IS 14927-1 (2001): Cable Trunking and Ducting Systems for Electrical Installations, Part 1: General Requirements [ETD 14: Electrical Wiring Accessories]

BLANK PAGE

भारतीय मानक

विद्युत संस्थापनों के लिए केबल ट्रंकन और वाहिनी तंत्र

भाग 1 सामान्य अपेक्षाएँ

Indian Standard

CABLE TRUNKING AND DUCTING SYSTEMS FOR ELECTRICAL INSTALLATIONS

PART 1 GENERAL REQUIREMENTS

ICS 29.060.21

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

August 2001

Price Group 7

FOREWORD

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

This standard is to be read in conjunction with the appropriate part of this standard, which contains clauses to supplement or modify the corresponding clauses of Part 1, to provide the relevant particular requirements for each type of product.

It is felt that this standard will help the users, contractors and design engineers who are presently involved in the extensive use of cable trunking and cable ducting which is better substitute for age old practice of using other conventional types of installation; such as wood casing and capping wiring system, cleated wiring system and metal sheathed wiring system.

This standard is based on corresponding IEC publication 61084-1:1991 'For cable trunking and ducting system for electrical installations: Part 1 General requirements' issued by the International Electrotechnical Commission. However there are deviations between this standard and the corresponding IEC standard due to National Conditions. The major deviations along with the reasons for the same are given below:

Sl No.	*Deviations*	*Reasons*
i)	Ambient test conditions	Due to climate conditions
ii)	Dimensions	Dimensions included for the guidance of manufacturers and buyers
iii)	Recommended sampling plan	For the guidance of buyers for checking conformity or otherwise of a lot

For the purpose of deciding whether a particular requirement of this standard is compiled with, the final value, observed or calculated, expressing the result of a test or analysis, 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 APRIL 2011
TO
IS 14927 (PART 1) : 2001 CABLE TRUNKING AND DUCTING SYSTEMS FOR ELECTRICAL INSTALLATIONS

PART 1 GENERAL REQUIREMENTS

(*Page* 4, *Table* 2) — Insert the following at the end:

Size	Approximate Internal Cross-Sectional Area	Outer Width	Outer Height	Wall Thickness (*Min*)
mm	mm^2	mm	mm	mm
(1)	(2)	(3)	(4)	(5)
100 × 40	3 333.00	100 ± 0.2	40 ± 0.2	2.5
200 × 30	5 000.00	200 ± 0.2	30 ± 0.2	2.5
225 × 25	4 687.00	225 ± 0.2	25 ± 0.2	1.6
225 × 38	7 125.00	225 ± 0.2	38 ± 0.2	1.6
250 × 25	5 203.00	250 ± 0.2	25 ± 0.2	1.6
250 × 38	7 916.00	250 ± 0.2	38 ± 0.2	1.6
300 × 25	6 250.00	300 ± 0.2	25 ± 0.2	1.6
300 × 30	7 500.00	300 ± 0.2	30 ± 0.2	2.5
300 × 38	9 500.00	300 ± 0.2	38 ± 0.2	1.6

(*Page* 4, *clause* **8.3.1**) — Substitute the following for the existing clause:

'The sizes of the cable trunking and ducting other than those specified in **8.3** are also acceptable as per the agreement between the purchasers and the manufacturers provided that the height and width are from combination of the following dimensions having tolerances of ±0.2 mm on both height and width of dimensions 12 mm, 16 mm, 20 mm, 25 mm, 32 mm, 38 mm, 40 mm, 50 mm, 75 mm, 100 mm, 225 mm, 250 mm, and 300 mm.'

[*Page* 4, *clause* **8.3.2**(d)] — Substitute the following for the existing:

'Any combination where size is above 50 mm, the wall thickness shall be at least 1.8 mm in case trunking and ducting is made of insulating material. For trunking

and ducting made of metal the wall thickness shall be at least 1.6 mm.'

(*Page* 8, *clause* **10.3.2** *para* 2) — Substitute the following for the existing:

'**10.3.2** The sample shall be kept inside the deep freezer the temperature of which is maintained at – 5 ± 2°C.'

(ET 14)

Reprography Unit, BIS, New Delhi, India

Indian Standard

CABLE TRUNKING AND DUCTING SYSTEMS FOR ELECTRICAL INSTALLATIONS

PART 1 GENERAL REQUIREMENTS

1 SCOPE

1.1 This standard (Part 1) specifies general requirements of cable trunking and cable ducting systems intended for the accommodation, and where necessary for the segregation of conductors, cables or cords and/or other electrical equipment in electrical installations.

1.2 This standard does not apply to conduits, cable trays or cable ladders or current-carrying parts within the system.

NOTE — There are many different designs of systems (*see* Annex A) particular requirements of which are intended to be covered in other parts of this standard.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard.

IS No.	*Title*
SP : 30	National Electrical Code
694 : 1990	PVC insulated cables working voltages up to and including 1 000 V ac (*third revision*)
732 : 1989	Code of practice for electrical wiring installations (*third revision*)
3043 : 1987	Code of practice for earthing
4648 : 1968	Guide for electrical layout in residential buildings
4905 : 1968	Methods for random sampling
8130 : 1984	Conductors for insulated electrical cables and flexible cords *(first revision*)
11000 (Part 2/ Sec 1) : 1984	Fire hazard testing : Part 2 Test methods, Section 1 Glow-wire test and guidance
12063 : 1987	Classification of degree of protection provided by enclosures of electrical equipment
14763 : 2000	Outside diameters of conduits for electrical installations and threads for conduit and fittings

3 TERMINOLOGY

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

3.1 Cable Trunking and Ducting System

3.1.1 *Cable Trunking System*

A system of closed enclosures comprising a base with a removable cover intended for the complete surrounding of insulated conductors, cables, cords and/ or for the accommodation of other electrical equipment.

3.1.2 *Cable Ducting System*

A system of closed enclosure of non-circular sections for insulated conductors, cable and cords in electrical installations, allowing them to be drawn in and replaced.

3.2 System Components

Parts used within the system, which include:

a) lengths of truncking or ducting;
b) trunking or ducting fittings;
c) fixing devices;
d) apparatus mounting devices; and
e) other accessories.

NOTE — The above mentioned components may not necessarily be included all together in a system. Different combinations of components may be used.

3.3 Trunking Length

The main component of a trunking system comprising a base with a removable cover.

3.4 Ducting Length

The main component of a ducting system, characterized by a close non-circular cross-section.

3.5 Fitting

System component used to connect, change direction or terminate trunking or ducting lengths.

3.6 Fixing Device

System device specifically designed to secure other components to the wall, ceiling or floor.

3.7 Apparatus Mounting Device

System component used to incorporate electrical apparatus (switches, socket-outlets, circuit-breakers,

telephone outlets, etc) added to a trunking or ducting length.

3.8 System Accessory

System component used for supplementary functions such as cable separation, cable retention, cable-outlets, etc.

3.9 Floor Service Unit

Specific apparatus mounting device used when installing a floor system.

3.10 Floor Access Units

Specific unit used for installing a floor system (inside, flush, external) that provides access to the cables.

3.11 Metal Component

Component which consists of metal only.

3.12 Insulated Component

Component which consists of insulting material and had no conductive parts.

3.13 Composite Component

Component comprising both conductive and insulation materials (plastic and metal or conductive plastic).

3.14 Non-flame Propagating Components

A component which may or may not ignite as a result of an applied flame and does not propagate the flame.

3.15 External Influence

The presence of water, oil or building materials, low and high temperatures, corrosive or polluting substance, solar radiation or mechanical stress.

3.16 Type Tests

Tests carried out to prove conformity with the requirement of this standard. These are intended to prove the general qualities and design of a given type.

3.17 Acceptance Tests

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

3.18 Routine Tests

Test carried out on each item to check the essential requirements which are likely to vary during production.

4 GENERAL REQUIREMENTS

4.1 Trunking and ducting systems shall be so designed and constructed that where required they ensure reliable mechanical protection to the conductors and/ or cables contained therein. Where required, the system shall also provide adequate electrical protection.

In addition, the system components shall withstand the stresses likely to occur during transport, storage, recommended installation practice and usage.

5 GENERAL CONDITIONS FOR TESTS

5.1 Test according to this standard are type tests. The individual standards on cable trunking and ducting system will specify type, acceptance and routing tests. A recommended sampling plan for acceptance tests and criteria for conformity is given in Annex B for general guidance. Unless otherwise specified, tests are carried out with the trunking or ducting installed as in normal use and the parts assembled according to the manufacturer's instructions.

Tests on components of a system containing insulating or composite material shall not commence earlier than 240 h after manufacturing. During this period, the samples may be conditioned in accordance with **10.3.1**.

5.2 Unless otherwise specified, the tests are carried out at an ambient temperature of 27 ± 5°C.

5.3 Samples of trunking or ducting, hereafter called samples, for various tests are taken from different lengths.

All tests are made on new samples.

Unless otherwise specified, tests are carried out with the cover, if any, in position as in normal use and assembled according to the manufacturer's instructions.

5.4 When toxic or hazardous processes are used, precautions shall be taken to safeguard the testing personnel.

5.5 In case of type tests, unless otherwise specified, the samples are deemed not to comply with the specification. If there are more failures than that of one sample in any one of the tests applicable. 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 comply.

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

6 CLASSIFICATION

6.1 According to Material

6.1.1 *Metal Trunking/Ducting Systems*

6.1.2 *Insulating Material Trunking/Ducting Systems*

6.1.3 *Composite Material Trunking/Ducting Systems*

6.2 According to Mechanical Properties

6.2.1 *Trunking/Ducting Systems for Very Light Mechanical Stresses*

6.2.2 *Trunking/Ducting Systems for Light Mechanical Stresses*

6.2.3 *Trunking/Ducting Systems for Medium Mechanical Stresses*

6.2.4 *Trunking/Ducting Systems for Heavy Mechanical Stresses*

6.2.5 *Trunking/Ducting Systems for Very Heavy Mechanical Stresses*

6.3 According to Temperatures

6.3.1 The cable trunking and ducting systems classified according to the temperature are given in Table 1.

Table 1 Temperature Classifications

(*Clause* 6.3.1)

Temperature Classification	Temperature not Normally Less Than		Permanent Application Temperature Range
	Storage and Transport	Use and Installation	
	°C	°C	°C
(1)	(2)	(3)	(4)
–45	–45	–15	–15 to +60
–25	–25	–25	–15 to +60
–5	–5	–5	–5 to + 60
+90	–5	–5	–5 to +60[1)]
+90/–25	–25	–25	–15 to +60[1)]
+90/–5	–5	–5	–5 to +90

NOTE — The above temperatures are operating temperatures. Ambient temperatures are given in IS 732.

[1)] These types for use in prefabricated concrete will temporarily withstand temperature up to +90°C.

6.4 According to Resistance to Flame Propagation

6.4.1 *Flame Propagating Trunking/Ducting Systems*

6.4.2 *Non-Flame Propagating Trunking/Ducting Systems*

6.5 According to Electrical Characteristics

6.5.1 *Trunking/Ducting Systems without Electrical Continuity Characteristics*

6.5.2 *Trunking/Ducting Systems with Electrical Continuity*

6.5.3 *Trunking/Ducting Systems without Electrical Insulating Characteristics*

6.5.4 *Trunking/Ducting Systems with Electrical Insulating Characteristics*

6.6 According to Protection Against External Influences

Systems shall be classified in the mounted position according to the manufacturer's instructions.

6.6.1 *Protection Against Ingress of Solid Objects* (*see* IS 12063).

6.6.1.1 *Trunking/ducting systems giving protection against solid objects of* 12.5 mm *dia and greater (IP2X)*

The sphere and not the test finger shall be used when testing for IP2X.

6.6.1.2 *Trunking/ducting systems giving protection against solid objects of* 2.5 mm *dia and greater (IP3X)*

6.6.1.3 *Trunking/ducting systems giving protection against solid object of* 1.0 mm *dia and greater (IP4X)*

6.6.1.4 *Trunking/ducting systems giving protection against dust (IP5X)*

6.6.1.5 *Dust-tight trunking/ducting systems (IP 6X)*

NOTE — The IP designations above also indicate the degree of protections of persons against access to hazardous parts in IS 12063.

6.6.2 *Protection Against Ingress of Water* (*see* IS 12063).

6.6.2.1 *Trunking/ducting systems giving no protection*

6.6.2.2 *Trunking/ducting systems giving protection against vertically falling water drops (IPX1)*

6.6.2.3 *Trunking/ducting systems giving protection against vertically falling water drops when enclosure tilted up to 15° (IPX2)*

6.6.2.4 *Trunking/ducting systems giving protection against spraying water (IPX3)*

6.6.2.5 *Trunking/ducting systems giving protection against splashing water (IPX4)*

6.6.2.6 *Trunking/ducting systems giving protection against water jets (IPX5)*

6.6.3 *Protection Against Corrosive or Polluting Substances*

6.6.3.1 *Trunking/ducting systems with low protection outside and inside*

6.6.3.2 *Trunking/ducting with medium protection*

outside and low protection inside

6.6.3.3 *Trunking/ducting systems with medium protection outside and inside*

6.6.3.4 *Trunking/ducting systems with high protection outside and low protection inside*

6.6.3.5 *Trunking/ducting systems with high protection outside and medium protection inside*

6.6.3.6 *Trunking/ducting system with high protection outside and inside*

6.6.4 *Protection Against Solar Radiation*

6.6.4.1 *Trunking/ducting systems without protection*

6.6.4.2 *Trunking/ducting systems with low protection*

6.6.4.3 *Trunking/ducting systems with medium protection*

6.6.4.4 *Trunking/ducting systems with high protection*

6.7 According to Cover Retention of the System

6.7.1 *Access Cover Removable without Tools*

6.7.2 *Access Cover Removable with Tools*

7 MARKING

7.1 Each length of trunking/ducting and each trunking/ducting fitting shall be marked with the manufacturer's or responsible vendor's name, trade-mark or other identifying symbol and the number of this standard.

When trunking/ducting fittings are supplied in a package, a label attached to each package and marked as above will be sufficient marking.

Flame propagating trunking/ducting systems shall bear a marking indicating clearly that they are flame propagating.

7.2 Marking shall be durable and easily legible.

NOTE — Marking may be applied, for example, by stamping, moulding, printing, labels or water-slide transfers.

Marking is checked by inspection and by rubbing the marking by hand.

Printed markings or markings applied by transfer shall withstand being rubbed by hand for 15s with a piece of cloth soaked with water and again for 15s with a piece of cloth soaked with petroleum spirit.

NOTES

1 Petroleum spirit is defined as the aliphatic solvent hexane with a maximum aromatics content of 0.1 percent volume, a kauri-butanol value of 29, an initial boiling-point of approximately 65°C, a dry-point of approximately 69°C and a density of approximate 0.68 g/cm^3.

2 To withstand the rubbing test described in **7.2** suitable protection may be applied to the markings.

8 DIMENSIONS

8.1 The manufacturer shall state in mm^2 the internal usable area for cable for the trunking/ducting.

NOTE — Certain accessories when mounted can reduce the internal usable area for cables.

8.2 Preferred length shall be in increments of 0.5 m starting with a minimum of 2 m.

8.3 The preferred dimensions of cable trunking and ducting are given in Table 2.

Table 2 Preferred Dimensions of Cable Trunking and Ducting

(*Clause* 8.3)

Size	Approximate Internal Cross-Sectional	Outer Width	Outer Height	Wall Thickness, *Min*
mm	mm^2	mm	mm	mm
(1)	(2)	(3)	(4)	(5)
12 × 12	119.5	12.0 ± 0.2	12.0 ± 0.2	1.20
16 × 12	153.0	16.0 ± 0.2	12.0 ± 0.2	1.20
16 × 16	196.00	16.0 ± 0.2	16.0 ± 0.2	1.20
25 × 12	239.10	25.0 ± 0.2	12.0 ± 0.2	1.20
25 × 16	307.40	25.0 ± 0.2	16.0 ± 0.2	1.20
25 × 25	510.80	25.0 ± 0.2	25.0 ± 0.2	1.20
38 × 16	474.40	38.0 ± 0.2	16.0 ± 0.2	1.30
38 × 25	793.00	38.0 ± 0.2	25.0 ± 0.2	1.30
50 × 16	611.00	50.0 ± 0.2	16.0 ± 0.2	1.50
50 × 50	2 209.00	50.0 ± 0.2	50.0 ± 0.2	1.50
75 × 75	5 098.00	75.0 ± 0.2	75.0 ± 0.2	1.80
100 × 50	4 473.00	100.0 ± 0.2	50.0 ± 0.2	1.80

8.3.1 The sizes of the cable trunking and ducting other than those specified in **8.3** are also acceptable as per the agreement between the purchasers and the manufacturers provided that the height and width are from the combination of the following dimensions having tolerances of ±0.2 mm on both height and width dimensions. 12 mm, 16 mm, 20 mm, 25 mm, 32 mm, 38 mm, 50 mm, 75 mm and 100 mm.

8.3.2 Wall thickness for cable trunking and ducting for any type of combination with respect to height and width as given in **8.3.1** shall be as follows:

a) Any combination where size is up to 32 mm the wall thickness shall be at least 1.20 mm

b) Any combination where size is up to 38 mm, the wall thickness shall be at least 1.30 mm

c) Any combination where size is up to 50 mm the wall thickness shall be at least 1.50 mm

d) Any combination where size is above 50 mm the wall thickness shall be at least 1.80 mm.

9 CONSTRUCTION

9.1 Any surface or edge shall not damage the

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

9.2 Any screws, studs or other securing devices shall be fitted so as not to damage the conductors or cables.

Slotted cable trunking may have prepared fixing holes. Such holes shall be in accordance with the relevant part of this standard. However on appropriate surfaces, the trunking and ducting system can be fixed using a suitable contact adhesive.

Any mounting device providing for the fixing of apparatus shall meet the requirements of the appropriate Indian Standard, if any.

Trunking/ducting systems may have means for the segregation of circuits. Such means shall be adequately secured to the trunking/ducting length.

Compliance is checked by the test of **10.2**.

With the exception of small screws and the like, accessible metal parts of system components, which are liable to become live in the event of failure of insulation, shall have the possibility of being adequately connected to the earthing conductor.

Compliance is checked by the test of **12.2**.

9.3 Fixing screws and small spring clips of insulating trunking fitting need not be of insulating material, if they do not come into contact with the conductors or cables.

9.3.1 Screws, where used for attached components or covers if any to trunking components shall have ISO metric threads or be of the thread forming type. Thread cutting screws may be used if suitable design provisions are made.

Fixing screws and small clips for use with insulating components need not be of insulating material if they are isolated from live parts, and are not capable of transmitting a fault current between equipment connected to the component.

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

Compliance for screw fixing using performed threads is checked by the test of **9.3.2**, followed by inspection.

9.3.2 The screws shall be tightened and removed:

— ten times for screws in engagement with a thread of insulating material and for screws of insulating material;

— five times in all other cases.

The test is made by using a suitable screwdriver or spanner applying a torque according to Table 3.

Table 3 Values of Torque for Screw Test

(*Clause* 9.3.2)

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

NOTES

1 Column 2 applies to screws which are tightened by means of a screwdriver.

2 Column 3 applies to screws and nuts which are tightened by means other than a screwdriver.

3 During 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. The screws shall not be tightened by sudden or jerky motions.

9.4 Access to Live Parts

9.4.1 Trunking/ducting systems shall be so designed that when they are installed and fitted with insulated conductors and apparatus in normal use, parts are not accessible.

Compliance is checked by inspection and, if necessary by the tests of **9.4.2**, **9.4.3**, **9.4.4** and **9.4.5** on the sample installed as in service and fitted with insulated conductors and accessories.

9.4.2 The standard test finger in accordance with IS 12063 is applied in every possible position, an electrical indicator with a voltage not less than 40 V and not more than 50 V being used to show contact with the relevant part.

9.4.3 Insulating and composite components are subject to the following additional test, which is carried out at an ambient temperature of 40 ± 2°C the sample being at this temperature.

The sample, is subjected for 1 min to a force of 75 N applied through the tip of a straight unjoined test finger of the same dimensions as the standard test finger of IS 12063.

The finger with an electrical indicator as described in **9.4.2** is applied to all places where yielding of insulating material could impair the safety of the system but is not applied to knock-outs, membranes and the like.

During this test system components with their

associated fixing devices shall not deform to such an extent that parts can be touched with the straight unjointed test finger.

9.4.4 Knock-outs are subjected for 1 min to a force of 10N applied through tip of a straight unjointed test finger of the same dimensions as the test finger of IS 12063. During this test knock-outs shall not break.

9.4.5 For accessible metal parts, not permanently and reliably connected to a protective earth conductor, for example, thin decorative metal foils or the like, precautions shall be taken in order to prevent creepage distances or clearances from becoming less than 6 mm, even if a conductor should get loose from its terminal.

Information on how to apply the metal foil or the like, in order to fulfill the requirement, shall be given in the manufacturer's instructions.

Compliance is checked by measurement and by inspection.

9.5 Inlet openings, if any, shall allow the introduction of the conduit or protective covering of the cable so as to afford complete mechanical protection and shall be so constructed that the conduit or protective covering can enter at least 1 mm into the component.

Inlet openings for conduit entries shall be capable of accepting the conduit.

Compliance is checked by inspection and measurement.

9.6 Membranes

9.6.1 Membranes and the like shall be replaceable and reliably fixed and shall not be displaced by the mechanical and thermal stresses occurring in normal use.

Compliance is checked by the test of **9.6.2**.

9.6.2 Membranes are tested when assembled in the system. The sample is placed for 2 h in a heating cabinet the temperature being maintained at 40 ± 2°C. Immediately after this period a force of 30 N is applied for 5s to various parts of the membranes by means of the tip of a straight unjointed test finger of the same dimensions as the test finger given in IS 12063.

During these tests, the membranes shall not deform to such an extent that live parts become accessible and shall not come out. For membranes likely to be subjected to an axial pull in normal use, an axial pull of 30N is applied for 5s. During this test, the membranes shall not come out.

9.6.3 Membranes shall be so designed and made of such material that the introduction of cables into the system is permitted when the ambient temperature is low.

Compliance is checked by the test of **9.6.4**.

9.6.4 The system component is fitted with membranes which have not been subjected to any ageing treatment, those without openings being suitably pierced.

The sample is then kept for 2 h in a refrigerator at a temperature as given in col 3 of Table 1.

After this period the sample is removed from the refrigerator, and immediately afterwards, while the sample is still cold, it shall be possible to introduce without undue force, cable of the heaviest type through the membranes.

After the test of **9.6.2** and **9.6.4**, the membranes shall show no harmful deformation, cracks or similar damage visible to normal or corrected vision without magnification.

9.7 Glands

9.7.1 Screwed glands, if any shall comply with the test of **9.7.2**.

9.7.2 Glands are fitted with a cylindrical metal rod having a diameter, in millimetres, equal to the nearest whole number below the internal diameter of the packing in millimetres.

The glands are then tightened by means of a suitable spanner, the torque shown in Table 4 being applied to the spanner for 1 min.

Table 4 Values for Torque in Gland Tests

(*Clause* 9.7.2)

Diameter of Test Rod mm	Torque, Nm	
	Metal Glands	Other Glands
(1)	(2)	(3)
Up to and including 14	6.25	3.75
Above 14 up to and including 20	7.5	5.0
Above 20	10.0	7.5

After the test, glands and the trunking/ducting shall show no damage visible to normal or corrected vision without magnification.

10 MECHANICAL PROPERTIES

10.1 Trunking/ducting systems shall have adequate mechanical strength.

Compliance is checked by the test specified in **10.2** to **10.6** and by any additional tests specified in the appropriate part of this standard.

After all mechanical properties test, the cover, if any, shall not have become detached.

10.2 Cable Supporting Test for Surface Mounting

10.2.1 The test is carried out on three samples of main components each having a minimum length of 2 m at a temperature of 27 ± 5°C. For insulating and composite main components, three samples each having a minimum length of 250 mm, shall be tested at a temperature of 60 ± 2°C.

Cable retainers, if their use is recommended by the manufacturer, are fitted at centres recommended by the manufacturer.

10.2.2 Each sample is in turn securely fixed to a rigid support by means of screws and washers having a minimum outside diameter of 10 mm according to the manufacturer's instructions. For samples whose internal configuration will not accept screws with 10 mm washers, the screws are suitably adapted.

10.2.3 For the test at 27 ± 5°C with the sample in position A of Fig. 1, each compartment is subjected to an evenly distributed load of 0.13 kg/cm^2 of internal usable compartment cross-sectional area per metre length.

The load consists of insulated flexible copper cables complying with Class 5 of IS 8130. In case the required load cannot be reached, the insulation is removed.

After the load has been applied for 2 h, the distortion is measured. The distortion shall not exceed 10 percent of *H* in Fig. 1 position A with a maximum of 10 mm. The cover shall not be detached during the test.

10.2.4 Again at 27 ± 5°C another set of samples is then placed in position B, and each compartment subjected to an evenly distributed load of 0.13 kg/cm^2 of internal usable compartment cross-sectional area per metre length.

After the load has been applied for 2 h, the distortion is measured. The distortion shall not exceed 10 percent of *W* in Fig. 1 position B with a maximum of 10 mm. The cover shall not be detached during the test.

10.2.5 For the test at 60 ± 2°C with the samples in position A of Fig. 1, each compartment is subjected to an evenly distributed load of 0.13 kg/cm^2 of internal usable compartment cross-sectional area per metre length.

After the load has been applied for 2 h, the distortion is measured. The distortion shall not exceed 10 percent of *H* in Fig. 1 position A with a maximum of 10 mm. The cover shall not be detached during the test.

10.2.6 Again at 60 ± 2°C, another set of samples is then placed in position B and each compartment is subjected to an evenly distributed load of 0.13 kg/cm^2 of internal usable compartment cross-sectional area per metre length.

After the load has been applied for 2 h, the distortion is measured. The distortion shall not exceed 10 percent

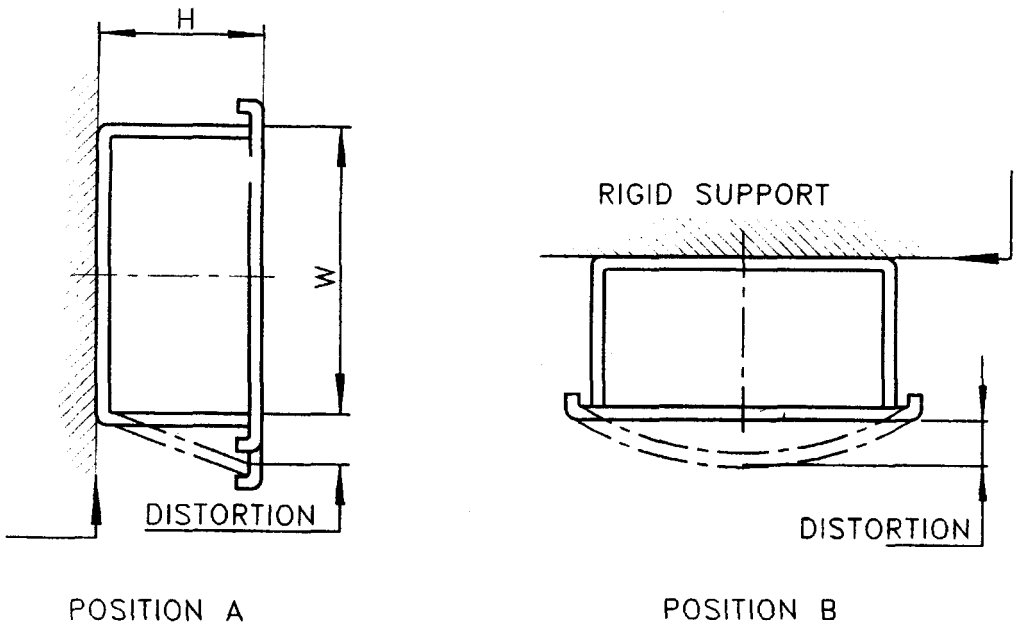


FIG. 1 DISTORTION TEST

of *W* in Fig. 1 position B with a maximum of 10 mm. The cover shall not be detached during the test.

10.3 Impact Test

10.3.1 The test is carried out on three samples each 250 ± 5 mm long.

Before the test insulating and composite components are conditioned at a temperature of 60 ± 2°C for 240 h continuously.

10.3.2 The test apparatus as shown in Fig. 2, is placed on a pad of closed cell expanded EPR sponge, 40 mm thick when uncompressed, and having a density of 450 kg/m^3 to 550 kg/m^3.

The test apparatus, together with the samples is placed in a refrigerator, the temperature within which is maintained at the appropriate temperature specified in col 2 of Table 1 within ±1°C.

10.3.3 After 2 h, each sample is in turn placed in position in the apparatus with the cover uppermost if any, such that a blow can be applied firstly to the centre of the sample or the cover, if any, and secondly to the edge of the sample or the cover, if any, the hammer is allowed to fall so that an impact energy according to Table 5 applied. The mass of the hammer and the height shall be as specified in Table 5.

10.3.4 After the test, the samples shall show no sign of disintegration nor shall there be any cracks visible to normal or corrected vision without magnification. Any cracks in internal dividers which are not likely to impair electrical safety or use are ignored.

10.4 Linear Deflection Test

10.4.1 The test is carried out on three samples, which are supported symmetrically at the maximum centre distance recommended by the manufacturer, and the length of the sample is equal to twice the distance

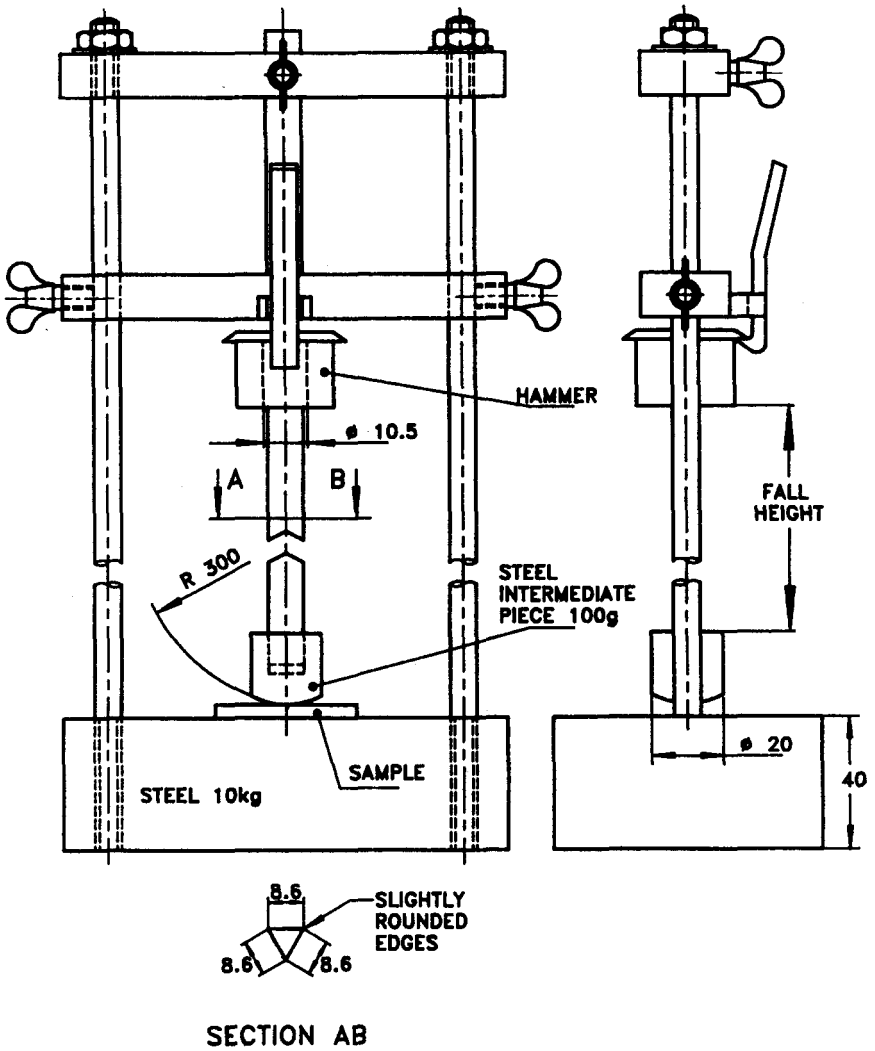


FIG. 2 IMPACT TEST APPARATUS

Table 5 Impact Test Values
(*Clause* 10.3.3)

Stress Classification	Approximate Energy	Mass of the Hammer	Fall Height
	J	kg	mm
(1)	(2)	(3)	(4)
Very light	0.5	0.5	100 ± 1
Light	1.0	1.0	100 ± 1
Medium	2.0	2.0	100 ± 1
Heavy	6.0	2.0	300 ± 1
Very heavy	20.0	6.8	300 ± 1

between supports. The sample is secured to the supports.

10.4.2 The tests are carried out at a temperature of 27 ± 5°C and for insulating and composite lengths also at a temperature of 60 ± 2°C.

10.4.3 The load is 0.13 kg/cm^2 of internal usable compartment cross-sectional area as specified by the manufacturer per metre length.

10.4.4 The load is applied internally, and evenly distributed over the entire length of the sample, and is produced by using chains weighing 1.16 kg/m and having a link with a ratio of internal length to width of at least 2.

The test is carried out with the cover if any, in each possible position that is mounted at the top, bottom and either side.

10.4.5 The load is applied for 1 h, and at the end of this period the deflection measure at the centre of the distance between the supports shall not exceed 1 percent of the distance between the supports.

The cover, if any, shall not be detached by the applied load.

10.5 External Load (*Under Consideration*)

10.6 Cover Retention Test

10.6.1 A system component, the cover of which can only be removed by the use of a tool is subjected to the test of **10.6.2**. The sample length is 250 mm.

10.6.2 The main part of the system component is firmly fixed to a horizontal support, and the cover fixed to the main part in accordance with the manufacturer's instructions.

Without the use of tool, all reasonable efforts shall be made to remove the cover manually. The cover shall not become detached from the main part.

11 RESISTANCE TO FLAME PROPAGATION

11.1 Non-flame propagating trunking/ducting shall either not ignite or if ignited, shall not continue to burn when the source of ignition is removed.

Compliance is checked as follows:

a) for length of trunking/ducting by the test of **11.1.1**; and

b) for other parts of insulating material by the test of **11.1.2**.

11.1.1 *Flame Test*

The test is made on three complete samples of 600 mm length. If the separators are not integral with the samples, they shall be mounted on the lengths of trunking/ducting.

The sample is mounted vertically.

The burner is supported so that its axis is at 45 ± 2°C 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. The axis of the flame intersects with the surface of the sample at a point 150 ± 5 mm above the lower edge of the sample or 100 ± 5 mm above any clamp. The axis of the flame is perpendicular to the surface and intersects with the axis of the sample.

The sample is clamped at both ends. In order to prevent distortion or movement of the sample itself under flame application conditions the flame is applied for 60 ± 1s, and is then removed.

The sample is regarded as having passed the test if:

— the sample does not ignite, or if

— in the case of ignition, flames extinguishes within 30 s after the removal of the flame.

11.1.2 *Glow-Wire Test*

The test is performed according to **4** to **10** of IS 11000 (Part 2/Sec 1) under the following conditions:

a) for parts of insulating material necessary to retain current-carrying parts in position, by the test made at a temperature of 850°C; and

b) for parts of insulating material not necessary to retain current-carrying parts in position, even though they are in contact with them, and for parts of insulating material retaining earthing terminals in position, by the test made at a temperature of 650°C.

Small parts, such as washers, are not subjected to the test of this subclause.

The test is not made on parts of ceramic material.

If possible, the sample should be a complete accessory.

If the test cannot be made on a complete accessory, a suitable part may be cut from it for the purpose of the test.

The test is made on one sample.

If the tests specified have to be made at more then one place on the same sample, care is taken to ensure that any deterioration caused by previous tests does not affect the result of the subsequent test.

In case of doubt, the test shall be repeated on two further samples.

The test is made by applying the glow-wire once.

The sample is positioned during the test in the most unfavourable position of its intended use (with the surface to be tested in a vertical position).

The tip of the glow-wire shall be applied to the surface of the sample, taking into account the conditions of the intended use under which a heated or glow element may come into contact with the sample.

The sample is regarded as having passed the glow-wire test if:

— there is no visible flame and no sustained glowing, or if

— flames and glowing at the sample extinguish within 30 s after the removal of the glow-wire.

There shall be no ignition of the tissue paper or scorching of the board.

12 ELECTRICAL CHARACTERISTICS

12.1 Trunking/ducting systems with electrical continuity characteristics shall be so constructed that they can be used in an installation as a bonding, earthing or protective conductor.

Compliance is checked by the following tests, which are made on three samples of a minimum length of 600 mm, each sample consisting of two trunking/ ducting lengths connected together according to the manufacturer's instructions.

Before the tests, all the samples are subjected to the following preparation treatment.

All grease is removed from the parts to be tested, by immersion in trichloroethane or an equivalent degreasing agent, for 10 min. The parts are then immersed for 10 min in a 10 percent solution of ammonium chloride in water at temperature of 27 ± 5°C. Without drying, but after shaking off any drops, the samples are then placed for 10 min in box containing air saturated with moisture at temperature of 27 ± 5°C.

The parts are then dried for 10 min in a heating cabinet at a temperature of 100 ± 5°C, and are left at room temperature for 24 h.

Then the tests of **12.2** and **12.3** are carried out.

12.2 Electrical Continuity Tests for Earthing or Bonding

12.2.1 *Resistance of the Sample per Unit Length*

A direct current of 1 A is passed through the sample, and the voltage drop between the two ends of the sample is measured as close as possible to the ends.

The measuring instrument shall have an input resistance of not less than 20 000 Ω V.

The sample shall have a resistance of not more than 5×10^{-3} ohm/m.

12.2.2 *Earthing Resistance*

A current of 25 A derived from an ac source with a no-load voltage not exceeding 12 V is passed between the earthing terminal or earthing contact and each of the accessible metal parts in turn.

The voltage drop between the earthing terminal and the accessible metal parts is measured, and the resistance is calculated from the current and the voltage drop. The resistance is also checked between the samples either side of the joint, and between the main part and the cover, if any, of the sample.

In no case shall this resistance exceed 0.05 Ω.

12.3 Electrical Insulating Strength and Insulation Resistance Test for Systems with Insulating Characteristics

Before the test, the samples are tested for the appropriate degree of protection against the ingress of water, as claimed by the manufacturer.

Where the samples have partitions or dividers, each compartment is tested as a separate trunking, the test voltage is also applied to the partitions and dividers.

One end of the sample is closed with a plug of insulating material, which shall allow two separate cables to penetrate 25 mm inside the sample, 12 mm of the cables within the sample being without insulation, the ends of the cable being spread so that there is a distance of 12.5 mm between them.

The inside of each compartment of the sample is then filled with spheroidal metal objects to a maximum size of 2.5 mm, and a bare copper wire is used to interconnect all compartments. The remaining end is then closed.

The set of samples is then subjected to humidity treatment, which is carried out in a humidity cabinet

containing air with a relative humidity between 91 percent and 95 percent and at a temperature maintained within ±1°C of any convenient value *t* between 15°C and 35°C. Before being placed in the humidity cabinet, the samples are brought to a temperature between *t* and *t* + 4°C, this may be achieved by keeping them at this temperature for at least 4 h before the humidity treatment.

The samples are kept in the cabinet for 48 h.

A relative humidity between 91 percent and 95 percent can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate (Na_2SO_4) or potassium nitrate (KNO_3) in water having a substantially large contact surface with air.

In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air within and, in general, to use a cabinet which is thermally insulated.

Immediately after the humidity treatment, the samples are coated on the outside with a foil or gauge of good conductivity.

The conductivity of the metal objects within the sample is checked by measuring the resistance between the two cables which have penetrated the sample. The resistance measured shall be less than 100 Ω.

The insulation resistance is measured by applying a dc voltage of at least 500 V between the cables and the foil or gauge.

The measurement is made 1 min after the application of the voltage. The insulation resistance shall be not less than 100 MΩ.

A voltage of 2 500 V of substantially sine-wave form and having a frequency of 50 Hz, from a test apparatus with a characteristic which enables it to supply 200 mA at 1 250 V, is then applied between the cables and the foil or gauze, as shown in Fig. 3. Initially not more than half the voltage is applied and this is raised to 2 500 V as rapidly as possible without transient over voltage. It is maintained for 1 min.

No breakdown shall occur during the test.

13 External Influences (*Under Consideration*)

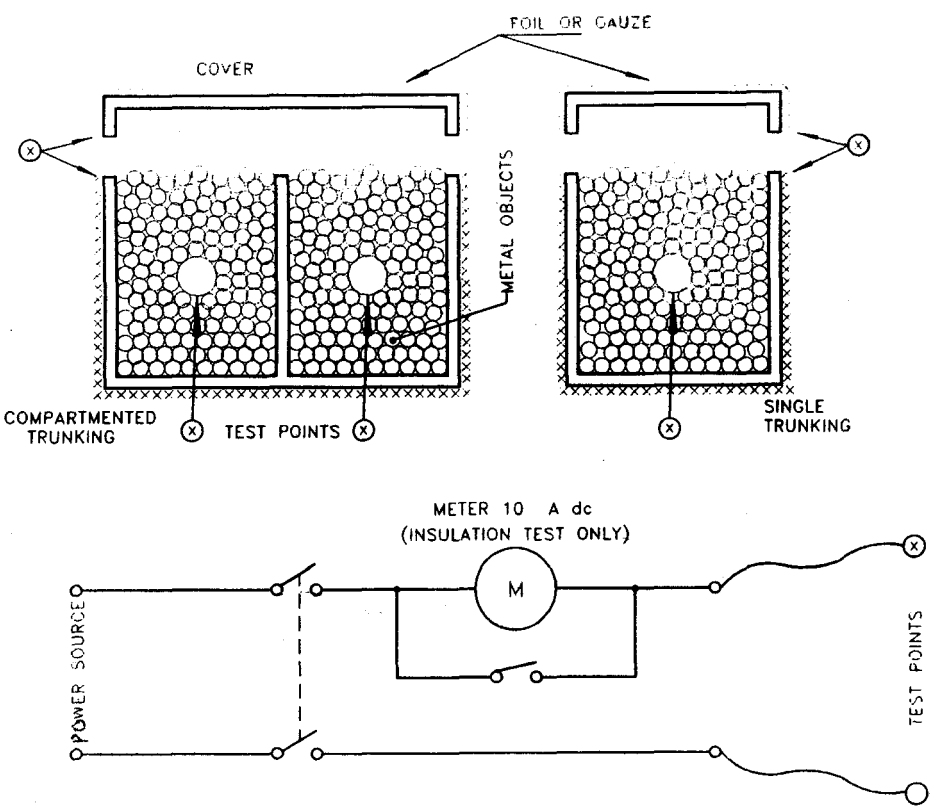


FIG. 3 ELECTRICAL INSULATING STRENGTH AND INSULATION RESISTANCE TEST APPARATUS

ANNEX A

(*Clause* 1.2)

DESIGNS OF CONDUIT SYSTEM

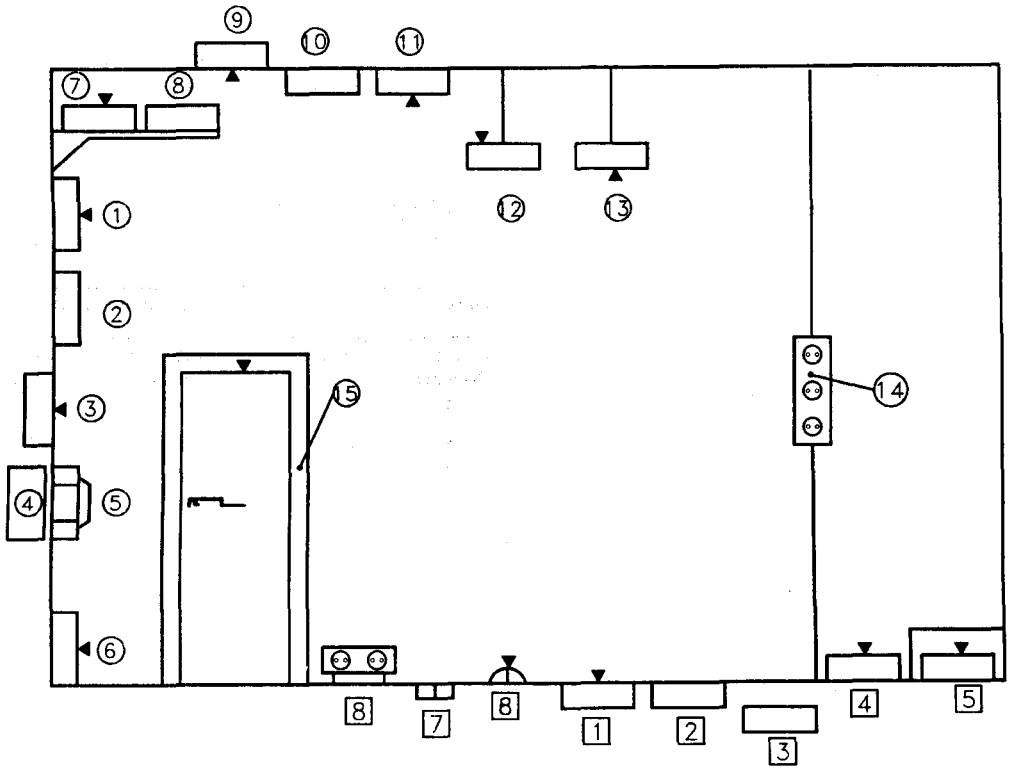
A-1 TYPES OF TRUNKING AND DUCTING SYSTEMS FOR WALL AND CEILING INSTALLATION

No. on Fig. 4	*Definition*	*For*	*Mounting*
1 7 11 12 13 15	Trunking and accessories	Insulated conductors, cables, cords	Surface on wall and ceiling, on walls mounted horizontally or vertically, ceiling suspended
3 9	Trunking and accessories	Insulated conductors, cables, cords	Flush in wall and ceiling, in walls mounted horizontally or vertically
5	Trunking and accessories	Insulated conductors, cables, cords, mounting devices for apparatus (switches, socket-outlets, circuit-breakers, etc)	Surface on wall and ceiling, on walls mounted horizontally or vertically
2 10 8	Ducting and accessories	Insulated conductors, cables, cords	Surface on wall and ceiling, on walls mounted horizontally or vertically, ceiling suspended
4	Ducting and accessories	Insulated conductors, cables, cords	Embedded in wall and ceiling, in walls mounted horizontally or vertically

NOTE — No. 14 refers to other parts of this standard.

A-2 TRUNKING AND DUCTING SYSTEMS FOR FLOOR INSTALLATION

No. on Fig. 4	*Definition*	*For*	*Mounting*
1	Trunking and accessories	Insulating conductors, cables, cords	Flush floor
1 5 6	Trunking and accessories	Insulating conductors, cables, cords	Surface on floor
2	Ducting and accessories	Insulated conductors, cables, cords	Flush floor
3	Ducting and accessories	Insulated conductors, cables, cords	In floor (embedded)
7	Electrical service unit	Apparatus	Flush floor
8	Electrical service unit Skirting systems	Apparatus	Surface on floor
6 15	Skirting trunking and accessories	Insulating conductors, cables, cords	Surface on wall and ceiling
Not shown	Skirting trunking and accessories	Insulating conductors, cables, cords, counting devices for apparatus	Surface on wall and ceiling
Not shown	Socket plinth	Mounting apparatus (socket-outlets)	Surface on wall



No. 5 represents an apparatus in a trunking system.

FIG. 4 TYPES AND APPLICATION OF TRUNKING AND DUCTING SYSTEM

ANNEX B

(*Clause* 5.1)

RECOMMENDED SAMPLING PLAN AND CRITERIA FOR CONFORMITY FOR ACCEPTANCE OF LOT

B-1 LOT

B-1.1 In any consignment, all the lengths of same nominal size and class manufactured for the same material under essentially similar conditions of production shall be grouped together to constitute a lot.

B-2 SCALE OF SAMPLING

B-2.1 For judging the conformity of a lot to the requirements of the acceptance test, sampling shall be done for each lot separately. For this purpose, the number of lengths to be selected at random from the lot shall be in accordance with Table 6.

B-2.2 These conduits shall be selected from the lot at random. In order to ensure the randomness of selection, procedures given in IS 4905 may be followed.

B-3 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

B-3.1 All the trunking and ducting system selected in the first sample at random according to col 1 and 3 of Table 6 shall be examined for dimensional requirements. A trunking and ducting system failing to satisfy any of these requirements shall be termed as 'defective'. The lot shall be considered as conforming to these requirements if the number of defectives found in the first sample is less than or equal to the corresponding acceptance number (*see* col 4). If the number of defectives is greater than or equal to the corresponding rejection number (*see* col 5). The lot shall be deemed as not conforming to the requirements. If the number of defectives is greater than the acceptance number but less than the rejection number, a second sample of the same size as the first shall be taken to determine the conformity or otherwise of the lot. The number of defectives found in the first and second samples shall be combined and if the combined number of defectives is less than or equal to the corresponding acceptance number of the second sample, the lot shall be declared as conforming to these requirements; otherwise not.

B-3.2 The lot which is found conforming to the dimensional requirements, shall then be tested for other acceptance tests. For this purpose, sample size, acceptance number and rejection number are given in col 6, 7 and 8 of Table 6 respectively.

B-3.3 The lot shall be considered as conforming to the requirements of acceptance tests if **B-3.1** and **B-3.2** are satisfied.

Table 6 Sample Size, Acceptance and Rejection Number

(*Clauses* B-2.1, B-3.1 *and* B-3.2)

Lot Size	Stage of Sample	For Dimensional Requirements			For Other Acceptance Tests		
		Sample Size	Acceptance Number	Rejection Number	Sample Size	Acceptance Number	Rejection Number
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Up to 300	First	8	0	2	3	0	2
	Second	8	1	2	3	1	2
301 to 500	First	13	0	2	5	0	2
	Second	13	1	2	5	1	2
501 to 1 000	First	20	0	3	8	0	2
	Second	20	3	4	8	1	2
1 001 and above	First	32	1	5	13	0	3
	Second	32	4	4	13	3	4

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 (3744).

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	254 12 16, 254 14 42 254 25 19, 254 13 15
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400 093	832 92 95, 832 78 58 832 78 91, 832 78 92

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

Printed at Prabhat Offset Press , Darya Ganj, New Delhi-2