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SPECIFICATION

FOR

Loose Tube Single Jacket Micro OPTIC CABLE

▶SINGLE MODE G652D /G657A1

▶LOOSE TUBE TYPE

▶NON METALLIC STRENGTH MEMBER

▶PE SHEATH

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1. SCOPE

1.1 General

This specification covers the requirements and constructional details for up to 60 cores single-mode optical fiber cable, which consist of loose tube for outdoor application.

1.2 Cable Description

Micro Single Jacket

Color-coded optical fibers in ultraviolet cured acrylate ink, jelly filled color-coded loose tubes, PE fillers (if required), SZ-stranding around central strength member, water swellable yarn/tape, glass yarn(if required),rip cord, and outer PE jacket.

2. REFERENCE

·EIA/TIA 598 Color Coding of fiber Optic Cables.
·GR-20 Optical Fiber Cables.
·ITU-T G.650 Definition and test methods for the relevant parameters of single-mode fibers
·ITU-T G.652 Characteristics of a single-mode optical fiber cable.
·ITU-T G.657 Characteristics of a single-mode optical fiber cable.
·IEC – 794 – 1

3. OPTICAL FIBER

3.1 Optical Fiber Material

Core: Silica (SiO_2) doped with Germanium Dioxide (GeO_2)
Cladding: Silica (SiO_2)
Coating: Dual Layers of UV-Curable Acrylate

3.2 The optical and geometrical performance of the optical fiber shall be in accordance with table 1,2.

Table 1 The Optical and Geometrical Performance of the Fiber (ITU-T G.652D)

Parameters	Value
Physcal Characteristics	
Clad Diameter	125±0.7 ㎛
Core-Clad Concentricity Error(Offset)	≤0.5 ㎛
Cladding Non-Circularity, maximum	≤0.7%
Coating Diameter (Colored)	253 ㎛±0.7 ㎛
Coating Diameter (Uncolored)	240 ㎛±0.5 ㎛
Coating-Clad Concentricity Error(Uncolored)	≤12 ㎛
Tensile Proof Test	100 kpsi (0.69 GPa)
Coating Strip Force	Range: 1.0N ≤ CSF ≤ 8.9N
Optical Specification	
Attenuation (After cable) at 1310nm at 1550nm	Maximum ≤ 0.35dB/km ≤ 0.25 dB/km
Dispersion, maximum	* 18 ps(nm-km) at 1550nm * 3.5 ps(nm-km) from 1285nm to 1330nm at 1310nm

Group Refractive Index at 1310 nm at 1550 nm		 1.467 1.468
Mode Field Diameter at 1310 nm at 1550 nm		 9.2 ± 0.4 μm 10.4 ± 0.5 μm
Polarization Mode Dispersion (PMD)[1] Fiber PMD Link Design Value (LDV)[2]		 < 0.04 ps/√km
Chromatic Dispersion Zero Dispersion Wavelength (λ0) Zero Dispersion Slope (S0) Typical Dispersion Slope		 1302 – 1322 nm ≤ 0.090 ps/nm2-km 0.087 ps/nm2-km
Cut-off Wavelength (λCC)	≤ 1260 nm	
Attenuation Uniformity / Point Discontinuities at 1310 nm and 1550 nm	≤ 0.05 dB	
Mechanical Specifications		
Macro bending Attenuation: The maximum attenuation with bending does not exceed the specified values under the following deployment conditions:		
Deployment Condition	Wavelength	Induced Attenuation
1 turn, 32 mm (1.2 inch) diameter	1550 nm	< 0.05 dB
100 turns, 50 mm (2 inch) diameter	1310 nm	< 0.05 dB
	1550 nm	< 0.05 dB
100 turns, 60 mm (2.4 inch) diameter	1550 nm	< 0.05 dB
	1625 nm	< 0.05 dB
Coating Strip Force, maximum	8.9N	
Coating Strip Force, minimum	1.3N	
Environmental Characteristics (at 1310, 1550 & 1625 nm)		
Temperature Cycling (-60º + 85º C)	≤ 0.05 dB/km	
High Temperature Aging (85 ± 2º C)	≤ 0.05 dB/km	
Temperature & Humidity Cycling (at -10º C to +85º C and 95% RH)	≤ 0.05 dB/km	
Water Immersion (23 ± 2º C)	≤ 0.05 dB/km	

Table 2 The Optical and Geometrical Performance of the Fiber (ITU-T G.657 A1)

Parameter	Specification
Optical Characteristics	
Attenuation (After cable) at 1310nm at 1550nm	Maximum ≤ 0.35dB/km ≤ 0.25 dB/km
Dispersion coefficient @ 1285 ~ 1330 nm @ 1550 nm	 ≤ 3.4 ps/(nm^2.km) ≤ 18.0 ps/(nm^2.km)
Zero-dispersion wavelength	1300 ~ 1324 nm
Zero-dispersion slope	≤ 0.092 ps/(nm^2.km)

PMD Maximum Individual Fiber	≤ 0.2 ps/km$^{1/2}$
Cable cut-off wavelength	≤ 1260 nm
Mode field diameter @ 1310 nm	8.9 ± 0.4 um
Geometrical Characteristics	
Cladding diameter	125.0 ± 0.7 um
Cladding non-circularity	≤ 0.7 %
Coating diameter	245 ± 10 um
Coating-Cladding concentricity error	≤ 12.0 um
Coating Non-circularity error	≤ 6.0 %
Core-Clad concentricity error	≤ 0.5 um
Curl (Radius)	≥4m
Mechanical Specification	
Proof test level	≥100 kpsi
Micro-bend induced attenuation 10 turns around a mandrel of 30mm diameter 10 turns around a mandrel of 30mm diameter 1 turn around a mandrel of 20mm diameter 1 turn around a mandrel of 20mm diameter	 ≤0.25 dB at 1550 nm ≤1.0 dB at 1625 nm ≤0.75 dB at 1550 nm ≤1.5 dB at 1625 nm
Coating strip force Average force	 1.7 N

4. CABLE DESIGN

4.1 Cable Core

The cable contains loose tubes and the number of PE fillers (if required), which are stranded around the central strength member. The cable core is dry core with water swellable yarn and tape.

4.2 Micro Single Jacket

The glass yarn(if required), rip cord, and outer black PE jacket shall be applied over the cable core.

4.3 The construction of the cable shall be in accordance with table 3.1, 3.2, 3.3 and annex 1,2.

Table 3.1 Construction of the Cable Core

Items	Description
Number of Fibers	2~60C
Type of Fiber	Single mode G652D or G657A1
Number of Fibers within Tube	Max 12 Cores
Loose Tube	PBT (Polybutylene terephthalate)
Filling Compound in Tube	Thixotropic jelly compound

Central Strength Member	FRP Rod or PE coated FRP Rod
Filler (If required)	PE or PP
Waterblocking in Cable Core	Water swellable yarn / Water blocking Tape

Table 3.2 Construction of the Cable (Micro Single Jacket)

Items	Description
Cable Core	Table 3.1
Rip Cord	Two rip cords
Peripheral strength member (If required)	Glass yarn
Outer Jacket	Black PE Thickness: Nom. 0.70 mm

Table 3-3 Composition of Cable Core

Fiber Counts	Fiber count /tube	No. of tube	No. of Filler	Cable Core Composition	
~12	~12	1	4	Single Layer	1*5 Tubes
24	12	2	3	Single Layer	1*5 Tubes
36	12	3	2	Single Layer	1*5 Tubes
48	12	4	1	Single Layer	1*5 Tubes
60	12	5	0	Single Layer	1*5 Tubes

5. OPTICAL FIBER AND LOOSE TUBE IDENTIFICATION

The color code of the loose tubes and the individual fibers within each loose tube shall be in accordance with table 4.

Table 4 The Color Code of the Individual Optical Fibers and Loos Tube

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

6. MECHANICAL AND ENVIRONMENTAL PERFORMANCE AND TESTS

The mechanical and environmental performance of the cable shall be in accordance with table 5.
All attenuation measurements required in this section shall be performed at 1550 nm.

Table 5 The Mechanical and Environmental Performance of the Cable

Items	Test Condition and Acceptance Criteria
Tensile Test	● Test method: IEC 60794-1-2 Method E1 - Tensile load: Ma. Pulling tension of Annex 2 for 1 hour ● Acceptance criteria - Attenuation increment: ≤ 0.10 dB - No Jacket cracking and fiber breakage

Crush Test	● Test method: IEC-60794-1-2 Method E3 - Crush load: 500 N/10 cm for 10 min ● Acceptance criteria - Attenuation increment: ≤ 0.10 dB - No Jacket cracking and fiber breakage
Impact Test	● Test method: IEC 60794-1-2 Method E4 - Impact load: 0.5kg - Impact height: 1 m - Number of impact: 1 times x 3 position ● Acceptance criteria - Attenuation increment: ≤ 0.10 dB - No Jacket cracking and fiber breakage
Cable Torsion Test	● Test method: IEC-60794-1-2 Method E7 - Cable Length twisted: 2 m - Torsion angle : ±180˚ - Number of cycles: 10 cycles ● Acceptance criteria - Attenuation increment: ≤ 0.10 dB - No Jacket cracking and fiber breakage
Cable Bend Test	● Test method: IEC-60794-1-2 Method E11A - Mandrel diameter: 20 D (D = cable diameter) - Angle: ±180˚ - Number of cycles: 4 ● Acceptance criteria - Attenuation increment: ≤ 0.10 dB - No Jacket cracking and fiber breakage
Temperature cycling Test	● Test method: IEC-60794-1-2 Method F1 - Temperature cycling step : +23℃ → −40℃ → +70℃→ +23℃ - Soak time at each temperature step: 16 hours - No. of cycles : 2 ● Acceptance Criteria - Attenuation increment : ≤ 0.20 dB/km(during testing) ≤ 0.10 dB/km(after testing
Water Penetration Test	● Test method: IEC-60794-1-2 Method F5 - Length of specimen: 3 m - Height of pressure head: 1 m - Test time: 24 hours ● Acceptance criteria - No leakage through the open cable end

7. CABLE MARKING

7.1 The completed cable shall have sequentially numbered length markers in meters at intervals of 1 meter along the outside of the cable jacket. Continuous sequential numbering shall be employed in a single length of cable and started from zero at the inner end of the cable.

7.2 Agreement between the actual length of the cable and the length marking on the cable jacket shall be within the limits of plus one percent, minus nothing.

7.3 Required information can be marked on the outer jacket at intervals of 1 meter sequentially.

(1) Cable type & counts
(2) Year of manufacture
(3) Name of manufacturer (ES CABLE)
(4) Serial No.
(5) Length marking (m)

7.4 Cable marking of the outer jacket shall be distinctly printed by white color.

8. PACKING AND MARKING

8.1 Cable Packing

8.1.1 Standard length of the cable shall be 2~4 km. Other cable length is also available if required by customer.

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

8.1.3 Both ends of the cable shall be sealed with a suitable heat shrinkable caps or PVC cap to prevent the entry of moisture during transportation and storage.

8.1.4 The cable end shall be securely fastened to the drum to prevent the cable from becoming loose during transit or becoming loose during placing operations.

8.1.5 The inner end of the cable is housed into a slot on the side of the reel without extra cable length for testing

8.1.6 The reels must have a number of rotations that there is a min. free space of 50mm between the upper layer and the edge of the flanges.

8.1.7 Circumference battens or Wood-fiber board shall be secured with steel band to protect the cable during normal handling and storage.

8.2 Cable Drum

8.2.1 Details given below shall be distinctly marked on a weatherproof material on both outer sides of the drum flange:

(1) Customer's name
(2) Type and size of cable
(3) Length of cable in meters
(4) Net weight and gross weight in kilograms
(5) Drum number
(6) Name of manufacturer
(7) Year of manufacture
(8) Arrow showing the direction of the drum should be rolled when handling
(9) End mark of cable
(10) Caution plate (label)

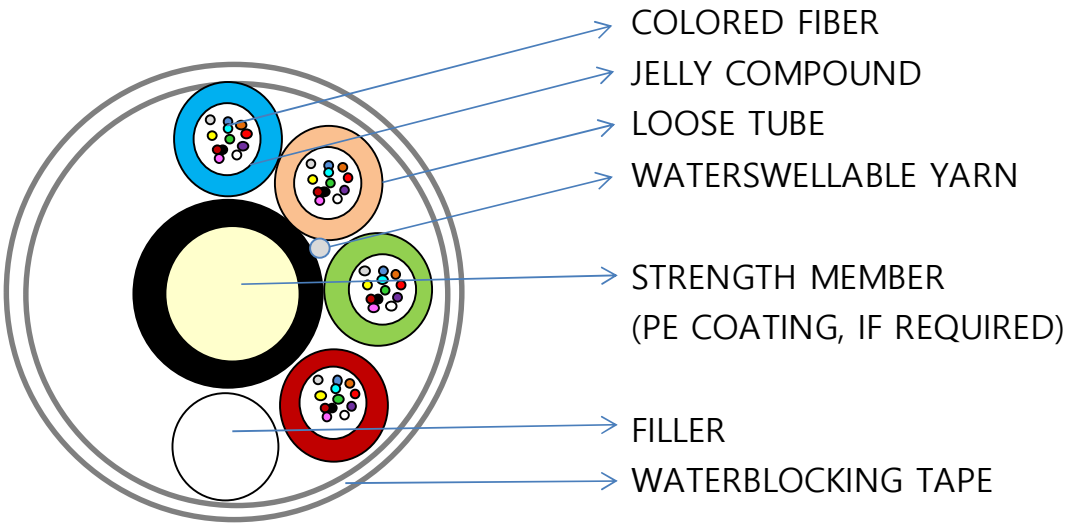
The other shipping mark is also available if required by buyer.

8.2.2 The minimum barrel diameter of the drum shall be 30 times to the overall cable diameter

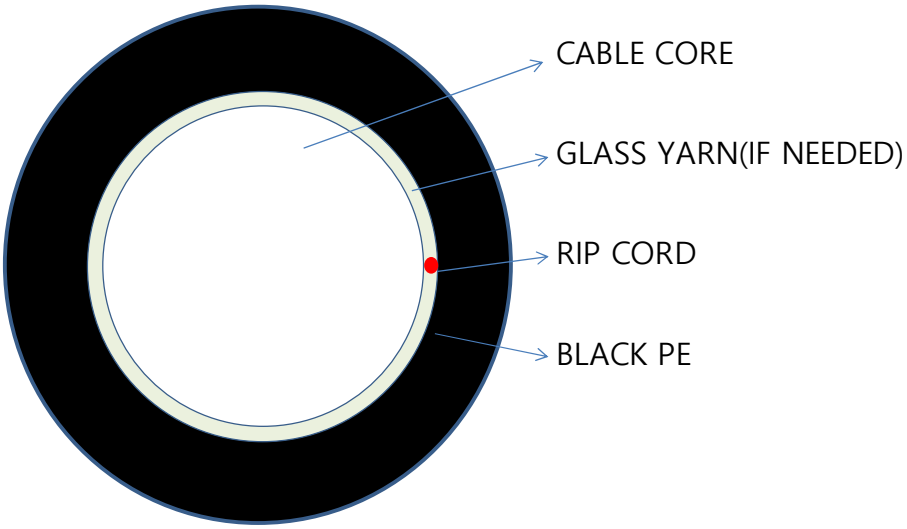
8.2.3 The arbor holes provided in the reels shall be 75 ~ 125 mm in diameter.

Annex. 1: Cross-sectional Drawing of the Cable

■ CABLE CORE



■ CABLE JACKET



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

Annex. 2: Diameter, Weight & Min. Bending radius, Max. Pulling Tension

- Micro Single Jacket Cable

No. of Fiber	Nom. Cable Diameter (mm)	Approx. Cable Weight (kg/km)	Max. Pulling Tension (kgf)	Standard cable Packing length	Min. Bending Radius (mm)	
					No Load	Load
~60	7.8	43	65	2~4 km	10D	20D