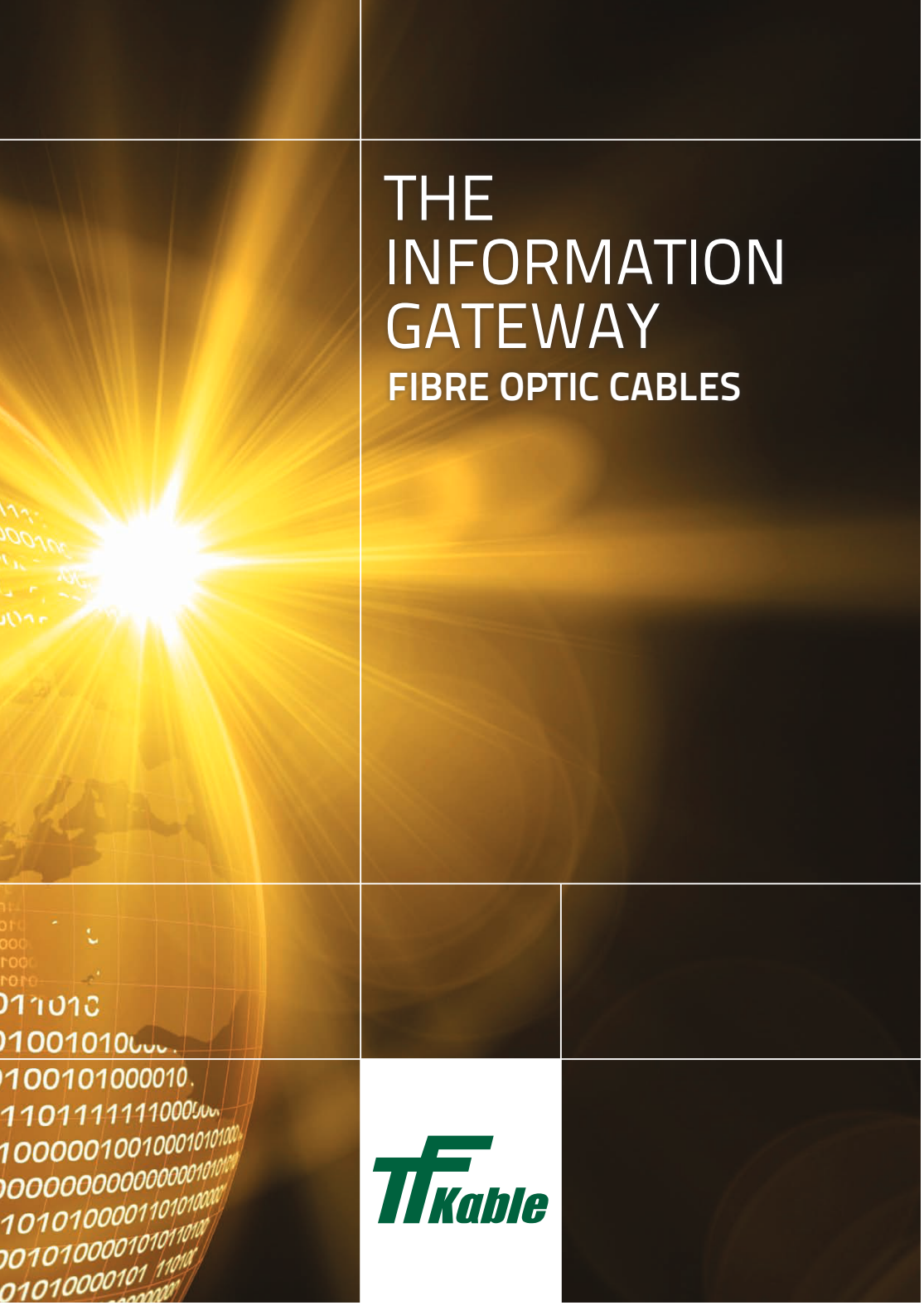
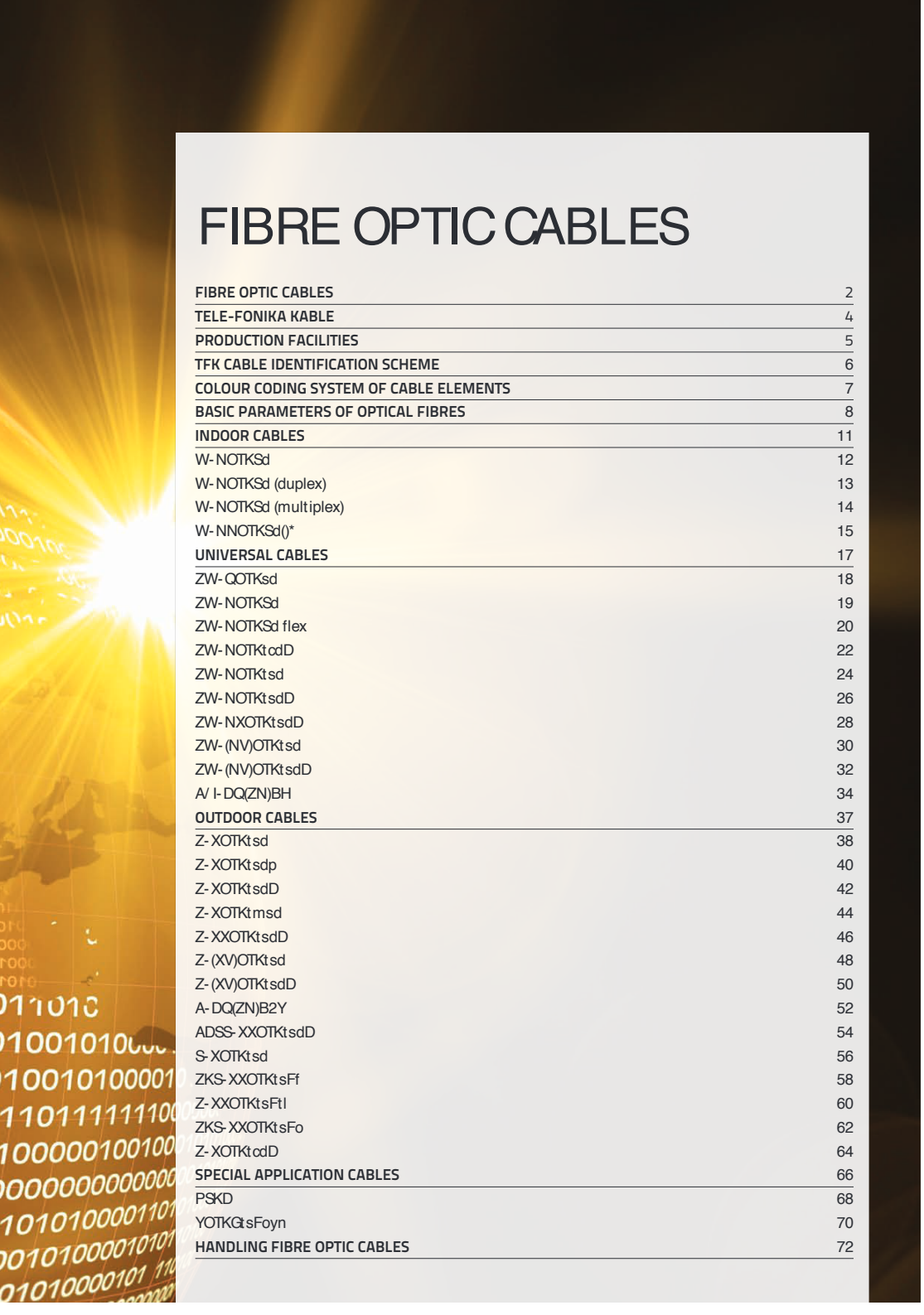


THE INFORMATION GATEWAY

FIBRE OPTIC CABLES

TFKable



FIBRE OPTIC CABLES

FIBRE OPTIC CABLES

Today's economy is based on the efficient and smooth flow of knowledge and information. As the volume of information continues to grow, there is a requirement for bigger and bigger bandwidths. Data transmission based on copper cables is limited, despite continued progress, and will not be able to provide the capacity foreseen in the future. The future-proof solution to this ever increasing problem is fibre optic cable, with the crucial component – optical fibres.
Optical fibres transfer the data signals, in this case the electromagnetic waves, in the infrared frequency range. They are resistant to electromagnetic interference and have the ability to transfer data at huge rates, reaching hundreds of Gb/s.

The design and construcEon of ¦bre opEc cables depends on the parEcular applicaEon. The locaEon, installaEon technique and the transmission distance all have to be taken into consideraEon.
The basic elements of a ¦bre opEc cable are:

- an opEonal central strength element
- opEcal ¦bres
- protecEve tube
- sealing
- reinforcement
- outer sheath

Depending on the number of transmiΣed modes (waves) of light, opEcal ¦bres are divided into single mode and mulEmode..

Single mode opEcal ¦bres have low dispersion and aΣenuaEon making them suitable for long-distance transmission. Minimum aΣenuaEon (signal loss) occurs at speci¦c wavelengths, the so called transmission windows at 1310 nm (II transmission window) and 1550 (III transmission window). Single-mode opEcal ¦bres allow for transmission using xWDM technology, which enables data throughput in the order of Tb/s.
Fibre opEc cable manufacturers use various types of single mode ¦bre depending on the applicaEon:
J– 9/125. SM , G.652.
Jn – G.655.
Ja, Jb – G.657 A,B

MulE mode opEcal ¦bres transmit many modes of light. Because of the higher dispersion compared to single mode ¦bres their applicaEon is usually limited to indoor cables and transmission over short distances. For telecommunicaEons, wavelengths of 850 nm and 1300 nm are used. MulEmode ¦bres are usually denoted by their core and protecEve layer (called the cladding) diameters. For example a ¦bre labelled 50/125 has a core diameter of 50mm and a cladding diameter of 125 mm. Another frequently used mulE mode ¦bre is 62.5/125. AlternaEve descripEons (used interchangeably) are G50 and G62.5. respecEvely.

Depending on their construcEon and use, ¦bre opEc cables can be divided into three basic types:

- Indoor – used inside buildings or building structures such as tunnels
- Outdoor – used for installaEon in the ground, in the open air, etc. This category includes self-supporEng, sewer and special applicaEon cables
- Universal – can be used in both internal and external installaEons.

TELEFONIKA Kable manufactures high quality tailored soluEons to meet the speci¦c requirements of the customer in all ¦bre and cable combinaEons.

TELE-FONIKA Kable began fibre optic cable manufacture in 1997 at the newly constructed, state-of-the-art production facility at Myślenice. From the beginning, emphasis was placed on supplying product of the highest quality and to this end the new plant was equipped with modern machinery and sophisticated control and measuring equipment. The high standard of production has been confirmed by the award of the ISO 9001 certification.

Wide product portfolio

Our product portfolio includes cables of various constructions up to 288 fibres. Such as, microcables for installation in microducts, self-supporting aerial cables for spans of varying length, mining, wind farm and special application cables as used by the military.

Uncompromising quality

The fibre optic department is equipped with sophisticated control and measuring equipment enabling comprehensive cable testing, thereby ensuring the highest quality. All tests are conducted according to IEC 60794 requirements. Each cable production length is tested and the documented results supplied with the cable. Clients can rest assured that the cables supplied are free from defects and meet their required specifications.

Experience and competence

The Fibre Optic Cable Team engineers have many years experience in the design and manufacture of fibre optic cables. Their cable designs and finished products have been the basis for many fibre optic networks around the world. Their commitment is a guarantee of care and workmanship for each cable manufactured by TELEFONIKA Kable.

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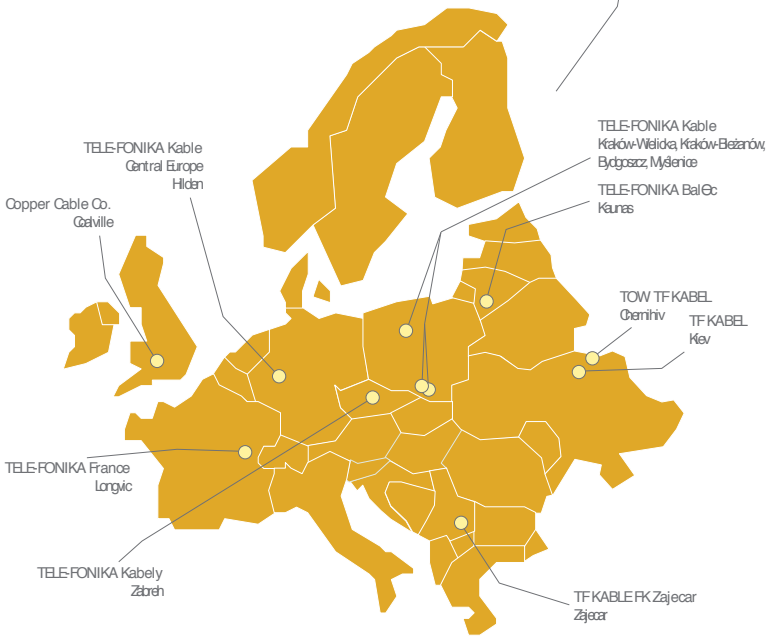
TELE- FONIKA Kable

The Group, TELE-FONIKA Kable (TF Kable) is ranked in the forefront of the global cable industry and is the third largest manufacturer of cables and wires in Europe.

Products manufactured by TF Kable are sold to over 90 countries worldwide. The product portfolio includes over 25 thousand cable types. The high quality production standards are reflected by over 460 certificates from 34 renown certification centres worldwide. The Group, TELE-FONIKA Kable currently consists of 10 commercial companies responsible for distribution of our products worldwide, 6 production facilities (four located in Poland, one in Serbia and one in Ukraine) and the Waste Cable Recycling Plant located in Bukowno (Poland).



PRODUCTION FACILITIES

Our chief asset is extensive technological know-how in the field of cable and wires production supported by experienced management and staff. Our products reflect the current manufacturing trends for environmentally friendly production processes, recycling and health and safety.

Kraków-Wielicka Plant

Kraków-Wielicka Plant was established in 1928. In 1992 it received the ISO 9002 certificate and in 1998 the ISO 14001 issued by the British company BASEC. The plant specializes in the production of rubber insulated cables and wires for mining and industrial applications. All types of rubber mixes are used for EPR, CR, EVA and CSP cables. The plant also manufactures medium voltage cables using XLPE technology as well as signal and control wires designed for unique applications.

Kraków-Bieżanów Plant

Kraków-Bieżanów Plant was established in 2001. In 1992 it received the ISO 9001:2,000 certificate and in 1996 the ISO 14001 issued by BASEC. The plant specializes in the production of alloyed aluminium overhead conductors, copper railway traction conductors and installation wires for general usage.

Bydgoszcz Plant

The Bydgoszcz Plant started production of cables and wires back in 1923. In 1992 it received the ISO 9002 certificate and in 1998 ISO 14001. The plant specializes in medium and high voltage power supply cables up to 500 kV. It is equipped with six modern chain lines for crosslinking polyethylene using XLPE technology. The significant investment in production machinery; from thick wire drawing, cable stranding and screening machines, to covering lines and two large size high voltage "Faraday cage" laboratories makes it the largest production centre of medium and high voltage cables in Europe.

Myślenice Plant

The Myślenice Plant was established in April 1992 under the name Zakłady Kablowe TELE-FONIKA s.c. In 1995 it received the ISO 9001:1994 certificate and in 1999 the ISO 14001:1996 certificate issued by DQS, Germany. In September 2007 the plant attained the SGS Polska IS/TS 16949 certificate for automotive cables. The Plant specializes in the production of copper and fibre optic telecommunication cables, computer cables and automotive wires.

TOW TF Kabel Ukraine

The plant was established in 1974 and in 2007 became part of the TELE-FONIKA Kable Group. It specializes in the production of overhead conductors and voltage cables up to 1 kV, including halogen-free, fire resistant and flame retardant versions.

TF Kable Fabrika Kablova Zajecar A.D. (Serbia)

The plant was established in 1974 and in 2007 became part of the TELE-FONIKA Kable Group. It specializes in the production of low and medium voltage cables, as well as halogen-free, fire resistant and flame retardant cables. The plant also manufactures telecommunication cables and PVC and polyethylene-coated conductors.

TFK CABLE IDENTIFICATION SCHEME

The identification scheme for fibre optic cables uses a combination of letters, symbols and numbers

Cable use

Z – outdoor
ZKS – outdoor for sewers
W – indoors
ZW – universal (indoor outdoor)
S – self-supporting (8-shaped)
ADSS – self-supporting (O-shaped)

Outer sheath material

X – polyethylene (PE)
V – polyamide (PA)
Xz – polyethylene with a moisture barrier
yn – flame-retardant polyvinyl
N – flame-retardant Zero halogen material (LSOH)
Q – polyurethane

In case of a two-layer outer sheath, brackets are used, e.g (VX) – the sheath consists of a PE and PA layers.

Inner sheath material

X – polyethylene (PE)
Y – polyvinyl chloride (PVC)
N – flame-retardant Zero halogen material (LSOH)

Fibre optic cable designation

OTK – fibre optic cable
OTKG – fibre optic cable for mines

Cable core

ts – dry sealed
tc – central tube
S – tight or semi-tight tube
tm – micro tube

Dielectric cable designation

d – dielectric cable

Reinforcement

D – dielectric aramide yarn
Db – dielectric glass yarn

Armouring

Rf – corrugated steel tape
Rl – lacquered steel tape
Fo – round steel wires

Flat cable designation

p – flat cable

Type and number of optical fibres

J – singlemode, non-shifted dispersion (matched cladding) G.652D
JA1, JA2, JB – singlemode, non-shifted dispersion (matched cladding) with higher bending resistance G.652D
Jn – singlemode, non-zero dispersion G.655
G50 – gradient multimode (50/125 m), type OM2 (OM3 and OM4 types available)
G62.5 – gradient multimode (62.5/125 m)

When fibres of different types are mixed in a cable, they are separated by a "+" sign, e.g. 8G50 + 8J.

Rated working tension (in case of self-supported cables)

e.g. 8 kN

Cables manufactured acc. to DIN VDE standards, e.g. A/I-DQ(ZN)BH, use the identification scheme described in DIN VDE 0888 standard.

COLOUR CODING SYSTEM OF CABLE ELEMENTS

1. Colour code of optical fibres in a tube

When a tube contains more than one optical fibre, the primary coating is coloured acc. to IEC 304:

- red
- green
- blue
- white
- violet
- orange
- grey
- yellow
- brown
- pink
- black
- turquoise

When a tube contains more than 12 optical fibres, additional colour rings are used.

2. Colour code of tubes in a cable

To differentiate the tubes in the cable, the following code is used:

- red colour – counter tube (the tube from which the counting starts)
- blue colour – directional tube (the tube that shows in which direction to count)

The other tubes are colourless

3. Colour code of the outer sheath of indoor cables

- yellow – singlemode fibres J (G.652D)
- brown – singlemode fibres Jh (G.655)
- orange – multimode fibres G50 (OM2)
- green – multimode fibres (G62.5)

CABLE MARKING

The outer sheath of the cable is marked to denote the cable type, type and number of optical fibres, manufacturer's name, year of production, pictogram and length in metres:

OPTICAL CABLE Z-XOTKtsd 16J TF KABLE 2012 2,200m

DESCRIPTION OF PICTOGRAMS USED IN CATALOGUE

- – Cable complies with requirements of RoHS directive
- – UV resistant jacket
- – Indoor cable
- – Universal cable, for outdoor and indoor installation
- – Outdoor cable
- – Direct buried cable, for installation in terrain with low risk of mechanical damage
- – Anti-rodent protection
- – Self-supporting cable
- – Temperature of installation
- – Exploatation temperature

BASIC PARAMETERS OF OPTICAL FIBRES

SINGLEMODE FIBRES:

Geometrical parameters	Unit	ITU-T G.652D, J	ITU-T G.657, JA1, JA2	ITU-T G.657, JB3	ITU-T G.655, Jh
Mode field diameter at wavelength 1310nm	μm	9.2±0.4	8.6 – 9.5 ± 0.4	8.6 – 9.5 ± 0.4	–
Mode field diameter at wavelength 1550nm	μm	10.4±0.5	-	-	9.2±0.5
Cladding diameter	μm	125±0.7	125±0.7	125±0.7	125±1.0
Primary coating diameter	μm	245±5	245±10	245±10	242±7
Mode field eccentricity	μm	≤0.5	≤0.5	≤0.5	≤0.5
Coating/cladding eccentricity	μm	≤12	≤12	≤12	≤12
Cladding ellipticity	%	≤0.7	≤1.0	≤1.0	≤1.0

Transmission parameters	Unit	ITU-T G652D, J	ITU-T G657, JA1, JA2, JB	ITU-T G.655, Jh
Attenuation – at 1310 nm – at 1550 nm – at 1625 nm	dB/km	≤0.35[1] (max. 0.4) ≤0.22[1] (max. 0.25) –	≤0.35[1] (max. 0.4) ≤0.22[1] (max. 0.25) –	– ≤0.22[1] (max. 0.25) ≤0.25[1] (max. 0.28)
Chromatic dispersion – at 1550 nm – at 1625 nm	ps/(nm·km)	≤18.0 ≤22.0	≤18.0 ≤23.0	– –
Chromatic dispersion at C and L bands – at 1530 – 1565 nm – at 1565 – 1625 nm	ps/(nm·km)	– –	– –	5.5 – 10.0 7.5 – 13.8
Polarisation mode dispersion (PMD)	ps/√km	≤0.1	≤0.2	≤0.2
Zero dispersion wavelength	nm	1300<λ_0<1324	1300<λ_0<1324	≤1460
Cut off wavelength λ_{cc}	nm	≤1260	≤1260	≤1450

[1] typical values for 95% of fibres measured in loose tube cables

MULTIMODE FIBRES:

Geometrical parameters	Unit	ITU-T G.651 G50 (OM2) [1]	G.62.5
Core diameter	μm	50±2.5	62.5±2.5
Cladding diameter	μm	125±2.0	125±2.0
Primary coating diameter	μm	242±5	242±5
Core ellipticity	%	≤5	≤5
Cladding ellipticity	%	≤1	≤1
Core/cladding eccentricity	μm	≤1.5	≤1.5
Numerical aperture	–	0.200±0.015	0.275±0.015

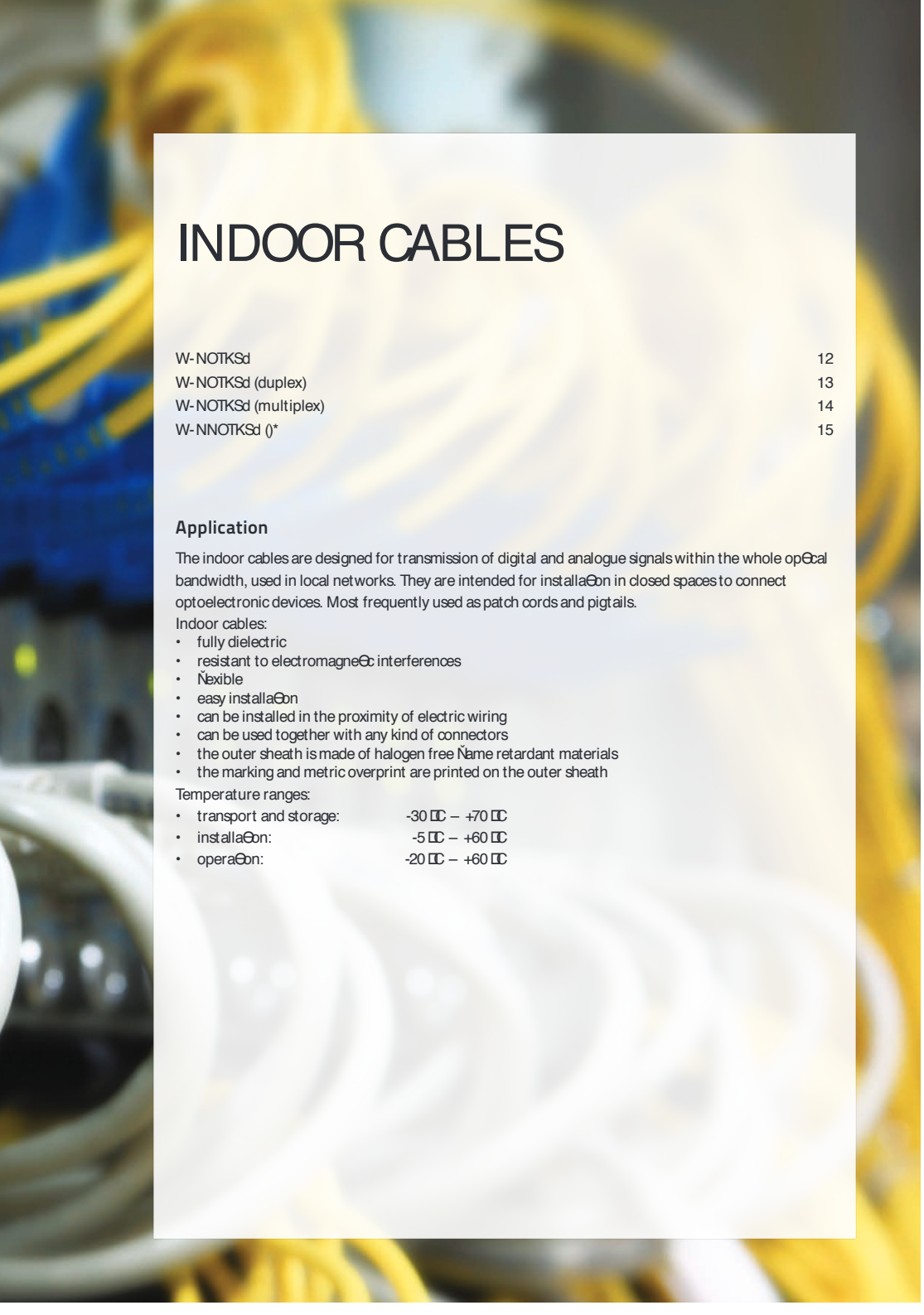
Transmission parameters	Unit	ITU-T G.651 G50 (OM2) [1]	G.62.5
Attenuation – at 850 nm – at 1300 nm	dB/km	≤2.6[2] (max. 3.0) ≤0.6[2] (max. 1.0)	≤2.9[2] (max. 3.5) ≤0.7[2] (max. 1.0)
Bandwidth – at 850 nm – at 1300 nm	MHz·km	≥500 ≥500	≥200 ≥500

[1] OM3 & OM4 types are also available
[2] typical values for 95% of fibres measured in loose tube cables

Delivering Data

TFKable

Experience and Innovation



INDOOR CABLES

Application

The indoor cables are designed for transmission of digital and analogue signals within the whole opEcal bandwidth, used in local networks. They are intended for installaEon in closed spaces to connect optoelectronic devices. Most frequently used as patch cords and pigtails.

Indoor cables:

- fully dielectric
- resistant to electromagneEc interferences
- Ñexible
- easy installaEon
- can be installed in the proximity of electric wiring
- can be used together with any kind of connectors
- the outer sheath is made of halogen free Ñame retardant materials
- the marking and metric overprint are printed on the outer sheath

Temperature ranges:

- transport and storage: -30 □C – +70 □C
- installaEon: -5 □C – +60 □C
- operaEon: -20 □C – +60 □C

W-NOTKSd

Analog acc. to VDE: I-V(ZN)H 1...

Optical fibre distribution cables with a single fibre

Standard	ZN-TF-12:2001
Description	W-NOTKSd – indoor (W), with a halogen free flame retardant sheath (N), optical fibre cable (OTK), distribution type with tight tube (S), fully dielectric (d)
CONSTRUCTION:	
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5) single mode with improved macrobending performance (JA1, JA2)
Tube	tight tube Ø 0.9 mm
Reinforcement	aramid yarns
Sheath	halogen free flame retardant, colour according to table on page 5

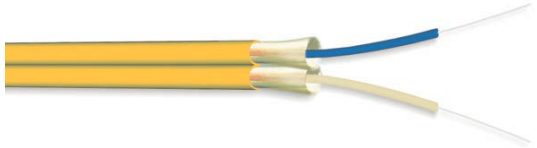
PARAMETERS:

Fibre count in cable	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
			Dynamic	Static	Dynamic	Static
1	1.7	3.2	200	100	17	25
	2.0	3.5	220	110	20	30
	2.4	4.4	300	150	24	35
	2.5	4.6	300	150	25	38
	2.8	7.2	380	190	28	42
	3.0	7.7	380	190	30	50

Packing length: to be agreed
Packing: reels

W-NOTKSd (duplex)

Analog acc. to VDE: I-V(ZN)H 2x1...



Optical fibre distribution cables with two fibres

Standard	ZN-TF-12:2001
Description	W-NOTKSd – indoor (W), with a halogen free flame retardant sheath (N), optical fibre cable (OTK), distribution type with tight tube (S), fully dielectric (d)
CONSTRUCTION:	
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jh) gradient multimode (G/50) gradient multimode (G/62.5) single mode with improved macrobending performance (JA1, JA2)
Tube	tight tube Ø 0.9 mm
Reinforcement	aramid yarns
Sheath	halogen free flame retardant, colour according to table on page 5

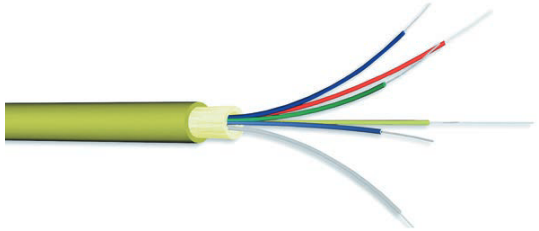
PARAMETERS:

Fibre count in cable	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
			Dynamic	Static	Dynamic	Static
2	2.0x4.0	7.0	440	220	20	30
	2.4x4.8	8.9	600	300	24	36
	2.5x5.0	9.2	600	300	25	38
	2.8x5.6	13.5	760	380	28	40
	3.0x6.0	16.5	760	380	30	50

Packing length: to be agreed
Packing: reels

W-NOTKSd (multiplex)

Analog acc. to VDE: I-V(ZN)H 4.6.8.12.24 ...



Optical fibre distribution cables, multiplex, terminating

Standard	ZN-TF-12:2001
Description	W-NOTKSd – indoor (W), with a halogen free flame retardant sheath (N), optical fibre cable (OTK), distribution type with tight tube (S), fully dielectric (d)
CONSTRUCTION:	
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50), gradient multimode (G/62.5) single mode with improved macrobending performance (JA1, JA2)
Tube	tight tube Ø 0.9 mm
Reinforcement	aramid yarns
Sheath	halogen free flame retardant, colour according to table on page 5

PARAMETERS:

Fibre count in cable	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
			Dynamic	Static	Dynamic	Static
2	3.5	13.5	700	350	40	60
4	4.3	14.4	800	400	45	70
6	4.6	17.2	900	450	50	75
8	4.8	19.7	1,000	500	50	75
10	5.5	23.3	1,100	550	55	80
12	5.5	27.7	1,200	600	60	90
24	8.0	50.0	1,200	600	90	140

Packing length: to be agreed
Packing: reels

W-NNOTKSd ()*

Analog acc. to VDE: I-V(ZN)HH

Optical fibre distribution cables, multiplex

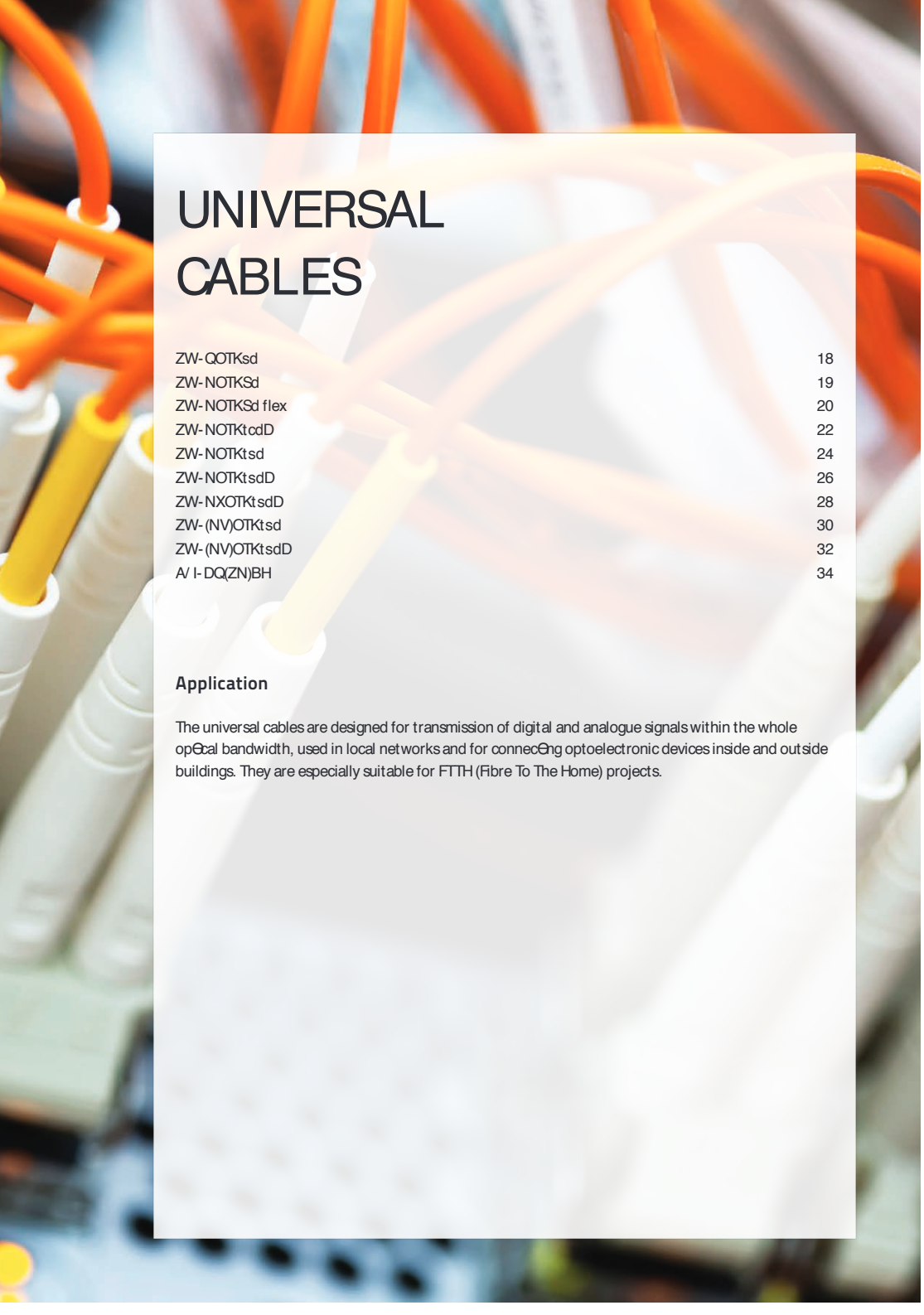
Standard	ZN-TF-12:2001, ZN-EK-106
Description	W-NNOTKSd () – indoor (W), with a halogen free flame retardant sheath (N), halogen free flame retardant module sheath (N), optical fibre cable (OTK), distribution type with tight tube (S), fully dielectric (d), distributive (())* * Number of modules and number of fibres, e.g. 4x4 – 4 modules, 4 fibres each
CONSTRUCTION:	
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50), gradient multimode (G/62.5) single mode with improved macrobending performance (JA1, JA2)
Tube	tight tube Ø 0.9 mm
Inner module	sheath is made of the same material as the cable sheath and may contain 1–12 optical fibres
Water barrier	swelling tape
Reinforcement	aramid yarns
Sheath	halogen free flame retardant, colour according to table on page 5

PARAMETERS:

Fibre count in cable	Number of modules	Number of optical fibres in a module	Max. module diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
						Dynamic	Static	Dynamic	Static
2	2	1	2.5	10.0	71	1,200	2,000	150	200
4	4	1	2.5	10.0	73			150	200
6	6	1	2.5	10.0	79			150	200
8	8	1	2.5	11.7	109			170	230
10	10	1	2.5	14.9	163			220	290
12	12	1	2.5	14.9	165			220	290
up to 48	4	4 - 12	5.5	18.0	170	4,000	2,000	270	360
up to 72	6	4 - 12	5.5	21,5	190	6,000	3,000	320	430
up to 96	8	4 - 12	5.5	27.5	300	8,000	4,000	410	550

Packing length: to be agreed, standard – 1 km
Packing: wooden drums

More than just a cable supplier

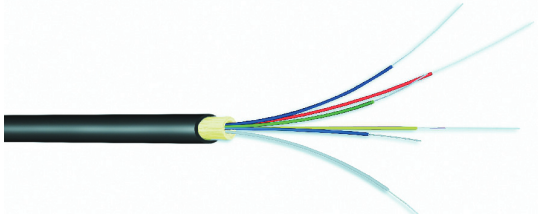


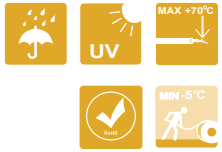
UNIVERSAL CABLES

Application

The universal cables are designed for transmission of digital and analogue signals within the whole optical bandwidth, used in local networks and for connecting optoelectronic devices inside and outside buildings. They are especially suitable for FTTH (Fibre To The Home) projects.

ZW-QOTKSd





Universal drop cable

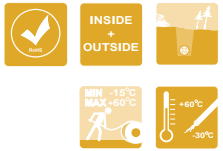
Standard	TT1-2513/5/0
Description	ZW-QOTKSd – indoor/outdoor (ZW), dry cable sealing (Q), optical fibre cable (OTK), distribution type with tight tube (S), fully dielectric (d)
CONSTRUCTION:	
Optical fibres	ITU-T G.652D; ITU-T G.657A or according to the attached specification
Tube	tight tube Ø 0.9 mm
Reinforcement	aramid yarn
Sheath	polyurethane
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • outer sheath resistant to abrasion, UV • flexible
Application	• for transmission of digital and analogue signals within the whole optical bandwidth used in the local, metropolitan and wide area networks • modern FTTH and CCTV installations • internal subscriber connections
Temperature ranges	• transport and storage: -20 °C – +70 °C • installation: -5 °C – +60 °C • operation: -25 °C – +70 °C

PARAMETERS:

Fibre count in cable	Outer diameter of tube [mm]	No. of elements in a cable [tubes/fillers]	Outer diameter of cable [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Static	Dynamic	Static
1 - 2	0.9	2	3.0 ±0.2	7.6	500	250	30	45
4	0.9	4	3.5 ±0.2	11.0	500	250	35	55
6	0.9	6	4.0 ±0.2	14.0	750	350	40	60
8	0.9	8	4.2 ±0.2	17.0	800	400	42	65
12	0.9	12	5.2 ±0.2	23.0	1000	500	52	78

Packing length: to be agreed, standard – 2.1 km (± 100 m)
Packing: wooden drums

ZW-NOTKSd



Universal fibre optic cable with multiple optical fibres in a tight tube

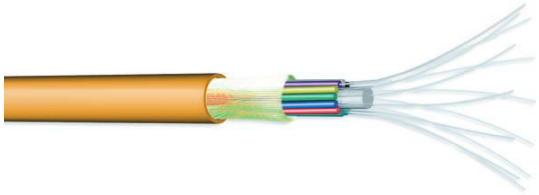
Standard	ZN-TF-12:2001
Description	ZW-NOTKSd – indoor/outdoor (ZW), with a halogen free flame retardant sheath (N), optical fibre cable (OTK), distribution type with tight tube (S), fully dielectric (d)
CONSTRUCTION:	
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	tight tube Ø 0.9 mm (with an acrylic buffer)
Sealing	dry
Reinforcement	aramid yarns
Sheath	halogen free flame retardant
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • easy installable • can be installed in the proximity to electric installation • can be used together with any kind of connectors • the outer sheath is made of halogen free flame retardant material • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements
Application	• for making connections between optoelectronic devices inside and outside buildings • suitable for use in cable ducts
Temperature ranges	• transport and storage: -30 °C – +70 °C • installation: -15 °C – +60 °C • operation: -30 °C – +60 °C

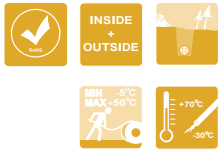
PARAMETERS:

Fibre count in cable	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
			Dynamic	Static	Dynamic	Static
2 - 8	10.5	100	1,600	800	150	160
10 - 12	11.0	110			210	220

Packing length: to be agreed, standard – 1 km
Packing: wooden drums

ZW-NOTKSd flex





Universal flexible fibre optic cable with multiple optical fibres in a tight tube

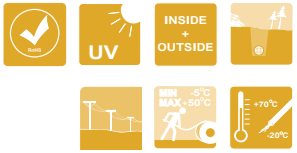
Standard	ZN-EK-106
Description	ZW-NOTKSd flex – indoor/outdoor (ZW), with a halogen free flame retardant sheath (N), optical fibre cable (OTK), distribution type with tight tube (S), fully dielectric (d) flexible (flex)
CONSTRUCTION:	
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50), gradient multimode (G/62.5) single mode with improved macrobending performance (JA1, JA2)
Tube	tight tube Ø 0.9 mm (with an acrylic buffer)
Sealing	dry
Central strength member	dielectric FRP rod
Reinforcement	aramid yarns (glass yarns on request)
Sheath	halogen free flame retardant, orange or black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • flexible • easy installable • can be installed in the proximity to electric installation • the outer sheath is made of halogen free flame retardant material • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements
Application	• for making connections between optoelectronic devices inside and outside buildings • suitable for use in cable ducts
Temperature ranges	• transport and storage: -30 °C – +70 °C • installation: -5 °C – +50 °C • operation: -30 °C – +70 °C

PARAMETERS:						
Fibre count in cable	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
			Dynamic	Static	Dynamic	Static
2, 4, 6	6.2	61	1,500	750	62	125
8	6.8	67			68	135
12	7.5	73			75	150

Packing length: to be agreed, standard – 2 km
Packing: wooden drums

ZW-NOTKtcdD

Analog acc. to VDE: A/I-DQ(ZN)2Y
U-DQ(ZN)2Y



Universal fibre optic cable with multiple optical fibres in a central tube

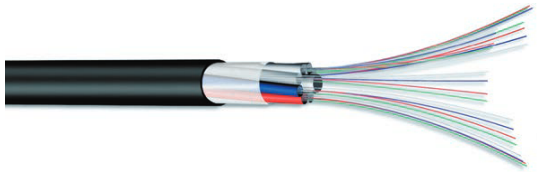
Standard	ZN-TF-11:2001
Description	ZW-NOTKtcdD – indoor/outdoor (ZW), with a halogen free flame retardant sheath (N), optical fibre cable (OTK), central tube (tc), fully dielectric (d), reinforced with aramid yarns (D)
Options	ZW-NOTKtcdDb – reinforced with glass yarn (Db)
CONSTRUCTION:	
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	central tube filled with a thixotropic jelly
Sealing	dry
Reinforcement	aramid yarns (or glass yarns)
Sheath	halogen free flame retardant, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • easy installable • can be installed in the proximity to electric installation • the outer sheath is made of halogen free flame retardant material • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements
Application	• for making connections between optoelectronic devices inside and outside buildings • suitable for use in cable ducts
Temperature ranges	• transport and storage: -25 °C – +70 °C • installation: -5 °C – +50 °C • operation: -20 °C – +70 °C

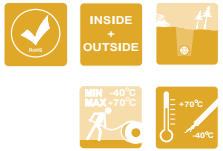
PARAMETERS:						
Fibre count in cable	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
			Dynamic	Static	Dynamic	Static
2 - 12	8.5	100	2,500	1,250	130	170
2 - 12	3.6	14	600	300	55	70

Packing length: to be agreed, standard – 2 km
Packing: wooden drums

ZW-NOTKtsd

Analog acc. to VDE: A/I-DQH
U-DQH





Universal fibre optic cable with multiple optical fibres in a loose tube, flame retardant

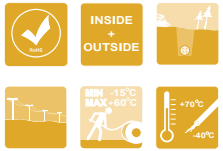
Standard	ZN-TF-11:2001; ZN-EK-103
Description	ZW-NOTKtsd – indoor/outdoor (ZW), with a halogen free flame retardant sheath (N), optical fibre cable (OTK), loose tube with dry core sealing (ts), fully dielectric (d)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Ripcord	2
Sheath	halogen free flame retardant, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • can be installed in the proximity to electric installation • the outer sheath is made of halogen free flame retardant material • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements
Application	• in telecommunication local, metropolitan and wide area networks in any spatial configuration • for making connection between optoelectronic devices in closed spaces • prepared for installation in closed spaces, road and railroad tunnels
Temperature ranges	• transport and storage: -40 °C – +70 °C • installation: -15 °C – +60 °C • operation: -40 °C – +70 °C

PARAMETERS:								
Fibre count in cable	Number of elements (tubes/ ller)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Static	Dynamic	Static
4 - 72	6	1.8	8	65	1,000	500	120	160
28 - 96	8	1.8	9.2	85	1,500	750	140	180
36 - 144	12	1.8	11.5	125	2,200	1,100	170	230
52 - 216	18	1.8	11.9	130	1,000	500	180	240
76 - 288	24	1.8	13.6	165	2,500	1,250	200	270
4 - 72	6	2.4	11.2	125	2,000	1,000	170	230
28 - 96	8	2.4	12.8	160	2,500	1,250	190	260
36 - 144	12	2.4	15.8	230	2,500	1,250	240	320
52 - 216	18	2.4	16.3	240	2,500	1,250	240	320
76 – 288	24	2.4	18.5	310	2,500	1,250	280	370

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

ZW-NOTKtsdD

Analog acc. to VDE: A/I-DQ(ZN)H
U-DQ(ZN)H



Universal fibre optic cable with multiple optical fibres in a loose tube, reinforced, flame retardant

Standard	ZN-TF-11:2001; ZN-EK-103
Description	ZW-NOTKtsdD – indoor/outdoor (ZW), with a halogen free flame retardant sheath (N), optical fibre cable (OTK), central tube (ts), fully dielectric (d), reinforced with aramid yarn (D)
Options	ZW-NOTKtsdDb – reinforced with glass yarn (Db) Analog acc. to VDE: A/I-DQ(ZN)BH, U-DQ(ZN)BH
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jh) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Reinforcement	aramid yarns (or glass yarns)
Ripcord	2
Sheath	halogen free flame retardant, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • can be installed in the proximity to electric installation • through the use of central dielectric strength member and aramid yarns reinforcement on the core with hot melt adhesive, cables are resistant to longitudinal and transverse stresses • the outer sheath is made of halogen free flame retardant material • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements
Application	• in telecommunication local, metropolitan and wide area networks in any spatial configuration • for making connection between optoelectronic devices in closed spaces • for laying on the outer walls of buildings • for laying in roads, railway tunnels or mine shafts • for horizontal and vertical suspension

CHARACTERISTICS cont.:	
Temperature ranges	• transport and storage: -40 °C – +70 °C • installation: -15 °C – +60 °C • operation: -40 °C – +70 °C

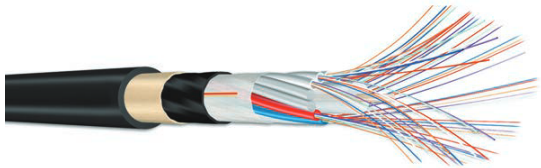
PARAMETERS:

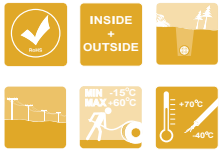
Fibre count in cable	Number of elements (tubes/fillers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Static	Dynamic	Static
4 - 72	6	1.8	8.5	75	2,700	1,350	130	170
28 - 96	8	1.8	9.7	90	3,000	1,500	150	190
36 - 144	12	1.8	12.0	135	4,000	2,000	180	240
52 - 216	18	1.8	12.4	140	4,000	2,000	190	250
76 - 288	24	1.8	14.1	175	4,000	2,000	210	280
4 - 72	6	2.4	11.7	130	4,000	2,000	175	235
28 - 96	8	2.4	13.3	170	5,000	2,500	200	265
36 - 144	12	2.4	16.3	240	6,000	3,000	245	325
52 - 216	18	2.4	16.8	250	6,000	3,000	250	335
76 - 288	24	2.4	19.0	340	6,000	3,000	285	380

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

ZW-NXOTKtsdD

Analog acc. to VDE: A/I-DQ2Y(ZN)H





Universal fibre optic cable with multiple optical fibres in a loose tube, reinforced, flame retardant

Standard	ZN-TF-11:2001
Description	ZW-NXOTKtsdD – indoor/outdoor (ZW), with an outer halogen free flame retardant sheath (N), inner polyethylene sheath (X), optical fibre cable (OTK), central tube (ts), fully dielectric (d), reinforced (D)
Options	ZW-NXOTKtsdDb – reinforced with glass yarn (Db)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jh) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12 or 18 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Reinforcement	aramid yarns
Ripcord	2
Sheath	halogen free flame retardant, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • can be installed in the proximity to electric installation • through the use of central dielectric strength member and aramid yarns reinforcement on the core with hot melt adhesive, cables are resistant to longitudinal and transverse stresses • the outer sheath is made of halogen free flame retardant material • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements

CHARACTERISTICS cont.:	
Applica⊖on	• for making connec⊖on between optoelectronic devices in closed spaces • for laying on the outer walls of buildings • for laying in roads, railway tunnels or mine sha⌀s • for horizontal and ver⊖cal suspension
Temperature ranges	• transport and storage: -40 □C – +70 □C • installa⊖on: -15 □C – +60 □C • opera⊖on: -40 □C – +70 □C

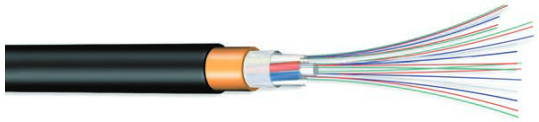
PARAMETERS:

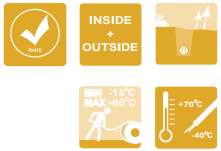
Fibre count in cable	Number of elements (tubes/ ⌊ llers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/ km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Sta⊖c	Dynamic	Sta⊖c
4 - 72	6	1.8	9.6	90	2,700	1,350	140	190
28 - 96	8	1.8	10.8	110	3,000	1,500	160	220
36 - 144	12	1.8	13.1	160	4,000	2,000	200	260
52 - 216	18	1.8	13.5	160	4,000	2,000	200	270
76 - 288	24	1.8	15.2	200	4,000	2,000	230	300
4 - 72	6	2.4	12.3	145	4,000	2,000	180	250
28 - 96	8	2.4	13.9	180	5,000	2,500	210	280
36 - 144	12	2.4	16.9	255	6,000	3,000	250	340
52 - 216	18	2.4	17.4	265	6,000	3,000	260	350
76 - 288	24	2.4	19.6	350	6,000	3,000	290	390

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

ZW-(NV)OTKtsd

Analog acc. to VDE: A/I-DQ4YH
U-DQ4YH





Fibre optic cable with multiple optical fibres in a loose tube, anti-rodent

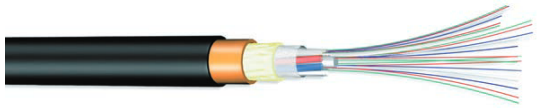
Standard	ZN-EK-103
Description	ZW-(NV)OTKtsd – indoor/outdoor (ZW) with double layer sheath, outer, halogen free flame retardant, inner, polyamide, black (NV) optical fibre cable (OTK), loose tube with dry core sealing (ts), fully dielectric (d)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Ripcord	2
Sheath	two-layer sheath: halogen free flame retardant (outer layer) – polyamide (inner layer), black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • can be installed in the proximity to electric installation • use of polyamide shell protects cables from rodents • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements
Application	• in telecommunication local, metropolitan and wide area networks in any spatial configuration • for making connection between optoelectronic devices in closed spaces • for laying on the outer walls of buildings • for laying in roads, railway tunnels or mine shafts
Temperature ranges	• transport and storage: -40 °C – +70 °C • installation: -15 °C – +60 °C • operation: -40 °C – +70 °C

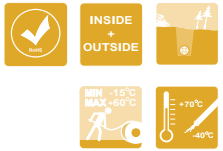
PARAMETERS:								
Fibre count in cable	Number of elements (tubes/fillers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Static	Dynamic	Static
4 - 72	6	1.8	9.7	95	1,000	500	150	190
28 - 96	8	1.8	10.9	115	1,500	750	160	220
36 - 144	12	1.8	13.2	165	2,200	1,100	200	260
52 - 216	18	1.8	13.6	70	1,000	500	200	270
76 - 288	24	1.8	15.3	210	2,500	1,250	230	310
4 - 72	6	2.4	11.6	125	2,000	1,000	170	230
28 - 96	8	2.4	13.2	160	2,500	1,250	200	260
36 - 144	12	2.4	16.2	230	2,500	1,250	240	320
52 - 216	18	2.4	16.7	240	2,500	1,250	250	330
76 - 288	24	2.4	18.9	305	2,500	1,250	280	380

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

ZW-(NV)OTKtsdD

Analog acc. to VDE: A/I-DQ(ZN)4YH
U-DQ(ZN)4YH





Fibre optic cable with multiple optical fibres in a loose tube, reinforced, anti-rodent

Standard	ZN-EK-103
Description	ZW-(NV)OTKtsdD – outdoor/indoor (ZW), with double layer sheath, outer, halogen free flame retardant, inner, polyamide, black (NV) optical fibre cable (OTK), loose tube with dry core sealing (ts), dielectric (d), reinforced with aramide yarn (D)
Options	ZW-(NV)OTKtsdDb – reinforced with glass yarn (Db)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jh) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Reinforcement	aramid yarns (or glass yarns)
Ripcord	2
Sheath	two-layer sheath: halogen free flame retardant (outer layer) – polyamide (inner layer), black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • can be installed in the proximity to electric installation • through the use of central dielectric strength member and aramid yarns reinforcement on the core with hot melt adhesive, cables are resistant to longitudinal and transverse stresses • use of polyamide shell protects cables from rodents • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements

CHARACTERISTICS cont.:	
Applica€on	• in telecommunica€on local, metropolitan and wide area networks in any spa€al con¦ gura€on • for making connec€on between optoelectronic devices in closed spaces • for laying on the outer walls of buildings • for laying in roads, railway tunnels or mine sha Ōs • for horizontal and ver€cal suspension
Temperature ranges	• transport and storage: -40 □C – +70 □C • installa€on: -15 □C – +60 □C • opera€on: -40 □C – +70 □C

PARAMETERS:

Fibre count in cable	Number of elements (tubes/¦ llers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Sta€c	Dynamic	Sta€c
4 - 72	6	1.8	10.2	100	2,700	1,350	150	200
28 - 96	8	1.8	11.4	125	3,000	1,500	170	230
36 - 144	12	1.8	13.7	175	4,000	2,000	210	270
52 - 216	18	1.8	14.1	180	4,000	2,000	210	280
76 - 288	24	1.8	15.8	220	4,000	2,000	240	320
4 - 72	6	2.4	12.2	140	4,000	2,000	180	240
28 - 96	8	2.4	13.8	175	5,000	2,500	210	280
36 - 144	12	2.4	16.8	250	6,000	3,000	250	340
52 - 216	18	2.4	17.3	260	6,000	3,000	260	340
76 - 288	24	2.4	19.5	325	6,000	3,000	290	390

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

A/I-DQ(ZN)BH

Outdoor fibre optic cable with multiple optical fibres in a central tube, with LSOH jacket	
Standard	DIN VDE 0888-3
Description	A/I-DQ(ZN)BH – indoor/outdoor (A/I), central tube filled with thixotropic gel (D), dry cable sealing (Q), dielectric reinforcement (ZN), anti-rodent layer made of glass yarns (B) with a halogen free flame retardant sheath (H)
CONSTRUCTION:	
Optical fibres	E9/125 (G652D) singlemode or singlemode with non – zero dispersion shifted (G.655), G50 – gradient multimode (50/125m) or G62.5 – gradient multimode (62.5/125m) (G.651)
Tube	loose tube filled with a thixotropic jelly
Cable sealing	dry
Reinforcement	glass yarns
Sheath	halogen free flame retardant, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • easy to install • use of glass yarn protects cable from rodents • the outer sheath is made of halogen free flame retardant material • the marking and the metric overprint are printed on the outer sheath. • the marking can also be tailored to meet customer's requirements
Application	• for quick connection between optoelectronic devices inside and outside buildings • suitable for use in cable ducts • for laying in primary and secondary cable ducts
Temperature ranges	• transport and storage: -25 °C – +70 °C • installation: -5 °C – +50 °C • operation: -25 °C – +70 °C

PARAMETERS:						
Fibre count in cable	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
			Dynamic	Static	Dynamic	Static
2 - 12	10	108	2,500	1,250	150	200
2 - 12	7.8	65	1,500	750	120	155

Packing length: to be agreed, standard – 2 km
Packing: wooden drums

TFkable

We look into the future

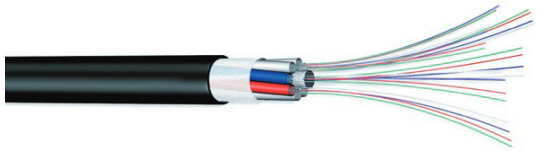
OUTDOOR CABLES

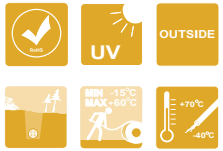
Application

The outdoor cables are designed for the transmission of digital and analogue signals within the whole optical bandwidth. Used in all systems for voice and image transmission in local, metropolitan and wide area networks, in any spatial configuration.
The cables are designed for installation in primary and secondary cable ducts.
Fully dielectric cables can also be installed near low, medium and high voltage power lines.

Z-XOTKtsd

Analog acc. to VDE: A-DQ2Y





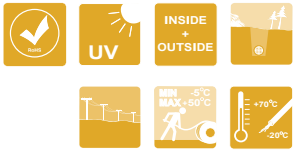
Outdoor fibre optic cable with multiple optical fibres in a loose tube, duct

Standard	ZN-TF-11:2001; ZN-EK-103
Description	Z-XOTKtsd – outdoor (Z), with a polyethylene sheath (X), optical fibre cable (OTK), loose tube with dry core sealing (ts), fully dielectric (d)
Options	Z-XOTKtd – with core filled with hydrophobic jelly (t) Z-XzOTKts – with moisture barrier made of aluminium tape under the sheath (Xz) Z-XzOTKt – with moisture barrier made of aluminium tape under the sheath (Xz), and the core filled with hydrophobic jelly (t)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Ripcord	2
Sheath	polyethylene, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric (except for cables with Al moisture barrier) • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • the outer sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements
Application	• in telecommunication local, metropolitan and wide area networks in any spatial configuration • for laying in primary and secondary cable ducts • can be laid near high voltage cable lines
Temperature ranges	• transport and storage: -40 °C – +70 °C • installation: -15 °C – +60 °C • operation: -40 °C – +70 °C

PARAMETERS:								
Fibre count in cable	Number of elements (tubes/fillers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Static	Dynamic	Static
4 - 72	6	1.8	8	50	1,000	500	120	160
28 - 96	8	1.8	9.2	70	1,500	750	140	180
36 - 144	12	1.8	11.5	105	2,200	1,100	170	230
52 - 216	18	1.8	11.9	110	1,000	500	180	240
76 - 288	24	1.8	13.6	140	2,500	1,250	200	270
4 - 72	6	2.4	11.2	100	2,000	1,000	170	230
28 - 96	8	2.4	12.8	125	2,500	1,250	190	260
36 - 144	12	2.4	15.8	190	2,500	1,250	240	320
52 - 216	18	2.4	16.3	200	2,500	1,250	240	320
76 - 288	24	2.4	18.5	255	2,500	1,250	280	370

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

Z-XOTKtsdp



Flat fibre optic cable with multiple optical fibres in a loose tube

Standard	ZN-EK-108
Description	Z-XOTKtsdp – outdoor (Z) with a polyethylene sheath (X) optical fibre cable (OTK), loose tube (ts), dielectric (d)
CONSTRUCTION:	
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Strength member	dielectric FRP rod with or without a PE cover, placed between two tubes or next to a single tube
Ripcord	2
Sheath	polyethylene, black or orange
CHARACTERISTICS:	
Tube identification	• 1-tube cables: any colour • 2-tube cables: 1st tube red, 2nd tube natural
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • easy installable • can be installed in the proximity to electric installation • can be installed in ducts • the outer sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements
Application	• telecommunications networks in each spatial configuration • broadband access networks • CATV networks • local area network LAN (academic, industrial, etc.) • temporary networks created for the purpose of transmission of sports events, culture, etc. • suitable to lay in primary and secondary ducts, especially with very limited space For temporary links, cables can be directly buried, laid on the ground or hung together with load-bearing ropes for spans up to 50 m. Cables are particularly useful for maintenance purposes and restoring damaged lines.

CHARACTERISTICS cont.:	
Temperature ranges	• transport and storage: -40 °C – +70 °C • installaeon: -15 °C – +60 °C • operaeon: -40 °C – +70 °C
Addieonal Informaeon	The possibility to install the cables in pareally ¦ lled secondary ducts using mechanical methods of pulling, stacking with small bending radii. Shorter cable joint preparaeon eme through the use of ripcords.

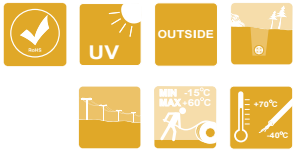
PARAMETERS:						
Fibre count in cable	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
			Dynamic	Staec	Dynamic	Staec
4 - 12	5.5x8	45	1,000	500	55/60	110/160
8 - 24	5.5x10.5	58	1,000	500	55/60	110/210

Packing length: to be agreed, standard – 4 km

Packing: wooden drums

Z-XOTKtsdD

Analog acc. to VDE: A-DQ(ZN)2Y



Outdoor fibre optic cable with multiple optical fibres in a loose tube, duct, reinforced

Standard	ZN-TF-11:2001; ZN-EK-103
Description	Z-XOTKtsdD – outdoor (Z), with a polyethylene sheath (X), optical fibre cable (OTK), loose tube with dry core sealing (ts), fully dielectric (d), reinforced with aramid yarns (D)
Options	Z-XOTKtsdDb – reinforced with glass yarns (Db) Z-XzOTKtD – with moisture barrier made of Aluminium tape under the sheath (Xz), and the core filled with hydrophobic jelly (t)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jh) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Reinforcement	aramid yarns (or glass yarns)
Ripcord	2
Sheath	polyethylene, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric (except for cables with Al moisture barrier) • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • through the use of central dielectric strength member and aramid yarns reinforcement on the core with hot melt adhesive, cables are resistant to longitudinal and transverse stresses • the outer sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements
Application	• in telecommunication local, metropolitan and wide area networks in any spatial configuration • for laying in primary and secondary cable ducts. • for installation on telegraph poles, low and medium voltage power lines or railway traction • can be laid near high voltage cable lines

CHARACTERISTICS cont.:	
Temperature ranges	• transport and storage: -40 °C – +70 °C • installaGon: -15 °C – +60 °C • operaGon: -40 °C – +70 °C

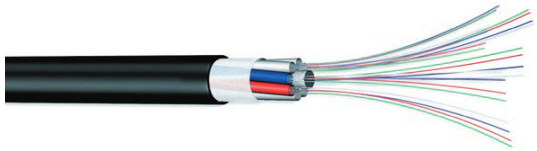
PARAMETERS:

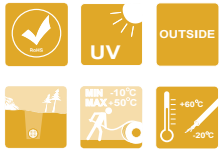
Fibre count in cable	Number of elements (tubes/ ¦ llers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/ km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	StaGc	Dynamic	StaGc
4 - 72	6	1.8	8.5	60	2,700	1,350	130	170
28 - 96	8	1.8	9.7	75	3,000	1,500	150	190
36 - 144	12	1.8	12.0	115	4,000	2,000	180	240
52 - 216	18	1.8	12.4	115	4,000	2,000	190	250
76 - 288	24	1.8	14.1	150	4,000	2,000	210	280
4 - 72	6	2.4	11.7	130	4,000	2,000	175	235
28 - 96	8	2.4	13.3	170	5,000	2,500	200	265
36 - 144	12	2.4	16.3	240	6,000	3,000	245	325
52 - 216	18	2.4	16.8	250	6,000	3,000	250	335
76 - 288	24	2.4	19.0	340	6,000	3,000	285	380

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

Z-XOTKtmsd

Analog acc. to VDE: A-DQ2Y micro





Outdoor fibre optic cable with multiple optical fibres in a micro-tube, duct

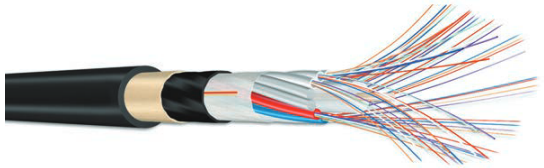
Standard	IEC 60794-1
Description	Z-XOTKtmsd – outdoor (Z), with a polyethylene sheath (X), optical fibre cable (OTK), loose (micro) tube with dry core sealing (tms), fully dielectric (d)
Options	Z-XOTKtmsdD – reinforced with aramid yarns (D)
CONSTRUCTION:	
Central strength member	dielectric FRP rod
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) single mode with improved macrobending performance (Ja, Jb) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube Ø 1,5 mm filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Water protection	water swellable yarns
Ripcord	1
Outer sheath	polyethylene, black
CHARACTERISTICS:	
Performance parameters	• small outer diameter • fully dielectric • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • the outer sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath. • the marking can also be tailored to meet customer's requirements
Application	• small outer diameter • in telecommunication local, metropolitan and wide area networks in any spatial configuration • cable for FTTH systems for laying in micro-ducts • suitable for blowing up to 2,000m
Temperature ranges	• transport and storage: -30 °C – +60 °C • installation: -10 °C – +50 °C • operation: -20 °C – +60 °C

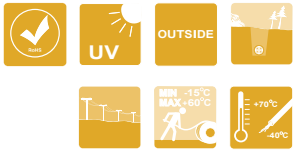
PARAMETERS:						
Fibre count in cable	Cable weight [kg/km]	Cable diameter [mm]	Max. pulling force [N]		Min. bending radius [mm]	
			Dynamic	Static	Dynamic	Static
4 - 72	27	5.7	700	220	90	115
74 - 96	40	6.6	1,200	250	100	130
98 - 144	60	8.7	1,500	300	130	170
146 - 216	70	9.0	700	220	135	180
218 - 288	90	10.5	1,200	250	160	210

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

Z-XXOTKtsdD

Analog acc. to VDE: A-DQ2Y(ZN)2Y





Outdoor fibre optic cable with multiple optical fibres in a loose tube, duct, reinforced	
Standard	ZN-TF-11:2001; ZN-EK-103
Description	Z-XXOTKtsdD – outdoor (Z), with outer and inner polyethylene sheath (XX), optical fibre cable (OTK), loose tube with dry core sealing (ts), dielectric (d), reinforced with aramid yarns (D)
Options	Z-XXOTKtdD – with core filled with hydrophobic jelly (t)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jh) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Reinforcement	aramid yarns
Ripcord	2
Sheath	polyethylene, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric (except for cables with Al moisture barrier) • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • through the use of central dielectric strength member and aramid yarns reinforcement on the core with hot melt adhesive, cables are resistant to longitudinal and transverse stresses • the outer sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements

CHARACTERISTICS cont.:	
Applicaeon	• in telecommunicaeon local, metropolitan and wide area networks in any spaeal conl guraeon • for laying in primary and secondary cable ducts. • for installaeon on telegraph poles, low and medium voltage power lines or railway traceon • can be laid near high voltage cable lines
Temperature ranges	• transport and storage: -40 °C – +70 °C • installaeon: -15 °C – +60 °C • operaeon: -40 °C – +70 °C

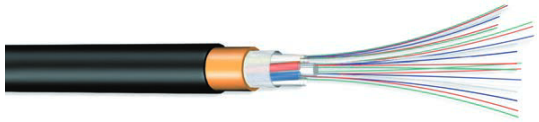
PARAMETERS:

Fibre count in cable	Number of elements (tubes/l llers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Staec	Dynamic	Staec
4 - 72	6	1.8	9.6	70	2,700	1,350	140	190
28 - 96	8	1.8	10.8	90	3,000	1,500	160	220
36 - 144	12	1.8	13.1	135	4,000	2,000	200	260
52 - 216	18	1.8	13.5	135	4,000	2,000	200	270
76 - 288	24	1.8	15.2	175	4,000	2,000	230	300
4 - 72	6	2.4	12.3	115	4,000	2,000	180	250
28 - 96	8	2.4	13.9	145	5,000	2,500	210	280
36 - 144	12	2.4	16.9	215	6,000	3,000	250	340
52 - 216	18	2.4	17.4	225	6,000	3,000	260	350
76 - 288	24	2.4	19.6	290	6,000	3,000	290	390

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

Z-(XV)OTKtsd

Analog acc. to VDE: A-DQ2Y4Y



Outdoor fibre optic cable with multiple optical fibres in a loose tube, duct, anti-rodent

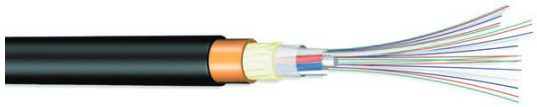
Standard	ZN-EK-103
Description	Z-(XV)OTKtsd – outdoor (Z), with a two-layer sheath: polyethylene (outer)-polyamide (inner) (XV), optical fibre cable (OTK), loose tube with dry core sealing (ts), fully dielectric (d)
Options	Z-(VX)OTKtsd – with a two-layer sheath: polyamide (outer)-polyethylene (inner) (VX) Z-(XV)OTKtd, Z-(VX)OTKtd – with core filled with hydrophobic jelly (t)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Ripcord	2
Sheath	black: polyethylene (outer)-polyamide (inner layer) orange: polyamide (outer layer)-polyethylene (inner layer)
CHARACTERISTICS:	
Performance parameters	• fully dielectric (except for cables with Al moisture barrier) • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • use of polyamide sheath protects cables from rodents • polyethylene sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements
Application	• in telecommunication local, metropolitan and wide area networks in any spatial configuration • for laying in primary and secondary cable ducts • can be laid near high voltage cable lines
Temperature ranges	• transport and storage: -40 °C – +70 °C • installation: -15 °C – +60 °C • operation: -40 °C – +70 °C

PARAMETERS:								
Fibre count in cable	Number of elements (tubes/ ¦ llers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/ km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Sta€c	Dynamic	Sta€c
4 - 72	6	1.8	9.7	75	1,000	500	150	190
28 - 96	8	1.8	10.9	95	1,500	750	160	220
36 - 144	12	1.8	13.2	140	2,200	1,100	200	260
52 - 216	18	1.8	13.6	140	1,000	500	200	270
76 - 288	24	1.8	15.3	180	2,500	1,250	230	310
4 - 72	6	2.4	11.6	105	2,000	1,000	170	230
28 - 96	8	2.4	13.2	135	2,500	1,250	200	260
36 - 144	12	2.4	16.2	200	2,500	1,250	240	320
52 - 216	18	2.4	16.7	210	2,500	1,250	250	330
76 - 288	24	2.4	18.9	270	2,500	1,250	280	380

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

Z-(XV)OTKtsdD

Analog acc. To VDE: A-DQ(ZN)2Y4Y



Outdoor fibre optic cable with multiple optical fibres in a loose tube, duct, anti-rodent

Standard	ZN-EK-103
Description	Z-(XV)OTKtsdD – outdoor (Z), with a two-layer sheath: polyethylene (outer)-polyamide (inner) (XV), optical fibre cable (OTK), loose tube with dry core sealing (ts), fully dielectric (d), reinforced with aramide yarns (D)
Options	Z-(VX)OTKtsdD – with a two-layer sheath: polyamide (outer)-polyethylene (inner) (VX) Z-(XV)OTKtdD – filled with hydrophobic jelly (t)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Reinforcement	aramid yarns
Ripcord	2
Sheath	black two layers polyethylene (outer)-polyamide (inner) sheath or orange two layers polyamide (outer)-polyethylene (inner) sheath
CHARACTERISTICS:	
Performance parameters	• fully dielectric (except for cables with Al moisture barrier) • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • use of polyamide sheath protects cables from rodents • polyethylene sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements

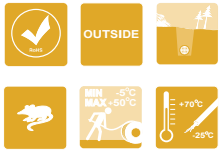
CHARACTERISTICS cont.:	
Applica€on	• in telecommunica€on local, metropolitan and wide area networks in any spa€al con¦ gura€on • for laying in primary and secondary cable ducts • for installa€on on telegraph poles, low and medium voltage power lines or railway trac€on • can be laid near high voltage cable lines
Temperature ranges	• transport and storage: -40 °C – +70 °C • installa€on: -15 °C – +60 °C • opera€on: -40 °C – +70 °C

PARAMETERS:

Fibre count in cable	Number of elements (tubes/¦ llers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Sta€c	Dynamic	Sta€c
4 - 72	6	1.8	10.2	85	2,700	1,350	150	200
28 - 96	8	1.8	11.4	105	3,000	1,500	170	230
36 - 144	12	1.8	13.7	150	4,000	2,000	210	270
52 - 216	18	1.8	14.1	150	4,000	2,000	210	280
76 - 288	24	1.8	15.8	190	4,000	2,000	240	320
4 - 72	6	2.4	12.2	115	4,000	2,000	180	240
28 - 96	8	2.4	13.8	145	5,000	2,500	210	280
36 - 144	12	2.4	16.8	215	6,000	3,000	250	340
52 - 216	18	2.4	17.3	225	6,000	3,000	260	340
76 - 288	24	2.4	19.5	290	6,000	3,000	290	390

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

A-DQ(ZN)B2Y



Outdoor fibre optic cable with multiple optical fibres in a central tube

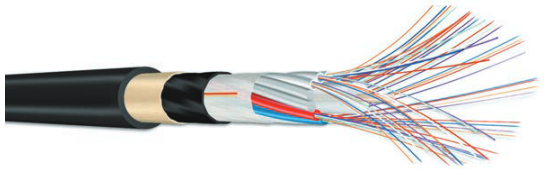
Standard	DIN VDE 0888-3
Description	A-DQ(ZN)B2Y – outdoor (A), central tube filled with thixotropic gel (D), dry cable sealing (Q), dielectric reinforcement (ZN), anti-rodent layer made of glass yarns (B) with a polyethylene sheath (2Y)
CONSTRUCTION:	
Optical fibres	singlemode E9/125 (G.652D) or singlemode with non zero dispersion shifted (G.655) gradient multimode 50/125 (G50) or 62.5/125 (G62.5)
Tube	central loose tube filled with a thixotropic jelly
Cable sealing	dry
Reinforcement	glass yarn
Sheath	polyethylene, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • easy to install • use of glass yarn protects cable from rodents • the outer sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath. • the marking can also be tailored to meet customer's requirements
Application	• for quick connection between optoelectronic devices inside and outside buildings • suitable for use in cable ducts • for laying in primary and secondary cable ducts
Temperature ranges	• transport and storage: -25 °C – +70 °C • installation: -5 °C – +50 °C • operation: -25 °C – +70 °C

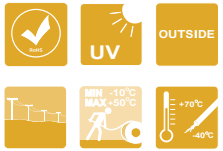
PARAMETERS:						
Fibre count in cable	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
			Dynamic	Static	Dynamic	Static
2 - 12	10	98	2,500	1,250	150	200
2 - 12	7.8	60	1,500	750	120	155

Packing length: to be agreed, standard – 2 km
Packing: wooden drums

ADSS-XXOTKtsdD

Analog acc. to VDE: ADSS-DQ2Y(ZN)2Y





Outdoor fibre optic cable with multiple optical fibres in a loose tube, reinforced, selfsupported

Standard	ZN-TF-14:2001
Description	ADSS-XXOTKtsdD...kN – all dielectric self supported (ADSS-), with outer and inner polyethylene sheath (XX), optical fibre cable (OTK), loose tube with dry core sealing (ts), fully dielectric (d), reinforced with aramid yarns (D), working tension (...kN)
Options	ADSS cables with up to 144 fibres, tube sizes 2.1, 2.4 and 2.8mm depending on fibre count
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jh) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Water protection	dry
Inner sheath	polyethylene
Reinforcement	aramid yarns
Ripcord	2
Outer sheath	polyethylene, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • through the use of central dielectric strength member and aramid yarns reinforcement on the core with hot melt adhesive, cables are resistant to longitudinal and transverse stresses • the outer sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements

CHARACTERISTICS cont.:	
Applicaϑon	• in telecommunicaϑon local, metropolitan and wide area networks in any spaϑal conl guraϑon • for installaϑon on telegraph poles, low and medium voltage power lines or railway tracϑon • can be installed near high voltage cable lines
Temperature ranges	• transport and storage: -40 °C – +70 °C • installaϑon: -10 °C – +50 °C • operaϑon: -40 °C – +70 °C

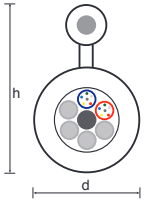
PARAMETERS:

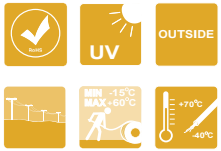
Fibre count in the cable	Rated Tensile strength (RTS) [kN]	Maximum working tension [kN]	Calculated work force [kN]	Cable diameter [mm]	Cable weight [kg/km]	Cable cross-seϑon [mm²]	Aramid yarn crosseϑon [mm²]	Central strength member crosseϑon [mm²]	Cable Young's Modulus [GPa]	Coeϵ cient of thermal expansion [1/K* 10-6]	Recom-mended span dis-tance [m]
ADSS-XXOTKtsdD with 2.1mm tubes											
4 - 24	19	8	3.5	12.8	125	128	12.5	4.15	12.5	5.8	120
	32	14	8	13.2	145	136	21	4.15	18.6	2.9	200
	48	20	14	14.3	160	160	28	4.15	20.6	2.3	350
	75	27	21	15.5	190	186	48	4.15	29.6	0.8	500
ADSS-XXOTKtsdD with 2.4mm tubes											
4 - 48	19	8	3.5	13.6	145	145	12.5	4.9	11.3	6.1	120
	32	14	8	14.2	155	158	21	4.9	16.3	3.3	200
	48	20	14	14.9	175	174	28	4.9	19.2	2.5	350
	75	27	21	16.0	200	201	50	4.9	28.7	0.97	500
ADSS-XXOTKtsdD with 2.8mm tubes											
48 - 72	19	8	3.5	14.8	166	172	14.8	7.06	11.6	5.7	120
	32	14	8	15.4	178	186	21.8	7.06	14.9	3.7	200
	48	20	14	15.9	190	198	28	7.06	17.4	2.7	350
	75	27	21	17.0	219	227	51.5	7.06	26.6	0.98	500
74 - 96	19	8	3.5	16.3	200	208	12.0	4.91	9.1	9.2	120
	32	14	8	16.6	210	216	16.8	4.91	11.6	6.5	200
	48	20	14	17.2	225	235	25.2	4.91	15.8	4.2	350
98 - 144	19	8	3.5	19.7	290	305	12.0	4.91	6.6	13.6	120
	32	14	8	20.0	300	314	16.8	4.91	8.4	10.0	200
	48	20	14	20.6	315	334	25.2	4.91	11.6	6.6	350

Packing length: to be agreed, standard – 4 km

Packing: wooden drums

S-XOTKtsd





Outdoor fibre optic cable with multiple optical fibres in a loose tube, selfsupporting, 8-type

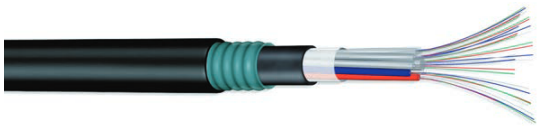
Standard	ZN-TF-016
Description	S-XOTKtsd – self-supporting, eight shape cable (S), with a polyethylene sheath (X), optical fibre cable (OTK), loose tube with dry core sealing (ts), fully dielectric (d)
Options	S-XOTKts – cable messenger: steel rope S-XOTKtsD – reinforced with aramid yarns (D)
CONSTRUCTION:	
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Cable sealing	dry
Sheath	polyethylene, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • the outer sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements
Application	• in telecommunication local, metropolitan and wide area networks in any spatial configuration • for hanging on telegraph poles • cables with dielectric strength members are suitable for hanging on poles of low and medium voltage power lines or railway traction
Temperature ranges	• transport and storage: -40 °C – +70 °C • installation: -15 °C – +55 °C • operation: -40 °C – +70 °C

PARAMETERS:								
Fibre count in cable	Number of elements (tubes/ ller)	Tube diameter	Cable diameter dxh [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Static	Dynamic	Static
4 - 72	6	2.4	10.6 x 18.6	120	3200	1,600	220	320
28 - 96	8		12.2 x 20.2	150		1,600	250	370
36 - 144	12		15.2 x 23.2	210		1,600	310	460

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

ZKS-XXOTKtsFf

Analog acc. to VDE: A-DQ2Y(SR)2Y



Outdoor fibre optic cable with multiple optical fibres in a loose tube, armoured with corrugated steel tape, for sewage ducts

Standard	ZN-TF-13:2001
Description	ZKS-XXOTKtsFf – outdoor cable for sewage systems (ZKS), with polyethylene outer sheath (X) and polyethylene inner sheath (X), fibre optic cable (OTK), loose tube with dry core sealing (ts), armoured with corrugated steel tape (Ff)
Options	ZKS-XXOTKtsDFf – reinforced with aramid yarn (D) (or with glass yarns (Db)) ZKS-XXOTKtFf – with core filled with hydrophobic jelly (t) ZKS-(VX)XOTKtsFf – with two layered sheath, outer polyamide, inner polyethylene (VX)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Inner sheath	polyethylene
Armouring	corrugated steel tape
Ripcord	2
Outer sheath	polyethylene, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric core • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • through the use of corrugated steel tapes, armoured cables are resistant to transverse and longitudinal stresses and rodent attack • the outer sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath. • the marking can also be tailored to meet customer's requirements

CHARACTERISTICS cont.:	
Applica€on	• in telecommunica€on local, metropolitan and wide area networks in any spa€al con¦ gura€on • for laying in sewage ducts • for burying directly in the ground in areas with higher risk of mechanical damage • for installa€on in primary cable ducts
Temperature ranges	• transport and storage: -40 °C – +70 °C • installa€on: -15 °C – +60 °C • opera€on: -40 °C – +70 °C

PARAMETERS:

Fibre count in cable	Number of elements (tubes/¦ llers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Sta€c	Dynamic	Sta€c
4 - 72	6	1.8	12.3	140	1,000	500	180	250
28 - 96	8	1.8	13.5	175	1,500	750	200	270
36 - 144	12	1.8	15.8	230	2,200	1,100	240	320
52 - 216	18	1.8	16.2	230	1,000	500	240	320
76 - 288	24	1.8	17.9	280	2,500	1,250	270	360
4 - 72	6	2.4	14.2	185	2,700	1,350	210	280
28 - 96	8	2.4	15.8	230	2,700	1,350	240	320
36 - 144	12	2.4	18.8	305	2,700	1,350	280	380
52 - 216	18	2.4	19.3	315	2,700	1,350	290	390
76 - 288	24	2.4	21,5	385	2,700	1,350	320	430

Packing length: to be agreed, standard – 4 km
Packing: wooden drums

Z-XXOTKtsFtl

Outdoor fibre optic cable with multiple optical fibres in a loose tube, armoured with steel tapes	
Standard	ZN-TF-13:2001
Description	Z-XXOTKtsFtl – outdoor (Z), with polyethylene outer sheath (X) and polyethylene inner sheath (X), optical fibre cable (OTK), central tube (ts), armoured with lacquered steel tapes (Ftl)
Options	Z-XXOTKtsDFtl – reinforced with aramid yarns (D) (or with glass yarns (Db)) Z-XXOTKtFtl, Z-XXOTKtDFtl – with core filled with hydrophobic jelly (t) Z-XXzOTKtsFtl – with aluminium moisture barrier under the inner sheath (Xz)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Inner sheath	polyethylene
Bedding	PVC tape
Armouring	lacquered steel tapes
Ripcord	2
Outer sheath	polyethylene, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric core • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • through the use of steel tapes, armoured cables are resistant to transverse and longitudinal stresses and rodent attack • the outer sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements

CHARACTERISTICS cont.:	
Applica⊖on	• in telecommunica⊖on local, metropolitan and wide area networks in any spa⊖al con| gura⊖on • for burying directly in the ground in areas with higher risk of mechanical damage • for installa⊖on in primary ducts
Temperature ranges	• transport and storage: -40 □C – +70 □C • installa⊖on: -15 □C – +60 □C • opera⊖on: -40 □C – +70 □C

PARAMETERS:

Fibre count in cable	Number of elements (tubes/| llers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Sta⊖c	Dynamic	Sta⊖c
4 - 24	6	1.8	13.0	210	1,000	500	200	260
6 - 72	6	2.4	15.0	270	2,700	1,350	230	300
6 - 96	8	2.4	16.5	330	2,700	1,350	250	330
6 - 144	12	2.4	19.6	490	2,700	1,350	290	390
12 - 216	18	2.4	20.2	510	2,700	1,350	300	400
12 - 288	24	2.4	22.3	580	2,700	1,350	340	450

Packing length: to be agreed, standard – 2 km
Packing: wooden drums

ZKS-XXOTKtsFo

Analog acc. to VDE: A-DQ2Y(SWA)2Y

Outdoor fibre optic cable with multiple optical fibres in a loose tube, armoured with steel wires, for sewage ducts, ground or under river installations

Standard	ZN-TF-13:2001
Description	ZKS-XXOTKtsFo – outdoor cable for sewage systems (ZKS), with polyethylene outer sheath (X) and polyethylene inner sheath (X), optical fibre cable (OTK), central tube (ts), armoured with round steel wires (Fo)
Options	ZKSXXOTKtsDFo – reinforced with aramid yarns (D) (or with glass yarns (Db)) ZKSXXOTKtFo – with core filled with hydrophobic jelly (t) ZKSXXzOTKtsFo – with an aluminium moisture barrier under the inner sheath (Xz)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jh) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Inner sheath	polyethylene
Bedding	PVC tape
Armouring	round steel wires
Ripcord	2
Outer sheath	polyethylene, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric core • resistant to electromagnetic interferences • protected from moisture and longitudinal water penetration • through the use of a central dielectric strength member, aramid yarn reinforcement on the core with hot melt adhesive; steel wire armoured cables are extremely resistant to longitudinal and transverse stresses and rodent attack • the outer sheath is resistant to abrasion, UV and stress corrosion cracking • the marking and the metric overprint are printed on the outer sheath • the marking can also be tailored to meet customer's requirements

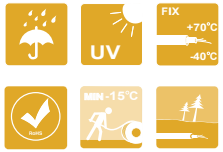
CHARACTERISTICS cont.:	
Applica⊖on	• in telecommunica⊖on local, metropolitan and wide area networks in any spa⊖al con‰ gura⊖on • for laying in sewage ducts • for burying directly in the ground in areas with higher risk of mechanical damage • for installa⊖on at the bo⌃om of water reservoirs and river crossings
Temperature ranges	• transport and storage: -40 □C – +70 □C • installa⊖on: -15 □C – +60 □C • opera⊖on: -40 □C – +70 □C

PARAMETERS:

Fibre count in cable	Number of elements (tubes/‰ llers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Sta⊖c	Dynamic	Sta⊖c
4 - 72	6	1.8	12.5	230	8,000	4,000	190	250
28 - 96	8	1.8	13.7	275	9,000	4,500	210	270
36 - 144	12	1.8	16.0	365	12,000	6,000	240	320
52 - 216	18	1.8	16.4	375	12,000	6,000	250	330
76 - 288	24	1.8	18.1	445	14,000	7,000	270	360
4 - 72	6	2.4	14.4	300	10,000	5,000	220	290
28 - 96	8	2.4	16.0	360	12,000	6,000	240	320
36 - 144	12	2.4	19.0	480	15,000	7500	290	380
52 - 216	18	2.4	19.5	490	15,000	7500	290	390
76 - 288	24	2.4	21.7	595	18,000	9,000	330	430

Packing length: to be agreed, standard – 2 km
Packing: wooden drums

FTTH Z-XOTKtcdD



Outdoor fibre optic cable for use in FTTH technology, subscriber type

Standard	TT1-2440/2
Description	FTTH Z-XOTKtcdD – outdoor (Z), fibre optic cable (OTK), with a central loose tube (tc), fully dielectric, reinforced with aramid yarns (D)
CONSTRUCTION:	
Optical fibres	ITU-T G.652D; ITU-T G.657A or according to the attached specification
Tube	central loose tube
Reinforcement	aramid yarns
Strength members	dielectric rod
Sheath	polyethylene, black
CHARACTERISTICS:	
Performance parameters	• fully dielectric • resistant to electromagnetic interferences • outer sheath resistant to abrasion, UV • the marking and the metric overprint are printed on the outer sheath • marking can also be tailored to meet customer's requirements • flexible
Application	• for transmission of digital and analogue signals within the whole optical bandwidth used in the local, metropolitan and wide area networks • external access networks • modern FTTH & CCTV • subscriber connections • can be installed directly in the ground
Temperature ranges	• transport and storage: -30 °C – +70 °C • installation: -15 °C – +55 °C • operation: -30 °C – +60 °C

PARAMETERS:								
Fibre count in cable	Number of elements (tubes/fillers)	Tube diameter [mm]	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Static	Dynamic	Static
2 - 12	1	2.1	6.0 ± 0.2	32.0	500	250	65	130

Packing length: to be agreed, standard – 2.1 km (± 100 m)
Packing: wooden drums

TFKable

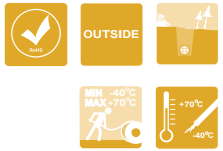
Quality takes priority

SPECIAL APPLICATION CABLES

Application

Cables for special military and mining applicaGons are used for transmission of digital and analogue signals within the whole opGcal bandwidth. Used in voice and data transmission lines, built to endure extreme condiGons and so require high mechanical resistance

PSKD



Field fibre optic cables for special applications

Standard	ZN-TF-017
Description	PSKD – field (P), fibre optic cable (SK), reinforced with aramid yarns (D)
CONSTRUCTION:	
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jh) gradient multimode (G/50) gradient multimode (G/62.5) with a special elastic buffer in a tight tube
Tube	tight tube Ø 0.9 mm
Inner sheath	halogen free polyurethane, flame retardant
Reinforcement	aramid yarns
Outer sheath	halogen free polyurethane, flame retardant, black or grey
CHARACTERISTICS:	
Tube identification	Colours of tubes at customer's discretion. The marking and the metric overprint are printed on the outer sheath. The marking can also be tailored to meet customer's requirements.
Performance parameters	• fully dielectric • light and durable due to double aramid reinforcement • resistant to electromagnetic interferences • highly flexible in low temperatures due to double polyurethane sheaths • suitable for repeated winding and unwinding • highly resistant to chemical agents, abrasion, mechanical vibrations • fire resistant due to flame retardant zero halogen polyurethane • resistant to longitudinal water penetration • can be installed in the proximity to electric installation
Application	• for military tactical field communication systems • for use in heavy environmental conditions where high resistance to mechanical damage is required • in places where geological, archeological or mining works are being carried out, both in the open air and underground • recommended if frequent winding and unwinding is required • for television communications vehicles transmission and cameras • use of high-speed automated cable pulling methods (such as from a moving car, car combat, etc.)
Temperature ranges	• transport and storage: -55 °C – +75 °C • installation: -40 °C – +70 °C • operation: -40 °C – +70 °C

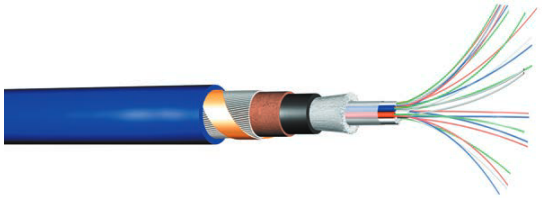
CHARACTERISTICS cont.:	
Other cable parameters	• max tensile force 2.5 kN • resistance to deformaGon (crash test) 3 kN • resistance to impact 3 Nm • resistance to mulGple bending 5,000 Gmes • resistance to mulGple rewinding 100.000 Gmes
AddiGonal InformaGon	The unique combinaGon of features make the PSKD cables very versaGle, lightweight and durable. The durability comes from double aramid ¦ bre reinforcement. Flexibility and resistance to ¦ re have been achieved using Ňame retardant polyurethane. Swellable aramid yarns provide water resistance and a special Ňexible buī er allows for operaGon in very low temperatures. Tight tubes protect the opGcal ¦ bres and allow for quick and easy cable terminaGon with an appropriate connector, also in the ¦ eld.

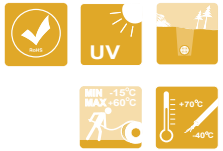
PARAMETERS:

Fibre count in cable	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
			Dynamic	StaGc	Dynamic	StaGc
2	5.8	24	2,500	1,250	85	110
4	5.8	25			85	110
6	6.3	29			85	110
8	6.5	32			90	120
12	7.1	38			100	130

Packing length: to be agreed, standard – 1 km
Packing: wooden drums

YOTKGtsFoyn





Mining fibre optic cable with multiple optical fibres in a loose tube, armoured with steel wires, flame retardant	
Standard	ZN-TF-115
Description	YOTKGtsFoyn – with PVC inner sheath (Y), fibre optic cable for mining (OTKG), loose tube with dry core sealing (ts), armoured with round steel wires (Fo), flame retardant PVC outer sheath (yn)
Options	YOTKGtsDFoyn – reinforced with aramid yarns (D) NOTKGtsFoN – with halogen free flame retardant inner sheath (N) and halogen free flame retardant outer sheath (N)
CONSTRUCTION:	
Central strength member	dielectric FRP rod with or without PE jacket
Optical fibres	singlemode (J) singlemode with non-zero dispersion (Jn) gradient multimode (G/50) gradient multimode (G/62.5)
Tube	loose tube filled with a thixotropic jelly
Filler	polyethylene
Cable core	6, 8, 12, 18 or 24 tubes or tubes and fillers stranded around central strength member
Sealing	dry
Inner sheath	polyethylene
Bedding	PVC tape
Armouring	round steel wires
Ripcord	2
Outer sheath	flame retardant PVC, blue
CHARACTERISTICS:	
Performance parameters	• dielectric cable cores • resistant to electromagnetic interferences • through the use of a dielectric strength member, aramid reinforcement (option) and armour made of round steel wires, cables are resistant to longitudinal and transverse stress • resistant to longitudinal water penetration • outer sheath is flame retardant and UV resistant • the marking and the metric overprint are printed on the outer sheath • cable markings can be tailored to customer's requirements

CHARACTERISTICS cont.:	
Applica€on	• for laying on the ground or underground in mines • for hanging – horizontally or ver€cally in pit sha€s
Temperature ranges	• transport and storage: -40 °C – +70 °C • installa€on: -15 °C – +60 °C • opera€on: -40 °C – +70 °C

PARAMETERS:

YOTKGtsFoyn

Fibre count in cable	Number of elements (tubes/ļ llers)	Fibre count in tube	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Sta€c	Dynamic	Sta€c
4 - 24	6	4	15.2	500	4,000	2,000	300	450
6 - 36	6	6	17.0	600	6,000	2,000	340	500
8 - 48	6	8	17.0	600	6,000	2,000	340	500
12 - 72	6	12	17.0	600	6,000	2,000	340	500

YOTKGtsDFoyn

Fibre count in cable	Number of elements (tubes/ļ llers)	Fibre count in tube	Cable diameter [mm]	Cable weight [kg/km]	Max. pulling force [N]		Min. bending radius [mm]	
					Dynamic	Sta€c	Dynamic	Sta€c
4 - 24	6	4	16.0	520	6,000	2,000	320	480
6 - 36	6	6	17.9	620	8,000	3,000	360	540
8 - 48	6	8	17.9	620	8,000	3,000	360	540
12 - 72	6	12	17.9	620	8,000	3,000	360	540

Packing length: to be agreed, standard – 4 km

Packing: wooden drums

Handling Fibre Optic Cables

GENERAL PRINCIPLES

1. Transport and storage of fibre optic cables

The same rules apply to fibre optic cables as to those for the transportation of copper cables. Cable drums must be secured from slipping during transport to avoid damage. Cable drums should only be transported in an upright standing position – on their flanges. Use fork-lift trucks, trucks with lifting arms or external cranes to remove the drums from the delivery truck. Do not drop cable drums on the ground.

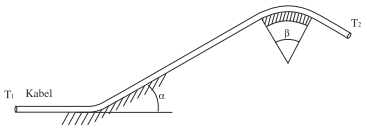
Temperature range for transport and storage – this should be in accordance with the manufacturer's data sheets. Typically these are, for outdoor cables -40 °C to +70 °C; indoor cables -30 °C to +70 °C. Avoid direct exposure to solar radiation, rain and snow. We recommend storing cables indoors on a concrete floor in a secure building. The cable ends must be secured with end caps to prevent moisture penetration.

2. Installation of fibre optic cables

The general principles for handling fibre optic cables during installation are described in Annex C of IEC 60794-1-1 Ed 3. Installation contractors and telecom operators may have their own additional standards and procedures.

3. Installing cables in cable ducts

The cable tensile stress expected during installation should be calculated at the planning stage. The tensile stresses (T) acting on a cable during installation are determined by the following formulas and are dependent on the cable route:



– a straight route $T_2 = \mu L W g + T_1$
– a route with a slope α $T_2 = L W g (\sin\alpha + \mu \cos\alpha) + T_1$
– a route with a twist β $T_2 = T_1 e^{\mu\beta}$

where:

$T_{(n)}$ – tensile stress at the end (2)/beginning (1) of a section
L – length in metres
μ – coefficient of friction between the cable and the duct
W – cable weight in kg/m
α – angle in radians („+" upwards, „-" downwards) (α = 0° for a horizontal route, α = 90° for a vertical route)
β – a twist angle in radians (in the horizontal plane)
g – acceleration of gravity (9.81 m/s²)

During the first installation of a fibre optic cable, the maximum tensile force stated on the data sheet should never be exceeded. If the estimated value of tensile force during installation in any section of a cable duct exceeds the limit, the method of cable installation should be changed (e.g. use blowing). The tensile force should be monitored during the installation of the cable, and if possible – recorded. The tensile stress exerted on the cable should be released after installation. Do not leave the fibre optic cable under permanent long-lasting tensile stress. Aerial suspension cables however are specially adapted to remain under tensile stress after installation.

The minimum bending radius stated on the cable data sheet should never be exceeded.

Adhering to these guidelines will ensure that the optical fibres remain undamaged and the cable will provide long-term performance and reliability.

NOTES

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