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मानक

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IS 9537-4 (1983): Conduits for Electrical Installations, Part 4: Pliable Self-recovering Conduits of Insulating Materials [ETD 14: Electrical Wiring Accessories]

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Indian Standard

SPECIFICATION FOR CONDUITS FOR ELECTRICAL INSTALLATIONS

PART 4 PLIABLE SELF-RECOVERING CONDUITS OF INSULATING MATERIALS

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Indian Standard

SPECIFICATION FOR CONDUITS FOR ELECTRICAL INSTALLATIONS

PART 4 PLIABLE SELF-RECOVERING CONDUITS OF INSULATING MATERIALS

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Indian Standard

SPECIFICATION FOR CONDUITS FOR ELECTRICAL INSTALLATIONS

PART 4 PLIABLE SELF-RECOVERING CONDUITS OF INSULATING MATERIALS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 18 November 1983, after the draft finalized by the Electrical Wiring Accessories Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The specification for conduits for electrical installation is being issued in different parts. This standard (Part 4) is to be read in conjunction with IS: 9537 (Part 1)-1980* to which references have been given regarding general requirements as well as their test methods. Should, however, any deviation exist between IS: 9537 (Part 1)-1980* and this standard, the provisions of the latter shall apply.

0.3 While preparing this standard, assistance has been derived from documents 23A (C.O.) 25 and 23A (C.O.) 34 'Conduits for electrical installations, Part 2D Particular specification for pliable self-recovering conduits of insulating materials', issued by the International Electrotechnical Commission.

0.4 The conduits covered in this standard (Part 4) are non-flame propagating and non-threadable.

0.5 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[†]. The number of significant places retained in the rounded off values should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part 4) specifies requirements and methods of tests for pliable self-recovering plain and corrugated conduits of insulating materials.

*Specification for conduits for electrical installations: Part 1 General requirements.

*Rules for rounding off numerical values (revised).

2. **DEFINITIONS**

2.1 The relevant provisions of 2 of IS: 9537 (Part 1)-1980* shall be applicable.

3. GENERAL REQUIREMENTS

3.1 The provisions of 3 of IS: 9537 (Part 1)-1980* shall be applicable.

4. GENERAL NOTES ON TESTS

4.0 In addition to **4** of IS : 9537 (Part 1)-1980*, the following provisions shall be applicable.

4.1 The tests shall be carried out at ambient temperature unless otherwise specifically mentioned in the individual tests.

4.2 The minimum total length of the conduit, in one or more lengths, to be submitted for all type tests is 36 m.

5. CLASSIFICATION

5.1 The conduits shall be classified according to mechanical properties as under:

- a) Conduits for very light mechanical stresses,
- b) Conduits for light mechanical stresses, and
- c) Conduits for medium mechanical stresses.

6. MARKING

6.1 Each length of the conduit shall be marked with the following:

- a) Manufacturer's name or trade-mark, if any;
- b) Nominal size of the conduit;
- c) Country of manufacture; and
- d) Information relating to classification as given in 5.1.

6.2 Marking of the conduits shall be repeated at regular intervals preferably of about 1 m, but not longer than 3 m.

6.2.1 The conduits supplied in coils shall, in addition, have an attached label containing the information given in 6.1.

6.3 The durability of the markings shall be tested as given in 6.4 of IS: 9537 (Part 1)-1980*.

^{*}Specification for conduits for electrical installations: Part 1 General requirements.

6.4 The conduits may also be marked with ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions, under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. DIMENSIONS

TABLE 1 DIMENSIONS OF THE CONDUITS				
Nominal Size of Conduit	OUTSIDE DIA- METER OF THE CONDUIT	TOLERANCE ON OUTSIDE DIAMETER	Inside Diameter, <i>Min</i>	P _{REFERRED} Length when Delivered as Coil
(1)	(2)	(3)	(4)	(5)
mm	mm	mm	mm	m
16 20	16 20	- 0·3 - 0·3	$\left.\begin{array}{c}10.7\\14.1\end{array}\right\}$	50 and 100
25 32 40	25 32 40	0·4 0·4 0·4	$\left.\begin{array}{c}18\cdot3\\24\cdot3\\31\cdot2\end{array}\right\}$	50
50 63	50 63	- 0.2 - 0.6	39·6 52·6	25

7.1 The dimensions of the conduits shall be as given in Table 1.

7.1.1 The maximum and minimum outside diameter of the conduit shall be checked by means of the gauges as given in Fig. 1A and 1B respectively.

7.2 Uniformity of Wall Thickness — In case of doubt with regard to the uniformity of the wall thickness of conduits, three samples, each taken from different lengths or from places separated by approximately 3 m, shall be cut along a plane perpendicular to the axis. The wall thickness at each cut edge shall be measured at four places as far as possible equally spaced around the circumference, one of the measurements being made at the thinnest place.

In no case shall the difference between the value measured and the average of the 12 values obtained from the three samples exceed 0.1 mm plus 10 percent of the average value.

8. CONSTRUCTION

8.1 The relevant provision of 8 of IS: 9537 (Part 1)-1980* shall be applicable.

9. MECHANICAL PROPERTIES

9.1 The conduits shall have adequate mechanical strength. Compliance is checked by the tests specified in 9.2 to 9.5.

9.2 Bending Test

9.2.1 Sample of conduits shall be subjected to the bending test by means of the apparatus shown in Fig. 2.

9.2.2 In case of type test, three samples shall be tested at room temperature and the other three samples shall be tested at low temperature of $-5 \pm 2^{\circ}$ C. As acceptance test, this test shall be carried out at room temperature only. The length of each sample shall be at least 30 times outside diameter for plain conduits and 12 times outside diameter for corrugated conduits.



OF CONDUITS

^{*}Specification for conduits for electrical installations: Part 1 General requirements.



<i>d</i> ₁ g*	b	d
mm	$\mathbf{m}\mathbf{m}$	mm
15.70 19.70 24.60 31.60 39.60 49.50	12 12 16 18 18 20	45 45 60 70 70 85
	<i>d</i> ₁ g* mm 15·70 19·70 24·60 30·60 39·60 49·50 62·40	$\begin{array}{ccc} d_{1g} * & b \\ \\ mm & mm \\ 15 \cdot 70 & 12 \\ 19 \cdot 70 & 12 \\ 24 \cdot 60 & 16 \\ 31 \cdot 60 & 18 \\ 39 \cdot 60 & 18 \\ 49 \cdot 50 & 20 \\ 62 \cdot 40 & 20 \end{array}$

*Manufacturing tolerance:_ 0 0.01 mm,

Admissible wear: + 0.01 mm.

Material: Steel.

It shall not be possible to slide the appropriate gauge completely over the conduit, under its own weight.

FIG. 1B GAUGE FOR CHECKING MINIMUM OUTSIDE DIAMETER OF CONDUITS

9.2.3 For the test at room temperature, the samples shall be clamped vertically in the apparatus, and shall then be bent by hand to the left through an angle of approximately 90° , back to the vertical position, to the right through an angle of approximately 90° and back to the vertical position, a rest period of 1 minute being provided between one bending operation and the next.

9.2.4 The sequence is made four times, except that, finally, the samples are not bent back to the vertical position. The samples are maintained in the bent position for 5 minutes, after which, with the sample in such a position that the straight portions are at 45° to the vertical with one end of the sample and the other downwards, it shall be possible to pass the appropriate gauge according to Fig. 3 through the conduit under its own weight and without any initial speed.

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9.2.5 The test at low temperature shall be made in a freezer in the same way, as described above, after the bending apparatus together with the samples, have been kept for 2 hours in the freezer at a temperature of $-5 \pm 2^{\circ}$ C.

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



SIZE OF CONDUIT	R_{ADIUS}, r		
	Plain conduit	Corrugated conduit	
mm	$\mathbf{m}\mathbf{m}$	mm	
16	96	48	
20	120	60	
25	150	75	
32	192	96	
40	300	160	
50	480	200	
63	600	252	

To pass the gauge according to Fig. 3 while the sample is bent, it must be possible to rotate the device around centre A.

FIG. 2 BENDING DEVICE



FIG. 3 GAUGE FOR CHECKING MINIMUM INSIDE DIAMETER OF CONDUITS IN THE BENT CONDITION

9.3 Compression Test

9.3.1 Samples of conduit, each 200 mm long, shall be subjected to a compression test using the apparatus shown in Fig. 1 of IS: 9537 (Part 1)-1980*.

Before the test, the outside diameters of the samples shall be measured. The samples shall then be conditioned at a temperature of 27 ± 2 °C for at least 10 hours.

9.3.2 Immediately after the conclusion of the conditioning period, the samples shall be positioned on a flat steel support, and a steel intermediate piece is placed on the middle of the sample.

A slowly increasing force shall then be applied to the intermediate piece within 30 seconds, determined in such a way as to flatten the sample by an amount exceeding 30 percent but not exceeding 50 percent of its

^{*}Specification for conduits for electrical installations: Part 1 General requirements.

initial outside diameters. This force shall not be less than the values given in Table 2.

TABLE 2 FORCE FOR COMPRESSION TEST		
Type of Conduit	$\begin{array}{c} \mathbf{Compression} \ \mathbf{Force} \\ \mathcal{N} \end{array}$	
Very light	125	
Light	320	
Medium	750	

TABLE 2 FORCE FOR COMPRESSION TEST

9.3.3 The force and the intermediate piece shall then be removed, and 15 minutes after removal, the outside diameter of the samples, where they have been flattened, is measured. 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.

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

9.4 Impact Test — The provision of **9.4** of IS : 9537 (Part 1)-1980* shall be applicable.

9.5 Collapse Test

9.5.1 Samples of conduit shall be subjected to a collapse test. The length of samples shall be at least 30 times the outside diameter for plain conduits and 12 times the outside diameter for corrugated conduits.

9.5.2 The test may normally be carried out at room temperature, but in case of doubt it shall be carried out at a temperature of $27 \pm 2^{\circ}$ C.

9.5.3 The samples shall be bent, using the apparatus shown in Fig. 2, once through approximately 90° , back to the vertical position and then through approximately 90° in the opposite direction. They shall then be fixed to a rigid support as shown in Fig. 4.

The support, with the sample in position, shall then be kept for 24 hours in a heating cabinet at a temperature of $60 \pm 2^{\circ}$ C.

9.5.4 After this period, with the support in such a position that the straight portions of the sample are at 45° to the vertical, it shall be possible to pass the appropriate gauge, according to Fig. 3 through the conduit, fixed to the support, under its own weight and without any initial speed.

10. RESISTANCE TO HEAT

10.1 The conduits shall have adequate resistance to heat. The compliance shall be checked by the test given in 10.2.

10.2 The samples, each approximately 100 mm long, together with the test apparatus, shall be kept for 4 hours in a heating cabinet at a temperature of $60 \pm 2^{\circ}$ C.

^{*}Specification for conduits for electrical installations: Part 1 General requirements.



All dimensions in millimetres. FIG. 4 ARRANGEMENT FOR COLLAPSE TEST

After this period, the samples shall be loaded for 24 hours in an apparatus as shown in Fig. 5 with a weight having a mass as shown below, placed in the middle of the sample:

Type of Conduit	Mass, kg
Very light	0.2
Light	1.0
Medium	2.0

The load shall be applied through a steel rod 6 mm in diameter, disposed at right angles to the axis of the conduit as shown in the figure.

The samples under load shall then be allowed to cool to approximately room temperature.

The load shall then be removed, and immediately after its removal, it shall be possible to pass the appropriate gauge according to Fig. 3 through the conduit, under its own weight and without any initial speed, with the sample in the vertical position.





11. RESISTANCE TO BURNING

11.1 This test shall be carried out in accordance with 11 of IS: 9537 (Part 1)-1980*.

11.2 The times of exposure of the sample to the flame shall be as specified below:

Material Thickness		Flame Application
Over	Up to and including	1 ime
mm	$\mathbf{m}\mathbf{m}$	seconds
	0.2	15
0.2	1.0	20
1.0	1.2	25
1.5	2.0	35
2.0	2.5	45
2· 5	3.0	55
$3 \cdot 0$	3.5	65
$3 \cdot 5$	4.0	75
4.0	4.2	85
4.5	5.0	130
5.0	5.5	200
5.5	6.0	300
6.0	6.5	500

*Specification for conduits for electrical installations: Part 1 General requirements.

12. ELECTRICAL CHARACTERISTICS

12.1 The provisions of 12 of IS: 9537 (Part 1)-1980* shall be applicable.

13. EXTERNAL INFLUENCES

13.1 The relevant provisions of 13 of IS: 9537 (Part 1)-1980* shall be applicable.

14. TESTS

14.1 Type Tests — The following shall constitute 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), and
- h) Electrical characteristics (12).

14.2 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).

14.2.1 A recommended sampling plan for acceptance tests is given in Appendix A.

APPENDIX A

(*Clause* 14.2.1)

RECOMMENDED SAMPLING PLAN AND CRITERIA FOR CONFORMITY FOR ACCEPTANCE OF LOT

A-1. LOT

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

A-2. SCALE OF SAMPLING

A-2.1 For judging the conformity of a lot, to the requirements of the acceptance tests, sampling shall be done for each lot separately. For this purpose, the number of coils to be selected at random from the lot shall be in accordance with Table 3.

	TABLE 3 SCA	LE OF SAMPLING	
LOT SIZE	FOR DIMENSION	OTHER ACCEPTANCE	
IN THE LOT)	Sample Size	Permissible No. of Defectives	SAMPLE SIZE
(1)	(2)	(3)	(4)
Up to 300	13	0	2
301 and above	20	0	3

A-2.2 These coils shall be selected from the lot at random. In order to ensure the randomness of selection, procedures given in IS: 4905-1968* may be followed.

A-3. NUMBER OF TESTS AND CRITERIA FOR ACCEPTANCE

A-3.1 From each of the coils selected at random according to col 2 of Table 3, suitable lengths of test samples shall be taken. From each of these test samples shall be subjected to the test given in 7. The number of test samples not fulfilling the requirements of this test shall be less than or equal to the corresponding permissible number of defectives given in col 3 of Table 3.

A-3.2 The lots conforming to the dimensional requirements shall be further tested for other acceptance tests. The lot shall be considered to have met the requirements for these tests if none of the samples selected according to col 4 of Table 3 fails.

^{*}Methods for random sampling.