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Concrete pipes and ancillary concrete products — Part 3: Specification for unreinforced and reinforced concrete inspection chambers

PUBLIC REVIEW DRAFT



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PUBLIC REVIEW DRAFT

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National foreword

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The work of preparing Uganda Standards is carried out through Technical Committees. A Technical Committee is established to deliberate on standards in a given field or area and consists of representatives of consumers, traders, academicians, manufacturers, government and other stakeholders.

Draft Uganda Standards adopted by the Technical Committee are widely circulated to stakeholders and the general public for comments. The committee reviews the comments before recommending the draft standards for approval and declaration as Uganda Standards by the National Standards Council.

This Draft Uganda Standard, DUS EAS 426-3: 2006, *Concrete pipes and ancillary concrete products — Part 3: Specification for unreinforced and reinforced concrete inspection chambers*, is identical with and has been reproduced from an East African Standard, EAS 426-3: 2006, *Concrete pipes and ancillary concrete products — Part 3: Specification for unreinforced and reinforced concrete inspection chambers*, and is being proposed for adoption as a Uganda Standard.

This standard was developed by the Building and civil engineering Standards Technical Committee (UNBS/TC 3).

Wherever the words, "East African Standard" appear, they should be replaced by "Uganda Standard."



EAS 426-3:2006

ICS 91.140.80

HS 6810.20.00

HS 6810.91.00

EAST AFRICAN STANDARD

**Concrete pipes and ancillary concrete products —
Part 3:
Specification for unreinforced and reinforced concrete inspection
chambers**

PUBLIC REVIEW DRAFT

EAST AFRICAN COMMUNITY

Table of contents

1	Scope	1
2	Normative references.....	1
3	Terms and definitions.....	2
4	Symbols.....	2
5	General requirements	2
5.1	Application.....	2
5.2	Concrete (4.2)	2
5.3	Finish (4.3.2)	4
5.4	Geometrical characteristics (4.3.3).....	4
5.5	Crushing strength of chamber and shaft units (4.3.5).....	7
5.6	Vertical strength of reducing units (4.3.6).....	7
5.7	Watertightness (4.3.8).....	8
6	Special requirements	8
6.1	Reinforced concrete units (5.2)	8
6.2	Vertical strength of cover slabs and reducing slabs (5.2.4)	8
7	Conformity evaluation	8
7.1	Application.....	8
7.2	Finish	8
8	Marking.....	8
	Annex B (normative) Standards relevant to CD/K/59/2004.....	10
	Annex C (normative) Surface void test.....	11
	Annex D (normative) Dimensional tests	12
	Bibliography	14

PUBLIC REVIEW DRAFT

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to achieve this objective, the Partner States in the Community through their National Bureaux of Standards, have established an East African Standards Committee.

The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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PUBLIC REVIEW DRAFT

Concrete pipes and ancillary concrete products — Part 3: Specification for unreinforced and reinforced concrete inspection chambers

1 Scope

CD/K/59/2004 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 CD/K/59/2004 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 CD/K/59/2004 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 CD/K/59/2004 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.

BS EN 752-2, BS EN 752-3, BS EN 752-4, 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.

BS 146, *Specification for blastfurnace cements with strength properties outside the scope of EAS 18-1.*

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

BS 3892-1, *Pulverized-fuel ash — Part 1: Specification for pulverized-fuel ash for use with Portland cement.*

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.*

BS 4449, *Specification for carbon steel bars for the reinforcement of concrete.*

BS 4482, *Specification for cold reduced steel wire for the reinforcement of concrete.*

BS 4483, *Steel fabric for the reinforcement of concrete.*

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

BS 6699, *Specification for ground granulated blastfurnace slag for use with Portland cement.*

EAS 426-3:2006

EAS 18-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements.*

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

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.*

CD/K/59/2004, *Concrete manholes and inspection chambers, unreinforced, steel fibre and reinforced.*

BS EN 12620, *Aggregates for concrete.*

3 Terms and definitions

For the purpose of this part of BS 5911, the terms and definitions given in CD/K/59/2004 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 given in Table 1, together with those given in CD/K/59/2004, Table 2.

Table 1 — Symbols

Symbol	Meaning	Unit	Reference
h_s	Height of studs on straightness gauge	mm	D.3.2
h'	Internal barrel length minus 0.03 m	m	D.3.2

5 General requirements

NOTE The numbers in brackets after subclause headings are the corresponding subclause numbers in CD/K/59/2004.

5.1 Application

The requirements of this part of BS 5911 shall be in addition to those specified in CD/K/59/2004 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 CD/K/59/2004 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

The cement (see CD/K/59/2004, 4.1) shall either:

- be factory-produced by the cement manufacturer and conform to one of the following Standards as appropriate:

Type of cement Standard

CEM I	BS EN 197-1
CEM II/B-V	BS EN 197-1
BIII/B	BS 146
sulfate-resisting Portland	BS 4027; or

- b) consist of a combination of cement conforming to CEM I as specified in EAS 18-1 and an addition in the form of ground granulated blastfurnace slag (ggbs) or pulverized-fuel ash (pfa) in the proportions specified in 5.2.1.2", to be included as part of the concrete mix by simultaneously combining them with the other concrete materials at the concrete mixer.

In all cases where combinations of cement conforming to CEM I as specified in EAS 18-1 and ggbs or pfa are used, the relevant proportion of ggbs or pfa shall be fully documented in the production records.

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 2. The composition/specification of cement groups shall be as shown in Table 3.

Table 2 — Cementitious contenta

Class ^b	Aggregate carbonate range ^c	Cement combination group	or	Minimum cement combination content kg/m ³	or	Maximum w/c ratio
DC-2	A, B, C	1, 2, 3		340		0.45
DC-3	A	2a		400		0.40
	A	2b, 3		380		0.45
	B, C	2, 3		340		0.45
DC-3*	B	2, 3		380		0.45
DC-3**	C	2, 3		380		0.45
DC-4	A	2a		400		0.35
	A	2b, 3		400		0.40
	A	2, 3		380		0.33
	B, C	2, 3		380		0.45
	B, C	2, 3		360		0.40
DC-4*	B	2, 3		380		0.33
	B	2, 3		400		0.40
DC-4**	C	2, 3		380		0.33
	C	2, 3		400		0.40
DC-4m	A	2b, 3		380		0.33
	A	2b, 3		400		0.40
	B	3		400		0.40
	B, C	3		360		0.40
	B, C	3		380		0.45
DC-4m*	B	3		380		0.33
DC-4m**	C	3		380		0.33
	C	3		400		0.40

^a The table is consistent with the provisions of BS 8500-1:2002 and BRE Special Digest 1 [1] insofar as they relate to precast concrete pipeline systems, except that the maximum water/cement (w/c) ratio is limited to 0.45 in accordance with CD/K/60/2004, 4.2.3.2.

^b The class designations are those for design chemical class (DC-class) in cd/k/58-1/2004, Table A.15. Where there is more than one option in a class the choice is at the manufacturer's discretion.

^c See BRE Special Digest 1 - Part 4, Table 4.

Table 3 — Cement or combination groups ^a

Type (see 5.2.1.1)	Designation	Standard	Grouping with respect to sulfate resistance
Portland cement	CEM I	BS EN 197-1	1
Portland fly ash cements	CEM II/B-V ^b	BS EN 197-1	2a ^c
Sulfate-resisting Portland cement	SRPC	BS 4027	3
Blastfurnace slag cements ^e	BIII/B ^d	BS 146	2b ^e
<i>Combinations conforming to BS 8500-2:2002, Annex A manufactured in the concrete mixer from Portland cement and pfa or ggbs:</i>			
CEM I cement conforming to BS EN 197-1 with a mass fraction of 6 % to 20 % of combination of pfa conforming to BS 3892-1	CIIA-V	BS 8500-2	1
CEM I cement conforming to BS EN 197-1 with a mass fraction of 21 % to 35 % of combination of pfa conforming to BS 3892-1	CIIB-V ^b	BS 8500-2	2a ^c
CEM I cement conforming to BS EN 197-1 with a mass fraction of 36 % to 55 % of combination of pfa conforming to BS 3892-1	CIVB-V ^b	BS 8500-2	2a ^f
CEM I cement conforming to BS EN 197-1 with a mass fraction of 6 % to 35 % of combination of ggbs conforming to BS 6699	CII-S ^g	BS 8500-2	1
CEM I cement conforming to BS EN 197-1 with a mass fraction of 36 % to 65 % of combination of ggbs conforming to BS 6699	CIIIA	BS 8500-2	1
CEM I cement conforming to BS EN 197-1 with a mass fraction of 66 % to 80 % ^e of combination of ggbs conforming to BS 6699	CIIB ^d	BS 8500-2	2b ^e
^a The table is consistent with BS 8500-1:2002, Table A.17 and BS 8500-2:2002, Table 1. ^b Where the proportions for sulfate resistance are required, i.e. not less than 25 % and not more than 40 % pfa, add to the abbreviation "+SR". ^c Provided the pfa content is a mass fraction of not less than 25 % of cement or combination. Where it is less than 25 %, the cement of combination falls within group 1. ^d Where the proportions for sulfate resistance are required (see e), add to the abbreviation "+SR". ^e Where the alumina content of the slag exceeds 14 %, the tricalcium aluminate content of the Portland cement fraction should not exceed 10 %. Where this is not the case, the grouping with respect to sulfate resistance is "1". ^f Provided the pfa content is a mass fraction of not more than 40 % of cement or combination. Where it exceeds 40 %, no guidance is provided. ^g Where necessary, this class can be subdivided into CIIA-S (6 % to 20 % ggbs) and CIIB-S (20 % to 35 % ggbs).			

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 CD/K/59/2004, 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 4.

5.4.3 Shape, size and position of openings in slabs

Cover slabs shall conform to the requirements of Table 4 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.

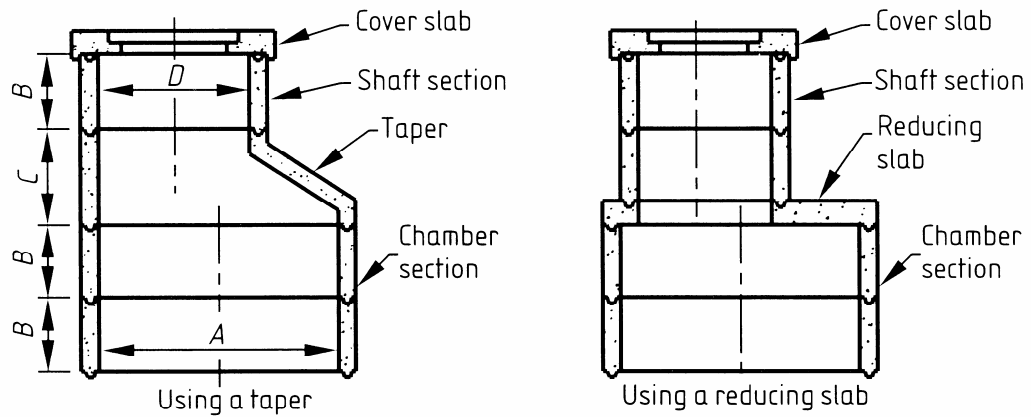
NOTE 1 It is permissible for the vertical face(s) of an opening to be cast with a nominal release angle away from the opening, and to be designed to provide a seating for the inspection chamber cover.

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.

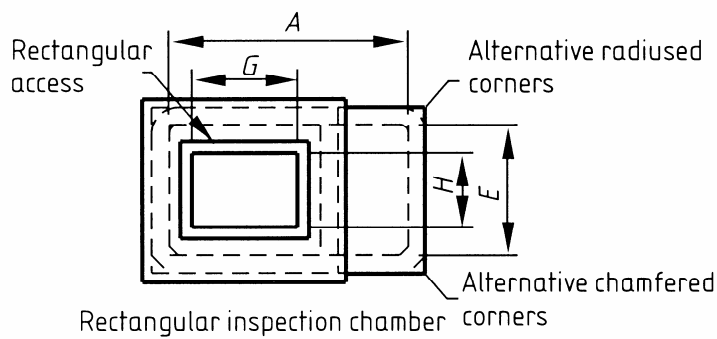
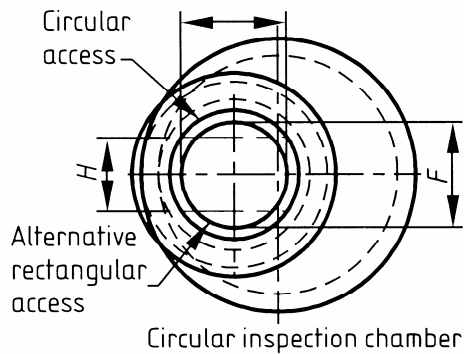
NOTE 3 These provisions are consistent with the recommendations in BS EN 752-3:1997, Table NB.2.

Table 4 — 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 BS EN 752-3:1997, Table NB.2.								



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 BS EN 752-3:1997, **NB.4.5**.

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 $\pm(3 + 0.005DN)$ 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 $\pm(3 + 0.005WN)$ 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.

5.4.5.4 Deviation from straightness

When measured in accordance with **D.3**, for the internal surface of a vertical unit having an effective height greater than 0.5 m, both ends of the gauge shall not make contact with the surface of the unit when using Edge X and the two studs shall be in contact simultaneously when using Edge Y.

NOTE See Figure D.1.

5.4.5.5 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 CD/K/59/2004, **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 5. Minimum crushing loads corresponding to strength classes shall be rounded up to the nearest kilonewton/metre.

Table 5 — Strength classes for chamber and shaft units

Nominal size/Nominal length DN / LN	Strength class mm
DN/LN < 600	40
600 < DN/LN ≤ 800	30
800 < DN/LN ≤ 1000	20
DN/LN ≤ 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 CD/K/59/2004 shall apply, except as otherwise required by, or stated in, this part of BS 5911.

EAS 426-3:2006

The minimum vertical crushing loads for “Medium Load” and “Light Load” reducing units shall be 62.5 kN and 12.5 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 1 tonne (10 kN). For “Medium Load” units, the load is increased to 5 tonnes (50 kN).

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 CD/K/59/2004, 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 CD/K/59/2004.

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 CD/K/59/2004, 5.2.3 and CD/K/59/2004, 5.2.4, the value of minimum concrete cover is consistent with the serviceability conditions specified in CD/K/59/2004, 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 CD/K/59/2004, 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 5 kN respectively.

7 Conformity evaluation

7.1 Application

The conformity evaluation requirements of CD/K/59/2004 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, thickness and straightness to 5.4.5.1, 5.4.5.2, 5.4.5.3 and 5.4.5.4 respectively shall be in accordance with those for “Geometrical characteristics — Units” in CD/K/59/2004, Table G.1.

8 Marking

In addition to the requirements of CD/K/59/2004, Clause 8 each unit or package of units shall be marked **BS 5911-4** immediately following **CD/K/59/2004** 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:	
	CD/K/60/2004	CD/K/61-1/2004
a) quantity, cross-sectional shape(s) and nominal size(s) of units	—	5.4.3
b) design chemical class (DC-class) of concrete in units	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

PUBLIC REVIEW DRAFT

Annex B (normative) Standards relevant to CD/K/59/2004

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

Table B.1 — British Standards relevant to CD/K/60/2004

4.1	<i>Cements</i>	EAS 18-1
		BS 146
		BS 4027
4.1	<i>Aggregates</i>	BS EN 12620
4.1	<i>Mixing water</i>	BS EN 1008a
4.1	<i>Admixtures</i>	BS EN 934-2
4.1	<i>Additions</i>	BS 3892-1
		BS 6699
4.1	<i>Reinforcing steel</i>	BS 4449
		BS 4482
		BS 4483

^a BS EN 1008:2002, 3.1 specifies that potable water does not need testing.

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.

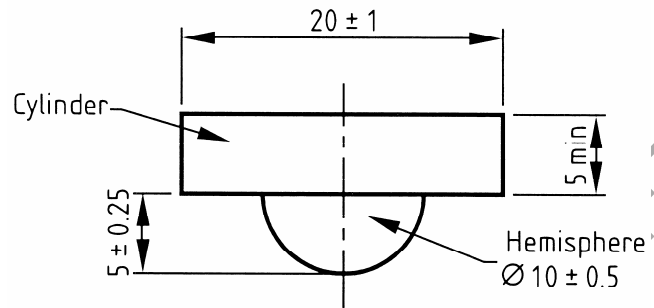


Figure C.1 — Gauge for assessing surface voids

Subclause number Material/Characteristic

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.

D.3 Straightness test

D.3.1 Principle

The purpose of this test is to evaluate whether the internal straightness of a vertical unit having an effective height greater than 0.5 m conforms to 5.4.5.4.

D.3.2 Apparatus

D.3.2.1 Rigid straightedge, made into a gauge of the form and dimensions shown in Figure D.1.

D.3.3 Procedure

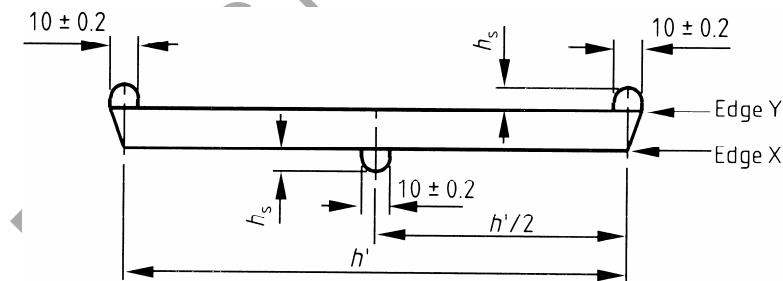
D.3.3.1 Place the straightedge within the unit with Edge X (see Figure D.1) in contact with the unit and on a line parallel to its vertical axis. Hold the plane of the gauge in a radial plane and make a record of whether or not both ends of the gauge, wherever so placed, were in contact with the internal surface of the unit.

D.3.3.2 If both ends of the gauge were not in contact with the internal surface of the unit at both ends, reverse the gauge so that Edge Y, placed as above (see Figure D.1), is adjacent to the internal surface of the unit.

D.3.4 Expression of result

Record whether both ends of the gauge were in contact with the surface of the unit when using Edge X, and whether the two studs (see Figure D.1) touched the surface simultaneously when using Edge Y.

Dimensions in mm



$$h_s = (3.5h' \pm 5\%) \text{ in mm}$$

NOTE The studs should be detachable from the basic straightedge to facilitate checking and replacement.

Figure D.1 — Gauge for measuring deviation from straightness

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