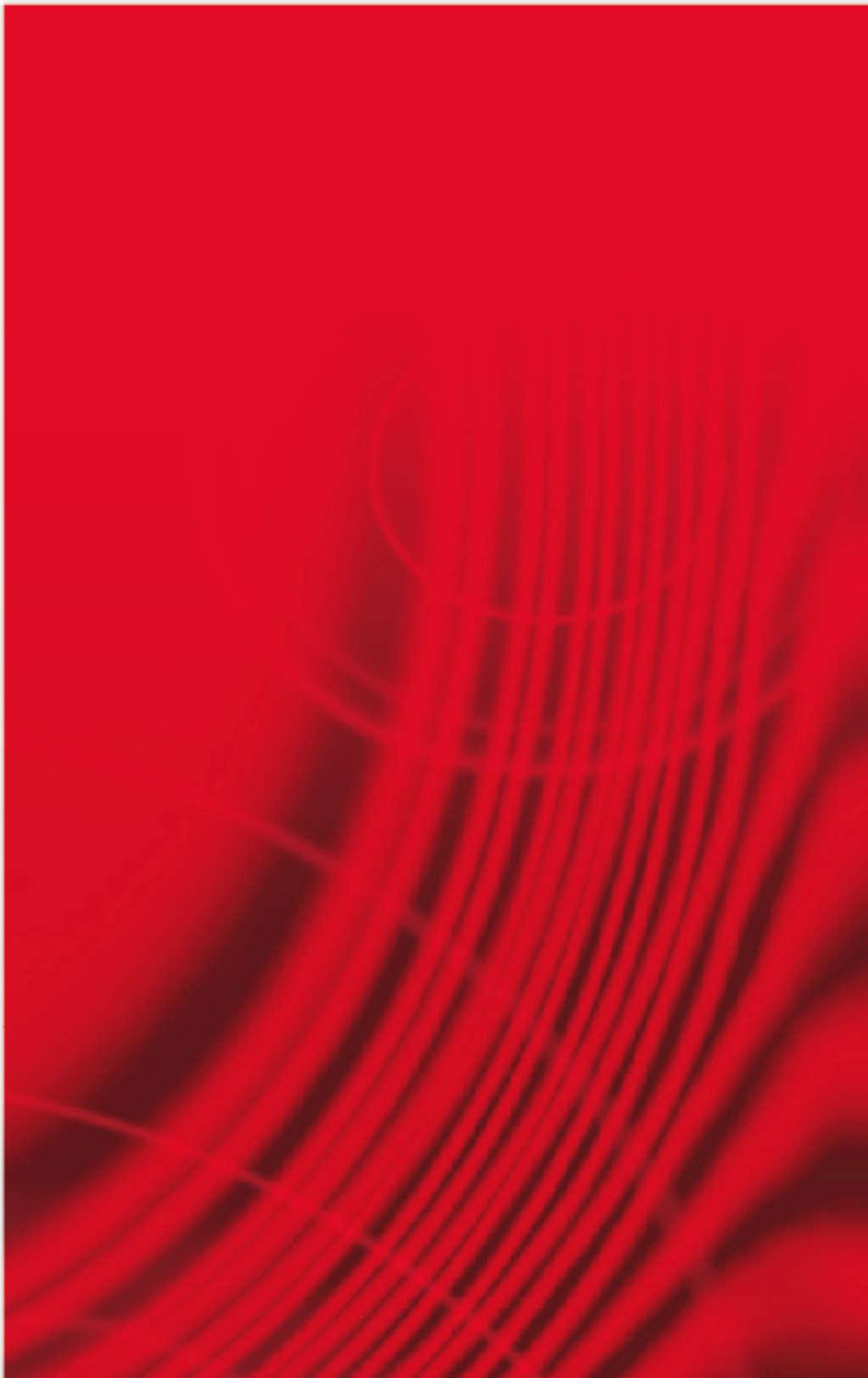
STANDARDS
NEW ZEALAND
PAEREWA AOTEAROA

NZS 7610:1991
Amendments 1 and 2 incorporated
Amendment A appended

This British Standard BS 3601:1987 has been adopted by the Standards Council of New Zealand for use in New Zealand, pursuant to the provisions of the Standards Act 1988.

NZS 7610:1991



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BRITISH STANDARD

BS 6572:1985

Incorporating Amendment Nos. 1 and 2

Specification for

Blue polyethylene pipes up to nominal size 63 for below ground use for potable water

Committees responsible for this British Standard

This British Standard was published under the direction of the Plastics Standards Committee (PLM/-). Its preparation was entrusted to Technical Committee PLM/9, upon which the following bodies were represented:

British Chemical Distributors' and Traders' Association Ltd.
British Gas Corporation
British Plastics Federation
British Valve Manufacturers' Association Ltd.
Copper Tube Fittings Manufacturers' Association
Department of the Environment (Housing and Construction Industries)
Department of the Environment (Property Services Agency)
Electricity Supply Industry in England and Wales
Engineering Equipment and Materials Users' Association
Institution of Civil Engineers
Institution of Production Engineers
Institution of Public Health Engineers
Institution of Water Engineers and Scientists
National Association of Plumbing, Heating and Mechanical Services Contractors
Plastics and Rubber Institute
Plastics Land Drainage Manufacturers' Association
Royal Institute of Public Health and Hygiene
Water Authorities Association
Water Companies Association
Water Research Centre
Coopted members

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Institute of Plumbing
Ministry of Agriculture, Fisheries and Food
National Brassfoundry Association

This British Standard, having been prepared under the direction of the Plastics Standards Committee, was published under the authority of the Board of BSI and comes into effect on
28 February 1985

The following BSI references relate to the work on this standard:
Committee reference PLM/9
Draft for comment 84/35918 DC

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Amendments issued since publication

Amd. No.	Date of issue	Comments
5170	January 1987	
5431	April 1987	Indicated by a sideline in the margin

Contents

Foreword

This British Standard has been prepared under the direction of the Plastics Standards Committee.

The prime purpose of this standard is to introduce a specification for potable water pipes characterized by a blue colour for use below ground, to distinguish the pipes from other services such as black electrical cables. This standard includes requirements for the effects of materials on water quality, to enable pipes meeting this British Standard to be acceptable to water undertakings.

Pipes are designated by their nominal metric size. This British Standard provides a specification for polyethylene pipes up to and including nominal size 63. The minimum wall thicknesses in this standard have been calculated using a maximum working stress for the material of 6.3 MPa at 20 °C when in pipe form to ensure a working pressure of at least 12 bar at 20 °C, based on data obtained using higher stresses and temperatures and including extrapolation of failure times at 20 °C to a period of 50 years.

Polyethylenes are manufactured by different processes and contain a range of, and varying quantities of, co-monomers which can result in substantial differences in basic properties, such as melt flow rate, density, creep resistance, etc. Different materials each known to be suitable for the manufacture of pipe to this standard may not be compatible for fusion jointing, and the guidance of the manufacturer should be sought before fusion jointing dissimilar materials.

Attention is drawn to CP 312-1 and CP 312-3 and to BS 5955-7 which have been prepared to assist users in assessing the suitability of plastics pipes for particular purposes and to give guidance on proper application.

The scope of this standard covers part of that of BS 3284, which is scheduled for withdrawal in January 1985, and of BS 1972, which is scheduled for amendment to relate to above ground uses only from April 1985.

A complementary British Standard for black polyethylene pipes up to nominal size 63 for above ground use for cold potable water is being prepared.

A complementary British Standard for polyethylene pipes for use in cold potable water services for sizes greater than nominal size 63 is being prepared.

A British Standard for fusion joints and fittings for use with pipes complying with this standard, i.e. BS 6572, and the proposed standard for pipes of nominal sizes greater than 63, is being prepared.

A British Standard for copper alloy compression fittings which will enable pipes complying with this standard, i.e. BS 6572, to be joined by mechanical means is being prepared.

Attention is drawn to the provisions of the Health and Safety at Work etc. Act 1974 and the need to ensure that appropriate precautions are taken to ensure the safety of personnel when carrying out the methods of test required by this standard.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations. In particular, attention is drawn to water industry requirements for materials in contact with potable work.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard specifies requirements for the composition, physical attributes, performance and identification of blue pigmented polyethylene (PE) pipe for use in cold potable water services at pressures up to 12 bar[1)] at 20 °C either in below ground systems or where protected from sunlight by enclosure in ducts or buildings.

The pipes are specified in nominal sizes 20 to 63 as straight or coiled pipe. Methods of test and information on quality control testing are given in appendices.

NOTE 1 The information on quality control testing is included because of particular features associated with the method of manufacture of these products, and adherence to the various clauses of appendix F will facilitate the production of pipes which meet the requirements of this British Standard.

NOTE 2 The titles of publications referred to in this standard are listed on the inside back cover.

2 Definition

For the purposes of this British Standard, the following definition applies.

ovality. The difference between the measured maximum outside diameter ($d_{y,max}$) and the measured minimum outside diameter ($d_{y,min}$) in the same cross section of the pipe

3 Dimensions and tolerances

3.1 Nominal size

The nominal size of the pipe shall be one of the sizes given in Table 1.

Table 1 — Pipe dimensions

Nominal size DN	Mean outside diameter		Wall thickness	
	min.	max.	min.	max.
	mm	mm	mm	mm
20	20.0	20.3	2.3	2.6
25	25.0	25.3	2.3	2.6
32	32.0	32.3	3.0	3.4
50	50.0	50.4	4.6	5.2
63	63.0	63.4	5.8	6.5

3.2 Outside diameter and wall thickness

The mean outside diameters of pipes shall comply with the limits specified in Table 1, when determined in accordance with BS 2782:Method 1101A at a point at least one diameter away from the pipe end.

The wall thickness of pipes shall comply with the limits specified in Table 1 when determined in accordance with BS 2782:Method 1101A at any point around the circumference.

3.3 Ovality

NOTE The ovality of pipe in coils is assessed in accordance with **3.3.1** or **3.3.2**. The ovality of straight pipe is assessed in accordance with **3.3.2**.

3.3.1 *Pipe in coils as manufactured.* When determined by the method described in Appendix A, the ovality, expressed in millimetres, of pipe from coils in the as manufactured condition shall not exceed the value of 0.06 of the nominal size (DN) of the pipe.

3.3.2 *Pipe in coils after relaxation and straight pipe.* When determined by the method described in Appendix A, the ovality, expressed in millimetres, of pipe from coils subjected to relaxation, and of straight pipe shall not exceed the value of 1 + [0.008 of the nominal size (DN) of the pipe].

3.4 Tolerance on length

Each end of the pipe shall be cleanly cut square with the axis to within the tolerances given in Table 2. If the lengths of individual pipes or coils are specified, such lengths shall be not less than that specified when determined at 23 ± 2 °C.

NOTE The preferred lengths of straight pipe are 6 m, 9 m or 12 m and of coils are 50 m, 100 m or 150 m.

Table 2 — Out-of-square tolerances for ends

Nominal size DN	Maximum out-of-square of each pipe end
	mm
20 to 32	2
50 to 63	3

3.5 Coil diameters

Coiled pipes shall have a minimum internal coil diameter in accordance with Table 3.

Table 3 — Coil diameters

Nominal size of pipe DN	Minimum internal coil diameter
	m
20	0.6
25	0.6
32	0.7
50	1.0
63	1.3

[1)] 1 bar = 10^5 N/m^2 = 0.1 MPa.

4 Compound composition

4.1 Effect of materials on water quality

When used under the conditions for which they are designed, materials in contact with or likely to come into contact with potable water shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odour, cloudiness or discoloration of the water.

Concentrations of substances, chemicals and biological agents leached from materials in contact with potable water, and measurements of the relevant organoleptic/physical parameters shall not exceed the maximum values recommended by the World Health Organization in its publication "Guidelines for drinking water quality" Vol. 1 "Recommendations" (WHO, Geneva, 1984) or as required by the EEC Council Directive of 15 July 1980 relating to the quality of water intended for human consumption (Official Journal of the European Communities L229 pp 11–29), whichever in each case is the more stringent.

NOTE 1 Requirements for the testing of non-metallic materials in these respects are set out in the UK Water Fittings Byelaws Scheme Information and Guidance Note No 5-01-02, ISSN 0267 – 0313 obtainable from the Water Research Centre, Fittings Testing Station, 660 Ajax Avenue, Slough, Berkshire SL1 4BG.

NOTE 2 Requirements for the testing of metallic materials in these respects are set out in DD 82.

NOTE 3 Pending the determination of suitable means of characterizing the toxicity of leachates from materials in contact with potable water, materials approved by the Department of the Environment Committee on Chemicals and Materials of Construction for use in Public Water Supply and Swimming Pools are considered free from toxic hazard for the purposes of compliance with this subclause. A list of approved chemicals and materials is available from the Technical Secretary of that Committee at the Department of the Environment, Water Division, Romney House, 43 Marsham Street, London SW1P 3PY.

NOTE 4 Products manufactured for installation and use in the United Kingdom which are verified and listed under the UK Water Fittings Byelaws Scheme administered by the Water Research Centre (address as in note 1) are deemed to satisfy the requirements detailed in this subclause.

4.2 Base polymer

4.2.1 The base polymer shall be polyethylene, or a copolymer of ethylene and higher olefins in which the higher olefin constituent does not exceed 10 % by mass, with a derived density of between 930 kg/m^3 and 944 kg/m^3 inclusive at 23 °C when determined in accordance with BS 3412:1976 (as amended by Amendment Nos. 1 and 2).

4.2.2 The base polymer shall be in accordance with clauses **4**, **5** and **9** of BS 3412:1976 (as amended by Amendment Nos. 1 and 2) in respect of density, melt flow rate, colour variation and impurities.

4.3 Additives

4.3.1 *General.* The base polymer shall include or be blended with additives (see **4.3.2** for antioxidants, **4.4.2** for pigment, **6.3** for UV stabilizers, etc.) as necessary to produce a compound for the manufacture, storage and use of pipes to this standard.

The compound shall be in accordance with clause **4**, **5** and **9** of BS 3412:1976 (as amended by Amendment Nos. 1 and 2) in respect of density, melt flow rate, colour variation and impurities.

4.3.2 *Antioxidants.* The compound shall be class N as defined in BS 3412:1976 (as amended by Amendment Nos. 1 and 2) and the antioxidants used shall comply with **8.1** and **8.2** of that standard. In addition, with the exception of 6,6′-di*tert*butyl-4,4′-thiodi-*m*-cresol, which shall not be used for the purposes of this British Standard, only antioxidants listed in Table 2 of BS 3412:1976 (as amended by Amendment Nos. 1 and 2) shall be used.

4.3.3 *Rework material.* If rework material is added or used, it shall be clean, derived from pipe produced in accordance with this standard and reground under the supervision of the same manufacturer, and it shall be compatible with any materials to which it is added.

4.4 Pipe material

4.4.1 *Conditioning.* Test pieces of pipe material, comprising or taken from samples of pipe, shall be conditioned or preconditioned in accordance with one of the procedures given in Appendix C as appropriate to the purpose of the test and references to that appendix by other clauses in this British Standard.

NOTE The conditioning periods and conditions given in Appendix C are considered appropriate to the non-hygroscopic nature of the material, the limited thickness of test pieces required by this British Standard and the need for some data for quality control purposes to be obtained with the minimum of delay.

4.4.2 *Pigmentation.* The colour of the pipe shall be blue within the range 18 E 51 and 18 E 53 of BS 4901. When tested across the pipe wall by the method described in BS 2782:Method 1106A:1983, the pigment dispersion shall be at least as uniform in appearance as that shown in photomicrograph 2 of Figure 1 of BS 2782:Method 1106A:1983, i.e. appearances similar to those shown in photomicrographs 3 to 6 of that figure are unacceptable.

4.4.3 *Thermal stability*

4.4.3.1 *General.* The material of which the pipe is made shall meet the requirements of either **4.4.3.2** or **4.4.3.3**.

4.4.3.2 *Residual antioxidant.* The total residual antioxidant content of samples taken across the full wall section shall be not less than 0.02 %(*m*/*m*), when tested in accordance with BS 2782:Methods 434B, 434C or 434D.

4.4.3.3 *Induction temperature.* The induction temperature of material in pipe form shall be at least 230 °C when tested by the method described in Appendix B.

5 Physical properties

5.1 Appearance

The internal and external surfaces of the pipe shall be free from defects visible without magnification, and the internal surface shall appear to be clean when viewed without magnification.

NOTE The ends of the pipes may be plugged or covered to maintain their condition and exclude contamination.

5.2 Hydrostatic pressure resistance

5.2.1 *Hydrostatic pressure resistance at* 20 °C. The pipe shall withstand a pressure equivalent to a circumferential stress of 12.0 MPa for 1 h at 20 ± 1.0 °C when tested in accordance with the method described in BS 4728, using the type of end caps shown in Figure 1 of BS 4728:1971 and one test piece. The test piece shall comprise a pipe with a free length between end caps of 250 mm minimum and shall be conditioned in accordance with **C.2**.

5.2.2 *Hydrostatic pressure resistance* at 80 °C. The pipe shall withstand a pressure equivalent to a circumferential stress of 4.0 MPa for 170 h at 80 ± 1.0 °C when tested in accordance with the method described in BS 4728, using the type of end caps shown in Figure 1 of BS 4728:1971 and one test piece which shall comprise a pipe with a free length between end caps of 250 mm minimum and shall be conditioned in accordance with **C.2**.

5.3 Elongation at break

The value of elongation at break shall be not less than 350 % from each of four test pieces of full wall thickness taken from positions equally spaced around the circumference of the pipe when tested according to BS 2782:Method 320A, using a rate of grip separation of 100 ± 10 mm/min and test pieces prepared in accordance with Appendix D.

6 Type test requirements

6.1 General

The requirements given in **6.2** to **6.5** shall be met whenever a change in process technique or introduction of a new or modified compound has occurred.

The relevant tests shall be applied to pipe taken from a production run from which the product has complied with all the preceding requirements of this standard.

6.2 Hydrostatic properties

6.2.1 *Long term hydrostatic strength at* 20 °C. When samples from the smallest and from the largest nominal size of pipe in the manufacturer's range in respect of this British Standard are tested in accordance with the method described in BS 4728 and the results analysed separately for each size in accordance with Appendix E:

a) the extrapolated failure time at a stress of 8.3 MPa shall be greater than 50 years;

b) the 97.5 % lower confidence limit of the failure time at a stress of 8.0 MPa shall be greater than 100 000 h;

c) no test piece shall fail in a brittle mode without visible yield deformation as illustrated in Figure 1 b), in less than 10 000 h.

6.2.2 *Hydrostatic pressure resistance at* 80 °C. The requirements of **5.2.2** shall be satisfied by each of five test pieces from each of three pipe sizes including the largest and smallest sizes from the manufacturer's range in respect of this British Standard.

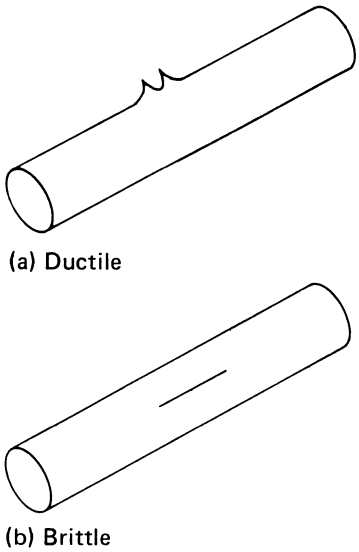

Figure 1 — Types of failure

6.3 Resistance to weathering

6.3.1 *General*. Following outdoor exposure for 1 year, performed in accordance with BS 2782:Method 550A for exposure at 45° facing south in the United Kingdom, of three 1 m long samples of pipe having the manufacturer's least nominal thickness, the weathered samples, or test pieces taken therefrom as appropriate, shall meet the requirements of **6.3.2** and **6.3.3** after having been washed with clean water free from any detergent.

NOTE 12 months' exposure in the manner specified approximates to a total radiation energy of 3.5 GJ/m^2.

6.3.2 *Physical requirements*. There shall be no cracking or crazing visible under × 10 magnification.

Test pieces taken from the weathered side of exposed samples shall comply with the requirements of **4.4.3** and **5.3**.

6.3.3 *Appearance requirements*. Either:

a) the colour requirement of **4.4.2** shall be met, or

b) exposed samples placed on a neutral background next to an unexposed reference sample, which has been stored in the dark below 30 °C, shall, when viewed normally with natural north light (or an artificial equivalent) incident at 45° and compared with a BS 1006, section A02C grey scale for assessing change in colour, exhibit a contrast produced by weathering not exceeding grade 3.

6.4 Fusibility

The following assemblies shall comply with the requirements of **5.2.2**:

a) test pieces weathered pipe fusion welded to sockets by using the manufacturer's recommended technique;

b) test pieces of pipe weathered in accordance with **6.3.1** and fusion welded to sockets by using the manufacturer's recommended technique.

6.5 Extension to nominal size, formulation or process range

6.5.1 *General*. For the extension of a manufacturer's range of sizes beyond that already tested in accordance with **6.2** to **6.4**, or for a change in material formulation or in pipe manufacturing process, the manufacturer can claim compliance for the modified range provided that all the requirements of this standard except **6.2.1**, **6.3.1** and **6.4** b) have been met in addition to the requirements of **6.5.2** and **6.5.3**.

6.5.2 *Hydrostatic strength at* 20 °C. The following requirements shall be met.

a) At failure times up to 2 500 h, the requirements of **6.2.1** a) and **6.2.1** c) shall be met.

b) Sufficient test pieces shall be under test, at appropriate stress levels, to enable a full regression analysis to be carried out in accordance with **6.2.1**.

c) The requirements of **6.2.1** shall be met subsequently by the test pieces under test in accordance with **6.5.2** b).

6.5.3 *Resistance to weathering*. The following requirements shall be met.

a) Three samples as specified in **6.3.1** and continuously exposed by the same procedure either for at least 16 weeks between the months of March and September inclusive or to a total radiation energy of at least 1 GJ/m^2, with the exception that the contrast produced by weathering shall not exceed grade 4 of BS 1006, section A02C, shall meet the requirements of **6.3.2** and **6.3.3**.

b) Sufficient samples shall be under test to enable the physical properties and appearance to be assessed in accordance with **6.3**.

c) The requirements of **6.3.2**, **6.3.3** and **6.4** b) shall be met subsequently by test pieces from the samples under exposure in accordance with **6.5.3** b).

7 Marking

7.1 All pipes shall be indelibly marked, by printing along the pipe in green or black at intervals not exceeding one metre, with the following information.

a) the manufacturer's identification, as a clear text or logo;

b) the number and date of this British Standard, i.e. BS 6572:1985[2)];

c) the nominal size, as specified in Table 1, followed by the letters "PE" and the pressure rating of "12 bar";

d) identification of the shift, production line and date of manufacture.Coding of this information is permitted provided that the meaning of the code is available on request.

In addition:

e) the word "WATER" shall be marked at regular intervals three times within each metre length.

7.2 The marking shall remain legible under handling, storage and installation procedures in accordance with CP 312-1 and CP 312-3. Marking by indentation to a depth not greater than 0.15 mm shall be deemed to comply with this clause without infringing the wall thickness requirements of **3.2**.

7.3 The manufacturer shall ensure that all non-complying pipe either is rejected or is not marked with the number of this British Standard.

[2)] Marking BS 6572:1985 on or in relation to a product is a claim by the manufacturer that the product has been manufactured in accordance with the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification to support such claims should be addressed to the Director, Quality Assurance Division, British Standards Institution, PO Box 375, Milton Keynes, MK14 6LO in the case of certification marks administered by BSI or to the appropriate authority for other certification marks.

Appendix A Method for the determination of ovality

A.1 Apparatus

A.1.1 *Measuring apparatus*, as described in BS 2782:Method 1101A for the outside diameter at any point method.

A.1.2 *Water bath*, having a length expressed in millimetres, of at least 6 times the nominal size (DN) of the pipe. (See **A.2**.)

A.1.3 *Heating device*, capable of maintaining the water in the water bath at 80 ± 1 °C.(See **A.2**.)

A.2 Preparation of test piece

If a test piece taken from a coil is to be tested after relaxation (see **3.3.2**) carry out the following relaxation procedure. Cut a test piece to a length, expressed in millimetres, corresponding to **5** times the nominal size (DN) of the pipe, immerse the test piece in water maintained at 80 ± 1 °C in a water bath (**A.1.2**) and leave for 30 min. Remove the test piece from the water bath and allow it to cool in air without restraint to 23 ± 2 °C.

A.3 Procedure

Use the procedure given in BS 2782:Method 1101A for the measurement of outside diameter at any point to measure the maximum outside diameter ($d_{y,max}$) and the minimum outside diameter ($d_{y,min}$).

A.4 Calculation

Calculate the ovality, expressed in millimetres, from the following equation:

$$\text{ovality} = d_{y,max} - d_{y,min}$$

A.5 Test report

The report shall include the following:

a) the identification of the test piece;

b) the ovality (in mm);

c) the date of the test.

Appendix B Method for the determination of induction temperature

B.1 Apparatus

A differential scanning calorimeter (DSC) shall be used to determine the induction temperature of the pipe material, using indium as a temperature reference. Except when in conflict with this appendix, the operating instructions of the instrument manufacturer shall be followed.

B.2 Test pieces

Three test pieces of suitable size (depending on the apparatus used) shall be cut across the full wall section of a sample of the pipe.

B.3 Procedure

Place one test piece in one pan of the DSC and a reference sample of indium in a similar pan. Use a heating rate of 10 °C/min in static air to determine the induction temperature of the polyethylene, where the induction temperature is the temperature at which the base line, on a graph of temperature change or heat absorption rate against temperature, intersects a line tangential to the leading slope of the exothermic decomposition peak, as shown in Figure 2.

Repeat the procedure for each test piece and record the individual results.

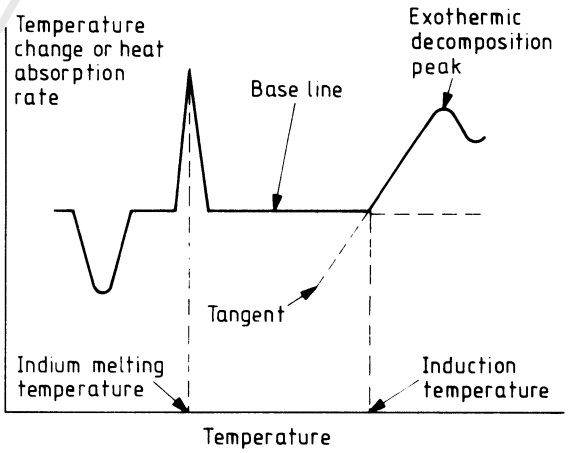

Figure 2 — Example of DSC trace

B.4 Test report

The report shall include the following:

a) the identification of the test pieces;

b) the individual results, in °C;

c) the date of the test.

Appendix C Conditioning

C.1 General conditioning

Test pieces shall be conditioned in air at 23 ± 2 °C for not less than 12 h for:

a) any type test requirement;

b) any tests performed in case of dispute, to condition test pieces prior to testing at 23 ± 2 °C or precondition test pieces prior to conditioning at other temperatures;

c) testing by reference to methods which specify a longer period of conditioning at 23 ± 2 °C, with or without controlled humidity.

C.2 Hydrostatic testing

Except in case of dispute, where test pieces shall first be preconditioned in accordance with **C.1**, test pieces for hydrostatic tests involving liquid immersion shall be conditioned for not less than 1 h in liquid maintained at the temperature required for testing.

C.3 Abbreviated conditioning

Except in case of dispute, where test pieces shall be conditioned in accordance with **C.1**, test pieces shall be conditioned in accordance with any defined procedure for which the effects of any deviation from conditioning in accordance with **C.1** or **C.2**, as appropriate, have been established for the property to be tested.

Appendix D Method for the preparation of test pieces for the determination of elongation at break

D.1 Principle

Dumb-bell test pieces are punched from strips cut from pipe, marked to define a gauge length portion on the waist of the test piece, and conditioned immediately prior to testing.

D.2 Apparatus

D.2.1 *Punches*, having cutting edges with the dimensions given in Figure 3 and Table 4. The cutting edges shall be sharp and free from notches.

D.2.2 *Marker*[3)], comprising an ink transfer tool having two parallel knife edges 25 mm apart, ground smooth and true, 0.05 mm to 0.10 mm wide at the edge and bevelled at an angle of not more than 15°, together with a source of an ink having no deleterious effect on the material being tested and of suitable contrasting colour.

D.3 Procedure

D.3.1 Without using heat as an aid to cutting and without permanent flattening of the pipe or the test piece, cut four strips of equal width from the pipe, with the long axis of each strip parallel to the long axis of the pipe and offset by 90° circumferentially from any previously cut strip.

NOTE A piece of pipe long enough to produce a test piece may be opened out sufficiently for the punching out of a test piece after being cut once longitudinally.

D.3.2 Punch test pieces from the centre of strips, using a single stroke of a punch (**D.2.1**). The thickness of the narrow parallel portion of the test piece (see Table 4) shall nowhere deviate by more than 2 % from the mean.

NOTE The mean and extreme thicknesses of the narrow parallel portion of the test pieces may be determined according to the procedure of BS 2782:Method 320A and using a wall thickness measuring apparatus which complies with the requirements of BS 2782:Method 1101A so that the circumference of the fixed contact point is parallel to the longitudinal axis of the test piece.

D.3.3 Without scratching, impressing or otherwise physically damaging the test pieces, provide two reference lines on the narrow portion of the test piece as shown in Figure 3, equidistant from its centre and at right angles to its longitudinal axis[3)].

D.3.4 Except in cases of dispute or for type testing, when **C.1** shall apply, condition the test pieces in accordance with procedure **C.3**.

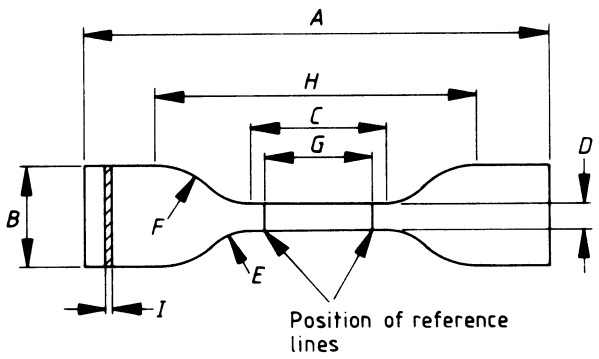

Figure 3 — Punched test piece

[3)] If pairs of clip-on extensometer markers or jaws which do not physically damage the test pieces are to be used when testing for compliance with **5.3**, then this method of marking is not appropriate.

Table 4 — Dimensions of punched test piece

Designation on Figure 3	Description	Full size dimensions
		mm
A	Overall length, min.	115
B	Width at ends	25 ± 1
C	Length of narrow parallel portion	33 ± 2
D	Width of narrow parallel portion	$6\ ^{+0.4}_{-0}$
E	Small radius	14 ± 1
F	Large radius	25 ± 2
G	Distance between reference lines	25 ± 1
H	Initial distance between grips	80 ± 5
I	Thickness[a]	⩽ 12.5

[a] Although test pieces cut from any pipe covered by the scope of this British Standard will satisfy this requirement, this limitation upon the applicability of the test piece is included to complete the description of the test piece.

Appendix E Method for the analysis of results from the determination of the long term hydrostatic strength of pipe at 20 °C

E.1 Procedure

Obtain at least 18 test results for the calculation of the log (time) versus log (stress) regression line with failure point distribution as given in Table 5. Include as failures at the time of testing those test pieces that have not failed after being under test for more than 10 000 h if they increase the value of the extrapolated time (see **E.2.4** and **E.2.5**).

Table 5 — Failure point distribution

Failure time range		Minimum data point distribution	Recommended[a] data point distribution
h			
> 10	but < 50	2	⩾ 4
⩾ 50	but < 2 500	3	⩾ 5
⩾ 2 500	but < 6 500	3	⩾ 4
⩾ 6 500	but < 10 000	3	⩾ 4
⩾ 10 000		1	⩾ 1
Total		11 + 7 others	⩾ 18

[a] Whilst 18 data points, distributed as shown in column 2, is the minimum pattern required, it is recommended that sufficient data points be obtained so that 18 data points distributed as shown in column 3 are included.

E.2 Calculation of linear regression with one independent variable

E.2.1 The following symbols are used:

n is the number of observations;

f_i is the log of stress (in MPa) of observation i; $i = 1, ..., n$;

h_i is the log of time (in h) of observation i; $i = 1, ..., n$;

$\bar{f}$ is the arithmetic mean of all f_i values $= \frac{1}{n}\sum_{i=1}^{n} f_i$ (1)

$\bar{h}$ is the arithmetic mean of all h_i values $= \frac{1}{n}\sum_{i=1}^{n} h_i$ (2)

The regression equation of log time (h) on log stress (f) is:

$$h = a + bf \quad (3)$$

E.2.2 Calculate the following three quantities:

$$S_{ff} = \sum_{i=1}^{n} f_i^2 - n(\bar{f})^2 \quad (4)$$

$$S_{hh} = \sum_{i=1}^{n} h_i^2 - n(\bar{h})^2 \quad (5)$$

$$S_{fh} = \sum_{i=1}^{n} f_i h_i - n\bar{f}\bar{h} \quad (6)$$

E.2.3 Calculate b and a from the following equations

$$b = \frac{S_{fh}}{S_{ff}} \quad (7)$$

$$a = \bar{h} - b\bar{f} \quad (8)$$

If the slope of the regression line, b, is not negative, the results shall be rejected.

E.2.4 Calculate the mean failure time (in h) at a stress of 8.3 MPa from equation (3).

E.2.5 Calculate the lower 97.5 % confidence limit as follows:

a) Determine the residual variance about the regression line, s_r^2, from the following equation:

$$s_r^2 = \frac{1}{n-2}\left[S_{hh} - \frac{S_{fh}^2}{S_{ff}}\right] \quad (9)$$

b) Calculate the lower 97.5 % confidence limit for one future observation at a given stress of 8.0 MPa from the following equation:

$$h_0 = a + bf_0 - t_\nu s_r \sqrt{\left[1 + \frac{1}{n} + \frac{(f_0 - \bar{f})^2}{S_{ff}}\right]} \qquad (10)$$

where

t_ν is Student's t for $\nu = n - 2$ degrees of freedom, as given in Table 6 which gives the upper 2½ % points;

h_0 is the estimated log time before failure (in h);

f_0 is the log of the stress (in MPa) (in this case, log 8.0).

E.3 Test report

The report shall include the following:

a) the identification of the test pieces;

b) the mean failure time (in h) at stress equal to 8.3 MPa;

c) the lower 97.5 % confidence limit at stress equal to 8.0 MPa;

d) the date of the test.

Table 6 — Percentage points of Student's t distribution (upper 2½ % points)

ν	t_ν	ν	t_ν	ν	t_ν
1	12.7062	46	2.0129	91	1.9864
2	4.3027	47	2.0117	92	1.9861
3	3.1824	48	2.0106	93	1.9855
4	2.7764	49	2.0096	94	1.9855
5	2.5706	50	2.0086	95	1.9853
6	2.4469	51	2.0076	96	1.9850
7	2.3646	52	2.0066	97	1.9847
8	2.3060	53	2.0057	98	1.9845
9	2.2622	54	2.0049	99	1.9842
10	2.2281	55	2.0040	100	1.9840
11	2.2010	56	2.0032	102	1.9835
12	2.1788	57	2.0025	104	1.9830
13	2.1604	58	2.0010	106	1.9826
14	2.1448	59	2.0010	108	1.9822
15	2.1315	60	2.0003	110	1.9818
16	2.1199	61	1.9996	112	1.9814
17	2.1098	62	1.9990	114	1.9810
18	2.1009	63	1.9983	116	1.9806
19	2.0930	64	1.9977	118	1.9803
20	2.0860	65	1.9971	120	1.9799
21	2.0796	66	1.9966	122	1.9796
22	2.0739	67	1.9960	124	1.9793
23	2.0687	68	1.9955	126	1.9790
24	2.0639	69	1.9949	128	1.9787
25	2.0595	70	1.9944	130	1.9784
26	2.0555	71	1.9939	132	1.9781
27	2.0518	72	1.9935	134	1.9778
28	2.0484	73	1.9930	136	1.9776
29	2.0452	74	1.9925	138	1.9773
30	2.0423	75	1.9921	140	1.9771
31	2.0395	76	1.9917	142	1.9768
32	2.0369	77	1.9913	144	1.9766
33	2.0345	78	1.9908	146	1.9763
34	2.0322	79	1.9905	148	1.9761
35	2.0301	80	1.9901	150	1.9759
36	2.0281	81	1.9897	200	1.9719
37	2.0262	82	1.9893	300	1.9679
38	2.0244	83	1.9890	400	1.9659
39	2.0227	84	1.9886	500	1.9647
40	2.0211	85	1.9883	600	1.9639
41	2.0195	86	1.9879	700	1.9634
42	2.0181	87	1.9876	800	1.9629
43	2.0167	88	1.9873	900	1.9626
44	2.0154	89	1.9870	1 000	1.9623
45	2.0141	90	1.9867	∞	1.9600

Appendix F Quality control testing

F.1 General

To demonstrate continuing satisfactory quality in day to day production, sampling frequency patterns are recommended in this appendix for control of start-up operations and of production operations for producing pipe to comply with this British Standard.

In addition to "normal" sampling frequencies specified for determining specific properties following process start-up (see **F.3**), more frequent (tightened) sampling is recommended in the event of material (production batch) or process changes or of unsatisfactory test results, and less frequent (reduced) sampling may be used subject to certain conditions after consistent production of satisfactory pipe has been established.

Alternative methods of measurement to those specified may be used, e.g. automatic equipment for measuring dimensions, provided that any such method is no less stringent than that specified for determining compliance of the pipe with this British Standard.

F.2 Sampling and frequency patterns

F.2.1 Tightened sampling should be applied at a minimum frequency of one sample every 6 h for the parameter(s) in question, when any three consecutive results have been unsatisfactory when obtained using normal sampling.

F.2.2 Normal sampling should be applied at a minimum frequency of one sample every 12 h, unless otherwise recommended by this appendix:

a) after start-up as given in **F.3**; or

b) after using tightened sampling, when satisfactory results have been obtained for at least 24 h of continuous production; or

c) after using reduced sampling, if one or more unsatisfactory results have been obtained.

F.2.3 Reduced sampling frequencies may be applicable by a manufacturer operating a nationally accredited quality system complying with, for example, the requirements of BS 5750-2. In such circumstances, the reduced sampling frequency should be at a minimum of one sample every 24 h, and should be applicable only after using normal sampling, when satisfactory results have been obtained for at least 24 h of continuous production.

F.3 Start-up procedure

At the start of each production run for each nominal size, or at each change of material formulation, or for each interruption of production greater than 1 h, pipe from each manufacturing machine should be checked for compliance with the following:

a) dimensions to **C.3** and **3.2** and **3.3**;

b) appearance to **5.1**;

c) marking to clause **7**.

When pipe complies with these requirements, samples should be taken and tested for compliance with the following:

d) short term hydrostatic pressure test at 20 °C to **C.2** and **5.2.1**;

e) elongation at break to **C.3** and **5.3**.

When pipe also complies with these requirements, then production to this British Standard is considered to have commenced at the time that the pipe samples were taken which complied with all these requirements.

F.4 Process control tests

F.4.1 *General*

Following the commencement of pipe production as described in **F.3**, unless otherwise specified in **F.4.2** and **F.4.3**, samples should be taken from each machine in production at least at the normal sampling frequencies stated in **F.2.2**.

F.4.2 *Material quality control*

F.4.2.1 When material is already compounded and is provided by the material supplier as complying with **4.1** to **4.3**, **4.4.2** and **4.4.3**, then one sample of material in pipe form should be tested, at intervals not exceeding 1 month of production, for each of the following:

a) colour and pigment dispersion to **4.4.2**;

b) thermal stability to either **4.4.3.2** or **4.4.3.3**.

F.4.2.2 When material is prepared by the pipe manufacturer by batch mixing, or by compounding, or where the material is already compounded and is not provided by the material supplier as complying with **4.1** to **4.3**, **4.4.2** and **4.4.3**, then one sample of material in pipe form should be tested, at intervals not exceeding 12 h when normal or tightened sampling is being used and at intervals not exceeding 24 h when reduced sampling is being used, for each of the following:

a) colour to **4.4.2**;

b) thermal stability to either **4.4.3.2** or **4.4.3.3**.

F.4.2.3 When material is processed by a continuous mixing method which is part of the extruder lines, then one sample of material in pipe form should be tested at intervals not exceeding 12 h when normal and tightened sampling is being used and at intervals not exceeding 7 days when reduced sampling is being used, for each of the following:

a) colour to **4.4.2**;

b) thermal stability to either **4.4.3.2** or **4.4.3.3**.

F.4.3 ***Product quality control***

F.4.3.1 In the case of coils, a minimum of one check should be made on every coil or every coil or every 150 m, whichever is the less frequent, or in the case of straight lengths, a minimum of one check should be made at intervals not greater than 1 h for each of the following:

a) dimensions to **C.3** and **3.2**;

b) appearance to **5.1**;

c) marking to clause **7**.

F.4.3.2 One test should be taken at random, at the applicable frequency specified in **F.2** for each of the following:

a) short term hydrostatic pressure test at 20 °C to **C.2** and **5.2.1**;

b) elongation at break to **C.3** and **5.3**;

c) dimensions to **C.3** and, for coiled pipe, to **3.3.1** only or, for straight pipe, to **3.3.2** and **3.4**.

F.4.3.3 A minimum of one sample from each size of pipe being produced on each extruder should be taken each week or part of a week for testing for each of the following:

a) colour and pigment dispersion to **4.4.2**

b) hydrostatic pressure resistance at 80 °C to **C.2** and **5.2.2**.

F.5 Limitations

In the event of a failure occurring, the production since the previous successful quality control inspection or test, as appropriate, should be checked for the parameter(s) in question and all failures rejected.

F.6 Records

Records of all inspection procedures and test results pertinent to production of pipe in accordance with this British Standard should be kept by or on behalf of the relevant manufacturer for a minimum period of 10 years.

F.7 Test equipment and facilities

The manufacturers should ensure that equipment and facilities used for sampling and testing pipe or test pieces thereof for the purposes of this British Standard are certified or calibrated to a system satisfying the requirements of BS 5781.

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Publications referred to

BS 1006, *Section A02C. Grey scale for assessing change in colour.*

BS 1972, *Specification for polythene pipe (Type 32) for cold water services*[4)].

BS 2782, *Methods of testing plastics.*

BS 2782-0, *Introduction.*

BS 2782:Methods 320A to 320F, *Determination of tensile strength, elongation and elastic modulus.*

BS 2782:Method 434B, *Determination of antioxidants in polyolefin compounds by ultra-violet absorption of the chloroform extract.*

BS 2782:Method 434C, *Determination of antioxidants in polyolefin compounds by ultra-violet absorption of the toluene/ethanol extract in ethanol solution.*

BS 2782:Method 434D, *Determination of antioxidants in polyolefin compounds by a spectrophotometric method.*

BS 2782:Method 550A, *Methods of exposure to natural weathering.*

BS 2782:Method 1101A, *Measurement of dimensions of pipes.*

BS 2782:Method 1106A, *Method for assessment of pigment dispersion in polyolefin pipes and fittings: microtome method.*

BS 3284, *Specification for polythene pipe (type 50) for cold water services*[4)].

BS 3412, *Polyethylene materials for moulding and extrusion.*

BS 4728, *Determination of the resistance to constant internal pressure of thermoplastics pipe.*

BS 4901, *Specification for plastics colours for building purposes.*

BS 5750, *Quality systems.*

BS 5750-2, *Specification for manufacture and installation.*

BS 5781, *Specification for measurement and calibration systems.*

BS 5955, *Plastics pipework (thermoplastics materials)*[4)].

BS 5955-7, *Recommendations for methods of thermal fusion jointing.*

CP 312, *Plastics pipework (thermoplastics materials).*

CP 312-1, *General principles and choice of material.*

CP 312-3, *Polyethylene pipes for the conveyance of liquids under pressure.*

DD 82, *Specification of requirements for suitability of materials for use in contact with water for human consumption with regard to their effect on the quality of water.*

"Guidelines for drinking water quality" Vol 1 "Recommendations", World Health Organization (WHO), Geneva 1984[5)].

EEC Council Directive of 15 July 1980 relating to the quality of water intended for human consumption (Official Journal of the European Communities L229 pp 11–29)[5)].

UK Water Fittings Byelaws Scheme Installation and Guidance Note No 5-01-02, ISSN 0267-0313[6)].

[4)] Referred to in the foreword only.

[5)] Available from HMSO.

[6)] Available from the Water Research Centre, Fittings Testing Station, 660 Ajax Avenue, Slough, Berkshire, SL1 4BG.

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NEW ZEALAND STANDARD

NZS 7610:1991
(BS 6572:1985)

BLUE POLYETHYLENE PIPES UP TO NOMINAL SIZE 63 FOR BELOW GROUND USE FOR POTABLE WATER

Pr Gratis

AMENDMENT A

November 1991

EXPLANATORY NOTE – Amendment A places on record the formal approval of British Standard BS 6572:1985, plus Amendments No. 1 and No. 2, as a New Zealand Standard, subject to the following changes.

APPROVAL IN NEW ZEALAND

BS 6572:1985 was approved on 20 November 1991 by the Standards Council to be a New Zealand Standard pursuant to the provisions of section 10 of the Standards Act 1988, and was designated NZS 7610:1991.

(Amendment A, November 1991)

PUBLICATION IN NEW ZEALAND

For use in New Zealand BS 6572:1985 requires the following additional text:

The expressions "this British Standard," and "BS 6572:1985" where used, shall mean and refer to "this New Zealand Standard" and "NZ 7610:1991."

(Amendment A, November 1991)

FOREWORD

Delete paragraph 12.

(Amendment A, November 1991)

4 Compound composition

4.1 Effect of materials on water quality

Delete Notes 3 and 4.

(Amendment A, November 1991)

4.4.2 *Pigmentation*

Amend line 1 of first sentence to read "The colour of the pipe shall be predominantly blue."

(Amendment A, November 1991)

6 Type test requirements

6.3 Resistance to weathering

In 6.3.1 **delete** "facing south in the United Kingdom" and **substitute** "facing north in New Zealand."

(Amendment A, November 1991)

6.5 Extension to nominal size, formulation or process range

In 6.5.3(a) **delete** "March and September" and **substitute** "September and March."

(Amendment A, November 1991)

7 Marking

In 7.1(b) **delete** the asterisk and the footnote at the bottom of page 5.

(Amendment A, November 1991)

To ensure receiving advice of the next amendment to NZS 7610:1991 please complete and return the amendment request form.

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