

US-21-LTDTJSJA-Rev.2



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# Specification

**SJSA Optic Cable**

**(LT Single Jacket Single Armor Dry/Dry)**

## 1. GENERAL

### 1.1 Scope

This document specifies the single mode optical fiber cables for use at long wavelength, which are suitable for long haul optical transmission system.

### 1.2 Application

The cable is suitable for direct buried installation.

### 1.3 Construction

**1.3.1** The fibers are multi mode type, which are having a loose secondary coating of high modulus plastic.

**1.3.2** The center of the core contains a non-metallic strength member. The strength member is optimized so as to limit the application of maximum recommended installation tension.

**1.3.3** The loose tubes and fillers are stranded around the strength member into a compact and circular cable core.

**1.3.4** A core wrap, followed by an **DIRECT BURIED** (Cable Core + Corrugated steel tape+ Outer MDPE) sheath is applied. Cross-sectional Drawing illustrates the cable construction.

## 2. REFERENCES

- EIA/TIA 598 Color Coding of fiber Optic Cables.
- IEC 794 Optical Fiber Cables. Part I Generic Specifications.
- 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.

## 3. DESIGN

### 3.1 Optical Fiber

**3.1.1** The core of the optical fiber with a higher refractive index compared to the cladding is made of SiO<sub>2</sub>(Silicon dioxide) doped with GeO<sub>2</sub>(Germanium dioxide).

**3.1.2** The cladding of the optical fiber is made of SiO<sub>2</sub>(Silicon dioxide).

**3.1.3** The primary coating shall be consisted of a double layer UV-cured acrylate. The coating shall be easy to remove from the glass fiber.

**3.1.4** The proof test level shall be 115 kpsi (0.8Gpa).

### 3.2 Loose Tube

**3.2.1** The jacket of each fiber shall be a tube of high modulus plastic (PBT).

**3.2.2** Each loose tube shall be filled with a watering swellable yarn to prevent water ingress and to ensure low stress levels of the fiber.

**3.2.3** The dimensions of which shall be such as to ensure that the fibers are subjected to no mechanical stresses or curvature that would cause any impairment in the transmission.

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**3.2.4** Fibers in the loose tube shall be individually color coded to facilitate their ready identification at either end of any cable length.

A common fiber color sequence shall be in accordance with the Annex 1.

### **3.3 Central Strength Member**

**3.3.1** The center of the core contains a non-metallic strength member of FRP.

**3.3.2** The strength is optimized so as to limit the application of maximum recommended installation tension.

**3.3.3** The strength member may be coated by polyethylene and is compatible with other outside plant materials.

### **3.4 SZ Stranding**

**3.4.1** The loose tubes and fillers are stranded around the strength member with S/Z direction to withstand the installation tensile strength.

**3.4.2** In general, the identification of the loose tubes shall be in accordance with the No.5 The color of fillers shall be natural.

**3.4.3** The sequence of counting the loose tube and the filler shall be in clockwise direction, seen at the running end of the cable.

### **3.5 Water swellable yarn (Dry core design)**

Water swellable yarn shall be applied around strength member to prevent axial and longitudinal flow of water throughout the cable.

### **3.6 Core Wrap Tape (Water swellable tape)**

A core wrap tape shall be applied over the cable core with suitable waterproof, thermal and dielectric properties.

### **3.7 Direct Buried Sheath**

#### **3.7.1 Armor**

Armor should be metallic. A corrugated steel tape coated on both sides with copolymer shall be applied longitudinally with overlap.

**3.7.2** Outer MDPE Sheath the sheath shall be consisted of a high molecular weight black MDPE. The sheath shall contain carbon black for UV light protection. The sheath shall be circular, free from pinholes, joints, mended places and other defects.

The nominal thickness of sheath shall be 1.5 mm.

### **3.8 Ripcords**

Two ripcords shall be provided under the outer sheath. The ripcord shall be hydrophobic and non-wicking, continuous throughout a length of cable and sufficient strength to open the sheath without breaking the cord. The color of ripcord shall be red..

## 4. PROPERTIES

### 4.1 Optical Properties

The fibers in the cable shall maintain their properties as specified below provided the mechanical and environmental conditions specified in paragraph 3.2 have not been exceeded and the proper installation procedures have been followed. The geometrical structures and optical characteristics shall be in accordance with Table 1 and the optical fibers shall meet ITU-T Multi mode recommendation and test method shall meet IEC 60793-1 and IEC 60793-2 international standard

**Table 1. ZWP(Zero Water Peak Fiber\_ITU-T G.652D)**

Parameters	Value
<b>Physical Characteristics</b>	
Clad Diameter	125±0.7 μm
Core-Clad Concentricity Error(Offset)	≤0.5 μm
Cladding Non-Circularity, maximum	≤0.7%
Coating Diameter (Colored)	253 μm±0.7 μm
Coating Diameter (Uncolored)	240 μm±0.5 μm
Coating-Clad Concentricity Error(Uncolored)	≤12 μm
Tensile Proof Test	100 kpsi (0.69 GPa)
Coating Strip Force	Range: 1.0N ≤ CSF ≤ 8.9N
<b>Optical Specification</b>	
Attenuation (After cable) at 1310nm at 1385nm at 1550nm	Maximum ≤ 0.35 dB/km ≤ 0.35 dB/km ≤ 0.25 dB/km
Backscatter Coefficient	-79.6 dB @ 1,310 nm -82.1 dB @ 1,550 nm
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 1385 nm at 1550 nm	1.467 1.468 1.468
Mode Field Diameter at 1310 nm at 1385 nm at 1550 nm	9.2 ± 0.3 μm 9.6 ± 0.6 μm 10.4 ± 0.5 μm

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Polarization Mode Dispersion (PMD) <sup>1</sup> Fiber PMD Link Design Value (LDV) <sup>2</sup>	< 0.04 ps/√km	
Chromatic Dispersion	1302 – 1322 nm	
Zero Dispersion Wavelength (λ <sub>0</sub> )	≤ 0.090 ps/nm <sup>2</sup> -km	
Zero Dispersion Slope (S <sub>0</sub> )	0.087 ps/nm <sup>2</sup> -km	
Typical Dispersion Slope	≤ 1260 nm	
Cut-off Wavelength (λ <sub>CC</sub> )	≤ 0.05 dB	
Attenuation Uniformity / Point Discontinuities at 1310 nm and 1550 nm		
<b>Mechanical Specifications</b>		
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
		< 0.05 dB
Coating Strip Force, maximum	8.9N	
Coating Strip Force, minimum	1.3N	
<b>Environmental Characteristics (at 1310, 1550 &amp; 1625 nm)</b>		
Temperature Cycling (-60° + 85° C)	≤ 0.05 dB/km	
High Temperature Aging (85 ± 2° C)	≤ 0.05 dB/km	
Temperature & Humidity Cycling (at -10° C to +85° C and 95% RH)	≤ 0.05 dB/km	
Water Immersion (23 ± 2° C)	≤ 0.05 dB/km	

**Table 2 The properties of single mode fiber (G.657 A1)**

Parameter	Specification
<b>Optical Characteristics</b>	
Attenuation (After cable)	Maximum
at 1310nm	≤ 0.35dB/km
at 1385nm	≤ 0.35dB/km
at 1550nm	≤ 0.25 dB/km

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Dispersion coefficient @ 1285 ~ 1330 nm @ 1550 nm	≤ 3.4 ps/(nm <sup>2</sup> .km) ≤ 18.0 ps/(nm <sup>2</sup> .km)
Zero-dispersion wavelength	1300 ~ 1324 nm
Zero-dispersion slope	≤ 0.092 ps/(nm <sup>2</sup> .km)
PMD Maximum Individual Fiber	≤ 0.2 ps/km <sup>1/2</sup>
Cable cut-off wavelength	≤ 1260 nm
Mode field diameter @ 1310 nm	8.8 ± 0.4 μm
<b>Geometrical Characteristics</b>	
Cladding diameter	125.0 ± 0.7 μm
Cladding non-circularity	≤ 0.7 %
Coating diameter	245 ± 10 μm
Coating-Cladding concentricity error	≤ 12.0 μm
Coating Non-circularity error	≤ 6.0 %
Core-Clad concentricity error	≤ 0.5 μm
Curl (Radius)	≥ 4m
<b>Mechanical Specification</b>	
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

**4.2 Cable Dimensions & Physical, Environmental, Mechanical Test Specifications**

**Table 3 . Dimensions and Specifications**

Item	Construction								
	12	24	36	48	72	96	144	288	432
Total fiber count	12	24	36	48	72	96	144	288	432
Nom. cable diameter (mm)	11.5	11.5	11.5	11.5	12.2	13.6	17.0	19.6	17.5
Fiber counts per loose tube	12	12	12	12	12	12	12	12	24
Loose tube No. + Filler No.	1+4	2+3	3+2	4+1	6+0	8+0	12+0	24+0	18+0

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Loose Tube	Material	PBT (Polybutylene Terephthalate)								
	Water proof	Water swellable yarn								
Filler Material		PE string								
Central Strength Member		FRP Rod (Fiber Reinforced Plastic) with or without PE coated								
Water Blocking Material		Water swellable Yarn								
Wrapping Tape		Water swellable Tape								
Ripcord		2 ea								
Armor		Corrugation Steel Tape								
Outer Sheath		MDPE - Black Thickness 1.5mm (Nominal)								
Cable Weight (Nom. kg/km)		115	115	115	115	133	160	241	303	252
<b>Physical Specifications</b>										
Min. Bending Radius(mm)	loaded	173	173	173	173	183	201	257	294	263
	unloaded	115	115	115	115	122	134	171	196	175
Tensile Load(N)	long term, max.	800	800	800	800	800	800	800	800	800
	short term, max.	2700	2700	2700	2700	2700	2700	2700	2700	2700
<b>Environmental Specifications</b>										
Environmental Space		Aerial, lashed / Buried								
Installation Temperature		-30°C ~ +70°C								
Operating Temperature		-40°C ~ +70°C								
Storage Temperature		-40°C ~ +75°C								
<b>Mechanical Test Specifications</b>										
Compression		44 N/mm Test Method : IEC 60794-1 E3								
Flex		35 cycles Test Method : IEC 60794-1 E6								
Impact		4.41 N-m(12 ~144C), 6.62 N-m(288C) Test Method : IEC 60794-1 E4								
Strain		See long and short term tensile loads Test Method : IEC 60794-1 E1								
Twist		10 cycles Test Method : IEC 60794-1 E7								
Water Penetration		24 h Test Method : IEC 60794-1 F5								
<b>Environmental Test Specifications</b>										
Cable Freeze		-2 °C Test Method : IEC 60794-1 F15								

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Heat Age	-40 °C to +85 °C Test Method : IEC 60794-1 F9
Low High Bend	-30 °C to +60 °C Test Method : IEC 60794-1 E11
Temperature Cycle	-40 °C to +70 °C Test Method : IEC 60794-1 F1
<b>Regulatory Compliance/Certifications</b>	
RoHS 2011/65/EU	Compliant
ISO 9001:2015	Designed, manufactured and/or distributed under this quality management system

## 5. Identification

### 5.1 Color Code of the individual fibers

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

### 5.2 Color Coding of Loose Tubes

No.	1	2	3	4	5	6	7	8	9	10	11	12
12F	Blue (12)	Filler	Filler	Filler	Filler	-	-	-	-	-	-	-
24F	Blue (12)	Orange (12)	Filler	Filler	Filler	-	-	-	-	-	-	-
36F	Blue (12)	Orange (12)	Green (12)	Filler	Filler	-	-	-	-	-	-	-
48F	Blue (12)	Orange (12)	Green (12)	Brown (12)	Filler	-	-	-	-	-	-	-
72F	Blue (12)	Orange (12)	Green (12)	Brown (12)	Gray (12)	White (12)	-	-	-	-	-	-
96F	Blue (12)	Orange (12)	Green (12)	Brown (12)	Gray (12)	White (12)	Red (12)	Black (12)				
144F	Blue (12)	Orange (12)	Green (12)	Brown (12)	Gray (12)	White (12)	Red (12)	Black (12)	Yellow (12)	Violet (12)	Pink (12)	Aqua (12)
288F	Blue (12)	Orange (12)	Green (12)	Brown (12)	Gray (12)	White (12)	Red (12)	Black (12)	Yellow (12)	Violet (12)	Pink (12)	Aqua (12)
	* Blue (12)	* Orange (12)	* Green (12)	* Brown (12)	* Gray (12)	* White (12)	* Red (12)	Natural (12)	* Yellow (12)	* Violet (12)	* Pink (12)	* Aqua (12)



No.	1	2	3	4	5	6	7	8	9	10	11	12
432F	Blue (24)	Orange (24)	Green (24)	Brown (24)	Slate (24)	White (24)	Red (24)	Black (24)	Yellow (24)	Violet (24)	Pink (24)	Aqua (24)
	13	14	15	16	17	18	19	20	21	22	23	24
	* Blue (24)	* Orange (24)	* Green (24)	* Brown (24)	* Slate (24)	* White (24)	-	-	-	-	-	-

( ) : Means the number of fiber per tube

\* : Stripe (color : black)

## 6. MARKING AND PACKING

### 6.1 Marking

#### 6.1.1 Sheath Marking

The cable shall have the following information clearly marked on the sheath at regular intervals of one meter to use white pigment tape.

- Customer' s name : CUSTOMER NAME (for example)
- Manufacturer' s name :
- Year of manufacture : 201X (for example)
- Serial Number : XXXX
- Fiber type & counts : SM 144C (for example)
- Length mark : XXXXM

In case of the SM 1444 fibers Cable

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0000M CUSTOMER NAME Maker 201X XXXX SM 144C 0001M

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Cable marking can be changed upon customer' s request.

#### 6.1.2 Drum marking

The information requested by customer shall be marked on flange by using ink and weatherproof label.

### 6.2 Packing

**6.2.1** Each factory length of the cable shall be coiled on one suitable wooden drum to be protected from putrefaction. The wooden drums shall meet ISPM No. 15 international standard. (Regulation of Wood Packing Material in International Trade

**6.2.2** The cable shall be reeled on the wooden drum in standard manufacturing length of 2km or special length will be provided in order.

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**6.2.3** After completion of the tests, cable end cap shall be installed on both ends of the cable.

**6.2.4** The diameter of the barrel shall not be less than 40 times of the outer diameter of cable.

**6.2.5** Circumference shall be completely enclosed with battens; nails on both sides shall secure these battens.

## **7. QUALITY CONTROL**

### **7.1 Incoming Inspection**

All the raw materials that are used for optical fiber cable shall be inspected by the raw material testing methods that are specified by the manufacturer and that are based on 'Korea Standard' or 'ASTM'

In some cases, suppliers' test report shall substitute for the raw material manufacturer's test.

Any materials that do not meet the manufacturer's raw material specification shall be rejected or scrapped, and the passed materials only shall be used in the process. Some raw material specifications and subsequent raw material test method may be changed without notice, if and only if the new specification and the new test method do not affect the quality of optical fiber cable.

### **7.2 In-Process Inspection**

Semi-final goods shall be inspected in accordance with specified manufacturer's testing method. The testing method may be changed without notice, if it does not affect quality of optical fiber cable.

### **7.3 Final Cable Inspection**

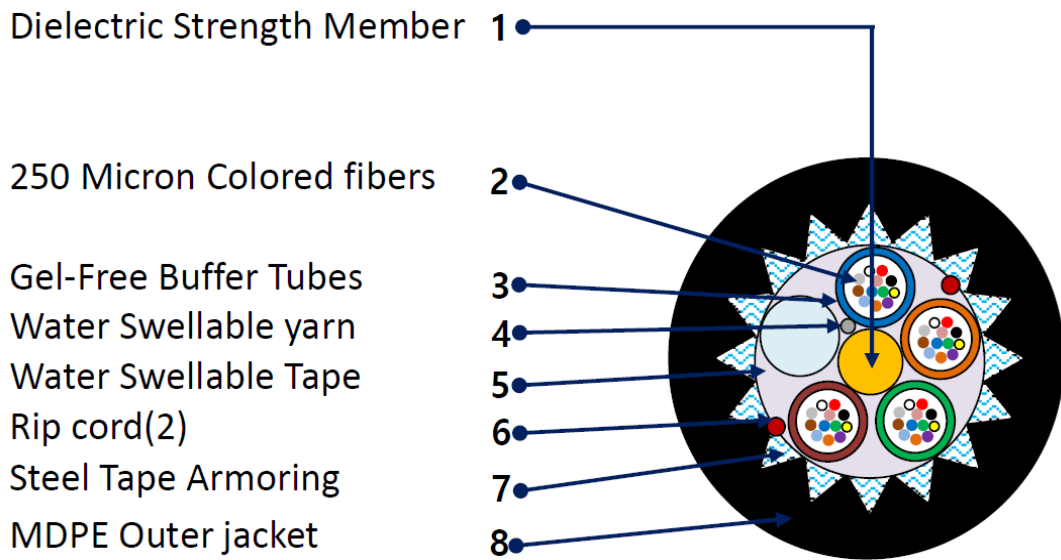
Following quality properties of finished cable shall be tested to assure the field performances.

- Optical characteristics (Table 1)
- Mechanical characteristics (Table 2)
- Cable construction (Tolerance of dimension :  $\leq \pm 5\%$ )

### **7.4 Quality System**

Korea Standard Association applies ISO 9001, ISO 14001 and TL 9000 to assure the conformance to specified requirements during our production.

# Cross-Sectional Drawing



- End of Specification -