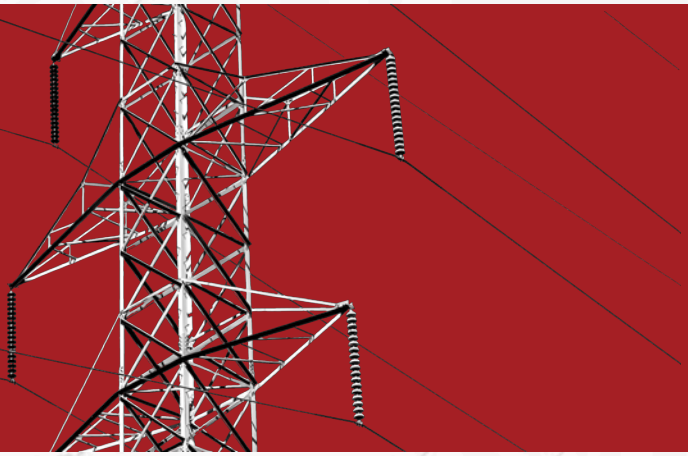
ZION

INSTALLATION MANUAL

ADSS CABLE

All Dielectric Self-Supporting Cable



Contents

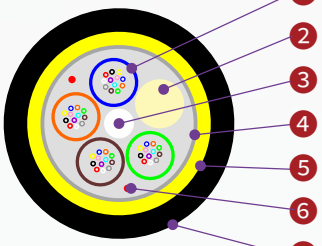
I. General Rules

This Installation Manual is a recommendatory installation document provided by HANGZHOU ZION COMMUNICATION CO., LTD. for ADSS cable customers. The installation manual is established based on the newest issued international standards such as IEEE Std 1222: 2004, "IEEE standard for all-dielectric self-supporting fiber optic cable", and IEEE 524: 2003 *Guide to the Installation of Overhead Transmission Line Conductors" and combined with the mature experiences held by Zion in ADSS cable installation and operation for many years.

Owing to the differences among various countries in power transmission lines, pole or tower circumstances, and geographic and weather conditions, the installation also should follow the regulations in the electric power industry of respective countries during practical installation.

I. General Rules

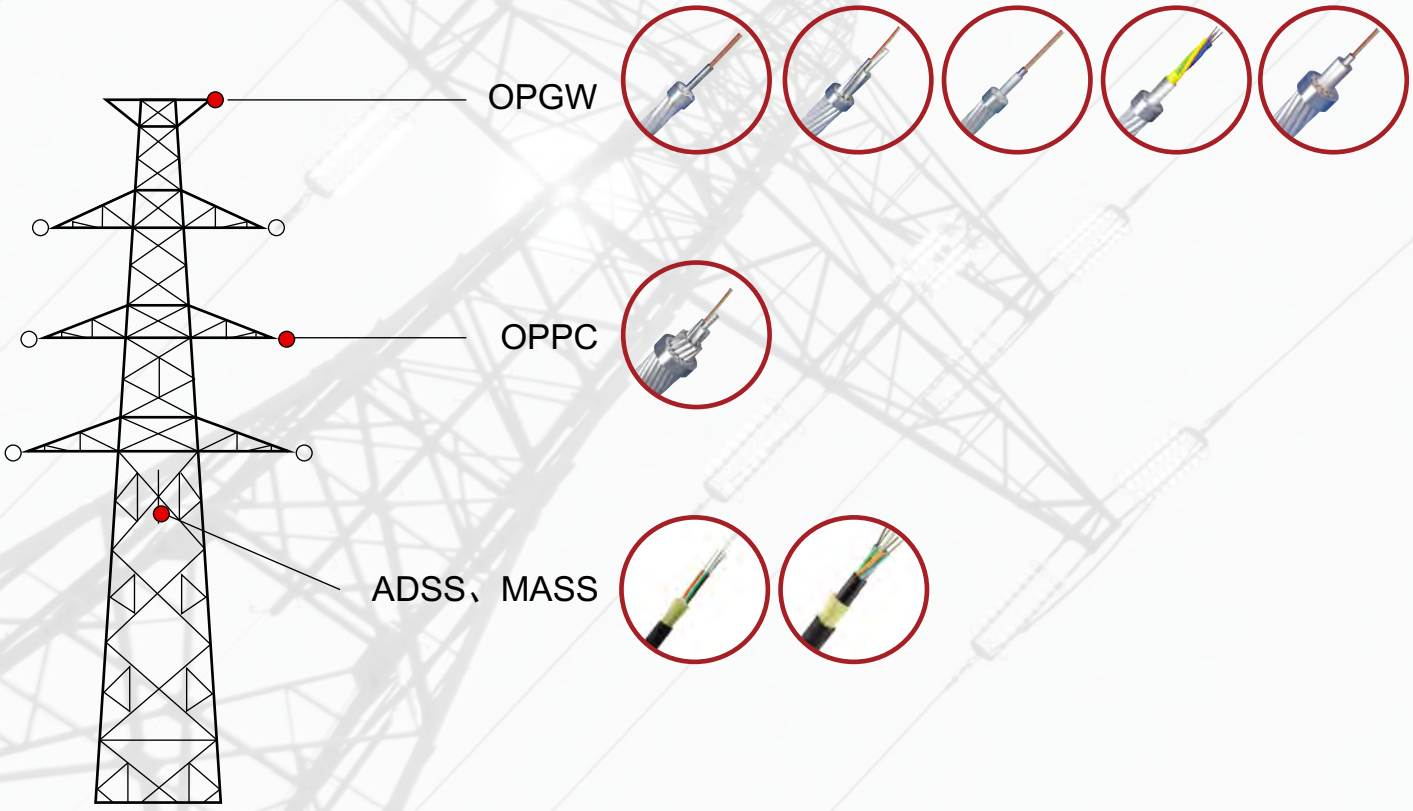
1.1 Cross-section Structure of ADSS Cable



1. Loose Tube: thermoplastic material, containing optical fibres and filled with gel.
2. Filler Elements: thermoplastic rods.
3. Central Strength Member(CSM): glass fibre reinforced plasticrod (GFRP), coated with polyethylene when needed.
4. Longitudinal Water Blocking Material: Water blocking tape.
5. Peripheral Strength Member: aramid yarn.
6. Ripcord
7. Outer Sheath: black polyethylene.

1.2 Advantages of ADSS Cable

- ADSS offers higher tensile strength and is suitable for long spans. Its overall thermal expansion coefficient is very low, so the effect of temperature on the ADSS sag is minimal.
- ADSS is made of non-metallic materials and can be installed and maintained in live line situations. It features convenient and safe installation and maintenance.
- Anti-track material allows ADSS to be used in applications with stronger electric fields.
- ADSS features a small diameter, lightweight, and small load affection on poles or towers.



II. Safety Precautions

2.1 Safety Precaution of ADSS Installation

Before ADSS installation, all the personnel who attend the ADSS installation should be familiar with the Occupational Safety and Health Act (OSHA) and the safety operation regulations for the local power industry, and the relative regulations for power industry of respective local government.

2.1.1 Work Aloft

The personnel who work aloft must have undergone physical examination and technical training, and are allowed to take part in the work aloft only after getting the qualifications; during work aloft, the personnel who take part in the work must use eligible insulation safety belts and insulated tools: the tools and materials to be used in work aloft should be put into insulated tool bags or tied up with insulated ropes, and delivering things up and down should use insulated ropes to hang, it is prohibited strictly to throw or cast things, in the case of atrocious weather such as strong wind above Force Five, rainstorm, thundering, thick fog, outdoor work aloft should be stopped.

2.1.2 Live Line Work

To prevent the electric shock of thunder and lightning and the high voltage lines, the operation persons must use insulation rods or take on insulation gloves and shoes when carrying out live line work near an electrified body, the minimum safe distance from the electrified body must accord to the stipulations of Fig.2.
When the safe distances can not be met in special circumstances reliable safety technical measures must be taken, and the installation is allowed to be carried out only after being approved by the chief engineer of the installation party.

Fig.2 Minimum safe distance from live wires

Ref. voltage rate (kV)	Safe distance (m)	Ref. voltage rate (kV)	Safe distance (m)
10 and below	0.7	154	2
20-35	1	220	3
44	1.2	330	4
60-110	1.5	500	5

2.2 Safety Management of Installation Equipments and Tools

- All the installation equipment and tools must be kept and operated by professionals according to the manufacturer's instructions.
- All installation equipment and tools must be checked and maintained in time before being used to ensure they are in good condition. Disqualified equipment and tools, such as deformed, damaged, or faulty ones, are prohibited from being used strictly.

2.3 Precaution for ADSS Cable Performance

- 2.3.1 During the installation of ADSS, the tension and pressure load should not be too big.
- 2.3.2 The optical fibers in ADSS cable are made of doped silicon dioxide, extremely fragile, and can be damaged due to external tension and pressure load. Therefore, the cable should not be subject to heavy crush and excessive tension during installation. When installation, the controlled paying-off method should be employed; the pulling tension should be stable and not exceed the rated value.
- 2.3.3 The cable outer sheath should not be worn and scratched.

The smooth sheath of ADSS can effectively reduce the residuum of contaminants, thereby relieving electric corrosion. In case the cable outer sheath suffers from abrasion. scratch, breakage, the cable will be corroded and damaged in a short time, consequently, during installation the ADSS is not allowed to occur friction and colliding with ground, tree, building, span supporting frame, pole or tower, edge of the drum, etc., and not allowed to use metallic tool scratching the cable.

- 2.3.4 The Bending Radius of ADSS

The bending radius of the ADSS is limited; when it is exceeded, the cable will be damaged.
The limits for the ADSS bending radius are as follows:
The allowable bending radius during installation: ≥20 D (D is the cable diameter)
The permissible bending radius during operation: ≥10 D (D is the cable diameter)

Therefore, it is required that the diameter of the cable paying-off pulley during installation should be as follows:
a)The pulley diameter on the straight line poles or towers:≥400 mm.
b)The pulley diameter on the poles or towers near the tensioner and puller :>600 mm.
c)The pulley diameter on the angle poles or towers with a turning angle of more than 60 degrees:>600 mm.

- 2.3.5 The ADSS is not allowed to be subject to moisture and water regression.

If the optical fiber is subject to moisture or water ingression, the attenuation of ADSS will be increased, even leading to the breakage of the optical fiber. Consequently, whether opening drums to test the cable or after the installation, the cable ends must be sealed with water-proof adhesive tape.

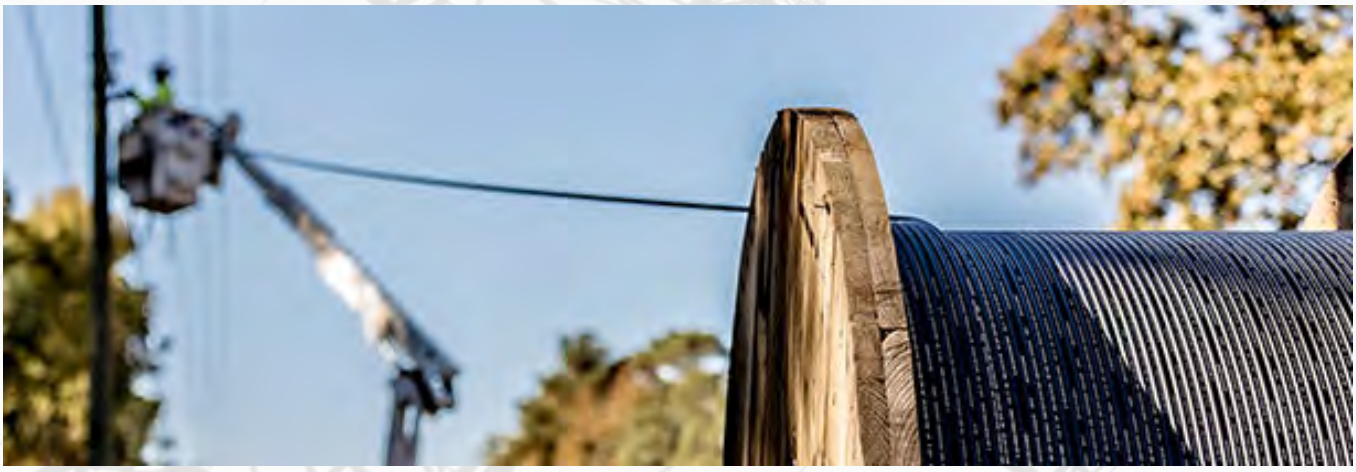
2.4 Precaution for the Use of Hardwares

- 2.4.1 The cable is not allowed to be exchanged at will, and the hardware is not permitted to be replaced at will.

The type, length, span, and hardware configuration for every drum of cable are different. Generally, the cables are produced according to the drum length datasheet. Each ADSS drum has a unified serial number. Each serial number corresponds to the specific pole or tower in the electric transmission line. Therefore, the cable is not allowed to be exchanged randomly during installation; the hardware is designed and produced based on the ADSS diameter, rated tensile strength (RTS), and span, so they are not allowed to be replaced randomly. The installation personnel should strictly follow the designed cable drum and hardware configuration to carry out ADSS installation.

- 2.4.2 Precaution in Mounting hardware

When mounting hardware on poles or towers, reliable measures must be taken to prevent the ADSS cable from moving back and forth. The same applies when crossing a power line, railway, or highway. or waterway, it is necessary to take measures to prevent the cable from dropping down.



III. Installation Preparation of ADSS Cable

3.1 Determination of Installation Scheme

The installation party plans the ADSS installation scheme according to the design drawings, the field survey results, the electric transmission line situation and routes, etc. The installation scheme should include diagrams of crossings and obstacles, a list of poles or towers, personnel division and duties, a schedule for ADSS installation, quality standards, and safety measures. And the installation party should also check relative data.
After the installation scheme has been established, it must be agreed upon by the installation supervision party, ADSS manufacturer, and the end user and be carried out.

3.2 Preparation of Installation Equipments and Tools

According to the ADSS installation scheme, a listing of installation equipment and tools is constituted, and the amount of them should be checked., and complimented when insufficient so as to ensure all the installation equipment and tools are qualified in quality and good operation.

- 3.2.1 The recommended amount of the main installation mechanical equipment (for one installation group), see Fig. 3.

Fig.3 The recommended amount of main installation equipments

NO	Name	Unit.	Quantity	Ref.Specifications.	Remark
1	Tensioner	set	1	1-3T	Tension adjustable
2	Puller	set	1	3T	Tension adjustable
3	Pay-off stand	set	2	~	With braking device
4	Pulley	piece	at least 20	Diameter of pulley: 400 mm	~
5	Pulley	piece	at least 6	Diameter of pulley: 600 mm	Used in poles or towers locatedin two ends of the pulling field
6	Insulation pulling rope	m	≥7000	~	Matching with cable iameter. the length related to the max drum length of the cable
7	Silk cord	m	≥500	~	~
8	Mesh wire pulling grip	piece	several	Matching with cable	Depending on the amount ofinstalled cable
9	Swivel	piece	several	~	~
10	Anti-twist device	piece	2	~	Optional
11	Tangent clamp	set	several	Adapting to cable diameter	Depending on the amount ofinstalled cable
12	interphone	set	20	Efficient range: 5 km	Suggested quantity
13	Chain hoist	set	several	1.5T	Depending on installation personnel
14	Telescope	set	2	300X	~

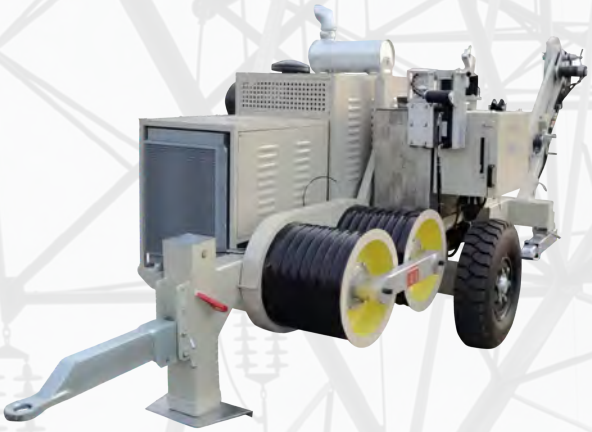
Note: Auxiliary facilities, such as vehicles, cranes, ascending plates, safety helmets, safety belts, earthing wires, electroscopes, ropes, small red flags with red and white colors, bamboo rods, and safety warning plates, should be prepared before installation.

III. Installation Preparation of ADSS Cable

- 3.2.2 Function Introduction of Main Equipments and Tools

- 3.2.2.1 **Tensioner and Puller**

The operation principle of the tensioner and puller: operating smoothly, preventing the sudden movement. A tensioner is equipped with tension indicators to adjust tension and pay. off speed and ADSS running stably at any time. Both the tensioner and puller should have agile brake devices so that when the paying-off of the cable is paused, the cable tension will keep changing.



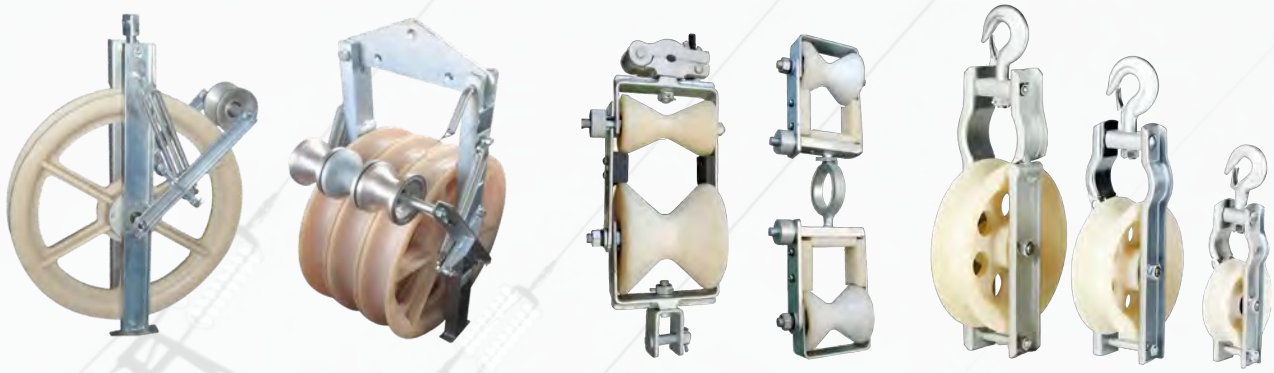
The wheel groove shape of the tensioner should be semi-circular, and the depth of the wheel groove should be not less than 50% of the diameter of the ADSS, and the wheel width should be more than 1.5 times the diameter of the ADSS: the diameter of the tensioner wheel (counting from the bottom of the wheel groove) must be more than 40 times the ADSS diameter and not less than 600 mm. In order to ensure the outer sheath of the ADSS is not scratched, the inner layer of the tensioner wheel should be covered with rubber or nylon so as to minimize abrasion.

III. Installation Preparation of ADSS Cable

- 3.2.2.2 **Pulley**

During the installation and jointing of ADSS, the minimum allowable dynamic bending radius is above 20 times the cable diameter. To ensure the cable is not damaged during installation, providing pulleys with diameters of 400 mm and 600 mm is suggested.

The groove bottom width of the pulleys should be wider than the cable diameter, and the groove bottom diameter of the pulleys must not be smaller than the requirement of the minimum allowable dynamic bending radius for the ADSS. The pulley groove is required to cover elastic buffer materials such as rubber or Nylon so as to increase friction force and prevent the ADSS from rotating in the groove. When the pulleys are to be used, they should be cleaned and lubricated with the appropriate quantity of lubrication oil.



- 3.2.2.3 **Pulling Rope**

The pulling rope adopts aramid yarn or nylon rope as the core member and covers it with PE.
It features high strength, good electrical insulation properties, light weight, small elongation, without kinking, etc.

- 3.2.2.4 **Mesh Wire Pulling Grip**

The mesh wire-pulling grip pulls ADSS, which passes through the pulley successfully.
The mesh grips should be hollow tubes consisting of two or three layers of stranding, and their inner diameters should match the diameters of ADSS.

- 3.2.2.5 **Swivel and Anti-twist Device**

The swivel works with a mesh wire pulling grip; it is mainly used to protect ADSS during pulling and prevent the pulling rope from kinking, leading to torsion of ADSS. The anti-twist device can effectively prevent ADSS from rotating during pulling so as to avoid the excess fiber length from being destroyed, allowing the ADSS to pass the pulley successfully without damage. The swivel and anti-twist devices are prohibited strictly from entering the pulley of the puller directly.

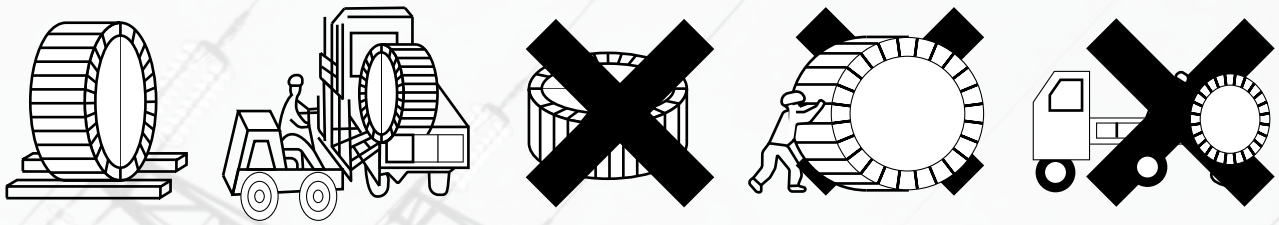
- 3.2.2.6 **Chain Hoist**

The operation principle of the chain hoist is to achieve the lift of articles by continuously pulling the manual chain or turning spanner, thereby transferring the internal mechanism; pay attention to checking the chain, rotation device, and brake device, and the operation persons are not allowed to stand beneath the chain hoist when operation.

III. Installation Preparation of ADSS Cable

3.3 Transportation and Storage of ADSS Drums

- 3.3.1 Usually ADSS is packaged using all-wood or iron/wood drums, consequently, they should be stored in dry and well-ventilated storehouses, the storage temperature should be within the allowable normal range of the ADSS, and the preventive measures, such as rain-proof, rodent-proof, anti. termite, should be taken.
- 3.3.2 The ADSS drums are allowed to roll at short distances only, i.e., not more than 5 meters, and the rolling direction must be by the rotation arrow direction indicated on the drums. Loading and unloading of ADSS must use special-purpose carriers, such as cranes and fork lifters, and are not allowed to be carried out directly with man power, During being transported, ADSS drums must be vertical, the end of the ADSS should be fixed well so as to avoid the cable from loosened: and all the drum bars and protection devices are allowed to be removed only after the drums arriving at the installation site and getting ready to install. It is prohibited strictly to pile up, up-side down, and stack other articles on ADSS.



III. Installation Preparation of ADSS Cable

3.4 Inspection and Acceptanceof ADSS Cables and Hardwares

After ADSS and hardware arrive at the installation site, the associated parties of the end user, supervisor, installer, and producer should be organized together to carry out inspection and acceptance of the ADSS calls and hardware.

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3.5 Training of Installation Skills

Before installation, all the personnel to attend the installation must undergo training of safety knowledge and installation procedures. The engineers or installation supervisors will teach the ADSS cable structure features, installation procedures, installation equipment requirements, installation precautions, hardware mounting methods, and so on, or will carry out operation demonstration if necessary (e.g. the mounting of' dead-end clamp and the splicing of optical fiber)

IV. ADSS Deployment Process

4.1 General Installation Methods

The general installation method for ADSS is tension string method, it is suitable for the spans more than 100m and the area where vehicles are dificult to enter, The tension string method makes the ADSS being subjected to a given constant tension during whole paying-off process, so as to ensure the ADSS keeping sufficient distance from obstacles and other objects, and avoiding firom abrasion each other and damaging the ADSS, at the same time enhance the installation efficiency.

4.2 Preparation before ADSS Cable Deployment

- 4.2.1 Putting up the Span Supporting Frame To prevent from accidental tension that was out of control during cable deployment. Pulled and tightened, it is required to put up span supporting frames in the areas where the ADSS will cross the power line, communications line, railway, or highway, and on the span supporting frame, marked warning plates should be hung; the putting up and removal of the span supporting fame should have specially assigned persons holding code flags to supervise. The minimum height of ADSS from ground and crossing points should be in accordance with the stipulations of Fig. 4.

Fig.4.Minimum allowable heightof ADSS from ground and crossing points

Vertical distance to premise	to the roof: 2.5m
Railway	to the top of the rail: 7m
Highway	to the road surface: 6m
Crossing distance to communications line	1m
Crossing distance to overhead ground wire	1m
Crossing distance to 10kV power line	1.5m
Crossing distance to 35kV power line	3m
Crossing distance to 110kV power line	3.5m

IV. ADSS Deployment Process

- 4.2.2 Choice of ADSS Pulling Field and Tension Field

4.2.2.1 The pulling field and tension field should be chosen in an open and wide place where the vehicle and hoist are easy to enter and exit. The field is arranged in an area 20-25 m long and 10-15 m wide. When the field is not flat, it should be leveled up to ensure all the equipment is supported stably. The puller, tensioner, and cable pay-off stands should be fixed on the ground.

4.2.2.2 The distance from the puller and tensioner to their neighboring first pole or tower should be at least 4 times of pulleys hanging height on the pole or tower, the position of the puller and tensioner should be placed so that the included angle between the paying-off ADSS and ground is less than 30°. The distance between the tensioner and paying-offstand should not be less than 5 m.

4.2.2.3 The capstan wheel of the puller and the cable pay-off stand, the guiding pulley of the tensioner, and the paying-off pulley on the pole or tower should basically be kept in a straight line so as to avoid the cable from damage due to the cable bending.

- 4.2.3 Hanging up of Pulley

4.2.3.1 On the first poles or towers neighboring the pulling field and tension field, the angle pole or tower, and the poles or towers having large height difference, the pulleys diameter is not less than 600 mm (or using combined pulleys of 400 mm).

4.2.3.2 For the paying-off through angle pole or tower, the pulley will experience a process that the droop of the pulley tends to decline towards the interior, so it is necessary to take measures to stabilize and fix the pulley and prevent the pulley from up and down shake. When the pulley shaking up, pressing cable measures should be taken to prevent the pulley from shaking up. When the turning angle is larger thereby needing to employ combined pulleys, the combined pulleys should be linked rigidly.

- 4.2.4 Deploying and Elevation of Pulling Rope

4.2.4.1 The pulling rope is deployed manually; the ropes are divided according to their drum length, and jointed with swivels. The jointing operation must be done by specialized persons; after the deployment is completed, all the pulling ropes should be checked to see if their jointing is perfect.

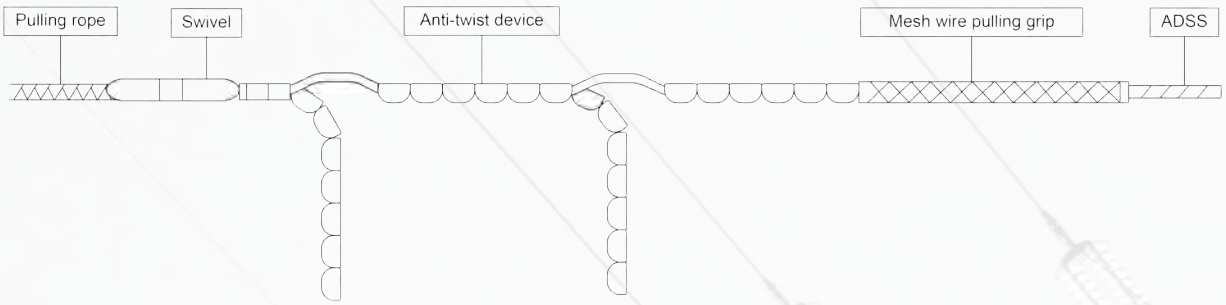
4.2.4.2 When using pulling ropes and swivels, they must be checked to see if there is any breakage or deformation. Disqualified pulling ropes and swivels are strictly prohibited. After the deployment of pulling ropes is completed, the ropes should be elevated into the groove of the paying-off pulleys on every pole or tower.

IV. ADSS Deployment Process

- 4.2.5 Jointing of the Pulling Ends

During the paying-off process, the optical fibers in ADSS easily suffer from affection and damage due to the twist of ADSS, therefore preventive actions should be taken to ensure the ADSS without twisting.

4.2.5.1 After the cable end is pulled from the drum, it cannot be winded directly on the tensioner. It will be appropriate to use a cord winding on the tensioner first and then pull it passing through to avoid excess torsion. After the cable is out of the tensioner, its jointing mode with the pulling rope is ADSS mesh wire pilling grip—anti-twist device—swivel—pulling rope



4.2.5.2 If the ADSS has a larger diameter, it is allowable to use two swivels tandem linked through steel wire rope instead of using an anti-twist device.

IV. ADSS Deployment Process

4.3 Deployment Process of ADSS Cable

- 4.3.1 The Checking and Requirements before Deployment

4.3.1.1 Checking the position, width, height, structure, and overall stability of the span supporting frame.

4.3.1.2 Checking the arrangement of pulling field and tension field.

4.3.1.3 Checking if the personnel of all positions are in their own places, if the interphones are communicating well, and if there are faults along the link.

4.3.1.4 The commissioning operation of the puller and tensioner should be normal, and break and safeguard should be reliable. The central axis of the pay-off stand should be in horizontal status.
Check if the jointing of the pulling end is firm.

4.3.1.5 Before paying off the cable, the nails on the drum and all the obstacles around the pay-off stand must be removed.

- 4.3.2 Deployment of the ADSS

4.3.2.1 Adjusting and controlling the tension on the cable according to the parameters given by the technical department, the paying-off tension is generally controlled within 10% RTS, and the maximum tension does not exceed 20% RTS. The pulling force should be controlled according to the value set by the technical department.

4.3.2.2 The initial paying-off speed will be 5 m/min, after the ADSS passing though the first pole or tower. The speed can be increased uniformly up to about 30 m/min, and the maximum paying-off speed should not exceed 40 m/min. The cable should go ahead at a uniform speed as possible; both sudden acceleration and deceleration are prohibited strictly, and shaking during the paying-off is prohibited strictly.

4.3.2.3 When paying-oft, the top of each angle pole or tower and the crossing points must be watched by specialized persons so that if a cable is clipped or other circumstances occurred, they can respond and report to the field principal in time. When the cable end and anti-twist device approach near the paying-off pulley, especially near the paying-off pulley of the angle pole or tower, the paying-of speed should be decreased uniformly, let the anti-twist device passing through the pulley favorably under the supervision of the specialized person. Then the speed may be increased uniformly up to the original pulling speed.

4.3.2.4 During the installation, the operation persons of the tensioner should constantly pay attention to the tension controlling circumstances; during the pulling process, the following circumstances should be considered abnormal: the pulling force suddenly increases significantly, and the hardware group which is used suspending paying-off pulley, excessively decline. In these cases, stop the tensioner in time, only after the causes are found out, and the troubles are removed, can the pulling operation be continued.

4.3.2.5 The minimum bending radius of the cable should be kept above 400 mm. When the cable paying-oft is broken off during the installation, the cable on the pay-off stand being further pulled out should be stopped in time by using a hand brake or friction lever. Otherwise, the cable may be damaged due to bending. At the same time, torsion should be avoided on the cable.

4.3.2.6 The cable is not allowed to fall to the ground during the deployment process; it is necessary to keep the cable at a certain safe distance from its crossing objects. All signaling persons should watch the cable deployment circumstances at any time and notice to adjust the tension in time so as to avoid the cable from being worn or folded due to the collision with installed wires and the span supporting frame, or other obstacles.

4.3.2.7 After the cable deployment is completed, the pigtail cable should be held, and its length should be not less than the height of the splicing pole or tower plus an additional 15 m for jointing or standby. The pigtail cable should not come into contact with the ground and should meet the requirement for a minimum bending radius of the ADSS; the case of barbaric bending is prohibited strictly.

- 4.3.3 Temporarily Fixing of ADSS and The End Anchoring

If the deployment of the ADSS can not be completed in one day, or the deployed ADSS can not be tightened and hung up on that day when the deployment is completed, in the pulled end and tensioned end, the ends of the pulling ropes and ADSS should be temporarily anchored using special-purpose clamping tools for them. It will be appropriate to make the slack between the anchoring point of the tensioned end and the tensioner able to remove the pulling force applied to the puller and tensioner. Still, the ADSS should not be excessively lax, and the ADSS should not be contacted with ground. Corresponding anti-twist measures should be taken in anchoring.

4.4 Sagging and Tensioning of ADSS

- 4.4.1 Observation of the ADSS Sag

The sag of the ADSS should be based on the value specified in the design; both the excessively large and small slacks will decrease the safety factor of the cable link.

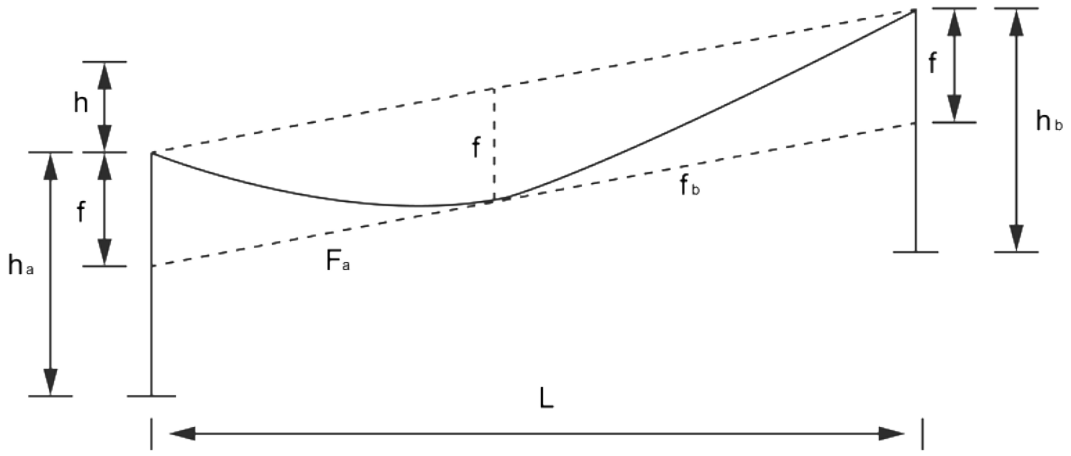
4.4.1.1 Choice of observation Span

in the continuous spans from the puller to the tensioner, the span with a more considerable span length and a minor height difference, which is in the middle span or near the middle span, is chosen as the observation span. If the number of spans is more significant, two observation spans should be selected from both ends. Choosing the span where a tension-resistant pole or tower exists is not advisable for exceptional cases.

4.4.1.2 Sag Observation with Equal Length Method

The equal length method is the most common used observation method, and features easy mastering and high accuracy, and The concrete operation method is as follows: measuring a length f below the suspension points of the A, B poles or towers, which are within the observation span.

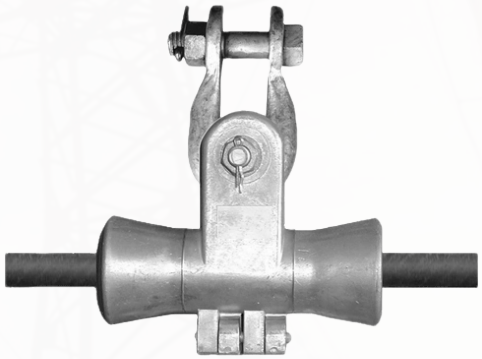
This length is just the sag value given by the technical department, binding two transverse observation plates at the f position. If the lowest point of the visual sag is in the same straight line with the transverse plates f and f, this sag will be the required f value. Utilizing equal length method to measure the slack should meet the following conditions: H<20%L, f≤h.-2 and ≤h.-2.



- 4.4.2 Tensioning and Hanging up of ADSS

4.4.2.1 Before the ADSS is tensioned, check first to see if there is any damage with the deployed cable, if there is any obstacle, and tangle and block at the crossing point if the pulling field is getting ready; if' the slack observers have been in place if the communications equipment is operating well, and if the personnel for tensioning the cable and the tools are getting ready.

4.4.2.2 After the ADSS is pulled up to in place, on the ton of the tension-resistant poles or towers from the puller to the tensioner, a special-purpose tangent clamp for ADSS is mounted, then the ADSS is hung up on the first pole or tower neighboring the tensioner is released. The fixed end is gradually and slowly loosened. If there are no special-purpose tangent clamps, dead end clamps can be used temporarily.
The ADSS tensioning starts at the puller end, where a tensiometer is hung on the first pole or tower. The cable tightening tension should be not more than 20% RTS to ensure the fiber's performance is not to be affected.



4.4.2.3 When the tensioning of the ADSS makes the sag approach the predetermined value, the pulling should be slowed and even stopped; instead, a chain hoist should be used to adjust the sag to achieve pre-determined requirements, made a mark on the ADSS, and wrapped colored adhesive fabric on the sides of the mark. If the error of the tensiometer is larger, the visually observed sag should be regarded as the criterion.

4.4.2.4 After the mark is made, hardware can be directly mounted on poles or towers starting from the pulling end (pay attention to meeting the minimum safe distances to the live lines, which can be seen in Fig. 2); it is also allowed to put the cable on the ground and mount it on hardware, then use a chain hoist to elevate the cable and tension and hang it up.

4.4.2.5 During the cable tensioning process, excessive pulling should be avoided; after hanging up the cable, the pulling rope should be released back slowly. At the same time high-speed pulling of the cable, the deformation circumstances of the dead-end clamps and the poles or towers due to the force applied should be observed

4.4.2.6 The hanging point of the ADSS should be chosen at the position where the electric field is relatively weak. The range of suitable electric field strength for different sheath materials is that: for anti-track sheath material ≤25 kV/m; for polyethylene sheath <12 kV/m.

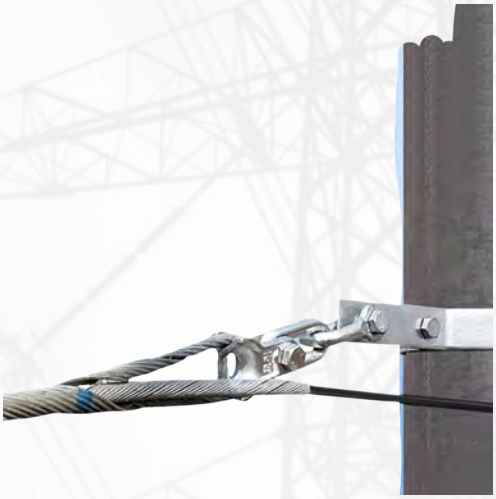
4.4.2.7 In the whole section from the pullers to the tensioner, after the cable tensioning is completed, the mounting of hardware should be completed in a short period to prevent the cable surface from being worn within the pulley or prevent the optical fibers from being damaged owing to the cable excessively fatigued from vibration.

V. Hardwares and Accessories

The main hardware for ADSS includes a dead-end clamp, suspension clamp, and spiral vibration damper. Corona coil, download clamp, special-purpose joint box for ADSS, etc.

5.1 Deadend Clamp

It is mainly mounted on terminal poles or towers, tension-resistant poles or towers, angle poles or towers for turning angles over 60°, or poles and towers with large height differences.
The ADSS can sustain relatively large tension when fixed on poles or towers. The preformed dead-end clamps can provide a relatively large holding force while ensuring the ADSS is within its allowable crush resistance range. Generally, each pole or tower has two sets of dead-end clamps, and the terminal pole or tower is supplied with one set.



- 5.1.1 The standard dead-end clamp should include internal layer structural reinforcing rods, outer layer preformed rods, thimble clevis, U-shape ring, extension link, bolt, nut, etc.

- 5.1.2 The Mounting Method of Deadend Clamp: Mounting internal layer structural reinforcing rod, The mounting position depends on the sag

Step 1: The tension of the cable, which has finished adjustment, and the two ends of the mounted internal layer structural reinforcing rods should be even.

Step 2: Mounting outer layer preformed rods, During the mounting process, there is a mark on the middle part of the outer layer preformed rods, this mark will show you to symmetrically wind for two ends when mounting the outer layer preformed rods.

Step 3: Mounting thimble clevis. The mounting position will be in the mark placed on the outer layer of preformed rods.

Step 4: Mount the first U-shape ring.

Step 5: Mounting extension link.

Step 6: Mount the second U-shape ring, which is linked together with the pole or tower's fasteners.

5.2 Suspension Clamp

It is mainly mounted on straight-line poles or towers, and the angle poles or towers for < 25° of turning angles. The ADSS is hung up on the poles or towers with it, which will play a supporting function, and one set of suspension clamps is mounted on each pole or tower.

Double suspension clamps are recommended when the turning angle is between 25- 60 °, or the span is relatively large.

- 5.2.1 The standard suspension clamp should include internal layer structural reinforcing rods, outer layer preformed rods, elastomeric insert clamp, casting aluminum shell, U-shape ring, bolt, nut, etc.

- 5.2.2 The Mounting Method of Suspension Clamp:

Step 1: Mounting internal layer structural reinforcing rods. There is a mark on the middle part of the internal layer structural reinforcing rods, This mark is symmetric about the two ends of the structural reinforcing rods. The suspension clamp is mounted from the mark place, and the two ends of the mounted internal layer structural reinforcing rods should be even.

Step 2: Mounting elastomeric insert clamp. It is mounted at the marked place in the middle of the internal layer of structural reinforcing rods.

Step 3: Mount the outer layer of preformed rods. There is also a mark on the middle part of the outer layer of preformed rods. This mark should be placed in accordance with the mark placed in the middle of the internal structural reinforcing rods.

Step 4: Mount the casting aluminum shell in the middle of the outer layer of preformed rods and tighten the bolt.

Step 5: Mounting a U-shaped ring is linked to the fasteners of the pole or tower.

5.3 Spiral Vibration Damper

It is mainly mounted on both ends of ADSS hardware; it mainly acts as the damper of the ADSS vibration and prevents ADSS from damage due to vibration.

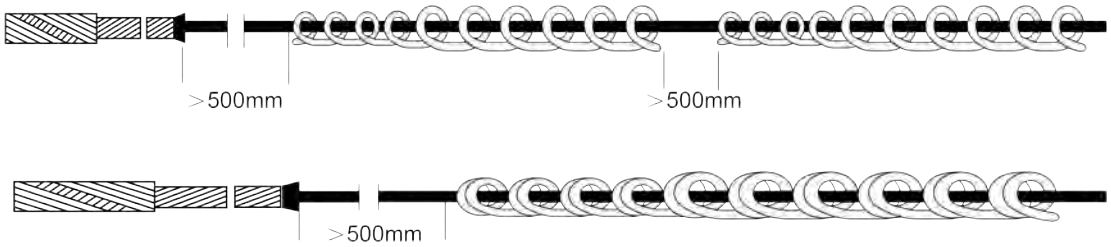
- 5.3.1 The spiral vibration damper consists of gripping section and damping section.
- 5.3.2 Mounting Principles of Spiral Vibration Damper. When mounting a spiral vibration damper, one needs to pay attention to the gripping section of the spiral vibration damper being towards the direction of the pole or tower. Their allocation quantity and mounting distance should follow the specifications in Fig.5.

If the conditions are allowable, the distance from the spiral vibration damper to the end of the mounting hardware should be as far as possible to prevent electric corrosion effectively.

In addition, Zion can provide a patent anti-track spiral vibration damper.

Fig.5 Mounting and allocation principle

Span	<100m	100~250m	250~500m	250~500m
Quantity of spiral vibration damper	No Need	One piece at each side	Two pieces at each side	Three pieces at each side



5.4 Corona Coil

It is mainly mounted on the ends of the hardware, which is used in power lines above 110 kV.
It can decrease the electric field at the ends of the hardware and at least double the corona voltage on the surface of the ADSS sheath at the hardware end. Each pole or tower is provided with two pieces, and the terminal pole or tower is provided with one piece.

- 5.4.1 The corona coil consists of gripping section and coil section.
- 5.4.2 Mounting Principles of Corona Coil:

The gripping section of the corona coil is mounted on the internal layer of structural reinforcing rods; the distance from the end of gripping section to the end of the internal layer structural reinforcing rods will be about 400 mm.

5.5 Downlead Clamp

It is mainly mounted on poles or towers with dead-end clamps, which fix the ADSS and prevent the sheath from scraping when the ADSS swing touches the pole.

- 5.5.1 The basic constitutional parts should include fixing elastomeric pad, bolt, nut, etc
- 5.5.2 Mounting Principles of Downlead Clamp:
  5.5.2.1 On the poles or towers with cable joints, the downlead clamps are mounted at an interval of 1.5~2.0 m in principle.
  5.5.2.2 On the poles or towers without cable joints, two downlead clamps are mounted to fix the cable.
  5.5.2.3 On the terminal pole or tower, several downlead clamps are used to fix the cable on the pole or tower.

5.6 ADSS Tray and Special Joint-box

After each drum of cable is installed, a sufficient length of redundant cable must remain on the pre-determined cable jointing poles or towers. The redundant cable is coiled on the redundant cable tray, and the diameter of the cable tray should meet the ADSS's bending radius requirement. In addition, the special-purpose joint-box for ADSS, which Zion provides, is employed so that good electromagnet aging resistance and damage resistance against external force are achieved.

- 5.6.1 Mounting Method of ADSS Special-purpose Joint-box

Step 1: Tidy up the remaining cable, cut off damaged or excessive cable, strip the pair of cables to be joined, and account for the remaining sufficient length of loose tubes.

Step 2: Take the stripped cable through the cable entering hole, using the cable fixture out of the base to fix the ADSS, letting the loose tubes getting into the fiber tray and binding them tightly using Nylon binding tape.

Step 3: Fixing the central strength member of the ADSS in the strength member bracket, remove the loose tubes, clean fibers gently using alcohol-immersed cotton, then spool the fibers in the fiber tray, slipping a thermally shrinkable tube over any one of The pair of fibers to be spliced. After the fibers being fusion spliced, slipping the thermal shrinkable tube to the position so that the splice of the fibers will be in the middle of the thermal shrinkable tube, heating the thermal shrinkable tube and making it being melted together with the fibers, finally press the protected fiber splice into one of the fiber distribution grooves.

Step 4: Putting the pre-remained fibers uniformly into the fiber distribution grooves, after all the fibers are spliced (in general from bottom gradually up to top), covering a cover over the top layer. Wrapping a self-adhesive tape at the cable entry position, then fixing the cable using semicircular clamper based on the cable diameter, and sealing with adhesive. Covering the joint-box cap and linking up the locking tape, straining the two sides uniformly utilizing screws so that getting them combined tightly.

Step 5: The joint-box is mounted in the appropriate position of the main material or declined material of the pole or tower, having a certain height from the ground. It is necessary to prevent from man-made and mechanical destroying. The mounting should be firm and keep unified all over the link.

VI. Splicing and Testing

6.1 Splicing of Optical Fiber

When everything of the ADSS is finished tensioned provider and all hardware attachments mounted up, the ADSS is almost ready to be in service. This is the point where optical fibers should be joined together, and the optical attenuation monitoring for confirmation up to the end to assess if any fiber was defective. It is normally emphasized to ensure the optical attenuation at a wavelength of 1550 nm and the results should be analyzed and kept. The optical fiber fusion splicing method uses the principle of producing an arc using high voltage discharge, which in its turn melts the end part of both fibers, hence fuses the fibers together. Although often residuals left behind in the form of bare optical fibers in the splicing process, the process must be done by professional individuals using the fusion machine made specially for this purpose. We, Zion, are capable of executing in-field fusion splicing.

6.2 Final Acceptance Testing

Following on, transmission experiments should be done with the bi-directional whole-link testing – where optical fiber loss in one direction is observed and averaged – in determining a number of issues, including to achieve the metrics that fit the provisions of the contract specifications. The contract services given to the optical time-domain reflectometer (OTDR based) employs the single link loss measurement, the average link loss is determined from the results of the tasting. In fact, the use of optical power conducts cable which include the whole-link non-link directive and assesses fiber positioning with. As for the cable circuit and fusion splicing point fiber circuit diagram, the technical report should also include cable drum and the data recording for the further inspection and tests should also be made.

VII. Documents on File

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.

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.

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.

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