Single-Mode Attenuation with Bending

Measurement Method

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Optical Fiber

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Scope

This information describes the current reference method for measuring the attenuation due to bending of Corning® single-mode optical fibers.

General

This test is designed to measure the attenuation change associated with bending various Corning single-mode fibers. The induced loss from wrapping fibers per Table 1 below characterizes fiber performance in various bend configurations which may be encountered in actual system installations. Examples are fiber or pigtail (interconnect cable) routing within equipment racks, bending of excess fiber within splice enclosures, and cable routing.

Example Bending Test Conditions

Table 1:

	Mandrel Diameter			
No. of Turns	SMF-28™	SMF-28e™	LEAF®	MetroCor™
100	50 mm	50 - 75 mm	75 mm	75 mm
1	32 mm	32 mm	32 mm	32 mm

Measurement Description

The test fiber is wound under essentially zero tension onto a smooth mandrel surface as called out in Table 1. Precautions are made to assure that no over-wrap conditions exist and that there is sufficient fiber length to complete the required number of wraps and allow termination at the source and detector. A narrow spectral band of light is launched into the coiled fiber and the transmitted intensity is measured. The measurement is repeated for the same fiber in an uncoiled or essentially straight (all bends ≥ 280 mm in diameter) configuration without disturbing the input end of the fiber. (This repeat measurement for the 100 turns is done using a 2 m cutback section of the test fiber.) A higher order mode (HOM) filter is used to establish single-mode conditions for the straight or uncoiled reference measurement.

The attenuation introduced by bending is calculated as follows:

$$A_b = -10 \log_{10} \left[\frac{P_{bend}}{P_{straight}} \right] \text{ [dB]}$$

where:
A_b = attenuation introduced by bending
P_{bend} = transmitted power level of fiber wrapped per Table 1
$P_{straight}$ = transmitted power level of the same fiber (2 m cutback) in an essentially straight (all bends ≥ 280 mm in diameter) configuration

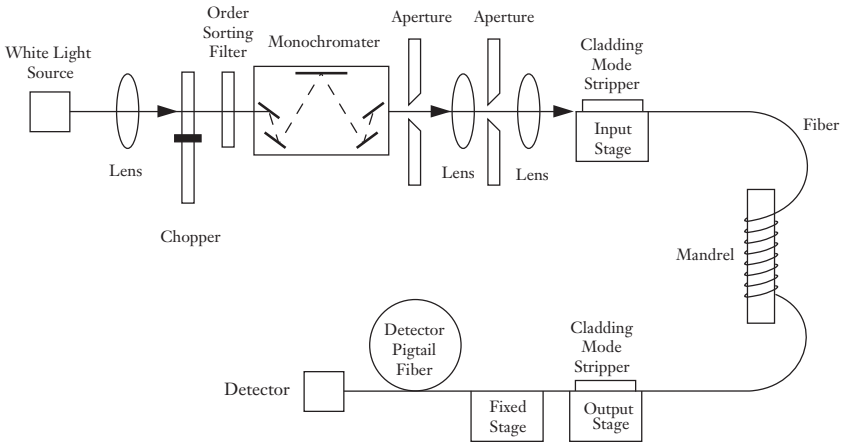
Measurement Conditions

The fiber ends are stripped of coating and prepared with end angles less than 2° with near perfect mirror surfaces. Mode stripping is provided to assure the removal of cladding modes.

• Fiber Length	Sufficient length to complete the required wraps around the specified mandrel diameter (per Table 1) and allow termination at the source and detector
• Launch Spot Size	200 µm
• Launch Numerical Aperture	0.20
• Source Spectral Width	≤ 10 nm Full Width at Half Maximum (FWHM)
• Mandrel Size	Per Table 1 (precision-machined hard aluminum)
• Measurement Wavelength	Reference the appropriate product information sheet for specific wavelength

Typical Apparatus to Measure Single-Mode Attenuation With Bending

The apparatus shown below is used to measure the attenuation due to bending in single-mode optical fibers.



References

EIA/TIA-455-62A (FOTP-62), Optical Fiber Macrobend Attenuation.

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