BRITISH STANDARD

BS 5911-4:2002
+A2:2010

Concrete pipes and ancillary concrete products —

Part 4: Specification for unreinforced and reinforced concrete inspection chambers (complementary to BS EN 1917:2002)

ICS 23.040.50; 91.100.30; 93.030

BSI
British Standards

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee B/505, Wastewater engineering, upon which the following bodies were represented:

British Plastics Federation

Chartered Institution of Water and Environmental Management

Clay Pipe Development Association

CPSA — Concrete Pipeline Systems Association

Institute of Cast Metals Engineers

Institution of Civil Engineers

LOTAG — London Technical Advisors Group

METCOM

ODPM represented by BRE

Water UK

This British Standard, having been prepared under the direction of the Engineering Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 18 November 2002

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Amendments issued since publication

Amd. No.	Date	Comments
15038	27 May 2004	See Foreword
A2	June 2010	See Foreword

Contents

Foreword

The several parts of BS 5911 specify requirements for various types of precast concrete pipe and ancillary concrete products such as manholes, inspection chambers and street gullies.

BS 5911-4 has been prepared under the direction of Technical Committee B/505. It is a revision of part of the content of BS 5911-2. BS 5911-4 was prepared to complement, and to be used in conjunction with, BS EN 1917. In order not to create any barrier to trade, products under the scope of this British Standard are specified as conforming to "BS EN 1917 and BS 5911-4 or equivalent".

BS 5911-4:2002+A2:2010 supersedes BS 5911-4:2002+A1:2004, which is withdrawn.

BS EN 1917:2002 does not contain all the requirements for inspection chambers in the existing national specifications of CEN members because complete agreement could not be achieved. BS 5911-4 contains requirements from BS 5911-2 that could not be agreed upon for inclusion in BS EN 1917.

〉A1〈 The requirements for cementitious content and cement groupings have been aligned with the provisions of BS 8500-1:2006 and BRE Special Digest 1 [1] insofar as they relate to precast concrete pipeline systems. 〉/A1〈

The start and finish of text introduced or altered by Amendments No. 1 and No. 2 is indicated in the text by tags 〉A1〈 〉/A1〈 and 〉A2〈 〉/A2〈. Minor editorial changes are not tagged.

Amendment A2 introduces the following principal changes:

- all references to other standards have been updated;
- Table 1 has been removed, and Table 2 and Table 3 have been replaced to align with BS 8500;
- Figure 1 has been updated;
- the straightness test (**D.3**) has been removed.

For an enquiry or order to be fully understood it is essential that the manufacturer be given the information set out in Annex A of this part of BS 5911.

Product certification. Users of this part of BS 5911 are advised to consider the desirability of third party certification of product conformity with this British Standard. Appropriate conformity attestation arrangements are described in BS EN 1917. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

BSI Committee B/505, whose constitution is shown in this British Standard, takes collective responsibility for its preparation under the authority of the Standards Policy and Strategy Committee. The Committee wishes to acknowledge the contribution of the following organizations:

The British Precast Concrete Federation;

The Concrete Society;

The Institution of Highways and Transportation.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 13 and a back cover.

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1 Scope

BS EN 1917 specifies requirements and describes test methods for precast concrete inspection chambers, designed to be used for inverts not exceeding 2 metres deep, of circular, rectangular (with or without chamfered or rounded corners) or elliptical cross-section, unreinforced, steel fibre and reinforced, with nominal sizes or nominal lengths not exceeding DN 1250 or LN 1250, respectively. The intended use of BS EN 1917 is to permit access to, and to allow aeration of, drain or sewer systems for the conveyance of sewage, rainwater and surface water under gravity or occasionally at low head of pressure, mainly installed in areas subjected to vehicular and/or pedestrian traffic.

This part of BS 5911 specifies complementary requirements to those in BS EN 1917 for unreinforced and reinforced concrete inspection chambers of circular and rectangular cross-section (with or without chamfered or rounded corners), as provided for in that European Standard. This part also specifies requirements for inspection chamber units less than or equal to DN 1000 or LN/WN 1000/675 not exceeding 1 metre depth to invert. The inspection chambers are mainly intended for installation in areas outside the highway and where vehicle loading is restricted.

The scope of BS EN 1917 includes steel fibre concrete inspection chambers, which are not manufactured in the United Kingdom although this was at one time contemplated. Therefore, they have been excluded from this part of BS 5911.

The scope of BS 5911-2 originally included inspection chamber covers. However, these have been excluded from this part of BS 5911 because they now come under the scope of BS EN 124.

〉A2〈 BS EN 752 〉A2〈, BS EN 1295-1 and BS EN 1610 deal with the planning, design, installation and testing of drains and sewers.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

〉A2〈 *Text deleted* 〉A2〈

〉A1〈 *Text deleted* 〉A1〈

BS 3123*, Specification for spring calipers and spring dividers.*

〉A2〈 *Text deleted* 〉A2〈

BS 4027*, Specification for sulfate-resisting Portland cement.*

BS 4035*, Specification for linear measuring instruments for use on building and civil engineering constructional works — Steel measuring tapes, steel bands and retractable steel pocket rules.*

〉A2〈 BS 4449*, Steel for the reinforcement of concrete — Weldable reinforcing steel — Bar, coil and decoiled product — Specification.* 〉A2〈

〉A2〈 BS 4482*, Steel wire for the reinforcement of concrete products — Specification.* 〉A2〈

〉A2〈 BS 4483*, Steel fabric for the reinforcement of concrete — Specification.* 〉A2〈

BS 4484-1*, Specification for measuring instruments for constructional works — Part 1: Metric graduation and figuring of instruments for linear measurement.*

〉A2〈 BS 7979, *Specification for limestone fines for use with Portland cement.* 〉A2〈

〉A2〈 BS 8500-2:2006, *Concrete — Complementary British Standard to BS EN 206-1 — Part 2: Specification for constituent materials and concrete.* 〉A2〈

〉A2〈 *Text deleted* 〉A2〈

BS EN 197-1*, Cement — Part 1: Composition, specifications and conformity criteria for common cements.*

〉A2〈 BS EN 197-4, *Cement — Part 4: Composition, specifications and conformity criteria for low early strength blastfurnace cements.* 〉A2〈

〉A2〈 BS EN 450-1, *Fly ash for concrete — Part 1: Definition, specifications and conformity criteria.* 〉A2〈

BS EN 934-2*, Admixtures for concrete, mortar and grout — Part 2: Concrete admixtures — Definitions, requirements, conformity, marking and labelling.*

〉A1〈 BS EN 1008*, Mixing water for concrete — Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete.* 〉A1〈

BS EN 1917:2002*, Concrete manholes and inspection chambers, unreinforced, steel fibre and reinforced.*

[A1] BS EN 12620, *Aggregates for concrete.* [A1]

[A2] BS EN 14216, *Cement — Composition, specifications and conformity criteria for very low heat special cements.* [A2]

[A2] BS EN 15167-1, *Ground granulated blast furnace slag for use in concrete, mortar and grout — Part 1: Definitions, specifications and conformity criteria.* [A2]

3 Terms and definitions

For the purpose of this part of BS 5911, the terms and definitions given in BS EN 1917 and the following apply.

3.1
cementitious content
amount of cement plus any pozzolanic or latent hydraulic addition in the concrete mix

4 Symbols

The meanings of symbols used in this part of BS 5911 shall be as [A2] *Text deleted* [A2] given in BS EN 1917:2002, Table 2.

[A2] *Text deleted* [A2]

5 General requirements

NOTE The numbers in brackets after subclause headings are the corresponding subclause numbers in BS EN 1917:2002.

5.1 Application

The requirements of this part of BS 5911 shall be in addition to those specified in BS EN 1917 and for the purposes of the latter the reference specifications shall be those listed in Annex B of this Standard. For inspection chambers designed to be used for inverts at depths other than those not exceeding 2 metres deep the requirements of BS EN 1917:2002 shall also apply, except as otherwise required by, or stated in, this part of BS 5911.

5.2 Concrete (4.2)

5.2.1 *Composition*

5.2.1.1 *Types of cement*

[A2] The cement used shall conform to Table 1. [A2]

5.2.1.2 *Cementitious content*

The fully compacted concrete shall have a minimum cementitious content of not less than the relevant amount shown in Table 1. The composition/specification of cement groups shall be as shown in Table 2.

Table 1 — Limiting values of composition and properties for concrete where a DC-class is specified

DC-class (design chemical class)	Max. water content ratio	Min. cement or combination content in kg/m³ for max. aggregate sizes (mm) of:				Cement and combination types[a]	Grouping used in BRE SD1:2005
		≥40	20	14	10		
DC-1[b]	—	—	—	—	—	All in Table 2	A to G
DC-2	0.55	300	320	340	360	IIB-V+SR, IIIA+SR, IIIB+SR, IVB-V	D, E, F
	0.50	320	340	360	380	CEM I, SRPC, IIA-D, IIA-S, IIA-V, IIB-S, IIB-V, IIIA, IIIB	A, G
	0.45	340	360	380	380	IIA-L or LL ≥ class 42,5	B
	0.40	360	380	380	380	IIA-L or LL class 32,5	C
DC-2z	0.55	300	320	340	360	All in Table 2	A to G
DC-3	0.50	320	340	360	380	IIIB+SR	F
	0.45	340	360	380	380	IVB-V	E
	0.40	360	380	380	380	IIB-V+SR, IIIA+SR, SRPC	D, G
DC-3z	0.50	320	340	360	380	All in Table 2	A to G
DC-4	0.45	340	360	380	380	IIIB+SR	F
	0.40	360	380	380	380	IVB-V	E
	0.35	380	380	380	380	IIB-V+SR, IIIA+SR, SRPC	D, G
DC-4z	0.45	340	360	380	380	All in Table 2	A to G
DC-4m	0.45	340	360	380	380	IIIB+SR	F

[a] For the sulfate-resisting characteristics of other cements and combinations, see BRE SD1 [1] and IP 17/05 [2].
[b] If the concrete is reinforced or contains embedded metal, the minimum concrete quality for 20 mm maximum aggregate size is C25/30, 0.65, 260 or designated concrete RC25/30.

〈A2〉 Table 2 — General purpose cements and combinations

Type	Notation	British Standard	Broad designation	Grouping used in BRE SD1:2005
Portland cement	CEM I	BS EN 197-1	CEM I	A
Portland silica fume cement[a]	CEM II/A-D	BS EN 197-1	IIA	A
Portland limestone cement	CEM II/A-L CEM II/A-LL	BS EN 197-1 BS EN 197-1	IIA IIA	B[b] or C[b] B[b] or C[b]
Portland slag cements	CEM II/A-S CEM II/B-S	BS EN 197-1 BS EN 197-1	IIA IIB-S	A A
Portland fly ash cements	CEM II/A-V CEM II/B-V CEM II/B-V+SR[c]	BS EN 197-1 BS EN 197-1 BS EN 197-1	IIA IIB-V IIB+SR	A A D
Blastfurnace cements	CEM III/A CEM III/A+SR[d] CEM III/B CEM III/B+SR[c]	BS EN 197-1 or BS EN 197-4 BS EN 197-1 or BS EN 197-4	IIIA IIIA+SR IIIB IIIB+SR	A D A F
Pozzolanic cement	CEM IV/B(V)	BS EN 197-1 or BS EN 14216	IVB-V	E
Sulfate-resisting Portland cement	SRPC	BS 4027	SRPC	G
Combinations conforming to BS 8500-2:2006, Annex A, manufactured in the concrete mixture from Portland cement and fly ash, ground granulated blast furnace slag (ggbs) or limestone fines:				
CEM I cement conforming to BS EN 197-1 with a mass fraction of 6% to 20% of combination of fly ash conforming to BS EN 450-1	CIIA-V	BS 8500-2:2006, Annex A	IIA	A
CEM I cement conforming to BS EN 197-1 with a mass fraction of 21% to 35% of combination of fly ash conforming to BS EN 450-1	CIIB-V CIIB-V+SR[c]	BS 8500-2:2006, Annex A	IIB-V IIB+SR	A D
CEM I cement conforming to BS EN 197-1 with a mass fraction of 36% to 55% of combination of fly ash conforming to BS EN 450-1	CIVB-V	BS 8500-2:2006, Annex A	IVB-V	E
CEM I cement conforming to BS EN 197-1 with a mass fraction of 6% to 20% of combination of ggbs conforming to BS EN 15167-1	CIIA-S	BS 8500-2:2006, Annex A	IIA	A
CEM I cement conforming to BS EN 197-1 with a mass fraction of 21% to 35% of combination of ggbs conforming to BS EN 15167-1	CIIB-S	BS 8500-2:2006, Annex A	IIB-S	A
CEM I cement conforming to BS EN 197-1 with a mass fraction of 36% to 65% of combination of ggbs conforming to BS EN 15167-1	CIIIA CIIIA+SR[d]	BS 8500-2:2006, Annex A	IIIA IIIA+SR	A D
CEM I cement conforming to BS EN 197-1 with a mass fraction of 66% to 80% of combination of ggbs conforming to BS EN 15167-1	CIIIB CIIIB+SR[d]	BS 8500-2:2006, Annex A	IIIB IIIB+SR	A F
CEM I cement conforming to BS EN 197-1 with a mass fraction of 6% to 20% of combination of limestone fines conforming to BS 7979	CIIA-L CIIA-LL	BS 8500-2:2006, Annex A	IIA IIA	B[b] or C[b] B[b] or C[b]

[a] When IIA or IIA-D is specified, CEM I and silica fume may be combined in the concrete mixer using the *k*-value concept; see BS EN 206-1:2000, **5.2.5.2.3**.
[b] The classification is B if the cement or combination strength is class 42,5 or higher and C if it is class 32,5.
[c] With a minimum proportion of fly ash of 25%.
[d] Where the alumina content of the slag exceeds 14%, the tricalcium aluminate content of the Portland cement fraction should not exceed 10%.

〈A2〉

5.3 Finish (4.3.2)

5.3.1 ***Surface voids***

With the exception of the external edges of slabs, when tested in accordance with Annex C surfaces of units shall be free from voids that permit diametrically opposite points of the rim of the gauge to touch the surface of the unit simultaneously.

Units exhibiting any surface void greater than 12 mm deep shall be deemed not to conform to this part of BS 5911.

NOTE Voids up to and including 12 mm deep may be made good by the manufacturer — see BS EN 1917:2002, **4.3.2**.

5.4 Geometrical characteristics (4.3.3)

5.4.1 ***General***

Subject to the requirements of this clause, the dimensions and thickness of units shall conform to those stated in the factory documents.

5.4.2 ***Internal dimensions***

The manufacturer shall make available the sizes of inspection chamber that can be supplied. The internal diameter, length and width shall conform to the requirements of Table 3.

5.4.3 ***Shape, size and position of openings in slabs***

Cover slabs shall conform to the requirements of Table 3 and be either:

a) Type 1 — suitable for depths not greater than 1.2 metres to invert with a minimum size access of 430 mm × 430 mm or 430 mm in diameter; or

b) Type 2 — suitable for depths greater than 1.2 metres to invert with a maximum size access of 300 mm × 300 mm or 350 mm in diameter.

Openings in cover slabs shall be circular or rectangular.

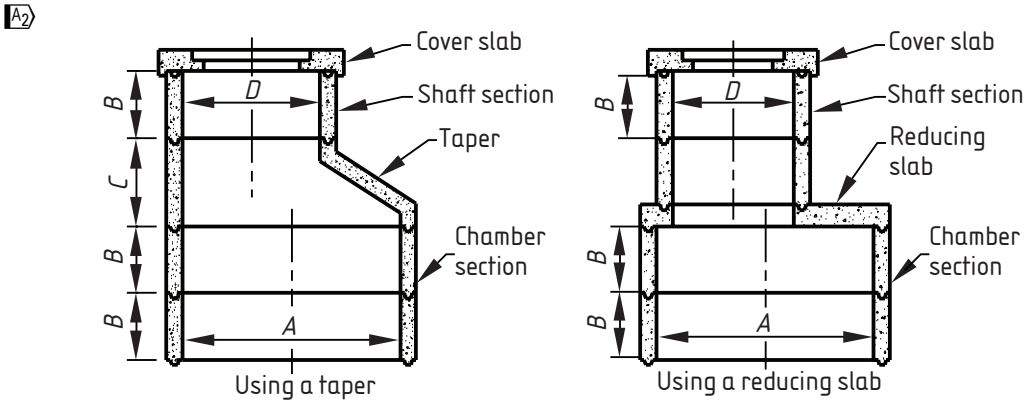
NOTE 1 It is permissible for the vertical face(s) of an opening to be cast with a nominal release angle away from the opening, and to be designed to provide a seating for the inspection chamber cover.

NOTE 2 A larger clear opening is permitted in Type 2 cover slabs provided the access is restricted to the above dimensions stated in b) above.

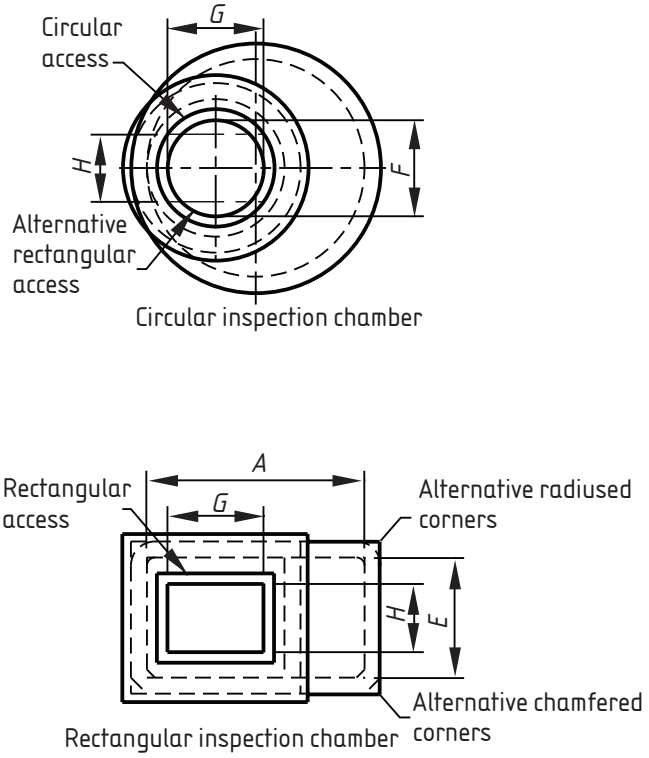
NOTE 3 These provisions are consistent with the recommendations in A2 BS EN 752:2008, Table NA.21 A2.

Table 3 — Inspection chambers (see Figure 1)

Inspection chamber type	**Dimensions** (mm)							
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
Type 1 (for chambers not greater than 1.2 m in depth from cover level to invert)	Not less than 600	Not less than 75	Not less than 150	Not more than dimension *A*	Not less than 450	Not less than 430	Not less than 430	Not less than 430
Type 2 (for chambers greater than 1.2 m in depth from cover level to invert)	Not less than 600	Not less than 75	Not less than 150	Not more than dimension *A*	Not less than 450	Not more than 350	Not more than 300	Not more than 300
NOTE 1 Dimensions *A* to *H* are shown in Figure 1.								
NOTE 2 A larger clear opening is permitted in Type 2 cover slabs provided the access is restricted to the dimensions *F*, *G* and *H*.								
NOTE 3 The above guidance is consistent with the recommendations in A2 BS EN 752:2008, Table NA.21 A2.								



a) Sectional elevations



b) Plan views

Figure 1 — Typical inspection chamber arrangements

5.4.4 *Benching*

If a base unit is supplied with benching, the slope of the benching shall be a minimum of 5 % and shall conform to that stated in the factory documents.

The height of the benching from the invert of the channel shall be half of the nominal size of the largest connecting pipe, expressed in millimetres.

NOTE The requirement for benching height is consistent with the recommendation of A2 BS EN 752:2008, **NA.12.4.6** A2.

5.4.5 *Dimensional tolerances*

5.4.5.1 *Tolerances on the internal diameter of circular vertical units and related tapers*

The tolerances on the internal manufactured diameter of circular vertical units and related tapers shall be ±(3 + 0.005DN) mm (rounded to the nearest mm), limited to ±15 mm. No individual measurement, measured in accordance with **D.1**, shall be outside the specified limits when compared to the relevant value stated in the factory documents (see **5.4.1**).

5.4.5.2 *Tolerances on the internal size of rectangular vertical units*

The tolerances on the internal manufactured size of rectangular vertical units shall be ±(3 + 0.005WN) mm (rounded to the nearest millimetre), limited to ±15 mm. No individual measurement, measured in accordance with **D.1**, shall be outside the specified limits when compared to the relevant value stated in the factory documents (see **5.4.1**).

5.4.5.3 *Tolerance on the thickness*

Any value of thickness measured in accordance with **D.2** shall be not less than the value stated in the factory documents.

A2 *Text deleted* A2

5.4.5.4 *Squareness of ends*

Vertical units and tapers shall be capable of being jointed with their relevant axes coincident. For circular chamber and shaft units this requirement shall apply in any orientation.

NOTE Squareness of ends is significant only to the extent that it relates to the type of sealing material and the performance of the joint assembly.

5.5 Crushing strength of chamber and shaft units (4.3.5)

NOTE Strength class is defined in BS EN 1917:2001, **3.1.21** as the minimum crushing load in kilonewtons per metre, divided by one thousandth of either a unit's nominal size (DN) or nominal length (LN).

The strength classes of chamber and shaft units shall be in accordance with Table 4. Minimum crushing loads corresponding to strength classes shall be rounded up to the nearest kilonewton/metre.

Table 4 — Strength classes for chamber and shaft units

Nominal size/Nominal length DN/LN	Strength class
DN/LN < 600	40
600 ≤ DN/LN < 800	30
800 ≤ DN/LN < 1000	20
DN/LN A2 ≥ A2 1000	15

5.6 Vertical strength of reducing units (4.3.6)

Where an edge of an access opening is designed to be greater than 150 mm from the inner wall of the supporting unit, the vertical loading requirements of BS EN 1917 shall apply, except as otherwise required by, or stated in, this part of BS 5911.

The minimum vertical crushing loads for "Medium Load" and "Light Load" reducing units shall be 62.5 kN and [A2] 18.75 [A2] kN respectively.

NOTE "Light load" units are intended for installation in areas where the vertical loading is from pedestrians or the occasional wheel load not exceeding [A2]15 kN [A2]. For "Medium Load" units, the load is increased to [A2] 50 kN [A2].

5.7 Watertightness (4.3.8)

For units designed to be used for inverts not exceeding 1.2 metre deep and having nominal sizes less than or equal to DN 1000 or LN/WN 1000/675, the internal hydrostatic pressure for the purposes of BS EN 1917:2002, Annex C shall be 15 kPa (0.15 bar or approximately 1.5 metre water column).

6 Special requirements

NOTE The numbers in brackets after subclause headings are the corresponding subclause numbers in BS EN 1917:2002.

6.1 Reinforced concrete units (5.2)

6.1.1 ***Concrete cover*** (5.2.2)

The minimum concrete cover shall be 20 mm for slabs and 15 mm for all other units, or the relevant nominal maximum size of aggregate stated in the factory documents, whichever is the larger in each case.

NOTE 1 Given the inspection procedures specified in this part of BS 5911 and the maximum permitted stabilized surface crack width specified in BS EN 1917:2002, **5.2.3** and BS EN 1917:2002, **5.2.4**, the value of minimum concrete cover is consistent with the serviceability conditions specified in BS EN 1917:2002, **4.3.9**. Taken together, these factors are also consistent with the crack control provisions given in BS 8110-1 and BS 8110-2.

NOTE 2 Units conveying sea water, industrial waste, etc. and those to be installed in more aggressive serviceability conditions than those specified in BS EN 1917:2002, **4.3.9** may need additional concrete cover. The advice of the manufacturer should be sought in such a situation.

6.2 Vertical strength of cover slabs and reducing slabs (5.2.4)

The vertical proof load for "Medium Load" and "Light load" cover slabs and reducing slabs shall be 25 kN and [A2] 7.5 kN [A2] respectively.

7 Conformity evaluation

7.1 Application

The conformity evaluation requirements of BS EN 1917 shall apply to this part of BS 5911, supplemented by the following sampling procedures.

7.2 Finish

If subjected to the test in Annex C the finish of any unit (except for the external edges of slabs) shall conform to **5.2.1** for surface voids.

7.2.1 ***Geometrical characteristics***

Sampling procedures to evaluate the conformity of internal diameter, internal size and thickness to **5.4.5.1**, **5.4.5.2** and **5.4.5.3** respectively shall be in accordance with those for "Geometrical characteristics — Units" in BS EN 1917:2002, Table G.1.

8 Marking

In addition to the requirements of BS EN 1917:2002, Clause **8** each unit or package of units shall be marked "**& BS 5911-4**" immediately following "**BS EN 1917**" and with the letter "**R**" if it is a reinforced concrete unit.

Annex A (informative)
Information to be supplied in an enquiry or order

The following particulars cover essential details required by the manufacturer so that an enquiry or order may be fully understood:

	Reference in BS EN 1917	Reference in this part of BS 5911
a) quantity, cross-sectional shape(s) and nominal size(s) of units	—	**5.4.3**
b) [A1] design chemical class (DC-class) of concrete in units [A1]	**4.3.9**	**5.2.1**
c) if additional concrete cover is required	**4.3.9** and **5.2.2**	**6.1.1**
d) if the products are to be fully covered by a third party certification scheme	**7.1**	Foreword

Annex B (normative)
British Standards relevant to BS EN 1917:2002

The reference specifications prescribed in **5.1** are listed in Table B.1.

Table B.1 — British Standards relevant to BS EN 1917:2002

Reference in BS EN 1917:2002		Relevant British Standard
Subclause number	Material/Characteristic	
4.1	*Cements*	BS EN 197-1 [A2] BS EN 197-4 [A2] BS 4027
4.1	*Aggregates*	[A1] BS EN 12620 [A1]
4.1	*Mixing water*	[A1] BS EN 1008[a] [A1]
4.1	*Admixtures*	BS EN 934-2
4.1	*Additions*	[A2] BS EN 450-1 [A2] [A2] BS EN 15167-1 [A2]
4.1	*Reinforcing steel*	BS 4449 BS 4482 BS 4483

[a] [A1] BS EN 1008:2002, **3.1** specifies that potable water does not need testing. [A1]

Annex C (normative)
Surface void test

C.1 Principle

The purpose of this test is to evaluate whether any void in the surface of a unit (except for the external edges of slabs) conforms to the limiting requirements in **5.3.1**.

C.2 Apparatus

C.2.1 *Gauge*, as shown in Figure C.1.

Dimensions in mm

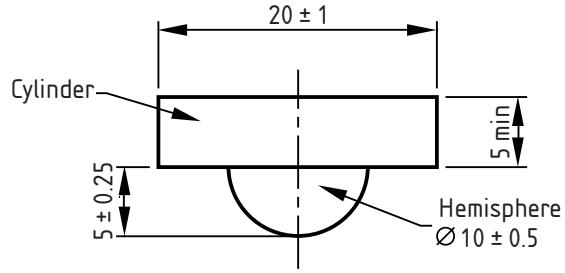


Figure C.1 — Gauge for assessing surface voids

C.3 Procedure

Apply the ball of the gauge to the void.

C.4 Expression of result

Record whether diametrically opposite points in the rim of the gauge simultaneously touched the surface of the unit.

Annex D (normative)
Dimensional tests

NOTE At the manufacturer's discretion it is permissible to use purpose-made "go/no-go" gauges for dimensional measurements in lieu of the apparatus specified for the tests in this Annex.

D.1 Internal dimensions test

D.1.1 *Principle*

The purpose of this test is to evaluate whether the internal diameter of circular vertical units and tapers, or the internal width/length of rectangular vertical units, conforms to **5.4.5.1** or **5.4.5.2** as appropriate.

D.1.2 *Apparatus*

D.1.2.1 *Steel measuring tape or retractable pocket rule*, conforming to BS 4035, with metric graduation and figuring conforming to BS 4484-1.

D.1.3 *Procedure*

For circular vertical units and tapers, make three measurements of the internal diameter at each end at approximately 60° to each other. For rectangular vertical units, make two measurements of each internal dimension at each end. For base units, take the measurements only at the upper end. For all units, take measurements at approximately 50 mm from the end(s) of the unit.

D.1.4 *Expression of results*

Record whether each measured value of the internal diameter or length/width conforms to **5.4.5.1** or **5.4.5.2** as appropriate.

D.2 Thickness tests

D.2.1 *Principle*

The purpose of these tests is to evaluate whether the thickness of a unit conforms to **5.4.5.3**.

D.2.2 *Apparatus*

D.2.2.1 *Outside spring caliper*, conforming to BS 3123.

D.2.2.2 *Steel measuring tape or retractable pocket rule*, conforming to BS 4035, with metric graduation and figuring conforming to BS 4484-1.

D.2.3 ***Procedure***

For circular vertical units, use the outside spring caliper to measure the wall thickness at approximately 50 mm from the end of the external barrel at the upper end, at three positions equidistant around the circumference of the unit.

For rectangular vertical units, use the outside spring caliper to measure the wall thickness at approximately 50 mm from the end of the external barrel at the upper end, at each quarter point around the perimeter.

Measure the thickness of tapers using the outside spring caliper at three positions approximately equidistant around the upper circumference of the unit and repeat the procedure for the lower circumference.

Measure the thickness of slabs using the steel measuring tape or retractable pocket rule at each quarter point around the circumference or perimeter.

D.2.4 ***Expression of results***

Record whether each measured value of the thickness conforms to **5.4.5.3**.

〖A2〉 *Text deleted* 〈A2〗

blank

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[A2] [1)] Now withdrawn.

[2)] BS 8110-1 and BS 8110-2 have been withdrawn and superseded by BS EN 1992-1-1. [A2]

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