Cavicel

Conducting Value

OPTICEL

Fibre Optic Cables

ISO 9001:2008
Certificate No. CS1-249

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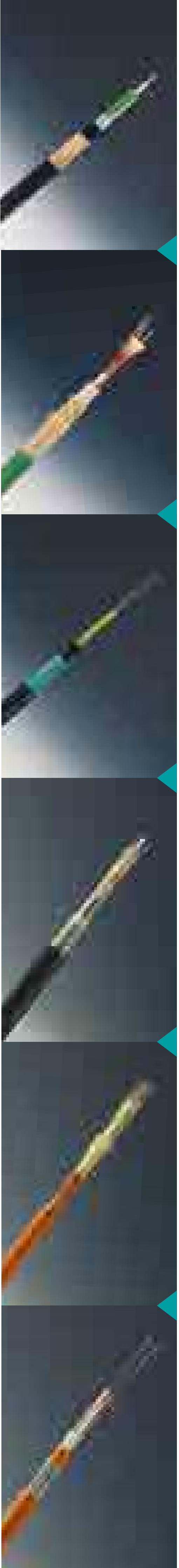
Cert/LPCB ref. 217

GOST ISO 9001-2011
(ISO 9001:2008)
certification N СдС.TII.CM.04293-14

ISO 9001:2008
n. 9125.CAVL

ISO 14001:2004
n. 9191.CVCL

Our commitment to environmentally friendly products.
CAVICEL is committed to providing our customers with environmentally friendly products in compliance with the European Union (EU) RoHS Directive (Restriction of Hazardous Substances) and REACH Regulation (Registration, Evaluation, Authorization and Restriction of Chemicals).



Cavicel

OPTICEL
Fibre Optic Cables

"Light moves the world around"

More and more data, more and more information, getting faster everywhere in the world.

Optical fibers now represent the new world for a safer and more reliable communication.

Experience is our Power.

With this catalogue we try to demonstrate our experience, our way of thinking and the way we operate to create our OPTICEL cables. The cables you will see are genuine practical examples.
When it comes to your own cable we can design it together. Let us know your specific requirements and we will create your cable around them.

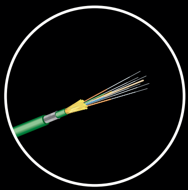
Your cable, our passion.

TIGHT CABLES

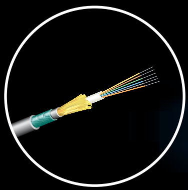
Simplex/Duplex/Pico Fibre

Multitight Distribution

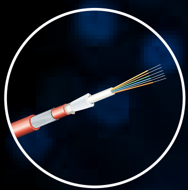
Multifibre Breakout



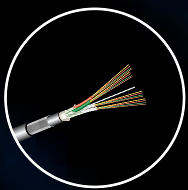
LOOSE BUFFERED CABLES



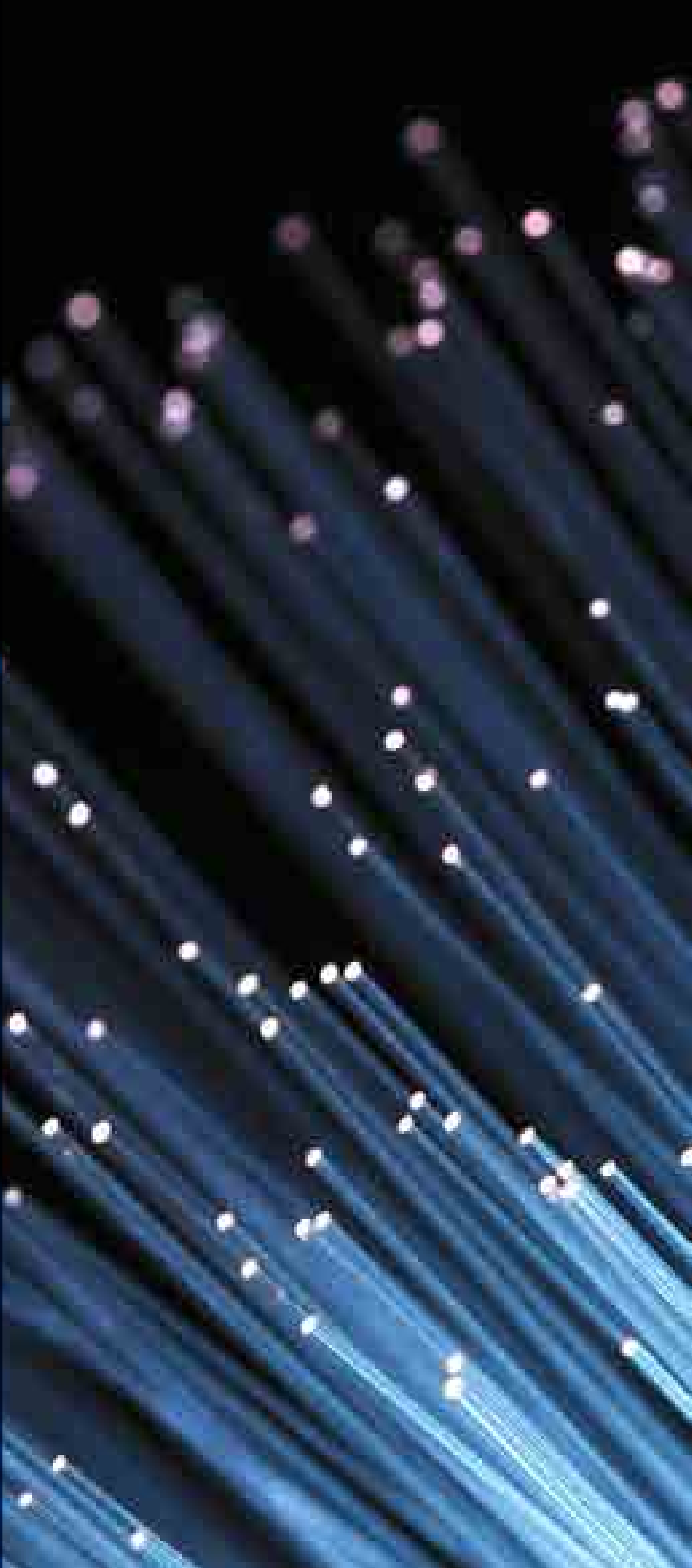
FIRE RESISTANT LOOSE BUFFERED CABLES

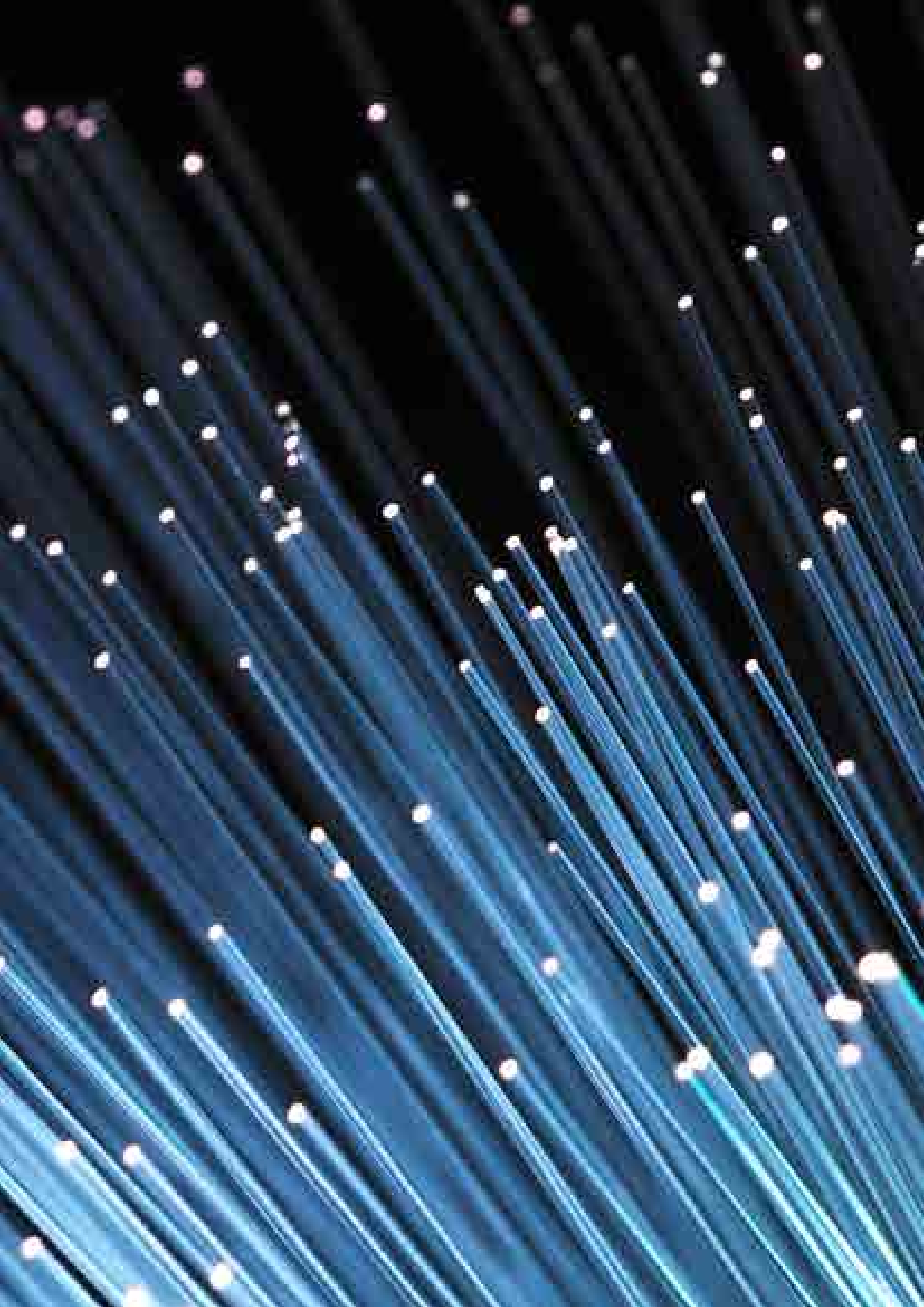


SPECIAL HIGH PERFORMANCE CABLES

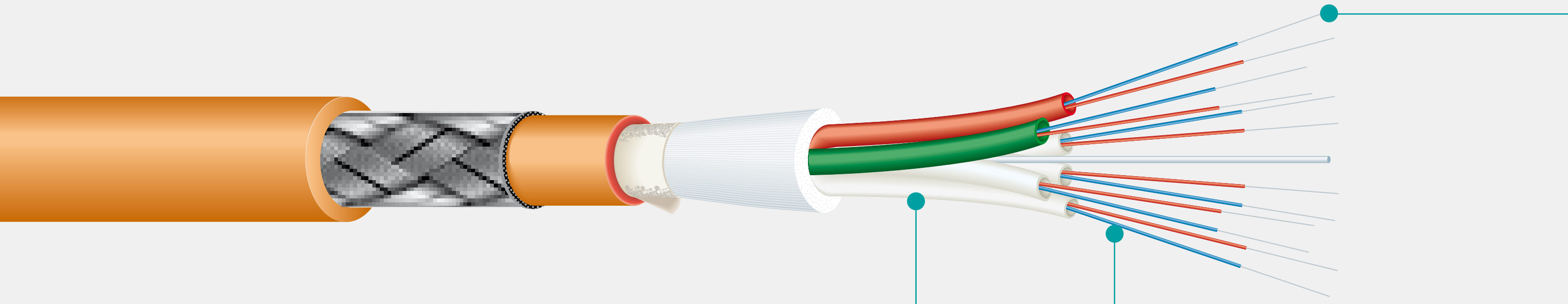


HYBRID FIBER-COPPER CABLES



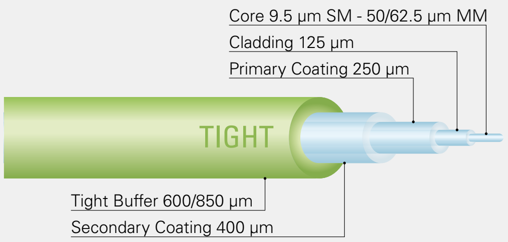


CONSTRUCTION AND GENERAL INFORMATION

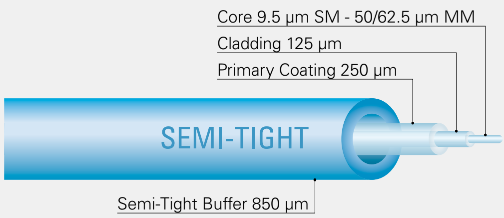


Fibre coating

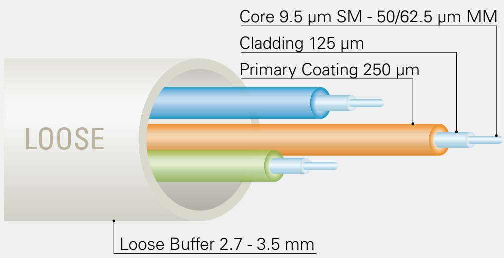
- Fibre primary protection is carried out by mainly using most common techniques in optical cables manufacturing.



- Tight protection consists in applying a double layer tight to the fibre, whose inner layer, generally made of a UV curable resin , is meant to act as a cushion, while the outer layer, made of polyamide or other technopolymer, has a protective function.
  This solution is normally used to manufacture patch cord or for breakout cables.



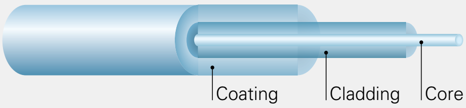
- Semi-Tight protection consists in a thin thermoplastic coating, applied in a non-tight way on one or more fibres. Commonly used materials are flame retardant and low smoke.
  This solution is used for flexible and/or with small dimensions cables, type FTTH, when, for instance, it is necessary to peel the fibre for long lengths.



- Loose protection consists in a rigid high stability material such as PBT or PA tube applied in a loose way on one or more fibres.
  This construction is used to protect the fibres against external stresses. Generally these elements are filled with a moisture protection gel.
  This solution is used for telecommunications, when both optical and mechanical high performances are required or for heavy duty working conditions.

Fibres

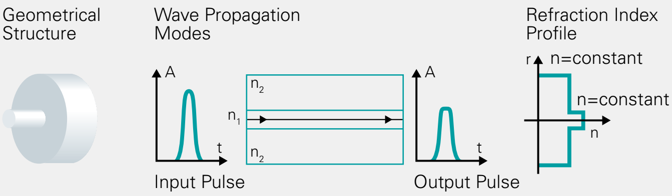
- The fibres generally used when manufacturing optical cables are either multimode or singlemode.



- Singlemode fibres (9.5/125), are used for urban telephone lines and premises (FTTH) for video transmission (CATV), telecommunications and intelligent traffic networks.
- Multimode fibres (50/125 and 62.5/125), are used for data transmission in short length transmissions and for transmission capacity up to 10 Gb/s.

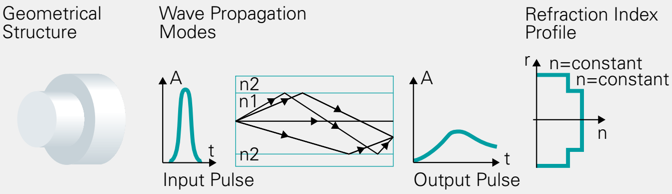
SINGLEMODE STEP-INDEX FIBRE

- It presents a step-index profile, with a smaller core (8÷10 μm) compared to multimode fibres. In this situation only a single mode (an axial ray) is allowed to travel through the fibre. This produces no pulse dispersion which essentially offers an infinite bandwidth.



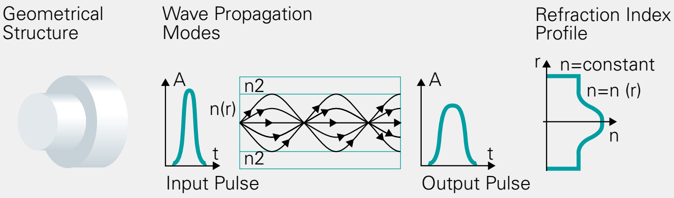
MULTIMODE STEP-INDEX FIBRE

This type exhibits a distinct change in refractive index between the core and cladding, and so it is called step-index for this reason. Light is transmitted along a fibre by a multimode of different paths, ranging from one which is parallel to the axis to those propagating at angles close to the critical angle, with many in between. Each path at a different angle is termed a "transmission mode". The distances travelled by various modes, and hence the time taken, are not equal. Consequently, a short pulse of light, launched simultaneously into many modes, will have various transmission delays, causing a pulse spreading (intermodal dispersion).



MULTIMODE GRADED-INDEX FIBRE

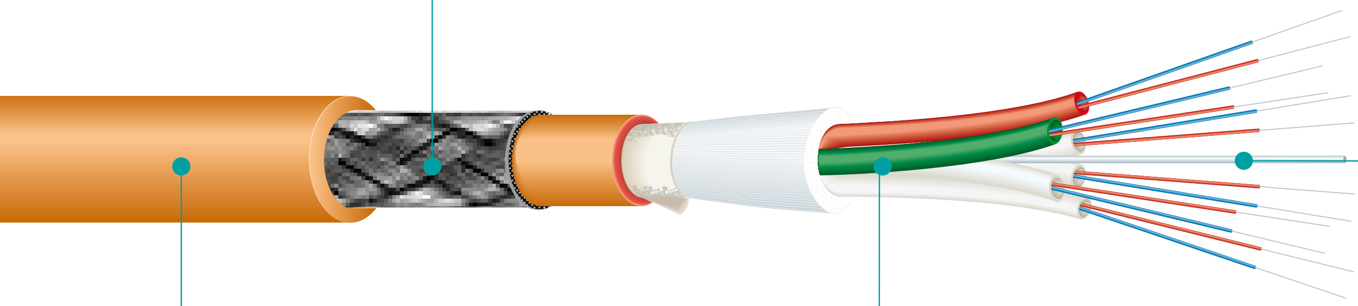
In a graded index fibre, the index of refraction of the core is highest in the centre and gradually decreases as the distance from the centre increases. In this way, the light rays are continually being bent towards the fibre optical axis, and this causes a reduction in dispersion.



A=Amplitude
t=Time
r=Fibre Radius

$$n = \frac{\text{Velocity of light in vacuum}}{\text{Velocity of light in medium}}$$

CONSTRUCTION AND GENERAL INFORMATION



Sheaths

Various materials can be used to realize the outer or intermediate protective sheaths of the optical cables. The choice of the most suitable material is carried out on the basis of the environmental conditions in which the cable is meant to operate. Most commonly used materials are: PE, PVC, LSZH.

The main considerations to be kept in mind when selecting the material are:

- Type of installation (external/internal, buried …)
- Presence of moisture, corrosive vapours, drilling muds
- Range of the operating temperatures
- Behaviour in case of fire (fire propagation, toxic gas emission, smoke emission, …)
- Presence of animals or insects (rodents, termites….)

In case of particular problems, specific materials can be traced or developed.
Material table, page 12, provides the general criteria to choose the most suitable material.

Armouring and protections, with choise criteria, are shown on page 11.

Armouring and protections

They can be either metallic or dielectric and are used to guarantee the following characteristics:

- Protection against accidental damages
- Protection against rodents
- Ballistic protection
- Moisture protection
- Protection against laying operations

In the table on page 11 you will find main protection types and the choice criteria.

Reinforcing elements

Reinforcing elements in optical cables are used to withstand the axial stresses due to the laying, the working conditions or to the thermal variations, thus preventing that the same are passed on to the fibres.

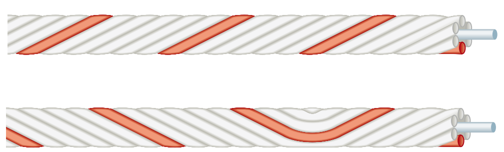
- Traction central element, is a rigid element located inside the cable core that can be made either of steel or FRP (fibreglass reinforced plastic).

- Traction peripheral element, consists of dielectric yarns, normally made of aramid or glass, applied helically or in a parallel way around the optical cord.

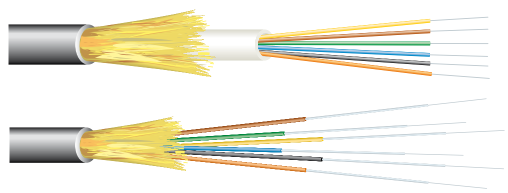
Cabling

Construction of optical cables can have either a concentric structure with optical elements helically stranded (continuous or S/Z) around a central element, or a parallel structure. In both cases, the optical element can contain one or more fibres (max. 24 per tube, max. 12 tubes for concentric structure).

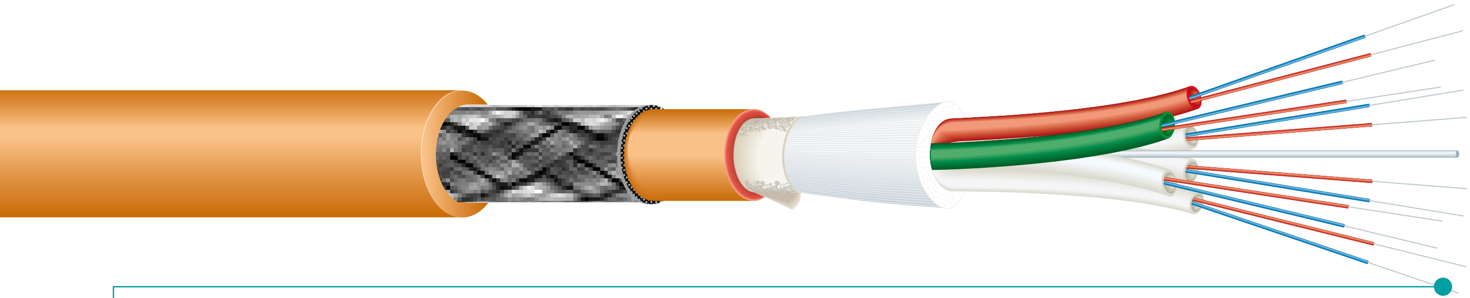
- The concentric structure is used to manufacture cables with high mechanical, optical and environmental performance.



- The longitudinal structure is recommended for cables that are lightweight, highly flexible and with less extreme performances.



CONSTRUCTION AND GENERAL INFORMATION

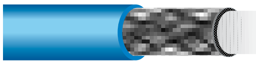
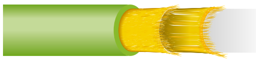
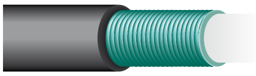
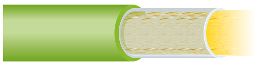
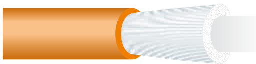
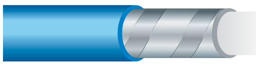
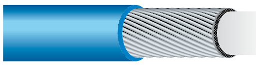
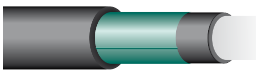
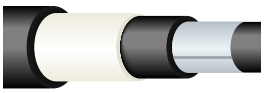


Protections against water penetration (Water Blocking - WB)

These protections are meant to prevent water penetration and propagation inside the cable in case of damages of sheaths or of ends flooding. The water blocking protections can be achieved by jelly filled solution or dry solution.

- "Jelly Filled" protections, are generally silicone-oil based or polyolefines-oil based, both silicon-thickened, that are used to fill the cable interstices. These products are characterized by a high stability in a wide temperature range. They are thixotropic, and therefore are fluid during the application, but do not drip at rest.
  This type of protection is among the most effective in granting the tightness of optical cables. As a negative aspect, it has to be pointed out that the cleaning procedure requires a longer time for the joints and/or ends preparation.
- "Dry" protections with water swellable materials. These materials generally take advantages from the capacity to remarkably increase their volume when in presence of water and to prevent its passage.
  Among these semi-finished products are:
  - Stiff elements made of FRP (fibreglass reinforced plastic), with a water blocking coating
  - Textile fillings impregnated with water blocking resins.
  - Binding tapes made of water blocking non woven tapes.
  - Water blocking special glass or aramid reinforcing rowings.

The use of those materials allows to realize dry cables, plugged with water blocking, that do not show the problems of the cables plugged with gel.

			Main characteristics	Tensile performance	Crush performance	Rodent protection
A1	**Galvanized Steel Wire Braid** Zinc plated braid. It can be used for highly flexible and mechanical resistant cables.		• Rodent protection • Fexibility • General application	●●●	●●●	●●●●
A2	**Aramide Yarn Armour** It consists in a layer made of aramidic yarns helically or longitudinally applied around the cable cord. This solution is adopted for totally dielectric cables, such as the aerial cables, that, besides the light weight, are characterized by high traction resistance and ballistic protection (when combined with aramidic tape).		• Flexibility • Dielectric • Traction strength • Lightweight	●●●●	●	●
A3	**Corrugated Steel Tape** Laminated corrugated steel tape applied in a longitudinal way, close on its own and bonded to the sheath. It is applied as anti-rodent protection and as protection against cable deflection for cables that can be directly buried.		• Moisture resistance • Burial laying	●●●	●●●●	●●●●●
A4	**Polyamide protection** This protection assures an anti-rodent and anti-termite function in dielectric cables.		• Dielectric • Lightweight	●●●	●●●	●●●
A5	**Glass Yarn Armour** Dielectric armouring in glass yarns with high traction resistance and with anti-rodent protecting function.		• Flexibility • Lightweight • Dielectric	●●●	●●	●●●●
A6	**Steel Tape Armour** Steel tapes helically applied assure crush resistance and anti-rodents protection, for directly buried installation.		• Compression resistance • Burial laying	●●●	●●●●	●●●●●
A7	**Steel Wire Armour** Zinc plated steel spiral wires. It is applied as an anti-rodent protection and/or on cables that require high tensile load.		• Traction strength • Burial laying	●●●●●	●●●●	●●●●●
A8	**Copolymer Coated Aluminium Tape** It consists of a laminated aluminium tape applied longitudinally, closed and bonded on its own and on the sheath.		• Moisture resistance	●●	●●	●
A9	**HI-PACK** It is a multi-layer AL/PE/Polyamide protection, used as a protection against moisture, chemical and petrochemical agents (construction as A8 with a further polyamide sheath). This is a valid alternative to lead sheath, with a lower weight and a smaller diameter.		• Chemical agent protection • Moisture resistance • Burial laying	●●	●●●●	●●
LC	**Lead Sheath** It is applied between two other sheaths and is the best protection against aggressive chemicals. This is an expensive solution, increases weight and bending radius. It presents poor vibration resistance and normally an armour is required to protect it from crushing.					

●●●●● excellent ●●●● very good ●●● good ●● fair ● poor

MATERIALS

	Temperature range °C	Abrasion resistance	Oil resistance	Solvent resistance	Water resistance	Nuclear radiation resistance	Flame retardancy	Flexibility
PVC	-40 +105	●●●	●●●	●●	●●●	●●	●●●	●●●
Polyethylene	-40 +80	●●●	●●	●●●	●●●●	●●	●	●●
Polypropylene	-40 +105	●●●●	●●●●	●●●●	●●●●	●●	●	●●
Polyamide	-70 +120	●●●●	●●●●	●●●●	●●	●●	●	●●
Polyurethane	-40 +80	●●●●	●●●●	●●	●●●	●●●	●●●	●●●
XLPE	-60 +90	●●	●●●	●●●	●●●	●●	●	●●
Fluoropolymer FEP	-80 +205	●●	●●●●	●●●●	●●●●	●	●●●●	●●
Fluoropolymer ETFE	-80 +155	●●	●●●●	●●●●	●●●●	●●●	●●●●	●
Hytrel	-40 +80	●●●	●●●●	●●●●	●●●	●	●	●●
Peek	-60 +250	●●	●●●●	●●●●	●●●●	●●●●	●●●●	●
Kapton	-75 +200	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●
Technopolymer LSZH	-30 +90	●●	●●●	●●	●●●●	●●●●	●●●	●●
Thermoplastic Rubber	-55 +125	●●●●	●●●	●●	●●●	●	●●●	●●●●
LSZH	-30 +90	●●	●●●	●●	●●●	●●●	●●●	●●

●●●● very good ●●● good ●● fair ● poor

TRANSMISSION PARAMETERS

Main characteristics of optical connection are the attenuation and the dispersion.

Attenuation

WHAT IS IT

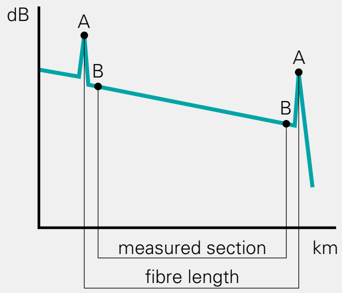
Attenuation indicates the power loss of a light pulse going through an optical fibre having a certain length. The signal reduction, due to dispersion and absorption phenomena, has an exponential decay based on the fibre length. The ratio between the outlet power and the inlet power, expressed in a logarithmic function, represents a quantity linearly depending on the fibre length. Such a quantity is expressed in dB/Km. This is defined as intrinsic attenuation depending on the type of fibre and on its length. However, if a fibre is subject to side pressure (microbending) or to narrow bending radius (macrobending), the attenuation can undergo even drastic increments.
Attenuation is the most important parameter to be kept under control while manufacturing and laying optical cables.
The cable manufacturer must guarantee, during those phases, the prescribed attenuation levels.

HOW TO MEASURE IT

The measuring methods for the attenuation are essentially three: reflectometric method, measurement with power meter and cut-back method or spectral attenuation method. The first two methods use monochromatic light sources and therefore measure only at the fixed wavelengths (850, 1300,…nm), while the third method allows to measure the attenuation for each wavelength of the spectrum of interest (800 - 1650 nm).

OTDR (optical time domain reflectometers)

It consists in measuring the backscattered power, due to the Rayleigh effect, of a light pulse, with a defined wavelength, injected into a fibre. Each fibre section reflects in every direction a light pulse going through it. The part of the signal that is reflected backwards is measured by the instrument that, on the basis of the delay, redefines the attenuation map according to the fibre length.



The measuring speed, the possibility of measuring on one end only, the possibility to carry out length measurements and to analyze the trend and the events localized along the whole length, make this method the most common and the most reliable one.
It is in fact used to measure during all the cable constructive phases, in the manufacturing testing sizes and on the laid sections.
The picture shows an OTDR measurement graph, with the following information:

- fibre length delimited by two reflection peaks (A);
- measured section delimited by two inner markers (B);
- absolute attenuation of the measured section expressed in dB;
- attenuation by length unit expressed in dB/km.

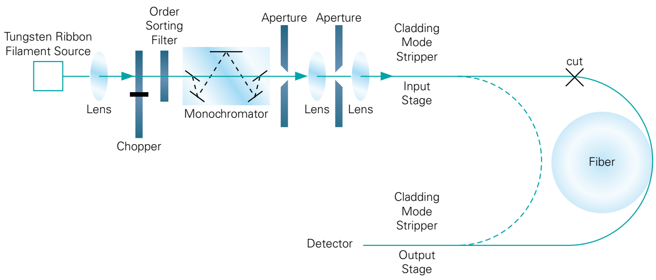
TRANSMISSION PARAMETERS

Attenuation

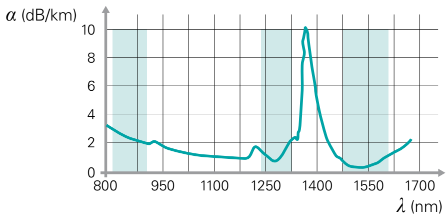
How to measure it

CUTBACK or Spectral Attenuation

It consists in comparing, for each wavelength, the optical power transmitted by the measured fibre to the inlet optical power. Where, the meaning of inlet power is the power transmitted by a short initial section (approx. 2 m) of the same fibre to be measured (cutback), by keeping the launching conditions as unaltered. The measuring apparatus in this case (see picture) is formed by a white light source decomposed by means of a monochromator in the various spectral components, by a high-sensibility photodetector and by the acquisition/processing system.



In the graph is shown an example of the measure carried out by this method, where the attenuation is calculated according to the following formula.



$$\alpha_{dB} = -\frac{10}{z}\log_{10}\frac{P_{out}}{P_{in}}$$

The need to access the two measuring ends, the cost and the delicacy of the instrumentation, make it a non-routine measuring method, mainly suitable to the fibre characterization and to the laboratory measures.

POWER METER

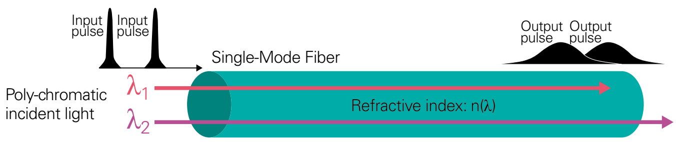
It consists in noting the signal level getting out of a fibre, injected by a monochromatic source, and comparing it with the inlet level that is achieved by cutting a short piece of fibre in the inlet side.
This method therefore requires a source and a meter and then the two ends of the fibres to be measured.
Normally, this method is used as a relative attenuation measure, that is to say to monitor the power variations transmitted by the fibre under test.

Dispersion

What is it

There are two types of dispersion: chromatic dispersion and modal dispersion. Both have an impact on the bandwidth limitation (quantity of transmittable data) and are expressed in ps/(nm.km).

- Chromatic dispersion, is the phenomenon causing a light pulse in a fibre to run at a speed that depends on its wavelength. Since perfectly monochromatic pulses do not exist in reality (even laser ones), the various pulse components, inside the fibre, run with their own speed and consequently, the pulse at the outlet is wider than the original one (the components close to the infrared slow down, the ones close to the ultraviolet accelerate). When two pulses, close to each other, interfere till they become indistinguishable, then you have a band limitation. See picture below.
  This phenomenon exists both for singlemode and for multimode fibres.



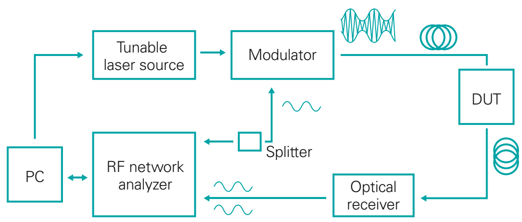
- Modal dispersion, is only referred to MM fibres and is due to the differences in the transit time of the various modes in which the original pulse is decomposed. Since each mode covers optical paths with different lengths (and therefore with different times), the consequence is always the widening of the pulse and the consequent risk of band overlapping or limitation.

How to measure it

Main measuring methods are essentially three: MPS (modulation phase-shift), DPS (differential phase-shift) and PULSE-DELAY. The first two methods require to access the two connecting heads and the use of complex instrumentation; as a consequence, the use on the field is not really feasible.
The third method, on the contrary, only requires to access one measuring head and uses compact instrumentation.

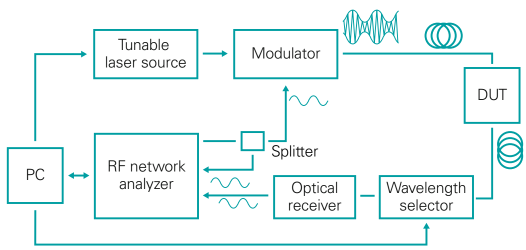
MPS, calculates the group pulse delay by measuring the phase displacement that is formed between a modulated pulse that goes through the section fibre and the original modulated pulse. The apparatus is mainly formed (see picture) by a modulated laser source and a vectorial RF network analyzer.

- The MPS method measures the phase difference between a transmitted and received signal. The RF network analyzer modulates the amplitude of the laser's signal.

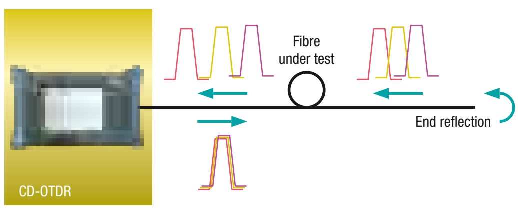


DPS, is very similar to the previous one, except for the fact that, being equipped with a wavelength selector (see picture), it is possible to select very tight windows within the laser emission spectrum. In this way, it is possible to directly measure the chromatic dispersion on the basis of the wavelength.

- Like the MPS method, the DPS method also modulates the amplitude of the laser's signal. But the DPS method also slightly varies, or dithers, the laser's wavelength.



PULSE-DELAY, is the quickest and most practical method and uses a CD-OTDR for the measurement. It is based on the principle that different wavelengths pulses travel at a different speed. By launching a multiple laser pulses into a fibre by means of a CD-OTDR and by analyzing the delay of the pulses reflected by the end itself, it is possible to calculate the chromatic dispersion time. See picture.



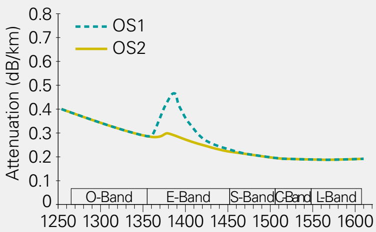
SINGLEMODE FIBRE CHARACTERISTICS

FIBRE TYPE			Single mode std	Single mode Bend insensitive	Single mode Bend insensitive xs	NZDSF
IEC 11801 classification			OS1/OS2	OS1/OS2	OS1/OS2	-
ITU-T type			G.652D	G.657A1	G.657A2	G.655/G.656
Cavicel Code			009	009/G.657A1	009/G.657A2	NZD
OPTICAL SPECIFICATION						
Attenuation	1310 nm	dB/km (max)	≤ 0.35	≤ 0.35	≤ 0.35	≤ 0.40
	1550 nm		≤ 0.21	≤ 0.21	≤ 0.20	≤ 0.25
	1625 nm		≤ 0.23	≤ 0.23	≤ 0.21	≤ 0.28
Bending loss 1 turn D = 10 mm	1550 nm	dB	-	≤ 0.75	≤ 0.1	≤ 0.50
	1625 nm		-	≤ 1.5	≤ 0.2	-
Chromatic Dispersion	1285-1330 nm	ps/(nm*km)	≤ 3.0	≤ 3.0	≤ 3.0	-10 ÷ -3
	1550 nm		≤ 18	≤ 18	≤ 18	8
	1625 nm		≤ 22	≤ 22	≤ 22	10
GEOMETRICAL SPECIFICATION						
Mode field diameter	1310 nm	µm	9.0 ±0.4	9.0 ±0.4	8.8 ±0.4	-
	1550 nm		10.1 ±0.5	10.1 ±0.5	9.8 ±0.5	9.2 ±0.5
Cladding diameter		µm	125 ±0.7	125 ±0.7	125 ±0.7	125 ±1.0
Coating diameter		µm	242 ±7.0	242 ±7.0	242 ±7.0	242 ±7.0
APPLICABLE DISTANCE (*)						
Gigabit Ethernet	Sx (1310 nm)	m	10,000	10,000	10,000	-
	Lx (1550 nm)		40,000	40,000	40,000	-
10 Gigabit Ethernet	Sx (1310 nm)		10,000	10,000	10,000	-
	Lx (1550 nm)		40,000	40,000	40,000	-

(*) These are the allowable distances at given frequencies. For lower frequencies, distances increase.

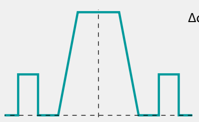
OS1 are first generation fibres.

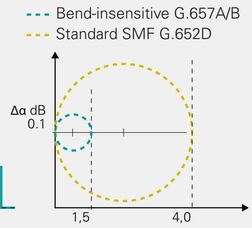
OS2 are fibres with low water content, and therefore they allow to exploit a wider transmission spectrum.



The "Bend-insensitive" fibres are equipped with a particular index profile that makes them particularly insensitive to bendings.

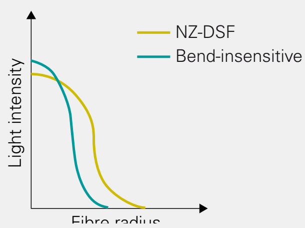
- Type "G657A" is optimized to operate at 1550 - 1625 nm, and therefore it is suitable to realize type FTTH connections.
- Type "G657B" is equipped with a limited mfd and can therefore withstand even more extreme bendings and is suitable to make patch cord and connections that require narrow bending radius.


Refraction Index profile



Behaviour with bendings

NZD fibres have an index profile similar to the Bend-insensitive, but with a bigger effective area (65 µm2) that, together with an optimized chromatic dispersion, make them suitable to DWDM transmissions in long distances connections with long and very long distances.

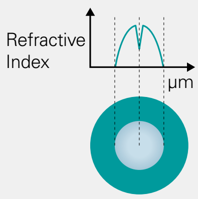


MULTIMODE FIBRE CHARACTERISTICS

FIBRE TYPE			Multimode 62.5/125 std	Multimode 50/125 std	Multimode 50/125	Multimode 50/125	Multimode 50/125	Multimode 200/230
IEC 11801 classification			OM1	OM2	OM2+	OM3	OM4	-
ITU-T type			-	G.651	G.651	G.651	G.651	-
Cavicel Code			062	050	050/OM2	050/OM3	050/OM4	200
OPTICAL SPECIFICATION								
Attenuation	850 nm	dB/km (max)	≤ 2.7	≤ 2.3	≤ 2.3	≤ 2.3	≤ 2.3	-
	1300 nm		≤ 0.6	≤ 0.6	≤ 0.6	≤ 0.6	≤ 0.6	-
Numerical aperture			0.275 ±0.015	0.200 ±0.015	0.200 ±0.015	0.200 ±0.015	0.200 ±0.015	
Bending loss 100 turns D = 75 mm	850 nm	dB	≤ 0.5	≤ 0.2	≤ 0.2	≤ 0.2	≤ 0.2	-
	1300 nm		≤ 0.5	≤ 0.2	≤ 0.2	≤ 0.2	≤ 0.2	-
Bandwidth	850 nm	MHz x km	≥ 200	≥ 500	≥ 700	≥ 1500	≥ 3500	≥ 20
	1300 nm		≥ 600	≥ 500	≥ 500	≥ 500	≥ 500	-
GEOMETRICAL SPECIFICATION								
Core diameter		µm	62.5 ±2.5	50.0 ±2.5	50.0 ±2.5	50.0 ±2.5	50 ±2.0	200 ±4.0
Cladding diameter		µm	125 ±1.0	125 ±1.0	125 ±1.0	125 ±1.0	125 ±1.0	230 +0/-10
Coating diameter		µm	242 ±5.0	242 ±5.0	242 ±5.0	242 ±5.0	242 ±5.0	500 ±30.0
APPLICABLE DISTANCE* (m)								
1 Gb/s (1000 BASE-SX)			275	550	750	1000	1100	-
1 0 Gb/s (10 GBASE-SR)			33	82	150	300	550	-
40 Gb/s (40 GBASE-SR4)			-	-	-	100	150	-
100 Gb/s (100 GBASE-SR10)			-	-	-	100	150	-

(*) These are the allowable distances at given frequencies. For lower frequencies, distances increase.

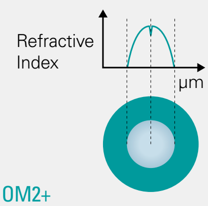
OM1 are the standard 62,5 µm MM fibres. Because of the production process, the index profile shows a "hole" that creates troubles in the propagation modes, thus limiting the transmission length towards high frequencies. Suitable for LED sources.



OM1

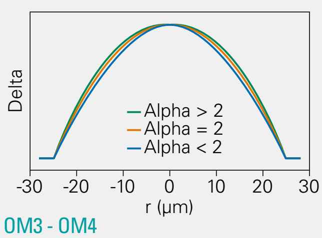
OM2 are standard 50 µm MM fibres. They are realized by means of a modified constructive process and show an index profile almost without discontinuity. Suitable for LED sources.

OM2+ they are similar 50 µm MM fibres, but optimized for bigger transmission lengths.



OM2 - OM2+

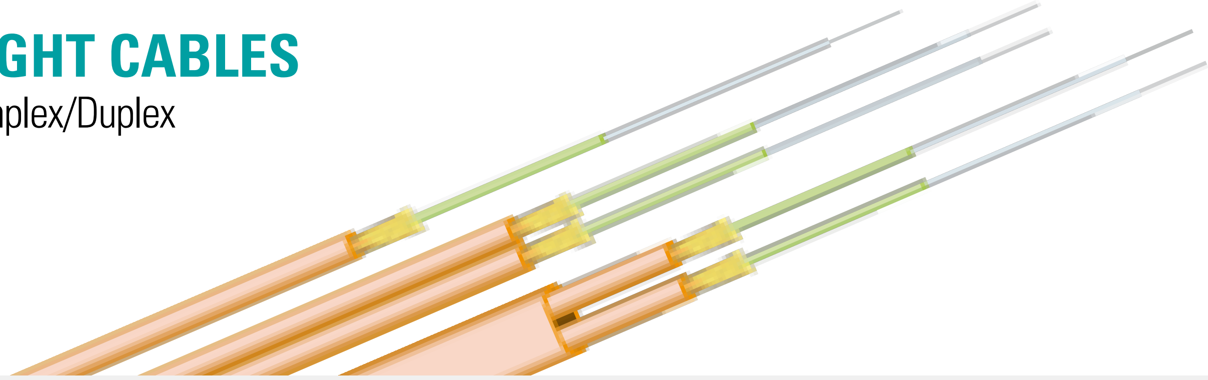
OM3 - OM4 are 50 µm MM with optimized index profile to minimize the modal dispersion (DMD) thus making these fibres suitable to use laser sources (VCESL) and therefore allowing transmissions on bigger lengths at higher frequencies.



OM3 - OM4

TIGHT CABLES

Simplex/Duplex



SIM-000-01-M1 Simplexi
DUP-000-02-M1 Duplex Zip-Cord
DDG-000-02-M1 Duplex Double Sheath

FEATURES & APPLICATIONS

- Patch cords
- Workstation equipment connections
- Compatible with all standard connectors

TEMPERATURE RANGE

-20/+70°C (operating);
-30/+70°C (storage);
-5/+60°C (installation)

MINIMUM BENDING RADIUS

20 times overall diameter (dynamic)
10 times overall diameter (static)

CABLE CONSTRUCTION

Fibres

Singlemode and multimode fibres, with tight or semi-tight (S) coating.

Structure

- In SIM and SIM(S) cables, the coated fibre is protected by a reinforcement layer made of aramidic yarns and by a LSZH (M1) sheath.
- DUP cable is formed by two singlefibre SIM placed side by side, easily separable and suitable for direct connector installation.
- DDG cable is formed by two singlefibre SIM placed side by side and protected with LSZH (M1) sheath having an oval section to grant a higher mechanical protection.

APPLICATION STANDARD

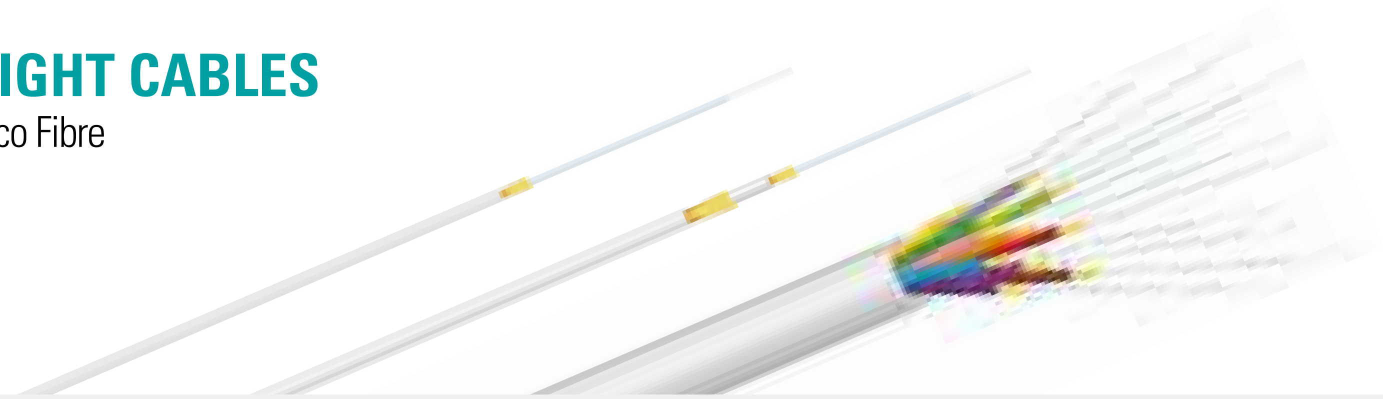
Optical fibre characteristics IEC 60793-1
Optical fibre cable characteristics IEC 60794-1
Fire retardant IEC 60332-3 EN 50266
Flame retardant IEC 60332-1 EN 60332-1
Test on gases evolved during combustion IEC 60754 EN 50267-2
Low smoke emission IEC 61034-2 EN 50268-2

Type	Fibre (n°)	Diameter (mm)	Weight (kg/km)	Tension load (N)	Crush (N/100mm)
SIMPLEX					
SIM-000-01-M1*	1	1.6	2.0	200	150
SIM-000-01-M1	1	2.0	4.0	200	150
SIM-000-01-M1	1	2.5	6.0	300	150
SIM-000-01-M1	1	3.0	9.0	300	150
DUPLEX					
DUP-000-02-M1*	2	1.6 x 3.5	5.0	400	200
DUP-000-02-M1	2	2.0 x 4.2	10.0	600	200
DDG-000-02-M1	2	3.0 x 5.0	20.	600	250

* Tight diameter 0,6 mm.
approximate values

TIGHT CABLES

Pico Fibre



PSF-000-01-KM Pico Single Fibre
RPF-000-01-KM Reinforced Pico Single Fibre
MPF-000-**-KM/M Multi Pico Fibre

FEATURES & APPLICATIONS

- Small size, high flexibility
- Patch cords
- Workstation equipment connections
- Compatible with all standard connectors

TEMPERATURE RANGE

-10 °C / +60 °C (operating)
-20 °C / +70 °C (storage)
-5°C / +60 °C (installation)

MINIMUM BENDING RADIUS

20 times overall diameter (dynamic)
10 times overall diameter (static)

CABLE CONSTRUCTION

Fibres

- Singlemode fibres, tight coated with acrilate resine, 400µm.

Structure

- In Pico cables, the coated fibre is protected by a reinforcement layer made of aramidic yarns and by a LSZH (M) sheath with a very small diameter (0,9 mm).
- Fibre can be protected by a polyamide (R4) sheath, instead a LSZH (M) one, on request.
- In Reinforced Pico cable, Pico Single Cable is protected by an additional reinforcement layer made of aramidic yarns and by a LSZH (M) sheath.
- In Multi Pico, Pico Single Cables are contained within a loose LSZH (M) sheath. Pico Single Cables are treated with a sliding agent to make them easy to peel.

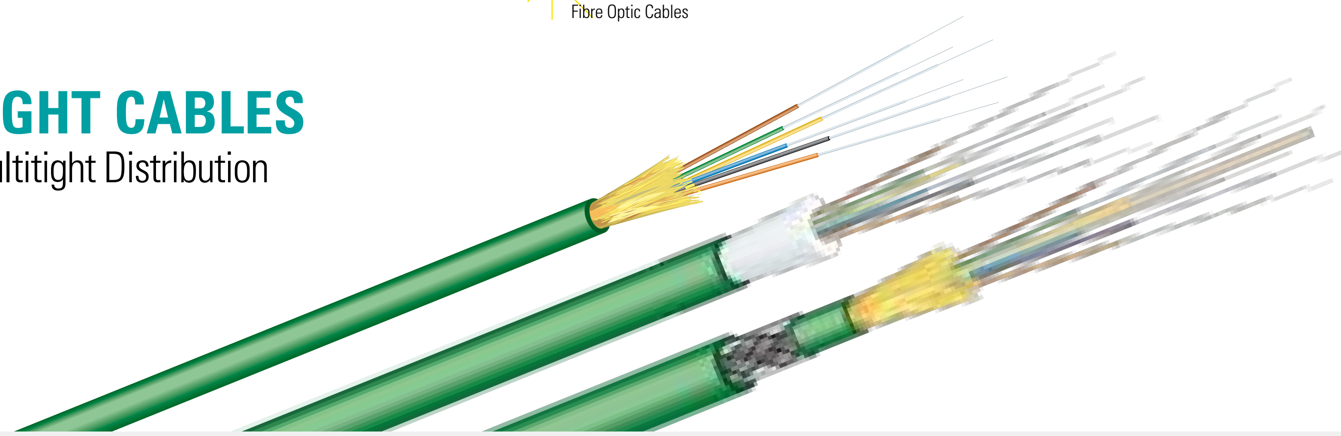
APPLICATION STANDARD

Optical fibre characteristics IEC 60793-1
Optical fibre cable characteristics IEC 60794-1
Fire retardant IEC 60332-3 EN 50266
Flame retardant IEC 60332-1 EN 60332-1
Test on gases evolved during combustion IEC 60754 EN 50267-2
Low smoke emission IEC 61034-2 EN 50268-2

Type	Fibre (n°)	Diameter (mm)	Weight (kg/km)	Tension load (N)	Crush (N/100mm)
PSF-000-01-KM	1	0.9	1.2	100	20
RPF-000-01-KM	1	2.6	2.0	150	100
MPF-000-04-KM/M	4	4	20	400	500
MPF-000-08-KM/M	8	6	29	400	500
MPF-000-12-KM/M	12	6	30	400	500
MPF-000-16-KM/M	16	7	50	400	500
MPF-000 24-KM/M	24	8	65	400	500
MPF-000-32-KM/M	32	9,5	90	400	500
MPF-000 36-KM/M	36	9,5	95	400	500

TIGHT CABLES

Multitight Distribution



FDI-000-**-M1
FDI-000-**-M1-A5
MTI-000-**-M1-A1

FEATURES & APPLICATIONS

- High flexibility
- Mainly for indoor installation and connections among optical patch panels
- LAN networks
- Tunnels and closed areas in general

TEMPERATURE RANGE

-20/+70°C (operating);
-30/+70°C (storage);
-5/+60°C (installation)

MINIMUM BENDING RADIUS

20 times overall diameter (dynamic)
10 times overall diameter (static)

CABLE CONSTRUCTION

Fibres
Singlemode and multimode fibres, with tight coating.

Structure
- In FDI cables, the fibres are longitudinal and reinforced with aramidic yarns as a traction element.
- In MTI cables, the fibres are cabled around a FRP (fibreglass reinforced plastic) and reinforced with aramidic yarns.

Inner sheath
LSZH (M1) compound (only for A1 armoured cables)

Armouring
A1 Galvanized steel wire braid; A5 Anti-rodent glass yarns and traction element, instead of aramidic yarns

Outer sheath
LSZH (M1) compound

APPLICABLE STANDARDS

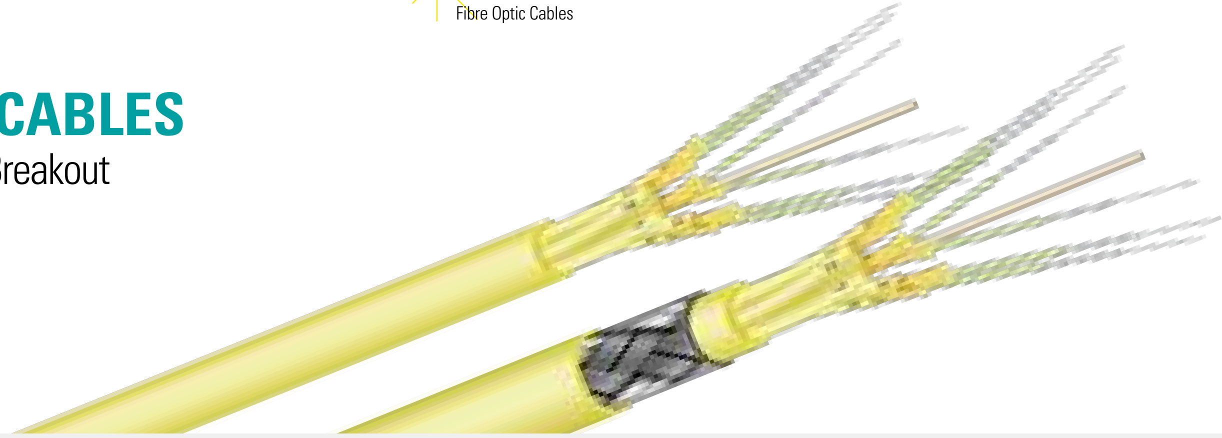
Optical fibre characteristics IEC 60793-1
Optical fibre cable characteristics IEC 60794-1
Fire retardant IEC 60332-3 EN 50266
Flame retardant IEC 60332-1 EN 60332-1
Test on gases evolved during combustion IEC 60754 EN 50267-2
Low smoke emission IEC 61034-2 EN 50268-2

Type	Fibre (n°)	Diameter (mm)	Weight (kg/km)	Tension load (N)	Crush (N/100mm)
FDI UNARMOURED					
FDI-000-02-M1	2	4.7	25	400	800
FDI-000-04-M1	4	4.7	25	400	800
FDI-000-06-M1	6	5.5	30	600	800
FDI-000-08-M1	8	6.8	35	800	800
FDI-000-12-M1	12	7.7	40	1000	800
FDI-A5 DIELECTRIC ARMOURED					
FDI-000-02-M1-A5	2	7.8	80	600	1000
FDI-000-04-M1-A5	4	7.8	80	600	1000
FDI-000-06-M1-A5	6	8.0	90	800	1000
FDI-000-08-M1-A5	8	9.0	120	1000	1000
FDI-000-12-M1-A5	12	9.8	140	1200	1000
MTI-A1 METALLIC ARMOURED					
MTI-000-02-M1-A1	2	7.8	80	600	1500
MTI-000-04-M1-A1	4	7.8	80	600	1500
MTI-000-06-M1-A1	6	8.0	90	800	1500
MTI-000-08-M1-A1	8	9.0	120	1000	1500
MTI-000-12-M1-A1	12	9.8	140	1200	1500

approximate values

TIGHT CABLES

Multifibre Breakout



MLD - 000-**-M1
MLD - 000-**-M1-A1

FEATURES & APPLICATIONS

- Mainly for indoor installation, raised floor, cables trays or "ladder racks"
- LAN networks
- Tunnels and closed areas in general

TEMPERATURE RANGE

-20/+70°C (operating);
-30/+70°C (storage);
-10/+60°C (installation)

MINIMUM BENDING RADIUS

20 times overall diameter (dynamic)
10 times overall diameter (static)

CABLE CONSTRUCTION

Fibres
Singlemode and multimode fibres, with tight or semi-tight (S) coating. Each single fibre is coated with aramidic yarns and covered with a sheath made of LSZH (M1) material, thus forming a SIM optical unit.

Structure
The SIM optical units are cabled around a central FRP (fibreglass reinforced plastic).

Inner sheath
LSZH (M1) compound

Armouring
A1 Galvanized steel wire braid

Outer sheath
LSZH (M1) compound

APPLICABLE STANDARDS

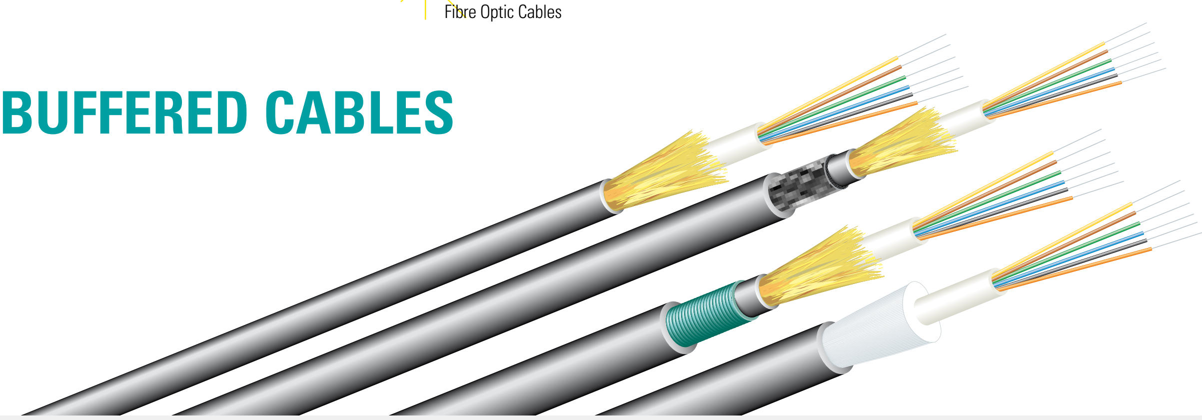
Optical fibre characteristics IEC 60793-1
Optical fibre cable characteristics IEC 60794-1
Fire retardant IEC 60332-3 EN 50266
Flame retardant IEC 60332-1 EN 60332-1
Test on gases evolved during combustion IEC 60754 EN 50267-2
Low smoke emission IEC 61034-2 EN 50268-2

Type	Fibre (n°)	Subunit Diameter (mm)	Diameter (mm)	Weight (kg/km)	Tension load (N)	Crush (N/100mm)
UNARMOURED						
MLD-000-04-M1	04	2.0	7.5	50	600	1000
MLD-000-06-M1	06	2.0	9.0	75\	800	1000
MLD-000-08-M1	08	2.0	10.0	100	1000	1000
MLD-000-12-M1	12	2.0	12.5	125	1500	1000
MLD-000-16-M1	16	2.0	13.0	135	2000	1000
MLD-000-18-M1	18	2.0	13.5	150	2000	1000
MLD-000-24-M1	24	2.0	15.0	200	2500	1000
A1 METALLIC ARMOURED						
MLD-000-04-M1-A1	04	2.0	10.0	150	800	1500
MLD-000-06-M1-A1	06	2.0	11.5	180	1000	1500
MLD-000-08-M1-A1	08	2.0	13.0	260	1500	1500
MLD-000-12-M1-A1	12	2.0	14.5	280	1800	1500
MLD-000-16-M1-A1	16	2.0	15.0	285	2200	1500
MLD-000-18-M1-A1	18	2.0	16.0	290	2500	1500
MLD-000-24-M1-A1	24	2.0	17.0	320	2800	1500

approximate values

LOOSE BUFFERED CABLES

Single Tube



SLO-000-**-M1
SLO-000-**-M1-A1
SLO-000-**-M1-A3
SLO-000-**-M1-A5

FEATURES & APPLICATIONS

- High flexibility
- Mainly for indoor installation and connections among optical patch panels
- LAN networks
- Tunnels and closed areas in general

TEMPERATURE RANGE

-30/+70°C (operating);
-30/+70°C (storage);
-5/+60°C (installation)

MINIMUM BENDING RADIUS

20 times overall diameter (dynamic)
10 times overall diameter (static)

CABLE CONSTRUCTION

Fibres
Singlemode and multimode fibres, with loose technology coating.

Structure
The jelly filled tube containing the fibres is reinforced with aramidic yarns.

Inner sheath
LSZH (M1) compound (only for A1 and A3 armoured cables)

Armouring
A1 Galvanized steel wire braid
A3 Corrugated steel tape
A5 Anti-rodent glass yarns and traction element, instead of aramidic yarns

Outer sheath
LSZH (M1) compound. Other materials (PVC, polyethylene) can be used for special applications (resistance to water, oil, hydrocarbons, UV rays).

APPLICABLE STANDARDS

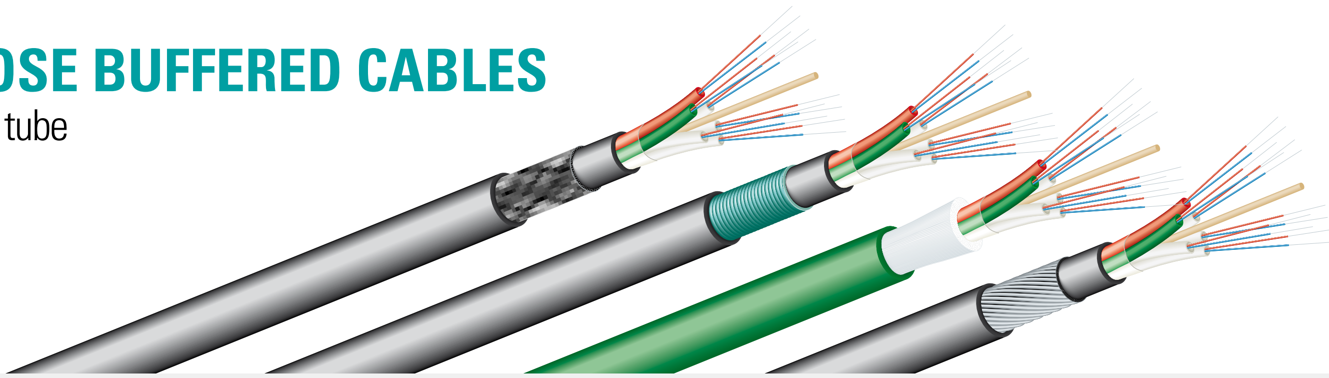
Optical fibre characteristics IEC 60793-1
Optical fibre cable characteristics IEC 60794-1
Fire retardant IEC 60332-3 EN 50266
Flame retardant IEC 60332-1 EN 60332-1
Test on gases evolved during combustion IEC 60754 EN 50267-2
Low smoke emission IEC 61034-2 EN 50268-2

Type	Fibre (n°)	Tube Diameter (mm)	Diameter (mm)	Weight (kg/km)	Tension load (N)	Crush (N/100mm)
UNARMOURED						
SLO-000-**-M1	02 ÷ 12	2.7	6.0	35	1000	1000
SLO-000-**-M1	16 ÷ 24	3.5	6.7	45	1000	1000
A1 METALLIC ARMOURED						
SLO-000-**-M1-A1	02 ÷ 12	2.7	8.1	90	1500	2000
SLO-000-**-M1-A1	16 ÷ 24	3.5	9.0	105	1500	2000
A3 METALLIC ARMOURED						
SLO-000-**-M1-A3	02 ÷ 12	2.7	10.0	130	2000	2500
SLO-000-**-M1-A3	16 ÷ 24	3.5	10.5	135	2000	2500
A5 DIELECTRIC ARMOURED						
SLO-000-**-M1-A5	02 ÷ 12	2.7	7.5	70	2000	1500
SLO-000-**-M1-A5	16 ÷ 24	3.5	8.0	75	2000	1500
A7 METALLIC ARMOURED						
SLO-000-**-M1-A7	02 ÷ 12	2.7	9.5	170	2500	3000
SLO-000-**-M1-A7	16 ÷ 24	3.5	10.5	180	2500	3000

approximate values

LOOSE BUFFERED CABLES

Multi tube



MLO-000-**(n)-M1-A1
MLO-000-**(n)-M1-A3
MLO-000-**(n)-M1-A5
MLO-000-**(n)-M1-A7

FEATURES & APPLICATIONS

- Indoor and outdoor installation
- Armoured version suitable for burial, inside conduit and aerial installation

TEMPERATURE RANGE

-40/+70°C (operating)
-40/+70°C (storage)
-10/+60°C (installation)

MINIMUM BENDING RADIUS

20 times overall diameter (dynamic)
10 times overall diameter (static)

CABLE CONSTRUCTION

Fibres

Singlemode and multimode fibres, with loose technology coating.

Structure

The jelly filled tubes containing the fibres, are cabled around a central steel or FRP (fibreglass reinforced plastic) element, wound with polyester tape.

Inner sheath

LSZH (M1) compound (only for A1, A3 and A7 armoured cables)

Armouring

A1 Galvanized steel wire braid
A3 Corrugated steel tape
A5 Anti-rodent glass yarns
A7 Steel wire armour

Outer sheath

LSZH (M1) compound. Other materials (PVC, polyethylene) can be used for special applications (resistance to water, oil, hydrocarbons, UV rays).

APPLICABLE STANDARDS

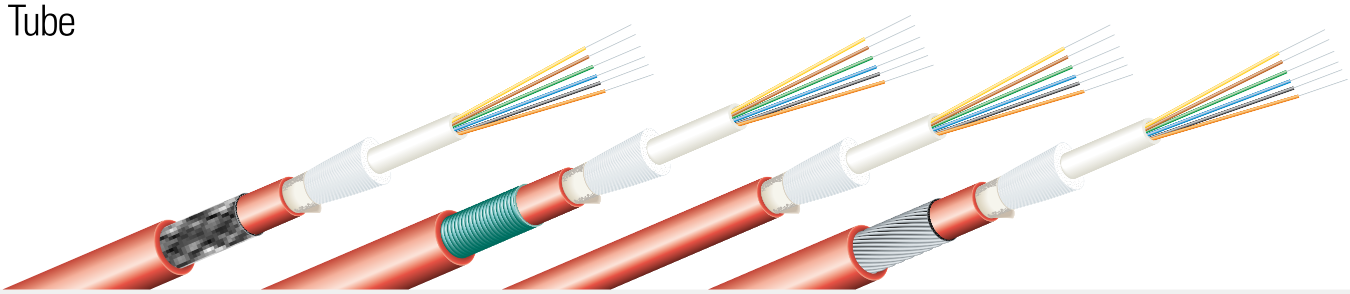
Optical fibre characteristics IEC 60793-1
Optical fibre cable characteristics IEC 60794-1
Fire retardant IEC 60332-3 EN 50266
Flame retardant IEC 60332-1EN 60332-1
Test on gases evolved during combustion IEC 60754 EN 50267-2
Low smoke emission IEC 61034-2 EN 50268-2

Type	Fibre (n° max)	Tube Diameter (mm)	Diameter (mm)	Weight (kg/km)	Tension load (N)	Crush (N/100mm)
A1 METALLIC ARMOURED						
MLO-000-**(n)-M1-A1	72	2.0	14.5	280	1500	3000
MLO-000-**(n)-M1-A1	96	2.0	16.5	310	2000	3000
MLO-000-**(n)-M1-A1	144	2.0	20.0	350	2500	3000
A3 METALLIC ARMOURED						
MLO-000-**(n)-M1-A3	72	2.0	14.8	270	3000	3500
MLO-000-**(n)-M1-A3	96	2.0	16.0	290	3000	3500
MLO-000-**(n)-M1-A3	144	2.0	19.0	350	3500	3500
A5 DIELECTRIC ARMOURED						
MLO-000-**-(n)-M1-A5	72	2.0	12.0	150	3000	2500
MLO-000-**(n)-M1-A5	96	2.0	14.5	250	3500	2500
MLO-000-**(n)-M1-A5	144	2.0	17.0	300	3500	2500
A7 METALLIC ARMOURED						
MLO-000-**(n)-M1-A7	72	2.0	13.5	300	3500	4000
MLO-000-**(n)-M1-A7	96	2.0	14.5	340	4000	4000
MLO-000-**(n)-M1-A7	144	2.0	17.5	400	4000	4000

approximate values

FIRE RESISTANT LOOSE BUFFERED CABLES

Single Tube



SLO-000-**-M1-A1-FR
SLO-000-**-M1-A3-FR
SLO-000-**-M1-A5-FR
SLO-000-**-M1-A7-FR

FEATURES & APPLICATIONS

- Safety Systems, Critical Connections and Fire Fighting Systems
- Indoor and outdoor installation
- Tunnels and closed areas in general

TEMPERATURE RANGE

-30/+70°C (operating)
-30/+70°C (storage)
-10/+60°C (installation)

MINIMUM BENDING RADIUS

20 times overall diameter (dynamic)
10 times overall diameter (static)

CABLE CONSTRUCTION

Fibres
Singlemode and multimode fibres, with loose technology coating.

Structure
The jelly filled tube containing the fibres is reinforced with glass yarns and is wound with a flame resistant tape.

Inner sheath
LSZH (M1) compound (only for A1, A3 and A7 armoured cables)

Armouring
A1 Galvanized steel wire braid
A3 Corrugated steel tape
A5 Anti-rodent glass yarns
A7 Steel wire armour

Outer sheath
LSZH (M1) compound

APPLICABLE STANDARDS

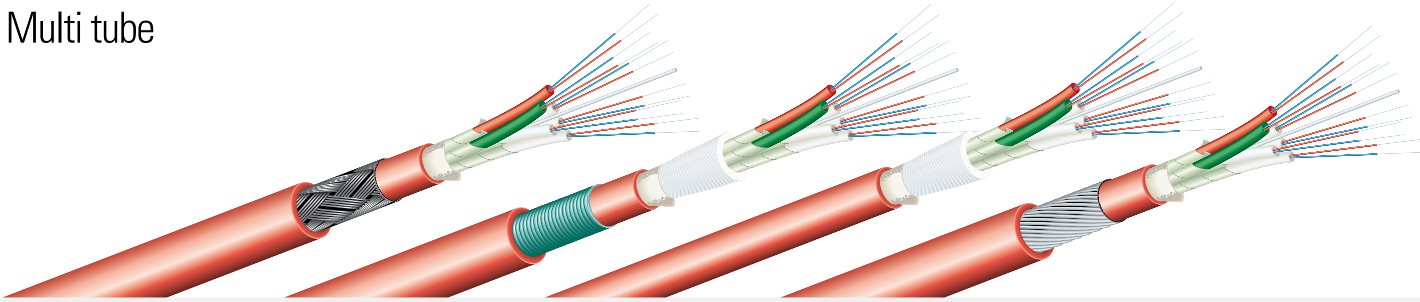
Optical fibre characteristics IEC 60793-1
Optical fibre cable characteristics IEC 60794-1
Fire resistant IEC 60331-25
Fire retardant IEC 60332-3 EN 50266
Flame retardant IEC 60332-1 EN 60332-1
Test on gases evolved during combustion IEC 60754 EN 50267-2
Low smoke emission IEC 61034-2 EN 50268-2

Type	Fibre (n°)	Tube Diameter (mm)	Diameter (mm)	Weight (kg/km)	Tension load (N)	Crush (N/100mm)
A1 METALLIC ARMOURED						
SLO-000-**-M1-A1-FR	02 ÷ 12	2.7	11.5	160	1700	2000
SLO-000-**-M1-A1-FR	16 ÷ 24	3.5	12.0	180	1700	2000
A3 METALLIC ARMOURED						
SLO-000-**-M1-A3-FR	02 ÷ 12	2.7	9.0	100	2000	2500
SLO-000-**-M1-A3-FR	16 ÷ 24	3.5	10.0	120	2000	2500
A5 DIELECTRIC ARMOURED						
SLO-000-**-M1-A5-FR	02 ÷ 12	2.7	7.5	70	1500	1500
SLO-000-**-M1-A5-FR	16 ÷ 24	3.5	8.0	80	1500	1500
A7 METALLIC ARMOURED						
SLO-000-**-M1-A7-FR	02 ÷ 12	2.7	10.5	180	2500	3000
SLO-000-**-M1-A7-FR	16 ÷ 24	3.5	11.0	210	2500	3000

approximate values

FIRE RESISTANT LOOSE BUFFERED CABLES

Multi tube



MLO-000-**-M1-A1-FR
MLO-000-**-M1-A3-FR
MLO-000-**-M1-A5-FR
MLO-000-**-M1-A7-FR

FEATURES & APPLICATIONS

- Safety Systems, Critical Connections and Fire Fighting Systems
- Indoor and outdoor installation
- Tunnels and closed areas in general

TEMPERATURE RANGE

-40/+70°C (operating)
-40/+70°C (storage)
-10/+60°C (installation)

MINIMUM BENDING RADIUS

20 times overall diameter (dynamic)
10 times overall diameter (static)

CABLE CONSTRUCTION

Fibres
Singlemode and multimode fibres, with loose technology coating.

Structure
The jelly filled tubes containing the fibres are individually wound with a mica tape and are cabled around a central steel or FRP (fibreglass reinforced plastic) element. When necessary glass yarn is the traction element. A flame resistant tape improves fire resistance.

Inner sheath
LSZH (M1) compound (only for A1, A3 and A7 armoured cables)

Armouring
A1 Galvanized steel wire braid
A3 Corrugated steel tape
A5 Anti-rodent glass yarns
A7 Steel wire armour

Outer sheath
LSZH (M1) compound

APPLICABLE STANDARDS

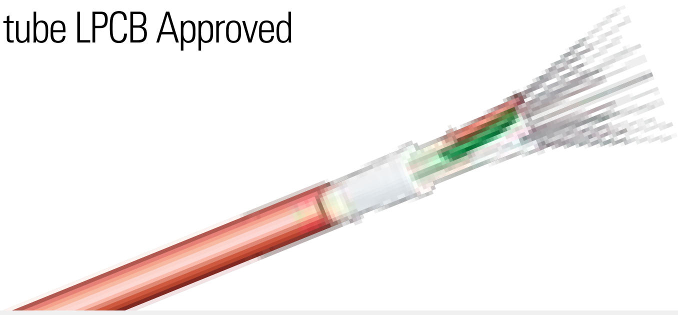
Optical fibre characteristics IIEC 60793-1
Optical fibre cable characteristics IEC 60794-1
Fire resistant IEC 60331-25
Fire retardant IEC 60332-3 EN 50266
Flame retardant IEC 60332-1 EN 60332-1
Test on gases evolved during combustion IEC 60754 EN 50267-2
Low smoke emission IEC 61034-2 EN 50268-2

Type	Fibre (n° max)	Tube Diameter (mm)	Diameter (mm)	Weight (kg/km)	Tension load (N)	Crush (N/100mm)
A1 METALLIC ARMOURED						
MLO-000-**(n)-M1-A1-FR	72	2.0	15.0	280	2000	3000
MLO-000-**(n)-M1-A1-FR	96	2.0	17.5	310	2000	3000
MLO-000-**(n)-M1-A1-FR	144	2.0	21.5	350	2000	3000
A3 METALLIC ARMOURED						
MLO-000-**(n)-M1-A3-FR	72	2.0	14.8	270	3000	3500
MLO-000-**(n)-M1-A3-FR	96	2.0	18.5	350	3000	3500
MLO-000-**(n)-M1-A3-FR	144	2.0	22.5	450	3500	3500
A5 DIELECTRIC ARMOURED						
MLO-000-**(n)-M1-A5-FR	72	2.0	15.0	230	3000	2500
MLO-000-**(n)-M1-A5-FR	96	2.0	16.5	250	3000	2500
MLO-000-**(n)-M1-A5-FR	144	2.0	20.5	280	3000	2500
A7 METALLIC ARMOURED						
MLO-000-**(n)-M1-A7-FR	72	2.0	15.0	360	3500	4000
MLO-000-**(n)-M1-A7-FR	96	2.0	16.5	390	4000	4000
MLO-000-**(n)-M1-A7-FR	144	2.0	18.5	430	4000	4000

approximate values

FIRE RESISTANT LOOSE BUFFERED CABLES

OPTICEL FR - Multi tube LPCB Approved



MLO-000-**-M1-A5-FR

LPCB ref. 217i
For the scope of the LPCB Approval
see www.redbooklive.com

FEATURES & APPLICATIONS

- Safety Systems, Critical Connections and Fire Fighting Systems
- Indoor and outdoor installation
- Tunnels and closed areas in general
- Metro and railway station, airport.

LPCB certification ensures constant and maximum control of behavior during a fire, providing the utmost guarantee of reliability and safety.

TEMPERATURE RANGE

-40 °C / +70 °C (operating)
-40 °C / +70 °C (storage)
-10 °C / +60 °C (installation)

MINIMUM BENDING RADIUS

20 times overall diameter (dynamic)
10 times overall diameter (static)

CABLE CONSTRUCTION

Fibres
Singlemode and multimode fibres, with loose technology coating.

Structure
The jelly filled tubes containing the fibres are individually wound with a mica tape, and are cabled around a central FRP (fiberglass reinforced plastic) strength member.
Glass yarn is an additional traction element, and also acts as anti-rodent protection.
A special flame resistant tape improves fire resistance.
The outer jacket is LSZH (M1) compound.

APPLICABLE STANDARDS

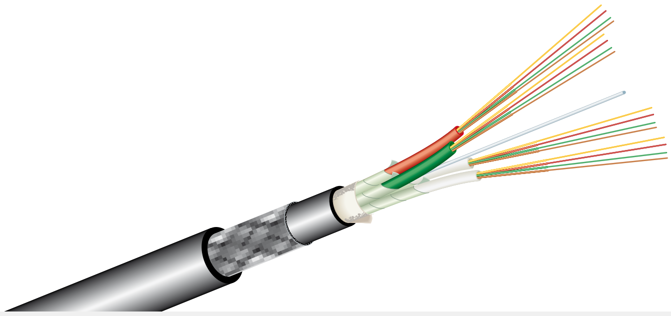
Optical fibre characteristics IIEC 60793-1
Optical fibre cable characteristics IEC 60794-1
Fire resistant IEC 60331-25
Fire retardant IEC 60332-3 EN 50266
Flame retardant IEC 60332-1 EN 60332-1
Test on gases evolved during combustion IEC 60754 EN 50267-2
Low smoke emission IEC 61034-2 EN 50268-2

Type	Max n. of fibres	Tube Diameter (mm)	Diameter (mm)	Weight (kg/km)	Tension load (N)	Crush (N/100mm)
A5 DIELECTRIC ARMOURED						
MLO-000-**(n)-M1-A5-FR	48	2.0	10.6	120	3000	3000
MLO-000-**(n)-M1-A5-FR	72	2.0	12.0	130	3000	3000

approximate values

SPECIAL HIGH PERFORMANCE CABLES - FIRE RESISTANT

QFCI/QFCU - Multiloose



MLO-000-**-M1-A1-FR-QFCI/QFCU

Approved by:

DNV ABS NEK

FEATURES & APPLICATIONS

- Safety Systems, Critical Connections and Fire Fighting Systems
- Outdoor installation in Off-shore, Oil & Gas and Marine applications
- Data transmission and telecommunication systems

TEMPERATURE RANGE

-40/+70°C (operating)
-40 /+70°C (storage)
-10 /+70°C (installation)

MINIMUM BENDING RADIUS

20 times overall diameter (dynamic)
10 times overall diameter (static)

CABLE CONSTRUCTION

Fibres
Singlemode and multimode fibres, with loose technology coating.

Structure
The jelly filled tubes containing the fibres are individually wound with a mica tape and are cabled around a central steel or FRP (fibreglass reinforced plastic) element. A flame resistant tape improves fire resistance.

Inner sheath
LSZH (M1) compound

Armouring
A1Galvanized steel wire braid

Outer sheath
QFCI type: LSZH (M1) compound
QFCU type: oil and mud resistant LSZH (M1) compound

APPLICABLE STANDARDS

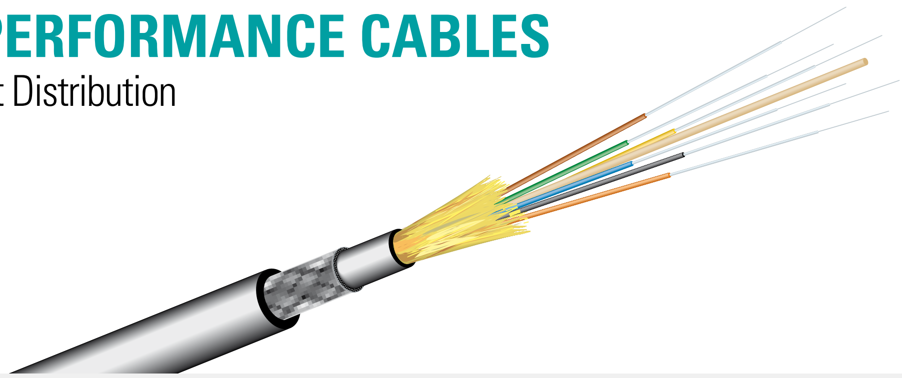
Optical fibre characteristics IEC 60793-1
Optical fibre cable characteristics IEC 60794-1
Fire Resistant IEC 60331-25 EN 50200 PH30/PH120
Fire retardant IEC 60332-3 EN 50266
Flame retardant IEC 60332-1EN 60332-1
Test on gases evolved during combustion IEC 60754 EN 50267-2
Low smoke emission IEC 61034-2 EN 50268-2
Cables for offshore installation NEK 606

Type	Fibre (n° max)	Tube Diameter (mm)	Diameter (mm)	Weight (kg/km)	Tension load (N)	Crush (N/100mm)
MLO-000-**(n)-M1-A1-FR-QFCI/QFCU	4	2.0	13.5	230	1500	3000
MLO-000-**(n)-M1-A1-FR-QFCI/QFCU	8	2.0	13.5	230	1500	3000
MLO-000-**(n)-M1-A1-FR-QFCI/QFCU	12	2.0	13.5	230	1500	3000
MLO-000-**(n)-M1-A1-FR-QFCI/QFCU	24	2.0	13.5	230	1500	3000
MLO-000-**(n)-M1-A1-FR-QFCI/QFCU	48	2.0	13.5	230	1500	3000

approximate values

SPECIAL HIGH PERFORMANCE CABLES

AICI/AIOI/AICU - Multitight Distribution



MTI-000-**-M1-A1-AICI/AIOI/AICU

Approved by:

ABS
DNV
NEK

FEATURES & APPLICATIONS

- Outdoor installation in Off-shore, Oil & Gas and Marine applications
- Data transmission and telecommunication systems

TEMPERATURE RANGE

-40/+70°C (operating)
-40/+70°C (storage)
-10/+70°C (installation)

MINIMUM BENDING RADIUS

20 times overall diameter (dynamic)
10 times overall diameter (static)

CABLE CONSTRUCTION

Fibres
Singlemode and multimode fibres, with tight coating.

Structure
Fibres are cabled around a FRP (fibreglass reinforced plastic) and reinforced with aramidic yarns.

Inner sheath
LSZH (M1) compound

Armouring
AICI type: galvanized steel wire braid
AIOI type: bare or tinnedd copper wire braid

Outer sheath
AICI type: LSZH (M1) compound
AICU type: oil and mud resistant LSZH (M1) compound

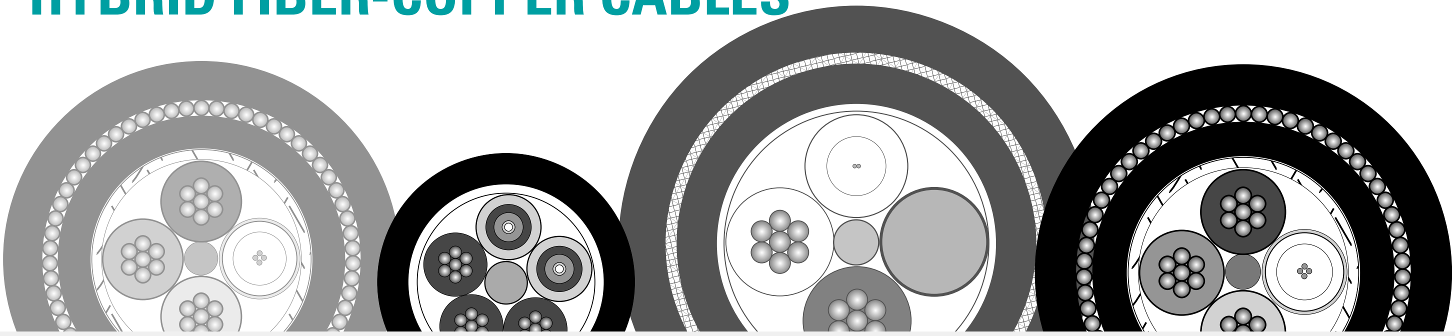
APPLICABLE STANDARDS

Optical fibre characteristics IEC 60793-1
Optical fibre cable characteristics IEC 60794-1
Fire retardant IEC 60332-3 EN 50266
Flame retardant IEC 60332-1EN 60332-1
Test on gases evolved during combustion IEC 60754EN 50267-2
Low smoke emission IEC 61034-2EN 50268-2
Cables for offshore installation NEK 606

Type	Fibre (n° max)	Diameter (mm)	Weight (kg/km)	Tension load (N)	Crush (N/100mm)
MTI-000-02-M1-A1-AICI/AIOI/AICU	2	7.8	80	600	2000
MTI-000-04-M1-A1-AICI/AIOI/AICU	4	8.0	88	600	2000
MTI-000-06-M1-A1-AICI/AIOI/AICU	6	8.0	90	800	200
MTI-000-08-M1-A1-AICI/AIOI/AICU	8	9.0	110	1000	2000
MTI-000-12-M1-A1-AICI/AIOI/AICU	12	10.0	130	1000	2000
MTI-000-16-M1-A1-AICI/AIOI/AICU	16	10.5	165	1000	2000
MTI-000-24-M1-A1-AICI/AIOI/AICU	24	12.0	190	1200	2000

approximate values

HYBRID FIBER-COPPER CABLES



Hybrid cables offer a solution suitable for every special application where a single cable with copper conductors and optical is preferred.
These are not standard constructions, as cables are designed to provide the right solution for every individual need.
Copper cables can be for data transmission, or control application or for power.
Fibres can be either tight jacketed or loose tube construction.

APPLICATIONS

Hybrid cables can be used for optical data transmission, electrical instrument and power circuit.
They can be installed for indoor/outdoor applications, with flame retardant or fire resistant properties.
Cable can be used for fix installation or for temporary installation in open ground, in forests, water, populated areas. Temporary cables are rolled up again to be re-installed on another occasion.

CABLE CONSTRUCTION

Copper elements
Conductors: plain or tinned annealed electrolytic cooper wire according to IEC 60228.
Insulation: XLPE, PE, PVC or LSZH compound, mica tape/XLPE for fire resistant applications.
Cabling: conductors can be twisted in pairs or in concentric layers.
Screen option: alluminium/polyester tape, copper/polyester tape or copper braid.

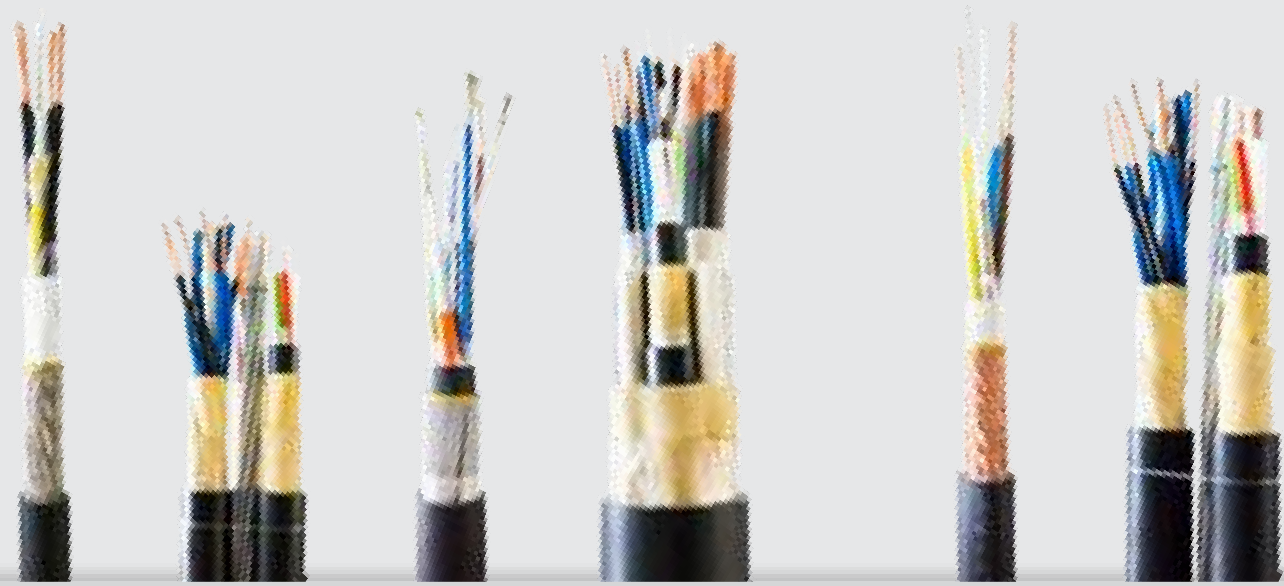
Fibre Optic Elements
Fibres: singlemode or multimode fibres.
Loose construction: jelly filled loose tubes containing 1/24 fibres, mica tape wrapped when fire resistance is required.
Tight construction: tight buffered fibres with aramide yarns and protected by a thermoplastic jacket.

Additional elements
Water blocking tapes.
Central strength member, steel or FRP (fibre reinforced plastic).

Armour:	SWA	Steel Wire Armour
	GSWB	Galvanized Steel Wire Braid
	CSTA	Corrugated Steel Tape Armour
	GSTA	Galvanized Steel Tape Armour

Sheath: PVC, PU or LSZH thermoplastic material

On request other special materials or construction solution.




KNOW HOW
AND EXPERTISE
ADVANCED TEST
FACILITIES
RESEARCH
AND DEVELOPMENT
PERFORMANCES

CERTIFIED QUALITY

OPTICEL fibre optic cables are designed and manufactured according torelevant international standards and client specific requirements.
Some of these are international standard whilst other specifications are custom requirements based on a project, environmental or other basis.
It is important for manufacturing bespoke cables to understand the standards, the client, as well as the influence plant and environmental conditions have on the materials used and the manufacturing processes.
It is important to verify compliance of the requirements once the cable has been manufactured. Hence, a qualified/ specialized personnel in carrying out these checks, as well as advanced testing equipment are necessary. Cavicel has as fully equipped lab enabling it to carry out the required optical, mechanical, chemical and functional tests.
The team conducting these tests are specialized and have the know-how experience to conduct these test to its best, following detailed Inspection and Testing Plans approved by our clients.

Not only light transmission is important: on top of the requirements detailed in the standards, depending on their use, cables have to withstand different environments and installation conditions.

Following performance must be valued very carefully:

RESISTANCE TO EXTREME TEMPERATURES
RESISTANCE TO HUMIDITY
RESISTANCE TO CORROSIVE ENVIRONMENTS
RESISTANCE TO CHEMICAL ENVIRONMENTS
HIGH MECHANICAL RESISTANCE
HEALTH & SAFETY REQUIREMENTS:
FIRE RESISTANCE AND FLAME RETARDANT
RESISTANCE AGAINST RODENTS AND TERMITES

Cavicel Cables distinct itself from other manufacturers by performing to its best even in the harshest conditions.

Reliability is our Specialty.

MECHANICAL RESISTANCE

Frequently cables are subject to mechanical forces, during installation and whilst in use. It is important to verify all these requirements.
Specific tests, according to international standard, can be performed in our laboratory to certify torsion, traction, compression, bending, impact and water penetration resistance of fibre optic cables.

Compression test


Impact test


Tensile Strength test


Torsion test


Rodent and termite resistance

In some instances cables can be damaged by rodents, termites or other animals which can compromise the integrity of the cable and hence its performance. To protect the cable from this, these cables can have a metallic armor applied in different forms and materials; steel wire, steel braid, tape armor, etc. Anti-animal additives can also be added. Here too, it is important to be able to test their characteristics.

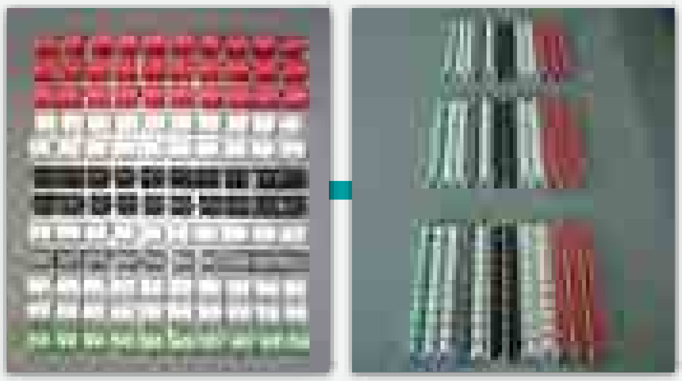
Termite resistant test

No.	Sample Description	Weight Loss of Material due to Termite Feeding (%)			
		Replicate 1	Replicate 2	Replicate 3	Replicate 4
1	AT-treated cable (MLO-009-36(6)-M1/ NY/M1-A5-WB-FR)	0,3	0,7	0,0	0,3
2	Non AT-treated cable (FUTGCP008009)	0,9	1,0	1,9	1,3
3	Soft wood block	55,2	4,7	9,6	23,2
4	Tree branch	13,2	14,6	15,1	14,3

*T-test statistical analysis between the AT-treated cable and non AT-treated cable gives a p-value of 0.08, which indicates that there is no significant difference in the repellency against termite feeding for the cables treated with and without the anti-rodent additive.

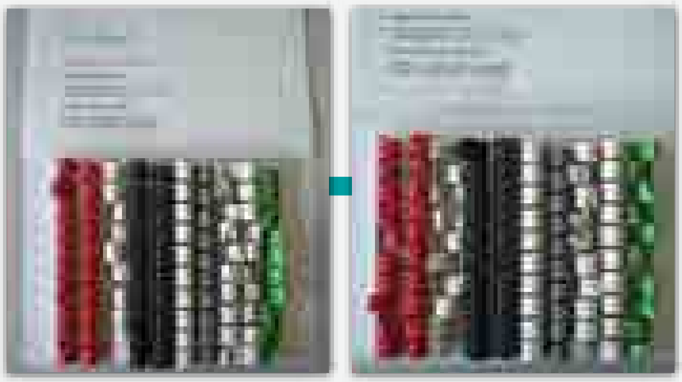
Crack Resistant Jacket

During the last years some problems of cracking on Halogen Free Flame Retardant (HFFR) sheaths have been observed by main cables company, relative clients and contractors.
Cables involved in this kind of inconvenience generally were stored or installed in projects in the Far East area where sometimes the direct exposition to sun causes an increase of surface temperature up to 70°C.
The mechanical characteristics of HFFR sheathing compounds exposed for a long period at high temperature (from 50 to 70°C) get radically worse: the material becomes soft, weak, and cracks more easily.
Significant claims were made against cable suppliers requiring cable removal and replacement.
This is why Cavicel decided to study the behavior of mechanical characteristics of different types of HFFR compound at high temperature and to set up some specific test to characterize the sheaths with specific experimental test.



Samples prepared for ageing in oven at different temperature.

Samples in oven at different temperature.



Samples after ageing

Stress bending test at high temperature with high grade compound

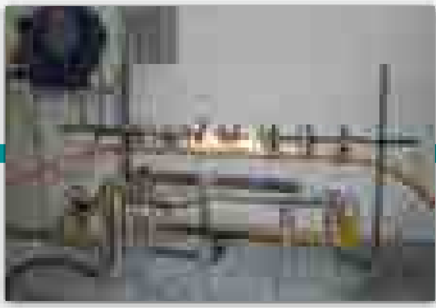
Stress bending test at high temperature with standard compound

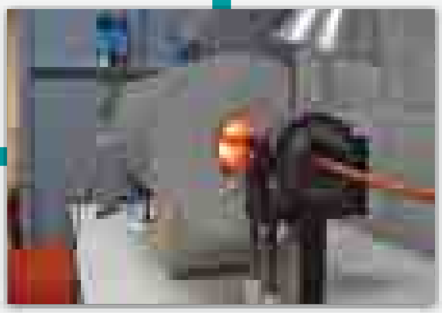
FIRE PERFORMANCE TESTS

Fire resistant tests

These tests verify the performance of the cable under conditions of a fire. This feature can be a paramount feature for cables used in Chemical and Petrochemical Installations to ensure a correct performance of safety systems, but also the plant in any situation, even the most critical. These requirements can differ from cable to cable and hence their test requirements.

BS EN 50200
NS EN 50200 – Annex E
BS 6387 CWZ
BS 8434-2
BS 8491
IEC 30331-21/23/25
NFC 32070 CR1





Fire/Flame propagation tests

Flame retardant cables can resist the spread of fire, but the cable is fully consumed by the flame and no circuit integrity is assured. All the systems connected to these cables are disconnected.
Flame retardant cables are not intended to assure service during a fire but are intended to prevent the flame spreading.

BS EN 60332-1
BS EB 60332-2
BS EN 60332-3
IEC 60332-1
IEC 60332-2
IEC 60332-3

Gas emission test

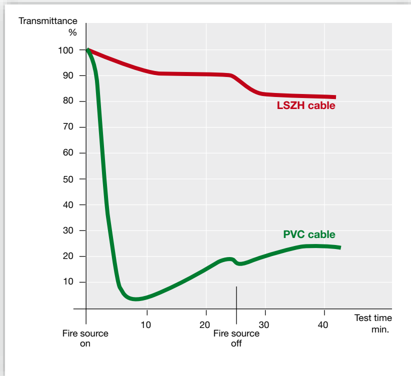
The victims of a fire aren't only subject to the hazard of the fire, but also due to the gases that are created and released from the burning of materials. Acid gas evolved from materials such as PVC can be dangerous to people and equipment's. This is why Low Smoke Zero Halogen (LSZH) material are preferred not only in closed space but also in critical plants. Specific tests are performed to measure the quantity of acid gas evolved during combustion of cables, and also measuring corrosiveness of gases released when cables burns, through PH and Conductivity.

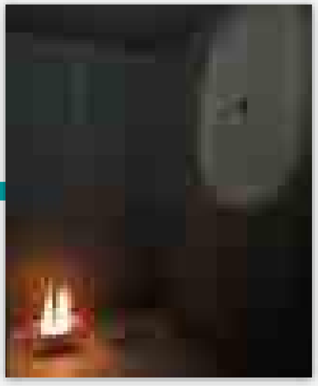
BS EN 60754-1
BS EN 60754-2
IEC 60754-1
IEC 60754-2

Smoke Density Test

This test measures the intensity of the fumes created when burning a predetermined length of cable. The transmittance value recorded allows to ensure, that in case of a fire, a line of sight is maintained for a safer evacuation of the premises and easier intervention from the emergency services. Higher the transmittance value, the better visibility and line of sight.

BS EN61034-2
IEC 61034-2





STANDARDS

BS	British Standard Institution
BS 6425-1	Method of determination of amount of halogen acid gas evolved during combustion of polymeric materials taken from cables
BS 6425-2	Determination of degree of acidity (corrosivity) of gases by measuring PH and conductivity
BS 6724, Appendix F	Measurement of smoke density using the 3 m test cube (Absorbance)
CEI	**Comitato Elettrotecnico Italiano**
CEI 20-11 / EN 50363	Insulating, sheathing and covering materials for low voltage energy cables
CEI 20-22/2	Prove di incendio su cavi elettrici. Prova di non propagazione dell'incendio
CEI 20-22/3 / EN 50266	Test for vertical flame spread of vertically-mounted bunched wires and cables
CEI 20-35/1 / EN 60332-1	Test for vertical flame propagation for a single insulated wire or cable
CEI 20-36/2 -5 IEC 60331-25	Test for electrical and optical cables under fire conditions. Circuit integrity.
CEI 20-36/4 - EN 50200	Methods of test for resistance to fire of unprotected small cables for use in emergency circuit
CEI 20-36/5 - EN 50362	Method of test for resistance to fire of larger unprotected power and control cables for use in emergency circuits
CEI 20-37/2-1 / EN 50267-2-1	Method of determination of amount of halogen acid gas evolved during combustion of polymeric materials taken from cables
CEI 20-37/2-2 / EN 50267-2-2	Determination of degree of acidity (corrosivity) of gases by measuring PH and conductivity
CEI 20-37/2-3 / EN 50267-2-3	Determination of degree of acidity of gases for cables by determination of weighted average of pH an conductivity
CEI 20-37/3 - EN 61034	Measurement of smoke density of cables burning under defined conditions
CEI 20-37/4	Determinazione dell'indice di tossicità dei gas emessi dai cavi
EN	**European Norm**
EN 50200	Methods of test for resistance to fire of unprotected small cables for use in emergency circuit
EN 50266	Test for vertical flame spread of vertically-mounted bunched wires and cables
EN 50267/2-1	Method of determination of amount of halogen acid gas evolved during combustion of polymeric materials taken from cables
EN 50267/2-2	Determination of degree of acidity (corrosivity) of gases by measuring PH and conductivity
EN 60332-1	Test for vertical flame propagation for a single insulated wire or cable
EN 60332-2	Test for vertical flame propagation for a single small insulated wire or cable
EN 61034	Measurement of smoke density of cables burning under defined conditions

IEC	International Electrotechnical Commission
IEC/ISO 11801	Information technology - Generic cabling for customer premises
IEC 60331	Test for electrical and optical cables under fire conditions. Circuit integrity. Part 25 - Optical fibre cables
IEC 60332-1	Test on electric and optical fibre cables under fire conditions. Test on a single vertical insulated wire or cable
IEC 60332-2	Test on electric cables under fire conditions. Test on a single small vertical insulated copper wire or cable
IEC 60332-3	Test on electric cables under fire conditions.Test for vertical flame spread of vertically-mounted bunched wires or cables
IEC 60754-1	Method for determination of amount of halogen acid gas evolved during combustion of polymeric materials taken from cables
IEC 60754-2	Determination of degree of acidity (corrosivity) of gases by measuring pH and conducivity
IEC 60793	Optical fibres
IEC 60794	Optical fibre cables
IEC 61034-2	Measurement of smoke density of electric cables burning under defined conditions (LT)
ITU-T	**International Telecommunication Union**
G.651.1	Characteristics of a 50/125 µm multimode graded index optical fibre cable for the optical access network
G.652	Characteristics of a single-mode optical fibre and cable
G.655	Characteristics of a non-zero dispersion-shifted single-mode optical fibre and cable
G.656	Characteristics of a fibre and cable with non-zero dispersion for wideband optical transport
G.657	Characteristics of a bending loss insensitive single mode optical fibre and cable for the access network
NEK	**Norsk Elektroteknisk Komite**
NEK 606	Cables for offshore installations halogen-free and/or mud resistant
NF	**Norme Française**
NF-C-32-070	Essais de clasification des conducteurs et cables du point de vue de leur comportament au feu
NF-X-70-100	Analyse de gaz de pyrolyse et de combustion
VDE	**Verband der Elektrotechnik**
VDE 0888	Optical fibre cables

Fibers Color Code Chart as per TIA/EIA 598-B	
Fiber No.	*Color*
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Rose
12	Aqua
13-24	Color code is repeated, Black ring is added. Fiber No 20 will be Natural color with Black ring.

DESIGNATION SYSTEMS

Italian Standard

according to CEI-UNEL 36011

Cable type	
TO	Optical cable

Core	
L1	single loose tube
LmD	m (number of tubes) with dielectric central member
LmM	m (number of tubes) with metallic central member
T	tight buffered fibres without central member
TD	tight buffered fibres with dielectric central member
TM	tight buffered fibres with metallic central member

Type of fibre	
MMd	multimode fibre (d = core diameter)
SMR	single mode fibres with zero dispersion at 1310 nm
SMDS	single mode fibres with dispersion shifted at 1550 nm
SMNZD	single mode fibres with non zero dispersion at 1550 nm

Armour/Protection	
T	jelly filled
H5	longitudinal aluminium tape bonded to a sheath
H9	longitudinal corrugated steel tape bonded to a sheath
N	steel tapes armour
N1	dielectric tapes
F	steel wire armour
F1	dielectric rods
F2	steel wire braid
Z1	dielectric flat rod
K	aramide yarns
K1	water blocking aramide yarns
V	glass yarns
V1	water blocking glass yarns
W	aramide and glass yarns
W1	water blocking aramide and glass yarns
L	lead alloy sheath

Sheath	
E	polyethylene
P	polyurethane
M	low smoke zero halogen thermoplastic compound
R	PVC
R4	polyamide

Special characteristic	
F	flat cable
D	divisibile flat cable
Z	"zip" cord
S	round self supporting cable

German Standard

according to VDE 0888

Core	
F	optical fibre
V	tight buffered fibre
K	semitight buffering
H	jelly free loose buffer
W	jelly filled loose buffer
B	multi fibre jelly free loose buffer
D	multi fibre jelly filled loose buffer
M	multi mode optical fibre
E	single mode optical fibre

Type of fibre	
G	graded index fibre
S	step index fibre
K	plastic fibre

Cable design	
A	outdoor cable
I	indoor cable
S	metallic element in cable core
F	filled cable core
Y	PVC sheath
2Y	polyethylene sheath
4Y	PA sheath
H	halogen free sheath
(L) 2Y	longitudinal aluminium tape bonded to a polyethylene sheath
(D) 2Y	dielectric laminated sheath
(ZN) 2Y	polyethylene sheath with dielectric strength member
(L) (ZN)2Y	aluminium tape bonded to a polyethylene sheath with dielectric strength member
(D) (ZN)2Y	dielectric laminated sheath with dielectric strength member
B	armour
BY	armour with PVC sheath
B2Y	armour with polyethylene sheath
Q	swellable tape

CAVICEL Code

AAA - 000 - ** (n) - ZZZ - A0 - YY

- AAA: Type of Cables
- 000: Type of Fibres
- **: Number of Fibres
- (n): (Number of Tubes/Groups)
- ZZZ: Sheath
- A0: Armour
- YY: Other characteristics

Type of Cables	AAA
MIC	Microsimplex
SIM	Simplex
SIM(S)	Simplex semitight
DDG	Duplex Double Sheath
DUP	Duplex Zip-cord
FDI	Duplex (Round)
PSF	Pico Single Fibre
RPF	Reinforced Pico Fibre
MPF	Multi Pico Fibre
MTI	Multitight distribution
MLD	Multifibre Breakout
MLD(S)	Multifibre Breakout semitight
SLO	Single Tube
MLO	Multi Tube

Type of fibres		000
009	9/125	single mode
NZD	9/125	single mode Non Zero Dispersion
050	50/125	multimode
050/OM2	50/125	multimode
050/OM3	50/125	multimode
062	62,5/125	multimode
062/OM1	62,5/125	multimode
200	200/230	multimode
1000	980/1000	plastic fibre

Number of fibres	**(n)
**	Number of fibres
(n)	The symbol (n) after the number of fibres, if indicated, means: *For MLO construction with multiple fibres per tube:* number of tubes *For MTI:* number of groups

Sheath	ZZZ
PVC	PVC
PE	Low density polyethylene
HDPE	High density polyethylene
PU	Polyurethane
M1	Halogen free thermoplastic compound
NY	Polyamide
HY	Hytrel

Armour	A0
A1	Galvanized steel wire braid
A2	Layer or braid of aramid yarns
A3	Copolymer coated corrugated steel tape
A4	Polyamide rodent protection
A5	Glass yarn or flat glass rod rodent protection
A6	Steel tapes
A7	Steel wire armour
A8	Copolymer coated aluminium tape
A9	Hi-Pack protection

Other characteristics	YY
WB	Water blocking
DRY	Water blocking unfilled
FR	Fire resistant
HD	Heavy Duty
LT	Low temperature
LC	Lead covered


Conducting Value

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Cavicel firmly believes in the importance of the quality of its products and it undertakes itself to produce them using clean technologies for the respect and the protection of the environment.