

Precast concrete pipes and ancillary concrete products —

Part 110: Specification for ogee pipes and fittings (including perforated)

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Cement, Gypsum, Aggregates and Quarry Products Standards Policy Committee (CAB/-) to Technical Committee CAB/12, upon which the following bodies were represented:

- Association of Consulting Engineers
- Association of Metropolitan Authorities
- British Cement Association
- British Precast Concrete Federation Ltd.
- Concrete Pipe Association
- Concrete Society
- County Surveyors' Society
- Department of Transport
- Federation of Civil Engineering Contractors
- Institution of Civil Engineers
- Institution of Highways and Transportation
- Institution of Water and Environmental Management
- Ministry of Agriculture, Fisheries and Food
- Pipe Jacking Association
- Sand and Gravel Association Limited
- Water Services Association of England and Wales

The following body was also represented in the drafting of the standard, through subcommittees and panels:

- Department of Transport

This British Standard, having been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 November 1992

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The following BSI references relate to the work on this standard:
Committee reference CAB/12
Draft for comment 90/11575 DC

ISBN 0 580 19992 4

Amendments issued since publication

Amd. No.	Date	Comments
8155	March 1994	Indicated by a sideline in the margin

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Foreword

This Part of BS 5911 has been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Policy Committee. It supersedes BS 5911-3:1982 which is withdrawn.

Following the revision of the Part numbering system for BS 5911, led by the revision of Part 1 under the number BS 5911-100, this Part becomes BS 5911-110.

This revision follows the relevant changes to Part 1 incorporated in Part 100.

The principal changes, as compared with BS 5911-3:1982 are as follows.

- a) The previous standard referred to the use of products for “land drainage and sewerage”. Usage now relates to ground water and surface water only, “sewerage” category pipes having been omitted because of lack of use. Similarly, sizes above DN 1 200 have been omitted.
- b) The types of joint dealt with are now described as rebated, ogee joints being regarded as a special example of rebate (see Figure 1).
- c) The specifications for cement and concrete have taken note of the use of pulverized-fuel ash (p.f.a.) or ground granulated blastfurnace slag (g.g.b.s.) in combination with Portland cement. The limits of chloride content of the concrete have been included.
- d) Perforated pipes have been included and the dimensions and frequency of perforations have been specified.
- e) Requirements relating to finish and dealing with the use of additives have been expanded.
- f) Cube crushing tests have been introduced for the concrete used in monolithic bends and junctions.
- g) A bending moment resistance test has been introduced for certain pipes up to and including DN 300.

This Part of BS 5911 is a specification incorporating tests, on pipes in manufacturers’ works or in testing stations, that relate to performance of buried pipelines. The criteria are intended to ensure that the pipeline will carry ground or surface water at atmospheric pressure without suffering structural damage. Pipes to be installed in an environment aggressive to concrete should be the subject of special consideration, for example as regards depth of concrete cover to reinforcement.

For an enquiry or order to be fully understood it is essential that the supplier be given the information set out in Appendix A.

Product certification. Users of this British Standard are advised to consider the desirability of third party certification of product conformity with this British Standard based on testing and continuing surveillance, which may be coupled with assessment of a supplier’s quality systems against the appropriate Part of BS 5750.

Enquiries as to the availability of third party certification schemes will be forwarded by BSI to the Association of Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching an appropriate body from the list of Association members.

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

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 26, an inside back cover and a back cover.

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

Section 1. General

1 Scope

This Part of BS 5911 specifies requirements for precast concrete cylindrical units, perforated or unperforated, each with ogee or other rebated joints, either unreinforced or reinforced with steel cages or hoops. Perforated unreinforced pipes are also included.

The units specified are intended for drainage and for the construction of culverts, other than systems carrying foul water.

The specification covers constituent materials, dimensional requirements, performance requirements, appropriate test methods and inspection procedures.

This standard does not include the structural or hydraulic design of the pipeline, its durability under unusual environmental conditions or standards of workmanship and supervision during construction and operation. For guidance on these topics, work on further British Standards is in hand.

NOTE The titles of the publications referred to in this Part of BS 5911 are listed on page 26.

2 Definitions

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

2.1 unit

a pipe, bend or junction

2.2 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 profile

NOTE The inclusion of reinforcement solely for handling purposes does not exclude a pipe from this definition.

2.3 reinforced concrete pipe

a pipe, as defined in 2.2, but reinforced with one or more prefabricated steel cages or hoops suitably positioned to resist tensile stresses imposed by the specified test loads

2.4 perforated pipe

an unreinforced concrete pipe with circular perforations

2.5 splayed end pipe

a pipe having one or both of its ends designed to be in a plane not at right angles to its longitudinal axis

2.6 rebated joint

a joint made within the wall thickness of a unit, including ogee joints

NOTE See Figure 1.

2.7 nominal size (DN)

a numerical designation of the bore of a unit, which is a convenient round number approximately equal to the internal diameter in millimetres

2.8 manufacturing diameter

a diameter of a unit that a manufacturer seeks to achieve

2.9 actual diameter

a diameter found by measurement

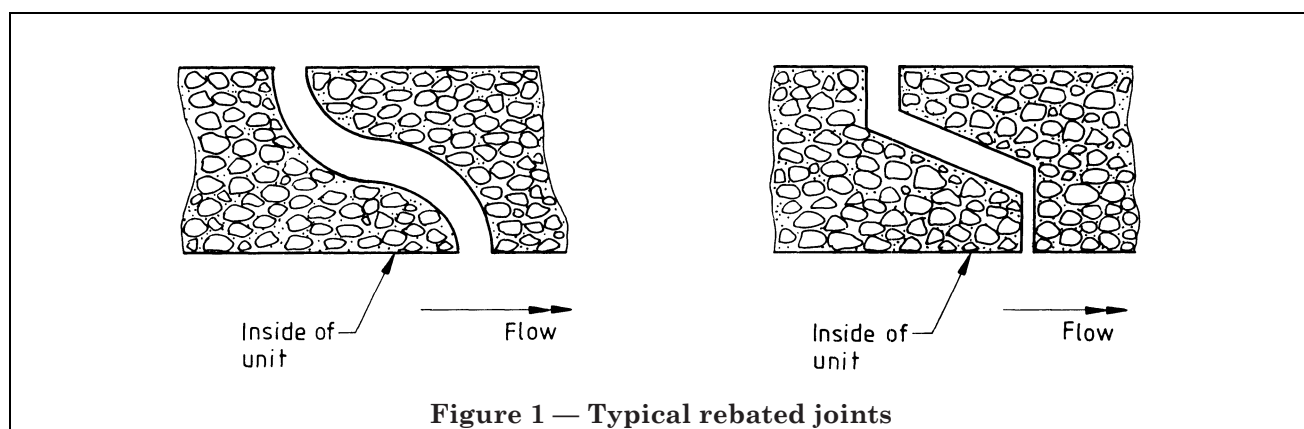
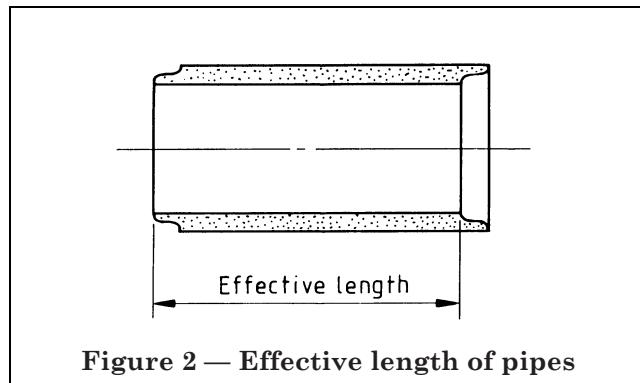


Figure 1 — Typical rebated joints

2.10
effective length

the length of a pipe measured as shown in Figure 2



2.11
characteristic strength of concrete

that value of cube strength below which 5 % of all possible strength measurements of the specified concrete are expected to fall

2.12
batch

the number of units of a particular specification produced under uniform conditions during a given production period by one particular process

2.13
reinforcement

steel, other than stainless steel, cast within a unit so as to reinforce the concrete, or to locate steel for that purpose

Section 2. Materials

3 Cement

The cement shall:

- a) be factory-produced by the cement manufacturer and comply with 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
sulfate-resisting Portland	BS 4027
Portland p.f.a.	BS 6588

or

- b) consist of a normal or special combination of cement complying with BS 12 and g.g.b.s. or p.f.a. in accordance with the following, to be included as part of the concrete mix by simultaneously combining them with the other concrete materials at the concrete mixer:

Cementitious component other than cement	Standard to be complied with	% by mass of total cementitious content	
		normal	special (additional resistance to sulfate, see note)
g.g.b.s.	BS 6699	0 % to 65 %	70 % to 90 %
p.f.a.	BS 3892-1	15 % to 35 %	25 % to 40 %

NOTE The minimum cement content and maximum water/cement ratio specified in 6.1 will ensure that any of the cements listed in item a) or normal combinations of cement complying with BS 12 and g.g.b.s. or p.f.a. as specified in item b) will facilitate resistance to sulfate attack equivalent to classes 1 and 2 in Table 6.1 of BS 8110-1:1985. Class 3 resistance will be provided by the use of special combinations of cement complying with BS 12 and g.g.b.s. or p.f.a. as specified in item b) or by cement complying with BS 4027; the latter will also facilitate class 4 resistance if the minimum cement content is 370 kg/m³. The advice of the pipe manufacturer should be sought where class 5 conditions exist.

4 Aggregates

4.1 General

Aggregates shall consist of materials complying with BS 882:1983 except that the manufacturer may modify the grading requirements of clause 5 of that standard (see clause 0 of BS 882:1983).

4.2 Testing

4.2.1 Mechanical properties

When tested in accordance with BS 812-111, BS 812-112 and BS 812-105.1 respectively the limiting values on the mechanical properties of coarse aggregates shall be either a minimum of 10 % fines value of 100 kN or a maximum aggregate impact value of 30 %. Flakiness index shall be not more than 35.

4.2.2 Nominal maximum size

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

- 20 mm;
- the depth of concrete cover to reinforcement (see 7.2);
- one-quarter of the minimum thickness of the wall of the unit.

5 Other concrete materials

5.1 Water

Water shall be clean and free from harmful matter in such quantities as would affect the properties of the concrete in the plastic or hardened state (see Appendix A of BS 3148:1980).

NOTE As a general rule, potable water, whether treated for distribution through the public supply or untreated, is suitable for making concrete.

5.2 Admixtures

Admixtures shall comply with BS 5075.

NOTE Admixtures, when used (see Appendix A), should not impair the durability of the concrete, nor combine with the ingredients to form harmful compounds nor increase the risk of corrosion of reinforcement.

The chloride ion content of admixtures shall not exceed 2 % by mass of the admixture or 0.03 % by mass of the cement, when used in:

- any concrete containing reinforcement or other embedded metal;
- and
- any concrete made with cement complying with BS 4027.

The manufacturer shall make available details of:

- the relevant production records;
- the admixture(s) used;
- the dosage rate of each admixture;
- the effect of under-dosing and over-dosing.

6 Concrete mix, casting and finish

6.1 Cement content

The fully compacted concrete shall contain not less than 360 kg of cement (inclusive of any g.g.b.s. or p.f.a.) per cubic metre and shall have a water/cement ratio not greater than 0.45. Where a special combination of cement complying with BS 12 and g.g.b.s. or p.f.a. is used (see item b) of clause 3), the minimum cementitious content shall be increased from 360 kg/m³ to 380 kg/m³.

6.2 Chloride content

The total chloride ion content of the concrete mixes shall be as given in Table 1.

Table 1 — Limits of chloride content of concrete

Type of concrete	Maximum total chloride content expressed as a percentage of chloride ion by mass of cement (inclusive of g.g.b.s. or p.f.a. when used)
	%
Heat-cured concrete containing embedded metal	0.1
Concrete made with cement complying with BS 4027	0.2
Concrete containing embedded metal and made with cement complying with BS 12, BS 146, or combinations of cement complying with BS 12 and g.g.b.s. or p.f.a.	0.4

6.3 Work in cold weather

Concrete, when placed, shall have a temperature of at least 5 °C, which shall be maintained until the concrete is hardened.

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

Other materials and moulds, if at a temperature below 0 °C, shall not be used.

6.4 Compaction

All units shall be compacted so that, when hardened, they shall be free from honeycombing and from any individual large void (i.e. greater than 6 mm) as defined in 4.4.1 of BS 1881-120:1983. Blistering shall not be regarded as a void.

6.5 Surface finish

6.5.1 Surface evenness

When tested in accordance with B.1, the internal surface of a pipe shall not have irregularities that cause the central portion of the gauge to touch the pipe.

NOTE For pipes of the smaller nominal sizes, it may prove impracticable to test the central portion of the pipe.

6.5.2 Surface voids

Surfaces of units shall be free from voids that, when tested in accordance with B.2, permit diametrically opposite points of the rim of the gauge to touch simultaneously the surface of the unit.

Units exhibiting surface voids greater than 12 mm deep shall be deemed not to comply with this standard.

NOTE Voids up to and including 12 mm deep may be made good using material complying with 6.6.1.

The surface finish of units containing reinforcement shall be in accordance with 7.2.

6.6 Making good

6.6.1 Materials

Materials for making good shall be one of the following.

- Neat cement grout, with or without the addition of styrene-butadiene rubber (SBR), the type of cement being compatible with that in the unit to be made good.
- 1 : 3 cement/sand mortar proportioned by mass with or without the addition of SBR. The cement shall be compatible with that in the unit to be made good and the sand shall comply with the requirements for fine aggregate in BS 882 but have a grading such that 100 % of the material passes a 5 mm sieve.
- A sample of the concrete mix minus the aggregate retained on the 5 mm sieve, with or without the addition of SBR.
- Epoxy or polyester resin, or polymer latex mortar.

NOTE For guidance on the use of epoxy and polyester resins, see CIRIA Report 69 "Effective use of epoxy and polyester resins in civil engineering structures", published by the Construction Industry Research and Information Association¹⁾. See also "The Repair of Concrete Structures" published by the Cement and Concrete Association²⁾, which also deals with polymer latex mortars, and 6.10.5 of BS 8110-1:1985.

6.6.2 Blistering

Any blistering shall be made good using material complying with 6.6.1 d).

¹⁾ Obtainable from CIRIA, 6 Storey's Gate, London SW1P 3AU.

²⁾ Obtainable from BCA, Wexham Springs, Slough, Bucks SL3 6PL and from 1st January 1993 from BCA, Telford Avenue, Crowthorne, Berks RG11 6YS.

Flaking of the surface of a unit does not constitute blistering.

6.6.3 Joint surfaces

Before a unit is tested for compliance it is permissible:

- a) subject to 6.4 to rework a joint profile for compliance with clause 15 by the application of material complying with 6.6.1 b) or c) to a depth not exceeding 5 mm whilst the concrete is still green, or material complying with 6.6.1 d), or by grinding off;
- b) subject to 6.4 to make good using material complying with 6.6.1 b) or c) any spalling of the arrises of spigots or sockets that has occurred during de-moulding or handling.

6.6.4 Exposed steel

Where, on de-moulding, bar steel not forming part of the reinforcement of a unit is visible, or found to be within the concrete cover, it is permissible to remove a maximum of two such pieces each having a length not exceeding half the thickness of the unit and to make good the void(s) with material complying with 6.6.1 d) before the unit is assessed for compliance.

6.6.5 Rubbing down

After a unit has been cured and prior to despatch, it is permissible to rub down where necessary to produce a surface finish to comply with 6.5.

7 Reinforcement

7.1 Materials and arrangement

Reinforcement shall comply with one of the following standards, as appropriate.

Type of reinforcement	Standard to be complied with
Carbon steel bars for the reinforcement of concrete	BS 4449
Cold reduced steel wire for the reinforcement of concrete	BS 4482
Steel fabric for the reinforcement of concrete	BS 4483

The main reinforcement shall normally be placed in a circular arrangement, in the form of concentric 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 effective method shall be used to control spacing and shape and to ensure safe handling.

The clear space between circumferential bars shall be not less than the nominal maximum size of the coarse aggregate plus 5 mm.

7.2 Protection for reinforcement

The concrete cover over all 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 be of grade 316S31 austenitic stainless steel complying with BS 970-1 or other rustproof material. Units exhibiting rust marks that originate from steel within the unit shall be deemed not to comply with this Part of BS 5911.

There shall be no steel, other than stainless steel, within the concrete cover.

Reinforcement shall be free from mud, oil, paint, retarders, loose rust, loose mill scale, snow, ice, grease or any other substance which can be shown to affect adversely the steel or concrete chemically, or to reduce the bond.