High Fiber Count Cable Miniaturization using SMF-28® Ultra 200 Fiber

White Paper

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Author: Dr. Russell Ellis

Introduction

Corning® SMF-28® Ultra 200 fiber is a low loss, bend insensitive ITU-T Recommendation G.652.D and G.657.A1 single-mode fiber with a reduced outer coating diameter. It is designed for use in high-fiber count micro cable for FTTx and access network applications that can be further miniaturized by taking advantage of the smaller 200 micron coating diameter. Smaller, lightweight cables that are more compact offer easier handling and installation, especially in urban areas where cabling infrastructure (e.g. ducts and microducts) are overcrowded due to space limitations. SMF-28 Ultra 200 fiber features a 9.2 micron nominal mode field diameter (MFD) – which offers greater compatibility with conventional and legacy ITU-T G.652 single-mode fibers (which have the same nominal MFD value) – and provides optical bend resilience that surpasses the requirements of the ITU-T G.657.A1 industry standard.

200 Micron Diameter Fiber Coating

To enable the development of a new class of smaller, lighter cables, Corning has developed a fiber with a reduced overall diameter of 200 microns (nominal), shown in Figure 1. Conventional single-mode fibers used throughout the telecommunications industry, that make up the majority of network cabling already installed, have a typical nominal coating diameter in the range of 242 ~ 250 microns. The reduction in coating diameter is made possible through advances in coating technology and the use of an innovative glass fiber design that achieves enhanced optical bending resilience without comprising the MFD or any other optical attributes. The optical properties and transmission specifications are based upon SMF-28 Ultra fiber which is ITU-T G.652.D and G.657.A1 compliant and retains the same conventional 125 micron cladding diameter used throughout the industry. A comparison of the attributes of SMF-28 Ultra 200 fiber to industry standard specifications is shown in Table 1.

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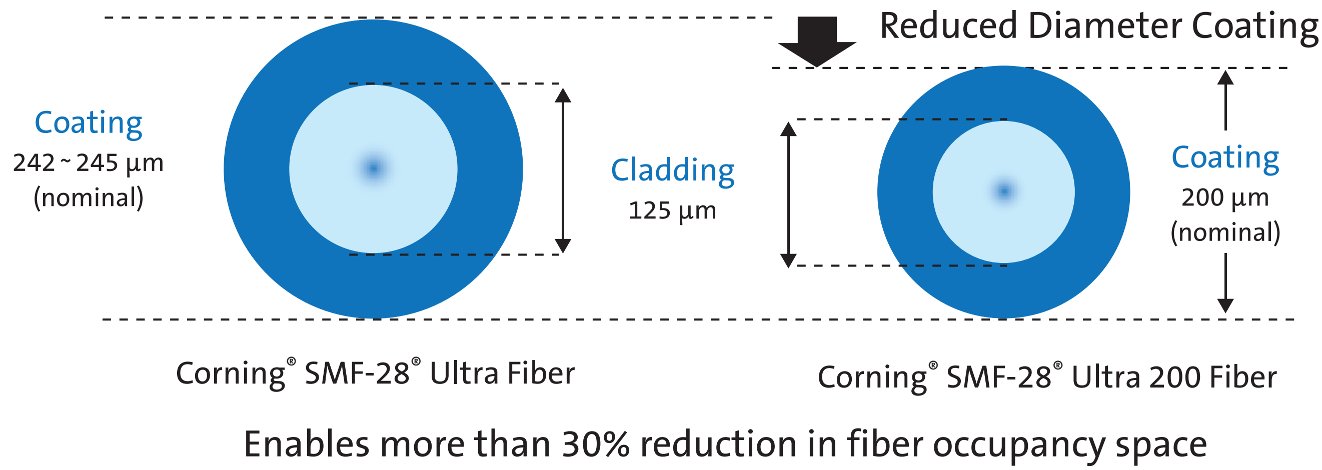

Figure 1 . Comparison of fiber outer diameter: conventional coating diameter fiber alongside SMF-28® Ultra 200 fiber which features a reduced coating diameter of 200 microns.

Attribute	Units	Corning® SMF-28® Ultra 200 fiber	ITU-T G.652.D/ IEC 60793-2-50, type B1.3	ITU-T G.657.D/ IEC 60793-2-50 type B6.a1
Coating Diameter:				
200 micron fibers	microns	200 ± 5	200 ± 10*	200 ± 10*
Conventional diameter fibers	microns	–	(235 – 255)	(235 – 255)
Coating-cladding concentricity error	microns	≤10	≤10*	≤10*
Attenuation:				
1310 nm	dB/km	≤0.32	≤0.4	≤0.4
1383 ± 3 nm	dB/km	≤0.32	≤0.4	≤0.4
1550 nm	dB/km	≤0.18	≤0.3	≤0.3
1625 nm	dB/km	≤0.20	≤0.4	≤0.4
Macrobend Loss (dB):				
100 turns, 30 mm radius at 1625 nm	dB	≤0.01	≤0.1	≤0.1
1 turn, 10 mm radius at 1550 nm	dB	≤0.50	Not specified	≤0.75
1 turn, 10 mm radius at 1625 nm	dB	≤1.5	Not specified	≤1.5
Mode Field Diameter at 1310 nm	microns	9.2 ± 0.4	8.6-9.5 ± 0.4	8.6-9.5 ± 0.4
Polarization Mode Dispersion (PMD):				
Link Design Value (ps/√km)	(ps/√km)	≤0.04	≤0.20	≤0.20
Maximum Individual Fiber PMD	(ps/√km)	≤0.1	Not specified	Not specified

*Published specified limits for 200 micron fibers. The values shown above are for un-colored fibers.

Table 1. Key fiber specifications for SMF-28® Ultra 200 fiber as compared to pertinent published international industry standards established for conventional and 200 micron fibers.

Cable Miniaturization

The reduction in fiber coating diameter enables space savings by reducing the overall occupancy of all the fibers inside a cable. Figure 2 shows an example of the relative size reduction that may be achieved in a loose-tube design duct cable. In Figure 2, a cable containing 144 fibers can be re-engineered with SMF-28 Ultra 200 fiber to achieve equivalent or better cabled performance but with a reduced outside diameter. By placing a higher number of fibers in each tube (24 fibers instead of 12) and reducing the tube and central stranding element dimensions, in-scale with the reduced occupancy of the 200 micron fibers, smaller lightweight cables can be engineered. Alternatively, a duct cable may be re-designed using 200 micron fibers to accommodate a greater number of fibers contained in the cable without increasing the overall diameter. These cable design approaches can be employed to make best use of the available duct space, whilst increasing the fiber count to boost the overall data throughput capability to help overcome bottlenecks in the network. The fundamental principles of cable design still apply; therefore, the mechanical and material properties must be maintained to retain the same levels of cable performance (e.g. when to operate within extreme temperatures, or resist the effects of moisture ingress, cable bending, crush or tensile stress). By maintaining the necessary requirements with a smaller and lighter cable design, installers and network operators can improve installation efficiency and achieve operational cost savings through longer reach of air blown cable installation in microducting.

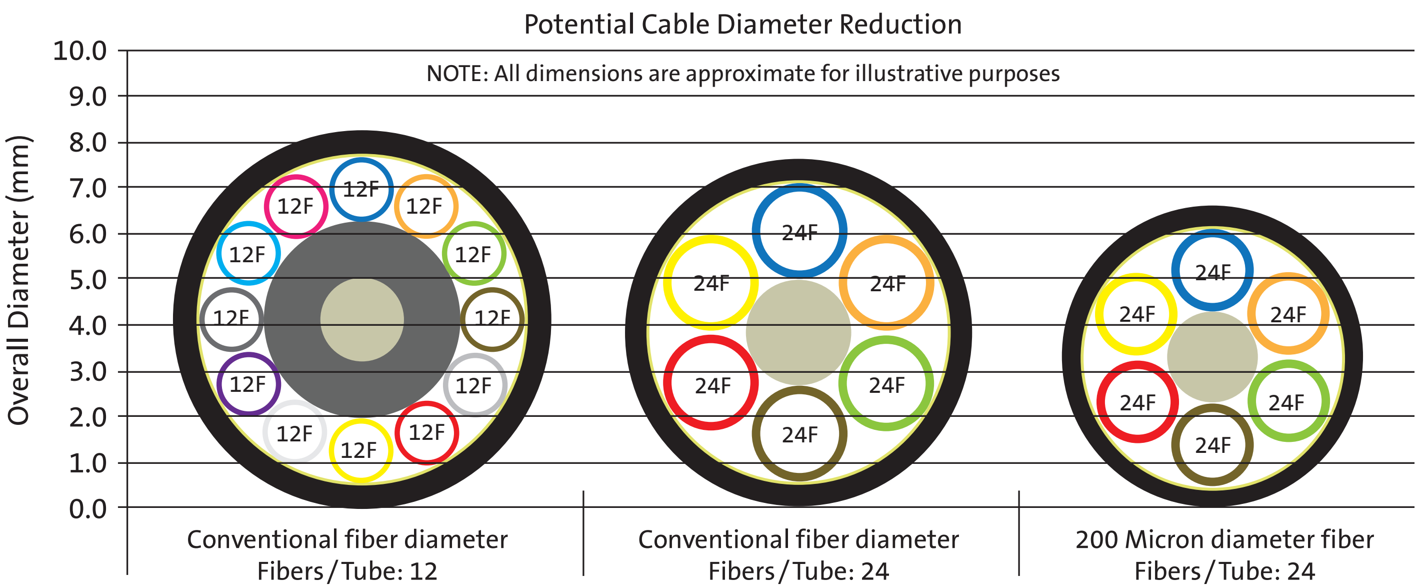

Figure 2. Illustration of cable diameter reduction possible with SMF-28® Ultra 200 fiber.

This design approach can be used where telecommunication network utilities in urban areas such as towns and cities are congested with existing cables or otherwise space limited and require the use of smaller duct and cable. Similar design benefits may be considered for aerial deployments, such as all-dielectric self-supporting cables (ADSS) or telegraph type optical fiber cables. Smaller lightweight cables reduce the levels of mechanical stress imparted on to the supporting structures, poles or towers, through reduced wind/ice loading. In some cases this may also enable co-location of additional optical fiber cables on existing structures or poles or towers and/or increase span lengths or overcome ground/obstacle clearance issues in built-up areas that would otherwise not be achievable with a high number of conventional fibers.

Network System Performance

The combination of enhanced optical bending resilience and low loss means that SMF-28 Ultra 200 fiber offers network operators further opportunities for advantaged network design. Smaller optical fiber cabling can be deployed to support the distribution of fixed-line and wireless high-speed subscriber services, where cable deployment is challenging without compromise on transmission performance or signal reach. The low loss of SMF-28 Ultra 200 fiber, offers a signal reach advantage of ~10% over conventional ITU-T G.652 fiber types, and a ~20% increase in coverage served by a point of presence or central office. Furthermore, with MFD conventionally targeted to 9.2 microns, SMF-28 Ultra fiber can be seamlessly spliced into the existing network without risk of incurring expensive rework.

Summary

International industry standards are changing to accommodate fibers with a reduced coating diameter based around a target of 200 microns. SMF-28 Ultra 200 fiber is an ITU-T G.652.D and G.657.A1 compliant fiber that has been developed by Corning to enable a new generation of miniaturized high fiber count cables. Smaller cables provide many benefits, such as better handling, easier installation, and improved space utilization.

References

[1] IEC 60793-2-50 – Sectional specifications for class B single-mode fibres – Edition 4.0, December 2012.

Corning Incorporated
www.corning.com/opticalfiber

One Riverfront Plaza
Corning, New York
USA

Phone: (607)248-2000
Email: cofic@corning.com