TrueWave® RS Fiber
Low Water Peak

ofs
A Furukawa Company

Optimized for lowest total systems cost of EDFA-amplified networks in metro, regional, and long haul applications

Overview

OFS' TrueWave® *RS* Low Water Peak (LWP) Fiber is a Nonzero Dispersion Fiber (NZDF) that provides exceptional performance for Dense Wavelength Division Multiplexing (DWDM) used in metropolitan, regional, and long haul optical transmission systems.

Product Description

TrueWave *RS* LWP Fiber offers low dispersion slope and low dispersion values that accommodate today's lower channel counts as well as tomorrow's full band capabilities. It is an excellent choice for networks that traditionally operate in the C-band (1530 nm – 1565 nm), as well as in emerging L-band (1565 nm – 1625 nm) systems, and also provides transmission capability at 1310 nm.

Compared to standard single-mode and other G.655 fibers, TrueWave *RS* LWP Fiber offers:

- Low dispersion values and dispersion slope
- Easy, less expensive dispersion compensation
- Low Polarization Mode Dispersion (PMD)
- Low attenuation at the water peak
- Compliance with ITU-T G.655.C and D standards

TrueWave *RS* LWP Fiber provides this outstanding performance while minimizing total system costs. The fiber's optimized dispersion values and dispersion slope reduce the need for expensive dispersion compensation for erbium-doped fiber amplified (EDFA) networks in single or DWDM channels. Minimized dispersion compensation enables the use of simplified, less expensive EDFA amplifiers, further reducing overall systems cost.

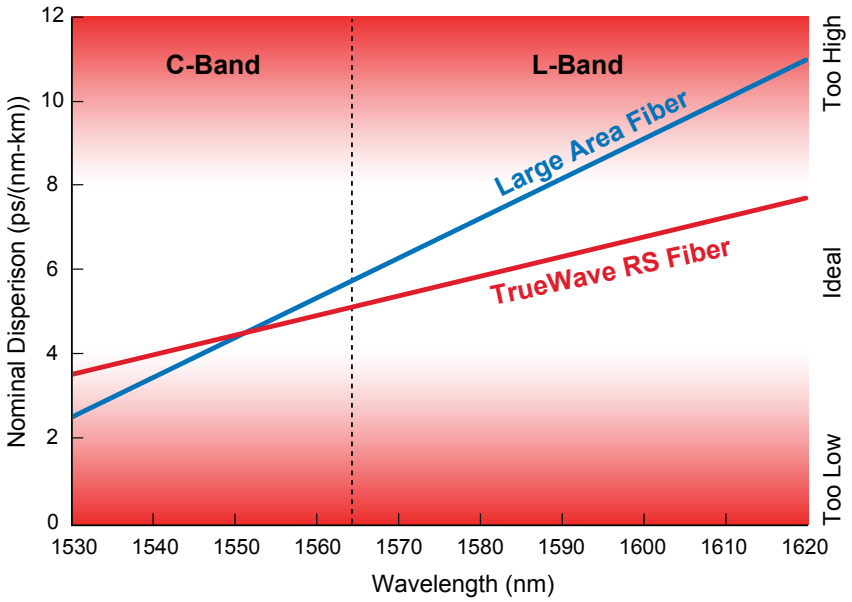
TrueWave *RS* LWP Fiber also excels in the Coarse Wavelength Division Multiplexing (CWDM) applications that are popular in metro and regional applications. The fiber's low and stable attenuation at the water peak opens up the entire wavelength range from 1310 to 1625 nm for transmission. Combined with its low dispersion values in this broad wavelength range, this significantly increases link distances without need for dispersion compensation.

Features/Benefits:

- Eliminates dispersion compensation costs for metro networks, providing lowest first channel costs @ 10 Gb/s
- Enables use of DWDM, CWDM, or a combination of the two
- Lowers dispersion compensation and amplifier costs for EDFA-amplified long haul networks
- Offers the lowest dispersion slope over both C-band and L-band wavelength windows to provide similar cost savings over entire C- and L- band channels
- Provides lowest residual dispersion, an important requirement for fiber in next-generation applications such as OXC-based optical networks

Low Dispersion Slope

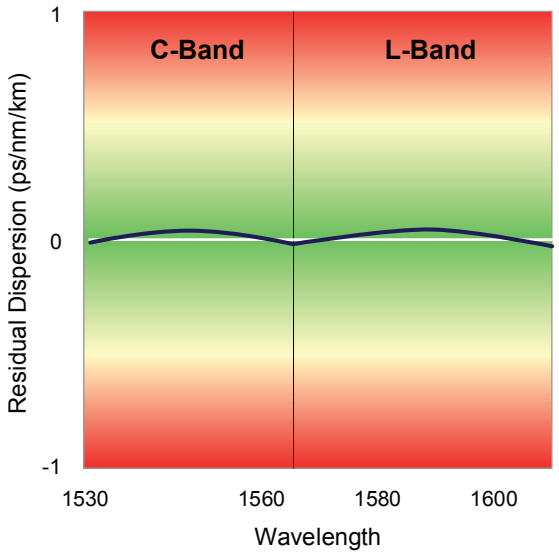
The low dispersion slope of TrueWave *RS* LWP Fiber enables more uniform performance across the entire wavelength band for high speed, multi-channel DWDM networks. It also minimizes four wave mixing, which can occur at the lower end of the C-band in NZDFs with high dispersion slope, degrading multichannel DWDM system performance. Because of its low dispersion slope, the minimum dispersion of TrueWave *RS* LWP Fiber can be increased in this region to better suppress FWM, while keeping the fiber's maximum dispersion low enough for signals to travel over long distances with minimum need for costly dispersion compensation.



Lowest Residual Dispersion

In a transparent optical network, residual dispersion will accumulate from one node to the next. Lower residual dispersion minimizes the accumulation of dispersion in an OXC network, thereby enabling larger transparent networks with lower total system costs. TrueWave *RS* LWP Fiber's low dispersion slope enables better and lower cost dispersion compensation for high-speed regional and metro networks. For example, the cost of dispersion compensating Large Area NZDF fiber can easily be more than 50 percent higher than that of TrueWave *RS* LWP Fiber.

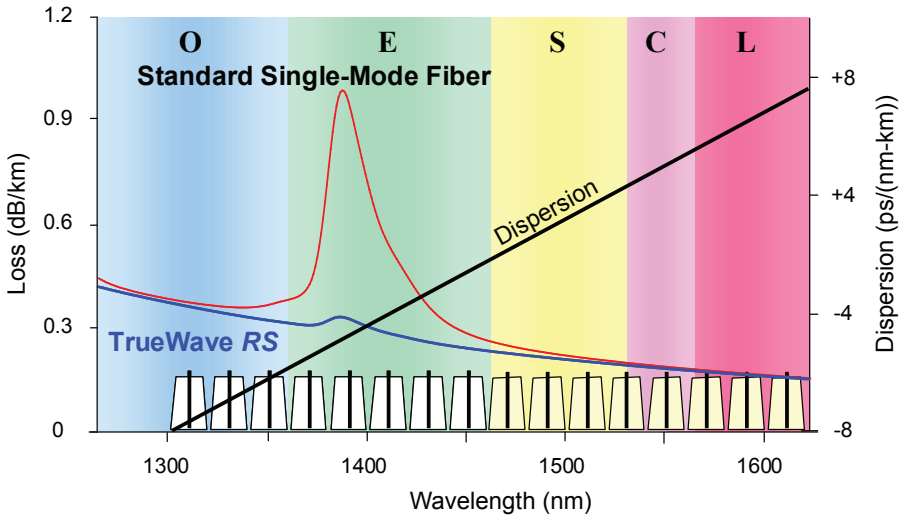
OFS is also a leader in dispersion compensation technology. Using OFS' commercial dispersion compensation modules, the residual dispersion of TrueWave *RS* LWP Fiber can be as low as 0.15 ps/nm/km in both the C- and L-bands, providing longer reach, larger transparent networks and lower system costs.



Longer Reach in CWDM Systems

TrueWave *RS* LWP Fiber offers one of the industry's lowest attenuation values at the water peak region. Its typical value of ≤ 0.35 dB/km at 1383 nm is maintained after exposure to hydrogen according to test defined in IEC 60793-2-50.

This highly stable and low water peak, in combination with the low dispersion over the total wavelength range, ensures full-band CWDM transmission (16*10 Gb/s CWDM channels of 20 nm width over a 40 km link). Large cost savings can be realized even when using inexpensive, uncooled 2.5 Gb/s directly modulated lasers modulated at 10 Gb/s.



Low and Stable PMD

OFS was the first fiber manufacturer to adopt specifications for Polarization Mode Dispersion (PMD) in single-mode fibers. Manufactured using a patented fiber drawing method and extensive process control, TrueWave *RS* LWP Fiber has a PMD specified at levels much lower than the minimum requirements defined by ITU-T G.655.

At OFS, we recognize that PMD values depend on the geometrical and mechanical condition of the fiber. OFS continues to lead the industry in the understanding and minimization of PMD to ensure that today's fibers will excel with tomorrow's network.

ITU-T G.655 specifies a maximum PMD link design value of 0.2 ps/√km, which means that transmission link length over 160 km using 40 Gb/s transmission speed can be very complicated and expensive. With the much lower PMD value specified on the TrueWave *RS* LWP Fiber (0.04 ps/√km), the link length is increased to about 4000 km using the same transmission speed.

Reduced System Cost

Conventional G.652 single-mode fiber was designed to minimize loss and maximize bandwidth in 1310 nm systems. Its high chromatic dispersion at 1550 nm (approximately 17 ps/nm/km) requires costly dispersion compensation when data rates are above 2.5 Gb/s. However, dispersion compensation fiber normally introduces higher loss, PMD and cost into a system.

TrueWave *RS* LWP Fiber's unique fiber design enables a significant reduction in total system cost (including compensation, amplifiers, and even lasers) compared to standard single-mode fiber and other NZDF fibers. Specifically, TrueWave *RS* LWP Fiber is unique among NZDF fibers in providing both immediate first-cost benefits, flexibility for low-cost capacity upgrade, and capabilities for emerging networks.

Product Specifications

Physical Characteristics

Clad Diameter	125.0 ± 0.7 µm
Clad Non-Circularity	≤ 0.7 %
Core/Clad Concentricity Error (Offset)	≤ 0.5 µm, ≤ 0.2 µm typically
Coating Diameter (Uncolored)	235 - 245 µm
Coating-Clad Concentricity Error (Offset)	≤ 12 µm
Tensile Proof Test	100 kpsi (0.69 GPa)
Coating Strip Force	Range: 1.0 N ≤ CSF ≤ 8.9 N
Fiber Curl Radius	≥ 4 m
Dynamic Fatigue Parameter (N_d)	≥ 20
Reel Lengths	Standard as well as customer specific lengths are available up to 50.4 km

Optical Characteristics (after hydrogen aging)

Attenuation	Maximum	Typical
at 1310 nm	≤ 0.4 dB/km	≤ 0.35 dB/km
at 1383 nm	≤ 0.4 dB/km	≤ 0.35 dB/km
at 1550 nm	≤ 0.22 dB/km	≤ 0.20 dB/km
at 1625 nm	≤ 0.24 dB/km	≤ 0.21 dB/km
Attenuation Uniformity / Point Discontinuities at 1550 nm	≤ 0.05 dB	
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, 60 mm (2.4 inch) diameter	1550 nm	≤ 0.05 dB
	1625 nm	≤ 0.05 dB
Chromatic Dispersion		
C-Band 1530-1565 nm	2.6 to 6.0 ps/(nm-km)	
L-Band 1565-1625 nm	4.0 to 8.9 ps/(nm-km)	
Dispersion Slope at 1550 nm	≤ 0.05 ps/(nm^2 -km)	
S - L bands 1460 - 1625 nm	-1.0 – 8.9 ps/(nm-km)	
Chromatic Dispersion at 1310 nm	-8 ps/(nm-km) (typical)	
Group Refractive Index		
at 1310 nm	1.471	
at 1550 nm	1.470	
at 1625 nm	1.470	
Mode Field Diameter	8.4 ± 0.6 µm @ 1550 nm	
Effective Area	52 µm^2 (typical) @ 1550 nm	
Cable Cut-off Wavelength (λ_{cc})	≤ 1260 nm	
Polarization Mode Dispersion (PMD)[1]		
Fiber PMD Link Design Value (LDV)[2]	≤ 0.04 ps/$\sqrt{km}$	
Maximum Individual Fiber	≤ 0.1 ps/$\sqrt{km}$	
Typical Fiber LMC PMD	≤ 0.02 ps/$\sqrt{km}$	

[1] As measured with low mode coupling (LMC) technique in fiber form, 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, September 2001 (N = 20, Q = 0.01%). Details are described in IEC 61282-3 TR Ed 2, October 2006.

Environmental Characteristics (at 1550 & 1625 nm)

Temperature Cycling (-60° C to +85° C)	≤ 0.05 dB/km
High Temperature Aging (85° C)	≤ 0.05 dB/km
Damp Heat Aging (85° C and 85% RH)	≤ 0.05 dB/km
Water Immersion (23° C)	≤ 0.05 dB/km

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