Tender No.	:	Spec. No.	: WLSGS-23-OC0245-00
User / Customer	:	Page No.	: 1 of 11
Tender Title	:		
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Specification

For

Fiber Optic Cable
Gel Filled Loose Tube /
Dry Core / Single Jacket
All-Dielectric / Self-Supporting

Connecting the World

1. GENERAL

This specification covers the general requirements of all dielectric self-supporting cable for aerial application.

2. NORMATIVE REFERENCES

Unless otherwise specified, all cables shall be in accordance with all applicable section of the following Codes, Standards and Regulations, and their current amendments.

Table 1. Normative references

Normative	Designation
IEC 60793-1	Optical fibers, Generic specification
IEC 60793-2	Optical fibers, Product specification
ITU-T G.652	Characteristics of a single-mode optical fiber
ITU-T G.657	Characteristics of bending-loss insensitive a single-mode optical fiber
TIA/EIA-455-3B	Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components
TIA/EIA-455-25D	Impact Testing of Optical Fiber Cables
TIA/EIA-455-33B	Fiber Optic Cable Tensile Loading and Bending Test
TIA/EIA-455-41A	Compressive Loading Resistance of Fiber Optic Cables
TIA/EIA-455-82C	Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable
TIA/EIA-455-85A	Fiber Optic Cable Twist Test
TIA/EIA-455-104A	Fiber Optic Cable Cyclic Flexing Test
TIA/EIA-598-D	Optical Fiber Cable Color Coding
IEEE 1222	Standard for Testing and Performance for All-Dielectric Self-Supporting (ADSS) Fiber Optic Cable

3. OPTICAL FIBER

The optical, geometrical, mechanical and environmental performance of the optical fiber shall be in accordance with Table 2 to Table 3 below.

Table 2. Performance of Single Mode Fiber (ITU-T G.652D)

ITEMS		UNITS	SPECIFICATION
Attenuation at 1310/1383/1550 nm		dB/km	≤ 0.35 / ≤ 0.35 / ≤ 0.25
Chromatic Dispersion at 1285~1330/1550nm		ps/nm.km	≤ 3.5 / ≤ 18
Zero Dispersion Wavelength		nm	1300 ~ 1324
Zero Dispersion Slope		$ps/nm^2.km$	≤ 0.092
Cable PMD (PMD_Q)		ps/√km	≤ 0.2 (20 section link)
Cut-off wavelength (λcc)		nm	≤ 1260
Bending loss	R30mm x 100[1]	dB	≤ 0.1 at 1625nm
MFD at 1310 / 1550nm		μm	9.2 ± 0.4 / 10.4 ± 1.0
Core/Cladding Concentricity Error		μm	≤ 0.6
Cladding Diameter		μm	125 ± 0.7
Cladding Non-circularity		%	≤ 1.0
Coating Diameter		μm	245 ± 10
Proof Test		GPa	≥ 0.69

Table 3. Performance of Single Mode Fiber (ITU-T G.657A)

ITEMS		UNITS	SPECIFICATION	
			G.657A1	G.657A2
Attenuation at 1310/1383/1550nm		dB/km	≤ 0.35 / ≤ 0.35 / ≤ 0.25	
Chromatic Dispersion at 1285~1330/1550nm		ps/nm.km	≤ 3.5 / ≤ 18	
Zero Dispersion Wavelength		nm	1300 ~ 1324	
Zero Dispersion Slope		$ps/nm^2.km$	≤ 0.092	
Cable PMD (PMD_Q)		ps/√km	≤ 0.2 (20 section link)	
Cut-off wavelength (λcc)		nm	≤ 1260	
Attenuation vs Bending at 1550/1625nm	R15mm x 10	dB	≤ 0.25 /≤ 1.0	≤ 0.03 /≤ 0.1
	R10mm x 1	dB	≤ 0.75 /≤ 1.5	≤ 0.1 /≤ 0.2
	R7.5mm x 1	dB	-	≤ 0.5 / ≤ 1.0
MFD at 1310nm		μm	8.9 ± 0.4	8.6 ± 0.4
Core/Cladding Concentricity Error		μm	≤ 0.5	
Cladding Diameter		μm	125 ± 0.7	
Cladding Non-circularity		%	≤ 1.0	
Coating Diameter		μm	245 ± 10	
Proof Test		GPa	≥ 0.69	

[1] 100 turns with radius 30mm

4. FIBER AND LOOSE BUFFER TUBE IDENTIFICATION

The color code of loose buffer tubes and individual fibers within each loose buffer tube shall be in accordance with Table 4 to Table 5 below.

Table 4. Color code of the individual fibers

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

Table 5. Color code of loose buffer tubes

No.	Color	No.	Color	No.	Color
1	Blue	9	Yellow	17	Slate/BK stripe
2	Orange	10	Violet	18	White/BK stripe
3	Green	11	Rose	19	Red/BK stripe
4	Brown	12	Aqua	20	Black/WH stripe
5	Slate	13	Blue/BK stripe	21	Yellow/BK stripe
6	White	14	Orange/BK stripe	22	Violet/BK stripe
7	Red	15	Green/BK stripe	23	Rose/BK stripe
8	Black	16	Brown/BK stripe	24	Aqua/BK stripe

5. CABLE CONSTRUCTION

The construction of the cable shall be in accordance with Table 6 below.

Table 6. Construction of the cable

ITEMS		DESCRIPTION S-500FT & S-750FT
Number of fibers		Up to 288
No. of fibers per tube		12
Loose buffer tube	Material	PBT (Polybutylene Terephthalate)
	Filling material	Thixotropic gel compound
	Diameter	Nom. 2.5mm
Central strength member		FRP (Fiber reinforced plastic) with PE Over-Coating (If necessary)
Water blocking material		Water blocking yarn around CSM
Core wrapping tape		Water blocking tape
Peripheral strength member		Aramid yarns
Ripcord		Two polyester ripcords
Outer jacket[2]		Standard Black PE or Track-Resistant PE

[2] Space Potential : ≤12kV for Standard Black PE, ≤25kV for Track-Resistant PE
Although space potential is equal or less than 12kV, Track-Resistant PE may be applied at low pollution index area by customer's requirement.

6. PHYSICAL/MECHANICAL/ENVIRONMENTAL PERFORMANCE AND TESTS

6.1 Temperature Range

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

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

6.2 Mechanical and Environmental Performance of the Cable

The mechanical and environmental performance of the cable shall be in accordance with Table 7 below. Unless otherwise specified, all attenuation measurements required in this section shall be performed at 1550nm.

Table 7. The Mechanical and Environmental Performance of the Cable

<table>
<tr><th>ITEMS</th><th>TEST METHOD AND ACCEPTANCE CRITERIA</th></tr>
<tr><td>Tensile loading and bending test</td><td>▪ Test method: TIA/EIA-455-33B
- Load: MRCL in Table 9 & Table 10 for 1 hour
▪ Acceptance criteria
- Fiber strain: Max. 0.20%
- Attenuation increment: ≤ 0.1 dB
- No jacket cracking and fiber breakage</td></tr>
<tr><td>Compressive loading resistance test</td><td>▪ Test method: TIA/EIA-455-41A
- Applied load:
<table><tr><td>Short term (For 1min)</td><td>Long term (For 10min)</td></tr><tr><td>220N/cm</td><td>110N/cm</td></tr></table>▪ Acceptance criteria
- Attenuation increment:
≤ Reversible after the short term load
≤ 0.1 dB during the long term load
- No jacket cracking and fiber breakage</td></tr>
<tr><td>Impact test</td><td>▪ Test method: TIA/EIA-455-25D
- Impact Energy: 4.4N.m (3kg x 150mm)
- No. of impact per point: 2 times at 3 points each
▪ Acceptance criteria
- Attenuation increment: ≤ 0.1 dB after completion of the test
▪ No jacket cracking and fiber breakage</td></tr>
<tr><td>Cable twist test</td><td>▪ Test method: TIA/EIA-455-85A
- Cable length twisted: 2m
- No. of twist cycles: 10 cycles
- Twist angle: ±180°
▪ Acceptance criteria
- Attenuation increment: ≤ 0.1 dB after completion of the test
- No jacket cracking and fiber breakage</td></tr>
</table>

ITEMS	TEST METHOD AND ACCEPTANCE CRITERIA
Cyclic flexing test	▪ Test method: TIA/EIA-455-104A - Sheave diameter: 20D (D = cable diameter) - No. of flexing cycles: 25 cycles - Flexing speed: 30 cycles/minute ▪ Acceptance criteria - Attenuation increment: ≤ 0.1 dB after completion of the test - No jacket cracking and fiber breakage
Water penetration test	▪ Test method: TIA/EIA-455-82C - Length of specimen: 3m - Height of pressure head: 1m - Test time: 24 hours ▪ Acceptance criteria - No leakage through the open cable end
Temperature cycling test	▪ Test method: TIA/EIA-455-3B - Temperature cycling schedule : 23°C → -40°C → 70°C → -40°C → 70°C - Soak time at each temperature: Min.14hours ▪ Acceptance criteria - Attenuation increment: ≤ 0.15 dB/km

7. SAG/TENSION PARAMETERS AND TABLES

Table 8. Maximum Operating Condition

ITEMS	NESC Light
Temperature (°C)	-1
Wind Pressure (kg/m2)	43.9
Ice Thickness (mm)	No Ice
Constant (kg/m)	0.0745

Table 9. Configuration of Cables for **S-500FT**

Item	12 ~ 72F	96F	144F	288F
MIT (Max. Installation Tension) (kgf)	131	172	268	358
MRCL (Max. Rated Cable Load) (kgf)	305	362	466	583
RTS (Rated Tensile Strength) (kgf)	795	968	1,053	1,433

* Actual values for configuration may deviate from the calculated values given in the tables above.

Table 10. Configuration of Cables for **S-750FT**

Item	12 ~ 72F	96F	144F	288F
MIT (Max. Installation Tension) (kgf)	195	254	394	550
MRCL (Max. Rated Cable Load) (kgf)	422	515	672	867
RTS (Rated Tensile Strength) (kgf)	1,132	1,305	1,516	2,109

* Actual values for configuration may deviate from the calculated values given in the tables above.

8. CABLE PACKING AND MARKING

8.1 Cable marking

The outer surface of the cable shall be marked with white characters at intervals of two feet(or one meter) with the following information. Other marking is also available upon request.

1) Cable type
2) Fiber type and counts
3) Name of the manufacturer
4) Year of manufacture
5) Length marking

8.2 Cable packing

8.2.1 Standard length of the cable shall be 3,000m and 4,000m. Other cable length is also available if requested by customer.

8.2.2 Each length of the cable shall be wound on a separate wooden reel.

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

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

8.2.5 Circumference battens or wood-fiber board shall be secured with bands to protect the cable during normal handling and shipping.

8.3 Cable reel

8.3.1 Details given below shall be distinctly marked with a weather proof materials on both outer sides of the reel flange:

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

* Other shipping mark is also available upon request.

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

8.3.3 The arbor holes provided in the reels shall be at least 65 mm and at most 120 mm in diameter.

9. HEALTH, SAFETY AND ENVIRONMENT

9.1 ROHS directive

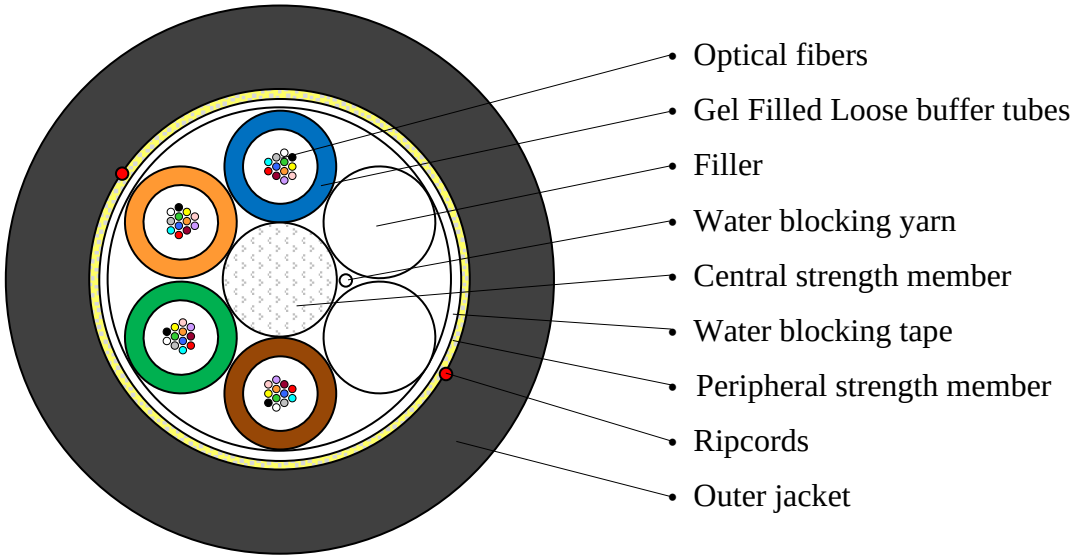
All cables and any associated packing and labeling materials shall meet RoHS (Restriction of the Use of certain Hazardous Substances) regulations as appropriate.

9.2 ISPM 15

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

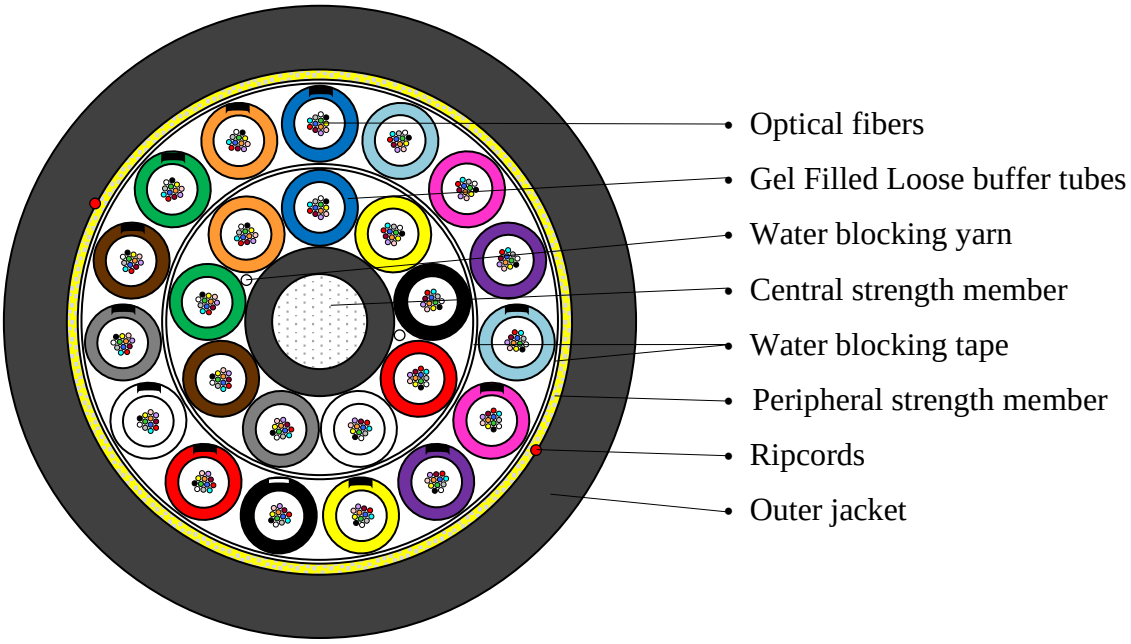
10. CROSS-SECTIONAL DRAWING OF CABLE

Ex) 48 fiber cable



– Not to Scale –

Ex) 288 fiber cable



– Not to Scale –

Table 11. Diameter, weight and minimum bending radius

Type	Fiber counts	Cable Diameter (±0.5 mm)	Approx. cable weight (kg/km)	Minimum bending radius (mm)	
				Under load	No load
S-500FT	12 ~ 72	11.4	98	230	115
	96	12.9	130	260	130
	144	16.3	200	330	165
	288	19.2	270	380	190
S-750FT	12 ~ 72	11.6	102	230	115
	96	13.1	133	260	130
	144	16.5	205	330	165
	288	19.8	285	400	200

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

11. SAG-TENSION INFORMATION

Table 12. Sag/Tension Tables for **S-500FT**

No. of fiber	Everyday Tension			Max. Rated Cable Load NESC Light		
	Span (m)	Sag (%)	Tension (kgf)	Vertical Sag (m)	Horizontal Sag (m)	Tension (kgf)
12 ~ 72	100	1.5	82	0.7	3.4	215
	110	1.5	90	0.7	3.8	231
	120	1.5	98	0.8	4.2	246
	130	1.5	106	0.9	4.7	261
	140	1.5	114	1.0	5.1	276
	150	1.5	122	1.1	5.6	291
	160	**1.5**	**131**	**1.2**	**6.1**	**305**
96	100	1.5	108	0.7	3.2	254
	110	1.5	118	0.8	3.6	273
	120	1.5	129	0.9	4.0	291
	130	1.5	140	1.0	4.4	309
	140	1.5	151	1.1	4.8	327
	150	1.5	161	1.2	5.3	345
	160	**1.5**	**172**	**1.3**	**5.7**	**362**
144	100	1.5	168	0.9	3.1	324
	110	1.5	184	1.0	3.4	348
	120	1.5	201	1.1	3.8	372
	130	1.5	218	1.2	4.2	396
	140	1.5	235	1.3	4.6	420
	150	1.5	251	1.4	5.1	443
	160	**1.5**	**268**	**1.5**	**5.5**	**466**
288	100	1.5	224	0.9	2.9	402
	110	1.5	246	1.0	3.2	434
	120	1.5	269	1.1	3.6	464
	130	1.5	291	1.3	3.9	494
	140	1.5	313	1.4	4.3	524
	150	1.5	336	1.5	4.7	554
	160	**1.5**	**358**	**1.6**	**5.1**	**583**

* Actual values may deviate from the calculated values given in the tables above.

Table 13. Sag/Tension Tables for **S-750FT**

No. of fiber	Everyday Tension			Max. Rated Cable Load NESC Light		
	Span (m)	Sag (%)	Tension (kgf)	Vertical Sag (m)	Horizontal Sag (m)	Tension (kgf)
12 ~ 72	170	1.5	144	1.2	6.0	352
	180	1.5	152	1.3	6.5	367
	190	1.5	161	1.4	7.0	382
	200	1.5	169	1.5	7.4	397
	210	1.5	178	1.6	7.9	412
	220	1.5	186	1.7	8.4	427
	230	**1.5**	**195**	**1.8**	**8.8**	**442**
96	170	1.5	188	1.3	5.8	409
	180	1.5	199	1.4	6.2	427
	190	1.5	210	1.5	6.6	445
	200	1.5	221	1.6	7.1	463
	210	1.5	232	1.7	7.5	481
	220	1.5	243	1.8	7.9	498
	230	**1.5**	**254**	**1.9**	**8.4**	**515**
144	170	1.5	291	1.6	5.5	530
	180	1.5	308	1.7	5.9	554
	190	1.5	325	1.8	6.3	578
	200	1.5	343	1.9	6.7	602
	210	1.5	360	2.0	7.1	625
	220	1.5	377	2.1	7.5	648
	230	**1.5**	**394**	**2.2**	**7.9**	**672**
288	170	1.5	406	1.7	5.0	681
	180	1.5	430	1.8	5.4	713
	190	1.5	454	1.9	5.8	744
	200	1.5	478	2.0	6.1	775
	210	1.5	502	2.1	6.5	806
	220	1.5	526	2.3	6.9	837
	230	**1.5**	**550**	**2.4**	**7.2**	**867**

* Actual values may deviate from the calculated values given in the tables above.

= End of Specification =