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Optical and Mechanical Resilience of Reduced Coating Diameter Fibers

Corning Optical Fiber and Cable
Application Note AN2000
Issued: August 2026
Supersedes: March 2021
ISO 9001 Registered

Nikita Korotkov
korotkovnm@corning.com

Bryan Musk
muskbj2@corning.com

John Hedgpeth
hedgpethjm@corning.com

Introduction

Miniaturization of cables, assemblies, and other optical products is a major trend in the telecommunications industry. This is born out of a necessity to improve installation space-efficiency and accelerate penetration of fast optical fiber-based bandwidth service coverage to subscriber areas which are difficult to reach or costly to service. It is also now growing more rapidly based on the proliferation of hyperscale data center designs and their AI enabling GPU interconnectivity operations.

Urban areas can be especially challenging for network operators when trying to deploy high-fiber-count cables in underground duct infrastructure that is either congested or duct-size restricted. Smaller diameter and higher fiber-density micro cables offer several distinct advantages: more efficient utilization of duct space, easier handling, and faster installation. Smaller, lightweight cables can be deployed quickly and more efficiently by blowing into smaller duct sizes. Additionally, smaller form factor cable, connectivity, and hardware products can help reduce costs associated with packaging, storage, and freight. This new generation of micro cables and related products requires smaller diameter optical fibers that occupy less space and offer greater optical transmission resilience in a wide range of current and emerging applications where density matters for efficient space utilization.

Reduced coating diameter fibers started to emerge at commercial scale beginning in 2014 and any initial concerns in the industry about the standardization and multiple sourcing of these products have been addressed by the standard IEC 60793-2-50 to include an option of uncolored coating diameter of 180 to 210 µm across single-mode fiber types and 180 to 220 µm for colored fibers. Most leading fiber suppliers now offer reduced diameter fiber options, which add value to all applications from subsea and long-haul to metro and datacenters.

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Corning's first large scale reduced coating diameter product was SMF-28® Ultra 200 fiber, which featured a reduced coating diameter of 200 µm beneficial for high fiber-density outside plant cabling and provided 100% ITU-T G.652.D backwards compatibility with enhanced bending resistance. In response to the growing market acceptance of reduced coating diameter products, Corning expanded its portfolio and now offers market-leading reduced coating diameter Contour™ fiber in a 190 µm form factor with up to ITU-T G.657.A2 bend resistance to help further increase fiber density in a growing number of cable application spaces [1]. This application note explains some of the key features of these advanced, reduced coating diameter types and how the superior transmission capability of the fiber can be maintained while continuing to minimize potential glass damaging mechanisms that might otherwise be aggravated by the reduced thickness of the surrounding coating. As the market continues to demand higher fiber-count cables, Corning will position its fiber portfolio to meet these needs, enabling our customers to install market-leading optical fibers into their networks.

Reduced Diameter Fiber Coating

Conventional single-mode optical fibers, the foundation of modern-day optical telecommunication networks, feature a protective coating layer with a nominal outside diameter of 242 to 250 µm depending on application. Since Corning developed the first low-loss fibers in the 1970s, optical fiber technologies have evolved tremendously. Enhancements in both glass and coating technologies have improved optical transmission capabilities and the protective qualities of coating that preserve the optical and mechanical properties of the fiber. For decades, Corning's optical fibers have been mechanically and environmentally durable and optically reliable across numerous cabling applications which have been used in a wide range of deployments. Corning has also developed fibers with a reduced diameter coating to enable the development of smaller diameter, higher fiber-density cables [2]. These fibers have glass technology which helps to advance the optical performance levels of the fiber and a coating system which protects the functionality of the fiber even with the reduced overall coating thickness. Figure 1 illustrates the two main functions of Corning's dual layer CPC® protective coating system:

1) The softer inner layer with a lower Young's modulus and low glass transition temperature works to minimize microbend and preserve the fiber's optical performance properties during its operational lifetime. 2) The harder (higher modulus) outer coating layer serves to protect the glass from mechanical damage during processing, installation, handling for splicing/connectivity operations, and throughout an expected long service life.

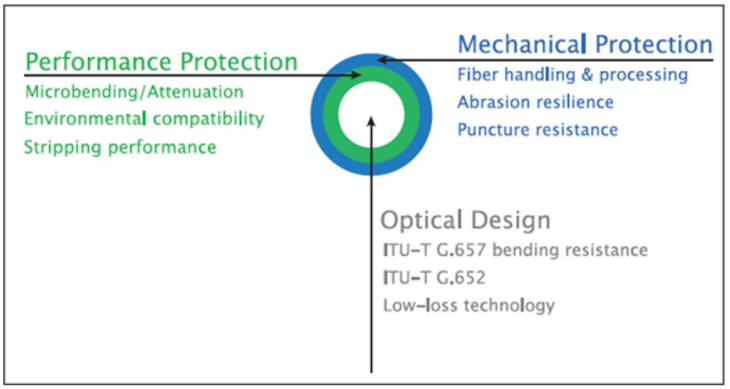


Figure 1: The main functions of protective coating and profile design

The smaller form factor of 190 µm compared to 242 µm, along with cable design changes, presents the opportunity to fit up to 2X the fiber in the same cable diameter and improve the network capacity in a space-constrained environment. As an example, illustrated in Figure 2, Contour™ Flow Cables containing 190 µm OD Contour fiber achieve a 1,728 fiber-count, where a legacy ribbon cable with 242 µm fiber only fits 864 fibers in the same cable outer diameter.

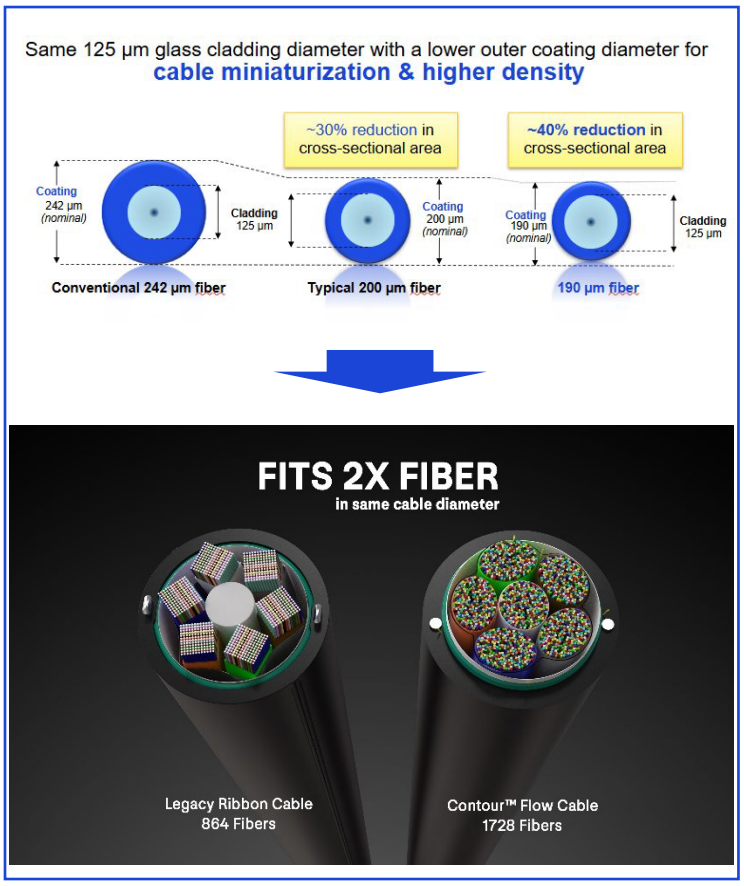


Figure 2: 2x increase in fiber count in the same cable diameter

Functional Understanding of Reduced Coating Diameter Fibers

1. Microbend Performance

Microbend performance can be influenced by changes to the coating geometry and should be considered as a part of cable design for reduced coating diameter fibers. Since there is no current industry standard test method for microbend performance, developmental cables with control standard fibers are considered the best method to understand specific cable design influences. Cable design constraints, like free space and excess fiber length, need to be considered due to the decrease in cushioning, seen with the reduction in coating thickness.

2. Strength and Reliability

Glass or cladding diameter is the same for current generation of reduced coating diameter fibers compared to traditional fibers, both 125 µm. As the tensile strength and mechanical reliability properties of optical fiber are determined by the glass material properties including the distribution of lower strength flaws present in the cladding surface, reduced coating diameter fibers share the same mechanical specifications as conventional products based on maintaining the same proof test level [3].

Intrinsic strength represents the strength of glass absent introduced flaws. Figure 3 showcases the intrinsic strength comparison, which is expected, as the glass itself is unchanged. Furthermore, fiber strength and reliability models developed by Corning are still applicable for reduced coating diameter fiber. The applied stress guidelines which set out safe stress limits for tensile and bending stress applications demanding near zero failure risk or managed risk, continue to apply for Corning's reduced coating diameter fibers [4].

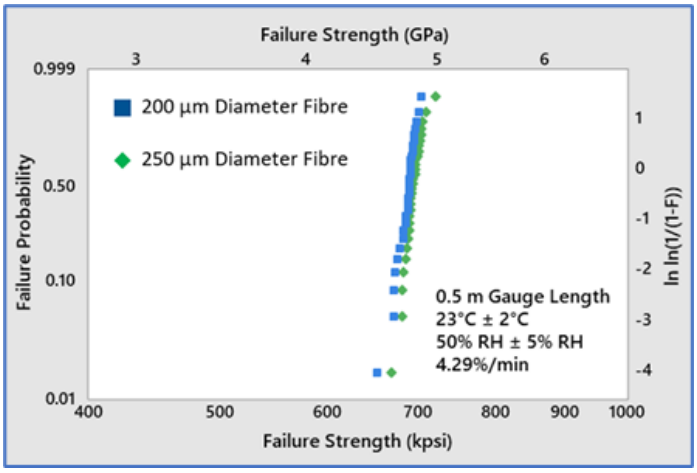


Figure 3: Intrinsic strength comparison

3. Mechanical Protection and Fiber Handling Properties

The mechanical protective qualities of the fiber coating are dependent on the properties of the outer coating layer. Achieving the desired levels of coating toughness requires the outer coating to have high fracture toughness and sufficient radial thickness to protect the glass from damage during handling and subsequent cable or other optical connectivity or device processing, and to remain effective during its operational lifetime. Corning has studied the coating toughness properties over many years to understand how to design advantaged materials that enable reduced diameter fiber to be deployed in the interest of higher fiber density and maximizing network capacity [5]. The polymer material for the outer layer of the current generation of Corning's CPC® coating system was designed to have higher puncture resistance than the preceding versions. However, an optical fiber with a reduced coating diameter will have lower puncture resistance when compared to a fiber with a 242 µm coating layer because of the reduced thickness of the outer material, Figure 4.

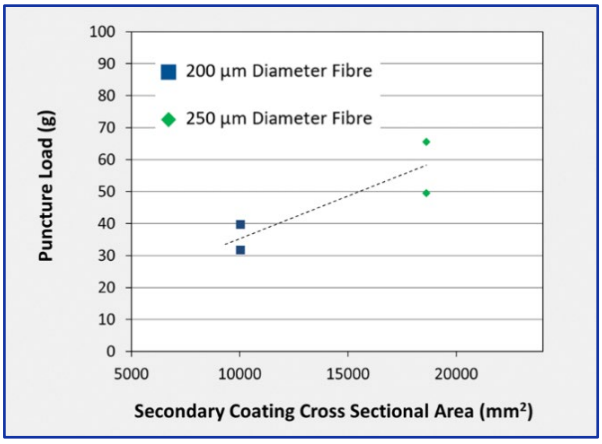


Figure 4: Comparison of puncture resistance using indention method

With the consequential reduction in protective material, a cable manufacturer might be concerned and expect to encounter more breaks per thousand kilometers due to process related puncture mechanisms. With exception to die and tooling sizes being proportionately smaller for reduced coating diameter fibers, processing and cable manufacturing equipment is generally interchangeable for 242 µm fiber. In more than 10 years since reduced coating diameter fibers have been deployed, no concerns in fiber robustness have been raised by the industry. This is due to the fibers delivered strength being determined by the proof test of Corning's reduced coating diameter fiber products, which is unchanged from the 242 µm design.

While overall delivered fiber strength is unchanged, there are still important best practices for the cable manufacturer to follow to minimize the potential for external damage to the

coating. Some of the external damage mechanisms that could be more impactful for a fiber with lower coating diameter and that need particular attention paid to control are as follows: whip (i.e., penetration of the coating from flailing fiber ends, as may occur during an in-process break or end of run), abrasion from an uneven or damaged/worn fiber contact surface, abrasion from fiber running across a static contact surface (e.g., seized pulley guide), puncture by dirt or accumulated debris captured between the fiber and a contact surface, and manual handling during equipment setup.

After several years of experience running reduced coating diameter fibers since introduction in 2014, Corning has reviewed cable factory break rates in one of the global factories where both conventional and reduced coating diameter fibers are processed in large volumes. Equivalent low break rates are found to be achievable in both the coloring and buffering processes for both versions of the product. With close attention to routine cleaning of the fiber contact points on the production equipment machinery (pulleys, rollers, guide dies, etc.) and diligent housekeeping in the general vicinity of the manufacturing equipment, the reduction in the coating diameter is not expected to lead to an increased break rate.

Based on these experiences, some suggestions that could assist a cable manufacturer when starting to process reduced coating diameter fibers for the first time are as follows:

- Consider increasing the frequency of line inspection and cleaning regime of fiber processing equipment with focus on fiber-contact component inspection. In addition to routine cleaning and inspection regimes in-step with equipment utilization, less frequent but regular deep cleaning of each machine with fiber contact surfaces is recommended. Fiber contact surfaces that are found to be damaged in a manner that could compromise the fiber coating should be replaced immediately, all rotating parts that contact the fiber should be checked to ensure that they rotate freely, and line operators should be educated on the importance of completing the cleaning regimes thoroughly.

- Tighter specifications for fiber contact part surface finishes should be considered.

- Use reduced diameter mechanical grade fiber, rather than conventional diameter mechanical grade fiber, for setting up lines that will process reduced diameter fiber. Please contact your Corning account manager to receive the necessary mechanical grade fiber to perform these set-ups.

- Re-check fiber pay-out paths to ensure correct pay-out tension and proper alignment as the fiber is un-wound from the spool. Excessive pay-out tension and un-controlled fiber pay-out angle increases risk of fiber contact with machinery parts that can cause damage potentially leading to breaks.

4. Coating Strip Force

Corning's reduced diameter fibers were also tested to measure coating strip force against existing requirements for conventional fibers in accordance with the sectional requirements of IEC 60793-2-50 for Class B fibers. Figure 5 shows the peak and average measured coating strip force for conventional coating diameter and reduced coating diameter fibers using the same coating type.

This study agrees well with fiber and cable processing and handling trials, during which no changes to any fiber handling or fiber processing practices were deemed necessary, other than the required use of smaller sized machine tooling to make best use of the smaller form factor.

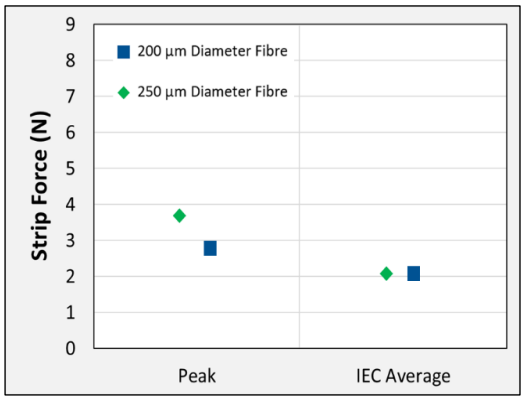


Figure 5: Comparison of coating strip force

5. Fusion Splicing: Performance Compatibility

The fusion splicing performance of reduced coating diameter ITU-T G.652.D fiber when spliced to conventional 242 µm ITU-T G.652.D fiber type is equivalent to splicing two conventional 242 µm fibers together due to the same mode-field diameter (MFD) specifications. The adoption of ITU-T G.657.A1 and ITU-T G.657.A2 fibers in high fiber-count outside plant cables, which feature smaller MFD, has been deferred by some network operators due to perceived concerns over splice compatibility with the existing network installed base of legacy ITU-T G.652 fibers. Earlier versions of ITU-T G.657 fibers derived some enhanced optical bending resistance from their smaller MFD, which is typically 8.6 - 8.8 µm and smaller than legacy ITU-T G.652 fibers that have a nominal MFD of 9.2 µm. Corning offers reduced coating diameter fibers that are ITU-T G.657.A1 and ITU-T G.657.A2 compliant with MFD options from 8.6 to 9.2 µm to maintain backwards compatibility where desired.

When splicing reduced coating diameter products, some caution needs to be taken to ensure that the coating layer is stripped to a sufficiently long distance, such that only the fully stripped portion of the glass of the fiber lies within the V-groove holding mechanism of the fusion splicer. This is particularly true if attempting to splice conventional coating diameter to reduced coating diameter product as the effect of the coating in the two V-grooves will be different and could lead to a core misalignment issue.

Corning Application Engineers have observed that not all single fiber strippers strip reduced coating diameter fibers as cleanly as 242 µm fibers. Therefore, extra care should be taken to ensure all coating is removed with an alcohol wipe before attempting to splice. Stripping tools are also available that are marketed as offering enhanced performance with lower coating diameter.

The same concerns exist regarding handling ribbonized reduced diameter fibers. Care must be taken to ensure no matrix material (which bonds the ribbon structure) overhangs, thereby affecting the quality of the splice. Mass fusion splicing of ribbons with reduced coating diameter fibers requires the usage of appropriate fiber holders provided by splicing machine manufacturers. As spacing between fibers in the ribbon structure is different for 242 µm fibers and reduced coating diameter fibers, mass fusion splicing of ribbons with dissimilar coating diameter fibers requires some additional procedures to be taken prior to the splice. Multiple vendors offer a process for splicing 250 µm ribbons to 200 and 190 µm ribbons including flexible ribbon modifications. Some of these techniques are described in a separate Application Engineering Note [6].

		1310 nm		1550 nm	
Fiber A	Fiber B	Mean (dB)	Max (dB)	Mean (dB)	Max (dB)
Contour™ 190 µm	Contour™ 190 µm	0.02	0.04	0.02	0.03
Contour™ 190 µm	SMF-28® Ultra 200 µm	0.02	0.05	0.02	0.04
Contour™ 190 µm	SMF-28e+® 242 µm	0.04	0.09	0.03	0.06
Contour™ 190 µm	ClearCurve® LBL 242 µm	0.03	0.07	0.03	0.05

Table 1: Splice loss results for reduced coating diameter fibers

During fusion splicing studies of reduced diameter single-mode fiber products, using both core- and cladding-alignment modes and standard splicing recipes found on all the commercially available splicing machines tested, a typical splice loss of 0.02 dB to 0.04 dB was achievable (see Table 1), well within Telcordia GR-20-Core recommendation of ≤ 0.10 dB [7]. Reduced diameter fiber was identifiable as ITU-T G.652.D single-mode fiber with all splicing machines tested – including independent studies conducted by a well-known fusion splicer equipment manufacturer.

Submarine Cable Application

The submarine cable industry is now leveraging Corning's ultra-low-loss, 200 µm submarine fibers to enable more fibers to be deployed without a commensurate increase in cable size or weight and without the complexity of significantly redesigning a proven cable structure. Corning offers reduced coating options across its submarine fiber portfolio, including SMF-28® ULL S+, Vascade® EX2000, and Vascade® EX2500 optical fibers.

Subsea cables have high standards for reliability, generally only using fiber with a minimum proof test of 200 kpsi, to withstand the potential at-sea stresses as may be experienced during the cable deployment and any future retrieval or upgrade/repair processes. Even in these challenging conditions, Corning's reduced coating diameter submarine fibers maintain the same standard for strength and reliability as standard diameter fibers. This equivalent performance is enabled by the glass and process design along with the proof test, which does not change in Corning submarine fibers across either diameter [8].

Like terrestrial cabling, handling concerns can be addressed by following best practices which are likely already employed.

Summary

Reduced coating diameter optical fiber products have successfully enabled the introduction of densely packed micro cables for more space efficient fiber deployment in access networks. Having proven their value over the previous decade, this concept is now being extended to other products and application spaces. As a result, Corning is increasing the number of products that are being made available in a smaller form factor. With a strong track record, those experiences from the earlier generation of products have been collected to provide information and recommendations for cable manufacturers and installers who may be experiencing reduced diameter coating fiber for the first time. With correct procedures in place, Corning's reduced coating diameter fiber can be operated with the same confidence as derived from Corning's conventional coating diameter products.

References

[1] Corning® Contour™ fiber product information sheets. www.corning.com/opticalfiber

[2] Corning White Paper WP1850 “Corning® Contour™ Fiber Single-Mode Fiber Innovations for Increased Fiber Density in Constrained Spaces”, May 2023. www.corning.com/opticalfiber

[3] Optical Fiber Mechanical Reliability – Corning White Paper WP8002, July 2017. www.corning.com/opticalfiber

[4] Mechanical Reliability: Applied Stress Guidelines – Corning White Paper WP5053, August 2001. www.corning.com/opticalfiber

[5] Quantifying the Puncture Resistance of Optical Fiber Coatings, Glaesemann & Clark, Proceedings of 52nd IWCS, 2003

[6] Corning Application Engineering Note AEN171 “Mass Fusion Splicing of 200-Micron Fibers”, September 2023. https://www.corning.com/optical-communications

[7] Corning Application Note AN2020 “Corning® Contour™ Optical Fiber Fusion Splicing Report”, June 2023. www.corning.com/opticalfiber

[8] Hedgpeth, et al, “Strength & Reliability of Smaller Diameter Fibers for Submarine Applications”, SubOptic 2023

Corning Incorporated
www.corning.com/opticalfiber
One Riverfront Plaza
Corning, New York, USA

Phone: (607) 248-2000 (U.S. and Canada)
Email: cofic@corning.com

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