A Furukawa Company

PowerGuide® ADSS Cable
Installation Guideline for Long Span Utility Transmission Line Applications

Contents **Section**

1. Scope

1.1 This practice provides a general outline for network design engineers and outside plant construction personnel on the methods of installing an all dielectric, self-supporting (ADSS) Fiber Optic Aerial Cable for utility transmission lines. Typically span lengths for transmission line applications are from 500 to 2000 feet. The methods and instructions are intended as guidelines as each installation will be influenced by local conditions.

1.2 OFS Fitel PowerGuide® Cable meets NESC loading requirements for heavy, medium and light loading conditions. Contact OFS Fitel Applications Eng. Dept. for sag and tension tables. NOTE: When requesting sag and tension tables be sure to specify the ruling span, the sag requirement, and the loading conditions.

1.3 Sag tensions greater than those shown in the sag and tension tables are not to be used unless specifically authorized by OFS Fitel.

1.4 Hardware not listed within this practice or the PowerGuide® Hardware Ordering Guide is not approved for use and is not to be used unless specifically authorized by OFS.

1.5 It is understood that a site survey should be performed for any installation requiring OFS PowerGuide® Cable with a complete understanding of this practice to ensure its proper use.

1.6 Application notes and installation practices which are referenced in this document can be obtained by contacting OFS at 1-888-Fiber Help (888-342-3743) or by visiting the OFS web site at www.ofsoptics.com.

2. Cable Description

2.1 PowerGuide® cable is a self-supporting, circular, all dielectric (ADSS) fiber optic aerial cable intended for use on utility distribution and transmission lines. This installation practice addresses ADSS installations on high voltage transmission lines.

2.2 Maximum tensions under worse case loading conditions (short term) for PowerGuide® cable designs are determined on a per job basis. A sag and tension sheet will be engineered for each cable design. The short term loading conditions for that particular job can be found on the sag and tension sheet provided by OFS.

2.3 The maximum allowable tension under normal continuous load (long term) is based on sag and span requirements. In most cases for distribution pole line applications the cable is sagged to meet existing cable plant which is an acceptable practice as long as the long term tension does not exceed the cable design's long term maximum rating. For transmission line applications, the final sag and tension is generally set by the long term tension for the ruling span from the sag and tension tables for the specific cable design. This is especially true where the cable incorporates the use of tracking resistant outer jacket material for applications where e-field space potentials are >12kv. The specifications for the pole attachment locations must be adhered to since the e-field space potential has been calculated based on the ADSS cable attachment location (section 4). If specific sag is required, check the sag and tension tables provided with the quote for specific loads for the cable provided. For further information contact OFS.

2.4 Proper considerations should be taken relative to clearance requirements with other facilities. Typically standard conductors and neutrals sag more in the warm summer months than in the winter months. Due to the PowerGuide® cables small linear expansion coefficient, temperature variations do not severely affect the vertical sag of the cable. Consult OFS cable design sag and tension table for accurate long term and short term sag and tension values. Use these values to determine the appropriate structure attachment location to maintain clearances with existing facilities and to clear obstructions. For applications where tracking resistant sheath material is in use for applications where the e-field space potential is >12kv, the attachment locations are pre-determined based on the e-field profile completed during the cable design process (section 4)

2.5 Cable Benefits

a) All Dielectric - no metallic or electrically conductive cable components.
b) Circular Cross Section - minimizes effects of vibration and ice loading compared to figure 8 designs.
c) Self-Supporting - integral messenger eliminates need for lashing.
d) One step installation process.

3. Electrical Stress Mechanisms: Dry Band Arcing and Corona

3.1 Dry Band Arcing - Over time the surface of the PowerGuide® cable jacket may become conductive due to rain or pollutants.

3.2 In space potentials greater than 12 kV, this could lead to an electrical stress mechanism called dry band arcing which can lead to degradation of the jacketing material. To protect against dry band arcing two classes of cable jacketing materials have been established per Section 3.7 IEEE 1222.

- **Class A**: Medium density polyethylene (MDPE) suitable for applications where the electrical space potential is less than or equal to 12 kV.
- **Class B**: Tracking resistant jacket (TR) suitable for applications where the electrical space potential is less than or equal to 24 kV.

3.3 It is recommended that the electrical space potential be calculated when installing cables in routes where the conductor voltage exceeds 69kv by completing OFS AN-203 and returning it to OFS. OFS can then provide e-field space potential profiles to determine the most suitable location for cable placement. To obtain a copy of AN-203 please contact our customer service department at 1-888-Fiber-Help (888-342-3743)

3.4 Corona – Corona occurs on both conductor and ADSS attachment hardware and can be seen with special light enhancing binoculars at night. In laboratory testing corona has occurred at space potentials as low as 16 kV. Unlike dry band arcing, corona is not a heat generating process. It discolors and may chemically change the jacketing material, which might limit the expected lifetime of the cable. To control corona, OFS recommends the use of corona coils when using tracking resistant cables (section 5). Corona coils effectively increase the onset of corona to above 30 kV, which is well above the maximum space potential voltage of 25 kV recommended for PowerGuide® TR cables. See section 5 for information on corona coils.

3.5 Vibration – ADSS cable designs under long term installation conditions may see either low or high frequency vibration during the service life of the cable design. Vibration dampers are recommended for ADSS cables especially for transmission line applications. Labor costs are minimal during the initial cable installations. Going back after initial installation of the cable for damper installations will carry a much high labor cost. Please refer to OFS Application Note

AN-812, *Recommendations for Vibration Damping,* and section 5 of this document for further information on vibration dampers.

4. Approved Vendor Hardware

4.1 Installation hardware for OFS PowerGuide® cable is available from either Preformed Line Products or Mosdorfer. Hardware part number information is provided on the sag and tension table for the specific cable design.

4.2 Dead End Assembly - each assembly comes complete with the dead end grip and the structural reinforcing rods (see Figure 1). The thimble clevis is included with dead end assemblies purchased from Tyco Inc. (Dulmison), Preformed Line Products, or through OFS (see Figure 1).

a) Dead end assemblies are used for line angle changes > 20° or 30° (which occur as a result of changes in direction or elevation), for cable splice locations, and cable start and end points.
b) Figure 1 identifies the associated hardware to be used with the dead end assemblies. Through bolts, washers and nuts are usually standard pole line hardware items that may be purchased through any local hardware distributor. Figure 1 identifies the use of an extension link with the dead end assemblies. The use of this extension link is recommended to maintain a uniform bend radius at dead end locations.
c) The use of this extension link is not mandatory as long as the cable minimum bend radius is maintained. For PowerGuide® cables the minimum bend radius is 15 times the cable outer diameter during dynamic conditions (during installation) and 10 times the cable outer diameter during static conditions (installed). For PowerGuide® AccuTube™ ribbon cables the recommended bend radius is 15 times the cable outer diameter for both dynamic (during installation) and static (installed) conditions.

4.3 Downlead cushion kits provide strain relief for the cable as it exits the dead end assembly to access splice locations, or as the cable exits the cable guard when making the transition from aerial to underground. Downlead cushion kits for attachments to structures are available from either Preformed Line Products or Tyco Dulmison (Figure 6).

4.4 Heliformed suspension units are for spans between 600 feet – 2000 feet and line angle changes which occur as a result of changes in direction or elevation up to 30 degrees. These suspension units may be substituted for dead ends for line angles from 20 to 30 degrees which occur as a result in changes in direction or elevation (Figure 2).

4.5 Tangent supports such as the Tyco Fiber Optic Support and the Preformed Line Products Fiberlign Dielectric Support are for spans up to 600 feet and line angles from 0 to 20 degrees which occur as a result of changes in direction or elevation. Tangent clamps may be installed as a fixed attachment or as a suspension attachment (figure 3).

4.6 Washers, machine bolts, eye nuts, thimble clevis, and extension links may be ordered through several different pole line hardware suppliers.

4.7 Vibration dampers are recommended and can be purchased through either Preformed Line Products or Tyco. See OFS Applications Note AN-812, *Recommendations for Vibration Damping* (Figure 4)

4.8 Corona coils (Figure 5) are intended to reduce electrical stress at the ends of the metal reinforcing rods of dead end assemblies. The corona coils are designed to be used with a specific size dead end. Corona coils are recommended for use with OFS PowerGuide® TR (tracking resistant) cable in applications where the e-field space potential at the attachment location exceeds 12 kv. Refer to OFS AN-811 *Recommendations for Electrical Stress Mechanisms* and AN-203 *Space Potential Calculation* for further information.

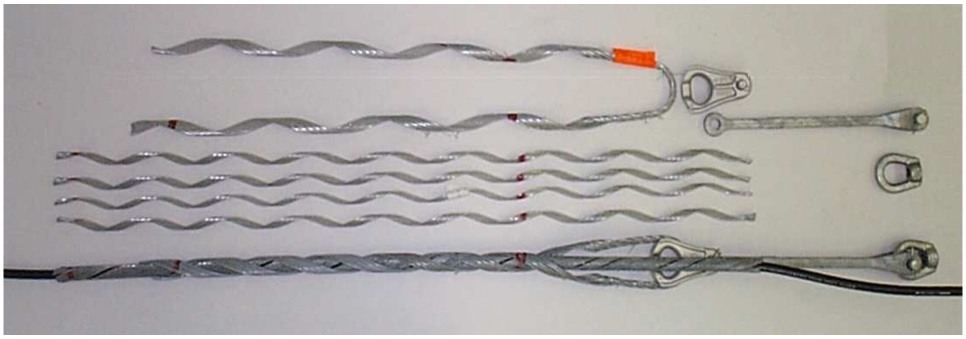

Figure 1 - Dead End Assemblies - used at start & end points, splice locations, and slack storage locations.

Figure 2 - Heliformed Suspension Units – used as intermediate attachments between dead ends for span lengths up to 2000 feet and line angles due to changes in elevation or direction up to 30°.

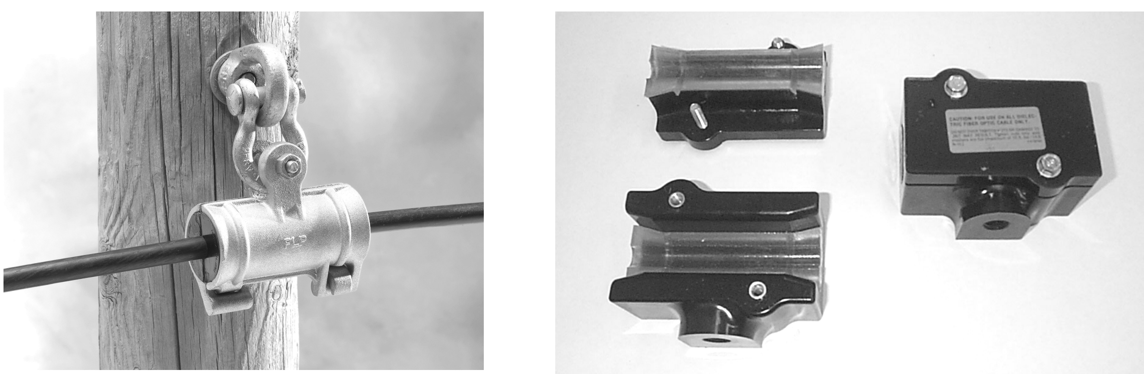

Figure 3 - Intermediate Suspension Attachments – used between dead ends for span lengths up to 600 feet and for line angles up to 20° due to changes in elevation or direction.

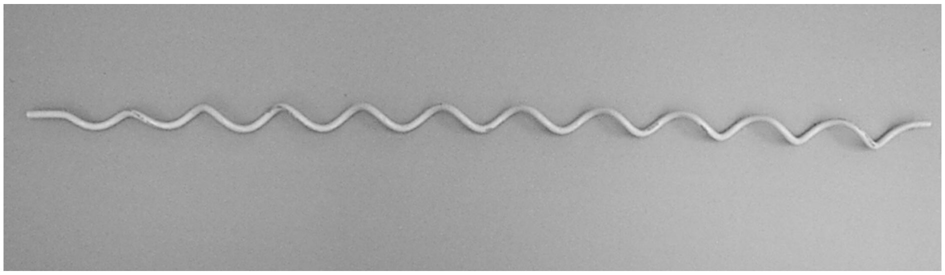

Figure 4 – Spiral Vibration Dampers – see OFS AN-812 *Recommendations for Vibration Damping.*

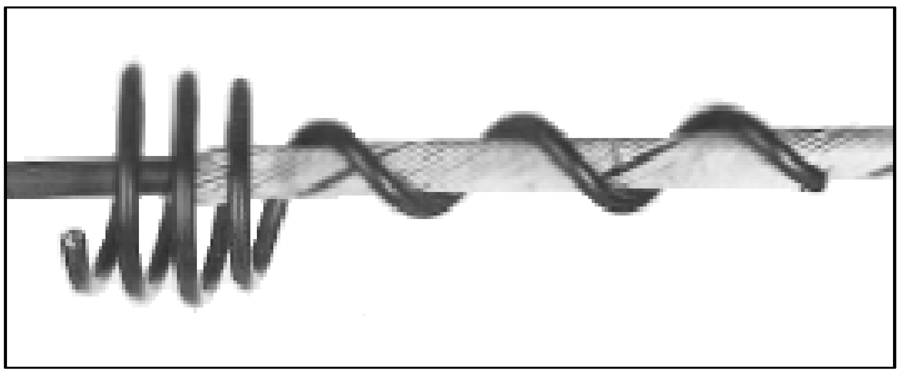

Figure 5 – Corona Coils – recommended for use with OFS PowerGuide® TR (tracking resistant) cable where e-field space potentials exceed 12kv.

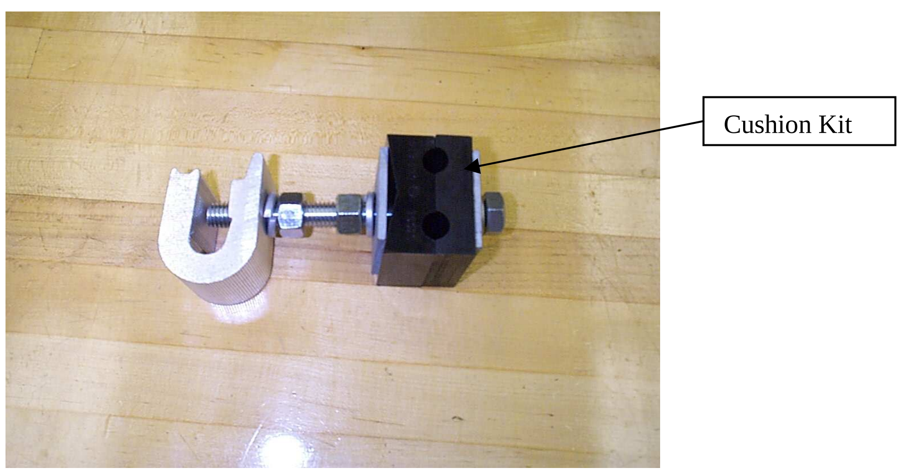

Figure 6 – Downlead Cushion Kits for use on either wood pole, concrete, or steel structures. The figure below is the set up for steel lattice towers. For wood poles applications, the cushion kit, washer, and a lag screw are used.

5. Equipment

5.1 Bucket trucks or equivalent.

5.2 Single wheel stringing blocks (Sherman Reilly type) are recommended for all installation applications. OFS recommends the use of unlined rollers whenever possible. If lined rollers are used, urethane lined rollers are preferred over neoprene lined rollers. Multiple wheel quadrant blocks, or "3-blocks", are not recommended. The sheave (wheel) diameter of the stringing block is determined by the minimum cable bend diameter. PowerGuide® loose tube cable minimum bend diameter is 30 times the outer diameter during installation and 20 times the cable outer diameter after the installation has been completed. PowerGuide® ribbon cable designs have a minimum bend diameter of 30X the OD during installation and 30X after the installation has been completed. Select stringing blocks for your applications according to Tables 1 through 3. Use of permanent attachment hardware as a substitute for stringing blocks is not recommended.

Note: Consult the OFS sag and tension table for the recommended long term cable tension. If the long term cable tension is higher than the installation tension, larger diameter stringing blocks may be required for the cable sagging operation. See method 2 on page 14 for further details.

5.3 Mid-span blocks - used to support cable in mid-span over roadways and obstructions.

5.4 Pulling grip with swivel - used to secure the pulling rope to the cable during installation. Breakaway swivels are recommended when other forms of load measurement are not being used. OFS recommends the use of pulling equipment equipped with a line tension indicator to monitor installation tensions.

5.5 Pulling rope - used to pull cable through the stringing blocks. If the cable will be installed in one continuous pull, the pulling rope must be as long as the cable. High quality torque-balanced ropes with adequate tensile strength and minimum elongation properties are recommended. The torque balanced rope helps minimize the effects of torsional twisting during the installation process.

5.6 Take-up equipment - used to pull the rope and cable through the stringing blocks. The take-up equipment should have tension and speed controls to ensure proper installation. The take-up equipment may also be used to tension the cable to its fianl sag and tension. The take up equipment should have an accurate means of monitoring the line tension in pounds. This will insure compliance with the maximum recommended installation tension and corresponding stringing blocks detailed in Tables 2 - 4.

5.7 Payoff machine - used to payoff cable during installation. The payoff should be equipped with an automatic or manual braking device to prevent the cable from running free. Trailers equipped an over-spin brake are generally acceptable for span lengths up to 500 and installation tensions up to 800 pounds. For longer span lengths and higher installation tensions that are generally associated with transmission line applications, bull wheel tensioners are recommended in addition to the cable pay off equipment (see photos 1, 3, and 4)

5.8 Bull wheel tensioners - the depth and flare of the grooves in the bull wheels are not critical, but here are some general recommendations and guidelines.

- Semicircular grooves with depths of 50% or more of the cable diameter, and with a flare angle of 50° to 150° from the vertical center line reference, are generally found to be acceptable.
- The minimum diameter of the bull wheel (measured at the bottom of the groove) should be at least 70 times the diameter of the cable.
- Tandem bull wheels should be aligned with the offset equal to approximately one-half the groove spacing. The material and finish of the grooves should not mar the surface of the cable.
- Elastomer lined grooves are recommended. At least t**wo** wraps of cable around the bull wheels are recommended to minimize slippage**.**

5.9 Dynamometer - used to monitor cable tension during sagging operation after the cable has been installed.

5.10 Chain hoist, winching device, or equivalent - used to sag cable at the appropriate tension between dead end locations.

6. Installation Procedure – Transmission Line Applications

6.1 This procedure assumes a stationary reel method of installation where the pulling rope and stringing blocks are installed prior to the installation of the cable (see Figure 7). Determination of the installation method will depend upon local conditions.

6.2 This procedure also assumes that any company or contractor installing OFS ADSS cable has familiarity and experience with aerial outside plant construction practices, equipment, and safety procedures that are required to properly install cable.

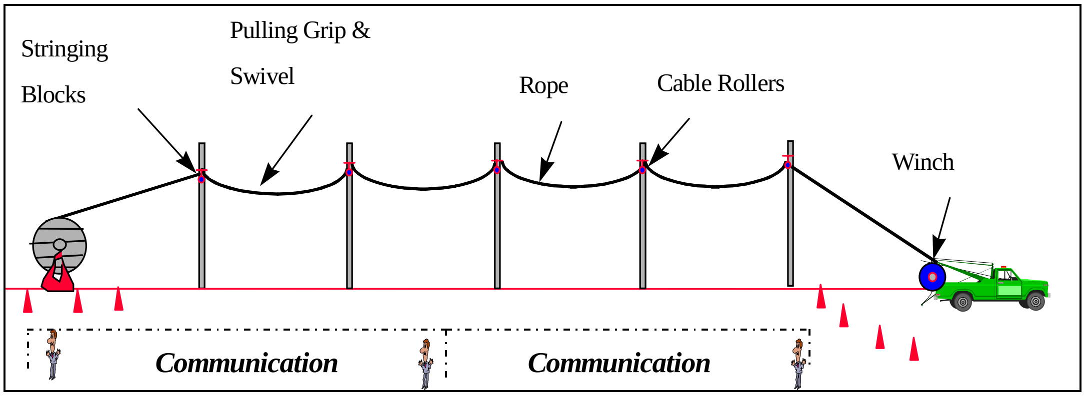

Figure 7 - Stationary Reel Method for Pulling Cable

6.3 Route Survey

a) A route survey shall be conducted prior to cable installation for both new and existing pole lines. During the survey, determine the most effective method of installation.

b) Deviations from a straight pole line, either horizontal or vertical, shall be noted to enable ordering of required hardware. Depending on the cable suspension hardware, horizontal or vertical line angle changes over 20^o or 30^o shall be double dead-ended. This will be very important when ordering the required amount of hardware.

c) A route survey shall indicate if route clearing, e.g. tree trimming, is necessary.

d) Inspect all end and corner structures to determine if additional guys or anchors are required.

e) If the length of the route will require more than one reel of cable;
- Locate the splice or splices at a position that will minimize the number of turns in each section.
- Locate the splice at a point that will be easily accessible for maintenance and splicing purposes and minimize the amount of slack cable required.
- Consider the structure type for determining the configuration of the cable splice points. For steel lattice towers the cables are generally routed down the tower to a storage cabinet for easy access.
- For all applications on transmission line structures where the e-field strength at the cable attachment location is >12kv, OFS recommends routing the cable down the structure for storage and easy access. This includes both cable splice locations and slack cable storage locations.

f) When surveying attachment points for the fiber optic cable, insure that grade changes in the route are considered. The transition in grade changes should be made over several spans whenever possible.

g) Determine the quantity and location of maintenance coils.

h) For transmission line applications structures may be wood, concrete, steel, or steel lattice structures. For concrete or steel poles, pole band brackets may be used for the cable attachment hardware. For steel lattice towers, special fabrications may be needed for hardware attachment. Insure that all attachment configurations meet the loading requirements of the appropriate storm load region.

i) Evaluate structures relative to the placement of stringing blocks. This should include the calculation of line angles due to changes in elevation or direction. Take into consideration elevation changes and corresponding attachment locations from structure to structure.

6.4 Installing Stringing Blocks, Rope, and Cable Suspension Hardware

a) Structure types: wood poles, concrete poles, steel poles, and steel lattice towers are the main types of structures associated with utility distribution and transmission aerial routes.

b) Placing the appropriate cable suspension hardware, installation of stringing blocks, and installation of pulling rope can be accomplished in one pass of the installation route.

c) Secure the proper sized stringing block on the pole at an attachment height relative to grade changes. Tables 2 - 4 show the proper stringing block groove diameter relative to the cable OD, line angle change, and estimated installation and sagging tensions.

d) During cable installation, the minimum bend diameter of OFS PowerGuide® and PowerGuide® AccuTube™ cables is 30 times the cable OD. Following installation, the minimum bend diameter of OFS PowerGuide® cable is 20 times the cable OD. For PowerGuide® AccuTube™ cable, the minimum bend diameter following installation is 30 times cable OD.

Example roller size calculation:

Line Angle = 90° (due to changes in elevation or direction)
PowerGuide® Cable OD = 1.00”
Minimum Bend diameter = 1.00” x 30 = 30”
Minimum Pulling Block Diameter = 30” (bottom groove diameter)

e) When selecting stringing blocks, make sure the bottom groove diameter of the stringing block meets the required bend diameter of the cable. Most manufacturers measure the diameter from the flanges of the stringing block rather than the bottom of groove. Table 1 shows the required bottom groove diameter relative to the cable OD and line angle change. Check the manufacture’s specifications to ensure the bottom groove diameter meets the cable bending requirements.

f) The use of unlined stringing blocks is recommended. For lined stringing blocks, urethane lining is recommended.

g) The total line angle change (changes in elevation or direction) at a specific structure is determined by the position of the previous structure in the back span and the position of the next structure in the route. For intermediate attachment hardware, the maximum line angle on either side of the structure must not exceed 10° for intermediate suspension hardware or 15° on either side of heliformed suspension hardware (Figure 8). For line angle changes > 30°, dead end hardware is required. Use the same criteria regarding line angle changes for the selection of stringing blocks.

Table 1 – Sherman & Reilly Stringing Block Diameter vs. Bottom of Groove Diameter

Typical Sheave Sizes	
Outside Diameter (in.)	Bottom Groove Diameter (in.)
7	4.8
10	7.5
12	9.5
14	12
16	14
20	16
22	18
28	24
35	30.5
42	36

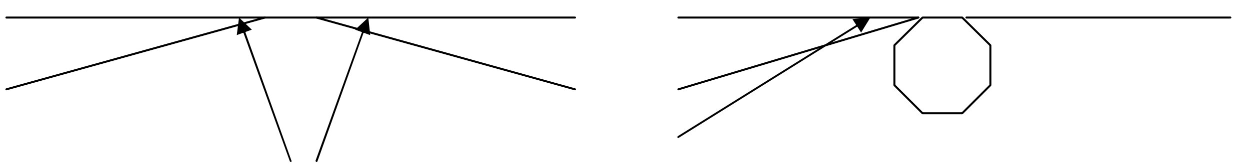

Figure 8 – The arrows indicate a 10° maximum line angle change on either side of intermediate attachment hardware (total line angle change up to 20°) or 15° maximum line angle change on either side of heliformed suspension hardware (total line angle change up to 30°).

h) When large diameter stringing blocks are used (i.e. > 16" in diameter), secure the block in such a way that it remains parallel to the ground during cable placement. This will prevent the block from excessive movement during cable placement and prevent the cable from riding up or jumping out of the groove of the stringing block. It is the responsibility of the installer to make sure that stringing blocks are placed on the structures in a manner which will facilitate the cable installation without causing mechanical damage to the cable. Inspect the stringing block surfaces to insure that there are no burrs or defects which could cause mechanical damage to the cable during placement.

i) Once the block has been secured, place the pulling rope through the block and continue to the next pole location.

j) Use mid-span supports where necessary to clear roadways and obstructions.

k) Repeat steps c – j for all structures throughout the installation route.

6.5 Payoff Set-Up

a) Remove all lagging material from the reel including the lagging that protects the inside tail of the cable. Failure to remove this lagging could result in cable damage.

b) The plastic guides over the tail should not be removed but lifted out of the flange grooves. During cable installation, the cable tail may tend to “walkout” from the cable reel. This occurs when the cable tail is forced out of the cable slot during the installation process causing the tail length to increase. The plastic guides are provided to allow the cable tail to move freely while the cable is being installed. If the cable tail is restricted so that cable walkout cannot occur, the excess cable length is forced between the layers of cable which may result in cable damage.

c) The distance between the reel payoff and the pole should be at least 4 times the cable attachment height. Calculate the line angle at the pole based on the position of the reel payoff. Use the appropriate sized stringing block based on the recommendations in Tables 2 - 4.

d) The reel payoff should be aligned with the stringing blocks on the first two structures from the reel payoff so that when the cable travels through the stringing block on the first structure the cable will sit in the bottom of the groove on both the entry and exit side of the stringing block.

e) Correct alignment of the payoff and bull wheel tensioner will minimize the effect of torsional twisting of the cable between the payoff and the first structure (see Figure 9).

Figure 9

Table 2 – Minimum Stringing Block Diameters for Cable Tension ≤ 600 lb			
	Line Angle		
Cable OD, in.	**0-20°**	**21-45°**	**46-90°**
1.15	8	18	35
1.10	8	18	33
1.05	8	18	32
1.00	8	18	30
0.95	6	18	29
0.90	6	16	27
0.85	6	14	26
0.80	6	14	24
0.75	6	14	23
0.70	6	12	21
0.65	4	12	20
0.60	4	12	18
0.55	4	8	17
0.50	4	8	15

Table 3 – Minimum Stringing Block Diameters for Cable Tension 600 to 1000 lb			
	Line Angle		
Cable OD, in.	0-20°	21-45°	46-90°
1.15	18	30	35
1.10	18	30	33
1.05	18	24	32
1.00	18	24	30
0.95	18	24	29
0.90	16	24	27
0.85	14	24	26
0.80	14	24	24
0.75	14	18	23
0.70	12	18	21
0.65	12	18	20
0.60	12	16	18
0.55	8	12	17
0.50	8	12	15

Table 4 – Minimum Stringing Block Diameters for Cable Tension 1000 to 1500 lb			
	Line Angle		
Cable OD, in.	0-20°	21-45°	46-90°
1.15	24	30	35
1.10	24	30	33
1.05	24	30	32
1.00	24	30	30
0.95	24	30	29
0.90	24	24	27
0.85	20	24	26
0.80	20	22	24
0.75	18	22	23
0.70	18	18	21
0.65	16	18	20
0.60	16	16	18
0.55	12	16	17
0.50	12	16	15

f) Insure that the cable is paying off the top of the reel.

g) Attach the pulling grip and swivel (Figure 10) to the PowerGuide® cable. See OFS Installation Practice IP-013 for pulling grip attachment procedure

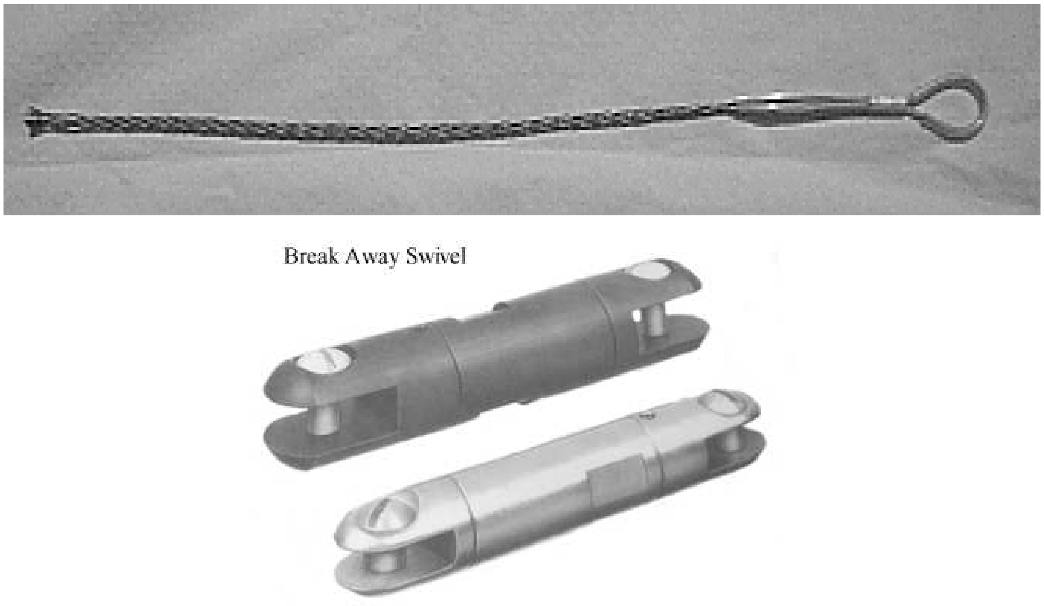

Figure 10

h) Check the cable reel flanges for any obstructions that may interfere with the cable payoff.

i) The reel payoff should have a brake assembly (Figure 11) to control the cable payoff during the installation by applying back tension to the cable. The breaking system will keep the cable from over spinning if a sudden stop occurs as well as controlling the cable sag during the installation process.

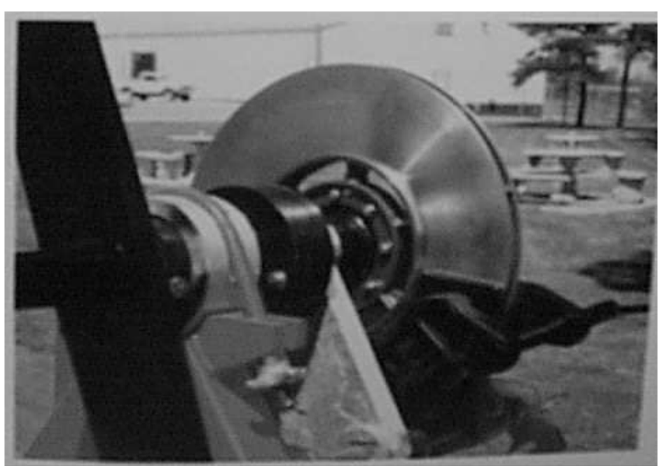

Photo 11 - Disc brake on reel payoff.

j) A bull wheel tensioner (Figure 12) should be used with the cable payoff when installation tensions are expected to exceed 800 lb or where span lengths exceed 500 feet. Use of the bull wheel tensioner in combination with the reel payoff allows for better control of the cable payoff and tension during installation. Generally, the bull wheel tensioner is used in tandem with the reel payoff and over spin brake control.

Figure 12 - Bull wheel tensioner

k) The brake on the bull wheel tensioner should be set as low as possible, generally at about 20% of the brake load on the reel payoff. The brake for the cable payoff is generally set higher and is adjusted more frequently during the installation. Adjustments in the back tension for the bull wheel tensioner and cable payoff should be made in the first four or five spans to get a smooth and consistent payoff, minimize surging, and maintain cable clearances over roads, driveways, etc. Once the appropriate back tension is achieved, only minor adjustments should be required for the remainder of the installation.

6.6 Cable Installation

a) Start the take up device and pull the cable at a speed of no more than 40 m/min (130 ft/min). The take up equipment should have a method for measuring the line tension during installation.

b) Ensure that the brake at the payoff reel and bull wheel tensioner is engaged and make adjustments as required within the first four or five spans to achieve a smooth payoff. Adjust the back tension as needed throughout the installation to insure a smooth cable payoff and to maintain clearances.

c) Some torsional twisting of the cable may occur during the installation and is not considered unusual. Use of a swivel and proper setup of the cable payoff will limit the effect. If the cable rotates more than one full twist (360°) within a 25 foot length between the payoff and the first stringing block, check the alignment of the reel payoff and bull wheel tensioner as described in Section 7.5.

d) The construction foreman shall follow the lead end of the cable to monitor the back tension and pulling speed while maintaining constant communication between the payoff and the take up point. As the cable enters and exits each stringing block, ensure that the cable stays properly positioned in the stringing block. If the cable is floating out of the stringing block, or “walking” up the side walls of the stringing block, the installation should be stopped and the position of the stringing block should be adjusted.

e) Once the pull is started, maintain a constant pulling speed until the installation is completed.

f) When the cable installation is complete, be sure enough excess cable is available at both ends for cable termination.

g) It is recommended that additional linemen be used to monitor the cable at critical points in the route. These critical points may include major intersections, hard corners, or other locations where a minimum cable clearance must be maintained. The additional linemen should also have to capability to communicate with the cable take-up and payoff locations, and be prepared to make adjustments to stringing blocks as required during the installation.

6.7 Tensioning Cable to its Final Long-Term Sag

a) Two methods of tensioning the cable to its final sag and tension are described in this section.

b) Before sagging the cable, the appropriate cable tension should be determined from the OFS sag and tension table.

c) Sag and tension tables differ for each PowerGuide® cable design. If you don't have the correct sag and tension table for your cable, contact OFS customer service at 888-FIBER HELP (888-342-3743) to obtain the proper data.

Method 1 – Tensioning Cable Between Dead End Locations

a) The cable must be dead-ended at both ends of the cable, at any location where the change in line angle exceeds 20 or 30 degrees (depending on the attachment hardware), and at slack storage locations.

b) Once the cable installation is complete, secure the pull-end of the cable to the structure with a dead end assembly. Follow the manufacturers recommended assembly procedures for the dead end assembly. Be sure that sufficient slack has been provided to access the splice location. ***Note:*** Do not cut the cable at the reel until the entire cable has been tensioned to its final sag and tension.

c) Before tensioning the cable to its final sag and tension, ensure that all intermediate stringing blocks in the span are in place and of the proper size to maintain the minimum bend diameter of the cable. See Tables 2 - 4 for the required stringing block diameters.

d) Attach a temporary dead end at the next dead end location. Make sure the temporary dead end is installed far enough out from the structure to take up all of the slack required for final sag and tension. Depending on the amount of slack that is taken up, it may be necessary to secure the cable on the opposite side of the structure to maintain clearance in the adjacent span.

Note: A temporary dead end is a dead end that is partially installed for use as a pulling device. This is the only device that is recommended for pulling the PowerGuide® cable at mid-span locations.

e) Attach a chain hoist or other tensioning device between the structure and the temporary dead end.
f) If the exact stringing tension is desired, or if over-tensioning the cable is possible, a dynamometer should used to measure cable tension. The dynamometer should be installed between the chain hoist and the temporary dead end.

g) Use the chain hoist or tensioning device to pull the cable to the desired sag or tension.

h) Hold the end of the extension link adjacent to the attachment point and position the dead end assembly adjacent to the cable to determine the location that the dead end will be installed on the cable. Install the dead end assembly on the cable.

i) Install a temporary dead end on the cable at the opposite side of the structure and use a chain hoist to relieve cable tension on the stringing block. Remove the cable stringing block and secure the first dead end to the structure. Remove the first temporary dead end and chain hoist. Use the chain hoist and temporary dead end on the opposite side of the structure to adjust and transition the cable slack from one dead end to the other. Position, install, and attach a permanent dead end on the opposite side of the structure. **Note:** When installing a double dead end (two dead end assemblies on one structure) sufficient cable slack should be provided so that the cable assumes a gentle and uniform curvature between the two dead ends without contacting any obstructions. A double dead end is required at each splice location, slack storage location, and locations where the line angle exceeds 20° or 30° (depending on the attachment hardware) due to changes in direction or elevation.

j) After both dead ends have been installed and attached to the structure, release the tension on the remaining temporary dead end and remove it and the chain hoist. The cable should now be at the desired long term sag and tension**.**

k) At cable storage locations, slack cable must be pulled from the reel to the slack storage location. A temporary dead end must be placed in the span in the direction of the cable reel. The position of the temporary dead end is determined by the amount of slack cable that is needed. A pulling rope is then attached to the temporary dead end and the cable slack is pulled from the cable reel to the structure. If needed, the stringing block can be left in place to guide the cable. If not needed, the stringing block can be removed during this process. After pulling the slack cable, install a permanent dead end on the cable and attach it to the structure. The temporary dead can then be removed and the cable slack stored as required. Some common slack storage methods are shown in Figures 13, 14, and 15.

l) Repeat the tensioning procedure for each dead end location until the entire cable has been tensioned to its final long-term sag and tension.

m) When cable tensioning is complete, secure the cable at each intermediate structure using the appropriate attachment hardware. OFS recommends that the cable be secured in the intermediate attachment hardware immediately after a cable section has been dead-ended. Alternatively, a second crew can secure the cable in the intermediate attachment hardware while the dead-end crew proceeds ahead to the next cable section.

Method 2 – Tensioning the Entire Cable Length Using a Hydraulic Puller

a) This method uses the hydraulic puller to tension the entire length of cable through stringing blocks. The cable tensioner/puller is used to set the sag and tension for each cable section between dead ends. **Note: When using this method, ensure that proper size string blocks are in place to maintain the minimum bend diameter of the cable. See Tables 2 - 4 for the required stringing block diameters.**

b) Once the cable installation is complete, secure the pulling end of the cable to the structure using a dead end assembly. Follow the manufacturers installation procedures for the dead end assembly. Be sure that sufficient cable slack has been provided to access the splice point.

c) Set up the hydraulic puller at the cable reel. Install a temporary dead end on the cable between the reel payoff and the first structure.

d) Connect the pull rope from the tensioner to the temporary dead end. A dynamometer should be used to measure and set the long term tension of the cable based on the OFS sag and tension table.

e) Use the tensioner to pull slack cable until the long term tension is reached.

f) After the desired cable tension has been reached, the stringing block must be removed at the first double dead-end location. Use temporary dead ends and cable hoists on either side of the structure to pull sufficient slack so that the cable can be removed from the stringing block. Use caution and do not violate the minimum bend diameter of the cable when removing the cable from the stringing block. After removing the cable from the stringing block, the dead end assembly can be installed per the manufacturer's recommendations. **Note:** When installing a double dead end (two dead end assemblies on one structure), sufficient cable slack must be provided so that the cable assumes a gentle and uniform curvature between the two dead ends without contacting any obstructions.

g) After the first double dead end has been installed, remove the temporary dead ends and chain hoists..

h) Working towards the cable reel, repeat the process for additional dead end locations.

i) At slack storage locations, the cable slack must be pulled from the cable reel before the second dead end is installed. Before pulling slack cable, the temporary dead end at the cable reel must be removed. While pulling slack cable, the cable tension should be minimal. Maintain only enough tension to clear obstructions. Utilize proper equipment during this process to maintain the cable minimum bend diameter.

j) Install a temporary dead on the cable in the span towards the cable reel. The position of the temporary dead end is determined by the required length of slack cable. Attach a pulling rope to the temporary dead end and pull the cable slack from the cable reel to the structure. If needed, the stringing block may be left in place to guide the cable. If not needed, the stringing block can be removed. Once the required cable slack has been pulled, install and secure the second dead. The cable should now be at the desired long term sag and tension.

k) Remove the temporary dead end and store the cable slack as required. Some common slack storage methods are shown figures 13, 14, and 15.

l) Repeat the tensioning procedure for each dead end location until the entire cable has been tensioned to its final long-term sag and tension.

n) When cable tensioning is complete, secure the cable at each intermediate structure using the appropriate attachment hardware. OFS recommends that the cable be secured in the intermediate attachment hardware immediately after a cable section has been dead-ended. Alternatively, a second crew can secure the cable in the intermediate attachment hardware while the dead-end crew proceeds ahead to the next cable section.

Applicable Documentation

IP-006 – PowerGuide Sheath Removal
IP-013A – Pulling Grip Attachment Procedure
AN-200 – Minimum Information Necessary to Design the PowerGuide ADSS
Electric Field – Considerations When Placing ADSS Optical Fiber Cable
AN-810 – Electrical Stress Mechanisms
AN-811 – Recommendations for Electrical Stress Mechanisms
AN-812 – Recommendations for Vibration Damping

To obtain documentation please contact OFS at 1-888-Fiber Help (888-342-3743) or visit the OFS website at www.ofsoptics.com.

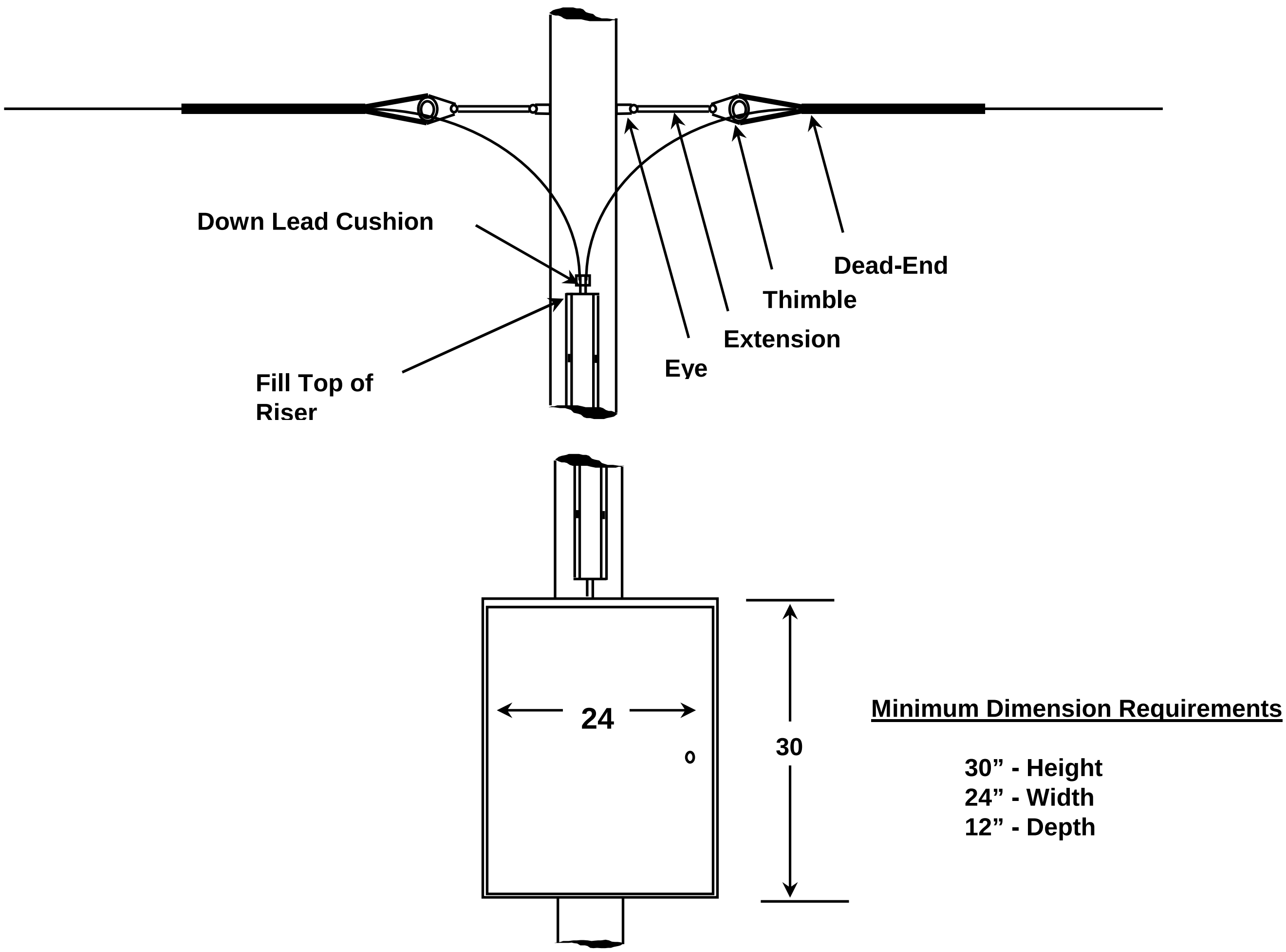

Figure 13 – This slack storage method can also be configured for H structures and steel lattice towers.

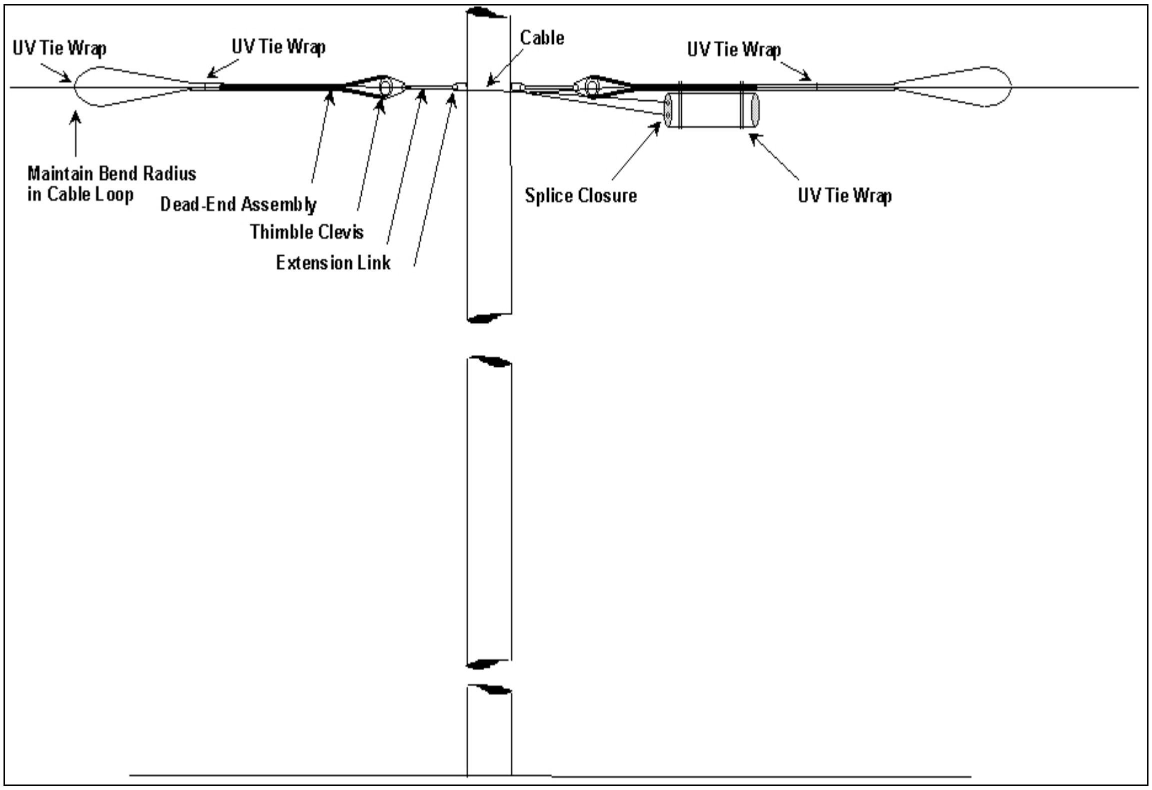

Figure 14 – Cable storage loop using tie-wraps. This storage method is generally used for distribution applications or for transmission line applications where e-field space potentials are < 12 kv and where tracking resistant sheath materials are not required.

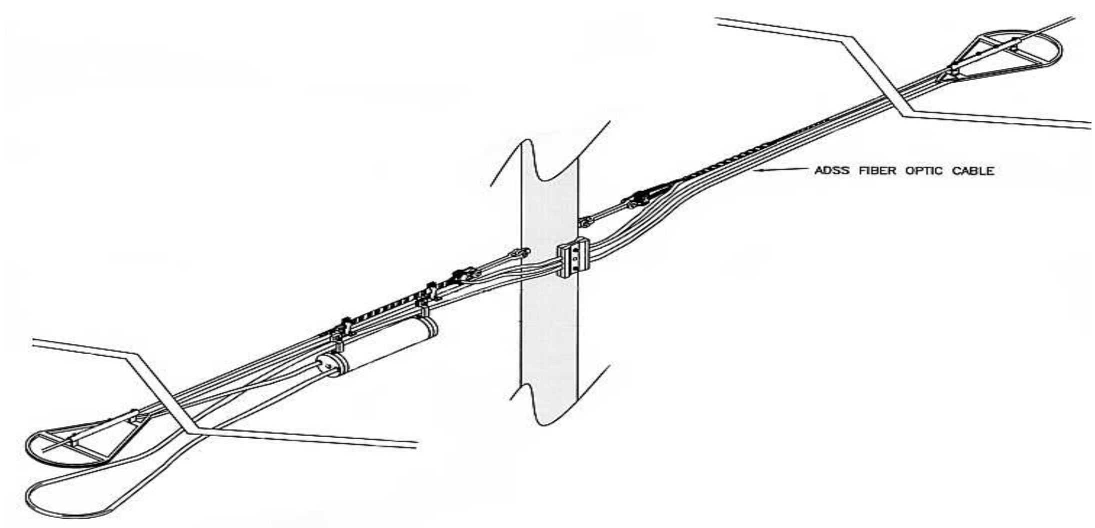

Figure 15 – Cable storage using "snow-shoes". This storage method is generally used for distribution applications or for transmission line applications where e-field space potentials are < 12 kv and where tracking resistant sheath materials are not required.