Installation Guideline for Placing Fiber Optic Cable into a Lashed Aerial Position

Table of Contents

A. Purpose

A.1 This procedure applies to the installation of Superior Essex fiber optic cable into a lashed aerial position. The objectives of this guideline are:

- Provide to the cable installer a general guideline for installing fiber optic cable in an outside plant aerial facility. It is assumed that the cable handling crew already has an understanding of generic aerial cable installation and lashing. (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 Applications Engineering.)
- Prevent damage to the fiber optic cable during the setup, handling, and installation.

A.2 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.

B. Introduction

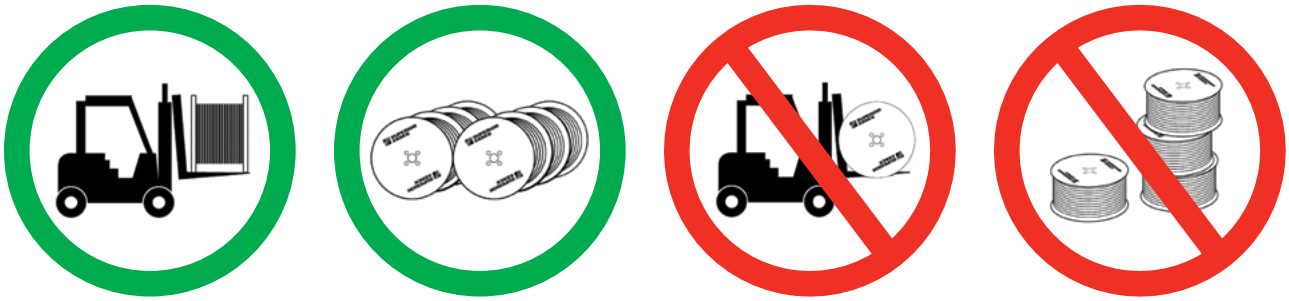
B.1 The practice of handling fiber optic cables has become much more common in recent years. Fiber optic cables are designed to withstand all typical installation and environmental stresses expected in the specific application.

B.2 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 fiber cable installation, contact **Superior Essex Technical Support by calling 1-877-263-2818.**

C. General Precautions

C.1 The following precautions always apply when handing fiber optic cable.

- 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: Always check specific product data sheet for cable design limitations. Cables are designed based on applications. Typical Bellcore GR-20 cable designs are to the following:

Maximum Pulling Tension	600 lbs	2700 N
Maximum Long Term Tension	200 lbs	890 N
Minimum Bend Radius, under tension	20 x O.D.	
Minimum Bend Radius, zero tension	10 x O.D.	
Maximum Crush Load, for one minute	125 lbs/in	220 N/cm
Maximum Crush Load, for ten minutes	63 lbs/in	110 N/cm

C.2 Additional general safety precautions exist when working with overhead facilities or in areas of traffic congestion.

- 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).
- 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.

D. Reference Documents

- **D.1** Bellcore GR-20-CORE, *(General Requirements for Optical Fiber and Fiber Cable)*
- **D.2** USDA Rural Utilities Service Bulletin 1753F-601 (PE-90), *(Specification for Filled Fiber Optic Cables)*
- **D.3** USDA Rural Utilities Service Bulletin 1751F-635, (*Aerial Plant Construction*)
- **D.4** IEEE 524, (*Installation of Overhead Conductors*)
- **D.5** USDA Rural Utilities Service Bulletin 1753F-401 (PC-2), *(RUS Standard for Splicing Copper and Fiber Optic Cables)*

E. Aerial Lashing Overview

E.1 Methods

E.1.1 Fiber optic cables that are lashed into an aerial plant rely on an existing support wire for tensile strength and stability. The support wire may be a stand-alone steel messenger (installed only to support the fiber optic cable) or it may be a pre-existing communications plant wire. In this document, messenger wire and support wire are used interchangeably and refer to the strength wire that the fiber optic cable is lashed to.

E.1.2 Two lashing methods are discussed in this document. Selection of the installation method is dependent on the preferences of the contractor and available resources.

E.1.2.1 *Lashing using a Stationary Reel Method*, is typically used when the route is not fully accessible by support vehicles. Temporary blocks are placed on the messenger wire throughout the run. The fiber cable is pulled into place from a stationary reel located at one end of the section run. Once the cable is in position, the lashing operation joins the fiber cable to the messenger wire.

E.1.2.2 *Lashing using a 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 a position for the lashing operation to be performed along the length of the section run.

E.2 Limitations and Precautions

E.2.1 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.

E.2.2 Whenever supporting a fiber cable in the air, insure the curvature of the support device is greater than the minimum bend radius of the cable to prevent damaging the cable.

E.2.3 Leave the lagging on the fiber cable reel until the reel is delivered to the installation site to prevent handling damage. When lagging 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.

E.2.4 Communications must be established at key control functions along the run to coordinate cable travel or lashing.

E.2.5 Avoid surges in fiber cable tension during reel payout.

E.2.6 Do not drag fiber cable over fixed surfaces to avoid damage to the cable jacket.

E.2.7 Permanent slack storage, including splice locations, may be assembled in a continuous direction loop configuration or a "figure eight". "Figure eight" configuration is best to minimize torsion and stress build up in the cable fibers over long lengths and is preferred over single direction coiling.

- 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" storage of standard loose tube cables (multiple tubes around a central strength member) may be strung out along the length of the span and must not exceed minimum bend radius limitations.
- "Figure eight" storage of single tube cables (Single Loose Tube, Single Flex Tube, Core Tube, Dri-Lite Ribbon, etc.) should be stored in a more compact figure-8 (4–6 feet end to end) and must not exceed minimum bend radius limitations. This method will provide additional insurance against a phenomenon known as "fiber retraction".

Procedure

E.2.7.1 Ensure all required materials are on hand. If using a storage device, ensure that it will maintain the proper bend radius for the installed cable and accommodate two passes of each cable.

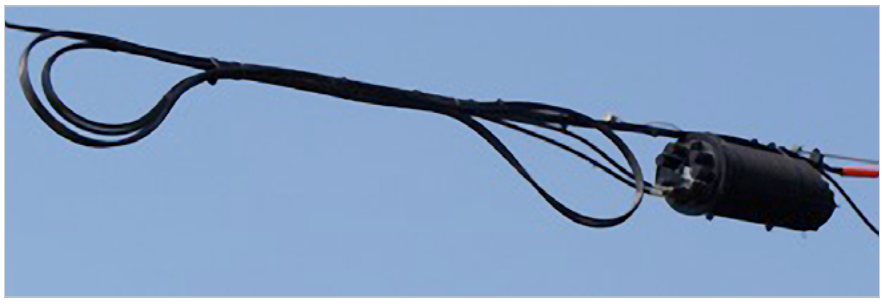
E.2.7.2 Provide a minimum of 50 feet of slack.

E.2.7.3 If storing slack at a splice location, attach the splice closure to the support strand using the standard procedure, but allowing the slack to remain free.

E.2.7.4 Gather up the cable slack forming two double loops*, approximately 4–6 feet end to end. Form the loops around the storage devices and secure.

NOTE: If retrofitting an existing installation and sufficient slack is not available to form two double loops, form as many as possible.

E.2.7.5 Attach the slack loops to the support strand using the cable ties.



Example: 3-Loop Retrofit Without Storage Devices

- 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.

E.2.8 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". "Figure eight" 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.

E.2.9 If the fiber cable is on the ground, always use barricades to prevent inadvertent access to the area.

E.2.10 The use of drip loops at each pole 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.

E.2.11 At all system dead-end poles and crossover locations, the fiber cable should be routed to the inside of the intersection.

E.3.Construction Planning

E.3.1 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 lashing installation technique
- Condition of existing messenger wire, if present
- Condition of poles and guying support
- Location of fiber cable splice points
- Locations for equipment setup
- Clearances to existing power lines and other cables

E.3.2 Fiber cable splice locations must be selected with consideration of splice vehicle accessibility. Fiber cable 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.

E.3.3 Engineering activities will be required to evaluate the sag and tension performance of the lashed system. Sag and tension evaluation will be dependent on environmental design conditions and will be used to determine the size and installation tension of the messenger wire.

E.3.4 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.

E.3.5 After completing the above planning activities, create an overall installation plan as the formal guide to the installation crew or contractors.

F. Lashing Fiber Optic Cable Using a Stationary Reel Method

F.1 Equipment and Materials

F.1.1 Pulling grips are required and must be sized for the cable 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.

F.1.2 A low elasticity pull line, such as an aramid yarn or wire rope, is recommended to minimize elastic induced surges during the pulling process.

F.1.3 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 eye and available to the winch operator during the pulling process.

F.1.4 Any hardware (sheaves, capstans, blocks) used during the installation of fiber optic cables must maintain the cable's minimum bend radius. The minimum bend radius during tensioned installation (dynamic) is 20 times the cable's outer diameter. The minimum bend radius during zero tension (static) cable handling is 10 times the cable's outer diameter. Blocks suspended under the messenger wire, for tangent support of the fiber cable, may have a groove diameter of 10 times the cable's O.D. if block spacing is 50 feet (15 meters) maximum.

F.1.5 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 and is maintained to ensure safe conditions for the fiber cable exist throughout the installation.

F.1.6 The lashing machine is selected based on the bundle size to be lashed. Refer to the operating instructions provided by the lasher vendor for detailed setup and operating instructions for the lasher unit.

F.1.7 The lashing material may be a steel wire or a dielectric type material such as aramid yarn. Refer to the lasher operating instructions for proper sizing of the lashing material. Double lashing should be considered if over-lashing over an existing aerial cable or when placing the cable over roadways or railways.

F.1.8 Ensure that properly sized hardware accessories are on hand to clamp the lashing wire to the messenger wire. Superior Essex recommends that the lashing wire be clamped to the messenger wire at each end of every span in the route to maximize lashing integrity.

F.2 Initial Conditions

F.2.1 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 fiber cable are reviewed with the handling crew.
- Installation equipment is reviewed for adequacy.
- Detailed setup and operating instructions for the lasher unit have been reviewed.
- Fiber 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.
- Supporting messenger wire is installed and at the proper tension.

F.3 Lashing Using the Stationary Reel Method

F.3.1 Prior to installation, all traffic safety zones, barricades, and flagmen must be in place. Observe all local safety ordinances and practices.

F.3.2 Set up winches, monitoring devices, and routing sheaves per the installation plan. Establish communication between reel and puller, and all intermediate locations.

NOTE: Set up payoff reel and lashing equipment so that the direction of lashing will be towards the cable payoff reel.

F.3.3 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.

F.3.4 Attach the pulling grip to the cable, if not factory installed, and attach the swivel to the pulling grip's flexible eye to prevent the cable from twisting during the pull.

Attaching the Pulling Grip

F.3.4.1 Apply the correct sized pulling grip over the cable end and mark the gripping length of the grip onto the cable. Continue to push the grip down on the cable to expose the full gripping length.

F.3.4.2 Remove the cable jacket from the outside half of the gripping length being careful not to score or damage the strength yarns over the cable core. Tightly wrap a layer of friction tape around the unjacketed portion of the cable.

NOTE: Do not use vinyl tape under the pulling grip due to its slick surface finish

F.3.4.3 Slide the pulling grip back up over the cable end so that the cable core extends about ¼"–½" (6–13 mm) beyond the grip mesh. Under the wire mesh should be about half jacketed cable and half friction tape. Tighten the grip onto the cable.

F.3.4.4 Tightly wrap over the grip with a vinyl tape. Begin the tape wrap about 1" (25 mm) below the mesh (on the cable jacket) and wrap towards the pulling eye to about 1" (25 mm) above the mesh.

F.3.4.5 Attach swivel to pulling grip eye.

F.3.5 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.

F.3.6 Check communication between the reel, pulling device, and all intermediate locations as appropriate.

F.3.7 Begin the pull slowly. Pull the optical fiber 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.

F.3.8 Do not exceed the cable's maximum rated pulling tension.

F.3.9 Stop the pull, and correct, if any of the following occur:

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

F.3.10 After the cable is pulled into position for lashing, pull sufficient slack for slack span and fiber cable splicing at terminating pole. Minimum slack should be height of pole attachment plus 30 feet (9 meters). Cut 10 feet (3 meters) from the end of the cable. Apply a protective cap to end of the cable. Fix both cable ends in place until lashing begins.

(For steps F.3.11 through F.3.15, refer to detailed lasher unit setup and operating procedures. Below steps are provided as general information only.)

F.3.11 Setup lasher unit per instruction manual and install lashing material into the lasher machine. If double lashing is to be performed, load lashing material into both sides of the lasher machine.

NOTE: Lashing is to be performed in the direction back towards the payoff reel.

F.3.12 Install the cable positioner and guide chute onto the messenger wire. Use spacers (or "shotguns") to fix the distances between the lasher-cable positioner and cable positioner-guide chute.

F.3.13 Secure the lasher to the messenger and install the fiber cable to the lasher per vendor procedures. Ensure any guides that close onto the fiber cable are snug but not too tight as to cause damage to the cable.

F.3.14 Feed the fiber cable through the cable positioner and guide rollers. Terminate the lashing using a lashing wire clamp and an appropriate cable spacer.

F.3.15 Commence the lashing operation per lasher operating instructions.

F.3.16 As lashing process occurs back towards the cable reel, slack will develop. Operate the cable reel to take up slack as necessary.

F.3.17 At each pole location the lasher will be transferred to the next span. Use caution during transfers to prevent damage to equipment or injury to personnel. Transfer should be done in the following sequence:

F.3.17.1 Temporarily clamp the lashing wire to the completed span messenger. Do not over-tighten to prevent damage to the lashing wire.

F.3.17.2 Pull enough wire out of the lasher to fully terminate the lashing on the span end then cut the lashing wire. Superior Essex recommends that lashing be fully terminated at each span end.

F.3.17.3 If the pole is to be a fiber cable splice location, then add appropriate fiber cable slack to allow for splice point construction (distance from pole attachment to ground plus 30 feet (9 meters) minimum. If the pole is to be a bypass point, then a drip loop should be installed. Ensure during formation of a drip loop that the fiber cable bend is smooth and gradual. Do not exceed the minimum bend radius of the cable.

F.3.17.4 Install cable guards, as appropriate, to ensure that the fiber cable bypass does not rub on any portion of the pole or pole hardware.

F.3.17.5 Transfer and reattach the lasher unit, cable positioner, and spacers to the messenger on the next span to be lashed.

F.3.17.6 Reinstall the fiber cable into the lasher unit.

F.3.17.7 Fully terminate the lashing on the end of the previous span and on the end of the span to be lashed. Fully inspect the conditions of the pole paying close attention to:

- Fully terminated lashing on both sides of pole.
- Drip loop installed with smooth transition for fiber cable.
- Cable guards installed on fiber cable as appropriate.
- If cable splice point, sufficient fiber cable slack remaining at pole.

F.3.18 Repeat above sequence for all remaining spans to be lashed.

F.3.19 At the end of the run verify slack span and cable splice length requirements prior to making any cable cuts. As appropriate, make a cable cut or leave remaining reel of fiber cable at site. For any cable cuts or free cable ends, ensure the end is capped and taped to prevent water entry. Coil and secure any free cable end for later splicing.

G. Lashing Fiber Optic Cable using a Moving Reel Method

G.1 Equipment and Materials

G.1.1 Vehicles selected for use using this method must provide full accessibility on the placement side of the poles along the entire section run.

G.1.2 Since fiber cable payoff is direct from the vehicle to the lasher, no pulling blocks, pulling grips, or swivels are required.

NOTE: Fewer materials are required for the moving reel method.

G.1.3 Radio communication must be established between the cable reel payoff unit and the ground supervisor. Fewer communication points are required for the moving reel method as the payoff vehicle and the lasher unit remain in close proximity throughout the process. This link can be provided by two-way radios and is maintained to ensure safe conditions for the fiber cable throughout the installation.

G.1.4 The lashing machine is selected based on the bundle size to be lashed. Refer to the operating instructions provided by the lasher vendor for detailed instructions.

G.1.5 The lashing material may be a steel wire or a dielectric type material such as aramid yarn. Refer to the lasher operating instructions for proper sizing of the lashing material. Double lashing should be considered if over-lashing over an existing aerial cable or when placing the cable over roadways or railways.

G.1.6 Ensure that properly sized hardware accessories are on hand to clamp the lashing wire to the messenger wire. Superior Essex recommends that the lashing wire be clamped to the messenger wire at each end of every span in the route to maximize lashing integrity.

G.2 Initial Conditions

G.2.1 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 fiber cable are reviewed with the handling crew.
- Installation equipment is reviewed for adequacy.
- Detailed setup and operating instructions for the lasher unit have been reviewed.
- Fiber 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.
- Supporting messenger wire is installed and at the proper tension.

G.3 Lashing Procedure Using a Moving Reel

G.3.1 Prior to installation, all traffic safety zones, barricades, and flagmen must be in place. Observe all local safety ordinances and practices.

G.3.2 Verify that vehicle access is available on the cable placement side of the system along the entire run.

G.3.3 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 on the cable payoff vehicle. Pay off the cable from the top of the reel.

G.3.4 Position payoff vehicle in line with lashing unit, and raise the fiber cable to lashing unit guide chute and cable positioner.

G.3.5 Pay off enough slack fiber cable to support fiber splicing at pole location. Slack length should be a minimum of height of pole attachment plus 30 feet (9 meters).

(For steps G.3.6 through G.3.11, refer to detailed lasher unit setup and operating procedures. Below steps are provided as general information only.)

G.3.6 Setup lasher unit per instruction manual and install lashing material into the lasher machine. If double lashing is to be performed, load lashing material into both sides of the lasher machine.

G.3.7 Install the cable positioner and guide rollers onto the messenger wire. Use spacers (or "shotguns") to fix the distances between the lasher-cable positioner and cable positioner-guide chute.

G.3.8 Secure the lasher to the messenger and install the fiber cable to the lasher per vendor procedures. Ensure any guides that close onto the fiber cable are snug but not too tight as to cause damage to the cable.

G.3.9 Feed the fiber cable through the cable positioner and guide chute. Terminate the lashing using a lashing wire clamp and an appropriate cable spacer.

G.3.10 Establish communications between cable payoff vehicle and ground supervisor.

G.3.11 Commence the lashing operation per lasher operating instructions. Coordinate payoff vehicle movement with lashing unit progress. Payoff vehicle should be about 50 feet (15 meters) in front of the lasher. Ensure movement of fiber cable is smooth and that minimum bend radius of cable is not exceeded.

G.3.12 At each pole location the lasher will be transferred to the next span. Use caution during transfers to prevent damage to equipment or injury to personnel. Transfer should be done in the following sequence:

G.3.12.1 Temporarily clamp the lashing wire to the completed span messenger. Do not over-tighten to prevent damage to the lashing wire.

G.3.12.2 Pull enough wire out of the lasher to fully terminate the lashing wire to the messenger using a lashing wire clamp and an appropriate cable spacer. Superior Essex recommends that lashing be fully terminated at each span end.

G.3.12.3 If the pole is to be a fiber cable splice location, then add appropriate fiber cable slack to allow for splice point construction (distance from pole attachment to ground plus 30 feet (9 meters) minimum. If the pole is to be a bypass point, then a drip loop should be installed. Ensure during formation of a drip loop that the fiber cable bend is smooth and gradual. Do not exceed the minimum bend radius of the cable.

G.3.12.4 Install cable guards, as appropriate, to ensure that the fiber cable bypass does not rub on any portion of the pole or pole hardware.

G.3.12.5 Transfer and re-attach the lasher unit, cable positioner, and spacers to the messenger on the next span to be lashed.

G.3.12.6 Reinstall the fiber cable into the lasher unit.

G.3.12.7 Fully terminate the lashing on the end of the previous span and on the end of the span to be lashed. Fully inspect the conditions of the pole paying close attention to:

- Fully terminated lashing on both sides of pole.
- Drip loop installed with smooth transition for fiber cable.
- Cable guards installed on fiber cable as appropriate.
- If cable splice point, sufficient fiber cable slack remaining at pole.

G.3.13 Repeat above sequence for all remaining spans to be lashed.

G.3.14 At the end of the run verify slack span and cable splice length requirements prior to making any cable cuts. As appropriate, make a cable cut or leave remaining reel of fiber cable at site. For any cable cuts or free cable ends, ensure the end is capped and taped to prevent water entry. Coil and secure any free cable end for later splicing.

If you have any further questions or need additional information, please call **Superior Essex Technical Support at 1-877-263-2818.**