IS 14930-1 (2001): Conduit Systems for Electrical Installations, Part 1: General Requirements [ETD 14: Electrical Wiring Accessories]

BLANK PAGE

भारतीय मानक

विद्युत संस्थापनों के लिए कन्ड्यूट प्रणाली

भाग 1 सामान्य अपेक्षाएँ

Indian Standard

CONDUIT SYSTEMS FOR ELECTRICAL INSTALLATIONS

PART 1 GENERAL REQUIREMENTS

ICS 29.120.10

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

May 2001

Price Group 7

Electrical Wiring Accessories Sectional Committee, ET 14

FOREWORD

This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards, after the draft finalized by the wiring Accessories Sectional Committee had been approved by the Electrotechnical Division Council.

This standard (Part 1) which specifies general requirements for all conduit systems, is to be used in conjunction with the appropriate parts of this standard, which contains clauses to supplement or modify the corresponding clauses in Part 1, to provide the relevant particular requirements for each type of product.

A conduit system which conforms to the standard, is deemed safe for use.

To ensure safety in electrical installations use of metallic conduits as earth continuity conductor shall not be permitted.

This standard is based on IEC 61386-1 (1996) Conduit systems for electrical installations Part 1 General requirements issued by International Electrotechnical Commission. However there are deviations between this standard and the corresponding IEC standard due to national conditions. The National deviations alongwith the reason for the some are given below.

Clauses **5.2, 5.4, 3.1.1, 11.3.2.1, 14.2.2.2, 14.2.2.3**: Ambient temperature changed to 27°C due to climate conditions prevailing in India.

Clause **11.2, 11.3.1.2** : A frequency of 50 Hz has been specified as specified in National Electricity Rules.

Clause **11.3.2.2**: Thickness of aluminium foil is specified for the purpose of uniformity in test procedure.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 1 MAY 2002
TO
IS 14930 (PART 1) : 2001 CONDUIT SYSTEMS FOR ELECTRICAL INSTALLATIONS
PART 1 GENERAL REQUIREMENTS

(*Cover page and page* 1, *title*) — Substitute the following for the existing title:

CONDUIT SYSTEMS FOR ELECTRICAL AND COMMUNICATION INSTALLATION
PART 1 GENERAL REQUIREMENTS

(*Page* 1, *clause* 1, *second sentence*) — Substitute the following for the existing:

'This standard applies to metallic, non-metallic and composite conduit systems including threaded and non-threaded entries which terminate the system.'

(*Page* 1, *clause* 3.9, *title*) — Substitute **'Corrugated Conduit'** *for* **'Plain Conduit.'**

(*Page* 2, *clause* 3.18, *line* 2) — Substitute the word 'by' *for* 'be'.

(*Page* 3, *clause* 6.1.2.1) — Substitute the following for the existing:

6.1.2.1 *Very light*

6.1.2.2 *Light*

(ET 14)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 APRIL 2011
TO
IS 14930 (PART 1) : 2001 CONDUIT SYSTEMS FOR ELECTRICAL AND COMMUNICATION INSTALLATION

PART 1 GENERAL REQUIREMENTS

(*Page* 3, *clause* **6.2.1**, *Table* 2, *col heading* 2) — Substitute **'Temperature not More than'** *for* **'Temperature not Less than'**.

(*Page* 4, *clause* **6.4.1**) — Substitute the following for the existing matter:

'With protection in accordance with IS 12063 to IP6X.'

(*Page* 4, *clause* **6.4.2**) — Substitute the following for the existing matter:

'With protection in accordance with IS 12063 to IPX7.'

(*Page* 6, *clause* **10.3.2**, *para* 3) — Substitute the words 'The mass of the hammer and the fall height' *for* 'The hammer and the fall height'.

(*Page* 7, *Table* 5, *col heading* 4) — Substitute **'Tolerance ±1 percent'** *for* **'Tolerance +1 percent'**.

(*Page* 11, *clause* **12.1.2.4**, *para* 3, *line* 5) — Substitute 'there is no evidence of burning or charring within 50 mm of lower extremity of upper **clamp** and also within 50 mm of the extremity of lower **clamp'** *for* 'there is no evidence of burning or charring within 50 mm of the lower extremity of the upper and also within 50 mm of the upper extremity of lower clamp'.

(*Page* 14, *clause* **14.2.2.3**, *para* 2) — Substitute 'having a specific gravity of 1.186 kg/l at 27 ± 2°C' *for* 'having a specific gravity of 1.186 kg at 27 ± 2°C'.

(ET 14)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 3 AUGUST 2011
TO
IS 14930 (PART 1) : 2001 CONDUIT SYSTEMS FOR ELECTRICAL AND COMMUNICATION INSTALLATION*

PART 1 GENERAL REQUIREMENTS

(*Page* 13, *clause* **14.1**, *para* 1) — Substitute the following for the existing:

'Conduit system when assembled in accordance with the manufacturer's instructions shall have adequate resistance to external influences with a minimum requirement of IP 67.'

* Title changed vide Amendment No. 1 issued in May 2002.

(ETD 14)

Reprography Unit, BIS, New Delhi, India

Indian Standard

CONDUIT SYSTEMS FOR ELECTRICAL INSTALLATIONS

PART 1 GENERAL REQUIREMENTS

1 SCOPE

This standard (Part 1) specifies requirements and tests for conduit systems including conduits and conduit fittings, for the protection and management of insulated conductors and/or cables in electrical installation or in communication system up to 1.1 kV ac and/or 1 500V dc. This standard applies to metallic, non-threaded entries which terminate the system. This standard does not apply to enclosures and connecting boxes which come within the scope of IS 14772.

NOTES

1 Certain conduit systems may also be suitable for use in hazardous atmospheres. Regard should then be taken for the extra requirement necessary for equipment to be installed in such conditions.

2 Earthing conductors may or may not insulated. Earthing conduits may or may not be insulated if laid outside, but invariably be insulated when drawn inside.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard.

IS No.	*Title*
11000 (Part 2/ Sec 1) : 1984	Fire hazard testing: Part 2 Test methods, Sec 1 Glow-wire test and guidance
12063 : 1987	Classification of degrees of protection provided by enclosures of electrical equipment
14763 : 2000	Outside diameters of conduits for electrical installation and threads for conduits and fittings
14772 : 2000	General requirements for enclosures for accessories for household and similar fixed electrical installations

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Conduit System

A closed wiring system consisting of conduits and conduit fittings for the protection and management of insulated conductors and/or cables in electrical or communication installations, allowing them to be drawn in and/or replaced, but not inserted laterally.

3.2 Conduit

A part of a closed wiring system of general circular crosssection for insulated conductors and/or cables in electrical or communication installations, allowing them to be drawn in and/or replaced.

3.3 Conduit Fitting

A device designed to join or terminate one or more components of a conduit system, or change direction.

3.4 Metallic Conduit and/or Conduit Fitting

Conduit or conduit fitting which consists of metal only.

3.5 Non-Metallic Conduit and/or Conduit Fitting

Conduit or conduit fitting which consists uniquely of non-metallic material and has no metallic components whatsoever.

3.6 Composite Conduit and/or Conduit Fitting

Conduit or conduit fitting comprising both metallic and non-metallic materials.

3.7 Non-flame Propagating Conduit and/or Conduit Fitting

Conduit or conduit fitting which is liable to catch fire as a result of an applied flame, in which the flame does not propagate and which extinguishes itself within a limited time after the flame is removed.

3.8 Plain Conduit

A conduit in which the profile is even in the longitudinal section (*see* Note at **3.9**).

3.9 Plain Conduit

A conduit in which the profile is corrugated in the longitudinal section.

NOTE — Both annular and helical corrugated conduits are permissible and a combination of both corrugated and plain conduit is possible.

3.10 Rigid Conduit

A conduit which cannot be bent, or only be bent with the help of a mechanical aid and with or without special treatment.

3.11 Pliable Conduit

A conduit which can be bent by hand, with a reasonable force, and which is not intended for frequent flexing.

3.12 Flexible Conduit

A conduit which can be bent by hand, with a reasonable small force, and which is intended to flex frequently throughout its life.

3.13 Self-Recovering Conduit

A pliable conduit which deforms when a transverse force is applied for a short time and which after removal of this force returns close to its original shape within a further short time.

3.14 Material Thickness of a Plain Conduit

The average difference between the outside and inside diameter, divided by two.

3.15 Material Thickness of a Corrugated Conduit

The average thickness of material measured at any point along the shape of one corrugation.

3.16 Material Thickness of a Combined Plain and Corrugated Conduit

The sum of the plain conduit material thickness and the corrugated material thickness.

3.17 Threadable Conduit and Conduit Fitting

Conduit and conduit fitting which carry as thread for connection; or in or on which a thread can be formed.

3.18 Non-Threadable Conduit and Conduit Fitting

Conduit and conduit fitting which are suitable for connection only be means other than threads.

3.19 Conduit Joint

An interface between two or more components of a conduit system, or between a conduit system and other equipment.

3.20 External Influence

Factors which may affect the conduit system.

NOTE — Examples of such factors are a presence of water, oil or building materials, low and high temperatures and corrosive or polluting substances.

3.21 Hot Dip Galvanizing

A coating of zinc, and zinc-iron alloy layers, obtained by dipping prepared iron or steel articles in molten zinc.

NOTE — Under some circumstances, the whole coating may consist of zinc-alloy layers.

3.22 Sherardizing

A diffusion process in which articles are heated in close contact with a zinc dust and inert operating media.

NOTE — The process is normally carried out in a slowly rotating closed container at a temperature in the region of 385°C. The corrosion resistance is proportional to the coating thickness which can be controlled.

3.23 Type Tests

Tests carried out to prove conformity with the requirements of this standard. These are intended to prove the general quantities and design of a given type of conduit system.

3.24 Acceptance Tests

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

4 GENERAL REQUIREMENTS

4.1 Conduit and conduit fittings within the scope of this standard shall be so designed and constructed that in normal use their performance is reliable and without danger to the user or surroundings.

When assembled in accordance with manufacturer's instruction as part of a conduit system, they shall provide mechanical and, where required electrical protection of the insulated conductors and cables contained therein.

4.2 The protective properties of the joint between the conduit and conduit fittings shall be not less than that declared for the conduit system.

4.3 Conduit and conduit fittings shall withstand the stresses likely to occur during transport, storage, recommended installation practice and application.

4.4 In general compliance is checked by carrying out all the tests specified.

5 GENERAL CONDITIONS FOR TEST

5.1 Tests in accordance with this standard are type tests.

5.2 Unless otherwise specified, the tests shall be carried out an ambient temperature of 27 ± 2°C.

5.3 Unless otherwise specified each test shall be made on three new samples.

NOTE — Certain tests, for instance checking the dimensions, do not affect a change in the property of the samples and therefore, these samples are considered as new samples and can be used for future tests.

5.4 Samples of non-metallic and composite conduits and conduit fittings shall be conditioned for at least 240 h, at a temperature of 27 ± 2°C and a relative humidity between 40 percent and 60 percent. All tests shall be carried out immediately after general conditioning.

5.5 Unless otherwise specified, the samples for each tests shall be in a clean and new condition, with all parts in place and mounted as in normal use. After checking dimensions in accordance with **8**, and unless otherwise specified in the relevant test, the conduit fittings shall be assembled with adequate lengths of conduit of the type for which they are intended. Due regard shall be taken of the manufacturer's instructions, especially where force is required in the assembly of the joint.

NOTE — Where similarities are claimed, the selection of representative fittings for test purposes can be agreed between the manufacturer or responsible vendor and the testing authority.

5.6 Where the conduit entries are part of the detachable or loose type conduit fitting, the detachable conduit fittings shall be capable of being assembled again, after the tests, according to the manufacturer's instructions without loss of the declared properties according to **6**.

5.7 Unless otherwise specified, three samples are submitted to the tests and the requirements are satisfied if the tests are met.

If only one of the samples does not satisfy a test due to an assembly or a manufacturing defect, that test and any preceding one which may have influenced the result of the test shall be repeated and also the tests which follow shall be made in the required sequence on another full set of samples, all of which shall comply with the requirements.

NOTE — If the additional set of samples is not submitted at the same time, a failure of one sample will entail a rejection. The applicant when submitting the first set of samples, may also submit the additional set of samples which may be necessary, should one sample fail. The testing authority shall then, without further request, test the additional set of samples and shall reject only if a further failure occurs.

5.8 When toxic of hazardous processes are used, due regard shall be taken of the safety of the persons within the test area.

5.9 Conduit systems which are used as an integral part of the equipment shall also be tested in accordance with the relevant standard for that equipment.

6 CLASSIFICATION

NOTE — Annex A shows the classification coding format for declared properties of the conduit system, which may be incorporated in the manufacturer's literature.

6.1 According to Mechanical Properties

6.1.1 *Resistance to Compression*

6.1.1.1 *Very light*

6.1.1.2 *Light*

6.1.1.3 *Medium*

6.1.1.4 *Heavy*

6.1.1.5 *Very heavy*

6.1.2 *Resistance to Impact*

6.1.2.1 *Light*

6.1.2.3 *Medium*

6.1.2.4 *Heavy*

6.1.2.5 *Very heavy*

6.1.3 *Resistance to Bending*

6.1.3.1 *Rigid*

6.1.3.2 *Pliable*

6.1.3.3 *Pliable/Self-recovering*

6.1.3.4 *Flexible*

6.1.4 *Tensile strength*

6.1.4.1 *Very light*

6.1.4.2 *Light*

6.1.4.3 *Medium*

6.1.4.4 *Heavy*

6.1.4.5 *Very heavy*

6.1.5 *Suspended Load Capacity*

6.1.5.1 *Very light*

6.1.5.2 *Light*

6.1.5.3 *Medium*

6.1.5.4 *Heavy*

6.1.5.5 *Very heavy*

6.2 According to Temperature

6.2.1 The classification according to lower and upper temperature range are given in Table 1 and Table 2.

Table 1 Lower Temperature Range

Classification (Ist Numeral)	Transport, Permanent Application and Installation Temperature not Less than, °C
(1)	(2)
1X	+5
2X	−5
3X	−15
4X	−25
5X	−45

Table 2 Upper Temperature Range

Classification (Ist Numeral)	Transport, Permanent Application and Installation Temperature not Less than, °C
(1)	(2)
X1	60
X2	90
X3	105
X4	120
X5	150
X6	250
X7	400

6.3 According to Electrical Characteristics

6.3.1 *With Electrical Continuity Characteristics*

6.3.2 *With Electrical Insulating Characteristics*

6.4 According to Resistance to External Influences

6.4.1 *Protection Against Ingress of Solid Objects*

With protection in accordance with IS 12063 to a minimum of IP3X.

6.4.2 *Protection Against Ingress of Water*

With protection in accordance with IS 12063 to a minimum of IPXO.

6.4.3 *Resistance Against Corrosion*

6.4.3.1 *Without protection*

6.4.3.2 *With protection as detailed in Table 10*

6.5 According to Resistance to Flame Propagation

6.5.1 *Non-flame Propagating*

6.5.2 *Flame Propagating*

6.5.3 *Other Fire Effects are Under Consideration*

7 MARKING

7.1 The conduit shall be marked on the product with:

a) the name or a trademark of the manufacturer, or responsible vendor; and

b) a product identification mark.

The conduit shall also be marked in such a way that it can be identified in the manufacturers or responsible vendors literature.

7.1.1 The conduit may also be marked with the classification code which shall be in accordance with Annex A and shall include at least the first four digits.

7.1.2 The manufacturer shall be responsible for indicating the compatibility of parts within a conduit system.

7.2 The conduit fitting shall be marked in accordance with 7.1, on the product wherever possible but where this is impractical then the mark may be on a label attached to the product or to the box or carton containing the fittings.

7.3 Flame propagating material shall be orange in colour. It shall not be coloured orange by painting or other superficial means.

Non-flame propagating material may be any colour except yellow, orange or red, unless clearly marked on the product to be of non-flame propagating material.

7.4 Earthing facility shall be indicated by the symbol ⏚ for protective earth. This marking shall not be placed on easily removable parts, for example screws.

7.5 This marking shall be durable and easily legible.

Compliance 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.

NOTES

1 Petroleum spirit is defined as the aliphatic solvent hexane with a content of aromatics of maximum 0.1 percent volume, a kauri-butanol value of 29, initial boiling point 65° C, a dry point 69°C, and specific gravity 0.68 kg/l.

2 Marking may be applied, for example, by moulding, pressing, engraving, printing, adhesive labels, or water slide transfer.

3 Marking made by moulding, pressing or engraving is not subjected to this test.

After the test, the marking shall be legible.

8 DIMENSIONS

8.1 Threads and outside diameters, where appropriate, shall comply with IS 14763.

Compliance is checked by means of the gauges specified in IS 14763.

8.2 Other dimensions shall comply with the requirements of the relevant part of this standard.

9 CONSTRUCTION

9.1 Within the conduit system there shall be no sharp edges, burrs or surface projections which are likely to damage insulated conductors or cables or inflict injury to the installer or user.

The manufacturer shall be responsible for providing guidelines to assist the safe installation of the conduit system.

Compliance is checked by inspection, if necessary after cutting the samples apart.

9.2 Screws, if any, used for attaching components or covers to conduit fittings, or in joints to conduits shall

not cause damage to cable insulation when correctly inserted. They shall have ISO metric threads. Thread cutting screws shall not be used.

Fixing screws and small clips for use with non-metallic or composite conduit fittings need not be of non-metallic if they are isolated from insulated conductors or cables.

Screw fixing means shall be so designed to withstand the mechanical stresses occurring during installation and normal use.

Compliance for screw fixing using preformed threads is checked by the test in **9.3**, followed by inspection.

Compliance for screw fixing using thread forming screws is checked by the test in **9.4**, followed by inspection.

9.3 Screws used with preformed threads shall be tightened and loosened ten times for screws in engagement with a thread of non-metallic material and for screws of non-metallic material, and five times in all other cases.

The test shall be made by using a suitable screwdriver or spanner applying a torque in accordance with Table 3. The screws shall not be tightened by sudden or jerky motions.

After the test, there shall be no damage sustained by the screws or nut such as breakage of the screw or damage to the head or thread that will impair the further use of the screw or nut.

Table 3 Torque Value for Screw Tests

(*Clauses* 9.3 *and* 9.4)

Nominal Dimeter of Thread mm		Torque Nm	
Over	Up to and including	*See* Note 1	*See* Note 2
(1)	(2)	(3)	(4)
-	2.8	0.4	0.4
2.8	3.0	0.5	0.5
3.0	3.2	0.6	0.6
3.2	3.6	0.8	0.8
3.6	4.1	1.2	1.2
4.1	4.7	1.8	1.8
4.7	5.3	2.0	2.0
5.3	6.0	2.5	3.0
6.0	8.0	3.5	6.0
8.0	10.0	4.0	10.0

NOTES

1 It applies to screws which are tightened by means of a screwdriver.

2 It applies to screw and nuts which are tightened by means other than a screw driver.

9.4 Thread forming screws are tightened and loosened ten times for screws in engagement with a thread of insulating material and five times in all other cases. Screws in engagement with a thread of insulating material shall be completely removed each time.

The test is made by using a suitable screwdriver or spanner applying a torque in accordance with Table 3. The screw shall not be tightened by sudden or jerky motions.

After the test, there shall be no damage such as breakage of the screw or damage to the head or thread that will impair the further use of the screw.

9.5 Any material, for example rubber, fiber, etc, within the joint which may be exposed to external influences when assembled according to the manufacturers instructions, shall have at least the same level of resistance to the external influence as either the conduit or the conduit fitting.

Compliance is checked by means of tests specified in **14**.

9.6 For conduit systems that are assembled by means other than threads, the manufacturer shall indicate whether the system can be disassembled and if, so, how this can be achieved.

10 MECHANICAL PROPERTIES

10.1 Mechanical Strength

10.1.1 Conduit systems shall have adequate mechanical strength.

10.1.2 Conduits according to their classification, when bent or compressed, or exposed to impact or extreme temperature, of a specified value in accordance with impact and temperature classification declared for the product, either during, or after, installation according to the manufacturer's instructions, shall not crack and shall not be deformed to such an extent that introduction of the insulated conductors or cables becomes difficult, or that the installed insulated conductors, or cables are likely to be damaged while being drawn in.

10.1.3 Conduit systems intended as a mounting for other equipment shall have adequate mechanical strength to support equipment and to withstand the force required to operate the equipment, both during and after installation.

10.1.4 Compliance is checked by the tests specified in **10.2** to **10.8**.

10.2 Compression Test

10.2.1 Samples of conduit each 200 ± 5 mm long, shall be subjected to a compression test, using the apparatus shown in Fig. 1.

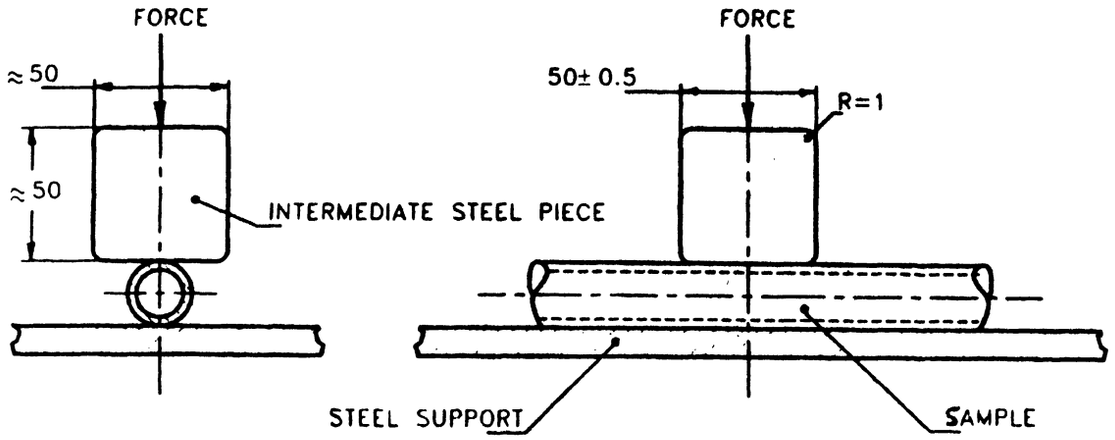


FIG. 1 ARRANGEMENT FOR COMPRESSION TEST

10.2.2 Before the test, the outside diameters of the samples shall be measured.

10.2.3 The samples shall be positioned on a flat steel support, and a steel intermediate piece, as shown in Fig. 1, shall be placed in the middle of the sample.

10.2.4 A continuously increasing compression force, reaching the values shown in Table 4, within 30s, shall be applied to the intermediate piece.

10.2.5 After the force shown in Table 4 has been applied for 60s ± 2s, the outside diameter of the sample shall be measured where flattening has taken place, without removing the force.

Table 4 Compression Force

(*Clauses* 10.2.4 and 10.2.5)

Classification	Conduits	Compression Force (Tolerance $^{+4}_{0}$ Percent), N
(1)	(2)	(3)
1	Very light	125
2	Light	320
3	Medium	750
4	Heavy	1 250
5	Very heavy	4 000

10.2.6 The difference between the initial outside diameter and the diameter of the flattened sample shall not exceed 25 percent of the initial outside diameter measured before the test.

10.2.7 The force and the intermediate piece are then removed and 60s after removal the outside diameter of the sample, where they have flattened, shall be measured again.

The difference between the initial diameter and the diameter of the flattened samples shall not exceed 10 percent of the outside diameter, measured before the test.

10.2.8 After the test, the sample shall show no cracks visible to normal or corrected vision without additional magnification.

10.3 Impact Test

10.3.1 Twelve samples of conduit each 200 ± 5 mm in length or twelve conduit fittings are subjected to an impact test by means of the apparatus shown in Fig. 2.

Before the test, the samples are assembled with all the components as for normal use, including conduits required for conducting the test.

NOTE — Fittings are not required when testing conduits.

Parts which are not accessible when mounted in normal use, and small conduit fittings whose maximum dimension is less than 20 mm are not subjected to this test.

10.3.2 The test apparatus shall be placed on a pad of closed cell expand sponge 40 ± 1 mm thick when uncompressed, and having a density of 538 ± 22 kg/m.

The test apparatus together with the samples shall be placed in a refrigerator, the temperature within which shall be maintained at the declared temperature specified in Table 1 with a tolerance of ± 2° C.

When the samples have attained the temperature specified, or after 2 h, whichever is the longer period, each sample shall be placed in position on the steel base as shown in Fig. 2. The hammer and the fall height shall be as specified in Table 5.

The test shall be made on the weaker part of the conduit fitting, except that it shall not be applied within 5 mm of any conduit entry. Samples of conduit are tested at the center of their length.

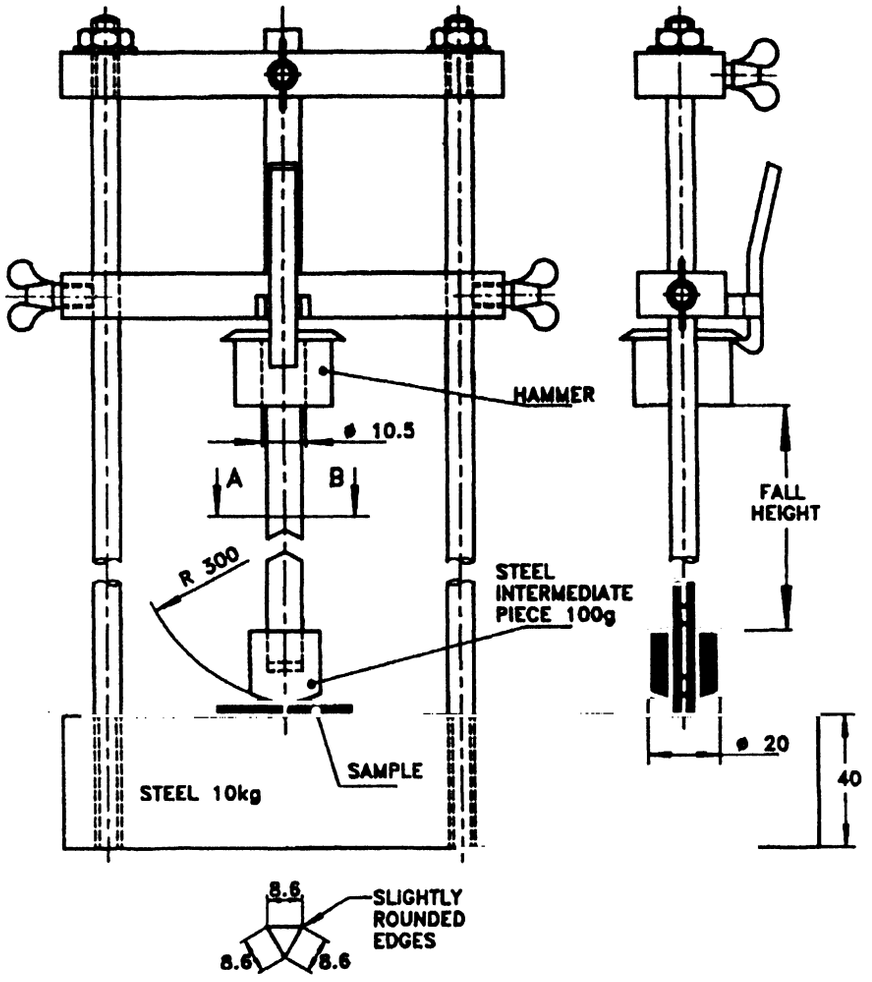


FIG. 2 IMPACT TEST APPARATUS

Table 5 Hammer and the Fall Height

(*Clause* 10.3.2)

Classification	Conduits	Mass of Hammer (Tolerance $^{+1}_{0}$ percent) Kg	Fall height (Tolerance +1 percent) mm
(1)	(2)	(3)	(4)
1	Very light	0.5	100
2	Light	1.0	100
3	Medium	2.0	100
4	Heavy	2.0	300
5	Very Heavy	6.8	300

10.3.3 After the test, at least in nine of the samples there shall be no sign of disintegration, nor shall there be any crack visible to normal or corrected vision without magnification and there shall be no deformation impairing its normal use.

10.4 Bending Test

Compliance is checked by the relevant tests specified in relevant parts of this standard.

10.5 Flexing Test

Compliance is checked by the relevant tests specified in relevant parts of the standard.

10.6 Collapse Test

Compliance is checked by the relevant tests specified in relevant parts of the standard.

10.7 Tensile Test

10.7.1 Conduits systems declaring tensile strength shall be tested as follows:

A sample of conduit and two terminating fittings are assembled in accordance with the manufacturer's instruction so that the overall length is approximately 300 mm. The assembly is subjected to slowly increasing tensile force over a period of 30s to 40s to the value specified in Table 6. After 2 min ±10s the

force is removed.

10.7.2 Where elongation occurs, the manufacturer shall be responsible for providing guidelines to assist the safe installation of the conduit system.

10.7.3 For conduit systems where tensile strength is not declared, the tensile strength of the joints shall meet the requirements of the relevant parts of this standard.

10.7.4 After the test the terminating fittings shall remain properly assembled to the conduit and there shall be no damage visible to normal or corrected vision without magnification.

Table 6 Tensile Force

(*Clause* 10.7.1)

Classification	Conduits and Fittings	Tensile Force (Tolerance $^{+2}_{0}$ Percent) N
(1)	(2)	(3)
1	Very light	100
2	Light	250
3	Medium	500
4	Heavy	1 000
5	Very Heavy	2 500

10.8 Suspended Load Test

The conduit fitting, declared by the manufacturer to be suitable for suspended load, is secured to a rigid structure using a method provided by the manufacturer, with the suspension means pointing downwards.

A load with a time duration in accordance with Table 7 is suspended by the means provided and in accordance with the manufacturer's instructions.

The fitting shall be deemed to have passed if at the end of the test, there are no cracks visible to normal or corrected vision without magnification, and there is no deformation of the conduit fitting impairing its normal use.

For non-metallic and composite conduit fittings, the test shall be carried out in a heating cabinet, the temperature within which is maintained at the declared maximum temperature according to Table 2 with a tolerance of ± 2°C.

11 ELECTRICAL PROPERTIES

11.1 Electrical Requirements

11.1.1 Conduit systems declaring electrical continuity characteristics shall be checked by the tests specified in **11.2** immediately after the test specified in **14.2.**

NOTE — A conduit systems may, in some circumstances may be used in total or in part as a protective conductor in an electrical installation. In that event, the system will be tested after final installation to confirm its suitability for that purpose, in accordance with the installation rules.

Table 7 Suspended Load

(*Clause* 10.8)

Classification	Fittings	Load (Tolerance $^{+2}_{0}$ Percent) N	Duration (Tolerance $^{+15}_{0}$ min) h
(1)	(2)	(3)	(4)
1	Very light	20.0	48
2	Light	30.0	48
3	Medium	150.0	48
4	Heavy	450.0	48
5	Very Heavy	850.0	48

11.1.2 Conduit system of metal or composite materials shall be so constructed that accessible metal parts can be bonded to earth.

Compliance is checked by test in **11.2.**

11.1.3 Accessible conductive parts of the metal or composite conduit system, shall be effectively earthed.

Compliance is checked by test in **11.2.**

11.1.4 Conduit system of non-metallic or composite materials, where declared, shall have an adequate electrical insulating strength and insulating resistance.

Compliance is checked by test in **11.3.**

11.2 Bonding Test

An arrangement of conduit and conduit fittings consisting of ten pieces of conduit shall be coupled together in accordance with the manufacturer's instructions and Fig. 3 by means of conduit fittings representing, in approximately equal numbers, each type of fitting in the batch. The fitting shall be spaced between 25 mm and 28 mm apart. A current of 25 A having a frequency of 50 Hz derived from ac source having a no-load voltage not exceeding 12 V is passed through the assembly for 1 min ± $^{+5}_{0}$s after which the voltage drop is measured and the resistance calculated from the current and that voltage drop.

The resistance shall not exceed 0.05 ohm.

If the numbers of different types of fittings cannot all be accommodated in a single test, the test described above shall be repeated until all such different types of fittings have been tested.

Where special devices are required for the coupling of conduit and conduit fittings, they shall be sufficient to remove the protective coating from the conduit, or the protective finish must be removed in accordance with the manufacturer's instructions.

11.3 Electrical Insulating Strengths and Resistance

11.3.1 *Conduits*

11.3.1.1 Samples of conduit are immersed over a

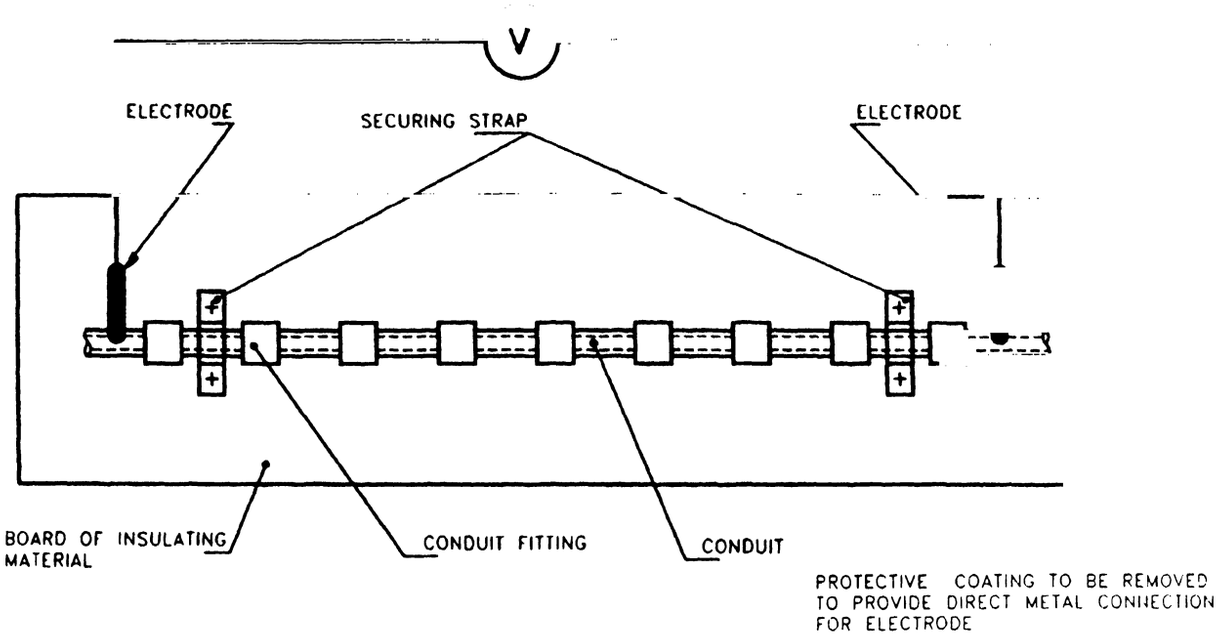


FIG. 3 ASSEMBLY OF CONDUIT AND CONDUIT FITTING FOR BONDING TEST

length of 1 m ± 10 mm in accordance with Fig. 4 or Fig. 5, in a salt water solution at 27 ± 2°C with a length of 100 mm kept above the level of the solution.

Rigid conduit samples are to be supplied by the manufacturer complete with one end sealed with an appropriate insulating material with high electrical insulation for example silicon elastomer (*see* Fig. 4).

Pliable and flexible conduit samples are bent into a 'U' shape and then immersed (*see* Fig. 5).

Salt water solution is made by complete dissolving 1 g/l of sodium chloride.

The salt water solution is poured into the open end of the conduit to match external level. An electrode is placed inside the conduit and another placed into the tank.

11.3.1.2 After 24 h ±15 min, voltage is applied across the two electrodes, gradually being increased from 1 000 V to 2 000 V of substantially sine wave form and having a frequency of 50 Hz. Having reached 2 000 V the voltage is maintained for period of 15 min $+ {}^{+5}_{0}$s.

The high voltage transformer used for the test is so designed that, when the output terminals are short circuited after the output voltage has been adjusted to the appropriate test voltage, the output currents is of at least 200 mA. The over current relay shall not trip when the output current is less than 100 mA. Care is taken that the r.m.s. value of the test voltage applied is measured with ±3 percent.

The samples shall be considered to have adequate electrical insulating strength if a 100 mA trip device, incorporated into the circuit does not trip during the 15 min test.

Immediately after the sets in **11.3.1.2** the same samples shall be subjected to an electrical insulation resistance test. A voltage of 500 V dc shall be applied across the two electrodes.

After 60 ± 2s from the application of the voltage the insulation resistance between the electrodes shall be obtained. Conduits shall be considered to have adequate electrical insulation resistance if the measured resistance is greater than 100 MΩ.

11.3.2 *Conduit Fittings*

11.3.2.1 Samples of conduit fittings shall be immersed for 24 h ± 15 min, in water at 27 ± 2°C and then thoroughly dried at room temperature.

11.3.2.2 Conduit fittings samples shall be assembled in accordance with the manufacturer's instructions with a short length of conduit. All other open ends are sealed with an appropriate insulating material. The inside of the fitting is filled with lead shot of a diameter between 0.5 mm and 1.0 mm, and an electrode is inserted into lead shot *via* the conduit.

An outer electrode of aluminum foil with a thickness of 0.08 ± 0.02 mm is wrapped around the outside of the fitting and compressed so that it follows the outer contour of the fitting as closely as possible.

11.3.2.3 Conduit fitting samples shall be tested in accordance with **11.3.1.2** within one hour of removal

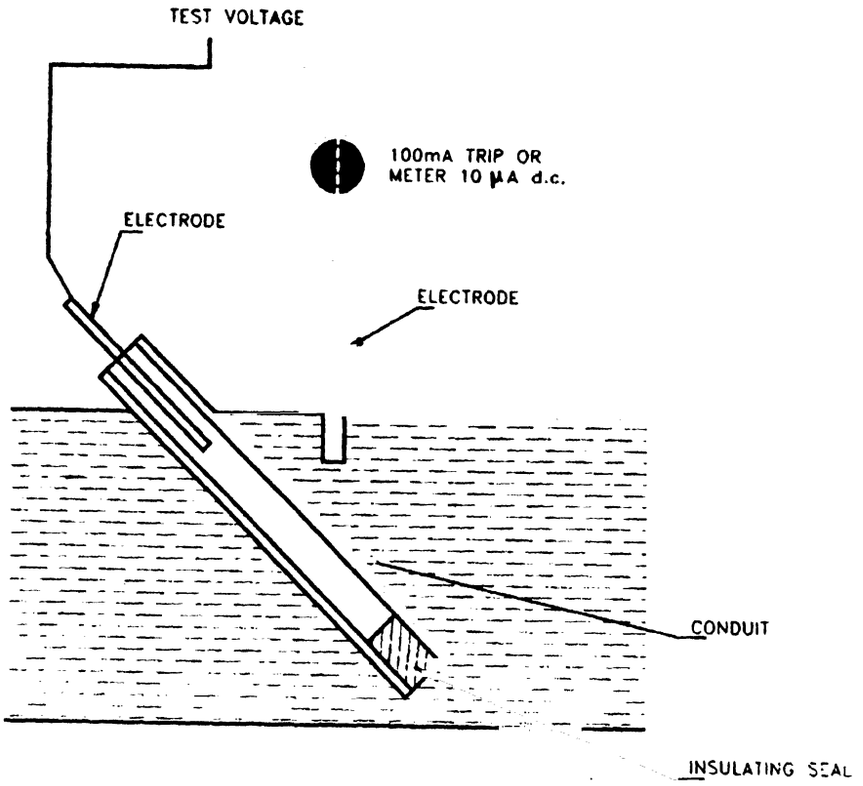


FIG. 4 ARRANGEMENT FOR INSULATION RESISTANCE AND ELECTRIC STRENGTH TEST-RIGID CONDUIT

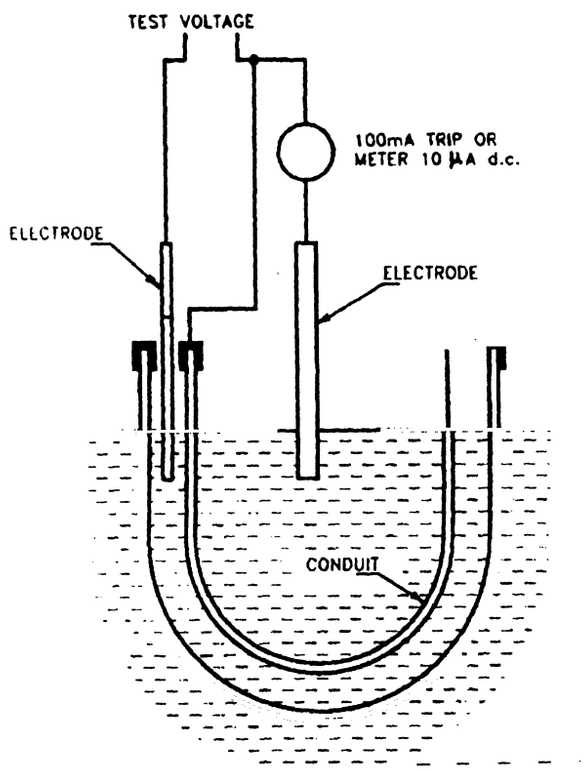


FIG 5 ARRANGMENT FOR INSULATION RESISTANCE AND ELECTRIC STRENGTH TEST-PLIABLE AND FLEXIBLE CONDUIT

from the water.

11.3.2.4 Immediately after the test in **11.3.2.3**, the same samples are subjected to an electrical insulation resistance test. A dc voltage of 500 V is applied across the two electrodes.

11.3.2.5 After 60 ± 2s from the application of the voltage, the insulation resistance between the electrodes is obtained. Fittings are considered to have adequate electrical insulation resistance if the resistance is greater than 5 MΩ.

12 THERMAL PROPERTIES

12.1 Resistance to Flame Propagation

12.1.1 Non flame propagating conduit systems shall have adequate resistance to flame propagation.

12.1.2 Samples of non-metallic and composite conduit shall be checked by applying a 1 kW flame.

12.1.2.1 A samples of length 675 ±10 mm is mounted vertically in a rectangular metal enclosure with one open face, as shown in Fig. 6 in an area substantially free from draughts.

The general arrangements is shown in Fig. 7.

Mounting is by means of two metal clamps approximately 25 mm wide spaced 550 ± 10 mm apart and approximately equidistant from the ends of the sample.

A steel rod of 2.0 ± 0.1 mm for sizes up to 12 mm, 6.0 ± 0.1 mm for sizes 16 to 25 mm and 16.0 ± 0.1 mm for conduits with diameters 32 mm and above is passed through the sample. It is rigidly and independently mounted and clamped at upper end to maintain the sample in a straight and vertical position. The means of mounting is such as not to obstruct drops from falling onto the tissue paper.

A suitable piece of white pinewood board, approximately 10 mm thick, covered with single layer of white tissue paper is positioned on the lower surface of the enclosure.

The assembly of sample, rod and clamping apparatus is mounted vertically in the centre of the enclosure, the upper extremity of the lower clamp being 500 mm ± 10 mm above the internal lower surface of the enclosure.

12.1.2.2 The burner is supported so that its axis is 45 ± 2° to the vertical. The flame is applied to the sample so that the distance from the top of the burner tube to the sample measured along the axis of the flame is 100 ± 10 mm and the axis of the flame intersects with the surface of the samples at a point 100 ± 5 mm from the upper extremity of the lower clamp, and so that the axis of the flame intersects with the axis of the sample.

12.1.2.3 The test is carried out on three samples.

The flame is applied to the samples for the period specified in Table 8 and is then removed. During the application of the flame, it shall not be moved except to remove it at the conclusion of the period of the test.

Table 8 Times of Exposure of the Sample to the Flame

(*Clause* 10.1.2.3)

Material Thickness mm		Flame Application (Tolerance $^{+1}_{0}$ s) s
Over	Upto	
(1)	(2)	(3)
–	0.5	15
0.5	1.0	20
1.0	1.5	25
1.5	2.0	35
2.0	2.5	45
2.5	3.0	55
3.0	3.5	65
3.5	4.0	75
4.0	4.5	85
4.5	5.0	130
5.0	5.5	200
5.5	6.0	300
6.0	6.5	500

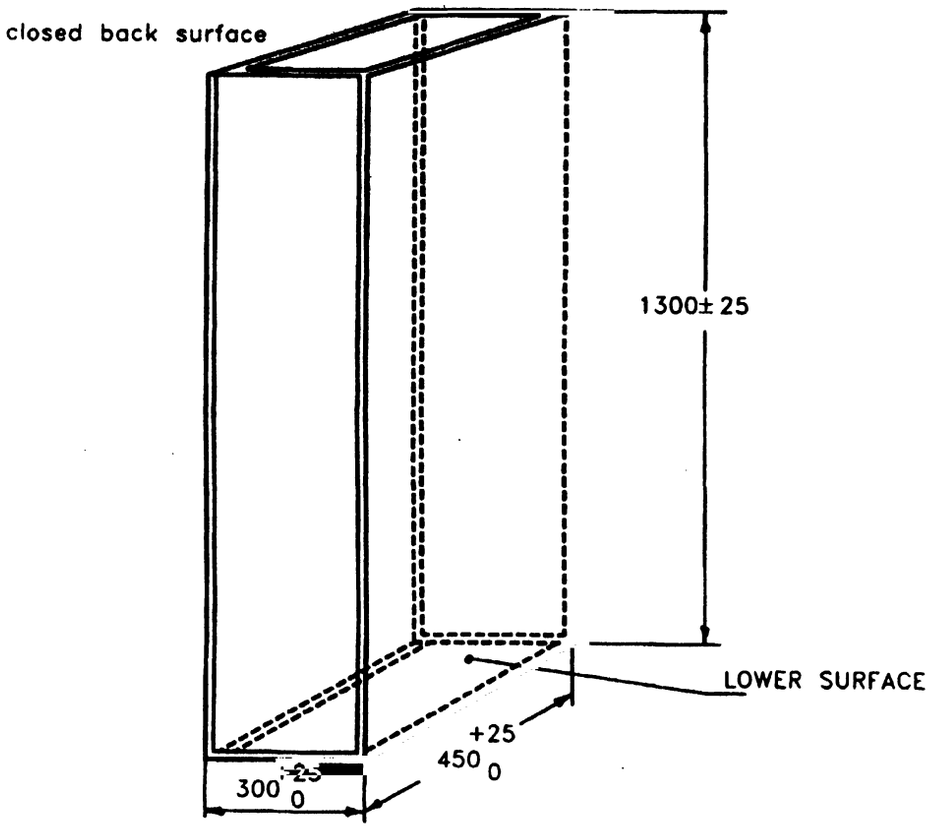
After the conclusion of the test, and after any burning of the sample has ceased, the surface of the sample is wiped clean by rubbing with a piece of cloth soaked with water.

12.1.2.4 All three samples shall pass the test. If the sample is not ignited by the flame, it shall be deemed to have passed the test.

If the sample burns, or is consumed without burning, the sample shall be deemed to have passed the test if after burning has ceased, and after the sample has been wiped in accordance with **12.1.2.3**, there is no evidence of burning or charring within 50 mm of the lower extremity of the upper and also within 50 mm of the upper extremity of the lower clamp.

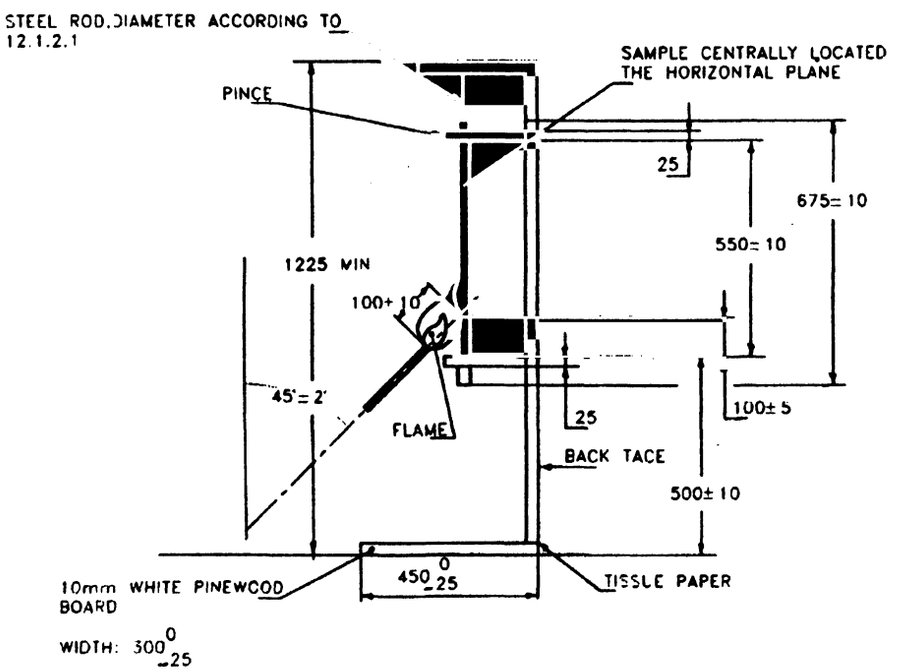
If the sample burns, it shall be deemed to have failed the test if combustion is still in progress 30s after removal of the flame.

If the tissue paper ignites, the sample shall be deemed to have failed the test. For the parts of the same below the burner, the presence of molten material on the internal or external surfaces shall not entail failure if the sample itself is not burned or charred.



NOTE — This drawing is not intended to govern design except as regards the dimensions shown.

FIG. 6 ENCLOSURE FOR BURNING TEST



NOTE — This drawing is not intended to govern design except as regards the dimensions shown.

FIG. 7 ARRANGEMENT FOR BURNING TEST

12.1.3 Compliance of non-metallic and composite conduit fittings is checked by using the glow wire test IS 11000 (Part 2/Sec 1).

The glow wire shall be applied once to each sample in the most unfavourable position of its intended use, with the surface tested in vertical position, at a temperature of 750°C.

The sample is deemed to have passed this test if there is no visible flame or sustained glowing or if flames or glowing extinguishes within 30s of the removal of the glow wire.

12.2 Resistance to Heat

12.2.1 Non metallic and composite conduits shall have adequate resistance to heat.

Compliance is checked by the test given in **12.2.3** and verified with **12.2.4**.

12.2.2 The load for the heating test shall be of the same classification as the declared compression classification.

12.2.3 Samples of conduit each 100 ± 5 mm long together with the test apparatus as shown in Fig. 8 shall be kept for 4 h ± 5 min, in a heating cabinet at the declared temperature given in Table 2 with a tolerance of ± 2°C.

After this period, each sample is loaded for 24 h ± 15 min, in an apparatus as shown in Fig. 8, with an appropriate mass applied through a steel rod, 6.0 ± 0.1 mm in diameter, disposed a right angles to the axis of the conduit.

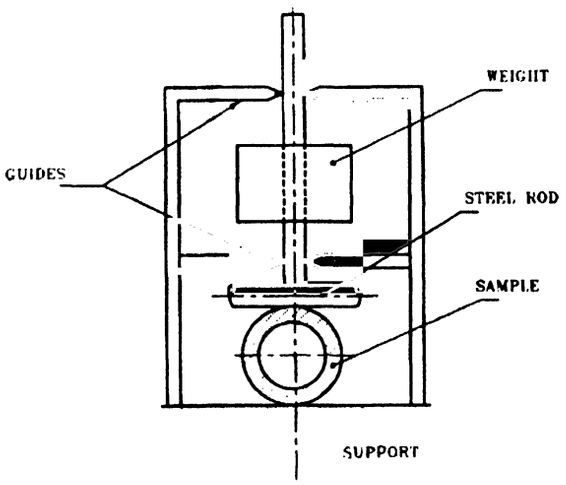


FIG 8 TEST APPARATUS FOR RESISTANCE TO HEAT

The sample is subjected to a total mass, including the mass of the rod, as shown in Table 9, placed in the middle of the sample.

The sample, under load, shall then be allowed to cool to room temperature.

Table 9 Load for Heating Test

(*Clause* 12.2.3)

Classification	Conduits	Mass (Tolerance $^{+1}_{0}$ Percent) Kg
(1)	(2)	(3)
1	Very light	0.5
2	Light	1.0
3	Medium	2.0
4	Heavy	4.0
5	Very heavy	8.0

12.2.4 The load is then removed and immediately after its removal it shall be possible to pass appropriate gauge, specified in the relevant parts of this standard, through the conduit, under its own weight and without any initial speed, with the sample in the vertical position.

13 FIRE EFFECTS

Under Consideration.

14 EXTERNAL INFLUENCES

14.1 Degree of Protection Provided by Enclosure

Conduit systems, when assembled in accordance with the manufacturer's instructions, shall have adequate resistance to external influences according to the classification declared by the manufacturers with a minimum requirements of IP 30.

Compliance is checked by the tests specified in **14.1.1** and **14.1.2**.

14.1.1 *Degree of Protection Ingress of Foreign Solid Objects*

14.1.1.1 An assembly is made of a conduit fittings with a short length of conduit assembled in each entry. Where necessary, the open ends of the assembly are plugged, or are not part of the test.

14.1.1.2 The assembly shall be tested in accordance with the appropriate test of IS 12063. For numeral 5, category 2 applies.

14.1.1.3 The assembly tested for numeral 5 or 6, shall be deemed to have passed the test if there is no ingress of dust visible to normal or corrected vision without magnification.

14.1.2 *Degree of Protection — Ingress of Water*

14.1.2.1 An assembly is made of a conduit fitting with a short length of conduit assembled in each conduit entry. Where necessary, the open end of the conduit is plugged, or is not part of the test.

14.1.2.2 The assembly shall be tested in accordance with the appropriate test IS 12063.

14.1.2.3 The assembly tested for numeral 1 and above shall be deemed to have passed the test if there is not sufficient ingress of water to form a drop visible to normal or corrected vision without magnification.

14.2 Resistance Against Corrosion

14.2.1 Metallic and composite conduit systems, excluding screw threads shall have adequate resistance against corrosion, both inside and outside, in accordance with the classification shown in Table 10.

Compliance is checked by the tests specified in **14.2.2.1**, **14.2.2.2** and **14.2.2.3**.

Table 10 Resistance to Corrosion Classification

(*Clause* 14.2.1)

Classification	Protection afforded	Example
(1)	(2)	(3)
1	Low protection, inside and outside	Priming paint
2	Medium protection, inside and outside	Stove enamel/electro zinc plate air drying paint
3	Medium/High composite protection Inside: Class 2 Outside: class 4	Stove enamel Sheradizing
4	High protection, inside and outside	Hot dip zinc coating Shearadizing Stainless Steel

14.2.2 Tests of resistance to corrosion for steel and steel composite conduit systems.

14.2.2.1 Low protection conduit and conduit fittings shall be cleaned with a piece of wadding soaked in trichloroethane or similar agent and then dried.

14.2.2.2 Medium protection conduits and conduit fittings shall be inspected for completeness of covering by the protective coating, both inside and outside cleaned with a piece of wadding soaked in trichlorethane or similar agent and then dried.

They shall then be totally immersed in a solution of 0.75 percent potassium ferricyanide [K_3 Fe $(CN)_6$] and 0.25 percent ammonium persulphate [$(NH_4)2\ S_2O_8$] in water and a quantity of about, 0.1 percent of a suitable wetting agent, for instance a sodium salt of an alkylnapthhaline sulphonic acid, shall be added.

The solution and the samples shall be maintained at a temperature of 27 ± 2°C.

Each sample shall be tested separately, a fresh solution being used each time.

After immersion for 5 min in + $^{+5}_{0}$s , samples shall be removed from the solution and left to dry at ambient temperature in air. After completion of the test as described above, the samples shall show no more than two blue coloured spots on each square centimeter of the surface, and no blue spot shall have a dimension larger than 1.5 mm. Traces of rust on sharp edges, screw threads and machined surfaces, also any yellowish film removable by rubbing, shall be ignored.

14.2.2.3 High protection conduit and conduit fittings shall be degreased by immersion in trichloroethane or a similar degreasing agent for 10 min + $^{+5}_{0}$s , and wiped dry with a piece of soft cloth. They shall then be immersed in 2 percent solution of sulphuric acid in water for 15s, thoroughly cleaned in running water and again wiped dry with a piece of clean soft cloth.

Each sample shall then be totally immersed in solution of copper sulphate ($CuSo_4.5H_2O$) in distilled water, having a specific gravity of 1.186 kg/at 27 ± 2°C.

The solution and the samples shall be maintained at a temperature of 27± 2°C without stirring.

NOTE — The solution is made by dissolving 360 g of crystalline copper sulphate in one litre of distilled water and neutralizing with copper carbonate or copper hydroxide (about 1 g/l). The specific gravity is then checked and adjusted as necessary.

Each sample shall be immersed four times in succession in the same solution, each time for 1 min $^{+5}_{0}$s . A fresh solution shall be used for each sample. After each immersion the sample shall immediately be cleaned in running water with a brush to remove any black deposit. The sample shall then be wiped dry with a piece of clean soft cloth and except after the fourth immersion, returned to the solution. Care should be taken to clean out all holes and pockets.

After the test the sample shall show no precipitation of copper which cannot be scrubbed off in running water, if necessary after immersion for 15s in 10 percent solution of hydrochloric acid in water.

Traces of copper precipitation on screw threads, sharp edges and machined surfaces may be ignored.

14.2.3 Tests for resistance to corrosion for metals other then steel (*under consideration*).

15 ELECTRO MAGNETIC COMPATIBILITY

15.1 Products covered by this standard are, in normal use, passive in respect of electromagnetic influences (emission and immunity).

NOTE — Products covered by this standard are installed as part of wiring installation, the installation may emit or may be influenced by electromagnetic signals. The degree of influence will depend on the nature of the installation within its operating environment and the apparatus connected by the wiring.

ANNEX A

(*Clauses* 6 *and* 7.1.1)

CLASSIFICATION CODING FOR CONDUIT SYSTEMS

This Annex shows the classification coding format for declared properties of the conduit system, which may be incorporated in the manufacture's literature.

First digit — Resistance to compression (*see* **6.1.1**)

Very light compression strength	1
Light compression strength	2
Medium compression strength	3
Heavy compression strength	4
Very heavy compression strength	5

Second digit — Resistance to impact (*see* **6.1.2**)

Very light impact strength	1
Light impact strength	2
Medium impact strength	3
Heavy impact strength	4
Very heavy impact strength	5

Third digit — Lower Temperature Range (*see* Table 1)

+ 5°C	1
- 5°C	2
-15°C	3
-25°C	4
-45°C	5

Fourth digit — Upper temperature range (*see* Table 2)

+ 60°C	1
+ 90°C	2
+ 105°C	3
+ 120°C	4
+ 150°C	5
+ 250°C	6
+ 400°C	7

Fifth digit — Resistance to bending (*see* **6.1.3**)

Rigid	1
Pliable	2
Pliable/Self recovering	3
Flexible	4

Sixth digit — Electrical characteristics (*see* **6.3**)

None declared	0
With electrical continuity characteristics	1
With electrical insulating characteristic	2
With electrical continuity and insulating characteristics	3

Seventh digit — Resistance to ingress of solid objects (*see* **6.4.1**)

Protected against solid foreign objects of 2.5 mm diameter and greater	3
Protected against solid foreign objects of 1.0 diameter and greater	4
Dust protected	5
Dust tight	6

Eight digit — Resistance to ingress of waters (*see* **6.4.2**)

None declared	0
Protected against vertically falling water drops	1
Protected against vertically falling water drops	2
when conduit system tilted up to an angle of	15°
Protected against spraying/ water	3
Protected against splashing water	4
protected against water jets	5
Protected against powerful water jets	6
protected against the effects of temporary immerssion in water	7

Ninth digit — Resistance against corression (*see* **6.4.3** and Table 10)

Low protection inside and outside	1
Medium protection inside and outside	2
Medium protection inside, high protection outside	3
High protection inside and outside	4

Tenth digit — Tensile strength (*see* **6.1.4**)

None declared	0

Very light tensile strength	1
Light tensile strength	2
Medium tensile strength	3
Heavy tensile strength	4
Very heavy tensile strength	5

Eleventh digit — Resistance to flame propagation
(*see* **6.5**)

Non-flame propagating	1
Flame propagating	2

Twelfth digit — Suspended load capacity
(*see* **6.1.5**)

None declared	0
Very light suspended load capacity	1
Light suspended load capacity	2
Medium suspended load capacity	3
Heavy suspended load capacity	4
Very heavy suspended load capacity	5

Thirteenth digit — Fire effects
(*Under consideration*)

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act,* 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc : No. ETD 14 (5071).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110 002
Telephones : 323 01 31, 323 33 75, 323 94 02

Telegrams : Manaksanstha
(Common to all offices)

Regional Offices :		Telephone
Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110 002	323 76 17 323 38 41
Eastern	: 1/14 C. I. T. Scheme VII M, V. I. P. Road, Kankurgachi CALCUTTA 700 054	337 84 99, 337 85 61 337 86 26, 337 91 20
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160 022	60 38 43 60 20 25
Southern	: C. I. T. Campus, IV Cross Road, CHENNAI 600 113	235 02 16, 235 04 42 235 15 19, 235 23 15
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400 093	832 92 95, 832 78 58 832 78 91, 832 78 92

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM.

Printed at : Prabhat Offset Press, New Delhi-2