



Precast concrete pipes and fittings for drainage and sewerage

Part 1. Specification for pipes and fittings with flexible joints and manholes.

Tuyaux et raccords d'évacuation et d'assainissement en béton préfabriqué.
Partie 1. Tuyaux et raccords avec joints flexibles et trous d'homme - spécifications.

Fertig-Betonrohre und formstücke für Entwässerungs- und Abwasserleitungen
Teil 1. Rohre und Formstücke mit flexiblen Verbindungen und Mannlöchern.

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Foreword

The BSI committee set up in 1978 to be responsible for all standards relating to concrete pipes and fittings has decided that there should be a single British Standard in Parts covering the complete range of precast concrete pipes and fittings for the conveyance, under atmospheric pressure, of sewage and surface water.

The first Part of the standard covers precast concrete cylindrical pipes, bends and junctions with flexible joints, and also manholes, unreinforced or reinforced with steel cages or hoops. Other Parts of the standard dealing with rectangular section chambers, gullies, ogee pipes and pipes for jacking are in course of preparation. The committee is also considering Drafts for Development giving guidance on pipes of composite construction, e.g. using glass fibre or chopped steel.

Following the publication of this Part of BS 5911, BS 556 : Part 1 : 1966 is withdrawn. However, BS 556 : Part 2 : 1972 will remain in use for a limited period to be agreed by the committee.

The principal differences between the requirements of this Part and those of BS 556 : Part 2 are as follows.

- (a) The upper limit of the range of nominal sizes (DN) has been extended from DN 1800 to DN 3000.
- (b) The number of classes of pipe has been reduced from four to three, by incorporating standard class in class L.
- (c) Requirements for reducing slabs have been included.
- (d) Routine works proof deflection tests for manhole cover slabs have been introduced, based on recent research. The committee will review the criteria in the light of results as they become available.

(e) Type tests for joints and routine tests for depth of cover to reinforcement and internal surface irregularity of pipes have been introduced.

NOTE. An appropriate test for bending moment resistance of pipes at the small end of the range of nominal sizes is being developed and will be published as an amendment to this standard as soon as possible.

(f) The quality assurance clauses have been completely revised and, wherever possible, comply with the requirements of BS 6001 or BS 6002.

Attention is drawn to the additional benefits that a third party certification scheme (e.g. the BSI Kitemark) confers with regard to assurance of compliance with the requirements of this standard.

As regards performance of pipes in the ground, it should be noted that this Part of this British Standard is a performance specification based on testing pipes in manufacturers' works or in testing stations. The tests in this Part are intended to ensure that the pipes will be capable of carrying sewage or surface water at atmospheric pressure without leaking or suffering structural damage, provided that the method of installation and the general conditions under which the pipeline is operating are suited to the original design concept. Pipes conveying sea water, industrial waste, etc. may require extra concrete cover to the reinforcement.

In a properly designed and constructed reinforced concrete pipeline, operating at atmospheric pressure, the probability of cracking is very small. For guidance on general principles of design and installation of pipelines, see CP 301 and CP 2005.

Certification. Attention is drawn to the certification facilities described on the inside back cover.

British Standard

Precast concrete pipes and fittings for drainage and sewerage

*Part 1, Specification for pipes and fittings
with flexible joints and manholes.*

Section one. Specification

1. Scope

This Part of BS 5911 covers precast concrete cylindrical pipes, bends and junctions with flexible joints, and also manholes, unreinforced or reinforced with steel cages or hoops, intended to be used for the conveyance, under atmospheric pressure, of sewage or surface water, and for the construction of culverts.

A range of nominal sizes (DN) of units is covered, namely DN 150 to DN 3000, by increments of 75.

A range of specified crushing test loads is given for each nominal size of pipe.

2. References

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

3. Definitions

For the purposes of this Part, the following definitions apply.

3.1 unit. A pipe, bend, junction or manhole component.

3.2 unreinforced concrete pipe. A hollow cylinder manufactured from concrete, cast as one piece and of uniform cross section throughout its length, except at the joint. (The inclusion of steel reinforcement solely for handling purposes does not exclude a pipe from this definition.)

3.3 reinforced concrete pipe. A pipe, as described in 3.2, but reinforced with one or more prefabricated steel cages or hoops suitably positioned to resist tensile stresses imposed by the specified test loads.

3.4 splayed end pipe. A pipe having one or both of its ends designed in a plane not at right angles to the longitudinal axis.

3.5 manhole. A chamber of circular cross section, with or without access shaft, constructed over a sewer or principal drain to permit inspection and access.

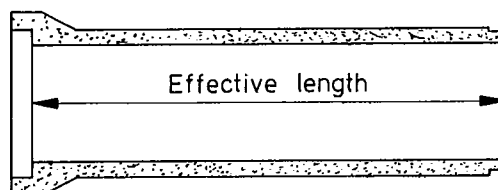
3.6 nominal size (DN). A numerical designation of the size of a unit, which is a convenient round number approximately equal to a manufacturing dimension.

3.7 manufacturing diameter. The internal diameter of a unit that a manufacturer seeks to achieve.

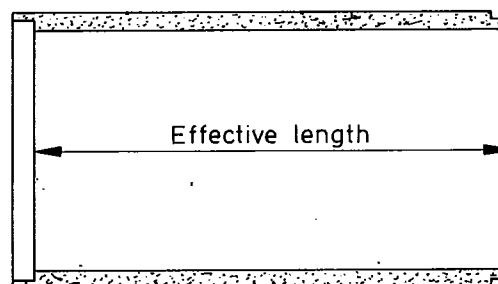
3.8 actual diameter. Any internal diameter found by measurement.

3.9 outside diameter. The maximum outside diameter of the barrel of a unit.

3.10 effective length. The length of a unit measured as shown in figure 1.



Unit with flexible
spigot and socket
joint



Unit with flexible
rebated joint

Figure 1. Effective length of units

3.11 characteristic strength. That value of cube strength below which not more than 5 % of the population of all possible strength measurements of the specified concrete are expected to fall.

3.12 batch. The number of units of a particular specification produced under uniform conditions during a given production period by the same process.

4. Information to be given to the manufacturer in an enquiry and order

For an enquiry and order to be fully understood, it is essential that the manufacturer be given the information set out in appendix A.

5. Cement

The cement shall comply with the relevant requirements of one of the following standards as appropriate.

Type of cement	Standard to be complied with
Ordinary and rapid-hardening Portland	BS 12
Portland-blastfurnace	BS 146
Sulphate-resisting Portland	BS 4027



Documents

Document Sharing Hub

6. Aggregates

6.1 General. Aggregates shall consist of materials complying with the requirements of BS 882, 1201 : Part 2, except that the pipe manufacturer shall be permitted to modify gradings to suit the manufacturing process.

A typical sample of the aggregates shall be supplied to the purchaser on request.

When required by the purchaser, evidence of satisfactory performance of the concrete manufactured with such aggregates shall be made available at the time of placing the order.

6.2 Testing. The coarse aggregates, when tested in accordance with BS 812 : Part 1 and Part 3 respectively, shall fulfil the following requirements:

- (a) flakiness index: not more than 35;
- (b) 10 % fines test: not less than 100 kN.

 The maximum nominal size of aggregate shall not exceed the least of the following:

- (a) 20 mm;
- (b) the concrete cover (see clause 9);
- (c) three-quarters of the minimum clear distance between reinforcing bars (see clause 9).

7. Other concrete materials

7.1 Water. Water shall be clean and free from harmful amounts of deleterious matter, either in suspension or in solution.

7.2 Admixtures. Admixtures shall not be used without the prior approval of the purchaser.

The composition and use of admixtures, including calcium chloride, shall follow the recommendations of CP 110 : Part 1.

8. Concrete

 **8.1 Cement content.** The fully compacted concrete shall contain not less than 350 kg of cement per cubic metre and shall have a maximum water/cement ratio of 0.45.

8.2 Chloride content. The total chloride ion content of the concrete mix shall follow the recommendations of CP 110 : Part 1.

8.3 Work in cold weather. Concrete, when placed, shall have a temperature of at least 5 °C, which shall be maintained until the concrete is thoroughly hardened.

It is permissible to heat aggregates and water before mixing, to a temperature not exceeding 60 °C.

Other materials and moulds, if frozen, shall not be used.

9. Steel reinforcement

9.1 Materials and arrangement. Longitudinal bars, main reinforcement and reinforcement for handling purposes shall comply with the requirements of one of the following standards as appropriate.

Type of reinforcement	Standard to be complied with
Hot rolled steel bars for the reinforcement of concrete	BS 4449
Cold worked steel bars for the reinforcement of concrete	BS 4461

Hard drawn mild steel wire for the reinforcement of concrete	BS 4482
Steel fabric for the reinforcement of concrete	BS 4483

Reinforcement shall be free from loose rust, scale, oil, grease or any other deleterious matter.

It is permissible to use main reinforcement in the form of hoops, either hooked, butt welded or lap welded, or in the form of a continuous helix or fabric, suitably welded. Longitudinal bars or wires or any other method to control spacing and shape and to ensure safe handling are also permitted.

The reinforcement shall normally be placed in a circular arrangement, but an elliptical or any other arrangement is permissible, subject to the provision of a cast-in lifting hole at the crown of the pipe and appropriate marking (see clause 18).

For reinforced pipes, both the barrel and the socket shall be reinforced. It is permissible for such reinforcement to be in separate cages, provided that the shear test requirements in 25.8.3 are complied with.

The clear space between circumferential bars shall be not less than 12 mm.

9.2 Protection for reinforcement. The concrete cover over all steel reinforcement shall be such that, in any finished unit, it is nowhere less than 12 mm and in man-hole slabs nowhere less than 20 mm.

An effective means shall be provided for maintaining the reinforcement in position and for ensuring correct cover during manufacture of the unit. Spacers for this purpose shall be of rustproof material or be of steel protected against corrosion. Rust marks on the concrete originating from the steel within a unit shall signify that it does not comply with the requirements of this Part.

There shall be no steel, other than stainless steel, within 12 mm of the internal surface of a unit.

10. Nominal size (DN)

The nominal sizes (see 3.6) of units shall normally be those shown in column 1 of table 1.

However, it is permissible to specify pipes in the range DN 1200 to DN 3000 with nominal sizes half way between those shown in column 1, i.e. at intervals of 75, under the following conditions.

- (a) The tolerances on diameter and wall thickness shall be those relating to the next highest size to the nominal size specified (see table 1).
- (b) The crushing test loads for the nominal size and class specified shall be interpolated between the values given in table 2 for adjacent nominal sizes of the same class (see clause 20).

11. Manufacturing diameter and actual diameter

The manufacturing diameter (see 3.7), which shall be stated by the manufacturer prior to the order being placed, shall not be outside the limits shown in column 2 of table 1.

The actual diameter (see 3.8) shall not deviate from the manufacturing diameter by an amount greater than that given in column 3 of table 1.

Table 1. Nominal sizes and permissible tolerances for units

1		2		3	4
Nominal size of units		Permissible limits of manufacturing diameter (see clause 11)		Permissible deviation of actual diameter (plus or minus) from manufacturing diameter (see clause 11)	Permissible variation of wall thickness (see clause 13)
Pipes, bends and junctions	Manhole shaft and chamber sections	Maximum diameter	Minimum diameter		
DN	DN	mm	mm	mm(±)	mm
150		155	150	5	6
225		230	225	5	6
300		305	300	5	6
375		385	365	6	6
450		460	440	6	6
525		535	515	6	6
600		610	590	6	6
675	675 (see note 1)	695	655	6	6
750		770	730	6	6
825		845	805	6	6
900	900 (see note 2)	920	880	6	6
975		995	955	6	6
1050	1050	1070	1030	6	6
1125		1145	1105	6	6
1200	1200	1220	1180	10	10
1350	1350	1380	1330	10	10
1500	1500	1530	1480	10	10
1650		1680	1630	10	10
1800	1800	1830	1780	10	10
1950		1980	1925	16	16
2100	2100	2135	2075	16	16
2250		2285	2225	16	16
2400	2400	2435	2375	16	16
2550		2590	2525	16	16
2700	2700	2740	2675	16	16
2850		2890	2825	16	16
3000	3000	3040	2975	16	16

NOTE 1. Nominal size DN 675 does not apply to manhole chamber sections.

NOTE 2. Nominal size DN 900 is the largest size of manhole shaft section normally available.

12. Outside diameter

The outside diameter (see 3.9) shall be stated by the manufacturer prior to an order being placed, if required.

13. Permissible variation in the thickness of wall

The radial thickness of the wall of any unit shall not vary by more than the amount stated in column 4 of table 1 for the appropriate nominal size.

14. Squareness of ends

The ends of each unit (except spigot end pipes) shall be square with its longitudinal axis or, for a bend, the tangent to it.

NOTE. In practice, methods of computing and measuring any variation will differ for pipes of different sizes, lengths and wall thicknesses.

15. Permissible deviation from straightness

When measured as described in appendix C, the maximum permissible deviation from straightness shall be 3.5 millimetres per metre of the total effective length (see 3.10) of the pipe.

16. Permissible irregularity of internal surface

After testing in accordance with the procedure given in appendix J, the internal surface of a pipe shall not retain

irregularities that cause either of the 2 mm rims of the gauge to lose contact with the surface.

It is permissible to stone off isolated protuberances in order to secure compliance with this clause.

NOTE 1. The requirement for checking surface irregularity inside (but not outside) pipes is to resolve differences of opinion on site regarding what is an acceptable finish. It is recognized that minor variations of surface finish arising from the manufacturing process (but not from subsequent physical damage) have no practical significance as regards the long-term hydraulic performance of the pipeline.

NOTE 2. For pipes of the smaller nominal sizes, it may prove impracticable to carry out the necessary measurements in the central portion of the pipe.

17. Joints

17.1 Joints of pipes, bends and junctions. Joints of pipes, bends and junctions shall be of the flexible spigot and socket type or of the flexible rebated type. The joint and joint ring dimensions shall conform to the manufacturer's standard dimensions and tolerances. The joint ring shall be of such size and shape that, when joined in accordance with the manufacturer's instructions, it will provide a watertight seal within the specified range of angular deflection, straight draw and shear loading (see 25.8) under all combinations of joint and joint ring dimensional tolerances.

Joint rings shall comply with the requirements for type 2 as specified in BS 2494.

Joints shall be tested in accordance with 25.8. For joints of nominal size greater than DN 1800, the maximum angular deflection, the straight draw, and the shear load that the joint will tolerate without loss of water-tightness under the test pressure, shall be stated by the manufacturer.

NOTE. For typical joints, see figure 2.

17.2 Joints of manhole sections. Joints of manhole sections shall be of the ogee type, or the rebated type,

or the tongued and grooved type. The axial length of each ogee or rebated end of a manhole section shall be not less than $(0.03 \text{ DN} + 7) \text{ mm}$, where DN is the nominal size of the manhole section. For example, for a section of DN 1200, the axial length shall be not less than $(0.03 \times 1200 + 7) \text{ mm} = 43 \text{ mm}$. Other joint dimensions shall conform to the manufacturer's stated dimensions and tolerances.

NOTE. For typical joints, see figure 3.

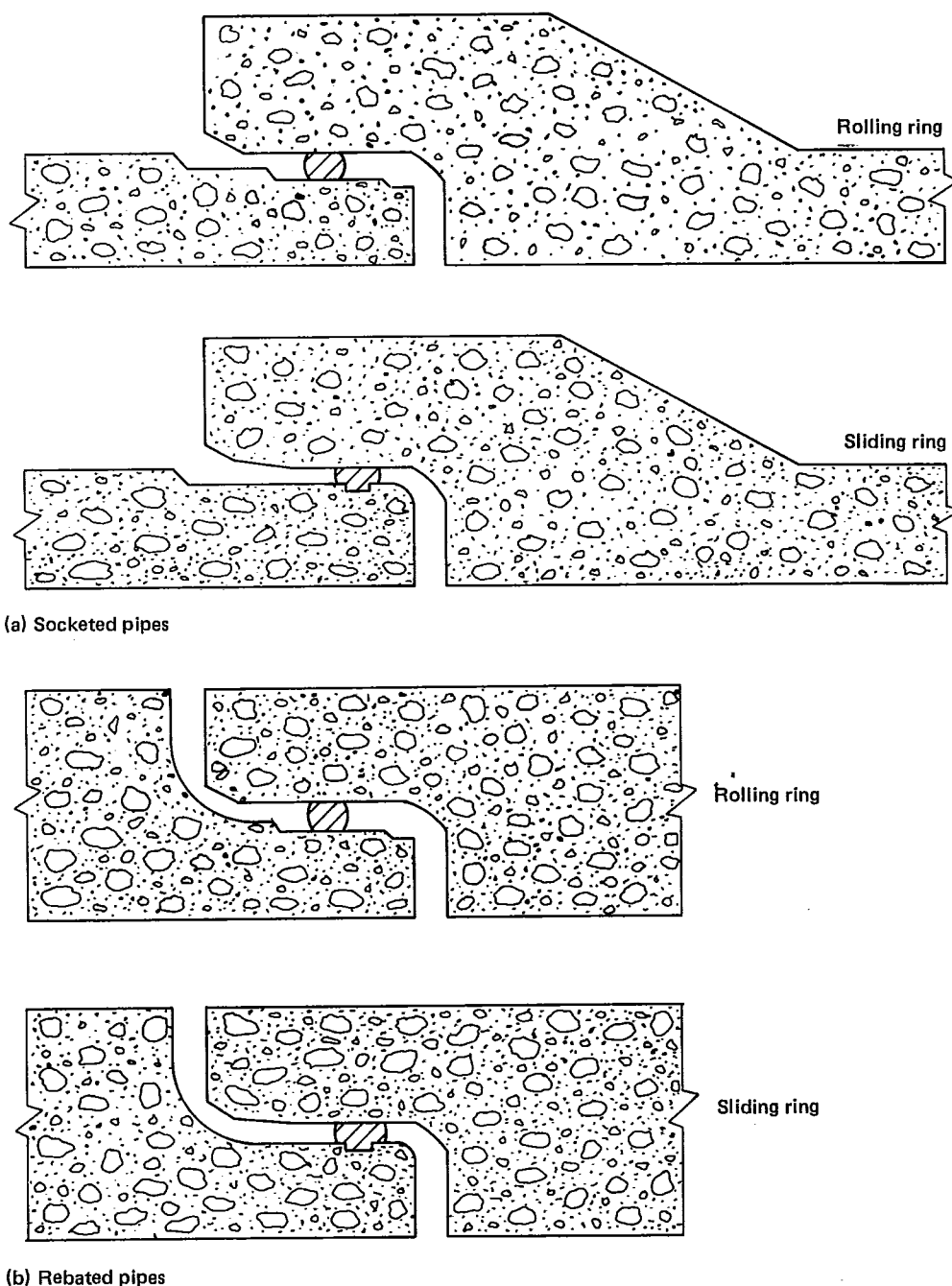


Figure 2. Typical flexible joints for pipes

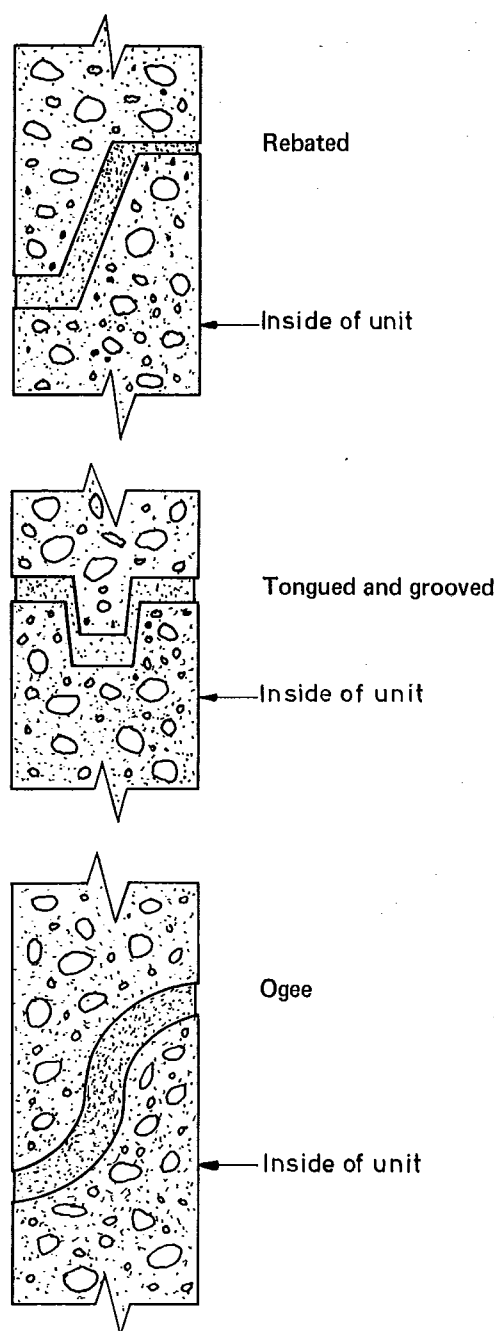


Figure 3. Typical manhole joints

18. Marking of units

18.1 Requirements for marking. Each unit shall be clearly marked with the following information:

- the number of this British Standard, i.e. BS 5911 : Part 1*;
- the letter 'R', if the unit is reinforced;
- an indication of the crushing test load(s), which shall normally consist of the letters 'L', 'M' or 'H' to denote 'light', 'medium' or 'heavy' class pipes, as shown in table 2, or the letters 'L.D' or 'H.D' to denote 'light duty' or 'heavy duty' manhole cover slabs, as shown in table 14;

However, where higher crushing test loads than those given in table 2 for a given nominal size of pipe have been specified (see clause 20), the pipe shall be marked with the specified works proof and maximum crushing test loads in kilonewtons per metre of effective length;

(d) the letter 'S' where sulphate-resisting Portland cement has been used;

(e) the day, month and year of manufacture;

(f) the manufacturer's mark and works identification mark;

(g) where tests, as described in 25.3, 25.4 or 25.7.2 have been successfully carried out on the unit;

(1) the words 'Hyd' or 'Proof', as appropriate;

(2) a reference symbol after the words in (1) above to identify the results of the tests in the manufacturer's quality control records.

Bends shall additionally be marked externally with indelible stripes at least 25 mm wide and 225 mm long, at each end of the two springing lines, to denote the longest and shortest lengths along the outside of the bend.

Reinforced pipes designed to meet the maximum stresses set up by loading only when tested or laid in a specified position shall also be marked 'LIFT HERE — TOP' at the crown of the pipe and 'INVERT' at the bottom of the pipe.

18.2 Examples of marking

18.2.1 'A' 'X'

BS 5911 Pt 1 R M S

2.5.81

'Hyd' 'Z'

The above marking on a concrete pipe shall signify:

'Claimed by manufacturer 'A' to have been made at his works 'X' and to comply with the requirements of BS 5911 : Part 1; to be reinforced, of class M and made with sulphate-resisting cement; to have been made on 2 May 1981, and to have been successfully tested hydrostatically, as specified in 25.3, with results recorded in the manufacturer's quality control records 'Z'.'

18.2.2 'B' 'Y'

BS 5911 Pt 1 R 240/300

3.6.81

'Proof' 'T'

The above marking on a concrete pipe shall signify:

'Claimed by manufacturer 'B' to have been made at his works 'Y' and to comply with the requirements of BS 5911 : Part 1; to be reinforced and made to resist works proof and maximum crushing test loads of 240 kN and 300 kN per metre of effective length respectively; to have been made on 3 June 1981, and to have been successfully subjected to the works proof load test, as specified in 25.4, with results recorded in the manufacturer's quality control records 'T'.'

18.3 Method of marking. Units shall be marked with either:

- indelible paint, applied by stencil brush or spray as soon as possible after removal from the moulds;

*Marking BS 5911 : Part 1 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 this Part 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, British Standards Institution, Maylands Avenue, Hemel Hempstead, Herts HP2 4SQ in the case of certification marks administered by BSI or to the appropriate authority for other certification marks.

or:

(b) impressed characters approximately 2 mm deep.

All marks shall be visible and legible. For units of nominal size DN 675 and above, marking shall be on the internal surface of the unit.

19. Effective lengths of pipes

Effective lengths of pipes (see 3.10) shall be between 0.45 m and 5 m inclusive. The manufacturer shall inform the purchaser of the effective lengths of pipes that he is able to supply in a given nominal size named in an enquiry or order. (See appendix A.)

20. Crushing test loads for pipes

The crushing test loads for pipes shall normally be those shown in table 2.

However, it is permissible to specify pipes with greater crushing strengths, under the following conditions.

(a) The maximum load shall be given to the manufacturer when making an enquiry or order.

(b) The works proof load shall be taken to be 80 % of the maximum load.

Pipes shall be marked as specified in clause 18 and sampled and tested in accordance with the appropriate requirements given in table 9.



Table 2. Crushing test loads

Kilonewtons per metre of effective length

Nominal size of pipe DN	Class L		Class M		Class H	
	Works proof load	Maximum load	Works proof load	Maximum load	Works proof load	Maximum load
150	20	25				
225	20	25				
300	20	25	23	29		
375	20	25	31	39	36	45
450	20	25	35	44	41	52
525	20	25	38	48	46	58
600 (see note 2)	20	25	46	58	54	68
675	20	25	50	63	60	75
750	38	48	53	67	65	81
825	41	52	58	72	69	86
900	46	58	67	84	85	106
975	48	60	72	90	91	114
1050	51	64	76	95	96	120
1125	53	67	82	103	106	133
1200	57	72	87	109	110	138
1350	63	79	95	120	122	153
1500	69	87	104	130	132	165
1650	75	94	116	145	146	183
1800	82	103	124	155	158	198
1950	88	110	135	169	169	212
2100	96	120	146	183	184	230
2250	102	128	155	194	195	244
2400	108	135	165	207	210	263
2550	116	145	177	222	223	279
2700	124	155	186	233	235	294
2850	130	163	195	244	251	314
3000	135	169	207	259	260	326

Notes to table 2

NOTE 1. Works proof loads are 80 % of maximum loads for each size and class of pipe. However, for ease of use, values in the table have been rounded off to the nearest kilonewton per metre of effective length.

NOTE 2. Unreinforced pipes are not normally available in nominal sizes greater than DN 600.

NOTE 3. For information on the application of the pipe crushing test loads in table 2 to design of pipelines, reference should be made to 'Simplified tables of external loads on buried pipelines (revised edition)' published by Her Majesty's Stationery Office (HMSO).

It should be noted that the terms 'proof load' and 'ultimate load' in those tables correspond to the terms 'works proof load' and 'maximum load' respectively in table 2 of this standard.

BS 5911 : Part 1 : 1981

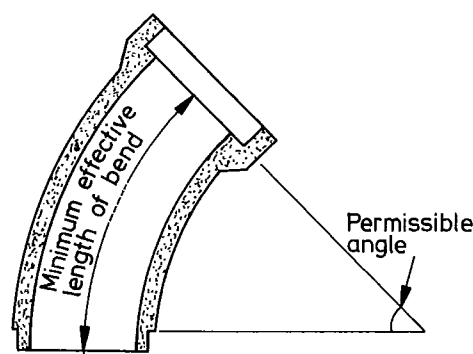
21. Bends

Bends shall be either monolithic (cast as one piece) or polygonal, i.e. fabricated using sections of pipe and adhesive. (See appendix A.)

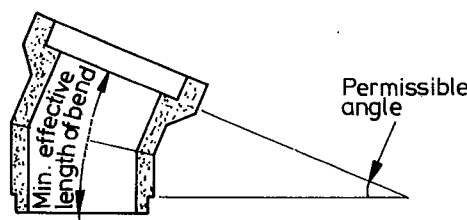
The minimum effective lengths and permissible angles of bends, measured as shown in figure 4, shall be as shown in table 3.

NOTE 1. Typical bends are shown in figure 4.

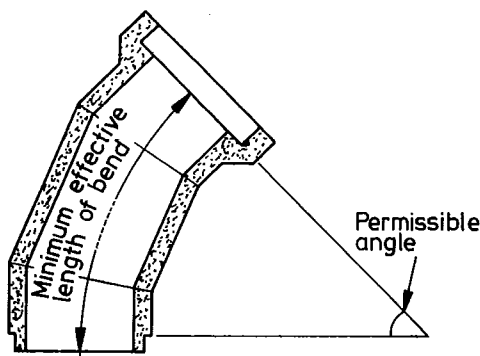
NOTE 2. For guidance on use of adhesives, see CIRIA Report 69, 'Effective use of epoxy and polyester resins in civil engineering structures', published by the Construction Industry Research and Information Association (CIRIA).*



(a) Monolithic



(b) Polygonal (two piece)



(c) Polygonal (three piece)

Figure 4. Types of bend

Table 3. Minimum effective lengths and permissible angles of bends

Nominal size	Minimum effective length	Permissible angles
DN	mm	
150 to 225	300	45°, 22 1/2°, 11 1/4°
300 to 600	450	45°, 22 1/2°, 11 1/4°
675 and upwards	500	22 1/2°, 11 1/4°

NOTE 1. Bends should have the same manufacturing diameter and wall thickness as the pipes with which they are to be laid.

NOTE 2. Bends may not necessarily have the same load-bearing capacity as the pipes with which they are to be laid.

*Obtainable from CIRIA, 6 Storey's Gate, London SW1P 3AU.

Full document details: BS 5911-1:1981

Bends shall be marked as specified in clause 18 and sampled and tested in accordance with the appropriate requirements given in table 9.

Polygonal bends shall be made from pipes selected from an accepted batch.

22. Junctions

The nominal sizes and dimensions of junctions shall be as shown in tables 4 and 5.

NOTE 1. The main pipes should have the same manufacturing diameter and wall thickness as the corresponding straight pipes with which they are to be laid.

NOTE 2. Typical junctions are shown in figure 5.

The dimensions and materials of branches shall be specified by the purchaser in his enquiry or order.

The junction shall be either cast as one piece or built up by inserting a branch pipe in the main concrete pipe. Concrete pipes used for built up junctions shall be selected from an accepted batch.

Table 4. Right angled junctions

Nominal size		A (mm)	B (mm)
D	D ₁		
See table 1	To be the same size as D or any nominal size less than D	Not more than 375	See clause 19

Table 5. Oblique angled junctions

Nominal size		B (mm)
D	D ₁	
See table 1	To be the same size as D or any nominal size less than D	The length of the oblique branch shall not extend beyond the socket or spigot of the main pipe

When built up, the branch shall be adequately secured with adhesive material. Where sand:cement mortar is used, it shall follow the recommendations for pipes in table 2 of CP 2005 : 1968. Where the branch is built up by using a length of vitrified clay this shall comply with the requirements of BS 65.

NOTE. For guidance on use of adhesives, see CIRIA Report 69, 'Effective use of epoxy and polyester resins in civil engineering structures', published by the Construction Industry Research and Information Association (CIRIA).*

The internal surface at the intersection of the branch pipe and the main pipe shall have a flush and fair finish.

Junctions shall be marked as specified in clause 18 and sampled and tested in accordance with the appropriate requirements given in table 9.

NOTE. Junctions may not necessarily have the same load-bearing capacity as the pipes with which they are to be laid.

23. Manholes

23.1 General. Manholes shall consist of two or more of the following precast components:

- shaft cover slabs (heavy duty or light duty);
- shaft sections;

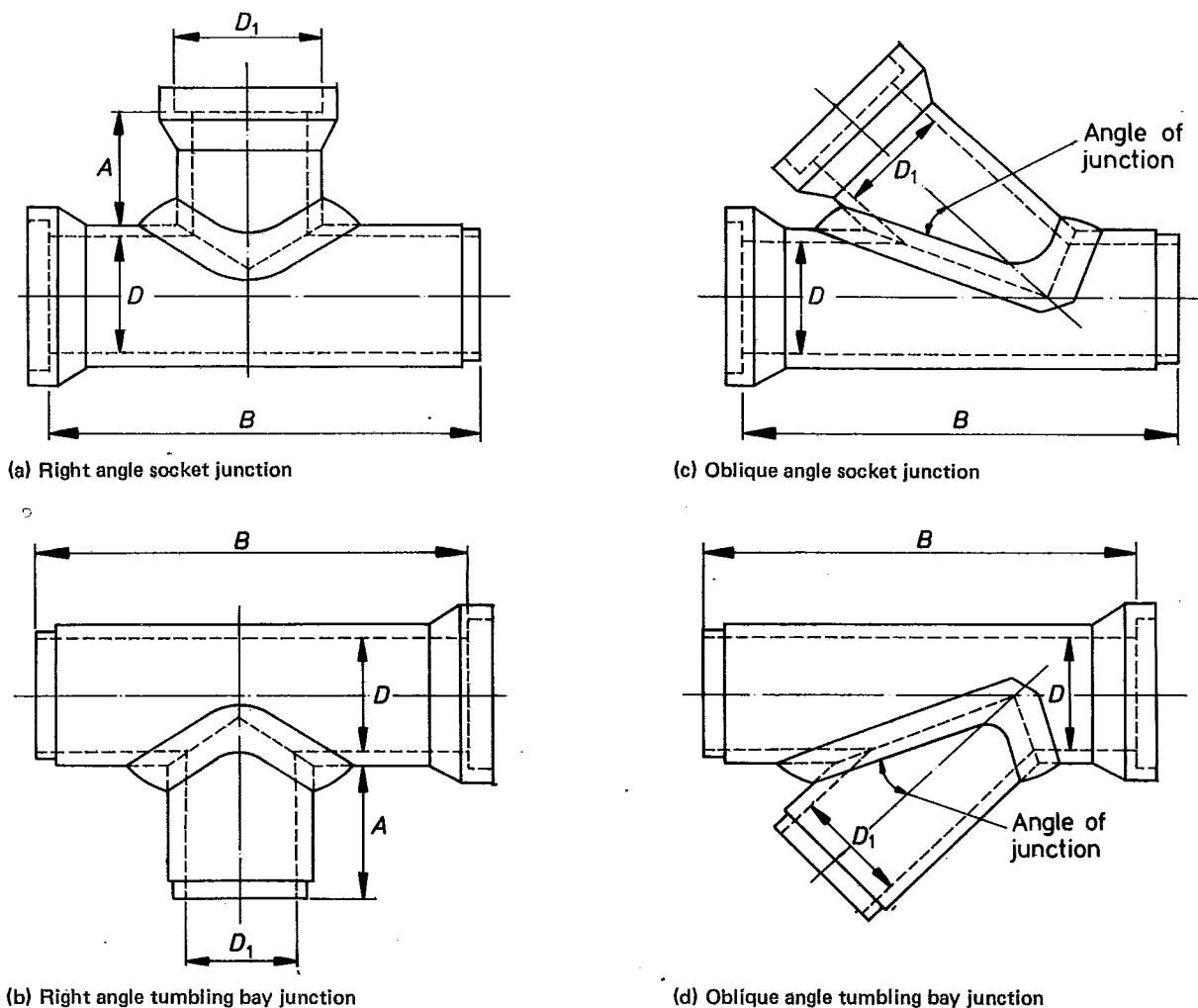


Figure 5. Typical junctions

reducing slabs;
tapers (straight back);
chamber cover slabs (heavy duty or light duty);
chamber sections.

Manhole components, except cover slabs and reducing slabs, shall be jointed by means of one of the joints described in 17.2.

Manhole components shall be sampled and tested in accordance with the appropriate requirements given in table 9.

NOTE. Typical manhole arrangements are shown in figure 6(a) and (b).

23.2 Dimensions. The dimensions of manhole components are given in tables 1, 6, 7 and 8. The lengths of shaft and chamber sections shall normally be 300 mm to 1200 mm in multiples of 150 mm (dimension B in table 6). However, it is permissible to use lengths of 250 mm to 1000 mm in multiples of 125 mm (dimension B^1 in table 6), provided that all sections within a given manhole are multiples of 125.

23.3 Lifting facilities. Suitable points for lifting shall be incorporated in all precast manhole components.

23.4 Step irons. Step irons complying with the appropriate requirements of BS 1247 shall be fixed by the manufacturer in the manhole chamber, taper and shaft sections and, if necessary, the reducing slabs unless otherwise specified, and the tail shall be contained within the wall thickness.

The vertical interval between all step irons within a given manhole (dimension K in figure 6(a) and 6(b)) shall be 300 or 250 mm and, with the exception of sections immediately below a cover slab, there shall be a step iron at a distance equal to half this vertical interval below the top of each unit (dimension L in figure 6(a) and (b)).

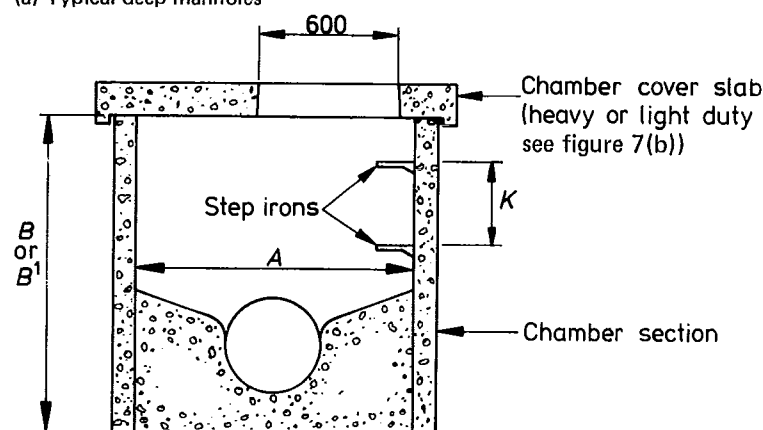
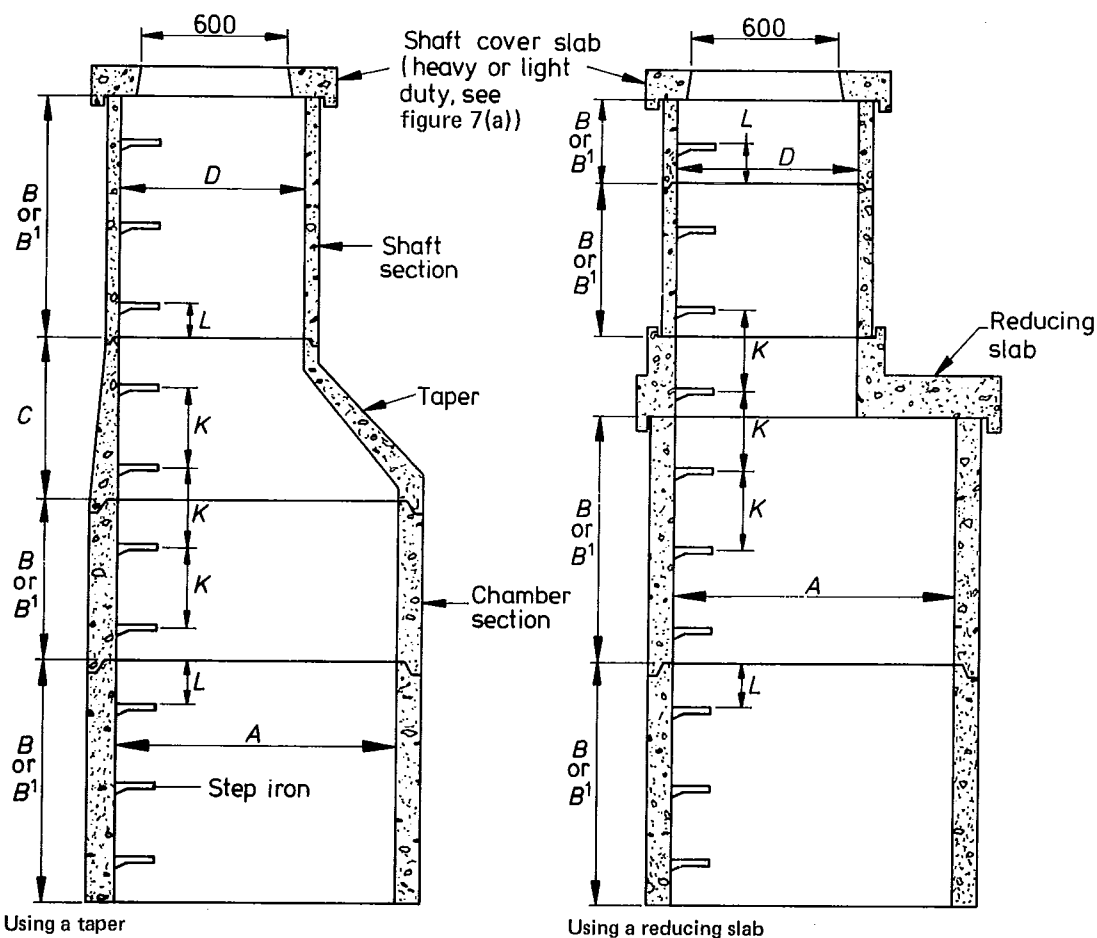
For sections immediately below a cover slab, there shall be a step iron at a distance equal to half the vertical interval above the bottom of the unit (dimension L in figure 6(a) and (b)).

In all cases, step irons shall be staggered horizontally as shown in figure 7(d).

Table 6. Shaft sections, chamber sections and tapers

Nominal sizes		Lengths (mm)				
A	D	C	B	B ¹	K	L
900	675 or 900	600	300 to 1200	250 to 1000	300, where B applies, or 250 where B ¹ applies.	150, where B applies, or 125, where B ¹ applies.
1050		600	in multiples of	in multiples of		
1200		600	300 except for	250 except for		
1350		900	bottom sections	bottom sections		
1500		900	and those	and those		
1800		900	immediately	immediately		
2100		900	below a cover	below a cover		
2400	See note	See note	slab, where	slab, where		
2700			multiples of	multiples of		
3000			150 shall apply	125 shall apply		

NOTE. For sizes of A greater than DN 1800, reducing slabs are normally used.

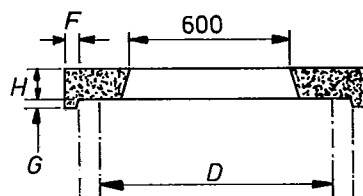


All dimensions are in millimetres.

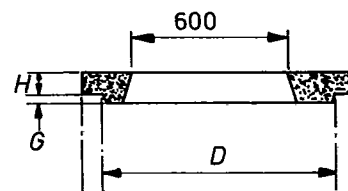
Figure 6. Typical manhole arrangements

23.5 Cover slabs

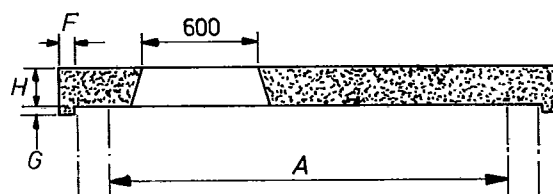
23.5.1 Shaft cover slabs. Shaft cover slabs (for DN 675 or DN 900 shafts) shall be provided having an access hole 600 mm in diameter or 600 mm square, with corners radiused or chamfered 75 mm as shown in figure 7(c). There shall be two classes, heavy duty slabs, and light duty slabs, in accordance with figure 7 and table 7.



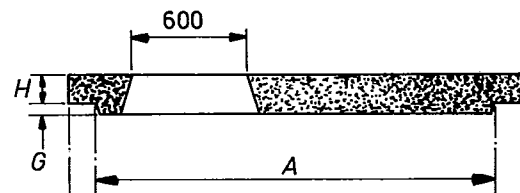
Type 1 (heavy or light duty)



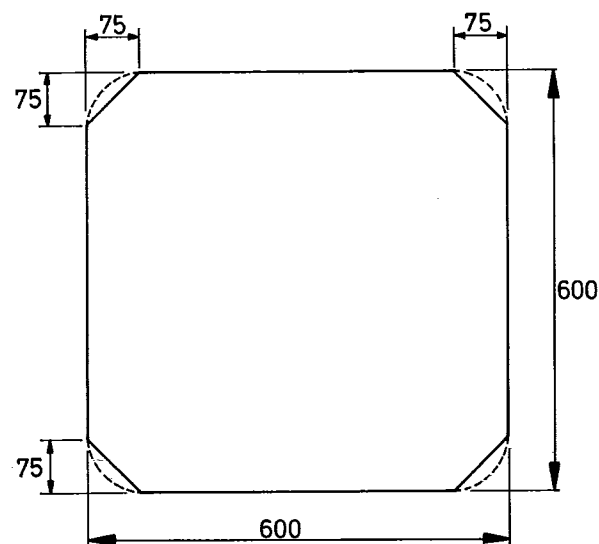
Type 2 (light duty only)



Type 1 (heavy or light duty)



Type 2 (light duty only)



Detail of square opening in heavy and light duty cover slabs

(c) Detail of square access hole

All dimensions are in millimetres.

Figure 7. Manhole cover slabs