

1. General Rules

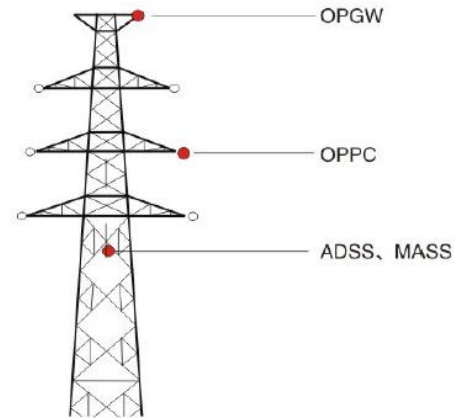
The handbook is formulated on IEEE 1138-2008 and IEEE 524-1992 etc. OPGW has two functions: electric aerial ground wire and fiber communication. It is constituted of AS wire, AA wire and stainless steel tube op-unit. The installation rules of OPGW are almost the same as the engineering and installation modes of traditional aerial electric power wire, referring to electric power company's aerial transmit circuitry installation skills, management and other related files. In order to guarantee the installation of OPGW and avoid the waste of personnel and material resources, we compile the handbook as the reference, not instead of any other manufacturers' installation instructions.

OPGW is usually installed on the top of pole of the electric power aerial wire. The following disadvantages should be considered: vibration caused by wind, hurricane, ice thickness, unsteady operation caused by temperature, and possible thunder attack, short circuit etc. Therefore, detailed engineering program should be formulated according to different structures of OPGW and specific route conditions. According to design requirement, OPGW should be allotted correctly; every tray of optical fiber cable should be installed in the appointed part of route and should be laid according to engineering chart operation file.

2. Installation Preparation of OPGW

2.1 Establishment of OPGW installation and engineering

In principle, the tension pay-off method is adopted. Suitable tension should be maintained to keep OPGW hanging in the air to avoid abrasion of the OPGW cable on the ground. Meanwhile, it can reduce green shoots compensation, mitigate physical labor and increase the speed of engineering. Every project can be allocated with suitable equipments and tools according to project capacity. The design part should send the design drawing to the engineering, which should compile the engineering program (or operation guide including striding chart and time limit table) of OPGW cable according to the route, the length and the pre-remaining splice place and check on related data. Master the ingredients and the distribution of the whole communication system and fix the detailed allocation and patterns of joining of different sub-stations including patterns of installation and specific position from termination pole to termination generator room. Nail down the structure, the quantity and the accessory allocation. Put forward suitable erecting pattern according to the special condition of particular area. Master the parameters such as mechanic property, transmission properly and splice loss etc. of OPGW according to its design rules and report before acceptance and other data to prepare for the test on the spot and checking on the delivery.



2.2 Preparation of installation tools

2.2.1 Main operation equipments and transportation tools recommended (one team)

No	Name	Quantity	Specification	Notes
1	Tension Machine	1	3.5t	Flexible Range
2	Traction Machine	1	3t	Flexible Range
3	Pay-off Machine	2	5t	
4	Pulley	20	Diameter of the groove is 600/800mm	
5	Tensionless Steel Wire	7000		Match with Diameter of the cable
6	Traction Net	Several	Match with the cable	Match with the Number of the cable
7	Torsion Releaser	2		Match with the Cable
8	Anti-torsion Whip	2		Optional
9	Tightening Pre-stranding Wire	Several	Match with the cable diameter	Match with the Number of the cable
10	Interphone	20		Advised Amount
11	Radio Station	2		Advised Amount
12	Sag Board	4		Advised Amount
13	Theodolite	1		Advised Amount
14	Hand Chain Block	Several		Determined by Constructor
15	Telescope	2	300times	

Notes: auxiliary facilities like transportation instruments, crane, climbing board, safety helmet, safety belt, earth wire, electroscope, rope, red and white flags, bamboo, protection net, safety warning signboard etc should be prepared before engineering.

2.2.2 Main points about engineering equipments

(1) Traction and tension machine operation

Traction and tension machine should have tension instructions and limiting device which can adjust tension and pay-off speed at all times so that OPGW can operate at specific tension value. Tension and traction machine should have flexible brake apparatus that can keep OPGW at original tension when paying off the cable momentarily. Self-protection brake apparatus should be used in principle (see picture 2 and 3).

Tension machine's groove should be semi-round, of which the suggested depth should be not less than 50% of OPGW. The angle of the wall and middle vertical line should be between 5°-15°. The diameter should be more than 70 times but not less than 1200 mm the diameter of OPGW. In order to prevent outside stranding wire from damage, chlorine robber



Picture 2: Active Hydraulic Tension Machine



Picture 3: Traction Machine

should be wrapped in the groove at least to avoid abrasion and OPGW should be wrapped at least 6 circles and fastened on the tension pulley. **The end of OPGW can't be directly wrapped on the tension machine after being pulled from the drum; we should firstly use a tightrope to wrap on the tension machine and then draw the cable to avoid man-made cable torsion.**

(2) Pulley

The minimum allowed bending radius should be about 20D during the process of installation and splicing. The diameter of the pulley is advised to use 600mm and 800mm so as to promise no damage to the cable. The width of the pulley groove shouldn't be less than the diameter of the cable and should be as large as possible. At no times can it be less than the minimum dynamic bending radius. In order to increase abrasion and prevent OPGW from rotating in the groove, pulley groove should be coated with chlorine rubber elastic buffer layer.

Pulley stents edge should be smooth or can be protected by colloid, and the gap of the pulley should be less than 10mm so as to prevent damages to cable surface or cable blocking (see picture 4).

Picture 4: Pulley

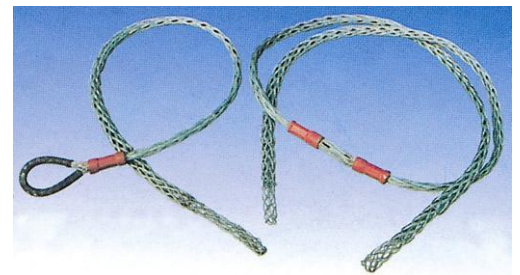


Pulley should be in good state and lubricated properly in order to ensure OPGW smooth operation without extrusion and lessen the abrasion of OPGW outer stranded string. The cushion layer cannot be dilapidated or aging and desquamated. Pulley is often grounded when cutting the electricity to install OPGW; At least, pulleys at the two towing sections should be grounded with tower at the same time.

Pulley is usually connected with tower, hook etc. Besides, application of thimble clevis, which is being used to hang hoop and other accessories, guarantees its free movement. However, the tension and the type of pulley often decide the application of the thimble.

(3) Pull-off net

Pull-off net is used to tow the OPGW cable through pulley smoothly and should be made up of two or three decked stranded hollow tube (see picture 5). Its inside diameter should be corresponding with the cable. During the process of towing, traction should be identical with pay off tension. Application of pull-net should obey the instructions of manufacturer strictly. It is not allowed to adjust tension with pull-off net or hold the cable when adjusting tension.



Picture 5: Pull-off Net

(4) Anti-torsion whip

Anti-torsion whip (see picture 6) is often used with pull-off net at the same time (see picture 7). Its weight length should be above 5N.m so as to prevent OPGW from revolving on the process of traction and protect extra fiber length from damage. Meanwhile, it also can avoid torsion release and ungluing and sign of bird caging. Besides, it can protect the cable from damage. Pull-off torsion releaser is used to protect pull-off rope from knotting.



Picture 6: Torsion Releaser



Picture 7: Torsion Releaser Used with Pull-off Net.

(5) Pre-stranding wire for tightening

Temporarily pretension pre-stranding wire for tightening is used to adjust tension and arc. Its repetitive times can reach more than 3 times.



Picture 8: Pre-stranding Wire for Tightening.

2.3 Transportation and storage of optical cable reels

OPGW cable should be packaged with wooden or iron-wooden drums which contain wooden materials. The following matters should be paid attention to during transportation and storage for the essential factors of wooden materials:

- (1) Cable should be stored at indoor venues which are dry and ventilative, if indoor venues are not accessible, then the venue to place the cable should be flat, solid and with good drainage facilities.
- (2) When in seasons with too much rain, then waterproof cloth should be covered on the cable so as to avoid deformation and rot after being got wet in the long-term rain.
- (3) When in dry season, after being laid for a long time, the wooden materials would shrink. The drum should be checked before laying, the cable can have water immersing one say before laying if it is accessible.
- (4) Effective measures should be taken to prevent moth and other harmful insects.
- (5) Cable drum can't be rolled for more than 5m, and it should be rolled according to the stamped rotate arrow on the drum in short distance.

(6) The cable must be transported, loaded and unloaded by special-purpose vehicles (cranes and forklifts), during the process, the cable drum must be vertical so as to avoid damaging the wooden lagging, and it can't be pushed from cars to the ground by manpower.

(7) During transportation process, the cable drum must be vertical; the cable end should be fastened so as to prevent the cable from loosening. After the cable drum arrived at the installation site can the wooden lagging and other protective facilities be dismantled.

(8) Cable drums are forbidden to be piled and placed upside down, and other materials are forbidden to be laid on the drum.



Picture 9: Cable Transportation Sketch Map.

2.4 On-the-spot checking before acceptance of OPGW and Hardware and Accessories

After OPPC and hardware and accessories having arrived construction materials warehouse, construction unit should carry out unpacking acceptance inspection together with the owner, supervisor and supplier representative. Check the attenuation of OPPC cable, the number of hardware and accessories, the type and the appearance etc. After on-the-spot inspection is qualified, all the participants fulfill the signature handover procedure.

(1) Opening test of OPPC

Check out the continuity, length and attenuation of optical fiber by using optical time domain reflectometer (OTDR), generally check out 1550nm wavelength. Write down and keep the results tested (optical fiber backscattering curve).

After the cables are tested qualified can they be set up.

(2) Checking of hardware and accessories

Each construction section should carry out checking, classification and trial erection of hardware and accessories according to design drawing and technical agreement, change the product when there are problems as soon as possible. Material store keeper should issue the materials in accordance with the requirements of design drawing.

2.5 Staff training

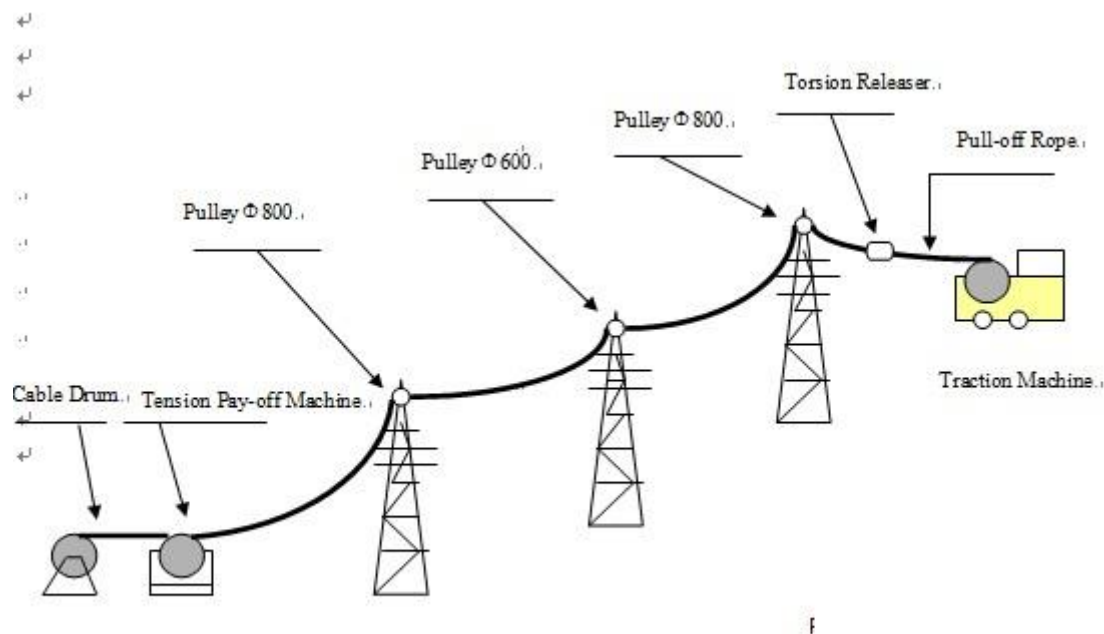
Carry out electric power industrial technology management rules, electric power security regulations, on the spot overhauling rules. Train the engineering operator and laboratory technician effectively with this handbook.

Engineers should study and communicate with each other before construction. Technicians or supervisory should explain the structure, property, quality criteria, engineering procedure, requirements of installation tools, special attentions during installation and using method of hardware and accessories etc. Operation demonstration and trial erection can be used when there is necessary (such as tension clamp, suspension clamp). Discuss the installation method under special circumstance.

3. Installation of OPGW

3.1 Frequently-used installation of OPGW

The method of OPGW installation is tension payoff. Tension payoff can make OPGW receive constant tension in the whole payoff process through payoff system which remains enough spare from obstacles and other objects and avoid friction, so as to protect OPGW. And it also can lighten physical labor and improve the speed of the project.



Picture 10: OPGW Installation

3.2 Laying preparation of OPGW

3.2.1 Dealing with pay-off channel, obstacles, cross agreement and safeguard procedures

We usually carried out with power line construction according to relevant provisions in “Overhead Transmission Lines Design Technology procedures” and “Power Line Construction and Acceptance Interim Technical Specifications”. Before construction, pay-off channels would be made out in the areas where lines go through to ensure unblocked transport. Find out obstacles, specific location of cross, make cross agreement, build protection frame



Picture 11: Protection Frame

(see picture 11) measures in advance for crossing railways, expressways, rivers, uninterrupted lines,

communications radio lines, streets, fruit-bearing forest and so on, try hard not to damage surrounding crops. When operated crossing other liners, we should avoid any touch and pulled by load-carrying insulation rope so as to avoid short-circuit accident. Streets and bridges that tension stringing equipment passes must be prospected and should be repaired when necessary.

3.2.2 Arrangement of traction site and tension site

- (1) Tension site usually choose a field of width: 10m and length: 25m and should be convenient for the storage and transportation for tension machine, cable reels and other materials and facilities. Traction site can be chosen as the tension site (see picture 12).



Picture 12: Arrangement of Tension Site.

- (2) Tension site and traction site should be located at the outside of the tension tower of two ends of the erection section and should be in the line direction. It can also be chosen in the inner side when confined to geography. If traction site can't be placed in the line direction, we can use a pulley with large diameter, please be careful not to slide during pay-off.
- (3) The distance between traction machine and tension machine to the first fundamental tower should be at least 3 times the height of the tower, and the distance between tension machine and the spool of pay-off stand shouldn't be less than 5m.
- (4) The force direction of traction machine wheel, tension machine pulley, cable pay-off stand, pulling rope and pulling rope drum should be perpendicular to the axis, and avoid direction change in the pulley.
- (5) The traction machine, tension machine and cable pay-off stand should be anchored according to the requirement.

3.2.3 Hang the pay-off pulley

Hang a pulley that meets dimensional requirement on each tower according to OPGW construction technical requirements.

First fundamental tower, corner tower that close to traction site and tension site and the tower that makes cable can't meet the requirement of pulley's envelope angle for the large height difference, we should hang a pulley whose tank bottom diameter is more than 800mm (or can use combined type pulley block with a diameter of 600mm).

For the pay-off in corner tower, during pay-off period, the pulley has a period that leans from vertical direction to corner inside, this period is unstable, especially the impact force of anti-torsion whip from the

pulley and it is easy to cause the cable leaping from the groove which leads to thread jamming. In order to avoid this, we can put the pulley to pre-leaning inside.

3.2.4 Laying and levitation of pulling rope

Pulling rope is laid in section by manual work according to their drum length, and then connected by bending resistance connector and this process must have a responsible specialist; after this, to check whether the fair line of the pulling rope is intact.

Before using pulling rope connector, check whether there is fracture, formation and it is strictly prohibited to use nonconforming product.

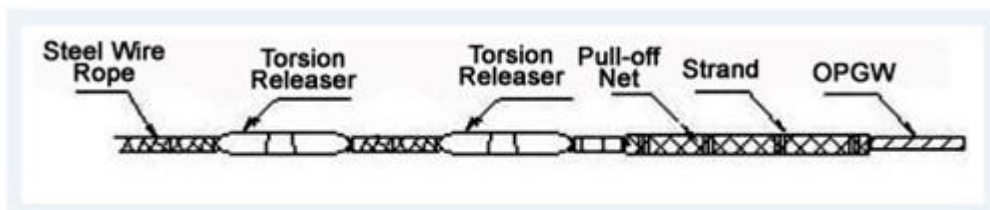
After the laying of pulling rope is finished, it should be raised up to the groove of pay-off pulley.

3.2.5 Traction end connection

During pay-off period, fibers in the OPGW can easily be effected and damaged for extra torsion of OPGW, so the traction end need to be made well to make sure OPGW won't have torsion during pay-off period.

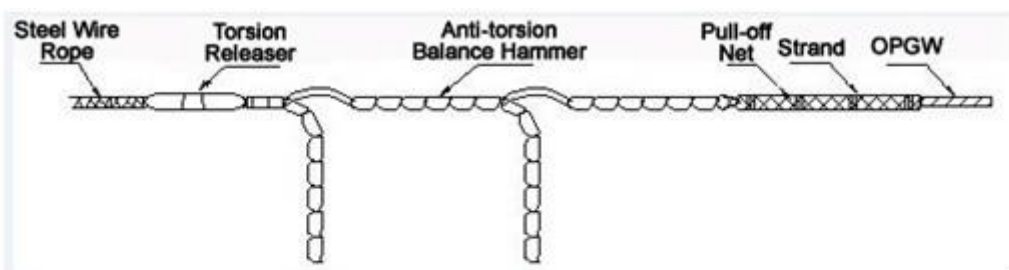
The end of the cable can't be directly wrapped on the tension machine after being pulled from the drum; we should firstly use a tightrope to wrap on the tension machine and then draw the cable to avoid man-made cable torsion. The connection method of cable with pulling rope after the cable passes through tension machine is: cable—traction net pipe—bending resistance connector—anti-torsion whip (optional)—spiral connector—traction rope.

If OPGW is stranded type, anti-torsion whip is not necessary, while we use two spiral connectors to connect in series through steel wire rope (See picture 13.1).



Picture 13.1: Torsion Releaser without Anti-torsion Whip

If OPGW is center type, suitable anti-torsion whip is a must (See picture 13.2). It can't be installed reversed and should slow down when it passes through the pulley.



Picture 13.2: Torsion Releaser with Anti-torsion Whip

Traction net pipe must match with the outer diameter of the cable so as to guarantee the tightness between the net pipe and cable. It is better to wrap the net pipe end with iron wire (not less than 30 turns) and then it should be wrapped in black tape.

3.3 Laying process control of OPGW

3.3.1 Check up and requirement before laying

- (1) Check the location, width, length, structure firm degree and overall stability degree of the cross frame.
- (2) Check the arrangement of traction site and tension site and machine anchoring situation.
- (3) Whether all staff is in place, whether the communication is smooth and whether there is fault along the lines.
- (4) Traction machine and tension machine should be normally operated, and the brake equipment and safety device should be reasonable; central shaft of pay-off stand should be horizontal. Whether the traction ends are firm.
- (5) Before paying off, mails should be removed and sundries along the pay-off stand should be cleared.
- (6) Stern line should be fastened and checked during laying process at all times.

3.3.2 OPGW laying process

- (1) Adjust and control the tension according to the parameters from technical department, the tension is controlled less than 10%RTS, any tension put on the cable during the process of installation should be no more than 20%RTS.
- (2) Traction should be controlled according to the value given by technical department.
- (3) The speed of payoff at the beginning is 5m/min, after the cable arrives at the first base tower can it be speeded up to about 30m/min. The maximum speed should be no more than 40m/min. The speed should be constant, abrupt acceleration or slowdown is forbidden, and vibration is forbidden during payoff.
- (4) During pay-off process, each corner tower top and cross point should have a specialist to look after so that they can report instantly when thread clamp happens or other circumstances. The cable traction end should pass through the pulley under surveillance of construction personnel.
- (5) Tension machine operator should care the tension control during installation. In the traction process, it is normal that the traction is suddenly increased by a big margin or hard strings of suspended payoff pulley are excessively leaned.
- (6) When cable end and anti-torsion whip is close to the pulley especially the corner tower pulley, the

traction speed should be slow down so as to let the scourge pass the pulley successfully. After that, we can speed up to the original traction speed.

- (7) The cable can fall to the ground during laying process, and make sure that the cable has a safety distance of 3-5m with across things. All personnel should observe the laying conditions at all times and informs to adjust the tension so as to avoid collision between cable and conductor and across frame or other obstacles that lead to abrasion and torsion.
- (8) The minimum bending radius of cable should be more than 0.5m, when the set up process temporarily discontinues, we should stop the cable keeping going by hand brake, or it can easily cause damages and at the same time avoid torsion on the cable.
- (9) After the laying of cable is finished, stern line should be kept and the length shouldn't be less than the height of the tension tower (or door model structure height) and add 15m as a joint or follow-up spare. Stern line shouldn't touchdown and the bending radius should be more than 0.5m. Hard bend and gold hooks are forbidden.
- (10) Cable drums can't be placed in two stets, if limited by geography, cable can be placed in two sets after being confirmed by relevant respects and detailed plan should be made out.

3.3.3 OPGW temporary fixation and anchor end

- (1) If the cable can't be laid out in one day, pulling rope and cable in traction end and tension end should be anchored. Cable relaxation degree from tension end to tension machine should be advisable to remove the tension of traction machine and tension machine and it shouldn't be too loose, and the cable can't touch the ground.
- (2) If the cable can't be tightened or hung after laid out, it should be anchored. At this time, anchor lines should be made at the end of the cable, special cable yarn trapper should be placed about 3-5m at the tail end of the cable.
- (3) When anchoring lines, related torsion resistance measures can be taken. Heavy stuff can be hung on U-type shackle which connects with the yarn trapper.

3.4 Tightening and observation of suspension arc

- (1) Tightening payoff shouldn't be more than 20%RTS, so as to make sure optical fiber properties are not affected.
- (2) High altitude soft hang can be done at one end of tension section, and then slowly loosen the anchor to make tension string get force, remove this anchor, tightening can be done at the other end.
- (3) When tightening, the traction speed should be stable and the direction should be the same as the

lines. If limited by geography that the direction needs to change, pulleys should be installed. When tightening in short section, cable sag raises fast, so the speed should be slow. Parallel hang line method is suitable to tightening the lines when there is large height difference and flip angle.

- (4) Tightening preformed armor rods is advised as a tool to tension OPGW or adjust tension sag. Tension clamp can be used as tightening tool for the first time, but it must be used as installation materials for the second time. It should be stressed through thimble when used as tightening tool, while pulling outer preformed armor rods is not allowed, try best not to make it deformation. Yarn trapper is forbidden to hold OPGW, for it can cause too much side pressure that could cause damage to op-unit (see picture 14).



Picture 14: Yarn Tapper is Forbidden to Hold OPGW.

- (5) When the sag is close to the design requirement, stop tightening, use spanner bottle gourd to tighten the cable sag to the design value, then use a marking pen to sign it .At last, install the tension clamp.
- (6) During tightening operation, keep the signal clear.
- (7) Straight-through type tension tower sag should be controlled according to the following principles: when the cable passes below the earth wire stand, the sag is usually controlled about $400\pm 100\text{mm}$; When the cable passes over the earth wire stand, the sag is usually controlled about $150\sim 200\text{mm}$. The jumper wire should satisfy not only the minimum bending radius but also without collision with fittings and tower materials.
- (8) After tightening is finished, make downlead clamp as soon as possible according to design requirement. Spare cable reel with a diameter of about 1.2m is laid flat on conductor cross arm and is fastened with nylon cord which is used for later joint.

4. Installation of Hardware and Accessories of OPGW

Install the fittings and accessories in 48 hours after tightening the cables in the tension section to avoid unnecessary damage to the fibers caused by overfatigue of the cable, for the cable could be easily abraded or vibrates in the pulley. Fittings and accessories of OPGW usually include: tension clamp,

suspension clamp, special earth wire, vibration damper, armor rods, downlead clamp, joint box and so on.

4.1 Installation of tension clamp

Tension clamp is the key hardware to install OPGW which not only fixes the cable on the pole and tower and affords much pressure but also grips the cable tightly while not exceeds the side pressure intensity of OPGW. Tension clamp is usually used in the termination tower, corner tower of over 15°, the cabling tower or pole tower of large altitude difference. The standard pre-stranding tension clamp is constituted of inner stranding wire, outer stranding wire, thimble, bolt, nut and so on (see picture 15).



Picture 15: Tension Clamp Assembly Drawing⁴

Steps of installation:

- A. Fix the hardware in the tower after the cable arc is adjusted with putt-off equipments.
- B. Pull the outside stranding wire of tension set through heart-shaped loop of the transit hardware. Make the stranding wire parallel with the cable and mark the cable in the place of coloring on the wire.
- C. Correspond the inside stranding wire with mark on the cable, and then, reel the first group of pre-stranding wire on the cable. Reel the other pre-stranding wires or insert the grounding flake by the coloring mark to ensure all the pre-stranding wires reeling together tightly and the ends are trim and well-proportioned. Prevent pre-stranding wire from transmutation by overexerting so as not to influence the distance of bolts
- D. Put the pre-stranding wire into the thimble and correspond the cross-section mark of outside stranding wire with the coloring earmark of inside stranding wire. And then, reel the outside stranding wire. Keep the space symmetrical no matter reel from one part or two parts.

4.2 Installation of suspension clamp

Pre-stranding suspension clamp is used to hang the cable in the lower, which is constituted of inside stranding wire, outside stranding wire, rubber clamp, alloy ingot crust, bolt, nut and gasket

(see picture 16).



Picture 16: Suspension Clamp Assembly Drawing¹



Steps of installation:

- A. Mark the suspension fixed point on the OPGW cable and reel the inside stranding wire from the middle part, which has been marked. Use hands not tools to reel the termination part after reeling all the inside stranding wires.
- B. Put the center of the inside stranding wire to the center of rubber clamp and fixed with the insulated tape, And then, reel the outside stranding wire on the rubber clamp along with the curve or insert the grounding Hake. Keep the space symmetrical and avoid intersecting.
- C. Put the center of the crush to the center of the stranding wire end rip the bolt and fix it. And then connect with suspension staple, rip the bolt and hang on the tower.

4.3 Installation of vibration damper

Vibration damper is used to eliminate or loosen the vibration caused by all kinds of factors during OPGW operation so as to protect OPGW cable and prolong the life of the cable.

4.3.1 Installation number allocation principle:

The number of vibration damper is allocated according to the following principle: span≤250m: 2 sets; span: 250~500m (including 500m), 4 sets; span: 500~750m (including 750m), 6 sets; when the span is over 1000m, allocation plan should be changed according to line situation.

4.3.2 Installation position

(1) Computational formula:

$$L1 = 0.4D\sqrt{T/M} \qquad L2=0.7L1 \qquad L3=0.6L1$$

D : cable diameter (mm)

T : cable annual average stress (kN), generally 20% RTS

M: cable unit weight (kg/km)

(2) Starting point of vibration damper installation: the starting point of L1 is the center line of suspension

clamp and the center line of tension clamp thimble; the starting point of L2 is the center of the first vibration damper, the starting point of L3 is the center of the second vibration damper, and so on.

(3) The first vibration damper should be installed on the inner stranding wire of accessories, and others are installed on special armor rods from second vibration damper.

4.4 Installation of earth wire

The earth wire is mainly used to supply access to short cut electricity when the OPGW is grounding. It is stranded by alloy wire and connected with accessories with parallel groove clamp or illustration and the other end is connected to tower grounding hole. The installation of earth wire should be aesthetic, with suitable length, without bend or twist. Connection points should have good contacts and keep unified in all lines.

4.5 Installation of downlead clamp, cable tray and joint box

Cable at the splicing point on the tower should be spliced after being lead to the ground. Along two sides of earth wire stand of the tower to the tower body and then lead along the inside of the tower body.

Bending radius of the route where downlead passes through shouldn't be less than 1m, and the minimum bending radius should be promised during operation, generally more than 0.5m.

After the cable is lead to the ground, downlead clamp is used to fasten the cable on principle material or other material of the cable. Anchor ear type downlead clamp should be used when it is lead along concrete pole (such as converting station, power plant structure).

Cable downlead should be straight and beautiful.

Joint box and cable tray should be installed at suitable place on the tower, and about 8~10m above the datum surface of the tower. The installation should be firm and all the lines should be unified (see picture 17).



Picture 17: Installation of Downlead Clamp, Cable Tray and Joint Box.

5. Optic Fiber Splice and Whole Process Test of OPGW

5.1 Optic fiber splicing of OPGW

After the lightning of OPGW, fittings and accessories, downlead clamp and cable tray are all installed, OPGW is almost in the state for normal operation, then optic fibers should be spliced and at the same time, attenuation should be tested on the fibers to make sure whether any damages has caused during laying process. Attenuation usually tested at 1550nm, record and store the test results.

5.2 Whole process test

5.2.1 Bidirectional whole test should be carried out after the installation of cables finished. Test items include unidirectional fiber splicing loss, bidirectional average loss and average attenuation etc. Test results should be in accordance with the contract.

(1) Cable unidirectional loss is tested by OTDR. At the same time, back scattering signal curve and schedule list should be provided. And calculate bidirectional whole process average loss according to test results.

(2) Carry out repeat test of total loss of the whole process by light power method and check out the order of fiber core.

5.2.2 Drum list of cable route

Check out ODF from A to B of the drum list. Parameters such as length of leading cable, erected length of each pallet and place of connecting box etc should be labeled.

5.2.3 Fiber reel list for splicing list of cable route

Check out fiber reel list for splicing list of all connecting points from A to B end of ODF.

6. Main Points of Quality Control and Special Attentions during Installation

6.1 Quality control points

(1) Transportation and storage control points

Whether OPGW, fittings and accessories get abraded during transportation or get damp and corroded during storage.

(2) Lightening and laying control points

The bending radius of optical cable during laying process should be effectively guaranteed to avoid “gold hooks” and avoid too much tension, abrasion and too many times of twists and turns.

(3) Fittings and accessories installation control points

To avoid too much tighten torque of bolts and avoid abrasion, twist and unreasonable pressure to the optical cable.

6.2 Special Attentions during Installation

(1) Before construction, calibrations should be made on frequency and sensitivity of the interphone; during laying process, take physical truth and former experience into account and subject to unified scheduling command.

(2) During construction, OPGW and accessories must reliable grounding, thus avoiding damage to personnel and facilities caused by capacitance and inductive coupling.

(3) The end of the cable can't be directly wrapped on the tension machine after being pulled from the

drum; we should firstly use a tightrope to wrap on the tension machine and then draw the cable to avoid man-made cable torsion.

- (4) The installation of OPGW must be operated during power off in principle and can't be operated during gale and thunderstorm; we should strictly conform to "Electricity Safety Rules", fill out work sheet, carry out organization measure of aerial transmission line safety work and follow related work procedures of power system.
- (5) Although the structure of OPGW is sturdy and durable, we should be careful to avoid wrong operations that cause unnecessary damage to the cable; during the laying of OPGW, sudden vibrations, pull and jump should be avoided.
- (6) When operating on streets and expressways, the direction of OPGW should be in consistent with traffic flow, special person should be arranged to direct the traffic, warnings and traffic guide signs can be used to delimit the work area, we can also ask the public security police to ease traffic when necessary.

7. Documents on File

7.1 Original record documents on the spot should be collected and assembled according to provisions and hand them to installation units before schedule time. When in cases of system transformation and critical situation, they can be referred to solve problems.

7.2 The following on-the-spot documents are suggested to be classified.

- (1) The measuring method of test with the project process, project arc and crossing span organized by the representatives on the installation site, who are dispatched by the construction company; the qualified record of secret project; the checking and acceptance of system open.
- (2) The relief map for the system: the detailed form of pole tower, junction site, crossing span diagram etc.
- (3) System integral diagram: mark the cable drum numbers, drum length, optical fiber cable and the type, length, data and quantity of fiber, the color spectrum arrangement for fiber connection, patch cord materials, which have been used in every junction or branch of every point, terminal equipment, the main road.
- (4) Installation of data form: record the actual equipment devices, tower installation, dimension, the pre-remained length of every junction or terminal, ground connection and fixture etc used in every pole tower.
- (5) Checking and acceptance of data form: including input light power, receivable light power, fiber

average attenuation, the input loss of junction and patch cord, the length of the optical fiber cable, etc.

7.3 Requirements:

- (1) Project files should be collected, organized and filed with original copy (document).
- (2) Written materials should be intact, legible, icon neat and with complete signatures. The damaged file materials should be repaired.
- (3) The files shouldn't be written or drawn with easy fade materials, copies should be made on illegible and easy fade files.