SEC DISTRIBUTION MATERIAL SPECIFICATION	23-SDMS-01
	DATE: 19-03-2011

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SPECIFICATION

FOR

DUCT, HDPE Main

Mini & Micro-Ducts

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CONTENTS

DOCUMENT CONTROL & RECORD

Issue No.	Date	Action	Reason
3			
4			

1.0 GENERAL

1.1 Scope

This specification covers the minimum standards and requirements for the construction, properties, testing and packing of High Density Polyethylene (HDPE) ducts and their accessories to be supplied to Saudi Electric Company (SEC).

1.2 Intended Use

1.2.1 HDPE ducts are used for the construction of underground duct system for fiber optic and copper cables in the telecommunication's outside plant network. They are intended to be installed by direct buried in a normal trench or mini trench at standard depths.

1.2.2 The HDPE ducts are intended for housing of copper or fiber optic cables installed by traditional pulling techniques. Also, the ducts can accommodate fiber optic cables that are installed by blowing method.

1.3 Long Term Performance Requirements

1.3.1 The HDPE Plain ducts and their accessories supplied in compliance with this specification shall be capable of withstanding the typical service conditions of the Kingdom of Saudi Arabia for a period of fifty (50) years without detriment to the transmission or operation and maintenance characteristics of the products.

1.3.2 The HDPE Plain ducts shall be designed, manufactured and packaged so that the physical, transmission and operation and maintenance characteristics shall not degrade when exposed to the environmental conditions of Saudi Arabia and the expected environmental conditions during storage and transportation outside of the Kingdom. The environmental conditions of Saudi Arabia may include ambient air temperature variations from -10°C to +55°C. In addition, direct solar radiation is known to increase the temperature of some outside plant to approximately 70°C.

1.4 Reserved Right

1.4.1 The Saudi Electric Company (SEC) reserves the rights to make changes to this Specification without prior notice.

1.4.2 The Saudi Electric Company (SEC) cannot guarantee if any of the standards and requirements of this specification are not covered or protected by copyright or patent of a third party.

1.5 Associated Specifications

1.5.1 The following unattached international and/ or national standards shall be applied, and deemed to be an integral part of this specification:

ISO 9001:2008	**Quality management system**
ISO 12162	**Standard for Thermoplastics Materials for pipes and Fittings for pressure applications**
ISO/TR 10358	**High density polyethylene pipes and fittings – Combined Chemical resistance Classification Table**
DIN 8074	**Polyethylene (PE) Pipes - Dimensions.**
DIN 8075	**Polyethylene (PE) Pipes –General quality requirements and testing.**
ASTM D 1525	**Test Method for Vicat Softening Temperature of Plastics**
ASTM D 1693	**Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics**
ASTM D 1473	**Standard Test Method for Slow Crack Growth - Polyethylene Notch Test.**
ASTM D 1603	**Test Method for Carbon Black in Olefin Plastics**
ASTM D 2122	**Test Method for Determining Dimensions of Thermoplastic Pipe & Fittings.**
ASTM D 256	**Test Method for Tensile Properties of Plastics**

ASTM D 696	**Test Method for Coefficient of Linear Thermal Expansion of Plastics**
ASTM D 638	**Test Method for Determining the Pendulum Impact Resistance of Notched Specimen Plastics.**
ASTM D 746	**Test Method for Brittleness Temperature of Plastics**
ASTM D 790	**Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials**
ASTM D 792	**Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement**
ASTM D 1238	**Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.**
ASTM D 2240	**Test Method for Rubber Property – Durometer Hardness**
ASTM D 2837	**Test Method for obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials**
ASTM D 3350	**Specification for Polyethylene Plastics Pipe and Fittings Materials**
ASTM F 2160	**Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD).**
ASTM F 2176	**Standard Specification for Mechanical Couplings Used on Polyethylene Conduit, Duct and Inner-duct**
Telcordia GR-356	**Generic Requirements for Telecommunications Conduit, Inner-duct, Duct, and Accessories**

1.6 Definitions and Abbreviations

1.6.1 Definitions

DIN German Institute for Standardization (Deutsches Institut fur Normung).

ASTM	**American Society for Testing and Materials**
ISO	**International Standards Organization**
Main ducts	**Ducts which available in two sizes, with OD of 110mm and 75mm.**
Mini-ducts	**Ducts which available in five sizes, with OD of 20, 32, 40 and 50mm.**
Micro-ducts	**Ducts which are less than 20 mm OD.**

1.6.2 Abbreviations

HDPE	**High Density Polyethylene**
MRS	**Minimum Required Strength**
SDR	**Standard Dimensional Ratio**
PN	**Nominal Pressure (Bar)**
ID	**Inside Diameter**
OD	**Outside Diameter**

2. TECHNICAL REQUIREMENTS

2.1 General

2.1.1 The HDPE ducts shall be compatible with the latest installation standards and operation and maintenance practices for the telecommunication's duct system.

2.1.2 Any alternative proposals for Type and Acceptance Testing will be subject to technical evaluation by SEC with regards to satisfactory compliance with the material and product qualities implied by this specification.

2.1.3 HDPE ducts, to be supplied in variety of sizes, categorized as Main, Mini-ducts and Micro-ducts.

2.1.4 The HDPE ducts supplied empty or with built-in sub-ducts or inner-ducts, shall be flexible and easy to install.

2.1.5 The HDPE ducts shall have inner and outer surfaces that are clean and free from grooves, cracks, blisters, shrink holes or any other defects or foreign matters, which might impair the performance of the ducts in service.

2.1.6 The HDPE ducts shall be acceptably rounded. They shall be supplied with its ends neat, smooth and cut cleanly at right angles or perpendicular to the axis of the ducts.

2.1.7 The HDPE ducts shall be highly resistant to all kinds of corrosive liquids, aggressive media and chemicals usually found in the ground.

2.1.8 The HDPE ducts shall have no requirement for end load restraint for fusion weld system.

2.1.9 The HDPE ducts shall be Light weight, flexible and shall contain correct type of carbon black protection against Ultra Violet (UV) degradation.

2.1.10 The HDPE ducts and its accessories shall be unaffected by all kinds of corrosive liquids and other compounds which exist in the underground system.

2.1.11 All material used in the HDPE ducts shall be non-toxic and dermatologically safe.

2.1.12 The manufacturer shall be ISO certified in accordance with the ISO9000:2008 for quality management system.

2.2 Design Requirements

2.2.1 The HDPE ducts shall be supplied according to the requirements specified in Table 1.

<table>
<tr><th>Clause</th><th>Parameters</th><th>Requirements</th></tr>
<tr><td>2.2.1</td><td>HDPE Ducts</td><td></td></tr>
<tr><td>2.2.1.1</td><td>Material</td><td>High density polyethylene (HDPE), as specified in Clause 2.3.1.</td></tr>
<tr><td>2.2.1.2</td><td>Dimensions (DIN 8074)
<table>
<tr><th>Type</th><th>Nominal OD, mm</th></tr>
<tr><td rowspan="2">Main Duct</td><td>110</td></tr>
<tr><td>75</td></tr>
<tr><td rowspan="4">Mini-duct</td><td>50</td></tr>
<tr><td>40</td></tr>
<tr><td>32</td></tr>
<tr><td>20</td></tr>
<tr><td>Micro-duct</td><td>14</td></tr>
</table></td><td>
<table>
<tr><th>Nominal Wall Thickness, mm</th><th>Nominal ID, mm</th><th>SDR</th></tr>
<tr><td>5</td><td>100</td><td>22</td></tr>
<tr><td>3.4</td><td>68.2</td><td>22</td></tr>
<tr><td>3.0</td><td>44</td><td>17</td></tr>
<tr><td>2.4</td><td>35.2</td><td>17</td></tr>
<tr><td>1.9</td><td>28.2</td><td>17</td></tr>
<tr><td>1.8</td><td>16.4</td><td>13.6</td></tr>
<tr><td>1.5</td><td>11</td><td>9</td></tr>
</table></td></tr>
<tr><td>2.2.1.3</td><td>OD Tolerances</td><td>± 0.5 percent (maximum) of Nominal values.</td></tr>
<tr><td>2.2.1.4</td><td>Color Code</td><td>Ducts with OD from 50mm to 20 mm shall be Black in color with 4 green equally spaced stripes of sufficient width and color intensity to be easily distinguished from a distance of 3 meters and from any angle.</td></tr>
<tr><td>2.2.1.4</td><td>Supply lengths</td><td>300, 600, 900 and 1200 m, unless otherwise requested or agreed.</td></tr>
<tr><td>2.2.2</td><td>HDPE Duplex Micro-Ducts</td><td></td></tr>
<tr><td>2.2.2.1</td><td>Material</td><td>High density polyethylene (HDPE), as specified in Clause 2.3.1.</td></tr>
<tr><td>2.2.2.2</td><td>Dimensions , mm</td><td>• Two (Duplex) of 14mm Micro-ducts inside an HDPE jacket.
• Outside cross-sectional diameter for outer jacket is 31mm, nominal as shown in Appendix 2.</td></tr>
<tr><td>2.2.2.3</td><td>Wall thickness</td><td>1.5 mm, for 14 mm Micro-duct as well as for outer jacket.</td></tr>
<tr><td>2.2.2.4</td><td>OD Tolerances</td><td>± 0.5 percent (maximum) of Nominal values.</td></tr>
<tr><td>2.2.2.5</td><td>Color code</td><td>• Outer jacket: Black with two green stripes.
• 14mm Micro-Ducts: first duct is black and second duct is green.</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

2.2.2.6	Supply lengths	300, 600, 900 and 1200 m, unless otherwise requested or agreed.
Clause	Parameters	Requirements
2.2.3.2	Dimensions , mm	Seven units of 14mm Micro-ducts inside a 50mm OD HDPE Mini-duct, with respective dimensions specified in Clause 2.2.1.2, and as illustrated in Appendix 2.
2.2.3.4	OD Tolerances	± 0.5 percent (maximum) of Nominal values.
2.2.3.5	Color code	• 50 mm duct: Black with four equally spaced green stripes. • 14mm Micro-Ducts: first duct is black and remaining six ducts are green.
2.2.3.6	Supply lengths	300, 600, 900 and 1200 m, unless otherwise requested or agreed.
2.2.4	Wall designs	
2.2.4.1	Outer wall	Shall be smooth and free from defects.
2.2.4.2	Inner walls	Shall be with low coefficient of friction can be either smooth, permanently lubricated co-extruded layer or longitudinally ribbed with: • Smooth-wall: The internal surface shall be smooth. • Ribbed-wall: Ribs shall be rounded and shall not protrude into the bore by more than 0.4 mm.
2.2.5	Other Design Criteria	
2.2.5.1	Bending	Maximum permissible bend radius 30 times OD in temperature 20 C°.
2.2.5.2	Cuttings	Can be cut using either a specialized cutter, or a sharp knife or a metal or woodworking saw.
2.2.5.3	Labeling	The following information shall be clearly marked on the duct at the intervals of 1 meter throughout the whole length of the duct. The marking shall be durable, clear and distinct to the naked eye from a minimum distance of 50cm. • Example : SEC - HDPE- SDR 17- 110/100 - Mfr. Name • The meter sequential length marking.
2.2.6	HDPE Duct Accessories	
2.2.6.1	HDPE Duct Jointing	• All of joint fittings must be compliant to ASTM F 2176. • The HDPE duct can be joint using the Mechanical or any equivalent technique such as fusion method. • The Mechanical joint fitting is installed by pushing the back nut, spring follower and rubber ring on to

		the plain pipe end, and then inserting into the socket of the filling. The back nut is then tightened by hand. • No special machine required to install the fitting as shown in Appendix 3.
2.2.6.2	HDPE Duct Sealing Plug	Used for sealing the duct ends before cable installation, prevents ingress of dirt, water, moisture, insects etc. As shown in Appendix 3.
2.2.6.3	HDPE Duct 90° Bend	Long sweep 90° bend is used for routing of conduits around corners and for the interfacing between the duct and the base of a cabinet or termination boxes as shown in Appendix 4.

Table 1 Design Requirements

2.3 Material Properties and Test Requirements

The HDPE ducts shall meet all the material properties and test requirements as specified in ASTM F2160 as listed in Table 2, with customized sizes and dimensions to metric measurements (DIN 8074) as mentioned in Table 1, Clauses 2.2.1.3 and 2.2.2.3.

Clause	Properties	Requirements	Test Method
2.3.1	HDPE Raw Materials		
2.3.1.1	Primary properties	Identified by ASTM D3350 with Minimum Cell Classification Limits of PE 345440 C/E.	ASTM F2160
2.3.2	Material Primary Properties		
2.3.2.1	Density (Compound)	0.941 to 0.955 g / cc (Cell 3 or 4 as per ASTM D3350)	ASTM D 792
2.3.2.2	Melt flow index at 190 C°/2.16 Kg	< 0.15 g/10min (Cell 4 as per ASTM D3350)	ASTM D 1238 E
2.3.2.3	Flexural Modulus	552 - < 1103 MPa (Cell 4 or 5 as per ASTM D3350).	ASTM D 790
2.3.2.4	Tensile Strength	21 - <24 Mpa (Cell 4 as per ASTM D3350)	ASTM D 638
2.3.2.5	Slow Crack Growth Resistance (10% Igepal)	F20 >600 hours ESCR per ASTM D 1693 Condition C; or >10 hours per ASTM F 1473 PENT. (Cell 4 as per ASTM D3350)	ASTM D 1693; ASTM F 1473

2.3.2.6	Hydrostatic Design Basis	Not Pressure Rated (Cell 0 as per ASTM D3350)	ASTM D 2837
2.3.2.7	Color and UV resistance	C–Black with 2% min. Carbon Black. E- Colored with UV stabilizer Note that Carbon black content, 2.25 ± 0.25 % as per ASTM D1603	ASTM D 3350
2.3.2.8	Other	All values at 23 C° unless specified otherwise.	
2.3.3	Physical Properties		
2.3.3.1	Induction temp (DSC)	220 °C	ASTM D 3350
2.3.3.2	Poisson ratio	0.45	-
2.3.3.3	Izod impact (notch)	> 2.5 ft.lb/in	ASTM D 256
2.3.3.4	Co-efficient of friction	</= 0.15	Telcordia GR-356
2.3.3.5	Ovality (prior to bundling or coiling) % Ovality =[(ODmax – ODmin) / (ODmax +ODmin)] *200	< 5%	ASTM D 2160
2.3.4	Mechanical Properties		
2.3.4.1	Tensile Strength (Break) (50mm/min)	38 MPa	ASTM D 638
2.3.4.2	Tensile Strength (Yield) (50mm/min)	25 MPa	ASTM D 638
2.3.4.3	Elongation at break (ultimate)	> 600 %	ASTM D 638
2.3.4.4	Hardness	> 60 Shore "D"	ASTM D 2240
2.3.5	Thermal Properties		
2.3.5.1	Brittle Temperature	<-100 °C	ASTM D 746
2.3.5.2	Vicat Softening Temp	127 °C	ASTM D 1525
2.3.5.3	Co-efficient of Linear Thermal Expansion	0.2 mm/m °C	ASTM D 696
2.3.5.4	Specific Heat	2.7-2.9 kj / kg °k	Calorimetric
2.3.5.5	Thermal conductivity	0.38 W/m. °C	DIN 52612
2.3.5.6	PN grade	10 (max pressure 10 bar)	
2.3.6	Chemical Properties		

2.3.6.1	Chemical Resistance	Resistant to hydrous solutions of acids, alkalis and salts as well as to a large number of organic solvents.	DIN 8075 supplement 1 ISO/TR 10358

Table 2: Material Properties and Test Requirements

3. OTHER REQUIREMENTS

3.1 Packing

3.1.1 HDPE duct:

3.1.1.1 The HDPE duct should be supplied in steel reels to protect the HDPE from damage during handling, storage and transportation.

3.1.1.2 Drum lengths as mentioned in Clauses 2.2.1.4 & 2.2.2.5. Different cut lengths per drum must be available when requested.

3.1.1.3 If the duct stored in open area (for a short time only) must be protected from direct sunlight or heat and must not be in contact with hot surfaces.

3.1.2 HDPE duct Accessories:

3.1.2.1 The accessories shall be sufficiently packaged in a carton box to be protected from damage during handling, storage and transportation.

3.1.2.2 The individual packages may be multi-packed in a strong carton box suitable for shipping, handling and storage, to a maximum weight of 25 Kg.

3.2 Marking

3.2.1 HDPE duct:

The HDPE reels shall be tagged with weather tight plastic-covered cards with the following information in Arabic and English, on both sides of the reel:

- **SEC Saudi Electric Company.**
- **HDPE <*diameter*>mm OD duct (Name of the item according to section 3.3).**
- **MIC Number (according to clause 3.3).**
- **Length in meter.**
- **Country of Origin.**
- **Manufacture name or trademark.**
- **Date of manufacture**

3.2.2 HDPE duct Accessories:

Each individual crate and carton shall be marked in legible color with the following information, in Arabic and English, on at least two sides of the package and the carton box.

- **Saudi Electric Company (SEC), Saudi Arabia.**
- **Name of the item (according to section 3.3).**
- **MIC Number (according to section 3.3).**
- **Country of Origin.**
- **Manufacturer's Name or Trademark.**
- **Month and Year of Manufacture**

3.3 SEC Standard Edit Name and MIC Numbers

3.3.1 HDPE Duct:

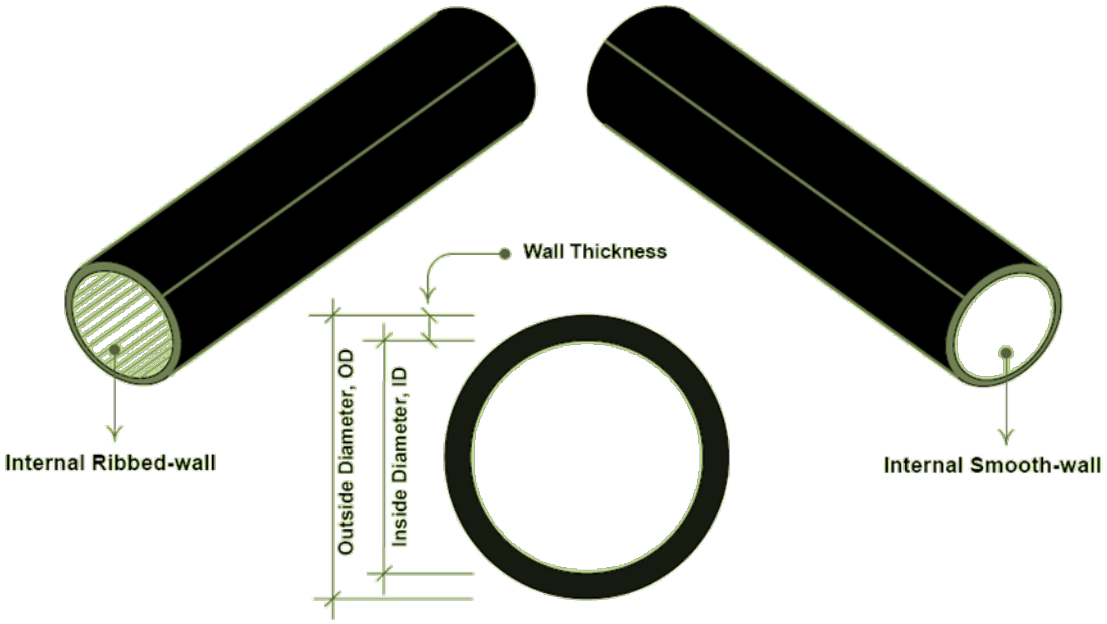
No.	Name OF Item	Unit	MIC No.
1	Duct, HDPE, Main-duct, 110 mm	Meter	
2	Duct, HDPE, Main-duct, 75 mm	Meter	
3	Duct, HDPE, Mini-duct, 50 mm	Meter	
4	Duct, HDPE, 50mm, Pre-installed with 7 X 14 mm Micro-ducts	Meter	
5	Duct, HDPE, Mini-duct, 40 mm	Meter	
6	Duct, HDPE, Mini-duct, 32 mm	Meter	
7	Duct, HDPE, Mini-duct, 20 mm	Meter	
8	Duct, HDPE, Micro-duct, 14 mm	Meter	
9	Duct, HDPE, Micro-duct, Jacketed 2 X 14 mm (Duplex)	Meter	

3.3.2 HDPE Duct Accessories:

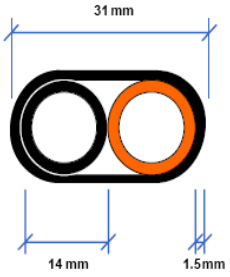
No.	Name OF Item (English & Arabic)	Unit	MIC No.
1	HDPE Duct Mechanical joint fitting (110mm OD)	Each	
2	HDPE Duct Mechanical joint fitting (75mm OD)	Each	
3	HDPE Duct Mechanical joint fitting (50mm OD)	Each	
4	HDPE Duct Mechanical joint fitting (40mm OD)	Each	
5	HDPE Duct Mechanical joint fitting (32mm OD)	Each	
6	HDPE Duct Mechanical joint fitting (20mm OD)	Each	
7	HDPE Duct Mechanical joint fitting (14mm OD)	Each	

8	Empty HDPE Duct Sealing Plug 110mm	Each	
9	Empty HDPE Duct Sealing Plug 75mm	Each	
10	Empty HDPE Duct Sealing Plug 50mm	Each	
11	Empty HDPE Duct Sealing Plug 40mm	Each	
12	Empty HDPE Duct Sealing Plug 32mm	Each	
13	Empty HDPE Duct Sealing Plug 20mm	Each	
14	Empty HDPE Duct Sealing Plug 14mm	Each	
15	HDPE Duct 90 Bend 110mm OD	Each	
16	HDPE Duct 90 Bend 75mm OD	Each	
17	HDPE Duct 90 Bend 50mm OD	Each	
18	HDPE Duct 90 Bend 40mm OD	Each	

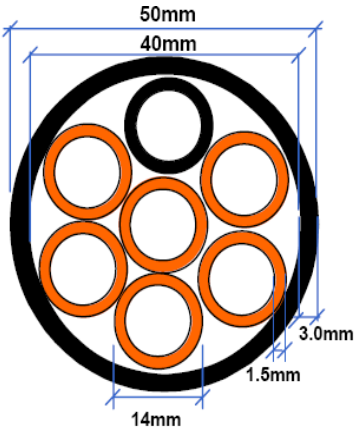
Appendix 1: HDPE Duct (Plain) Internal Ribbed-wall & Smooth-wall Types



Appendix 2: HDPE Duplex & 50mm with 7 x 14 mm Micro-ducts



HDPE Jacketed Duplex 14 mm OD Micro-ducts



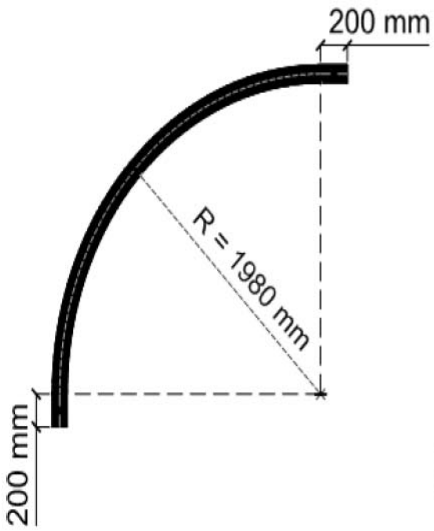
HDPE 50 mm OD, Pre-installed with 7 x 14 mm Micro-ducts

Appendix 3: HDPE Duct Accessories

Duct Mechanical Joint fitting

Duct Sealing Plugs

Appendix 4: HDPE 90° Bend Dimensions



OD	R	L
40	1980	200
50		
75		
110		

Notes:

- **All units in mm.**
- **Minimum bend radius (R) shall be 18 times of the OD.**
- **Linear tolerance of +/-20mm.**
- **Angular tolerance of +/- 2º with no reversion.**