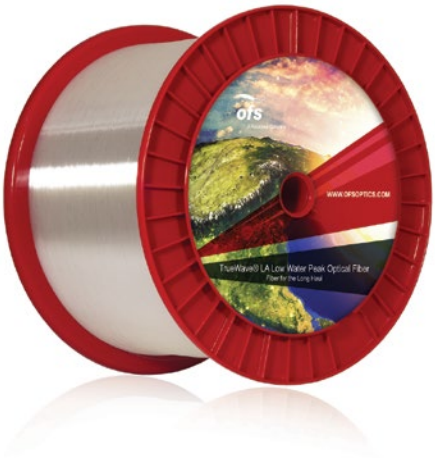
A Furukawa Company

TrueWave® *REACH* Optical Fiber

Optimized for 40+ Gb/s transmission



Features and Benefits

- Low and stable full spectrum performance to maximize transmission distance and minimize transmitter power
- Ultra-low and stable PMD to support the highest data rates with lower electronics costs
- Low dispersion slope to provide more DWDM channels and lower residual dispersion as well as less temperature variation
- Optimized for both EDFA and Raman amplification to maximize system design options

Overview

TrueWave *REACH* Optical Fiber provides maximum performance for optically amplified systems over longer distances with higher capacity. TrueWave *REACH* Fiber meets and exceeds both the ITU-T G.655 C and E and G.656 standards. Optimized for Raman amplification, the fiber minimizes the need for complex dispersion and dispersion slope compensators and additional amplification. With fully matched dispersion compensation modules available in the C-, L-, and S-bands, TrueWave *REACH* Fiber enables the highest performance and minimal system cost for 10 and 40 Gb/s transmission and beyond.

Product Description

TrueWave *REACH* Optical Fiber allows Dense Wavelength Division Multiplexing (DWDM) transmission channels to be used over the full S, C, and L-bands (1460 to 1625 nm). Not only is the fiber fully compatible with erbium doped fiber amplifiers (EDFAs), it is also optimized for the fast emerging distributed Raman amplification technology.

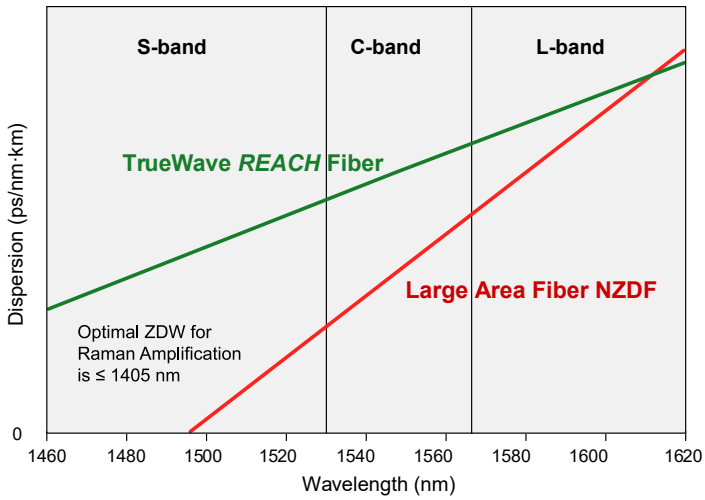
Transmission examples using TrueWave *REACH* Fiber with 100 km spans, consistent with many terrestrial deployments:

- 3200 km transmission of 80 wavelength channels operating in the C-band alone, at 10 Gb/s each
- Greater than 3 Tb/s per second transmission over 1200 km of TrueWave *REACH* Fiber, with 77 wavelength channels operating in both the C- and L-bands, each at 40 Gb/s
- S-band transmission of 40 wavelength channels at 10 Gb/s each, over 1200 km, with a Raman amplified system.
- 2000 km transmission of 80 wavelength channels, each at 40 Gb/s, with wideband Raman amplification and RightWave® DCMs that simultaneously compensate both the C- and L-bands

Wide Operating Band

Ideally, the chromatic dispersion of an optical fiber should have a constant, moderate value over the entire operating wavelength region. However, the dispersion of all fibers changes with wavelength, as determined by the dispersion slope. The smaller the slope, the less the dispersion changes with wavelength. For optimum performance over the C-, L-, and S-bands, dispersion slope should be minimized. TrueWave *REACH* Fiber fulfills the G.656 requirement based on its low dispersion slope.

The small dispersion slope of TrueWave *REACH* Fiber allows its minimum dispersion to be increased to better suppress the four wave mixing (FWM) nonlinearity. At the same time, this keeps the fiber's maximum dispersion small enough for signals to travel over long distances with minimum need for dispersion and dispersion slope compensation over the C-, L-, and S-bands. Finally, TrueWave *REACH* Fiber keeps the ZDW ≤ 1405 nm in order to avoid FWM between Raman pump source and transmission signal for optimum distributed Raman amplification.

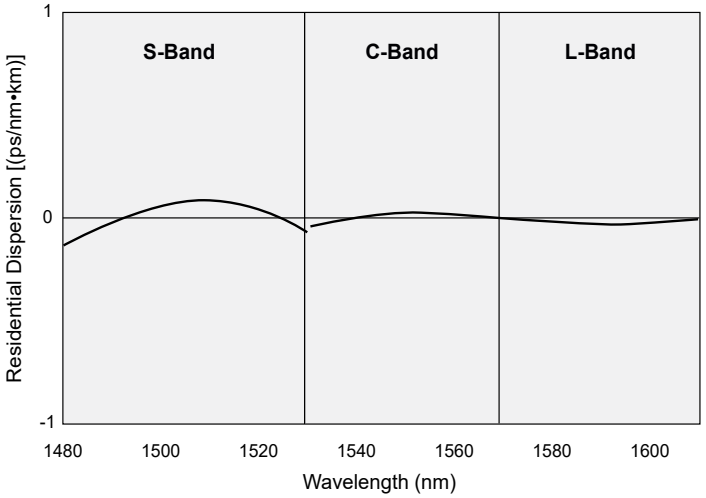


TrueWave *REACH* Has Optimal Dispersion Across All Three Bands

Precise Dispersion Compensation

The highest capacity systems today use the wide spectral bands available in optical fibers. To achieve long distance transmission for 10 Gb/s systems, and especially for 40 Gb/s systems, precise dispersion compensation over the full extent of these bands is required.

TrueWave *REACH* Fiber is optimized to achieve precise wideband dispersion over the C-, L-, and S-bands. TrueWave *REACH* Fiber's dispersion properties result in a low relative dispersion slope across all three bands. This makes it easier to create the precise wideband compensating modules needed for high capacity systems. Coupled with OFS' RightWave Dispersion Compensating Modules (DCM), TrueWave *REACH* Fiber provides unsurpassed system performance compared with other NZDF products.

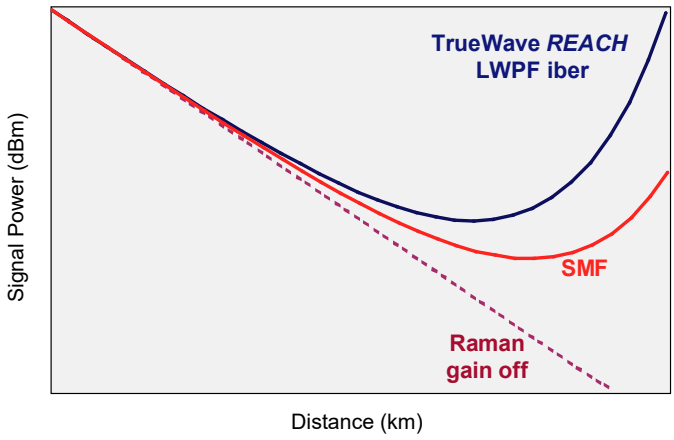


RightWave® DCM with TrueWave *REACH* LWP Delivers Unsurpassed Residual Dispersion

Flexible Amplification

TrueWave *REACH* Fiber allows DWDM transmission channels to be used over the full S, C and L-bands (1460 to 1625 nm). Amplifier technologies used may be both EDFAs and the fast emerging distributed Raman amplification technology.

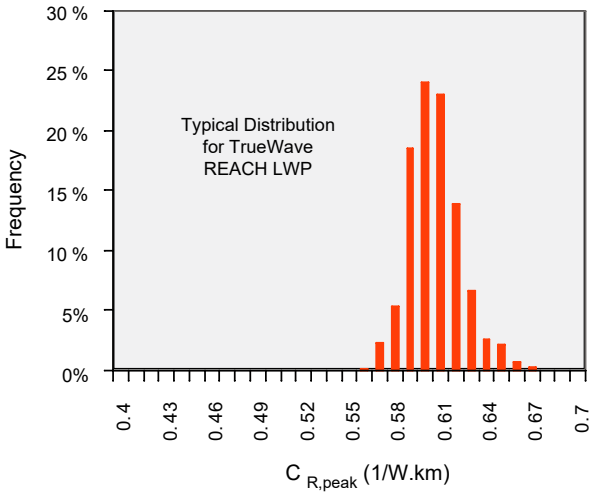
Distributed Raman amplification technology shows advantages in reducing system noise and enabling wideband amplification as compared to today's EDFAs. How well the transmission fiber can utilize this new amplifier technology is defined by the Raman Gain Efficiency.



Raman Amplification Performance

Optimal Raman Gain Efficiency

TrueWave *REACH* Fiber has been optimized to have one of the best Raman gain efficiencies compared to other transmission fibers due to the optimized effective area of the fiber. A typical value for TrueWave *REACH* Fiber is 0.60 W-1 km-1 compared to 0.40 – 0.45 for Standard Single-Mode Fiber and Large Effective Area NZDF respectively.



Raman Gain Efficiency ($C_{R,Peak}$)

TrueWave® *REACH* Optical Fiber

Product Specifications	TrueWave *REACH* Optical Fiber	
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 1450 nm	≤ 0.26 dB/km	≤ 0.25 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	5.5 – 8.9 ps/nm-km	
L-Band 1565-1625 nm	6.9 – 11.4 ps/nm-km	
Dispersion Slope at 1550 nm	≤ 0.045 ps/nm² -km	
S - L bands 1460 - 1625 nm	2.0 – 11.4 ps/nm-km	
Zero Dispersion Wavelength	≤ 1405 nm	
Chromatic Dispersion at 1310 nm	-5 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	8.6 ± 0.4 µm @ 1550 nm	
Effective Area	55 µm² (typical) @ 1550 nm	
Cable Cut-off Wavelength (λ_{CC})	≤ 1310 nm	
Polarization Mode Dispersion (PMD)[1]		
Fiber PMD Link Design Value (LDV)[2]	≤ 0.04 ps/√km	
Maximum Individual Fiber	≤ 0.1 ps/√km	
Typical Fiber LMC PMD	≤ 0.02 ps/√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.		
Typical Raman Gain Efficiency	≥ 0.6 (1/W.km) using 1450 nm pump source	
Environmental Characteristics (at 1310, 1550 & 1625 nm)		
Temperature Cycling (-60° 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	

For additional information please contact your sales representative.

You can also visit our website at **www.ofsoptics.com** or call **1-888-fiberhelp** (1-888-342-3743) USA or **1-770-798-5555** outside the USA.

North America
Telephone: 508-347-8590
Toll Free: 800-799-7732
Fax: 508-347-1211
E-mail: fibersalesnar@ofsoptics.com

Asia Pacific
Telephone: +852 2506 5054
Fax: +852 2506 0166
E-mail: fibersalesap@ofsoptics.com

Caribbean, Latin America
Telephone: +1-508-347-8590
Fax: +1-508-347-1211
E-mail: fibersalescala@ofsoptics.com

Japan
Telephone: +81-3-3286-3424
Fax: +81-3-3286-3708 or 3190
E-mail: fibersalesjapan@ofsoptics.com

Europe, Middle East, Africa
Telephone: +45-43 48 3736
Fax: +45 4348 3444
E-mail: ofssalesdk@ofsoptics.com

China
Telephone: +86 10 6505 3660
Fax: +86 10 65059515
E-mail: fibersaleschina@ofsoptics.com

OFS Marketing Communications
Doc ID: fiber-124
Date: 0617