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Incorporating Corrigendum No.1

BSI Standards Publication

Surface boxes, guards and underground chambers for the purposes of utilities

Part 2: Specification for surface boxes

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 28, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 5834 is published by BSI Standards Limited, under licence from the British Standards Institution, and came into effect on 31 July 2011. It was prepared by Technical Committee B/504, *Water supply.* A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 5834 supersedes BS 5834-2:1983 and BS 5834-3:1985, which are withdrawn.

Relationship with other publications

BS 5834 is published in three parts:

- Part 1: *Specification for guards and plinths*;
- Part 2: *Specification for surface boxes*;
- Part 4: *Specification for utility chambers*.

Information about this document

This standard is a revision and an amalgamation of BS 5834-2:1983 and BS 5834-3:1985. It has been extended to include surface boxes made from cast iron, cast aluminium, plastics and fabricated steel and to include surface boxes designed for use with all types of utility.

Text introduced or altered by Corrigendum No. 1 is indicated in the text by tags [C1⟩ ⟨C1]. Minor editorial corrections are not tagged.

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Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

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1 Scope

This part of BS 5834 specifies requirements for surface boxes to be used with guards and underground chambers designed for the purposes of utilities including those intended for factory infill having a maximum designated overall clear opening of 450 mm × 450 mm. This British Standard specifies surface boxes made from cast iron, cast aluminium, plastics and fabricated steel. The selection, use and surface finish of infill materials for factory infilled covers is outside the scope of this standard.

A test method for loading tests is specified in Annex A and a summary of the optional items to be agreed between the manufacturer and the purchaser is given in Annex B.

NOTE 1 See Table 4 for permitted intrusions to the clear opening.

NOTE 2 Requirements for covers having a larger clear opening than 450 mm x 450 mm are specified in BS EN 124. In BS EN 124, such covers are referred to as gully or manhole tops.

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 3412:1992, *Methods of specifying general purpose polyethylene materials for moulding and extrusion*

BS 4190, *ISO metric black hexagon bolts, screws and nuts – Specification*

BS 4439:1991, *Specification for screwed studs for general purposes – Metric series*

BS 5139, *Method of specifying general purpose polypropylene and propylene copolymer materials for moulding and extrusion*

BS 5834-1:2009, *Surface boxes, guards and underground chambers for the purposes of utilities – Part 1: Specification for guards and plinths*

BS 7668, *Weldable structural steels – Hot finished structural hollow sections in weather resistant steels – Specification*

BS EN 1561, *Founding – Grey cast irons*

BS EN 1563, *Founding – Spheroidal graphite cast iron*

BS EN 1676, *Aluminium and aluminium alloys – Alloyed ingots for remelting – Specification*

BS EN 1706, *Aluminium and aluminium alloys – Castings – Chemical composition and mechanical properties*

BS EN 10025-1, *Hot rolled products of structural steels – Part 1: General technical delivery conditions*

BS EN 10025-2, *Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels*

BS EN 10025-3, *Hot rolled products of structural steels – Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels*

BS EN 10025-4, *Hot rolled products of structural steels – Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels*

BS EN 10025-5, *Hot rolled products of structural steels – Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance*

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BS EN 10025-6, *Hot rolled products of structural steels – Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition*

BS EN 10029, *Specification for tolerances on dimensions, shape and mass for hot rolled steel plates 3 mm thick or above*

BS EN 10210-1, *Hot finished structural hollow sections of non-alloy and fine grain steels – Part 1: Technical delivery measurements*

BS EN 12390-3, *Testing hardened concrete – Part 3: Compressive strength of test specimens*

BS EN 14598-3, *Reinforced thermosetting moulding compounds – Specification for sheet moulding compound (SMC) and bulk moulding compound (BMC) – Part 3: Specific requirements*

BS EN ISO 527-2:1996, *Plastics – Determination of tensile properties – Part 2: Test conditions for moulding and extrusion plastics*

BS EN ISO 580:2005, *Plastics piping and ducting systems – Injection-moulded thermoplastics fittings – Methods for visually assessing the effects of heating*

BS EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods*

BS EN ISO 2063, *Thermal spraying – Metallic and other inorganic coatings – Zinc, aluminium and their alloys*

DD CEN/TS 14541:2007, *Plastics pipes and fittings for non-pressure applications – Utilisation of non-virgin PVC-U, PP and PE materials*

3 Terms and definitions

For the purposes of this part of BS 5834 the following terms and definitions apply.

3.1 bedding load
load applied to a surface box to achieve bedding-in of the load-bearing parts

3.2 clear opening
access opening in a surface box through which a horizontal disc or a horizontal rectangular plate passes unimpeded, without deviation from a vertical axis, when a surface box is placed in its normal position and with the cover fully open

NOTE See Note A to Table 4 for permitted intrusions.

3.3 combination unit
cover and frame set in a concrete surround and suitable for bedding on a sectional-type guard or chamber

NOTE A surface box embedded in concrete post-production does not constitute a combination unit.

3.4 cover
moveable part of a surface box that covers the access opening

NOTE The cover may comprise one or more sections.

3.5 designation
categorization of a small surface box by grade and type

3.6 frame
part of a surface box that receives and supports the cover

3.7 horizontal disc
theoretical disc used to assess the clear opening of a small surface box when passed through at a horizontal angle

3.8 horizontal rectangular plate
theoretical rectangular plate used to assess the clear opening of a large surface box when passed through at a horizontal angle

3.9 planar surface
horizontal plane of a surface box cover, the vertical location of which is determined by the percentage covered by raised or recessed pattern

3.10 raised pattern
areas of a surface box cover raised above the cover planar surface

3.11 recessed pattern
areas of a surface box cover recessed below the cover planar surface

3.12 surface box
assembly of a frame and cover to allow access to any utility apparatus

3.13 test load
load applied to a surface box cover for the determination of load-bearing capacity

4 Classification and grading

4.1 Classification

Surface boxes shall be classified as one of the following.

a) *Small surface box*. A surface box having a clear opening of [C1] 300 mm [C1] or less in diameter.

b) *Large surface box*. A surface box having at least one specified clear opening dimension exceeding [C1] 300 mm [C1], up to a maximum overall clear opening of 450 mm × 450 mm.

4.2 Grading

Surfaces boxes shall be graded in accordance with Table 1.

Table 1 **Surface box grades**

Grade	Description
Grade A (heavy)	Surface boxes suitable for use in carriageways carrying fast-moving commercial vehicles having wheel loads [A] up to 5 tonnes, and in accordance with **8.10**.
Grade B [B] (medium)	Surface boxes capable of bearing wheel loads up to 5 tonnes, for use in areas to which vehicles would have only occasional access.
Grade C [B] (light)	Surface boxes for use in situations not intended for use by vehicles.

[A] The magnitude of the stated wheel load is as exerted by a stationary vehicle.
[B] Grade B1 and Grade C1 boxes (see **8.1** and Table 3) are suitable for use for pipe-type guards conforming to BS 5834-1.

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5 Materials

5.1 General

The materials used for the manufacture of surface boxes or combination units shall conform to **5.2**, **5.3**, **5.4**, **5.5** and **5.6**, as applicable.

5.2 Cast iron

The metal used for the manufacture of iron covers or frames shall be either:

a) grey cast iron (flake graphite iron) conforming to BS EN 1561; or

b) ductile cast iron (spheroidal graphite iron or nodular graphite iron) conforming to BS EN 1563.

5.3 Cast aluminium

The metal used for the manufacture of aluminium castings shall suit the design and dimensions of the surface box and conform to the applicable grade in accordance with either BS EN 1676 or BS EN 1706.

5.4 Plastics

5.4.1 Thermoplastic

Thermoplastic materials used shall comprise one of the following plastics, incorporated or blended with other ingredients in accordance with Table 2.

a) Unplasticized poly(vinylchloride) (PVC-U).

b) Polyethylene (PE), specified as Code W in accordance with BS 3412:1992, Table 2.

c) Polypropylene (PP), specified as Code L in accordance with BS 5139:1991, Table 2.

d) Non virgin materials in accordance with DD CEN/TS 14541:2007, **3.1.2** and **3.1.5**.

Table 2 **Performance of thermoplastics materials**

Performance	PE	PP	PVC-U	Test method
Tensile strength (N/mm²)	16	18	42	BS EN ISO 527-2:1996
Elongation at break (%)	140	200	100	BS EN ISO 527-2:1996
Temperature resistance (°C)	150	120	150	BS EN ISO 580:2005

5.4.2 Thermoset

Thermoset materials used shall be either:

a) BMC conforming to BS EN 14598-3:2005; or

b) SMC conforming to BS EN 14598-3:2005.

5.5 Steel for fabrication

Steel for fabrication shall conform to BS 7668, BS EN 10029, BS EN 10210-1, BS EN 10025-1, BS EN 10025-2, BS EN 10025-3, BS EN 10025-4, BS EN 10025-5 or BS EN 10025-6, as applicable.

5.6 Concrete surround for combination units

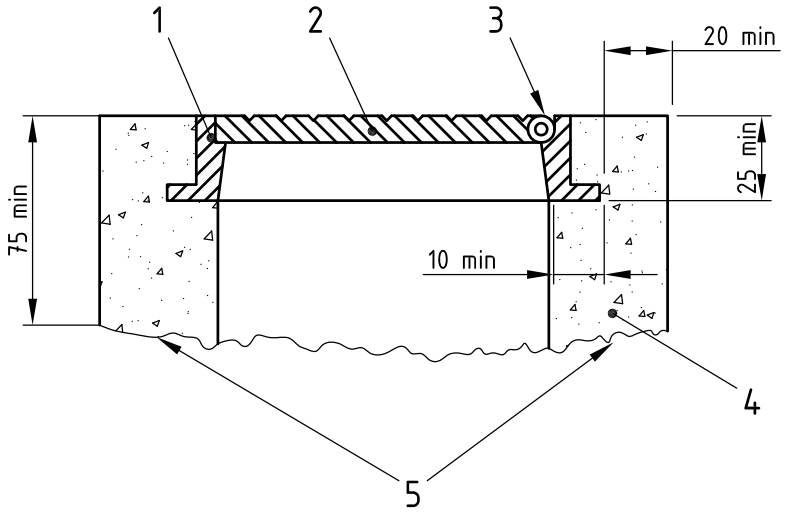
The materials used for the concrete surround shall conform to BS 5834-1:2009, **8.3.**

6 Frames for combination units

Frames for combination units shall be set in the concrete surround and conform to the minimum dimensions given in Figure 1 and Figure 2.

Figure 1 **Typical section and minimum dimensions for a combination unit and frame for a small surface box**

Dimensions in millimetres



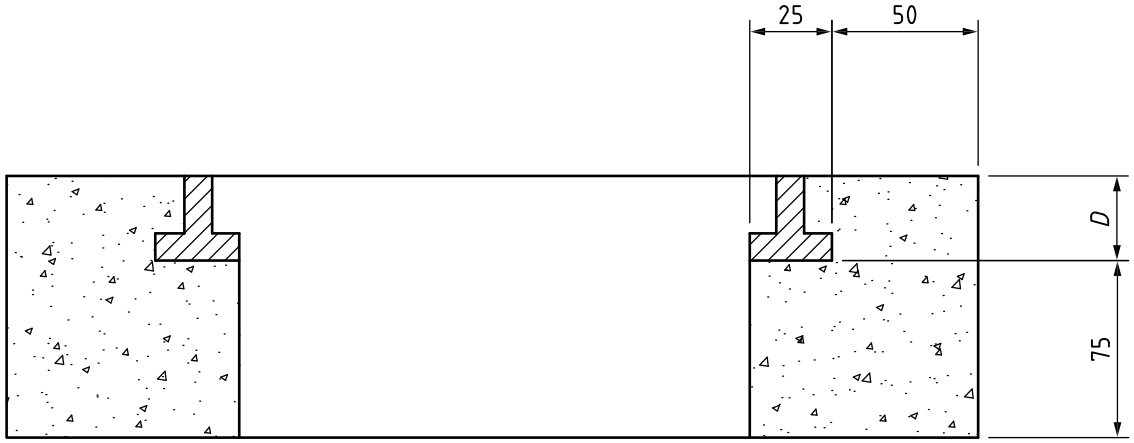
Key

1	Frame	4	Concrete [A]
2	Cover	5	Base arrangement [B]
3	Hinge		

[A] The concrete shall be a minimum thickness of 38 mm for 150 mm guards or of 50 mm for 175 mm guards.
[B] The base arrangement shall match the type of guard specified by the purchaser. The type of guard shall conform to BS 5834-1.

Figure 2 **Typical section and minimum dimensions for combination unit and frame for a large surface box**

Dimensions in millimetres



Key

Dimension *D* :	Grade A	75 mm
	Grade B	50 mm
	Grade C	25 mm

NOTE This figure gives minimum dimensions.

7 Fasteners

7.1 General

Fasteners supplied for loosely coupling separate sections of covers shall be of steel or ductile iron and shall have cross sections of not less than:

a) 28 mm² for small surface boxes having minimum clear opening diameters of 100 mm and 135 mm (see Table 3);

b) 50 mm² for small surface boxes having a minimum clear opening diameter of [C1] 300 mm [C1] (see Table 3);

c) 100 mm² for large surface boxes having clear openings of 380 mm × 230 mm and 450 mm × 300 mm (see Table 4);

d) 140 mm² for surface boxes having larger clear openings than all of those specified in **7.1**a) to **7.1**c).

Where bolts or studs are used, they shall conform to BS 4190 or BS 4439.

Small surface boxes having clear openings of 100 mm, 135 mm, 225 mm and [C1] 300 mm [C1] in diameter, respectively, shall have a nominal size and thread diameter of not less than M6, M8, M10 and [C1] M10 [C1].

Large surface boxes having clear openings greater than [C1] 300 mm [C1] in diameter shall have a nominal size and thread diameter of not less than M12.

7.2 Hinge pins for small surface boxes

Hinge pins used shall be solid (e.g. not hollow, roll or split pins) and made from stainless steel, plastic or non-ferrous metals. Plastics hinge pins shall only be used in conjunction with plastic surface boxes.

Hinge pins shall be not less than 6 mm in diameter. Hinged units shall be capable of supporting the specified test loads without the hinge pins forming part of the load-bearing surface.

NOTE A surface box having a hinged cover may be referred to as a "Type H" surface box.

7.3 Swivel pins for small surface boxes

Swivel pins shall be solid (e.g. not hollow, roll or split pins) and made from stainless steel, plastics or non-ferrous metals**,** securely anchored or integral to the cover, and captive to the frame. Plastic swivel pins shall only be used in conjunction with plastic surface boxes. The swivel pin shall have a minimum diameter of 12 mm and shall be of such a length as to allow the cover to be lifted and swivelled.

NOTE A surface box with a swivel pin may be referred to as a "Type S" surface box.

8 Dimensions and design of surface boxes

8.1 General

With the exception of combination units, the designations and dimensions of surface boxes shall conform to Table 3 or Table 4, as applicable.

The minimum depth of frame for combination units shall conform to the combined surface box and concrete surround measurements given in Figure 1 and Figure 2.

Table 3 **Designations and specified dimensions of small surface boxes**

Designations				Minimum clear opening diameter [B]	Minimum depth of frame	Minimum bedding width of frame	Minimum bedding area
Grade	Type						
	Non-rock [A]	Hinged	Swivel cover				
				mm	mm	mm	mm^2
Grade A	100 AN	100 AH	—	100	100	35	—
(heavy)	135 AN	135 AH	—	135	100	35	—
	225 AN	—	—	225	100	35	—
C1	300 AN	—	—	300	100	35	— C1
Grade B1 [C]	—	100 B1H	100 B1S	100	75	—	See **8.2.2**
(medium)	—	135 B1H	—	135	75	—	See **8.2.2**
Grade B2 [D]	—	100 B2H	100 B2S	100	75	—	15 000
(medium)	—	135 B2H	—	135	75	—	15 000
Grade C1 [C]	—	100 C1H	—	100	75	—	See **8.2.2**
(light)	—	135 C1H	—	135	75	—	See **8.2.2**
Grade C2 [D]	—	100 C2H	—	100	75	—	10 000
(light)	—	135 C2H	—	135	75	—	10 000

[A] A surface box with a non-rock feature is known as a Type N surface box.
[B] The minimum clear opening diameter may be ±1 mm.
[C] Grade B1 and C1 boxes conform to 8.2.2 and are suitable for use with or without pipe-type guards conforming to BS 5834-1.
[D] Grade B2 and C2 boxes shall be permanently supported over their entire bedding area.

Table 4 **Minimum dimensions of large surface box frames [A]**

Dimensions in mm

Clear opening [B]	Overall depth						Bedding width		
	Grade A		Grade B		Grade C		Grade A	Grade B	Grade C
mm	NC [C]	C [D]	NC [C]	C [D]	NC [C]	C [D]			
380 × 230	100	150	75	125	40	100	50	50	40
430 × 280	100	150	75	125	40	100	50	50	40
450 × 450	100	150	75	125	40	100	75	75	40

[A] All dimensions may be ±1 mm.
[B] Intrusions into the minimum clear opening area are permitted at the corners provided that each intrusion does not exceed 1 600 mm^2 for 380 mm × 230 mm and 430 mm × 280 mm sizes and 3 800 mm^2 for larger sizes.
[C] NC = non-combination unit.
[D] C = combination unit.

8.2 Small surface boxes

8.2.1 General

The minimum clear opening sizes shall be as specified in Table 3.

8.2.2 Contact and bedding surfaces for small surface boxes

The contact surfaces of the bedding surfaces of Grade B1 and Grade C1 surface boxes shall be not less than 85% of the flange face for Grade B boxes and shall be not less than 70% of the flange face for Grade C boxes (see Table 3), when placed centrally over a circular flange having an internal diameter of 150 mm and a width of 25 mm.

NOTE 1 The shape (e.g. square, rectangular or circular) and the actual size are due to the individual manufacturer's design.

NOTE 2 If the purchaser desires a particular shape, this ought to be stated on the enquiry and/or order.

8.3 Large surface boxes

Large surface boxes shall be nominally rectangular in plan, and the frames shall conform to Table 4.

NOTE The actual dimensions are determined by the manufacturer.

8.4 Resistance to cover displacement

The design shall incorporate features to resist cover displacement arising from loadings applicable to the cover grade as specified in **4.2**.

NOTE Examples of such features are locking pins, additional mass or cover and frame design methodology.

8.5 Drainage and skid/slip resistance

8.5.1 General

Surface box covers shall be self-draining with the exception of small enclosed areas of lettering or logo.

With the exception of factory infilled surface box covers, surface box covers shall have either a defined raised or a defined recessed pattern that is well distributed across the upper surface of the cover. The raised or recessed pattern shall conform to **8.5.2** or **8.5.3**, as applicable.

8.5.2 Raised pattern

For skid/slip resistance, raised patterns on Grade A surface boxes shall be measured in accordance with Figure 3 and have a height of between 3 mm and 5 mm. Raised patterns on Grade B and Grade C surface boxes shall be measured in accordance with Figure 3 and have a height of between 1 mm and 4 mm. Raised pattern measurements shall be recorded in a test report (see Table B.1).

Parts of lettering or markings shall be considered to be part of the raised pattern.

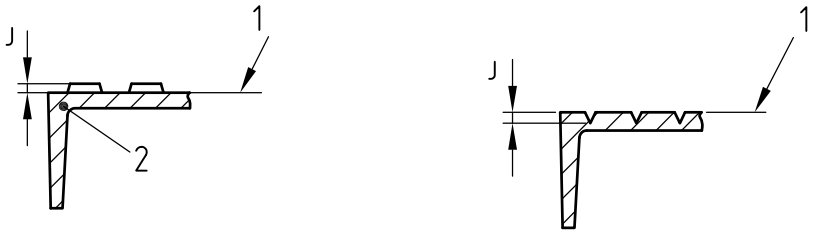
NOTE 1 Although there are some frictional test methods that determine the resistance of pavement surfaces to skid/slip, recent research has questioned their suitability for the macro textures and variable raised patterns of small surface boxes. These test methods are therefore not referenced within this standard. It is recognized, however, that reducing the size of raised pattern blocks increases the interlock with footwear and vehicle tyres, thereby reducing the risk of slip/skid.

The raised pattern on large surface boxes shall cover an area of between 10% and 70% of the total upper surface area of the cover.

NOTE 2 The upper surface area of the cover is considered to be that which is in contact with traffic when the surface box is installed in its in-service condition.

NOTE 3 Small surface boxes should conform to the raised pattern surface area requirements where practicable; however, it is accepted that due to the small area of some small surface boxes and marking requirements, this is not always possible.

Figure 3 **Height or depth of raised or recessed patterns**



a) Raised pattern b) Recessed pattern

Key

1 Cover planar surface
2 Cover
J Height/depth of raised or recessed pattern

8.5.3 Recessed patterns

For skid/slip resistance, recessed patterns on Grade A surface boxes shall be measured in accordance with Figure 3 and have a depth of between 3 mm and 5 mm. Recessed patterns on Grade B and Grade C surface boxes shall be measured in accordance with Figure 3 and have a depth of between 1 mm and 4 mm. Recessed pattern measurements shall be recorded in a test report (see Table B.1).

Parts of lettering or markings shall be considered to be part of the recessed pattern.

The recessed pattern on large surface boxes shall cover an area of between 10% and 70% of the total upper surface area of the cover.

NOTE 1 The upper surface area of the cover is considered to be that which is in contact with traffic when the surface box is installed in its serviceable condition.

NOTE 2 Small surface boxes should conform to the recessed pattern surface area requirements where practicable; however, it is accepted that due to the small area of some small surface boxes and marking requirements, this is not always possible.

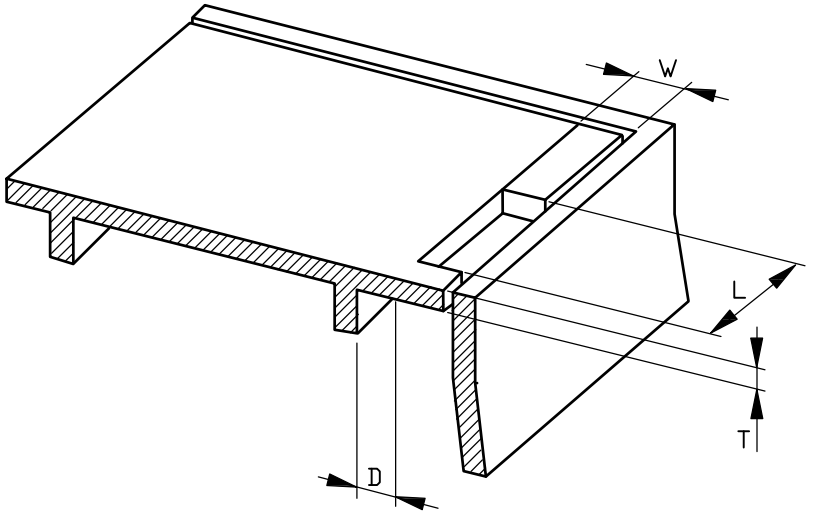
8.6 Prising slots

At least one prising slot per cover section shall be provided for the purpose of opening hinged covers and for initially loosening removable covers.

The dimensions of the prising slots shall conform to Figure 4 and Table 5.

Where the prising slot is integral to the frame, dimension W shall apply to the width of the recess in the upper edge of the frame and shall extend at least 40 mm below the upper edge. This may take the form of a tapered recess.

Figure 4 **Dimensions of prising slots**



Key
See Table 5.

NOTE The prising slot may be incorporated in either cover section or the adjacent frame.

Table 5 **Prising slots**

Dimensions in mm

Prising slot size	Length (L)	Width (W)	Thickness (T)	Depth (D)
Small (min.)	12	6	4	6
Large	35^{+10}_{-5}	10^{+10}_{-2}	5–8	≥10

NOTE It is advisable to incorporate prising slots widths (W) that are towards the upper tolerance specified, which can permit operation with a wider range of prising bar tip dimensions.

8.7 Keyways and keys

8.7.1 General

Covers that are not hinged shall incorporate at least one keyway per cover section, either open or closed, and conform to the dimensions given in Table 6, Figure 5 and Figure 6, for lifting.

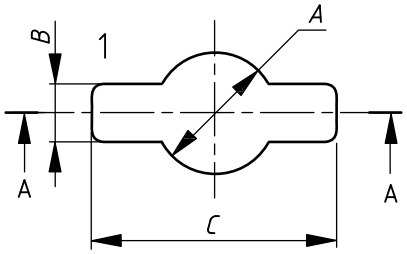
NOTE The purchaser should specify in the enquiry and/or order if open or closed keyways are required.

Table 6 **Keyway dimensions**

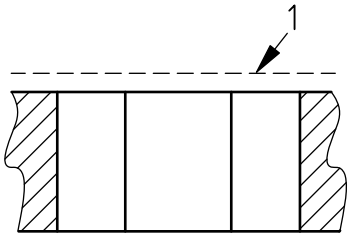
Dimensions in mm

Keyway size	*A*	*B*	*C*	*D*	*E*	*F*
	min./ max.	min./ max.	min.	min.	min.	min.
Small	14–16	9–11	29	6	17	6
Large	22–25	9–13	44	6	35	10

Figure 5 **Open keyway**



a) Plan



b) Cross-section

Key

1 Line of raised pattern

NOTE Dimensions A, B and C are given in Table 6. A indicates a section line.

8.7.2 Large surface boxes

Large keyways (see Table 6) shall be used in Grade A and Grade B covers. In Grade C covers the keyway shall be small or large, as appropriate for the design and mass of the cover.

8.7.3 Keys

For compatibility with small and large keyways, keys shall conform to the dimensions given in Figure 7 and Table 7.

8.8 Clearance

The maximum clearance between the cover and its frame shall be 3 mm all round, having a further clearance of a maximum of 3 mm between cover sections.

8.9 Coupling of cover sections

Where cover sections are to be loosely coupled, fasteners (see Clause **7**) shall be provided with a means to prevent overtightening which would result in the cover sections being drawn together too closely and being raised up.

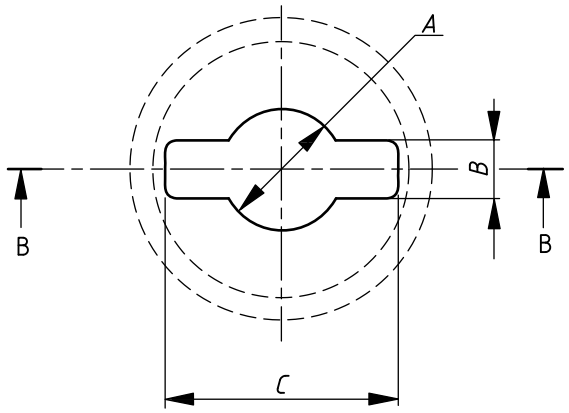
Large surface box cover sections that are loosely coupled shall be provided with two fasteners to ensure stability during lifting.

8.10 Non-rock feature

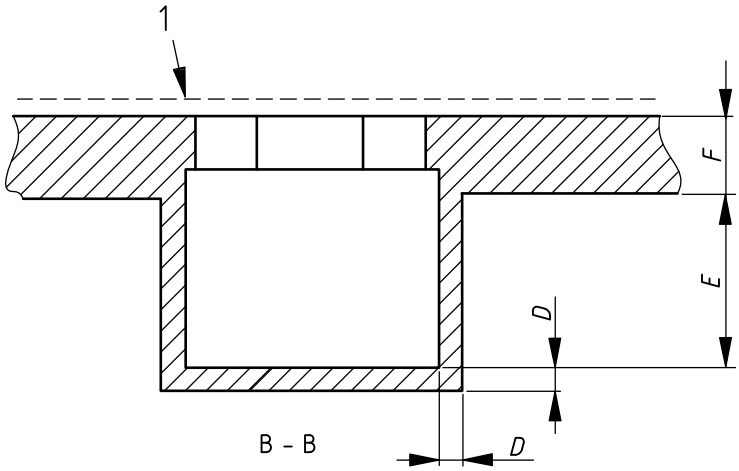
Grade A units shall incorporate a permanent non-rock feature (Type N, see Table 3), to prevent rocking between the cover and frame.

NOTE Other grades may also incorporate this feature.

Figure 6 **Closed keyway**



a) Plan



b) Cross section

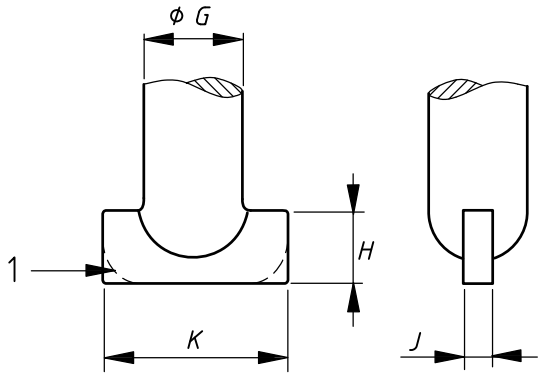
Key

1 Line of raised pattern

NOTE 1 Dimensions A, B and C are given in Table 6. B *indicates a section line.*

NOTE 2 Closed keyways may incorporate a drainage aperture.

Figure 7 **Keys**



Key

1 Alternative shape

NOTE Dimensions G, J, H and K are given in Table 7.

Table 7 **Key dimensions**

Dimensions in mm

Key size	*G*	*H*	*J*	*K*
Small	12	12	6	25
Large	20	15	6	40

8.11 Metal detection component for plastics surface boxes

Plastics surface box covers shall be provided with a corrosion-resistant or suitably protected metal component moulded into or permanently fixed to their underside to enable detection via an electronic surface-box finder. The metal of the component shall have a minimum plan area of 5 000 mm^2 and a minimum thickness of 1 mm.

9 Manufacture and workmanship

9.1 Cast iron and cast aluminium surface boxes

All parts of the surface box shall be cast without defects and irregularities and shall be visibly free from air holes, sand holes, cold shuts and chill. All castings shall be free from voids, whether due to shrinkage, gas inclusions or other causes.

NOTE All parts of the surface box should be neatly dressed and carefully fettled.

9.2 Fabricated steel components

The joints in fabricated steel components shall be formed, welded or riveted to create a firm and rigid assembly that is free from distortion. All weld slag, burrs and sharp edges shall be removed.

When assembled, covers shall sit in their frames without twist or distortion.

Where temporary retaining straps are provided with the frame, these shall be fitted in such a way that the straps can be easily removed after the frame has been fixed in position.

9.3 Plastic surface boxes

Plastic surface boxes shall be uniform in colour and composition and free from visible cracks, weld lines, surface voids, surface contamination, blistering and distortion. All excess flash shall be removed.

NOTE Flash should be removed neatly.

9.4 Concrete surrounds for combination units

9.4.1 Protection from frost

Material that has been exposed to temperatures below 0 °C shall be used only after it has completely thawed. The temperature of moulds shall be higher than 0 °C. The frame and the concrete surround shall be protected from frost for at least 48 h after casting.

9.4.2 Surface level

The concrete surround shall finish level with the top of the frame (see Figure 1 and Figure 2).

9.4.3 Strength

When tested in accordance with BS EN 12390-3, the concrete shall have a 28-day cube strength of not less than 32 N/mm^2.

10 Coatings and corrosion protection

Fabricated steel units shall be protected against corrosion by either hot-dip galvanizing conforming to BS EN ISO 1461, or zinc spraying conforming to BS EN ISO 2063.

NOTE 1 It is advisable to remove all sharp edges resulting from hot-dip galvanizing.

Zinc sprayed steel sections between 2 mm and 5 mm thick shall have a zinc coating with a minimum thickness of 75 μm.

Zinc sprayed steel sections of 5 mm thick and above shall have a zinc coating with a minimum thickness of 150 μm.

NOTE 2 In general, coatings are for aesthetic purposes only and are not regarded as protection against corrosion. Where a more durable coating is required, this should be specified.

NOTE 3 Surface boxes made of cast iron or aluminium may be supplied uncoated or coated.

NOTE 4 Users of the standard should be aware of the impact that solvent-based bitumen coatings can have on health and the environment.

11 Bedding-in, permanent set and durability requirements

11.1 Cover to frame alignment after bedding-in load test

When tested in accordance with the bedding-in test given in Annex A:

a) the upper surface of the cover shall be not higher than 2 mm above the adjacent upper face of the frame. The highest point of the tread pattern on a Grade A surface box shall be not higher than 7 mm above the adjacent upper face of the frame; for a Grade B or Grade C surface box the highest point of the tread pattern shall be not higher than 6 mm above the adjacent upper face of the frame; and

b) the upper surface of the cover shall be not more than 2 mm below the upper edge of the frame.

NOTE Where the raised pattern has a surface area that is less than 70% of the surface area of the cover, the upper surface should be considered to be the surface above which the raised pattern protrudes. However, where the raised pattern has a plane surface area in excess of 70% of the surface area of the cover, then the upper surface should be considered to be the plane at the top of the raised pattern. Where the raised pattern does not have a flat measurable surface area (i.e. it has pointed or irregular heights) then the upper surface should be considered to be the surface level above which the raised pattern protrudes.

11.2 Test for permanent set

11.2.1 Covers

When tested in accordance with Annex A (see **A.3.5**), any permanent set at the centre of the cover section shall be not greater than the following fractions of the greatest length of the cover or cover section.

NOTE This is measured in millimetres.

a) Small surface box covers:

   1) 1/500 (0.2%) for Grade A (heavy) boxes;

   2) 2/500 (0.4%) for Grade B (medium) boxes;

   3) 3/500 (0.6%) for Grade C (light) boxes.

b) Large surface box covers: 1/500 (0.2%).

11.2.2 Frame

When tested in accordance with Annex A (see **A.3.5**), any permanent set between the test bed for the device applying the load and the top edge of the frame shall be not greater than 1 mm.

11.2.3 Seating

When tested in accordance with Annex A (see **A.3.5**), any permanent set of the upper surface of the cover relative to the upper edge of the frame, shall be not greater than 0.5 mm.

11.3 Deflection under load of plastic surface boxes

When plastics surface boxes are subjected to the permanent set test loads in accordance with **A.3.5**, the measured deflection of the cover under load shall be not greater than 4 mm.

11.4 Full load test for surface box durability

When tested in accordance with Annex A (see **A.3.6**), surface boxes shall not fracture or crack.

NOTE The manufacturer should supply a copy of the test records where requested by the purchaser.

12 Marking

12.1 Each cover section and frame shall be marked with the following:

a) the number and year of this standard, i.e. BS 5834-2:2011 [1)];

b) the appropriate grade (e.g. Grade A);

*NOTE 1 This may also include type e.g. Type N (see **8.10**).*

c) the name and/or identification mark of the manufacturer;

d) the factory of manufacture;

NOTE 2 This may be a code.

e) the week or month and year of manufacture (coded or not coded).

NOTE 3 Other markings may include but are not restricted to:

f) any markings relating to the intended application/identity of the user;

g) the mark of a certification body, when applicable;

h) the product identification (name and/or catalogue number);

i) the weight of individual components in kg.

12.2 All markings on covers and frames shall be clear, permanent and form an integral part of the structure. With the exception of fabricated steel surface boxes, the markings shall not be applied by riveting, bolting, chemical adhesives or welding.

NOTE Wherever practicable, markings should be visible on the upper side (visible from the trafficked area) after the unit is installed. Where this is not practicable, they may be placed on the underside of the cover.

12.3 Where functional identifying marks are used on the upper surface of each cover, e.g. W, G, F, H, the minimum character height shall be 25 mm for small surface boxes and 50 mm for large surface boxes.

[1)] Marking BS 5834-2:2011 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 solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

Annex A (normative) Loading tests

A.1 Principle

Three different types of load tests are undertaken for each surface box cover or cover section: a bedding-in test, a test for permanent set, and a full load test. Before a test load is placed on the surface box cover, a series of measurement points are established on the surface box cover or cover sections and measurements are taken on the cover and frame. These are all recorded in a test report. The bedding-in test is undertaken in which two-thirds of the full test load (a permanent set test load) are placed on the surface box cover or cover section, and the points are re-measured and recorded in the test report. Four more permanent set test loads are placed on the same surface box cover or cover section in turn and removed. The measurements are re-taken after the removal of the fifth permanent set test load and recorded in the test report.

Immediately after the permanent set test, the surface box is subjected to a full load test, in which a full test load is applied at a set rate and sustained for a set period of time before being removed and the surface box cover and frame being visually inspected and the results recorded in a test report.

NOTE A permanent set test is not necessary for grey iron covers.

A.2 Apparatus

A.2.1 *Device for applying the load*, preferably a hydraulic test press, capable of applying a load at least 25% greater than the applicable test load specified in Table A.1 or Table A.2, and accurate to within 2% of the indicated load.

A.2.2 *Full test load or permanent set test load*, in accordance with Table A.1 or Table A.2, as applicable.

A.2.3 *Intermediate layer of hard rubber*, or equivalent material, having a thickness of 10 mm ±3 mm, not less than 70° IRHD (International Rubber Hardness Degree), which is at least equal in size to the loading face of the test block used.

A.2.4 *Measuring device*, having a measurement range of at least 10 mm and a minimum accuracy of 0.1 mm for indicating deflection measurements.

A.2.5 *Measuring device support.*

NOTE A typical example of a measuring device and support used to measure the effects of permanent set test loads on the cover and frame is shown in Figure A.1.

A.2.6 *Test bearing block*, of a size specified in Table A.1 or Table A.2 for the clear opening of the surface box being tested and rigid such that the load is evenly distributed over the full area of the block.

A.3 Procedure

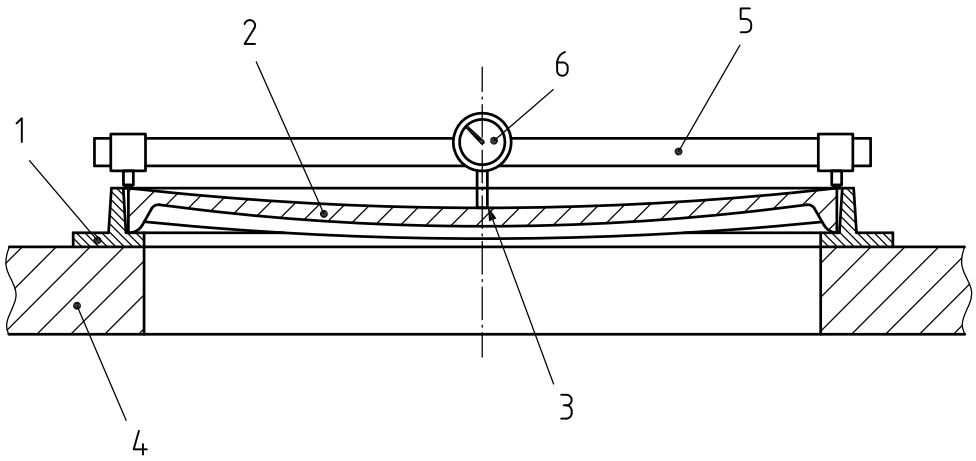
*COMMENTARY ON **A.3***

It is permissible for surface boxes classified as Grade C to be provided with further support, as would result in use when following installation in accordance with the manufacturer's instructions. Where those instructions specify the provision of a concrete surround to provide peripheral support to the surface box, this may be simulated by placing a rigid steel collar around the frame, provided that there is a minimum of 1 mm clearance on all sides between the collar and the frame.

A.3.1 Environmental conditions

Test plastics surface boxes within an ambient temperature of 23 °C ±3 °C.

Figure A.1 **Example of a measuring device support used for measuring cover and frame movement under permanent set loads**



Key

1	Frame	4	Bed of testing machine
2	Cover or grating	5	Measuring device support
3	Geometric centre	6	Measuring device

A.3.2 Establishing initial measurements

Prior to the application of any test load, measure E, F, G and J on the untested surface box in accordance with Figure A.3 and Figure 3 and record in a test report (see Table B.1).

NOTE 1 For the test for permanent set, the measurements should be taken at the extremities of the greatest length of the cover or cover section. On a single piece rectangular cover, this will be the diagonal.

Establish measurement positions A, B, C and D in accordance with Figure A.6 on a line through the greatest length of the cover or cover section.

To determine the initial value of H (see Figure A.4 and Figure A.5), measure points B and C on the cover planar surface and upper frame edge for each cover or cover section (see Figure A.6).

*NOTE 2 Conformity to the cover to frame alignment requirement (**11.1**) is determined by the measured value of H1, not the initial value of H.*

In the case of multiple cover sections, take the measurements as near as practicable to the measurement line [Figure A.6c)].

Where there are apertures for non-structural inserts or other openings in the cover and these coincide with the measurement location, use a bridging piece to take the measurements. Any such bridging piece shall not exceed the dimensions shown in Figure A.6d) and shall be removed prior to the application of any load.

NOTE 3 Figure A.6 indicates measurement locations.

A.3.3 Application and removal of permanent set test loads and full test loads

Assemble the apparatus with the surface box under test, selecting the applicable test bearing block dimensions in accordance with Table A.1 and Table A.2. Place the intermediate layer of hard rubber (see **A.2.3**) centrally under the test bearing block to evenly distribute the test load over the test block face.

NOTE The surface box cover should always be tested in its frame.

Table A.1 **Test loads for small surface boxes**

Grade	Minimum clear opening (see Table 3) mm	Diameter of bearing block mm	Full test load [A] kN
A (heavy)	100	100	$350 \times \frac{a}{70\,686} \times 1.3$ [B]
	135	135	$350 \times \frac{a}{70\,686} \times 1.3$ [B]
	225	225	$350 \times \frac{a}{70\,686}$ [B]
[C1]	300	300	350 [C1]
B (medium)	100	100	$150 \times \frac{a}{70\,686} \times 1.3$ [C]
	135	135	$150 \times \frac{a}{70\,686} \times 1.3$ [C]
C (light)	100	100	$10 \times \frac{a}{70\,686}$ [D] or 5 kN, whichever is the greater
	135	135	$10 \times \frac{a}{70\,686}$ [D] or 5 kN, whichever is the greater

[A] For permanent set test loads, the test load used shall be two-thirds of the calculated test load.

[B] Where the test load derived from this formula exceeds 350 kN, a load of 350 kN shall be used.

[C] Where the test load derived from this formula exceeds 150 kN, a load of 150 kN shall be used.

[D] Where the test load derived from this formula exceeds 10 kN, a load of 10 kN shall be used.

NOTE The test loads are all related to a standard bearing block measuring 300 mm in diameter. For the purposes of calculating the test loads in accordance with the formulas in this table, "a" is the total top surface area of the cover(s) in mm². The value 70 686 is the area in mm² of a 300 mm diameter circle and 1.3 is a factor intended to compensate for additional loadings imposed on smaller surface boxes when they protrude slightly above the road surface.

Select the full test load or permanent set test load, as applicable, in accordance with Table A.1 or Table A.2. For large surface boxes, apply the test load, at a load rate of 1 kN/s to 5 kN/s, to a test load position given in Figure A.2. For small surface boxes, place full test loads or permanent set test loads centrally. Sustain the load for a minimum period of 30 s before removing.

For large surface boxes, repeat the permanent set test procedure in each test load position indicated in Figure A.2 using a new surface box specimen each time. For small surface boxes the permanent set test procedure may be carried out on a single surface box.

Carry out the full load test on the large surface box specimen for all of the applicable test load positions indicated in Figure A.2, or on one position on a small surface box, following the permanent set test. For large surface boxes, it is permissible for all of the tests to be applied to one surface box cover but in cases of dispute, use a separate cover for each full load test at each position.

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Table A.2 **Test loads for large surface boxes**

Grade	Clear opening mm	Bearing block dimension(s) mm	Full test load [A] kN	Permanent set test loads kN
A	380 × 230	300 × 200	300	200
	430 × 280	300 × 235	350	233
	All others	300 dia.	350	233
B	380 × 230	300 × 200	125	83
	430 × 280	300 × 235	150	100
	All others	300 dia.	150	100
C	380 × 230	300 × 200	10	7
	430 × 280	300 × 235	10	7
	All others	300 dia.	10	7

[A] The test load can be of any material.

A.3.4 Bedding-in load test

Establish the initial measurements in accordance with **A.3.2**. In accordance with **A.3.3**, assemble the apparatus and surface box, apply and remove a permanent set test load to the surface box under test.

Re-measure E, F, G and H in accordance with Figure A.3. Record these new measurements as E1, F1, G1 and H1 on a test report (see Table B.1).

A.3.5 Test for permanent set and deflection under test load

Establish the initial measurements in accordance with **A.3.2**. Apply a permanent set test load in accordance with **A.3.3**. Carry out the bedding-in load test in accordance with **A.3.4**. Apply four more permanent set test loads in turn, in accordance with **A.3.3**, removing the previous permanent set test load before applying another.

NOTE 1 The test for permanent set can be continued from the bedding-in load test. Where it is only the test for permanent set being undertaken, the E1, F1, G1 and H1 measurements may be omitted.

For plastics surface boxes, before release of the fifth permanent set test load, measure the maximum deflection of the surface box cover at point A (see Figure A.6) from the underside of the cover to the test bed. Record the measurement as E6 in the test report (see Table B.1).

NOTE 2 The test for permanent set might be referred to as the test for permanent deflection as a consequence of loading.

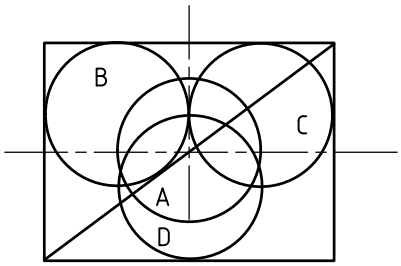
Immediately after the removal of the fifth permanent set test load on all surface boxes, re-measure E, F and G in accordance with Figure A.3. Record these new measurements as E5, F5 and G5 on a test report (see Table B.1).

A.3.6 Full test load durability test

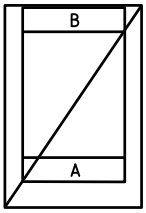
Establish the initial measurements in accordance with **A.3.2**. Apply a full test load in accordance with **A.3.3**.

After removal of the test load and any apparatus, inspect the cover and frame visually for fractures or cracks.

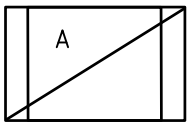
Figure A.2 **Test load positions for large surface boxes**



1

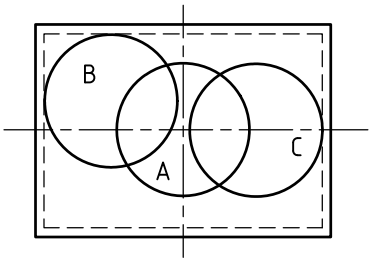


2



3

a) Double triangular covers



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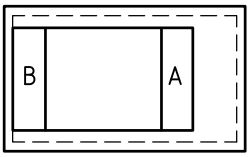
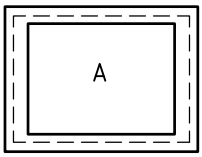




3

b) Rectangular covers

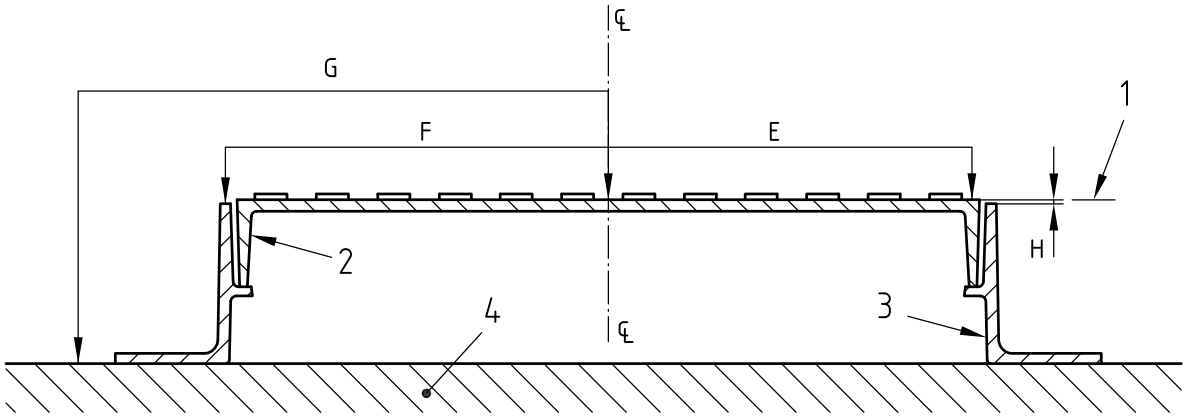
Key

1 Surface box clear opening measuring >430 mm × 280 mm
2 Surface box clear opening measuring 430 mm × 280 mm
3 Surface box clear opening measuring 380 mm × 230 mm

NOTE 1 The cover shapes represent the outline of the cover.

NOTE 2 A, B, C and D represent test load positions.

Figure A.3 **Cover and frame: arrangement of measurements**

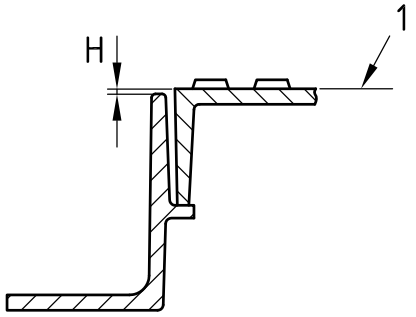


Key

1 Cover planar surface (See Figure. A.7a and Figure A.7.b)
2 Cover
3 Frame
4 Machine bed
E Measurement from cover centre, CL, to perimeter point [A)]
F Measurement from cover centre, CL, to highest frame point
G Measurement from cover centre, CL, to test-machine bed
H Measurement of depth from the upper surface of the cover to the adjacent top edge of frame
CL Geometrical vertical axis through centre of frame or product assembly

[A)] The perimeter point should be located as closely to the edge of the surface box cover or cover section as is practicable. Where cover planar surface patterns make it difficult to measure a perimeter point that is absolutely on the edge of the surface box cover or cover section, the perimeter point should still be within 10 mm from the edge.

Figure A.4 **Cover to frame alignment relative to cover planar surface for raised patterns**

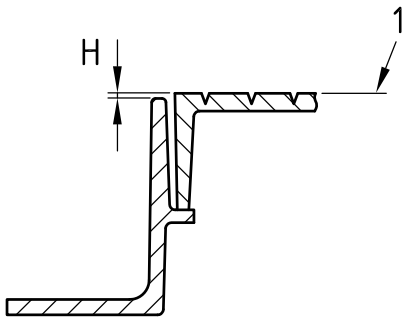


Key

1 Cover planar surface
H Measurement of depth from the upper surface of the cover to the adjacent top edge of frame

NOTE The diagram shows the bottom of the pattern, where the top of the pattern is <70% of the cover area.

Figure A.5 **Cover to frame alignment relative to cover planar surface for recessed patterns**



Key

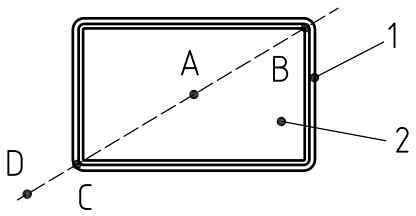
1 Cover planar surface

H Measurement of depth from the upper surface of the cover to the adjacent top edge of frame

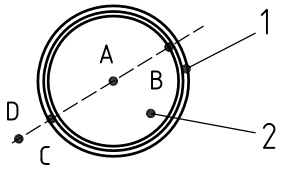
NOTE The diagram shows the top of the pattern, where the top of the pattern is >70% of the cover area.

Figure A.6 **Views of cover and frame assemblies illustrating measurement positions**

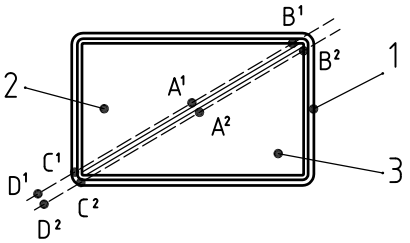
Dimensions in mm



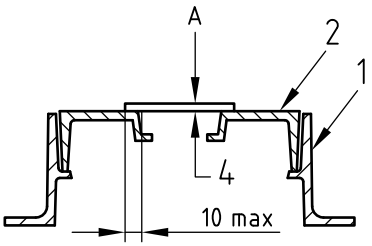
a) Plan view (single piece cover)



b) Plan view (circular cover)



c) Plan view (double triangular cover indicating separate measurement arrangements for each cover segment)



d) Section view (covers with apertures)

Key

1	Frame
2	Cover [first cover section in c)]
3	Second cover section
4	Temporary bridge
A	Centre line measurement position
A^1	Centre line measurement position for first cover section
A^2	Centre line measurement position for second cover section
B	Measurement position at perimeter of cover within 10 mm of cover edge
B^1	Measurement position at perimeter of first cover section
B^2	Measurement position at perimeter of second cover section
C	Measurement position on upper face of frame
C^1	Measurement position on upper face of frame on first cover section
C^2	Measurement position on upper face of frame on second cover section
D	Measurement position on test bed
D^1	Measurement position on test bed on first cover section
D^2	Measurement position on test bed on second cover section

Annex B (informative) Optional items to be agreed between the manufacturer and the purchaser

B.1 Information to be supplied by thepurchaser with the enquiry and/or order

The purchaser should supply the following information with the enquiry and/or order:

a) designation of surface box required (see Clause **8**);

b) what material is required (see Clause **5**);

c) if a combination unit is required (see **3.3**);

d) whether open or closed keyways are required (see **8.7**);

e) whether uncoated surface boxes are required (see Clause **10**);

f) what grade of surface box is required (see Table 3 and Table 4);

g) what size of minimum clear opening is required (see Table 3 and Table 4)

NOTE For items e), f) and g) the designations given in Table 3 and Table 4 can be used to state what is required.

h) whether the purchaser wishes to inspect covers and frames prior to the application of coating;

i) whether the purchaser wishes to witness the tests;

j) whether a certificate of compliance with this standard is required;

k) whether any special marking is required (see Clause **12**).

B.2 Certification of compliance

If requested, the manufacturer should supply the purchaser with a certificate in respect of each delivery certifying that the surface boxes conform to this standard.

A test report including the information given in Table B.1 may also be included.

Table B.1 **Example of a test report**

Measurements	**Surface box (size/specification/model)**	**Test date** **Results calculation**		**Limits within specification**	**Pass/Fail**
Initial measurements Unloaded/unbedded E = mm F = mm G = mm J = mm	**Height of raised pattern/Depth of recessed pattern** (see **8.5.2**, **8.5.3**, Figure 3, **J**)	=	mm	**(Variable)**	
	Bedding-in test/Permanent set test				
	Cover to frame alignment determined after removal of 1st permanent set load (see **11.1**, Figure A.4 and Figure A.5, **H**)	= (F1 – F) – E1 =	mm	**±2.0 mm max.**	
	Seating permanent set, determined after removal of 5th test load (see **11.2.3**)	= (F5 – F1) – (E5 – E1) =	mm	**0.5 mm max.**	
At end of bedding-in test E1 = mm F1 = mm G1 = mm H1 = mm	Frame permanent set, determined after removal of 5th test load (see **11.2.2**)	= (G5 – G1) – (E5 – E1) – (F5 – F1)=	mm	**1.0 mm max.**	
	Cover permanent set, determined after removal of 5th test load (see **11.2.1**)	= E5 =	mm	**(Variable)**	
At end of permanent set test E5 = mm F5 = mm G5 = mm	**Test loads**				
	Force of test load (see Table A.1 and Table A.2)	=	kN	**(Variable)**	
	Plastics surface box deflection under test load (see **11.3**)	= E6 =	mm	**4.0 mm max.**	

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 750, *Specification for underground fire hydrants and surface box frames and covers*

BS EN 124, *Gully tops and manhole tops for vehicular and pedestrian areas – Design requirements, type testing, marking, quality control*

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