



GAON CABLE CO., LTD.
CERTIFIED TO ISO 9001:2015
200001098 TLR6



GAON CABLE CO., LTD.
CERTIFIED TO ISO 14001:2015
200001098 UM15

Issued : Feb. 17, 2020
Revised : 5
Page : 1 of 10

Specification

GF US-035

For

**Loose Tube / Gel-Free / All Dielectric /
Single Jacket None Armored /
Optical Fiber Cable**

[GAON code : OPP-LT / OYP-LT]
[Optical Fiber based on SM & MM]

Rev.	Date	Prepared	Checked	Approved	Remark
00	Feb. 17, 2020	B.S. Jang	C.S. Kim	Y.C. Park	Issue
01	Mar. 11, 2020	B.S. Jang	C.S. Kim	Y.C. Park	Revise Appendix 2 values
02	Apr. 08, 2020	B.S. Jang	C.S. Kim	Y.C. Park	Add G.657A1/2 characteristics
03	Jun. 18, 2020	B.S. Jang	C.S. Kim	Y.C. Park	Add Multi-mode characteristics
04	Sep. 18, 2020	B.S. Jang	C.S. Kim	Y.C. Park	Add PP material in loose buffer tube
05	Oct. 15, 2020	B.S. Jang	C.S. Kim	Y.C. Park	Modify Twist load, Temp soak time

1. Scope

1.1 Application

This specification covers the general requirements for the optical fiber telecom. The cable intended for outdoor applications.

1.2 Cable Description

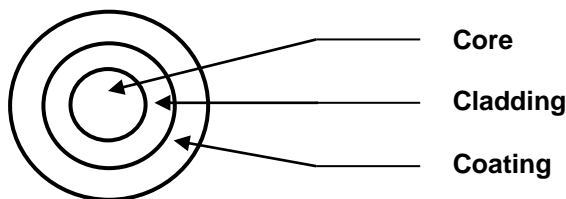
The cable core consist of color coded fibers, dry water swellable material, color coded loose tubes, PE filler(if necessary), SZ-stranded around the dielectric central strength member with water blocking yarn(s).

Single Jacket / Non Armored (SJNA)

The cable structure is completed by the application of a core wrapping tape, auxiliary strength member if necessary, which with the core, are 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 around 1310 & 1550nm.

2.3 Material of the Fibers

The fiber shall be made from high grade silica glasses and the coating shall be made from UV curable acrylate material. A protective UV cured acrylate coating shall be applied over the fiber cladding and it shall be able to 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 140°F (- 30 to 60 °C)
- Storage : - 40 to 158°F (- 40 to 70 °C)

2.5 The optical, geometrical and mechanical performance of the optical fiber shall be in accordance with Table 1 (below).

**Table 1-1 Characteristics for Single mode fiber
 (The 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		
Coating diameter	μm	245 ± 15		
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 _Q (Linked value, M=20, Q=0.01)	ps/√km	≤ 0.2		
Proof test (Nom)	kpsi	100		

**Table 1-2 Characteristics for MM fiber
 (optical, geometrical & 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 ≤ 1.5 @ 1300 nm	≤ 3.5 @ 850 nm ≤ 1.5 @ 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 MM fiber for 10G grade
 (optical, geometrical & 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	≤ 3.5 @ 850 nm ≤ 1.5 @ 1300 nm	≤ 3.5 @ 850 nm ≤ 1.5 @ 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 construction of the cable shall be in accordance with Table 2 (below).

Table 2 Construction of the cable

Items	Description
Fiber type	See Table 1
No. of fibers	Max. 576
Loose buffer tube material	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 use for a circular-section core. (To make good core configuration)
Central strength member	FRP (If necessary, PE coating)
Water blocking material	Water blocking yarn(s) or tape (To prevent the 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 (To provide easy cable entry)
Outer jacket	Black colored MDPE

4. Fiber & Loose tube Identification

4.1 The color code of the loose tubes and the individual fibers within each loose tube shall be accordance with 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

* : It is possible to be replaced by Yellow color longitudinal stripe.

5. Mechanical / Environmental Performance & Tests

5.1 The mechanical & environmental performance of the cable shall be in accordance with Table 4 (below). Unless otherwise specified, all attenuation measurements required in this section shall be performed at 1550 nm for single mode(SM) and at 1300nm for multi mode(MM) fiber. The measurement equipment error can be occurred in range of 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 <ul style="list-style-type: none"> - Mandrel diameter : 40D (D : Cable dia.) - Applied Tensile load : 2,700N - Duration of loading : 60 min. ● Acceptance criteria <ul style="list-style-type: none"> - Attenuation increment : ≤0.15 dB for SM, after test <li style="padding-left: 40px;">≤0.40 dB for MM, after test
Crush resistance (Compressive loading)	<ul style="list-style-type: none"> ● Test method : IEC 60794-1-2 Method E3 <ul style="list-style-type: none"> - Applied load : 1,100N - No of points : 1 point - Plate size : 100mm x 100mm - Duration of loading : 10min. ● Acceptance criteria <ul style="list-style-type: none"> - Attenuation increment : ≤0.15 dB for SM, after test <li style="padding-left: 40px;">≤0.40 dB for MM, after test
Impact resistance	<ul style="list-style-type: none"> ● Test method : IEC 60794-1-2 Method E4 <ul style="list-style-type: none"> - Drop hammer mass : 9.8N.m - No. of impact per point : 1 time @ 3 point ● Acceptance criteria <ul style="list-style-type: none"> - Attenuation increment : ≤0.15 dB for SM, after test <li style="padding-left: 40px;">≤0.40 dB for MM, after test
Cable bend	<ul style="list-style-type: none"> ● Test method : IEC 60794-1-2 Method E11A <ul style="list-style-type: none"> - Mandrel diameter : 20D (D : Cable dia.) - No. of bend cycles : 4 turns - Bend angle : ±180 degree ● Acceptance criteria <ul style="list-style-type: none"> - Attenuation increment : ≤0.15 dB for SM, after test <li style="padding-left: 40px;">≤0.40 dB for MM, after test

<p>Torsion</p>	<ul style="list-style-type: none"> ● Test method : IEC 60794-1-2 Method E7 <ul style="list-style-type: none"> - Cable twisted length : 2 m - No. of twist cycles : 10 cycles - Twist angle : ± 180 degree - Twist load : 55N (5.5kg) ● Acceptance criteria <ul style="list-style-type: none"> - Attenuation increment : ≤ 0.15 dB for SM, after test ≤ 0.40 dB for MM, after test
<p>Water penetration</p>	<ul style="list-style-type: none"> ● Test method : IEC 60794-1-2 Method F5 <ul style="list-style-type: none"> - Length of specimen : 3 m - Height of pressure head : 1 m - Test time : 24 h ● Acceptance criteria <ul style="list-style-type: none"> - No leakage through the open cable end
<p>Temperature Cycling</p>	<ul style="list-style-type: none"> ● Test method : IEC 60794-1-2 Method F1 <ul style="list-style-type: none"> - Cable length : ≥ 500m (1,640ft) - 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 : 12h - No. of cycles : 2 ● Acceptance criteria <ul style="list-style-type: none"> - Attenuation increment : ≤ 0.15 dB/km for SM, after test ≤ 0.40 dB/km for MM, after test

6. Packing and marking

6.1 Cable marking

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

- 1) Cable type & counts
- 2) Name of the manufacturer
- 3) Year of manufacture (****)
- 4) Serial number (#####, 4digits or 5digits)
- 5) Length marking (FEET or m)

- Ex) For SM 72 fiber cable

00002FEET OPP-LT SM 72C GAON ** ##### 00004FEET**

6.2 Cable packing

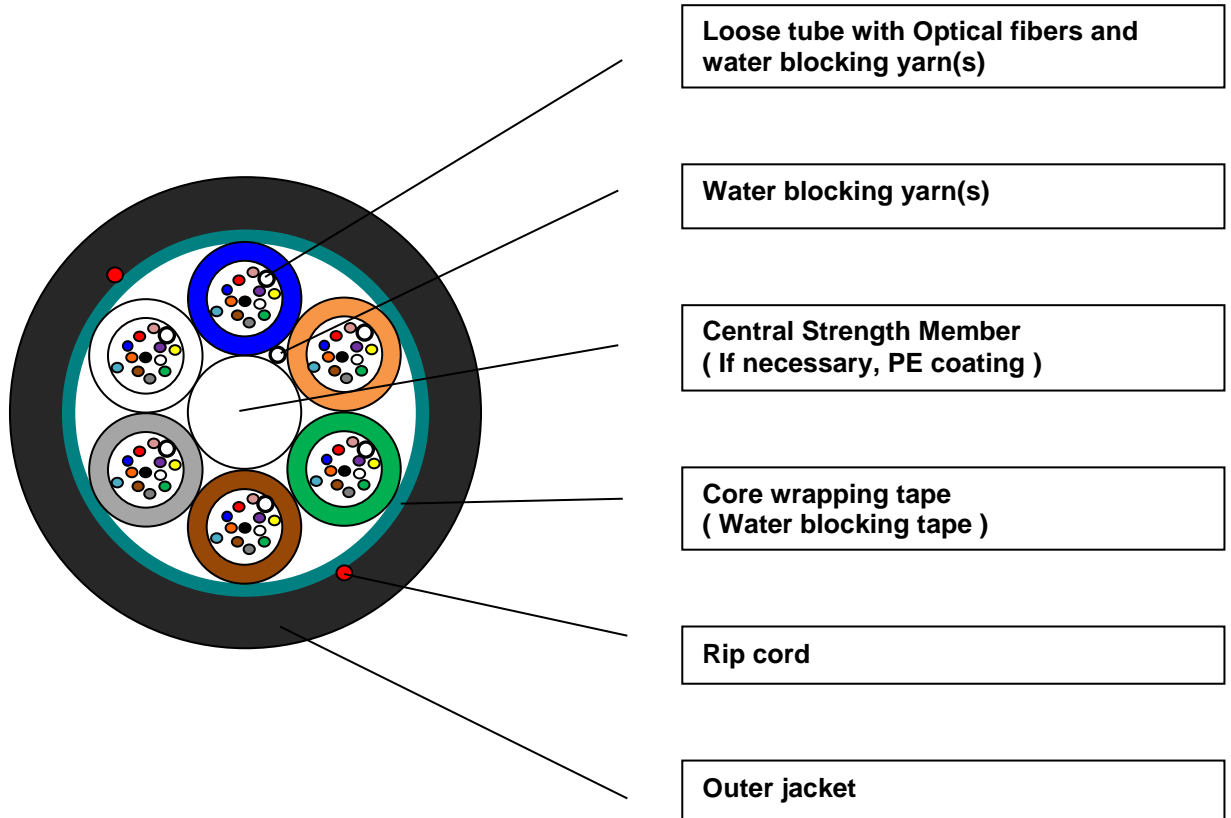
- 6.2.1 Standard length of cable shall be 13,124ft (4,000m) up to 144C, and 6,560ft (2,000m) up to 576C. Other cable length is also available if required by customer.
- 6.2.2 Each length of the cable shall be wound on a separate wooden reel.
- 6.2.3 Both ends of the cable shall be sealed with a suitable plastic cap to prevent the entry of moisture during shipping, handling and storage.
- 6.2.4 The cable ends shall be securely fastened to the reel to prevent the cable from becoming loose in transit or during placing operations.
- 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 number of rotations that there is a min. free space of 50mm between the upper layer and the edge of the flanges.
- 6.2.7 Circumference battens or Wood-fiber board shall be secured with steel band to protect the cable during normal handling and storage.

6.3 Cable reel

- 6.3.1 Details given below shall be distinctly marked on a weather proof materials on both 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
 - 5) Drum number
 - 6) Gross & Net weight in kilograms
 - 7) Year of manufacture
 - 8) Name of the manufacturer
 - 9) Arrow showing the direction the drum shall be rolled* Other shipping mark is also available if required by customer.
- 6.3.2 The cable shall be wound on the reel designed to prevent damages during shipment and installation.
- 6.3.3 The minimum barrel diameter of the cable drums shall be at least 40 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 shall be reinforced with a bearing plate.

Appendix 1

(Cable Cross-Sectional)
 (Drawing not to scale)
 (OPP-LT / OYP-LT Type 72 Fiber)



"The drawing appearing on this page may be 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 type	PP tube type	No Load	Under Load
~ 72	6	0.421 (10.7mm)	54 (80kg/km)	54 (80kg/km)	10 D	20 D
96	8	0.492 (12.5mm)	74 (110kg/km)	67 (100kg/km)	10 D	20 D
120	10	0.551 (14.0mm)	91 (135kg/km)	84 (125kg/km)	10 D	20 D
144	12	0.610 (15.5mm)	111 (165kg/km)	104 (155kg/km)	10 D	20 D
216	18 (6+12)	0.630 (16.0mm)	108 (160kg/km)	101 (150kg/km)	10 D	20 D
288	24 (9+15)	0.728 (18.5mm)	144 (215kg/km)	128 (190kg/km)	10 D	20 D
432	18 (6+12)	0.768 (19.5mm)	151 (225kg/km)	134 (200kg/km)	10 D	20 D
576	24 (9+15)	0.886 (22.5mm)	202 (300kg/km)	181 (270kg/km)	10 D	20 D

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