WideBand Multimode Fiber

Attenuation Requirement at 953 nm

OM2, OM3 and OM4 multimode fibers have traditionally been measured for attenuation at 850 and 1300 nm. The new TIA-492AAAE wideband multimode fiber standard has an additional attenuation requirement at 953 nm to ensure operation across the entire wideband window, which extends from 840 to 953 nm.

A question that arises is whether 953nm attenuation needs to be measured on wideband fibers and cables. This paper explains why it is not necessary to do so, based on the attenuation properties of optical fibers and the testing that is done by the fiber manufacturer.

A typical attenuation curve for 50/125 µm multimode fiber is shown in Figure 1:

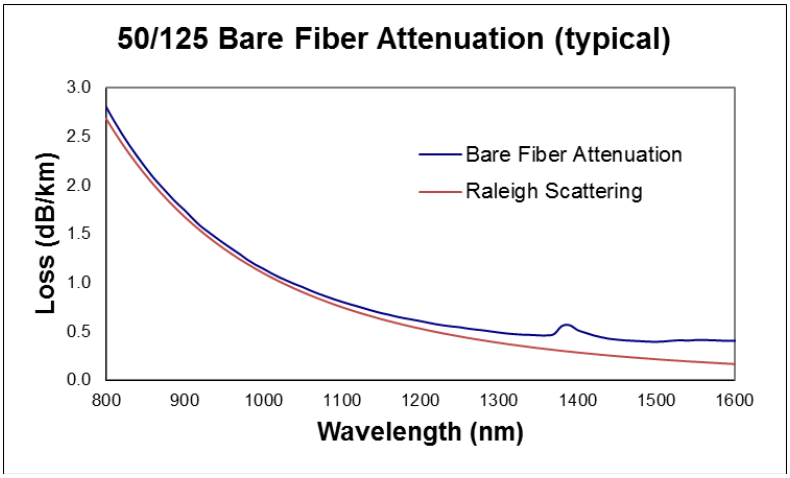

FIGURE I. 50/125µm Bare Fiber Attenuation

For a glass optical fiber the attenuation (α) of the fiber as a function of wavelength (λ) can be determined using the following equation:

$$\alpha(\lambda) = A*(1000/\lambda)^4 + B + C(\lambda)$$

A - Rayleigh Scattering coefficient

B - wavelength independent term (typically 0-0.5 in cabled multimode fibers)

C - wavelength dependent term

The wavelength independent effects (B) are dominated by microbending. This is typically seen when comparing fiber attenuation to cable attenuation, and is caused by multiple small perturbations to the fiber (usually less than ~1mm radius). The ~0.2 to 0.5 dB/km typical increase in cabled fiber attenuation over bare fiber is observed across the applicable wavelength spectrum. Since this loss is wavelength independent, any significant attenuation increase measured at 850 nm would be reflected in a similar 1300 nm increase. This loss is minimal in fiber form over the 850-953nm window of interest, as seen in Figure 1.

The wavelength dependent effect (C) is close to zero in the 850 – 953 nm region of the spectrum and has relative maxima near 1383 nm, often referred to as the "water peak". Attenuation on all OFS fibers is measured at both 850 and 1300nm. If a fiber has extremely high loss in the water peak region, it will be reflected in an elevated 1300nm attenuation, eventually causing the fiber to fail the OFS requirement of 0.6dB/km or the TIA requirement of 0.8dB/km.

Wavelength (λ)	Multimode Fiber Attenuation (dB/km)		
	TIA 492AAAE Standard	Calculated Values from Specification	
		TIA	OFS
800		3.08	2.76
850	**2.50**	**2.50**	**2.20**
900		2.07	1.78
950	**1.80**	**1.75**	**1.47**
1000		1.50	1.23
1050		1.31	1.05
1100		1.16	0.91
1150		1.04	0.80
1200		0.94	0.72
1250		0.86	0.65
1300	**0.80**	**0.80**	**0.60**
1350		0.75	0.56

TABLE I. Attenuation Requirements and Calculated Values

Given specific maximum limits for attenuation at 850nm and 1300nm, attenuation at other wavelengths can be calculated using the formula above. For example, using the TIA-492AAAE standard requirements of ≤ 2.5 dB/km at 850nm and ≤ 0.80 dB/km at 1300, the calculated value at 950nm is 1.75dB/km, below the 1.80 dB/km required in the standard. Using the OFS specification values of ≤ 2.20 dB/km at 850nm and ≤ 0.6 dB/km at 1300nm, the calculated attenuation at 950nm would be 1.47 dB/km, much lower than the 1.80 dB/km specified value (see Table 1).

These calculations clearly show that if the attenuation requirements of wideband multimode fiber are met at the 850nm and 1300nm wavelengths, 953nm attenuation is assured and measurement is not required.