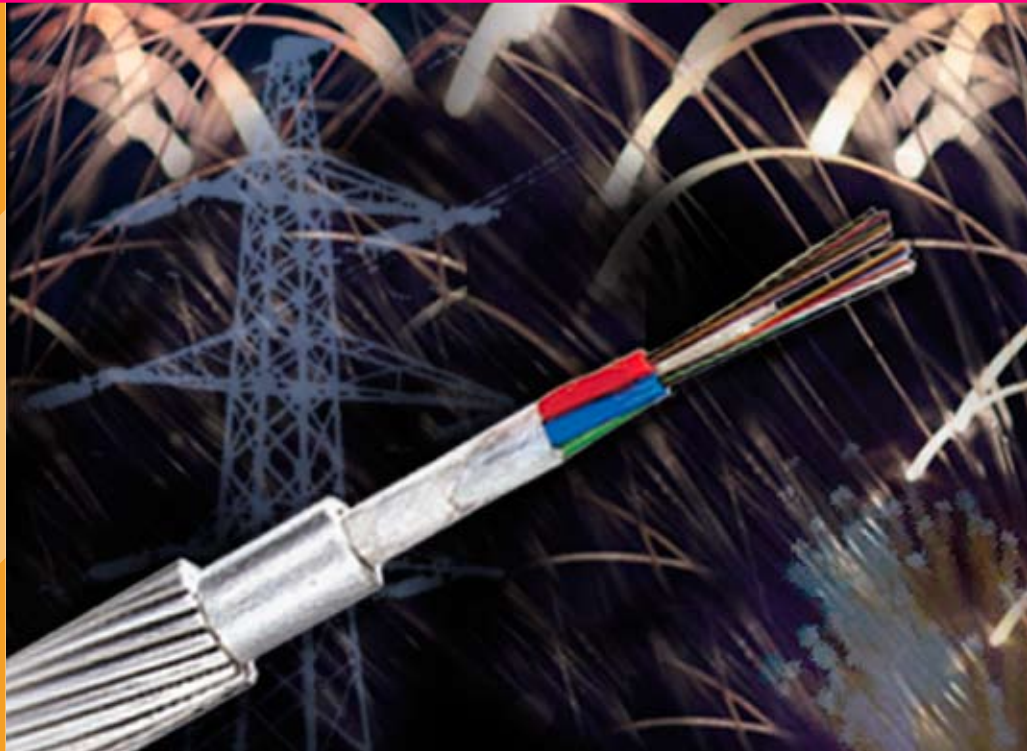




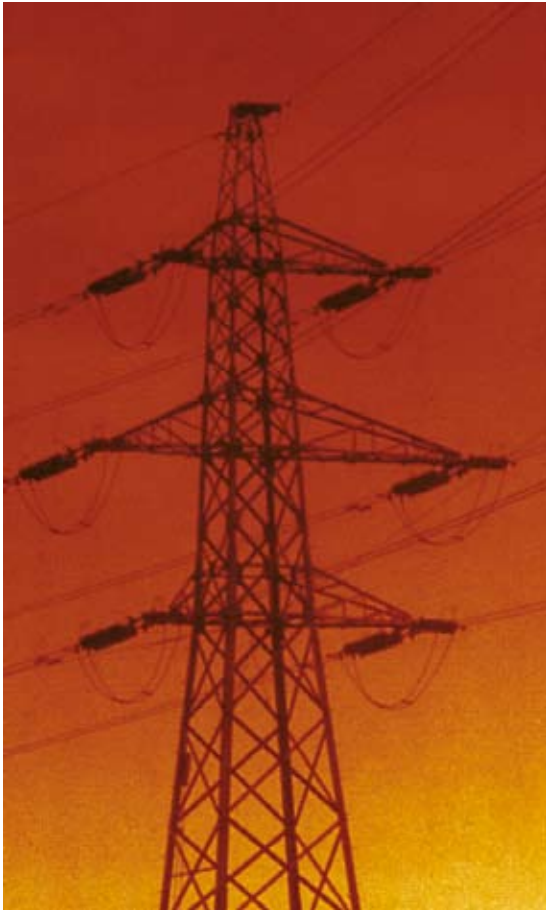
**TELECOM**



# OPGW Cable System

The PRYSMIAN solution for the integration of telecommunications networks on high voltage overhead lines

# Overhead optical fibre cable systems



Overhead optical fibre cable systems have become a key factor in telecommunications networks used by operators and power utilities.

Due to the fact that no civil works are required and the rights of way have already been established, it is possible to minimise costs and, most importantly, the time required to begin network operation.

**Prysmian offers its customers a complete range of overhead optical systems:**

## **OPGW Cable Systems**

Composite optical ground wire system for installation on high voltage electric lines.

## **Self-supporting cable system (ADSS)**

Self-supporting optical cable system for all types of lines: electric lines, overhead distribution lines for railways, etc.

## **Lashed cable system**

Optical cable system lashed to the ground wire or the phase cable on the electric lines.

## **OPPC cable system**

Composite optical phase cable system, for high voltage electric lines up to 135 kV.

# OPGW-PRYSMIAN Cable System, the “never wrong” decision

Customers who choose the Prysmian OPGW system can be sure that their decision will lead to a successful experience during installation and operation. The main advantages of Prysmian OPGW are the following:

## > High reliability and demonstrated experience

High reliability supported by over 110,000 km. of cables installed, with systems in operation since 1983 in more than 70 countries in the five continents.

## > Supply of a full system

Easy to install since Prysmian OPGW includes all components which the system requires from end to end:

- OPGW cables and terminal cables
- Joint boxes, optical distribution frame and connection accessories
- Components for securing the cable to the high voltage towers
- Engineering and installation services, with turn key projects
- Drum lengths up to 10.000 m.

## > Manufacturing capabilities

The OPGW-PRYSMIAN cable is produced at Prysmian’s OPGW Centre of Excellence in Vilanova i la Geltrú (Spain) and also in Sorocaba (Brazil) and Wuxi (China) facilities. With these three factories Prysmian can deliver cable to any part of the world, with very high flexibility and in quantities synchronized to the timing of the project.

## > Aluminium Tube Technology

The extruded aluminium tube technology used by Prysmian in the manufacture of OPGW Composite Optical Ground Cables has demonstrated its high quality and reliability, with fully satisfactory installations in operation for more than 20 years. Furthermore, the ongoing research in new materials and the experience gained ensure the continuous development of our products.

## Prysmian Aluminium Tube OPGW Design

Working conditions	Risk for the optical fibre and cable	Solutions adopted in the Prysmian design
Wind, temperature, ice	Increased attenuation or breakage due to elongation and/or compression.	<ul style="list-style-type: none"> <li>· Loose fibre protection with excellent control of fibre extra length, which allows elongation or compression of the cable without affecting the fibres</li> </ul>
Hydrogen generation in metal structure	Increased attenuation due to hydrogen absorption in the optical fibre.	<ul style="list-style-type: none"> <li>· Core filled with hydrogen-absorbent gel</li> </ul>
Rain and moisture	Increased attenuation due to water penetration in the optical fibre	<ul style="list-style-type: none"> <li>· Intrinsic radial sealing of the extruded aluminium tube.</li> <li>· Optical core protected by sealing gel.</li> </ul>
Line short-circuit Impact of lightning	Increased attenuation and breakage of the wires	<ul style="list-style-type: none"> <li>· Design with high aluminium content.</li> <li>· Selection of AS, AA or GS (*) wires.</li> <li>· Thermal protection of core.</li> <li>· Suitable preforming of wires to prevent cable dismounting if wire breakage occurs.</li> </ul>
Corrosion	Increased attenuation and breakage of the wires	<ul style="list-style-type: none"> <li>· Aluminium tube in contact with AA and AS (*) wires for highly corrosive areas</li> </ul>

(\*) AS= Aluminium clad steel. AA= Aluminium alloy GS= galvanized steel

# Complete solution for the integration of telecommunications



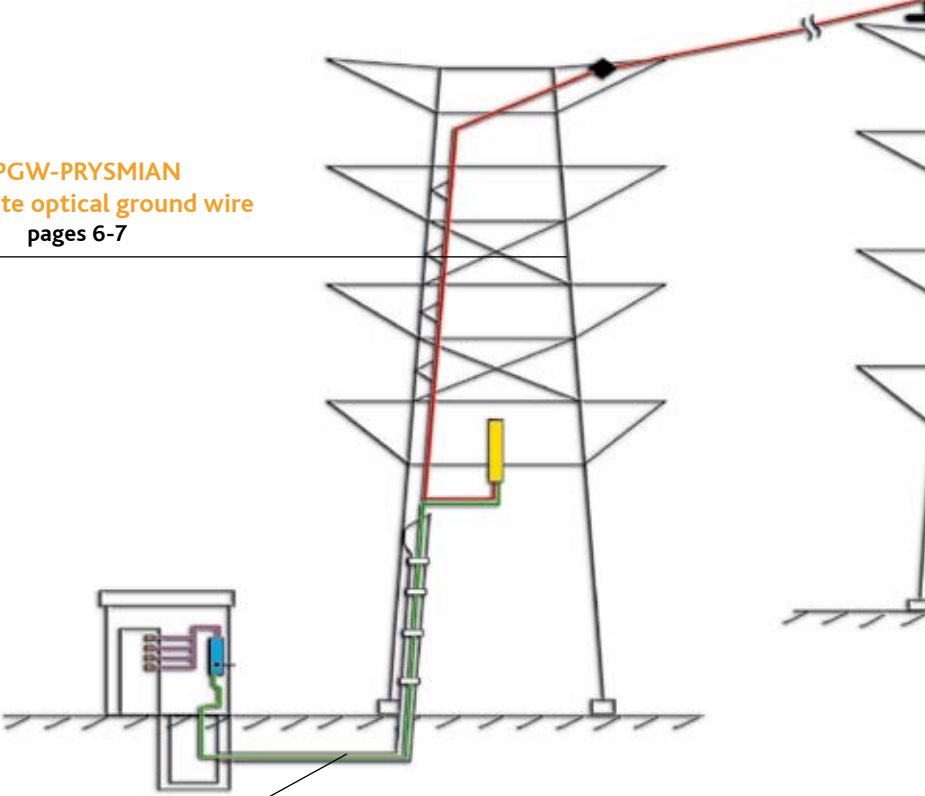
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# networks on high voltage overhead lines



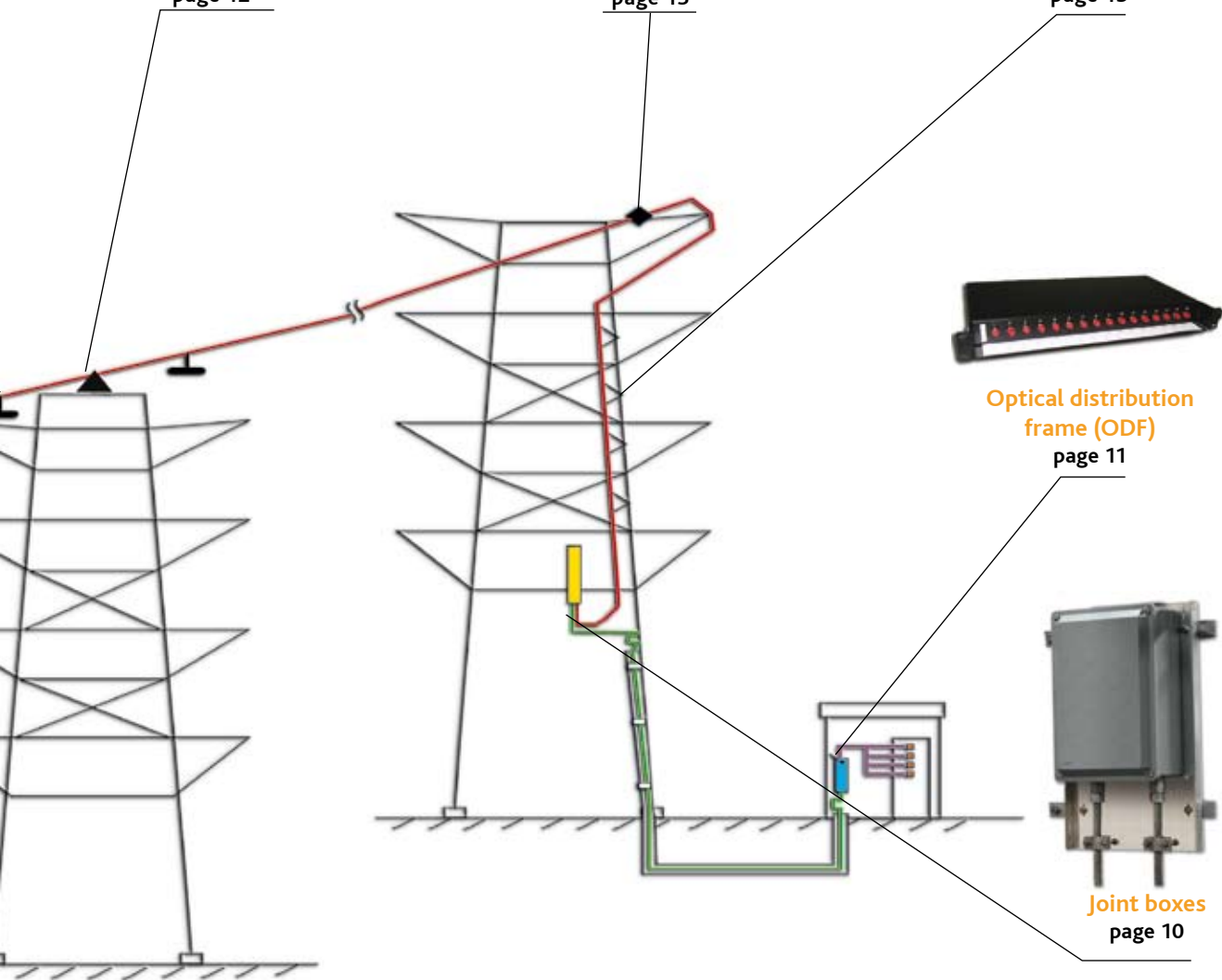
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# PRYSMIAN-OPGW Composite Optical Ground Cables

## Single layer

The PRYSMIAN-OPGW SINGLE LAYER cables are the most widely used cables. Their design is fully adapted to the most common electric line needs. They offer excellent value for money.



### Structure

#### Hydrogen-absorbent optical core:

- > Optical fibres.
- > One or more tubes with loose fibre protection, sealed with moisture-proof gel.
- > Thermal protection tape.

#### Metal protection:

- > Extruded aluminium tube.
- > Armour with choice of three wires
  - aluminium clad steel.
  - aluminium alloy.
  - galvanized steel.

## Product Details

Prysmian Standard	Fibre Count (Max)	Diameter (mm)	Weight (kg/km)	UTS (kN)	Short Circuit (kA2 sec)
OPGW 00A35	12	10,0	349	55	20
OPGW 16A41	12	11,6	412	64	35
OPGW 28C58	16	12,8	580	91	58
OPGW 03A35	24	10,3	347	53	23
OPGW 09A42	24	10,9	416	74	26
OPGW 12A39	24	11,2	386	63	30
OPGW 20B50	24	12,0	500	81	41
OPGW 32E48	24	13,2	475	64	68
OPGW 40H49	24	14,0	490	62	91
OPGW 46J52	24	14,6	523	65	116
OPGW 50J67	24	15,0	670	97	110
OPGW18A48	36	11,8	484	79	36
OPGW 27D50	36	12,7	503	72	67
OPGW 10A32	48	11,0	316	41	29
OPGW 17A47	48	11,7	471	74	35
OPGW 24C43	48	12,4	429	63	44
OPGW 33F44	48	13,3	450	59	77
OPGW 37F61	48	13,7	610	90	83
OPGW 60L70	48	16,0	696	89	151
OPGW 51E67	64	15,1	650	98	76
OPGW 62J72	96	16,2	719	103	138
OPGW 07N97	288	20,8	789	82	198

NOTE: The designs above are only a sampling of the options available from PRYSMIAN. Please contact us for a cable designed to your exact specifications.

# PRYSMIAN-OPGW Composite Optical Ground Cables

## Double layer

The PRYSMIAN-OPGW DOUBLE LAYER cables are used when the requirements of our customers specify a high ultimate load and/or high short-circuit current.

### Structure

#### Hydrogen-absorbent optical core:

- > Optical fibres.
- > Tubes with loose fibre protection, sealed with moisture-proof gel.
- > Thermal protection tape.

#### Metal protection:

- > Extruded aluminium tube.
- > Armour with choice of three wires:
  - aluminium clad steel.
  - aluminium alloy.
  - galvanized steel.
- > Additional armour with choice of three wires:
  - aluminium clad steel.
  - aluminium alloy.
  - galvanized steel.



## Product Details

Prysmian Standard	Fibre Count (Max)	Diameter (mm)	Weight (kg/km)	UTS (kN)	Short Circuit (kA <sup>2</sup> sec)
OPGW 53H60D	12	15,3	600	82	111
OPGW 59K65D	24	15,9	645	93	151
OPGW 66M59D	24	16,6	585	74	175
OPGW 90S86D	24	19,0	860	118	400
OPGW 94P81D	32	19,4	812	102	237
OPGW 97M116D	36	18,7	1161	188	212
OPGW 20T172D	36	22,0	1716	305	386
OPGW 56J64D	48	15,6	642	92	122
OPGW 86Q73D	48	18,6	729	88	278
OPGW 24U100D	144	22,4	1000	120	430

NOTE: The designs above are only a sampling of the options available from PRYSMIAN. Please contact us for a cable designed to your exact specifications.

# Terminal Cables

These cables are used to connect the optical fibres of the OPGW cable at the end of the high voltage line to the optical distribution frame in the substation.

## The most widely used cable types are as follows:



**Terminal Cable: EKE**

The EKE cables, whose fully dielectric design prevents the generation of secondary currents.

If there are rodents in the area, these cables should be installed in duct.



**Terminal Cable: EKH9E**

The EKH9E cables equipped with anti-rodent metal armour.

This armour must be connected to earth to prevent electric discharge when secondary currents are generated.



**Terminal Cable: EKDE**

The EKDE cables whose fully dielectric anti-rodent protection, combines the advantages of the two prior solutions.

In all of these cables, Prysmian can offer a wide range of sheaths which respond to specific installation needs . We supply the fire resistant Afumex® type, hydrocarbons resistant, termites resistant, etc.



# Optical Fibres

The optical fibre of the cables supplied by Prysmian is manufactured in-house and is designed to provide optimum transmission services. These fibres are used primarily in telecommunications networks characterised by long distance links and high capacity.

## Single-mode of general application OPG Light

OPG Light is a G.652 fibre optimized for OPGW networks, with:

- Better splicing performance.
- Lowest PMD in the market.
- Characterization in 4<sup>th</sup> window.

### (ITU-T G.652)

Cladding diameter	125 ± 0.7 µm
Mode field diameter at 1310 nm	from 9,2 ± 0,4 µm
Attenuation (*) at 1310 nm at 1550 nm	0,36 dB/km max. 0,22 dB/km max.
Chromatic dispersion at 1310 nm from 1285 to 1330 nm at 1550 nm from 1525 to 1575 nm	2,8 ps/ (nm.km) 3,5 ps/ (nm.km) 18 ps/ (nm.km) 20 ps/ (nm.km)
PMD (Polarisation Mode Dispersion)	≤ 0.1 ps/√km

Prysmian can supply its Magnilight ITU-T G.652 D for metro applications upon request.

## Non zero dispersion shifted FreeLight®

Fibre designed for DWDM applications. It is characterised by very low dispersion from 1530 to 1625 nm and a high effective area, which prevents the non-linear effects of high speed in this type of transmission, offering improved service in comparison to the previous fibres.

### (ITU-T G.655)

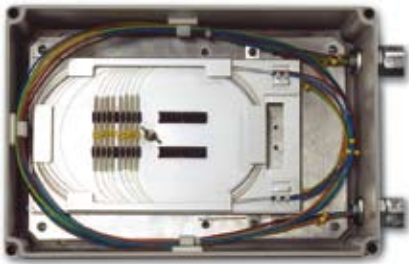
Cladding diameter	125 ± 1,0 µm
Mode field diameter at 1550 nm	from 9,2 to 10,0 µm
Attenuation (*) at 1550 nm at 1625 nm	0,25 dB/km max. 0,27 dB/km max.
Chromatic dispersion from 1530 to 1565 nm from 1565 to 1625	from 2,0 to 6,15 ps/ (nm.km) from 4,5 to 12,4 ps/ (nm.km)
PMD (Polarisation Mode Dispersion)	≤ 0,5 ps/√km

(\*) The attenuation values indicated are provided as an example. Consult our sales office to determine the fibre characteristics which are most appropriate for your needs.

# Joint Boxes EWMJ, up to 96 splices

# Joint Boxes EWJ, up to 240 splices

The EWMJ and EWJ joint boxes are especially designed to guarantee the maximum sealing, reliability and durability of the fibre optic cables connections. They are highly versatile, and can be used in OPGW systems as well as other types of optical wiring systems.



## Structure

- > **Box**
  - aluminium alloy
  - anti-ageing neoprene coupling
  - cover secured by 4 stainless steel screws
  - clamp plate for central cable components
- > **Joint organiser**
  - capacity of up to 24 fusion joints per organiser
  - control minimum bending radius of fibres
- > **Cable inlets**
  - aluminium gland seal
  - cable anchored on armour
  - neoprene sealing rings (IP67)
  - aluminium stern for plastic sheath cable (in their case)
  - thermoretractile tube for plastic sheath cable sealing (in their case)
- > **Cable securing**
  - aluminium clamp systems adaptable to all diameter of cables
- > **Outer protection**
  - optional protection from sunbeams and other impacts
- > **Vertical tower anchoring**

## Configuration

Prysmian can supply any configuration requested.

### Basic Configurations

Cable entrance	1 OPGW 1 OPGW	1 OPGW 1 plastic sheath	2 OPGW 1 plastic sheath	3 OPGW	2 OPGW 2 plastic sheath	3 OPGW 1 plastic sheath	4 OPGW	2 plastic sheath
EWMJ	A	B	C	D	-	-	-	H
EWJ	A	B	C	D	E	F	G	H

# Optical Distribution Frame (ODF)

Prysmian has a wide range of ODFs which provide suitable connection of the terminal cable to the transmission equipment.

The optical distribution frame ODF33 is a flexible and modular system that allows termination of a small number of cables of low capacity up to a large number of cables of high capacity.



Flexibility is obtained by the superposition of different optical distribution modules, inside a 19"/ETSI standard cabinet.

The enclosures permit a capacity up to 47U, in wall mounted or floor stand format.

The modules are designed for 12, 24 or 48 fibre capacity, fully equipped with adapters and pigtails. The adapter type can be chosen between the most common adapters in the market; FC, SC, ST, E2000, etc..



## The ODF includes all the necessary functions:

- > cable securing and grounding
- > housing of mechanical and/or fusion joints
- > connector/adapters termination
- > storage of fibre cords

# Suspension assembly

Assembly with reinforced suspension clamp and neoprene inner covering, especially designed for OPGW cables. Includes grounding clamps for tower connection.



## Structure

- > **Straight shackle** - (Galvanized forged steel).
- > **Twisted link** - (Galvanized forged steel).
- > **Parallel connection clamp** - (Aluminium).
- > **Armour grid suspension clamp** - (Aluminium).
- > **Preformed rods** - (Aluminium alloy).
- > **Grounding clamp** - (Aluminium).

## Configuration

According to the environmental conditions, length of span and types of cables it may be necessary to use extra protection rods (reinforced suspension assembly).

The assembly components can be provided with optimum features in accordance with Client requirements.

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# Dampers

The dampers are used to absorb the cable vibrations. The number of dampers is determined by the environmental conditions, the distance between towers, the type of OPGW cable and the installation parameters.

On request, Prysmian can calculate a customized vibration study.



Stockbridge Damper

## Structure

- > **Securing clamp** - (Aluminium alloy)
- > **Messenger cable** - (Galvanized steel wire).
- > **Counterweights** - (Galvanized forged steel).



Spiral Vibration Damper

## Structure

- > **Solid PVC helical rod.**

# Downlead clamp

The downlead clamps are used to fix the cable to the tower in the down lead to the joint box.



## Structure

- > **Clamp** - (Aluminium).
- > **M-12- rod** - (Galvanized steel).
- > **Support body** - (Galvanized steel).
- > **Lock screw** - (Stainless steel).

## Configuration

There are different types of clamps:

- > **individual clamp**, for a single cable.
- > **standard clamp**, for two cables, adaptable to all diameters.

# Tension assembly

Preformed tension assembly especially designed for OPGW cables. Includes grounding clamps for tower connection. When the distance between two anchor towers is greater than the maximum length of OPGW cable drums, there are special tension assemblies for installation in suspension towers, allowing a cable joint to be included.



## Structure

- > **Straight shackle** - (Galvanized forged steel).
- > **Extension link**- (Galvanized laminated steel).
- > **Dead end** - (Compression aluminium clad steel).
- > **Thimble** - (Cast galvanized steel).
- > **Protection splice** - (Compression aluminium clad steel).
- > **Grounding clamp** - (Aluminium).

## Configuration

There are three types of assemblies for installation in tension towers:

- > **passing tension assembly**: for intermediate towers.
- > **splicing tension assembly**: for towers with joint boxes.
- > **final tension assembly**: for final towers.

Also there are tension assemblies for suspension towers:

- > **splicing tension assembly**, for towers with joint boxes.

The assembly components can be provided with customized features in accordance with Client requirements.

# Quality and Testing



Stress strain



Sheave test



Salt fog



Lighting test

Prysmian, with more than 80 OPGW cable designs successfully type-tested, has extensive experience in OPGW qualification. Additionally, our in-house laboratories certify that all our cables are manufactured in compliance with the design specifications. Prysmian's manufacturing plants are fully ISO certified.

## Prysmian has the following in-house OPGW testing facilities:

- > Tensile machine (20t).
- > Sheave.
- > Crush.
- > Impact.
- > CW Lightning test (400C).
- > Salt fog test chamber.
- > (-40/85°C) Climatic chamber.

Agreements with international laboratories allow to complete cable qualification according to IEEE 1138 and/or IEC 60794.

Optical fibre parameters such cut-off wavelength, MFD, spectral attenuation, chromatic dispersion and PMD can be measured.

The laboratory is also equipped with tensile machines for characterization of metallic wires and plastic sheath.

Prysmian OPGW manufacturing plant are ISO 9001 and 14001 certified and the quality assurance systems are managed accordingly.

# Engineering and Installation

In order to ensure that the OPGW cables will operate successfully in a high voltage network, all aspects associated with the implementation of this technology must be correctly analysed.



Prysmian has designed global pre-sales and after-sales services to optimise the installation, operation and maintenance of these networks:

- > **optimised design of cables and accessories**
- > **project engineering** (calculation of spans, drum lengths, etc.)
- > **definition of optical fibre**
- > **line survey.** The cable parts, type and quantity of accessories, splice points, etc. are determined at this time
- > **supervision of installation,** to ensure correct cable stringing and splicing
- > **final certification** (measurement of fibre attenuation)
- > **preparation of joints**
- > **turn key projects,** including from the executive design to the acceptance protocol.
- > **maintenance,** providing the material required (instruments, repair units, etc.)

Prysmian has designed these services to adapt to the specific needs of each installation, thus optimising the resources of our customers.

## Prysmian Live Line Installation Services

When there are severe restrictions to planned outages, OPGW stringing in energized transmission systems becomes necessary. Prysmian masterizes the technology of OPGW installation in live line condition, offering a full range of services that bring to our customers the benefits of this new but safe technology.

## Turn-key installation references

Prysmian has references of more than 13.000 km of cable installed in turn-key basis, of which more than 5.000 km were installed in live line conditions.

The Prysmian Group began installation of OPGW systems in 1983. Since then our technology has been used by the following Customers throughout the world.



<b>ALBANIA</b>		<b>ETHIOPIA</b>
ABB		JYOTI STRUC. (EEPCO)
<b>ALGERIA</b>	<b>BULGARIA</b>	KEC INT. (EEPCO)
SONELGAZ	ELECTROIMPEX (NEK)	<b>GHANA</b>
KAHRAKIB	<b>CANADA</b>	GNPC
<b>ARGENTINA</b>	SUNCOR	VRA
ALUSA-YPF	<b>CHECOSLOVAQUIA</b>	<b>HUNGARY</b>
INTESAR S.A.	CEPS	MVM
LIMSA	<b>CHILE</b>	<b>ICELAND</b>
PAN AMERICAN ENERGY	B.BOSCH S.A.	LANDSVIRKJUN
SADE	ENTEL	<b>INDIA</b>
TECHINT	INGENDESA	APTRANSCO
TEYMA-ABENGOA	MINERA ESCONDIDA	POWER GRID
TRANSENER	SIGDO KOPPERS	<b>INDONESIA</b>
<b>AUSTRALIA</b>	<b>CHINA</b>	P.L.N.
POWERLINK	CHINA E.P.T., I&E CO.	<b>IRAQ</b>
<b>BANGLADESH</b>	EST CHINA E.P.F. E&T CO.	SOE
COBRA	GUANGDONG P.C.C.	ALBARQ
<b>BOLIVIA</b>	HUNAN TRADING CO.	<b>ITALY</b>
SEIM INGENIERÍA	NORTH CHINA E.G.	BASICTEL
SIRTI	NORTH EAST CHINA E.G.	ENEL
<b>BRAZIL</b>	STATE POWER CORP.	EDISONTEL
ABENGOA	ZHEJIANG P.E.P. CO.	RODA
CELPA	<b>COLOMBIA</b>	VITROSELENIA
CEMIG	ELECTRICAS DE MEDELLIN	<b>IVORY COAST</b>
CEEE	ISA	ABB
CHESF	LA ALIANZA	SOC. IVOIR. CABLES
COBELUX	SIEMENS	<b>JORDAN</b>
COPEL	<b>COSTA RICA</b>	NEPCO
CTEEP	ICE	<b>KAZAKHASTAN</b>
EMBRATEL	<b>ECUADOR</b>	ASPMK
ELETRONORTE	FUTURE OPTIC SYSTEMS	KEGOC
ELETROPAULO	HIDROPAUTE	POWER GRID CO.
ELETROSUL	TRANSELECTRIC	<b>KENYA</b>
FURNAS	<b>EGYPT</b>	KEN GEN
PETROBRAS	E.E.A.	<b>KUWAIT</b>
		KEC INT. (MOE)





OPGW-PRYSMIAN in the world

<b>KINGDOM OF SAUDI ARABIA</b>	<b>PAPUA NEW GUINEA</b>	<b>TAIWAN</b>
ELECTRICITY CORP.	PNG POWER	THAI SOTO ENGINEERIN
SEC-C	<b>PARAGUAY</b>	<b>THAILAND</b>
SEC-E	ADMINIST. NAC. ELEC.	EGAT
SEC-W	<b>PERU</b>	<b>TUNEZ</b>
YANBU CORP.	E.G.ELEC. SAN GABAN	JYOTI (STEG)
YANPET PET.INF.	<b>PHILIPPINES</b>	<b>TURKEY</b>
<b>LEBANON</b>	NATIONAL POWER CORP.	MITAS
ÉLECTRICITÉ DU LIBAN	SOUTHEM ENERGY	TEIAS
<b>LIBYA</b>	TRANSCO	<b>UKRAINE</b>
DALING D.O.O.	<b>PORTUGAL</b>	TTC MARCONI
KEC (GECOL)	E I P (REN)	<b>UNITED ARAB EMIRATES</b>
<b>LITHUANIA</b>	<b>QATAR</b>	ADWEA
LIETUVO ENERGIJA	NCC (KAHARAMAA)	FEWA
<b>MALAYSIA</b>	VOLTAGE ENG. (KAHARAMAA)	MEW
SESCO	<b>ROMANIA</b>	DEWA
TENAGA N.B.	TRANSELECTRICA	<b>URUGUAY</b>
<b>MALI</b>	<b>RUSSIA</b>	UTE
SOGEM	FEDERAL GRID CO.	<b>USA</b>
<b>MAURITANIA</b>	<b>SOUTH AFRICA</b>	ENTERGY
UTE MANANTALI	ESKOM	GREAT RIVER ENERGY
<b>MEXICO</b>	<b>SPAIN</b>	MAGIC VALLEY
BESTEL	ABENGOA	MID AMERICAN ENERGY
COMISION FEDERAL ELE.	COBRA	SCANA
LUZ Y FUERZA C.	ELECNOR	WASHINGTON INT. GROUP
<b>MONGOLIA</b>	ENDESA	WORLEY PARSONS
BEIJING ENG.CO.B.P. (ER&DC)	GAMESA	<b>VENEZUELA</b>
<b>MOZAMBIQUE</b>	H.CANTABRICO	ABB
ISOLUX	IBERDROLA	PEDEVESA
<b>NICARAGUA</b>	IBERINCO	SADEVEN HWC ANDINA
SINTER	ISOLUX	ZTE/CADAFE
<b>NIGERIA</b>	REE	<b>VIETNAM</b>
ABB (PHCN)	UNION FENOSA	E.V.N.
PIVOT ENG. (PHCN)	<b>SUDAN</b>	<b>YEMEN</b>
CI2000 (PHCN)	MOHAN (NEC)	HYUNDAI
<b>NORWAY</b>	<b>SWEDEN</b>	<b>YUGOSLAVIA</b>
NEKS ELECTRIC	SVENSKA KRAFTNÄT	EPS
<b>OMAN</b>	<b>SWITZERLAND</b>	<b>ZAMBIA</b>
KEC (MEW)	AET	KALPATARU (ZESCO)
<b>PAKISTAN</b>	<b>SYRIA</b>	<b>ZIMBABWE</b>
GEODIS UK	PEEGT	ZESA
ICC	SCOT	

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