
British Standard

Precast concrete pipes and fittings for drainage and sewerage

Part 3. Specification for pipes and fittings with ogee joints

Tuyaux et raccords d'évacuation et d'assainissement en béton préfabriqué
Partie 3. Tuyaux et raccords à bagues ogivales — Spécifications

Fertig-Betonrohre und -Formstücke für Entwässerungs- und Abwasserleitungen
Teil 3. Rohre und Formstücke mit S-förmigen Anschlüssen

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

Foreword

This Part of BS 5911 has been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Committee. This third Part of BS 5911 covers precast concrete cylindrical pipes with ogee (rebated) joints, unreinforced or reinforced with steel cages or hoops.

This Part supersedes BS 4101 : 1967 and, together with Parts 1 and 2, supersedes BS 556 : Part 2 : 1972.

The superseded standards are withdrawn.

The requirements for 'Sewerage' pipes are essentially the same as those for flexibly jointed pipes complying with BS 5911 : Part 1, except that there are no type tests for ogee joints. Attention is drawn to the fact that an ogee joint is not normally designed to resist water pressure.

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 manufacturer's works or in testing stations. The tests in this Part are intended to

ensure that the pipes are 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.

For an enquiry and order to be fully understood, it is essential to provide the information listed in appendix A.

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

British Standard

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Part 3. Specification for pipes and fittings with ogee joints

Section one. Specification

1. Scope

This Part of BS 5911 specifies requirements for two categories of precast concrete cylindrical unit, each with ogee (rebated) joints and unreinforced or reinforced with steel cages or hoops, namely 'Land drainage' units and 'Sewerage' units.

'Land drainage' units are intended to be used primarily for land drainage and for the construction of culverts. 'Sewerage' units are intended to be used in conditions where more stringent requirements are necessary, for example in headings or in the construction of culverts where extra strength is required.

A range of nominal sizes (DN) is covered, namely DN 150 to DN 1800 by increments of 75 for 'Land drainage' units and 'Sewerage' units.

2. References

The titles of the publications referred to in this Part of BS 5911 are listed on the inside back cover.

3. Definitions

For the purposes of this Part of BS 5911 the following definitions apply.

3.1 unit. A pipe, bend or junction.

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 pipe longitudinal axis.

3.5 ogee (rebated) joint. A joint made within the wall thickness of a unit (see figure 2).

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 which a manufacturer seeks to achieve.

3.8 actual diameter. Any internal diameter found by measurement.

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

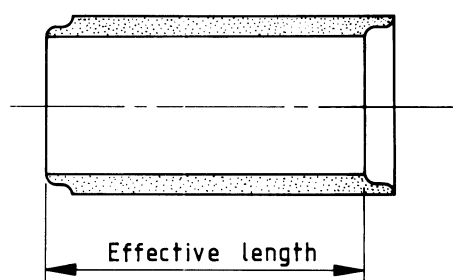


Figure 1. Effective length of units

3.10 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.

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

4. 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

5. Aggregates

5.1 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.

NOTE. Typical samples of aggregates and evidence of satisfactory performance of the concrete manufactured with such aggregates should be made available to purchasers on request (see A.2).

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

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

The maximum nominal size of aggregate as defined in

BS 882, 1201 : Part 2 shall not exceed the least of the following:

- (a) 20 mm;
- (b) the concrete cover (see 8.2);
- (c) three-quarters of the minimum clear distance between reinforcing bars (see 8.1).

6. Other concrete materials

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

6.2 Admixtures. The composition and use of admixtures, including calcium chloride, shall follow the recommendations of 6.2.4 of CP 110 : Part 1 : 1972.

7. Concrete

7.1 Cement content. The fully compacted concrete shall contain not less than 360 kg of cement per cubic metre and shall have a maximum water/cement ratio of 0.45.

7.2 Design mix (monolithic bends and junctions cast as one piece). For monolithic bends and junctions cast as one piece, the 28-day characteristic strength of the concrete shall be not less than 30 N/mm², assessed in accordance with the requirements of BS 5328.

NOTE. Cube tests for the concrete used in pipes, polygonal bends and built-up junctions are not required because the concrete used in the manufacture of these units is generally compacted in quite a different way from the method specified in BS 1881 : Part 3.

For each mix design, samples of freshly made concrete shall be taken from not less than 2 % of the total number of batches of concrete. Sampling shall be at a rate of not less than one sample per 20 m³ of fresh concrete taken daily.

7.3 Chloride content. The total chloride ion content of the concrete mix shall follow the recommendations of 6.3.8 of CP 110 : Part 1 : 1972.

7.4 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. Heating of aggregates and water before mixing, to a temperature not exceeding 60 °C, shall be permitted. Other materials and moulds shall not be used if they are frozen.

8. Steel reinforcement

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

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
Austenitic stainless steel	BS 970 : Part 4, Grade 320S17

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

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 shall be permitted. Longitudinal bars or wires or any other method to control spacing and shape and to ensure safe handling shall also be permitted.

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

8.2 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.

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 either be of rust proof material or be of steel protected against corrosion, except that only stainless steel shall be permitted within 12 mm of the internal surface of a unit. 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.

9. Nominal size (DN)

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

Pipes with nominal sizes halfway between those shown in column 1 for the range DN 1200 to DN 1800 shall be permitted, provided the tolerances on diameter and wall thickness are those relating to the next highest nominal size.

10. Manufacturing diameter and actual diameter

The manufacturing diameter (see 3.7) 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.

11. 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.

12. Squareness of ends

The ends of each unit (except splayed end pipes) shall be square with its longitudinal axis, or, for a bend, the tangent to it, within the manufacturer's stated tolerances.

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

13. Permissible deviation from straightness

When measured as described in appendix C, the maximum permissible deviation from straightness shall be 3.5 mm per metre of the total effective length (see 3.9) of the pipe.

14. Permissible irregularity of internal surface

After testing in accordance with the procedure given in appendix G, the internal surface of the pipe shall not retain irregularities which cause either of the 2 mm rims of the gauge to lose contact with the surface.

Stoning off isolated protuberances in order to secure compliance with this clause shall be permitted.

NOTE. 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

Table 1. Nominal sizes and permissible tolerances for units

1		2		3	4
Nominal size of units		Permissible limits of manufacturing diameter (see clause 10)		Permissible deviation of actual diameter (plus or minus) from manufacturing diameter (see clause 10)	Permissible variation of wall thickness (see clause 11)
'Land drainage' units	'Sewerage' units	Maximum diameter	Minimum diameter		
DN	DN	mm	mm	mm(±)	mm
150	150	155	150	5	6
225	225	230	225	5	6
300	300	305	300	5	6
375	375	385	365	6	6
450	450	460	440	6	6
525	525	535	515	6	6
600	600	610	590	6	6
675	675	695	655	6	6
750	750	770	730	6	6
825	825	845	805	6	6
900	900	920	880	6	6
975	975	995	955	6	6
1050	1050	1070	1030	6	6
1125	1125	1145	1105	6	6
1200	1200	1220	1180	10	10
1350	1350	1380	1330	10	10
1500	1500	1530	1480	10	10
1650	1650	1680	1630	10	10
1800	1800	1830	1780	10	10

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.

15. Joints

The axial length of each ogee joint of a unit shall be not less than 15 mm or $(0.03 \text{ DN} + 7)$ mm, where DN is the nominal size of the unit, whichever is the greater. For example, for a section of DN 1200, the axial length shall be not less than $(0.03 \times 1200 + 7)$ mm = 43 mm. Other joint dimensions shall conform to the manufacturer's stated dimensions and tolerances.

NOTE. For typical joints, see figure 2.

16. Marking of units

16.1 Requirements for marking 'Land drainage' units

16.1.1 Units of nominal size greater than DN 600.

Each 'Land drainage' unit of nominal size greater than DN 600 shall be clearly marked with the following information:

- the number of this British Standard, i.e. BS 5911 : Part 3*;
- the letter 'R', if the unit is reinforced;
- where higher crushing test loads than those given in clause 18 for a given nominal size of pipe have been

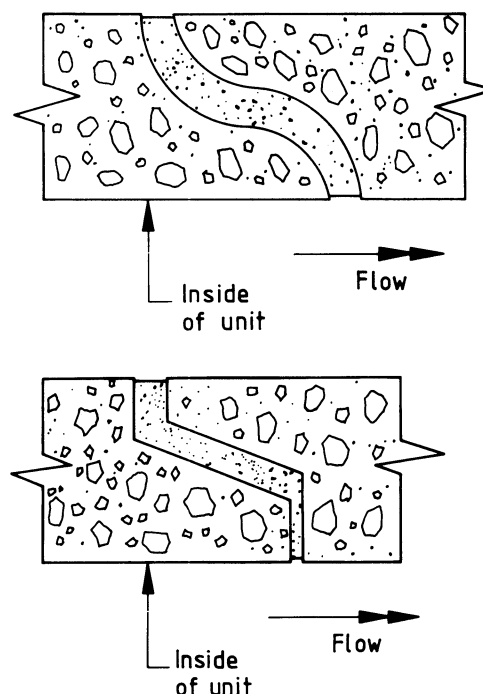


Figure 2. Typical ogee joints

*Marking BS 5911 : Part 3 on or in relation to a product is a claim by the manufacturer that the product has been manufactured in accordance with the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification to support such claims should be addressed to the Director, Quality Assurance Division, British Standards Institution, 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.

specified, the works proof and maximum crushing test loads in kilonewtons per metre of effective length;

(d) a blue coloured mark 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 22.2 and 22.3 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 (see figure 5) to denote the longest and shortest lengths along the outside of the unit.

16.1.2 Units of nominal size DN 600 or less. Each unit of nominal size DN 600 or less shall be clearly marked with the following information:

(a) a blue coloured mark where sulphate-resisting Portland cement has been used;

(b) where crushing test loads higher than those given in clause 18 for a given nominal size of pipe have been specified, the works proof and maximum crushing test loads in kilonewtons per metre of effective length;

(c) where tests as described in 22.2 and 22.3 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.

16.2 Requirements for marking 'Sewerage' units.

Each 'Sewerage' unit shall be clearly marked with the following information:

(a) the number of this British Standard, i.e. BS 5911 : Part 3*;

(b) the letter 'R' if the unit is reinforced;

(c) an indication of the crushing test load(s), which normally consists of the letters 'L', 'M' or 'H' to denote 'light', 'medium' or 'heavy' class pipes, as shown in table 2;

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

(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 22.2 and 22.3 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 unit.

16.3 Examples of marking

16.3.1 'A' 'X'

BS 5911 : Pt 3 R 32/40

2.5.82 + Blue mark

'Proof' '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 3 for 'Land drainage' units; to be reinforced and made with sulphate-resisting cement; to resist works proof and maximum crushing test loads of 32 kN and 40 kN per metre of effective length respectively; to have been made on 2 May 1982, and to have been successfully subjected to the works proof load test, as specified in 22.3, with results recorded in the manufacturer's quality control records 'Z'.

16.3.2 'B' 'Y'

BS 5911 : Pt 3 R M S

3.6.82

'Hyd' '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 3 for 'Sewerage' units; to be reinforced, of class M and made with sulphate-resisting cement; to have been made on 3 June 1982, and to have been successfully subjected to the hydrostatic test, as specified in 22.2 with results recorded in the manufacturer's quality control records 'T'.

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

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

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.

17. Effective lengths of pipes

Effective lengths of pipes (see 3.9) shall be from 0.45 m to 2.5 m inclusive.

NOTE. Manufacturers should advise purchasers which effective lengths in a given nominal size can be supplied (see A.1).

18. Crushing test loads for pipes

For 'Land drainage' pipes the works proof load and the maximum load shall be not less than 20 kN and 25 kN per metre of effective length respectively.

For 'Sewerage' pipes, the crushing test loads shall be not less than those shown in table 2. For nominal sizes halfway between those shown in the range DN 1200 to DN 1800 (see clause 9), the crushing test loads shall be obtained by interpolation.

Pipes with greater crushing strengths shall be permitted, provided the works proof load is not less than 80 % of the

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