1. General

This specification covers the design and performance of the single mode optical cables to be used in air blown micro duct application.

1.1 Cable Description

- 12/24/36/48/72/96/144/192/216/288 /432/576 G.652.D / G.657.A1 SM-fibers.
- Loose tubes SZ-stranded.
- Suitable for air blown installation in micro-duct .

1.2 Quality

NETCOM ensures a continuing level of quality in our cable products through several programs including ISO 9001.

1.3 Reliability

NETCOM ensures product reliability through rigorous qualification testing of each product family. Both initial and periodic qualification testing are performed to assure the cable's performance and durability in the field environment.

1.4 Reference

ITU-T G.652/G.657	Characteristics of a single-mode optical fiber
IEC 60794-1-1	Optical fiber cables- part1-1-Generic specification-General
IEC 60794-1-21	Optical fiber cables- part1-2-Generic specification-Basic optical cable test procedure-Mechanical test methods
IEC 60794-1-22	Optical fiber cables- part1-2-Generic specification-Basic optical cable test procedure-Environmental test methods
IEC 60794-3	Optical fiber cables- part3-Sectional specification- Outdoor cables
IEC 60794-5-10	Optical fibre cables –Part 5-10 Family specification for outdoor microduct optical and protected microducts for installation by blowing

1.5 Working Condition

Transportation and storage temperature: -30ºC ~ +70ºC
Installation temperature: -10ºC ~ +50ºC
Operation temperature: -30ºC ~ +70ºC

1.6 Minimum Allowable Bending Radius

Static: 10D
Dynamic: 20D
D is the out diameter of the cable

1.7 Life Time

Optical fiber cables supplied in compliance with the specifications can be capable of withstanding the typical service condition for a period of twenty-five (25) years without detriment to the transmission or operation and maintenance characteristics of the cable.

2. Optical Fiber In Cable

Geometrical, optical, and mechanical characteristics of fiber in cable as the following table:

G.652.D			
Category	**Description**	**Specification**	
		Before cable	**After cable**
Geometrical Characteristics	Cladding diameter	125±1.0 μm	
	Cladding non-circularity	≤ 1.0 %	
	Core concentricity error	≤ 0.6 μm	
	Coating diameter	235~255 μm (Before Colored) 250±15 μm (Colored)	
	Coating/cladding concentricity error	≤ 12 μm	
Optical Characteristics	Mode field diameter at 1310 nm	8.7~9.5 μm	
	Point discontinuity at 1310nm and 1550nm	≤ 0.05 dB	
	Attenuation at 1310 nm	≤ 0.34 dB/km	≤ 0.36 dB/km
	Attenuation at 1383 nm	≤ 0.34 dB/km	≤ 0.35 dB/km
	Attenuation at 1550 nm	≤ 0.20 dB/km	≤ 0.22 dB/km
	Zero dispersion wavelength	1300 ~ 1324 nm	
	Zero dispersion slope	≤ 0.092 ps/(nm^2·km)	
	Cable cut-off wavelength	≤ 1260 nm	
	Polarization mode dispersion individual fiber	≤ 0.2 ps/√km	
	Polarization mode dispersion design link value (M=20, Q=0.01%)	≤ 0.1 ps/√km	
	Macro-bend loss (100 turns, 30mm radius)	1550nm and 1625nm: ≤ 0.05 dB	
Mechanical Specification	Proof stress level	≥100kpsi (0.69 GPa)	
	Coating strip force(peak value)	1.3~8.9 N	
	Dynamic Fatigue Parameter (n_d)	≥ 20	

G.657.A1			
Category	**Description**	**Specification**	
		Before cable	**After cable**
Geometrical Characteristics	Cladding diameter	125.0±0.7 μm	
	Cladding non-circularity	≤ 0.7 %	
	Core concentricity error	≤ 0.5 μm	
	Coating diameter	235~255 μm (Before Colored) 250±15 μm (Colored)	
	Coating/cladding concentricity error	≤ 12 μm	
Optical Characteristics	Mode field diameter at 1310 nm	9.0±0.4 μm	
	Point discontinuity at 1310nm and 1550nm	≤ 0.05 dB	
	Attenuation at 1310 nm	≤ 0.35 dB/km	≤ 0.36 dB/km
	Attenuation at 1383 nm	≤ 0.35 dB/km	≤ 0.35 dB/km
	Attenuation at 1550 nm	≤ 0.21 dB/km	≤ 0.22dB/km
	Zero dispersion wavelength	1300~1324 nm	
	Zero dispersion slope	≤ 0.092 ps/(nm^2·km)	

	Cable cut-off wavelength	≤ 1260 nm
	Polarization mode dispersion individual fiber	≤ 0.2 ps/√km
	Polarization mode dispersion design link value (M=20, Q=0.01%)	≤ 0.1 ps/√km
	Macro-bend loss (10 turns, 15mm radius)	1550nm: ≤ 0.25 dB; 1625nm: ≤ 1.0 dB;
	Macro-bend loss (1 turn, 10mm radius)	1550nm: ≤ 0.75 dB; 1625nm: ≤ 1.5 dB;
Mechanical Specification	Proof stress level	≥100kpsi (0.69 GPa)
	Coating strip force(peak value)	1.3~8.9 N
	Dynamic Fatigue Parameter (n_d)	≥ 20

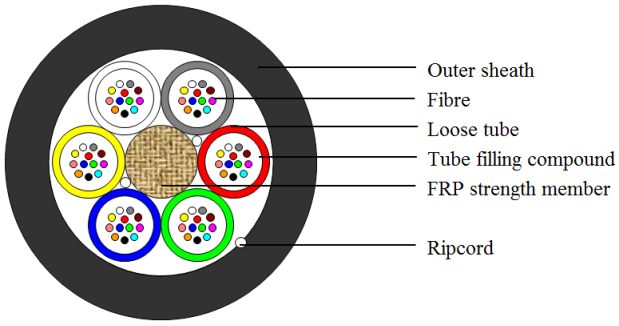
3. Optic Cable

3.1 General Design

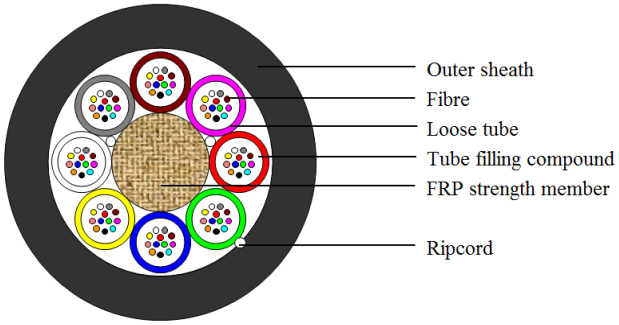
Optical fibers are housed in loose tubes that are made of high-modulus plastic and filled with waterproof compounds.
FRP is applied as central strength member.
Loose tubes are SZ-stranded around the strength member.
Water blocking yarns are used in and over the cable core to prevent it from water ingress.
Polyethylene sheath is applied over the cable core as the outer sheath.

3.2 Construction

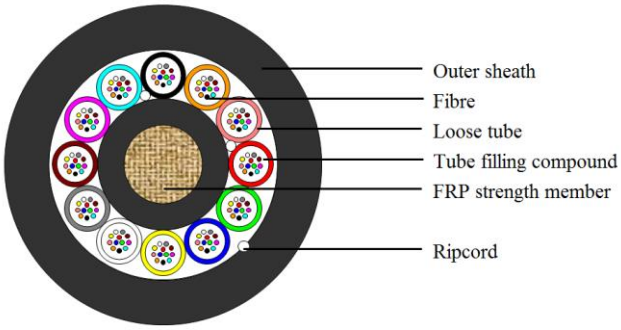
3.2.1 Cross Section of Cable



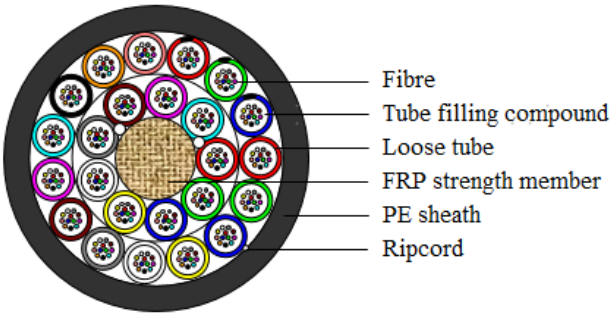
GCYFY-12~72B6a1



GCYFY-96 B6a1



GCYFY-144 B6a1



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Structure of other fibre counts refer to 3.2.2

Schematic for reference only

3.2.2 Dimensions and Descriptions of Cable Constructions

Item	contents	Value														
		12	**24**	**36**	**48**	**72**	**96**	**144**	**192**	**216**	**288**	**144**	**192**	**288**	**432**	**576**
Loose tube	Material	PBT														
	Number	1	2	3	4	6	8	12	16	18	24	6	8	12	18	24
	Fiber counts / tube	12										24				
	Outer diameter (mm)	1.45										2.1				
Filler	Number	5	4	3	2	0	0	0	2	0	0	0				
Central strength member	Material	FRP														
	Diameter (mm)	1.6					2.4	2.4	1.6		2.8	2.25	2.8	2.8	2.25	2.8
	PE layer dia. (mm)	/					/	4.1	/		/	/	3.5	6.1	/	4.1
Peripheral strength member	Material	Aramid yarn														
Outer sheath	Material	HDPE														
	Color	Black														
	Thickness (mm)	Approx.0.5														
Cable diameter (±0.2mm)		5.4					6.1	7.9	7.9		9.3	7.3	8.8	11.4	11.4	13.4
Cable weight (kg/km) Approx.		26					36	52	52		80	42	76	110	105	140
For micro–duct inside diameter (mm)		8～12						10～14			12～14	10～14	12～14	14～16		16～20
Max. tensile strength (N)		600					800		600		1000	800	1000	1200	1000	1200
Crush (N/100mm)		Short term: 500 Long term: 200														

3.2.3 Color Code of the Fiber

Each fiber can be identifiable throughout the length of the cable in accordance with the following color sequence. Fiber color in each tube starts from No. 1 Red.

Fiber color code						
6 fibers per tube	1	2	3	4	5	6
	Red	Green	Blue	Yellow	White	Grey
12 fibers per tube	1	2	3	4	5	6
	Red	Green	Blue	Yellow	White	Grey
	7	8	9	10	11	12
	Brown	Purple	Aqua	Black	Orange	Pink
24 fibers per tube	1	2	3	4	5	6
	Red	Green	Blue	Yellow	White	Grey
	7	8	9	10	11	12
	Brown	Purple	Aqua	Black	Orange	Pink
	13	14	15	16	17	18
	Red with black ring	Green with black ring	Blue with black ring	Yellow with black ring	White with black ring	Grey with black ring
	19	20	21	22	23	24
	Brown with black ring	Purple with black ring	Aqua with black ring	Natural with black ring	Orange with black ring	Pink with black ring

3.2.4 Color Code of the Loose Tube and Filler

The loose tubes will be identifiable in accordance with the following color sequence. The color of the fillers will be natural.

Tube color code						
1~12 tubes	1	2	3	4	5	6
	Red	Green	Blue	Yellow	White	Grey
	7	8	9	10	11	12
	Brown	Purple	Aqua	Black	Orange	Pink
16 tubes + 2 fillers	Inner1	Inner 2	Inner 3	Inner 4	Inner 5	Inner 6
	Red	Green	Blue	Yellow	Filler	Filler
	Outer 1	Outer 2	Outer 3	Outer 4	Outer 5	Outer 6
	Red	Green	Blue	Yellow	White	Grey
	Outer 7	Outer 8	Outer 9	Outer 10	Outer 11	Outer12
	Brown	Purple	Aqua	Black	Orange	Pink
18 tube	Inner1	Inner 2	Inner 3	Inner 4	Inner 5	Inner 6
	Red	Green	Blue	Yellow	White	Grey
	Outer 1	Outer 2	Outer 3	Outer 4	Outer 5	Outer 6
	Red	Green	Blue	Yellow	White	Grey
	Outer 7	Outer 8	Outer 9	Outer 10	Outer 11	Outer12
	Brown	Purple	Aqua	Black	Orange	Pink

24 tubes	Inner 1	Inner 2	Inner 3	Inner 4	Inner 5	Inner 6
	Red	Green	Blue	Yellow	White	Grey
	Inner 7	Inner 8	Inner 9	Outer 1	Outer 2	Outer 3
	Brown	Purple	Aqua	Red	Green	Blue
	Outer 4	Outer 5	Outer 6	Outer 7	Outer 8	Outer 9
	Yellow	White	Grey	Brown	Purple	Aqua
	Outer 10	Outer 11	Outer 12	Outer 13	Outer 14	Outer 15
	Black	Orange	Pink	Red with black Stripe	Green with black Stripe	Blue with black Stripe

3.3 Mechanical, Electrical and Environmental Test Characteristics

The finished cables can be subjected to the following mechanical, electrical and environmental conditions.

Item	**Test Method**	**Requirements**
Tensile performance	IEC 60794-1-21-E1 Load: according to short term tensile described in 3.2.2 Cable length under tension: Not less than 50m. Duration of load sustain: 1min. Velocity of transfer device: 10mm/min	The maximum fiber strain less than 0.6% under maximum tensile short term load. The maximum increase in attenuation less than 0.1dB. No change in attenuation after test at 1550nm. Under visual examination without magnification, no damage to the sheath or to the cable elements after test.
Crush	IEC 60794-1-21-E3 Load: 500N Duration of load: 1min	No change in attenuation after test at 1550nm. Under visual examination without magnification, no damage to the sheath or to the cable elements. The imprint of the striking surface on the sheath is not considered mechanical damage.
Bend	IEC 60794-1-21-E11A Mandrel radius: 10 times cable diameter Turns:10 Cycles:5	No change in attenuation at 1550nm after test. Under visual examination without magnification, no damage to the sheath or to the cable elements.
Repeated bending	IEC 60794-1-21-E6 Bending radius: 20 times cable diameter Cycles: 25 Load: 25N Duration of cycle: Approx. 2s.	No change in attenuation at 1550nm after test. Under visual examination without magnification, no damage to the sheath or to the cable elements.
Torsion	IEC 60794-1-21-E7 Cycles:5 Length under test: 1m Turns: ±180° Load: 40N	The variation on attenuation for each fiber less than 0.05dB at 1550nm. Under visual examination without magnification, no damage to the sheath or to the cable elements. No permanent change in attenuation after test
Temperature cycling	IEC 60794-1-22-F1 Sample length: at least 1000m	There is no change in attenuation coefficient at 1550nm after the test.

	Temperature range: -30ºC ~ +70ºC Cycles: 2 Temperature cycling test dwell time: 12 hours	
Water Penetration	IEC 60794-1-22-F5B Time : 24 hours Sample length : 3m Water height : 1m	No water leakage
Compound flow	IEC 60794-1-21-E14 Temperature: 70ºC Sample count:5 Sample length:200 ±5 mm, Remove length: 100 ±2.5 mm, Time:24h	No filling compound dripped.
Other parameters	According to IEC 60794 ,YD/T 1460.4-2006	

Remark: "No attenuation changes" is considered as the attenuation changes ≤ 0.05 dB.

4. Cable Sheath Marking

Unless otherwise specified, the cable sheath marking shall be as follows:

- Color: white
- Contents: NETCOM, the year of manufacture, the type of cable, length marking
- Interval: 1m

5. Packaging and Shipping

5.1 Reel Length

Standard reel length: 2/3/4/5/6 km/reel

5.2 Cable Drum

The cables are packed in ply-wooden drums

5.3 Labeling

The direction of rotation of the color scheme is shown by marking the clockwise and anti-clockwise ends with red and green adhesive tape respectively.
The markings are on both sides of the flanges as follows:

- Cable Type/Size
- Cable Length
- Gross Weight.
- NETCOM.
- Shipping mark.

5.4 Cable Packing

Both cable ends are provided with protections against water penetration and firmly secured to the drum, so the cable cannot move and the turns cannot slide when it is moved, handled or laid. the inner end is available for testing.