BRITISH STANDARD

BS 4607-3: 1971

Incorporating Amendment Nos. 1 and 2

Specification for

Non-metallic conduits and fittings for electrical installations —

Part 3: Pliable corrugated, plain and reinforced conduits of self-extinguishing plastics materials

Co-operating organizations

The Electrical Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Associated Offices' Technical Committee
Association of Consulting Engineers*
Association of Manufacturers of Domestic Electrical Appliances
Association of Mining Electrical and Mechanical Engineers
Association of Supervisory and Executive Engineers
British Electrical and Allied Manufacturers' Association*
British Railways Board
British Radio Equipment Manufacturers' Association
Crown Agents for Oversea Governments and Administrations
Department of Employment and Productivity*
Department of the Environment*
Department of Trade and Industry
Electric Cable Makers' Confederation*
Electrical Contractors' Association (Incorporated)*
Electrical Contractors' Association of Scotland
Electrical Research Association
Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales*
Electronic Engineering Association
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Ministry of Defence, Army Department
Ministry of Defence, Navy Department
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National Physical Laboratory (Department of Trade and Industry)
Oil Companies Materials Association
Post Office
Public Road Transport Association
South of Scotland Electricity Board

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Aluminium Federation
Association of Industrialized Building Component Manufacturers
British Electric Conduit Systems Manufacturers
British Plastics Federation
Confederation of British Industry
Light Metal Founders' Association
Zinc Development Association

This British Standard, having been approved by the Electrical Industry Standards Committee, was published under the authority of the Executive Board on 30th July 1971

The following BSI references relate to the work on this standard:
Committee reference ELE/80/2
Draft for comment 70/16231

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Amendments issued since publication

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4786	February 1985	Indicated by a sideline in the margin

Contents

Foreword

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 5000, fully indexed and with a note of the contents of each, will be found in the British Standards Yearbook. The BS Yearbook may be consulted in many public libraries and similar institutions.

This British Standard has been prepared under the authority of the Electrical Industry Standards Committee, as a result of proposals by the Codes of Practice Committee for Electrical Engineering, in view of the increasing use of plastics conduits for electrical installations in the United Kingdom and other countries.

Parts 1 and 2 dealt respectively with rigid PVC conduits and fittings in metric and inch dimensions. This Part is in close agreement with Part 1 and differs from it only in those respects necessary to adopt the requirements of Part 1 to pliable rather than rigid conduits. It is thus also in close agreement with the requirements of CEE[1)] Publication 26: "Rigid conduits of polyvinyl chloride for electrical installations and their fittings" and with a draft CEE recommendation for pliable conduits of self-extinguishing plastics material based on CEE 26 presently under review.

This Part of this British Standard differs from Parts 1 and 2 as to material in that it allows the use of any plastics self-extinguishing materials which meet the requirements of the tests specified and is not limited to PVC. The materials are, however, still classified according to their behaviour at low temperatures as in Part 1.

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

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14, an inside back cover and a back cover.

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

1) The International Commission on rules for the approval of electrical equipment. Membership includes Austria, Belgium, Czechoslovakia, Denmark, Federal Republic of Germany, Finland, France, Greece, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom and Yugoslavia.

1 Scope

This Part of this British Standard specifies the requirements for pliable corrugated, plain and reinforced conduits of self-extinguishing plastics materials, intended for the protection of cables in electrical installations. These conduits are classified according to their behaviour at low temperatures.

NOTE 1 For the same nominal outside diameters, the inside diameter of such conduits is smaller than the inside diameter of rigid PVC conduits of corresponding size manufactured in accordance with Part 1 of this standard

NOTE 2 Conduits may be connected by couplers complying with the requirements of Standard sheets 2 and 3 of Part 1 of this standard.

NOTE 3 Pliable conduits to this standard may not be suitable for use in situations in which they would be subjected to continuous flexing, e.g. for connection to the moving parts of machinery.

2 Definition

For the purposes of this Part of this British Standard the following definition applies:

pliable conduits

corrugated, plain or reinforced which may be bent by hand without special preparation and without the aid of a tool

NOTE While the corrugated type may be bent without appreciable force, the plain and reinforced types requires for bending the application of a certain force which can, however, still be exerted by hand.

3 General requirements

3.1 Conduits shall be so designed and constructed that they ensure reliable mechanical protection to the cables contained therein, and withstand the stresses likely to occur during transport, storage and installation.

3.2 Compliance shall be checked by carrying out all the tests specified.

4 General conditions for tests

4.1 Tests according to this standard are type tests.

4.2 Unless otherwise specified, the tests shall be carried out at an ambient temperature of 20 ± 5 °C.

4.3 Unless otherwise specified, each test shall be made on three new samples. A length of 18 m is required, the samples for the various tests being taken from different places in this length.

4.4 Unless otherwise specified, conduits shall be deemed not to comply with this standard if there are more failures than that of one sample in any one of the tests. If one sample fails in a test, that test and those preceding, which may have influenced the result of that test, shall be repeated on another set of samples of the number specified, all of which shall then comply with the repeated tests.

NOTE The applicant, when submitting the first testing length, may also submit the additional lengths of conduit which may be wanted should one sample fail. The testing station will then, without further request, test the additional samples and will only reject if a further failure occurs. If the additional testing lengths of conduit are not submitted at the same time, a failure of one sample will entail a rejection.

5 Classification

Conduits are classified according to their behaviour at low temperatures:

Type A. Conduits suitable for installation, storage or transport at temperatures not normally below – 5 °C.

Type B. Conduits suitable for installation, storage or transport at temperatures not normally below – 25 °C.

6 Marking

6.1 Each coil of conduit shall have an attached label bearing the maker's name or trade mark, immediately followed by a minus sign and the number:

5 for conduits of type A

25 for conduits of type B

In addition the tube shall be marked either – 5 or – 25 as applicable, throughout its length at intervals not greater than 3 m.

6.2 Marking shall be indelible and easily legible.

6.3 Compliance with the requirements of **6.1** and **6.2** shall be checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

NOTE 1 Marking may be applied by stamping, printing, paper stickers or waterslide transfers.

NOTE 2 Attention is drawn to certification facilities offered by BSI; see the back cover of this standard.

7 Dimensions

7.1 Conduits shall comply with the Standard sheet 1.

7.2 Compliance shall be checked on three samples, each having a length of 3 m by measurement and by means of gauges according to the following figures:

Figure 1 for the maximum outside diameter.

Figure 2 for the minimum inside diameter.

Figure 3 for the minimum outside diameter.

In case of doubt with regard to the uniformity of the wall thickness of plain conduits, three samples, taken from different lengths, shall be cut with a saw, a sharp knife or the like, along a plane perpendicular to the axis. The wall thickness of each cut edge shall be measured at four places as far as possible equally spaced around the circumference, one of the measurements being made at the thinnest place.

In no case shall the difference between the value measured and the average of the twelve values obtained from the three samples, exceed 0.1 mm + 10 % of the average value.

8 Construction

8.1 Conduits shall be manufactured from self-extinguishing plastics materials.

8.1.1 Compliance shall be checked by the tests of Clause **11**.

8.2 The inside and outside surfaces of conduits shall be smooth and free from burrs, flash and similar defects.

NOTE This does not preclude the corrugate form of construction.

8.2.1 Compliance shall be checked by inspection.

9 Mechanical properties

9.1 Conduits shall have adequate mechanical strength. Conduits, when bent or compressed, or exposed to impacts or extreme temperatures, either during or after installation, shall show no cracks and shall not be deformed to such an extent that introduction of the cables becomes difficult, or that the cables are likely to be damaged while being drawn in.

9.1.1 Compliance shall be checked by the relevant tests of **9.2** to **9.4**.

9.2 Three samples of conduit, each 200 mm long, shall be subjected to a compression test in the manner shown in Figure 4.

Before the test, the outside diameter of the samples shall be measured and they shall then be conditioned at a temperature of 20 ± 1 °C for at least 10 h.

Immediately after the conclusion of the conditioning period, the samples shall be positioned on a flat steel support, and a steel intermediate piece, as shown in Figure 4, shall be placed on the middle of the sample. The test shall then be made in accordance with **9.2.1**.

9.2.1 A slowly increasing force shall be applied to the intermediate piece in such a way that a total force of 450 N is exerted after 30 s.

After the full force has been applied for 1 min, the outside diameter of the sample shall be measured where flattening has taken place, without removing the force. The difference between the initial diameter and the diameter of the flattened sample shall not exceed 25 % of the outside diameter measured before the test.

The force and the intermediate piece shall then be removed and, 1 min after removal, the outside diameter of the sample where it has been flattened, shall be again measured. The difference between the initial diameter and the diameter of the flattened sample shall then not exceed 10 % of the outside diameter measured before the test.

If the test is not made at the conditioning temperature, the measurements shall be completed within 5 min after removal of the samples from the conditioning atmosphere.

After the test the sample shall show no cracks visible to the naked eye.

9.3 Twelve samples of conduit, each 200 mm long, shall be subjected to an impact test by means of the apparatus shown in Figure 5.

Before the test, the samples shall be conditioned at a temperature of 60 ± 2 °C for 10 days (240 h). The test apparatus shall then be placed on a pad of sponge rubber, 40 mm thick, and these, together with the samples, shall be placed in a refrigerator, the temperature within which is maintained at:

– 5 ± 1 °C for conduits of type A

– 25 ± 1 °C for conduits of type B

When the samples have attained the temperature of the air within the refrigerator, or after 2 h, whichever is the longer period, each sample shall be in turn placed in position on the steel base as shown in Figure 5, and the hammer, which has a mass of 1 kg, shall be allowed to fall from a height of 200 mm.

After the test, them shall be no sign of disintegration, neither shall there be any crack visible to the naked eye in at least nine of the samples.

9.4 Conduits shall be subjected to a bending test by means of a device as shown in Figure 6.

The test shall be made on three samples of conduit, each 500 mm long, at room temperature, and on three similar samples in a refrigerator, the temperature within which shall be maintained at:

– 5 ± 2 °C for conduits of type A

– 15 ± 2 °C for conduits of type B

Before the test at low temperature, the samples shall be conditioned for at least 2 h in the refrigerator at the temperature specified above.

The samples shall be clamped in a testing apparatus according to Figure 6. In this condition the conduits shall be bent by hand as follows:

one bend to the left,

one bend back to the vertical,

one bend to the right,

one bend back to the vertical,

a resting pause of 1 min being inserted between each bending operation. This sequence of bends shall be repeated three times.

Five minutes after completion of this testing sequence the conduit shall be bent through 90°, either to the left or to the right, and while maintained in this position it shall be possible to pass the test gauge shown in Figure 2 with the appropriate diameter, through the conduit.

After these tests, the samples shall show no cracks visible to the naked eye.

10 Resistance to heat

10.1 Conduits shall be resistant to heat.

10.1.1 Compliance shall be checked by a test which is made by means of the apparatus shown in Figure 7.

The samples shall be prepared by cutting three pieces of conduit, each about 100 mm long, the sample being placed in a heating cabinet at a temperature of 50 ± 2 °C.

After 4 h the centre of the sample shall be loaded with a force of 20 N by means of a steel rod of 6 mm diameter, disposed at right angle with respect to the axis of the conduit as shown in Figure 7.

The samples shall be held under these conditions for 24 h.

After completion of this test and after the samples have cooled to room temperature, a polished steel ball of the appropriate diameter according to Table 1 shall pass through the sample under its own weight.

11 Resistance to burning

11.1 Conduits shall be self-extinguishing.

11.1.1 Compliance shall be checked by the following test, which is made on three samples, each 200 mm long.

The test shall be made in still air with a Bunsen burner, having a nozzle with an internal diameter of 9 mm, burning butane, propane or equivalent gas. While the burner is in the vertical position, the flame shall be adjusted so that its overall length is 100 mm and the length of the inner blue cone is 50 mm. The burner shall then be supported so that its axis is at an angle of 45° to the vertical.

The sample shall be held in such a position that the part above the flame is vertical and that the tip of the inner cone of the flame touches the surface of the sample at a distance of approximately 100 mm from its lower end, as far as is practicable. The sample shall be held in the flame for the time shown in Table 2.

Table 2 — Duration of burning test

Thickness of the conduit wall	Minimum time
mm	s
Up to and including 0.5	15
Over 0.5 and up to and including 1	30
Over 1 and up to and including 3	60
Over 3 and up to and including 5	120
Over 5	180

If the sample burns, it shall do so slowly and the burning shall not spread appreciably; any flame shall have died out in less than 30 s after the removal of the burner.

NOTE In order to verify that the flame is hot enough for the purpose of this test, a bare copper wire, 0.7 mm in diameter and at least 100 mm long, is held horizontally so that it passes through the middle of the flame, 50 mm above the top of the burner, its free end being vertically above the edge of the burner. The wire should melt within 6 s.

12 Insulation resistance and electric strength

12.1 The insulation resistance and the electric strength of conduits shall be adequate.

12.2 Compliance shall be checked by the tests of **12.2.1** and **12.2.2** which are made on three samples of appropriate length.

For the purpose of the test of **12.2.2** the ends of each sample shall be provided with a conductive coating at least 10 mm long.

12.2.1 The samples shall be bent at a radius of about three times their outside diameter and immersed over a length of 1 m in water at a temperature of 20 ± 5 °C, a length of about 100 mm at each end being kept above the water level. Water shall then be poured into the samples until the levels inside and outside-are approximately the same and an electrode shall be immersed in the water inside each sample, and also in the water outside.

After 24 h, a voltage of 2 000 V, of substantially sine-wave form and having a frequency of 50 Hz, shall be appled for 15 min between the electrodes

No breakdown shall occur during the test.

12.2.2 Immediately after the test of **12.2.1** the samples shall be immersed as described in **12.2.1** in water maintained at a temperature of 60 ± 2 °C and the electrodes shall be again placed in position.

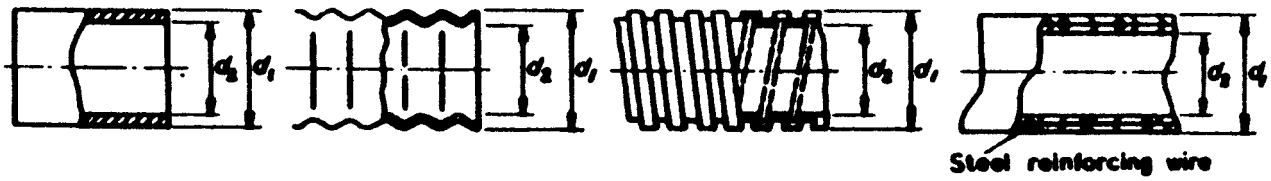
After 2 h, the insulation resistance of each sample shall be determined by applying a d.c. voltage of approximately 500 V between the electrodes, the conductive coatings being also connected to the voltage source but not included in the measuring circuit. The measurement shall be made 1 min after application of the voltage. The test arrangement is illustrated in Figure 8.

The insulation resistance shall be not less than 100 MΩ.

NOTE The voltage is applied to the conductive coatings in order to exclude any leakage current across the exposed surface.

Pliable conduits, corrugated, plain, or reinforced, of self extinguishing plastics materials | **Standard sheet 1**

Design P plain **Design C corrugated** **Design R reinforced**



Examples

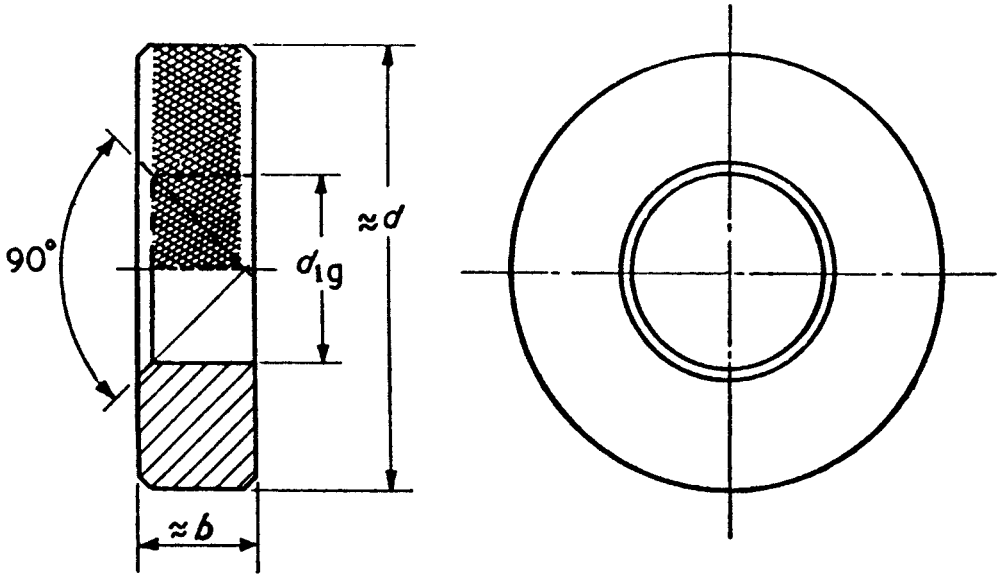
Code designation for a pliable conduit of design C (corrugated) and type A (– 5 °C) and a nominal size 20:

BS 4607/3.1.CA 20

Nominal size of conduit	Outside diameter d_1		Minimum inside diameter d_2			Preferred delivery length in coils
	Dimension	Tolerance	Conduits PA and PB	Conduits CA and CB	Conduits RA and RB	
	mm	mm	mm	mm	mm	m
16	16	+ 0 – 0.3	11.7	10.7	9.4	50
20	20		15.5	14.1	13.4	
25	25	+ 0 – 0.4	19.8	18.4	16.4	50
32	32		26.4	24.4	22.4	
40	40		34.0	31.2	—	
50	50	+ 0 – 0.5	43.5	39.7	—	25
63	63		56.0	49.6	—	

Type A (– 5 °C) and type B (– 25 °C) see Clause **5**.

The sketches are not intended to govern design except as regards the dimensions shown.

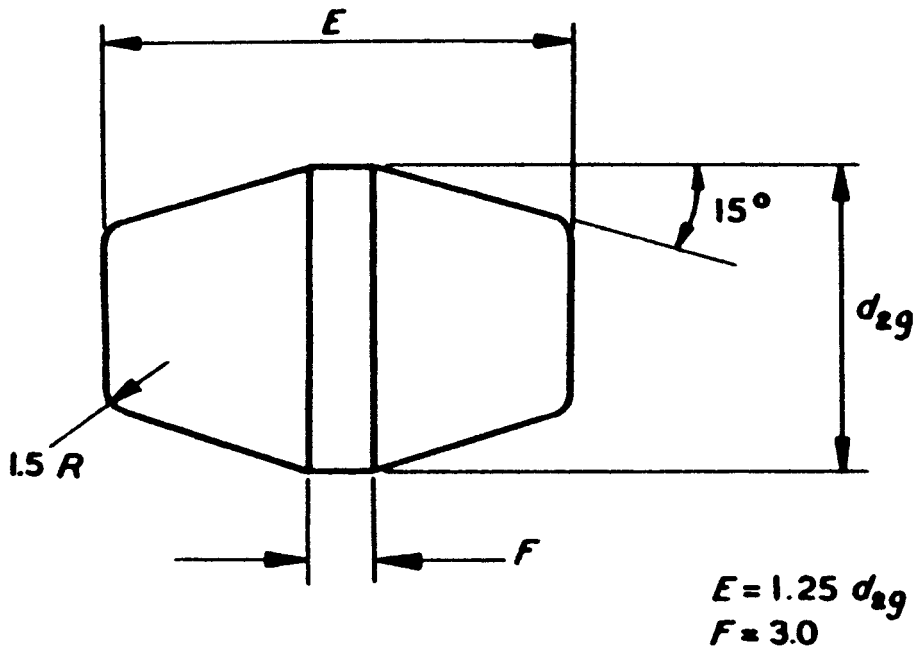


Nominal size of conduit	d_{1g} [a]	b	d
	mm	mm	mm
16	16.04	12	45
20	20.04	12	45
25	25.04	16	60
32	32.04	18	70
40	40.04	18	70
50	50.04	20	85

[a] Manufacturing tolerance: $^{+0}_{-0.01}$ mm.

Permissible wear: + 0.01 mm.
Material: steel.
It shall be possible to slide the appropriate gauge completely over the conduit.

Figure 1 — Gauge for checking maximum outside diameter of conduits



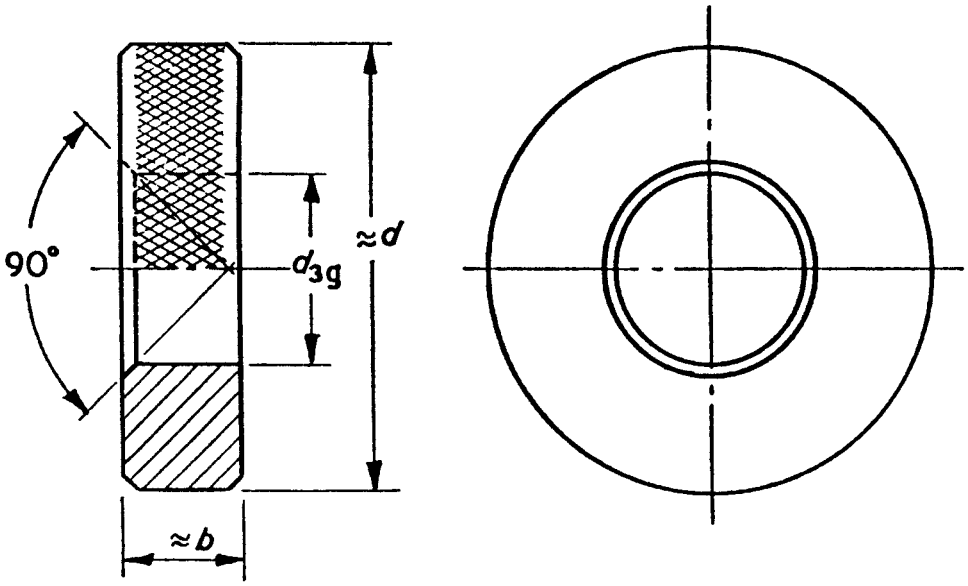
Dimensions in mm

Nominal size of conduit	$d_{2\,g}$ [a]					
	Bend test (Clause 9.4)			Straight test (Clause 7.2)		
	Plain	Corrugated	Reinforced	Plain	Corrugated	Reinforced
16	9.4	8.6	7.5	11.4	10.4	9.1
20	12.4	11.3	10.8	15.2	13.8	13.1
25	15.8	14.7	13.2	19.5	18.1	16.1
32	21.1	19.6	18.0	26.1	24.1	22.1
40	27.2	25.0	23.5	33.7	30.9	29.0
50	34.8	31.8	30.8	43.2	39.4	38.0

[a] Manufacturing tolerance: $^{+\,0.05}_{-0}$ mm.

Permissible wear: + 0.01 mm.
Material: polished steel.
It shall be possible for the appropriate gauge to pass through the conduit under its own weight.

Figure 2 — Dimensions of test gauge

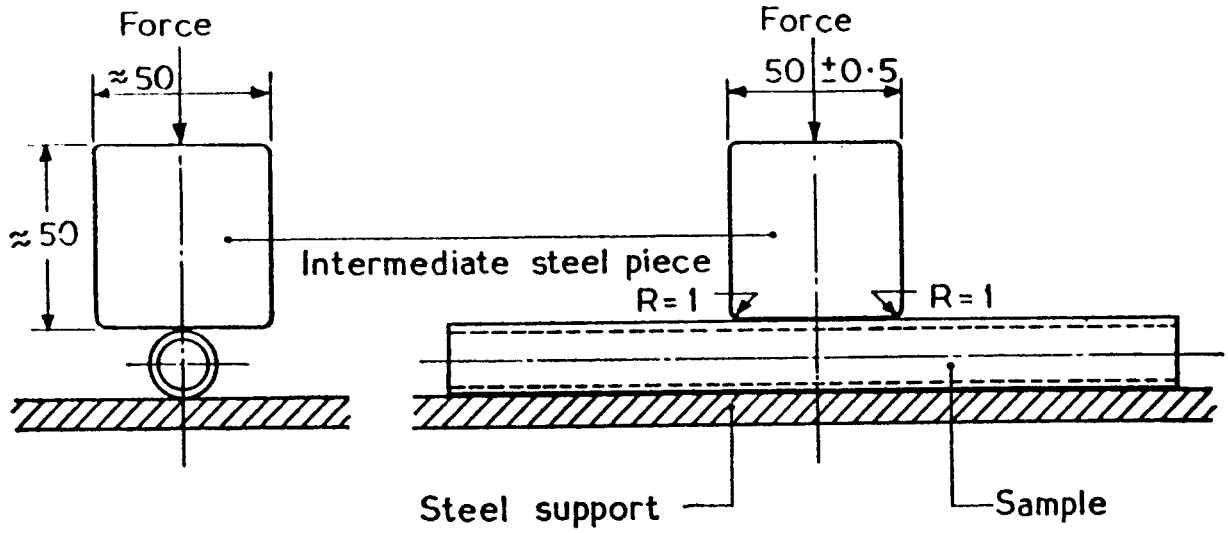


Nominal size of conduit	d_{2g}[a]	b	d
	mm	mm	mm
16	15.70	12	45
20	19.70	12	45
25	24.60	16	60
32	31.60	18	70
40	39.60	18	70
50	49.50	20	85

[a] Manufacturing tolerance: $^{+0}_{-0.01}$ mm.

Permissible wear: + 0.01 mm.
Material: Steel.
It shall not be possible to slide the appropriate gauge over the conduit without undue force.

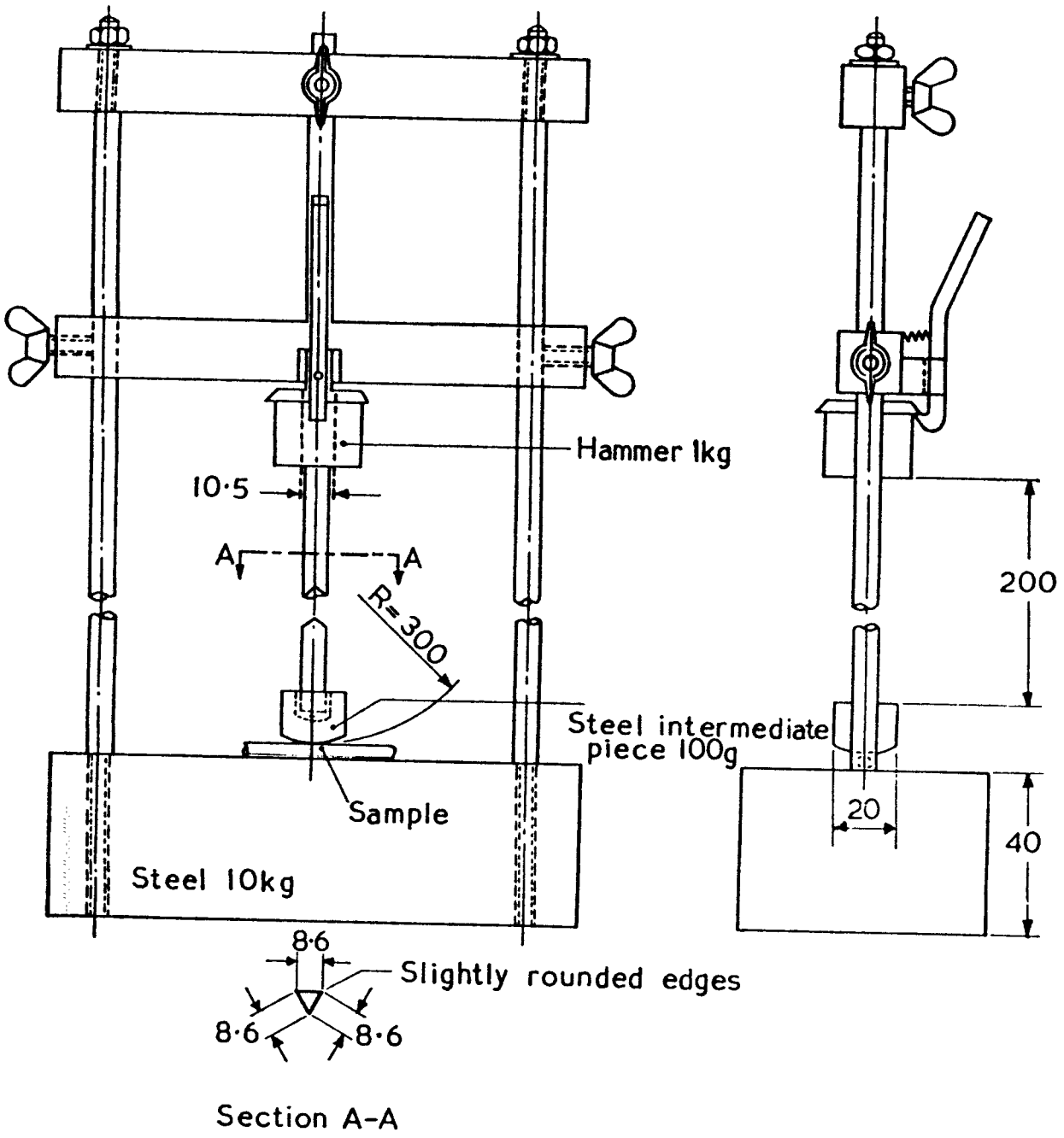
Figure 3 — Gauge for checking minimum outside diameter of conduits



Dimensions in mm

NOTE The sketch is not intended to govern design except as regards dimensions shown.

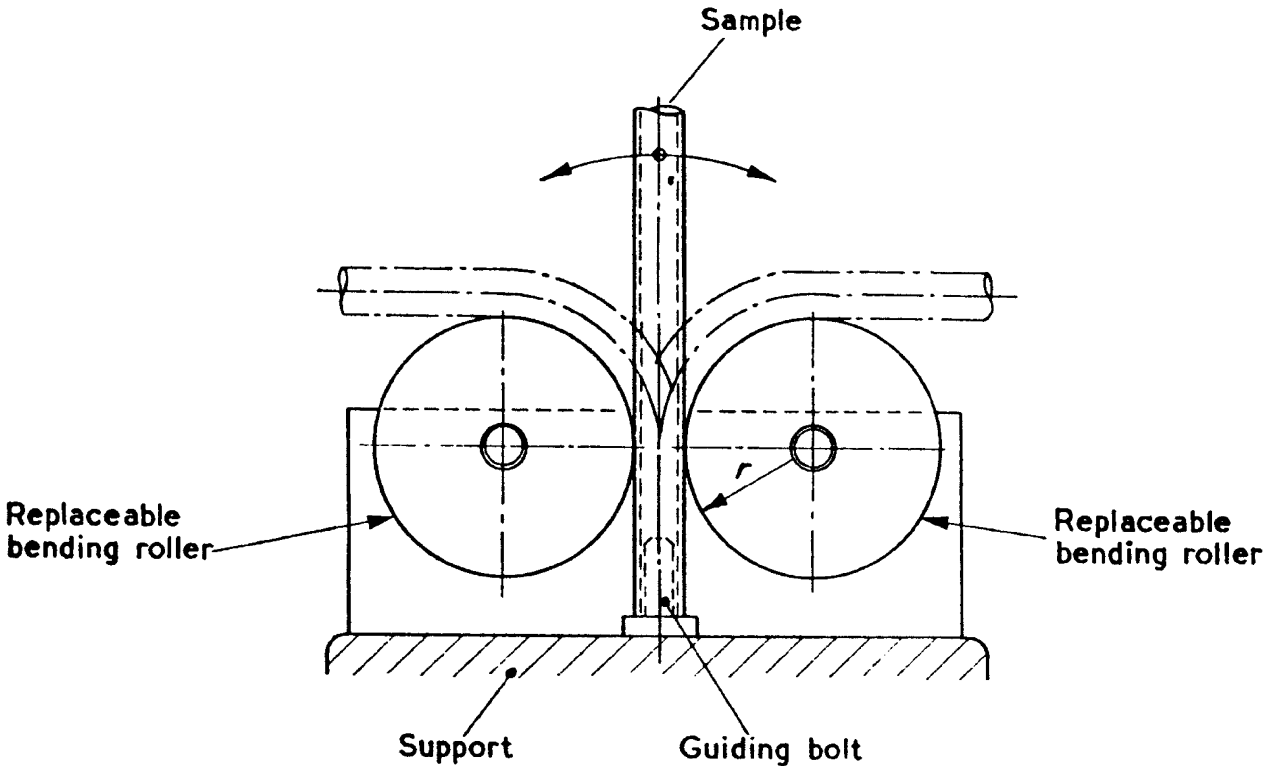
Figure 4 — Arrangement for compression test



Dimensions in mm.

NOTE The sketch is not intended to govern design except as regards dimensions shown.

Figure 5 — Impact test apparatus



Size	Nominal radius of curvature, *r*	
	Corrugated conduit	Plain and reinforced conduit
16	48	96
20	60	120
25	75	150
32	96	192
40	120	240
50	150	300

Figure 6 — Apparatus for bend test

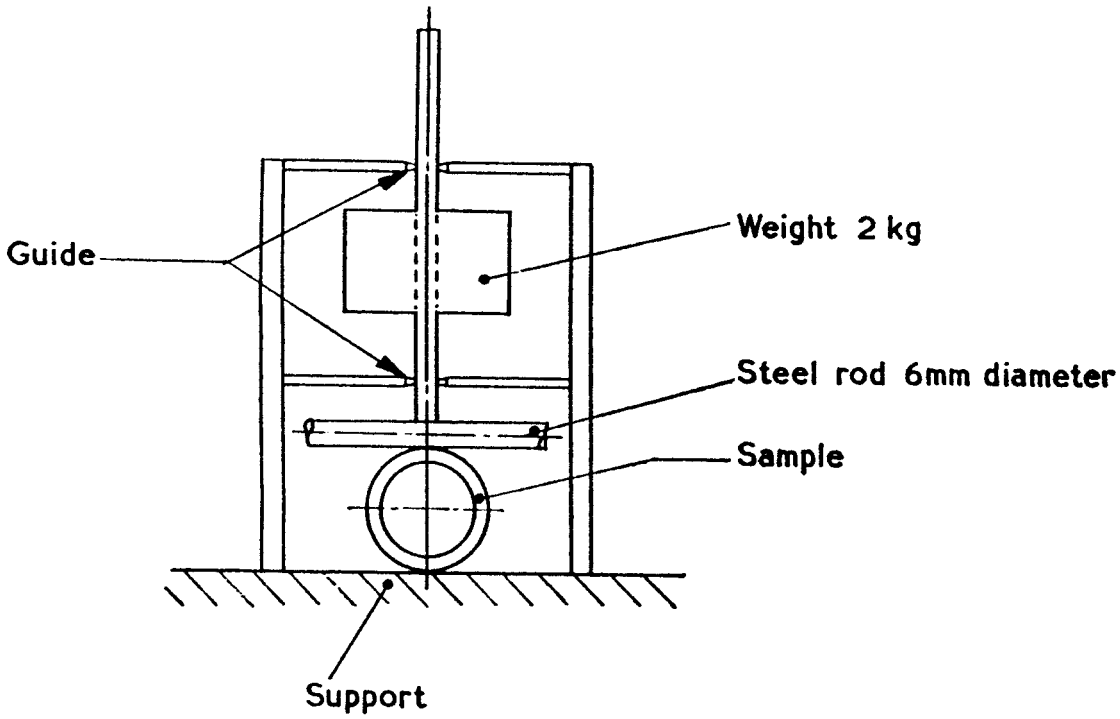
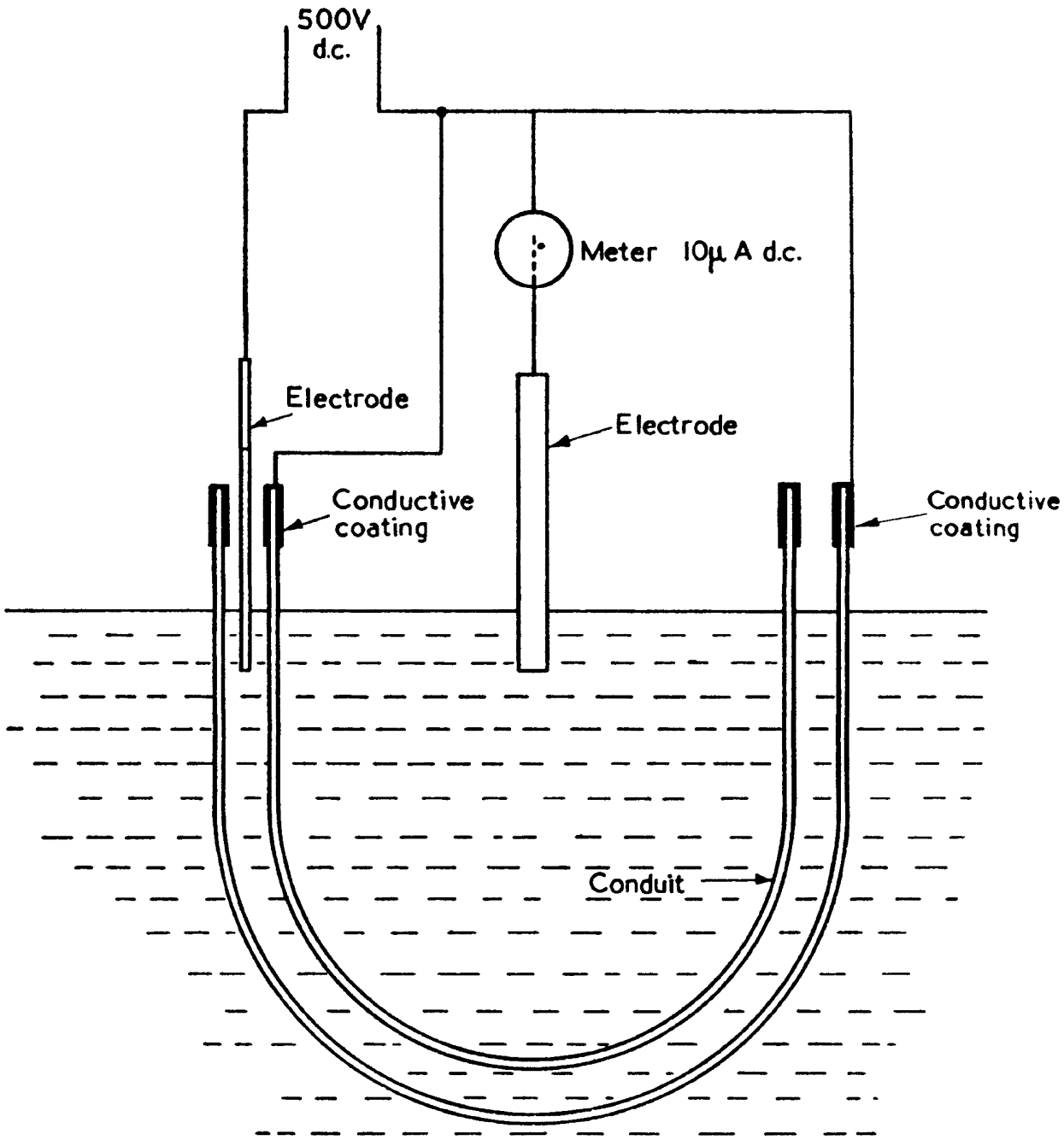


Figure 7 — Apparatus for high temperature compression test



Remove sharp edges and burrs

Figure 8 — Circuit diagram for insulation test

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British Standards

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