AllWave® Fiber

ofs
Leading Optical Innovation

The New Standard for Single-Mode Fiber!

Product Description

OFS' AllWave® non-dispersion shifted single-mode optical fiber (NDSF) is the industry's first Full-Spectrum™ fiber designed for optical transmission systems operating over the entire wavelength range from 1260 nm to 1625 nm. Since 1998, OFS has shipped billions of meters of AllWave fiber to satisfied customers all over the world. AllWave fiber is now OFS' standard single-mode fiber, and offers customers industry leading performance specifications, reliability and unsurpassed quality. OFS has led the industry in continually driving improved product performance in critical areas that include optical loss, splicing, connectorization and Polarization Mode Dispersion (PMD). AllWave fiber sets the benchmark and maintains leadership with specifications that are fully compliant with ITU-T G.652 standards for single-mode optical fiber and even exceed requirements of the latest ITU-T G.652.C and G.652.D low water peak fiber standards.

Before AllWave fiber was introduced, systems were limited to operating in either the O-band (1310 nm window) or the C- and L-bands (1530 nm to 1625 nm). Since the commercialization of AllWave fiber in 1998, the E-band (1400 nm window) is available to inexpensively expand the capacity of optical networks. This is due to an OFS patented manufacturing process that ***permanently*** removes the water peak defect to ensure low and stable loss performance in the 1400 nm band and over the lifetime of the cable. AllWave Zero Water Peak fiber offers the lowest loss of all commercial low water peak (LWP) fibers in the industry.

Why AllWave fiber for Metro and Access Networks?

AllWave Zero Water Peak fiber is ***the*** fiber of choice for metropolitan, local and the fast evolving access networks due to its superior specifications - low optical loss across the entire wavelength range from 1260 to 1625 nm, tightest available geometry, low splice loss and low PMD. These features, combined with complete compatibility with embedded fiber base, provide network design flexibility and enable cost effective solutions to maximize return on investment. AllWave fiber supports many different architectural designs, such as ring, mesh, branch, laterals, drops, passive optical, and point-to-point networks.

Features of the World's Best Single-Mode Fiber:

- Fully compatible with all conventional single-mode fiber applications and with international standards
- Best in class, low optical loss across the entire spectrum from 1260 to 1625 nm (See Figure 1)
- Absence of hydrogen aging defects ensures long-term attenuation reliability across the entire wavelength range (1260-1625 nm)
- A 50% increase in usable optical spectrum enabling both 16- channel CWDM now, and future DWDM support
- Best in class, tightest geometry control for lowest splice loss and improved connectorization performance
- Best in class, low fiber PMD for risk-free speed and distance upgrades
- Protected by the industry-leading DLux™ coating system for outstanding reliability, environmental performance, and strippability

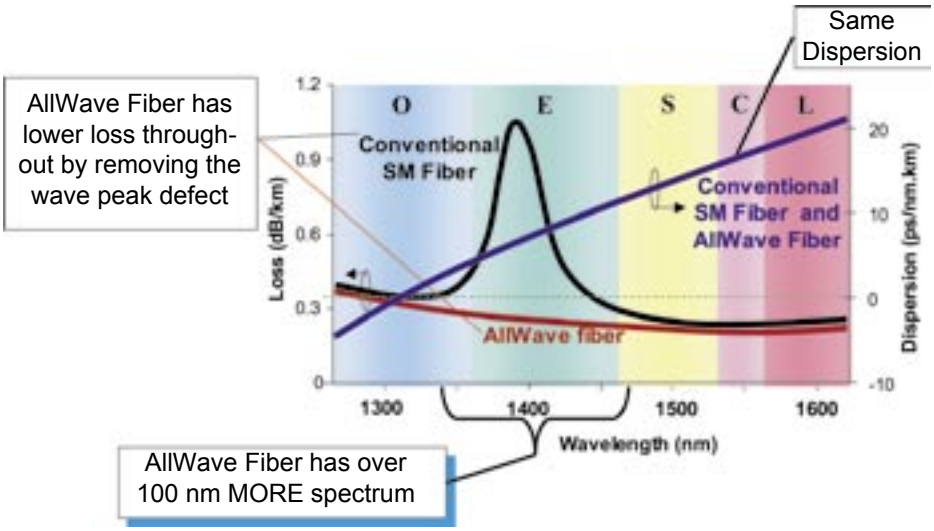

Figure 1. AllWave® Fiber- Compatible with Conventional Single-Mode fiber, but with More Available Spectrum

It supports the most demanding applications, including 10 Gigabit Ethernet, Asynchronous Transfer Mode (ATM), 10 and 40 Gb/s Synchronous Optical Network (SONET), and Synchronous Digital Hierarchy (SDH), using single channel, Dense Wavelength Division Multiplexing (DWDM) and/or multi-channel Coarse Wavelength Division Multiplexing (CWDM) transmission.

To extend today's network or design tomorrow's emerging networks, look for the fiber that will provide you the greatest capacity and flexibility at the lowest cost.

CWDM and High-Speed Applications in the E-band

Service requirements of metropolitan area networks demand that multiple service platforms be available over network architectures at low cost. CWDM is a good choice as it allows the use of low-cost, uncooled lasers with direct modulation technology and lower cost multiplexers. AllWave Full-Spectrum fiber provides 50% more (>100 nm) usable wavelengths than conventional single-mode fiber (G.652.A or G.652.B).

Deploying CWDM over AllWave fiber and, using commercially available equipment from multiple systems vendors, can reduce system costs by 35% or more relative to a DWDM system over conventional single-mode fiber! AllWave fiber also supports higher transmission rates without dispersion compensation in the E-band further lowering network cost while leaving room for future upgrades.

AllWave Fiber in HFC Networks and FTTX

Traditionally, Hybrid Fiber Coax (HFC) has provided distributed video service to residential homes, with the network being largely unidirectional, downstream from cable headends to residential homes. With the growth of Internet traffic, IP telephony, and video on demand services, up-stream traffic is now evolving to AllWave fiber based Fiber-to-the-X (FTTX) networks from HFC networks. The traffic on most networks now is bi-directional and digital service is becoming more important for both broadcast and business channels. The typical unavailability of low cost upstream optical paths limits the scope of these bi-directional networks. AllWave fiber solves the problem by providing more upstream paths with low cost CWDM technology.

In addition, AllWave fiber enables low cost CWDM overlays on spectrum-challenged Passive Optical Networks (PONs) to provide premium point-to-point services for high bandwidth business customers. AllWave fiber based PONs can also enable low cost CWDM upgrade capacity for instant on-demand HDTV services. Finally, the AllWave fiber based FTTX network extends the reach of both PON and point-to-point systems by minimizing channel insertion loss through lower attenuation, splice, and connection loss.

Best-in-Class Splice Performance

The excellent geometrical properties and tight mode field control of AllWave fiber enable consistent low loss splices when matched to either AllWave fiber or other standard G.652 fibers. This helps eliminate splice remakes in the field, lowering the cost of deploying fiber.

Low System PMD

OFS was the first to adopt specifications for Polarization Mode Dispersion (PMD) in single-mode fibers, a critical parameter for high performance optical systems. Manufactured using both a patented fiber drawing process and unsurpassed quality control, AllWave fiber is specified at levels that improve upon even the most recent PMD specifications in ITU G.652.D.

OFS understands that PMD is a statistical value that is dependent on the properties of the fiber as well as the mechanical condition of the fiber in cable. OFS' AllWave fiber PMD is specified in fiber form with a best in class Link Design Value (LDV) and a Maximum Individual Fiber Value to support customer validation of system performance as well as individual product performance.

Choose AllWave Fiber for Long-Term Reliability

- AllWave fiber is manufactured using a process that ensures that the full spectrum attenuation will remain stable throughout the life of the cable, even when exposed to hydrogen.
- AllWave fiber features OFS' high performance DLux coating for excellent environmental performance and long-term reliability. This robust dual coating system is applied over the cladding to protect the fiber but can be easily removed for splicing and connectorization.
- Each fiber is proof-tested to at least 0.7 GPa (100 kpsi) to ensure durable installation and long-term reliability.

Transmission Characteristics:

Attenuation (uncabled fiber)

The maximum attenuation coefficient (loss) may be specified as follows:

Wavelength (nm)	Attenuation (dB/km)	
	Maximum	Typical
1310	0.34	0.32
1383	0.31	0.28
1550	0.21	0.19
1625	0.24	0.20

Attenuation vs. Wavelength:

The maximum attenuation in the wavelength range from 1285 to 1330 nm is no more than 0.03 dB/km greater than the attenuation at 1310 nm.

The maximum attenuation in the wavelength range from 1525 to 1575 nm is no more than 0.02 dB/km greater than the attenuation at 1550 nm.

Change in Attenuation at Water Peak:

The uncabled fiber attenuation coefficient at the OH^- absorption peak (1383±3 nm) after 10 days exposure to 0.01 atmospheres of hydrogen at room temperature is ≤ 0.31 dB/km and ≤ 0.28 dB/km typically. This test simulates long-term hydrogen aging in installed cables.

Macrobending Attenuation:

The maximum attenuation with bending does not exceed the specified values under the following deployment conditions:

Deployment Condition	Wavelength	Induced Attenuation
1 turn, 32 mm (1.2 inch) diameter	1550 nm	≤ 0.5 dB
	1625 nm	≤ 0.5 dB
100 turns, 50 mm (2 inch) diameter	1310 nm	≤ 0.05 dB
	1550 nm	≤ 0.10 dB
100 turns, 60 mm (2.4 inch) diameter	1550 nm	≤ 0.05 dB

Point Discontinuities:

There are no attenuation discontinuities greater than 0.05 dB at 1310 nm or 1550 nm.

Chromatic Dispersion:

Zero dispersion wavelength (λ_0):	1302-1322 nm
The maximum dispersion slope (S_0) at λ_0:	0.092 ps/nm^2 -km

Mode Field Diameter:

at 1310 nm	9.2 ± 0.4 µm
at 1550 nm	10.4 ± 0.5 µm

Cutoff Wavelength:

Cable Cutoff Wavelength (λ_{cc})	≤ 1260 nm

Fiber Polarization Mode Dispersion[1]

PMD Link Design Value (LDV)[2]	≤ 0.08 ps/$\sqrt{km}$
Maximum Individual Fiber	≤ 0.2 ps/$\sqrt{km}$
Typical PMD in Cable[3]	≤ 0.05 ps/$\sqrt{km}$

[1] PMD value may change when cabled. Check with your cable manufacturer for specific PMD limits in cable form.

[2] The PMD Link Design Value complies with IEC 60794-3 Ed.3.0, Method 1, March 31,2000 (N=24, Q=0.1%). Details are described in IEC 61282-3 TR Ed1.0, October 27, 2000.

[3] Check with your cable manufacturer for specific PMD limits in cable form. Ask for both LDV and maximum individual in cable.

Geometrical Characteristics:

Glass Geometry:	
Cladding Diameter	125.0 ± 0.7 µm
Core/Clad Concentricity Error	≤ 0.5 µm
Cladding Non-circularity	≤ 1.0%
Typical Splice Loss (AllWave fiber to AllWave fiber)	0.02/dB
DLux™ Coating Geometry:	
Coating Diameter (colored)	245 - 260 µm
Coating/Cladding Concentricity Error	≤ 12 µm
Length:	
Lengths can be cut to specific customer specifications	
Standard spool lengths	12.6, 25.2, 37.8 and 50.4 km

Environmental Characteristics:

Operating Temperature	-60º C to +85º C
Temperature Dependence of Attenuation	
Induced attenuation at 1310 & 1550 nm at -60º C to +85º C	≤ 0.05 dB/km
Temperature — Humidity Cycling	
Induced attenuation at 1310 & 1550 nm at -10º C to +85º C and 95% relative humidity	≤ 0.05 dB/km
Water Immersion, 23º C	
Induced attenuation at 1310 & 1550 nm due to water immersion at 23 ± 2º C	≤ 0.05 dB/km
Accelerated Aging (Temperature), 85º C	
Induced attenuation at 1310 & 1550 nm due to temperature aging at 85 ± 2º C	≤ 0.05 dB/km
Retention of DLux Coating Color	
OFS coated fiber shows no discernible change in color when aged for: • 30 days at 95º C and 95% relative humidity • 20 days in dry 125º C heat	

Mechanical Characteristics:

Proof Test Level:	0.7 GPa (100 kpsi)*
Dynamic Tensile Strength:	
The median tensile strength of unaged samples with a 0.5 meter gauge length is:	≥ 3.8 GPa (550 kpsi)
Coating Strip Force:	
The force to mechanically strip the dual coating is:	≥ 1.3 N (0.3 lbf.) and < 8.9 N (2.0 lbf.)
Pullout Force (Adhesion of DLux Coating to Glass Surface):	
The pullout force is:	> 6.2 N (1.4 lbf.) and < 22.2 N (4.9 lbf.)
Fiber Curl:	≥ 4 m

Fiber Shipping Spool Mechanical Specifications:

	A (for lengths ≤ 30 km)	B (for lengths > 30 km)
Flange diameter	23.50 cm (9.25 in)	26.49 cm (10.43 in)
Barrel Diameter	15.24 cm (6.00 in)	16.99 cm (6.69 in)
Traverse Width	11.94 cm (4.70 in)	15.01 cm (5.91 in)
Weight	0.51 kg (1.36 lbs)	0.89 kg (1.95 lbs)

* Higher proof test levels are available upon request.

Other Performance Characteristics:

Nominal Zero Dispersion Wavelength (λ_0)	1312 nm
Nominal dispersion slope at λ_0	0.088 ps/nm²-km
Effective Group Index of Refraction	
1310 nm	1.466
1550 nm	1.467
Dynamic Fatigue Parameter (N_d)	> 20
Rayleigh Backscattering Coefficient (for 1 ns pulse width)	
1310 nm	-79.6 dB
1550 nm	-82.1 dB
Weight per unit length	64 grams/km

Compatibility with Legacy Equipment and Other Industry Standard Single-Mode Fibers

With the same dispersion characteristics at 1310 nm and 1550 nm as conventional single-mode fiber, AllWave fiber is also fully compliant with *and* exceeds the latest ITU-T G.652.A and G.652.B requirements. Therefore, AllWave fiber fully supports legacy transport equipment and applications.

Comparison to Standards

Fiber attributes

Attribute	G.652.A Value	G.652.B Value	G.652.C Value	G.652.D Value	AllWave® Fiber Value
Mode field diameter at 1310 nm	Nominal: 8.6 - 9.5 µm, Tolerance: ± 0.7 µm				Better by >40%
Mode field diameter at 1550 nm	No Recommendation				—
Cladding Diameter	125 ± 1.0 µm				Better by >30%
Core concentricity error	≤ 0.8 µm				Better by >35%
Cladding noncircularity	≤ 2.0%				Better by >50%
Cable cut-off wavelength	≤ 1260 nm				Meets
Macrobend loss at 1310	No Recommendation				—
Macrobend loss at 1550	≤0.5 dB			≤0.5 dB	Better by >95%
Macrobend loss at 1625		≤0.5 dB	≤0.5 dB	≤0.5 dB	Better by >60%
Proof stress	≥0.69 GPa				Meets
Zero dispersion Wavelength	1300-1324 nm				Better by >15%
Zero dispersion slope	≤0.093 ps/nm^2/km				Meets

Cable attributes (in OFS cables)

Attribute	G.652.A Value	G.652.B Value	G.652.C Value	G.652.D Value	AllWave® Cable Value
Attenuation at 1310 nm	≤0.5 dB/km	≤0.4 dB/km	≤0.4 dB/km	≤0.4 dB/km	Better by >10%
Attenuation at 1383 nm ± 3 nm (post H_2 aging)			≤1310 nm value	≤1310 nm value	Better by >10%
Attenuation at 1550 nm	≤0.4 dB/km	≤0.35 dB/km	≤0.3 dB/km	≤0.3 dB/km	Better by >25%
Attenuation at 1625 nm		≤0.4 dB/km	≤0.4 dB/km	≤0.4 dB/km	Better by >35%
Maximum PMD_Q	≤0.5 ps/√km	≤0.2 ps/√km	≤0.5 ps/√km	≤0.2 ps/√km	Better by >60%

For additional information please contact your sales representative. You can also visit our website at http://www.ofsoptics.com or call 1-888-fiberhelp. For regional assistance:

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