



Draka



Draka FiberConnect[®]

The solution for fiber optical and industrial interface within and between towers

Draka FiberConnect® is a program of fiber optical cables and accessories for wind turbine application.

Draka Communications

Draka Communications previously known as Draka Comteq, has 30 years of experience as a global provider of fiber optical technology and cabling solutions (tele- and data communications) for a great number of market segments, including the wind turbine industry. We design, develop and manufacture our own pre-forms, fibers and cables based upon technologies that Draka, as market leader, have developed.

FiberConnect® Program

Draka FiberConnect® is a comprehensive and specialized optical program, that includes both pre-fabricated cable kits, connectorised ready for installation, as well as customized solutions for any wind turbine environment or project. We provide every type of fiber optic solution used by the wind turbine industry.

Standards and Approvals

As Draka is world leading in fiber optical and cable manufacturing, naturally all our fiber optical cables are proven to meet the highest possible standards. All Draka fiber products or cable groups are approved according to relevant standards, such as ISO, IEC or UL. Requirements for these approvals include tests for behaviour in a fire such as smoke density, acidic gas emission as well as ITU-652-D and OM1-OM3 enhanced.

Tower Cables

Draka tower cables are extremely flexible and pliable. All fibers are well protected by glass or aramid yarn within the various sheaths. Standard types are the Polyurethane cable with 2 or 4 fibers buffered with a polyester 900µm or the Break-Out tight buffered cable with 4 or more fibers. The latter cables have a LSZH sheath, with excellent behaviour in a fire, they contain no halogens and produce no acidic gasses or dense smoke. The fibers in either of these cables may be any of the multi-mode types - the BendBright® single mode, the graded-index 100/140µm or Step index 200/230µm multi mode.

Ready made cable sets comes as standard on a carton reel for lengths beyond 80 meters. The fan out units may be mounted with ST, FSMA, Beachman housing and HP Vpin or any other standard connectors. Solid protection tubes and pulling eye or pulling socket is an option for any customized cable set. Comes with any MM or SM fiber.

Offshore Cables

Draka has long term experience of manufacturing cables for different types of under water installation, including connection of wind turbines. We deliver cables for both power and signal transmission, many of which are custom-made for the specific application or installation. Our cable solutions include fiber optical subsea cables with or without power conductors and the connecting hardware, such as splice boxes and other accessories.

Optical Ground Wire

Optical Ground Wires (OPGW) are applicable for interfacing wind turbines to the public distribution grid as well as between wind turbines. We deliver two basic constructions with subordinated cable types in materials; aluminium alloy, E-aluminium, aluminium clad steel, zinc coated steel with fibers integrated, stranded or in central steel tubes. Depending upon the performance requirements specified by the customer, standard types can be modified to suit the exact application.

Fiber Optical SWA Cables

Fiber Optical Cables (Steel Wire Armored) are available in many variants, either single or double layered and with LSZH or PE sheath. They are available with any type of fiber SM, MM and even Step index fibers. SWA cables may be used when a high degree of protection against mechanical abuse is required.



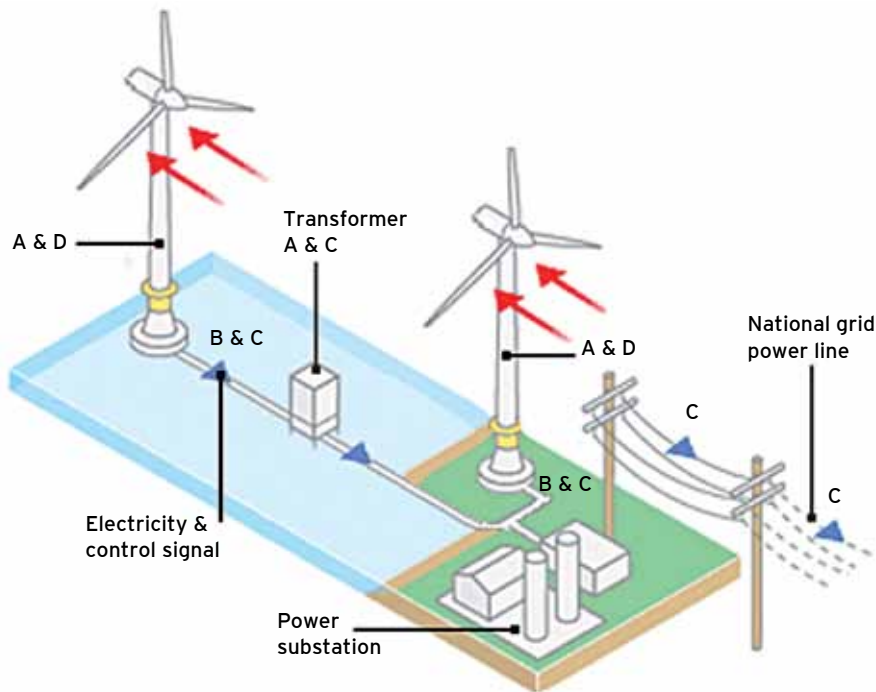
We know fiber optics

Draka FiberConnect® Solution is a comprehensive and specialized optical cable program, that includes both pre-fabricated cable kits connectorized ready for installation as well as customized designs for any wind turbine environment or project.

The product family is comprised of 3 main groups of cables and a variety of accessories:

- Flexible fiber optic cables inside towers (A)
- Fiber optical cables for interconnecting between towers (B)
- Optical Ground Wire & ADSS interfacing to distribution nets (C)
- Cabinets, fiber drawers, splice boxes, patch cables etc. (D)

FiberConnect® includes standard and custom-made cables, accessories and cable sets.



FO Cable Type Availability

Because we provide customized manufacturing of the fiber content into all of the FO cables

that we produce, we can provide any FO combination that the wind energy industry may require, such as:

All cables for interconnecting and patching with single-mode fiber contain our unique Bend Bright®XS. BendBright®XS is a low macro-bending sensitive single-mode fiber for cable mounting inside buildings.

Single mode	ITU-T G652-D / OS1 & OS2	9/125 µm
BendBright® XS	ITU-T G657D-A&B / IEC 60793-2-50	9/125 µm
OM1	IEC 60793-2-10A1b	62,5/125 µm
OM2	ITU-T G651 / IEC 60793-2-10A1a	50/125 µm
OM3 MaxCap300®	ITU-T G651 / IEC 60793-2-10A1a 2	50/125 µm
OM4 MaxCap550®	ITU-T G651	50/125 µm
Graded index		100/140 µm
Step index		200/230/500 µm

Bend Bright®XS supports installation with low cable bending radius and compact organizers. Proprietary ColorLock® coating process further enhances the performance, durability and reliability of the fibers, even in the harshest environments.

Tower Cable with Tear Resistant PUR Sheath, 2-8 fibers (A)

Flexible cable with two 200/230µm step index multi-mode fibers or any other fiber



Application

Very flexible and robust cable for industrial use. It contains two break-out units ø2.2 mm, each with a large core step index multi-mode fiber. Typical application for laser power delivery, medium distance and avionics communications, factory automation, Near-IR spectroscopy and wind turbines.

Construction

- Design according to DIN / VDE: 1VH11Y 2K200/300.
- Nominal weight 50 kg/km.
- Nominal diameter 7.0 mm.
- Temperature range at operation -40°C to +70°C.
- Temperature range at installation -40°C to +70°C.
- Tensile strength during installation 450 N.
- Tensile strength during operation 225 N.
- Minimum bending radius during installation 60 mm.
- Minimum bending radius during installed 45 mm.
- Torsion ±180° 500 times per 2 m, ± 360° 5 times per 2 m.

Standards

Fire rating optional acc. to IEC 60332-1.

Fiber Optic Connectivity Products (D)

An important part of Draka industrial fiber solution is the connectivity products, such as wall mounted distribution boxes and cabinets, termination boxes, splice cassettes, pigtails and patch cables - convenient and ready to install. Draka Patch Cords are pre-connected cables 2.0 - 3.0 mm, simple or duplex - with any fiber type available on the market. Connector types are LC, ST, FC, ST and other special connectors.



TOWER Cable - Break-Out Cable, 2-24 fibers (A)

ø2.0 mm units, Aramid yarns, UV stabilized LSZH sheath



Application

Robust indoor cable with separate 2.0 mm break-out units, that can contain any of our fiber types. For interconnecting within towers, between control electronic cable and termination boxes.

Construction

- ø2.0 mm unit tightly buffered fiber 900µm ± 50µm. Aramid yarn. LSZH sheath, grey, marked with unit number.
- Central FRP strength member, covered with LSZH material as appropriate.
- 2 - 24 units SZ stranded around the strength member.
- Wrapping made of polyester foil.
- Ripcord made of polyester.
- Sheath 1.1 mm grey FireRes® sheath, UV stabilized acc. to EN 50290-2-27.

Standards

Standard design according to EN 50173-1, IEC 60794-2-20.

Fire rating according to IEC 60332-1-2, IEC 61034-2.

IEC 60332-3-24 = IEC 332-3C,

IEC 60754-1, IEC 60754-2.

Physical and mechanical properties

Fiber count		2.4	6	8	12	16	24
Permanent tensile strength N	E11	450	600	800	1150	1000	1500
Maximum installation load N		1300	1800	2400	3500	3000	4500
Crush	E3	1500 N / 100 mm.					
Torsion	E7	5 cycles ± 1 turn					
Temperature range	F1	Operation and installation -20°C to +70°C. Storage -40°C to +70°C.					

Fiber count	Nominal diameter mm	Nominal Weight kg / km	Minimum bending radius mm
2.4	7.5	60	130 / 75
6.0	8.5	75	150 / 100
8.0	10.0	100	150 / 100
12.0	12.5	160	250 / 150
16.0	12.0	145	240 / 140
24.0	14.5	210	280 / 175

Note additional fiber counts are available on request.

INTERCONNECTING Cable Reinforced (B)



Application

From 6 to 96 optical fibers, with 6, 8 or 12 fibers per $\varnothing 2.3$ mm tube, rodent protection and FireRes® sheath. For application indoor and in outdoor ducts, in tunnels and metro lines.

Construction

- Design according to DIN / VDE: I/A DQ(ZN) BH - outer diameter core counts up to 36 fibers: 13.0 mm nominal.
- Strength member central $\varnothing 2.5$ mm FRP rod.
- Loose tube $\varnothing 2.3$ mm jelly filled, with 2 - 12 fibers each, up to 22 tubes in two layers, for lay-up refer to B04.
- Water blocking - core is waterblocked using swellable tape and thread.
- Reinforcement with heavy layer of glass fiber yarns as reinforcement and rodent protection, effective in most cases.
- Sheath 1.5 mm FireRes®, standard colour grey, UV stabilized, EN 50290-2-27.
- Tensile strength dynamic up to 6000N and permanent up to 4000 N.
- Compressive strength up to 3000 N.
- Impact up to 25 Nm.
- Torsion 5 cycles ± 1 turn.
- Temperature range -40°C to $+70^{\circ}\text{C}$.
- Water penetration: no water on free end.
- Nominal diameter 6 - 36 core: 10.5 mm.

Standards

- Standard design acc. to IEC 60794-2-21, IEC 60794-2 ,EN 50 173-1, IEC 60794-2-20 ISO 11801 ^{2nd edition}, EN 187000.
- Fire rating acc. to IEC 60332-1-2, IEC 60332-3-24, IEC 60754-1, IEC 60754-2, IEC 61034-2.
- Physical properties acc. to IEC 60974-1-2.
- Transmission characteristics acc. to IEC 60793-2.

Jelly Filled Stranded Out-door Cable (B)



Application

From 6 to 264 optical fibers; loose tube construction; 6, 8 or 12 fibers per $\varnothing 2.3$ mm. Tube black MDPE sheath.

Construction

- Design according to DIN / VDE: A-D F 2Y n x (6, 8 or 12) outer diameter core counts up to 10.5 mm nominal.
- Strength member $\varnothing 2.5$ mm FRP rod.
- Loose tube $\varnothing 2.3$ mm jelly filled loose tubes, with 2 - 12 fibers each, up to 22 tubes in two layers, for lay-up refer to B04.
- Water blocking - the core is completely filled with a synthetic filling compound, acc. to IEC 60811-5-1.
- Sheath 1.5 mm black MDPE, IEC 60811, IEC 60708.
- Tensile strength dynamic up to 1800 N and permanent up to 1200 N.
- Compressive strength up to 3000 N.
- Impact up to 20 Nm.
- Torsion up to 5 cycles ± 1 turn.
- Temperature range between -40°C to $+70^{\circ}\text{C}$.
- Water penetration: No water on free end.
- Nominal diameter 6 - 36 core, 13 mm.

Standards

- Standard design: EN 187 000, IEC 60794-3, IEC 60794-3-10, IEC 60794-3-12, ISO 11801 ^{2nd edition}, EN 50 173-1.
- Physical properties acc. to IEC 60974-1-2.
- Transmission characteristics acc. to IEC 60793-2.

Steel Wire Armored Out-door Cable (B)



Loose tube fiber optical cable, dry core SM-LEWE

Application

4-144 fibers loose tube dry core double PE sheath. Use when high degree of protection against mechanical abuse is required. Standard delivery lengths are 2, 4 or 6 km with a tolerance of -1% to +3%.

Construction

- Central strength member made of glass fiber reinforced plastic rod (FRP), with plastic overshathing when needed.
- Loose tube made of thermoplastic material, containing up to 12 fibers and filled with a suitable water tightness compound.
- Filler elements made of thermoplastic rods, where needed.
- Stranding made of loose tubes (and fillers), SZ stranded around the CSM.
- Cable core - swellable tapes are applied over the stranding.
- Inner & outer sheaths made of PE (Black).
- Armor one layer of galvanized steel wires.
- Min. bending radius when repeated 15 x cable \varnothing and bend 10 x cable \varnothing .
- Temperature range at installation from -10°C to $+50^{\circ}\text{C}$ and in operation from -30°C to $+70^{\circ}\text{C}$.
- Nominal diameter 6 - 36 core: 14.1 mm.
- SWA diameter 1.0 mm.

Standard tests and specific value

- Crush acc. to IEC 60794-1-2-E3, 4000 N / 100 mm.
- Impact acc. to IEC 60794-1-2-E4, 30 Nm, R= 200 mm, 3 spots.
- Repeated bending according to IEC 60794-1-2-E6, R=15 x D, 100 cycle.
- Cable bend according to IEC 60794-1-2-E11, R=10 x D.
- Water penetration acc. to IEC 60794-1-2-F5B, sample=3m, watercolumn=1m.

OPGW cables are available with steel tube or slotted core design.

(C) OPGW - Optical Ground Wire Solutions

The easiest way to connect power plants with control centres and to control wind turbines, is by the use of the existing high voltage transmission lines.

The most common method for this is to install an optical ground wire (OPGW), which contains optical fibers, as a substitute for an existing ground wire.

Another possibility is to incorporate the optical fibers in a conductor that replaces one of the standard phase overhead lines. This solution is called an optical phase conductor (OPPC).

The illustration below shows several types including ADSS, MASS and ADL

cables. Each project must be carefully considered to find the optimum solution in terms of maximum electrical tower carrying-capacity, including ice load, wind forces and temperature range. Each relevant parameter must be carefully considered and evaluated.

Draka not only supplies the full range of hardware required, including fiber optic cables and interconnectivity products, we can also provide a complete solution which includes design and engineering, project management and on- or off-site training.

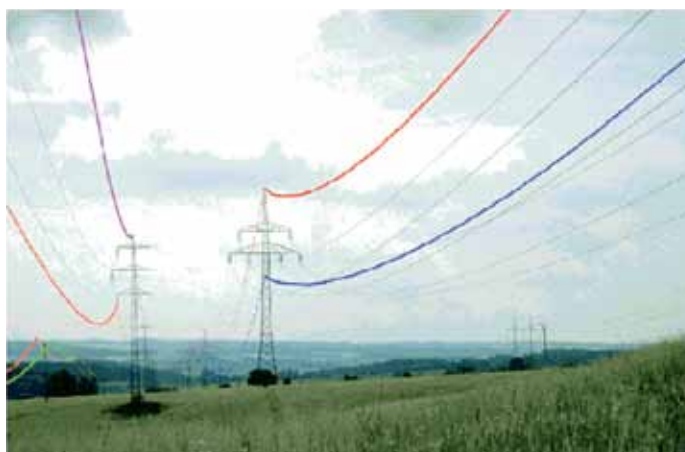
Please ask for a copy of our informative CD-Rom, which contains all relevant datasheets, guidelines, installation videos and an overview of the accessories needed.

ADL on ground wire

OPGW

ADSS or MASS

OPPC for 110 kV
OPPC for 30 kV
ADL on phase conductor



Draka Optical Ground Wire Designs

Draka has developed two basic types of cables which are predominantly used as OPGW.

Apart from OPGW cables, we also supply joint boxes and accessories needed to install and operate an optical link on power lines. Draka additionally offer installation supervision and guidelines as well as on-the-job training and follow-up service for all our products and solutions.



The Steel Tube Design

In which the optical fibers are protected by tubes of stainless steel, replacing one or more of the armoring wires of a bare ground conductor thus, forming a completely metallic solution.



The Slotted Core Design

Where the fibers are contained in plastic tubes, which are helically laid into a slotted core. Optional outer protection with an aluminium tube and further armoring is available.

With our knowledge and experience we can help you to find the right product solution for your application.

How to determine the right OPGW cable for a transmission line:

An OPGW solution has to perform two classical functions. That of being an earth conductor as well as housing the optical fibers for high speed data transmission. The solution also has to provide protection from a variety of environmental conditions, such as extreme or fluctuating temperatures, wind forces and ice loads.

The main characteristics of an OPGW are:

- The mechanical strength needed, which is mainly determined by the content of steel.
- The short-circuit current-capacity needed, which is mainly determined by the content of aluminium (alloy).
- The number of optical fibers needed, for the data transmission.

OPGW Cable Construction

Basic for the construction is the slotted core or steel core, made of a central wire and one layer of wires stranded around this. In this layer one or more steel wires can be substituted by steel tubes.

To protect the steel tubes from radial pressure the coverage in this layer is optimized. Like in standard conductors the core structure is greased for corrosion protection. One, two or more layers of aluminium (alloy) wires are stranded around this core construction, to give the OPGW the right conductivity.

With our knowledge and expertise we can help you with line planning, sag calculation and determination of fittings. Delivery of suitable fittings for installation as well as joint boxes, is naturally also available.



Cable Type	ASLH-D(S)bb 1x48SMF	ASLH-D(S)bb 1x48SMF	ASLH-D(S)bb 1x48SMF	ASLH-D(S)bb 1x48SMF	ASLH-D(S)bb 1x48SMF
	(AA/ACS 79/59-12,1)	(AA/ACS 108/59-15,2)	(AA/ACS 115/59-16,0)	(AA/ACS 138/59-18,5)	(AA/ACS 187/59-23,7)
Cross Section					
Construction	S 5.1	S 5.2	S 5.3	S 5.4	S 5.5
Center	1 ACS wire \varnothing 3,75mm				
1st layer Steel Tube	1 Stainless Steel Tube with Maximum 48 Optical Fibres				
ACS, [mm]	5 x ACS \varnothing 3,5mm				
2nd layer AA - wires	16 x AA 2,5mm	13 x AA 3,25mm	12 x AA 3,5mm	11 x AA 4,0mm	16 x AA 2,5mm
3rd layer AA - wires	-	-	-	-	22 x AA 2,5mm
Technical Data					
Cable Diameter	15,6mm	17,3mm	17,8mm	18,8mm	20,8mm
Cable Weight	654kg/km	735kg/km	756kg/km	819kg/km	957kg/km
Supporting Cross Section	137,7mm ²	167,0mm ²	174,6mm ²	197,4mm ²	245,7mm ²
Rated Tensile Strength	92,0kN	100,6kN	102,9kN	106,5kN	123,7kN
Modulus of Elasticity	102,1kN/mm ²	94,2kN/mm ²	92,6kN/mm ²	88,5kN/mm ²	80,8kN/mm ²
Thermal Elongation Coefficient	16,210 ⁻⁶ /K	16,910 ⁻⁶ /K	17,110 ⁻⁶ /K	17,510 ⁻⁶ /K	18,210 ⁻⁶ /K
Max. Perm. Working Stress	280,6N/mm ²	253,0N/mm ²	247,4N/mm ²	233,1N/mm ²	211,6N/mm ²
Everyday Stress (16% RTS)	106,9N/mm ²	96,4N/mm ²	94,2N/mm ²	88,8N/mm ²	80,6N/mm ²
Ultimate Exceptional Stress	481,1N/mm ²	433,6N/mm ²	424,1N/mm ²	399,6N/mm ²	362,7N/mm ²
DC Resistance	0,330 Ω /km	0,256 Ω /km	0,242 Ω /km	0,208 Ω /km	0,160 Ω /km
Continuous Current (T _{max} =80°C)	349A	405A	420A	460A	537A
Short Time Current (1s, 20-200°C)	12,1kA	15,2kA	16,0kA	18,5kA	23,7kA
Short Current Capacity (20-200°C)	145,5kA ² s	231,6kA ² s	257,2kA ² s	341,9kA ² s	561,3kA ² s
Normal Delivery Length	4000m				
Temperature Range in Operation	-40 to +80°C				

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Draka is a brand of the Prysmian Group situated in Milano, Italy - which is the mother company for a large number of operating companies worldwide - involved with developing, manufacturing and supplying cables and cable systems. Worldwide Prysmian Group consists of 98 operating companies in 50 different countries with approx. 22,000 employees.



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