

# The Business Unit Telecom & Industry Systems

This Business Unit contains the segments Telecommunications and Industry with the product lines fibre optic cables (FOC), flexible copper cables as well as customised special and hybrid cables.

## Product Development

At the Brugg Cables production sites, our development teams work on innovative products and solutions. This results in constant technical and economic advance development of products. Continuous maintenance of the standard product assortment is also at the center of focus.

## Production in Switzerland

The experienced and competent staff at our production sites in Switzerland guarantee high-quality products.

## Cable Assembly according to your Specifications

At the modern workplaces in the assembly department, we assemble, test, label and package plug-type connectors for FO cables and copper cables. Depending on the application, the anti-kink coating can be coloured with the same material and colour as the cable sheath. This partially takes place under clean room conditions.

## Global Distribution of our Products

Brugg Cables has a global distribution network with many partners.

## Certified according to ISO 9001 and 14001

A continuous process (certificate ISO 9001) optimises the process sequences from the product idea up to customer service. We use and process resources and materials environmentally friendly (certificate ISO 14001).

## Communication through the Sewer System: FTTS®

The specially designed SewerLINK rope enables communication through sewage systems FTTS® (Fibre Through The Sewage), water channels, compressed water canals and lakes using optical transmission. Communities can also network their operating points with each other through their sewage systems. Realisation times and costs are substantially reduced thanks to an extensive range of accessories as well as easy installation without digging work. Brugg Cables has long-standing experience in the installation of these cables, also in water.

## Sensor Technology Applications with the BRUsens by Brugg Cables

The application-specific optical sensor cables developed by Brugg Cables are excellently suited for measuring temperatures and distances. There are almost no limits to the possible application fields. Larger damage can often be prevented by early detection and exact localisation. Some application examples are: Detection of oil, gas or water leaks in buildings or pipelines, overheating of installations and high-voltage cables, fires, etc. These cables can be used in environments from -200°C up to 300°C or chemically aggressive environments as well as in the food industry.

## Alpine Telecommunication

Mountain railways and transport facilities are equipped with telecom ropes all over the world. Spanned via masts, this passive cabling system connects the mountain with the valley station and ensures communication and data transfer also in extreme climates or heavy mechanical strain.



*SewerLINK rope in application at SN Energie.*



*Telecom rope for data communication with mountain stations.*

# Fibre optic cable products overview

## Fibres

New applications require the use of powerful optical cables. Besides standard single and multimode fibres, Brugg Cables also offers fibre types for high-end applications. Depending on your demands, we also offer optimised fibres as well as fibres with an extended temperature range.

## Independent Fibre Purchase

We purchase high-quality fibres from the most renowned fibre suppliers worldwide. On request, we offer the most varied fibre types and qualities for our cables.

## Optical Cables for Indoor Use

Indoor cables are installed in cable lines, cable or parapet ducts. With respect to the optical properties, these cables correspond to the building cabling standards ISO/IEC 11801 and EN 50173. All our indoor cables have a FRNC sheath and meet the requirements of IEC 60332-x.

## Optical Cables for Outdoor Use

Outdoor cables are installed in tubes, lines and cable ducts. For years, our BRUclean cables have been setting standards with respect to quality and easy installation. Outstanding properties like longitudinal water tightness, tensile load, lateral pressure and four rodent protection designs are united in this product family. Fitters appreciate its dry construction and user-friendly handling. This results in shorter installation times and therefore also in reduced costs.

## Optical Cables for Indoor/Outdoor Use (Universal Cables)

Our BRUuniversal cables unite the quality attributes of the BRUclean cables with the demands of building and campus cabling regarding the properties in case of a fire, meaning: halogen-free, flame-retardant materials (FRNC). Therefore, they also meet the demands of IEC 60332-x.

## Metallic Optical Cables and Ropes

Our metallic ropes have a high technical and quality standard and are applied in the most varied fields.

As thin and robust metal-reinforced optical cables, the miniature optical cables BRUsteel and BRUsens offer new application options, e.g. the temporary application for data transmission outdoor or special applications in extreme environments. These cables perform excellently under high pressure, in strong heat and/or in chemically aggressive environments.

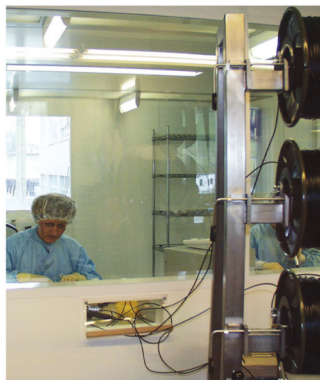
Besides its function as lightning conductor, the optical ground wire (OPGW) is also capable of data transmission. With the OPGW, Brugg Cables has established itself globally and sets standards in the technical development of this cable type. The Centro, an alternative to standard OPGWs, has additional features with the same high quality and safety standard.

## Optical Cable Assembly according to your Specifications

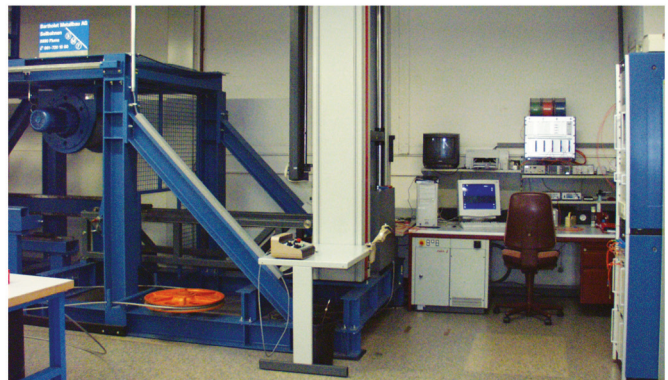
Besides the standard products (patch and pigtail cables), our assembly department not only designs the FIBER-QUICK® cables but also realises special customer requests, if necessary under clean room conditions.



*Climatic test cabinet for cyclic and ageing tests.*



*Clean room for designing optical cables.*



*Modern test installation for traction and lateral pressure tests.*














































# Colour code / icons

3\_0\_3

## Standard Fibre Colour Code of Brugg Cables





(Colour Code based on Swisscom Document 6PHETOP\_1069\_00E\_1)

 1 red	 2 green	 3 yellow	 4 blue	 5 white	 6 violet	 7 orange	 8 black	 9 grey	 10 brown	 11 pink	 12 turquoise
 13 red/1 stripe	 14 green/1 stripe	 15 yellow/1 stripe	 16 blue/1 stripe	 17 white/1 stripe	 18 violet/1 stripe	 19 orange/1 stripe	 20 trans./1 stripe	 21 grey/1 stripe	 22 brown/1 stripe	 23 pink/1 stripe	 24 turquoise/1 stripe
 25 red/2 stripes	 26 green/2 stripes	 27 yellow/2 stripes	 28 blue/2 stripes	 29 white/2 stripes	 30 violet/2 stripes	 31 orange/2 stripes	 32 trans./2 stripes	 33 grey/2 stripes	 34 brown/2 stripes	 35 pink/2 stripes	 36 turquoise/2 stripes
 37 red	 38 green	 39 yellow									
 49 red	 50 green										
										 48 * turquoise	
											 60 * turquoise

\* Colour code on request

## Standard Loose Tube Colour Code of Brugg Cables

Code Swisscom 6PHETOP\_1069\_00E\_1

No.		stranded cables
1		red
2		green
Following		natural
Filler		black

### Cable with high tensile strength



Maximum tensile strength of above 3000 N (300 daN).

### Cable with a flame-retardant and halogen-free sheath, IEC 60332-3 Cat. C



Sheath is self-extinguishing, flame-retardant and halogen-free. In case of fire, no toxic or corrosive gases will be produced by sheath material. Please refer to data sheet 3.0.7.

### Cable with a high crush resistance



Crush resistance of above 300 N/cm (long term). The load will not irreversibly affect the optical characteristics of the fibre or damage the cable.

### Cable with circuit integrity



Cable with circuit integrity allows data transmission for a certain time period depending on system itself as well as prior consultation with the manufacturer.

### Rodent protection



Cable with rodent protection.

### Rodent protection



Cable with standard rodent protection.

### Rodent protection



Cable with enhanced rodent protection.

### Rodent protection



Cable with excellent rodent protection.

### Non-metallic cable



No metals are used in the cable and therefore it requires neither to be grounded nor shielded. Communication via optical fibre cables is insensitive to electromagnetic fields.

### Longitudinal water-tight



If sheath is damaged, water will not spread along the cable core.

### Metallic armoured cable



Cable with increased mechanical and/or chemical resistance.

## Used standards

3\_0\_9

Value	Standard	Remarks
<b>Fibres</b>		
Attenuation	IEC 60793-1-40 (07/1996) IEC 60793-1-40 C1C (07/2001)	Single-mode fibres Multi-mode fibres
Chromatic dispersion coefficient	IEC 60793-1-42 (07/2001)	
Zero dispersion wavelength	IEC 60793-1-C5C (07/1996)	
Cut-off wavelength	IEC 60793-1-44 (07/2001)	
Mode field diameter	IEC 60793-1-45 (07/2002) Corr. 1 (07/2002)	Acc. Petermann II
Modal bandwidth	IEC 60793-1-41 (04/2003)	Multi-mode fibres only
Numerical aperture	IEC 60793-1-43 (07/2001)	
Physical characteristics	IEC 60793-1 20 (09/2001)	
PMD	IEC 60793-1 48 (05/2003)	
<b>Cables</b>		
Cable diameter	The given values are nominal values, which have a tolerance due to the manufacturing process	
Cable weight	The given values are nominal values, which have a tolerance due to the manufacturing process	
Cable bending	EN 60794-1-2-E11 IEC 60794-1-2-E11	
Tensile strength	EN 60794-1-2-E1 IEC 60794-1-2-E1	
Crush resistance	EN 60794-1-2-E3 IEC 60794-1-2-E3	
Operating temperature	EN 60794-1-2-F1 IEC 60794-1-2-F1	

Description of some standards which are mentioned in the data sheets

Short description	Standard
These standards describe the structure of a generic cabling system. They also describe several optical parameters of fibres and optical connectors used in a generic cabling system.	ISO/IEC 11801 EN 50173
These standards describe the geometrical structure and the optical parameters of multi-mode fibres 50/125 µm.	IEC 60793 I-TUT G.651
These standards describe the geometrical structure and the optical parameters of standard single-mode fibres.	IEC 60793 I-TUT G.652
This standard is required by Swisscom for their own cables. It defines optical parameters, the respective test methods, and test criteria of single mode fibres.	Swisscom 6PHETOP_1066_00E_1
This standard is required by Swisscom for their own cables. It defines mechanical structure and the optical parameters, the respective test methods and test criteria of fibre optic cables.	Swisscom 6PHETOP_1069_00E_1
Defines single-mode fibres for use in diAx networks.	diAx-according spec. no 1 version 6.0, 21.9.98

# Halogen-free fibre optic cables

3\_0\_7

In a building, fire can spread along cables from one room to another. If the sheath of the cable contains halogens (e.g. chlorine or fluorine), a burning cable will produce reaction products which are toxic and corrosive, as well as smoke.

Therefore we offer cables with a flame-retardant, non-corrosive (halogen-free) sheath (FRNC). These cables will be named as Fire Security Cables. They will be checked according to the following standards.

## 1. Flame retardance

Flame-retardant cables must be self-extinguishing when the source of fire is removed. FRNC-cables from Brugg Cables are equipped with a flame-retardant jacket.

### 1.1 Test methods

The flame-retardant qualities are determined by two different methods:

IEC 60332-1 Test on a single vertical cable

IEC 60332-3 (Cat. C) Test on a cable bundle

## 2. Smoke density and acid gas corrosiveness

Smoke emission is a major problem in the event of fire where the number of escape routes is limited. The sheath of our optical cables is made of halogen-free material, eliminating the problems of metal corrosion.

### 2.1 Test methods

The smoke emission characteristics are determined by the following method:

IEC 61034-2 Emission of smoke. Measurement of smoke density as a function of light transmission in percentage through a 27 m<sup>3</sup> oven.

Corrosive gases according to IEC 60754-x

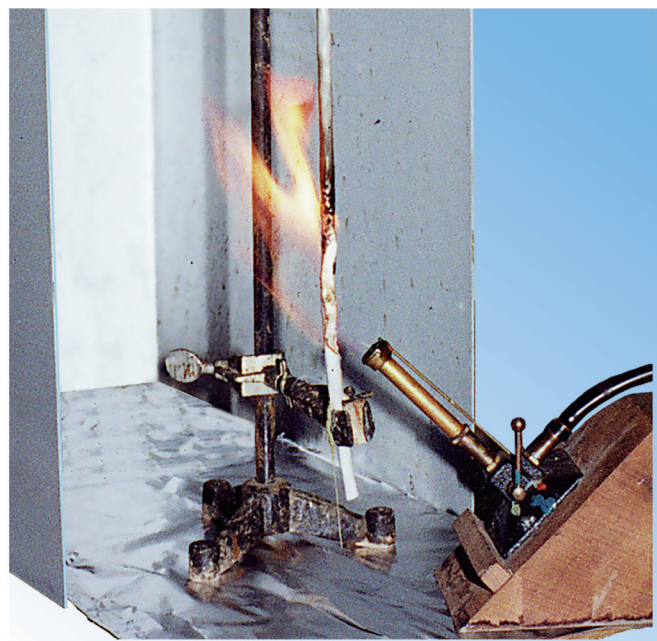
## 3. Circuit integrity

Cables with circuit integrity allow data transmission over a certain period of time under fire conditions.

### 3.1 Test methods

The circuit integrity will be tested according to:

IEC 60331-25 Circuit integrity for fibre optic cable.



# Fibre, single-mode - standard

2\_1\_20\_1

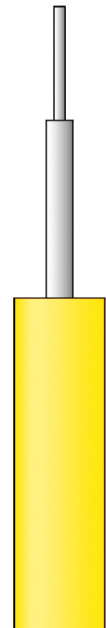
According to ITU-T G.652 A

**Construction:**

- Step index glass/glass optical fibre E9/125
- Primary coating with polyamide

**Standards:**

- Standards, see also data sheet 3\_0\_9


**Optical data (cabled)**

Type	Attenuation		Chromatic dispersion		Zero dispersion wavelength nm	Cut-off wavelength nm	PMD ps/√km
	dB/km 1310 nm	dB/km 1550 nm	ps/(nm x km) 1310 nm	ps/(nm x km) 1550 nm			
FSM standard	≤0.36	≤0.25	≤3.5	≤18	1302...1322	≤1260	≤0.5
FSMA	≤0.40	≤0.25	≤3.5	≤18	1302...1322	≤1260	≤0.5
FSMF	≤0.36	≤0.22	≤3.5	≤18	1302...1322	≤1260	≤0.5

**Geometric values**

Type	Mode field ø		Cladding ø	Primary coating ø	Mode field non-circularity %	Cladding non-circularity %	MFD/cladding/co-ncentricity μm
	μm 1310 nm	μm 1550 nm	μm	μm			
FSM standard	9.2±0.4	10.4±0.8	125±1	245±10	≤6	≤2	≤0.8
FSMA	9.2±0.4	10.4±0.8	125±1	245±10	≤6	≤2	≤0.8
FSMF	9.2±0.4	10.4±0.8	125±1	245±10	≤6	≤2	≤0.8

**These values correspond to following standards**

Type	6PHETOP_1066_ODE_1/V.-1.0	DIN VDE 0888	FTZ TL no. 6015-3003	IEC 60793	diAx spec. no. 1	ITU-T G.652
FSM standard	x	x	x	x		x
FSMA	x	x		x		x
FSMF	x	x		x	x	x

# Fibre, single-mode - low water peak

2\_1\_20\_2

According to ITU-T G.652 D (Low Water Peak)

## Construction:

- Step index glass/glass optical fiber E9/125
- Primary coating with polyamide

## Standards:

- Standards, see also data sheet 3\_0\_9



## Optical data (cabled)

Type	Attenuation		Chromatic dispersion		Zero dispersion wavelength nm	Cut-off wavelength nm	PMD ps/√km
	dB/km 1310 nm	dB/km 1550 nm	ps/(nm x km) 1310 nm	ps/(nm x km) 1550 nm			
FSL standard	≤0.36	≤0.25	≤3.5	≤18	1302...1322	≤1260	≤0.2
FSLA	≤0.40	≤0.25	≤3.5	≤18	1302...1322	≤1260	≤0.2
FSLF	≤0.36	≤0.22	≤3.5	≤18	1302...1322	≤1260	≤0.2

## Geometric values

Type	Mode field ø		Cladding ø µm	Primary coating ø µm	Mode field non-circularity %	Cladding non-circularity %	MFD/cladding/concentricity µm
	µm 1310 nm	µm 1550 nm					
FSL standard	9.2±0.4	10.4±0.8	125±1	245±10	≤6	≤2	≤0.8
FSLA	9.2±0.4	10.4±0.8	125±1	245±10	≤6	≤2	≤0.8
FSLF	9.2±0.4	10.4±0.8	125±1	245±10	≤6	≤2	≤0.8

## These values correspond to following standards

Type	6PHETO-P_1066_ODE_1/V.1.0	DIN VDE 0888	FTZ TL no. 6015-3003	IEC 60793	diAx spec. no. 1	ITU-T G.652
FSL standard	x	x	x	x		x
FSLA	x	x		x		x
FSLF	x	x		x	x	x



# Fibre, single-mode - NZDSF

2\_1\_23

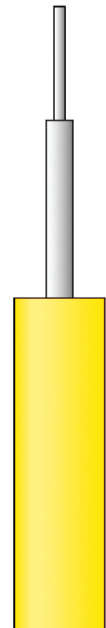
According to ITU-T G.655 C

## Construction:

- Glass/glass optical fiber
- Primary coating with polyamide

## Standards:

- Standards, see also data sheet 3\_0\_9



## Optical data (cabled)

Type	Attenuation		Chromatic dispersion		Increase of dispersion	Cut-off wave-length nm	PMD ps/√km	Effect. area (A <sub>eff</sub> ) μm <sup>2</sup>
	dB/km 1550 nm	dB/km 1625 nm	ps/(nm x km) C-band	ps/(nm x km) L-band	ps/(nm <sup>2</sup> x km) 1550 nm			
LEAF®	≤0.30	≤0.35	3.0-6.0	4.5-11.2	0.085	≤1260	≤0.2	≤72
FutureGuide™	≤0.30	≤0.35	2.0-6.0	4.5-11.2	0.050	≤1450	≤0.2	≤65
TrueWave®RS	≤0.30	≤0.35	2.6-6.0	4.0-8.9	0.045	≤1260	≤0.2	≤52

## Geometric values

Type	Mode field ø μm 1550 nm	Cladding ø μm	Primary coating ø μm 1310 nm	Cladding non-circularity %	MFD/cladding/concentricity μm
LEAF®	9.6±0.4	125±1	245±5	≤1.0	≤12
FutureGuide™	9.6±0.4	125±1	245±5	≤1.0	≤12
TrueWave®RS	8.4±0.6	125±1	245±5	≤0.7	≤10

## These values correspond to following standards

Type	IEC 60793	ITU-T G.655
LEAF®	x	x
FutureGuide™	x	x
TrueWave®RS	x	x



# Fibre, multi-mode - standard

2\_1\_30\_1

For standard LAN applications

## Construction:

- Graded index glass/glass optical fiber
- Primary coating with polyamide

## Standards:

- Standards, see also data sheet 3\_0\_9



## Optical data (cabled)

Type	Attenuation		Bandwidth/length product		Numeric aperture
	dB/km 850 nm	dB/km 1300 nm	MHz x km (OFL) 850 nm	MHz x km (OFL) 1300 nm	
FG5 - OM2	≤2.7	≤0.8	≥500	≥800	0.200±0.02
FG5A - OM1	≤3.0	≤1.0	≥400	≥600	0.200±0.02
FG5F - OM2	≤2.5	≤0.7	≥600	≥1200	0.200±0.02
FG6 - OM1	≤3.5	≤1.0	≥200	≥500	0.275±0.02
FG6A - OM1	≤3.0	≤0.8	≥250	≥800	0.275±0.02

## Geometric values

Type	Core ø µm	Cladding ø µm	Primary coating ø µm	Core non-circularity %	Cladding non-circularity %	Core/sheath concentricity µm
FG5 - OM2	50±3	125±2	250±15	≤6	≤2	≤1.5
FG5A - OM1	50±3	125±2	250±15	≤6	≤2	≤1.5
FG5F - OM2	50±3	125±2	250±15	≤6	≤2	≤1.5
FG6 - OM1	62.5±3	125±2	250±15	≤6	≤2	≤1.5
FG6A - OM1	62.5±3	125±2	250±15	≤6	≤2	≤1.5

## These values correspond to following standards

Type	ITU-T G.651 (50/125µm)	DIN VDE 0888	EN 50173	ISO / IEC 11801	IEC 60793
FG5 - OM2	x	x	x	x	x
FG5A - OM1	x	x	x	x	x
FG5F - OM2	x	x	x	x	x
FG6 - OM1			x	x	x
FG6A - OM1			x	x	x

Subject to changes without notice

# Fibre, multi-mode - application

2\_1\_32

Optimised for 10 Gigabit Ethernet application

## Construction:

- Graded index glass/glass optical fibre
- Primary coating with polyamide

## Standards:

- Standards, see also data sheet 3\_0\_9



## Optical data (cabled)

Type	Attenuation		Bandwidth/length product			Numeric aperture	DMD characteristics
	dB/km 850 nm	dB/km 1300 nm	MHz x km (OFL) 850 nm	MHz x km (OFL) 1300 nm	MHz x km (LASER) 850 nm		
FG5M - OM3	≤2.7	≤0.9	≥1500	≥500	≥2000	0.200±0.02	TIA-492 AAAC

## Geometric values

Type	Core ø µm	Cladding ø µm	Primary coating ø µm	Core non-circularity %	Cladding non-circularity %	Core/sheath concentricity µm
FG5M - OM3	50±2.5	125±2.0	245±10	≤6	≤1	≤1.5

## These values correspond to following standards

Type	ITU-T G.651 (50/125µm)	DIN VDE 0888	EN 50173	ISO / IEC 11801	IEC 60793	IEEE 802.3ae
FG5M - OM3	x	x	x	x	x	x