

## Technical description For a duct cable Containing enhanced standard single mode fibers

Our proposed offer is in full compliance with ITU-T G.652D and annexes.  
The offered cable is fully compliant to the relevant IEC specifications, especially IEC 60793-1,2, IEC 60794-3.

A technical comment is prepared for optical fiber cables having the following characteristics:

### Cable design:

- 12, 24, 36, 48, 60, 72, 96, 144, 192 SMF 28-e™ -fibers with reduced OH- peak.
- Operating wavelength at 1310 nm and 1550 nm.
- Non metallic strength and anti-buckling element.
- Loose buffer tubes SZ-stranded.
- Dry cable core by swellable elements.
- Outer PE-jacket.
- Suitable as: fully dielectric duct cable.

<b>Cable type:</b>	A-DQ(ZN)2Y	2x6 E9/125 0.36F3.5 + 0.22H18 LG
	A-DQ(ZN)2Y	4x6 E9/125 0.36F3.5 + 0.22H18 LG
	A-DQ(ZN)2Y	3x12 E9/125 0.36F3.5 + 0.22H18 LG
	A-DQ(ZN)2Y	4x12 E9/125 0.36F3.5 + 0.22H18 LG
	A-DQ(ZN)2Y	5x12 E9/125 0.36F3.5 + 0.22H18 LG
	A-DQ(ZN)2Y	6x12 E9/125 0.36F3.5 + 0.22H18 LG
	A-DQ(ZN)2Y	8x12 E9/125 0.36F3.5 + 0.22H18 LG
	A-DQ(ZN)2Y	12x12 E9/125 0.36F3.5 + 0.22H18 LG
	A-DQ(ZN)2Y	16x12 E9/125 0.36F3.5 + 0.22H18 LG



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## Optical and mechanical characteristics of an enhanced single mode fiber SMF 28e™ - low water peak fiber -

Mode field diameter (1310 nm):	9.2 $\mu\text{m} \pm 0.4 \mu\text{m}$
Mode field diameter (1550 nm):	10.4 $\mu\text{m} \pm 0.8 \mu\text{m}$
Cladding diameter:	125 $\mu\text{m} \pm 0.7 \mu\text{m}$
Mode field concentricity error:	$\leq 0.5 \mu\text{m}$
Cladding non circularity:	$\leq 1 \%$
Refractive index profile:	step
Design:	matched cladding
Effective group index of refraction $N_{\text{eff}}$ (at 1310nm):	1.4677
Effective group index of refraction $N_{\text{eff}}$ (at 1550nm):	1.4682
Cut off wavelength of cabled fiber:	$\leq 1260 \text{ nm}$
Coating diameter:	245 $\mu\text{m} \pm 5 \mu\text{m}$
Attenuation at 1310 nm *):	$\leq 0.36 \text{ dB/km}$
Attenuation at 1383 nm (OH-peak):	$\leq 0.36 \text{ dB/km}$
Attenuation at 1550 nm *):	$\leq 0.22 \text{ dB/km}$
Dispersion in the range 1288 to 1339 nm:	$\leq 3.5 \text{ ps/nm} \times \text{km}$
Dispersion at 1550 nm:	$\leq 18 \text{ ps/nm} \times \text{km}$

\*) measured values

### Core material

The core of the optical fiber, with a higher refractive index compared to the cladding, is made of SiO<sub>2</sub> (Silicon dioxide) doped with GeO<sub>2</sub> (Germanium dioxide).

### Cladding material

The cladding of the optical fiber is made of SiO<sub>2</sub> (Silicon dioxide).

### Type of primary coating

The primary coating is made of an UV-curable acrylate. It is applied in two layers, each of a different Young's modulus. The inner layer is somewhat softer than the outer one.

This make-up protects the fiber against microbending losses and against abrasion.

<b>Fiber colour coding:</b>	fiber-# 1 : red	fiber-# 7 : grey
	fiber-# 2 : green	fiber-# 8 : violet
	fiber-# 3 : yellow	fiber-# 9 : black
	fiber-# 4 : blue	fiber-# 10 : orange
	fiber-# 5 : brown	fiber-# 11 : turquoise
	fiber-# 6 : white	fiber-# 12 : pink

### Dimension of primary coating

The dimension of the primary coating is 245  $\mu\text{m} \pm 5 \mu\text{m}$ .



## Mechanical characteristics of the primary coating

The primary coating is easily strippable by means of a mechanical stripping tool. No chemicals are required.

## Mechanical characteristics of fiber

Proof test stress: 8 N for 1 second ; strain: 1 %. Breaking strength of fiber at least: 150 N/mm<sup>2</sup>.

## Loose buffer tube technique

In the loose buffer tube technique the primary coated fiber is accommodated in a secondary coating, called buffer tube. The buffer may contain one or more fibers, which are loosely laying in the tube. The tube is filled with a non-hygroscopic, non-nutritive fungus, electrically non-conductive, homogenous gel in order to prevent water penetration and migration. The gel will be free from dirt and foreign matter and is easily removable with conventional non-toxic solvents.

The loose buffer technique is also coping best to temperature induced contractions or dilatations of the cable. The structure also provides good protection against transverse compression.

As a result the whole cable construction is, within a wide range, insensitive to external influences.

## Reverse lay (SZ) stranding

The elements (loose buffer tubes and if necessary filling elements) are stranded around a central member according to the reverse lay method, which means, that the direction of stranding reverses after a predetermined number of revolutions. At the reverse point the elements are laying parallel to the axis of the cable.

A binder is wound around the elements in order to retain them in the proper position.

## Cable core

Around a dielectric central member made of fiber reinforced plastic, buffer tubes and filling elements are stranded to form the core of the cable. The central member serving mainly as anti-buckling element will be coated with a PE-jacket, if this is required to obtain the correct stranding radius. The buffer tubes contain up to 12 fibers.

<b>Colour coding:</b> up to 144 fibers	buffer tube-# 1 : red	buffer tube-# 7 : grey
	buffer tube-# 2 : green	buffer tube-# 8 : violet
	buffer tube-# 3 : yellow	buffer tube-# 9 : black
	buffer tube-# 4 : blue	buffer tube-# 10 : orange
	buffer tube-# 5 : brown	buffer tube-# 11 : turquoise
	buffer tube-# 6 : white	buffer tube-# 12 : pink



**Colour coding:**  
1<sup>st</sup> layer, 192 fibers

buffer tube-# 1 : red  
buffer tube-# 2 : green  
buffer tube-# 3 : yellow

buffer tube-# 4 : blue  
filler  
filler

**Colour coding:**  
2<sup>nd</sup> layer, 192 fibers

buffer tube-# 1 : red  
buffer tube-# 2 : green  
buffer tube-# 3 : yellow  
buffer tube-# 4 : blue  
buffer tube-# 5 : brown  
buffer tube-# 6 : white

buffer tube-# 7 : grey  
buffer tube-# 8 : violet  
buffer tube-# 9 : black  
buffer tube-# 10 : orange  
buffer tube-# 11 : turquoise  
buffer tube-# 12 : pink

Due to stranding of the buffers an overlength of about 0.3 to 0.5 % is produced. (The overlength depends on stranding radius, tube diameter and lay length).

That means, if a tensile force is applied to the cable and hence to the core, an elongation in a wide range will not result in fiber-strain and no attenuation increase is observed.

### **Cable make up**

Waterswellable elements are placed over the cable core in order to block any possible water ingress.

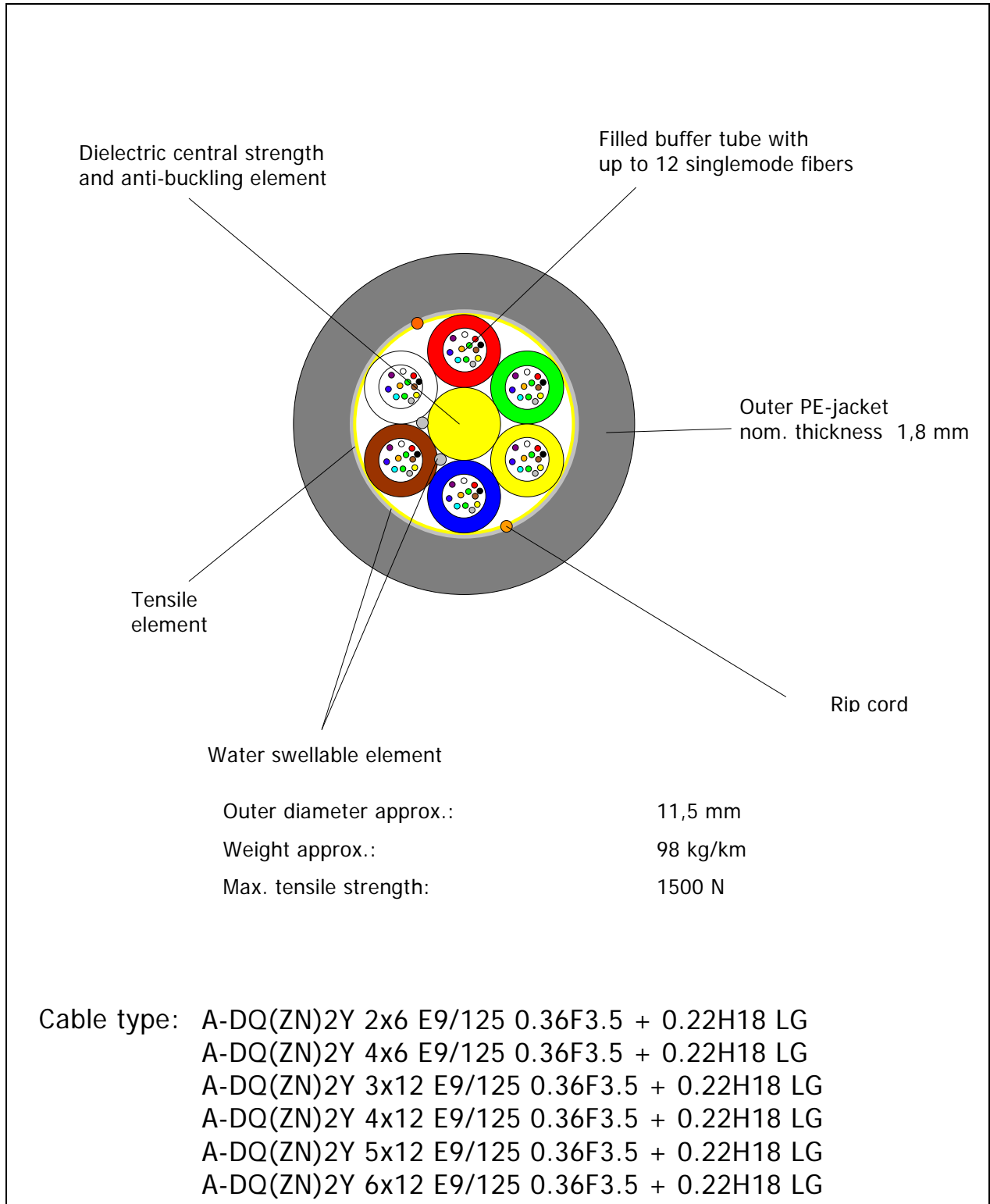
Finally an outer PE-jacket is extruded. The polymer shall contain carbon black for ultraviolet light protection and shall not promote the growth of fungus and shall be free of holes, splits and blisters.

**Technical characteristics:**

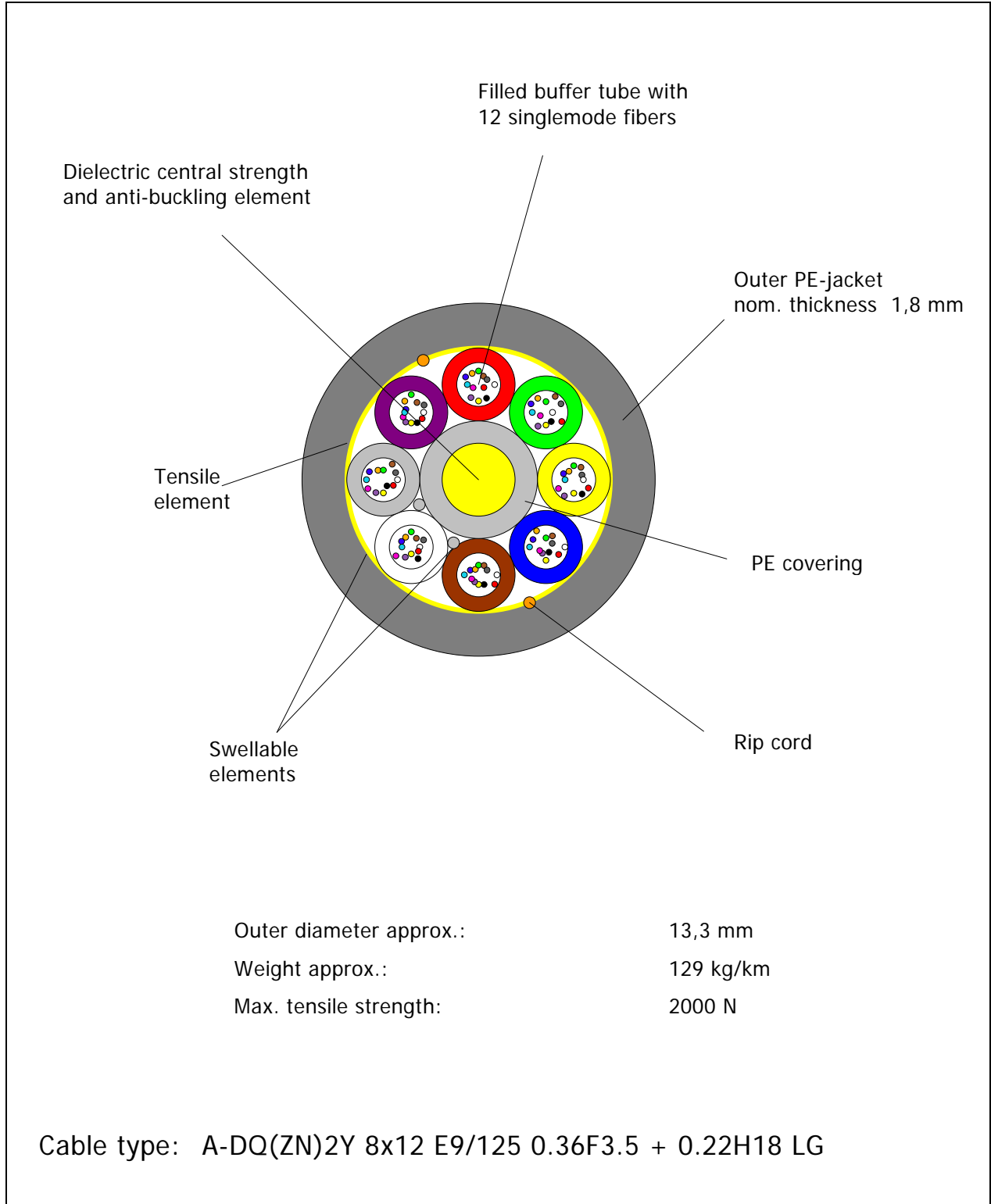
<b>Cable type : A-DQ(ZN)2Y fiber count</b>		12, 24, 36, 48, 60, 72	96
Diameter (D) approx.	[mm]	11,5	13,3
Weight approx.	[kg/km]	98	129
Min. bending radius			
- during installation	[mm]	230	265
- installed	[mm]	170	200
Tensile strength			
- short term (during installation),	[N]	1500	2000
- long term (installed)	[N]	900	1100
Compressive stress/crush	[N/10cm]	2500	2500
(Attenuation increase fully reversible)			
Impact resistance (E= 30 Nm, r = 300 mm)	[impacts]	1	1
(Attenuation increase fully reversible)			
Operating temperature range	[°C]	-30...+70	-30...+70
Installation temperature range	[°C]	-5...+50	-5...+50

<b>Cable type : A-DQ(ZN)2Y fiber count</b>		144	192
Diameter (D) approx.	[mm]	17.0	17.2
Weight approx.	[kg/km]	213	207
Min. bending radius			
- during installation	[mm]	340	350
- installed	[mm]	255	265
Tensile strength			
- short term (during installation),	[N]	3300	3300
- long term (installed)	[N]	1200	1200
Compressive stress/crush	[N/10cm]	2500	2500
(Attenuation increase fully reversible)			
Impact resistance (E= 30 Nm, r = 300 mm)	[impacts]	1	1
(Attenuation increase fully reversible)			
Operating temperature range	[°C]	-30...+70	-30...+70
Installation temperature range	[°C]	-5...+50	-5...+50

### Cable Cross-section

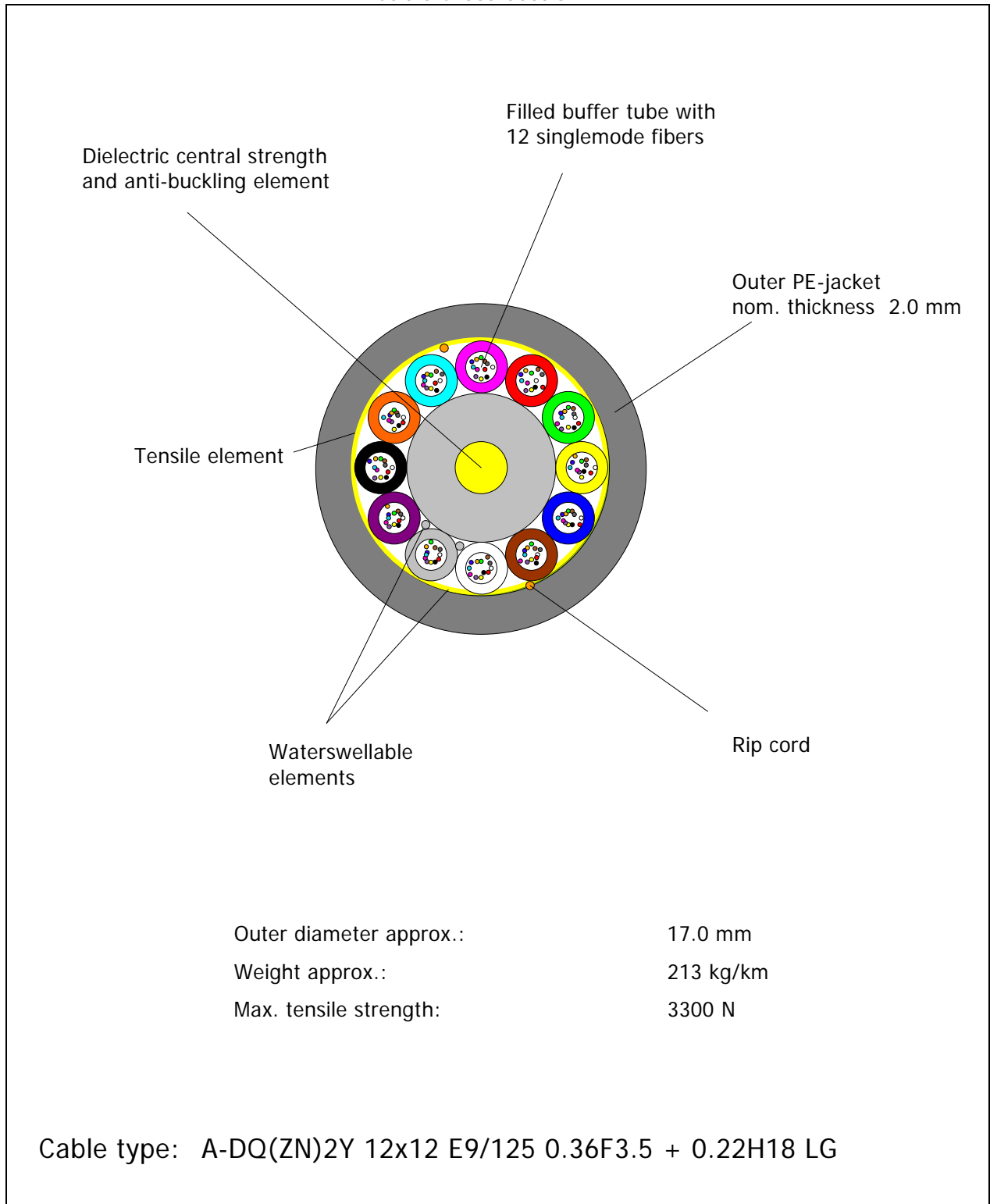


### Cable Cross-section





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## Cable Cross-section

