20001787 TL
20004748 QM
20001787 UM
20001787 BSOH

TL 9000
ISO 9001
ISO 14001
OHSAS 18001

LS Cable & System

Tender No.	:	Spec. No.	: LSGS-17-OC0287-05
User / Customer	:	Page No.	: 1 of 9
Tender Title	:		
Bidder	: LS Cable & System Ltd.		
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Specification

For

Fiber Optic Cable
All Dry PP Loose Tube
Dry Core / All-Dielectric / Self-Supporting
FRP Armored for Rodent Protection
Double Jacket

Rev. No.	Date	Descriptions	Prepared By	Reviewed By	Approved By
05	Apr. 20, 2020	Expanded fiber counts of 12 ~ 60F into the range	Lee, Mansu	Jun, Youngho	Lee, YuHyoung
04	Oct. 18, 2019	Added Sag-tension table for 1.5% sag	Lee, Mansu	Jun, Youngho	Lee, YuHyoung
03	Jul. 3, 2019	Added color stripe option	Lee, Mansu	Jun, Youngho	Lee, YuHyoung
02	Jun. 14, 2019	144F, 288F cable added	Jun, Youngho	Lee, Mansu	Lee, YuHyoung
01	Apr. 4, 2019	96F cable added, TB1 changed to 60°	Lee, Mansu	Jun, Youngho	Lee, YuHyoung
00	Jun. 28, 2017	Original Issue	Lee, Mansu	Jun, Youngho	Seo, Jaetae

1. GENERAL

This specification covers the general requirements of all dielectric self-supporting cable for aerial and underground duct 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
TIA-598-D	Optical fiber cable color coding
ITU-T G.652	Characteristics of a single-mode optical fiber
IEC 60794-1-1	Optical fiber cables – Part 1 : Generic specification - General
IEC 60794-1-21	Optical fiber cables – Part 1-21 : Generic specification – Basic optical cable test procedures – Mechanical test methods
IEC 60794-1-22	Optical fiber cables – Part 1-22 : Generic specification – Basic optical cable test procedures – Environmental test methods
IEC 60794-4-20	Family specification for ADSS optical cables

3. OPTICAL FIBER

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

Table 2. Performance of the single mode fiber (ITU-T G.652D)

ITEMS		UNITS	SPECIFICATION
Attenuation at 1310/1383/1550nm		dB/km	□ 0.36 / □ 0.35 / □ 0.22
Chromatic Dispersion		ps/nm.km	□3.5 at 1285nm ~ 1330nm □ 18 at 1550nm
Zero Dispersion Wavelength		nm	1300 ~ 1324
Zero Dispersion Slope		ps/nm2.km	□ 0.092
Cable PMD (PMDQ)		ps/□km	□ 0.2 (20 section link)
Cut-off wavelength (□cc)		nm	□ 1260
Bending loss	R30mm x 1001	dB	□ 0.1 at 1625nm
MFD at 1310 / 1550nm		□m	9.2 □ 0.4 / 10.4 □ 1.0
Core/Cladding Concentricity Error		□m	□ 0.6
Cladding Diameter		□m	125 □ 1.0
Cladding Non-circularity		%	□ 1.0
Coating Diameter		□m	245 □ 10
Proof Test		GPa	□ 0.69

[1] 100 turns with radius 30mm

4. FIBER AND LOOSE BUFFER TUBE IDENTIFICATION

Color code of the loose buffer tubes and the individual fibers within each loose buffer tube shall be in accordance with Table 3 and Table 4 below.

Table 3. Color code of the individual fibers

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

Table 4. Color code of the individual loose tubes

No.	Color	No.	Color	No.	Color
1	Blue	9	Yellow	17	Gray/BK stripe
2	Orange	10	Violet	18	White/BK stripe
3	Green	11	Pink	19	Red/BK stripe
4	Brown	12	Aqua	20	Black/WH stripe
5	Gray	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	Pink/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 5 below.

Table 5. Construction of the cable

ITEMS		DESCRIPTION			
Cable Type		S-400M			
Number of fibers		2 ~ 60	96	144	288
No. of fibers per tube		12			
Loose buffer tube	Material	PP			
	Number	Max. 5	8	12	9+15
	Diameter	Nom. 2.4mm			
WB material in the tube		Water Blocking Yarn			
Central strength member		FRP (Fiber reinforced plastic)			
Water blocking material		Water blocking yarn			
Core wrapping tape		Water blocking tape			
Ripcord		2 ripcords			
Inner jacket		Black PE, Nom. 1.0mm			
Rodent Protection Layer & Peripheral strength member		Flat FRP			
Wrapping tape		Non-woven PET tape			
Ripcord		2 ripcords			
Outer jacket	Material	Black PE or TR(Tracking Resistant) PE with optiona stripe			
	Thickness	Nom. 1.4mm			

6. QUALIFICATION TEST

The product shall be type tested for the qualifications according to Table 6 below. Unless otherwise specified, all attenuation measurements required in this section shall be performed at 1,550nm for SMF (single mode fiber).

Table 6. Qualification test items

ITEMS	TEST METHOD AND ACCEPTANCE CRITERIA
Tensile	▪ Test method: IEC 60794-1-21 E1 - MAT2 in Table 8 for 1 hour ▪ Acceptance criteria - Fiber strain: Max. 0.33% during the test - Attenuation increment: □ 0.15 dB
Repeated Bending	▪ Test method: IEC 60794-1-21 E6 - Bending radius : 20D (D = cable diameter) - Number of cycles: 25 cycles - Bending speed: 30 cycles/minute ▪ Acceptance criteria - Attenuation increment: □ 0.05 dB after the test - No damage to the sheath or cable elements under visual examination without magnification
Impact	▪ Test method: IEC 60794-1-21 E4 - Impact energy : 10J (1kg × 1m) - Striking surface radius : 300mm - Number of impact: 3 in a different place (Min. 500mm apart) ▪ Acceptance criteria - Attenuation increment: □ 0.05 dB after the test - No jacket cracking and fiber breakage - No damage to the sheath or cable elements under visual examination without magnification
Crush	▪ Test method: IEC 60794-1-21 E3 - Long term 1,100N/10cm for 10min - Short term 2,200N/10cm for 1min - Number of tests : 3 with interval 500mm ▪ Acceptance criteria - Attenuation increment . For long term: □ 0.05 dB during the test . For short term: □ 0.05 dB after the test - No damage to the sheath or cable elements under visual examination without magnification

[2] MAT (Max. Allowable Tension) : Maximum tensile load that may be applied to the cable without detriment to the performance requirements (optical performance, fiber durability) due to fiber strain

<table>
<tr><th>ITEMS</th><th>TEST METHOD AND ACCEPTANCE CRITERIA</th></tr>
<tr><td>Torsion</td><td>▪ Test method: IEC 60794-1-21 E7
- Cable length twisted: 2m
- No. of twist cycles: 10 cycles
- Twist angle: ±180°
▪ Acceptance criteria
- Attenuation increment: ≤ 0.05 dB after the test
- No damage to the sheath or cable elements under visual examination without magnification</td></tr>
<tr><td>Temperature cycling</td><td>▪ Test method: IEC 60794-1-22 Method F1
- Temperature condition
<table><tr><td></td><td>Operation(1)</td><td>Storage(2)</td></tr><tr><td>Low (A)</td><td>TA1 : -30℃</td><td>TA2 : -40℃</td></tr><tr><td>High (B)</td><td>TB1 : 60℃</td><td>TB2 : 70℃</td></tr></table>- Temperature cycle sequence (2 cycles)
. 1st cycle: TA2 → TB2
. 2nd cycle: TA1 → TA2 → TB1 → TB2 → 23℃
- Soak time at each temperature : ≥16 hours
- Attenuation shall be measured at 23℃ (reference attenuation) before the sequence and at the end of the soak time at each step (T_{A1}, TA2, TB1, TB2) in the 2nd cycle
▪ Acceptance criteria
- Max. 0.05dB/km for TA1 and TB1
- Max. 0.15dB/km for TA2, TB2</td></tr>
<tr><td>Water penetration</td><td>▪ Test method: IEC 60794-1-22 F5B
- Armor and outer jacket shall be removed prior to the test.
- Length of specimen: 3m
- Height of pressure head: 1m
- Test time: 24 hours
▪ Acceptance criteria
- No water shall be detected at the unsealed end of the sample</td></tr>
</table>

7. SAG/TENSION PARAMETERS AND TABLES

Table 7. Operating Condition

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

Table 8. MAT of Cables

Cable Type	S-400M			
Fiber count	Max. 60F	96F	144F	288F
Max. Allowable Tension (kgf)	885	1,056	1,307	1,501

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

Table 9. Sag/Tension Table for sag 1.5%

No. of fiber	Span (m)	Initial Installation		Max. Allowable Tension		
		Sag (%)	Tension (kgf)	Vertical Sag (m)	Horizontal Sag (m)	Tension (kgf)
S-400M 2 ~ 60F	200	1.5%	290	1.6	5.8	612
	220	1.5%	319	1.8	6.5	658
	240	1.5%	348	2.0	7.2	704
	260	1.5%	377	2.2	8.0	749
	280	1.5%	406	2.4	8.7	793
	300	1.5%	435	2.6	9.5	836
S-400M 96F	200	1.5%	379	1.7	5.4	742
	220	1.5%	417	1.9	6.1	799
	240	1.5%	455	2.1	6.8	855
	260	1.5%	493	2.3	7.4	911
	280	1.5%	531	2.6	8.1	965
S-400M 144F	200	1.5%	527	1.8	5.0	936
	220	1.5%	580	2.1	5.6	1,009
	240	1.5%	633	2.3	6.3	1,082
	260	1.5%	685	2.5	6.9	1,153
S-400M 288F	200	1.5%	630	1.9	4.9	1,079
	220	1.5%	694	2.1	5.5	1,165
	240	1.5%	757	2.3	6.1	1,249
	260	1.5%	820	2.6	6.8	1,332
	280	1.5%	883	2.8	7.4	1,414
	300	1.5%	946	3.1	8.0	1,494

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

Table 10. Sag/Tension Table for sag 2.5%

No. of fiber	Span (m)	Initial Installation		Max. Allowable Tension		
		Sag (%)	Tension (kgf)	Vertical Sag (m)	Horizontal Sag (m)	Tension (kgf)
S-400M 2 ~ 60F	300	2.5%	264	3.2	11.3	706
	320	2.5%	282	3.4	12.2	743
	340	2.5%	299	3.7	13.2	779
	360	2.5%	317	3.9	14.1	815
	380	2.5%	334	4.2	15.1	850
	400	2.5%	352	4.5	16.1	885
S-400M 96F	300	2.5%	345	3.4	10.9	839
	320	2.5%	368	3.7	11.7	884
	340	2.5%	391	4.0	12.6	927
	360	2.5%	414	4.2	13.5	971
	380	2.5%	437	4.5	14.5	1,013
	400	2.5%	460	4.8	15.4	1,056
S-400M 144F	300	2.5%	476	3.8	10.3	1,036
	320	2.5%	508	4.1	11.1	1,091
	340	2.5%	540	4.4	11.9	1,146
	360	2.5%	572	4.7	12.8	1,200

No. of fiber	Span (m)	Initial Installation		Max. Allowable Tension		
		Sag (%)	Tension (kgf)	Vertical Sag (m)	Horizontal Sag (m)	Tension (kgf)
S-400M 288F	380	2.5%	603	5.0	13.6	1,254
	400	2.5%	635	5.3	14.5	1,307
	300	2.5%	570	3.9	10.1	1,188
	320	2.5%	608	4.2	10.9	1,252
	340	2.5%	645	4.5	11.8	1,315
	360	2.5%	683	4.8	12.6	1,378
	380	2.5%	721	5.1	13.4	1,440
	400	2.5%	759	5.5	14.3	1,501

* Actual values 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 one meter with the following information. Other marking is also available upon request.

1) Cable type (ex, "ADSS RP")
2) Fiber type and counts (ex, " SM48C")
3) Name of the manufacturer (" LS Cable & System")
4) Year of manufacture
5) Length marking

Ex.1) For a single mode 48 fibers cable

0000M ADSS RP SM48C LS Cable & System 2019 0001M...

8.2 Cable Re-marking

The re-marking shall be marked, preferably with yellow characters, on a different position of the outer cable jacket, and shall have a numbering scheme differing by a minimum of 1000 from the original number. Any cable that contains two sets of cable markings shall be marked to indicate the color of the marking to be used.

8.3 Cable packing

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

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

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

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

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

8.4 Cable reel

8.4.1 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.

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

8.4.3 The arbor holes provided in the reels shall be at least 75 mm and at most 110 mm in diameter.

9. SAFETY

9.1 ROHS directive

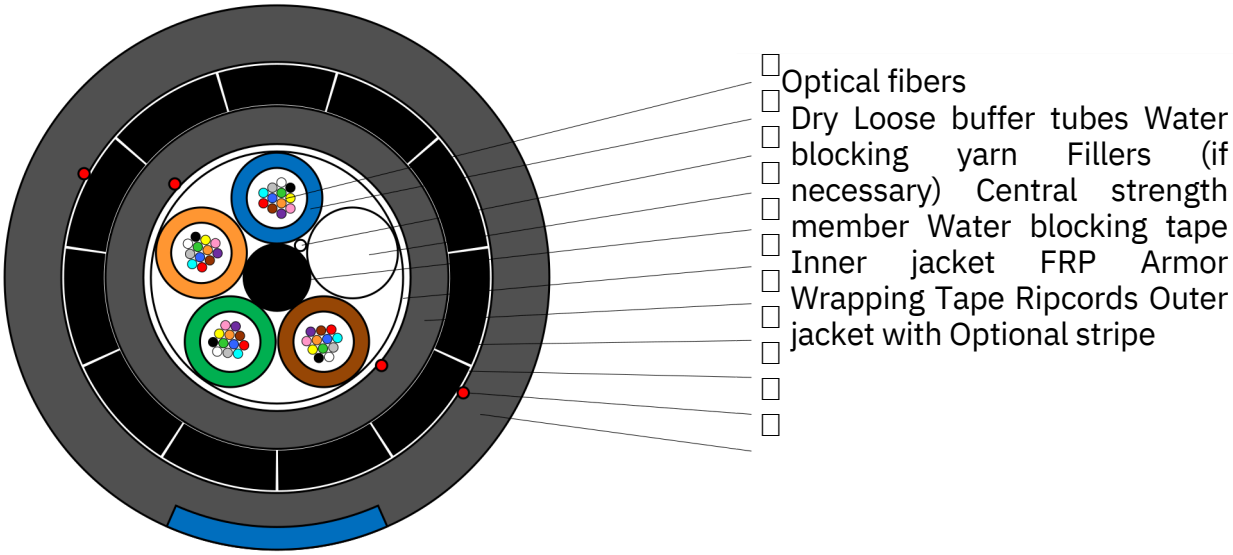
All cables and any associated packing and labeling materials shall meet RoHS (Restriction of the Use of certain Hazardous Substances) regulations as appropriate.

9.2ISPM 15 directive

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

< Cross-sectional drawing of cable >

Ex) 48F ADSS Cable



- Not to scale -

Cable Type	Fiber counts	Cable dia. (mm)	Approx. cable weight (kg/km)	Minimum bending radius (mm)	
				Under load	No load
S-400M	2 ~ 60F	14.3 ± 0.5	175	290	145
S-400M	96F	16.6 ± 0.5	229	330	165
S-400M	144F	19.7 ± 0.5	316	390	195
S-400M	288F	22.5 ± 0.5	378	450	225

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

= End of Specification =