

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.
- Non metallic strength members over the core.
- Outer PE-jacket.
- Suitable as: fully dielectric duct cable.

Cable type:	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_{eff} (at 1310nm):	1.4677
Effective group index of refraction N_{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 SiO₂ (Silicon dioxide) doped with GeO₂ (Germanium dioxide).

Cladding material

The cladding of the optical fiber is made of SiO₂ (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.

Fiber colour coding:	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/mm².

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.

Colour coding: 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:
1st layer, 192 fibers

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

buffer tube-# 4 : blue
filler
filler

Colour coding:
2nd 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. Around the cable core aramid yarns will be wrapped to provide the required tensile strength.

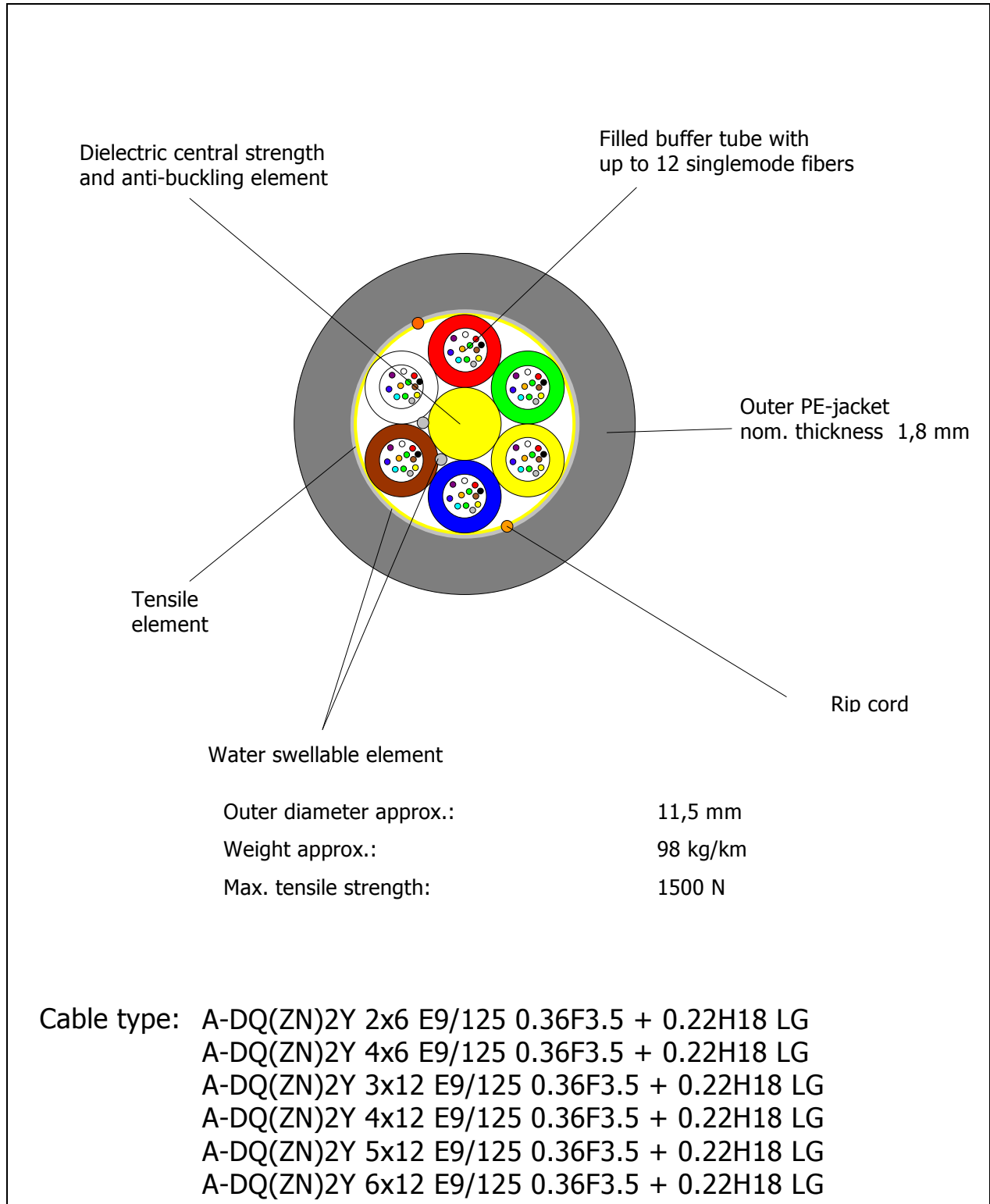
Finally an outer PE-jacket is extruded. The polymer shall contain carbon black for ultraviolet light protection and shall not promote the growth of fungus and shall be free of holes, splits and blisters.

Technical characteristics:

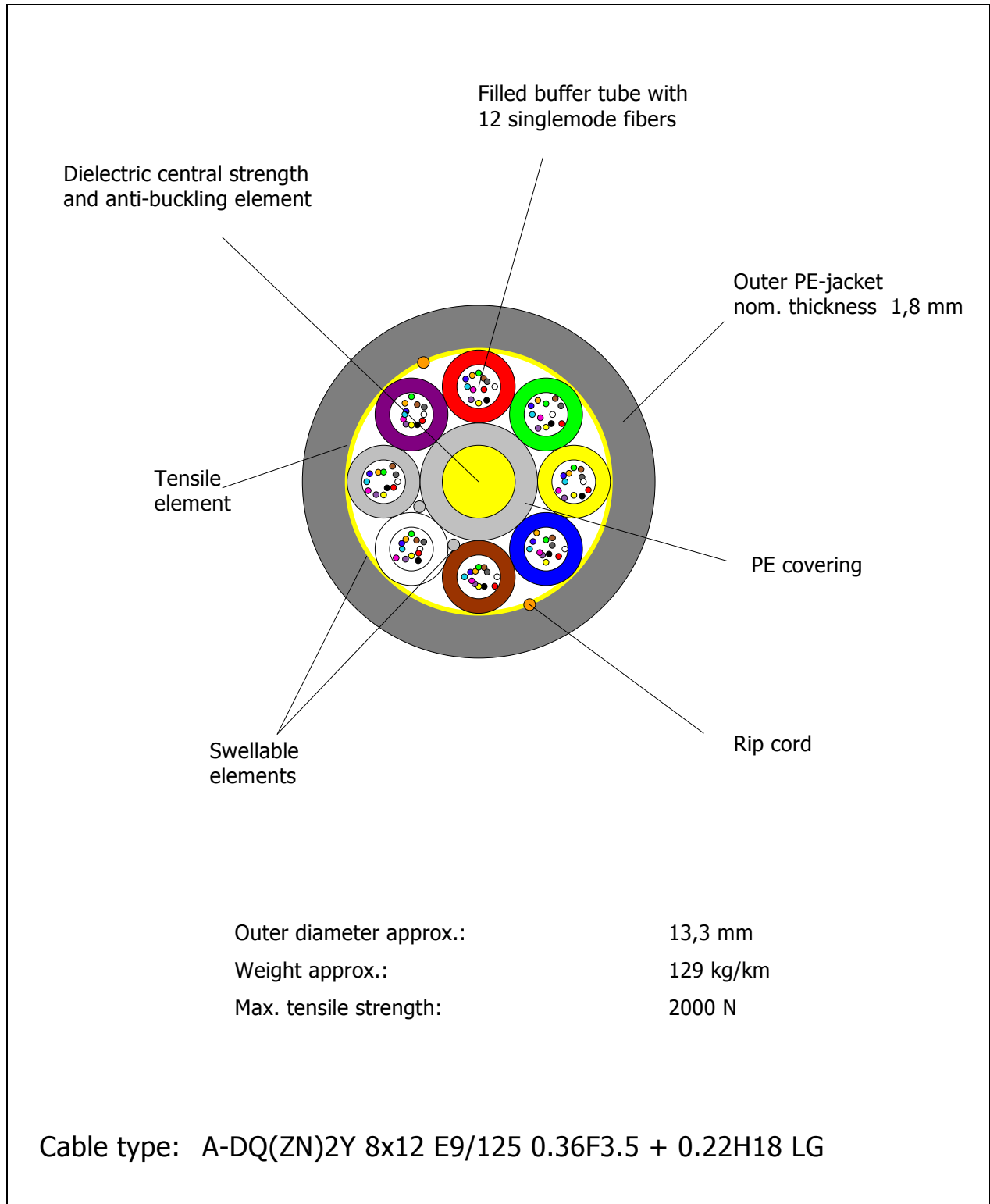
Cable type : A-DQ(ZN)2Y fiber count		12, 24, 36, 48, 60, 72	96
Diameter (D) approx.	[mm]	11,5	13,3
Weight approx.	[kg/km]	98	129
Min. bending radius			
- during installation	[mm]	230	265
- installed	[mm]	170	200
Tensile strength			
- short term (during installation),	[N]	1500	2000
- long term (installed)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

Cable type : A-DQ(ZN)2Y fiber count		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 (Attenuation increase fully reversible)	[N/10cm]	2500	2500
Impact resistance (E= 30 Nm, r = 300 mm) (Attenuation increase fully reversible)	[impacts]	1	1
Operating temperature range	[°C]	-30...+70	-30...+70
Installation temperature range	[°C]	-5...+50	-5...+50

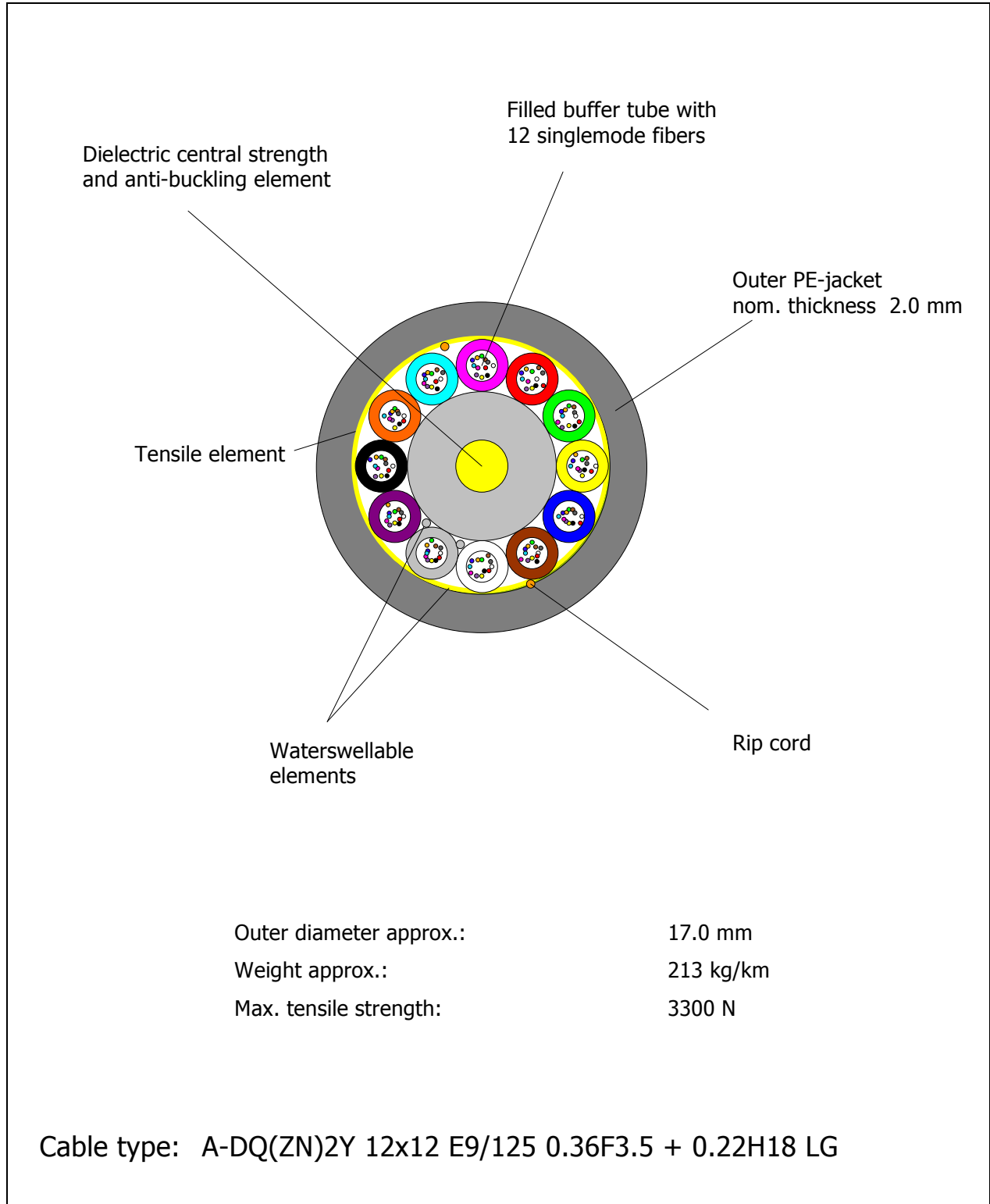
Cable Cross-section



Cable Cross-section



Cable Cross-section



Cable Cross-section

