वर्गीय आवश्यकताओं के लिए मानक
टीईसी ७२०३०: २०२५

(टीईसी/जीआर/एफए/सीडीएस-008/04/अगस्त-19 को अधिक्रमित करता है)

STANDARD FOR GENERIC REQUIREMENTS
TEC 72030:2025

(Supersedes No. : TEC/GR/FA/CDS-008/04/AUG-19)

परमनेंटली लुब्रिकेटेड एचडीपीइ टेलीकॉम डक्ट्स फॉर उसे आस अंडरग्राउंड ऑप्टिकल फ़ाइबर केबल कंदुइट्स

PERMANENTLY LUBRICATED HDPE TELECOM DUCTS FOR USE AS UNDERGROUND OPTICAL FIBRE CABLE CONDUITS

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र
खुर्शीदलाल भवन, जनपथ, नई दिल्ली–११०००१, भारत

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FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of the Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE) Policy
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centers (RTECs) have been established which are located in New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This document covers the requirement of permanently lubricated High Density Polyethylene ducts (PLB HDPE ducts) for use as underground cable conduits for optical fibre cables, suitable for cable installation by blowing technique.

CONTENT

HISTORY SHEET

S.No.	Name of the Generic Requirements	No. of the Generic Requirements	Remarks
1)	Permanently Lubricated HDPE Telecom Ducts For Use As Underground Optical Fibre Cable Conduits	G/CDS-04/01. MAY 94	First issue
2)	Permanently Lubricated HDPE Telecom Ducts For Use As Underground Optical Fibre Cable Conduits	C/CDS-008/02.NOV 2004	Second issue
3)	Permanently Lubricated HDPE Telecom Ducts For Use As Underground Optical Fibre Cable Conduits	TEC/GR/TX/CDS-008/03/MAR-11	Third issue
4)	Permanently Lubricated HDPE Telecom Ducts For Use As Underground Optical Fibre Cable Conduits	TEC/GR/FA/CDS-008/04/AUG-19	Fourth issue
5)	Permanently Lubricated HDPE Telecom Ducts For Use As Underground Optical Fibre Cable Conduits	TEC 72030:2025	Fifth issue

REFERENCES

IS:2530	Methods for test for Polyethylene Moulding Materials and Polyethylene Compounds.
IS: 4984	High density polyethylene pipes for water supply
IS: 5175	Polypropylene ropes
IS:7328	High density polyethylene materials for moulding and extrusion
IS:9938	Recommended colours for PVC insulation for LF wires and cables
IS:12235 (Part-9)	Methods of test for unplasticized PVC pipes for potable water supplies – Impact strength at 0°C
IS:14151 (Part-1)	Polyethylene pipes for sprinkler irrigation systems (Part-1 Pipes)
ASTM D 638	Standard Test Method for Tensile Properties of Plastics
ASTM D 648	Test method Deflection Temperature of plastics under flexural load.
ASTM D 790	Test Method for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials.
ASTM D 1693	Test Method for environmental stress cracking of ethylene plastics
ASTM D 1712	Standard Practice for Resistance of Plastics of to Sulfide Staining.
ASTM D 2240	Standard Test Method for Rubber Property
ASTM D 4565	Standard Methods of Testing Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable.
ASTM F 2160	Standard Specifications for solid Wall, HDPE Conduit Based on Controlled OD.
ASTM G 154	Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Non-metallic materials.

Note:

Unless otherwise explicitly stated, the latest approved issue of the standard/GR/IR, with all amendments in force, listed in references, on the issuance date of this GR/IR applicable ”

PART-I

1.0 GENERAL:

1.1 Scope: This document covers the requirement of permanently lubricated High Density Polyethylene ducts (PLB HDPE ducts) for use as underground cable conduits for optical fibre cables, suitable for cable installation by blowing technique.

2.0 PRODUCT DESCRIPTION:

2.1 The PLB HDPE duct shall consist of two concentric layers, the outer layer being HDPE; co-extruded with an inner layer of solid permanently 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 OF cable. The lubricant layer shall be clearly visible in cross-section, concentric with the outer layer.

2.2 The PLB HDPE duct shall be supplied in a continuous length in coil form, suitable for shipping and handling purposes.

3.0 MATERIAL:

3.1 Two layer construction:

3.1.1 Outer Layer: The base HDPE resin used for the outer layer of the PLB HDPE duct shall conform to any designation of IS: 7328 or to any equivalent standard meeting the following requirements. However, the manufacturers shall furnish the designation for HDPE resin as per IS: 7328, as applicable.

Table-1

a)	Density	0.940 to 0.958 g/cc at 27°C, when tested as per IS: 2530 or IS: 7328
b)	Melt Flow Rate (MFR)	0.2 to 1.1 g/10 minutes at 190° C & 5 kg load, when tested as per IS: 2530
c)	Tensile Strength at Yield	20 N/mm² minimum. when tested as per ASTM D 638, Type-IV specimens
d)	Elongation at break	>600% when tested as per ASTM D638, Type-IV specimens
e)	Flexural Modulus at 1% strain	690 N/mm² minimum, when tested as per ASTM D 790.
f)	Hardness, Shore-D	Between 60 and 65 units, When tested as per ASTM D 2240
g)	Heat Deflection Temperature at 45 g/mm²	65°C minimum., when tested as per ASTM D 648.
h)	Environmental Stress Crack resistance, when tested with 10% Igepal, CO 0630 Solution at 50° C.	96 hrs., when tested as per ASTM D 1693, No cracks
i)	Weathering in artificial (UV) light (Specimens shall be as per ASTM D 638 Type-IV) and cut from compression moulded sheet.	After exposure for 720 hrs., Tensile strength shall be tested. The variation shall not be greater than 20% compared to tensile strength obtained at c) above. For detail of cycle time etc., refer clause 4.22
j)	OIT (in Aluminium Pan)	30 minutes minimum, when tested as per Annexure-I of this GR.
k)	UV Stabliser Content	Hindered Amine Light Stabliser minimum 0.15%,

		When analysed as per FT-IR method. (external agency report conforming to the requirement shall be submitted by vendor)

3.1.2 Inner Layer: The inner lubrication material shall be of friction reducing, polymeric material which shall be integral with HDPE layer. The lubricant materials shall have no toxic or dermatic hazards for safe handling. In the finished PLB 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. The density of inner layer material shall be between 0.940 and 0.958 g/cc at 27°C. The test will be conducted by collecting raw material from the hopper during extrusion & tested as per ASTM D 792 or IS 7328.

3.1.3 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.

3.2 The raw material (s) used for the duct shall meet the following requirements:

a) The anti-oxidants used shall be physiologically harmless.
b) None of the additives shall be used separately or together in quantities as to impair long term physical and chemical properties of the duct.
c) Single pass rework material of the same composition produced from the manufacturer ' s own production shall be used and it shall not exceed 10% in any case.
d) The raw material used for extrusion shall be dried to bring the moisture content to less than 0.1%.

e) Suitable UV stablisers shall be used for manufacture of the duct to protect against UV degradation, when stored in open for a minimum period of 8 months.

f) 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.

Note: Undertaking from OEM/Manufacturer for the service life of the finished product and all its accessories including the life of permanent lubricant shall be submitted in support of 50 years of life.

2)

a) The ash content of the colour master batch shall not be more than 12% when tested as per method detailed below:
Test Method for ash content: About one gram of the sample under test shall be taken and dried at 105°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 ± 50°C and allowed to remain there for three hours. The ash content may be calculated as a percentage of the weight of the original sample.

3.3 Source approval: The HDPE resin raw material used in the manufacture of ducts shall have source approval of CACT/ TEC designated CAB/Accredited laboratory. The source approval for the HDPE resin raw material will be granted by CACT/ TEC designated CAB/Accredited laboratory if the material conforms to clause 3.1.1.

PART-II

4.0 COMPLETED PLB HDPE DUCT REQUIREMENTS:

4.1 Visual Inspection: The ducts shall be checked visually for ensuring good workmanship. The ducts shall be free from blisters, shrink holes, flaking, chips, scratches, roughness, break and other defects. The ducts shall be smooth, clean and round. The end shall be clearly cut and shall be square with axis of the duct.

4.2 Colour of the Duct:

Table-2

Sub-clause No. W.r.t to Main Clause No.4.2	Description of the sub-clause
4.2.1	The colour of the offered duct for Type Approval shall be made in eight colours viz. GREEN, ORGANGE, BLUE, YELLOW, BROWN, VIOLET, GREY AND RED
4.2.2	The colour of the duct shall be uniform throughout(visual inspection)
4.2.3	Each duct shall contain four approximately equispaced continuous, longitudinal stripes of width minimum 3 mm, in white colour
4.2.3	The white coloured strips on the duct surface shall be co-extruded during the duct manufacturing
4.2.4	The material of the stripes shall be same as that of base compound of the duct/raw material used for Outer Layer of the Duct.
4.2.5	The purchasing authority shall specify the colour of the duct ordered(Refer Appendix 1 regarding guidelines for Tendering Authority).

4.2.6	The inner layer shall be white in colour
4.2.7	The colours of the duct, stripe and inner layer shall be

4.3 Dimensions of ducts: The nominal size of the ducts shall be 32/26 mm, 40/33 mm, 50/42 mm, 63/50 mm & 110/80 mm and shall meet the following requirements:

Table-3

	32 mm/26 mm	40 mm /33 mm	50 mm/42 mm	63mm/50 mm	110mm/80 mm
a) Outside diameter	32 mm + 0.3 mm – 0.0 mm	40 mm + 0.4 mm – 0.0 mm	50 mm + 0.5 mm – 0.0 mm	63 mm + 0.6 mm – 0.0 mm	110 mm + 1.0 mm – 0.0 mm
b) Wall thickness	3.0 mm ± 0.2 mm	3.5 mm ± 0.2 mm	4 mm ± 0.3 mm	6.5 mm ± 0.40 mm	15.0 mm ± 0.60 mm
c) Thickness of the Inner Layer	Minimum: 0.24mm Maximum: 0.36mm	Minimum: 0.28 mm Maximum: 0.42 mm	Minimum: 0.32 mm Maximum: 0.48 mm	Minimum: 0.36 mm Maximum: 0.54 mm	Minimum: 0.56 mm Maximum: 0.84 mm
d) Standard length	1000 ± 100 meters	1000 ± 100 meters	1000 ± 100 meters	500 ± 50 meters	200 meters ± 20 meters.
e) Maximum outer diameter of OF cable that can be installed by blowing technique.	12 mm	16 mm	21 mm	25 mm (144 fibres)	40 mm (576 fibres)

Note 1: Selection of duct size will depend on the outside diameter of the O. F. cable to be installed.

Note 2: Purchaser may ask for different standard length depending upon its requirement.

4.4 Optional pre-installed rope for the above standard length duct: The duct shall be supplied with pre-installed rope when so ordered by the purchasing authority.

Name of the Test	Test Limits various types of duct dimensions				
	32 mm/26 mm	40 mm/ 33 mm	50 mm/ 42 mm	63 mm/ 50 mm	110 mm/80 mm
Polypropylene Rope size (Optional pre-installed rope dia as per IS 5175)	4 mm dia with a minimum slackness of 2%	4 mm dia with a minimum slackness of 2%	4 mm dia with a minimum slackness of 2%	6 mm dia	6 mm dia

4.5 Tensile Strength and Elongation: The sample taken from the PLB HDPE ducts when tested as per ASTM F 2160 (using type IV specimens of ASTM D 638) shall meet the following requirements:

Tensile Strength at yield --- Min. 20 N/mm² } When tested at a machine
Elongation --- Min. 500% } speed of 50 mm/min.

4.6 Longitudinal 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 ± 2°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.

4.7 **Environmental Stress Crack Resistance**: The test specimen cut from the PLB HDPE ducts(for ≤ 50 mm outer dia duct) or from compression molded sheet from the material of finished duct(for more than 50 mm outer dia duct), shall meet the environmental stress cracking as described in ASTM D-1693, when tested with 10% Igepal (CO 630) solution at 50 ± 1°C for 96 hours. There shall be no failure/cracks.

4.8 Impact Strength: 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°. 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 a 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.

4.9 Crush Resistance: Samples of duct of 150 mm ± 2 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.

4.10 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 metre length of duct, freely throughout the length, when the duct is bent to a radius of 5 metres.

4.11 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.

Table-4

Name of the Test	Test Limits various types of duct dimensions				
	32 mm/	40 mm/	50 mm/	63 mm/	110 mm/

	26 mm	33 mm	42 mm	50 mm	80 mm
Oveality Test as per IS: 4984	shall not exceed 1.3 mm	shall not exceed 1.4 mm	shall not exceed 1.4 mm	shall not exceed 1.5 mm	shall not exceed 2.2 mm

4.12 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 recoiling. For this purpose, when a minimum length of 50 metres duct taken from the coil and laid on the ground, it shall be straight without any bends or kinks and without deformation, except 5 metres from each end.

4.13 Oxidation Induction Test: The induction time in oxygen when tested as per method in Annexure-I, shall not be less than 30 minutes.

4.14 Hydraulic Characteristics: The duct shall be tested for internal pressure creep rupture test 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 brust 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:

Table-5

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

4.15 Internal Co-efficient of Friction:

Internal Co-efficient of Friction (applicable to 32/26mm, 40/33mm, 50/42mm & 63/50mm ducts):

The Internal Co-efficient of Friction when tested as per the method in Annexure-2, shall not exceed following value as mentioned below:

- For Nylon Jacketed unarmoured OFC: 0.06 Max. for HDPE PLB Ducts.

- For HDPE Jacketed unarmoured OFC : 0.20 Max. for HDPE PLB Ducts.

4.16 Identification Markings: The duct shall be prominently marked with indelible ink, with the following information at intervals every metre to enable identification of the pipe. The size of ink markings shall be distinct, clearly and easily visible.

- Service Provider/Purchaser cable duct
- Telephone Emblem (specific to purchaser)
- Manufacturer ' s name (also can be in abbreviated form)
- Name of the duct with size
- For marking machine number/specific Serial No. of the duct and date of manufacture, a composite number as mentioned below would be used.

A composite no. shall be given in the format PXXSSSS DDMMYY, where –

P- Site / Plant No
XX- Machine Number,
SSSS - Serial No. of the duct length manufactured in machine number X.

DD - Date of manufacture,
MM- Month of manufacture
YY- Year of manufacture,

Along with the above composite number, sequential marking at every metre shall be done for each duct length.

4.17 Optical Fibre Cable Blowing Test (applicable to 32/26mm, 40/33mm, 50/42mm & 63/50mm ducts): For this test an optical Fibre Cable of a diameter nearest to the diameter indicated in clause 4.3 (e) of the GR; relevant to the size of duct under test shall be installed by blowing of the cable in a length of 1 km of the 32/26mm, 40/33mm , 50/42mm duct and 500 meter of the 63/50mm duct. The duct shall be laid with bends in the horizontal and vertical planes and a raise in the middle as detailed in the Figure-1. The 1 km section shall include two couplings and 500 meters section shall include two coupling at suitable locations as shown in the Figure 1 and figure 2 respectively.

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 possible to blow in the Optical Fibre Cable through the 1 km duct, each time in not more than 35 minutes, for 32/26mm, 40/33mm & 50/42mm ducts and through 500 meters 63/50mm duct as decided by purchaser. There shall be no visible damage to OFC.

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

4.18 Density: The density of the duct shall be between 0.940 and 0.958 gms/cc at 27°C and shall not differ from that of the raw material by more than 0.003 gms/cc, when tested as per IS:2530 or IS: 7328. The same test method shall be used for determining the density of the raw

material as well as the completed duct. The test will be conducted by collecting raw material from the hopper during extrusion and finished duct made from the same material.

4.19 Melt Flow Rate (MFR): The change in the MFR caused by processing of raw material into 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%, when tested as per IS: 2530. The test will be conducted by collecting raw material from the hopper during extrusion and finished duct made from the same material.

4.20 Ash Content: The ash content of duct shall not be more than 0.3% when tested as per method described in clause 3.2 (g).

4.21 Test for fading of colours of duct: The duct shall be tested for the fading of colours as per ASTM D 1712. There shall be no discolouration.

4.22 UV Stabliser 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/m²/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 specimens)

After aging the specimens shall be tested for tensile strength at yield at a speed of 50 mm/minute. The variation compared to the value obtained before aging as in clause 4.5 shall not be more than 20%."

5.0 PLB HDPE DUCT ACCESSORIES:

5.1 The following accessories are required for jointing the ducts and shall be supplied along with the ducts. The manufactures shall provide complete design details, procedure for method of installation and type/grade of the material used for the accessories. The required quantity shall be indicated by the Purchasing Authority in the purchase order.

a) Plastic Coupler (Push-fit type/Compression type): 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 the two ducts are butted smoothly without any step formation in the inner surface. The jointing shall meet the air pressure test of 15 kg/cm² for a minimum period of two hours without any leakage. The material of the coupler shall be injection moulding grade HDPE or polypropylene and the manufacturer shall furnish specification, make and grade of the material.

Either Screw-fit (also called Compression type) OR Push-fit Couplers, meeting the above requirements may be used.

Manufacturer shall furnish the complete engineering drawings of the various components used. 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 (opening for entry of duct) shall be covered with removable caps, to prevent the entry of foreign matter while not in use.

b) 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.

c) 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 standard sizes of optical fibre cable taking into account the variation in diameter due to tolerance limits, etc.

d) End Cap: This cap, made of hard rubber/suitable plastic material, shall be fitted onto 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.

Note: The accessories in Clause 5.1 (b) and (c) shall be tested for air tightness with a pressure of 1 bar for 30 minutes. For carrying out the tests for the above accessories, suitable length of duct shall be taken. No part of the accessory shall be made of metal.

5.2 Pulling force required to pull out two pieces of duct joined by coupler: The pulling force required shall be a minimum of 800 kgf for 110/80 mm duct, 550 kgf for 63/50 mm duct, 450 kgf for 50/42 mm duct, 320 kgf for 40/33 mm duct and 250 kgf for 32/26 mm duct. The test may be

conducted by loading the coupler joined by two pieces of duct for 15 minutes using a Universal Tensile testing machine. ”

5.3 Ageing Test for Accessories: The accessories, viz., coupler, end plug and cable scaling plug covered in Clause 5.1 of the GR shall be subjected to an ageing test. In this test, the accessory under test shall be installed on a piece or pieces of duct as the case may be. It shall then be tested for tightness as per the GR and it shall pass the test. The accessory thus installed shall then be aged in an air circulating oven at 70 ± 2°C for 168 hours. At the end of the period, it shall be allowed to cool to room temperature and then be tested for tightness as per the GR and it shall pass the test.

5.4 The following additional tools are required for jointing of the ducts and installation of optical fibre cable. These items can be procured as per the Manufacturer/Supplier ’s specification, as and when required by the Purchasing Authority.

a) Rotary Duct Cutter: This is required to cut the duct ends squarely without any burr or notch.

b) C-Spanner: This is required to tighten Plastic Coupler properly so as to ensure air/water tightness as specified above, in case of compression type coupler.

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

d) Blowing Equipment: The equipment used for installing optical fibre cable by blowing technology shall be capable of pushing 1 km (minimum) cable into the duct with powerful air stream generated by a compressor. The compressor shall have the following characteristics:

Pressure	:	Min. 8 bar Max. 12 bar
Flow rate	:	10 m^3/minute

The mechanical feeder of the equipment shall not cause any damage to the sheath/jacket of the optical fibre cable.

Note: It shall also be possible to pull the OF cable manually over shorter sections (up to 200 metres) which will be described in the Engineering Instructions.

6.0 Type Approval/Technical specification evaluation:

6.1 All the tests mentioned in this document shall be carried out on ducts as per the procedure described in the following paragraphs and the samples must pass these tests before according the type approval/technical specification evaluation certificate. For according type approval/technical specification evaluation certificate, the manufacturer shall furnish the samples as per the sample plan given in Clause No. 6.2 and 6.3 below for carrying out these tests. Bulk manufacture and supply shall start only after the issue of type approval/technical specification evaluation certificate. The type approval certificate/technical specification evaluation certificate shall clearly indicate the type/grade/source of high density polyethylene raw material, the size of the duct and the construction of the duct that is " two layers. "

6.2 When single colour, single size duct is offered, the following sampling plan etc are to be followed.

Sampling Plan	UV ageing test to be done on	Blowing test to be done	All other tests to be done on	Remarks

		on		
Five ducts each having the standard length, to be offered.	Only one duct per size per colour.	Two ducts per size.	All the five ducts for one size.	-Nil-

6.3 Sampling plan etc when multi colour, multi size ducts are offered.

Sampling Plan	UV ageing test to be done on	Blowing test to be done on	All other tests to be done on	Remarks
Minimum two ducts per one colour per one size should be offered.	For each size and each colour one duct should be offered.	Two ducts (colour independent) per one size	All the ducts	For all the colour and size put together the number of ducts offered should not be less than 5 nos.

6.4

OEMs/Manufacturers shall inform the purchaser whenever grade/source of raw material (s) is changed, alongwith valid source approval certificate in accordance with the provision of clause 3.3 above. In case, the grade/source of raw material(s) like HDPE resin or Solid Lubricant, is changed, the OEM/ Manufacturer shall obtain Fresh Type Approval Certificate (TAC) /TSEC, on furnishing compliance to the following incremental tests:

i) Hydraulic Characteristic;

ii) Impact strength;

iii) Crush Resistance;

iv) Environmental Stress Crack Resistance (ESCR);

v) UV Ageing test;

vi) Oxidation Induction Test;

vii) Density and Melt Flow Rate.

However, the purchaser may specify the exact requirement of incremental tests in modification of above tests, if any.

Type Approval Certificate/TSEC shall be issued for each grade/source of raw material in accordance with the above-mentioned incremental test(s) as applicable. Further initially issued TAC/TSEC in respect of particular source of raw materials shall remain valid till its validity Period.

7.0 ACCEPTANCE TEST:

7.1 The acceptance tests shall be carried out on samples selected from the lot as per Table-6 for Dimensional and Visual requirements. The requirements for Tensile Strength & Elongation, Reversion Test, Environmental Stress Crack Resistance, Impact Strength, Crush Resistance, Oxidation Induction Test, Hydraulic Characteristics and Internal Co-efficient of Friction shall be carried out as per Table-7. In addition to measuring wall thickness and testing for internal co-efficient of friction at the ends, these two parameters shall be checked at any point between the ends by cutting the duct at intermediate points. The duct thus cut can be supplied to the field with an additional coupler.

7.2 The dimensions and breaking load of rope shall be checked when duct is supplied with pre-installed rope.

7.3 The acceptance tests and the sampling plan can be modified by the Service provider/purchaser at his discretion at any point of time.

8.0 STORAGE

8.1 All the materials shall be stored in the manufacturer ' s premises in such a manner that it will not affect the performance of the product.

9.0 PACKING AND DELIVERY:

9.1 The store shall be supplied in coils of suitable size for delivery in such a manner that they arrive at their destination in a safe and undamaged condition and will permit the loading, unloading and handling the stores using standard moving equipment. The minimum inner bending diameter of the coiled duct shall be 18 times the outer diameter of the duct.

10.0 QUALITY REQUIREMENTS OF THE MANUFACTURING SYSTEM

The item shall be manufactured in accordance with International quality standards ISO 9001: 2015(or latest) for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted.

7 m Vertical Raise; R > 1 m

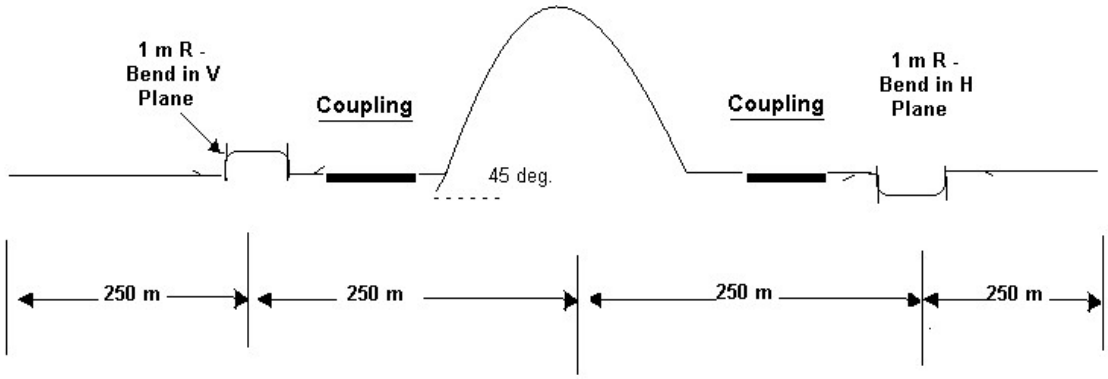

Figure-1
(For 32/26mm, 40/33mm & 50/42mm Ducts)

3 m Vertical Raise; R >1.6m

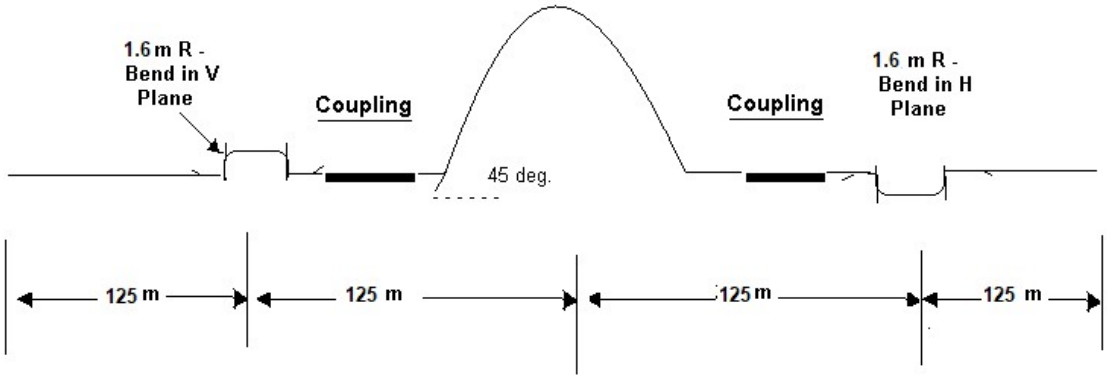

Figure-2
(For 63/50mm Duct)

DUCT LAYOUT FOR BLOWING TEST

Note:- 1. Dimentions are not to scale
2. For clarity sake, the duct is shown as laid straight. It can be a closed curve in the factory permises for convenience.

TABLE – 6

SCALE OF SAMPLING FOR VISUAL AND DIMENSIONAL REQUIREMENTS

No. of coils (Ducts) in the Lot	Sample No.	Sample Size	Cumulative Sample Size	Acceptance No.	Rejection No.
(1)	(2)	(3)	(4)	(5)	(6)
Up to 150	First	13	13	0	2
	Second	13	26	1	2
151 to 280	First	20	20	0	3
	Second	20	40	3	4
281 to 500	First	32	32	1	4
	Second	32	64	4	5
501 to 1200	First	50	50	2	5
	Second	50	100	6	7
1201 to 3200	First	80	80	3	7
	Second	80	160	8	9
3201 to 10000	First	125	125	5	9
	Second	125	250	12	13
10001 to 35000	First	200	200	7	11
	Second	200	400	18	19

Criteria: The number of ducts given for the first sample in Column 3 shall be examined for dimension and visual requirements. A duct failing to satisfy any of these requirements shall be considered as defective. The lot shall be deemed to have satisfied these requirements, if the number of defectives found in the first sample are less than or equal to the corresponding

acceptance number given in Column 5. The lot shall be deemed not to have met these requirements if the number of defectives found in the first sample is greater than or equal to the corresponding rejection number given in Column 6. If, however, the number of defectives found in the first sample lies between the corresponding acceptance and rejection number given in Column 5 and 6, the second sample of the size given in Column 3 shall be taken and examined for these requirements. The lot shall be considered to have satisfied these requirements, if the number of defectives found in the cumulative sample is less than or equal to the corresponding acceptance number given in Column 5; otherwise not.

TABLE – 7

SAMPLING FOR ACCEPTANCE TESTS

A separate sample size for each of the tests shall be taken as stipulated at random from the samples already examined for dimensions and visual inspection. All the ducts in each of the sample size shall be tested for compliance for the requirements for:

(a) Tensile Strength & Elongation (Clause 4.5)
(b) Longitudinal Reversion Test (Clause 4.6)
(c) Environmental Stress Crack Resistance (Clause 4.7)
(d) Impact Strength (Clause 4.8)
(e) Crush Resistance (Clause 4.9)
(f) Oxidation Induction Test (Clause 4.13)
(g) Hydraulic Characteristics (Clause 4.14)
(h) Internal Co-efficient of Friction (Clause 4.15)

The lot shall be considered to have met the requirements of these tests, if none of samples tested fails.

No. of coils	Sample Size
Up to 150	3
151 to 1200	5
1201 to 35000	8

ANNEXURE - 1

OXIDATION INDUCTION TEST

1.0 A short length of completed duct (approximately 30 cm) shall be sealed at the ends and placed in an oven at temperature of 68 ± 1°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).

2.0 Instrument Test Procedure:

2.1 Cell Cleaning: The cell shall be held at approximately 400°C for 10 minutes in Nitrogen. The cell shall be cleaned after standing over night and between testing of different formulations.

2.2 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°C at a heat rate of 5°C per minute or any other heat rate as indicated in the manual of the equipment is permitted.

2.3 Aluminium Pan Preparation: Standard aluminium DSC pans as per ASTM D 4565 are required to hold specimens during testing. A fresh pan shall be used for each test.

2.4 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.

2.5 Nitrogen Purge: Place the sample pan and reference pan in instrument cell. Flush for 5 minutes wit cylinder of nitrogen (99.6% extra dry grade) at 60 ± 10 cc per minute.

2.6 Oxidation Test: Rapidly increase the temperature of the sample (20°C/min or greater) from 100°C or lower initial temperature to 199 ± 1°C. After thermal equilibrium is obtained (steady recorder signal) switch to 80 ± 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.

2.7 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.

2.8 Automatic OIT equipment ” (Differential Scanning Calorimeter) for testing the Oxidation Induction Time shall be available as the test equipment for testing OIT parameter.

Annexure – 2

INTERNAL CO-EFFICIENT OF FRICTION

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

2. 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.

3. METHOD:

a) A suitable length of the duct, pre-conditional at 23 ± 2°C for 2 hours, shall be secured to the text fixture such that the sample completes a 450° wrap, with one end extending vertically 200 mm towards the floor.
b) A suitable length of optical fibre cable shall be inserted into the sample.
c) The extensometer and the test fixture shall be aligned and secured from 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 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

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

$$\text{Internal Co-efficient of Friction (ICF)} = \frac{\log_e (T_1 / T_2)}{Q}$$

Where, T_1 = Pulling force in kg; T_2 = 25 kg

Q = Angle of the subtending are between T_1 & T_2, in radians

(i.e., 450° = 7.85398 radians)

APPENDIX- 1

GUIDELINES FOR TENDERING AUTHORITY

1. COLOUR OF THE PLB HDPE DUCT (Clause 4.2):

The PLB HDPE Ducts are made of eight colours viz., Green, Orange, Blue, Yellow, Brown, Violet, Grey and Red. The colour of the duct is uniform throughout. Each duct shall contain four approximately equispaced, continuous, longitudinal stripes of width 3 mm (minimum), in white colour. The purchasing authority shall specify the colour/colours of the duct ordered for.

2. SIZE OF DUCTS(Clause 4.3):

The PLB HDPE Ducts are available in five sizes viz., a) 32 mm/26 mm, b) 40 mm/33 mm c) 50 mm/42 mm d) 63 mm/50 mm & e) 110 mm/80 mm. Selection of duct size will depend on the outside diameter of the Optical Fibre Cable to be installed. The purchasing authority shall specify the size of the duct ordered for.

3. PLASTIC COUPLER (Clause 5.1a):

It is used to couple two ducts. Either

a) Screw-fit (also called Compression Type) or
b) Push-fit Coupler may be used.

The purchasing authority is at liberty to use any one of the above couplers. The purchasing authority may specify the type of coupler ordered for.

Note: If Screw-fit couplers are ordered, then C-Spanners are required to tighten properly so as to ensure air/water tightness.

4. In case, the grade/source of raw material(s) like HDPE resin or Solid Lubricant, is changed, the purchaser may specify the exact requirement of incremental tests in modification of the tests prescribed at Section 6.4, Part-II above, if any for issuing fresh Type Approval Certificate (TAC) /TSEC.

ABBREVIATIONS

ASTM	American Society for Testing and Materials
Cc	Cubic Centimeter
cm^2	Square Centimeter
°C	Degree Centigrade
CACT	Component Approval Centre Telecommunications
DOT	Department of Telecommunications
DSC	Differential Scanning Calorimeter
F	Fibre
G	Gram
GR	Generic Requirements
HDPE	High Density Polyethylene
ICF	Internal Co-efficient of Friction
IS	Indian Standard
Kg	Kilogram
MFR	Melt Flow Rate
Mm	Millimeter
mm^2	Square millimeter
MPa	Mega Pascal
N	Newton
OF	Optical Fibre
PLB	Permanently Lubricated
%	Percentage
TQA	Telecom Quality Assurance
UV	Ultra Violet

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