Figure 8 Cable Installation Guideline

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I. Purpose

This procedure applies to the installation of Superior Essex Figure 8 copper and fiber optic cable into an aerial position. The objectives of this guideline are:

- Provide the cable installer with a general guideline for installing figure 8 cable in an outside plant aerial facility. It is assumed that the cable handling crew already has an understanding of generic aerial cable installation. (It is not the intent of this procedure to cover all possible installation scenarios or conditions. Special circumstances or questions can be addressed by contacting Superior Essex Technical Support by calling 1-800-551-8948.)
- Prevent damage to the OSP cable during the setup, handling, and installation.

It is intended that this guideline be used in conjunction with procedures that describe the detailed operation of handling equipment. Equipment procedures are provided by the equipment suppliers.

II. Introduction

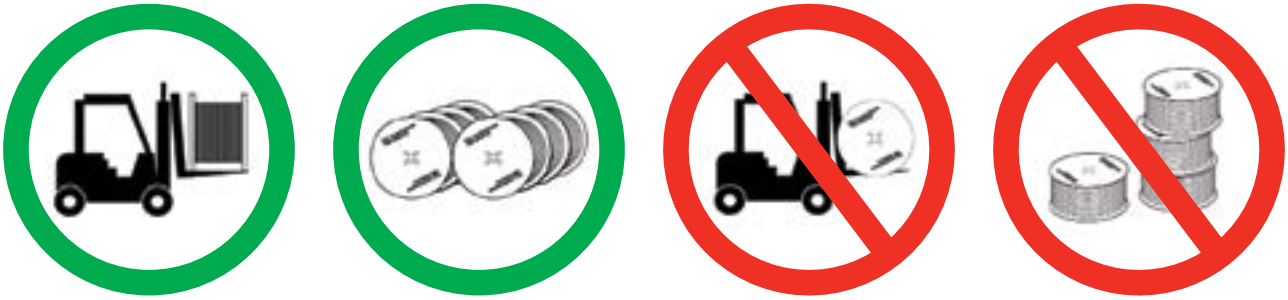
The practice of handling fiber optic cables has become much more common in recent years. Fiber optic cables are designed to withstand all typical installation and environmental stresses expected in the specific application.

Copper and fiber optic cables can be damaged if not handled properly during the installation process. In fact, the cable installation process is the most aggressive event the cable will most likely ever be exposed to. Adherence to the cable's design limits of **pull tension, minimum bend, and crush force** during installation will ensure that the cable will perform properly throughout its full design lifetime. The greatest mistake when handling fiber optic cable is assuming that all outside plant (OSP) handling equipment is suitable for use - it is not. If in doubt prior to or during any cable installation, contact Superior Essex Technical Support by calling 1-800-551-8948.

III. General and Safety Precautions

The following precautions always apply when handing fiber optic and copper cables.

- DO NOT exceed the cable's stated **maximum pulling tension**.
- DO NOT exceed the cable's stated **minimum bending radius**.
- DO NOT exceed the cable's **maximum crush load**.
- NEVER set a cable reel on a flange side (to prevent cable crossings during payoff).



- DO adhere to local personnel safety practices.
- DO review and follow equipment safety practices.
- ALWAYS apply caps over free cable ends to prevent water intrusion.

NOTE: These installation instructions have been written for qualified, experienced personnel. Please read them thoroughly before starting assembly work. Superior Essex disclaims any liability or responsibility for the result of improper or unsafe installation practices.

WARNING: When working with overhead conductors and facilities, ensure that all personnel are aware and trained on the applicable safety requirements of the Occupational Safety and Health Act (OSHA) and the National Electric Safety Code (NESC), or the appropriate local safety regulations.

Use of gloves, eye protection, hard hat and boots are required to safely complete installation of cable. When working aloft also include the use of insulated gloves, body belt, harness/lanyard and protective clothing.

Inspect all personal safety gear as well as equipment prior to use. It is important to replace any worn or defective tools and equipment. Failure to comply with safety regulations can result in bodily injury or death.

Additional general safety precautions exist when working with overhead facilities or in areas of traffic congestion.

- Ensure adequate clearances between the cable being installed and all existing cables. Follow the current NESC requirements, local ordinances and company standards.
- Ensure cables are properly grounded during installation in overhead facilities near power lines. Fiber cables with metallic components can accumulate an electric potential when near power lines.
- Proper safety cones and traffic control devices should always be used. The project manager should coordinate his work with local traffic officials. Safety zones utilizing traffic signs and cones should be placed at all working locations.

Please note that safety precautions listed in this guide for The Stationary Reel Method and Moving Reel Installation Methods must be followed to avoid bodily injury.

CAUTION: When working in road right of way, wear proper safety vests and hard hats as required by state Department of Transportation (DOT) and OSHA. Use of proper signage and cones will protect workers and the general public. Use strobe lights on equipped vehicles while stationary or in motion while paying off cable.

IV. Reference Documents

- Bellcore TR-NWT-001121, *(General Requirements for Self-Supporting Optical Fiber Cable)*
- Bellcore GR-20-CORE, *(General Requirements for Optical Fiber and Fiber Cable)*
- USDA Rural Utilities Service Bulletin 1753F-601 (PE-90), *(Specification for Filled Fiber Optic Cables)*
- USDA Rural Utilities Service Bulletin 1751F-635, *(Aerial Plant Construction)*
- IEEE 524, *(Installation of Overhead Conductors)*
- USDA Rural Utilities Service Bulletin 1753F-401 (PC-2), *(RUS Standard for Splicing Copper and Fiber Optic Cables)*

V. Installation Overview

A. Methods

Figure 8 cables feature a built-in support wire for tensile strength and stability. The support wire is typically a ¼ inch 7-strand, Extra High Strength (EHS) galvanized steel messenger, flooded to inhibit corrosion. Other sizes are used based on installation requirements.

Two installation methods are discussed in this document.

- The **Moving Reel (or "Drive Off") Method** is used when the entire route is accessible by support vehicles. The route must be free of trees, limbs, and guy wires to allow full vehicle access. Support vehicles are used to pay off and raise the fiber cable to temporary support hardware. Once the cable is in position, it is transferred to the permanent support hardware.
- The **Stationary Reel Method** is typically used when the route is not fully accessible by support vehicles. The cable is pulled into place from a stationary reel located at one end of the section run, and supported by temporary hardware. Once the cable is in position, it is transferred to the permanent support hardware.

Figure 8 fiber cables and Figure 8 copper cables containing flooding compound may also be installed via the underground duct or direct bury method. Please refer to *FAPP.01 FAPP01 Installation Guideline for Placing Fiber Optic Cable into an Underground Duct FAPP.02 or Installation Guideline for Direct Burying of Fiber Optic Cable* as necessary.

B. Limitations and Precautions

The procedural installation of aerial fiber optic cable is essentially the same as for copper cable. However, fiber cable performance can be more easily degraded if the rigors of installation are too excessive. Installation crews must be sensitive to the limitations of the fiber cable regarding **maximum tension, minimum bend radius, and crush resistance**, and take action throughout the installation process to prevent exceeding these limits.

Whenever supporting a cable in the air, ensure the curvature of the support device is greater than the minimum bend radius of the cable to prevent damaging the cable.

Leave the lagging or other protective wrap on the cable reel until the reel is delivered to the installation site to prevent handling damage. When lagging or wrap is removed, carefully inspect the reel for integrity and to ensure the inside flanges are smooth and nail-free. Correct any conditions that may cause unstable cable payout during the installation.

Communications must be established at key control functions along the run to coordinate cable travel and tensioning.

Avoid surges in cable tension during reel payout.

To avoid damage to the cable jacket, do not drag the cable over fixed surfaces.

Slack coils may be assembled in a continuous direction loop configuration or a "figure eight" (not to be confused with figure 8, the cross-section of the cable). "Figure eight" configuration is best to minimize torsion and stress build-up in fiber cables over long lengths

and is preferred over single direction coiling. Using figure eight configuration for copper cables also minimizes cable twist and memory.

- Single direction coiling should only be used for lengths less than 100 feet (30 meters). Do not exceed minimum bend radius of cable.
- "Figure eight" coil sizing should be approximately 15 feet (5 meters) end to end with each half loop about 5 - 8 feet (1.5 - 2.5 meters) in diameter.
- Figure 8 cable is much easier to coil if the messenger is removed from the section to be coiled.

Slack coils should be secured in a location to prevent damage. Fix the coils securely in place with suitable cable ties to prevent rubbing and long-term abrasion on the cable. **NOTE: Do not use cable spoolers or other equipment designed to replace manual "figure eighting" on figure 8 fiber optic cable. Doing so risks damage to the cable and will void the warranty.**

If a "figure eight" is used during the installation to accumulate a significant length of cable, protect the cable crossover point by using cardboard shims or consider multiple "figure eights."

If cable is on the ground, always use barricades to prevent inadvertent access to the area.

The use of drip loops at each pole for fiber cables is at the discretion of the facility engineer. The presence, or absence, of drip loops does not affect the performance of the fiber cable. In either case, it is imperative that any cable slack at the pole location be protected from abrasion on the pole or any existing hardware.

At all system dead-end poles and crossover locations, the cable should be routed to the inside of the intersection.

C. Construction Planning

Perform a detailed site survey of the aerial cable route to identify potential issues, determine accessibility, and create an installation plan. The survey should include a representative from each agency with an interest in the route or associated location. Site survey should include analysis of the following:

- Route accessibility
- Right of way/permitting issues
- Determination of installation technique
- Condition of poles and guying support
- Location of fiber cable splice points
- Locations for equipment setup
- Clearances to existing power lines and other cables

Cable splice locations must be selected with consideration of splice vehicle accessibility. For fiber cable(s), slack must be added to both cable ends at each splice location to allow for splicing. Cable slack must allow the cables to reach ground level and into a splice truck plus 30 feet (9 meters) minimum. These added slack lengths must be considered when ordering the cable.

Engineering activities will be required to evaluate the sag and tension performance of the installed cable. Sag and tension evaluation will be dependent on environmental design conditions and will be used to determine the installation tension of the messenger wire.

Figure 8 fiber optic cable generally weighs less than copper cable and will tend to sag less. It should therefore generally be installed in the uppermost available communications space to ensure sufficient clearance, whereas copper cables should be installed in the lower most locations.

Engineering must also examine the temporary loads that will be exerted on dead-end poles during messenger tensioning. Temporary guy wires may be required.

Engineering analysis is also required to evaluate the installation tension and its effect on messenger wire fatigue life. Installing the messenger wire at too high of a tension will cause faster fatigue of the wire at hardware attachments. A vibration dampening system may need to be considered.

After completing the above planning activities, create an overall installation plan as the formal guide for the installation crew or contractors.

VI. Installation Using a Moving Reel Method

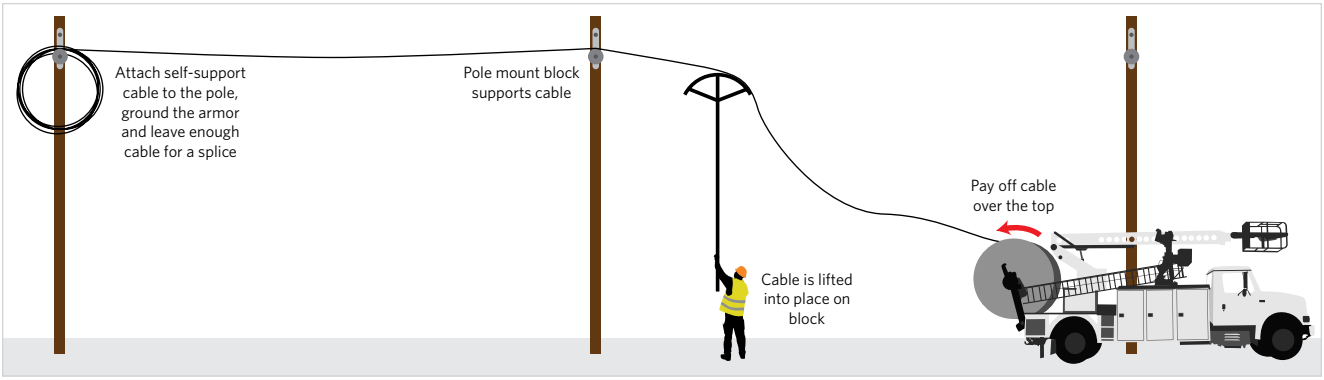


Figure 1: Moving reel method

A. Equipment and Materials

Vehicles selected for use using this method must provide full accessibility on the placement side of the poles along the entire section run.

Note: Fewer materials are required for the moving reel method. Since cable payoff is direct from the vehicle to the temporary supports, no pulling grips or swivels are required.

Radio communication must be established between the cable reel payoff unit and the ground crew. Fewer communication points are required for the moving reel method. Links can be provided by two-way radios or cell phones and is maintained to ensure safe conditions for the line crew and cable being installed throughout the installation.

When placing figure 8 cable using the moving reel method, the cable is payed off of the reel while vehicle is moving along the pole line.

During set up ensure that cable pays off over the top of the reel as shown in Figure 1. When beginning, pull off needed cable for slack and position truck a minimum of 50 feet (15 meters) away from starting pole. Install cable blocks or J hooks that have a minimum of a 1.5 inches (3.75 cm) radius for use on intermediate poles as temporary supports. Lift the cable into place via a layup stick or another line truck.

Continue placing cable while driving slowly towards dead-end pole. If splices or slack storage is required along the route, be sure to dead-end the cable and follow the instructions in the stationary reel cable installation instructions noted above. The final cable installation will need to be tensioned, twisted if required (see section "F. Pole Line Hardware"), removed from temporary hardware and secured in permanent hardware.

Next, follow steps in section "VIII. General Installation Procedures" for Moving Reel and Stationary Reel Methods.

VII.Installation Using a Stationary Reel Method

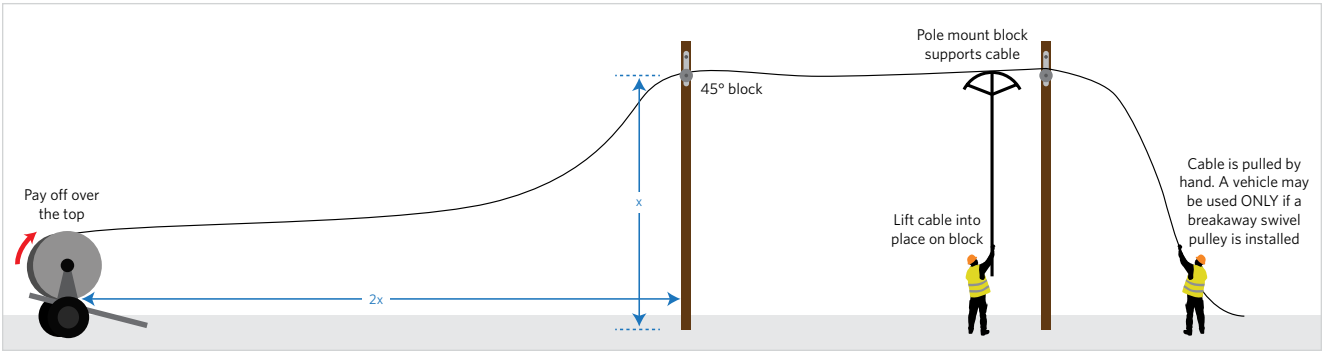


Figure 2: Stationary reel method

A. Equipment and Materials

Pulling grips are required and must be sized for the messenger diameter. Pulling grips for fiber optic cable are made of galvanized steel strand. They feature a multi-weave mesh for holding strength. A flexible eye provides easy attachment of a swivel.

A low-elasticity pull line, such as an aramid yarn or wire rope, is recommended to minimize elastic-induced surges during the pulling process.

Pulling may be performed by hand or by a pulling winch. If used, a pulling winch with a calibrated maximum tension should be used. A dynamometer can be used to monitor tension of the pull line near the winch. Tension monitoring should be at or near the pulling grip and available to the winch operator during the pulling process.

Any hardware (sheaves, capstans, and blocks) used during the installation must maintain the cable's minimum bend radius. The minimum bend radius during tensioned installation (dynamic) is 20 times the cable's outer diameter (O.D.). The minimum bend radius during zero tension (static) cable handling is 10 times the cable's O.D.. Copper cable single shield design is 12 times the O.D.. Double shield designs are 15 times the O.D. Blocks suspended

under the cable for tangent support may have a groove diameter of 10 times the cable's O.D. if block spacing is 50 feet (15 meters) maximum.

Radio communication must be established between the cable reel, the pulling device, and all intermediate locations during the pulling process. This link can be provided by two-way radios or cell phones and is maintained to ensure safe conditions for the cable exist throughout the installation.

Next, follow steps in section "VIII. General Installation Procedures" for Moving Reel and Stationary Reel Methods.

VIII. General Installation Procedures

A. Initial Conditions

Prior to commencing the cable installation event, the following actions must be accomplished:

- System prints are obtained and thoroughly reviewed
- Job area survey is complete
- Installation plan and equipment setup locations are defined
- Limitations of the cable are reviewed with the handling crew
- Installation equipment is reviewed for adequacy
- Detailed setup and operating instructions for all equipment have been reviewed
- Cable reels are inspected to verify no damage and good flange surfaces
- The event is reviewed and briefed, at least one day prior, with install crew
- All required equipment is on site the day of the installation event

B. Installation

Prior to installation, all traffic safety zones, barricades, and flagmen must be in place. Observe all local safety ordinances and practices.

Set up winches, monitoring devices, and stringing blocks per the installation plan. Establish communication between reel and puller, and all intermediate locations.

Visually inspect each cable reel for physical damage. Ensure the cable reel inner flanges are smooth and nail-free to allow free payoff of the cable. Set up the reel and reel trailer at the predetermined location per the installation plan. Pay off the cable from the top of the reel.

Attach the pulling grip to the messenger wire, if not factory installed, and attach the breakaway swivel to the pulling grip's flexible eye to prevent the cable from twisting during the pull and to avoid exceeding the cable maximum installation tension.

1. Attaching the Pulling Grip (for Stationary Reel Method)

Separate the messenger and cable components by using an appropriate web splitting tool like GPM 82730 Model B Slitter (known as 305B tool) for 0.250 inch or 6.4 mm messengers shown. Residual web on the messenger component need not be removed.

Figure 3: Web splitting tool

Cut off the separated cable component at an angle to taper the transition from figure 8 to messenger only.

Apply the correct sized pulling grip over the jacketed messenger end. Continue to push the grip onto the messenger until the messenger extends about ¼ to ½ inch (6 to 13 mm) beyond the grip mesh.

Figure 4: Pulling grip

Tighten the grip onto the cable by pulling on the eye.

Tightly wrap over the grip with a vinyl tape. Begin the tape wrap about 1 inch (25 mm) past the cable component cutoff point and wrap towards the pulling eye to about 1 inch (25 mm) above the mesh.

Attach appropriately rated breakaway swivel to pulling grip eye.

Figure 5: Breakaway swivel

Attach the swivel to the route pull line. Note: If manual pulling is to be performed, the swivel connects to a messenger mounted cable puller.

Check communication between the reel, pulling device, and all intermediate locations as appropriate.

Begin the pull slowly. Pull the cable as steadily as possible ensuring cable is set properly on all rotating sheaves along the messenger route. Observe cable tension throughout

the pull so that cable rated tension is not exceeded. If pulling manually, add tangent support blocks at 30 - 50 feet (9 - 15 meters) intervals or less. If pulling manually, the cable puller will need to be transferred around each pole.

Do not exceed the cable's maximum rated pulling tension.

Stop the pull and correct if any of the following occur:

- Cable rated tension is reached
- Cable is not positioned properly on any routing sheave or winch

After the cable is pulled into the temporary blocks, pull sufficient slack for slack span and cable splicing at terminating pole. When installing fiber cable, the minimum slack should be the height of the pole attachment plus 30 feet (9 meters). Cut 10 feet (3 meters) from the end of the fiber cable. Apply a protective cap to end of the cable. Fix both cable ends in place until tensioning begins.

C. Tensioning Setup

After placing cable, the messenger must be tensioned before it is permanently affixed into cable clamps on intermediate poles and dead-end fixture locations.

Once the cable has been installed into temporary support hardware between dead-end poles, use appropriate web splitting tool to separate the cable jacket from the messenger.

At the end pole, install a dead-end or strand-vise and attach to the guy hook.

The messenger can be tensioned by pulling on its opposite free end by using a chain hoist.

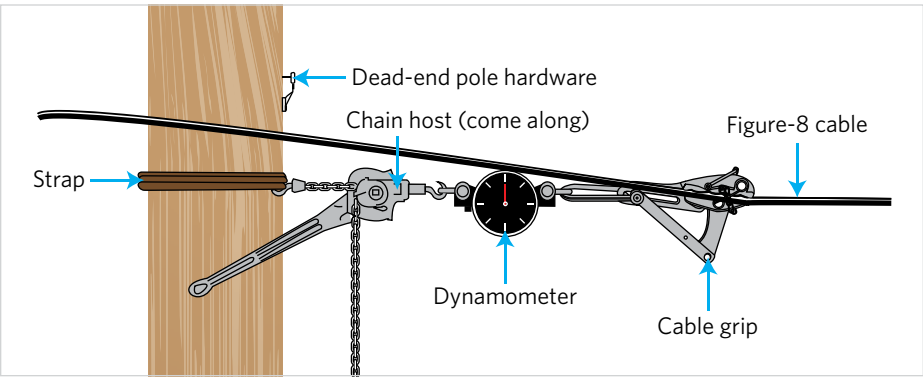


Figure 6: Tensioning setup

A dynamometer or tension meter should be used to measure the tension on the strand during the tensioning operation and should be monitored closely. The dynamometer should be placed between the hoist and strand puller. Strap the chain hoist to the dead-end pole with a sling. Follow the equipment manufacturer's recommendations for safety and use.

With the dead-end or strand vice fitting in place and attached to far end pole, tensioning can begin at opposite unattached free end by using the chain hoist configuration.

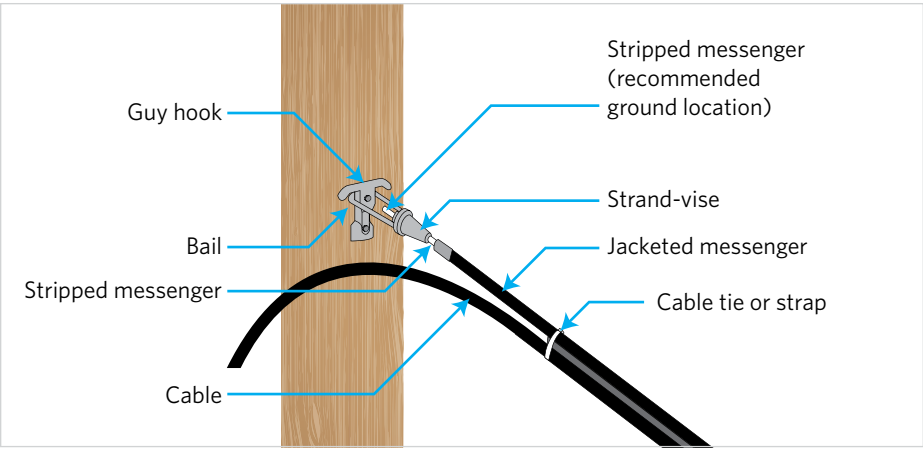


Figure 7: Dead-ending

D. Tensioning

Tension the cable messenger with chain hoist in a slow and steady pull. Always stay within the limits of maximum pulling tension for the messenger. It may be necessary to slightly over tension the messenger and back off until the desired tension is achieved. It is important not to exceed the cables maximum pulling tension. Tension charts are available at **SuperiorEssexCommunications.com/Resources/Technical-Guidelines**. For long spans, two chain hoists may be used in succession to gain the required tension.

If required tension is not adequate, it may be necessary to tension the messenger from intermediate poles. Use the same method as stated above and work towards the tensioning dead-end. As each section is properly tensioned, install the messenger in support hardware.

The procedure used to tension the messenger across a change of grade will result in the cable pulling up or down, depending on the direction of grade change. Temporary support hardware should be mounted accordingly to compensate.

E. Cable Twist

Adding cable twist when installing figure 8 cable reduces airfoil conditions when icing and wind conditions are present. Figure 8 cable has a non-symmetrical shape and is susceptible to vibration and cable damage if cable twist is not employed.

Add twist when the cable is moved from temporary hardware to the permanent hardware after tensioning and dead-ending cable is complete. The twist should be applied between poles and at a 360 degree revolution every 20-30 feet (6-9 meters). If poles are equally spaced, the twist can be applied in alternating directions at every other pole. Pole spans of varying lengths require the cable to be twisted at each pole location.

CAUTION: Intermediate poles are usually not configured for lateral stress. In the event that installation requires a significant intermediate tensioning, perform in gradual steps, repeating the process until required tension is achieved.

Personnel must stay on the pole side of the cable while tension operations are performed on the inside turn pole. Working on the inside increases the risk of bodily harm.

F. Pole Line Hardware

1. Clamps

The typical clamps used when installing Superior Essex Figure 8 cable are as follows:

- **C Cable Clamps** are designed to support all Superior Essex Figure 8 cables. This clamp is suitable for use on intermediate poles. Please see manufactures specifications for maximum pull forces.

Figure 8: C cable clamp

- **Three Bolt Suspension Clamps** are used on intermediate poles. Please see manufactures specifications for maximum pull forces.

Figure 9: Three blot suspension clamp

- **Corner Attachment Brackets** are used for cable runs at angles ranging from 35° to 60°. Please see manufactures specifications for additional information.

Figure 10: Corner attachment bracket

2. Grounding of Messenger

The messenger is required to have electrical continuity throughout the cable run. At dead-end poles where the messenger is attached to pole fixtures, install a bonding clamp and follow appropriate safety standard or code.

At intermediate poles where bonding to the power ground neutral is required, follow appropriate safety standard or code.

Figure 11: Bonding clamp

3. Slack Storage and Splice Locations

Location of splice closures and terminals are best located at or very near a pole location for easier access and workman safety.

Slack storage for fiber optic cable can be achieved using several different methods. Please refer to your company-required installation practice for this process. By dead-ending the cable at the pole and removing the messenger, the cable will be lighter and easier to route for slack storage and into a splice closure. When utilizing fiber storage units (snow shoes), please see cable manufacturer's fiber optic minimum bend radius to select the correct size unit.

For copper cable splices, separate the cable from the messenger and route through splice terminal.

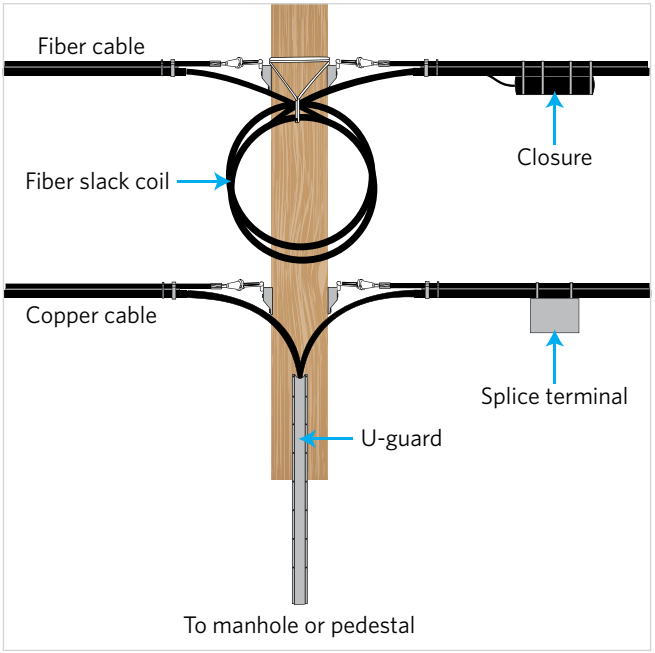


Figure 12: Typical splice locations

G. Transition from Aerial to Buried Figure 8

Figure 8 cables are manufactured with an integrated messenger and are intended for aerial use. It is acceptable to transition from aerial to buried, after dead-ending of the cable. The messenger can be removed from the cable with appropriate web cutting tool. If separation of the messenger is required, install a wire mess pulling grip on fiber optic cable and a set screw or wire mesh grip for copper cables. Only copper cables containing flooding compound are recommended for this application. Avoid installing aircore copper cables in underground conduit.

Conduit installations can also allow for the messenger to remain in place, providing there is adequate duct space available. Refer to the Superior Essex pulling tension guidelines for correct pulling tensions. If pulling a cable into a duct with messenger in place, the messenger component can be used for pulling. Do not exceed the maximum pulling tension of the messenger.

For questions or additional information please contact Superior Essex Technical Support by calling 1-800-551-8948.