	106.6

NOTE — Type tests shall be carried out when a change is made in polymer composition or method of manufacture, and in any case at least once every twelve months.

107 STORAGE AND TRANSPORT

107.1 The following precautions shall be taken during storage and transport of polyethylene pipes:

- At all times the pipes shall be covered to protect them from heat absorption and direct sunlight.
- Pipes shall be stored to a maximum height of 2 m on a smooth surface free from stones or sharp objects, and free from any superimposed loading.
- During handling and transport the foregoing shall apply, and the pipes shall not be restrained in a manner likely to cause damage.

108 MARKING

108.1 All pipes shall be durably marked with letters of a minimum height of 3 mm for pipes up to and including 25 mm nominal bore and 4 mm for larger pipes. Such marking shall be repeated at intervals of not more than 1 m. The surface shall be not scored or broken in marking except that hot foil printing shall be permitted. The marking shall be in black.

108.2 The marking shall show the following:

- The manufacturer's name or trademark, or both.
- The words "HDPE Gas".
- The SDR rating of the pipe.
- The nominal bore of the pipe.
- The batch number or batch details, including date of manufacture.
- The number of this standard, that is NZS 7646.

NOTE —

THE STANDARD CERTIFICATION MARK SCHEME



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For further particulars, apply to The Director, attention Certification Mark Section.

PART 2 FITTINGS

201 SCOPE

201.1 This Part of this standard applies to polyethylene fusion fittings for polyethylene pipes manufactured to Part 1 of this standard.

202 CLASSIFICATION

202.1 Fittings shall be classified as follows:

- Class A : for butt fusion
- Class B : for socket fusion

Socket fusion may be used for pipe sizes up to and including 50 mm. Butt fusion shall be used for pipe sizes greater than 50 mm.

203 GENERAL REQUIREMENTS

203.1 **Composition.** Polyethylene fusion fittings shall be manufactured from polyethylene extrusion compound complying with AS 1685*. The addition of not more than 10 percent of the manufacturer's own rework material resulting from the manufacture of fittings to this standard shall be permitted.

NOTE –

- (1) The colour specified in AS 1685* for the extrusion compound corresponds to colour No. 309 of NZS 1050*.
- (2) The ultraviolet stabilizer specified in AS 1685* should ensure that there is no deterioration in the physical properties of fittings exposed to direct sunlight for a period of two months.

203.2 **Freedom from defects.** The fittings shall be homogeneous throughout and the internal and external surfaces shall be clean, smooth and free from grooves, blisters, wrinkles, dents and heat marks.

203.3 **Dimensions.** Fittings for butt fusion shall have a minimum wall thickness equal to that of the pipe to which they are joined (see table 1), and an outside diameter equal to that of the pipe. Heavy wall fittings may be used with lighter walled pipe by reaming the inside diameter of the fitting to an included angle of 10° until the wall thickness at the butt face equals that of the pipe to be joined. Any lettering or reinforcing patterns, where applied, shall increase the outside diameter.

204 TESTING

204.1 **Frequency of sampling for testing.** The manufacturer shall select samples for testing at the frequency stated in table 4 and when there is a change in formulation.

*See list of related documents.

204.2 **Chemical resistance.** Twenty-five specimens conforming to the dimensions given in fig. 4, Appendix E shall be prepared from fittings moulded from the same batch of compound. Each specimen shall be tested by the method described in Appendix E. The specimens shall not increase in mass by more than 0.5 percent nor change in tensile strength at yield by more than 12 percent.

204.3 Resistance to internal pressure at elevated temperature

204.3.1 For type tests, six fittings from each production run of each machine shall be fused to pipes by means of the tools specified in Appendix G so as to provide six test specimens. All branches or outlets of fittings shall be completely assembled in accordance with the use for which they are intended, except that any screwed caps may be fused on to the fitting. The specimens shall be tested by the method described in Appendix F. Three specimens shall be subjected to an internal pressure equivalent to a circumferential stress of 4.19 MPa for a period of 44 h at $80 \pm 1^\circ\text{C}$, and the other three specimens shall be subjected to an internal pressure equivalent to a circumferential stress of 3.00 MPa for a period of 170 h at $80 \pm 1^\circ\text{C}$. The fittings shall show no sign of bursting or other failure.

204.3.2 For production testing, two fittings from each production run of each machine shall be fused to pipes by means of the tools specified in Appendix G, and shall be tested by the method described in Appendix F. The fittings shall be subjected to an internal pressure equivalent to a circumferential stress of 4.19 MPa for a period of 44 h at $80 \pm 1^\circ\text{C}$, and shall show no sign of bursting or other failure. All branches or outlets of fittings shall be completely assembled in accordance with the use for which they are intended, except that any screwed caps may be fused on to the fitting.

204.4 **Certificate of compliance.** When requested by the purchaser, the manufacturer shall supply a certificate showing the results of tests carried out to determine compliance of the fittings with this specification.

204.5 **Inspection.** The purchaser shall notify the manufacturer, when placing his order, of his request for a certificate of compliance and whether it is his intention to inspect the fittings at the manufacturer's works. The manufacturer shall afford the purchaser all reasonable facilities to inspect the fittings and to witness tests being carried out.

205 PACKING, STORAGE AND TRANSPORT

205.1 Fittings shall be packed, stored and transported in a manner which will provide protection from ultraviolet radiation and mechanical damage.

Table 4

FREQUENCY OF SAMPLING OF FITTINGS FOR TESTING

Test	Test method	Clause No.	Minimum sampling frequency		
			8-hourly	Each production run	Type test
Dimensions	Appendix A	203.3	x		
Chemical resistance	Appendix E	204.2			x
Resistance to internal pressure at elevated temperature	Appendix F	204.3			
(a) 44 h test				2 tests per production run	x
(b) 170 h test					x

NOTE – Type tests shall be carried out at each change of design of a fitting, on each new fitting configuration and at each change of polymer composition, and in any case at least once every twelve months.

206 MARKING

206.1 All fittings shall be permanently marked by means of indentation with the following information:

- (a) The manufacturer's name or registered trademark, or both.
- (b) The words "HDPE Gas".

- (c) The nominal bore of the pipe for which the fitting is intended (identified by a permanent or temporary indicator).
- (d) The SDR rating of the fitting.
- (e) The number of this standard, that is NZS 7646.

NOTE –

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APPENDIX A

METHOD FOR DETERMINING THE SECTIONAL DIMENSIONS OF PIPE

A1 Determination of diameter

A1.1 Apparatus: Micrometer or vernier calipers of accuracy of ± 0.02 mm, or other equipment of at least equivalent proven accuracy.

A1.2 Procedure

A1.2.1 Outside diameter. The outside diameter shall be measured at any point on the pipe at 20 ± 1 °C using the micrometer or vernier calipers in such a manner that it is at right angles to the axis of the pipe.

A1.2.2 Mean outside diameter (D). The outside diameter shall be measured at two points at right angles to each other around the pipe on the same cross-section. The mean of these two measurements shall be reported as the mean diameter.

A1.2.3 Maximum diameter including ovality. A continuous series of diameter measurements shall be taken around the pipe on the same cross-section. The maximum diameter obtained by this procedure shall be reported as the maximum diameter including ovality of the pipe.

A1.2.4 Minimum diameter including ovality. A continuous series of diameter measurements shall be taken around the pipe on the same cross-section. The minimum diameter obtained by this procedure shall be recorded as the minimum diameter including ovality of the pipe.

A2 Determination of wall thickness

A2.1 Apparatus. Ball micrometer of accuracy ± 0.02 mm having a ball of 3 mm nominal radius, or other equipment of at least equivalent proven accuracy.

A2.2 Procedure

A2.2.1 Wall thickness. The wall thickness shall be measured at any point at 20 ± 1 °C using the ball micrometer in such a manner that it is at right angles to the axis of the pipe.

A2.2.2 Maximum wall thickness. A continuous series of wall thickness measurements shall be taken around the pipe on the same cross-section. The maximum reading obtained by this procedure shall be reported as the maximum wall thickness of the pipe.

A2.2.3 Minimum wall thickness. A continuous series of wall thickness measurements shall be taken around the pipe on the same cross-section. The minimum reading obtained by this procedure shall be reported as the minimum wall thickness of the pipe.

APPENDIX B**HYDROSTATIC PRESSURE TEST FOR PIPE**

B1 Apparatus. The apparatus shall consist of the following:

- (a) *Constant temperature bath.* A water bath equipped with agitator and specimen manifold with individual valves for specimens and equipment capable of maintaining a temperature within the range of $20 \pm 5 - 0$ °C. Other suitable fluids may be used.
- (b) *Pressurizing system.* A device capable of supplying and maintaining constant internal pressure in the pipe specimen under test. The range of pressure is 0.7 to 3.8 MPa at 2 percent accuracy for 1 h.

NOTE – The suggested procedure is to use water. Pressure vessel approval may be required for the use of compressible fluids.

- (c) *Pressure gauge.* A pressure gauge complying with the requirements for industrial gauges given in BS 1780* : Part 2. The gauge should be capable of operating within the range 0.7 to 3.8 MPa and the calibration should be checked regularly.
- (d) *Fittings.* Fittings shall be provided that will make a water-tight connection at each end of the test specimen. Fig. 1 illustrates a suitable type of fitting. One fitting shall be connected to the hydraulic system permitting the specimen to be suspended vertically or in a manner which will give similar results.

B2 Conditioning of test specimens. Test specimens shall be conditioned in water at the test temperature for at least 1 h prior to test.

B3 Procedure. The test specimen shall be subjected to 6 times the appropriate operating pressure of the pipe as specified in clause 104.1 for a period of 1 h.

*See list of related documents.

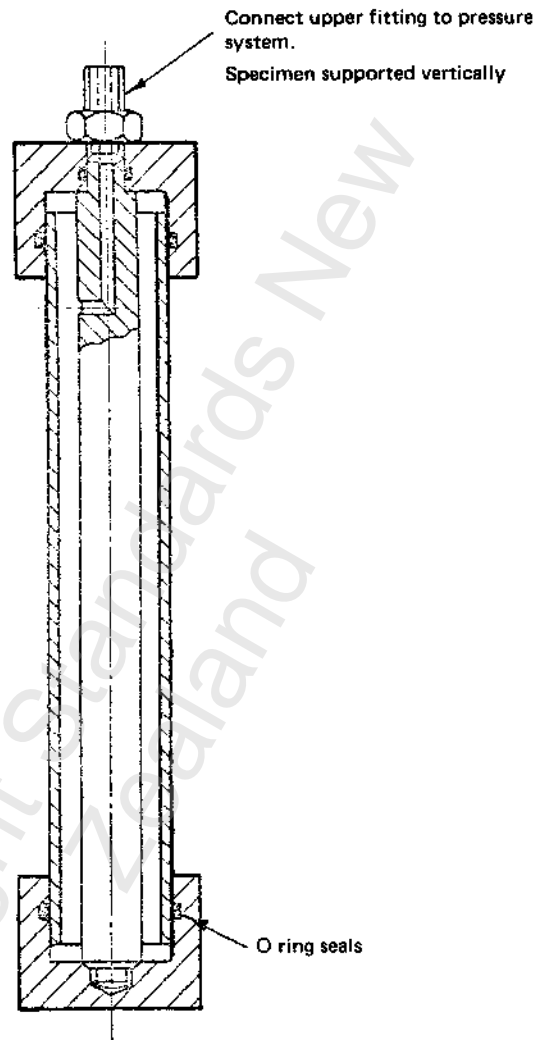


Fig 1

END FITTINGS FOR PRESSURE TESTS

APPENDIX C

METHOD OF SIMULATING SQUEEZE-OFF PROPERTIES OF POLYETHYLENE PIPE TO 100 mm NOMINAL BORE

C1 Apparatus. A rounded parallel bar press, the diameter of the bars preferably to be equal to half the nominal bore of the pipe but not less than 25 mm.

C2 Conditioning of test specimens. The test specimens shall be conditioned until the temperature is stabilized at -2 to 0°C .

C3 Procedure. Immediately after removal from the cooling medium each test specimen in turn shall be squeezed in the centre of its length in the press until the distance between the parallel bars is equal to twice the measured wall thickness of the pipe. The maximum time to squeeze each specimen shall be not greater than one minute. The specimen shall be thus held for 4 h, after which it shall be removed. After release it shall be allowed to assume its natural shape.

APPENDIX D

METHOD OF TEST FOR HEAT REVERSION OF PIPE

D1 Apparatus. A thermostatically controlled bath capable of maintaining the temperature of the heat transfer medium at $105 \pm 1^\circ\text{C}$.

D2 Heat transfer medium. The heat transfer medium shall be ethanediol (ethylene glycol) or polyethylene glycol having molecular mass not less than 600.

D3 Marking of test specimen. Two circumferential marks shall be scribed around the periphery of the test specimen at 100 ± 1 mm apart, and in such a way that one of these marks is approximately 10 mm from one end of the specimen (see fig. 2).

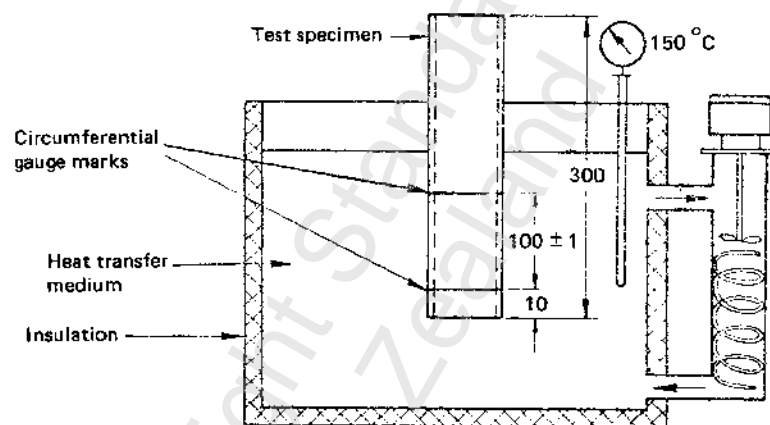


Fig. 2 HEAT REVERSION APPARATUS (DIAGRAMMATIC ONLY)
Dimensions in millimetres

D4 Procedure. The distance between the two marks on the specimen shall be determined to within 0.25 mm at $20 \pm 2^\circ\text{C}$ after conditioning the test specimen at this temperature for at least 2 h. The temperature of the heat transfer medium shall be set at $105 \pm 1^\circ\text{C}$. The test specimen shall then be suspended vertically in the heating medium by the end farthest from the marks, so that the portion of the test specimen which is not immersed is not greater than 100 mm. The test specimen shall remain suspended in this way without touching the walls or floor of the bath for a minimum of 60 min. The test specimen shall be removed from the bath and, after complete cooling to $20 \pm 2^\circ\text{C}$ by exposure to the air, the distance between the marks shall be measured to determine the maximum and minimum distances between the scribed lines.

D5 Calculation and report. The variation of the distance between the marks on the test specimen shall be calculated as a percentage, by means of the formula:

$$T = \frac{\Delta L}{L_o} \times 100$$

where

T = percentage length variation or longitudinal reversion

ΔL = $L_o - L$

L_o = distance in millimetres between the marks before the test

L = distance in millimetres between the marks after the test

Those measurements of L which give the greatest value of ΔL shall be chosen, where ΔL could be positive or negative.

NOTE – This means that the greatest variation of L must be sought as the test specimens are usually no longer rectilinear after the test.

The arithmetic mean of the value of T for each of three test specimens shall be calculated, and this mean value shall be reported as the longitudinal reversion of the pipe.

APPENDIX E

DETERMINATION OF CHEMICAL RESISTANCE OF PIPE AND FITTINGS

E1 Apparatus. The apparatus shall consist of the following:

- (a) A ball type micrometer of accuracy 0.01 mm.
- (b) A testing machine verified to be Grade B, according to the requirements of NZS 1021*. The testing machine shall be capable of operation in the range 0 to 500 kN, and at a rate of testing of 12.5 ± 2.5 mm/min.
- (c) A test fixture as illustrated in fig. 3 installed on the grips of the testing machine.

E2 Reagents:

- (a) Mineral oil – water-white of density 0.87 to 0.89 g/ml at 20 °C and viscosity 63 to 68 mPa s.
- (b) Tetrahydrothiophene – 5 percent (v/v) in mineral oil as specified.
- (c) T-butyl mercaptan – 5 percent (v/v) in mineral oil as specified.
- (d) Methanol – laboratory solvent grade.

NOTE – Tetrahydrothiophene and T-butyl mercaptan are extremely malodorous materials which should be handled with extreme care.

E3 Preparation of test specimens. The test specimens, conforming to the dimensions of fig. 4, shall be cut from the pipe sample with their edges at right angles to the axis of the pipe. The specimens shall be free from machining marks. The minimum width, and the thickness at the position of minimum width of each specimen shall be determined with the micrometer to the nearest 0.02 mm.

E4 Conditioning of test specimens. All test specimens shall be conditioned at 20 ± 2 °C and 15 ± 5 percent relative humidity for 24 h.

E5 Procedure

E5.1 Immersion. Twenty specimens shall be weighed individually to an accuracy of 0.5 mg and five shall be completely immersed in covered beakers of each reagent at the conditioning temperature for a period of 72 ± 1 h. The specimens shall be removed from the reagents, wiped dry with a clean cloth and conditioned as in clause E4 for a period of 2 to 2.5 h. The specimens shall then be reweighed.

E5.2 Change in apparent tensile stress at yield. The tensile stress at yield of the five specimens which have not been immersed shall be determined in kPa in accordance with ASTM D 2290*. The mean of the five results shall be recorded as the initial tensile stress at yield. The mean tensile stress at yield of the five specimens after immersion in each reagent shall be separately determined in accordance with ASTM D 2290*.

*See list of related documents.

E6 Report. The following data shall be reported:

- (a) The individual change in mass of immersed specimens.
- (b) The mean change in tensile stress at yield of the five specimens immersed in each of the four reagents.

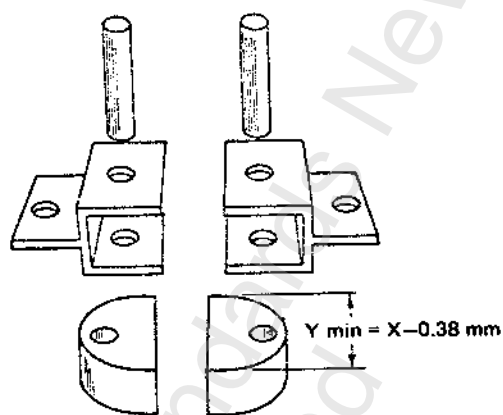


Fig. 3

FIXTURE FOR RING TENSILE TEST

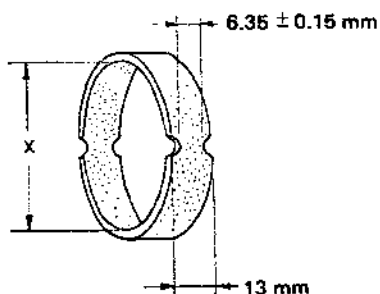


Fig. 4

REDUCED SECTION PIPE TEST SPECIMEN

APPENDIX F

RESISTANCE TO INTERNAL PRESSURE
AT ELEVATED TEMPERATURE

F1 Apparatus. The apparatus shall consist of the following:

- (a) *Constant temperature bath.* A water or other suitable fluid bath equipped with agitator and specimen manifold with individual valves for specimens and equipment capable of maintaining a temperature of $80 \pm 1^\circ\text{C}$.
- (b) *Pressurizing system.* A device capable of supplying and maintaining constant internal pressure in the specimen under test. The range of pressure is 0 to 1 MPa at 2 percent accuracy.

NOTE – The suggested procedure is to use water. Pressure vessel approval may be required for use of compressible fluids.

- (c) *Pressure gauge.* A pressure gauge complying with the requirements for industrial gauges given in BS 1780* : Part 2. The gauge should be capable of operating within the range 0 to 1 MPa and the calibration should be checked regularly.
- (d) *Fittings.* Fittings shall be provided that will make a water-tight connection at each end of the test specimen. Fig. 1 illustrates a suitable type of fitting. One fitting shall be connected to the hydraulic system permitting the specimen to be suspended vertically or in a manner which will give similar results.

F2 Preparation of test specimens. The mean outside diameter and the minimum wall thickness of each specimen shall be measured.

F3 Test pressure. The test pressure P to be applied shall be calculated from the following formula:

$$P = \frac{2St_{min}}{D - t_{min}}$$

where

t_{min} = minimum wall thickness, in millimetres

D = mean outside diameter, in millimetres

S = circumferential stress, in megapascals, from table 5

Alternatively, for production control purposes, the values for minimum mean pipe outside diameter and maximum wall thickness of pipe from table 1 may be used to calculate the test pressure.

*See list of related documents.

F4 Test procedure. Each test specimen shall be subjected to test pressure while immersed in a bath maintained at the specified test temperature. The test pressure shall be maintained within ± 2 percent of the calculated value for the period specified in table 5.

Table 5

**REQUIREMENTS FOR ELEVATED TEMPERATURE
STRESS RESISTANCE TEST**

<i>Temperature</i>	<i>Circumferential stress S</i>	<i>Duration of test</i>
$^{\circ}\text{C}$	<i>MPa</i>	<i>h</i>
80 ± 1	4.19	44
80 ± 1	3.00	170

F5 Retests (type tests only). Failure of any two of the six test specimens before the minimum period stated in table 5 shall constitute a failure of the test. Should one of the six specimens fail, a further six test specimens shall be selected and both the three short-term and three long-term tests repeated. Failure of any one of these specimens in the repeat test shall constitute a failure of the test.

F6 Report. The following information shall be reported:

- (a) The test pressures and temperature at which the tests were made.
- (b) The number, if any, of the specimens which fail by bursting, cracking or loss of pressure.

NOTE — Loss of pressure associated with faulty end connections shall not constitute a failure. Under these circumstances the test shall be repeated with a new specimen.

APPENDIX G

DESIGN AND DIMENSIONS OF SOCKET FUSION TOOLS

G1 The female fusion tool shall conform to the design shown in fig. 5 and to the dimensions given in table 6.

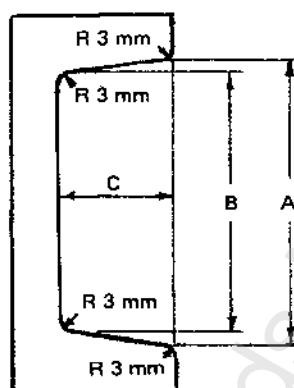


Fig. 5

DETAILS OF FEMALE FUSION TOOL

G2 The male fusion tool shall conform to the design shown in fig. 6 and to the dimensions given in table 6.

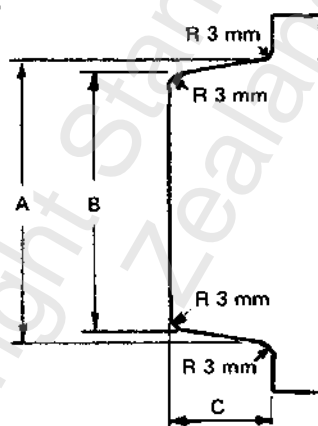


Fig. 6

DETAILS OF MALE FUSION TOOL

Table 6

DIMENSIONS OF SOCKET FUSION TOOLS

Nominal bore	Dimensions		
	A max.	B max.	C max.
mm	mm	mm	mm
10	16.2	14.1	12
15	21.7	19.4	13
20	27.1	24.3	16
25	34.0	30.7	19
32	42.5	38.8	21
40	48.6	44.9	21
50	60.8	58.8	23

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