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Engineering and Operations Committee

SPECIFICATION FOR PE80 AND PE100 SPIGOT FITTINGS AND DRAWN BENDS FOR NOMINAL SIZES UP TO AND INCLUDING 1000

FOREWORD

This document is the specification for PE80 and PE100 spigot fittings and drawn bends in the nominal size range up to and including 1000 for use with PE80 and PE100 pipe and fittings, with nominal pressure ratings up to and including 16 bar. It supersedes WIS 4-32-04.

This specification has been prepared by WRc plc under the direction of the Water Industry Engineering and Operations Committee in consultation with the British Plastics Federation.

It should be noted that the range of spigot fittings of nominal size 20 to 63 are designed for use with electrofusion couplers conforming to WIS 4-32-14, and are not intended for butt fusion jointing.

Where possible, this specification has been harmonised with the draft CEN standard for plastics piping systems for water supply - Polyethylene (PE) - Part 3 Fittings.

The dimensions and pressure ratings of the pipes with which fittings manufactured in accordance with this specification are to be used, are based on BS 5556 and are given in WIS 4-32-03, WIS 4-32-09, WIS 4-32-13, and WIS 4-32-14.

WIS 4-32-08 covers site fusion jointing of PE80 and PE100. The WSA/WRc manual for polyethylene pipe systems for water supply offers guidance to the UK Water Industry on the practical design, installation and operation of PE water pipeline systems.

This specification does not purport to include all the necessary provisions of a contract. Users of this specification are responsible for its correct application. Reference to a British Standard, Water Industry Specification or any other specification applies equally to any equivalent specification.

Compliance with this specification does not itself confer immunity from legal obligations.

This specification includes the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

It has been assumed in the drafting of this specification that the execution of its provision is entrusted to appropriately qualified and experienced people.

Information contained in this specification is given in good faith. Neither the UK Water Industry Research Ltd, the Water Services Association nor WRc plc can accept any responsibility for actions taken by others as a result.

Enquiries regarding the availability of National Accreditation and Certification of Competence Board (NACCB) or equivalent accredited third party certification should be addressed to an appropriate third party certification body or to WRc.

This document has been prepared by the UK Water Industry Engineering and Operations Committee and published by WRc plc.

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CONTENTS

1. SCOPE
2. DEFINITIONS
3. QUALITY ASSURANCE
4. MATERIALS REQUIREMENTS
 - 4.1 Base polymer
 - 4.2 Compound composition
 - 4.3 Antioxidants
 - 4.4 Rework material
 - 4.5 Colour
 - 4.6 Classification and designation
5. DIMENSIONS AND TOLERANCES
 - 5.1 General
 - 5.2 Spigot fittings
 - 5.3 Factory butt fused assemblies
 - 5.4 Drawn bends
 - 5.5 Tapping tees
6. TYPE TESTS
 - 6.1 General requirements
 - 6.2 Effects of materials on water quality
 - 6.3 Long term hydrostatic strength at 20°C
 - 6.4 1,000 hour hydrostatic strength at 80°C
 - 6.5 Compatibility
7. QUALITY CONTROL TESTS
 - 7.1 Hydrostatic pressure tests
 - 7.2 Oxidation induction time
 - 7.3 Freedom from defects
 - 7.4 Melt flow rate after processing
 - 7.5 Dimensions
8. CONTROL OF TEST CONDITIONS
 - 8.1 Test conditions
 - 8.2 Specimen conditioning during type testing or in case of disagreement
9. MARKING
10. PROTECTION OF FITTINGS
11. REFERENCES

1. SCOPE

This specification defines the performance requirements for blue pigmented and/or black pigmented polyethylene spigot fittings for use with PE 80 and PE 100 pipe at nominal pressures up to and including 16 bar for nominal sizes up to and including 1000.

NOTE 1: Stub flanges are covered by WIS 4-24-01.

NOTE 2: Blue is the preferred colour for underground polyethylene fittings for potable water use. If such fittings are used above ground, protection from sunlight is required.

Site fusion jointing of these fittings shall be conducted in accordance with the requirements of WIS 4-32-08, and with reference to the manufacturer's jointing instructions.

2. DEFINITIONS

For the purpose of this specification, the definitions given in WIS 4-32-14 apply.

NOTE: The titles of publications referred to in this document are listed under Clause 11 - References.

3. QUALITY ASSURANCE

Manufacturers shall operate a quality system relating to this specification in compliance with BS EN ISO 9002 (BS 5750: Part 2). This shall include a quality plan whereby details and results for each test relevant to each material, composition and manufacturing process shall be made available to the purchaser or his representative on request.

NOTE: The use of a quality assurance product certification mark on this product is an indication that a certification body is satisfied that the product conforms to this specification and in addition it is produced under a quality system which complies with the requirements of BS EN ISO 9002 (BS 5750: Part 2).

4. MATERIAL REQUIREMENTS

4.1 Base polymer

The base polymer shall be a single grade of polyethylene, either PE 80 or PE 100, with a conventional density greater than 931kg/m³ at 23°C, when determined in accordance with BS 3412. Copolymers of ethylene and higher olefins, in which the higher olefin constituent does not exceed 10% by mass are permitted.

The melt flow rate shall be determined in accordance with 2.2.1.3 of BS 3412:1992 and conform to the requirements of Table 5 of that standard.

4.2 Compound composition

The base polymer shall be compounded with additives (antioxidants, pigment, carbon black, UV stabilisers, etc.) that are necessary for the manufacture, storage and use of fittings to this specification.

The blue compound shall be Class C for PE 100, and class N for PE 80, and the black compound class W as defined in BS 3412: 1992.

Black compound shall conform to all relevant clauses of BS 3412 except where otherwise stated by this specification. The carbon black content shall not be less than 2% nor more than 2.5% by mass and the particle size shall fall within the range 0.01 to 0.025µm.

Additives shall be evenly distributed throughout the fitting. Compliance with Clause 4.5 shall be accepted as indicating adequate dispersion of additives.

4.3 Antioxidants

Only antioxidants as listed in Table 7 of BS 3412: 1992 (excluding 6,6'-diterbutyl-4,4'-thiodo-m-cresol) shall be used.

4.4 Rework material

Clean rework polyethylene material (e.g. sprues, runners or moulded preforms), generated from a manufacturer's own production of PE 80 or PE 100 fittings and/or pipe may be used providing these are made from the same compound. The manufacturer shall not incorporate any other reprocessible polyethylene material. Rework material shall be reground under the manufacturer's supervision. Fittings produced from this rework material and/or a virgin/rework blend shall meet the requirements of this specification.

Fittings manufactured totally or in part from PE rework material shall be identifiable as such

through reference to the batch identification code in Clause 9 - Marking.

4.5 Colour

Fittings shall be either blue or black. The colour of blue PE 100 shall lie within the range of 20D44 to 20D45 or 20E53 to 20E56 of BS 4901. The colour of blue PE 80 shall lie within the range 18E51 to 18E53 of BS 4901.

In the case of blue materials, when tested in accordance with BS 2872: Method 1306A, the pigment dispersion shall be equivalent to or better than that shown in photomicrograph 1 or 2.

In the case of black materials, when tested according to BS 2872: Method 823B, the carbon black dispersion shall be equivalent to or better than that shown in photomicrograph 4.

4.6 Classification and designation

When tested as extruded pipes, or injection moulded pipe if the material does not lend itself to extrusion, the MRS shall not be less than 10.0MPa for a PE 100 material, nor less than 8.0 MPa for a PE 80 material.

5. DIMENSIONS AND TOLERANCES

5.1 General

5.1.1 The maximum nominal pressure (PN) of each fitting design shall be determined by the manufacturer, taking account of the design stress of the material. The PN shall take account of any known stress concentrations.

Preferred PN ratings are shown in Table 1.

Table 1 - Preferred PN ratings for PE fittings

Fitting PN	For use with pipe	
16	SDR 11	PE 100
12.5/12 ¹	SDR 11	PE 80
10	SDR 17 ²	PE 100
8	SDR 17 ³	PE 80
6	SDR 26	PE 100

Note 1: Includes 12 bar service pipes
 2: Does not include SDR 17.6
 3: May include SDR 17.6

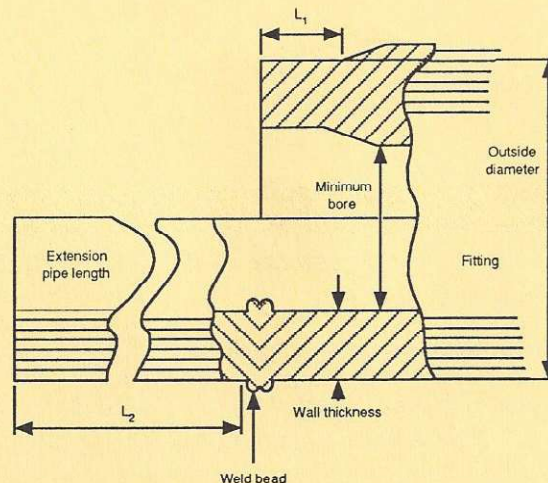


Figure 1 - Typical butt fusion fittings plus extension pipe lengths (pups) (location of dimensions)

5.1.2 When measured in accordance with BS 2782: Method 1101A the dimensions shall conform to the requirements of 6.1.2. As dimensions may change after manufacture, procedures for measurement shall be generated accordingly. In case of dispute, fittings shall be measured a minimum of 14 days after manufacture and subsequent conditioning at (23±2)°C for a minimum of 5 hrs.

5.1.3 The minimum wall thickness of any part of a fitting exposed to the full hydrostatic pressure shall not be less than that of a pipe of the same material with the same nominal pressure rating.

5.1.4 For fittings with sockets or spigots of different sizes (e.g. unequal tees and reducers), each socket and/or spigot shall be allocated a nominal size.

5.2 Spigot fittings

5.2.1 All spigots on tees and reducers shall be allocated a nominal size. The dimensions of spigots up to and including nominal size 63 shall conform to the requirements of Table 1.

The dimensions of spigots larger than nominal size 63 shall conform to the requirements of Table 3.

5.2.2 Fittings for electrofusion jointing, where the length of the spigot end is equal to the cut back length only, shall have extension pipe lengths, L₂, fusion jointed onto the cut back length, L₁, of the fitting, (see Figure 1). The minimum dimension of the extension pipe length is specified in Tables 2 and 3. Longer spigot lengths are permitted, and can facilitate use of correct clamping procedures.

For butt fusion jointing the extension pipe length for all sizes shall not be less than 500mm.

NOTE: For the purposes of this specification the extension pipe length and the joint are considered as part of the fitting.

5.2.3 Spigots with lengths L₂ as an integral part of the fitting shall be permitted.

5.3 Factory butt fused assemblies

Factory butt fused assemblies shall be jointed with reference to WIS 4-32-08 and shall have the external bead removed. The bead shall be free from contamination and slit defects.

5.4 Drawn bends

5.4.1 Drawn bends shall be made from PE 80 or PE 100 pipe conforming to the relevant pipe specification. The maximum wall thickness permitted for a pipe of the same nominal pressure may be exceeded.

5.4.2 The minimum thickness of the bend shall conform to the values specified in Table 1 of WIS 4-32-13 for PE 100, and in Table 1 of WIS 4-32-03 for PE 80. The centre line radius shall not be less than 4.5 × nominal outside diameter of the pipe. The leg length shall not be less than 500mm.

5.4.3 The tolerance on the nominal bend angle (in the same plane) shall not be greater than (+0-10)°.

6. TYPE TESTS

6.1 General requirements

Type tests shall be performed on fittings which conform to the requirements of clauses 4 and 5 of this specification. If there is a significant change in process or technique, or a new or modified material is introduced, then it will be necessary to ensure that the requirements of this specification are still satisfied. For third party certificated products, the significance of changes and any additional tests required shall be agreed with the certification body.

To ensure that, initially, a representative cross-section of the manufacturer's product range is evaluated, a minimum of the smallest and the largest fitting shall be evaluated from each size range (see Table 4(a)) for each class of fitting (see Table 4(b)) and shall conform to the requirements of 6.3 and 6.4. Sampling to meet the requirements of 6.2 shall be in accordance with clause 2.1 of BS6920:1990.

Following satisfactory completion of initial type tests, for ongoing confirmation purposes, at least one test piece shall be tested on rotation from each of the size, class and pressure combinations within the manufacturer's product range, and shall conform to the requirements of 6.4. All size, class and pressure combinations shall meet the requirements of 6.4 in a 2 year period.

When a manufacturer extends his product range, the product with the largest new nominal size in the size range shall be tested and shall conform to the requirements of 6.3 and 6.4.

Where a fitting includes sockets of different sizes (e.g. reducers, unequal tees) the fitting shall be considered as belonging to the size range of its largest part.

Table 4(a) - Size ranges for test

Range Number	Nominal Size
1	20 - 63
2	75 - 225
3	250 - 500
4	560 - 1000

Table 4(b) - Fittings classes for testing purposes

Class	Description
Moulded	Injection moulded fittings
Fabricated	Fittings which are assembled using fusion
Drawn	Fittings shaped from moulded fittings or pipes without fusion

6.2 Effect of materials on water quality

When used under the conditions for which they are designed, all materials in contact with, or likely to come into contact with water for public supply shall be introduced in accordance with the requirements of Regulation 25 of the Water Supply (Water Quality) Regulations 1989. [Water Supply (Water Quality) (Scotland) Regulations 1990 in Scotland]

For products not approved under the former voluntary system and not eligible for use under Regulation 25 (1) (b) or 25 (1) (c), Secretary of State approval shall be obtained via submission of the product to the "Department of the Environment Committee on Chemicals and Materials of Construction for Use in Public Water Supply and Swimming Pools" for consideration. Products shall comply with the requirements of BS 6920: Part 1: 1990; evidence of compliance shall be submitted to the above committee by the manufacturer.

NOTE 1: A list of approved substances and products is published annually and is available from the Technical Secretary of the Committee at the Drinking Water Inspectorate, Room B 153, 43 Marsham Street, London SW1 3PY.

NOTE 2: Regulation 25 applies only to products used by water companies in the treatment and distribution of public water supplies; it does not apply to use of fixtures and fittings on consumers' premises. All such fixtures and fittings should satisfy the requirements of BS 6920. Approval under the Water Byelaws Scheme and listing in the Water Fittings Directory is desirable.

6.3 Long term hydrostatic strength at 20°C

Test pieces shall each consist of a single fitting connected to PE80 and/or PE100 pipes with the same PN as the fitting. The test pieces shall be jointed in accordance with the manufacturer's instructions and with reference to WIS 4-32-08. Subject to the conditions indicated below, they shall be tested in accordance with the requirements of BS4728.

Prior to jointing, the test samples shall be conditioned in accordance with case 2 of Table 9. The conditioned test pieces shall be jointed in accordance with the manufacturer's instructions and with reference to WIS 4-32-08. With the exception of the maximum OD, the dimensions of the completed assembly shall conform to the dimensional requirements of Appendix G of BS7336.

The failure times recorded shall not be less than 2500, 5000 or 10000 hrs at a test pressure not less than that which would, according to the regression curve used to determine the PE class of the pipe(s) connected to the fitting, cause failure at 2500, 5000 and 10000 hrs respectively.

A sample which survives the 2500 hr test may be left for an additional 2500 hrs at or above the appropriate 5000 hr test pressure as a 5000 hr sample, or for a further 7500 hrs at or above the appropriate 10000 hr test pressure as a 10000 hr sample. A sample which survives a 5000 hr test may be left on test for an additional 5000 hrs at or above the appropriate 10000 hr test pressure as a 10000 hr test sample.

The test pressure P_t (in bar) for each test time shall be determined from the stress as follows:

$$P_t = \frac{20\sigma_t}{(\text{SDR} - 1)}$$

Where σ_t is the stress in MPa corresponding to a failure time t , and SDR is the SDR of the pipe used.

Manufacturers may obtain provisional acceptance of this requirement providing:

- (i) the 2,500 hour test has been satisfactorily completed; and
- (ii) the 5,000 and 10,000 hour tests are in progress.

If testing is not completed within 21 months, provisional acceptance shall be automatically withdrawn.

6.4 1,000 hr hydrostatic strength at 80°C

Fittings shall withstand the minimum pressures shown in Table 5 for 1,000 hrs at a temperature of $(80 \pm 2)^\circ\text{C}$ without leakage of the joint or rupturing of the fitting.

Table 5 - 1000 hr hydrostatic strength test at 80°C

PN	Test pressure
16 bar	10.1 bar
12.5 bar	7.9 bar
10 bar	6.3 bar
8 bar	5.1 bar
6 bar	3.8 bar

7. QUALITY CONTROL TESTS

7.1 Hydrostatic pressure tests

Test pieces shall each consist of a fitting connected to PE80 and/or PE100 pipes with the same PN as the fitting. The test pieces shall be jointed in accordance with the manufacturer's instructions and with reference to WIS 4-32-08. Subject to the conditions indicated below, they shall be tested in accordance with the requirements of BS4728. More than one fitting may be tested as the same time at the test pressure. In the event that one fitting fails before the required time, any fittings that have not been on test for at least the minimum test time shall be discarded, and a repeat test conducted.

End-load bearing end closures of the type shown in Figure 1 of BS 4728 shall be used. There shall be a free length, between any two fittings, or a fitting

and an end cap, of not less than three times the nominal size up to and including size 315. For sizes above 315, the free length shall be not less than 1m.

Failure of the pipe within a distance of less than 0.1L (where L is the free length of pipe between fittings or fitting and end cap) from the mouth of the fitting shall be disregarded.

For pupped fittings, the pups may be included in the free length and the end caps may be attached to them if appropriate.

7.2 165 hr hydrostatic pressure test at 80°C

Fittings shall withstand the minimum stress shown in Table 6(a) for 165 hrs at a temperature of (80+2-1)°C without leakage of the joint or rupturing of the fitting.

Table 7(a) - 165 hr hydrostatic pressure test at 80°C

PN	Test pressure
16 bar	11.6 bar
12.5 bar	9.0 bar
10 bar	7.2 bar
8 bar	5.8 bar
6 bar	4.4 bar

A fracture in a brittle mode in less than 165 hrs shall constitute failure. However, if a sample fractures in a ductile mode in less than 165 hrs, a retest may be conducted at one of the stresses shown in Table 6(b). Fracture in any mode in less than the specified time shall constitute failure.

Table 6(b) - Hydrostatic strength at 80°C retest requirements

PN	Test pressure in bar for minimum failure time of					
	165 hrs	233 hrs	332 hrs	476 hrs	688 hrs	1000 hrs
16 bar	11.6	11.2	11.1	10.8	10.6	10.1
12.5 bar	9.0	9.0	8.8	8.4	8.3	7.9
10 bar	7.2	7.0	6.9	6.7	6.6	6.3
8 bar	5.8	5.6	5.6	5.4	5.3	5.1
6 bar	4.4	4.2	4.2	4.1	4.0	3.8

7.3 1 hr hydrostatic strength test at 20°C

Fittings shall withstand the minimum test pressure shown in Table 7 for 1 hr at a temperature of (20+2, -1)°C without leakage of the joint or rupturing of the fitting.

The pressure shall then be raised so that the assembly fails within 30 s. The pipe shall fail before the fitting.

Table 7 - 100 hr hydrostatic strength test at 20°C

PN	Test pressure
16 bar	38.4 bar
12.5 bar	30.0 bar
10 bar	24.0 bar
8 bar	19.2 bar
6 bar	14.4 bar

7.4 Oxidation induction time

The material in fitting form shall have an oxidation induction time (OIT) of at least 20 minutes when tested according to Appendix D of BS7281.

7.5 Freedom from defects

The internal and external surfaces shall be free from features such as cracks, holes, blisters, distortion, inclusions and dents which may impair the performance of the product in service.

7.6 Melt flow rate after processing

When tested by the method specified in Clause 4.1, the melt flow rate of specimens, obtained from fittings, shall not vary from the measured value of the compound by more than (+10%,-25%).

7.7 Dimensions

The dimensions of fittings shall comply with the requirements of Clauses 5.2 to 5.4 as appropriate.

Table 2 - Spigot fittings for use with electrofusion couplers - dimensions (mm)

Nominal pipe size	Mean outside diameter		Wall thicknesses (SDR 11)	Nominal pipe size	Minimum bore	Cut Back Length L ₁ min	Out of Roundness max	Min spigot length L ₁
	min	max	minimum					
20	20.0	20.3	2.3	20	14.8	25	0.3	37
25	25.0	25.3	2.3	25	19.8	25	0.4	40
32	32.0	32.3	3.0	32	25.2	25	0.5	44
50	50.0	50.4	4.6	50	39.6	25	0.8	55
63	63.0	63.4	5.8	63	50.0	25	0.9	63

Note: Fittings meeting the requirements of this specification and conforming to the dimensions in Table 2 are intended for use with electrofusion fittings and should not be used for butt fusion jointing

Table 3 - Spigot fittings for electrofusion and butt fusion jointing
All dimensions in millimetres

Nominal Fitting Size	Mean Outside diameter		Maximum Thickness of Spigot				Min Bore	Cut Back Length L ₁ min	Spigot Length L ₂ min	Out of Roundness max
			SDR 33	SDR 26	SDR 17	SDR 11				
	min	max	max	max	max	max				
75	75.0	75.5	-	-	4.8	7.7	59.0	27	66.0	1.2
90	90.0	90.6	-	-	5.8	9.2	71.0	28	79.0	1.4
110	110.0	110.7	-	-	7.1	11.2	87.0	32	82.0	1.7
125	125.0	125.8	-	-	8.0	12.7	99.0	35	87.0	1.9
160	160.0	161.0	-	7.0	10.2	16.3	127.0	42	98.0	2.4
180	180.0	181.1	-	7.7	11.4	18.2	143.0	46	105.0	2.7
225	225.0	226.4	-	9.7	14.3	22.8	179.0	55	120.0	3.4
250	250.0	251.5	-	10.7	15.8	25.2	199.0	60	130.0	3.8
280	280.0	281.7	-	12.0	17.7	28.1	223.0	75	139.0	4.2
315	315.0	316.9	-	13.5	19.9	31.7	251.0	75	150.0	4.8
355	355.0	357.2	12.2	15.1	22.3	35.7	283.0	75	165.0	5.4
400	400.0	402.4	13.8	17.0	25.2	40.2	319.0	75	180.0	6.0
450	450.0	452.7	15.4	19.1	28.4	45.3	359.0	100	195.0	6.8
500	500.0	503.0	17.1	21.2	31.3	50.3	399.0	100	215.0	7.5
560	560.0	563.4	19.2	23.8	35.1	56.1	447.0	100	232.0	8.4
630	630.0	633.8	21.5	26.6	39.5	63.1	503.0	100	255.0	9.5
710	710.0	714.0	24.2	30.2	44.5	-	-	-	-	-
800	800.0	804.6	27.2	33.9	50.1	-	-	-	-	-
900	900.0	905.0	30.6	38.3	56.2	-	-	-	-	-
1000	1000.0	1005.0	33.9	42.5	62.5	-	-	-	-	-

Note 1: Longer spigots are permitted to facilitate clamping

8. CONTROL OF TEST CONDITIONS

8.1 Test conditions

Unless otherwise specified, test measurements shall be conducted at $(23 \pm 2)^\circ\text{C}$.

8.2 Specimen conditioning

For type testing or in case of disagreement, specimens shall be conditioned prior to test by being kept at $(23 \pm 2)^\circ\text{C}$ in air for not less than 12 hours for fittings of wall thickness up to and including 12.7mm or not less than 24 hours for fittings of wall thickness over 12.7mm, unless otherwise specified.

For hydrostatic tests involving liquid immersion the specimens shall be conditioned in the liquid at the test temperature for at least one hour.

9. MARKING

Marking shall remain legible under normal handling and storage procedures. No method of marking shall prejudice the performance of the fitting. The marking shall give the following information:

- (a) the manufacturer's identification;
- (b) the polymer type identification, i.e. PE 100 or PE 80;
- (c) batch identification including date of manufacture code;
- (d) the nominal size of the fitting and nominal pressure rating in bar, at which the fitting is intended to be used;
- (e) the number of this specification, i.e. WIS 4-32-15;
- (f) third party certification mark (if permissible). NOTE: The use of this mark is a claim by the manufacturer that the product has been manufactured in accordance with the requirements of this

specification and the claim is his sole responsibility;

NOTE to (b), (c) and (f): This information may be integral or printed on a label.

10. PROTECTION OF FITTINGS

Fittings shall be packaged to protect them from the ingress of dirt and moisture and contamination during normal storage and site handling prior to use.

NOTE: 500 gauge polyethylene is the preferred packaging material for electrofusion fittings.

Good practices shall be employed during the packaging of fittings to prevent the entrapment of moisture or dirt particles.

Any components that are lubricated shall be separately packaged to prevent contamination of fusion surfaces.

11. REFERENCES

This specification makes reference to the latest edition of the following documents, including all addenda and revisions:

British Standards

BS 2782	Methods of testing plastics. Part 0 Introduction. Method 720A Determination of melt flow rate of thermoplastic. Method 823B Methods for assessment of carbon black dispersion in polyethylene using a microscope. Method 1101A Measurement of dimensions of pipes. Method 1106A Assessment of pigment dispersion on polyolefin pipes and fittings.
BS 3412	Polyethylene materials for moulding and extrusion.

BS 4728	Determination of the resistance to constant internal pressure of thermoplastics pipe.		flanges for polyethylene pipes for the conveyance of potable water for the size range 90 to 1000 inclusive made of metal or plastics or a combination of both.
BS 4901	Specification for plastics colours for building purposes.		
BS 5556	Specification for general requirements for dimensions and pressure ratings for pipes of thermoplastics materials (metric series).	4-32-03	Specification for blue polyethylene (PE) pressure pipe for cold potable water (nominal sizes 90 to 1000 for underground or protected use).
BS 5750	Quality systems. Part 2 Specification for production and installation.	4-32-04	Specification for polyethylene socket and spigot fittings, saddles and drawn bends for fusion jointing for use with cold potable water PE pressure pipes. (Withdrawn.)
BS 6572	Specification for blue polyethylene pipes up to nominal size 63 for below ground use for cold potable water.	4-32-08	Specification for site fusion jointing of MDPE pipe and fittings.
BS 6730	Specification for black polyethylene pipes up to nominal size 63 for above ground use for cold potable water.	4-32-09	Specification for black polyethylene pressure pipes for potable water above ground or sewage (nominal sizes 90 to 1000).
BS 6920	Suitability of non-metallic products for use in contact with potable water intended for human consumption with regard to their effect on the quality of the water. Part 1 Specification. Part 2 Method of test.	4-32-13	Specification for blue higher performance polyethylene HPPE/PE 100, pressure pipes, nominal sizes 90 to 1000, for underground or protected use for the conveyance of water intended for human consumption.
BS 7281	Polyethylene pipes for the supply of gaseous fuels.	4-32-14	Specification for PE 80 and PE 100 electrofusion fittings, for nominal sizes up to and including 630.
BS EN ISO 9002	Specification for production, installation and servicing (to be published to replace BS 5750: Part 2).		

International Standards

ISO 4065	Thermoplastic pipe - Universal wall thickness table.
ISO TR 9080	Thermoplastic pipes - Standard extrapolation method for the long term resistance to constant internal pressure.

Water Industry Specifications:

4-24-01	Specification for mechanical fittings and joints including
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Other References

WSA/WRc	Manual for polyethylene pipe systems for water supply.
HMSO	Water Supply (Water Quality) Regulations 1989.
HMSO	Water Supply (Water Quality) (Scotland) Regulations 1990.