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# LANscape® Solutions with ClearCurve® Multimode Fiber

Corning has developed a revolutionary 50 µm multimode fiber technology that can withstand tight bends with significantly less signal loss than traditional multimode fiber. The purpose of this document is to provide a detailed explanation of the advantages provided by the use of Corning's new ClearCurve® multimode fiber in LANscape® products.

The enhanced bend performance of Corning Cable Systems OM3 jumpers is enabled by Corning's new ClearCurve multimode fiber. Light's natural tendency is to maintain a straight-line momentum. When an optical fiber is bent, the light's natural desire for a straight path results in escape from the core of the fiber. Although there are many proven technologies to achieve optimized bend performance, Corning selected an engineered optical trench technology for the new ClearCurve multimode fiber. The optical trench secures the modes in the core of the fiber, resulting in less signal loss.

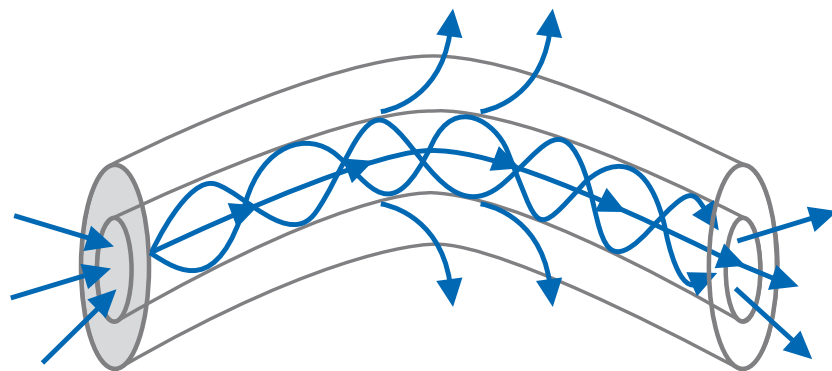


Figure 1 – Light Traveling Down a Bent Multimode Fiber.

The data center market is rapidly moving towards higher bandwidth applications. High transmission speed systems like 10 Gb/s, 40 Gb/s and 100 Gb/s require tighter loss budgets and become very sensitive to additional loss. These budgets are under strict consideration when networks are designed, but additional accidental loss to the system may be caused during installation or moves, adds and changes (MACs). We will focus on these accidental losses that a system can undergo on a daily basis.

Accidental losses are defined as unexpected or unintentional losses exerted on the system. These types of losses can be detrimental to the integrity and performance of the system. Examples of these situations may include kinked cables, jumpers pinched in housing doors, jumpers pulled too tightly against tie wraps and jumpers caught in drawers as they are pulled from the housing. These accidental bends can be very severe and include 90 degree bends (Figure 2).

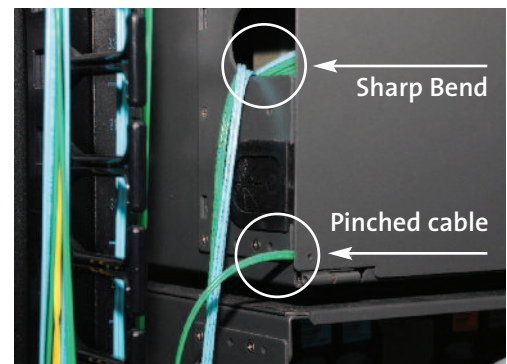


Figure 2 – Macrobend Induced with a Standard Multimode Fiber Jumper.



Accidental mishandling in the data center may cause downtime or reduction in the system performance especially when moves, adds and changes (MACs) are performed. Corning Cable Systems cables with ClearCurve® multimode fiber will greatly reduce if not eliminate most outages and degradation in the system caused by macrobending. Even when best practices are employed, mistakes can occur that result in kinked cables and cables bent beyond the recommended minimum bend radius.

The following tables provide system loss budgets for the different transmission speeds. Each table compares the loss associated with a standard OM3 jumper versus a ClearCurve OM3 jumper under a series of 90 degree bends with a conformed 7 mm radius. The loss data is plotted against the loss budget. A typical low-loss system (tip to tip) for a data center has an estimated loss of 1.3 dB. Any accidental 90 degree bend represents a delta from this number. Green indicates that the link-loss budget has not been exceeded. Conversely, the red indicates that the link-loss budget has been exceeded.

Link	Budget (dB)	Number of 90° Bends	Standard OM3	ClearCurve OM3
4 G FC	2.88	0	1.30	1.30
		1	1.76	1.46
		2	2.21	1.62
		3	2.67	1.78
		4	3.13	1.94
		5	3.58	2.10
		6	4.04	2.26

Table 1 – 4 Gb Fiber Channel

Link	Budget (dB)	Number of 90° Bends	Standard OM3	ClearCurve OM3
8 G FC	2.04	0	1.30	1.30
		1	1.76	1.46
		2	2.21	1.62
		3	2.67	1.78
		4	3.13	1.94
		5	3.58	2.10
		6	4.04	2.26

Table 2 – 8 Gb Fiber Channel

Link	Budget (dB)	Number of 90° Bends	Standard OM3	ClearCurve OM3
16 G FC	1.86	0	1.30	1.30
		1	1.76	1.46
		2	2.21	1.62
		3	2.67	1.78
		4	3.13	1.94
		5	3.58	2.10
		6	4.04	2.26

Table 3 – 16 Gb Fiber Channel

Link	Budget (dB)	Number of 90° Bends	Standard OM3	ClearCurve OM3
10 GbE	2.6	0	1.30	1.30
		1	1.76	1.46
		2	2.21	1.62
		3	2.67	1.78
		4	3.13	1.94
		5	3.58	2.10
		6	4.04	2.26

Table 4 – 10 Gb Fiber Channel

Link	Budget (dB)	Number of 90° Bends	Standard OM3	ClearCurve OM3
40/100 GbE	1.9	0	1.30	1.30
		1	1.76	1.46
		2	2.21	1.62
		3	2.67	1.78
		4	3.13	1.94
		5	3.58	2.10
		6	4.04	2.26

Table 5 – 40/100 Gb Fiber Channel

As indicated in the tables, the systems can only tolerate a few accidental bends with standard jumpers. The advantages are very clear when using ClearCurve® multimode jumpers. This value only increases as systems migrate to high-data-rate networks where tighter margins are specified. Using ClearCurve jumpers ensures a much more reliable and efficient network by avoiding these unnecessary downtimes.

Tables 1-5 illustrate the vulnerability of standard fiber to acute, but fairly modest bends. The situation is considerably worsened by tighter bends. For example, the photos below compare the attenuation and bit error rate (BER) impact on a standard OM3 jumper pinched in a housing door versus a ClearCurve jumper under the same circumstances.

Five and a half minutes after pinching the standard jumper in the housing door, the BER was  $10^{-6}$  with an attenuation of 3.40 dB (Figure 3).

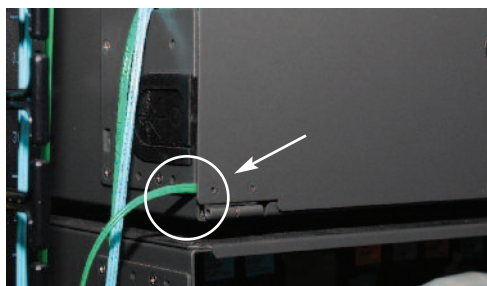
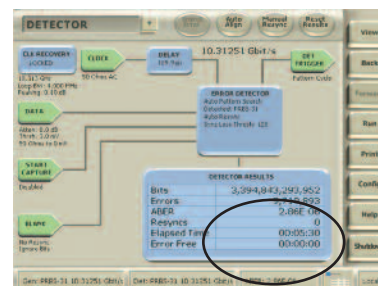


Figure 3



Five and a half minutes after pinching the ClearCurve OM3 jumper in the housing door, the BER level was better than  $10^{-12}$  with an attenuation of 1.51 dB (Figure 4).

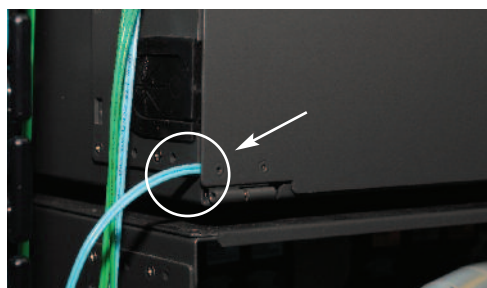
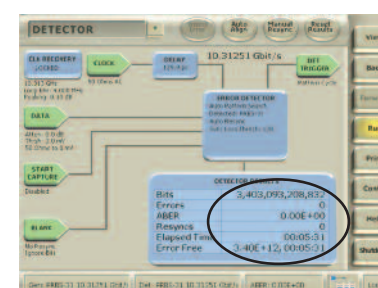
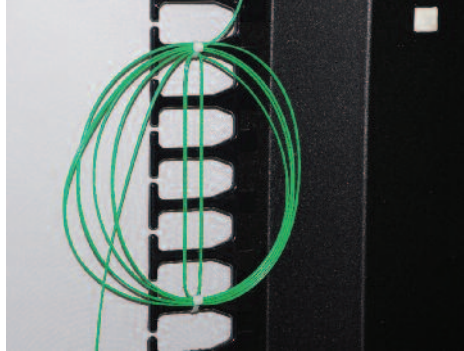


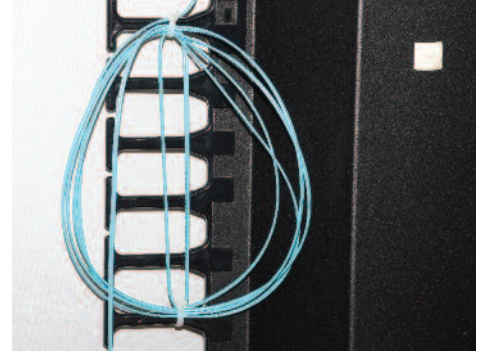
Figure 4



Figures 5 and 6 demonstrate the impact of a standard laser-optimized jumper and the ClearCurve® OM3 jumper in a slack loop with a tightly applied zip tie. This test was used to simulate a typical MAC event when the slack loop is not properly adjusted and is pulled too tight as the jumper is rerouted. With ClearCurve multimode fiber, what would normally have been a probable outage becomes a non-event.

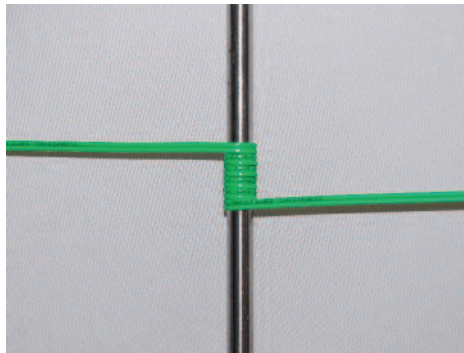


**Figure 5 – Attenuation of Standard OM3 Jumper 5.39 dB**

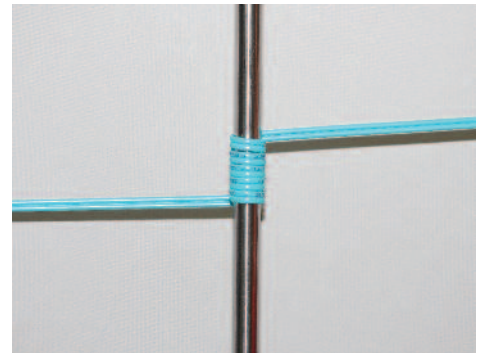


**Figure 6 – Attenuation of ClearCurve OM3 Jumper 0.54 dB**

Figures 7 and 8 represent the attenuation impact of a 2.0 mm standard laser-optimized zipcord cable versus the ClearCurve OM3 zipcord cable under mandrel wrap conditions. An 11 mm mandrel was used.



**Figure 7 – Attenuation of Standard OM3 Jumper 1.12 dB**



**Figure 8 – Attenuation of ClearCurve OM3 Jumper 0.21 dB**

## Summary

As networks migrate to higher data rates, data center applications will benefit from the protection and reliability provided by LANscape® Solutions with ClearCurve multimode fiber. Inadvertent macrobend events that would result in elevated attenuation with traditional 50 µm cables experience minimal attenuation increase with LANscape Solutions enabled with ClearCurve multimode fiber. Please contact Corning Cable Systems for more information on this innovative product.