

Specification

LA-LT-041

**Loose Tube / Gel-Free /
Single Jacket Single Armored Optical Fiber Cable**

[LAC code : OPSP-041]
[Optical Fiber based on SM & MM]

1. Scope

1.1 Application

This specification covers the general requirements for outdoor optical fiber applications.

1.2 Cable Description

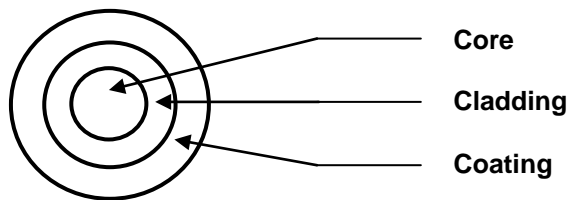
The cable core consists of color coded fibers, dry water swellable material, color coded loose tubes, PE filler (if necessary), SZ-stranded around the dielectric central strength member with water blocking yarn(s).

Single Armored / Single Jacket

The cable structure is reinforced by the application of a core wrapping tape and a corrugated steel tape covered by an outer PE jacket.

2. Optical Fiber

2.1 Construction of the fibers



2.2 The operating wavelength region of single-mode is 1310 & 1550nm.

2.3 Fiber Material

The fiber is made from high grade silica glasses coated by a UV curable acrylate material. A protective UV cured acrylate coating is applied over the fiber cladding and it can be removed mechanically or chemically.

- Core : Silica (SiO₂) Doped with Germanium Dioxide (GeO₂)
- Cladding : Silica (SiO₂)
- Coating : Dual Layers of UV curable acrylate (or equivalent)

2.4 Environmental conditions; up to 100 % non-condensing humidity

- Operation : - 40 to 158 °F (- 40 to 70 °C)
- Installation : - 22 to 158 °F (- 30 to 70 °C)
- Storage : - 40 to 158 °F (- 40 to 70 °C)

2.5 The optical, geometrical and mechanical performance of the optical fiber is reflected in Table 1 (below).

Table 1-1. Characteristics for Single mode fiber
(Optical, geometrical, and mechanical performance)

Items	Unit	Specification		
		G.652D	G.657A1	G.657A2
Type of Fiber		G.652D	G.657A1	G.657A2
Mode Field Diameter @1310nm	μm	9.2 ± 0.4	8.9 ± 0.4	8.6 ± 0.4
Mode Field Concentricity Error	μm	≤ 0.8		
Cladding Diameter	μm	125 ± 1.0		
Cladding Non-circularity	%	≤ 1.0		
Transmission Wavelength	nm	1310, 1550		
Attenuation (Max. 288C)	dB/km	≤ 0.35 @ 1310 nm ≤ 0.25 @ 1550 nm		
Attenuation (Max. 576C)	dB/km	≤ 0.40 @ 1310 nm ≤ 0.30 @ 1550 nm		
Zero Dispersion Wavelength	nm	1300 ~ 1324		
Chromatic Dispersion	ps/nm.km	≤ 3.2 @ 1290 ~ 1330 nm ≤ 18 @ 1550 nm		
Zero Dispersion Slope	ps/nm ² /km	≤ 0.092		
PMD Coefficient (PMDQ) (M=20, Q=0.01)	ps/km ^{1/2}	≤ 0.2		
Proof Test (Nom.)	kpsi	100		

Table 1-2. Characteristics for Multi mode fiber
(Optical, geometrical, and mechanical performance)

Items	Unit	Specification	
		OM1 (62.5/125 MM)	OM2 (50/125 MM)
Type of Fiber		OM1 (62.5/125 MM)	OM2 (50/125 MM)
Attenuation co-efficient	dB/km	≤ 3.5 @ 850 nm ≤ 1.0 @ 1300 nm	≤ 3.5 @ 850 nm ≤ 1.0 @ 1300 nm
Bandwidth	MHz.km	≥ 200 @ 850nm ≥ 500 @ 1300nm	≥ 400 @ 850nm ≥ 600 @ 1300nm
Numerical Aperture	-	0.275 ± 0.015	0.200 ± 0.015
Core Diameter	µm	62.5 ± 3.0	50 ± 3.0
Core-cladding Concentricity Error	µm	≤ 3.0	≤ 3.0
Cladding Diameter	µm	125 ± 2.0	125 ± 2.0
Cladding Non-circularity	%	≤ 2.0	≤ 2.0
Coating Diameter	µm	245 ± 15	245 ± 15
Coating Non-circularity	%	≤ 6.0	≤ 6.0
Proof test (Nom)	kpsi	100	100

Table 1-3. Characteristics for 10G Multi mode fiber
(Optical, geometrical, and mechanical performance)

Items	Unit	Specification	
		OM3 (50/125 MM)	OM4 (50/125 MM)
Type of Fiber		OM3 (50/125 MM)	OM4 (50/125 MM)
Attenuation co-efficient	dB/km	≤ 3.0 @ 850 nm ≤ 1.0 @ 1300 nm	≤ 3.0 @ 850 nm ≤ 1.0 @ 1300 nm
OFL Bandwidth	MHz.km	≥ 1500 @ 850nm ≥ 500 @ 1300nm	≥ 3500 @ 850nm ≥ 500 @ 1300nm
Effective Modal Bandwidth	MHz.km	≥ 2000 @ 850nm	≥ 4700 @ 850nm
Transmission link length for 10Gbps Ethernet SX	m	300 @ 850nm	550 @ 850nm
Numerical Aperture	-	0.200 ± 0.015	0.200 ± 0.015
Core Diameter	µm	50 ± 3.0	50 ± 3.0
Core-cladding Concentricity Error	µm	≤ 3.0	≤ 3.0
Cladding Diameter	µm	125 ± 2.0	125 ± 2.0
Cladding Non-circularity	%	≤ 2.0	≤ 2.0
Coating Diameter	µm	245 ± 15	245 ± 15
Coating Non-circularity	%	≤ 6.0	≤ 6.0
Proof test (Nom)	kpsi	100	100

3. Cable Construction

3.1 The physical construction of the cable is shown in Table 2 (below).

Table 2.1 Construction of the cable

Items	Description
Fiber Type	See Table 1
No. of Fibers	Max. 576C
Loose buffer tube	Made of PBTP (Polybutylene Terephthalate) or PP (Polypropylene)
No. of fiber per tube	12 (Max. 288C); 24 (Max. 576C)
Filler	Natural color PE rod(s). If necessary, the PE filler(s) can be used for circular-section core(s) (for better core configuration).
Central Strength Member	FRP (If necessary, PE coating)
Water blocking material	Water blocking yarn(s) or tape (to prevent ingress of water)
S-Z Stranding (Cable Core)	The required numbers of loose tube and filler rod are S-Z stranded tightly around the CSM.
Core wrapping tape	Water blocking tape
Rip cord	Two ripcords (for easy cable entry)
Armor Tape	A corrugated steel tape of ECCS (Electrolytic Chrome Coated Steel) coated with polymer on both sides. This tape shall be bonded with outer jacket. -. Nom. 0.15mm (Steel tape thickness) -. Nom. 0.05mm (Plastic coating on one-side thickness)
Outer Jacket	Black colored MDPE

4. Fiber & Loose tube Identification

4.1 The loose tubes and the individual fibers are color coded as reflected in Table 3 (below).

Table 3-1 Color code of the fibers

No	Color	No	Color
1	Blue	13	Blue + Single dot marking
2	Orange	14	Orange + Single dot marking
3	Green	15	Green + Single dot marking
4	Brown	16	Brown + Single dot marking
5	Gray	17	Gray + Single dot marking
6	White	18	White + Single dot marking
7	Red	19	Red + Single dot marking
8	Black	20	Natural + Single dot marking
9	Yellow	21	Yellow + Single dot marking
10	Violet	22	Violet + Single dot marking
11	Pink	23	Pink + Single dot marking
12	Aqua	24	Aqua + Single dot marking

Table 3-2 Color code of the loose buffer tubes

No	Color	No	Color
1	Blue	13	Blue + Black longitudinal stripe
2	Orange	14	Orange + Black longitudinal stripe
3	Green	15	Green + Black longitudinal stripe
4	Brown	16	Brown + Black longitudinal stripe
5	Gray	17	Gray + Black longitudinal stripe
6	White	18	White + Black longitudinal stripe
7	Red	19	Red + Black longitudinal stripe
8	Black	20	Black + White* longitudinal stripe
9	Yellow	21	Yellow + Black longitudinal stripe
10	Violet	22	Violet + Black longitudinal stripe
11	Pink	23	Pink + Black longitudinal stripe
12	Aqua	24	Aqua + Black longitudinal stripe

*: White can be replaced by Yellow longitudinal stripe.

5. Mechanical / Environmental Performance & Tests

5.1 The mechanical & environmental performance of the cable is in accordance with Table 4 (below). Unless otherwise specified, all attenuation measurements required in this section are performed at 1550 nm for single mode and at 1300 nm for multi mode fiber. The measurement equipment error will be no more than 0.02dB.

Table 4 Mechanical & Environmental Performance of the cable

Items	Description
Tensile Strength	<ul style="list-style-type: none"> ● Test method: IEC 60794-1-2 Method E1 - Mandrel diameter: 40D (D: cable diameter) - Applied tensile load: 2,700 N - Duration of loading: 60 min. ● Acceptance criteria - Attenuation increment: ≤ 0.15 dB for SM; ≤ 0.40 dB for MM
Crush Resistance (Compressive loading)	<ul style="list-style-type: none"> ● Test method: IEC 60794-1-2 Method E3 - Applied load: 2,200N - No of points: 1 point - Plate size: 100 mm x 100 mm - Duration of loading: 10 min. ● Acceptance criteria - Attenuation increment: ≤ 0.15 dB for SM; ≤ 0.40 dB for MM
Impact resistance	<ul style="list-style-type: none"> ● Test method: IEC 60794-1-2 Method E4 - Drop hammer mass: 9.8 N.M - No. of impact per point: 1 time @ 3 point ● Acceptance criteria - Attenuation increment: ≤ 0.15 dB for SM; ≤ 0.40 dB for MM
Cable bend	<ul style="list-style-type: none"> ● Test method: IEC 60794-1-2 Method E11A - Mandrel diameter: 20D (D: cable dia.) - No. of bend cycles: 4 cycles - Bend angle: ± 180 degree ● Acceptance criteria - Attenuation increment: ≤ 0.15 dB for SM; ≤ 0.40 dB for MM
Torsion	<ul style="list-style-type: none"> ● Test method: IEC 60794-1-2 Method E7 - Cable twisted length: 2 m - Applied load: 55 N (5.5 kg weight) - No. of twist cycles: 10 cycles - Twist angle: ± 180 degree ● Acceptance criteria - Attenuation increment: ≤ 0.15 dB for SM; ≤ 0.40 dB for MM
Water penetration	<ul style="list-style-type: none"> ● Test method: IEC 60794-1-2 Method F5 - Length of specimen: 3 m - Height of pressure head: 1 m - Test time: 24 h ● Acceptance criteria - No leakage through the open cable end
Temperature Cycling	<ul style="list-style-type: none"> ● Test method: IEC 60794-1-2 Method F1 - Cable length: $\geq 1,000$ m - Test condition: ≥ 2 fibers shall be spliced - Temperature cycling schedule : $+23^{\circ}\text{C} \rightarrow -40^{\circ}\text{C} \rightarrow +70^{\circ}\text{C} \rightarrow +23^{\circ}\text{C}$ - Soak time at each temperature: 16 h - No. of cycles: 2 ● Acceptance criteria - Attenuation increment: ≤ 0.15 dB/km for SM; ≤ 0.40 dB for MM

6. Packing and marking

6.1 Cable marking

The jacket is marked every two feet or one meter with following information.

- 1) Cable type & counts
- 2) Name of the manufacturer
- 3) Year of manufacture (YYYY)
- 4) Serial number (NNNNN)
- 5) Length marking (FT)

- Ex) For SM 72 fiber cable

00002FT SJSA-041 SM 72C LEXINGTON AMES YYYY NNNNN 00004FT

6.2 Cable packing

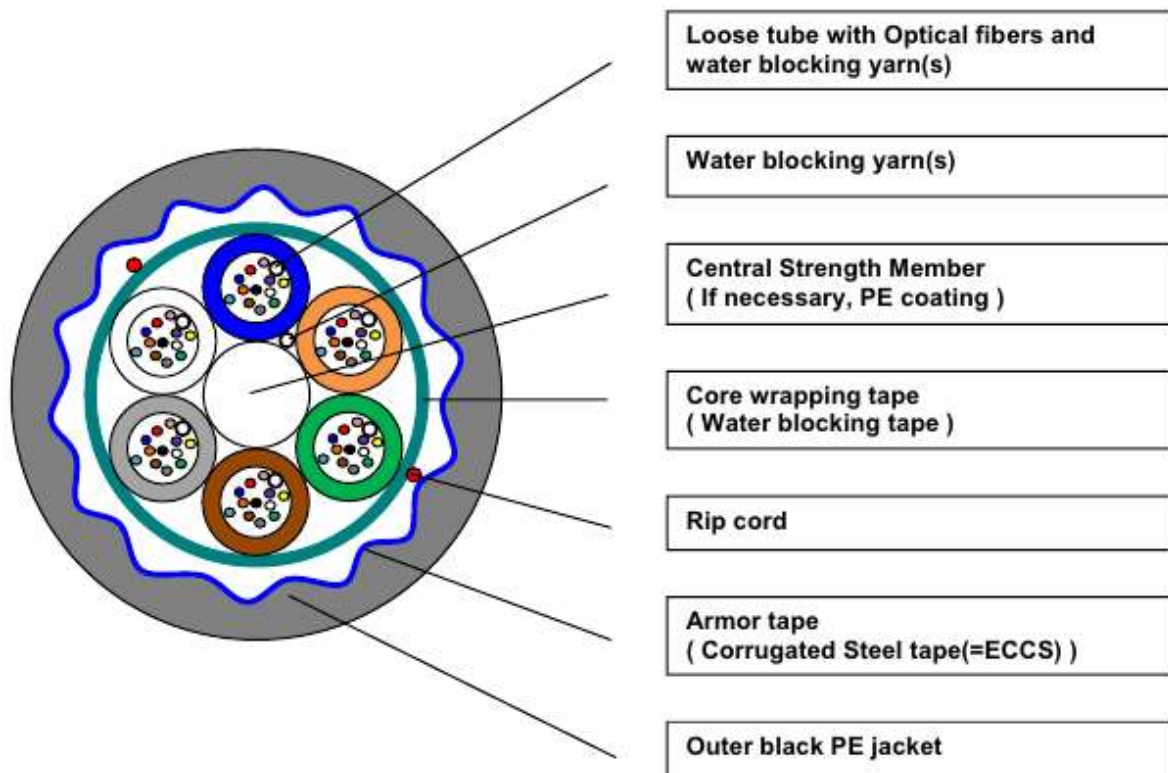
- 6.2.1 Standard length of cable is in accordance with Appendix 2. Other cable lengths are available per customer demand.
- 6.2.2 Each length of the cable is wound on a separate wooden reel.
- 6.2.3 Both ends of the cable are sealed with a suitable plastic cap to prevent the entry of moisture during shipping, handling and storage.
- 6.2.4 The cable ends are securely fastened to the reel to prevent the cable from becoming loose in transit or during placing operations.
- 6.2.5 The inner end of the cable is housed into a slot on the side of the reel without extra cable length for testing.
- 6.2.6 The reels must have a minimum of 50mm of free space between the upper layer and the edge of the flanges.
- 6.2.7 Circumference battens or Wood-fiber board is secured with a steel band to protect the cable during normal handling and storage.

6.3 Cable reel

- 6.3.1 The following details are indicated on the outer sides of the reel flange;
 - 1) Customer's name
 - 2) Contract Number
 - 3) Type & fiber counts of cable
 - 4) Length of cable in meter/feet
 - 5) Drum number & Gross & Net weight in kilograms/pounds
 - 6) Year of manufacture and the manufacturer
 - 7) Arrow showing the direction the drum shall be rolled
- 6.3.2 The cable is wound on the reel specifically to prevent damage during shipment and installation.
- 6.3.3 The minimum barrel diameter of the cable drums will be at least 30 times the overall cable diameter.
- 6.3.4 The arbor holes provided in the reels shall be 75 ~ 125 mm in diameter. The arbor hole on each flange is reinforced with a bearing plate.

Appendix 1

(Cable Cross-Sectional, drawing not to scale, 72 Fiber)



"The illustration on this page is subject to change or modification without any prior notice"

Appendix 2

Diameter, Weight & Min. Bending radius

No. of Fiber	No. of Loose Tube Positon	Nom. Cable Diameter (inch)	Nom. Cable Weight (lbs/kft)		Min. Bending Radius (mm)	
			PBT tube	PP tube	No Load	Under Load
~ 72	6	0.480 (12.2mm)	91 (135kg/km)	91 (135kg/km)	10 D	20 D
96	8	0.539 (13.7mm)	114 (170kg/km)	107 (160kg/km)	10 D	20 D
120	10	0.610 (15.5mm)	138 (205kg/km)	131 (195kg/km)	10 D	20 D
144	12	0.669 (17.0mm)	161 (240kg/km)	155 (230kg/km)	10 D	20 D
216	18 (6+12)	0.689 (17.5mm)	161 (240kg/km)	155 (230kg/km)	10 D	20 D
288	24 (9+15)	0.787 (20.0mm)	208 (310kg/km)	192 (285kg/km)	10 D	20 D
432	18 (6+12)	0.846 (21.5mm)	229 (340kg/km)	215 (320kg/km)	10 D	20 D
576	24 (9+15)	0.965 (24.5mm)	292 (435kg/km)	270 (400kg/km)	10 D	20 D