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IS 9537 (Part 6): 2000

भारतीय मानक विद्युत संस्थापनों की नलिकाएँ — विशिष्टि भाग 6 धातु अथवा मिश्रित धातु की अनम्य नलिकाएँ

Indian Standard

CONDUITS FOR ELECTRICAL INSTALLATIONS — SPECIFICATION PART 6 PLIABLE CONDUITS OF METAL OR COMPOSITE MATERIALS

ICS 29.120.10

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

FOREWORD

This Indian Standard (Part 6) 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.

Since many requirements and test methods relevant to different types of conduits are similar, these have been covered in Part 1 of this 'standard with the intention of covering specific requirement of individual types of conduits in subsequent parts. This standard (Part 6) is thus, one of this series.

This standard (Part 6) is to be read in conjunction with IS 9537 (Part 1) to which reference has been given regarding general requirements as well as test methods. Should, however, any deviations exist between IS 9537 (Part 1) and this standard, the provisions of the latter shall apply. Sequence of clauses used in this standard is the same as in IS 9537 (Part 1) for easy reference. Whenever particular requirement is not applicable to this type of conduits, the same has been indicated accordingly. Any addition to the existing provisions of a sub-clause of IS 9537 (Part 1) has been indicated as under:

Addition — Followed by the text of the additional matter.

Clauses/Tables which are additional to those of IS 9537 (Part 1) are numbered starting from 101 and additional sub-clauses are numbered with the main clause number followed by 101,102, for example, 5.101.

The Indian Standards which are necessary adjuncts to this standard are given in Annex A.

The normal trade practice, while supplying conduits, is to provide one coupler with each conduit. However, for the purpose of conformity to this standard, this is not a mandatory condition of compliance.

While preparing this standard, considerable assistance has been derived from corresponding IEC Publication 614-2-6 (1992) 'Specification for conduits for electrical installations: Part 2 Particular requirement, Section 6 Pliable conduits of metal or composite material', issued by the International Electrotechnical Commission.

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 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.

Indian Standard

CONDUITS FOR ELECTRICAL INSTALLATIONS — SPECIFICATION

PART 6 PLIABLE CONDUITS OF METAL OR COMPOSITE MATERIALS

1 SCOPE

This clause of Part 1 is applicable except as follows:

Addition

This standard specifies requirements for pliable conduits of metal or composite materials for the protection of conductors and cables in electrical installations. It does not cover requirements for conduit fittings.

2 DEFINITIONS

This clause of Part 1 is applicable except as follows:

Additional Sub-clauses

2.101 Terminating Fitting

A fitting which allows a non-threadable conduit to be connected to a threadable conduit or to conduit entries.

2.101.2 Type Tests

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

3 GENERAL REQUIREMENTS

This clause of Part 1 is applicable.

4 GENERAL NOTES ON TESTS

This clause of Part 1 is applicable.

5 CLASSIFICATION

This clause of Part 1 is applicable except as follows:

5.1(b)(1), **5.1**(d)(1), **5.1**(d)(2), **5.1**(d)(3) and **5.1**(h) are not applicable.

Additional Sub-clause

5.101 According to Temperature

Conduits shall be classified in accordance with Table 101.

Note — Conduits of composite materials for temperatures up to 200°C are under consideration.

6 MARKING

This clause of Part 1 is applicable except as follows:

Additional Sub-clauses

6.101 The conduits shall be marked with a classification code in accordance with Annex B.

Table 101 Classification According to Temperature

(Clauses 5.101, 9.2.2 and 9.4.2)

Temperatures not Normally Less Than				
Temperature Classification	Storage and Transport	Use and Installation	Permanent Application Temperature Range	
	℃	°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	$-5 \text{ to } +60^{\circ}$	
+ 90/-25	- 25	- 15	$-15 \text{ to } + 60^{10}$	
+ 90/-5	- 5	- 5	- 5 to + 60	

¹⁾ These types, for the prefabricated concrete, will temporally withstand temperatures up to 90°C.

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6.102 The conduits may also be marked with Standard Mark.

6.102.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act*, 1986, and the Rules and Regulation made thereunder. The details of conditions under which the licence for the use of Standard Mark may also granted to the manufacturers or producers may be obtained from the Bureau of Indian Standards.

7 DIMENSIONS

This clause of Part 1 is applicable except as follows:

7.1 Addition

The minimum inside diameter shall be in accordance with Table 102.

Table 102 Dimensions

(Clauses 7.1, 9.2.1, 9.2.2 and 9.5)

Nominal Outside Diameter	Minimum Inside Diameter
	m m
121)	7.0
16	10.7
20	14.1
25	18.3
32	24.3
40	31.2
50	39.6
63	50.6

¹⁾ Non-preferred size for special applications only.

Compliance is checked by means of a guage according to Fig. 101.

8 CONSTRUCTION

This clause of Part 1 is applicable.

9 MECHANICAL PROPERTIES

This clause of Part 1 is applicable except as follows:

9.2 Replacement

- **9.2.1** Conduit shall be subjected to a bending test by means of a device as shown in Fig. 102.
- **9.2.2** The test is made on six samples of conduit, the length of each sample being at least:
 - 30 times the nominal diameter for plain conduits;
 - 12 times the nominal diameter for corrugated conduits.

Three of the samples are tested at room temperature; the other three samples are tested at the minimum applicable temperature according to Table 101.

For the test at room temperature, the samples are clamped vertically in the bending apparatus according to Fig. 102, and are bent to the left through approximately 90° and back to the vertical position, then bent to the right through approximately 90° and back to the vertical position. A rest period of 15 s is allowed between each of the four bending operations in each sequence.

This sequence of operations is carried out four times, except that, finally, the sample is not to be bent back to the vertical position. The sample is maintained for 5 min in the bent position, after which it shall be possible to pass the appropriate gauge according to Fig. 103 through the sample. The sample is placed in such a position that the straight portions are at 45° to the vertical, one end of the sample pointing upwards and the other downwards.

The test is repeated at low temperature in a cold chamber after the bending apparatus together with the sample have been kept for 2 h in the cold chamber at a temperature equal to the minimum application temperature claimed for the conduit at ± 1 °C. The length of the sample may be reduced for this test to suit the cold chamber.

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

9.3.3 Para I—Replacement

The difference between the nominal diameter and the diameter of the flattened sample shall not exceed 25 percent of the nominal diameter while the compression load is still applied, 60 ± 5 s after the load has been removed, the appropriate gauge in Fig. 103 shall be able to pass through the sample.

9.4.1 Para 2— Replacement

Before the test, samples containing plastic materials are conditioned at a temperature of $60 + 2^{\circ}$ C for 240 h.

9.4.2 Replacement

The test apparatus is placed on a pad of closed cell EPR sponge rubber 40 ± 1 mm thick when uncompressed, with a density of 450 kg/m^3 to 550 kg/m^3 , and this, together with the samples is placed in a refrigerator, the temperature within which is maintained at the minimum storage and transport temperature given in Table 101 for the conduit under test with a tolerance of $\pm 1^{\circ}\text{C}$.

9.5 Replacement

Samples of conduit are subjected to a collapse test, the length of the samples being at least:

- 30 times the nominal diameter for plain conduits;

^

12 times the nominal diameter for corrugated conduits.

The samples are bent, using the apparatus shown in Fig. 102, at room temperature, once through approximately 90°, back to the vertical position and then through approximately 90° in the opposite direction. They are then fixed to a rigid support, as shown in Fig. 3 of Part 1, having a radius in accordance with the Table of Fig. 102.

The support, with the sample in position, is kept for 24 h in a cabinet with an atmosphere having the composition and pressure of the ambient air and ventilated by natural circulation at a homogeneous temperature of $60^{\circ} \pm 2^{\circ}$ C.

After the period, it shall be possible to pass the appropriate gauge, according to Fig. 103, through the conduit, fixed to the support. The support is in such a position that the straight portions of the sample are at 45° to the vertical, one end of the sample pointing upwards and the other downwards.

10 RESISTANCE TO HEAT

This clause of Part 1 is applicable except as follows:

Additional Sub-clauses

10.101 Compliance is checked by the test given in 10.102 which shall be made in a heating cabinet set to the appropriate temperature within \pm 2°C as given in Table 101, equal to the upper limit of the permanent application temperature range for this conduit.

10.102 The samples, each approximately 100 mm long, together with the test apparatus, are kept for 4 h in the heating cabinet at the specified temperature.

After this period each sample is loaded for 24 h in apparatus as shown in Fig. 104, with an appropriate mass so that the sample is subjected to a total mass including the mass of the rod, as shown in Table 103, placed in the middle of the sample.

Table 103 Load for Heat Resistance Test (Clause 10.102)

Conduit Classification	Mass k g
Very Light	0.5
Light	0.1
Medium	2.0
Heavy	4.0
Very heavy	8.0

The load is applied through a steel rod 6 mm in diameter, disposed as far as possible at right angles to the axis of the conduit as shown in Fig. 104.

In the case of conduits with a spiral reinforcement the steel rod is applied parallel to and between two spirals. The temperature specified in 10.101 is maintained while the sample is under load.

The sample under load is then removed from the heating cabinet and allowed to cool to approximately room temperature. The load is then removed and it shall be possible to pass the appropriate gauge according to Fig. 103 through the sample in the vertical position.

NOTE—Care shall be taken that when removing the sample and apparatus from the cabinet, the operation is made in such a way as not to influence the result of the test.

11 RESISTANCE TO BURNING

This clause of Part 1 applicable, except as follows:

11.3 Addition

The time of exposure of the sample to the flame shall be 60 ± 5 s.

12 ELECTRICAL CHARACTERISTICS

This clause of Part 1 is applicable except as follows:

12.1 Para 1-Addition

Pliable composite conduits may be classified as insulating conduits.

For conduits of composite materials, the tests for insulation shall be carried out on the samples after the mechanical tests.

12.1.1 Para I— Modification

Replace 'Fig. 4' by 'Fig. 105'.

12.1.2 Para I -- Replacement

Immediately after the test of 12.1.1 the same samples as those used in 12.1.1 are immersed in water maintained at a temperature of $60^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and the electrodes are placed in position as shown in Fig. 105.

13 EXTERNAL INFLUENCES

This clause of Part 1 is applicable except as follows:

13.2 Replacement

Samples of conduit shall have an adequate length (approximately 500 mm).

Where necessary, the open ends are plugged or excluded from the test.

The sample is tested in accordance with IS 12063 for the appropriate characteristics.

The sample is deemed to have passed the test if the ingress of water is less than 0.1 percent of the internal volume of the sample under test.

13.3 Replacement

An assembly is prepared as for 13.2.

The sample is tested in accordance with the appropriate test of IS 12063.

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The assembly tested for numeral 5 is deemed to have passed the test if the ingress of dust is less than 0.1 percent of the internal volume of the sample under test.

101 CLASSIFICATION OF TESTS

101.1 Type Tests

The following shall consititute the type tests:

- a) Checking of dimensions (7),
- b) Bending test (9.2),
- c) Compression test (9.3),
- d) Impact test (9.4),
- e) Collapse test (9.5),
- f) Resistance to heat (10),

- g) Resistance to burning (11),
- h) Electrical characteristics (12), and
- j) External influences (13).

101.2 Acceptance Tests

The following shall constitute the acceptance tests:

- a) Checking of dimensions (7),
- b) Bending test (at room temperature only) (9.2),
- c) Compression test (9.3),
- d) Collapse test (9.5),
- e) Resistance to burning (11), and
- f) Electrical characteristics (12).

101.2.1 A recommended sampling plan for acceptance tests is given in Annex C.

ANNEX A

(Foreword)

IS No.	Title	IS No.	Title
2500 (Part 1):1992	Sampling inspection procedure: Part 1 Attribute sampling plans indexed by acceptable quality level (AQL) for lot by lot inspection (second revision)	9537 (Part 1) :1980 12063 : 1987	Specification for conduits for electrical installations: Part 1 General requirements Classification of degree of protection provided by enclosures of electrical equipment

ANNEX B

(Clause 6.101)

CONDUIT MARKING CLASSIFICATION CODES

B-1 MANDATORY MARKING CODE	Heavy med	chanical stresses				
Metal conduit shall be marked with a single digit code	Very heavy mechanical stresses5					
denoting mechanical properties.	Second an	nd third digits by temperature classification				
Insulating and composite conduits shall be marked	-5	conduits05				
with a three-digit code, the first digit shall denote mechanical properties, the second and third digits shall	-25	conduits25				
denote temperature classification.	-45	conduits45				
The code shall be in accordance with the following	+90	conduits90				
table:	+90/-25	conduits95				
First digit mechanical properties	+90/-5	conduits99				
Very light mechanical stresses1	B-2 ADD	ITIONAL MARKING CODE				
Light mechanical stresses2	↑ 1 % 1					
Medium mechanical stresses3	_	ure classification. The additional code, if				

used, shall follow immediately after the code marking required by **B-1** and shall be separated from it by an oblique stroke(/).

The additional code shall consist of seven digits; if code markings in respect of any of the additional properties are not required, they shall be replaced by zeros in the seven digit sequence.

The code shall be in accordance with the following:
First additional digit-suitability with the following:
Rigid conduits1
Pliable conduits2
Self-recovering conduits3
Flexible conduits4
Second additional digit-electrical properties
Conduits with electrical continuity1
Conduits suitable for use as supplementary insulation2
Conduits with electrical continuity, and suitable for use as supplementary insulation3
Conduits suitable for use as a protective conductor4
Third additional digit-resistance to ingress of water
Conduits giving protection against dripping water
Conduits giving protection against spraying water3
Conduits giving protection against splashing water4
Conduits giving protection against water jets5
Conduits giving protection against heavy seas
Conduits giving protection against the effects of immersion7
Conduits giving protection against the effects of submersion
Fourth additional digit-resistance to ingress of solid objects
Conduits giving protection against solid objects
greater than 12.5, mm
Conduits giving protection against solid objects greater than 2.5, mm

Conduits giving protection against solid objects
greater than 1 mm4
Conduits giving protection against dust5
Dust-tight conduits6
Fifth additional digit-resistance to corrosion
Conduits with low protection outside and inside
Conduits with medium protection outside, low protection inside2
Conduits with medium protection outside and inside3
Conduits with high protection outside, low protection inside4
Conduits with high protection outside, medium protection inside5
Conduits with high protection outside and inside6
Sixth additional digit-resistance to solar radiation
Conduits with low protection1
Conduits with medium protection2
Conduits with high protection3
Seventh additional digit-suitability to support a suspended load

The seventh additional digit is not applicable.

B-3 EXAMPLE OF CODE MARKING

A marking of 3 denotes a metal conduit suitable for medium mechanical stress, no other property being claimed.

A marking of 225 denotes an insulating or composite conduit suitable for light mechanical stress, with a temperature classification of -25, no other property being claimed.

A marking of 4/100 060 0 denotes a rigid metal conduit suitable for heavy mechanical stress, with high protection against corrosion, both outside and inside.

A marking of 390/2255030 denotes a pliable insulating or composite conduit suitable for medium mechanical stress, with a temperature classification of +90, suitable for use as supplementary insulation, giving protection against water jets and dust, and with high protection against solar radiation.

ANNEX C

(Clause 101.2.1)

SAMPLING AND CRITERIA FOR CONFORMITY

C-1 LOT

- C-1.1 In any consignment, all the manufactured lengths of conduits of the same type and size manufactured by the same factory during the same period shall be grouped together to constitute a lot.
- C-1.2 The number of conduits to be selected from each lot shall depend upon the size of the lot and shall be in accordance with col 1 and 3 of Table 104.
- C-1.2.1 These conduits shall be selected from the lot at random. In order to ensure the randomness of selection, procedure given in IS 2500 (Part 1) may be followed.

C-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

C-2.1 All the conduits selected in the first sample at random according to col 3 of Table 104 shall be examined for dimensional requirements. A conduit 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

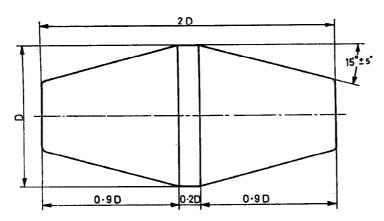
to the corresponding acceptance number (see col 4). If the number of defectives is greater than or equal to the corresponding rejection number (see col 5), the lot shall be deemed as not conforming to the requirements. If the number of defectives is greater than the acceptance number but less than the 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 second sample, the lot shall be declared as conforming to these requirements; otherwise not.

- C-2.2 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 104 respectively.
- C-2.3 The lot shall be considered as conforming to the requirements of acceptance tests if A-2.1 and A-2.2 are satisfied.

Table 104 Sample Size, Acceptance and Rejection Number

(Clause C-1.2)

-	Stage of Sample		For Dimensional Requirements		For Other Acceptance Test		
		Sample Size	Acceptance No.	Rejection No.	Sample Size	Acceptance No.	Rejection No.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Up to	First	8	0	2	3	0	2
300	Second	8	1	2	3	1	2
301 to	First	13	0	2	5	0	2
500	Second	13	1	2	5	1	2
501 to	First	20	0	3	8	0	2
000	Second	20	3	4	8	1	2
001 and	First	32	1	5	13	0	3
bove	Second	32	4	4	13	3	4



Size	Diameter D mm
12	6.70
16	10.00
20	14.00
25	18.00
32	24.00
40	30.00
50	39.00
63	50.00

Material: Steel hardened and polished slightly rounded edges

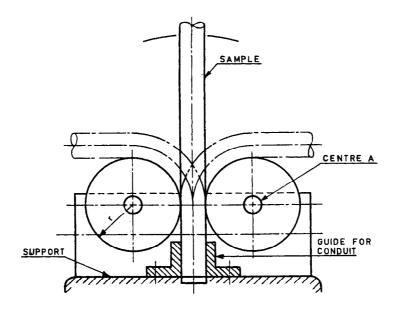
Manufacturing tolerance: + 0.05 mm

Tolerance on axial dimension: ± 0.2 mm

Admissible wear: 0.01 mm

It shall be possible to pass the appropriate gauge through the conduit under its own weight and without any initial speed.

Fig. 101 Gauge for Checking Minimum Inside Diameter of Conduits in the Straight Condition

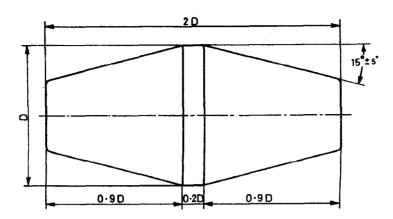


Size	Radius 'r' in mm			
	Plain Conduits	Corrugated Conduits		
16	96	48		
20	120	60		
2.5	150	75		
32	192	96		
40	300	160		
50	480	200		
63	600	252		

In order to pass the gauge according to Fig. 103 while the sample is still bent, it shall be possible to rotate the apparatus round centre A, and the bisecting line of the bending angle on the centre A shall be in the horizontal position.

Fig. 102 Apparatus for Bending Test

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Size	Diameter D mm	_
12	6.00	
16	8.00	
20	12.00	
25	15.00	
32	20.00	
40	25.00	
50	31.00	
63	40.00	

Material: Steel hardened and polished, slightly rounded edges

Manufacturing tolerance : ± 0.05 mm 0

Tolerance on axial dimension: ± 0.2 mm

Admissible wear: 0.01 mm

If the profile of the conduit is not truly circular, it may be reshaped by hand when checking with this gauge.

It shall be possible to pass the appropriate guage through the conduit under its own weight and without any initial speed.

Fig. 103 Gauge for Checking Minimum Inside Diameter of Conduits Subjected to the Bending Test, Compression Test and Collapse Tests and to the Heat Resistance Test

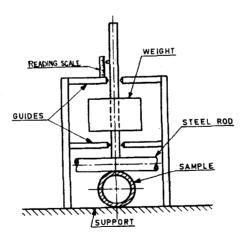


Fig. 104 Apparatus for Heat Resistance Test

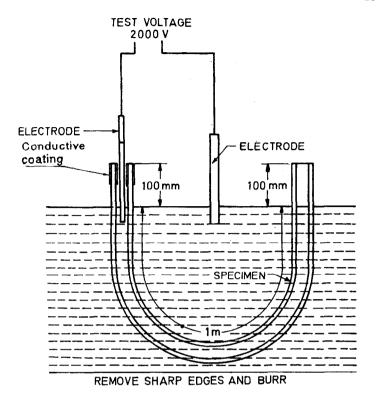


Fig. 105 Arrangement for Electric Strength Test

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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 Handbook' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc: No. ETD 14 (3882).

Amendments Issued Since Publication

Amend No.		Date of Issue	Text Affected
	44		
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