» New Products

2000-Fiber Ultra-High Density Underground Optical Cable

1. INTRODUCTION

Recently, according to the increasing demand for an optical communication in the context of FTTH, a construction of an efficient optical network is required. A General optical network is shown in Figure 1. The optical fiber cables installations from the network center, through an underground section cable, a pulling section cable and an aerial section cable, are connected to drop cables and led into subscriber's residences and then wired to an Optical Network Unit (ONU) in the premise.

In the underground section, it is required to install more optical fibers in the existing conduit lines. However, in the case of a cable installation in the existing conduit line, the number of optical fibers which can be installed in one conduit line has been limited up to 3000 fibers corresponding to three 1000-fiber cables (See Figure 2). Therefore, we have developed a 2000-fiber cable which has twice the number of optical fibers with the same outer diameter as a conventional 1000-fiber underground optical cable and are introducing it here in this paper.

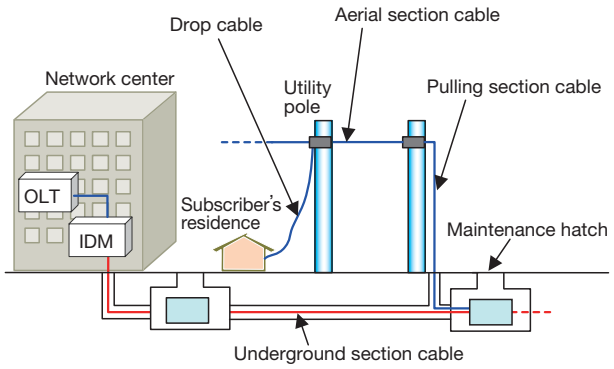


Figure 1 Example of an optical cable installation.

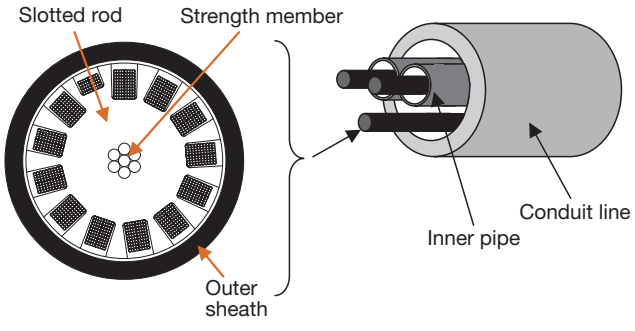


Figure 2 Structure of a conventional 1000-fiber cable.

2. STRUCTURE AND CHARACTERISTICS

2.1 8-Fiber rollable optical fiber ribbon

Figure 3 shows the structure of the 8-fiber rollable optical fiber ribbon as a basic element of the developed 2000-fiber cable. The structure is that four units of 2-fiber ribbons which use SM fibers of 15 mm-allowable bending radius are aligned in parallel and the adjacent two units of 2-fiber ribbons are adhered longitudinally at intervals.

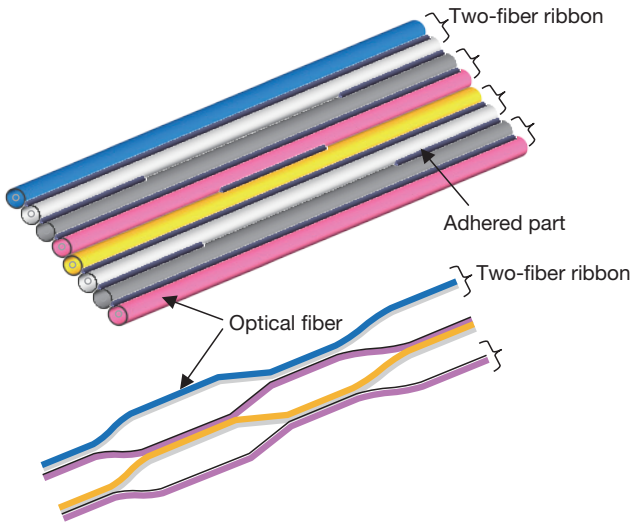


Figure 3 Structure of the rollable optical fiber ribbon.

Changing the form of the 8-fiber rollable optical fiber ribbon as shown in Figure 4, it becomes possible to install optical fibers efficiently in the cable. Moreover, since the rollable optical fiber ribbon is restored to ribbon form when it is taken out, the mass fusion splicing is possible.

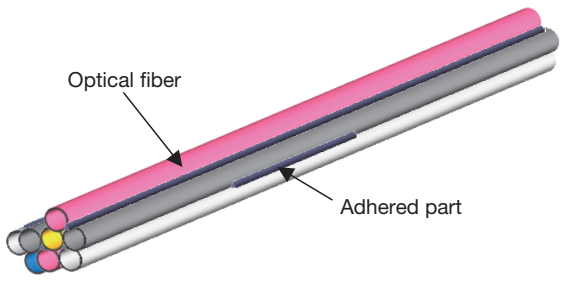


Figure 4 "Rolled" rollable optical fiber ribbon.

2.2 80-Fiber optical fiber unit

Figure 5 shows a 80-fiber optical fiber unit. It has an 80-fiber unit structure where the ten units of the 8-fiber rollable optical fiber ribbons are tied in bunch by the cross-winding of two bundling materials and the unit is identified by the color combinations of the two bundling materials. Adhering the intersection points of the cross-winding of the bundling materials, its cohesion is enhanced and its handleability becomes improved.

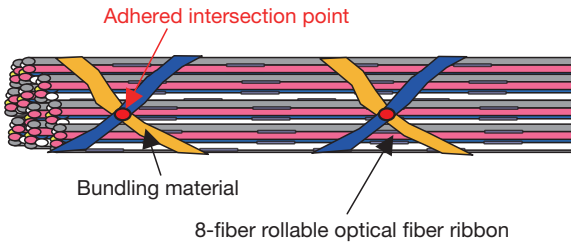


Figure 5 Optical fiber unit.

2.3 2000-Fiber ultra-high density optical cable

The conventional slot-type cable has relatively large ratio of slot area occupying in the cable's cross section. Therefore, to achieve a high-density packaging of optical fibers, we employ the slot-less structure which does not use a slot. Figure 6 shows the 2000-fiber ultra-high density optical cable that we have developed. 25 units of 80-fiber units are intertwined and then wrapped around by water absorbents to make a 2000-fiber cable core. It is also covered by the outer sheath with strength members and rip cords. We developed a cable using flame resistant (FR) polyolefin for its outer sheath in addition to a cable using non-flame resistant (non FR) polyolefin.

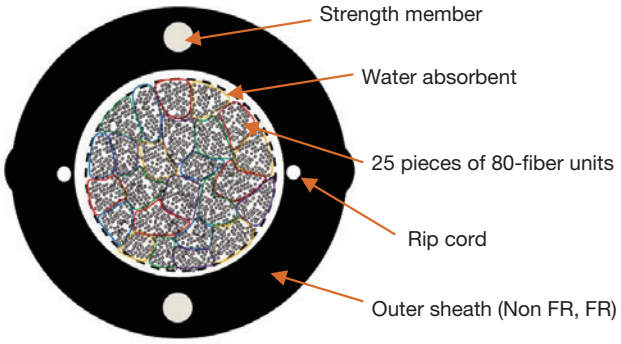
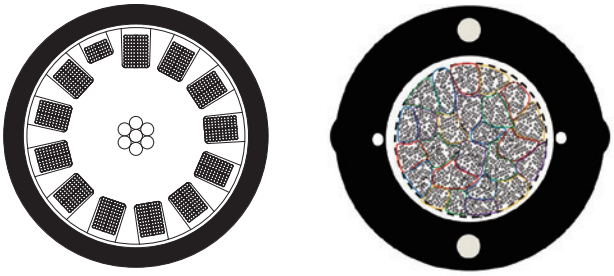


Figure 6 2000-fiber ultra-high density optical cable.

When adopting the structure using the rollable optical fiber ribbon, we achieved the 2000-fiber ultra-high density optical cable which has the same diameter and twice the number of fibers installed to the conventional 1000-fiber underground optical cable. Figure 7 shows the outer diameter comparison of the conventional cable and the developed cable. Using our developed 2000-fiber ultra-high density optical cable, it becomes possible to install up to 6000 fibers in one existing conduit line.



1000-Fiber cable (Conventional)

Outer diameter: 23.0 mm

2000-Fiber ultra-high density optical cable

Outer diameter: 23.0 mm

Figure 7 Comparison of cable diameters.

2.4 Properties

Table 1 shows the properties of the 2000-fiber ultra-high density optical cable. It has good performances in its transmission, its mechanical and its temperature characteristics.

Table 1 Properties of the 2000-fiber ultra-high density optical cable.

Item	Test condition	Result	
		Non FR	FR
Transmission loss	λ = 1,310 nm	<0.35 dB/km	
	λ = 1,550 nm	<0.25 dB/km	
Bending	R= 240 mm, 10 cycles	<0.1 dB	
Lateral pressure	1960 N/10 mm, 1 min.	<0.1 dB	
Squeezing	R= 600 mm, 4 cycles, 3000 N	<0.1 dB	
Twist	±90° /1 m	<0.1 dB	
Impact	Weight: 1 kg, Drop height: 1m	<0.1 dB	
Temperature cycle	-30℃ - +70℃, 3 cycles	<0.1 dB/km	
Water proof	Artificial seawater, Water height: 1 m, Cable length: 40 m, Test time: 240 hrs.	No water flowed from the end face	
Frame retardancy	JIS C 3521	—	Extent of combustion < 1.8 m

Note: Mechanical & temperature characteristics are measured at λ = 1,550 nm.
Note: The characteristics values in the above table are representative values.

3. CONCLUSION

We have developed the 2000-fiber ultra-high density optical cable which has the same diameter and twice the number of fibers installed to the conventional 1000-fiber optical cable. It makes it possible to install more fibers

than ever in the existing conduit lines of the underground areas and it can contribute to construct an efficient optical networks.

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