AFL

SPECIALTY FIBRE OPTIC CABLE

Downhole | Subsea | Sensing

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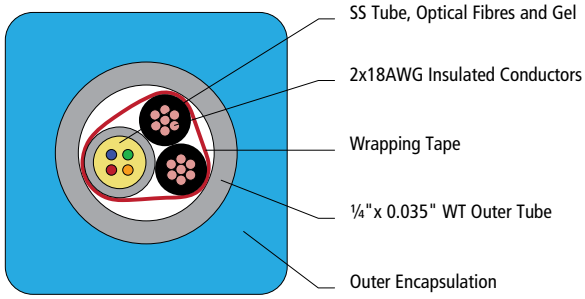
Traditional Downhole Cable

Traditional Downhole cable from AFL is designed to perform in the well and withstand elevated temperatures, high pressure and corrosive environments. The cable is customised to the customer's specifications in order to maximize performance at the best possible price. AFL's Traditional Downhole cable is targeted to ≤ 150°C offshore and land-based wells where ruggedness is essential.

Features

- Customized to customer specifications
- Up to 150°C
- Up to 20,000 psi operating pressure
- Loose tube design
- Hydrogen scavenging gel

Cable Components



Options and Specifications

PARAMETER	VALUE
Inner Stainless Steel Tube Diameter	0.125"
Outer Tube Diameter	0.250"
Outer Tube Wall Thickness	0.028", 0.035", 0.049"
Outer Tube Material	Stainless Steel 316L, Incoloy™ 825
Fibre Coating	Carbon Polyimide, Silicone/PFA, Pure Silica Core and others
Gel Types	No gel, standard gel, hydrogen scavenging gel
Diameter	11 mm x 11 mm square, 11 mm round
Polymer Options	Polypropylene, PVDF, Nylon, Santoprene™
Operating Temperature	-40°C to 150°C
Operating Pressure Limit	0 to 20,000 psi

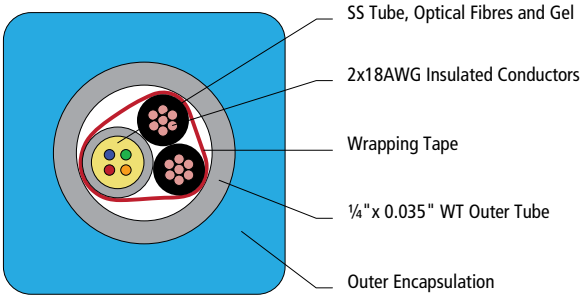
Hybrid Downhole Cable

Hybrid Downhole cable from AFL combines copper conductors and optical fibres within the same cable structure for simultaneous deployment. This construction is intended to withstand elevated temperatures, high pressure and corrosive environments. The cable may be customized to the customer's specifications in order to balance performance capability with cost considerations. This design is targeted toward well applications than have operating temperatures ≤ 150˚C.

Features

- Up to 150°C
- Incorporates insulated 18AWG copper conductors
- Loose tube design for optical fibres
- Hydrogen scavenging gel
- Customized to customer specifications

Cable Components



Options and Specifications

PARAMETER	VALUE
Inner Stainless Steel Tube Diameter	0.095"
Copper Conductors	2 x 18 AWG
Outer Tube Diameter	0.250"
Outer Tube Wall Thickness	0.035"
Outer Tube Material	Stainless Steel 316L, Incoloy™ 825
Fibre Types	Single-mode, Multimode
Gel Types	Hydrogen scavenging gel
Encapsulation Options	None, 11 mm x 11 mm Square, 11 mm Round
Polymer Types	Polypropylene, PVDF, Nylon, Santoprene™
Operating Temperature	-40°C to 150°C
Operating Pressure Limit	0 to 20,000 psi

STRATAJAC™

Downhole Cable Encapsulation

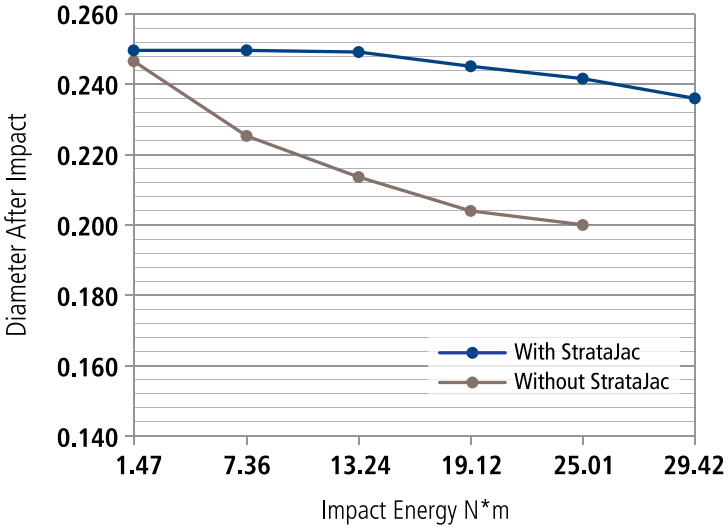
Cables installed in oil and gas wells are exposed to severe mechanical and chemical conditions. Cable damage during run-in and subsequent completion processes such as hydraulic fracturing can lead to premature cable failures. StrataJac™ is the first cable encapsulation designed exclusively to protect downhole cables by resisting the extreme impact energies and abrasion encountered during run-in, and high pressure, high velocity frac' jobs. Abrasion testing has demonstrated a three-fold increase in the amount of time required to breach StrataJac when compared to other commercially available encapsulations. Furthermore, cable impact strength is significantly enhanced when encapsulated with StrataJac. These combined properties make StrataJac ideal for preserving and extending the life of fibre optic cables, TEC cables, and chemical injection lines used in critical downhole applications.

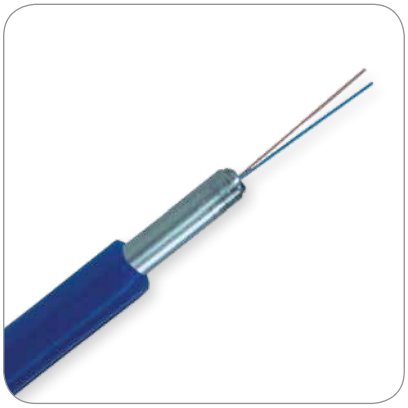
Features

- Highly Abrasion and Impact Resistant
- Suitable for use in severe chemical environments containing H_2S, CO_2, Methane, Oil, Diesel, Gasoline, Toluene, and other organic solvents
- Wide operating temperature range from -40° C to 150° C
- Easy to strip using commercially available encapsulation strippers.

Physical Properties

DIAMETER (MM)	WEIGHT (KG/KM)	PROFILE
11	76.7	Round
12.7	115	Round





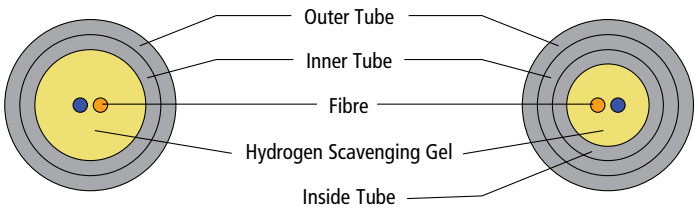
Features

- Small diameter
- Low weight
- Redundant hermetic seal
- Encapsulation options
- Lower cost
- Patent pending

Low Profile Downhole Cable

AFL's unique offering for shallow, land-based wells provides the best combination of ruggedness and size for the price. AFL will customize the design to meet the customer's needs in order to maximise their return on investment.

Cable Components



Options and Specifications

PARAMETER	VALUE	
	DOUBLE TUBE	TRIPLE TUBE
Outer Tube Diameter	0.125	0.125
Tube Wall Thickness	0.016	0.024
Tube Material	Stainless Steel 316L, Incoloy™ 825	
Fibre coating	Carbon Polyimide, Silicone/PFA, Pure Silica Core and others	
Gel types	No gel, high temperature gel, hydrogen scavenging gel	
Polymer options	Polypropylene, PVDF, Nylon, Santoprene™	

STAINLESS STEEL 316L OPTION		
Weight	21 lbs / 1,000 ft	28 lbs / 1,000 ft
Tensile	760 lbs	1,060 lbs
Collapse pressure	30,000 psi	44,000 psi
Bend radius (dynamic)	12.6"	12.6"

INCOLOY™ 825 OPTION		
Weight	22 lbs / 1,000 ft	28 lbs / 1,000 ft
Tensile	814 lbs	1,134 lbs
Collapse pressure	21,000 psi	32,000 psi
Bend radius (dynamic)	12.6"	12.6"

ENCAPSULATION OPTION	
Diameter	1/4"
Weight	
Santoprene™	15 lbs / 1,000 ft
Polypropylene	14 lbs / 1,000 ft
PVDF	28 lbs / 1,000 ft
Nylon	16 lbs / 1,000 ft

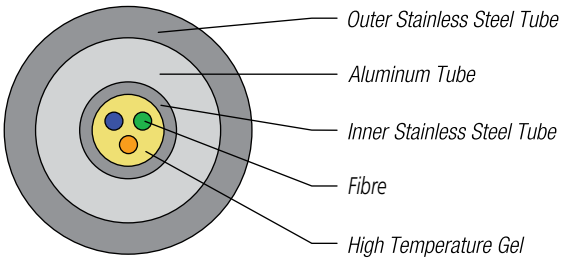
High Temperature Downhole Cable

AFL's unique solution for applications > 150°C is a three-layer design with the secondary layer being 0.040" thick aluminum. Research indicates hydrogen permeability through aluminum is 100 times less than stainless steel resulting in an extended life for the optical fibre. The all metal design eliminates concerns with polymers at elevated temperatures and provides for stable, predictable performance.

Features

- Hydrogen resistant
- All metal construction
- Tight tolerances
- 300°C temperatures and beyond
- Loose tube design
- Patent pending

Cable Components



Options and Specifications

PARAMETER		VALUE
Inner Stainless Steel Tube Diameter		0.094"
Outer Tube Diameter		0.250"
Outer Tube Wall Thickness		0.028"
Outer Tube Material		Stainless Steel 316L, Incoloy™ 825
Weight	Stainless Steel 316L Incoloy™ 825	142 kg/km 144 kg/km
Fibre Types		Single-mode, Multimode, Pure Silica Core Single-mode
Fibre Coating		Polyimide, Carbon Polyimide, Silicone/PFA, Gold, Aluminum, Copper
Gel Types		No gel, high temperature gel, hydrogen scavenging gel
Polymer Options		Polypropylene, PVDF, Nylon, Santoprene™
Operating Temperature		-40°C to 300°C, higher upon request
Operating Pressure Limit		0 to 20,000 psi

MiniBend™ Fibre Optic Component

For Downhole Double-ended Systems and Optical Connectivity

The MiniBend miniature fibre optic component employs a revolutionary technology that will change the way you plan and engineer the fibre management in your oil or gas well. This patented technology allows for a single strand of multimode or single-mode fibre to be formed at a 180° bend with a 1 mm fibre bend diameter, saving valuable real estate.

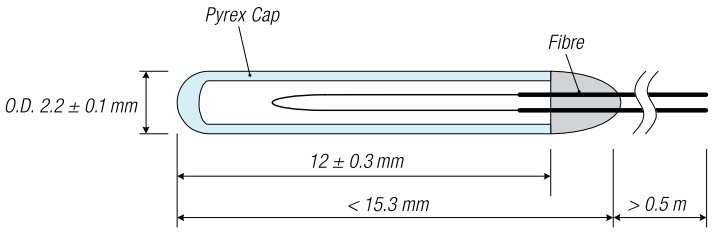
Features

- Elegant, low profile solution for achieving downhole fibre optic double-ended system
- Provides low-loss sub-millimeter bends for miniaturizing fibre components and circuits
- No stress with the small bend radii
- Bi-directional
- Mechanically and environmentally robust
- Small and protective package

Applications

- Downhole fibre optic turnaround
- Fibre management systems
- Modulators, splitters, circulators, connectors and polarisers
- Circuit boards and back planes
- Compact test instrumentation and sensors

Dimensions



Specifications

PARAMETER	VALUE			
Item Number	DNS-1574	DNS-1575	DNS-1885	DNS-1890
Fibre Coating Type	50 µm multimode carbon mid-temperature acrylate	50 µm multimode carbon/polyimide	single-mode carbon mid-temperature acrylate	single-mode carbon/polyimide
Operation Wavelength Range	900 to 1340 nm, 1430 to 1600 nm		1280 to 1340 nm, 1430 to 1600 nm	
Insertion Loss	< 0.2 dB at 1310 nm of wavelength at room temperature		< 0.3 dB at 1550 nm of wavelength at room temperature	
Operating Temperature	0 to 150°C	0 to 200°C	0 to 150°C	0 to 200°C
Storage Temperature	-60 to 85°C			
Body Size	Outside Diameter = 2.2 mm +/-0.1, Length = 15 mm +/-0.3			
Fibre Tail Length	> 0.5 m			
Straight Pull	500 g			

Verrillon®
Harsh Environment Fibres

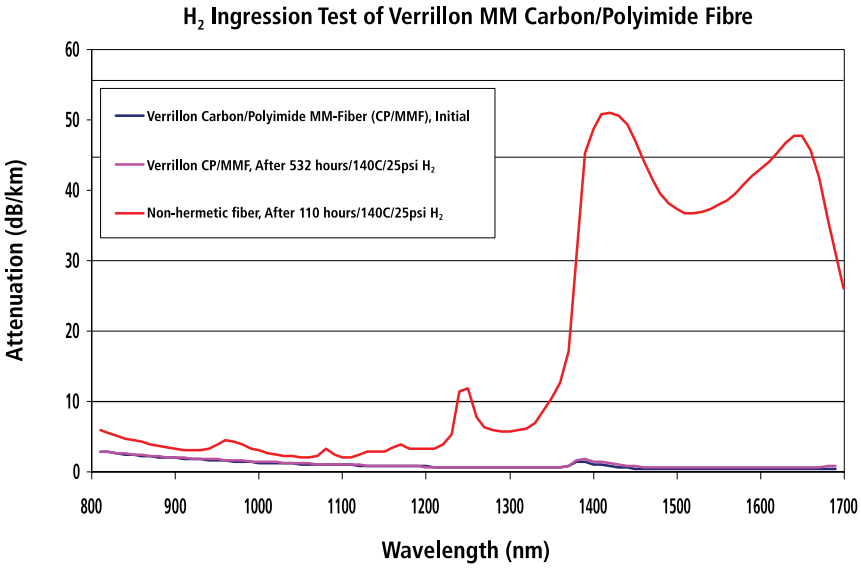
Verrillon Harsh Environment Fibres from AFL are available in a number of designs. Starting with fibre design, we offer both single-mode and multimode optical fibres having coatings and coating combinations, including Polyimide, Silicone-PFA, Silicone-MTA, MTA and Carbon, which can be applied in conjunction with any of these outer coatings. Typically, these fibres are used in downhole data logging, distributed sensing and imaging applications.

Verrillon coated fibres provide exceptionally high levels of hermeticity compared to commercial fibres. We provide extensive data that demonstrates the performance of our fibre. In addition, we provide one-stop shopping for customers requiring multi-count cabled hermetic fibres, if required, in metal jacketing tubes.

Consistent with our founding principles, we specialize in application optimised fibres, providing our customers unmatched flexibility in the their system design and performance.

Features

- Wide range of protective coatings available, depending on application requirements
- Suitable for use in high pressure, high temperature and corrosive environments
- Carbon fibre provides exceptional resistance to H2 and moisture ingression
- Predicted lifetime for hermetic fibre under typical operating conditions that exceed most requirements
- Extensive test and measurement data for optical fibre performance under "harsh conditions" provided with fibre



Verrillon®
Harsh Environment Fibres

Verrillon offers the broadest range of specialty fibres for oil and gas sensors of all types:

- Distributed Temperature Sensors – **DTS**
- Distributed Pressure Sensors – **DPS**
- Distributed Strain Sensors – **DSS**
- Distributed Acoustic Sensors – **DAS**
- Ocean Bottom Seismic - **OBS**

Verrillon Optical Fibre Selection Matrix

MAXIMUM TEMPERATURE	CONDITIONS	SINGLE-MODE	MULTIMODE
85°C	Hydrogen Present	VHS100-CA	VHM2000-CA
150°C	No Hydrogen	VHS100-MTDA VHS100-SMTA	VHM2000-MTDA VHM2000-SMTA
	Hydrogen Present	VHS100-CMTDA VHS100-CSMTA	VHM2000-CMTDA VHM2000-CSMTA
200°C	All Conditions	VHS500-CSPFA VHS500-P VHS500-CP	VHM3000-CSPFA VHM3000-P VHM3000-CP
300°C	All Conditions	VHS500-P VHS500-CP	VHM3000-P VHM5000-P VHM3000-CP VHM5000-CP

Verrillon®
VHM5000 Series Fibres

Verrillon Harsh Environment Fibres from AFL are available in a number of designs. The VHM5000 Series is a multimode graded-index optical fibre available with coatings and coating combinations, including Polyimide, high temperature acrylates, Silicone-PFA and hermetic Carbon. Typically, these fibres are used in down-hole data logging, distributed sensing and imaging applications where the temperature and hydrogen partial pressures are extreme.

Verrillon carbon-coated optical fibres provide exceptionally high levels of hermeticity compared to commercial fibres. We provide extensive data that demonstrates the performance of our fibre. In addition, we provide one-stop shopping for customers requiring multi-count cabled hermetic fibres, if required, in metal jacketing tubes.

Consistent with our founding principles, we specialise in application optimized fibres, providing our customers unmatched flexibility in the their system design and performance.

Features

- Best glass resistance to hydrogen at high temperatures and pressures in the entire industry
- Wide range of protective coatings available, depending on application requirements
- Suitable for use in high pressure, high temperature and corrosive environments
- Carbon coating provides exceptional resistance to H_2 and moisture ingression
- Predicted lifetime for hermetic fibre under typical operating conditions exceeds most requirements
- Extensive test and measurement data for optical fibre performance under "harsh conditions" provided with fibre

Specifications

PART NO.	**MMF-50-4-P-125-4**
Description	50/125/155 µm Polyimide coated, Graded Index, Multimode Fibre
PARAMETER	**VALUE**
Material	
Coating	Polyimide
Geometry	
Core Diameter (µm)	50 ± 2.5
Clad Diameter (µm)	125 ± 2
Core Non-Circularity (%)	≤ 5
Clad Non-Circularity (%)	≤ 1
Core/Clad Offset (µm)	≤ 1.5
Coating Diameter (µm)	155 ± 5
Polyimide Coating Concentricity[1]	≥ 80
Optical	
NA (nominal)	0.20
Attenuation[2] @ 850 nm (dB/km) @ 1300 nm (dB/km)	 ≤ 3.0 ≤ 1.2
Bandwidth @ 850 nm (MHz-km) @ 1300 nm (MHz-km)	 ≥ 300 ≥ 300
Mechanical	
Proof Test (kpsi)	≥ 100
Operating Temperature (°C)	-65 to +300

[1] Measured as (Min. Wall/Max. Wall) x 100 [2] Measured on loose coil

Verrillon®
VHM5000 Series Fibres

Specifications

PART NO.	MMF-50-4-CP-125-2	MMF-50-4-CP-125-3	MMF-50-4-CP-125-4
Description	50/125/155 µm Carbon/Polyimide coated, Graded Index Multimode Fibre, 200 kpsi	50/125/155 µm Carbon/Polyimide Graded Index, Multimode Fibre, 150 kpsi	50/125/155 µm Carbon/Polyimide coated, Graded Index Multimode Fibre
PARAMETER	**VALUE**		
Material			
Hermetic	Carbon	Carbon	Carbon
Coating	Polyimide	Polyimide	Polyimide
Geometry			
Core Diameter (µm)	50 ± 2.5	50 ± 2.5	50 ± 2.5
Clad Diameter (µm)	125 ± 2	125 ± 2	125 ± 2
Core Non-Circularity (%)	≤ 5	≤ 5	≤ 5
Clad Non-Circularity (%)	≤ 1	≤ 1	≤ 1
Core/Clad Offset (µm)	≤ 1.5	≤ 1.5	≤ 1.5
Coating Diameter (µm)	155 ± 5	155 ± 5	155 ± 5
Polyimide Coating Concentricity[1]	≥ 80	≥ 80	≥ 80
Optical			
NA (nominal)	0.20	0.20	0.20
Attenuation[2] @ 850 nm (dB/km) @ 1300 nm (dB/km)	 ≤ 3.0 ≤ 1.2	 ≤ 3.0 ≤ 1.2	 ≤ 3.0 ≤ 1.2
Bandwidth @ 850 nm (MHz-km) @ 1300 nm (MHz-km)	 ≥ 300 ≥ 300	 ≥ 300 ≥ 300	 ≥ 300 ≥ 300
Mechanical			
Proof Test (kpsi)	≥ 200	≥ 150	≥ 100
Operating Temperature (°C)	-65 to +300	-65 to +300	-65 to +300

[1] Measured as (Min. Wall/Max. Wall) x 100

[2] Measured on loose coil

Verrillon®
VHM5000 Series Fibres

Specifications

PART NO.	MMF-50-4-CSPFA-125-1	MMF-50-4-CSPFA-125-5	MMF-50-4-CSPFA-125-6	MMF-50-4-CSPFA-125-7
Description	50/125/750 µm Carbon/ Silicone/PFA, Graded Index, Multimode Fibre, 150 kpsi	50/125/400 µm Carbon/ Silicone/PFA coated, Graded Index, Multimode Fibre	50/125/250 µm Carbon/ Silicone/PFA coated, Graded Index, Multimode Fibre	50/125/250 µm Carbon/ Silicone/PFA coated, Graded Index, Multimode Fibre, 150 kpsi
PARAMETER	**VALUE**			
Material				
Hermetic	Carbon	Carbon	Carbon	Carbon
Primary Coating	Silicone	Silicone	Silicone	Silicone
Secondary Coating	PFA	PFA	PFA	PFA
Geometry				
Core Diameter (µm)	50 ± 2.5	50 ± 2.5	50 ± 2.5	50 ± 2.5
Clad Diameter (µm)	125 ± 2	125 ± 2	125 ± 2	125 ± 2
Core Non-Circularity (%)	≤ 5	≤ 5	≤ 5	≤ 5
Clad Non-Circularity (%)	≤ 1	≤ 1	≤ 1	≤ 1
Core/Clad Offset (µm)	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5
Combined Coating Diameter (µm)	750 ± 25	400 ± 50	250 ± 50	250 ± 50
Optical				
NA (nominal)	0.20	0.20	0.20	0.20
Attenuation[1] @ 850 nm (dB/km) @ 1300 nm (dB/km)	 ≤ 3.0 ≤ 1.0	 ≤ 3.0 ≤ 1.2	 ≤ 3.0 ≤ 1.2	 ≤ 3.0 ≤ 1.2
Bandwidth @ 850 nm (MHz-km) @ 1300 nm (MHz-km)	 ≥ 300 ≥ 300	 ≥ 300 ≥ 300	 ≥ 300 ≥ 300	 ≥ 300 ≥ 300
Mechanical				
Proof Test (kpsi)	≥ 150	≥ 100	≥ 100	≥ 150
Operating Temperature (°C)	-40 to +200	-40 to +200	-40 to +200	-40 to +200

[1] Measured on loose coil

Verrillon®
VHM2000 Series Fibres

Verrillon Harsh Environment Fibres from AFL are available in a number of designs. Starting with fibre design, we offer both single-mode and multimode optical fibres having coatings and coating combinations, including Polyimide, Silicone-PFA, Silicone-MTA, MTA and Carbon, which can be applied in conjunction with any of these outer coatings. Typically, these fibres are used in downhole data logging, distributed sensing and imaging applications.

Verrillon carbon-coated optical fibres provide exceptionally high levels of hermeticity compared to commercial fibres. We provide extensive data that demonstrates the performance of our fibre. In addition, we provide one-stop shopping for customers requiring multi-count cabled hermetic fibres, if required, in metal jacketing tubes.

Consistent with our founding principles, we specialize in application optimised fibres, providing our customers unmatched flexibility in the their system design and performance.

Features

- 50/125 µm graded index multimode fibre, enhanced resistance level to H_2 ingression
- Suitable for use in low/mid-temperature, no/low hydrogen environments
- Carbon coating provides exceptional resistance to H_2 and moisture ingression
- Wide range of protective coatings available

Specifications

PART NO.	**MMF-50-3-CP-125-3**	**MMF-50-3-P-125-3**
Description	50/125/155 µm Carbon/Polyimide coated, Graded Index, Multimode Fibre	50/125/155 µm Polyimide coated, Graded Index, Multimode Fibre
PARAMETER	**VALUE**	
Material		
Hermetic Coating	Carbon	—
Coating	Polyimide	Polyimide
Geometry		
Core Diameter (µm)	50 ± 2.5	50 ± 2.5
Clad Diameter (µm)	125 ± 2	125 ± 2
Core Non-Circularity (%)	≤ 5	≤ 5
Clad Non-Circularity (%)	≤ 1	≤ 1
Core/Clad Offset (µm)	≤ 1.5	≤ 1.5
Coating Diameter (µm)	155 ± 5	155 ± 5
Polyimide Coating Concentricity[1]	≥ 80	≥ 80
Optical		
NA (nominal)	0.20	0.20
Attenuation[2] @ 850 nm (dB/km) @ 1300 nm (dB/km)	 ≤ 3.0 ≤ 1.2	 ≤ 3.0 ≤ 1.2
Bandwidth @ 850 nm (MHz-km) @ 1300 nm (MHz-km)	 ≥ 300 ≥ 300	 ≥ 300 ≥ 300
Mechanical		
Proof Test (kpsi)	≥ 100	≥ 100
Operating Temperature (°C)	-65 to +300	-65 to +300

[1] Measured as (Min. Wall/Max. Wall) x 100

[2] Measured on loose coil

Verrillon®
VHM2000 Series Fibres

Specifications

PART NO.	MMF-50-3-MTDA-125-3	MMF-50-3-CSMTA-125-3	MMF-50-3-CMTDA-125-3	MMF-50-3-CMTDA-125-4
Description	50/125/245 µm Mid-Temp Dual Acrylate coated, Graded Index, Multimode Fibre	50/125/245 µm Carbon/ Si/Mid-Temp Dual Acrylate, Graded Index, Multimode Fibre	50/125/245 µm Carbon/ Mid-Temp Dual Acrylate coated, Graded Index, Multimode Fibre	50/125/245 µm Carbon/ Mid-Temp Dual Acrylate, Graded Index, Multimode Fibre, 200 kpsi
PARAMETER	**VALUE**			
Material				
Hermetic Coating	—	Carbon	Carbon	Carbon
Primary Coating	Mid-Temp Dual Acrylate	Silicone	Mid-Temp Dual Acrylate	Mid-Temp Dual Acrylate
Secondary Coating	Mid-Temp Dual Acrylate	Mid-Temp Dual Acrylate	Mid-Temp Dual Acrylate	Mid-Temp Dual Acrylate
Geometry				
Core Diameter (µm)	50 ± 2.5	50 ± 2.5	50 ± 2.5	50 ± 2.5
Clad Diameter (µm)	125 ± 2	125 ± 2	125 ± 2	125 ± 2
Core Non-Circularity (%)	≤ 5	≤ 5	≤ 5	≤ 5
Clad Non-Circularity (%)	≤ 1	≤ 1	≤ 1	≤ 1
Core/Clad Offset (µm)	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5
Combined Coating Diameter (µm)	245 ± 5	245 ± 20	245 ± 5	245 ± 5
Optical				
NA (nominal)	0.20	0.20	0.20	0.20
Attenuation @ 850 nm (dB/km) @ 1300 nm (dB/km)	 ≤ 2.5 ≤ 0.7	 ≤ 3.0 ≤ 1.2	 ≤ 2.5 ≤ 0.7	 ≤ 2.5 ≤ 0.7
Bandwidth @ 850 nm (MHz-km) @ 1300 nm (MHz-km)	 ≥ 300 ≥ 300	 ≥ 300 ≥ 300	 ≥ 300 ≥ 300	 ≥ 300 ≥ 300
Mechanical				
Proof Test (kpsi)	≥ 100	≥ 100	≥ 100	≥ 200
Operating Temperature (°C)	-40 to +150	-40 to +150	-40 to +150	-40 to +150

Verrillon®
VHM2000 Series Fibres

Specifications

PART NO.	MMF-50-3-SPFA-125-1	MMF-50-3-SPFA-125-6	MMF-50-3-CSPFA-125-5
Description	50/125/700 µm Silicone/PFA coated, Graded Index, Multimode Fibre	50/125/250 µm Silicone/PFA coated, Graded Index, Multimode Fibre	50/125/400 µm Carbon/Silicone/PFA coated, Graded Index Multimode Fibre
PARAMETER	**VALUE**		
Material			
Hermetic Coating	—	—	Carbon
Primary Coating	Silicone	Silicone	Silicone
Secondary Coating	PFA	PFA	PFA
Geometry			
Core Diameter (µm)	50 ± 2.5	50 ± 3	50 ± 2.5
Clad Diameter (µm)	125 ± 2	125 ± 2	125 ± 2
Core Non-Circularity (%)	≤ 5	≤ 5	≤ 5
Clad Non-Circularity (%)	≤ 1	≤ 1	≤ 1
Core/Clad Offset (µm)	≤ 1.5	≤ 1.5	≤ 1.5
Combined Coating Diameter (µm)	700 ± 50	250 ± 50	400 ± 50
Optical			
NA (nominal)	0.20	0.20	0.20
Attenuation[1] @ 850 nm (dB/km) @ 1300 nm (dB/km)	 ≤ 3.0 ≤ 1.2	 ≤ 3.0 ≤ 0.8	 ≤ 3.0 ≤ 1.2
Bandwidth @ 850 nm (MHz-km) @ 1300 nm (MHz-km)	 ≥ 300 ≥ 300	 ≥ 300 ≥ 300	 ≥ 300 ≥ 300
Mechanical			
Proof Test (kpsi)	≥ 100	≥ 100	≥ 100
Operating Temperature (°C)	-40 to +200	-40 to +200	-40 to +200

[1] Measured on loose coil

Verrillon®
VHS500 Series Fibres

Verrillon Harsh Environment Fibres from AFL are available in a number of designs. VHS500 is a pure silica core single-mode design available with all Verrillon harsh environment coating combinations, including Polyimide, Silicone-PFA, Silicone-MTA, MTA and Carbon, which can be applied in conjunction with any of these polymeric coatings. Typically, these fibres are used in downhole distributed sensing techniques for temperature, pressure, acoustics and seismic, as well as in data logging and imaging applications.

Our carbon-coated optical fibres provide exceptionally high levels of hermeticity compared to commercial fibres. We provide extensive data that demonstrates the performance of our fibre in simulated well conditions. In addition, we provide one-stop shopping for customers requiring single or multi-count cabled hermetic fibres in metal jacketing tubes and polymeric configurations.

Consistent with our founding principles, we specialize in application-optimised fibres, providing our customers unmatched flexibility in their system design and performance.

Applications

- Downhole in oil and gas
- Cabling processes with tight bending requirements
- Harsh environment applications
- Tight bend fibre installations

Features

- Optimised for 1550 nm Single Wavelength Operation
- Pure Silica Core chemistry for improved performance in hydrogen-rich environments
- Greater than 50x bend loss improvement at 1550 nm over standard SMF
- MFD compatible with standard SMF for ease of splicing and minimal splice loss
- Available with all Verrillon harsh environment coatings

Specifications

PART NO.	SMF-60-CP-125-1	SMF-60-P-125-1
Description	125/155 µm Carbon/Polyimide coated Single-mode fibre, 0.12 NA, 100 kpsi, 1550 nm Operating Wavelength	125/155 µm Polyimide coated Single-mode fibre, 0.12 NA, 100 kpsi, 1550 nm Operating Wavelength
PARAMETER	**VALUE**	
Material		
Hermetic Coating	Carbon	—
Coating	Polyimide	Polyimide
Geometry		
Clad Diameter (µm)	125 ± 2	125 ± 2
Clad Non-Circularity (%)	≤ 3	≤ 3
Core/Clad Offset (µm)	≤ 1.5	≤ 1.5
Coating Diameter (µm)	155 ± 5	155 ± 5
Polyimide Coating Concentricity[1] (%)	≥ 80	≥ 80
Optical		
NA (nominal)	0.12	0.12
Attenuation[2] @ 1550 nm (dB/km)	≤ 0.8	≤ 0.8
Cutoff Wavelength (nm)	≤ 1530	≤ 1530
Mode Field Diameter[3] @ 1550 nm (dB/km)	10.0 ± 0.7	10.0 ± 0.7
Mechanical		
Proof Test (kpsi)	≥ 100	≥ 100
Operating Temperature (°C)	-65 to +300	-65 to +300

[1] (Min. Wall/Max. Wall) x 100 [2] Measured on loose coil [3] Petermann II Definition

Verrillon®
VHS500 Series Fibres

Specifications

PART NO.	SMF-60-CSPFA-125-3	SMF-60-CSPFA-125-7
Description	125/700 µm Carbon/Silicone/PFA coated Single-mode fibre, 0.12 NA, 100 kpsi, 1550 nm Operating Wavelength	125/250 µm Carbon/Silicone/PFA coated Single-mode fibre, 0.12 NA, 150 kpsi, 1550 nm Operating Wavelength
PARAMETER	**VALUE**	
Material		
Hermetic Coating	Carbon	Carbon
Primary Coating	Silicone	Silicone
Secondary Coating	PFA	PFA
Geometry		
Clad Diameter (µm)	125 ± 2	125 ± 2
Core/Clad Offset (µm)	≤ 1.5	≤ 1.5
Combined Coating Diameter (µm)	700 ± 50	250 ± 50
Optical		
NA (nominal)	0.12	0.12
Attenuation @ 1550 nm (dB/km)	≤ 0.8	≤ 0.8
Cutoff Wavelength (nm)	≤ 1530	≤ 1530
Mode Field Diameter[1] @ 1550 nm (dB/km)	10.0 ± 0.7	10.0 ± 0.7
Mechanical		
Proof Test (kpsi)	≥ 100	≥ 150
Operating Temperature (°C)	-40 to +200	-40 to +200

[1] Petermann II Definition

Specifications

PART NO.	SMF-60-CMTDA-125-1
Description	125/245 µm Carbon Mid-Temp Dual Acrylate, Pure Silica Core, Single-mode fibre, 0.12 NA, 100 kpsi, 1550 nm Operating Wavelength
PARAMETER	**VALUE**
Material	
Hermetic Coating	Carbon
Coating	Mid-Temp Dual Acrylate
Geometry	
Clad Diameter (µm)	125 ± 2
Core/Clad Offset (µm)	≤ 1.5
Coating Diameter (µm)	245 ± 15
Optical	
NA (nominal)	0.12
Attenuation @ 1550 nm (dB/km)	≤ 0.8
Cutoff Wavelength (nm)	≤ 1530
Mode Field Diameter[1] @ 1550 nm (dB/km)	10.0 ± 0.7
Mechanical	
Proof Test (kpsi)	≥ 100
Operating Temperature (°C)	-40 to +150

[1] Petermann II Definition

Verrillon®
VHS100 Series Fibres

Verrillon Harsh Environment Fibres from AFL are available in a number of designs. Starting with fibre design, we offer both single-mode and multimode optical fibres having coatings and coating combinations, including Polyimide, Silicone-PFA and Carbon, which can be applied in conjunction with any of these outer coatings. Typically, these fibres are used in down-hole data logging, distributed sensing and imaging applications.

Verrillon carbon-coated optical fibres provide exceptionally high levels of hermeticity compared to commercial fibres. We provide extensive data that demonstrates the performance of our fibre. In addition, we provide one-stop shopping for customers requiring multi-count cabled hermetic fibres, if required, in metal jacketing tubes.

Consistent with our founding principles, we specialize in application optimised fibres, providing our customers unmatched flexibility in the their system design and performance.

Features

- Equivalent to 'standard' telecom SMF
- Optimized for 1310/1550 nm Dual Wavelength Operation
- Carbon coating provides exceptional resistance to H_2 and moisture ingression
- Wide range of protective coatings available

Specifications

PART NO.	SMF-1-P-125-2	SMF-1-P-125-3	SMF-1-CP-125-3
Description	125/155 µm Polyimide, Single-mode fibre, 0.12NA, 150 kpsi	125/155 µm Polyimide, Single-mode fibre, 0.12NA, 100 kpsi	125/155 µm Carbon/Polyimide, Single-mode fibre, 0.12NA, 100 kpsi
PARAMETER	**VALUE**		
Material			
Hermetic Coating	—	—	Carbon
Coating	Polyimide	Polyimide	Polyimide
Geometry			
Clad Diameter (µm)	125 ± 2	125 ± 2	125 ± 2
Core/Clad Offset (µm)	≤ 0.5	≤ 0.5	≤ 0.5
Coating Diameter (µm)	155 ± 5	155 ± 5	155 ± 5
Polyimide Coating Concentricity[1] (%)	≥ 80	≥ 80	≥ 80
Optical			
NA (nominal)	0.12	0.12	0.12
Attenuation[2] @ 1310 nm (dB/km) @ 1550 nm (dB/km)	 ≤ 0.7 ≤ 0.6	 ≤ 0.7 ≤ 0.6	 ≤ 0.7 ≤ 0.6
Cutoff Wavelength (nm)	1250 ± 50	1250 ± 50	1250 ±50
Mode Field Diameter[3] @ 1310 nm (µm) @ 1550 nm (µm)	 9.2 ± 0.6 10.4 ± 0.8	 9.2 ± 0.6 10.4 ± 0.8	 9.2 ± 0.6 10.4 ± 0.8
Mechanical			
Proof Test (kpsi)	≥ 150	≥ 100	≥ 100
Operating Temperature (°C)	-65 to +300	-65 to +300	-65 to +300

[1] Measured as (Min. Wall/Max. Wall) x 100 [2] Measured on Zero Tension spool [3] Petermann II Definition

Verrillon®
VHS100 Series Fibres

Specifications

PART NO.	SMF-1-CMTDA-125-1
Description	125/245 µm Carbon/ Mid-Temp Dual Acrylate coated, Single-mode fibre 0.12NA, 100 kpsi
PARAMETER	**VALUE**
Material	
Hermetic Coating	Carbon
Coating	Mid-Temp Dual Acrylate
Geometry	
Clad Diameter (µm)	125 ± 2
Core/Clad Offset (µm)	≤ 0.5
Coating Diameter (µm)	245 ± 15
Optical	
NA (nominal)	0.12
Attenuation[1] @ 1310 nm (dB/km) @ 1550 nm (dB/km)	 ≤ 0.5 ≤ 0.3
Cutoff Wavelength (nm)	≤ 1250 ±50
Mode Field Diameter[2] @ 1310 nm (µm) @ 1550 nm (µm)	 9.2 ± 0.6 10.4 ± 0.8
Mechanical	
Proof Test (kpsi)	≥ 100
Operating Temperature (°C)	-40 to +150

[1] Measured on loose coil [2] Petermann II Definition

Specifications

PART NO.	SMF-1-MTDA-125-1
Description	125/245 µm Mid-Temp Dual Acrylate coated, Single-mode fibre, 0.12NA, 100 kpsi
PARAMETER	**VALUE**
Material	
Coating	Mid-Temp Dual Acrylate
Geometry	
Clad Diameter (µm)	125 ± 2
Core/Clad Offset (µm)	≤ 0.5
Coating Diameter (µm)	245 ± 5
Optical	
NA (nominal)	0.12
Attenuation @ 1310 nm (dB/km) @ 1550 nm (dB/km)	 ≤ 0.40 ≤ 0.25
Cutoff Wavelength (nm)	1250 ± 50
Mode Field Diameter[1] @ 1310 nm (µm) @ 1550 nm (µm)	 9.2 ± 0.6 10.4 ± 0.8
Mechanical	
Proof Test (kpsi)	≥ 100
Operating Temperature (°C)	-40 to +150

[1] Petermann II Definition

Verrillon®
VHS100 Series Fibres

Specifications

PART NO.	SMF-1-CA-125-2	SMF-1-CA-125-3
Description	125/245 µm Carbon/Acrylate coated, Single-mode Fibre, 0.12 NA, 200 kpsi	125/245 µm Carbon/Acrylate coated, Single-mode Fibre, 0.12 NA, 100 kpsi
PARAMETER	**VALUE**	
Material		
Hermetic Coating	Carbon	Carbon
Coating	UV Acrylate	UV Acrylate
Geometry		
Clad Diameter (µm)	125 ± 2	125 ± 2
Core/Clad Offset (µm)	≤ 0.5	≤ 0.5
Coating Diameter (µm)	245 ± 15	245 ± 15
Optical		
NA (nominal)	0.12	0.12
Attenuation[1] @ 1310 nm (dB/km) @ 1550 nm (dB/km)	 ≤ 0.6 ≤ 0.5	 ≤ 0.6 ≤ 0.5
Cutoff Wavelength (nm)	≤ 1250 ±50	≤ 1250 ±50
Mode Field Diameter[2] @ 1310 nm (µm) @ 1550 nm (µm)	 9.2 ± 0.6 10.4 ± 1.0	 9.2 ± 0.6 10.4 ± 1.0
Mechanical		
Proof Test (kpsi)	≥ 200	≥ 100
Operating Temperature (°C)	-40 to +85	-40 to +85

[1] Measured on loose coil

[2] Petermann II Definition

Verrillon®
VPM400 Series Fibres

Verrillon® VPM400 Series is a family of Polarization-Maintaining (PM) Optical Fibres based on the Elliptical-Clad stress technology. These fibres exhibit extremely high birefringence resulting in beat lengths shorter than 2 mm at 1550 nm. VPM400 fibres show significantly lower attenuation at 1550 nm than other PM fibre designs. These fibres are available in various designs and operating wavelengths, as well cladding dimensions including 50, 80 and 125 microns.

Features

- Optimized for 1550 nm Single Wavelength Operation
- Round core
- Elliptical Clad designs provide high birefringence allowing the fibre to have an extremely short beat-length, excellent for high-precision gyroscopes
- Radiation-Resistant "Rad-Hard"
- Available in 80 µm clad diameter

Applications

- Fibre optic gyroscopes
- Fibre lasers
- Current sensors

Specifications

PART NO.	PMF-9-A-80-1	PMF-12-A-80-1
Description	80 µm Elliptical Clad Polarization maintaining Single-mode Fibre, 1550 nm Operational Wavelength	80 µm Elliptical Clad Polarization maintaining Single-mode Fibre, 1550 nm Operational Wavelength
PARAMETER	**VALUE**	
Material		
Coating	Dual UV Acrylate	Acrylate
Stress-inducing Design	Elliptical Clad	Elliptical Clad
Geometry		
Clad Diameter (µm)	80 ± 2	80 ± 2
Core/Clad Concentricity (µm)	≤ 1.0	≤ 1.0
Coating Diameter (µm)	165 ± 10	160 ± 10
Optical		
NA (nominal)	0.20	0.20
Attenuation (dB/km) @ 1550 nm	≤ 0.5	≤ 1.5
Mode Field Diameter[1] (µm) @ 1550 nm	7.0 ± 1.0	6.5 ± 0.5
Operational Wavelength (nm)	1550	1550
Cutoff Wavelength (nm)	≤ 1480	< 1520
Beat Length (mm) @ 1550 nm	≤ 2.00	≤ 2.2
Bend Loss[2] (dB/turn) @ 1550 nm	≤ 0.05	—
H-Parameter	—	≤ 5.0×10^{-5}
Mechanical		
Proof Test (kpsi)	≥ 100	≥ 100
Operating Temperature (°C)	-10 to +70	-60 to +80

[1] Gaussian Definition [2] 12 mm diameter mandrel

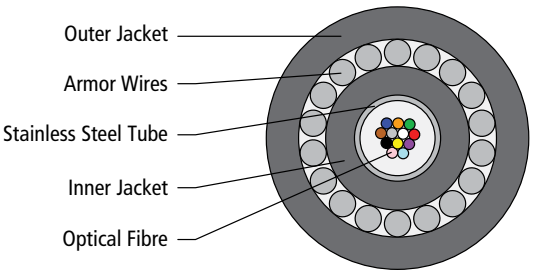
Fibre Optic Component for Umbilical Cable

AFL's Fibre Optic Component for Umbilical Cable is designed for subsea umbilical applications. AFL is the technology owner for hermetic stainless steel tubes which are the key building block for subsea cables. AFL provides customized designs to meet the most stringent requirements. AFL's Fibre Optic Component is suitable for depths of 10,000 feet and beyond.

Features

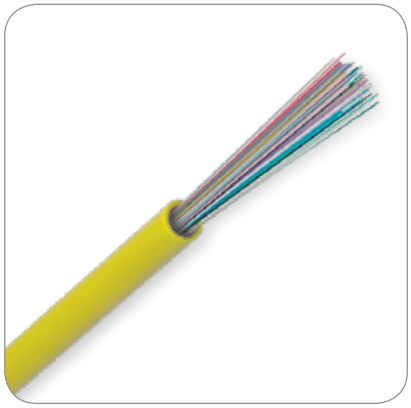
- Hermetic Stainless Steel Tube
- High Strength Wire
- Polyethylene Jacketed
- Hydrogen scavenging gel
- Long lengths
- In-line splice technology
- Proven technology
- Long life expectancy
- Custom Jacket Colours

Cable Components



Options and Specifications

PARAMETER	VALUE
Number of Fibres	Up to 72
Fibre	Single-mode, Multimode, 100 or 200 kpsi proof test
Stainless Steel Tube Sizes	2.4 mm to 3.8 mm
Stainless Steel Tube Types	304 or 316L Stainless Steel
Armor	16 x 1.02 mm (0.040") wires, a range of tensile specifications are available
Fibre Colours	EIA 598 or customer specification
Unit Weight	150 to 300 kg/km
Overall Diameter	7 mm to 16 mm
Storage Temperature Range	-40 to +85°C
Operating Temperature Range	-40 to +85°C
Breaking Load	Up to 25 kN (dependant on armor selection)
Bend Radius (design dependent)	120 mm to 320 mm
Cable Marking	To customer specification



Specialty Fibre Optic Plastic Buffer Tubes

AFL provides fibre optic plastic buffer tubes in a variety of sizes with various fibre counts. These tubes can be used in multiple applications as subcomponents in Umbilical Cables, Gas, Sewer and Water Line Fibre Optic Cables, Optical Ground Wire and Sensor Cables.

Anywhere there is a need for a fibre optic cable or component, AFL can provide or engineer the appropriate solution.

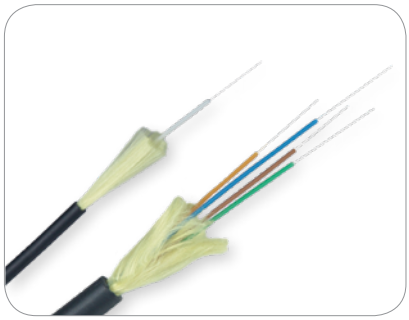
Applications

- Umbilical Cables
- Gas, Sewer and Water Line Fibre Optic Cables
- Optical Ground Wire
- Sensor Cables

Specifications

ITEM NUMBER	OUTSIDE DIAMETER (INCHES)	INSIDE DIAMETER (INCHES)	WALL THICKNESS (INCHES)	MAXIMUM FIBRE COUNT	OUTSIDE DIAMETER (MM)	INSIDE DIAMETER (MM)
1	0.063	0.047	0.008	4	1.60	1.20
2	0.079	0.055	0.012	6	2.00	1.40
3	0.083	0.059	0.012	8	2.10	1.50
4	0.087	0.067	0.010	12	2.20	1.70
5	0.098	0.075	0.012	12	2.50	1.90
6	0.106	0.077	0.015	12	2.70	1.95
7	0.118	0.087	0.016	18	3.00	2.20
8	0.140	0.106	0.017	24	3.55	2.70

Available in PBT. Others sizes and materials available on request.



Temperature Specifications

TEMPERATURE RANGE	
INSTALLATION	-46°C to +85°C
OPERATING	-46°C to +85°C
STORAGE	-55°C to +85°C

Tactical Tight Buffered Cable

AFL Tactical Tight Buffered Cables are ideal for use in installations where extreme environmental conditions are present. Designed to be deployed and retrieved in the field, AFL's Tactical Tight Buffered Cables are highly resistant to damage caused by repeated impacts crushing forces, abrasion and extreme temperatures.

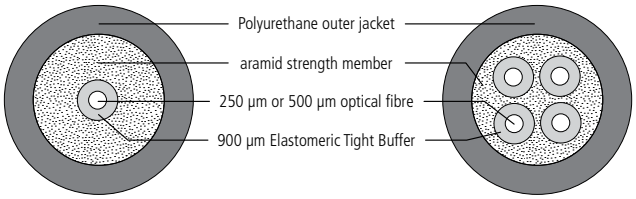
Features

- Cut resistant polyurethane jacket with flame retardant options available
- Highly flexible construction allows for multiple deployments
- All aramid strength members
- Performance in wide temperature range
- High impact and crush resistance
- Durable in high traffic areas
- MIL-PRF-46291 qualified fibre available (-RH designation)
- Tested to meet MIL-PRF-85045

Applications

- Field deployment in abusive environments
- Temporary installation of critical communications lines where quick retrieval and re-use is necessary
- High Traffic areas
- Security and Sensing applications
- Broadcast deployments
- Installations in harsh environments

Cable Components



Specifications

CHARACTERISTIC	TEST PROCEDURE	PERFORMANCE
Tensile and elongation	EIA/TIA-455-33	
Operating tensile strength	EIA/TIA-455-33	
Low-temp flexibility	EIA/TIA-455-37	
Cyclic flexing	EIA/TIA-455-104	2000
Crush resistance	EIA/TIA-455-41	1800 N/cm or greater
Impact	EIA/TIA-455-25	200
Temperature cycling	EIA/TIA-455-3	-46°C to 85°C
Temperature/humidity cycling	EIA/TIA-455-5 Method B	
Life aging	EIA/TIA-455-4	
Freezing water immersion	EIA/TIA-455-98	

Tactical Tight Buffered Cable

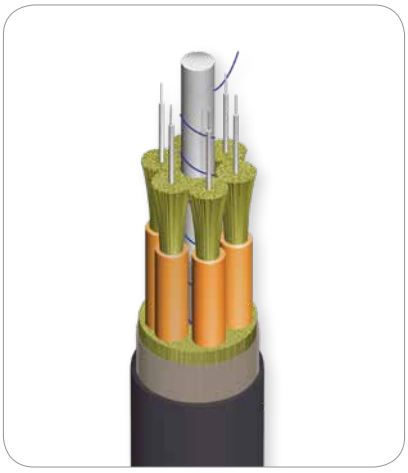
Mechanical Data

AFL NO.	FIBRE COUNT	NOMINAL DIA.		NOMINAL WT.		MAXIMUM TENSILE LOAD LBS (N)		MINIMUM BEND RADIUS INCHES (CM)	
		INCHES	(MM)	LBS/1000FT	(KG/KM)	INSTALLATION	LONG TERM	INSTALLATION	LONG TERM
XU001 30180H-SH	1	0.12	(3.0)	5.4	(8)	135 (600)	40 (178)	1.8 (4.5)	1.2 (3.0)
XU001 40180H-SH	1	0.16	(4.0)	9.1	(13.5)	180 (800)	54 (240)	2.4 (6.0)	1.6 (4.0)
XU001 46180H-SH	1	0.18	(4.6)	12.2	(18.1)	180 (800)	54 (240)	2.7 (6.9)	1.8 (4.6)
XU002 55180H-SH	2	0.22	(5.5)	16.2	(25)	400 (1780)	130 (578)	2.2 (5.5)	1.1 (2.8)
XU004 55180H-SH	4	0.22	(5.5)	16.2	(25)	400 (1780)	130 (578)	2.2 (5.5)	1.1 (2.8)
XU002 58180H-SH	2	0.23	(5.8)	21.5	(32)	400 (1780)	130 (578)	3.4 (8.7)	2.3 (5.8)
XU004 58180H-SH	4	0.23	(5.8)	21.5	(32)	400 (1780)	130 (578)	3.4 (8.7)	2.3 (5.8)
XU006 61180H-SH	6	0.24	(6.1)	22.2	(33)	400 (1780)	130 (578)	3.6 (9.2)	2.4 (6.1)
XU008 64180H-SH	8	0.25	(6.4)	28.8	(44)	470 (2090)	160 (712)	2.5 (6.4)	1.3 (3.2)
XU012 64180H-SH	12	0.25	(6.4)	30.8	(47)	470 (2090)	160 (712)	2.5 (6.4)	1.3 (3.2)
XU024 85180H-SH	24	0.33	(8.5)	38.7	(59)	670 (2980)	220 (979)	3.3 (8.5)	1.7 (4.3)

Note: Diameter and weight subject to change without notice
For flame retardant jacket option remove the extension –SH from the item number

Replace asterisk ( ) in AFL number with number corresponding below.
5 = 50/125 µm multimode GIGA-Link™ 600
6 = 62.5/125 µm multimode GIGA-Link™ 300
9 = Single-mode
K = SM Futureguide SR-15e Bend Insensitive

Fibre Notes/Options
G = Elastomer over 500 µm
– RH = Indicates Radiation Hardened Fibre



BU Series Tactical Breakout Cable

AFL's BU Series Tactical Breakout Cables are ideal for use in harsh environment applications requiring a rugged deployable cable solution. Consisting of 2 mm sub-cables, each optical fibre is suitable for direct termination enabling fast and easy installation. This reduced diameter, light weight, and high strength cable features a tough abrasion resistant polyurethane jacket that offers exceptional performance through a wide range of temperatures. It is also impervious to common chemicals found in industrial environments. Available with a flame retardant jacket option the BU series breakout cable is ideal for use in mines, petrochemical facilities, and other industrial applications.

Temperature Range

Operating: -55°C to +85°C

Storage: -60°C to +85°C

Installation: -50°C to +85°C

Mechanical

PARAMETER	VALUE
Tensile	
Installation	2112 (475)
Operational	333 (75)

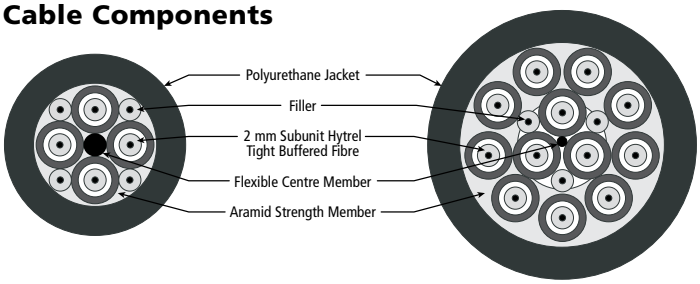
Features

- Deployable design
- UV, Fungus, and water resistant
- Highly crush and impact resistant
- 2.0 mm sub-cables available in a variety of colours
- Available with shiny or matte low-friction jacket
- Custom colours available
- Available with bend insensitive SM and MM optical fibre
- Supports all multi-gigabit Ethernet standards
- RoHS compliant

Specifications

- MIL PRF85045
- ANSI/ICEA-S-104-696
- RoHS Compliant
- Highly abrasion and cut resistant
- Resistant to most fuels, oils and greases
- Excellent low-temperature flexibility

Cable Components

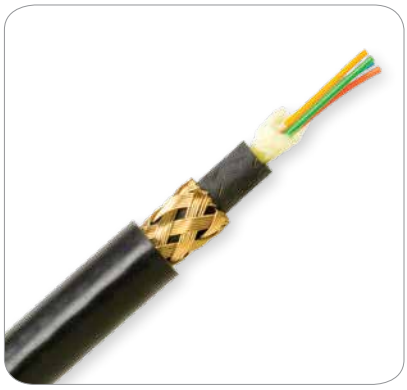


Ordering Information

AFL NO.	FIBRE COUNT	NOMINAL DIAMETER		NOMINAL WEIGHT		PHYSICAL PROPERTIES		MINIMUM BEND RADIUS INCHES (CM)
		INCHES	MM	LBS/1,000 FT	KG/KM	CRUSH (N/CM)	IMPACTS	
BU002★20180H	2	0.307	7.8	35	52	2000	200	3.0 (7.5)
BU004★20180H	4	0.307	7.8	35	52	2000	200	3.0 (7.5)
BU006★20180H	6	0.346	8.8	39	58	2000	200	3.5 (8.5)
BU008★20180H	8	0.394	10.0	52	77	2000	200	4 (10)
BU012★20180H	12	0.464	11.8	63	93	2000	200	4.3 (11)

★ Please specify fibre type when ordering (see below)

5 = 50/125 µm multimode GIGA-Link™ 600
7 = 50/125 µm multimode GIGA-Link™ 2000
6 = 62.5/125 µm multimode GIGA-Link™ 300
8 = 62.5/125 µm multimode GIGA-Link™ 1000
9 = 9/125 µm single-mode
L = 50/125 µm multimode Laser-Link 300 for 10 Gigabit Ethernet
K = Single-mode Futureguide SR-15e Bend Insensitive



Braided Armored Tactical Tight Buffered Cable

AFL Armored Tactical Tight Buffered Cables are ideal for use in installations where extreme environmental conditions are present. With the addition of a wire braid embedded within the jacketing system, these cables are highly resistant to damage caused by repetitive impacts, high flex, crush, and abrasion as well as other harsh conditions. By utilising AFL's tight buffered fibre technology field, termination is simplified.

Temperature Range

Operating: - 46°C to + 85°C

Installation: - 20°C to + 85°C

Storage: -57°C to 85°C

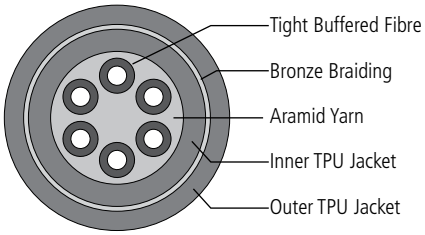
Features

- Cut resistant polyurethane outer jacket
- Highly flexible construction allows for multiple deployments
- Performance in wide temperature range
- High impact and crush resistance
- Durable in high traffic areas
- Water and UV resistant
- Multiple jacket colours available
- Capable of supporting all Multi-Gigabit Ethernet Protocols

Applications

- Field deployment in abusive environments
- High traffic areas
- Security and sensing applications
- High Flex Applications
- Installations in industrial environments
- Temporary installation of critical communications lines where quick retrieval and re-use is necessary

Cable Components



Ordering Information

AFL NO.	FIBRE COUNT	NOMINAL DIAMETER		NOMINAL WEIGHT		TENSION LBS (N)		MINIMUM BEND RADIUS INCHES (CM)
		INCHES	MM	LBS/1,000 FT	KG/KM	INSTALLATION	LONG TERM	
XU001✶30180#-BB	1	0.26	6.6	42.4	64	250 (1112)	66 (290)	2.6 (6.6)
XU002✶58180#-BB	2	.374	9.5	82.5	124	325 (1450)	66 (290)	3.7 (9.5)
XU004✶58180#-BB	4	.374	9.5	82.5	124	325 (1450)	66 (290)	3.7 (9.5)
XU006✶61180#-BB	6	.386	9.8	85.5	128	325 (1450)	66 (290)	3.8 (9.8)
XU012✶70180#-BB	12	.421	10.7	104.7	156	394 (1750)	79 (350)	4.2 (10.7)

Note: Diameter and weight subject to change without notice

Replace asterisk (✶) in AFL number with number corresponding below.
5 = 50/125 µm multimode GIGA-Link™ 600
6 = 62.5/125 µm multimode GIGA-Link™ 300
9 = Single-mode
K = SM Futureguide SR-15e Bend Insensitive
* Other fibre types available.

Replace pound sign (#) in AFL number with number corresponding below.
G = 500 µm Coated Optical Fibre
H = 250 µm Coated Optical Fibre

BU Series Braided Armored Breakout Cable

AFL's BU Series Braided Armored Breakout Cables are ideal for use in harsh environment applications requiring a rugged deployable cable solution. Consisting of 2 mm sub-cables, each optical fibre is suitable for direct termination enabling fast and easy installation. This reduced diameter, light weight, and high strength cable features a tough abrasion resistant polyurethane jacket that offers exceptional performance through a wide range of temperatures. It is also impervious to common chemicals found in industrial environments. Available with a flame retardant jacket option the BU series breakout cable is ideal for use in mines, petrochemical facilities, and other industrial applications.

Temperature Range

Operating: -55°C to +85°C

Storage: -60°C to +85°C

Installation: -50°C to +85°C

Mechanical

PARAMETER	VALUE
Tensile	
Installation	2112 (475)
Operational	333 (75)

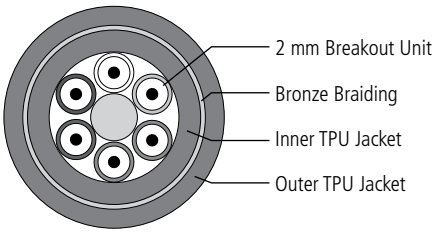
Features

- Deployable design
- UV, Fungus, and water resistant
- Highly crush and impact resistant
- 2.0 mm sub-cables available in a variety of colors
- Available with shiny or matte low-friction jacket
- Custom colours available
- Available with bend insensitive SM and MM optical fibre
- Supports all multi-gigabit Ethernet standards
- RoHS compliant

Specifications

- MIL PRF 85045
- ANSI/ICEA-S-104-696
- RoHS Compliant
- Highly abrasion and cut resistant
- Resistant to most fuels, oils and greases
- Excellent low-temperature flexibility
- Braid application per IEEE 1580 available

Cable Components



Ordering Information

AFL NO.	FIBRE COUNT	NOMINAL DIAMETER		NOMINAL WEIGHT		PHYSICAL PROPERTIES		MINIMUM BEND RADIUS INCHES (CM)
		INCHES	MM	LBS/1,000 FT	KG/KM	CRUSH (N/CM)	IMPACTS	
BU002★20180H-BB	2	0.452	11.5	113	68	2000	200	4.5 (11.5)
BU004★20180H-BB	4	0.452	11.5	113	68	2000	200	4.5 (11.5)
BU006★20180H-BB	6	0.492	12.5	124	185	2000	200	4.9 (12.5)
BU008★20180H-BB	8	0.539	13.7	147	219	2000	200	5.4 (13.7)
BU012★20180H-BB	12	0.610	15.5	178	9265	2000	200	6.1 (15.5)

★ Please specify fibre type when ordering (see below)

5 = 50/125 µm multimode GIGA-Link™ 600
7 = 50/125 µm multimode GIGA-Link™ 2000
6 = 62.5/125 µm multimode GIGA-Link™ 300
8 = 62.5/125 µm multimode GIGA-Link™ 1000
9 = 9/125 µm single-mode
L = 50/125 µm multimode Laser-Link 300 for 10 Gigabit Ethernet
K = Single-mode Futureguide SR-15e Bend Insensitive

Industrial Loose Tube Cable, LSZH, OFCG-LS, Aluminum Interlock Armor

AFL's Industrial Loose Tube Cables are designed for high reliability in heavy industrial and harsh environment applications. Consisting of a formed metallic armor, the cable features superior crush resistance and a high degree of flexibility. Furthermore, the cable features a flame retardant LSZH jacket which is UV stabilized and highly resistant to chemicals commonly found in industrial environments. With an OFCG-LS listing, the cable is suitable for both indoor and outdoor industrial installations.

Temperature Range

Operating: -40°C to +70°C

Storage: -60°C to +50°C

Installation: -20°C to +50°C

Mechanical

PARAMETER	VALUE
Tensile	
Installation	2670 (600)
Operational	800 (180)

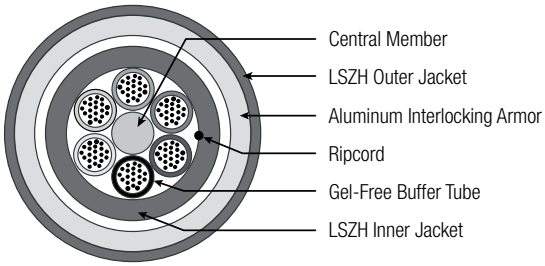
Features

- Eliminates need for conduit
- Simplified one-step installation
- Highly crush resistant
- Resistant to lubricating oil, gasoline, deionized water and many other chemicals
- Gel-free buffer tubes SZ stranded for quick easy access
- Available with bend insensitive SM and MM optical fibre
- Supports all multi-gigabit Ethernet standards

Specifications

- OFCG-LS, IEEE 1202 / FT4, UL1685
- ANSI/ICEA-S-104-696
- CSA 22.2 #230 and #232
- NFPA 130 / 502
- RoHS Compliant
- Sun light resistant
- Oil Res II compliant jacketing system

Cable Components



Ordering Information

AFL NO.	FIBRE COUNT	# OF BUFFER TUBES / FIBRES PER TUBE	NOMINAL DIAMETER		NOMINAL WEIGHT		MINIMUM BEND RADIUS	
			INCHES	MM	LBS/1,000 FT	KG/KM	INSTALLATION (20XOD) IN/CM	OPERATION (10XOD) IN/CM
LL0 - -✶C5111A1D	6 - 60	5 / 12	0.75	19.11	204	304	15/38	7.5/19.1
LL072✶C6111A1D	60-72	6 / 12	0.81	20.68	228	341	16.2/42	8.1/21
LL096✶C8111A1D	72-96	8 / 12	0.87	21.98	258	385	17.4/44	8.7/22
LL144✶CC111A1D	96 - 144	12 / 12	0.96	24.5	339	506	19.2/49	9.6/24.5
LL288✶CO311A1D	144 - 288	24 / 12	1.14	28.9	519	774	22.8/57.8	11.4/28.9

✶ Please specify fibre type when ordering (see below)

5 = 50/125 µm multimode GIGA-Link™ 600
7 = 50/125 µm multimode GIGA-Link™ 2000
6 = 62.5/125 µm multimode GIGA-Link™ 300
8 = 62.5/125 µm multimode GIGA-Link™ 1000
9 = 9/125 µm single-mode
L = 50/125 µm multimode Laser-Link 300 for 10 Gigabit Ethernet
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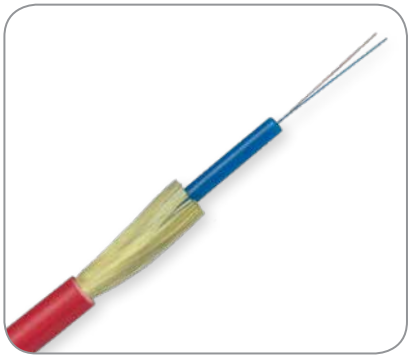


Distributed Temperature Sensing LSZH Fibre Optic Cable

Fibre Optic Distributed Temperature Sensing Cables from AFL are customized to suit the specific needs of the customer's application. AFL cables are specially designed for durability and reliability and are used in varying applications and environments. Suitable for outdoor applications with its UV stabilized jacket and limited indoor applications with its LSZH jacket (IEC 60332-1-2:2004 qualified). Quick and easy to install without special equipment or know how, these cables are an ideal solution and can be used with any DTS manufacturers' equipment.

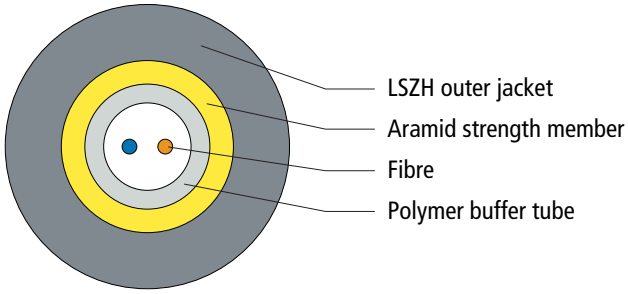
Benefits

- Cost effective solution compared with steel tube alternatives
- Easy installation
- Installations up to 6 km continuous length
- No specialised installation knowledge or equipment needed
- Jacket colouring and printing available to customer specification

Features

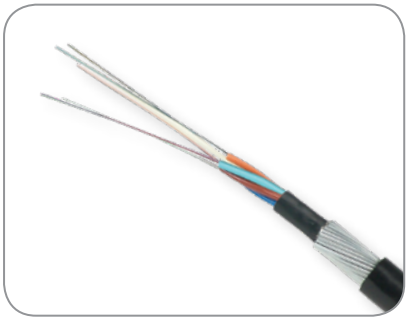
- Low smoke zero halogen jacket
- UV light stabiliser
- High tensile performance
- Small outside diameter
- Flexible

Cable Components



Specifications

PARAMETER	VALUE
Jacket Material	Low Smoke Zero Halogen
Cable Weight	18 ± 1 kg / km
Minimum Bend Radius	80 mm
Fibre Colours	Blue, Orange
Standard	Cable is Designed, manufactured and tested in accordance with ISO 9001 IEC 60332-1-2:2004, Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propogation for a single-insulated wire or cable – Procedure for 1 kW premixed flame

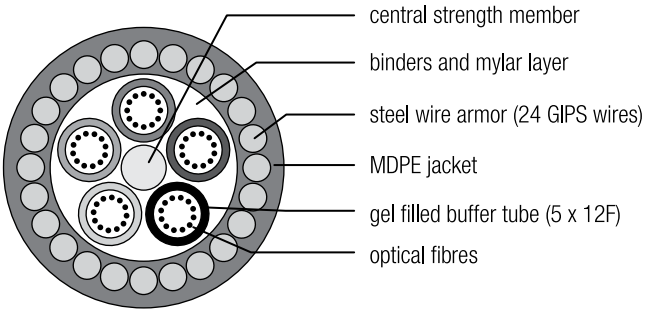


High Strength Steel Wire (HSSW) Armored Fibre Optic Cable

AFL's High Strength Steel Wire (HSSW) Armored Fibre Optic Cable provides the reliability needed for network backbones in harsh environment conditions. The high strength, galvanized plow steel armor is enhanced and offers a significant improvement in mechanical performance as compared to traditional steel tape armored cables.

With a near ten-fold improvement in tensile performance, a two-fold improvement in crush resistance and a three-fold improvement in impact energy resistance, AFL's HSSW Armored Fibre Optic Cable provides the strength and durability needed for the most extreme conditions. Ideal for use as a direct buried cable in heavy construction zones including wind farm developments, pipelines, oil and gas fields, heavy industrial sites and a variety of additional harsh environments, AFL's HSSW Armored Cable meets or exceeds all requirements specified in Telcordia GR-20-Core.

Cable Components



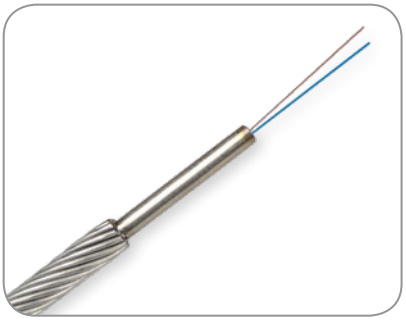
Physical Properties

PARAMETER	VALUE
Fibre Count	1-60 *
Nominal Diameter	0.65 inches / 16.5 mm
Nominal Weight	335 lbs/1000 ft. / 500 kg/km
Maximum Tensile Load	5,000 lbs/ 22.2 kN **
Minimum Bend Radius	13 inches / 33 cm
Temperature Range	Installation: -40°C to + 70°C Operation: -50°C to + 70°C ***

* Any combination of up to 60 fibres available

** Higher strength options available upon request

*** Expanded temperature ranges available upon request



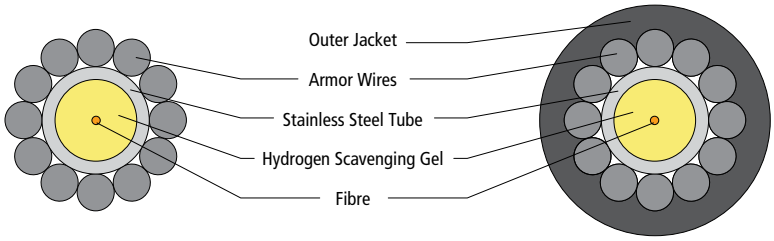
Armored Stainless Steel Tubes

Armored Stainless Steel Cables from AFL are based on our patented tube technology which provides for a hermetic seal. The armor wires provide improved crush and tensile performance while maintaining good flexibility. Armored Stainless Steel Tubes can be used in a variety of applications such as temperature sensing and surface cable.

Features

- Hermetic Stainless Steel Tube
- High Strength Wire
- Jacket Options
- Gel Options
- Flexible
- Rugged

Cable Components



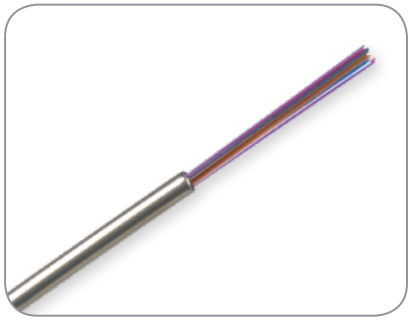
Options and Specifications

FIBRE COUNT	TUBE O.D. (mm)	FINAL O.D. (mm)	WEIGHT (kg/km)	BREAKING STRENGTH (kg)	BEND RADIUS (mm)
4	1.32	2.12	16	222	132
6	2.00	3.20	38	526	200
12	2.40	3.60	45	619	240

Based on 200 kpsi Gips wire, gel filled tube

Encapsulation Option

PARAMETER	VALUE
Materials	Polypropylene, Nylon, PVDF, Hytrel™
Diameter	To customer specifications
Cable markings	To customer specifications



Applications

- Umbilical Cables
- Downhole Cables for Oil and Gas
- Towed Arrays
- High Temperature Cables
- Hybrid Cables
- Sensor Cable
- OPGW

Stainless Steel Fibre Optic Tubes

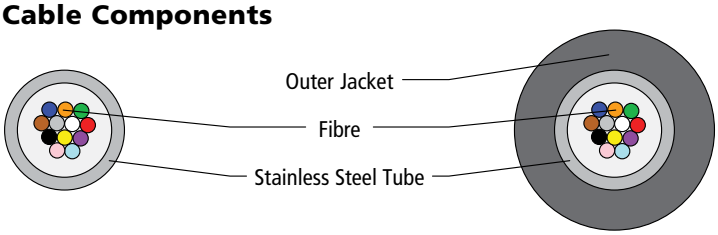
As the inventor and owner of the technology for placing optical fibres into stainless steel tubes, AFL offers a range of tube sizes and fibre counts for a variety of applications. Each tube is flooded with a thixotropic filling compound and hermetically sealed to protect the enclosed fibres from environmental degradation. This product is sometimes referred to as FIST (Fibre in Steel Tube) or FIMT (Fibre in Metal Tube).

Jacket Options

AFL can encapsulate any of our stainless steel tubes with any of the following polymers:

- Hytrel™
- Santoprene™
- Polyethylene
- Polypropylene
- Nylon
- PVDF

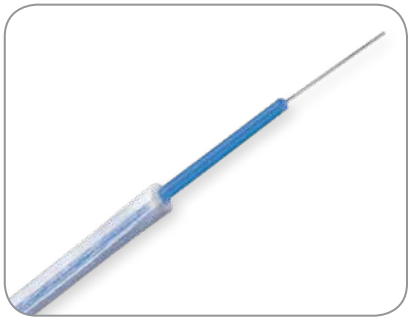
Cable Components



Specifications (without jacketing)

OPTION NUMBER	MAXIMUM FIBRE COUNT	OUTSIDE DIAMETER inches (mm)	INSIDE DIAMETER inches (mm)	WALL THICKNESS inches (mm)
1	3	0.046 (1.17)	0.036 (0.91)	0.005 (0.127)
2	4	0.052 (1.32)	0.042 (1.07)	0.005 (0.127)
3	4	0.055 (1.40)	0.039 (1.00)	0.008 (0.200)
4	4	0.065 (1.65)	0.049 (1.25)	0.008 (0.200)
5	6	0.071 (1.80)	0.055 (1.40)	0.008 (0.200)
6	8	0.074 (1.88)	0.058 (1.47)	0.008 (0.200)
7	8	0.078 (1.98)	0.062 (1.57)	0.008 (0.200)
8	8	0.079 (2.00)	0.063 (1.60)	0.008 (0.200)
9	12	0.092 (2.33)	0.076 (1.93)	0.008 (0.200)
10	16	0.094 (2.38)	0.078 (1.98)	0.008 (0.200)
11	16	0.095 (2.40)	0.079 (2.00)	0.008 (0.200)
12	16	0.098 (2.49)	0.082 (2.08)	0.008 (0.200)
13	16	0.106 (2.69)	0.090 (2.29)	0.008 (0.200)
14	24	0.118 (3.00)	0.102 (2.60)	0.008 (0.200)
15	36	0.125 (3.20)	0.109 (2.80)	0.008 (0.200)
16	48	0.134 (3.40)	0.119 (3.00)	0.008 (0.200)
17	60	0.142 (3.60)	0.126 (3.20)	0.008 (0.200)
18	72	0.150 (3.80)	0.134 (3.40)	0.008 (0.200)
19	72	0.156 (3.96)	0.140 (3.56)	0.008 (0.200)
20	72	0.158 (4.00)	0.142 (3.60)	0.008 (0.200)
21	72	0.165 (4.20)	0.150 (3.80)	0.008 (0.200)

Available in Stainless Steel 304, 316 and Incoloy 825. Others sizes and materials available on request.



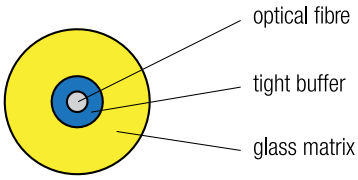
Fibre Rod

AFL's Fibre Rod takes an optical fibre of the customer's choice and encases it in a glass re-enforced matrix. The diameter of the structure is adjusted to provide the characteristics needed for the specific application. The performance of the optical fibre is retained in this structure providing for a very ruggedized fibre suitable for many harsh applications. Fibre Rod is best suited for high tensile or compressive requirements where the glass structure provides the rigidity to protect the optical fibre from harm. Additionally, AFL's Fibre Rod does not exhibit the typical curvature coming off the payoff reel like that of most cables. This makes deployments in applications such as pipelines and oil wells simpler. Applications such as strain sensing and temperature sensing in a host of environments up to 200°C are ideal for this product.

Features/Options

- **Strength** – Variable as glass matrix diameter can be increased which increases strength
- **Bend Diameter** – 50x the outer diameter
- **Temperature Performance** – Standard is 85°C
- **Ruggedised Option** – Product can be jacketed with various polymers such as PVDF, Hytrel, Polyethylene, Nylon, PVC, Fire Retardant PE, Polyurethane and others
- Available in lengths of up to 6 kilometers

Cable Components



Specifications

PARAMETER	VALUE		
	OD (mm)	ID (mm)	TOLERANCE (+/-mm)
85°C Version			
Optical Fibre	0.125	n/a	0.001
Coating (Silicone PFA)	0.700	0.125	0.100

Notes

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