

# FIBER OPTIC CABLES



In many applications, the optical fiber must be contained within a cable structure to ensure it survives the environment in which it is designed to be deployed.

The best fiber in the World cannot overcome an improperly designed or manufactured cable. Fibercore brings over 20 years of cable design knowledge and manufacturing expertise to create cable designs that are customized to the rigors of specific environments. Fibercore specializes in the harshest of environments, ranging from cryogenic applications to the some of the hottest enhanced oil recovery wells. Fibercore extends to a network of manufacturing facilities, each with a particular strength and are not limited to in-house capabilities. For the most challenging applications, Fibercore delivers the best solution.

## GOALS IN DESIGNING FIBER OPTIC CABLES

- Enable deployment of optical fiber
- Preserving optical transmission characteristics
- Optimizing the attribute to be measured
- Protecting from ecological/mechanical stress
- Providing reliable transmission throughout design life of cable

## CABLE APPLICATIONS

### Oil & Gas

Fiber optics are used for measuring a variety of attributes in an oil or gas well including: distributed temperature, distributed acoustic energy, and strain. This is also used alongside telemetry for fiber optic point sensors, such as pressure sensors and fiber Bragg gratings (FBGs). The types of cables used in the industry include: permanently installed fiber optic cables, logging cables (both wireline and slickline) and surface cables. With the information these types of cables can yield, the reservoir engineer can optimize the production from the oil or gas field thus improving the return on investment.

### Industrial Sensing

There are many environments where knowledge of the temperature, strain, acoustic energy or other attributes is beneficial to the user. Applications such as pipelines, LNG facilities, waterways, industrial facilities, power cables, dams, power generation facilities like nuclear, coal or gas have used fiber optics successfully to gain insight into their operation. Each of these applications would use slightly different cable structures to provide not only the robustness necessary for long term use, but also to optimize the measurement of the attribute desired.

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# DOWNHOLE FIBER OPTIC CABLE

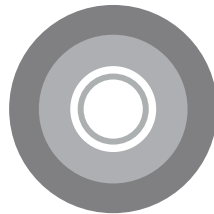
Fibercore offers a range of designs for downhole fiber optic cable to meet the specific requirements of your oil or gas well. These types of cables are permanently installed either cemented in behind the casing or strapped to the production tubing. The optical fibers can be used to sense temperature and listen to well bore activities along the entire length of the cable and can be used for telemetry to point fiber optic sensors, such as pressure sensors and strain sensors.

This information provides key data to the reservoir engineer to better manage both the well and the reservoir. Design variables include type and number of optical fibers, metal types to deal with different corrosive environments, thicknesses of metal tubes to handle different pressure requirements and outer encapsulations for improved handling and abrasion resistance.

## Typical Cable Cross Sections



Bare Downhole Cable



11mm Round Encapsulated Downhole Cable



11x11mm Square Encapsulated Downhole Cable

## SPECIFICATIONS

|   |   |
|---|---|
| Temperature Ratings (°C)                                    | 85<br><150<br><300<br>(higher temperature ratings available upon request) |
| Outer Encapsulation Options (11mm round and 11x11mm square) | Polypropylene, Nylon, Santoprene, PVDF, ETFE, ECTFE, FEP                  |

| TUBE MATERIAL        | Outer Diameter (mm) | Inner Diameter (mm) | Wall Thickness (mm) |
|----------------------|---------------------|---------------------|---------------------|
| 316L Stainless Steel | 6.35 (0.250")       | 4.57 (0.180")       | 0.89 (0.035")       |
|                      | 6.35 (0.250")       | 3.86 (0.152")       | 1.245 (0.049")      |
| Incoloy 825          | 6.35 (0.250")       | 4.57 (0.180")       | 0.89 (0.035")       |
|                      | 6.35 (0.250")       | 3.86 (0.152")       | 1.245 (0.049")      |

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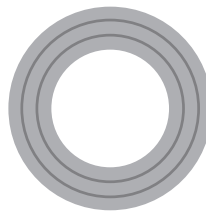
# SLICKLINE FIBER OPTIC CABLE

Fibercore offers a range of slickline fiber optic cables suitable for logging wells directly or to be incorporated into a coiled tube. The portfolio utilizes a fiber in metal tube to house and protect the optical fibers and to ensure that the excess fiber length is controlled appropriately. As with the permanent downhole fiber optic cables, these fibers can be used to sense temperature and listen to well bore activities along the entire length of the cable and can be used for telemetry to point fiber optic sensors, such as pressure sensors and strain sensors that are incorporated into a tool. This information provides key information to the reservoir engineer to better manage the well and the reservoir. Design variables include: type and number of optical fibers, metal types to deal with different corrosive environments and thicknesses of metal tubes to handle different pressure requirements.

## Typical Cable Cross Sections



Single Outer Tube Slickline



Multilayer Slickline

## SPECIFICATIONS

|                          |                    |
|--------------------------|--------------------|
| Temperature Ratings (°C) | 85<br><150<br><300 |
|--------------------------|--------------------|

| TUBE MATERIAL        | Outer Diameter (mm) | Inner Diameter (mm) | Wall Thickness (mm) |
|----------------------|---------------------|---------------------|---------------------|
| 316L Stainless Steel | 3.175 (0.125")      | 1.96 (0.077")       | 0.60 (0.024")       |
|                      | 4.000 (0.157")      | 2.50 (0.098")       | 0.75 (0.030")       |
| Incoloy 825          | 3.175 (0.125")      | 1.96 (0.077")       | 0.60 (0.024")       |
|                      | 4.000 (0.157")      | 2.50 (0.098")       | 0.75 (0.030")       |

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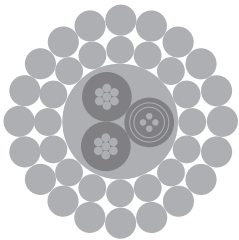


# WIRELINER FIBER OPTIC CABLE

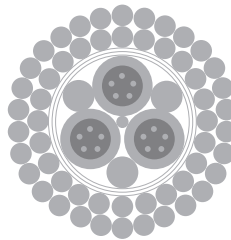
Fibercore, in conjunction with selected partners, offers wireline logging cables that utilize Fibercore's hydrogen resistant, high temperature fibers. The optical fibers are be protected in a hermetic metal tube to provide the necessary protection for incorporation into the wireline cable. By working closely with our partners, Fibercore ensures that our designs meet the rigorous requirements of wireline logging cables in regards to temperature, corrosion resistance and strength.

Optical fibers that are incorporated within these cables are used for telemetry to the tool, but can also be monitored for distributed temperature and acoustics, providing additional information for management of the well. In addition to the optical fibers, these cables can include insulated copper elements that can be used to power a tractor, components in the tool or for other sensors.

## Typical Cable Cross Sections



Electro-Optic Wireline



All Optical Wireline

## SPECIFICATIONS

Temperature Ratings (°C)

85  
<150  
<300  
(higher temperatures may be available upon request depending on application specifics)

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# FIBER IN METAL TUBE

Fibercore provides fiber in metal tubes (FIMTs) in different sizes, wall thickness and metal types. FIMTs are used in a variety of applications due to the hermeticity of the tube, strength, crush resistance, corrosion resistance and fiber density. Some of these applications include downhole fiber optic cables, logging cables, power cables, cryogenic applications, industrial monitoring, subsea cables and many more.

## Typical Cable Cross Sections



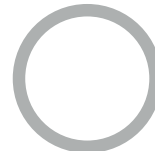
0.84mm



2.4mm



3.2mm



4.0mm



6.35mm

## SPECIFICATIONS

|                          |   |
|--------------------------|---|
| Temperature Ratings (°C) | 85<br><150<br><300<br>(higher temperature ratings available upon request)   |
| Outer Tube Materials     | 304 Stainless Steel<br>316 Stainless Steel<br>Incoloy 825<br>Inconel 625<br>(Other materials may be available upon request) |
| Diameter Range           | 0.84mm to 6.35mm (0.033" to 0.250")<br>(diameters are available in 0.1mm increments)  |
| Wall Thickness Range     | 0.127mm to 0.3mm (0.005" to 0.12")  |

Outer buffering over the FIMT is available upon request.

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# WIRE ARMORED METAL TUBE

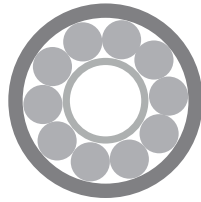
Fibercore provides fiber in wire armored metal tubes, enabling further robustness to the FIMT. FIMTs are prone to kinking and crushing, so are typically not used as a standalone product. With the addition of a high strength stranded wire layer over the FIMT, the handling characteristics improve tremendously along with crush performance and tensile strength.

The tube construction incorporates stainless steel components to provide improved corrosion resistance and an optional outer polymer jacket is also available upon request. Typical applications for wire armored metal tubes are for tactical applications (deploy/re-deploy), hydrological studies, industrial sensing, power cable monitoring and more applications.

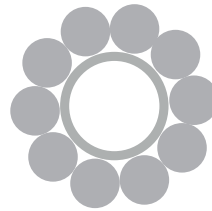
## Typical Cable Cross Sections



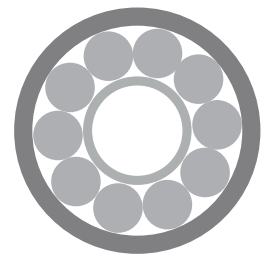
2.1mm



2.1mm Jacketed



2.8mm



2.8mm Jacketed

## SPECIFICATIONS

|                             |  |
|-----------------------------|--|
| Temperature Ratings (°C)    | 85<br><150<br><300<br>(higher temperature ratings available upon request)  |
| Construction                | 316L Stainless Steel tube<br>316L Stainless Steel wires<br>Optional outer sheath (polyamide, other types upon request)<br>Up to 8 optical fibers |
| Diameter Range              | 2.8mm to 4.8mm   |
| Weight Range                | 18kg to 46kg   |
| Maximum Operational Tension | 750N to 2600N  |
| Minimum Bend Radius         | 20xDiameter  |

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# FIBER OPTIC CABLES

## FIBER OPTIC CABLE VARIANTS

- Downhole fiber optic cable
- Slickline fiber optic cable
- Wireline fiber optic cable
- Fiber in metal tube
- Wire armored metal tube

**Fibercore** House | Southampton Science Park  
United Kingdom | SO16 7QQ  
T +44 (0)23 8076 9893 | E [info@fibercore.com](mailto:info@fibercore.com)

[fibercore.com](https://fibercore.com)