WHITE PAPER

BEND-OPTIMISED MULTI-MODE FIBRES ENHANCE TRANSMISSION RELIABILITY

In a LAN as well as in a data centre the use of bend-optimised multi-mode optical fibres offers improved transmission reliability. This fibre reduces the risk of additional losses on the optical transmission line that may arise as a result of typical faulty use and of mechanical stress.

In the case of standard multi-mode cables, where increasingly narrow margins are already being applied to attenuation budgets, faulty use or mechanical stress can quickly increase the connection attenuation to the extent that the consequences are reduced transmission rates or even failures.

Multimode cables with bend-optimised fibres offer greater transmission reliability in the LAN and in the data centre. This is the reason why Datwyler has, since the beginning of 2011, been using the bend-optimised G50/125µm fibre for OM2, OM3 and OM4 fibre categories – and all without affecting the price to the customer.

Marginal Loss Budgets

For optical transmission lines with multi-mode cables the following may be established: The higher the data rates the more unrealistic the attenuation values demanded in the standards become. Below are two examples of this:

For the transmission of a 10-Gbit/s Ethernet signal with a wavelength of 850 nm on an OM3 fibre in excess of 300 meters the standard EN50173-1:2011 allows for a maximum loss of 2.6 dB. According to this cable standard the glass fibre has an attenuation coefficient of 3.5 dB/km. The G50/125µm OM3 fibre used by Datwyler typically has a kilometric attenuation of 2.5 dB. Even this fibre exhibits an attenuation of 0.75 dB over a length of 300 metres.

In the link described above and for which a maximum attenuation of 2.6 dB is defined, there is therefore a residual loss budget of 1.85 dB available for all connectors together. This is no problem with two connectors. In a channel with four connectors, however, there is only around 0.45 dB left for each connector. On the other hand, the standard permits, for 95% of all FO connectors, an insertion loss of 0.5 dB maximum and even as high as 0.75 dB for the remaining 5%. There is something of a conflict here.

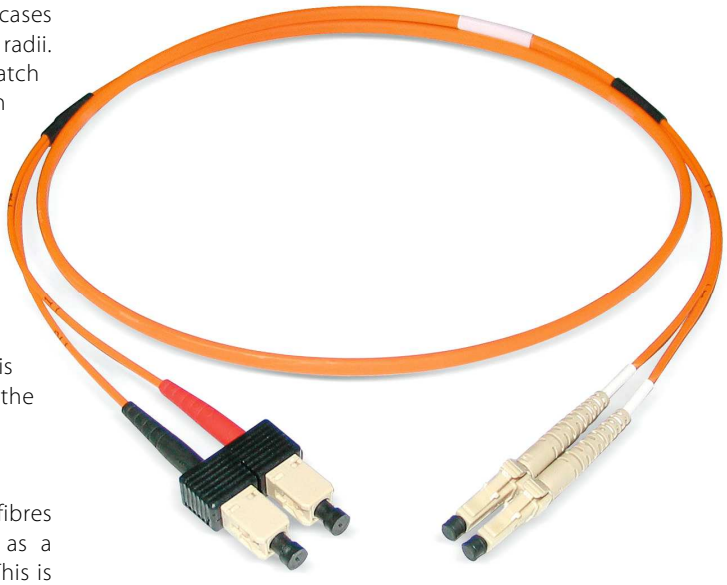
As regards the 40 and 100 Gbit/s transmission via OM3 and OM4 fibres, in the standard IEEE 802.3ba:2010 insertion losses (IL) on the transmission line of max. 1.9 dB (OM3) and 1.5 dB (OM4) inclusive of fibres are defined. Including fibres and modal noise, just 1.5 dB / 1.0 dB are left over for all connectors together. That is an acutely narrow margin in terms of practical application.

Naturally the fibre optic connectors available today feature better values. Their typical insertion loss is around 0.2 dB. But even this value may quickly change due to minor contaminations or as a result of wear.[1]

Adverse effect on transmission

So what does this have to do with bending radii? Frequently, small additional losses contingent on installation that arise as a result of micro- and macro-bending initially go unnoticed. Small additional losses in relation to the connectors can then suddenly lead at a later stage to a link in excess of the maximum permitted value.

[1] For more on this topic see the White Paper "Keep your connector noses clean! Dirty fibre optic connectors lead to performance problems" (Datwyler, 2011)



At the time of initial installation, attention is in most cases paid to precisely adhering to the permitted bending radii. This applies both to the installation cables and to the patch cables and pigtails. In day to day operation things often look quite different. In particular where patches are concerned, it frequently happens that the bending radius of a FO patch cable is significantly undercut.

The attenuation changes specified can, in a worst case scenario, lead to failure of a connection but at the very least to a reduction in transmission rate. Instead of 10 Gbit/s it may well be that only 1 Gbit/s for example is possible. When a number of work stations depend on this transmission path, all users connected will have to share the lower transmission rate.

Minimising risks

The use of bend-optimised G50/125µm multi-mode fibres reduces the risk of additional attenuation occurring as a result of typical faults in usage and mechanical stress. This is specifically shown by the table relating to the macro-bending characteristics of these fibres (see below). Even where there are several complete 360° windings the additional attenuation remains comparatively small and there is a higher degree of transmission reliability.

Bending radius	Number of windings	max. bending attenuation	
		850 nm	1300 nm
37.5 mm	100	≤ 0.05 dB	≤ 0.15 dB
15.0 mm	2	≤ 0.10 dB	≤ 0.30 dB
7.5 mm	2	≤ 0.20 dB	≤ 0.50 dB

Full compatibility

On occasions it has been pointed out that connections between bend-optimised and traditional multi-mode fibres would not be fully compatible. More extensive studies show (most recently e.g. in the German trade magazine LANline 8/2011), however, that the new generation of fibres have no effect on the insertion loss of FO connections or on the bandwidth of the transmission lines.

