# 23-SDMS-02

# REV. 0

# SPECIFICATIONS

# FOR

# DISTRIBUTION TELECOMMUNICATION DUCTS AND DUCT ACCESSORIES



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# Revision History

| # | Date | Revision No. | Major Revision Description |
|---|---|---|---|
| | | | |

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# 1. Objectives

The aim of this document is to provide information on the Multi Bundled HDPE Ducts to be used for the construction of underground duct system for underground fibre optic network for Distribution's telecommunication requirements. They are intended to be installed by direct buried in SEC specified normal and micro-trench at SEC standard depths. The proposed Multi Bundled (Mini) HDPE Ducts are intended for housing of fibre optic cables installed by blowing technique.

# 2. Scope

This document specifies the minimum technical requirements for design, engineering, construction, manufacture, inspection, testing and performance of High-Density Polyethylene (HDPE) ducts and their accessories to be supplied to Saudi Electric Company (SEC) for Distribution's telecom network deployment to be used by Integrated Dawiyat.

# 3. Applicable codes & standards

This Distribution Material Standard Specification shall be read in conjunction with the latest revision of Distribution General Specification titled "01-SDMS-01, Rev 01" which shall be considered as an integral part of this standard.

The latest revision/amendments of the following codes and standards shall be applicable for the equipment/material covered in this Distribution Material Standard Specification. In case of any conflict, the vendor/manufacturer may propose equipment/material conforming to one group of industry codes and standards quoted hereunder without jeopardizing the requirements of this standard 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 material. |
| 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 |

# 4. Definitions and abbreviations

| | |
|---|---|
| Mini Ducts | Ducts which available sizes, with OD of 20 mm and above. |
| HDPE | High Density Polyethylene |
| MRS | Minimum Required Strength |
| SDR | Standard Dimension Ratio |
| PN | Nominal Pressure (Bar) |
| ID | Inside Diameter |
| OD | Outside Diameter |

# 5. Requirements

## 5.1. General requirements

The Multi Bundled (Mini) HDPE Ducts with its accessories shall be compatible with the latest installation standards and maintenance practices for the telecommunication's duct system.

The High-Density Polyethylene (HDPE), used for the manufacturing of Multi Bundled (Mini) Ducts, which shall be of high quality PE100 and virgin raw materials. Recycled HDPE shall NOT be accepted.

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.

The HDPE Ducts, to be supplied in specified sizes and configurations, categorized as Multi Bundled (Mini) HDPE Ducts.

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

The (Mini) 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 blowing performance of the ducts installed.

The (Mini) HDPE Ducts shall be acceptably rounded to support maximum blowing distance. It shall be supplied with its ends neat, smooth, and cut cleanly at right angles or perpendicular to the axis of the ducts.

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

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

The HDPE Ducts shall be flexible, and ducts shall contain correct type of quoting for protection against Ultra Violet (UV) degradation.

The Multi Bundled (Mini) HDPE Duct and its accessories shall be unaffected by all kinds of corrosive liquids and other compounds which exist in the underground system.

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

The manufacturing of the HDPE Duct shall take place in a production environment which is ISO certified in accordance with the ISO 9001:2008 for quality management system.

## 5.2. Long term performance requirements

The HDPE Ducts 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 (30) years without detriment to the physical characteristics of the products.

The HDPE Ducts shall be designed, manufactured by virgin raw materials only and packaged so that the physical 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 +70°C.

# 6. Design requirements

The minimum & maximum ambient temperature shall be -10°C to +70°C

The HDPE Duct, shall be designed to offer proper protection, rendering it suitable for installation in different environments.

## 6.1. Multi Bundled (Mini) HDPE Duct requirements

The HDPE Ducts shall be supplied according to the requirements specified below.

Multi Bundled (Mini) HDPE Duct:

a) Material: PE 100 High density polyethylene (HDPE), as virgin raw material
b) Multi Bundled (Mini) HDPE Ducts, Dimensions (DIN 8074), See Table 1.

| Multi Bundled Mini Duct | | | | Duct inside Bundle | | | |
|---|---|---|---|---|---|---|---|
| **Type** | **Mini Duct (mm)** | **OD (mm)** | **Sheath (mm)** | **OD (mm)** | **ID (mm)** | **Thickness (mm)** | **SDR** |
| 1 | 7-way 20/16 | 62* | 1 | 20 | 16 | 2 | 10 |
| 2 | 16-way 20/16 | 102* | 1 | 20 | 16 | 2 | 10 |
| 3 | 12-way 12/08 | | 1 | 12 | 08 | 2 | 6 |

*: maximum width

**Table 1 – Multi Bundled (Mini) HDPE Ducts Dimensions**

**Multi Bundled (Mini) HDPE Duct**

Three types of HDPE multi bundled ducts are being specified.

**Type 1-Multi bundled duct (7-way):**

Seven units of mini-ducts with 20 mm OD and 16 mm ID, inside a 1 mm sheath, with respective dimensions specified in Table-1, and as illustrated in Appendix 8.1.

Outer sheath colour is Orange (RAL 2004). The mini ducts will have the following colours, 1. Red (RAL 3024); 2. Blue (RAL 5005), 3. Green (RAL 6038), 4. Yellow (RAL 1021), 5. Orange (RAL 2005); 6. White (RAL 9010) 7. Grey (RAL 9007)

**Type 2-Multi bundled duct (16-way):**

Sixteen units of mini-ducts with 20 mm OD and 16 mm ID, inside a 1 mm sheath, with respective dimensions specified in Table-1, and as illustrated in Appendix 8.1.

Outer sheath colour is Orange (RAL 2004). The mini ducts will have the following colours,1. Red (RAL 3024);2. Blue (RAL 5005), 3. Green (RAL 6038), 4. Yellow (RAL 1021); 5. Orange (RAL 2005); 6. White (RAL 9010), 7. Grey (RAL 9007), 8. Black (RAL 9005)

**Type 3-Multip bundle duct (12-way):**

Twelve units of mini-ducts with 12 mm OD and 08 mm ID, inside a 1 mm sheath with respective dimensions specified in Table -1 and as illustrated in Appendix 8.1.

Outer sheath colour is Orange (RAL 2004), The mini ducts will have the following colours,1. Red (RAL 3024);2. Blue (RAL 5005), 3. Green (RAL 6038), 4. Yellow (RAL 1021); 5. Orange (RAL 2005); 6. Grey (RAL 9007)

Supply length: 300, 600, 900 and 1200 m, unless otherwise requested or agreed.

## 6.2. Wall designs

Outer wall: Shall be smooth and free from defects.

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.

## 6.3. Other design criteria

Bending: minimum permissible bending radius of Multi bundled (Mini) HDPE Ducts shall be complied with below Table 2.

| Recommended Field Minimum Bending Radius (Mtr) | |
|---|---|
| 16-way (20/16) mm | 3 |
| 7-way (20/16) mm | 1.9 |
| 12-way (12/08) mm | 1.9 |

**Table. 2 Permissible bending radius of proposed Multi Bundled (Mini) HDPE Ducts**

Cutting: Can be cut using either a specialized cutter, or a sharp knife or a metal or woodworking saw.

Labelling: 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.

(SEC-Dawiyat – HDPE - PE100 - SDR code, No. of mini ducts, OD/ID mm, "Manufacturer Name", Production Year, Country of Origin, The Meter Sequential Length Markings)

Air Pressure: HDPE ducts shall be used for lower, shall be used for cable pulling and blowing with compressed air. The ducts shall withstand a minimum air pressure of 16 bars (PN16).

## 6.4. Multi bundled (Mini) HDPE ducts accessories

HDPE duct jointing:

a) All of joint fittings must be compliant to ASTM F 2176.
b) The HDPE duct can be joint using the Mechanical or any equivalent technique such as fusion method.
c) The Mechanical joint fitting is installed by pushing the back nut, spring follower and rubber and iron grip-ring on to the plain pipe end, and then inserting into the socket of the filling. The back nut is then tightened by hand.
d) Shall be easily removable, once fixed.
e) No special machine required to install the fitting as shown in Appendix 8.2.
f) Joint fittings shall be designed and suitable for blown purpose.
g) Joint fittings shall be designed to accommodate duct OD sizes as 20 mm and 12mm.
h) The connector for Mini duct with diameter of 20 mm and 12 mm shall withstand a pressure of 16 bars.

HDPE Ducts Sealing Plug: Used for sealing the duct ends before cable installation, prevents ingress of dirt, water, moisture, insects etc. As shown in Appendix 8.2.

## 6.5. Material Properties and Type Test Method

The HDPE ducts shall meet all the material properties and test methods as specified in ASTM F2160 as listed in Table 3 below, with customized sizes and dimensions to metric measurements (DIN 8074) as mentioned in Table 1 above.

**Table 3 – Material Properties & Test Methods**

| Clause | Properties | Requirements | Type Test Method |
|---|---|---|---|
| | Visual Appearance | Co-extruded inner smooth layer of solid permanent lubricant Silicone and smooth outside surface, free from blisters, shrink holes or any other defects or foreign matters, which might impair the blowing performance. | |
| | HDPE Raw Materials | HDPE PE100-, Silicone (inner lubricated) Virgin Raw Material Only | |
| a) | Primary properties | Identified by ASTM D3350 with Minimum Cell Classification Limits of PE 345440 C/E. | ASTM F2160 |
| | Material Primary Properties | | |
| a) | Density (Compound) | 0.941 to 0.955 g / cc<br>(Cell 3 or 4 as per ASTM D3350) | ASTM D 792 |
| b) | Melt flow index at 19° C /2.16 Kg | < 0.55 g/10min<br>(Cell 4 as per ASTM D3350) | ASTM D 1238 E |
| c) | Flexural Modulus | 552 - < 1103 MPa<br>(Cell 4 or 5 as per ASTM D3350). | ASTM D 790 |
| d) | Tensile Strength | 21 - <21 N/mm2<br>(Cell 4 as per ASTM D3350) | ASTM D 638 |
| e) | Slow Crack Growth Resistance (10% Igepal) | F20 >600 hours ESCR per ASTM D 1693<br>Condition C; or >10 hours per ASTM F 1473 PENT. (Cell 4 as per ASTM D3350) | ASTM D 1693<br>ASTM F 1473 |
| f) | Hydrostatic Design Basis | Not Pressure Rated (Cell 0 as per ASTM D3350) | ASTM D 2837 |
| g) | UV resistance | Outdoor - 1,000 hours of exposure as per ASTM G 155,<br>Standard Practice for Operating Xenon-Arc Light Apparatus. | ASTM G 155 |

| Clause | Properties | Requirements | Type Test Method |
|---|---|---|---|
| h) | Color | As per clause 6.1 | |
| i) | Outer Sheath Thickness (Mini) | 1.0 ± 0.2mm | |
| j) | Other | All values at 23° C unless specified otherwise. | - |
| | Physical Properties | | |
| a) | Induction Temp (DSC) | 220 °C | ASTM D 3350 |
| b) | Poisson Ratio | 0.45 | - |
| c) | Izod Impact (Notch ) | > 2.5 ft.lb/in | ASTM D 256 |
| d) | Co-efficient of friction | </= 0.06 | Telcordia GR-356 |
| e) | Ovality | (prior to bundling or coiling) % Ovality = [(ODmax – ODmin) / (ODmax + ODmin)] ×100 < 5% | ASTM D 2160 |
| | Mechanical Properties | | |
| a) | Tensile Strength (Break) | (50 mm/Min.) 38 MPa | ASTM D 638 |
| b) | Tensile Strength (Yield) | (50 mm/Min.) 20 MPa | ASTM D 638 |
| c) | Elongation at break (ultimate) | ≥ 400 % | ASTM D 638 |
| d) | Hardness | > 60 Shore "D" | ASTM D 2240 |
| e) | Pressure | PN16 | - |
| f) | Bending | Bend radius minimum shall be 30 times OD at temperature 20 Deg C. There shall be no kink. | |
| | Thermal Properties | | |
| a) | Brittle Temperature | <-100 °C | ASTM D 746 |
| b) | Vicat Softening Temp | 127 °C | ASTM D 1525 |
| c) | Co-efficient of Linear Thermal Expansion | 0.2 mm/m °C | ASTM D 696 |
| d) | Specific Heat | 2.7-2.9 kj / kg °k | Calorimetric |
| e) | Thermal conductivity | 0.38 W/m. °C | DIN 52612 |
| | Chemical Properties | | |

| Clause | Properties | Requirements | Type Test Method |
|---|---|---|---|
| a) | 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 |

## 6.6. Routine Test

1. Manufacturer shall provide complete routine test certificate for following tests conducted in routine for offered Multi bundled (Mini) HDPE Ducts as under:
   a) Visual inspection on outer and inner surface
   b) Dimensions – Diameter and thickness
   c) Tensile strength and elongation
   d) Reversion test
   e) Environmental stress crack resistance
   f) Impact strength
   g) Crush resistance
   h) Mandrel test
   i) Quality test
   j) Coil test
   k) Oxidation induction test
   l) Hydraulic characteristics
   m) Internal coefficient of friction

## 6.7. Packing and shipping

The Multi bundled (Mini) duct Duct should be supplied in steel reels to protect the HDPE from damage during handling, storage, and transportation.

Drum lengths as mentioned in Clause 6,1. Different cut lengths per drum must be available when requested.

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.

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

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

## 6.8. Marking

**Multi bundled (Mini) HDPE duct**

The Multi bundled (Mini) Duct reels shall be tagged with weather tight plastic-covered cards with the following information in Arabic and English, on both sides of the reel:

a) SEC Saudi Electric Company.
b) HDPE <diameter>mm OD duct (Name of the item according to Table-1).
c) MIC Number
d) Length in meter.
e) Country of Origin.
f) Manufacture name or trademark.
g) Month & Year of manufacture.
h) P.O No.

# 7. SEC Standard (editable) Name and MIC Numbers

SEC Standard (editable) Name and MIC Numbers for HDPE Bundled Duct.

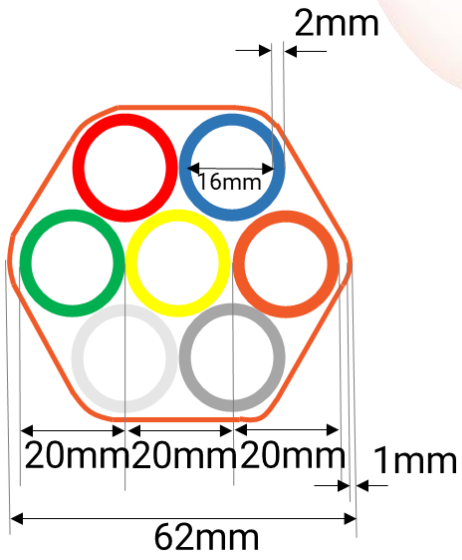
| No. | Name of Item | Unit | MIC No. |
|---|---|---|---|
| 1 | Multi bundled (Mini) HDPE Ducts with 1 mm sheath with pre-installed with 7 X 20 mm Mini-ducts, (Seven units of mini-ducts with 20 mm OD and 16 mm ID, inside a 1 mm sheath) | Meter | |
| 2 | Multi bundled (Mini) HDPE Ducts with 1 mm sheath with pre-installed with 16 X 20 mm Mini-ducts, (Sixteen units of mini-ducts with 20 mm OD and 16 mm ID, inside a 1 mm sheath) | Meter | |
| 3 | Multi bundled (Mini) HDPE Ducts with 1 mm sheath with pre-installed with 12 X 12 mm Mini-ducts, (Sixteen units of mini-ducts with 12 mm OD and 08 mm ID, inside a 1 mm sheath) | Meter | |

HDPE Duct Accessories

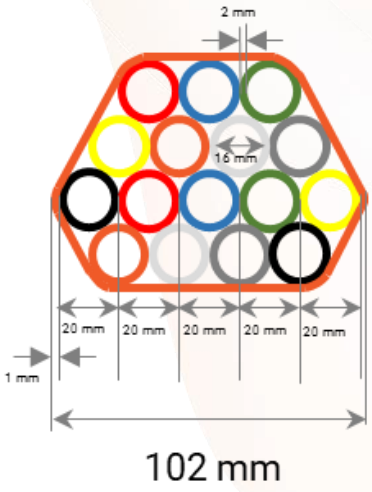
| No. | Name of Item | Unit | MIC No. |
|---|---|---|---|
| 1 | Couplers PN 16 Inner different Duct (Mini) | Each | |
| 2 | End Caps as per standard (Mini) Duct | Each | |
| 3 | End Plugs as per standard (Mini) Duct | Each | |

# 8. Appendix

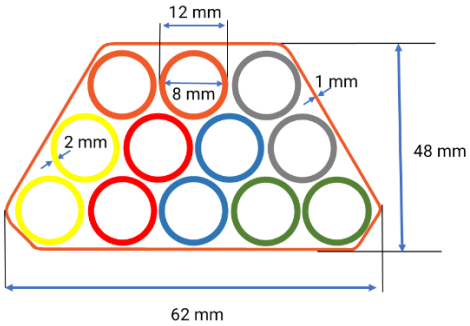
## 8.1. Multi bundled (Mini) HDPE Ducts




**Type 1. 7-Way 20/16**




**Type 2. 16-Way 20/16**




**Type 3. 12-Way 12/08**

## 8.2. HDPE Duct Accessories

**Push Fit Couplers**

**HDPE Duct sealing plugs / end cap**

**Tools**