



A Furukawa Company

Utilities and Alternative Energy Solutions

A FOX SOLUTION® OFFERING

The power network is changing. It needs the bandwidth and reliability of fiber. OFS brings unique solutions for fiber in the power network.

OFS' FOX Solution® for Utility and Alternative Energy applications features several end-to-end solutions optimized to distribute fiber in traditional Transmission and Distribution networks and connecting the wind and solar farm with the grid.

Solutions connecting the transmission and distribution networks:

- PowerGuide® AccuTube® ADSS Cable featuring AccuRibbon® Optical Ribbon
- PowerGuide DT (Dry Tube) Short Span ADSS Cable
- PowerGuide ADSS Cable
- PowerGuide TR (Tracking Resistant) ADSS Cable
- Pole line attachment hardware and accessories

Solutions for the substation:

- OPTION1™ DT Outdoor/Indoor Cable
- Jumpers and pigtails
- Wall Mount Units
- Shelves
- SlimBox™ Modules
- Mechanical Splice-On Connector (MSOC) and Fusion Splice-On Connector (FSOC)

Solutions for the wind and solar farm:

- Fortex™ DT (Dry Tube) Loose Tube Cable
- SlimBox 12-Fiber Wall Mount Module
- Jumpers and pigtails

These solutions are field proven in widespread utility and alternative energy deployments around the world.

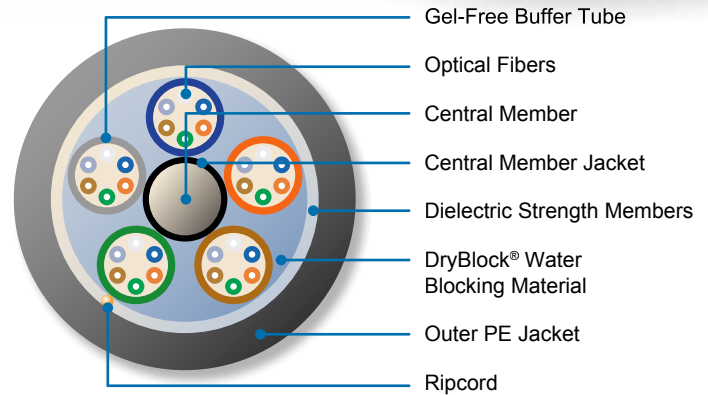
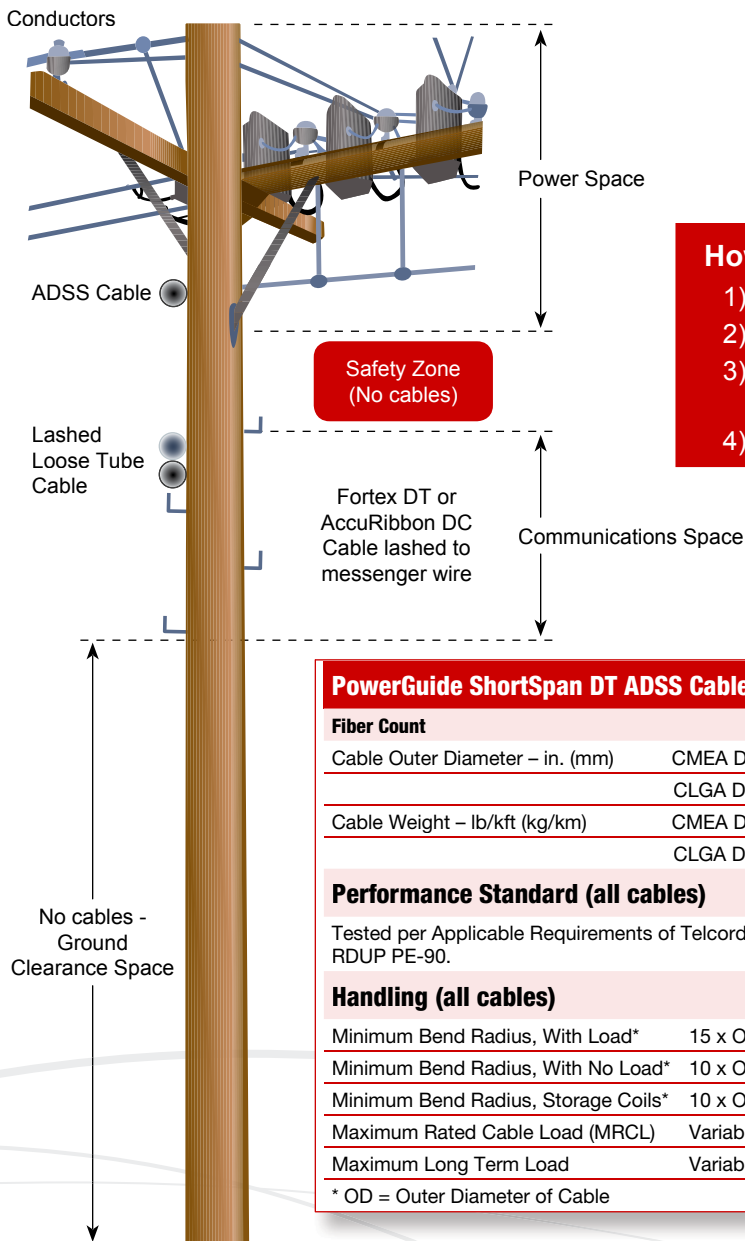
Cable Choices for the Distribution Network

All-Dielectric, Self-Supporting (ADSS) cables are the choice for the majority of distribution networks (69 kV and lower, single circuit).

ADSS cables can be placed in either the supply zone or communications zone on the pole, are non-metallic, are installed quickly and are rugged enough to provide decades of service on the power line.

OFS PowerGuide ShortSpan DT Cable, the world's first gel-free ADSS cable, offers the same high performance and reliability as gel-filled counterparts. Plus, it's completely dry, even inside the buffer tubes.

Fortex DT Single-Jacket Loose Tube and AccuRibbon DC Ribbon Cables are sometimes lashed to an existing messenger wire.



PowerGuide ShortSpan DT Cable Cross-Section

How to specify ADSS cable for distribution lines:

- 1) Fiber Count and type
- 2) Max Span Length
- 3) Environmental Loading Requirements (NESC Light, Medium, Heavy, or other)
- 4) Special sag/tension requirements

PowerGuide ShortSpan DT ADSS Cable Specifications for Distribution Applications

Fiber Count		2-60	61-72	73-96	97-120	121-144
Cable Outer Diameter – in. (mm)	CMEA Design	0.47 (11.8)	0.51 (12.8)	0.59 (14.8)	0.67 (16.9)	0.74 (18.6)
	CLGA Design	0.46 (11.7)	0.50 (12.7)	0.58 (14.7)	0.66 (16.8)	0.73 (18.5)
Cable Weight – lb/kft (kg/km)	CMEA Design	64 (95)	67 (99)	91 (135)	120 (178)	144 (214)
	CLGA Design	63 (93)	66 (98)	89 (133)	119 (177)	143 (213)

Performance Standard (all cables)

Tested per Applicable Requirements of Telcordia Technologies GR-20, ANSI/ICEA S-87-640, EIA/TIA, IEEE-1222 and RDUP PE-90.

Handling (all cables)

Minimum Bend Radius, With Load*	15 x OD
Minimum Bend Radius, With No Load*	10 x OD
Minimum Bend Radius, Storage Coils*	10 x OD
Maximum Rated Cable Load (MRCL)	Variable
Maximum Long Term Load	Variable

Temperature: Installation:	-22° F to 158° F (-30° C to 70° C)
Operation:	-40° F to 158° F (-40° C to 70° C)
Storage:	-40° F to 167° F (-40° C to 75° C)

* OD = Outer Diameter of Cable

Typical fiber optic cable deployment scenarios on distribution poles. (Drawing not to scale.)

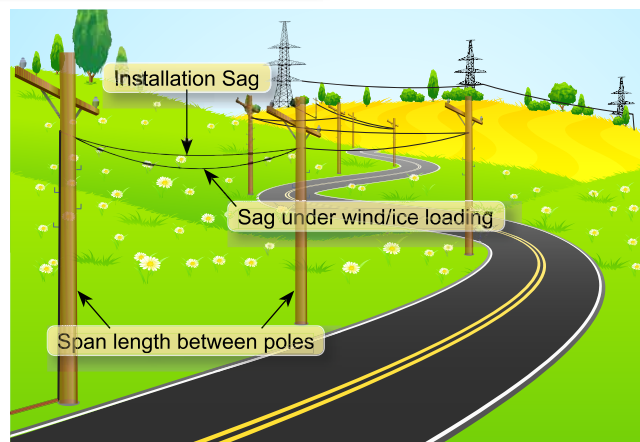
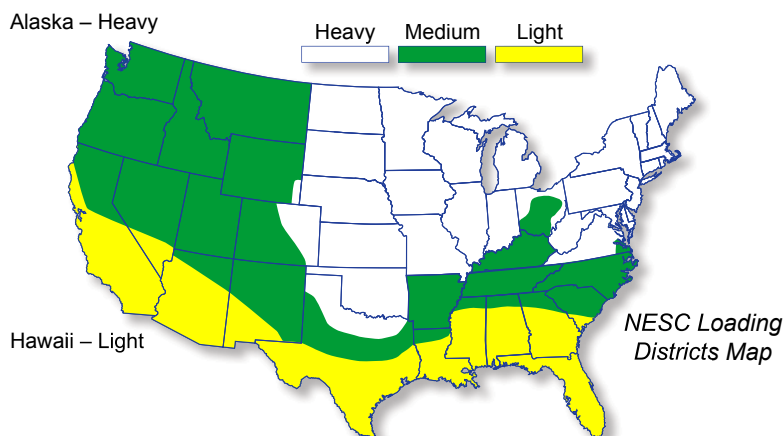
Specification and Ordering Information:

- 1) Determine fiber count
- 2) Identify loading district and maximum span length use to identify last 4-characters of cable part number
- 3) Choose cable length (route length + 1.5% for sag + spare cable)
- 4) Identify cable attachment and accessory hardware

PowerGuide ShortSpan DT Cable Capabilities (1.5% installation sag) *

Fiber Count	Max Span (1.5% installation sag) (ft) (NESC Light)		Max Span (1.5% installation sag) (ft) (NESC Med)		Max Span (1.5% installation sag) (ft) (NESC Heavy)		Diam (in)		Weight (lb/1000 ft)	
	CLGA Design	CMEA Design	CLGA Design	CMEA Design	CLGA Design	CMEA Design	CLGA Design	CMEA Design	CLGA Design	CMEA Design
Up to 48	875	1070	590	770	375	475	0.46	0.46	59	60
Up to 72	800	980	590	730	375	450	0.50	0.50	67	68
Up to 96	800	950	640	750	410	490	0.58	0.58	90	92
Up to 144	730	830	690	790	480	540	0.73	0.73	145	146

* Detailed sag and tension available – contact OFS for more information



PowerGuide ShortSpan DT ADSS Cable Ordering Information

Example: AT-3BE17NT-NNN-CMEA1

Part Number: AT-		Fiber ²	Sheath	Core	Fiber Count	Custom/ Special ³
		<u>S1</u> <u>S2</u> <u>SF</u>	<u>S3</u> <u>S4</u>	<u>S5</u> <u>S6</u>	-	<u>NNN</u> - <u>XXXX</u>
S1 = Fiber Selection		SF = Fiber Type²		S5 = Core Type		
3 = 1310/1550 nm (AllWave® ZWP)		E = AllWave ZWP Single-Mode		N = All-Dry ADSS Loose Tube		
6 = 1550 nm (TrueWave® RS LWP)		6 = TrueWave RS LWP				
R = 850/1300 nm (Multimode)		9 = 62.5/125 µm Multimode				
		2 = 50/125 µm Multimode		S6 = Fibers per Tube		
				T = 12 fibers		
S2 = Fiber Transmission Performance		S3 = Sheath Construction		NNN = Fiber Count = 002 – 144		
B = 0.35/0.31/0.27/0.25/0.27 dB/km @		1 = Single Jacket All-Dielectric				
1310/1385/1490/1550/1625 nm (AllWave ZWP/						
AllWave FLEX ZWP)						
2 = 0.25 dB/km @ 1550 nm (TrueWave RS LWP)		S4 = Tensile Load		XXXX = CMEA or CLGA		
U = 3.4/1.0 dB/km and 200/500 MHz-km @		7 = PowerGuide ShortSpan		(see footnote 3 below)		
850/1300 nm (62.5 µm Multimode)						
K = 2.5/0.7 dB/km and 500/500 MHz-km @						
850/1300 nm (50 µm Multimode)						

¹ Part Number shown is for standard AllWave ZWP Fiber attenuation and standard cable print:
Maximum AllWave ZWP Fiber attenuation: 0.35/0.31/0.27/0.25/0.27 dB/km (1310/1385/1490/1550/1625 nm)
Standard Print, example for PowerGuide ShortSpan DT Cable:
OFS OPTICAL CABLE AT-3BE17NT-NNN-CMEA [MM-YY] [HANDSET SYMBOL] [NNN]F [SERIAL #]

² Contact OFS Order Management for information on other cable variations, including additional fiber types, attenuation, and custom cable print.

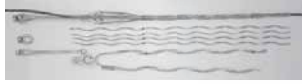
³ Custom/Special (XXXX): Consult with us regarding your application, span lengths, and loading conditions to complete the custom design and part number of your complete sheath strength system.

How to Specify ADSS Cable

Hardware Choices for the Network

Dead End Assembly

- Used whenever a cable should not slip
 - Cable start and end points
 - Where line angles exceed 20°
 - Road, river, railroad crossings
 - Closure locations
- Different types available dependent upon cable design and application
- Most attachment hardware is used with 5/8" pole line hardware



Tangent and Suspension Supports

- Typically used in small line angle ($<20^\circ$, depending on type) situations
- Provides vertical support, not designed to support cable tension
- Multiple types depending span length and application
- Allows cable slippage during imbalanced load situations



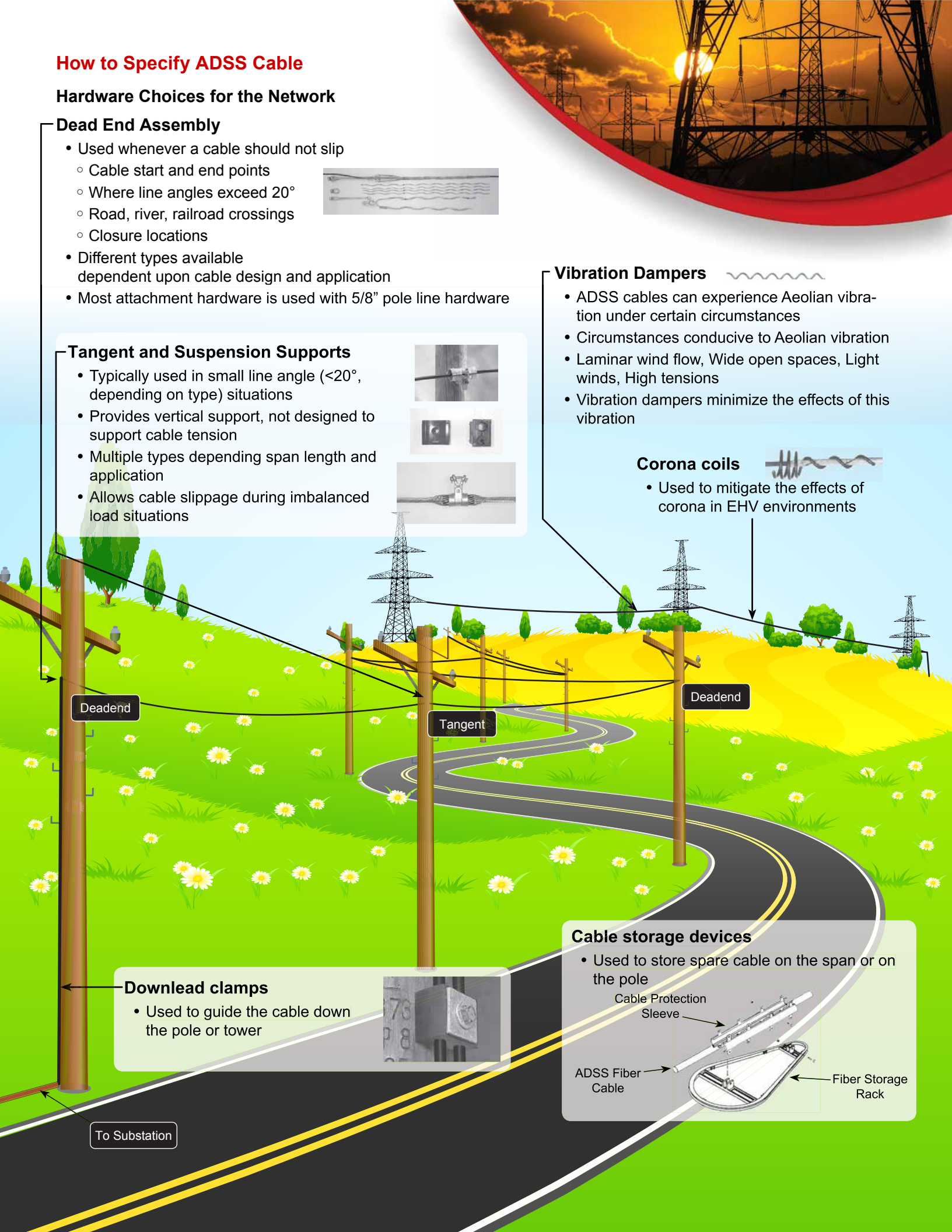
Vibration Dampers

- ADSS cables can experience Aeolian vibration under certain circumstances
- Circumstances conducive to Aeolian vibration
- Laminar wind flow, Wide open spaces, Light winds, High tensions
- Vibration dampers minimize the effects of this vibration



Corona coils

- Used to mitigate the effects of corona in EHV environments



Deadend

Tangent

Deadend

Downlead clamps

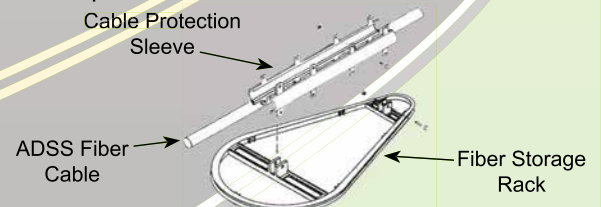
- Used to guide the cable down the pole or tower



To Substation

Cable storage devices

- Used to store spare cable on the span or on the pole



PowerGuide Short Span ADSS DT Cable Accessories (for both CLGA and CMEA Designs)*

Fiber Count	Load Condition	Max Span Length	1 layer deadend = 800 lbs application limit		Max Span Length		2 layer deadend = 2500 lbs application limit	
			PLP Code	Mosdorfer Code	CLGA	CMEA	PLP Code	Mosdorfer Code
Up to 48 fibers	Light	650	2875003TE	FOLT1170-TE	875	1070	2872003C1E1	AS02-FDES-0450
	Medium	450	2875003TE	FOLT1170-TE	590	770	2872003C1E1	AS02-FDES-0450
	Heavy	275	2875003TE	FOLT1170-TE	375	475	2872003C1E1	AS02-FDES-0450
Up to 72 fibers	Light	600	2875003TE	FOLT1170-TE	800	980	2872004C1E1	AS02-FDES-0500
	Medium	425	2875003TE	FOLT1170-TE	590	730	2872004C1E1 (2 Layer)	AS02-FDES-0500
	Heavy	250	2875003TE	FOLT1170-TE	375	450	2872004C1E1 (2 Layer)	AS02-FDES-0500
Up to 96 fibers	Light	475	2875005TE	FOLT1415-TE	800	950	2872007C1E1	AS02-FDES-0550
	Medium	350	2875005TE	FOLT1415-TE	640	750	2872007C1E1	AS02-FDES-0550
	Heavy	200	2875005TE	FOLT1415-TE	410	490	2872007C1E1 (2 Layer)	AS02-FDES-0550
Up to 144 fibers	Light	300	2875007TE	FOLT1730-TE	730	830	2872010C1E1	AS02-FDES-0700
	Medium	250	2875007TE	FOLT1730-TE	690	790	2872010C1E1	AS02-FDES-0700
	Heavy	150	2875007TE	FOLT1730-TE	480	540	2872010C1E1	AS02-FDES-0700

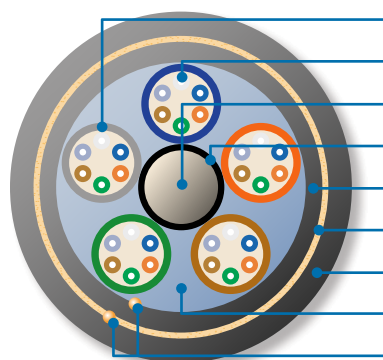
* Deadend part number recommendations, 1.5% installation sag

Accessories

Fiber Count	Tangent (<600' spans)		Suspension (>600' spans)		Cable Storage Devices (Snowshoes)		Vibration Dampers		Downlead Cushions
	PLP Code	Mosdorfer Code	PLP Code		PLP Code		PLP Code	Mosdorfer Code	
Up to 48	4450999	FOSC 0475	4470199-S		710012375U		50502274	SVD0462	8003041, Add "H1" for Wood Attachment Kit
Up to 72	4450100	FOSC 0525	4470201-S		710012375U		50502274	SVD0462	8003042, Add "H1" for Wood Attachment Kit
Up to 96	4450102	FOSC 0625	4470202-S		710012375U		50509862	SVD0464	8003043, Add "H1" for Wood Attachment Kit
Up to 144	4450104	FOSC 0775	P: 4470204-S		710012375U		50509862	SVD0464	8003044, Add "H1" for Wood Attachment Kit

Cable Choices for the Transmission Network

- PowerGuide TR (Tracking Resistant) ADSS Cable for EHV applications (typically ≥ 115 kV)
- PowerGuide AccuTube ADSS Cable with AccuRibbon Optical Ribbon for extra high fiber count applications (up to 864)
- Since all transmission lines are different most PowerGuide cables are custom-designed. Custom-designing does not add to the cost of the cable, and provides the best cable for the application



Buffer Tube
Optical Fibers
Central Member
Central Member Jacket
Inner Jacket
Sheath Strength Elements
Outer Jacket
DryBlock Water Blocking Material
Ripcords

PowerGuide ADSS Cable Cross-Section

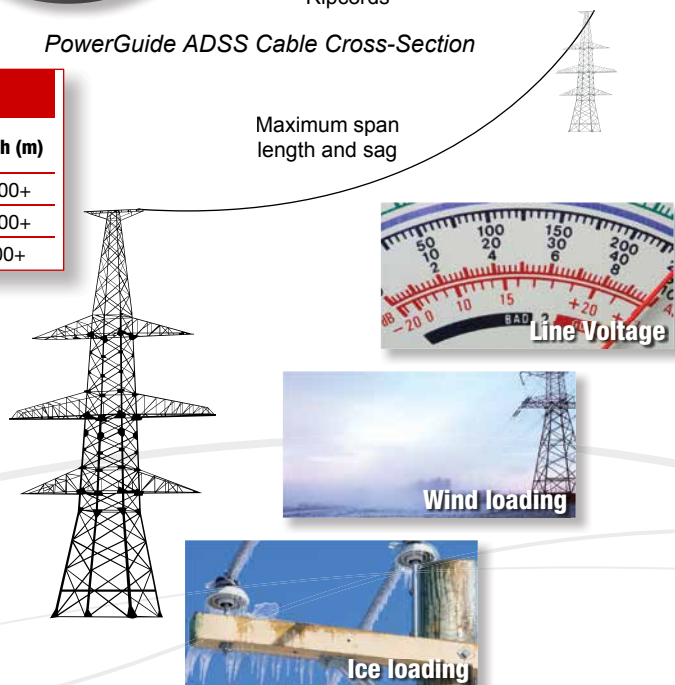
Which ADSS Cable is Right for My Transmission Line Network?

	Fiber Count	Typical Line Voltage (kV)	Space Potential (kV)	Span Length (m)
PowerGuide ADSS	< 288	≤ 115	< 12	Up to 1000+
PowerGuide TR	< 288	≤ 115	< 12	Up to 1000+
PowerGuide AccuTube	< 864	≤ 115	< 25	Up to 300+

Maximum span length and sag

How to specify ADSS cable for transmission lines:

- 1) Fiber Count and type
- 2) Max Span Length
- 3) Environmental Loading Requirements (NESC Light, Medium, Heavy, or other)
- 4) Line Voltage – For applications ≥ 115 kV, special conductor and phasing information will be needed
- 5) Special sag/tension requirements
- 6) Hardware is customized for the application



For the Substation – Fiber Management

OFS has a full set of fiber management components for the substation or central office.

- As the original inventor of the industry-standard LGX® panel and LC connector, the OFS lineage brings a wealth of knowledge and product options to simplify fiber management in the central office or substation
- Product options available for high and low fiber count networks
- Numerous solutions to simplify your installation

OSP Cross-Connect Cabinet – Used to cross connect fibers in the field away from substations

- Up to 240 fibers
- Can splice inside or outside of the cabinet



OSP Cross-Connect Cabinet

Inside Plant Equipment Options

Common wall mounted solutions
Various configurations available
Contact OFS for specific configuration

Fiber Count	Partial Item Number
24	WMU2
48	WMU4
96	WMU8



WMU
(Wall Mount Unit)

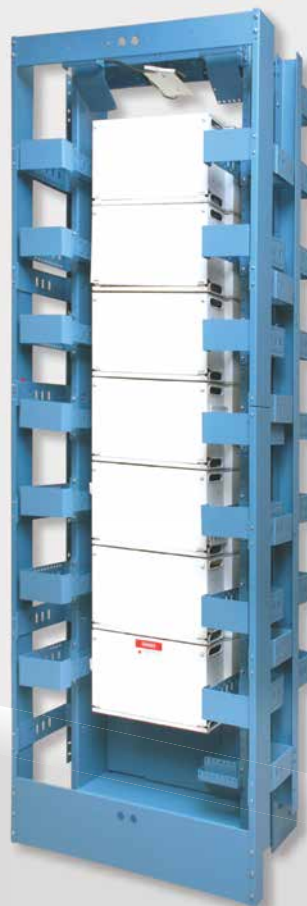
Wall-Mounted panels for splicing and patching



OCEF
(Optical Cable Entrance Facility)
With capacity to 1440 fibers

Common rack-mounted combination unit solutions
Contact OFS for specific configuration

Fiber Count	Partial Item Number
24	LSC1W-024
48	LSC1W-048
96	LSC1W-096
144	LSC1W-144
288	LSC1W-288
432	LSC1W-432



Pre-terminated patch panels – simply splice into the outside plant cable



Combination patching and splicing units – 2 functions in one unit



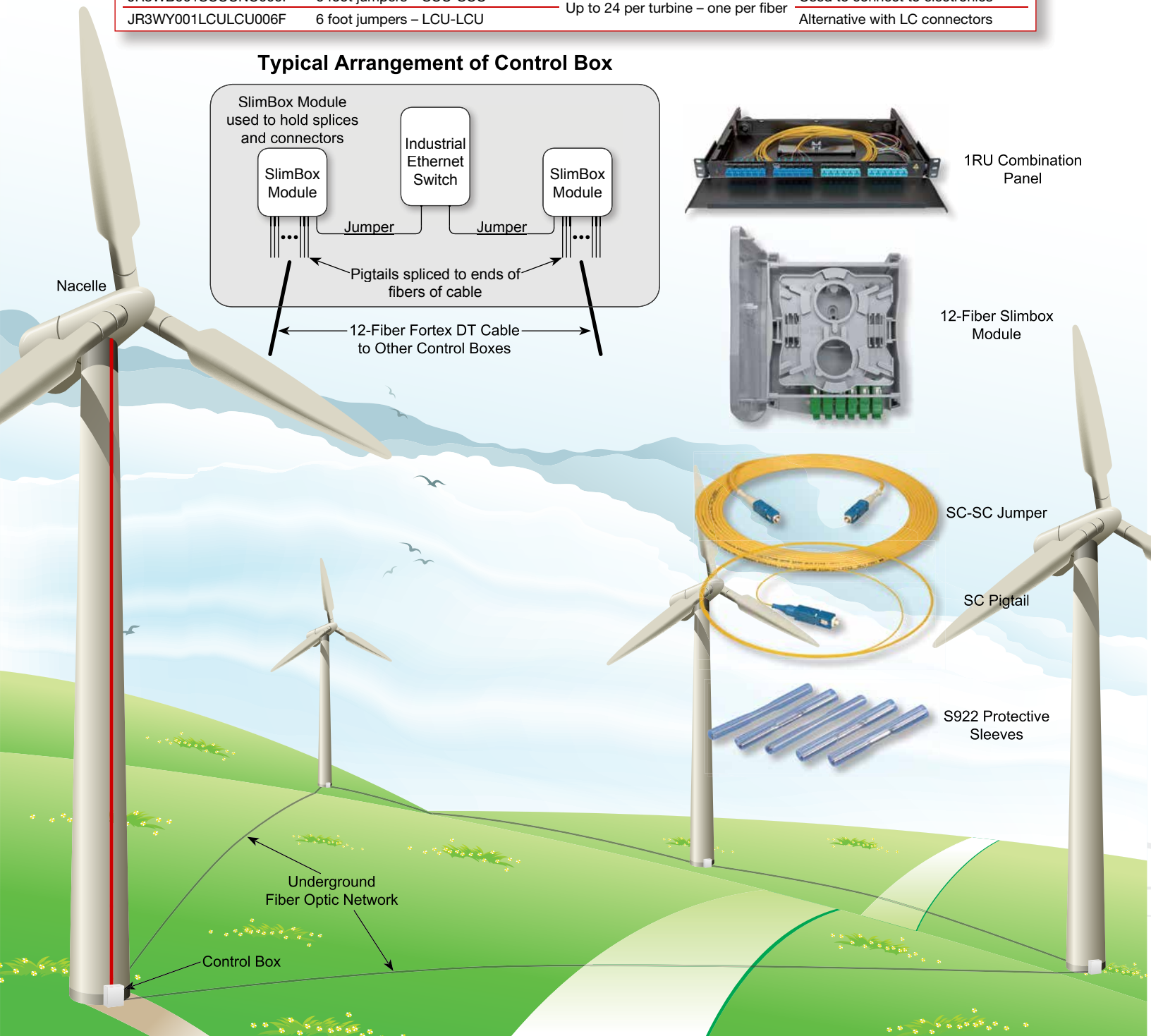
Adapter Plates for every application

For the Wind/Solar Farm

Typical Material List for a 12-Fiber Network

Item Number	Description	Quantity	Notes
AT-3BE12YT-012	12-Fiber Fortex DT Cable with All-Wave ZWP Fiber	Distance between turbines + 15 feet per turbine	12 fibers/turbine is common
SLIMBOX-V, INDOOR MDU-12F-SM-SCU-PT	12-Fiber SlimBox Module pre-loaded with pigtails and SCU connectors	2 per turbine	Use either SlimBox Module or 1RU Combination Panel
1U S-LIU SC12 Blue PT (300523784QT)	1 RU Combination Panel, SCU Connectors, pre-loaded with pigtails	1 per turbine	Alternative to the SlimBox Module, SC Connectors
1U S-LIU LC12 BLUE PT (300524097)	1 RU Combination panel, LCU Connectors, pre-loaded with pigtails		Alternative to the SlimBox Module, LC Connectors
S922 Protective Sleeves	40 mm splice sleeves	Up to 24 per turbine – one per splice	Used to protect splices
JR3WB001SCUSCU003F	3 foot pigtail – SCU connector	Up to 24 per turbine – one per splice	Spliced to main cable
JR3WY001LCUUNC006F	3 foot pigtail – LCU connector		Alternative with LC connectors
JR3WB001SCUUNC006F	6 foot jumpers – SCU-SCU	Up to 24 per turbine – one per fiber	Used to connect to electronics
JR3WY001LCULCU006F	6 foot jumpers – LCU-LCU		Alternative with LC connectors

Typical Arrangement of Control Box



Connectorization Options

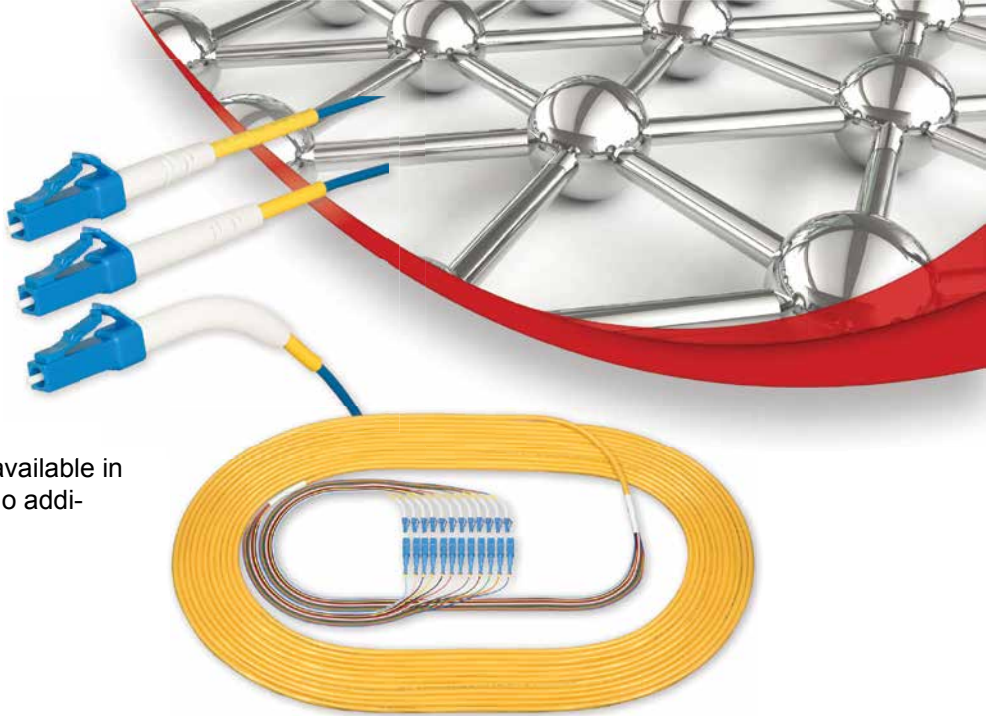
Pre-connectorized options

OFS brings a variety of connectorization options for MDU environments.

- All distribution systems, HomeRun Indoor and Outdoor MDU Cabling, V-Linx™ components, and riser cables are available in a variety of pre-connectorized lengths

Cables

- Pigtails, jumpers and patch cords are also available in customized lengths and configurations for no additional charge



Field-Installable Connectors

Fusion splice-on connectors (FSOC) or Mechanical splice-on connectors (MSOC) can be installed on-site in the field.

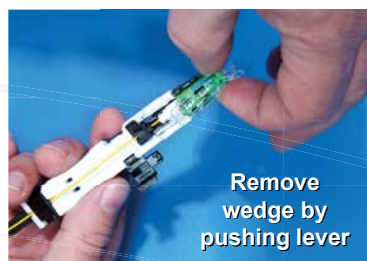
The main advantage of a field installable connector is to eliminate slack management issues.



Fusion Splice-on Connectors use a cleaver and fusion splicer to splice a connector to the fiber.

Available in a variety of connector ends with two different connector types.

Mechanical Splice-On Connectors only need a cleaver for installation. Available in a variety of common connector ends



The Fiber is the Network™

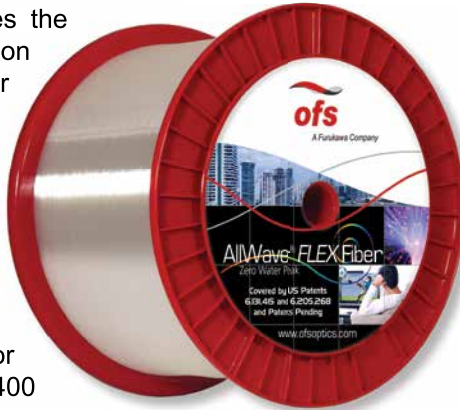
Power providers need the proven reliability of 100% synthetic silica fiber.

While other fibers may contain natural quartz in the fiber fiber, OFS AllWave, TrueWave, and LaserWave® Fibers are made with ultra-pure synthetic silica.

Although all fibers have a small amount of impurities, ultra pure synthetic silica minimizes risk of impurities that could cause alkali-based hydrogen aging losses, or degradation of strength.

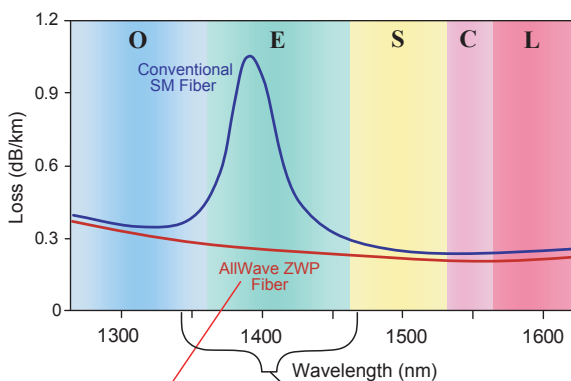
Ultra-pure synthetic silica also provides the backbone for Zero Water Peak attenuation performance. OFS' AllWave ZWP Fiber features low optical loss across the entire spectrum from 1260 – 1625 nm, providing a 50 percent increase in usable spectrum, enabling 16-channel CWDM as well as DWDM support.

The fiber is made using a patented manufacturing technology that permanently removes the water peak defect for low, stable loss performance in the 1400 nm window.



AllWave® ZWP Fiber [Zero Water Peak]

Compatible with Conventional Single-Mode Fiber, but with More Available Spectrum



AllWave ZWP Fiber has lower & stable loss throughout by removing the water peak defect

AllWave ZWP Fiber has over 100 nm MORE spectrum

AllWave ZWP Fiber provides up to 22.5% lower attenuation and longer range compared to "enhanced" or Low Water Peak (LWP) fibers



Figure 1. High purity synthetic silica fiber (OFS AllWave ZWP Fiber)



Figure 2. Natural quartz raw material fiber clearly shows many pits and imperfections (competing fiber).

Bumpy condition shows difference between pure and clean synthetic silica vs natural quartz with its impurities and inclusions.



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) from inside the USA or 1-770-798-5555 from outside the USA.



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