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**RDSO SPECIFICATION  
OF  
PERMANENTLY LUBRICATED HDPE DUCT**

SPECIFICATION NO. RDSO/SPN/TC/45/2013

**Revision 2.0**

Number of Pages : 24

**TELECOM DIRECTORATE  
RESEARCH DESIGNS & STANDARDS ORGANISATION  
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Specification  <b>RDSO/SPN/TC/45/2013</b>		Revision  <b>2.0</b>
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Approved by  Shri S. K. Vyas <b>Executive Director/ Telecom/ RDSO</b>		
Abstract  <b>This document specifies technical specification of Permanently Lubricated HDPE Duct.</b>		

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### DOCUMENT CONTROL SHEET

NAME	ORGANIZATION	FUNCTION	LEVEL
Director/ Telecom-II	RDSO	Member	Prepare
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## **I. SUMMARY**

This document covers the requirement of permanently lubricated high density polythene duct (PLB-HDPE Duct) for use as underground cable conduits for armoured optical fibre cable.

## **II. SOURCE**

Draft specification RDSO/ SPN/ 35-2002 was prepared by RDSO, Lucknow as per directives contained in Railway Board letter no. 2000/ Tele/ TC/ 3/ Vol. II dated 21/02/2002 (excluding pin point requirement) and minutes of 3<sup>rd</sup> MSG meeting No. STT/G/MSG/89 dated 27/03/2002.

Revision to this specification is being issued due to changes in the product and TEC having issued its latest specification in 2011 for the item.

## **III. FOREWORD**

Research Designs and Standards Organisation (RDSO) is an attached office of Ministry of Railways, engaged in design and standardization of equipment for use on Indian Railways.

RDSO/ SPN specification is issued as draft specification for discussion. This specification is circulated to customers/ Railways and field inspection units for comments.

RDSO/ SPN along with comments received from various quarters is discussed in Telecom Standards Committee Meeting (TCSC). Recommendation made by TCSC is put up to Railway Board for approval. After approval from Railway Board, the specification is given an IRS number and issued as Indian Railway Standard Specification.

In the absence of IRS specification, procurement may be made as per RDSO/ SPN specification.

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## 1.0 SCOPE :

This document covers the requirement of Permanently Lubricated High Density Polyethylene (PLB-HDPE duct) duct for use as underground cable conduits for armoured optical fibre cable. Duct shall be suitable for cable laying by blowing / pulling technique.

## 2.0 REFERENCES

In preparing this standard assistance has been taken from the following :

- (i) TEC Specification No. TEC/GR/TX/CDS-008/03/MAR-11
- (ii) IS specification No. IS 2530, 4984, 7328, 9938, 12235(Part-9)  
14151 (Part-1)
- (iii) ASTM - D - 1693, D - 790, D-1712, D - 4565, D - 2240,  
D- 638, D- 648, F- 2160, G- 154.

## 3.0 ABBREVIATIONS

- ASTM ---- American Society for Testing & Materials.
- CC ---- Cubic Centimeter.
- HDPE ---- High Density Polyethylene.
- PLB ---- Permanently Lubricated
- UV ---- Ultra Violet.
- MFI ---- Melt Flow Index.
- MFR ---- Melt flow Rate.
- SPN ---- Specification Provisional Number.
- IS ---- Indian Standard.

## 4.0 GENERAL REQUIREMENTS:

The PLB-HDPE duct shall consist of two concentric layers. The HDPE outer layer shall be co extruded with an inner layer of solid permanent lubricant to reduce the internal co-efficient of friction (ICF). The lubricant shall be of a solid layer of uniform thickness so formulated to provide a permanent, low friction boundary layer between the inner surface of the duct and armoured optical fibre cable.

### 4.1 Outer Layer:

The base HDPE (High-density polyethylene) resin used for the outer layer of the permanent lubricated HDPE Duct shall confirm to IS 7328 or to its equivalent. Manufacturer shall furnish designation for HDPE resin as per IS:7328, as applicable.

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## **4.2 Inner Layer:**

- 4.2.1 The inner layer of solid permanent lubricant shall be continuous all through and shall not come out during storage, usage and through out the life of duct. The inner lubrication material shall be of friction reducing polymeric material, which shall be integral with HDPE layer. The lubricant material shall have no toxic or dermatic hazards for safe handling. In the finished permanent lubricated HDPE duct, the co-extruded inner layer of solid permanent lubricant shall be integral part with HDPE and shall be white in colour and clearly visible in cross-section of duct.
- 4.2.2 The inner layer of solid permanent lubricant shall be continuous all through and shall not come out during storage, usage and throughout the life of the duct.

## **4.3 Requirements of Raw Materials used for the Duct:**

- 4.3.1 The anti-oxidants used shall be physiologically harmless.
- 4.3.2 None of the additives shall be used separately or together in quantities as to impair long term physical and chemical properties of the duct.
- 4.3.3 The raw material used for extrusion shall be dried to bring the moisture content to less than 0.1%.
- 4.3.4 Suitable UV stabilisers shall be used for manufacture of the duct to protect against UV degradation, when stored in open for a minimum period of 8 months.
- 4.3.5 The ash content of the colour master batch shall not be more than 12% when tested as per method described in Annexure-L.
- 4.3.6 The raw material used in the manufacture of the duct shall be such that the service life of the duct and all its accessories can be expected to be more than 50 years including the life of permanent lubricant.

## **4.4 Service Condition:**

The lubricated HDPE Duct shall be able to withstand the following environmental conditions:

- (a) Ambient temperature : 0°C to +55°C (50% RH Max.)  
over which Specifications  
are guaranteed

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## 5.0 TECHNICAL REQUIREMENT:

S.No.	Parameter	Specified Limit	Test Method
<b>A.</b>	<b>APPEARANCE</b>		
1.	Visual appearance	Smooth inside & out side surface, free of blisters, shrink, hole, flaking, scratches & roughness. Duct shall be smooth, clean and round. The end shall be clearly cut and shall be square with axis of duct.	
2. a.	Colour	The colour of the duct shall be bright orange/bright green and uniform throughout.  The colour of the inner layer shall be white.	IS: 9938
2. b.	Fading of colour	There shall be no decolouration after colour fading test.	ASTM D 1712
3.	Lubricated layer	Must have inner lubricant layer clearly visible & white in colour , uniform in thickness.	
4.	Identification marking	Permanently marked with indelible ink <ul style="list-style-type: none"> <li>• Specification No. RDSO/SPN/45/2013</li> <li>• I.R. cable duct</li> <li>• Manufacturer's name</li> <li>• Name of the duct with size</li> <li>• Serial number of the duct.</li> <li>• Date of manufacture</li> <li>• Sequential length marking at every meter</li> </ul>	
<b>B.</b>	<b>DIMENSION AND WEIGHT</b>		
1.	Out side diameter	40.0 mm + 0.4 mm - 0.0 mm	Annexure – A
2.	Wall thickness	3.50 mm $\pm$ 0.20 mm	Annexure – A
3.	Lubricated layer thickness	Should be min. 10% of wall thickness	Annexure – A
4.	Standard length	Standard length is 1000 meter +5%, -2%. Unless otherwise specified by the purchaser the tolerance on total quantity shall be $\pm$ 1.5%	--
5.	Weight	380 gm/ meter $\pm$ 10gm	--



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6.	Ovality test	Difference of maximum & minimum diameter should be less than 1.3 mm	IS 4984
<b>C.</b>	<b>CHEMICAL TESTS</b>		
1.	Melt flow rate	The change in the MFR caused by processing of raw material into the duct i.e. the difference between the measured value for the outer layer material from the duct and measured value for the raw material shall not be more than 30%.( The test will be conducted by collecting raw material from the hopper during extrusion and finished duct made from the same material).	IS 2530
2.	Ash content	0.3% max.	Annexure -L
3.	Environmental Stress cracking resistance ESCR	No cracking	ASTM D 1693 Annexure – B
4.	Oxidation Induction test	30 minutes (minimum)	Annexure-M
5.	UV stabliser content	During UV stabliser test, after aging the specimens shall be tested for tensile strength at a speed of 50 mm/minute. The variation compared to the value obtained before aging as in clause 5.0 (D.3) & 5.0 (D.4) should not be more than 20%.	Annexure – C
<b>D.</b>	<b>PHYSICAL TESTS</b>		
1.	Hardness	60 Shore D (min)	ASTM D 2240
2.	Density (Inner and Outer Layer)	0.940 to 0.958 g/cc at 27 <sup>0</sup> C	Test method as per IS:2530
3.	Tensile strength at yield. Speed of testing 50 mm/ minute	Min. 20 N/mm <sup>2</sup>	ASTM F 2160 (using type IV specimens of ASTM D 638)
4.	Elongation at Break Speed of testing is 50 mm/min.	Min. 500%	ASTM F 2160 (using type IV specimens of ASTM D 638)
5.	Heat Reversion	The dimensions shall not change by more than 3% in the longitudinal direction.	IS 4984, Annexure - O
6.	Crush Resistance	Deflection not greater than 10% and	Annexure - D

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	test	after recovery less than 2%	
7.	Impact strength	No crack or split	IS 12235 (Part - 9), Annexure - N
8.	Coefficient of friction	< 0.06	Annexure - E
9.	Mandrel Test	Mandrel should easily pass between one end to other	Annexure - F
10.	Coil test	No snaking or waving having zero coil set	Annexure - G
11.	Hydraulic characteristics	Minimum holding time to be observed as indicated in Test method at Annexure-H	Annexure - H
12.	Optical Fibre Cable blowing test	No visible damage	Annexure - I
13.	Termite test	No termite effect	Annexure – J
14.	Resistance To Flame Propagation Test	Combustion shall stop within 30 seconds	Annexure – P
<b>E.</b>	<b>TESTS ON PLB HDPE DUCT ACCESSORIES</b>		
1.	Coupler Leakage Test	The coupler jointing shall meet the air pressure test of 15 Kg/ cm <sup>2</sup> for a minimum period of 2 hours.	--
2.	Pull Strength of coupler	The pull strength of the coupler shall not be less than 320 kgf.	Annexure – K
3.	Air Tightness Test of End Plug	End Plug shall be tested with a pressure of 1 bar for 30 minutes. (Suitable length shall be taken)	--
4.	Air Tightness Test of Cable Sealing Plug	Cable Sealing Plug shall be tested with a pressure of 1 bar for 30 minutes. (Suitable length shall be taken)	--
5.	Pre-installed Polypropylene rope (as specified in clause no. 12.5)	Rope shall be of polypropylene of dia 4mm with minimum slackness of 2%	IS:5175

**Note :** All above mentioned tests shall be conducted on finished product.

## 6.0 PLB HDPE DUCT ACCESSORIES:

**6.1** The following accessories are required for jointing the ducts and shall be supplied along with the ducts. The manufacturers shall provide complete design details, procedure and method for installation and type/grade of the material used for the accessories. The required quantities of accessories are to be mentioned by the Purchasing Authority in the purchase order.

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#### 6.1.1 **Coupler:**

The coupler shall be of push-fit type meeting the following requirement :

It is used to couple two ducts. The design of this shall be simple, easy to install and shall provide air tight and water tight joint between the two ducts. The coupler shall ensure that two ducts are butted smoothly without any step formation in the inner surface. The jointing shall meet the air pressure test of 15 kg/cm<sup>2</sup> for a minimum period of 2 hours without any leakage. The material of the coupler shall be as per clause 4.1 of this specification.

Manufacturer shall furnish the complete engineering drawings of the various components used & material specifications. This will be recorded for that manufacturer for future verification. Installation instructions also shall be provided by the manufacturer.

Note: Both sides of the coupler shall be marked with the manufacturers' name by engraving and that the ends of the (opening for entry of duct) shall be covered with removable caps, to prevent the entry of foreign matter while not in use.

#### 6.1.2 **End Plug:**

This is for sealing the ends of the empty ducts, prior to installation of the OF cable and shall be fitted immediately after laying of the duct, to prevent the entry of any dirt, water, moisture, insects/rodents etc into the duct. The rubber component shall be of nitrile rubber for increased life.

#### 6.1.3 **Cable Sealing Plug:**

This is used to seal the ends of the ducts perfectly, after the cable is installed in the duct, to prevent the entry of dirt, water, moisture, insects/rodents etc. This is required at all places where cable has come out of the duct either for jointing or entry into the building as required. The sealing plug shall be capable of accommodating armoured optical fibre cable as per IRS:TC 55-2006 taking into account the variation in diameter due to tolerance limits, etc. The rubber component shall be of nitrile rubber for increased life.

#### 6.1.4 **End Cap:**

This cap is made of hard rubber/plastic, shall be fitted into both ends of duct coil after manufacturing the duct. This shall avoid entry of dust, mud and rain water into the duct during the transit and storage.

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## **6.2    Tools:**

The following additional tools are required for jointing of the ducts and installation of optical fibre cable.

### **6.2.1   Rotatry Duct Cutter:**

This is required to cut the duct ends squarely without any burr or notch.

### **6.2.2   C-Spanner:**

This is required to tighten Plastic Coupler properly so as to ensure air/ water tightness as specified above.

### **6.2.3   Chamferring Tool:**

This is required to give slight chamfer to the ends of PLB Ducts, to facilitate installation of coupler for jointing purpose.

## **7.0    PACKING REQUIREMENT**

7.1    The stores shall be supplied in coils of suitable size for delivery such that minimum inner bending diameter of the coiled duct shall be 20 times the outer Diameter of the duct.

7.2    The duct should be sealed with tight end caps.

7.3    If transportation is by road, the air tight sealed duct shall be transported in a vehicle exclusively used for it and no other consignments shall be loaded with it in the same vehicle.

## **8.0    TYPE TESTS:**

8.1    Two coils of standard length shall be manufactured for type tests.

8.2    All the tests as mentioned in clause 5 of this specification except optical fibre cable blowing test and termite test shall be carried out on both the coils. Tests shall be carried out on samples taken from any suitable location from the coil.

8.3    Optical Fibre Cable blowing test [Clause 5.0 D(12) and Termite test [Clause 5.0 D(13) shall be carried out on one coil each.

8.4    30 days Termite Test shall be carried out at IICT, Hyderabad or any other Test house accredited to carry out such test as per Annexure – J.

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8.5 Both the coils shall be unrolled and rolled for visual appearance and standard length test.

8.6 There shall be no failures on samples in any of tests conducted for Type Test. Test results shall be taken on standard formats circulated by RDSO.

## 9.0 ACCEPTANCE TESTS:

9.1 Lot size for acceptance test shall be restricted to 100 coils of standard length per lot.

9.2 Sampling Plan:

<u>Clause</u>	<u>Percentage of lot to be inspected</u>
5.0 (A)	100%
5.0 (B)	10%
5.0 [C (1,2,3,4)]	2 samples per lot
5.0 [D (1,2,3,4,5,6,7,8,9,10,11)]	2 samples per lot
5.0[E (1,2,3,4)]	2 samples per lot
7.0 and 12.0	10%

9.3 Dimensions as per clause 5.0 B shall be checked at both top & bottom ends. Standard length shall be verified by unrolling and rolling the coil.

9.4 Chemical and physical tests as per clause 5.0 C & 5.0 D shall be carried out on samples taken from any suitable location from the coil.

9.5 Coils for testing purposes shall be randomly selected as per the sampling plan.

9.6 In case the duct tested and inspected in accordance with this specification, fail to pass the tests or comply with the requirement of the specification, the whole consignment shall be rejected.

## 10.0 Routine Test :

10.1 Routine test shall be conducted by manufacturer on all offered coil.

10.2 Routine test shall be conducted as per Cl. 5.0 (A), 5.0 (B), 5.0 [C (1,2,3,4)], 5.0 [D (1,2,3,4,5,6,7,8,9,10,11)], 5.0 [E (1,2,3,4)] on all the offered coils.

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- 10.3 The result of routine test shall be made available to the inspecting authority along with the inspection call letter.

#### **11.0 INSPECTION:**

- 11.1 All the gauges/ test & measuring instruments shall be under calibration control at the time of inspection and proof to this office shall be produced.
- 11.2 Inspection and testing shall be carried out by the inspecting authority nominated by the purchaser to ensure that all the requirements of this specification are complied with for the acceptance of the materials offered by the supplier for inspection.
- 11.3 The purchaser or his nominee shall have free access to the works of the manufacturer and to be present at all reasonable times and shall be given facilities by the manufacturer to inspect the manufacturing of the duct at any stage of manufacture. He shall have the right to reject whole or part of any work or material that does not conform to the terms of this specification or any other specification or requirement applicable and may order the same to be removed/replaced or altered at the expense of the manufacturer. All reasonable/complete facilities considered necessary by the inspecting authorities for the inspection of the cables shall be supplied by the manufacturer free of cost.
- 11.4 The manufacturer shall supply the duct samples and samples of the raw materials free of charge as required by the inspecting authority and shall at his own cost prepare and furnish the necessary test pieces and appliances for such testing as may be carried out at his own premises in accordance with this specification. Failing the existence of facilities at his own premises for the prescribed tests, the manufacturer shall bear the cost of carrying out the tests in an approved laboratory, workshop or test house.

#### **12.0 ORDERING INFORMATION:**

- 12.1 Normally the duct will be supplied as per the standard dimensions and length as mentioned in this document. However purchaser may specify his own dimensions/ lengths/ packing requirements etc. In such cases necessary tolerance shall also be specified by the purchaser.
- 12.2 Two nos. each of end plug, cable sealing plug and end cap shall be supplied along with each coil. Purchaser may specify additional requirement.
- 12.3 Adequate no. of plastic couplers (No. of couplers to make a continuous length of the lot + 10% extra) shall be supplied along with each lot. Purchasers may specify additional requirement.

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- 12.4 One number of Duct cutter, C spanner and chamferring tool shall be supplied along with each lot of 100 coils. Purchaser may also indicate his specific requirement.
- 12.5 Pre-installed rope for the above standard length duct (Optional Item):  
The duct shall be supplied with pre-installed rope when so ordered by the purchasing authority. The rope shall be polypropylene, 4 mm in diameter and conform to IS: 5175, with a minimum slackness of 2%.

#### **Annexure – A (Dimension of the Duct)**

The wall thickness and the outside diameter shall be measured with the help of a Vernier Caliper with a least count of .01 mm.

The lubricant layer thickness shall be measured with the help of a traveling microscope with a least count of .01 mm.

#### **Annexure – B ( Environmental Stress Cracking Resistance Test)**

ESCR test shall be carried out as per ASTM D 1693 when tested with 10% Igepal (CO 630) solution at  $50 \pm 10^{\circ}\text{C}$ . The duration of testing shall be 96 hours for Type Test and Acceptance Test both.

#### **Annexure – C (UV Stabiliser Test)**

The test shall be conducted on specimens taken (as per type IV of ASTM D 638) from the duct. The aging shall be done with UV-B lamps at a typical irradiance of  $0.63 \text{ W/m}^2/\text{nm}$  as per cycle No.2 of ASTM G 154.

Lamp - UV-B lamp  
Cycle - 4 hrs, UV exposure at  $60^{\circ}\text{C}$   
4 hrs, condensation at  $60^{\circ}\text{C}$

Total cycle time - 720 hrs.

Reference - ASTM D 638 (Type IV specimen)

After aging the specimens shall be tested for tensile strength at a speed of 50 mm/minute. The variation compared to the value obtained before aging as in clause 5.0 (D.3) & 5.0 (D.4) shall not be more than 20%

#### **Annexure – D (Crush Resistance Test)**

Sample of duct of  $150 \text{ mm} \pm 2 \text{ mm}$  in length shall be subjected to a dead load of not less than 50 Kg for one minute and shall be allowed to recover for 5 minutes. The deflection with load on and after recovery period shall not exceed 10% and 2% respectively.

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### **Annexure – E (Internal coefficient of friction Test)**

Scope : This procedure details the method employed to determine internal friction properties of the duct.

Apparatus : Extensometer machine, circular test fixture of diameter 750 mm (capable of having secured to it), 25 Kg weight, optical fibre cable and pulley wheel.

Method :

- (a). A suitable length of the duct, pre-conditioned at  $23 \pm 2^{\circ}\text{C}$  for 2 hours shall be secured to the test fixture such that the sample completes a  $450^{\circ}$  deg wrap, with one end extending vertically 200 mm towards the floor.
- (b). A suitable length of armoured optical fibre cable as per IRS : TC 55-2006 shall be inserted into the sample.
- (c). The extensometer and the test fixture shall be aligned and secured from the movement.
- (d). The 25 Kg tail weight shall be attached to the optical fibre cable extending from the 200 mm vertical extension of the sample such that there is a minimum free travel of 150 mm for the weight.
- (e). The other end of the optical fibre cable shall be attached via a pulley, to the extensometer such that the planes of travel are in no direction diagonal and there shall be slack remaining in the optical fibre cable.
- (f). The extensometer shall be operated, and the maximum load applied, in lifting the 25 Kg weight to a minimum travel of 150 mm shall be noted.
- (g). Extensometer conditions

Load : Kg or Newtons  
Speed : 500 mm/minute  
Mode : Tension

The coefficient of friction shall be calculated by the following equation :

$$\text{Internal coefficient of friction (ICF)} = \log_e (T_1 / T_2) / Q$$

Where  $T_1$  = pulling force in kg.  
 $T_2$  = 25 Kg  
 $Q$  = Angle of subtending arc between  $T_1$  &  $T_2$  in radians  
(i.e.  $450^{\circ}$  deg = 7.85398 Radians)



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#### **Annexure – F (Mandrel Test)**

A 150 mm long mandrel of diameter, 3 mm less than the internal diameter of the duct shall be passed through a 5 meter length of the duct, freely throughout the length, when the duct is bent to a radius of 5 meter

#### **Annexure – G (Coil Set)**

The PLB HDPE duct shall unroll off the drums without snaking or waving having zero coil set. Thus the duct shall lay straight into the trench without re-coiling. For this purpose, when a minimum length of 50 meters duct taken from the coil and laid on the ground, it shall be straight without any bends or kinks and without deformation, except 5 meters from each end.

#### **Annexure – H (Hydraulic Characteristics)**

The duct shall be tested for internal pressure creep rupture test as per IS – 4984. For this purpose, a sample length of 10 times the outside diameter of the duct shall be taken. At the end of the test, the sample shall not show signs of localized swelling or leakage and shall not burst during the test duration. The test showing failure within a distance equivalent to the length of end cap from the end shall be disregarded and the test repeated. The test temperatures and the duration of the test shall be as follows:

Test	Test Temp. °C	Test Duration (Hrs.) (Min. holding time)	Induced stress (Mpa)
Type Test	80	165	3.5
Acceptance Test	80	48	3.8

#### **Annexure – I (Optical Fibre Cable Blowing Test)**

For this test an Armoured Optical Fibre Cable as per IRS : TC 55-2006 shall be installed by blowing of the cable in a length of 1 Km of the duct. The duct shall be laid with bends in the horizontal and vertical planes and a rise in the middle as detailed in the figure –1. The 1 Km section shall include two couplings at suitable locations as shown in the figure.

The OFC shall then be blown out. It shall be inspected for any visual damage. The OFC shall then be blown in again.

It shall be possible to blow in the Optical fibre Cable through the 1 Km duct, each time in not more than 30 minutes. There shall be no visible damage to OFC.

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The test will be conducted on two samples out of the five submitted for Type Approval.

### **Annexure – J ( Termite ResistanceTest)**

Termite Resistance Test shall be carried out at IICT, Hyderabad as per their standard operating protocol (DOP-TOX-E1, ISO 9002, IICT).

Test duct will be cut into suitable lengths and their edges will be smoothened with the help of sand paper. The initial weight of each labeled sample will be recorded by an analytical balance, and appropriate suitable caps will be fixed on both ends before commencement of the experiment. One set of test pieces consisting five replicates will be buried at a depth of 1½ feet in the termite mounds (field conditions) and another set will be placed in termites inhabiting soil (laboratory conditions) for a period of 30 days to study two sets of test pieces will be placed in identical conditions with out any termites and termed as controls.

The test samples will be removed carefully after 30 days from the respective places and observed the formation of nest building on the surface of the test samples. After removal of affixed mud and debris, samples will be evaluated visually under magnification for any feeding marks like nibbling, scraping, pitting and perforation on the surface. The final weight of each labeled sample (after exposure, without caps) will be recorded. The percent weight loss in each sample will be calculated and compared with control samples. Based on the results the appropriate rating will be allotted to the sample as follows :

Rating Chart :

<b>Degree of damage</b>	<b>Characteristics of damage</b>	<b>Rating</b>
OK	Undamaged	- 0 -
Nest Building	Formation of nest building on the surface of the test samples.	‘NB’
Surface nibbling	Surface roughened by the termites but not pitted	‘SN’
Slight attack	Surface with shallow pits and only in a few, restricted regions	‘SA’
Attack	Surface deeply pitted, shallowly pitted over extensive areas	‘A’
Destroyed	Sample perforated	‘D’

A rating of – 0 – shall indicate that the sample has successfully passed the termite resistance test.

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### **Annexure – K (Pull strength of coupler)**

2 Duct samples, each 30 cms. long, are jointed with the help of the Coupler, under test. The free ends of the 2 ducts are fitted to the two suitable grips of a tensile testing machine. The jointing shall meet pulling force of 320 Kgf. The test may be conducted by loading the coupler joined by two pieces of duct for 15 minutes using a dead load.

### **Annexure – L (Test method for Ash Content)**

About one gram of the sample under test shall be taken and dried at 105<sup>0</sup>C for two hours in a platinum or glazed porcelain or silica or quartz crucible. The weight of the sample shall be noted. Subsequently, the sample with the crucible shall be transferred to a muffle furnace maintained at 600  $\pm$  50<sup>0</sup>C and allowed to remain there for three hours. The ash content may be calculated as a percentage of the weight of the original shape.

### **Annexure – M (Oxidation Induction Test method)**

A short length of completed duct (approximately 30 cm) shall be sealed at the ends and placed in an oven at temperature of 68  $\pm$  1<sup>0</sup>C for 8 hours. The sample shall then be allowed to cool at room temperature for at least 16 hours. The sample shall be clean and dry. The sample shall then be tested by means of a Differential Scanning Calorimeter (DSC).

Instrument Test procedure:

- a) Cell Cleaning : The cell shall be held at approximately 400<sup>0</sup>C for 10 minutes in Nitrogen. The cell shall be cleaned after standing over night and between testing of different formulations.
- b) Temperature Calibration : This has to be done according to the instrument manual. The temperature scale should be adjusted until the determined melting point of pure Indium metal is 156.6<sup>0</sup>C at a heat of 5<sup>0</sup>C per minute or any other heat rate as indicated in the manual of the equipment is permitted.
- c) Aluminium Pan Preparation : Standard aluminum DSC pans as per ASTM D 4565 are required to hold specimens during testing. A fresh pan shall be used for each test.
- d) Sample Preparation : Take the sample weighing about 5 mg from the duct conditioned as indicated above. Position the sample in the centre of the pan.

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- e) Nitrogen Purge : Place the sample pan and reference pan in instrument cell. Flush for 5 minutes with cylinder of nitrogen (99.6% extra dry grade) at  $60 \pm 10$  cc per minute.
- f) Oxidation Test : Rapidly increase the temperature of the sample ( $20^{\circ}\text{C}/\text{min}$  or greater) from  $100^{\circ}\text{C}$  or lower initial temperature to  $199 \pm 1^{\circ}\text{C}$ . After thermal equilibrium is obtained (steady recorder signal) switch to  $80 \pm 20$  cc per minute oxygen flow and simultaneously start time-base recording. The oxygen used for the test should be equivalent to or better than 99.6% extra dry grade.
- g) Induction Period: The oxygen induction point shall be recorded as time zero, and the chart speed shall be sufficient to provide a clearly discernible slope at the start of the exothermic reaction. The test in the pure dry oxygen atmosphere shall continue until the exothermic peak is produced. The intersection of the tangent of the exothermic sloped line with the extended base line will be drawn. The time from time zero to this intersection point is read from the base line and recorded as the oxidative induction time.
- h) Automatic OIT equipment (Differential Scanning Calorimeter) for testing the Oxidation Induction Time shall be available as the test equipment for testing OIT parameter.

#### **Annexure – N (Impact Strength Test):**

The test has to be carried as per IS:12235 (Part-9). A sample duct 150 mm in length shall be placed on a heavy rigid block whose faces are at an angle of  $120^{\circ}$ . A striker with a hemispherical nose of 13 mm radius and loaded to a total weight of 10 kg shall be allowed to fall freely in suitable vertical guides through a height of 1.5 m before striking the duct. The line of fall of the striker shall coincide with the diameter of the duct. The duct shall not crack or split.

#### **Annexure –O (Heat Reversion Test):**

This test shall be carried out as per IS:4984. For this purpose, a duct length of 200 mm shall be placed horizontally in an air-oven or a suitable liquid bath on a support at  $110 \pm 2^{\circ}\text{C}$  for 60 minutes so that the dimensional changes in duct section are not impeded. After cooling to room temperature, the dimensional change of the duct section shall be measured in the longitudinal direction and the deviation from the initial length shall be calculated and stated in percentage. The dimensions shall not change by more than 3 percent in the longitudinal direction.

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### **Annexure – P (Resistance To Flame Propagation Test)**

Non flame propagating ducts shall have adequate resistance to flame propagation. Samples of HDPE Ducts shall be checked by applying a 1KW flame.

- (i) Samples of HDPE Ducts shall be checked by applying a 1KW flame.
- (ii) A sample of length  $675 \pm 10$  mm is mounted vertically in a rectangular metal enclosure with one open face, as shown in figure of clause no. 14.0 in an area substantially free from draughts. The general arrangement is shown in figure of clause no. 14.0.
- (iii) Mounting is by means of two metal clamps approximately 25mm wide spaced  $550 \pm 10$  mm apart and approximately equidistance from the ends of the sample. A steel rod of  $16 \pm 0.1$ mm is passed through the sample. It is rigidly and independently mounted and clamped at upper end to maintain the sample in a straight and vertical position. The means of mounting is such as not to obstruct drops from falling onto the tissue paper. A suitable piece of white pinewood board, approximately 10 mm thick, covered with single layer of white tissue paper is positioned on the lower surface of the enclosure. The assembly of sample, rod and clamping apparatus is mounted vertically in the center of the enclosure, the upper extremity of the lower clamp being  $500 \pm 10$  mm above the internal lower surface of the enclosure.
- (iv) The burner is supported so that its axis is  $45 \pm 2^\circ$  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  $100 \pm 10$  mm and the axis of the flame intersects with the surface of the samples at a point  $100 \pm 5$  mm from the upper extremity of the lower clamp, and so that the axis of the flame intersects with the axis of the sample.
- (v) The test is carried out on three samples. The flame is applied to the sample for the period specified in the table-1 given below and is then removed. During the application of the flame, it shall not be moved except to remove it at the conclusion of the period of the test. After the conclusion of the test and after any burning of the sample has ceased, the surface of the sample is wiped clean by rubbing with a piece of cloth soaked with water.
- (vi) All three samples shall pass the test. If the sample is not ignited by the flame, it shall be deemed to have passed the test. If the

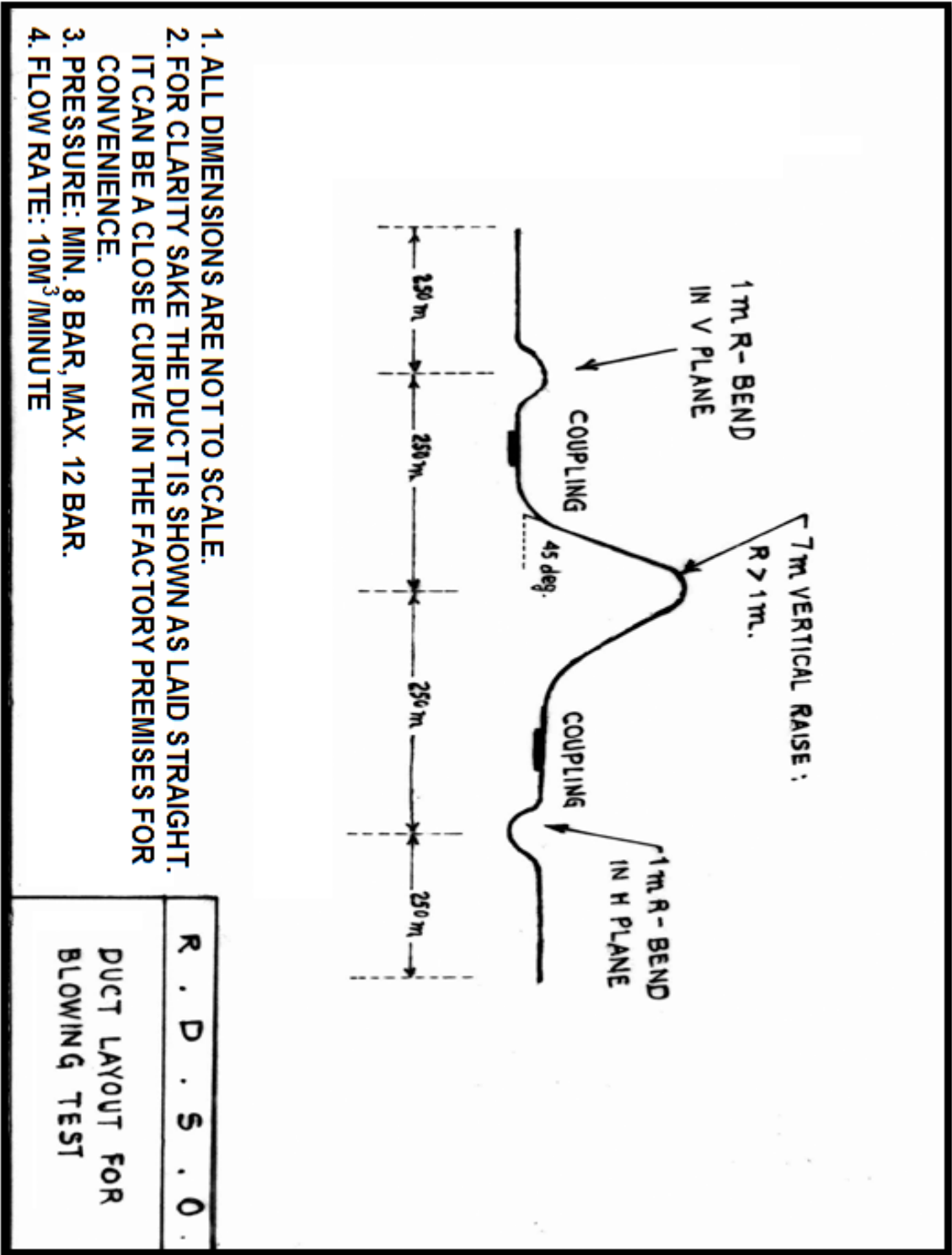
sample burns, or is consumed without burning, the sample shall be deemed to have passed the test if after burning has ceased, and after the sample has been wiped in accordance with (v) above, there is no evidence of burning or charring within 50 mm of the lower extremity of the upper and also within 50 mm of the upper extremity of the lower clamp.

- (vii) If the sample burns, it shall be deemed to have failed the test if combustion is still in progress 30 seconds after removal of the flame. If the tissue paper ignites, the sample shall be deemed to have failed the test. For the parts of the same below the burner, the presence of molten material on the internal or external surfaces shall not entail failure if the sample itself is not burned or charred.
- (viii) Compliance of HDPE Duct fittings is checked by using the glow wire test IS:11000 (Part 2/Sec 1). The glow wire shall be applied once to each sample in the most unfavourable position of its intended use, with the surface tested in vertical position, at a temperature of 750°C. The sample is deemed to have passed this test if there is no visible flame or sustained glowing or if flames or glowing extinguishes within 30s of the removal of the glow wire.

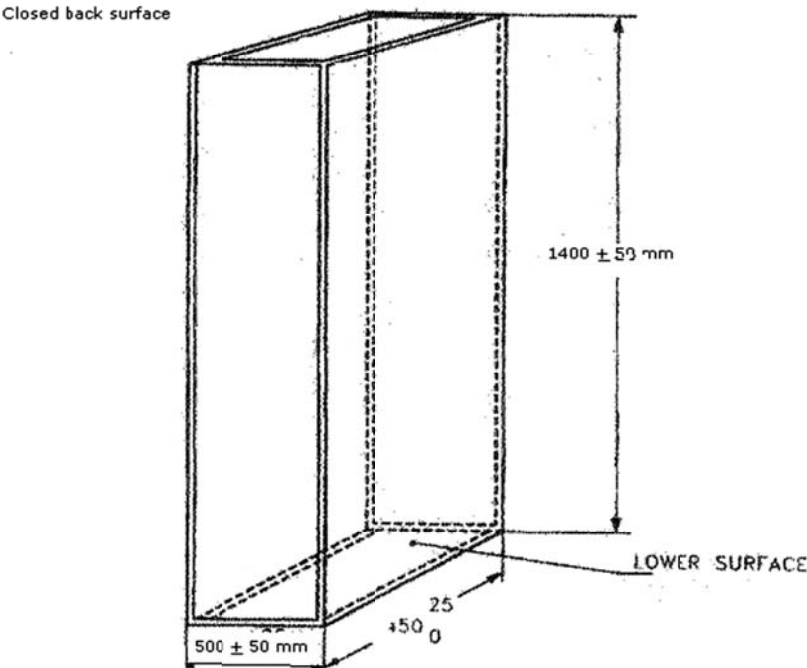
**Table-1**  
**TIME OF EXPOSURE OF THE SAMPLE TO THE FLAME**

Material	Thickness (mm)	Flame Application (Tolerances +1 sec.)
Over	Upto	
(1)	(2)	(3)
-	0.5	15
0.5	1.0	20
1.0	1.5	25
1.5	2.0	35
2.0	2.5	45
2.5	3.0	55
3.0	3.5	65
3.5	4.0	75
4.0	4.5	85
4.5	5.0	130
5.0	5.5	200
5.5	6.0	300
6.0	6.5	500

13.0 DUCT LAYOUT FOR BLOWING TEST:

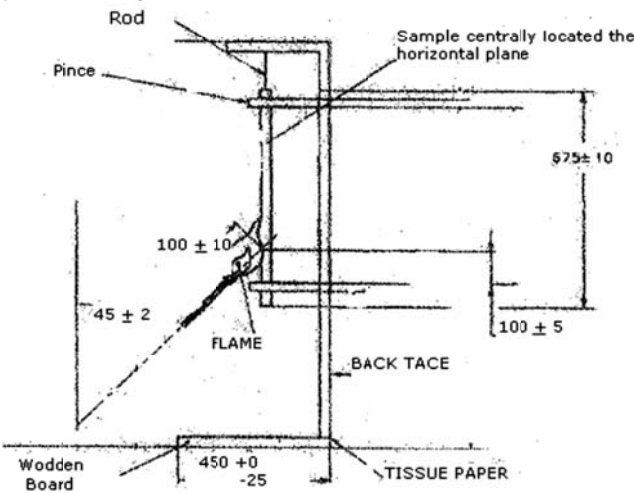


# 14.0 RESISTANCE TO FLAME PROPAGATION TEST APPARATUS:



Note: - This drawing is not intended to govern design

ENCLOSURE FOR BURNING TEST



Note: - This drawing is not intended to govern design except as regards the dimension shown

ARRANGEMENT FOR BURNING TEST



## Annexure “A”

### Amendment No. 1.0 to the Specification No. RDSO/SPN/TC/45/2013 Rev. 2.0. for PLB HDPE Duct .

1) The existing Clause no. 5.0 (C.5) shall be substituted as given below:

Clause no. 5.0 (C.5):

5.	UV stabilizer content	During UV stabilizer test, after aging the specimens shall be tested for tensile strength at a speed of 50 mm/minute. The variation compared to the value obtained before aging as in clause 5.0 (D.3) should not be more than 20%.	Annexure– C
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2) The existing Annexure – C (UV Stabilizer Test) shall be substituted as given below:

Annexure – C (UV Stabilizer Test):

The test shall be conducted on specimens taken (as per type IV of ASTM D 638) from the duct. The aging shall be done with UV-B lamps at a typical irradiance of 0.63 W/m<sup>2</sup>/nm as per cycle No. 2 of ASTM G 154.

Lamp	-	UV – B lamp
Cycle	-	4hrs,UV exposure at 60°C
	-	4 hrs, condensation at 50°C
Total Cycle time	-	720 hrs.
Reference	-	ASTM D 638 (Type IV specimen)

After aging the specimens shall be tested for tensile strength at a speed of 50 mm / minute. The variation compared to the value obtained before aging shall not be more than 20%.

3) The existing Clause no. 5.0 (B.6) shall be substituted as given below:

Clause no. 5.0 (B.6):

6.	Ovality test	Ovality is the difference between maximum outside diameter and the minimum outside diameter at the same cross-section of the duct, at 300 mm away from the end. The ovality shall not exceed 1.4 mm.	IS 4984
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4)The existing Annexure – B shall be substituted as given below:

Annexure – B (Environmental Stress Cracking Resistance Test):

ESCR test shall be carried out as per ASTM D 1693 when tested with 10% Igepal (CO 630) solution at 50 ± 1°C. The duration of testing shall be 96 hours for Type Test and Acceptance Test both.

\*\*\*\*\*End of the document\*\*\*\*\*

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भारत सरकार, रेल मंत्रालय  
अनुसंधान अभिकल्प और मानक संगठन  
लखनऊ - 226 001  
Government of India—Ministry of Railways  
Research Designs & Standards Organisation  
LUCKNOW - 226011

An ISO 9001  
CERTIFIED  
ORGANISATION

सं.: एस.टी.टी./ओ.एफ.सी./एच.डी.पी.ई./कन्ड्यूट/607/वाल्चूम-III

दिनांक : 17.10.2016

To,

1.	The CSTE, CSTE/Const.:	सी.एस.टी.ई., सी.एस.टी.ई./निर्माण, :
(i)	Central Rly., Mumbai, CST - 400001	मध्य रेलवे, मुम्बई सी.एस.टी.- 400 001
(ii)	Western Rly, Churchgate, Mumbai - 400020	पश्चिम रेलवे, चर्च गेट, मुम्बई - 400 020
(iii)	Eastern Rly., Fairlie Place, Kolkata 700001	पूर्व रेलवे, फेयरली प्लेस, कोलकाता - 700 001
(iv)	South Eastern Rly., Garden Reach, Kolkata	दक्षिण पूर्व रेलवे, गार्डन रीच, कोलकाता-700 043
(v)	Northern Rly. Baroda House, New Delhi-110001	उत्तर रेलवे, बड़ौदा हाउस, नई दिल्ली-110001
(vi)	North Eastern Rly., Gorakhpur- 273012	पूर्वोत्तर रेलवे, गोरखपुर - 273012
(vii)	North East Frontier Rly., Maligaon, Guwahati - 781011	पूर्वोत्तर सीमान्त रेलवे, मालीगांव, गुवाहाटी - 781011
(viii)	Southern Rly. Park Town, Chennai - 600003	दक्षिण रेलवे, पार्क टाउन, चेन्नई - 600 003
(ix)	South Central Rly., Secunderabad - 500371	दक्षिण मध्य रेलवे, सिकन्दराबाद -500371
(x)	East Central Railway, Hajipur	पूर्व मध्य रेलवे, हाजीपुर
(xi)	East Coast Railway, Rail Vihar BDA Rental Colony, Chandrasekharapur, Bhubneshwar	पूर्व तटीय रेलवे, रेल विहार बी.डी.ए. रेंटल कालोनी, चन्द्रशेखरपुर, भुवनेश्वर-751023
(xii)	North Central Railway, Hastings Road, Allahabad.	उत्तर मध्य रेलवे, हेस्टिंग रोड, इलाहाबाद
(xiii)	North Western Railway, Jaipur - 300206	उत्तर पश्चिम रेलवे, जयपुर-300206
(xiv)	South Western Railway, Club Road, Keshavpur, Hubli - 23.	दक्षिण पश्चिम रेलवे, क्लब रोड, केशवपुर, हुबली-23
(xv)	West Central Railway, OSD Office, Jabalpur	पश्चिम मध्य रेलवे, ओएसडी कार्यालय, जबलपुर
(xvi)	South East Central Railway, R.E. Office Complex, Bilaspur - 495004	दक्षिण पूर्व मध्य रेलवे, आरईओ ऑफिस कॉम्प्लेक्स, बिलासपुर- 495004
2.	The CSTE, Metro Railway, 23-A, Jawaharlal Nehru Road, Kolkata - 700071	सी.एस.टी.ई./ मेट्रो रेलवे, 23-ए, जवाहर लाल नेहरू रोड, कोलकाता - 71
3.	The CSTE, CORE, Nawab Yusuf Ali Road, Civil Lines, Allahabad	सी.एस.टी.ई./ कोर, नवाब यूसुफ अली रोड, सिविल लाइन्स, इलाहाबाद-211001
4.	The Director, IRISSET, Tarnaka Road, Lallaguda (P.O.), Secunderabad-500 017	निदेशक/इरीसेट/सिकंदराबाद-500017
5.	CAO/IRPMU IRCOT Building, Behind Shanker Market, New Delhi.	सी.ए.ओ./आई.आर.पी.एम.यू./इरकोट बिल्डिंग/शंकर मार्केट के पीछे/नई दिल्ली
6.	MD, RailTel Corporation of India Ltd., 10 <sup>th</sup> Floor, Bank of Baroda Building, Parliament Street, New Delhi	प्रबन्ध निदेशक, रेलटेल कॉर्पोरेशन आफ इंडिया लिमिटेड, 10 <sup>वीं</sup> मंजिल, बैंक आफ बड़ौदा भवन, पार्लियामेन्ट स्ट्रीट, नई दिल्ली

Sub : Amendment No. 2.0 to the specification of PLB HDPE  
Duct as per RDSO Specification No. RDSO/SPN/TC/45/  
2013 Revision 2.0 with Amendment No. 1.0.



In reference to above subject, an Amendment No. 2.0 to the Specification No. RDSO/SPN/TC/45/2013 Revision 2.0 with Amendment No. 1.0 for PLB HDPE Duct is issued by Telecom Directorate for information to Zonal Railways.

A copy of the same has been sent to CSTE's, & CSTE/Con. by E-mail. The copy of the same is also being uploaded on the RDSO's website.

संलग्नक : उपरोक्तानुसार

17.10.16

( विवेक कुमार )

निदेशक/दूरसंचार-II  
कृते महानिदेशक/दूरसंचार

प्रतिलिपि -

1.	The Executive Director/QA/S&T/RDSO, 4th Floor, Annexe-II, Manak Nagar, Lucknow-226011.	कार्यकारी निदेशक/क्यू.ए. (संकेत एवं दूर)/अ.अ.मा.स., चौथी मंजिल, एनैक्सी-2 अभिकल्प भवन, मानक नगर, लखनऊ।
2.	The Director/QA (S&T)/RDSO :-	निदेशक/क्यू.ए. (संकेत एवं दूर)/अ.अ.मा.स.:-
i.	4th Floor, Annexe-II, RDSO, Manak Nagar, Lucknow-226011.	चौथी मंजिल, एनैक्सी-2 अ.अ.मा.स., अभिकल्प भवन, मानक नगर, लखनऊ।
ii.	4th Floor, West Wing, Fairlie Place, Eastern Railway, 17, N.S. Road, Kolkata-700001	चौथी मंजिल, वेस्ट विंग, 17, एन.एस.रोड, फेयरली प्लेस, कोलकाता-700001
iii.	IRCOT Complex, Behind Shanker Market, Near Shivaji Bridge, New Delhi-110001.	इरकॉट कम्प्लेक्स, शिवाजी ब्रिज, शंकर मार्केट के पीछे, नई दिल्ली-110001
iv.	Ground Floor, DRM Office, South Western Railway, Bangalore-560023	भूतल, डी.आर.एम.आफिस बिल्डिंग, दक्षिण पश्चिम रेलवे, बैंगलूर-23
v.	New Annexe Building, Western Railway, Churchgate, Mumbai-400020	नया एनैक्सी बिल्डिंग, पश्चिम रेलवे, चर्च गेट, मुम्बई-400020
vi.	Hasanpura Road, In front of Railway Hospital, Jaipur - 302 006.	हसनपुरा रोड, रेलवे हास्पिटल के सामने, जयपुर - 302 006
3.	M/s Narayani Polypipes, 17 Buro Shibtolla, Main Road, Kolkata - 700 038	मैसर्स नारायणी पाली पाइप्स, 17, बरो शिवटोला, मन रोड, कोलकाता - 700 038
4.	M/s Duraline India Pvt. Ltd., Plot No. L-24 & 25, Verna Electronic City, Phase II A, Verna, Salcete, Goa - 403 722.	मैसर्स ड्यूरालाइन इंडिया प्राइवेट लिमिटेड, प्लॉट सं०:एल-24 एंड 25, वरना इलेक्ट्रॉनिक सिटी, फेस-2 ए, वरना, साल्टकेट, गोवा-403 722
5.	M/s Mukand Poly Products, Plot No. 38, Brahmaputra Industrial Park, VIII Sila Amingaon, Guwahati - 781031	मैसर्स मुकुन्द पाली प्रोडक्ट्स, प्लॉट सं०:-38, ब्रम्हपुत्र इंडस्ट्रियल पार्क, VIII सिला अमीनगांव, गोवाहाटी-781 031
6.	M/s Singla Cables, Lane-2, Phase-II, SIDCO Industrial Complex, Bari Brahama, Jammu - 181 133.	मैसर्स सिंगला केबिल्स, लेन-2, फेस-2, सिडको इंडस्ट्रियल कॉम्प्लेक्स, बरी ब्रम्हा, जम्मू-181133
7.	M/s Kriti Industries (I) Ltd., 13/1, Tarpura, Plot No 75 -86, Sector - 2, Pithampur, Distt. Dhar (M.P.)	मैसर्स कृति इंडस्ट्रीज इंडिया लिमिटेड, 13/1, तरपुरा, प्लॉट सं०:-75 से 86, पीथमपुरा जिला धार (मध्य प्रदेश)

**Amendment No. 2**  
**To**  
**Specification No. RDSO/SPN/TC/45/2013, Revision 2, Amendment No. 1**  
**of**  
**Permanently Lubricated HDPE Duct.**

Following Clause is added to the Specification No. RDSO/SPN/TC/45/2013, Revision 2, Amendment. 1.0

**Clause No. 15.**

“All the provisions contained in RDSO’s ISO procedures laid down in Document No. QO-D-7.1-11 dated 19.07.2016 (titled “Vendor-Changes in approved status”) and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways”.

\*\*\*\*\*End of the document\*\*\*\*\*



भारत सरकार - रेल मंत्रालय  
अनुसंधान अभिकल्प और मानक संगठन  
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Government of India - Ministry of Railways  
Research Designs & Standards Organisation  
LUCKNOW - 226011

Email: aamir.siddiquiner@gov.in



No.: RDSO-TELE0LK0(TECH)/1/2021.

Date: As signed

All PCSTE of Zonal Railways.

**Sub:** Amendment No. 3.0 to the specification of Permanently Lubricated HDPE Duct as per Specification No. RDSO/ SPN/TC/45/2013 Revision 2.0 with Amendment No. 1.0 & 2.0.

In reference to above subject, an amendment No-3 to the specification No. RDSO/ SPN/TC/45/2013 Rev. 2.0 Amendment No. 1.0 & 2.0. for Permanently Lubricated HDPE Duct is issued by S&T Directorate (Telecom Section) for information and use of Zonal Railways.

The copy of the same is also available on the RDSO's website.  
The specification No. RDSO/ SPN/TC/45/2013 Rev. 2.0 Amendment No. 1.0 , 2.0& 3.0 will now be available for use of the Zonal Railways .

Enclosure: As above.

मो. आमिर सिद्दीकी  
निदेशक / टेली- II  
कृते महानिदेशक / सिग. एवं दूर.

Mohammad Aamir Siddiqui  
Director/ Telecom- II  
for Director General/S&T

18/01/21

Effective date:17.06.2025	Reference: RDSO/ SPN/TC/45/2013 Revision 2.0 with Amendment No. 1.0 & 2.0.
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### Amendment No. 3

To

Specification No. RDSO/ SPN/TC/45/2013 Revision 2.0 with Amendment No.  
1.0 & 2.0

of

Permanently Lubricated HDPE Duct

S No	Clause no.	Amended Description		
1.	5A 2. a.	Parameter	Specified limit	Test method
		Colour	The colour of the duct shall be bright orange/ bright green and uniform through out. (or any other suitable colour as per the requirement of zonal railway.) The colour of the inner layer shall be white	IS: 9938
2.	Clause 6.1.3	<b>Cable Sealing Plug:</b> This is used to seal the ends of the ducts perfectly, after the cable is installed in the duct, to prevent the entry of dirt, water, moisture, insects/rodents etc. This is required at all places where cable has come out of the duct either for jointing or entry into the building as required. The sealing plug shall be capable of accommodating armoured optical fibre cable as per <b>Specification No. RDSO/SPN/TC-110/ 2020 Rev-0</b> component shall be of nitrile rubber for increased life.		



3.	Clause Annexure-E (b)	A suitable length of armoured optical fibre cable as per <b>Specification No. RDSO/SPN/TC-110/ 2020 Rev-0</b> shall be inserted into the sample.
4.	Clause Annexure -I	<p><b>(Optical Fibre Cable Blowing Test)</b></p> <p>For this test an Armoured Optical Fibre Cable as per <b>Specification No. RDSO/SPN/TC-110/ 2020 Rev-0</b> shall be installed by blowing of the cable in a length of 1 Km of the duct. The duct shall be laid with bends in the horizontal and vertical planes and a rise in the middle as detailed in the figure –1. The 1 Km section shall include two couplings at suitable locations as shown in the figure.</p> <p>The OFC shall then be blown out. It shall be inspected for any visual damage. The OFC shall then be blown in again.</p> <p>It shall be possible to blow in the Optical fibre Cable through the 1 Km duct, each time in not more than 30 minutes. There shall be no visible damage to OFC.</p> <p>The test will be conducted on two samples out of the five submitted for Type Approval.</p>

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