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SECTION - 7IDENTIFICATION, PACKING AND MARKING11 IDENTIFICATION

11.1 The following details shall be printed over the sheath of the cable within 1000mm :-

- i) Manufacturer's Name/Trade Mark
- ii) Rated voltage
- iii) Year of manufacture
- iv) Indication of insulating material and its operating temperature as per Clause 23.2 of IS : 9968 (Pt. I) - 1988 viz., HR 90.

v) Customer's Specification No. viz.,
IRS/E-14/01 (Part-II) : Rev - II - 1993.

12 PACKING AND MARKING

12.1 End sealing - All cables shall have their ends sealed with non-hygroscopic sealing materials.

12.2 The cables shall be either wound on reels or drums or supplied in coils packed and labelled.

12.3 The label or the stencilling on the drum shall contain the following information :-

- (a) Reference to this Specification, i.e.,
RDSO Specification No. E-14/01 (Pt.-II) - Rev-II - 1993.
- (b) Manufacturer's name, brand name or trade mark.
- (c) Types of cables and voltage grade.
- (d) Number of cores.
- (e) Nominal cross-sectional area of the conductor.
- (f) Cable Code : as defined in Clause 23.3 of IS : 9968 (Part-I) - 1988.
- (g) Length of the cable on the drum/reel/coil.
- (h) Number of length on the reel, drum or coil (if more than one)
- (i) Direction of rotation of drum (by means of arrow)
- (j) Approximate gross weight
- (k) Year of manufacture.

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TABLE - 1

S. No.	Normal area	Composition Class 5 & Ohmic Resistance			Composition Class 6 & Ohmic Resistance		
		Min. No. of wires & composition	Nominal Dia. of wire	Max. Resistance at 20°C	Min. No. of wires & composition	Nominal Dia. of wire	Max. Resistance at 20°C
	(mm ²)		(mm)	(Ohm/km)		(mm)	(Ohm/km)
1	2.5	50	0.25	8.21	140 (7 x 20)	0.15	8.21
2	4.0	56	0.30	5.09	228 (12 x 19)	0.15	5.09
3	6.0	84	0.30	3.39	189 (7 x 27)	0.20	3.39
4	10.0	80	0.40	1.95	324 (12 x 27)	0.20	1.95
5	16.0	126	0.40	1.24	513 (19 x 27)	0.20	1.24
6	25.0	196	0.40	0.795	783 (27 x 29)	0.20	0.795
7	35.0	276	0.40	0.565	1107 (27 x 41)	0.20	0.565
8	50.0	396	0.40	0.393	702 (27 x 26)	0.30	0.393
9	70.0	360	0.50	0.277	999 (37 x 27)	0.30	0.277
10	95.0	475	0.50	0.210	1332 (37 x 36)	0.30	0.210
11	120.0	608 (19 x 32)	0.50	0.164	1702 (37 x 46)	0.30	0.164
12	150.0	756 (27 x 28)	0.50	0.132	2109 (37 x 57)	0.30	0.132
13	185.0	925 (37 x 25)	0.50	0.108	2590 (37 x 70)	0.30	0.108
14	225.0	760	0.60	0.0911	-	-	-
15	240.0	1221 (37 x 33)	0.50	0.0817	3360 (48 x 70)	0.30	0.0817
16	270.0	950	0.60	0.0728	-	-	-
17	300.0	1525 (61 x 25)	0.50	0.0654	4270 (61 x 70)	0.30	0.0654
18	400.0	2013 (61 x 33)	0.50	0.0495	-	-	-
19	500.0	1769 (61 x 29)	0.60	0.0391	-	-	-
20	630.0	2257 (61 x 37)	0.60	0.0306	-	-	-

A tolerance of ± 0.01 mm shall be permitted on nominal

1500V Grade, single core Elastomer insulated cableCONSTRUCTION

- (a) Tinned annealed copper conductor;
 (b) Separator tape of polyester as per Clause 3.3;
 (c) Heat resisting EPR based insulation in accordance with type IE-3 of IS : 6380-1984;
 (d) Optional proofed Tape;
 (e) Heat resisting, oil resisting and flame retardant CSP based elastomeric sheath in accordance with type SE-4 of IS : 6380-1984.

S. No.	Nominal cross sectional area of conductor (mm ²)	Insulation thickness (mm)	Sheath thickness (mm)	External nominal diameter (mm)	Tolerance on external diameter. (mm)
1	2.5	1.8	1.2	8.7	± 0.7
2	4.0	1.8	1.2	9.3	± 0.7
3	6.0	1.8	1.2	10.0	± 0.7
4	10.0	1.8	1.4	11.3	± 0.7
5	16.0	1.8	1.4	12.8	± 0.7
6	25.0	1.8	1.6	14.7	± 0.8
7	35.0	1.8	1.6	16.3	± 1.0
8	50.0	2.0	1.6	18.5	± 1.0
9	70.0	2.0	1.6	20.6	± 1.0
10	95.0	2.0	1.7	23.3	± 1.0
11	120.0	2.3	1.8	25.2	± 1.0
12	150.0	2.3	1.8	27.2	± 1.0
13	185.0	2.6	2.0	30.3	± 1.1
14	225.0	2.6	2.0	32.1	± 1.1
15	240.0	2.8	2.1	34.1	± 1.3
16	270.0	2.8	2.1	35.7	± 1.3
17	300.0	3.0	2.2	37.9	± 1.5
18	400.0	3.3	2.3	42.7	± 1.5
19	500.0	3.6	2.4	47.1	± 1.6
20	630.0	4.0	2.5	51.8	± 1.8

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TABLE - 3

3000 V Grade, single core elastomer insulated cablesCONSTRUCTION

- (a) Tinned annealed copper conductor;
- (b) Separator tape of polyester as per Clause 3.3;
- (c) Heat resisting EPR based insulation in accordance with type IE-3 of IS : 6380-1984;
- (d) Optional proofed Tape;
- (e) Heat resisting, oil resisting and flame retardant CSP based elastomeric sheath in accordance with type SE-4 of IS : 6380-1984.

S. No.	Nominal cross sectional area of conductor (mm ²)	Insulation thickness (mm)	Sheath thickness (mm)	External nominal diameter (mm)	Tolerance on external diameter (mm)
1	10	2.6	1.5	13.1	± 0.7
2	16	2.6	1.5	14.6	± 0.7
3	25	2.6	1.7	16.7	± 1.0
4	35	2.6	1.7	18.1	± 1.0
5	50	2.8	1.7	20.3	± 1.0
6	70	2.8	1.7	22.4	± 1.0
7	95	3.0	1.8	25.1	± 1.0
8	120	3.1	1.8	26.8	± 1.0
9	150	3.1	2.0	29.3	± 1.1
10	185	3.2	2.0	31.5	± 1.1
11	225	3.2	2.0	33.8	± 1.1
12	240	3.4	2.1	35.3	± 1.3
13	270	3.4	2.1	37.1	± 1.3
14	300	3.5	2.2	38.9	± 1.5
15	400	3.5	2.2	42.9	± 1.5
16	500	3.6	2.4	47.1	± 1.6
17	630	4.0	2.5	51.8	± 1.8

APPENDIX1 RESISTANCE TO CRACKING

The insulation and/or the sheath should not crack during normal use. Checking shall be carried out by means of the following tests. Two samples of the appropriate length shall be taken from two separate points at least 1 metre apart. The complete cable sample shall be wound on to a mandrel in such a way that a spiral of adjoining turns shall be formed. The dia. of Dia-mandrel and the number of turns are specified in the table below :-

S. No.	Ex. Dia. of the sample (mm)	Dia. of Mandrel (mm)	No. of turns
1	Upto and inclusive of 2.5	5	6
2	From 2.5 to 4.5	9	6
3	From 4.5 to 6.5	13	6
4	From 6.5 to 9.5	19	4
5	From 9.5 to 12.5	40	2
6	From 12.5 to 15.0	60	2
7	From 15.0 to 20.0	120	2
8	From 20.0 to 25.0	180	2
9	From 25.0 to 30.0	200	2
10	From 30.0 to 35.0	250	2
11	From 35.0 to 45.0	300	2

Each sample, wound to the correct mandrel shall be kept for 7 hours in an oven at a temperature of $150 \pm 2^{\circ}\text{C}$. Afterwards the samples shall be allowed to cool at an ambient air temperature at which point they shall be examined without being unwound from the mandrel. No evidence of cracking should be visible to the naked eye on insulation and/or the sheath.

p.t.o. 2

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Appendix2 FLEXIBILITY (BENDING) TESTS

The test-pieces shall be wound round a mandrel with a dia. of :-

- for cables with a dia. of \leq 20mm - 3 times
- for cables with a dia. of $>$ 20mm - 5 times, being

the external dia. of the cable, and in such a way as to form 10 continuous turns in a right-hand direction. This procedure shall be followed 3 times.

The test-pieces shall be unwound carefully straightened and rewound 3 times on the same mandrel, in such a way as to form 10 continuous turns in a left-hand direction so that the external surface of the cable situated on the outside during the first operation is now on the inside. No cracks visible to the naked eye shall occur.

The cable shall withstand the high voltage test after the cable has been subjected to the above bending test.

3 FIRE RESISTANCE

The test shall be carried out in still air on a section of cable 300mm long using a Bunsen burner with an opening of 9mm, fed by the local gas supply.

The burner shall be regulated to provide a flame 100mm and an inner blue cone 50mm long.

The centre line of the burner shall be inclined at an angle of 45° from the vertical (See Fig. 1)

The sample for testing shall be placed vertically and at right angles to the centre line of the burner. The sample shall be positioned so that the whole of its periphery is enveloped in flame upto a distance of 100mm from the lower end and the sample is 35mm from the opening of the burner.

The flame shall be applied for one minute.

Any ignition of the insulating sheathing or the external sheathing must be of a subdued nature and must not spread noticeably, any flame produced on the cable must be extinguished of its own accord within 30 seconds after being withdrawn from the flame.

p.t.o. 3

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4. RESISTANCE TO SURFACE TRACKING

The annular electrodes shall consist of at least 3 continuous turns of copper wire of about 1.8mm dia. Care must be taken when applying the electrodes to ensure that the cable is not damaged. The samples with two annular electrodes 50mm apart shall be bent into a single loop and placed in water for 4 hours at a temperature from 15 to 20°C. The ends of the cable shall project at least 50mm above the surface of water. After this immersion, the samples shall be removed and dried with non-fluffy filter paper. Immediately afterwards, the leakage current shall be measured by a multi-ammeter when a voltage of 2000V, 50-Hz is applied for 10 seconds between the electrodes. The voltage shall then be raised, at the rate of 100 volts per second until tracking occurs followed by a flash-over.

The requirements are as follows :-

(a) Maximum leakage current

Cross sectional area of copper.	Maximum leakage current 10 Seconds at 2 kV
2.5 - 4.0 mm ²	5 mA
6.0 - 16.0 mm ²	7.5 mA
26.0 - 96.0 mm ²	10 mA
120.0 - 630.0 mm ²	20 mA

p.t.o. 4

A sample of length approximately 350mm is taken and bent to a radius of 150mm. The relative displacement of the conductor with insulation shall not be more than 10mm for cables upto 25mm dia. and 15mm for cables over 25mm dia.

SLIP-TEST

All wires must be of the same nominal dia. The dia. of wires must not differ from the nominal dia. beyond the tolerance ± 0.01 mm. The dia. of wire shall be measured by means of a rather micrometer or a dial micrometer, between smooth faces circular in shape and with a dia. of at least 5mm. The average of the readings of the two measurements taken at right angles to each other shall be accepted as the value of the dia.

COMPOSITION OF CONDUCTOR

Grade	(V)	Voltage at first step	(V)	Minimum puncture voltage
3000	12000	30000	15000	16000
1500	6000	10000	10000	10000
750	2500	3000	3000	3000
750 multi-core	2500	2500	2500	2500

A sample of cable of 1 metre length shall be immersed in water for 24 hours and thereafter an alternating voltage of 50 Hz shall be applied between the conductor and water, commencing from the voltage given below and increasing in steps of 750V every 30 seconds until puncture occurs. The voltage at which puncture occurs shall not be less than the value given below :-

DESTRUCTIVE PUNCTURE TEST

- (1) Surface tracking shall not occur below 7 kV
- (11) Flash-over shall not occur below 10 kV

FIRE RESISTANCE TEST

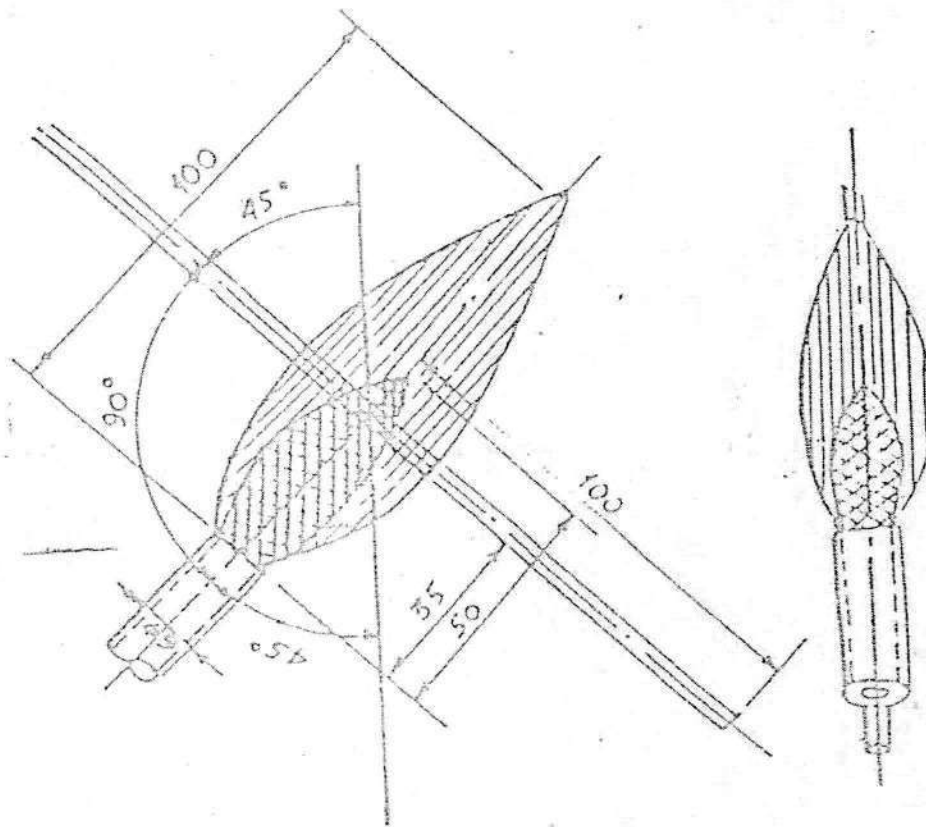


FIG-1

AMENDMENT NO.4 OF SEPTEMBER-2003
TO
RDSO SPECIFICATION NO.E-14/01(PART 2) REV.II – 1993 FOR FLEXIBLE
ELASTOMERIC CABLES WITH COPPER CONDUCTOR FOR ROLLING STOCK
APPLICATION

ADDENDUMS

SECTION IV, TYPE TEST CLAUSE 10.1 AND ACCEPTANCE TEST CLAUSE 10.2

(a) Add the following "Strippability Test" in Type as well as Acceptance Tests :

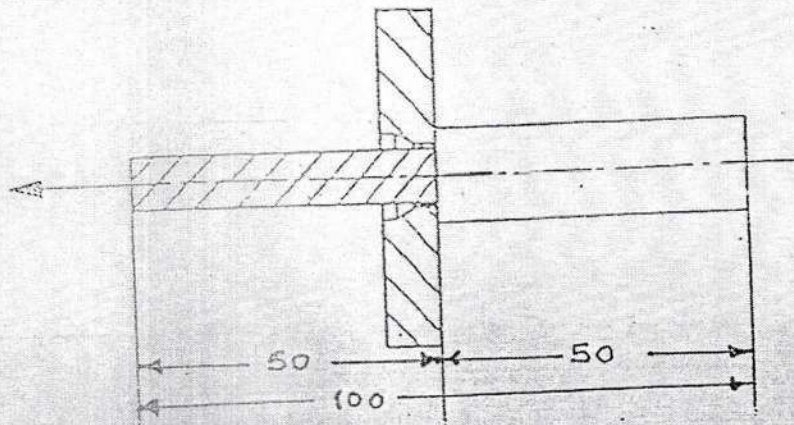
Test	Reference specification for requirement	Reference specification for test method
Strippability for section 2.5 to 06 mm sq.	The admissible stripping force shall be between the minimum and maximum values. The conductor shall not be damaged and shall be free of residues.	Appendix clause 9 of this specification.

(b) Add a new clause 9 in Appendix as under :-
Strippability Test

Test Method

A sample of 100 mm. length shall be stripped 50 mm. carefully, so that remaining portion of 50 mm. is not moved or deformed. The stripped end shall be slipped into the bush according to the figure. The diameter of the bore hole shall slightly exceed the diameter of the conductor. The conductor shall be pulled out from the insulation with constant speed by means of an elongation test equipment. The admissible stripping force for sizes 2.5 to 06 mm. sq. shall be between the min. and max. values indicated as under :

Nominal cross-section mm sq.	Pull Force	
	Minimum in N	Maximum in N
2.5	25	80
4.0	30	100
6.0	30	100



STRIPPABILITY TEST DEVICE