

Indian Standard

**SPECIFICATION FOR
CONDUITS FOR ELECTRICAL INSTALLATIONS
PART 3 RIGID PLAIN CONDUITS OF INSULATING MATERIALS**

1 SCOPE

This part of standard IS 9537 specifies requirements and methods of tests for circular, rigid non-flame propagating and non-threadables plain ended and socket ended conduits of insulating materials.

NOTE – In the case of socket ended conduits, the socket portion shall be integral with the conduit length at one end only.

2 DEFINITIONS

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

3 GENERAL REQUIREMENTS

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

4 GENERAL NOTES ON TESTS

The following provisions in addition to these given in 4 of IS 9537 (Part 1) **except Cl 4.2 of IS 9537 (Part 1).**

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

4.2 Six manufacturing lengths are required for carrying out all type tests.

5 CLASSIFICATION

5.1 Conduits shall be classified according to mechanical properties as under.

5.1.1 Conduits for light mechanical stresses.

5.1.2 Conduits for medium mechanical stresses.

5.1.3 Conduits for heavy mechanical stresses.

6 MARKING

6.1 Each length of the conduits shall be marked preferably at 50 mm, from one end, with the following information:

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

6.2 The durability of the markings shall be tested as given in **6.4** of IS: 9537 (part 1) – 1980.

6.3 BIS Certification Marking

The product may also be marking with Standard Mark.

6.3.1 The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 2016 and the Rules and Regulations made thereunder. The details of conditions under which the license for the use of Standard Mark may be granted to

Commented [D1]: Relevant clause of part one of IS may be changed as per the recommendation at Annex A

Commented [D2]: Clause 4.2 of IS 9537 (Part1 specifies the tests to be carried at 27+/- 5 deg C, unless otherwise specified) which in contrast to Cl 4.1 of IS 9537:Part 3

manufactures or producers may be obtained from the Bureau of Indian Standards.

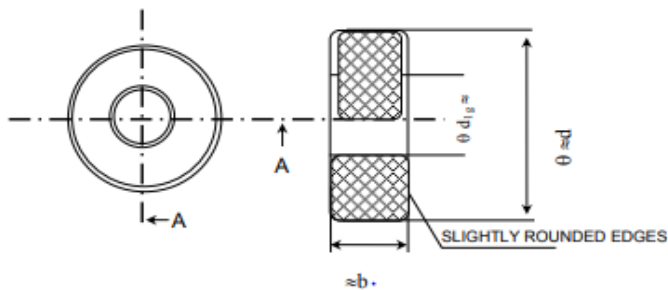
7 DIMENSIONS

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

7.1.1 Compliance to the dimension of the socket may be verified with the help of gauges as shown in Fig. 1 and Fig. 2

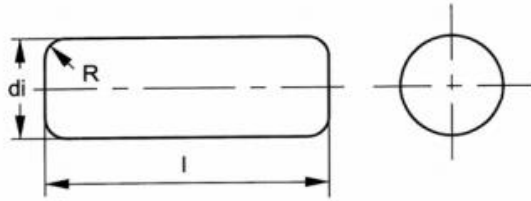
Table 1 Dimensions of the Conduits
(Clause 7.1)

NOMINAL SIZE	OUTSIDE DIAMETER	TOLERANCE ON OUTSIDE DIAMETER	INSIDE DIAMETER, <i>Min</i>		
			Light	Medium	Heavy
(1)	(2)	(3)	(4)	(5)	(6)
16	16	-03	137	130	122
20	20	-03	174	169	158
25	25	-04	221	214	206
32	32	-04	286	278	266
40	40	-04	358	354	344
50	50	-05	451	443	432
63	63	-05	570	-	-



Size	Diameter, <i>Max</i>	<i>b</i>	<i>d</i>
16	20.1	12	45
20	24.5	12	45
25	29.8	16	60
32	37.8	18	70
40	46.1	18	70
50	57.3	20	85
63	69.6	20	100

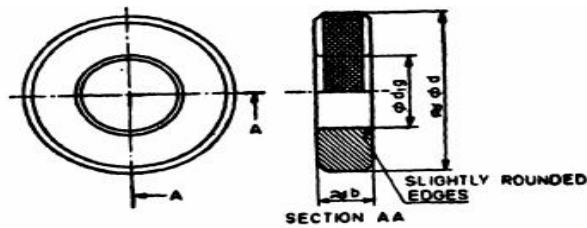
FIGURE 1 GAUGE FOR CHECKING MAXIMUM OUTSIDE DIAMETER OF SOCKET-END



Size	Diameter, d_i	l , Min	R
16	16.1+0.2	45	3
20	20.1+0.2	45	3
25	25.1+0.3	45	3
32	32.1+0.3	55	3
40	40.1+0.4	65	3
50	50.1+0.4	65	3
63	63.1+0.5	65	3

FIGURE 2 GAUGE FOR CHECKING MAXIMUM INSIDE DIAMETER OF SOCKET-END

7.1.2 The maximum and minimum outside diameters of the conduit shall be checked by means of the gauges as given in Fig. 3 and 4 respectively.

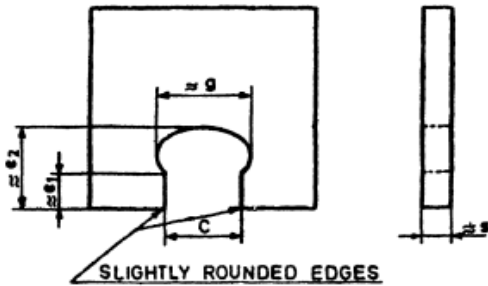


SIZE	d_{1g}^* mm	b mm	d mm
16	16.04	12	45
20	20.04	12	45
25	25.04	16	60
32	32.04	18	70
40	40.04	18	70
50	50.04	20	85
63	63.04	20	100

*Manufacturing tolerance : - 0
 : - 0.01 mm
 Admissible wear : + 0.01 mm
 Material : Steel

It shall be possible to slide the appropriate gauge completely over the conduit, under its own weight.

FIGURE 3 GAUGE FOR CHECKING MAXIMUM OUTSIDE DIAMETER



SIZE	C	MANUFACTURING TOLERANCES	ADMISSIBLE WEAR	e_1	e_2	R	r
	mm	mm	mm	mm	mm	mm	mm
16	15.70	0 -0.018	+0.018 0	8	17	18	8
20	19.70	0 -0.022	+0.022 0	10	23	27	9
25	24.6	0 -0.022	+0.022 0	10	23	27	9
32	31.6	0 -0.025	+0.025 0	12	29	34	10
40	39.6	0 -0.030	+0.030 0	14	35	42	10
50	49.5	0 -0.030	+0.030 0	16	42	52	12
63	62.4	0 -0.030	+0.030 0	18	49	65	12

Material: Steel.

It shall not be possible to pass the gauge over the conduit, in any position, without undue force.

FIGURE 4 GAUGE FOR CHECKING MINIMUM OUTSIDE DIAMETER

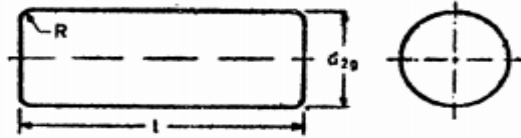
7.2 The minimum inside diameter shall be checked by the gauge as given in Fig. 5.

7.3 The preferred length of the conduit shall be 3 m. Other lengths are also permitted with agreement between manufacturer and purchaser.

7.4 Uniformity of the wall thickness.

In case of doubt with regard to the uniformity of the wall thickness of conduits, three samples, each taken from different lengths, 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 the measurement being made at the thinnest place. In no case shall the difference between the value measured

and the average of the twelve values obtained from the three samples exceed 0 1 mm + 10 percent of the average value.



SIZE	DIAMETER d2g			L	R
	Light	Medium	Heavy		
	mm	mm	mm	mm	mm
16	13.4	12.7	11.9	50	3
20	17.2	16.6	15.5	50	3
25	21.4	21.1	20.3	60	3
32	28.4	27.5	26.3	75	3
40	35.8	35.1	34.1	80	3
50	44.8	43.9	42.8	105	3
63	56.7	56.0	55.2	115	3

Manufacturing tolerance : $+0.05$
 0 mm
 Admissible Naer : 0.01 mm
 Material : Polished steel

it shall be possible for the appropriate gauge to pass through the conduit under its own weight.

FIGURE 5 GAUGE FOR CHECKING MINIMUM INSIDE DIAMETER OF CONDUITS

8 CONSTRUCTION

8.1 The relevant provision of IS: 9537 (Part 1)-1980 Specification for conduits for electrical installations: Part 1 General requirements shall be applicable.

9 MECHANICAL PROPERTIES

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

9.2 Bending Test

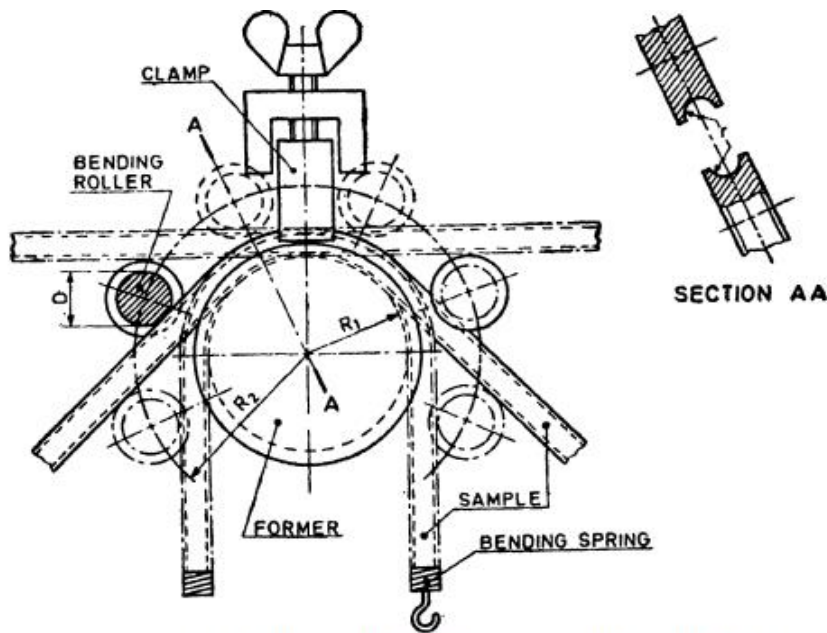
9.2.1 Only conduits of sizes 16, 20 and 25 shall be subjected to bending test by

means of the device apparatus shown in Fig.6.

9.2.2 In case of type test, three samples shall be tested at room temperature and other three samples shall be tested at low temperature of $-5 \pm 2^{\circ}\text{C}$. As acceptance test, this test shall be carried out at room temperature only. The length of each sample shall be 500 ± 10 mm.

9.2.3 A bending aid, in the form of a coiled spring of square section metal wire, without burrs and having an overall diameter between 0.7 mm and 1.0 mm less than the specified minimum inside diameter of the conduit or a bending aid as recommended by the manufacturer, is inserted into each sample before bending.

Commented [D3]: To increase accuracy of the test leading to reliable results.



SIZE OF CONDUIT	RADIUS TO BOTTOM OF GROOVE OF FORMER	RADIUS OF ARC TRACED OUT BY CENTRE OF BENDING ROLLERS	RADIUS OF GROOVE OF FORMER AND BENDING ROLLERS	DIAMETER TO BOTTOM OF GROOVE OF BENDING ROLLERS
	R_1	R_2	r	D
	mm	mm	mm	mm
16	48	84	8.1	24
20	60	105	10.1	30
25	75	131.25	12.6	37.5

FIGURE 6 BENDING APPARATUS

9.2.4 The sample shall be kept inside the deep freezer the temperature of which is maintained at $-5 \pm 2^\circ\text{C}$ and the test shall be conducted when the samples have attained the temperature of the air within the freezer or after 2 h, whichever is longer period. The test shall be carried out within $12 \text{ s} \pm 2 \text{ s}$ after the removal of the sample from the freezer.

9.2.5 Each sample is placed in position as shown in Fig. 6 and is lightly held in the groove of the former by means of the

clamp. The sample is bent, by moving the bending rollers round the former through a total angle of approximately 180 so that, when released, the sample has a bend of 90 ± 5 degrees. In this position, it shall be possible to remove the bending aid without damage to the sample or to the aid.

After the test, the sample shall show no cracks visible to normal or corrected vision without magnification and it shall be possible to pass the appropriate gauge, as shown in Figure 7 through the sample

Commented [D5]: To specify the tolerance

Commented [D4]: To ensure that the test sample is tested with the attained temperature. The same has also been mentioned in IEC 61386:part21

under its own weight and without any initial speed.

9.3 Compression Test

9.3.1 The test shall be carried out in accordance with 9.3 of IS 9537 (Part -1) 1980.

9.3.2 The difference between the initial diameter and the diameter of the flattened sample shall than not exceed 25 percent of the initial diameter, while the compression force is still applied.

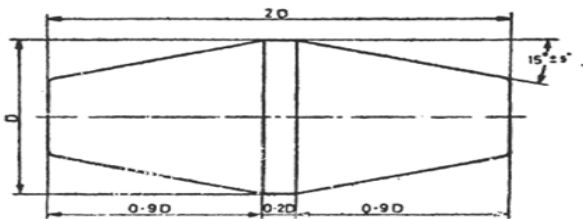
9.4 Impact test

9.4.1 The relevant provisions of 9.4 of IS: 9537 (part 1)-1980 shall be applicable.

9.5 Collapse Test

9.5.1 Only conduit of sizes 16, 20 and 25 shall be subjected to the collapse test in accordance with 9.5 of IS 9537 (Part 1)01980. The bending device shall be as shown in Fig 6.

9.5.2 The minimum internal diameter shall be checked with the help of appropriate gauge, according to Fig. 7. With the support in a position such that the straight portions of the sample are the at 45° to the vertical, it shall be possible to pass this gauge. Through the conduit, fixed to support, under its own weight and without any initial speed.



Size	DIAMETER		
	mm	mm	mm
16	10.9	10.3	9.8
20	13.9	13.5	12.6
25	17.7	17.1	16.5
Material	Steel hardened and polished edges slightly rounded.		
Manufacturing tolerance	+0.05mm 0		
Tolerance on axial dimension	±0.2 mm		
Admissible wear	0.01 mm		

Figure 7 GAUGE FOR CHECKING MIN INSIDE DIAMETER OF CONDUITS AFTER BENDING

10 RESISTANCE TO HEAT

10.1 Conduits shall have adequate resistance to heat. Compliance shall be

checked by a ball pressure test, which is carried out by means of the apparatus shown in Fig. 8

10.2 The samples shall be prepared by cutting three pieces of conduit, each about 80 mm long, in half longitudinally. One of each pair of samples so prepared shall be placed in the horizontal position on a steel support, as shown in Fig. 8 the support and the sample being placed in a heating cabinet. The temperature within which is maintained at 60 ± 2 C.

After 2 h, a steel ball of 5 mm diameter shall be pressed against the inner surface of the sample by a force of 20 N.

After 1 h, the ball shall be removed and the sample taken out of the heating cabinet. After 2 h, at room temperature, the diameter of the impression shall be measured; this shall not exceed 2 mm.

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 duration of exposure of the sample to the flam shall be as specified below.

Material Thickness mm	Flame Application Time
Up to 2.5	Three times successively, each time for 25s, with an interval of 5 s between each of the applications.
Over 2.5 up to 3	Once for 80 s
Over 3	Once for 125 s

12 ELECTRICAL CHARACTERISTICS

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

13 EXTERNAL INFLUENCE

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

14 CLASSIFICATION OF 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 burnings (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 lengths 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 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 2.

TABLE 2 SCALE OF SAMPLING

Lot SIZE	FOR DIMENSIONAL REQUIREMENTS		OTHER ACCEPTANCE TESTS
	Sample Size	Permissible No. of Defectives	
(1)	(2)	(3)	(4)
Up to 300	13	0	2
301,,500	20	0	3
501,, 1000	32	1	4
1001...3000	50	2	5
3001 and above	80	3	7

A- 2.2 These lengths shall be selected from the lot at random. In order to ensure the randomness of selection. Procedures given Is: 4905-1968* may be followed.

*Methods for random sampling.

A-3 NUMBER OF TESTS AND CRITERIA FOR ACCEPTANCE

A-3.1 Form each of the lengths selected at random according to col 2 of Table 2, suitable lengths of test samples shall be taken. 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 2.

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 Tale 2 fails.