

ADSS Cables

Installation Guide

This document presents Teldor Cables and Systems' recommendations for installation of its ADSS cables. Issues related to installing cables in the proximity of high voltage power cables are not discussed in this document.

This document is intended for use solely by those with adequate and suitable experience, knowledge, equipment and trained personnel to plan and execute any or all of the actions herein described.

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1. General

This document provides general information for installing Teldor Cables and Systems' ADS Series ADSS (All-Dielectric Self-Supporting) fiber optic cables. Every installation is influenced by local conditions.

The reader should be experienced in aerial fiber optic cable placement.

This guide contains references to specific tools and materials in order to illustrate a particular method. Such references are not intended as product endorsements.

2. Safety Precautions

This section discusses some basic safety considerations applicable to aerial cable installations.



Warning

- Cable installation in general and ADSS cable installation in particular requires skill and know-how. Never attempt to install ADSS cables with unskilled personnel.
- Use protective leather gloves and, if necessary, rubber gloves. Use the leather gloves when climbing or descending a pole, and when working with sharp instruments or materials. Wear rubber gloves when working near exposed electrical circuits.
- Use a safety harness on all bucket trucks and aerial lifts. A body belt and safety strap for the bucket or platform must be used when the equipment is in operation to minimize the chance of injury.
- Before climbing a pole, inspect it for significant deterioration and safety hazards; splintering, insect nests, sharp protrusions, etc.).
- Position all motorized equipment so that exhausts are directed away from the location where most work will be done.
- Under extreme conditions a cable under tension may snap free and cause injury. Therefore, unless absolutely necessary, personnel should not remain in an area where a cable is being pulled around a piece of hardware under tension. If needed, the installer can remain in such an area if he or she stays clear of the hardware under tension and has a clear path to safety.
- Keep hands free of tools or materials when climbing or descending a pole or ladder. Do not step on cables, cable enclosures, or suspended equipment which might provide unsafe footholds.

- Read the entire guide before starting a cable installation. Thoroughly understand the procedure, its precautions, as well as the tools and equipment required before starting work.

3. Cable Handling



Caution

Care must be taken to avoid cable damage during placement and handling. Fiber optic cables are sensitive to excessive pulling, bending, twisting, crushing and impact forces. Any such damage may alter the cable's characteristics to the extent that the cable section may have to be replaced. To ensure all specifications are met, consult the cable's data specification sheet for the cable you are installing.

3.1 Installation Tension

There are two different tensions to keep in mind during installation of ADSS cables. One is the maximum pulling tension during installation; the other is the span tension.

The maximum tension during installation depends on the cable construction and design. Values for standard Teldor ADSS cables are given in our data specification sheets.

After the cable is pulled in, it is placed in the pole hardware under tension. This tension, referred to as the span tension, is calculated for each cable to achieve a 1% installation sag at different environmental conditions. Such conditions are defined as Light, Medium and Heavy, reflecting different wind velocity and ice buildup on the cable.

3.2 Minimum Bend Radius

Excessively sharp bends can damage the fibers in fiber optic cables. The minimum bend radii for both tensioned and no-tension conditions are found on the cable data specification sheet. As a general rule, the minimum bend radius for a non-armored cable is as follows:

- Cable under load - 20 times the nominal outside diameter of the cable
- Cable under no load - 10 times the nominal outside diameter of the cable.

3.3. Installation

During aerial cable installation, the cable is pulled along the cable route through temporary support hardware installed for this purpose. This method is described in Section 5 below.

A complimentary installation technique is often used where the cable is coiled on the ground in a "figure-eight" configuration. This technique is often used in order to pull the cable in both directions from a central location.

The "figure-eight" configuration is shown in Figure 1. The "Figure-Eight" coil should measure at least 10 m by 5 m and be protected from passersby.

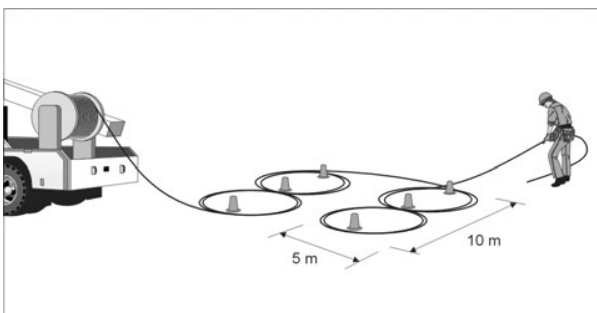


Figure 1: Laying down a cable in "figure eight" configuration

When long lengths of cable need to be unreeled, there is a danger that the weight of the coils may damage the cable at the bottom. This can be prevented by spreading the cable out into several figure-eight coils as shown in Figure 1.

In order to pull from a figure-eight coil, it is sometimes necessary to turn it over to expose the cable end. This task usually requires three people, one at the center and one at each end.

3.4 Cable Drum Care and Inspection

- Leave the protective covering on the drum intact until it arrives at the installation site. Upon removal of the protective covering, inspect the cable jacket for signs of damage.
- If the covering has already been removed, secure the cable end(s) during transit to prevent damage. Cable drums should be stored vertically on their flanges and chocked to prevent rolling.
- Teldor Cables and Systems recommends measuring the fiber attenuation in the cable just prior to installation using an Optical Time Domain Reflectometer (OTDR).

Make sure to have on hand the data sheet for the specific cable to be installed in order to have first hand information about its mechanical properties.

- During installation, periodically inspect the reel to ensure that the through-bolts do not loosen. Tightening them will ensure that the cable pays off the drum correctly.

4. Planning and Preparation

Prior to beginning an aerial cable installation, careful planning and preparation are necessary. Representatives of each organization potentially affected by the installation (utilities, street department, police, etc.) should be present during the route survey. Approval by all necessary parties should be secured before detailed planning begins. A few of the issues to be considered are listed in the following paragraphs. Planning should be undertaken jointly by construction and engineering personnel. Hardware requirements should also be considered at the planning stage.

4.1 Route Planning, Pole Selection and Authorization

- Determine the ability of existing pole lines and guys to support the new cable, as well as any restrictions imposed by the pole owner. The anchoring and guying of the cable is crucial for its safe operation. Ideally, the guying should remove all of the lateral stress on each pole so that the pole simply supports the weight of the cables, hardware and equipment attached to it. Your company's normal specifications concerning anchoring and guying of poles should be followed.
- Set new poles only when there is no existing utility and when a reasonable alternate route does not exist. Written permission must be obtained from the proper authorities before placing new poles, and all other utilities having underground plant in the area must be contacted so they can locate and mark their facilities prior to new pole placement.
- Examine the ability of existing dead-end poles to withstand the temporary stresses of installation. Because it is impractical to tension each of the spans along the route simultaneously, a dead-end pole will be subjected to an unbalanced load as the cable is tensioned on one end of the cable run before the other. This temporary unbalanced loading can be relieved by placing temporary guy wires on tangent poles where there is no down guy. Determine whether temporary guying is needed according to your company's standard route engineering guidelines.
- Ensure proper clearance from electric power lines and other cables that may sag near the fiber optic cable. Determine the clearances between the proposed fiber optic cable plant and existing facilities on a case-by-case basis by referring to local safety codes, and your company's standard operating procedures.

4.2 Installation Planning

Planning the actual installation should take place only after a thorough route survey.

4.3 Splice Locations and Cable Slack Requirements

- Select splice locations during the route survey and make plans for slack and splice closure storage. Splice locations should be placed to allow for the longest possible continuous cable spans and a minimum number of splices.
- The splice points should be chosen to facilitate later splicing operation and should be easily and conveniently accessible to a splicing vehicle.
- The amount of slack cable left at each splice point must be sufficient to reach from the pole's height to the planned splicing vehicle location on the ground. An additional 5 meters should be added onto this length to allow for closure requirements (Figure 3). This slack should be allowed for when planning the route and ordering cable. Leave sufficient slack at each future drop point to allow for splicing.

4.4 Pole Hardware

ADSS cable installations require a special tangent assembly or a mechanical dead-end at each pole. Wedge type clamps can be used as dead-ends in place of heliform designs. Use the following guidelines to identify the hardware needs of each pole:

- Line offsets of 0 to 20° (horizontal and/or vertical) require fiber optic tangent assembly (Figure 2)
- Line offsets >20° (horizontal and/or vertical) or at the ends of the cable require dead-ends (see Figure 3).

The cable must be properly tensioned as described in Section 7 before it is permanently secured into the tangent assemblies and dead-end fixtures. Section 8, ADSS Cable Hardware, provides guidance on installation of pole hardware.

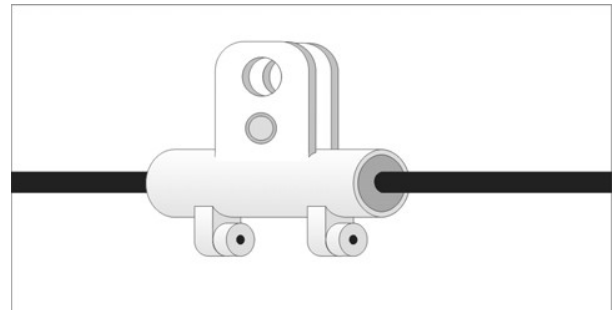


Figure 2: Fiberoptic Tangent Assembly

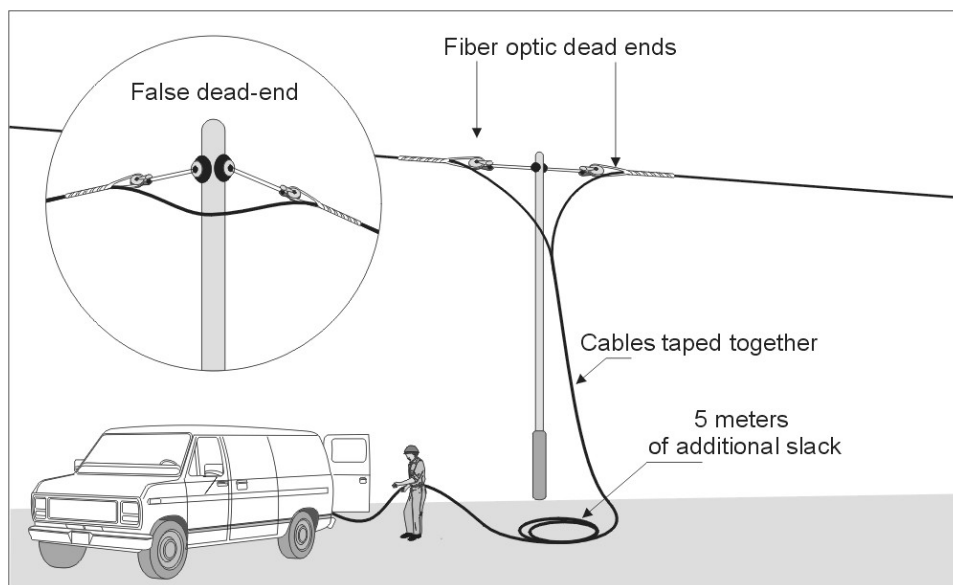


Figure 3: Dead-ends are needed for line offsets more than 20°

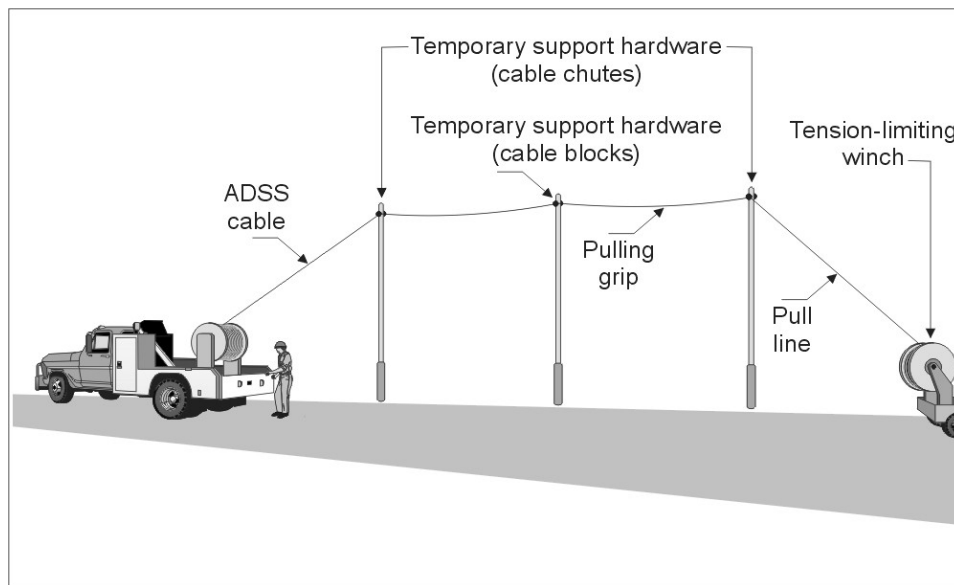


Figure 4: Stationary Drum Installation Method

5. Stationary Drum Installation Method

Using the stationary drum method of aerial cable installation, the cable is pulled along the cable route through temporary support hardware installed for this purpose (Figure 4). When the cable is in place between splice points, the cable is tensioned and terminated at each dead-end pole along the route. The cable spans are then lifted out of the temporary support hardware and placed in tangent clamps at each intermediate pole.

5.1 General Considerations

- Determine the cable drum and pull locations, each of which can be at any point along the route. The location of the cable drum and any subsequent intermediate pull points must be determined during the route survey. Some of the factors to consider are:
 - Where a significant elevation change occurs along the route, it is usually best to pull downhill.
 - The cable drum location should be accessible by the drum carrying truck, but removed from vehicle and pedestrian traffic.
- By using the "figure-eight" coiling procedure, cable from one drum can be pulled in both directions from a central point. The route can be subdivided into shorter pulls to:
 - Keep the pulling tension below the cable's rated installation strength.

- Avoid pulling across sharp turns.
- Maintain a line-of-sight along the entire cable route to account for obstacles
- Provide cable slack at designated points to allow for future drops.
- Compensate for insufficient temporary support hardware or personnel to cover the entire route.
- Installation time will be minimized if drums can be set up for continuous pulls in both directions from a splice point.
- Prevent damage to the cable during payoff:
 - Keep the cable drum leveled to avoid cable rubbing against the drum flanges.
 - Orient the cable drum so that the natural payoff direction is directly towards the first pole.
 - Pay out the cable from the top of the drum as shown in Figure 4 to eliminate possible cable contact with the ground.

5.2 Temporary Support Hardware

- Temporary support hardware must be selected and placed so as to maintain the cable's minimum bend radius throughout the route and to prevent the cable's entanglement on obstructions in the right-of-way.

5.3 Stringing Block Placement

- Hang the proper stringing block on each pole or support structure. 50 cm (or greater) blocks should be used for Any offset poles. The stringing block wheel should have a semi-circular profile suitable to the cable outer diameter
- 10° and 20 cm blocks are utilized for straight line poles (Figure 5).
- On poles with an offset greater than 10°, elevate the block by securing a rope to the shackle to ensure proper retention of the cable in the block. Attach the rope to one bottom pin of the shackle, bring the rope above the attachment point and back down to the opposite shackle pin.

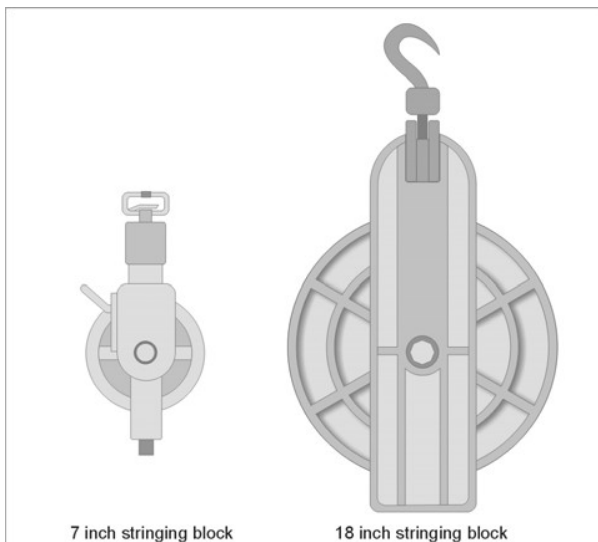


Figure 5. Stringing Blocks

5.4 Pulling Operation

- The pull can be accomplished by using a cable pulling winch. Care must be taken not to exceed the cable's rated pulling strength. The cable should be coupled to the pulling line with a double swivel eye and basket or "Kellam's" grip.(Figure 6).

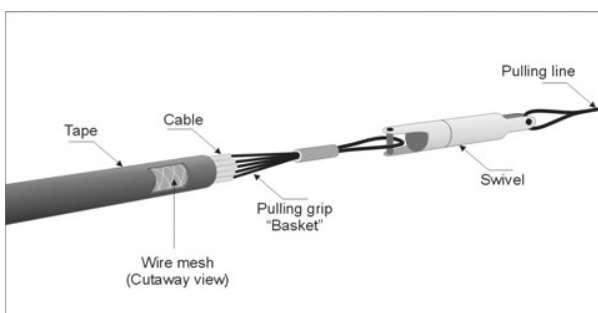


Figure 6. Swivel and pulling grip

- During the pull, sufficient personnel should be on hand to monitor the entire pull route. Two-way communication should be established between the pull point, the cable drum location, and each of the route observers.
- Start the pull very slowly as the cable is drawn from the drum at ground level up through the temporary support hardware located atop the first pole. Once the cable end is past the first pole, the pulling speed can be gradually and steadily increased. If sufficient support hardware is in place, pulling speeds on the order of 50 m per minute are typical.
- Observers at the pull point drum location and along the pull route must be alert for any condition which might cause cable damage and be able to stop the pull immediately if any damaging conditions are observed:
 - Avoid exceeding the cable's rated pulling strength and bending the cable beyond its minimum bend radius.
 - Control the unreeling of the cable either by hand or with a cable drum brake in order to prevent free-running or jerking of the cable.
 - At the pull point, winch the cable so as to prevent either free-running or jerking of the cable. If either is observed, the pull must be halted until the cause is eliminated.
- Excessive oscillation or surging of the cable can be damaging. Reduce the pulling speed or add additional temporary support hardware to minimize these conditions.
- When the cable reaches the pull point, do not allow it to engage the winch unless the winch maintains the cable's minimum bend radius.
- Pull the amount of cable specified in the route plan and pull plan. This amount should include all slack requirements as outlined above.
- When the cable has been pulled into place as specified by the route plan:
 - Install a dead-end on one end of the cable span at the cable drum end as outlined in Section 8.
 - Complete any pole modifications or additional temporary / permanent guying, as well as the installation of the dead-end and tangent clamp pole fixtures (see Section 8).
 - Proceed to Section 7 for instructions on tensioning and terminating the cable.

6. Cable Tensioning



Caution

Proper measuring of tension is critical for a safe installation of the aerial plant. Please read and understand all of Section 7 before attempting to apply tension to the cable.

6.1 General

After the proper amount of cable has been placed in temporary support hardware between the dead-end poles, the cable must be properly tensioned before it is permanently secured into tangent assemblies.

With a dead-end fitting already in place on one end of the span, the cable is tensioned by pulling on its opposite "free" end with a chain hoist, using the setup shown in Figure 7.

Once the cable sections are under the required tension, the "free" end of the cable is terminated into a dead-end described in Section 8.

6.2 Tensioning Operation

Note: Before beginning this stage of the installation, any pole modifications or additional temporary / permanent guying must be completed.

- Proceed to the end of the cable section which does not have a dead-end fitting already in place from the cable installation procedure. Pull out all cable slack between the dead-end poles.
- Install a temporary dead-end (as described in Section 7) approximately 3 to 4 meters away from the pole.

- Set up the temporary dead-end, a chain hoist, an in-line dynamometer, and other hardware as shown in Figure 7. Typically, the chain hoist is strapped to the dead-end pole. Specific operation of the chain hoist should follow manufacturer's recommendations.
- Apply tension to the cable with the chain hoist. During the tensioning operation, do not exceed the limits of maximum allowed pulling tension for the cable and the strength of the poles themselves. For long spans under high tension, it may be necessary to use two chain hoist temporary dead-end set-ups in succession to take out the slack and achieve the necessary tension.
- The tension can be initially monitored at the dead-end pole with the dynamometer shown in Figure 7. When tensioning several straight spans (with few offsets), it may be necessary to use false dead-ends even though the pole offset is less than 20° (Figure 13). This may be necessary to ensure that a 1% installation sag is maintained for all spans.
- The number of spans between false dead-ends will vary, depending on the route and span lengths, but up to 20 straight pole spans are typical before false dead-ends should be used.
- Once the cable section is under the required tension, terminate the cable into a dead-end as described in Section 8. The dead-end should be placed on the cable where it reaches the pole fixture, unless allowances are being made for grade changes or turns.

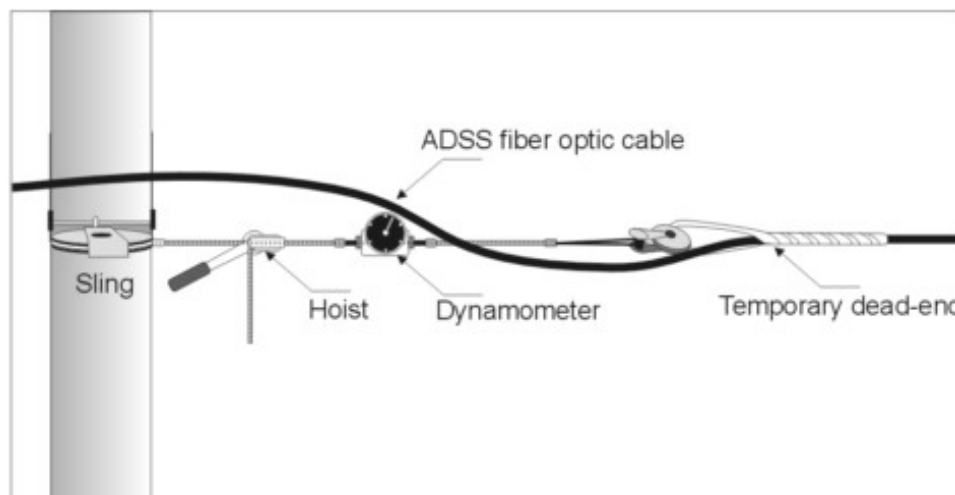


Figure 7. Tensioning equipment

6.3 Tensioning Across Turns and Grade Changes



Caution

As the cable is placed under tension, weaknesses in the cable plant can cause failure of pole fittings, support hardware or even the poles themselves.

The risk of death or injury due to such failures is best minimized by keeping all but essential personnel clear of the tensioning operation. Nobody should be allowed to climb intermediate poles as the span they support is being placed under tension. If possible, passersby on the ground should be kept away from the poles during this operation.

- While monitoring the tension, move the cable from the temporary support hardware at the inside turn to the cable's permanent support hardware on the pole.
- As the cable is pulled out to the pole, tension will increase. Take care not to exceed the maximum pulling tension of the cable or the capacity of the poles and hardware. It may be necessary to relieve tension by backing off with the chain hoist at the dead-end pole. Continue this process until the cable is in place on the pole at the inside turn.



Caution

Temporary support hardware used to restrain a cable being tensioned will be subjected to a significant portion of the cable's tensile loading and must be mounted accordingly.

Do not allow personnel on the inside turn pole while tension is being increased at the dead-end pole. If personnel are sent up the inside turn pole, they must stay on the pole side opposite the cable.

7. Vibration Damping

Vibration dampers must be installed at the same time the cable is clipped in to suppress Aeolian vibration which can be induced by local environmental conditions. Experts in the field state damage caused by Aeolian vibration is at its peak in the first 24 to 48 hours after sagging and dead ending than during any other period in the life of the cable.

Within the cable bend radius and limitations discussed in Section 3, the cable section may extend across turns and grade changes in the pole line. Since an ADSS cable is normally placed in the permanent support hardware after tensioning, any change in pole line direction complicates the process. Two possible cases are discussed below.

a) Cable on inside of turn:

As the cable in this situation is tensioned, the cable will naturally tend to pull inside of the corner pole. A horizontally mounted stringing block (per Figure 5) will keep separation to a minimum.

Tension the cable in stages:

- Tension the cable to the degree planned from the dead-end pole.

b) Cable on the pole at a grade change:

- The procedure used to tension the cable across a change of grade is similar to that used on an inside turn. The cable will pull up or down, depending on the direction of the grade change, rather than horizontally as in the case of an inside turn. Temporary support hardware must be mounted accordingly.

Spiral vibration dampers are recommended to be used on all ADSS installations where voltages are below 230 kV. These types of dampers are very effective in damping. They do not cause damage to the ADSS cable sheath. Since they don't require patch rods they are easy to install and are very economical.

8. Hardware

Teldor Cables and Systems does not recommend a specific hardware manufacturer. It is important, though, to use high quality hardware from reputable manufacturers in order to assure a long term reliable and safe ADSS cable installation.

In order to select the proper product the installer must know the following:

- nominal outside diameter of the cable
- degree of offset from one pole to the next
- maximum cable tension under fully loaded conditions
- When ordering dead-ends, it is important to ensure that all other necessary pole hardware is ordered. (see Figure 8) These items include:
 - thimble clevis
 - eye nuts
 - extension links (to maintain cable minimum bend radius)
- Determine the proper attachment location of the cable on the poles. Mark the location of the attachment point on the cable with a wrap of tape.
- Drill the appropriate holes in wooden poles or apply band attachments to concrete or metal poles and mount supporting hardware accordingly.
- Refer to the manufacturer's recommended procedures for installation.
- Use vibration dampers to minimize wind effects.

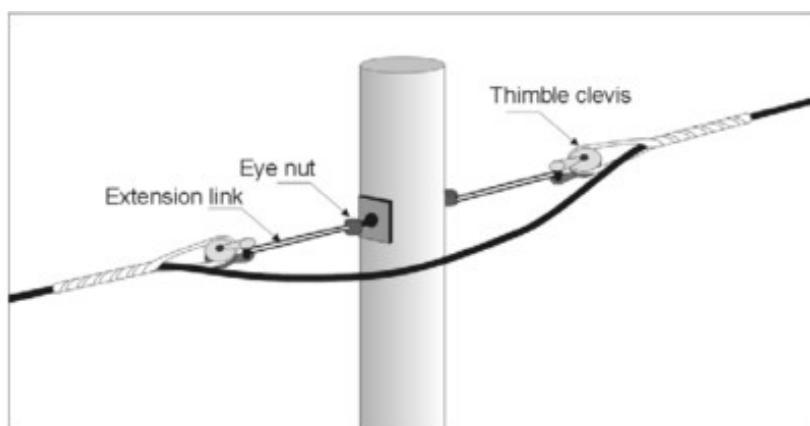


Figure 8. False dead-end