



## *Downhole Optical Cable*

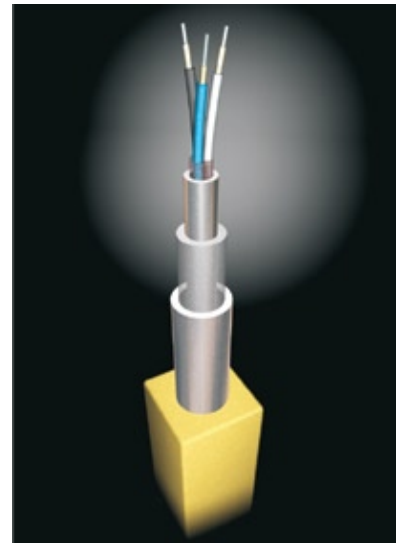
Weatherford's downhole optical cable provides a reliable, high-performance optical pathway for transmission of signals to in-well optical sensing systems such as pressure, temperature, flow, phase-fraction, distributed-temperature-sensing (DTS), and seismic systems.

The standard cable consists of two single-mode fibers for pressure gauges, flowmeters, and seismic systems and one multimode fiber for DTS systems. Pressure gauges and seismic stations are multiplexed on a single fiber, while a downhole cable splitter can be used to further enable multi-zone sensing architectures that deliver enhanced production monitoring capabilities.

The cable is engineered for reliable high performance throughout the life of the well. Weatherford's proprietary design incorporates a proven fiber-protection system that prevents the optical fibers from degrading over time, eliminating the need for periodic replacement. In addition, the fiber-protection system ensures that the factory calibration of the multi-mode fiber—used for DTS measurements—is maintained over the life of the well.

### *Applications*

Weatherford's downhole optical cable is used in downhole optical sensing applications, including reservoir pressure and temperature, DTS, flow, and phase-fraction sensing.





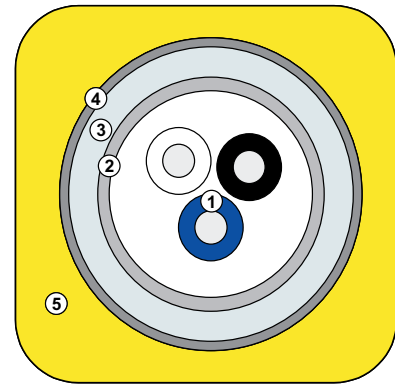
## Downhole Optical Cable

### Features, Advantages and Benefits

- Non-electrical design is intrinsically safe.
- In the event of accidental damage, cable can be repaired at the wellsite, minimizing interruptions in operation.
- Loose-tube design isolates and protects fibers from cable stresses. This feature, coupled with industry-leading fiber protection, ensures reliability throughout the life of the well.
- A standard, integrated system of dry- and wet-mate connectors enables the cable to pass readily through wellheads, packers, safety valves, and other in-well equipment.
- Cable packaging is identical to that of other in-well hydraulic and instrument lines, allowing use of standard handling and installation techniques.
- The cable complies with industry standards for instrumentation cable.

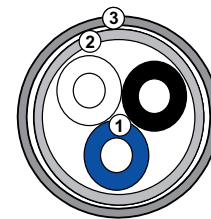
### Options

- Two sizes are available: 1/4 and 1/8 in.
- A choice of final encapsulation material is available. The cable can be packaged as part of a flat pack with other instrumentation and control lines to simplify rig-site deployment.
- Various cross-coupling clamping options are available.
- Custom optical fiber configurations can include any combination of single-mode and multi-mode optical fibers to meet application requirements.



1/4-in. Cable

- 1 Optical fibers
- 2 Fiber in metal tube
- 3 Buffer
- 4 Outer tube
- 5 Encapsulation



1/8-in. Cable

- 1 Optical fibers
- 2 Fiber in metal tube
- 3 Outer tube



## Downhole Optical Cable

### Specifications

Typical Encapsulation Options		
Material	Maximum Temperature Rating	
	(°F)	(°C)
Polyamide	200	90
Polyolefin copolymer	210	100
Heat-stabilized polyolefin copolymer	240	115
EPDM/propylene copolymer	260	130
Polyvinylidene fluoride	280	140
ETFE	310	155
Teflon® FEP	400	205
Teflon PFA	500	260

	1/8-in. Cable	1/4-in. Cable	
		0.028-in. Wall	0.035-in. Wall
<b>Construction</b>			
Optical fibers	2 single-mode, 1 multi-mode		
Inner metal tube	304 stainless steel		
Buffer	N/A	Teflon®	
Outer armor tube (in.)	316 SS or INCOLOY® 825 0.125 OD × 0.022 wall	INCOLOY 825 0.250 OD × 0.028 wall	INCOLOY 825 0.250 OD × 0.035 wall
<b>Mechanical Properties</b>			
Weight (in air) (lb/ft)	0.03	0.1	0.11
Working pressure (psi/bar)	20,000 (1,379)	20,000 (1,379)	25,000 (1,724)
Collapse pressure (psi/bar)	> 30,000 (2,068)	> 30,000 (2,068)	> 35,000 (2,413)
Burst pressure (psi/bar)	34,000 (2,344)	20,000 (1,379)	25,000 (1,724)
Maximum tensile load (lb/kg)	500 (227)	1,500 (680)	2,000 (907)
Maximum splice-free length (ft/m)	20,000 (6,096)		
Minimum bend radius >1 turn (in./mm)	2 (50.8)	4 (101.6)	
Minimum bend radius <1/2 turn (in./mm)	1(25.4)		
<b>Environmental Specifications</b>			
Operating temperature range (°F/°C)	32 to 212 (0 to 100)	32 to 347 (0 to 175)	
Storage temperature range (°F/°C)	-40 to 212 (-40 to 100)	-40 to 347 (-40 to 175)	
Pressure range (psi/bar)	Atmosphere to 20,000 (1,379)	Atmosphere to 20,000 (1,379)	Atmosphere to 25,000 (1,724)

Teflon is a registered trademark of DuPont. INCOLOY is a registered trademark of the Special Metals Corporation group of companies.