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TL 9000
ISO 9001
ISO 14001
OHSAS 18001

LS Cable & System

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Tender Title	:		
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Specification

For

Optical Fiber Cable
Loose PBT Tube / Dry Core
Single Jacket / Single-Armor

Rev. No.	Date	Descriptions	Prepared By	Reviewed By	Approved By
03	Dec. 23, 2015	Changed PP tube to PBT	Lee, Mansu	Jun, YoungHo	Lee, YuHyoung
02	Oct. 05, 2015	OM3 fiber type was added	Kim, Sangyub	Jun, Youngho	Lee, Yuhyoung
01	May. 14, 2015	LSZH sheath material was added	Kim, Sangyub	Jun, Youngho	Lee, Yuhyoung
00	Jan. 07, 2015	Original Issue	Kim, Sangyub	Jun, Youngho	Lee, Yuhyoung

LS Cable & System

1. SCOPE

1.1 Application

This specification covers the general requirements for fiber optic cables used for underground duct applications.

1.2 Cable description

Color coded fibers in jelly filled loose tubes, SZ-stranded Tubes and fillers (If necessary) around a dielectric central strength member, water blocking yarn and water blocking tape, glass yarn (if necessary), ripcords, corrugated steel armor and outer black PE (or LSZH) jacket.

2. OPTICAL FIBER

The optical, geometrical, mechanical and environmental performance of the optical fiber shall be in accordance with Table 1 below.

Table 1.-1) Performance of the Single Mode Fiber (ITU-T G. 652 D)

ITEMS	UNITS	SPECIFICATION
Attenuation	dB/km	≤ 0.36 at 1310nm ≤ 0.35 at 1383nm ≤ 0.22 at 1550nm
Chromatic Dispersion	ps/nm.km	≤ 3.5 at 1285nm ~ 1330nm ≤ 18 at 1550nm
Zero Dispersion Wavelength	nm	1300 ~ 1322
Zero Dispersion Slope	$ps/nm^2.km$	≤ 0.092
Polarization Mode Dispersion(PMD_Q)	$ps/(km)^{1/2}$	≤ 0.2 (20 section link)
Cut-off Wavelength (λcc, Cabled fiber)	nm	≤ 1260
Attenuation vs. Bending (30mm radius x 100turns)	dB	≤ 0.1 at 1625nm
Mode Field Diameter	μm	9.2 ± 0.4 at 1310nm 10.4 ± 1.0 at 1550nm
Core-Clad Concentricity Error	μm	≤ 0.6
Cladding Diameter	μm	125 ± 1
Cladding Non-circularity	%	≤ 1
Coating Diameter	μm	245 ± 10
Proof Test Level	Gpa	≥ 0.69

Table 1.-2) Performance of the Multi Mode Fiber (OM3)

ITEMS	UNITS	SPECIFICATION
		OM3
Attenuation	dB/km	≤ 3.0 at 850nm ≤ 1.0 at 1300nm
Overfilled Launch Bandwidth (LED based sources)	MHz.km	≥ 1500 at 850nm ≥ 500 at 1300nm
Effective Modal Bandwidth (Laser based sources)	MHz.km	≥ 2000 at 850nm
10 Gigabit Ethernet Maximum Link Distance	m	≥ 300 at 850nm
Numerical Aperture	-	0.20 ± 0.015
Core Diameter	μm	50 ± 3.0
Core Non-circularity	%	≤ 6.0
Cladding Diameter	μm	125 ± 2.0
Cladding Non-circularity	%	≤ 2.0
Core/Cladding Concentricity Error	μm	≤ 3.0
Coating Diameter	μm	245 ± 15
Proof Test	Gpa	≥ 0.69

3. CABLE CONSTRUCTION

The construction of the cable shall be in accordance with Table 2 below.

Table 2. Construction of the Cable

ITEMS		DESCRIPTION				
Number of Fibers		36	48	72	96	144
No. of Fibers per Tube		6	12			
Loose Buffer Tube	Material	PBT				
	Diameter (mm)	Nom. 2.0	Nom. 2.4			
Filling Compound in Loose Buffer Tube		Thixotropic Gel				
Filler		Polyethylene Rod (if necessary)				
Central Strength Member		FRP (Non-metallic, PE over-coat, if necessary)				
Water Blocking Material		Water blocking yarns around CSM				
Core Wrapping Tape		Water blocking tape				
Auxiliary Strength Member		Glass yarns (if necessary)				
Ripcord		2 ripcords				
Armor	Material	Corrugated steel tape with plastic coating				
	Thickness	Nom. 0.15mm (Steel tape) Nom. 0.05mm (Plastic coating on each side)				
Outer Jacket	Material	Black HDPE (or Black LSZH)				
	Thickness (mm)	Nom. 1.4 for HDPE (or Nom. 1.7 for LSZH)				

4. FIBER AND LOOSE BUFFER TUBE IDENTIFICATION

The color code of the loose buffer tubes and the individual fibers within each loose buffer tube shall be in accordance with Table 3 below.

Table 3. Color code of the individual fibers and loose buffer tube

No. of Fibers	Color	No. of Fibers	Color
1	Blue	7	Red
2	Orange	8	Black
3	Green	9	Yellow
4	Brown	10	Violet
5	Grey	11	Pink
6	White	12	Aqua

5. PHYSICAL / MECHANICAL / ENVIRONMENTAL PERFORMANCE AND TESTS

5.1 Temperature Range

For the cables covered by this specification, the following temperature ranges apply:

- Operation : -30°C to +70°C
- Installation : -10°C to +60°C
- Storage/Shipping : -40°C to +70°C

5.2 Mechanical and Environmental Performance of the Cable

The mechanical and environmental performance of the cable shall be in accordance with Table 4 below. Unless otherwise specified, all attenuation measurements required in this section shall be performed at 1550nm.

Table 4. The Mechanical and Environmental Performance of the Cable

ITEMS	TEST METHOD AND ACCEPTANCE CRITERIA
Tensile Strength	▪ Test method: IEC 60794-1-2 Method E1 - Mandrel diameter: 30D (D = cable diameter) - Length under tension: ≥ 50 m - Dynamic tensile Load: 2,700N for 1 hour - Permanent tensile load: 600 N for 10 minutes ▪ Acceptance Criteria - Fiber elongation strain: ≤ 0.6 % - Attenuation increment: ≤ 0.10 dB
Crush Resistance	▪ Test method: IEC 60794-1-2 Method E3 - Applied load: 2,000 N/10 cm for 10 minutes - No of points: 1 point ▪ Acceptance Criteria - Attenuation Increment: ≤ 0.10 dB - No jacket cracking and no fiber breakage
Impact resistance	▪ Test method: IEC 60794-1 Method E4 - Impact Energy: 10J - Diameter of impact mass: 25mm - No. of impact per point: 1time at 3 points ▪ Acceptance Criteria - Attenuation Increment : ≤ 0.10 dB after the test - No jacket cracking and no fiber breakage
Cable bend	▪ Test method: IEC 60794-1-2 Method E11A - Mandrel diameter: 20D (D = cable diameter) - No. of turns: 4 turns(wrapped and unwrapped) - No. of flexing cycles: 5 cycles ▪ Acceptance Criteria -Attenuation Increment : ≤ 0.10 dB after the test - No jacket cracking and no fiber breakage

ITEMS	TEST METHOD AND ACCEPTANCE CRITERIA
Torsion	▪ Test method: IEC 60794-1-2 Method E7 - Cable length twisted: 2m - No. of twist cycles: 10 cycles - Twist angle: ± 180° ▪ Acceptance Criteria - Attenuation Increment: ≤ 0.10 dB - No sheath cracking and no fiber breakage
Temperature Cycling	▪ Test method: IEC 60794-1-2 Method F1 - Cable length: at least 1000m - At least 6 fibers shall be spliced and tested. - Temperature cycling schedule : 23°C → -40°C → 70°C → -40°C → 70°C - Soak time at each temperature: 24 hours - No of cycles: 2 ▪ Acceptance Criteria - Attenuation increment: ≤ 0.10 dB/km
Water Penetration	▪ Test method: IEC 60794-1-2 Method F5B - Length of specimen: 3m - Height of pressure head: 1m - Test time: 24 hours ▪ Acceptance Criteria - No leakage through the open cable end

6. PACKING AND MARKING

6.1 Cable Marking

The jacket shall be marked with white or black characters at intervals of one meter with the following information. Other marking is also available upon request.

1) Cable type and number of fiber
2) Name of manufacturer
3) Year of manufacture
4) Length marking

Ex) For single mode 24-fiber cable

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6.2 Cable Packing

6.2.1 Standard length of cable shall be 4,000 meters. Other cable length is also available upon request.

6.2.2 Each length of the cable shall be wound on a separate wooden drum.

6.2.3 Both ends of the cable shall be sealed with a suitable plastic cap to prevent the entry of moisture during shipping, handling and storage.

6.2.4 The cable ends shall be securely fastened to the drum to prevent the cable from becoming loose in transit or during placing operations.

6.2.5 Wood-fiber board shall be secured with bands to protect the cable during normal handling and shipping.

6.3 Cable Drum

6.3.1 Details given below shall be distinctly marked with weather proof material on the both outer sides of the drum flange. Other shipping mark is also available if requested by customer.

1) Purchaser's name
2) Cable type and fiber counts
3) Length of cable in meter
4) Gross weight in kilogram
5) Reel number
6) Name of the manufacturer
7) Year of manufacture
8) Arrow showing the direction the drum shall be rolled

6.3.2 The cable shall be shipped on reels designed to prevent damage to the cable during shipment and installation.

7. SAFETY

7.1 RoHS Directive

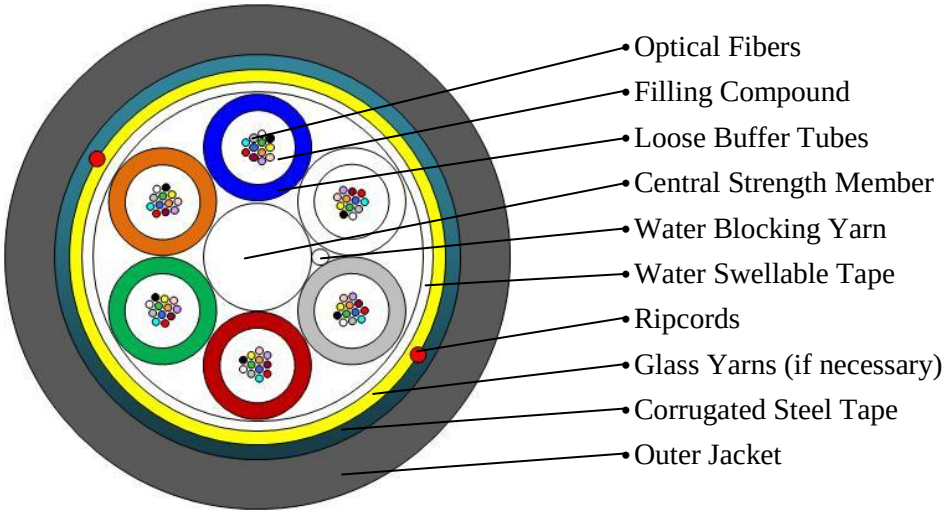
All cables and any associated packing and labeling materials shall meet RoHS (Restriction of the Use of certain Hazardous Substances) regulations as appropriate.

7.2 ISPM 15 Directive

All wooden packing materials shall meet ISPM (International Standards for Phytosanitary Measures) regulations as appropriate.

< Cross-sectional Drawing of Cable >

Example for 72-fiber cable



※ The drawing appearing on this page may be subject to change or modification without any prior notice

Sheath	No. of Fibers	No. of fibers per tube	Cable Diameter(mm)	Approx. Cable Weight(kg/km)	Min. Bending Radius(mm)	
					Under Load	No Load
HDPE	~ 36	6	11.3 ± 0.5	128	230	115
	~ 72	12	12.3 ± 0.5	143	250	125
	~ 96	12	13.8 ± 0.5	177	280	140
	~ 144	12	16.9 ± 0.5	249	340	170
LSZH	~ 36	6	11.9 ± 0.5	163	240	120
	~ 72	12	12.9 ± 0.5	183	260	130
	~ 96	12	14.4 ± 0.5	220	290	145
	~ 144	12	17.5 ± 0.5	302	350	175

*) Actual values for cable weight and diameter may deviate from the calculated values given in the table above.

= End of Specification =