



OPGW

OPTICAL GROUND WIRE

OPGW

Application



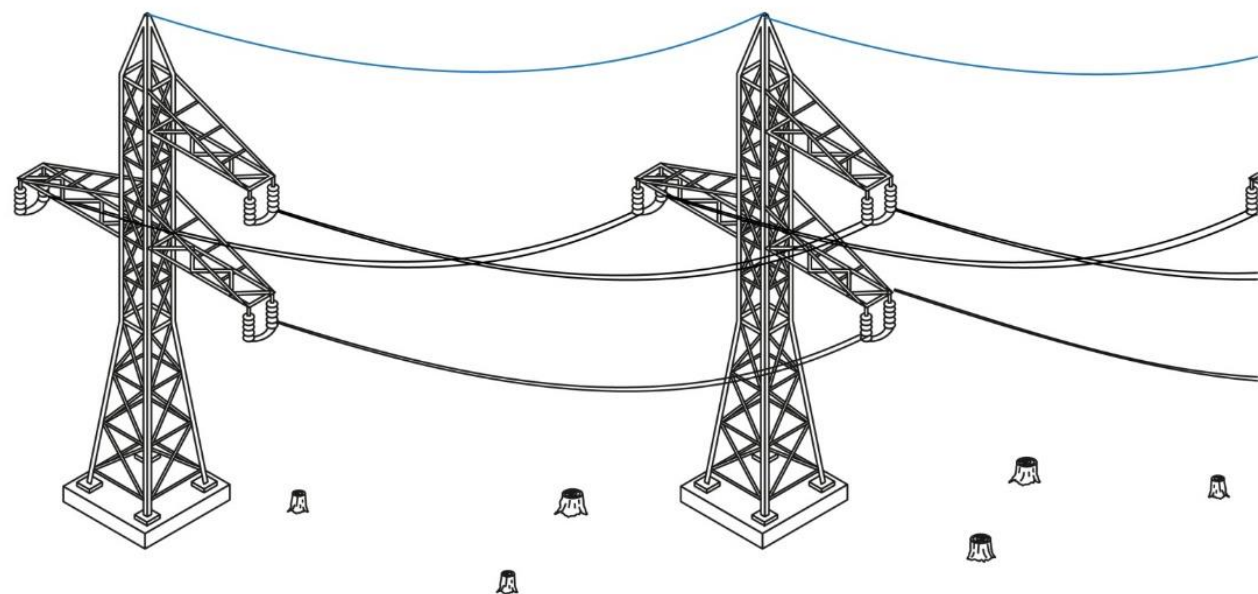
Protection of power lines from lightning overvoltage



Construction of optical communication systems



Two products in one



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Advantages



OPGW is the main construction method of communication lines on 69 kV power lines and above



No extra costs connected with installation on the power lines



No additional load on the power towers

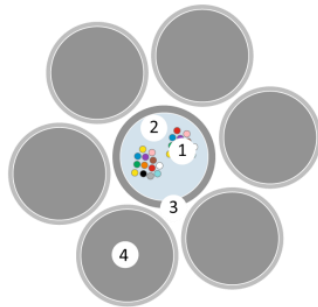


80% of present-day power towers carry ground wires with built-in optical tubes instead of conventional steel wires

MAIN TYPES

Center Tube Designs

a.

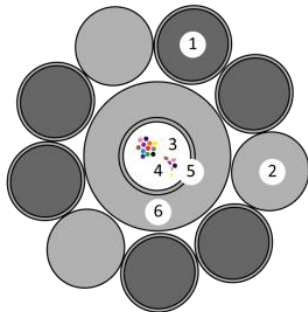


OPGW C

CONSTRUCTION:

1. Optical fiber
2. Stainless steel tube filled with water-blocking gel
3. Stranded wires (Aluminum-clad Steel wires and/or aluminum alloy wires)
4. Stranded wires (Aluminum-clad Steel wires and/or aluminum alloy wires)

b.

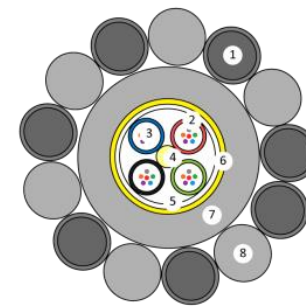


OPGW CA

CONSTRUCTION:

1. Aluminum-Clad Steel Wire 20SA
2. Aluminum alloy wire
3. Water-blocking gel
4. Optical fiber Corning SMF-28 Ultra
5. Stainless Steel Loose Tube (SSLT)
6. Aluminum jacket

Aluminum Pipe Design

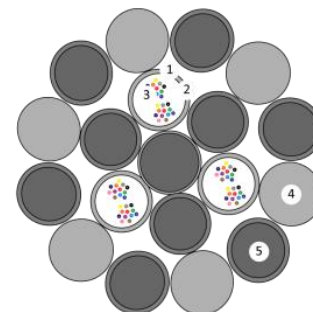


OPGW AP

CONSTRUCTION:

1. Aluminum-Clad Steel Wire 20SA
2. Gel filled loose tube
3. Optical fiber Corning SMF-28 Ultra
4. Central strength member FRP
5. Water swellable tape
6. Thermal barrier
7. Aluminum pipe
8. Aluminum alloy wire

Stranded Design



OPGW S

CONSTRUCTION:

1. Stainless Steel Loose Tube (SSLT)
2. Water-blocking gel
3. Optical fiber Corning SMF-28 Ultra
4. Aluminum alloy wire
5. Aluminum-Clad Steel Wire 20SA

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Center tube design

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Features

- Small size
- Low materials consumption
- Up to 48 fibers
- Stainless steel tube provides superior protection of optical fiber



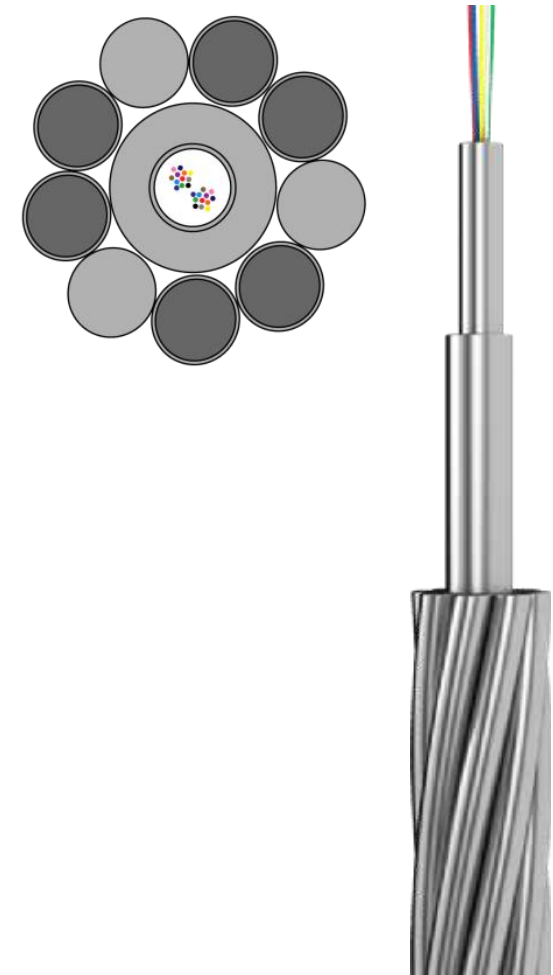
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Center tube design

OPGW CA

Features

- Additional defense due to lay of aluminum on loose tube
- Increased short circuit current capacity
- Up to 48 fibers
- Increased chemical resistance
- Increased crush resistance



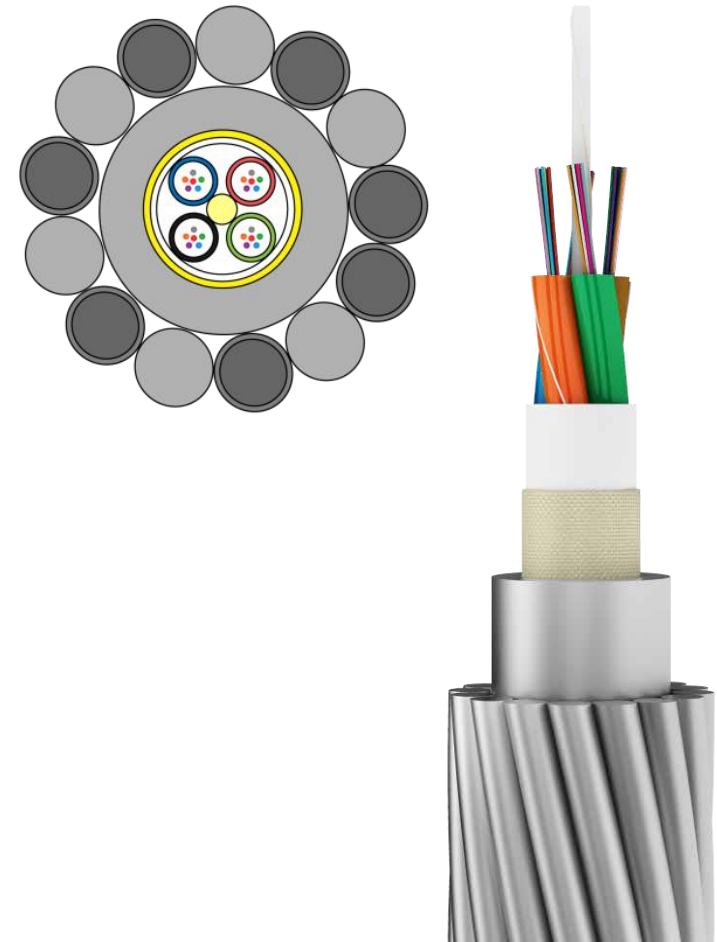
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Aluminum pipe design

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Features

- Old type of OPGW: core as classic optical cable structure in aluminum pipe
- Increased short circuit current capacity
- Up to 96 fibers
- Increased chemical resistance



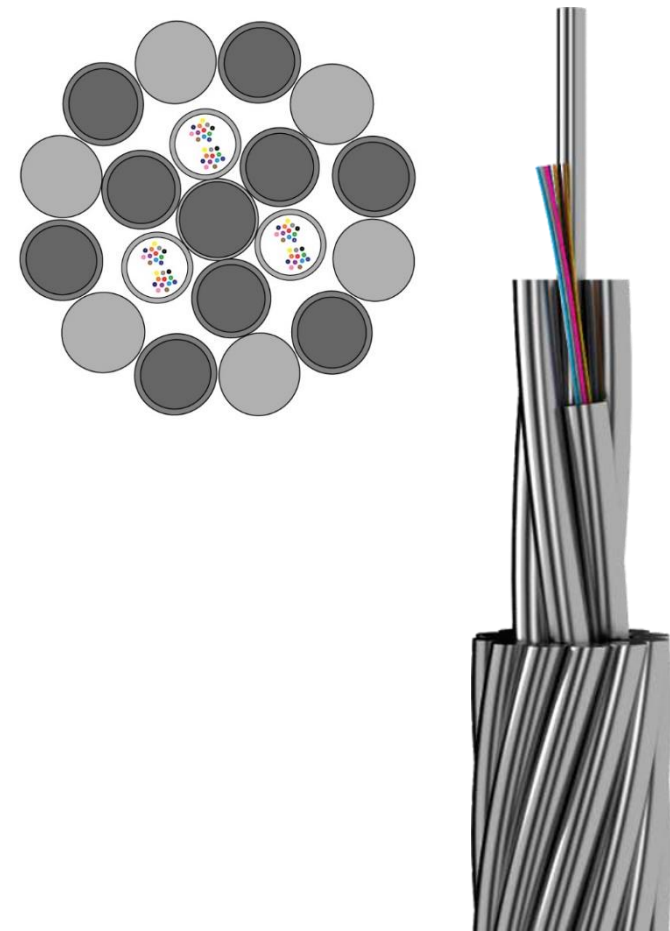
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Fully stranded design

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Features

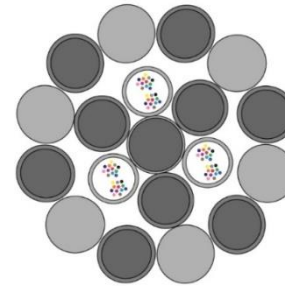
- Additional optic fiber exceed
- Increased allowable tensile strength
- Up to 288 fibers



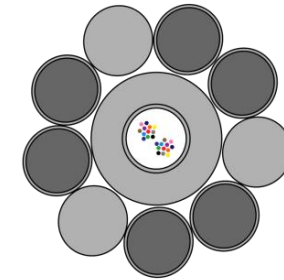
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OPGW C



OPGW S



OPGW CA

Number of optical fibers

Up to 48

Up to 288 and more

Up to 48

Main application

Low requirements to electrical and mechanical characteristics

Required in small cables designs with low weight

High requirements to mechanical characteristics

High requirements to electrical characteristics

Seashore and other areas with high chemical activity

Features

Outer diameter from 8 mm

Weight from 200 kg/km

Allowable tensile strength 20% higher.

Loose tubes stranded, that creates additional exceed of optical fibers

Number of fibers more than 48

Crush resistance 50% higher

The best corrosion resistance

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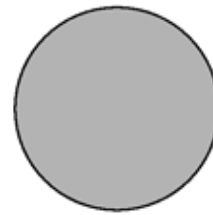
Combination of materials



Aluminum clad steel wire

Provides mechanical parameters of OPGW

- High RTS
- High elasticity modulus



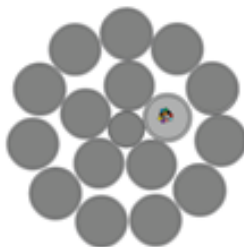
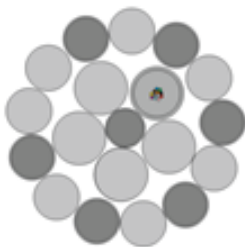
Aluminum alloy wire

Provides improved electrical parameters

- Low electrical resistance
- High short circuit current capacity

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Materials combination helps us to develop OPGW design with optimal parameters for each project

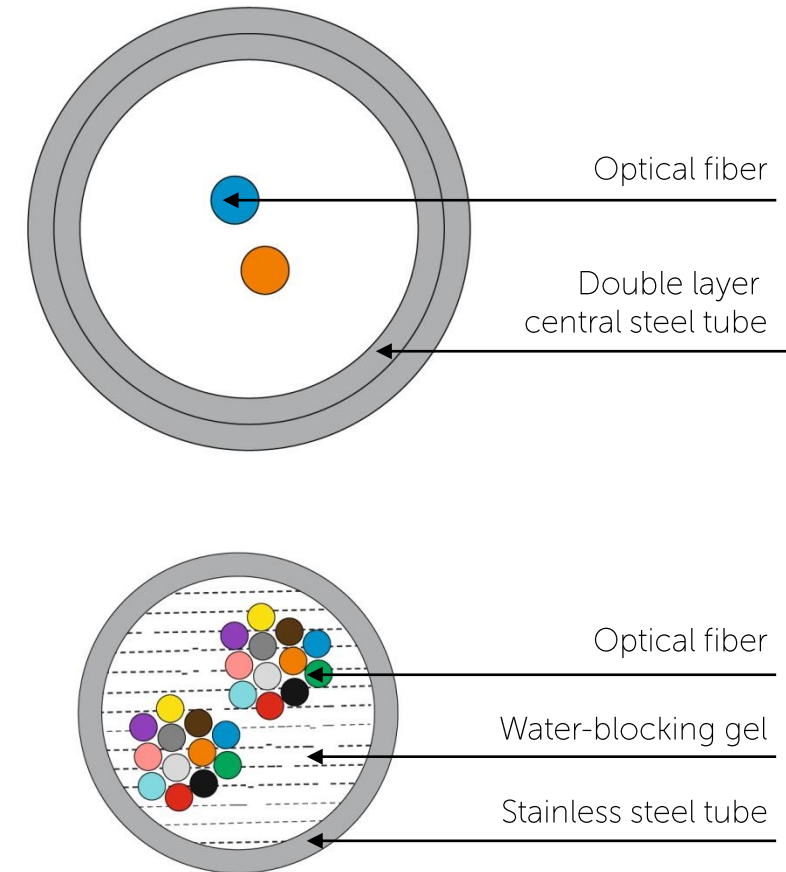


	OPGW-S-24 G.652D-13.1MM-80kA2s-56kN	OPGW-S-24 G.652D-13.1mm-45kA2s-120kN	Difference
Outer diameter, mm	13.1	13.1	0%
RTS, kN	56	120	+144%
Short circuit current capacity, kA2s	80	45	-44%
Weight, kg/km	390	640	+64%

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Stainless steel tube

- Thickness from 0,15 to 0,4 mm
- Special stainless steel
- Up to 96 fibers
- Outer diameter from 1,1 mm to 6,4 mm
- Special thixotropic gel with hydrogen scavenge effect inside
- Special cables can consist several layers of SST





CORNING

G.652

SMF-28 ULTRA 200 ← SMF-28 ULTRA → SMF-28 ULL

↑
SMF-28e+LL

↓
SMF-28e+

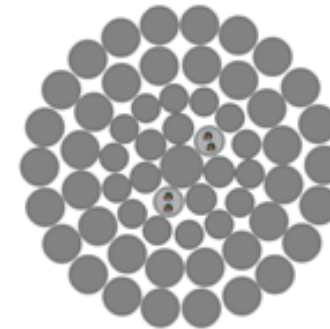
↓
SMF-28e

↓
SMF-28



TECHNOLOGICAL POSSIBILITIES

- Outer diameter up to 30 mm
- Short circuit current capacity up to 3000 kA²s (current 55 kA per 1 second)
- RTS up to 700 kN
- Number of optical fiber more than 288



Example of special cable design for big span above the river

MECHANICAL PARAMETERS

Installation tension



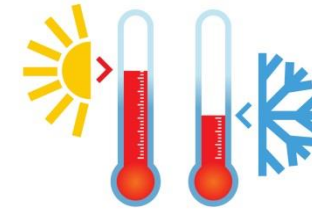
Ice



Wind



Temperature difference

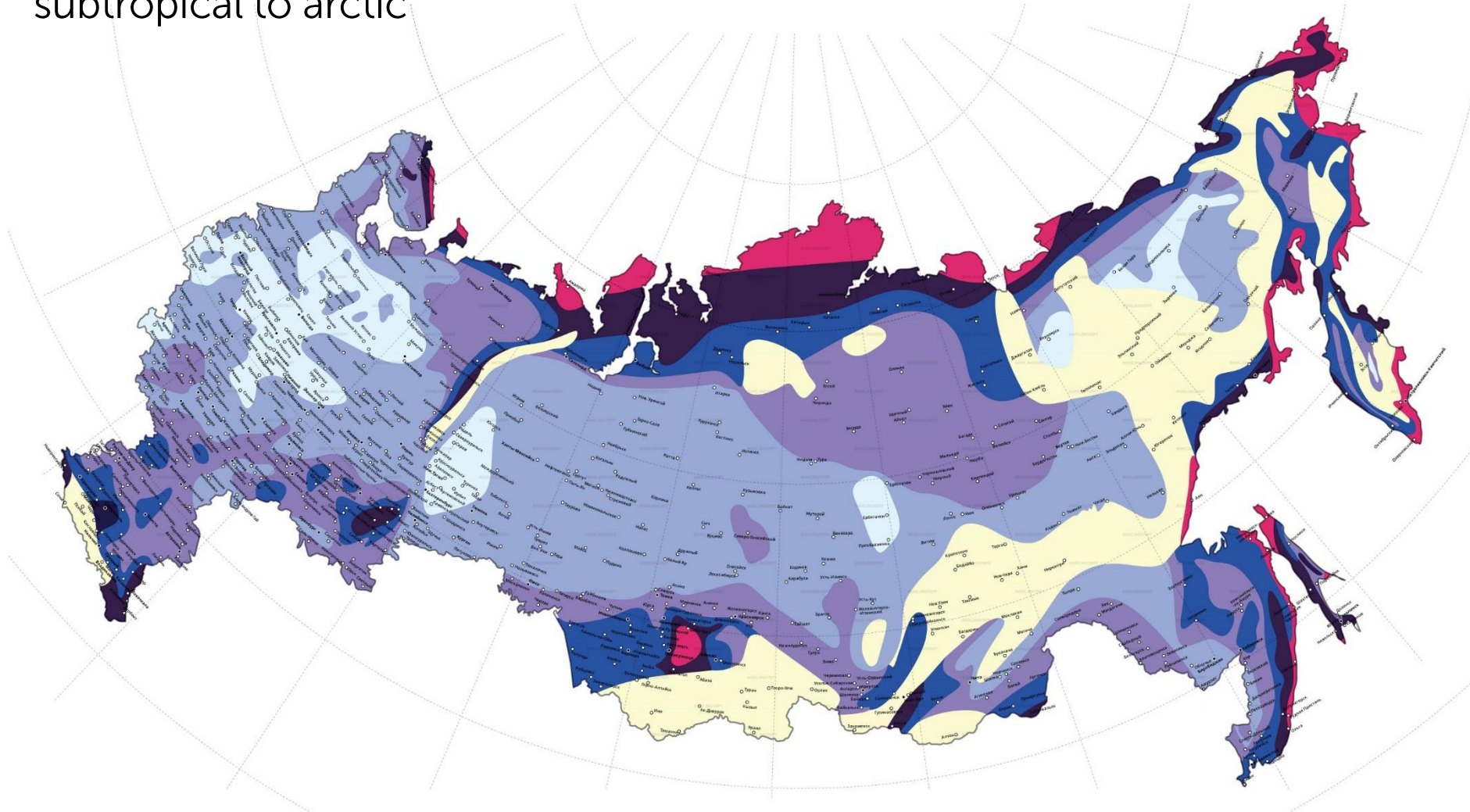


Work tension in every weather mode must be less than MAT.
Sag must be less than allowable value



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Incab OPGW works in the most harsh climatic conditions from subtropical to arctic



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Extreme low
temperature
and big
thermocline
($\Delta \approx 90^\circ\text{C}$)



OPGW

Extreme
ice load



OPGW

Extreme
wind load

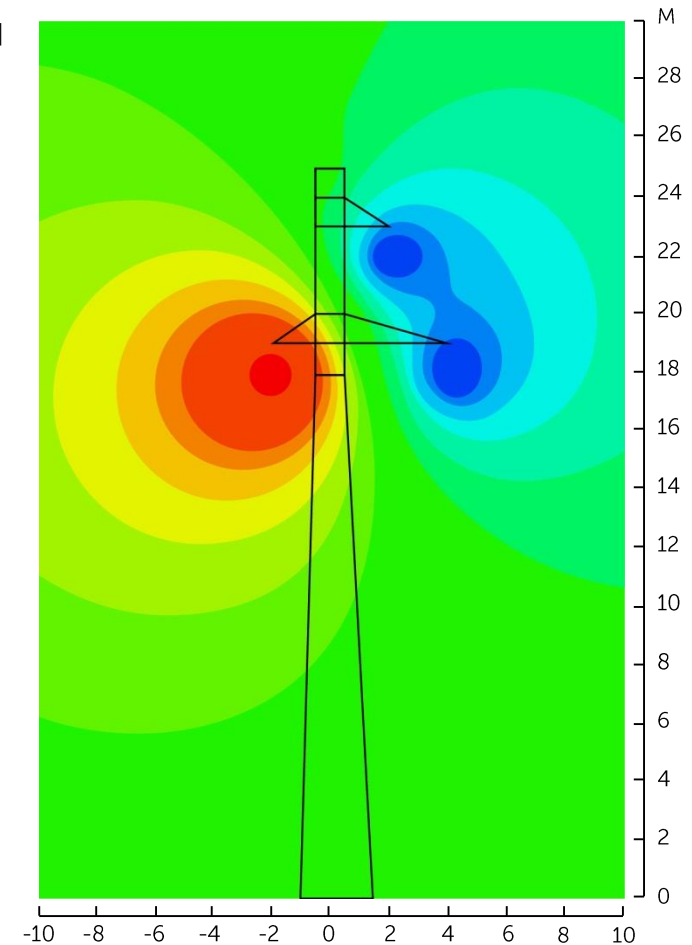
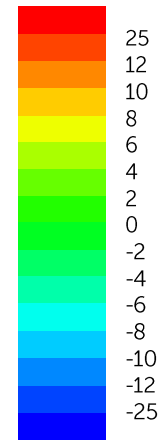


OPGW HAS NOT LIMIT INDUCED ELECTRIC POTENTIAL



ADSS damaged by electric field

Voltage [kV]



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Short circuit current capacity

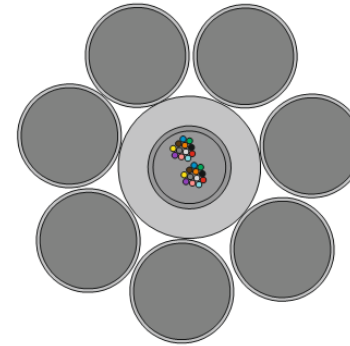
Short circuit from conductors to ground



Thermal influence on OPGW depends on current value and shutdown time of power line



Maximum
temperature
200 °C



Al / St

Short circuit current capacity depends on

- OPGW cross section
- Relation of aluminum and steel in cross section

Value of short circuit current capacity means how much current can flow through OPGW during defined time

CORROSION TEST IN SALT MIST CELL AFTER 2000 HOURS



- OPGW-C-A
- OPGW-C
- Galvanized steel wire

OPTICAL PHASE CONDUCTOR



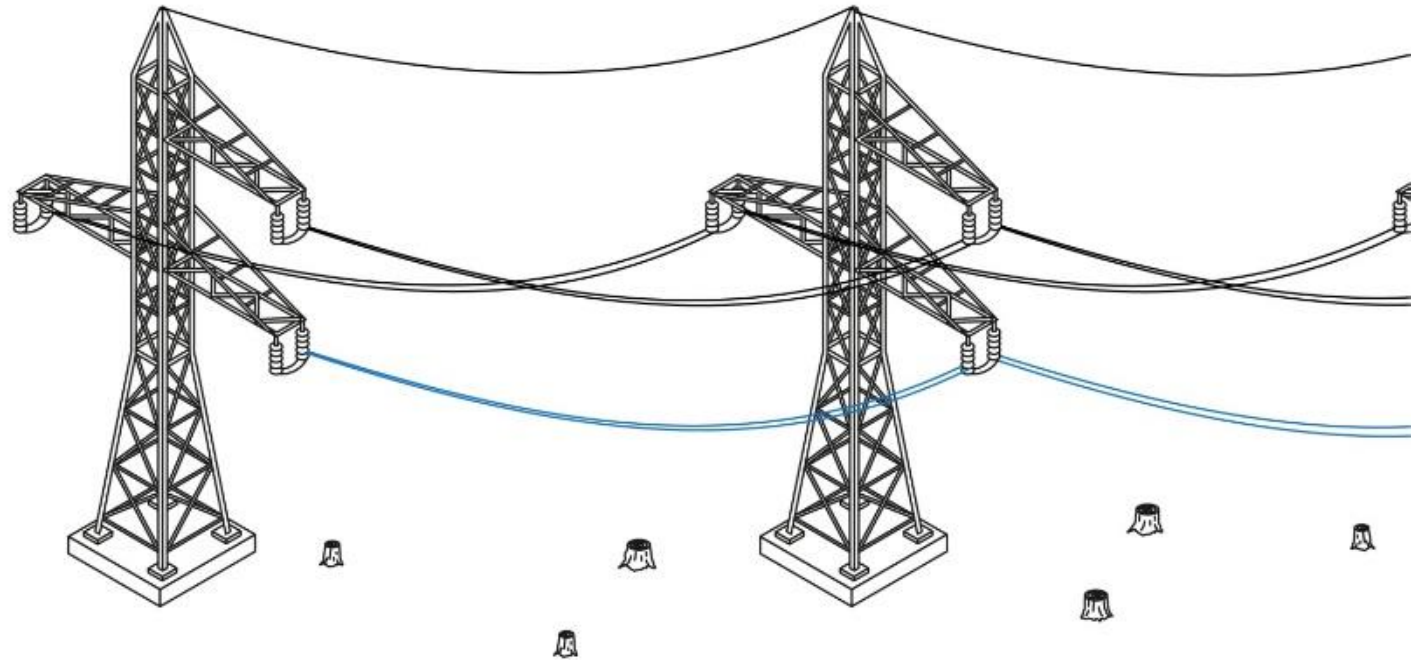
Power transmission



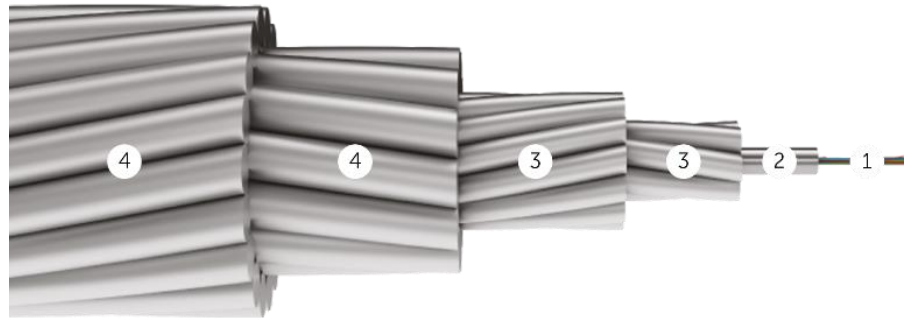
Construction of optical
communication systems



Two products
in one

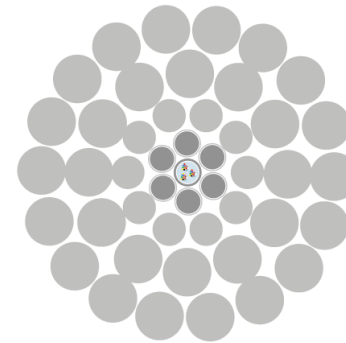


OPTICAL PHASE CONDUCTOR



CABLE DESIGN

1. Optical fiber
2. Stainless steel tube
3. Aluminum-clad steel wire
4. Aluminum alloy wire



FEATURES

- Up to 48 fibers
- Aluminum alloy wire effectively removes heat from a lightning strike point and increases short circuit current resistance
- ACS wires are highly corrosion resistant
- Effective solution to provide redundancy in harsh conditions, such as long cable spans, crossing of cable spans, power lines with previously installed OPGW and ADSS and others

OPGW marking system

Type of optical fiber

G.652D — single-mode with low attenuation and advanced bending rates (G.652D, G.657.A1)
G.655 — single-mode with nonzero dispersion (G.655)
G.651.1 — multi-mode 50/125 μm (G.651.1)
IEC 60793-2-10 — multi-mode 62.5/125 μm (IEC 793-2)

Number of optical fibers in cable

Type of design

S — stranded design
C — central loose tube design
AP — aluminum pipe design

Type of cable

OPGW — optical ground wire

Number of tubes

Not applicable for cables with single tube

Number of optical fibers per tube

Not applicable for cables with single tube

Outer diameter, mm

Short circuit current capacity, kA^2s

Rated breaking strength, kN

OPGW-S — 48 G.652D (2x24) — 13,2 mm — 28 kA^2s — 70kN

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Color identification

Color identification of the fibers into stainless steel tube:

- | | | |
|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| 1.  Blue | 5.  Slate | 9.  Yellow |
| 2.  Orange | 6.  White | 10.  Violet |
| 3.  Green | 7.  Red | 11.  Rose |
| 4.  Brown | 8.  Black | 12.  Aqua |

Other colors upon request.

Yarn color identification:

- | |
|-------------------------------------------------------------------------------------------------------|
| 1.  Blue |
| 2.  Orange |
| 3.  Green |
| 4.  Brown |

Other colors upon request.

Color identification of steel tubes :

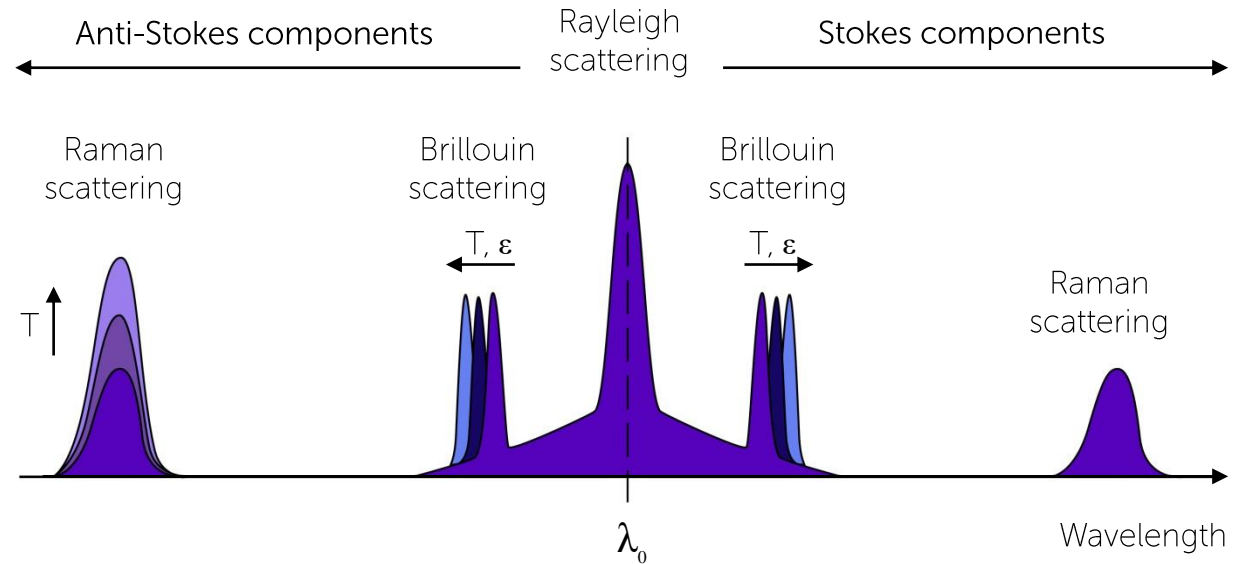
- | |
|------------------------------------------------------------------------------------------------------|
| 1.  Blue |
| 2.  Orange |
| 3.  Green |

Other colors upon request.

OPGW

Fiber optic sensing systems

- Acoustic sensor (works on Rayleigh scattering effect)
- Temperature sensor (works on Raman scattering effect)
- Strain sensor (works on Brillouin scattering effect)





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