New Products

Development of Optical Indoor Cables Using 0.9-mm Tight-Buffered Optical Fiber

1. INTRODUCTION

With the rapid growth of broadband services, recent years have seen full-fledged implementation of optical services aimed at ordinary houses, as well as at office buildings and apartment buildings. Figure 1 shows a layout example of optical indoor cables in apartment buildings.

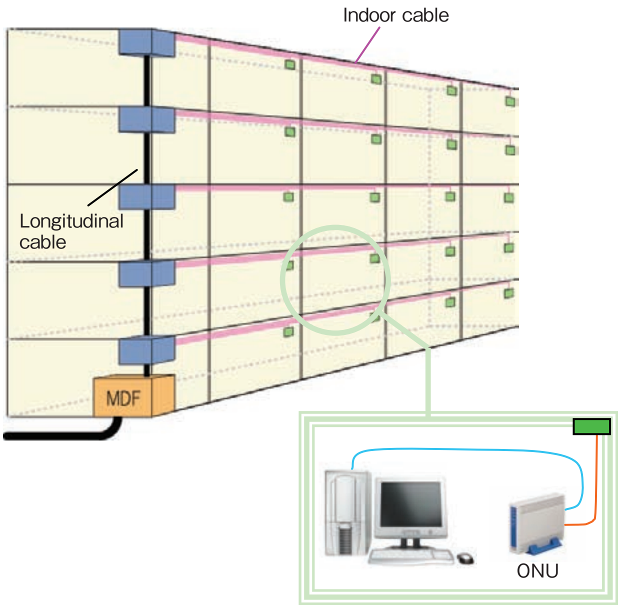

Figure 1 Typical layout of optical indoor cables in apartment buildings.

Optical fibers from a trunk cable are first accommodated in the main distributing frame (MDF) room, and there they are branched for wiring to each room. Here, indoor cables are used mainly for floor wiring. Then the optical fiber led into each room is connected via optical network unit (ONU) to personal computers and the like.

In such wiring work, high efficiency enabling large volume of work in a short time is required in addition to assuring function and quality. Accordingly, aiming at ease of wiring work and minimal skill requirement, we have developed indoor cables using a 0.9-mm tight-buffered optical fiber, placing importance on handling performance and ease of work.

2. CABLE STRUCTURE

Figure 2 shows a cross-section of the cable developed here. Two types of cables were developed, one using FlexiWave single-mode (SM) fiber having an allowable bending radius of 15 mm, and one using LaserWave multi-mode (MM) fiber having the same allowable bending radius of 15 mm. The indoor cable measuring 2.5 mm x 4.5 mm in outer shape is formed by arranging two strength members in parallel on the both sides of 0.9-mm tight-buffered optical fibers, then applying a flame-retardant halogen-free sheath.

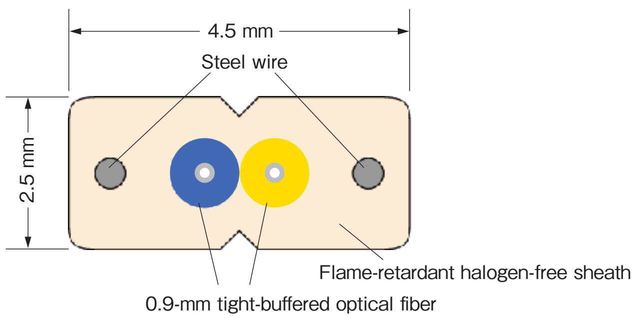

Figure 2 Cable cross-section.

3. CABLE FEATURES

3.1 Structure of Tight-Buffered Fiber

Although the diameter of an optical fiber generally used is 0.25 mm, this could lead to breaking due to poor visibility and inadvertent hooking during wiring work. Accordingly, to allow easy wiring work with a sense of security, handling performance has been improved by coating the core fiber to 0.9 mm in diameter using a high-strength thermoplastic resin.

Also, since the core fibers at cable ends must be terminated with a connector or fusion spliced at the time of cable laying, a suitable coating material has been selected to provide good removability of coating.

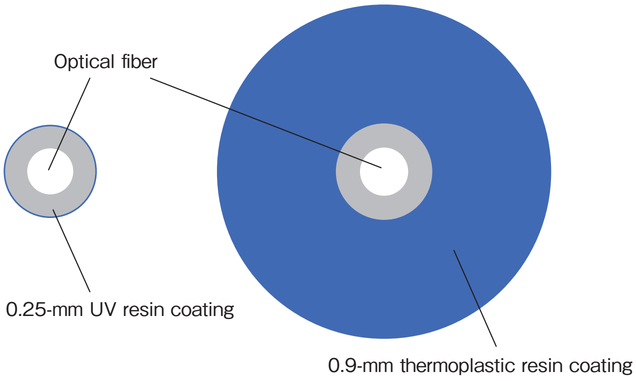

Figure 3 **Comparison between 0.25-mm fiber and 0.9-mm tight-buffered fiber.**

3.2 10-Gbps Transmission Capability

The MM fiber-based cable uses our LaserWave fiber suitable for 10-Gbps transmission. The LaserWave fiber allows 10-Gbps transmission for up to 600 m, making itself suitable for LAN wiring in office buildings and apartment buildings.

Figure 4 shows the result of 10-Gbps transmission tests over a 600-m indoor cable that uses LaserWave fiber. The transmitted waveform meets the standards of IEEE 802.3ae, demonstrating that the 10-Gbps signals have been properly transmitted even for a distance of 600 m.

Moreover, bit error rate (BER) measurements were conducted at 10 Gbps, and it has been confirmed that the BER is 1×10^{-12} or lower as specified by the IEEE 802.3ae.

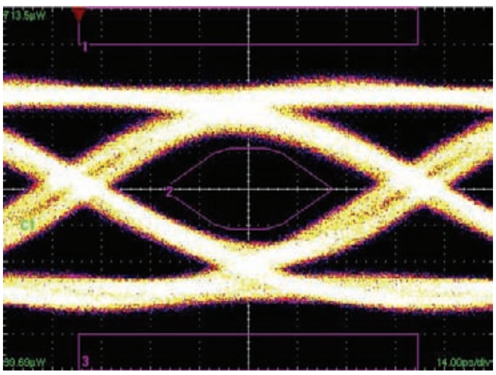

Figure 4 **10-Gbps waveform.**

4. CHARACTERISTICS

The characteristics of the indoor cable developed are shown in Tables 1 and 2.

The general mechanical and temperature characteristics required of an indoor cable have been confirmed. Also, with respect to flammability property, the cable has passed the 60° inclined flaming test specified by JIS C 3005.

Moreover, good results have been confirmed in terms of core fiber accessibility and removability of core fiber coating.

Table 1 **Characteristics of single-mode fiber cable.**

Test item	Test condition	Test result
		SM fiber (FlexiWave)
Transmission loss	1310 nm	≦ 0.36 dB/km
	1550 nm	≦ 0.22 dB/km
Bending	R=15 mm, ±90°	≦ 0.05 dB
Crush	1200 N / 25 mm, 1 min	≦ 0.05 dB
Impact	0.3 kg, 1 m	≦ 0.05 dB
Twist	±90°/m	≦ 0.05 dB
Tension	200 N	≦ 0.05 dB
Temperature cycling	-20~60℃, 10 cycle	≦ 0.10 dB/km
Temperature/humidity aging (I)	45℃·95%, 168 hr	≦ 0.10 dB/km
Temperature/humidity aging (II)	-10~25~65℃·93%, 10 cycle	≦ 0.10 dB/km
Flammability	JIS C 3005, inclined	Self-extinguishing
Fiber accessibility	Tear off and take out by hand	Good
Fiber protrusion	-20~60℃	≦ 0.2 mm
Coating stripping force	20-mm removing using a tool	≦ 20 N

•Wavelength for optical characteristics measurement is 1550 nm.
•The table above shows typical values, not guaranteed values.

Table 2 **Characteristics of multi-mode fiber cable.**

Test item	Test condition	Test result
		MM fiber (LaserWave)
Transmission loss	850 nm	≦ 2.30 dB/km
	1300 nm	≦ 0.60 dB/km
Differential mode delay (DMD)	IEC 60793-2-10, Ed 2.0	Templates 1~6 satisfied
Bending	R=15 mm, ±90°	≦ 0.10 dB
Crush	1200 N / 25 mm, 1 min	≦ 0.10 dB
Impact	0.3 kg, 1 m	≦ 0.10 dB
Twist	±90°/m	≦ 0.10 dB
Tension	200 N	≦ 0.20 dB
Temperature cycling	-20~60℃, 10 cycle	≦ 0.20 dB/km
Temperature/humidity aging (I)	45℃·95%, 168 hr	≦ 0.20 dB/km
Temperature/humidity aging (II)	-10~25~65℃·93%, 10 cycle	≦ 0.20 dB/km
Flammability	JIS C 3005, inclined	Self-extinguishing
Fiber accessibility	Tear off and take out by hand	Good
Fiber protrusion	-20~60℃	≦ 0.2 mm
Coating stripping force	20-mm removing using a tool	≦ 20 N

•Wavelength for optical characteristics measurement is 850 nm.
•The table above shows typical values, not guaranteed values.

5. CONCLUSIONS

Optical indoor cables using a 0.9-mm tight-buffered fiber have been developed, achieving better cable laying efficiency than before.

For more information, please contact:
Telecommunications Engineering Department,
Telecommunications Co.
TEL: +81-3-3286-3325 FAX: +81-3-3286-3708