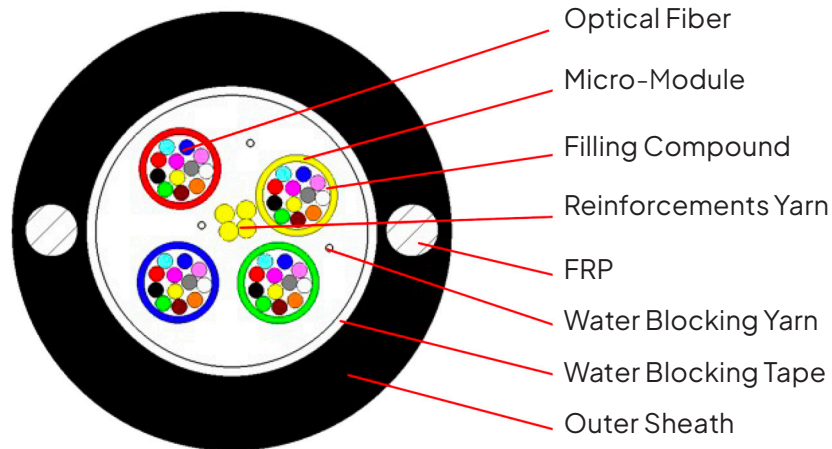


# Micro-Module Dielectric Cable

24F, 48F, 72F, 96F, 144F, 288F, 432F, 576F, 864F



## Typical Construction



## Scope

This specification covers the design and performance of the single mode optical cables to be used in outdoor application.

## Description

- G.652D/G.657A1/G.657A2 SM-fibers
- Outdoor optical cables for access networks, single-mode optical fibers, based on a micro-module structure of 12 fibers, for installation in duct.

## Quality

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

## Reliability

RaDD 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.

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## Reference

ITU-T G.652D	Characteristics of an unshifted dispersion single-mode optical fiber with a low water peak
ITU-T G.657A	Characteristics of a bending-loss insensitive single-mode optical fiber and cable for the access network
IEC-60794-1-1	Optical fiber cables - part 1-1-Generic specification - General
IEC-60794-1-21	Optical fiber cables - part 1-2-Generic specification - Basic optical cable test procedure - Mechanical test methods
IEC-60794-1-22	Optical fiber cables - part 1-2-Generic specification - Basic optical cable test procedure - Environmental test methods
IEC-60794-3	Optical fiber cables - part 3 - Sectional specification - Outdoor cables
IEC-60794-3-11	Optical fiber cables - Part 3-11: Outdoor cables - Product specification for duct, directly buried, and lashed aerial single - mode optical fiber telecommunication cables

## Lifetime

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.

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## Optical Fiber in Cable

Optical properties of the SM fiber are achieved through a germanium doped silica based core with a pure silica cladding which meets ITU-T G.652D/G.657A1/G.657A2, UV curable acrylate protective coating is applied over the glass cladding to provide the necessary maximum fiber lifetime.

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

Parameters	G.652D Specification
Cut-off wavelength	$\lambda_{cc} < 1260\text{nm}$
Attenuation coefficient	1310nm: $< 0.36 \text{ dB/km}$
	1550nm: $< 0.21\text{dB/km}$
Chromatic dispersion coefficient	1330nm: $< 3.5 \text{ ps / (nm*km)}$
	1550nm: $< 18 \text{ ps / (nm*km)}$
PMD of bare fiber	$< 0.1 \text{ ps/km}^{1/2}$
PMD of cabled fiber	$< 0.2 \text{ ps/km}^{1/2}$
Zero-dispersion wavelength	1300~1324 nm
Local irregularity of attenuation	$< 0.1 \text{ dB}$
MFD	1310 nm: $9.1 \pm 0.5 \mu\text{m}$
	1550 nm: $10.3 \pm 0.9 \mu\text{m}$
Cladding diameter	$125 \pm 1.0 \mu\text{m}$
Fiber diameter	$245 \pm 5 \mu\text{m}$
Core/cladding concentricity error	$< 0.6 \mu\text{m}$
Cladding non-circularity	$< 1\%$
Fiber proof stress	$> 0.7\text{G pa (1\% strain)}$

Parameters	G.657A1 Specification
MFD (1310 nm)	$8.8 \pm 0.4 \mu\text{m}$
MFD (1550 nm)	$9.8 \pm 0.5 \mu\text{m}$
Cladding diameter	$125 \pm 0.7 \mu\text{m}$
Fiber diameter	245 +/- 5um, with UV coating, and colored to: $250 \pm 15 \mu\text{m}$
Core/cladding concentricity error	$\leq 0.5 \mu\text{m}$
Coating/cladding concentricity error	$\leq 12.0 \mu\text{m}$
Cladding non-circularity	$\leq 0.7\%$
Cut-off wavelength	$\lambda_{cc} \leq 1260 \text{ nm}$
Attenuation coefficient	1310 nm: $\leq 0.36 \text{ dB/km}$
	1550nm: $\leq 0.22 \text{ dB/km}$ (for 90% fibers in cable), $\leq 0.23 \text{ dB/km}$ (for all fibers in cable)
	1625nm: $\leq 0.24 \text{ dB/km}$ (for 90% fibers in cable), $\leq 0.26 \text{ dB/km}$ (for all fibers in cable)

Parameters	G.657A1 Specification (cont.)
Bending-loss performance of optical fibers @1550 nm	$\leq 0.25$ dB (10 turns around a mandrel of 30 mm diameter)
Polarization mode dispersion link value	$\leq 0.06$ ps/km - 1/2
Zero-dispersion wavelength	1300~1324 nm
Zero-dispersion slope	$\leq 0.092$ ps/nm <sup>2</sup> *km

Parameters	G.657A2 Specification
Cut-off wavelength	$\lambda_{cc} < 1260$ nm
Attenuation coefficient	1310 nm: $< 0.36$ dB/km 1550 nm: $< 0.21$ dB/km
Zero dispersion slope	$< 0.092$ ps/nm <sup>2</sup> *km
PMD of bare fiber	$< 0.1$ ps/km <sup>1/2</sup>
PMD of cabled fiber	$< 0.2$ ps/km <sup>1/2</sup>
Zero-dispersion wavelength	1300~1324 nm
Local irregularity of attenuation	1310 & 1550 nm: $< 0.06$ dB
Macro-bend loss (10 turns, 15 mm radius)	1550 nm: $< 0.03$ dB
Macro-bend loss (1 turn, 10 mm radius)	1550 nm: $< 0.1$ dB
Macro-bend loss (1 turn, 7.5 mm radius)	1550 nm: $< 0.5$ dB
MFD	1310 nm: $8.8 \pm 0.4$ $\mu$ m 1550 nm: $9.8 \pm 0.5$ $\mu$ m
Cladding diameter	$125 \pm 0.7$ $\mu$ m
Fiber diameter	$245 \pm 10$ $\mu$ m
Cladding non-circularity	$< 0.7\%$
Fiber proof stress	$> 0.7$ Gpa (1% strain)

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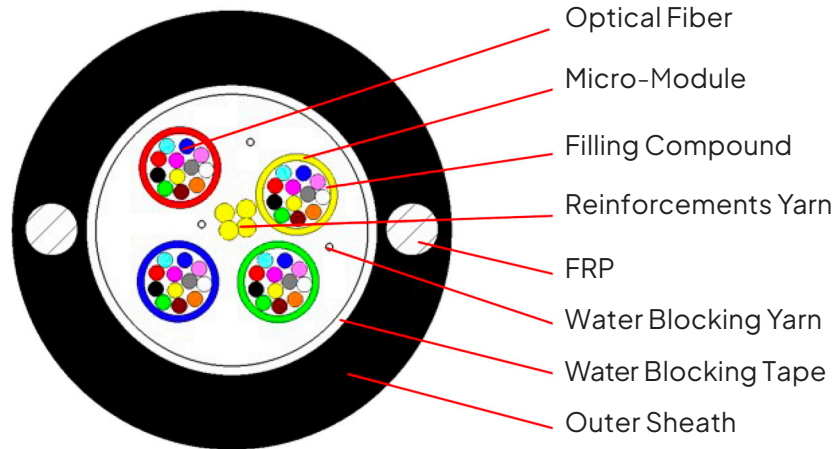


## GENERAL DESIGN

- Several micro-modules are housed in cable.
- Water blocking materials are designed for resistance water.
- HDPE with GFRP is applied over the cable core as outer sheath.

## CONSTRUCTION

### Cross Section of Cable



- Micro-Module: thin wall Elastomeric tubing, filled with a suitable cable compound, housing the optical fibers.
- Water blocking tape and yarns with dry elements.
- FRP reinforcement embedded in the jacket.
- HDPE outer sheath.

### Dimensions and Descriptions of Cable Constructions

Items Contents	Value								
	Y1024-12	Y1048-12	Y1072-12	Y1096-12	Y1144-12	Y1288-12	Y1432-12	Y1576-12	Y1864-12
Number of fibers	24	48	72	96	144	288	432	576	864
Number of micro-modules	2	4	6	8	12	24	36	48	72
Micro-Module - Ø (mm)	1.3 ± 0.05								
Fiber counts per micro-module	12								
Parallel reinforcements in sheath	FRP								

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## Dimensions and Descriptions of Cable Constructions (cont.)

Items Contents		Value							
Parallel reinforcements number		2							
Reinforcements in core		Aramid yarn (if needed) and polyester yarn							
Water blocking material		Water blocking yarn and tape							
Outer Sheath	Material	HDPE							
	Color	Black							
	Thickness (mm)	≥1.5							
	Minimum thickness around FRP (mm)	≥0.2							
Cable diameter (mm)		≤8.5	≤10.0	≤12.0	≤13.0	≤14.0	≤17.0	≤18.0	≤20.5
Cable weight (kg/km)		<50	<80	<100	<110	<135	<170	<220	<290
Cable non-circularity (%)		≤6							













## Mechanical Performance of Cable

Item	Test Requirements								
	Y1024-12	Y1048-12	Y1072-12	Y1096-12	Y1144-12	Y1288-12	Y1432-12	Y1576-12	Y1864-12
Cable type									
Tensile strength T <sub>m</sub> (N)	2000				2200	2700	2800	3000	3000
Impact resistance (N.m)	5						10		
Static bend diameter (mm)	10D								
Repeated bend diameter (mm)	20D								
Kink radius (mm)	10D								
Cut-through resistance	150								
Torsion	±180°/m, L = 40 N								
Crushing for Δa ≤ 0.1 dB	1000 N/10 cm					2000 N/10 cm			
Temperature range	Storage = -40°F, +158°F; Operating = -40°F, +158°F; Installation = 23°F, +104°F								

## Color Code of the Fiber and Micro-Module

Each fiber and the micro-module will be identifiable throughout the length of the cable in accordance with the following color sequence. The micro-module colors can be specified by customer.

Fiber colors:













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

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**Micro-Module colors (≤12 modules):**

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

**Micromodule colours (>12 modules):**

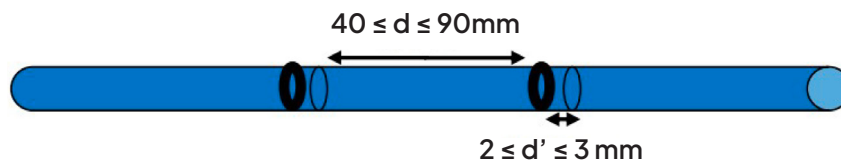
Micromodule No.	1	2	3	4	5	6	7	8	9	10	11	12
Color	Blue	Orange	Green	Brown	Grey	White	Red	Black	Yellow	Violet	Pink	Turquoise
												
Micromodule No.	13	14	15	16	17	18	19	20	21	22	23	24
Color	Blue	Orange	Green	Brown	Grey	White	Red	Black	Yellow	Violet	Pink	Turquoise
												
Micromodule No.	25	26	27	28	29	30	31	32	33	34	35	36
Color	Blue	Orange	Green	Brown	Grey	White	Red	Black	Yellow	Violet	Pink	Turquoise
												
Micromodule No.	37	38	39	40	41	42	43	44	45	46	47	48
Color	Blue	Orange	Green	Brown	Grey	White	Red	Black	Yellow	Violet	Pink	Turquoise
												
Micromodule No.	49	50	51	52	53	54	55	56	57	58	59	60
Color	Blue	Orange	Green	Brown	Grey	White	Red	Black	Yellow	Violet	Pink	Turquoise
												
Micromodule No.	61	62	63	64	65	66	67	68	69	70	71	72
Color	Blue	Orange	Green	Brown	Grey	White	Red	Black	Yellow	Violet	Pink	Turquoise
												

For cables with more than 12 micro-modules, each micro-module must be marked by:

- One ring for No.1 - No.12 module
- Two rings for No. 13 - No. 24 module
- Three rings for No. 25 - No. 36 module
- Four rings for No. 37 - No. 48 module
- One large ring (depth: 6mm~10mm) for No. 49 - No. 60 module
- One large ring and one ring for No. 61 - No. 72 module

It must be stable in time with no risk of transfer from one micro-module to another.

The distance  $d$  between two adjacent rings of the same sequence must be included between 2 mm and 3 mm. The distance  $d'$  between two sequences of rings must be included between 40 mm and 90 mm.



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## Mechanical and Environmental Test Characteristics

Item	Test Method	Requirements
Tensile performance	NF EN-60794-1-2-E1 Load: According to 3.2.3 Sample length: Not less than 100 m.	Elongation of the fibers must be less than or equal to 0.6%.
Impact	NF EN-60794-1-2-E4 - Striking surface radius = 10mm - Energy at impact : According to 3.2.3 - Testing temperature: 5°F and 68°F - Three impacts at different locations spaced from at least 200 mm.	The variation of the attenuation factor shall be reversible at the end of the test. No breakage of the sheath shall be visible.
Cut-through resistance	NF EN-60794-1-2-E12 - Load: According to 3.2.3	The variation of the attenuation factor shall be reversible at the end of the test. No breakage of the sheath shall be visible.
Static bending	NF EN-60794-1-2-E11 - Mandrel radius: According to 3.2.3 -Cycles: 10	$\Delta\alpha$ shall be reversible after test.
Cable kink	NF EN-60794-1-2-E10 Radius: According to 3.2.3 Testing temperature: -15°C and 20°C.	No straw effect.
Cable torsion	NF EN-60794-1-2-E7 - Load: According to 3.2.3 - Length under test = 1 m	The variation of the attenuation factor shall remain less than or equal to 0.1 dB throughout the test duration.
Crush	NF EN-60794-1-2-E3 - Load: According to 3.2.3 - Number of tests: 3 times, each separated 100 mm	The variation of the attenuation factor shall remain less than or equal to 0.1 dB during the test and must be reversible after test.
Abrasion resistance of optical fiber cable markings	NF EN-60794-1-2 E2B Method 2. - Load: 4 N - Number of cycles = 100	The marking shall be identifiable after 100 cycles.
Abrasion resistance of optical fiber cable sheaths	NF EN-60794-1-2 E2A. 1 mm needle - Applied force = 4 N - Minimum number of cycles = 1000.	After 1000 cycles, the test piece shall not have any perforated sheath and the attenuation shall be reversible.

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## Mechanical and Environmental Test Characteristics (cont.)

Item	Test Method	Requirements
Friction in ducts	$f \leq 0.35$	
Temperature cycling	NF EN-60794-1-2-F1 The cable length under test shall be greater than or equal to 3280 ft - Temperature range: -40°F to +158°F - Cycles: 2	$\Delta\alpha \leq 0.1\text{dB/km}$ at 1550 nm $\Delta\alpha$ reversible after test.
Water penetration	NF EN-60794-1-2-F5B Duration: 24 hours Sample length: 10 ft (10 cable samples) A watertight seal shall be applied to one end of the sample to allow a 3 ft height of water to be applied.	No water leakage.

## Packaging and Drum

### Cable Sheath Marking

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

**Color:** white

**Method:** inkjet

**Contents:** the year of manufacture, the type of cable, cable number, length marking

**Outer Sheath Marking Legend:** can be changed according to user's requests

### Reel Length

Standard reel length: 20,000 ft/reel, with a tolerance of -2% ~ +2%, other length is also available.

### Cable Drum~

The cables are packed in fumigated wooden drums.

### Cable Packing

Both ends of the cable will be sealed with suitable plastic caps to prevent the entry of moisture during shipping, handling and storage. The inner end is available for testing.

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## Part Numbers

10-22001.02A - 24F Micro-Module Cable

10-22006.02A - 48F Micro-Module Cable

10-22011.02A - 72F Micro-Module Cable

10-22016.02A - 96F Micro-Module Cable

10-22021.02A - 144F Micro-Module Cable

10-22026.02A - 288F Micro-Module Cable

10-22031.02A - 432F Micro-Module Cable

10-22036.02A - 576F Micro-Module Cable