OPGW

Optical Fiber Composite Ground Wire

ZHONGTIAN TECHNOLOGIES CO., LTD.

ZHONGTIAN HITACHI FIBER OPTI C CABLE CO., LTD.

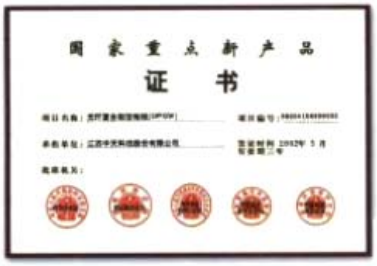
Company Profile

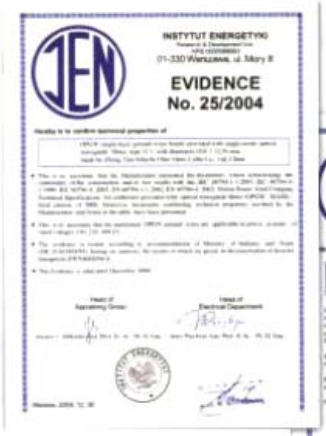
Zhongtian Hitachi Optic Fiber Cable Co., Ltd is a joint venture invested by Jiangsu Zhongtian Technologies Co., Ltd (SSE Code: 600522) and Hitachi Electric Wire Co., Ltd. The company was established on May 13, 2000 with 5 million USD original capital. In 2005, two shareholders increased the capital to 9 million USD, and now the total investment of the company is 25 million USD. Our company's headquarter is located in Shanghai Baoding Business Building, and the manufacturing factory stands in Rudong County. The company specializes in manufacturing and producing OPGW of the first-class level in the world. And we still keep consummating our after service. Now we have the capacity of manufacturing 23,000km OPGW annually. The new generation composite stainless steel tube OPGW has passed the product appraisal organized by the National Electric Power Company and the National Bureau of Mechanical Industry on December 23, 2000. The company has got the Network Access License for Special Telecommunication Equipment in Electric Power System. Besides that, we have passed the ISO9001:2000 Quality System Certificates and ISO14001:1996 Environmental System Certificates.

Layer Welding Line for Stainless Steel Tube Fiber Unit

Cabling Line for OPGW

Company Certificates





Design of Optical Fiber Unit

Fiber Types and Properties

OP-Unit Types

Items \ Fiber Type		ITU-T G.652 Fiber(B1)	ITU-T G.655 Fiber(B4)
Mode field diameter	1310nm	9.2±0.4μm	\
	1550nm	10.4±0.8μm	9.6±0.4μm
Cladding diameter		125±1μm	125±1μm
Cladding non-circularity		≤1%	≤1%
Proof test strength		0.69GPa	0.69GPa
Cut-off wavelength (λcc)		≤1260nm	≤1480nm
Attenuation	1310nm	≤0.36dB/km	\
	1550nm	≤0.22dB/km	≤0.22dB/km
Zero-dispersion wavelength		1300~1324nm	\
Zero-dispersion slope		≤0.092ps/nm^2.km	\
Dispersion	1285~1330nm	≤3.5 ps/nm^2.km	\
	1550nm（1530~1565nm）	≤18 ps/nm^2.km	1~6 ps/nm^2.km

SUS OP-Unit

SUSP OP-Unit

Note: various types of stainless-steel tube are available as required.

Stainless Loose Tube Optical Fiber Unit Characteristics

- ☐ Stainless tube provides higher modulus of elasticity, crush and impact resistance.
- ☐ Jelly filler prevents moisture or water penetration and providing good temperature characteristics.
- ☐ Better conducting heat, bigger specific heat volume and strength stability in high temperature.
- ☐ Design bigger fiber excess length, provide bigger stress-strain windows.

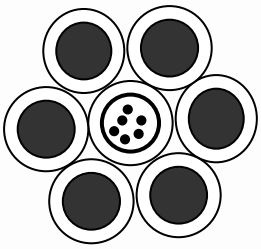
Composite Stainless Loose Tube Optical Fiber Unit Characteristics

- ☐ Ideally combine the well-rounded optical fiber second-coating technology with the advanced laser–welding stainless tube .
- ☐ Stainless tube with inner lining-effectively protects fibers from mechanical damage, such defects as burr, sawtooth formed during laser welding.
- ☐ Stainless tube, with inner lining tube, forms an organic whole with high strength adhesive, thereby has effective heat insulation for optical fibers.
- ☐ Fiber excess length has more uniformity and better consistency. The SUSP stainless tube needs no cold drawing, therefore the fiber excess length is effectively controlled.
- ☐ Totally waterproof structure can eliminate H_2 damaged effect of moisture penetration.

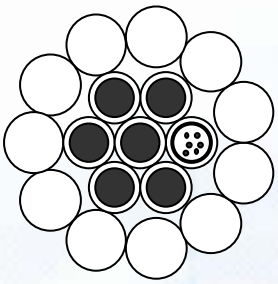
Design of OPGW Cable

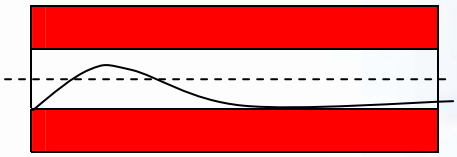
Fiber Excess Length Sketch Figure

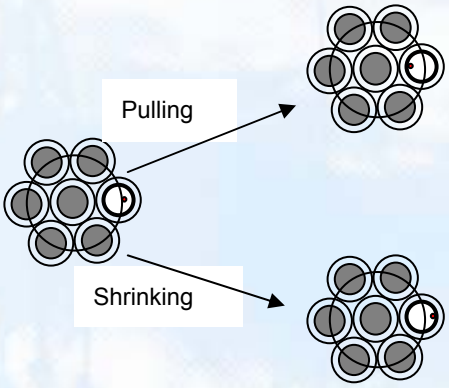
Central Stainless Tube Type OPGW



Layer Stranding Stainless Tube Type OPGW



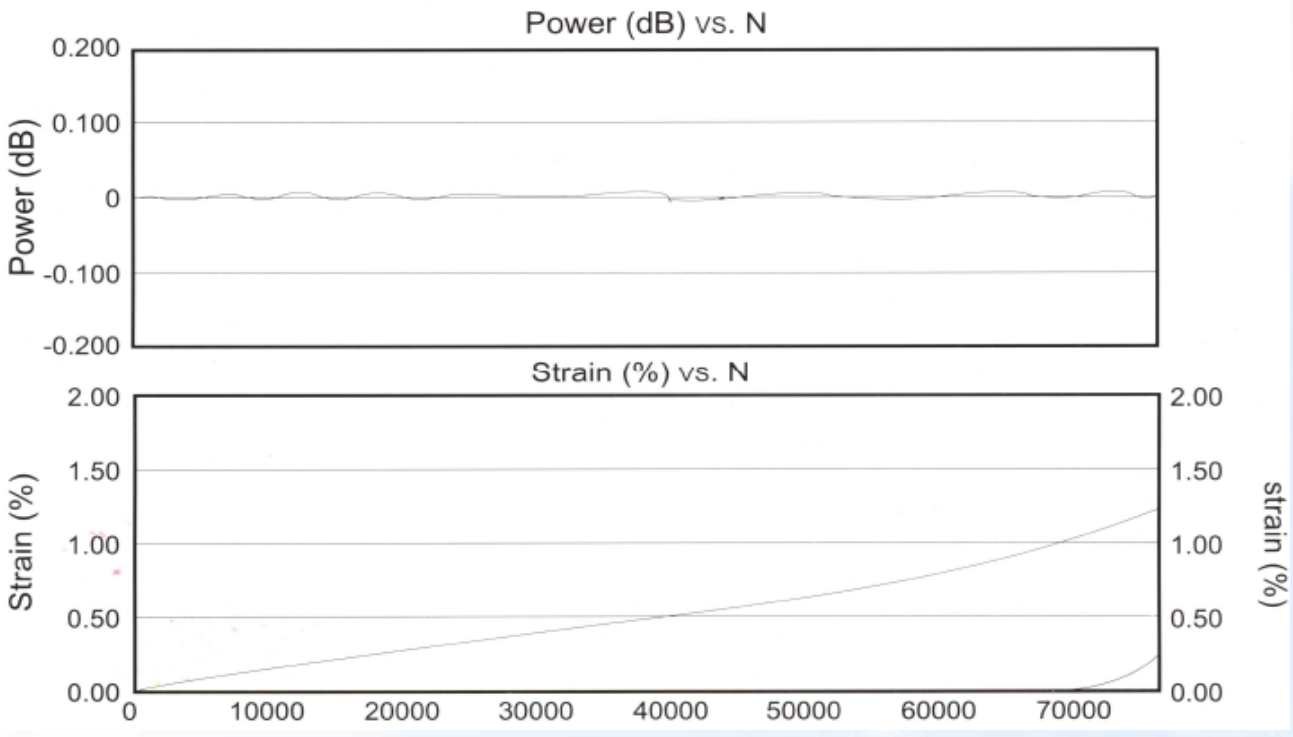




Primary Fiber Excess Length

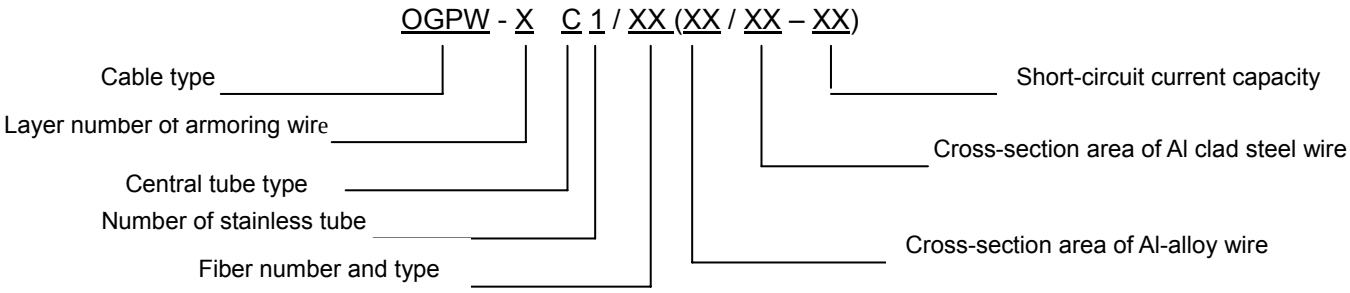
Second Fiber Excess Length

OPGW and Optical Fiber Stress-strain Curve



Central Stainless Tube Type

Code of products



Applications

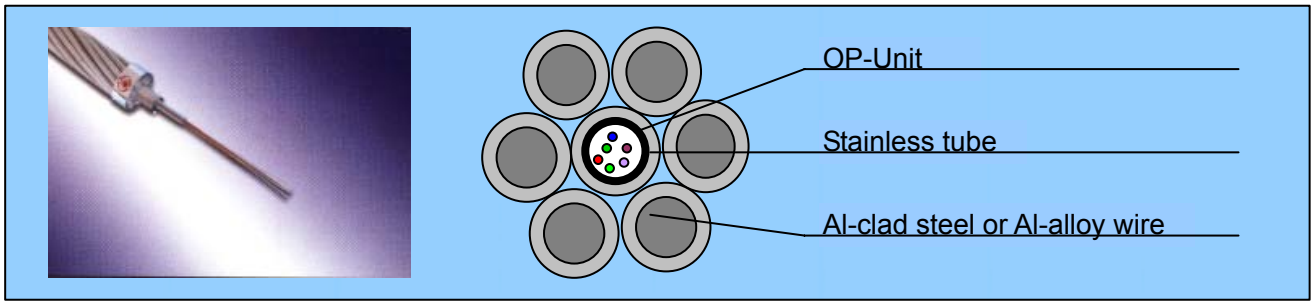
- Replace existing aerial ground wires, upgrading communications lines of power systems.
- Synchronously plan and design with ground wire when new aerial power lines are to be constructed.
- Provide stainless tube fiber unit with optimal protection.
- Conduct fault short-circuit current and providing lightning protection.

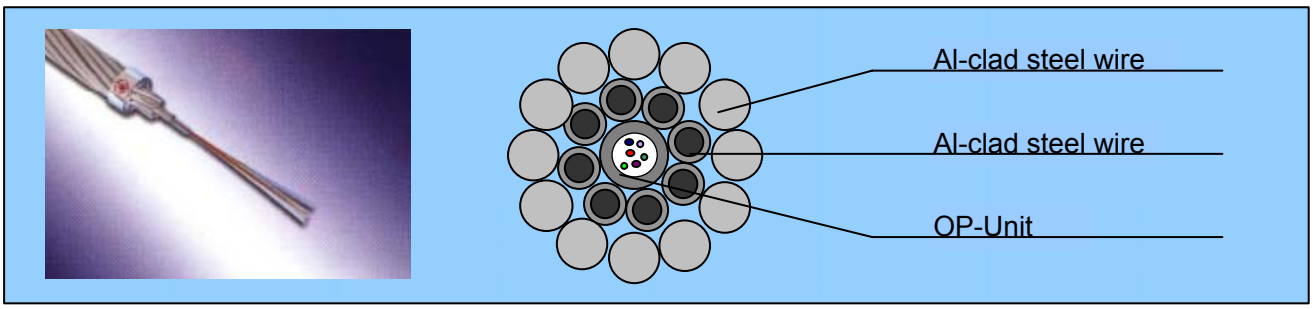
Structure Characteristics

- Small cable diameter, light weight, low additional load to poles/towers.
- The stainless steel tube fiber unit stands in the center of the strand layer.
- Obtain appropriate fiber excess length (primary) within stainless tube.
- With single armoring, the OPGW has a bit poor flexure and crush resistance, and a bit poor tensile strength.
- Obtaining the best balance of electric and mechanic performance by adjusting AA/AS Combination

Note: Multi-layer armoring is available as required.
SUS or SUSP OP-Unit is available as required.

Product Structure





Layer Stranding Stainless Steel Tube Type

Code of products

OPGW–X Sn / XX (XX/XX – XX)

- Cable Type
- Layer number of armoring wire
- Layer stranding type
- Number of Stainless tube
- Fiber number and type
- Short-circuit current capacity
- Cross-section area of Al clad steel wire
- Cross-section area of Al-alloy steel wire

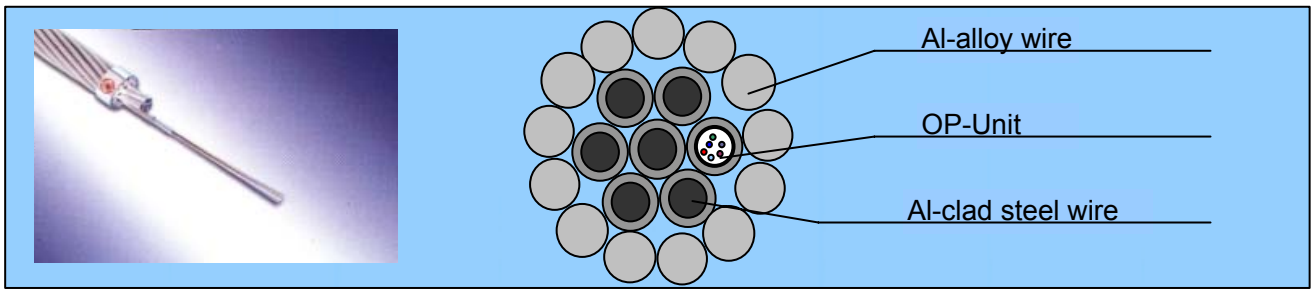
Applications

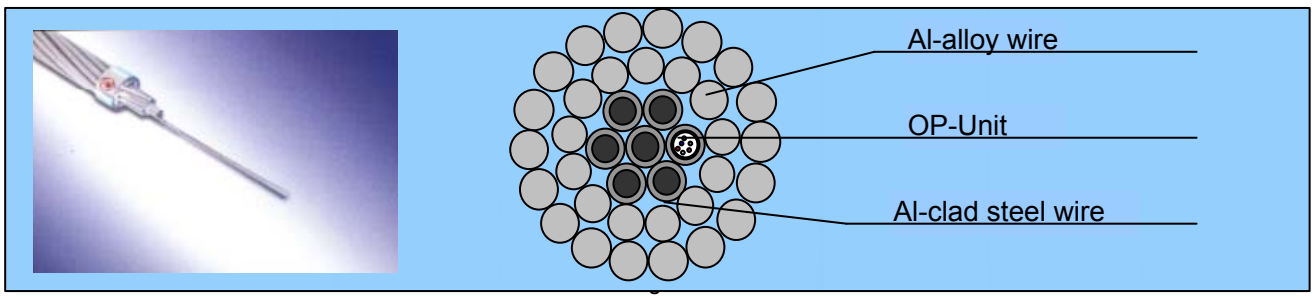
- ☐ Replace existing aerial ground wires, upgrading communication lines of power systems
- ☐ Synchronous plan and design with ground wire when new aerial power lines are to be constructed
- ☐ Provide stainless tube fiber unit with optimal protection
- ☐ Conduct large fault short-circuit current and providing lightning protection
- ☐ Suitable for application in high fiber count and super-high-voltage power lines
- ☐ Match with favorable tension-sag of the diffluent ground wire.

Structure Characteristics

- ☐ Typically have larger cable diameter.
- ☐ The stainless steel tube fiber unit is placed in an eccentric position and stranded together with Al-clad steel wires or Al-alloy wires simultaneously.
- ☐ The Al-clad steel wires being placed in the inner layer can avoid rusting, and have high reliability and long life.
- ☐ Optimum stranding design makes secondary fiber excess length available.
- ☐ Good flexure and crush resistance.
- ☐ Provide high mechanical strength and large short-circuit current capacity.
- ☐ Obtain the best balance of electric and mechanic performance by adjusting AA/AS combination.

Note: Multi layer armoring is available as required
SUS or SUSP OP-Unit is available as required





Central Sealed Al-covered Stainless Tube Type

Features and advantages

- Extremely good corrosion resistance.
- Improved lightning resistance and fault current.
- Double tube design offers better resistance of the optical fiber from moisture and horizontal fluid penetration resistance.
- Small diameter, light weight, compact design.
- No anticorrosion grease, clean environment, longer life.

Applications

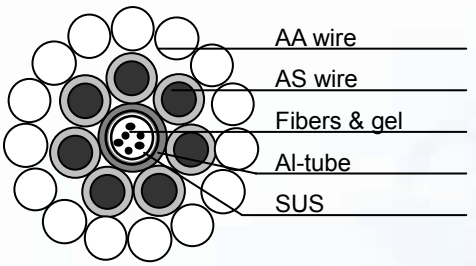
- Extremely corrosion areas, such as littoral, chemical areas
- High lightning area—possible to still have relatively small overall diameter when using wires of bigger diameter on the outer layer

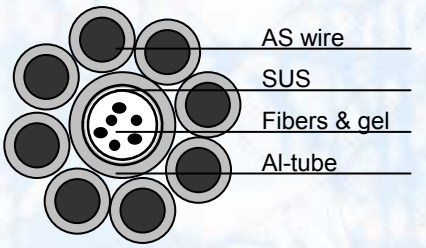
Product Structure

- The optical fibers loosely places in a hermetically sealed Al-covered stainless tube unit.
- Single or multi layer AS and AA wires are stranded together around the central Al-covered stainless tube.

Type Test

- The type test according to the latest IEEE 1138 and DL/T 832 was successfully completed by EPCRI





Engineering Application

- 2005.5 ---40km OPGW ---220kV Nanhua Caofeidian Tran. Line of Tangshan Supply Power Company
- 2005.11---3.4km OGPW---EXPORTING TO South Africa G.D.S.A Company
- 2005.11---8.8km OPGW---110kV Jinshang-baogai Trans. Line of Fujian Shishi Supply Power Co.

Specifications

Typical Parameter	Unit	OPGW-73	OPGW-81	OPGW-83	OPGW-95	OPGW-109
Max. number of fiber	Nos	24	24	36	36	48
Overall diameter	Mm	11.4	12.0	12.2	13.0	14.0
Standard weight	Kg/km	390	430	415	500	580
Rated tensile strength	kN	58	56	54	66	77
Fault current capacity	$KA^2.s$	35	47	48	65	86

Compressed Layer Wires Lightning Resistant Type

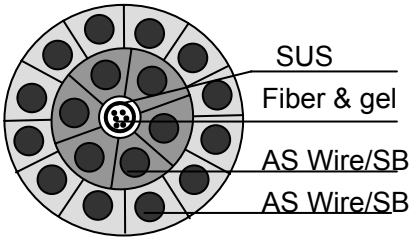
Features and Advantages

- Lightning resistance is extremely improved.
- Reduce inner layer diameter, extremely increase outer layer wire's diameter.
- Compact design, full use of cross-section.
- Available for central structure, single or multi layer stranding wires application.

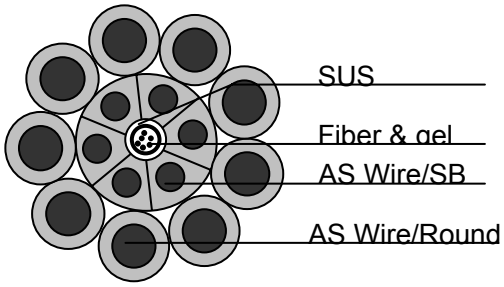
Application

- High lightning area-possible to use wires of bigger diameter on the outer layer and still have relatively small overall diameter.
- High pluviose, iced area.

Product Structure



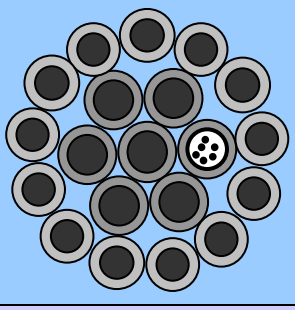
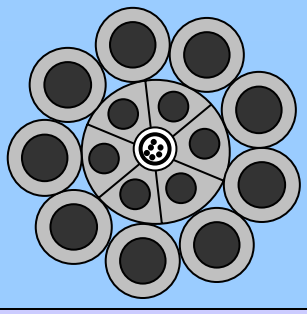
- OP-unit places in the center of the cable. The inner layer wires are compressed to smooth body, conductivity 30-40%.
- As wires of the outer layer may be smooth or round, a combination of AS and AA wires is applied in the outer layer.



Type Test

- The type test according to the latest IEEE 1138 and DL/T 832 has been successfully completed.

Specifications

			Conventional Round wire stranding type	Compressed Wires Lightning Resistance type
Structure Drawing				
Structure	Outer layer	Nos/mm	27AS 13/3.0	27AS 9/4.0
	Inner layer	Nos/mm	30AS 6/3.5 + SUS 1/3.2	30AS 6/ SB 2.3
	Center	Nos/mm	30AS 1/3.5	SUS 1/3.4
Max. number of fibers		Nos	36	36
Overall diameter		mm	16.0	16.0
Standard weight		kg/km	850	840
Rated tensile strength		kN	137	137
Fault current capacity		$kA^2.s$	146	152
Lightning resistant		C	150-200	250-300

Reference Standard

Optical Fiber Cable

IEC 61089	Round wire concentric lay overhead electrical stranded conductors
IEC 60794-4-1	The fourth section of optical fiber cable: Optical fiber composite overhead ground wire
IEEE std 1138	IEEE Standard construction of optical fiber composite overhead ground wire(OGPW) for use on electric utility power lines
DL/T 832-2003	Optical fiber composite overhead ground wire
GB/T 7424-2003	The fourth section of optical fiber cable: The criterion divided Optical fiber composite overhead ground wire

Raw Material

ITU G. 652~G. 655	Characteristics of single modefibers
ASTM B415-1998	Standard for hard drawing Al-clad steel wire
JB/T 8134-1997	Al-Mg-Si series alloy round wires used for the spanning overhead stranding wires (idt IEC 60104-1997)
DIN 48200 T8	Al-clad steel wires materials criterion
DIN 48200 T6	Al alloy wires materials criterion
IEC 61394	Overhead lines-characteristics of greases for Al, Al alloy and steel bare conductors
GB/T 9771	Single mode optical fiber series for communication
GB/T 15972	Optical fiber general criterion (eqv IEC 60793-1)
GB/T 17937-1999	Al-clad steel wires used by electricians (idt IEC 61232)

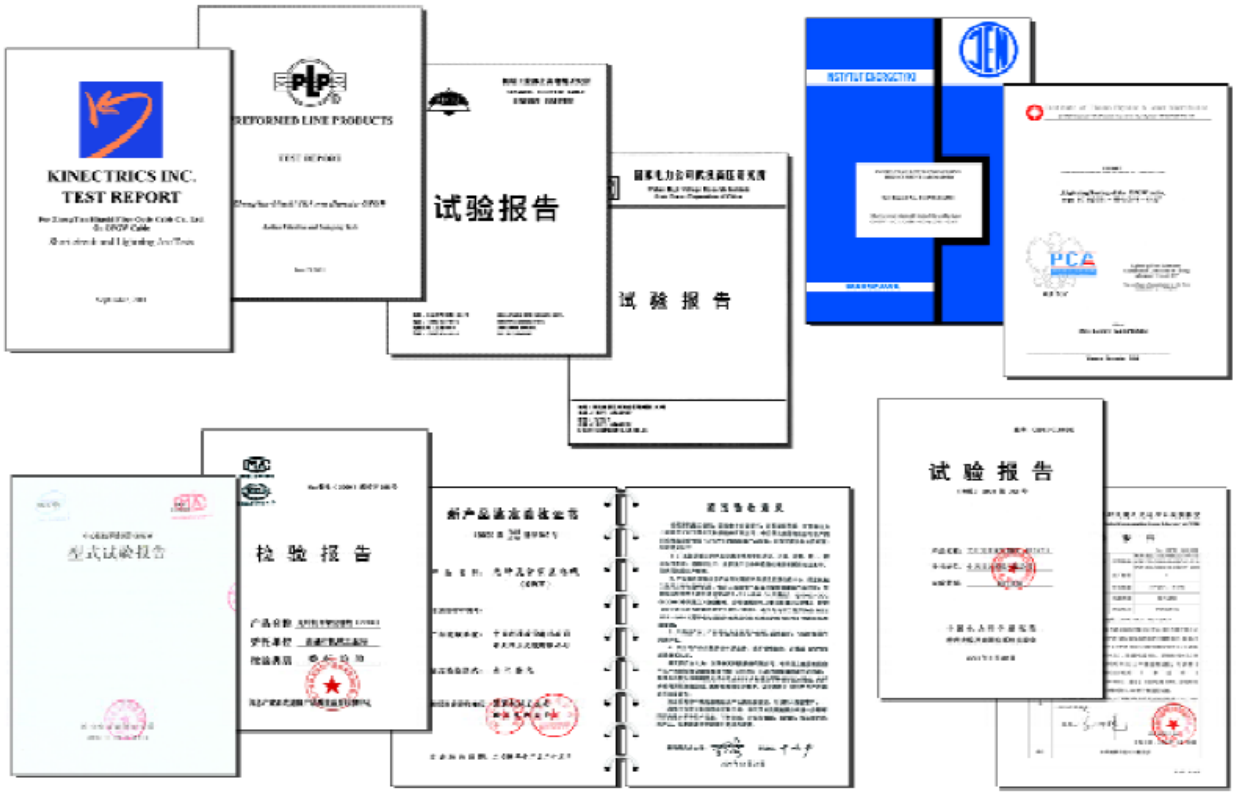
Fitting & Accessories

GB/T 34314-1997	Metal tools for the electric power
DL/T 766-2003	The technology conditions and the trial method of the performing fitting using Optical fiber composite overhead ground wire (OPGW)

Scientific Tests and Authoritative Qualification

Type Test Table

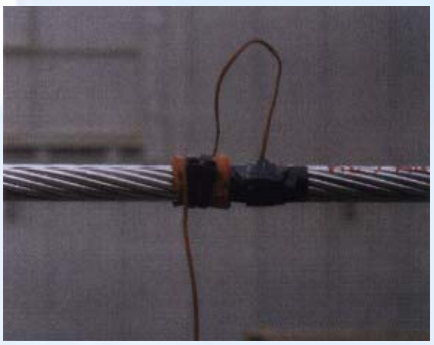
Test Item	Test Standard	Laboratory
Optical fiber chrematistics test	IEC 60793, ITU-T G652, ITU-T G655	Shanghai Electric Cable Research Institute China National Electric Power Construction Research Institute China Electric Power Research Institute Wuhan High Voltage Research Institute China Ministry of Information Industry Hitachi Electric Wires, Japan America PLP Laboratory Canada Kinectrics Laboratory Poland Natio nal Electric Jen Laboratory
Stranding wire test	IEC 61232 IEC 60104	
Stress-strain, Tensile strength test		
Crush, impact test		
Water penetration test		
Seepage of flooding compound	IEC 60794	
Temperature cycling	IEEE 1138	
Sheave test	DL/T 832-2003	
Aeolian vibration test	GB/T 7424.4-2003	
Galloping test		
Creep test		
Circuit test		
Lightning arc test		
Salt spray corrosion test		



Test Data and Chart

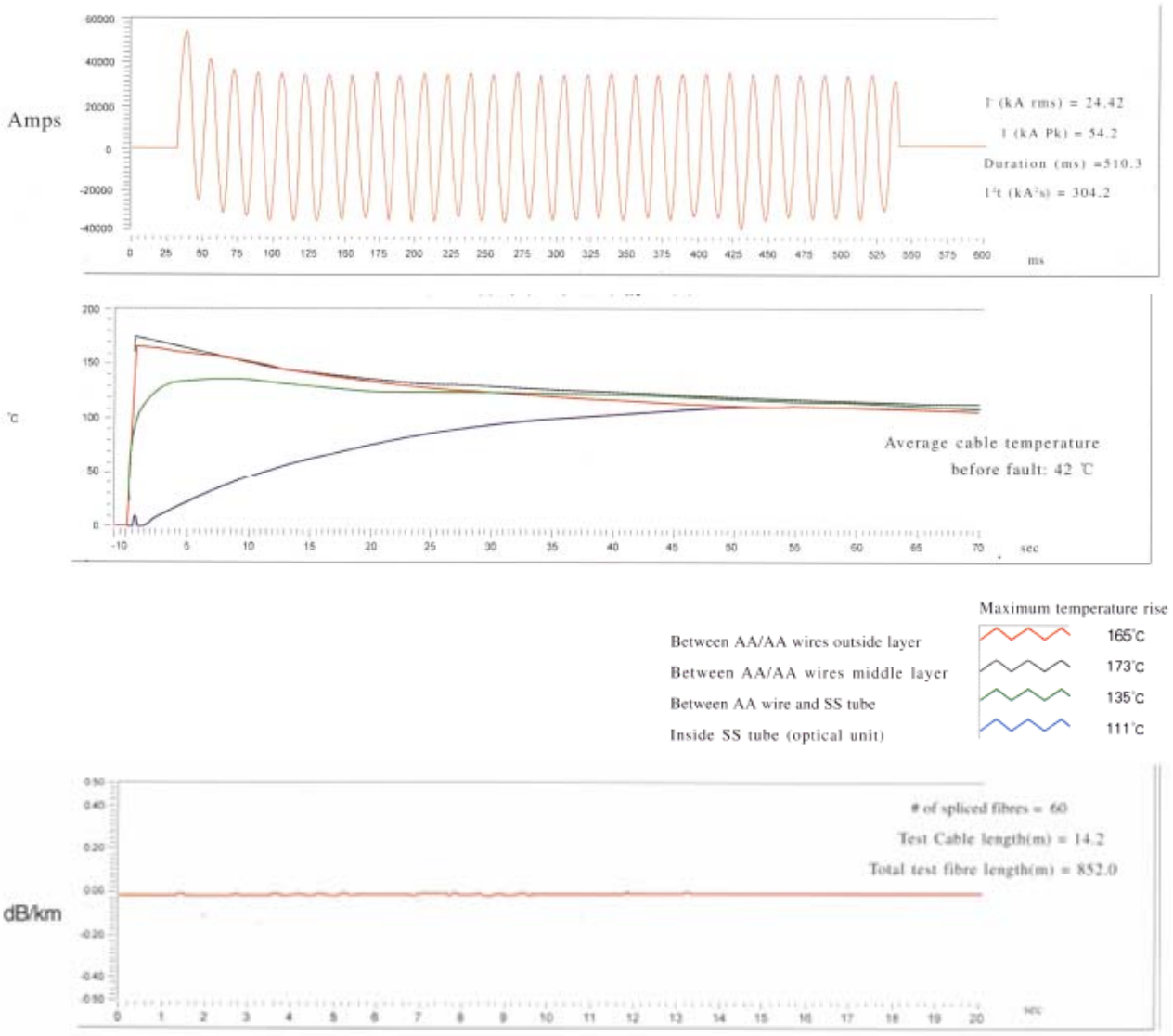
Short Circuit Test (Tested by Kinectrics Laboratory, Canada)

Typical Set-up for Short Circuit Test in High Current Yard



Typical Installation of Thermocouple on Temperature Sample

Test Chart



Test Data and Chart

Lightning Arc Test (Tested by Kinectrics Laboratory, Canada)

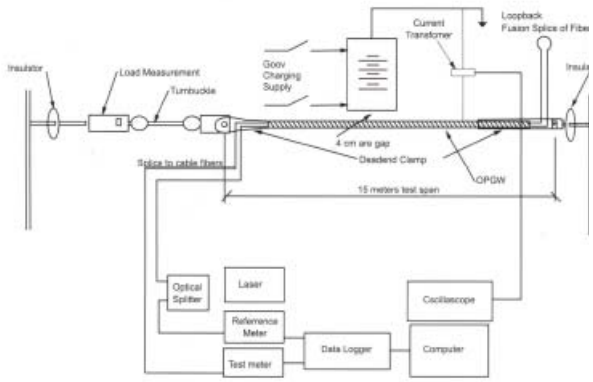
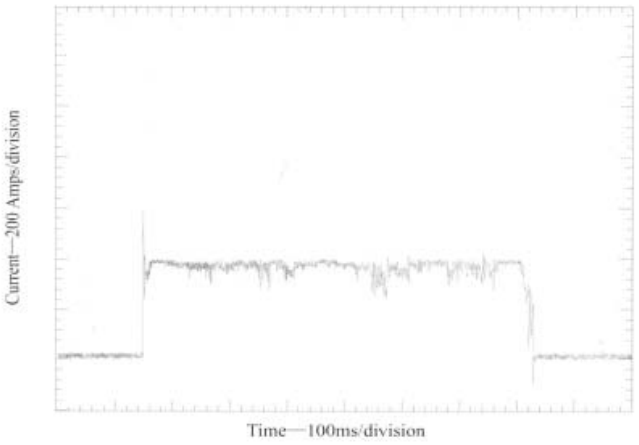
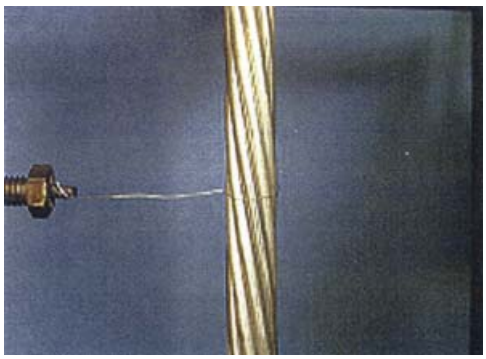


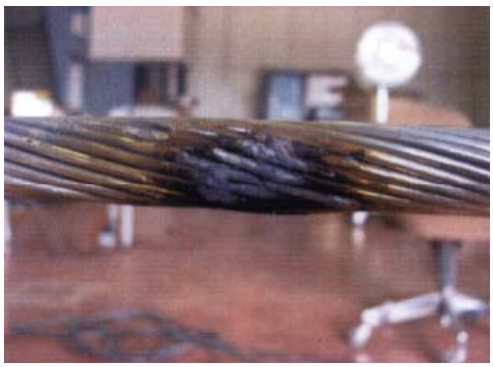
Figure 1a set-up for lightning arc test



Lightning Arc #P1 Damage (+245C)



Typical set-up of electrode, fuse-wire and Cable before Lightning Arc



Lightning Arc #P1 Damage

Summary of Results of Lightning Arc Test

Test NO.	Initial Temp (℃)	Initial Tension (kgf)	Mean Current of Component "B" (kA)	Charge (C)	Change of Attn (dB)	Remaining RTS
N1	44	801	2.28	−197	0.0	93%
N2	39	801	2.26	−146	0.0	98%
N3	40	816	2.12	−165	0.0	86%
N4	44	811	2.14	−142	0.0	97%
N5	37.5	812	2.10	−136	0.0	85%
P1	35	786	-	+245	0.0	99%
P2	39	789	-	+257	0.0	-
P3	41	780	-	+247	0.0	87%
P4	43	832	-	+259	0.0	75%
P5	45	793	-	+249	0.0	95%

Perfect Service

OPGW Primary Design Service

If you require quote of ZTT OPGW, please supply us the following information so that we can provide the best services.

OPGW length:_____km

Type of diffluence ground wire:_____

Numbers of fiber: G.652_____; G.655_____

OPGW diameter:_____mm

OPGW RTS:_____kN

Max. Short-circuit current:_____kA

Lasting time of short-circuit:_____s

Weather Temperature:_____°C

Max. Wind speed:_____m/s

Max. Ice thickness:_____mm

Customer contact: Name:

Company: Fax:

Tel:

Totally Mid-sales Services

▲ Tension-sag calculation

▲ Matching plate

▲ Fitting and vibration design

▲ Technological discussion

▲ Contacting meeting of design and factory checking

▲ Technological training and seminar

Perfect Post-sales Services

▲ Opening drum measurement

▲ Acceptance of the fittings & accessories

▲ Construction training and supervising

▲ Start the installation system and test when the project is finished

▲ Responses visiting users