
British Standard Specification for

Ductile iron pipes and fittings

Spécification des tuyaux et raccords en fonte ductile

Spezifikation für Rohre und Formstücke aus ductilem Gusseisen

Foreword

This British Standard constitutes the second revision of BS 4772 and has been prepared under the direction of the Piping Systems Components Standards Committee. It supersedes the 1980 edition which is withdrawn.

This British Standard is related to ISO 2531, published by the International Organization for Standardization (ISO), but is not identical in technical content. This standard covers a smaller range of sizes but includes a greater range of fittings; it specifies some different and some extra requirements and generally gives more detail than ISO 2531. The main extra requirements are for externally applied protective zinc coatings, related to those given in ISO 8179, which are included in this standard for the first time and for cement mortar linings, which are related to those given in ISO 4179 (see section three). Although related to the relevant ISO publications this standard is not identical to them.

This British Standard also introduces a new concept for the design of fittings in appendix K which are designated 'unified design'. Because of the large numbers of fittings of unified design included in appendix K, it is envisaged that their introduction will be phased over a long period of time; for this reason, the corresponding fittings which were included in BS 4772 : 1980 have been retained in this edition. The object of the new designs is to minimize the number of component parts of foundry tackle and so optimize efficiency and at the same time extend the range of fittings made available.

Other new concepts which have been incorporated in this revision for the first time are requirements for verification and testing, in particular, non-destructive testing and the use of smaller high tensile bolting for certain flanges.

In addition to cement mortar linings and zinc coatings, this British Standard also provides for protective surface coatings of bitumen applied to both external and internal surfaces. All the new requirements can be applied to:

- (a) ductile iron pipe with flexible joints;
- (b) ductile iron pipe with flanges welded-on or screwed-on;
- (c) ductile iron pipe with flanges cast-on;
- (d) ductile iron fittings (including unified design fittings).

Spigot and socket pipes in accordance with BS 1211 and fittings in accordance with BS 78 : Part 2 are not interchangeable with metric size units, and therefore the following optional methods of connecting metric size pipe with imperial size pipe are provided in this standard:

- (1) a change collar in accordance with table 33;
- (2) a spigot and socket change piece in accordance with table 34 with a metric size collar in accordance with table 32, where required;
- (3) a double spigot change piece in accordance with table 35 with a metric size collar in accordance with table 32 and/or an imperial size collar, where required.

Flanges specified in this standard have been rationalized dimensionally to facilitate production. This does not affect their interchangeability with the corresponding flanges given in BS 4504 : Part 1.

Detailed guidance on the use of components specified in this British Standard in pipelines and pipe systems is given in BS 8010 : Section 2.1.

Purchasers ordering to this standard are advised to specify in their purchasing contract that the manufacturer operate a quality system in compliance with BS 5750 : Part 2 to assure themselves that products claimed to comply with BS 4772 consistently achieve the required level of quality.

Compliance with a British Standard does not of itself confer immunity from legal obligations.



Amendment No. 1
published and effective from 30 November 1989
to BS 4772 : 1988

Specification for ductile iron pipes and fittings

Revised text

AMD 6270
 November 1989

Contents

After the entry for **2.5.2.2** insert the following.
'2.5.2.3 Retests'

AMD 6270
 November 1989

Clause 1.3.2 Effect of non-metallic materials on water quality

Delete the existing clause and substitute the following.

'1.3.2 Effect of non-metallic materials on water quality.'

When used under the conditions for which they are designated, non-metallic products in contact with or likely to come into contact with potable water shall comply with the requirements of BS 6920 : Part 1 : 1988.

NOTE 1. Non-metallic products for installation and use in the United Kingdom which are verified and listed under the UK Water Fittings Byelaws Scheme are deemed to satisfy the requirements of this subclause. Details of the Scheme are obtainable from the Water Research Centre Byelaws Advisory Service, 660 Ajax Avenue, Slough SL1 4BG.

Non-metallic products 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 adverse health effects for the purposes of compliance with this subclause.

NOTE 2. A list of approved chemicals and materials and details of the approvals scheme is available from the Secretary of the Committee at the Department of the Environment, Water Division, Romney House, 43 Marsham Street, London SW1P 3PY.'

AMD 6270
 November 1989

Clause 2.3.1.1 General

Delete the existing note 2 and substitute the following.

'NOTE 2. Flanges complying with this British Standard have mating dimensions compatible with the corresponding flanges complying with BS 4504 : Section 3.2.'

AMD 6270
 November 1989

Clause 2.3.1.2 Flange faces

Delete the existing clause including table 4 and substitute the following.

'2.3.1.2 Flange faces. The faces of flanges of pipes shall be at right angles to, and concentric with, the axis of the bore. The faces of the flanges on fittings shall be at right angles to, and concentric with, the directional axes. When compared by visual or tactile means with reference specimens, all flange jointing faces shall be within the ranges of values given in table 4.

NOTE. It is not intended that instrument measurements be taken on the flange faces and the values as defined in BS 1134 : Part 1 relate to the reference specimens.



Table 4. Surface finish of flange jointing faces		
Manufacturing process	R_a^*	R_z^*
Turning†	µm 3.2 to 12.5	µm 12.5 to 50
Other machining processes	3.2 to 6.3	12.5 to 25
Cast surface‡	3.2 to 25	—

NOTE. When selecting gaskets for flanged joints, reference should be made to the recommendation in BS 4865 : Part 1 or Part 3, as appropriate, that account be taken of operating conditions, the properties of gasket materials, flange bolt loading and surface finish of flange faces.

* R_a and R_z are defined in BS 1134 : Part 1.

†'Turning' covers any method of machine operation producing either serrated concentric or serrated spiral grooves.

‡'Cast surface' covers surfaces produced by moulding processes where the resultant castings may or may not be subjected to shot or grit blast cleaning operations. Such surfaces are assessed using roughness comparison specimens complying with BS 2634 : Part 3. Cast surfaces may have serrated concentric grooves to enhance gasket sealing efficiency. Cast surfaces are normally used for applications where joints incorporate gaskets of readily deformable material, e.g. rubber (see note).'

AMD 6270
November 1989

Clause 2.3.1.4 Angular displacement of bolt holes
In line 6, delete '2.4.2 (g)' and substitute '2.4.2.1 (g)'.

AMD 6270
November 1989

Clause 2.4.2.2 Marking of group II fittings
In (c) (1), line 1, delete 'on' and substitute 'of'.

AMD 6270
November 1989

New clause 2.5.2.3 Retests

After clause 2.5.2.2 insert the following new clause.

2.5.2.3 Retests. If a bar test piece tested in accordance with appendix D does not have mechanical properties as given in table 7, the manufacturer shall either:

- (a) repeat the test on two additional bar test pieces taken from the same test samples or from other test samples representative of the same batch; or
- (b) carry out additional testing to determine the number of pipes or fittings that the bar test piece failure represents.

In the case of (a), if both the additional bar test pieces have mechanical properties as given in table 7, the batch shall be accepted.

NOTE. If either or both of the additional bar test pieces fail the tensile test, the procedure given in (b) may be carried out.

Where batches or numbers of pipes or fittings are identified as being represented by failed bar test pieces, the manufacturer shall either:

- (1) reheat treat the pipes, take new samples and resubmit for testing or, in the case of fittings, reheat treat the fittings together with the representative test samples and resubmit for testing; or
- (2) reject the batch or number of pipes or fittings represented.'

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November 1989

New clause D.5 Retesting

After D.4 insert the following new clause.

'D.5 Retesting

If a bar test piece fails the tensile test due to one of the following reasons and not due to the quality of the cast iron, the results of that test shall be discarded:

- (a) faulty mounting of the bar test piece or defective operation of the testing machine;
- (b) fracture of the bar test piece beyond the original gauge length L_0 ;
- (c) casting defects in the test bar, evident after fracture.

In any of these cases a new bar test piece shall be prepared from the same test sample or other test samples representative of the same batch. The new bar test piece shall be tested and the results obtained shall be substituted for those of the defective bar test piece.'

AMD 6270
November 1989

Inside back cover

After the entry for BS 2494 in the list of publications referred to, insert the following.

'BS 2634 Specification for roughness comparison specimens
Part 3 Cast surfaces'

Delete the existing entry for BS 4865 in the list of publications referred to and substitute the following.

'BS 4865 Dimensions of gaskets for flanges to BS 4504
Part 1 Specification for non-metallic flat gaskets (including gaskets for flanges to BS 4772)
Part 3 Specification for non-metallic envelope gaskets'

After the entry for BS 6588 in the list of publications referred to, insert the following.

BS 6920 Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water
Part 1 Specification'

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Section one. General

1.1 Scope

1.1.1 General

This British Standard specifies requirements for materials, dimensions, mechanical properties, hardness, heat treatment, condition, tolerances and surface protection of ductile iron pipes (see 1.1.2) and fittings (see 1.1.3).

1.1.2 Pipes

1.1.2.1 This British Standard applies to the following.

- (a) Pipes of class K9 having spigots and/or sockets for flexible joints produced by centrifugal casting in metal or sand moulds. It also specifies the external dimensions of the spigots.
- (b) Pipes of class K9 or K12 having screwed-on flanges and pipes of class K9 having welded-on flanges, the pipe barrels in each case being produced by centrifugal casting.
- (c) Pipes of class K12 having integral cast-on flanges produced by casting in sand moulds.

It also specifies the dimensions of flanges for pressure ratings PN 10, 16, 25 and 40.

1.1.2.2 This British Standard also applies to pipes of class designations other than those given in 1.1.2.1 (see 2.1.1.2).

1.1.3 Fittings

1.1.3.1 This British Standard applies to fittings having spigots and/or sockets or flanges in two groups as follows.

- (a) *Group I.* Fittings of the class designations given in table 1 (including those in appendix K) which are manufactured and supplied in compliance with all the requirements of this British Standard (see 2.1.2.1);
- (b) *Group II.* Fittings which are manufactured and supplied in compliance with requirements covering (see 2.1.2.2):
 - (1) mechanical properties;
 - (2) tolerances on dimensions and mass;
 - (3) coatings and linings;
 - (4) manufacturer's certificates;
 - (5) marking.

The designs and dimensions of sockets and flexible joints, either of the 'push-in' type or of the mechanical type, are not within the scope of this standard.

NOTE 1. The unified design fittings given in appendix K (see foreword) include the complete size range from DN 80 to DN 1600 for bends, tees and tapers having both socket and flange ends.

NOTE 2. This British Standard allows a number of options. To assist the purchaser, a check list of these options in the form of information to be supplied on the enquiry and order is given in A.2.

NOTE 3. The titles of the publications referred to in this standard are listed on the inside back cover.

1.2 Definitions

For the purposes of this British Standard the following definitions apply.

1.2.1 ductile iron. A cast iron used for pipes and fittings in which graphite is present substantially in spheroidal form, instead of in flakes such as occur in grey iron.

1.2.2 pipe. A casting of uniform bore, straight in axis, having spigot, socket, flange or plain ends except for flanged socket pieces, flanged spigot pieces and collars.

1.2.3 fitting. Any casting other than a pipe.

1.2.4 flexible joint. A connection between individual pipes and/or fittings that provides angular deflection or axial movement, or a combination of both, in service without impairing the efficiency of the connection.

1.2.5 push-in joint. A flexible joint in which an elastomeric gasket is located in the socket and the joint assembly is effected by entering the spigot through the gasket into the socket.

1.2.6 mechanical joint. A flexible joint in which an elastomeric gasket is located in the socket, sealing being obtained by applying pressure to the gasket by means of a gland bolted to the socket.

1.2.7 gasket. A component used at the joint of two castings for the purpose of effecting a seal. This term includes push-in, mechanical or flange types.

1.2.8 maximum hydraulic working pressure. The maximum sustained hydraulic operating pressure, exclusive of surge, at which the pipe or fitting may be used.

NOTE. See BS 8010 : Section 2.1 with regard to surge pressure and site test pressures.

1.2.9 change fittings. Fittings enabling metric and imperial size spigot and socket pipes, and fittings made in ductile and/or grey cast iron, to be jointed together.

1.2.10 seal coating. A coating applied over cement mortar linings to provide a physical barrier between the lining and the contents of the main (see 3.2.10).

1.2.11 nominal size (DN). A numerical designation of size which is common to all components in a piping system other than components designated by outside diameters or thread size. It is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions.

NOTE 1. Nominal size is designated by the letters DN followed by a number.

NOTE 2. It should be noted that not all piping components are designated by nominal size.

NOTE 3. This definition is identical to that in ISO 6708.

NOTE 4. The designation 'dn' is used in this standard to denote nominal size of tees and tapers where these are less than DN.

1.2.12 nominal pressure (PN). A numerical designation which is a convenient rounded number for reference purposes. All equipment of the same nominal size DN designated by the same PN have compatible mating dimensions.

NOTE 1. Nominal pressure is designated by the letters PN followed by the appropriate reference number.

NOTE 2. The maximum allowable working pressure depends on materials, design and working temperatures and should be selected from the tables of pressure/temperature ratings given in the appropriate standards.

NOTE 3. This definition is identical to that in ISO 7268.

1.3 Materials

1.3.1 General

Various non-metallic materials are specified in this standard and where these materials are to be used in ductile iron pipes and fittings for conveying potable water then the materials shall comply with 1.3.2.

1.3.2 Effect of non-metallic materials on water quality

When used under the conditions for which they are designed, non-metallic 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 5-01-02, ISSN 0267-0313, obtainable from the Water Research Centre Water Byelaws Advisory Service, 660 Ajax Avenue, Slough, Berkshire SL1 4BG.

NOTE 2. 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 Construc-

tion for use in Public Water Supply and Swimming Pools are considered free from toxic hazard for the purposes of compliance with this clause. 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 3. 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 Water Byelaws Advisory Service, 660 Ajax Avenue, Slough, Berkshire SL1 4BG are deemed to satisfy the requirements detailed in this sub-clause.

1.4 Class designations and calculation of wall thicknesses of pipes and fittings

1.4.1 Class designations

NOTE. The system of class designations used in this British Standard follows that established in ISO 2531.

Each designation shall comprise:

- (a) a prefix K;
- (b) a whole number (this is the selected coefficient inserted into equation (1) of 1.4.2, e.g. K12 (see also table 1).

1.4.2 Calculation of wall thicknesses of pipes and fittings

The wall thickness of pipes and fittings e , in millimetres, shall be calculated as a function of the nominal size by one of the following two equations:

$$e = K(0.5 + 0.001 \text{ DN}) \quad (1)$$

$$e = 5.8 + 0.003 \text{ DN} \quad (2)$$

where

DN is the nominal size;

K is a whole number coefficient.

The equation resulting in the greater thickness shall be used.

1.5 Manufacturer's certificate

If a manufacturer's certificate is issued it shall contain a statement confirming that the pipes and fittings covered comply with this British Standard in all respects.

NOTE. A manufacturer's certificate is not normally provided, but if a purchaser requires such a certificate then this should be stated on his enquiry and order (see A.1(m)).

Section two. Materials, properties and dimensions

2.1 Pipes and fittings

2.1.1 Pipes

2.1.1.1 Where types of pipe of the class designations (e.g. K9) given in table 1 are manufactured and supplied, they shall comply with the mass, length and other dimensions specified in the appropriate tables indicated in table 1.

2.1.1.2 Where pipes of class designations other than those given in table 1 are manufactured and supplied, the wall thickness shall be calculated in accordance with 1.4.2 and the pipes shall be marked in accordance with 2.4.1(c). Such pipes shall comply with all the requirements of this British Standard with the exception of wall thickness e and mass.

In the case of centrifugally cast pipes, increases or decreases in the thickness of the pipe wall shall be obtained by variations of the internal diameter only.

2.1.1.3 Where pipes are required in lengths other than those given in tables 21 to 23 (e.g. for make-up purposes) the required length shall be marked on the pipe in accordance with 2.4.1(e).

NOTE. The purchaser should specify the required length on the enquiry and order (see A.1(d)).

In such cases the pipes shall comply with all the requirements of this British Standard except in regard to the length.

2.1.1.4 The maximum hydraulic working pressures for pipes of class designations complying with table 1 shall comply with table 2 (see A.1(a)(1)).

2.1.2 Fittings

2.1.2.1 Group I fittings

2.1.2.1.1 Where types of fitting of the class designations given in table 1 are manufactured and supplied, they shall comply with the masses and dimensions specified in the appropriate tables indicated in table 1.

In the case of tees, the wall thickness where the socket or flange ends join the body of the casting shall be class K12 and the greater thickness requirements of class K14 to K18 shall only apply to the highly stressed body of the casting.

2.1.2.1.2 Change fittings, enabling metric size spigot and socket ductile iron pipes and fittings to be jointed to imperial size cast iron pipes and fittings having external diameters complying with classes B, C and D of BS 1211, shall have the dimensions given in tables 33 to 35.

Dimensions of lead caulked joints shall comply with BS 78 : Part 2.

NOTE 1. Unless adequately anchored, the use of change collars complying with table 33 is recommended only where the differential force due to internal pressure is insufficient to cause movement of the collar.

NOTE 2. Change fittings are suitable for use with flexible joints at the metric size end and suitable for use with flexible joints or lead caulked joints at the imperial size end.

Table 1. Class designation of pipes and fittings and tables giving dimensional requirements

Pipe/fitting type	Class designation	Tables of dimensional requirements
Pipes with flexible joints	K9	21
Pipes with screwed-on flanges	K9* or K12	22
Pipes with welded-on flanges	K9	23
Pipes with cast-on flanges	K12	24
Flanged spigot pieces with screwed or welded flanges	K9 or K12	42
Fittings without branches	K12	25 to 28, 31, 32, 39 to 41, 47 to 52, 55 and 62 to 65
Fittings with branches (i.e. tees) (see 2.1.2.1)	K14 to K18	29, 30, 53 and 54 and tables 66 and 67
Change fittings	See tables	33 to 35
Caps	—	36
Plugs	K12	37
Double socket condensate receivers	—	38
Blank flanges	—	43 to 46

NOTE. Pipeline design considerations may justify or require the use of classes other than those detailed in this table (see 2.1.1.2 and 2.1.2.2.2).

*Pipes with screwed-on flanges will be supplied in accordance with class K9 unless otherwise specified by the purchaser on his enquiry and order (see A.2).

Table 2. Maximum hydraulic working pressures, exclusive of surge, for ductile iron pipes and fittings specified in table 1 and flanged joints

Nominal size DN	Maximum hydraulic working pressures					
	Centrifugally cast pipes class K9, fittings class K12 (including flanged pipes with integrally cast flanges)	Fittings (i.e. tees) class K14 and thicker	Flanged joints			
			PN 10	PN 16	PN 25	PN 40
	bar*	bar	bar	bar	bar	bar
80	60	60	10	16	25	40
100	60	60	10	16	25	40
150	60	60	10	16	25	40
200	60	50	10	16	25	40
250	53	40	10	16	25	40
300	47	40	10	16	25	40
350	43	25	10	16	25	40
400	40	25	10	16	25	40
450	38	25	10	16	25	40
500	36	25	10	16	25	40
600	33	25	10	16	25	40
700	31	25	10	16	25	
800	29	25	10	16	25	
900	28	25	10	16	25	
1000	27	25	10	16	25	
1100	26	25	10	16	25	
1200	25	25	10	16	25	
1400	25	25	10	16	25	
1600	25	25	10	16	25	

NOTE 1. Pipes and fittings in classes other than those covered in this table will have maximum hydraulic working pressures which vary from those given. The manufacturer should be consulted by the purchaser with regard to the production of such types of pipes and fittings.

NOTE 2. Not all flexible joints are suitable for the pressures given in this table and manufacturers should be consulted for the maximum hydraulic working pressures for particular joint designs.

NOTE 3. The maximum hydraulic working pressures given for flanged joints apply to joints in which axial thrusts generated by internal pressure impose tensile stresses to the bolting. Where the bolting of flanged joints is not subjected to tensile stresses created by axial thrusts from internal pressure (e.g. flanged valves connected by flanged sockets and flanged spigots in a spigot and socket non-anchored main) the preferred PN 16 flange (see the appropriate tables, e.g. table 24) is capable of operating at the pressure given for class K9 centrifugally cast pipe.

NOTE 4. The maximum hydraulic working pressures of flanged pipes and fittings is that of the flange or of the pipe or fitting body, whichever is the lower.

NOTE 5. The maximum hydraulic working pressures for pipes and fittings with flanges are applicable in the temperature range -10°C to 120°C . The manufacturer should be consulted in connection with maximum hydraulic working pressures for temperatures outside this range and for information in respect of the suitability of specific gasket materials for operating at particular temperatures.

NOTE 6. Internal pressure induces higher stresses in fittings with branches, i.e. tees, than in fittings without branches; consequently the maximum hydraulic working pressures for tees of class K14 and thicker are often lower than for class K12 fitting without branches.

NOTE 7. For information relating to surge pressures and site testing of pipeline installations see BS 8010 : Section 2.1.

NOTE 8. This table does not apply to the pipes covered in 2.1.1.2, the fittings covered by 2.1.2.2 nor condensate receivers, given in table 38.

*1 bar = 10^5 N/m^2 = 100 kPa. Pressures in this standard are given in bar (gauge).

2.1.2.2 Group II fittings

2.1.2.2.1 Where fittings, other than those given in table 1 are manufactured and supplied, i.e.:

- (a) other types of fittings, e.g. crosses and angle branches;
- (b) fittings of different thickness, class designation or maximum hydraulic working pressure (see 2.1.2.2.2 and 2.1.2.3);
- (c) fittings having laying dimensions different from those either specified in tables 25 to 55 inclusive or the unified design fittings in tables 62 to 66 inclusive;
- (d) fittings having combinations of nominal sizes different from those specified in tables 29, 31, 53 and 55 and the unified design fittings in tables 65 and 66,

they shall comply with the requirements for:

- (1) mechanical properties (see 2.5);
- (2) tolerances on dimensions and mass (see 2.10 and 2.11);
- (3) coatings and linings (see section three);
- (4) manufacturer's certificate (see 1.5);
- (5) marking (see 2.4.2.2).

2.1.2.2.2 Where fittings of class designations other than those given in table 1 are manufactured and supplied, the wall thicknesses of group II fittings shall be calculated in accordance with 1.4.2 and fittings shall be marked in accordance with 2.4.2.2(c). Such fittings shall comply with all the requirements of this British Standard with the exception of wall thickness and mass.

Increases or decreases in wall thicknesses of fittings shall be obtained by altering either:

(a) the external diameter (plugs, change pieces and flanged spigot pieces excepted); or

(b) the internal diameter.

2.1.2.3 Maximum hydraulic working pressure. The maximum hydraulic working pressure for group I fittings shall comply with table 2 (see A.1(a)(3)).

2.2 Requirements for works pressure test**2.2.1 Hydrostatic pressure**

When tested in accordance with appendix B, each pipe of a class designation complying with table 1 and each group I fitting shall withstand the works hydrostatic test pressures specified in table 3 without showing signs of leakage, sweating or other failure of any kind.

NOTE. Works hydrostatic pressure tests based on appendix B for each pipe of a class designation other than those in table 1 or group II fittings should be agreed between manufacturer and purchaser.

2.2.2 Air test

Following hydrostatic testing and before the application of any internal or external coating, pipes and fittings to be used for the conveyance of gas shall be subjected to an air test at a minimum gauge pressure of 3.5 bar. The pipe or fitting shall be either submerged in water, or coated on the external surface with a suitable foaming agent. The test pressure shall be steadily applied and maintained for a sufficient period of time so as to allow for inspection. The pipes and fittings shall show no signs of leakage or failure of any kind.

NOTE. The purchaser should inform the manufacturer on his enquiry and order when an additional air test is required with details of the duration of the test (see A.1(c)).

Table 3. Works hydrostatic test pressures and leak-tightness test pressures for pipes and fittings specified in table 1

Nominal size DN	Works hydrostatic test pressures					Works hydrostatic leak-tightness test pressure for fittings and for non-centrifugally cast pipes with cast-on flanges
	Centrifugally cast pipes with flexible joints	Pipes with screwed or welded-on flanges				
		PN 10 flange	PN 16 flange	PN 25 flange	PN 40 flange	
	bar (gauge)	bar (gauge)	bar (gauge)	bar (gauge)	bar (gauge)	bar (gauge)
80 to 300	50	16	25	32	40	25*
350 to 600	40	16	25	32	40	16
700 to 800	32	16	25	32	—	10†
900 to 1200	32	16	25	25	—	10†
1400 to 1600	25	16	25	25	—	2§

*16 bar (gauge) for pipes and fittings with PN 10 flanges and for condensate receivers in accordance with table 38.

†At the manufacturer's option a hydrostatic test at a pressure of 2 bar with an additional pneumatic test at a pressure of 1 bar may be substituted.

§ Additionally tested with air at a pressure of 1 bar.

NOTE. The works hydrostatic test pressures given in table 3 do not in all cases exceed the maximum hydraulic working pressures given in table 2. See BS 8010 : Section 2.1 for information relating to surge pressures and site testing of pipeline installations. The recommendations for surge and site test pressures given in BS 8010 : Section 2.1 ensure that site test pressures exceed the pressures to which a pipeline installation is to be subjected in service.

2.3 Types of joint

NOTE. The design and dimensions of flexible joints, either of the 'push in' type or of the 'mechanical' type are not within the scope of this standard (see clause 1). As the manufacturing dimensions and tolerances of individual types of joint may differ, the manufacturer's guidance should be obtained with regard to interchangeability where pipes and fittings of differing design are to be jointed.

2.3.1 Flanged joints

2.3.1.1 General. Ductile iron flanges designated PN 10, PN 16, PN 25 and PN 40 shall have the dimensions given in tables 17, 18, 19 and 20 respectively. The maximum hydraulic working pressures for these flanges shall comply with table 2 and are applicable to the temperature range -10°C to 120°C .

NOTE 1. The manufacturers should be consulted in connection with pressure and temperature conditions outside this range (see A.1(g) and table 2).

NOTE 2. Flanges complying with this British Standard are dimensionally compatible with the corresponding flanges complying with BS 4504 : Part 1.

NOTE 3. PN 10 is a non-preferred nominal pressure rating and PN 16 will normally be supplied.

2.3.1.2 Flange faces. The faces of the flanges of pipes shall be at right angles to, and concentric with, the axis of the bore. The faces of the flanges on fittings shall be at right angles to, and concentric with, the directional axes. All flange jointing faces shall be finished in accordance with table 4. The facings shall be compared by visual or tactile means with reference specimens which comply with the R_a and R_z values given in table 4.

NOTE. It is not intended that instrument measurements be taken on the flange faces and the R_a and R_z values as defined in BS 1134 : Part 1 relate to the reference specimens.

Table 4. Surface finish of flange jointing faces		
Manufacturing process	R_a	R_z
Turning	μm 3.2 to 12.5	μm 12.5 to 50
Other	3.2 to 6.3	12.5 to 25
NOTE. The term 'turning' applies to any method of machine operation producing either serrated concentric or serrated spiral grooves.		

2.3.1.3 Bolt holes. With the exception of the case covered in 2.3.1.4 all bolt holes shall be drilled or accurately moulded, shall be equally spaced on the pitch circle diameter and shall be located off-centre. Where there are two or more flanges, the bolt holes shall be aligned.

2.3.1.4 Angular displacement of bolt holes. If the angular displacement of the equispaced bolt holes on the pitch circle diameter, C , relative to the vertical centreline is

required to be different from that shown in tables 17 to 20 inclusive, the pipe or fitting shall be marked as specified in 2.4.1(i), 2.4.2(g) and 2.4.2.2(i).

NOTE. If the purchaser requires a different angular displacement of bolt holes this should be specified in the enquiry and order (see A.1(h)).

2.3.1.5 Screwed-on flanges. Ductile iron pipes having screwed-on flanges shall comply with the requirements of table 22 and 2.3.2.

The threaded joint between the pipe and the flange shall be sealed by a sealing compound. The sealing compound shall be suitable for use with raw and potable water (see 1.3) up to a temperature of 100°C , natural and town gas, domestic sewage and industrial effluent treated so as to be acceptable for discharge into public sewers.

NOTE. For other duties, such as the carrying of industrial effluents or chemicals, the purchaser should specify the operating conditions to enable the manufacturer to provide a suitable sealing compound (see A.1(f)).

2.3.1.6 Welded-on flanges. Ductile iron pipes having welded-on flanges shall comply with the requirements of table 23 and 2.3.2.

2.3.2 Requirements for type test for screwed-on and welded-on flanges

2.3.2.1 General. The manufacturer shall initially prove the designs of pipe to flange attachments of his full product range by carrying out type tests in accordance with appendix C on the groupings specified in 2.3.2.2.

When tested in accordance with appendix C, an assembled flange joint, when positioned at the mid-point of a simply supported span, shall support, without showing leakage or mechanical failure of any kind, a hydrostatic internal pressure of $2 \times \text{PN}$ in conjunction with an external load, applied at the assembled flange joint, which is sufficient to increase the bending moment at the joint up to the value given in table 5.

NOTE. The pipe to flange attachment for screwed-on and welded-on flanges should be capable of withstanding the site test pressures recommended in table 2 of BS 8010 : Section 2.1 : 1987.

2.3.2.2 Type test groupings. There shall be at least one test carried out in accordance with appendix C for each of the DN/PN groupings given in table 6.

Where pipes with PN 10 or 16 flanges are not part of a manufacturer's product range, groupings for PN 25 and 40 shall be those given for PN 10 or 16 flanges.

NOTE 1. Where a manufacturer's maximum size of pipe with PN 25 or PN 40 flanges is less than DN 300 a test should be carried out on the largest size manufactured.

NOTE 2. Where the design of hub for welded or screwed flanges is common for all PN ratings the test may be carried out on pipes having flanges to the highest PN rating produced only, but in the groupings given for PN 10 or 16 flanges.

Table 5. Bending moment and dimensional details for type test

Nominal size DN	Bending moment	Minimum distance <i>X</i> for class K9 pipe	Minimum length of unsupported span
	kN·m	mm	mm
80	7.2	145	480
100	9.3	150	600
150	16.0	162	900
200	24.0	172	1200
250	34.2	183	1500
300	104	194	1800
350	135	206	2100
400	168	216	2400
450	205	228	2700
500	251	238	3000
600	348	259	3600
700	463	281	4000
800	584	302	4000
900	724	323	4000
1000	886	343	4000
1100	1060	364	4000
1200	1250	385	4000
1400	1690	427	4000
1600	2190	468	4000

NOTE. Where *X* is the minimum distance from the jointing face of each flange of the joint to be tested (see C.3).

Table 6. Type test groupings

PN 10 or 16	PN 25	PN 40
Up to and including DN 250	DN 300 to DN 600	DN 300 to DN 600
DN 300 to DN 600		
DN 700 to DN 1000	DN 700 and above	—
DN 1100 and above		

NOTE. The DN groupings shown for PN 25 and PN 40 are applicable only where tests have been carried out according to the groupings given for PN 10 or 16.

2.3.3 Bolting of flanged joints

Flanged joints shall be bolted together using bolts of at least grade 4.6 of BS 4190 and washers, as necessary, in the normal series given in tables 1 and 3 of BS 4320 : 1968.

*Marking BS 4772 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity which may also be desirable.

NOTE 1. When joining flanges the use of the normal size bolting, given in tables 17 to 20 inclusive, requires the application of high bolt torques to seal flange joints in the larger sizes. To reduce these high torque loads to more convenient levels, flanges may be supplied having the smaller bolt hole size for use with the smaller high tensile bolting given in appendix J, table 61 (see A.2(c)).

NOTE 2. The manufacturer should indicate in his catalogue where flanges are supplied which use the smaller bolting given in table 61.

2.3.4 Gaskets

2.3.4.1 Gasket materials. Gaskets used in flexible joints and in flanged joints shall be manufactured from materials which are:

- (a) compatible with the fluid to be conveyed; materials for use with potable water shall comply with 1.3;

NOTE 1. The purchaser should state in his enquiry and order the fluid to be conveyed (see A.1(e)).

- (b) compatible with the pressures and temperatures to which the pipeline is to be subjected.

NOTE 2. The purchaser should state on his enquiry and order the applicable pressure and temperature conditions (see A.1(e)).

NOTE 3. In the case of elastomeric components, if the purchaser does not specify a requirement for a different material, the manufacturer will supply elastomeric components in accordance with BS 2494 (see A.2(b)).

2.3.4.2 Gaskets for flexible joints. The gasket shall be of such size and shape that, when the joint is made in accordance with the manufacturer's instructions, it provides a positive seal within the manufacturer's range of maximum joint deflection and withdrawal under the following:

- (a) all combinations of joint and gasket dimensional tolerance; and
- (b) in the range of pressures and temperatures likely to occur in the pipeline including, where applicable, pressures below atmospheric pressure.

2.3.4.3 Gaskets for flanged joints. The dimensions of gaskets for use with flanged joints shall comply with BS 4865 : Part 1.

NOTE. The use of gaskets having dimensions designed to suit more than one nominal pressure rating (PN) is permitted.

2.4 Marking

2.4.1 Marking of pipes

Each pipe shall be legibly and durably marked, at a convenient position with the following:

- (a) the manufacturer's name, initials or identification mark;
- (b) the nominal size, e.g. 100 representing DN 100;
- (c) the class designation on flanged pipes having screwed-on flanges and on all pipes having class designations other than those given in tables 21, 23 or 24 (see 2.1.1.2);
- (d) the number of this British Standard, i.e. BS 4772*;

- (e) the length of pipe when specially ordered (see A.1(d)) with lengths other than those shown on the diagrams in tables 21 to 23;
 - (f) where applicable, an indication of the length over which the pipe is suitable for cutting on site (see 2.10.1.3);
 - (g) where pipes shorter than the lengths detailed in table 21 are supplied, the actual length of pipe (see 2.10.3.3);
 - (h) the last two digits of the year of manufacture, e.g. '88' if manufactured in 1988;
 - (i) a short white line at the spigot end of each pipe with a flexible joint in sizes DN 700 and larger, to indicate the major axis of the spigot;
- NOTE. Manufacturers may recommend that the spigot end of such pipes be jointed with the major axis in the vertical position.
- (j) the letters 'C/L' on cement mortar lined pipes which are coated internally with bitumen or other materials;
 - (k) the type of cement used in cement mortar linings in pipes where the type is different from that stated in the manufacturer's catalogue (see 3.2.2.1);
 - (l) where applicable, an indication that the angular displacement of the equispaced bolt holes relative to the vertical centre line in flanges is different from that specified in 2.3.1.3 (see 2.3.1.4).

2.4.2 Marking of fittings

2.4.2.1 Marking of group I fittings. (See 2.1.2.1.) Each fitting shall be legibly and durably marked at a convenient position with the following:

- (a) the manufacturer's name, initials or identification mark;
- (b) the nominal size(s), e.g. 100 or 100/80;
- (c) the number of this British Standard, i.e. BS 4772*;
- (d) the last two digits of the year of manufacture, e.g. '88' if manufactured in 1988;
- (e) the angle of bends in degrees;
- (f) the letter 'U' on all unified design fittings in accordance with appendix K in order to differentiate between them and those shown in tables 25 to 31, 47, and 49 to 55;
- (g) where applicable, an indication that the angular displacement of the equispaced bolt holes relative to the vertical centre line in flanges is different from that specified in 2.3.1.3 (see 2.3.1.4).

2.4.2.2 Marking of group II fittings. (See 2.1.2.2.) Each fitting shall be legibly and durably marked at a convenient position with the following:

- (a) the manufacturer's name, initials or identification mark;
- (b) the nominal size(s), e.g. 100 or 100/80;

(c) the class designation on:

- (1) fittings on types not included in the dimensional requirements of this standard (see 2.1.2.2.1(a));
- (2) fittings of a type which are included in the dimensional requirements of this standard but are of a class designation different from that specified in table 1 (see 2.1.2.2.1(b));

(d) the maximum hydraulic working pressure of:

- (1) fittings of types not included in the dimensional requirements of the tables referred to in table 1 (see 2.1.2.2.1(a));
- (2) fittings of a type which are included in this standard but which have a maximum hydraulic working pressure different from that specified in table 2 (see 2.1.2.2.1(b));
- (3) fittings having laying dimensions different from those specified in tables 25 to 55 and 62 to 66 inclusive, which have maximum hydraulic working pressures different from those specified in table 2 (see 2.1.2.2.1(c));
- (4) fittings having combinations of nominal sizes different from those specified in tables 29, 31, 53, 55, 65 and 66, which have maximum hydraulic working pressures different from those specified in table 2 (see 2.1.2.2.1(d));

(e) the number of this British Standard, i.e. BS 4772*;

(f) the last two digits of the year of manufacture, e.g. '88' if manufactured in 1988;

(g) the angle of bends in degrees;

(h) the laying lengths of:

- (1) fittings of types not included in table 1 (see 2.1.2.2.1(a));
- (2) fittings of a type included in table 1, but having laying lengths different from those specified in tables 25 to 55 and 62 to 66 (see 2.1.2.2.1(c));

(i) where applicable, an indication that the angular displacement of the equispaced bolt holes relative to the vertical centre line in flanges is different from that specified in 2.3.1.3 (see 2.3.1.4).

2.5 Mechanical properties

2.5.1 Requirements

All pipes and fittings shall be made from ductile iron and have the mechanical properties given in table 7 when tested in accordance with 2.5.2.

NOTE. All ductile iron pipes and fittings have a minimum 0.2 % proof stress value of 300 N/mm². The measurement of 0.2 % proof stress, which is not a requirement, should, if required, be agreed between manufacturer and purchaser.

*Marking BS 4772 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity which may also be desirable.

Table 7. Mechanical properties

Nominal size DN	Type of casting	Tensile strength, min., R_m	Elongation, min., A
80 to 1000	Centrifugally cast pipes	N/mm ² * 420	% 10†
Over 1000	Centrifugally cast pipes	420	7
All sizes	Pipes not centrifugally cast, and fittings	420	5

*1 N/mm² = 1 MPa.
†7 % for pipes thicker than class K12 (see 2.1.1.2).

2.5.2 Verification procedures

2.5.2.1 General. The manufacturer shall carry out tests, as specified in 2.5.2.2, to verify the mechanical properties of pipes and fittings in order to ensure continuing compliance with the requirements in 2.5.1.

2.5.2.2 Alternative methods of verification of mechanical properties. The routine verification procedures for mechanical properties shall be:

- (a) either by a system of non-destructive testing, complemented by the mechanical testing of a small number of bar test pieces in accordance with appendix E; or
- (b) by a batch sampling system where the mechanical properties of samples taken from, or cast integrally with and being representative of finished products are tensile tested to verify mechanical properties in accordance with appendix F.

2.6 Hardness

When surface hardness tests are carried out (see 2.8.3) they shall be in accordance with BS 240 except that the period of application shall be 15 ± 1 s. The hardness of centrifugally cast pipes shall not exceed 230 HB and the hardness of all other castings shall not exceed 250 HB.

2.7 Heat treatment

2.7.1 Pipes

Pipes that are centrifugally cast in unlined water cooled metal moulds shall be heat treated in order to achieve the mechanical properties specified in 2.5 (see table 7) and to relieve casting stresses.

Pipes that are cast under controlled conditions (i.e. in lined or coated moulds, either centrifugally cast or sand cast)

shall comply with the mechanical properties specified in 2.5 (see table 7) by the application of heat treatment, if necessary.

2.7.2 Fittings

Fittings shall be supplied in either:

- (a) the 'as cast' condition; or
- (b) the heat treated condition.

In either case the fittings shall comply with the mechanical properties specified in 2.5 (see table 7). In the case of heat treated fittings, the test samples (see E.3.5 and F.2.2) shall be subjected to the same heat treatment process as the fittings of which they are representative.

2.8 Condition of pipes and fittings

2.8.1 Defects

2.8.1.1 Cracks and tears. Pipes and fittings having cracks and/or tears shall not be repaired, shall be deemed not to comply with this British Standard and shall be rejected.

2.8.1.2 Other defects. Pipes and fittings having defects, other than cracks or tears, on the body or on the jointing faces of pipes and fittings, shall be either repaired using a welding procedure or the casting shall be deemed not to comply with this British Standard and shall be rejected. The welding procedure shall define the parameters for selection, preparation, rectification, welder approval, inspection and acceptance.

NOTE. The welding procedure should be the subject of an agreement between the manufacturer and the purchaser.

2.8.2 Surface and other imperfections

The depth of imperfections on external surfaces shall not exceed those specified in table 8. Pipes and fittings having surface imperfections which exceed the maximum depths specified in table 8 shall be either repaired to comply with table 8 or shall be deemed not to comply with this British Standard and shall be rejected (see 2.8.1.2).

Table 8. Maximum depths of surface imperfections

Class K9 centrifugally cast pipes DN	Thicknesses (e) of other classes of centrifugally cast pipes and fittings	Maximum depth of surface imperfections
80 to 200	mm 6 to 6.5	mm 1.75
250 to 600	Above 6.5 to 10.0	2.0
700 to 900	Above 10.0 to 13.0	3.0
1000 to 1200	Above 13.0 to 15.5	4.0
1400	Above 15.5 to 17.5	4.5
1600	Above 17.5	5.0

NOTE. Where the wall thickness e is found to be greater than that specified in the appropriate tables of this standard, e.g. at the socket neck of centrifugally cast pipes, then the maximum depth of surface imperfection should be increased by the same amount.

NOTE. Pipes and fittings are permitted to have other imperfections which are inseparable from the method of manufacture and which are not detrimental to the functional quality of the castings. It is permissible to repair such minor imperfections by simple dressing.

2.8.3 Surface hardness

The surface hardness of pipes and fittings shall be such that they can be cut, drilled, tapped and machined. In cases of dispute a hardness test shall be carried out as specified in 2.6.

2.9 Straightness of pipe

Pipes shall not deviate from the straight by more than 0.00125 times the length of the pipe when the deviation is measured at the mid-point of a length equal to $\frac{2}{3}$ of the length of the pipe.

2.10 Tolerances on dimensions

2.10.1 External diameters of pipes and fittings

NOTE. No tolerance is specified in this standard for the external diameters of fittings (except for flanged spigot pieces, metric end of change pieces and plugs; see 2.10.1.1 and 2.10.1.2) or for pipes with flanges cast on.

2.10.1.1 The tolerance for the external diameter D_E of the spigots of spigot and socket pipes, flanged spigot pieces, metric end of change pieces and plugs shall be in accordance with table 9, when measured circumferentially using a diameter tape.

2.10.1.2 The tolerance for the external diameter D_E (see 2.10.1.1) of the spigots of flanged spigot pieces having integrally cast, screwed-on or welded-on flanges, metric end of change pieces and plugs shall apply only to the length of the jointing surface.

2.10.1.3 The tolerance on the external diameter D_E of the barrels of spigot and socket pipes and flanged pipes with screwed-on or welded-on flanges shall be in accordance with table 9 when measured circumferentially with a diameter tape. The tolerance shall apply along the length of the barrel of pipes up to and including DN 300 (see note 2).

Where pipes of size DN 350 and larger are ordered as suitable for cutting on site the tolerance shall apply along the length of the barrel (see note 2) and the pipes shall be marked to indicate the length over which the pipe is suitable for cutting (see 2.4.1(f)), this length being effective from the spigot end.

NOTE 1. In the case of pipe of size DN 350 and larger, the purchaser has the option of ordering a number of pipes as being required to be suitable for cutting on site (see A.1(i)).

NOTE 2. A transition from the pipe barrel to the external socket profile is permissible and where pipes are cut close to the socket in this transition length it may be necessary to reduce the external diameter by grinding.

NOTE 3. For information regarding the diameter of pipe barrels required to be cut on site, either in an existing pipeline or those not supplied as suitable for cutting, see appendix H.

NOTE 4. The spigots of pipes cut on site may require preparation in accordance with the manufacturer's recommendations prior to jointing.

2.10.1.4 Certain types of flexible joint will accept some degree of spigot ovality but the measured difference between the maximum and minimum axes of individual spigots shall not exceed the appropriate value in table 9.

NOTE 1. However, where the spigot ovality applicable to such joints is smaller than that given in table 9, the values should be detailed in the joint manufacturer's catalogue.

NOTE 2. Spigot ovality correction, using a jack internally or clamps externally, as recommended by the manufacturer, may be required prior to jointing.

Table 9. Tolerances on the external diameters of the spigots of pipes and (where applicable) fittings

Nominal size DN	Tolerance on the external diameter D_E of spigots and of plugs*	Maximum ovality of spigots of external diameter D_E †
	mm	mm
80 to 150	+1.0, -3.0	5
200 to 350	+1.0, -3.5	10
400 to 500	+1.0, -4.0	20
600 to 800	+1.0, -4.5	30
900 to 1000	+1.0, -5.0	40
1100 to 1200	+1.0, -6.0	50
1400	+1.0, -7.0	55
1600	+1.0, -8.0	65

*See 2.10.1.1, 2.10.1.2 and 2.10.1.3.

†See 2.10.1.4.

2.10.2 Tolerances on thickness

The tolerances on the wall thicknesses shall be in accordance with table 10.

Table 10. Tolerances on wall thickness e

Type of casting	Tolerance
Centrifugally cast pipe	mm - (1.3 + 0.001 DN*)
Pipes not centrifugally cast, and fittings	- (2.3 + 0.001 DN)

NOTE. For the purposes of calculating tolerances on wall thickness, DN is the nominal size in millimetres.

*For DN 80 and DN 100 ductile iron centrifugally cast pipe the minimum wall thickness shall not be less than 4.8 mm.

2.10.3 Tolerances on length

2.10.3.1 The tolerances on the lengths of pipes shall be in accordance with table 11.

NOTE. Where spigot and socket centrifugally cast pipes are intended for installation on fixed supports, e.g. on piers, account should be taken of variations from the specified length given in 2.10.3.1, 2.10.3.3 and 2.10.3.4.

Table 11. Tolerances on lengths of pipes

Type of casting	DN	Tolerance
Double plain-end and spigot and socket centrifugally cast pipes up to and including 5.5 m long	All sizes	mm ± 30
Double plain-end and spigot and socket centrifugally cast pipes over 5.5 m long	All sizes	± 50
Flanged pipes up to and including 2 m in length	All sizes	± 3.0
Flanged pipes over 2 m but less than 3 m in length	All sizes	± 4.0
Flanged pipes of 3 m and over in length	All sizes	± 5.0

2.10.3.2 The tolerances on the lengths of fittings shall be as specified in tables 47 to 53, 55 and 62 to 66.

2.10.3.3 Of the total number of spigot and socket centrifugally cast pipes to be supplied in each diameter on any one order, the manufacturer shall supply no more than 5 % in lengths shorter than the specified length given in table 21. The maximum allowable reduction in length shall be as given in table 12 and the reductions shall be of 0.5 m, or increments of 0.5 m.

The actual length of pipes shorter than the specified length given in table 21 shall be marked on the pipe (see 2.4.1(g)).

Table 12. Maximum allowable reduction in length

Specified length (see table 21)	Maximum reduction in length
m	m
5.5	2
8.0 and above	3

Where such pipes are supplied the manufacturer shall supply additional pipe and, where appropriate, jointing components, to make up the difference in length between the length given in table 21 and the shorter length pipes supplied.

The shorter length pipes supplied shall be subject to the tolerances on length given in table 11.

2.10.3.4 Where the manufacturer cuts test rings from pipes for quality control purposes, no more than 10 % of the total number of pipes of each size on an order shall be shorter than 150 mm less than the minimum length specified, in tables 21 and 11.

2.10.3.5 Where pipes are supplied on a meterage basis, the number of pipes to be supplied shall be determined by dividing the meterage specified by the purchaser by the pipe length specified in tables 21 to 23.

NOTE 1. The resultant meterage supplied may therefore vary from that specified by the purchaser as a result of the tolerances which apply to the specified length (see 2.10.3.1) and also the shorter length pipes as a result of test rings (see 2.10.3.4).

NOTE 2. Account should be taken of the negative tolerances on length when ordering pipes.

2.10.4 Tolerances on flanges

The tolerances on the dimensions of flanges specified in tables 17 to 20 shall be as specified in BS 4504 : Section 3.2.

2.11 Tolerances on mass

2.11.1 The mass of a pipe or fitting is dependent upon the design of the ends and shall be calculated on the nominal dimensions given in the appropriate table taking the density of ductile iron as 7050 kg/m³.

2.11.2 The tolerances on the mass of all pipes and fittings shall be those given in table 13.

NOTE 1. The masses shown in tables 21, 25 to 31, 39, 40 and appendix K, where applicable, are for pipes and fittings with sockets for typical 'push-in' flexible joints the masses of which are in accordance with those given in table 14.

NOTE 2. The masses shown in tables 32, 33, 36 and 38 are applicable to fittings with sockets for typical 'mechanical' flexible joints as these are not normally supplied with 'push-in' flexible joints.

Table 13. Tolerances on mass

Nominal size DN	Type of casting	Lower limit of mass
80 to 200	Centrifugally cast pipes	- 8 %
250 to 1600	Centrifugally cast pipes	- 5 %
All sizes	Pipes not centrifugally cast	- 8 %
All sizes	Fittings specified in the tables of this standard, excepting bends and fittings with branches	- 8 %
All sizes	All other fittings	- 12 %

Table 14. Mass of sockets of typical 'push-in' flexible joints used for the calculation of the mass of pipes and fittings (having class designations as given in table 1)		
Nominal size DN	Mass of sockets	
	Pipes	Fittings
	kg	kg
80	3.2	2.3
100	4.1	2.8
150	5.4	4.3
200	9.1	6.6
250	12.8	9.3
300	17.5	13.8
350	20.0	16.0
400	25.5	21.5
450	30.3	25.8
500	36.1	32.2
600	52.1	44.3
700	55.5	94
800	63.4	114
900	82.5	153
1000	120.0	188
1100	152.0	250
1200	190.0	290
1400	279.0	420
1600	375.0	560
NOTE. Where the actual masses of sockets for flexible joints differ from those shown in this table, these should be taken into account when applying the tolerances on mass given in table 13.		