

Mode-Field Diameter Measurement Method



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Optical
Fiber

MM16

Issued: August 2001

Supersedes: February 2000

ISO 9001 Registered

Scope

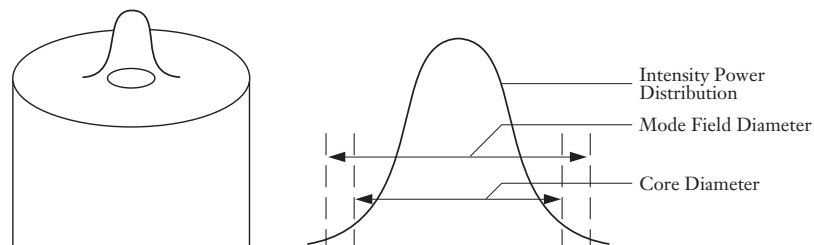
This information describes the reference method for measuring the mode-field diameter of Corning® single-mode optical fibers.

General

Mode-field diameter is a measure of the spot size or beam width of light propagating in a single-mode fiber. Mode-field diameter is a function of source wavelength, fiber core radius, and fiber refractive index profile. The vast majority of the optical power propagates within the fiber core, and a small portion propagates in the cladding near the core (Figure 1). The mode-field diameter is determined using Petermann's second definition of the mode-field diameter in the near field. Mismatches in mode-field diameter can affect splice loss. Fibers with varying mode-field diameters also display different bend loss sensitivities.

Light Distribution in a Single-Mode Fiber

Figure 1



Measurement Description

The reference measurement method for mode-field diameter is the Variable Aperture Method in the Far Field (VAMFF). This method uses a series of various-sized apertures mounted on a rotating wheel in the far field of the fiber's output. Each successive aperture restricts the far field power distribution to a specific radius. Intensity levels are measured for each of the apertures, and the data is plotted as power versus the sine of the aperture half angle (numerical aperture).

Petermann's second definition of the mode-field diameter is a mathematical model which does not assume a specific shape for the distribution. This near field definition is related to the far field by the Hankel Transform.

Pask's transformation of Petermann's definition of the mode-field diameter is applied directly to the two-dimensional far field data through a numerical integration routine. The Petermann mode-field diameter in the near field is calculated from the far field rms width.

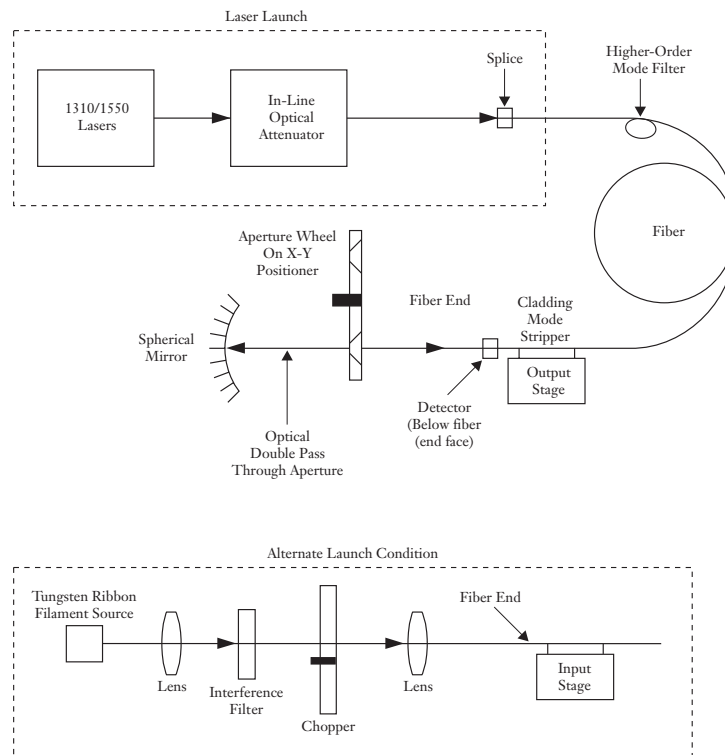
Measurement Conditions

The standard length of fiber required to measure the mode-field diameter is 2 meters deployed with an appropriate mode filter as determined by FOTP-77. The mode filter is used to ensure single moded operation for each single-mode product. It ensures that no higher order modes (such as LP_{11}) will affect the measurement. The fiber ends are stripped of coating and prepared with end angles less than 1° with near perfect mirror surfaces. Cladding mode stripping also is performed.

- Fiber Length 2 meters
- Source Spectral Width ≈ 10 nm Full Width at Half Maximum (FWHM)
- Launch Spot Size $\geq 100 \mu\text{m}$
- Launch Numerical Aperture ≥ 0.20
- Measurement Wavelengths $1300 \text{ nm} \pm 10 \text{ nm}$ and $1550 \pm 10 \text{ nm}$

Apparatus

Figure 2 shows the apparatus used to measure the power distribution in the far field of Corning® single-mode fibers.



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