

Precast concrete pipes, fittings and ancillary products —

Part 120: Specification for reinforced jacking pipes with flexible joints

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 Surveyor’s Society
- Department of the Environment (Property Services Agency)
- Department of Transport
- Federation of Civil Engineering Contractors
- Institution of Civil Engineers
- Institution of Highways and Transportation
- Institution of Water and Environmental Management (IWEM)
- Ministry of Agriculture, Fisheries and Food
- Pipe Jacking Association
- Sand and Gravel Association Ltd.
- Water Authorities’ Association

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 Board of BSI and comes into effect on 28 April 1989

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The following BSI references relate to the work on this standard:
Committee reference CAB/12
Draft for comment 85/12757 DC

ISBN 0 580 17246 5

Amendments issued since publication

Amd. No.	Date of issue	Comments
9020	March 1996	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. Like the other Parts it is a specification incorporating tests on pipes in manufacturers' works or in testing stations.

The pipes covered by this Part of BS 5911 are intended for installation by jacking which is a technique of installing pipes by driving a line of them through the ground by means of hydraulic jacks from a jacking pit to a reception pit. After pushing a full pipe length into the ground, a new pipe is placed into the pit and the process repeated. The direction is controlled by a steerable shield at the front of the pipes. Spoil is excavated at the forward shield by machine or manually and is removed along the pipeline by means of skips, conveyors or conduit. Tests are included to assist pipe jacking contractors and specifying engineers in respect of the pipes' ability to be jacked and to carry sewage or surface water at atmospheric pressure without leaking or suffering structural damage, always provided that the pipes are jacked, jointed and laid in accordance with agreed codes of practice and design procedures, such as "Jacking Concrete Pipes¹⁾" published jointly by the Pipe Jacking Association and the Concrete Pipe Association of Great Britain. 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 an enquiry or order to be fully understood it is essential that the manufacturer be given the information set out in Appendix A.

The joint face strength test (see 18.5) is included in the absence of a suitable jacking strength test. Research is presently being undertaken in order to devise such a test and this may be incorporated in a future revision.

Since the publication of this Part of BS 5911 it has been found that the method described in Appendix C for assessing the out-of-squareness of pipe ends is mathematically incorrect. No problems have been reported with the existing method and as far as is known the discrepancy is largely academic. Nevertheless, the correction is published in recognition of BSI's duty of care.

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 24, 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.

¹⁾ Obtainable from the Concrete Pipe Association of Great Britain, 60 Charles St., Leicester LE1 1FB or the Pipe Jacking Association, 56 Britton St., London EC1 5NA

Section 1. General

1 Scope

This Part of BS 5911 specifies requirements and describes methods of tests for precast concrete cylindrical pipes with flexible joints, reinforced with steel, intended to be installed by pipe jacking and to be used for the conveyance, under atmospheric pressure, of sewage or surface water, and for the construction of culverts. Requirements are given for materials, dimensions and inspection procedures.

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

2 Definitions

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

2.1 pipe

a hollow cylinder manufactured from concrete cast as one piece, reinforced with one or more prefabricated steel cages or hoops

NOTE When “pipe” is used alone in the text of this standard this indicates a jacking pipe, lead pipe or interjack pipe.

2.2 jacking pipe

a pipe of uniform cross section through-out its length, except at the joint, and which incorporates a flexible rebated joint or a butt-end joint with a fixed collar, in either case within the wall thickness

NOTE A jacking pipe is sometimes known as a line pipe.

2.3 lead pipe

a pipe designed for use behind a jacking shield

2.4 interjack pipe

a pipe designed for use at either end of an intermediate jacking station

2.5 nominal size (DN)

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

2.6 manufacturing diameter

a diameter of a pipe that a manufacturer seeks to achieve

2.7 actual diameter

a diameter found by measurement

2.8 effective length

the length of a pipe measured as shown in Figure 1

2.9 batch

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

2.10 make-up pipe sections

pipe sections used to complete jacked pipe runs

2.11 reinforcement

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

3 Marking

3.1 General

Each pipe shall be clearly marked with the following information:

- a) the number of this British Standard, i.e. BS 5911-120²⁾;
- b) the letter “R”, denoting the pipe is reinforced;
- c) an indication of the crushing test load(s), which shall consist of either the letter “J” to denote “jacking” class pipes, or, where higher crushing test loads have been specified, the specified works proof and maximum crushing test loads in kilonewtons per metre of effective length (see 18.3.1).
- d) the letter “S”, where sulphate-resisting Portland cement has been used;
- e) the letter “B”, where ground granulated blastfurnace slag (g.g.b.s.) has been used;
- f) the letter “P”, where pulverized-fuel ash (p.f.a.) has been used;
- g) the letter “A”, where an admixture has been used;
- h) the day, month and year of manufacture;
- i) the manufacturer’s mark and works identification mark;
- j) where tests, as specified in 18.1, 18.2 or 18.3.2 have been successfully carried out on the pipe;
 - 1) the words “Abs”, “Hyd” “N/C” (i.e. “no crack”), as appropriate,

²⁾ Marking BS 5911-120 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.

- 2) the symbol “MU” indicating pipes suitable only for make-up duties (see 2.10 and 18.3.3),
- 3) a reference symbol after the words in item 1) or 2) to identify the results of the tests in the manufacturer’s quality control records.

NOTE Examples of marking

1. “C” “X”

BS 5911-120 “RJS”

2.5.89

“Hyd” “Z”

The above marking on a concrete jacking pipe would signify:

“Claimed by manufacturer “C” to have been made at his works “X” and to comply with BS 5911-120; to be reinforced, of class J and made with sulphate-resisting Portland cement; to have been made on 2 May 1989, and to have been successfully tested hydrostatically, as specified in 18.2 with results recorded in the manufacturer’s quality control records “Z”.”

2. “D” “Y”

BS 5911-120 “RA” 150

2.6.89

“N/C” “T”

The above marking on a concrete jacking pipe would signify:
“Claimed by manufacturer “D” to have been made at his works “Y” and to comply with BS 5911-120; to be reinforced; to contain an admixture and made to resist a maximum crushing test load of 150 kN per metre of effective length; to have been made on 2 June 1989, and to have been successfully subjected to the “no crack” load test, as specified in 18.3.2, with results recorded in the manufacturer’s quality control records “T”.

3.2 Method of marking

Pipes shall be marked with either:

- a) indelible paint, applied by stencil brush or spray as soon as possible after removal from the mould; or
- b) impressed characters approximately 2 mm deep.

All marks shall be visible and legible and shall be on the internal surface of the pipe.

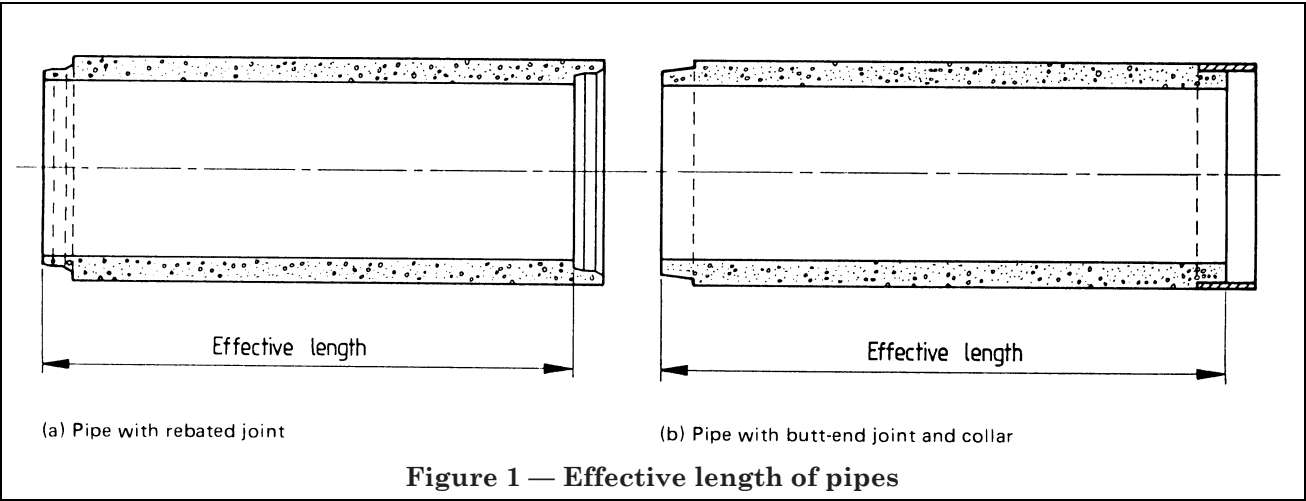


Figure 1 — Effective length of pipes

Section 2. Materials

4 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 146-2
sulphate-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
g.g.b.s.	BS 6699	0 % to 65 %	70 % to 90 %
			(additional resistance to sulphate, see note 1)
p.f.a.	BS 3892-1	15 % to 35 %	25 % to 40 %

NOTE 1 The requirements specified in 7.1 for minimum cement content and maximum water/cement ratio will ensure that any of the permitted cements or normal combinations of BS 12 cement and g.g.b.s. or p.f.a. will provide resistance to sulphate attack equivalent to classes 1 and 2 of Table 6.1 of BS 8110-1:1985. Class 3 resistance will be provided by the use of a special combination of cement complying with BS 12 and g.g.b.s. or p.f.a. 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.

NOTE 2 The purchaser should specify in the enquiry or order the classification of exposure conditions for sulphate attack if higher than class 2 (see Appendix A).

5 Aggregates

5.1 General

Aggregates shall consist of materials complying with BS 882:1983, except for the grading requirements of clause 5 of that standard.

NOTE The pipe manufacturer may modify the gradings to suit his manufacturing process. (See clause 0 of BS 882:1983.)

5.2 Mechanical properties

The limiting values on the mechanical properties of coarse aggregates shall be either a minimum 10 % fines value of 100 kN or a maximum aggregate impact value of 30 %. Flakiness index shall be not more than 35.

5.3 Nominal maximum size

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

- a) 20 mm;
- b) the concrete cover (see 8.2);
- c) one-quarter of the minimum thickness of the pipe;

6 Other concrete materials

6.1 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.

6.2 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.

The manufacturer shall make available details of:

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

7 Concrete mix, casting and finish

7.1 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 clause 4), the minimum cementitious content shall be increased from 360 kg/m³ to 380 kg/m³.

7.2 Chloride content

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

7.3 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.

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)
	% (m/m)
Heat-cured concrete	0.1
Concrete made with cement complying with BS 4027	0.2
Concrete made with cement complying with BS 12, BS 146-2, or combinations of cement complying with BS 12 and g.g.b.s. or p.f.a.	0.4

7.4 Compaction

All pipes 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.

7.5 Surface finish

7.5.1 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.

7.5.2 Surface voids. When tested in accordance with B.2, surfaces of pipes shall be free from voids that permit diametrically opposite points of the rim of the gauge to touch simultaneously the surface of the pipe.

Pipes 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 7.6.1.

7.5.3 Staining. Pipes shall not exhibit rust marks that originate from steel within the pipe.

7.6 Making good

7.6.1 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 pipe 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 pipe 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 Association³⁾. See also “The Repair of Concrete Structures” published by the Cement and Concrete Association⁴⁾, which also deals with polymer latex mortars, and 6.10.5 of BS 8110-1:1985.

7.6.2 Blistering. Any blistering shall be made good using material complying with 7.6.1 d).

NOTE Flaking of the surface of a pipe would not constitute blistering.

7.6.3 Joint surfaces. Before a pipe is tested for compliance it is permissible:

- subject to 7.4, to re-work a joint profile for compliance with clause 16 by the application of material complying with 7.6.1 b) or c) to a depth not exceeding 5 mm whilst the concrete is still green, or material complying with 7.6.1 d), or by grinding off;
- subject to 7.4 and to items 1) and 2), to make good using material complying with 7.6.1 b) or c) any spalling of the arrises of spigots or sockets that has occurred during de-moulding or handling.

- 1) In any pipe the total exposed area of broken concrete shall not exceed $6 \times (\text{DN}) \text{ mm}^2$ with no individual area greater than $3 \times (\text{DN}) \text{ mm}^2$.

NOTE For example, the total area for a DN 900 pipe is $5\,400 \text{ mm}^2$ with no individual area greater than $2\,700 \text{ mm}^2$.

- 2) No exposed area of broken concrete shall be in contact with both the outer and inner surface of the spigot or socket of a pipe.

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

⁴⁾ Obtainable from British Concrete Association, Wexham Springs, Slough, Bucks SL3 6PL.