Freeform Ribbon All-Dielectric Monotube OI Cable

1. Outline

Currently, data center (DC) construction is progressing to accommodate the rapid increase in traffic due to the emergence of generative AI and machine learning. By interconnecting multiple DCs, data can be shared, and services such as backup and redundancy can be provided. To realize these services, it is necessary to install optical cables in outdoor underground ducts that connect distant DCs, and there is an expectation that many fibers can be efficiently deployed within these space-limited ducts in a short term. In this context, Sumitomo Electric Lightwave Corporation (SEL) has commercialized new outdoor/indoor hybrid cables (OI cables) ranging from 288–3,456 fibers by changing the cable design from conventional central tube cable to Monotube Cable, resulting in a drastic reduction in cable outer diameter (OD) and weight compared to previous designs.

2. Cable Design

The Monotube OI cables feature the patented 200 µm 12-fiber pliable Freeform Ribbon (Fig. 1). The Freeform ribbon is designed with splits in the longitudinal direction for every two fibers to ensure both flexibility and ease of mass fusion splicing. These features are achieved by optimizing the ratio and length of the split section and the non-split section.

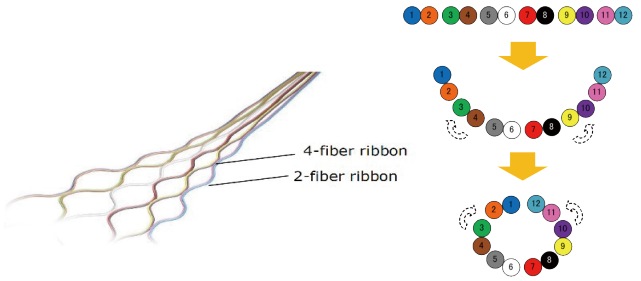

Fig. 1. Features of Sumitomo Electric's Freeform Ribbon

Freeform Ribbon enables high fiber density within a small cable diameter to maximize the effective use of limited duct space. SEL's Monotube designs utilize 72-fiber or 144-fiber color coded (blue through aqua) bundles of individually bar and block-marked ribbons for identification. These bundles are arranged for easy organization and to allow midspan access.

Water-blocking tape and, as needed, water-blocking yarns are inserted to achieve waterproof performance that meets the required levels. Additionally, the selection of outer jacket material and the thickness, along with the fiber reinforced plastic (FRP) strength members embedded in the cable sheath, provides OI cables with robustness comparable to that of outdoor cables.

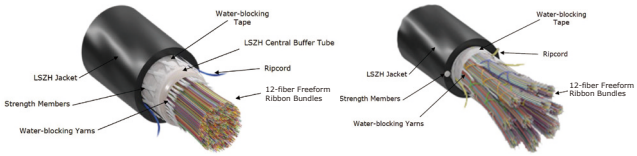

Fig. 2. Features of Sumitomo Electric's Freeform Ribbon (Left: Central tube cable, Right: Monotube Cable)

3. Features

(1) The use of Freeform Ribbon and Monotube Cable designs enable higher fiber density resulting in a 40–48% reduction in cable OD and a 28 to 41% reduction in weight compared to previous designs. This makes installation easier and also increases the number of optical fibers per duct.

(2) Significant reductions in OD and weight result in longer cable installation lengths by approximately 40–65%. A reduction in the number of connection points that were previously necessary is combined with low attenuation loss. Additionally, customers can reduce the land area required for drum storage by half because of the longer length cable.

(3) The designs utilize a highly flame-retardant, "Low-smoke Zero-Halogen" jacket compliant with UL standards in North America and CPR Cca or better in Europe.

Table 1. Monotube Cable Dimensions and Features

Fiber Count	288	423	864	1728	3456
Cable OD (mm) (Reduction %)	12.6 (-45%)	13.9 (-44%)	17.4 (-48%)	21.5 (-43%)	25.4 (-40%)
Cable weight (kg/km) (Reduction %)	254 (-31%)	286 (-28%)	486 (-41%)	685 (-40%)	938 (-38%)
Smallest duct size (Fill ratio)	0.75" 43%	0.75" 53%	1" 47%	1.25" 46%	1.25" 64%
Features	- ICEA S-104-696, GR-20, IEC 60794-6-10 - UL 1666, UL 1685-low smoke - CPR cca or better certified - Jetting compatible - Mid span access available - 20,000 ft (6000 m) shipping length - Yellow jacket available				

*Reduction % compared to conventional central tube cable.