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Applications
Engineering Note

Effects of Splicing Dissimilar Single-Mode Fibers

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When splicing single-mode fiber, a question that arises is "What is the effect of splicing fibers made by different vendors?" The driving force behind this question is the mode field diameter (MFD) differences between fibers. The purpose of this Applications Note is to discuss the effects of MFD differences on splice loss.

MFD Effect on Splice Loss

The MFD is a characteristic, which describes the mode field (cross-sectional area of light) traveling down a fiber at a given wavelength. MFD is the width of this mode field measured in micrometers (µm). When fibers with different MFDs are spliced together, a MFD mismatch occurs at the splice point. The additional splice loss incurred by the MFD mismatch can be estimated using the following relationship:

$$\text{LOSS} = 20\text{LOG}\ \frac{1}{2}\left(\frac{\text{MFD}_1}{\text{MFD}_2}+\frac{\text{MFD}_2}{\text{MFD}_1}\right)\text{dB} \quad \text{(eq. 1)}$$

One point to note about this relationship is that splice loss due to MFD mismatch does not depend on whether the light travels from a small MFD to a large MFD or vice versa. The splice loss is independent of the direction of light propagation.

In an effort to quantify the splice loss due to MFD mismatch, the following example is provided:

> Two fibers are being spliced together. One has a MFD of 8.8 µm and the other has a MFD of 9.3 µm. By inserting the given MFDs in equation 1, the theoretical splice loss due to MFD mismatch only can be calculated. The calculated splice loss due to the MFD difference is 0.013 dB.

Therefore, dissimilar fibers can be spliced together with only a marginal effect on splice loss. MFD differences also affect the OTDR displayed trace. These effects are discussed in the Applications Note on "Gainers" and the Applications Note on "Uni-Directional Single-Mode OTDR Measurements."

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