CORNING

FlexNAP™ System Cable Assembly Placing — Open Trench

005-206-AEN
Issue 1

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005-054	FlexNAP™ System Cable Assembly Placing - Duct
005-048	FlexNAP™ System Cable Assembly Placing - Lashed Aerial

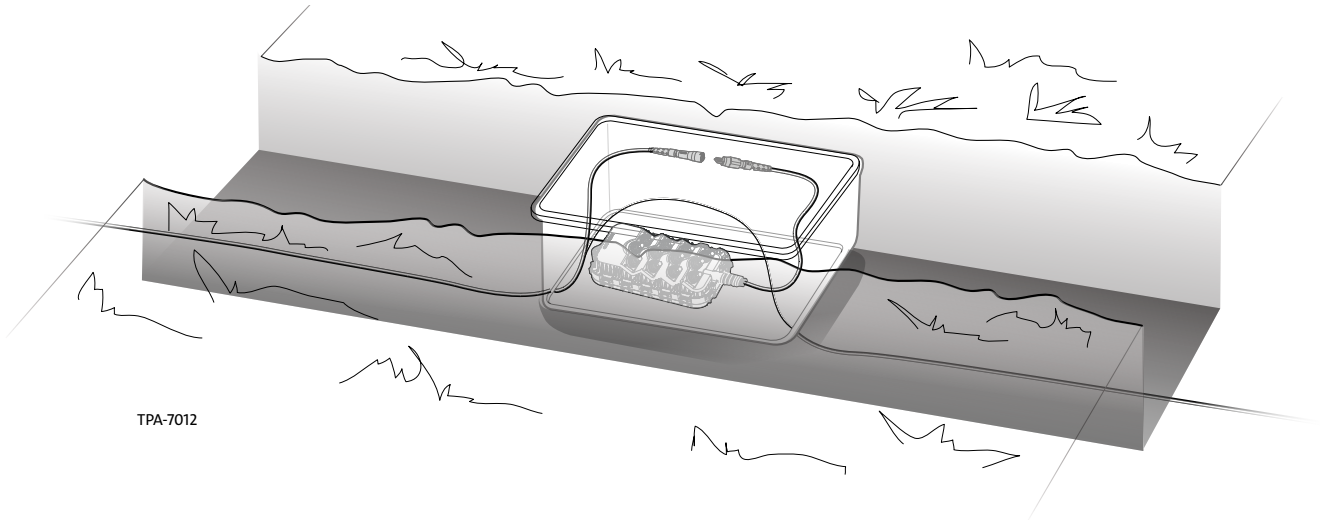
1. General

1.1 This procedure provides general information for duct installation of a Corning Optical Communications FlexNAP™ System cable assembly. These methods and instructions are intended only as guidelines, as each installation will be influenced by local conditions.

1.2 Methods used for placing an underground FlexNAP System cable assembly are essentially the same as those used for placing conventional fiber optic cable in an open trench system.

1.3 Two basic methods of cable installation are outlined in this procedure:

- The drive-off or moving reel method, used when the entire route can be traversed by reel carrying vehicles; the fiber optic cable is taken off the reel and placed in the trench in one operation.
- Back-pull, pull-in, or stationary reel methods used for cable routes which are inaccessible to vehicles or the cable needs to go under existing infrastructure. The cable is pulled into place beneath existing plant.



1.4 This procedure also describes variations and a combination of these two methods which can be used when cable route restraints prevent the use of the moving reel method for the entire installation.

1.5 Fiber optic cable is a high-capacity transmission medium whose qualities and characteristics can be degraded when it is subjected to excessive pulling tension, sharp bends, and crushing forces (see steps 2.6, *Cable Handling Precautions*, for specifications).

1.6 This practice may contain references to specific tools and materials in order to demonstrate a particular method. Such references are in no way intended as a product endorsement.

2. Safety Precautions

This section provides safety precautions which should be observed when working in manholes, underground vaults, or handholes. These practices may change, or may not be suitable in a specific situation, and so are suggested guidelines only. Your company's safety precautions and practices take precedence over any conflicting recommendations given in this document.

2.1 Laser Precautions

WARNING: Never look directly into the end of a fiber that may be carrying laser light**.** Laser light can be invisible and can damage your eyes. Viewing it directly does not cause pain. The iris of the eye will not close involuntarily as when viewing a bright light. Consequently, serious damage to the retina of the eye is possible. Should accidental eye exposure to laser light be suspected, arrange for an eye examination immediately.

2.2 General Safety Precautions

WARNING: : Before beginning any underground cable placing operation, all personnel must be familiar with their company's safety practices. Failure to do so may result in serious injury.

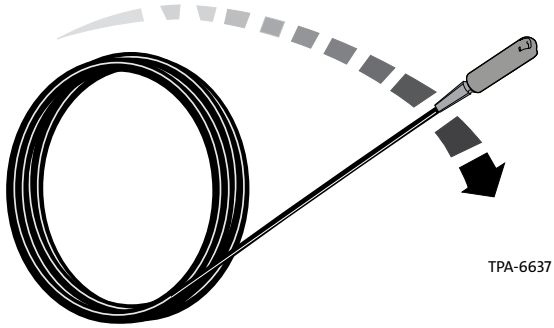
WARNING: To minimize hazards to yourself and others in or near the work area, follow all company rules for setting up barricades, manhole guards, and warning signs. Any material in the vicinity of a manhole should be arranged so that it cannot fall into a manhole, or unnecessarily impede pedestrian or vehicular traffic. Establish good communications between the pull, feed, and monitoring locations before starting any pull operation.

2.3 Lead Exposure Precautions

WARNING: Lead dust may be released into the manhole atmosphere any time the sheath of older lead sheath cable is disturbed. When working in manholes, precautions must be taken to limit the amount of exposure to lead. Strictly observe your company's lead handling procedures to eliminate this hazard. Failure to do so may result in serious, long-term health problems

2.4 Cable Handling Precautions

WARNING: Unrestrained cable ends may cause injury to your eyes or body and damage the cable, fitting, or fibers if suddenly released from a coil. Wear eye protection and use extreme care when handling a tether which uses flat-drop cable. Gently release the energy stored in the cable coil to avoid possible personal injury or damage to the cable or fitting components.



WARNING: Care must be taken to avoid cable damage during handling and placing. Fiber optic cable is sensitive to excessive pulling, bending, and crush forces. Any such damage may alter the cable's characteristics to the extent that the cable section may have to be replaced. To ensure all specifications are met, consult the specific cable specification sheet for the cable you are installing.

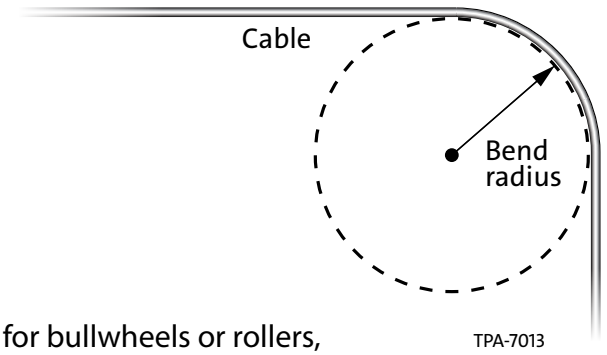
WARNING: The use of "figure-eight" machines is not recommended for the Corning Optical Communications FlexNAP™ System cable assemblies.

WARNING: Never use liquid detergent as a lubricant when placing fiber optic cable. Most detergents will promote stress cracks when used on polyethylene. Use only cable lubricants with manufacturer's approval for polyethylene.

2.5 The maximum pulling tension for a FlexNAP System cable is assembly is 2,700 Newtons (600 lbf). Monitoring equipment break-away swivels must be used to prevent over-tensioning the cable to avoid damage to the FlexNAP System cable assembly and to prevent possible personal injury.

2.6 The FlexNAP System cable assembly specification sheet lists the minimum cable bend radius both "Loaded" (during installation) and "Installed" (after installation) conditions. If these sheets are not available on the job site, the following formulas may be used to determine general guidelines for installing Corning Optical Communications FlexNAP System cable assemblies:

To determine the minimum bend radius for installing cable under tension, multiply the distribution cable outside diameter by 15 times.



Example:
Cable Diameter = 0.46 inches (11.8 mm)
15 x 0.46 in. (11.8 mm) = 6.9 in. (177 mm)

To find the minimum diameter requirment for bullwheels or rollers, simply double the minimum working bend radius

2.7 Before the installation begins, carefully inspect the FlexNAP™ System cable assembly and reel for anything that may cause damage to the cable as it is unreeled.

2.8 Protect the FlexNAP System cable assembly while unattended. Any damage to the FlexNAP System cable assembly may result in total replacement of the product.

2.9 Exercise caution when working with the FlexNAP System tether. Be careful not to kink the tether. Eliminate sources that could cause the release mechanism to get snagged on.

2.10 Whenever an unreeled FlexNAP System cable assembly is placed on the pavement or surface above a manhole, vault, or handhole, provide barricades or other means of preventing vehicular or pedestrian traffic through the area.

2.11 The "figure-eight" configuration should be used to prevent kinking or twisting when the cable must be unreeled or back fed.

Fiber optic cable should not be coiled in a continuous direction except for lengths of 100 feet (30 meters) or less. The preferred size for the "figure-eight" is approximately 15 feet (4.5 meters) in length, with each loop 5 feet (1.5 m) to 8 feet (2.4 m) in diameter. Traffic cones spaced 7 to 8 feet apart are useful as guides during "figure-eighting."

When "figure-eighting"' long lengths of cable, care should be taken to relieve pressure on the cable at the crossover of the eight. This can be done by placing cardboard shims at the crossover or by forming a second "figure-eight."

2.12 FlexNAP System cable assemblies which pass through hand/man-holes containing petroleum-based waste will require special protection. Some petroleum products will deteriorate the cable assembly's polyethylene sheath. Consult your company's practices regarding handholes/manholes and petroleum-based waste for specific instructions on how to remove the petroleum. Install duct that is impervious to future petroleum exposure.

2.13 At the completion of a day's installation, protect bare cable ends by placing a cable cap on the end of the cable, followed by several wraps of tape around each cap. This will assist the moisture-resisting material in Corning Optical Communications loose-tube cable in preventing water ingress due to long-term exposure to moisture. If a cap is not available, a few wraps of tape placed on the tip of the cable should prevent water from entering the cable.

NOTE: *If the cable ends are not capped while exposed to the environment for long periods of time, the customer may choose (but is not required) to cut off one meter of each cable end before splicing. This will ensure that no moisture ingress is present.*

3. Planning and Preparation

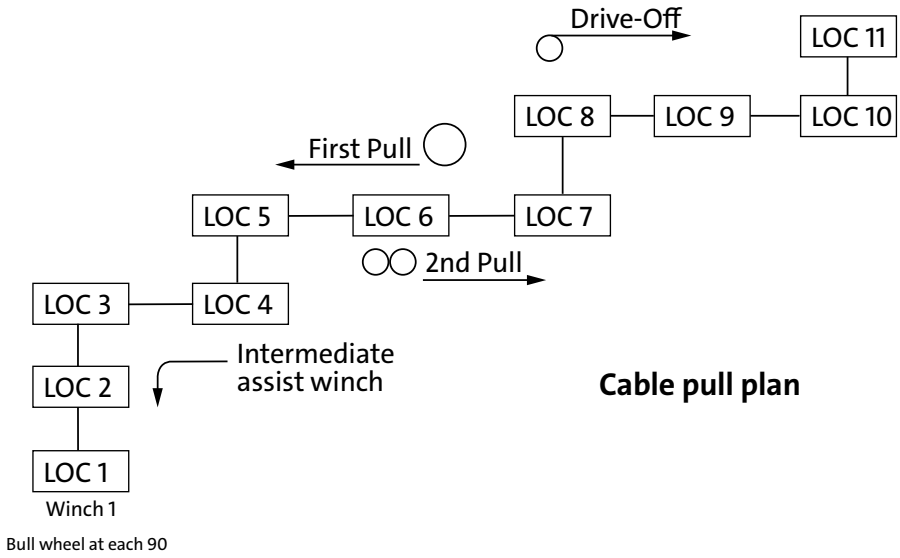
3.1 Consult Corning Optical Communications FlexNAP System Engineering and Planning Guidelines for guidance on planning an installation using the FlexNAP System product.

NOTE: *Accuracy in route planning and measurement is critical. Failure to provide accurate information will most likely result in a product that will not fit the intended Systems route.*

3.2 It is recommended that an outside plant engineer conduct a survey of the cable route. Handholes, manholes, and ducts should be inspected to determine the optimum splice point locations and duct assignments. Accurate duct length is needed to identify potential problems with duct and cable assembly placement at this time.

3.3 When designing a FlexNAP™ System cable for an open trench installation, the timing of the installations should be a consideration. Occasionally, these installations are done in phases, with a later phase being installed before the first phase. In a case like this, understanding how to store the remaining cable, or planning for a splice point, may be needed.

3.4 Once planning is complete, the build information is entered into a Corning Optical Communications web-based program called the "FlexNAP™ Systems Configurator." Access to the FlexNAP System Configurator requires prior authorization from Corning Optical Communications. Contact a customer service representative at 1-800-743-2671 for more information.



Cable pull plan

TPA-7014

3.5 The FlexNAP System cable assembly can normally be driven off from the CO end towards the field end. Develop a cable install plan based on the cable route survey.

3.6 The FlexNAP System cable assembly may also need to be pulled in toward the central office, if there is not a clear trench pathway. This could be caused by things such as road crossings or utility drops (water, power, sewer, etc.) where the FlexNAP System cable will need to be installed below the existing plant. Develop a cable pull plan based on the cable route survey.

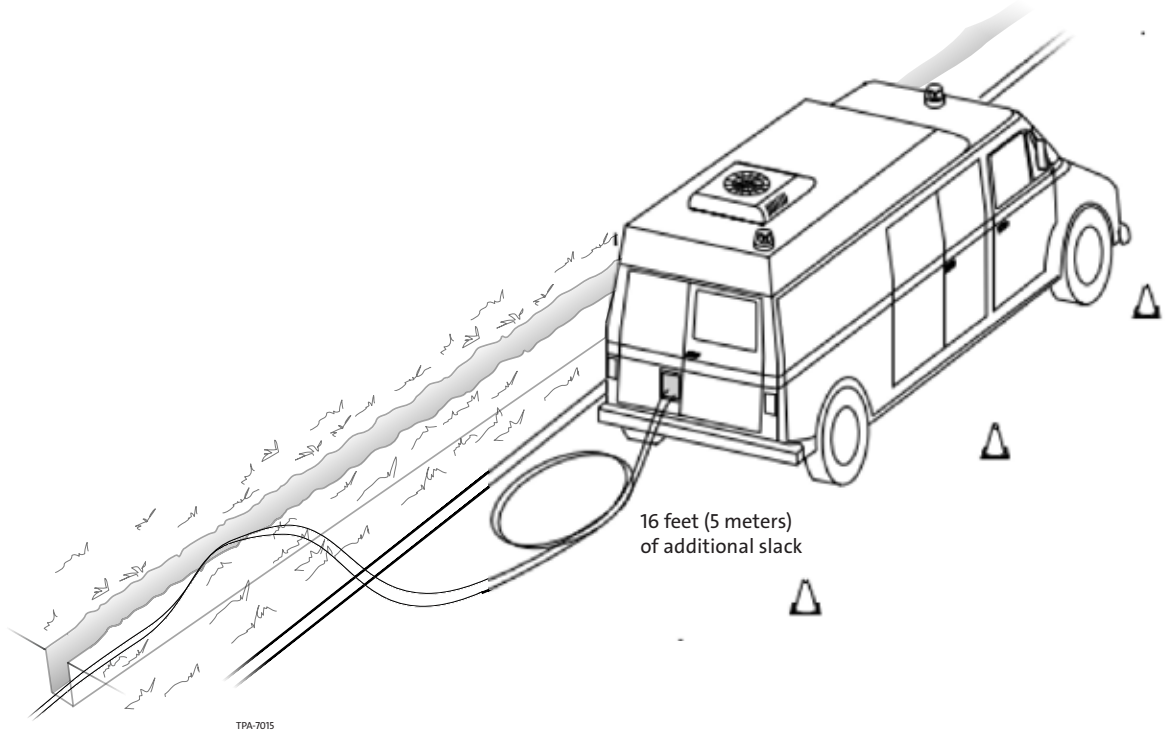
3.7 Factors to consider in developing the pull plan include changes in elevation and the locations of turns and offsets.

- Offsets in a pathway are more gradual variations from the ideal, straight path of a duct section.
- Offsets can impose greatly increased pulling tension.

To minimize the effect of bends and offsets, begin such pulls at the end of the section nearest the difficult area.

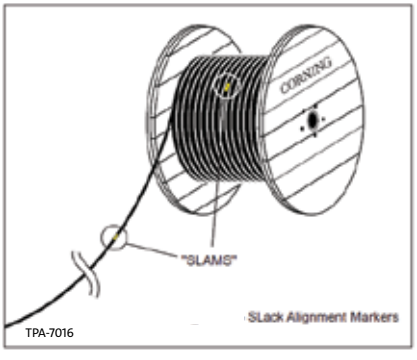
Splice locations

3.8 Select splice locations during the survey and make plans for closure and cable slack storage. Corning Optical Communications recommends that at splice points, installation crews leave enough cable slack on each cable end to reach out of the vault and into a splice vehicle, plus 16 feet (5 meters) .
This cable slack must be taken into account when ordering cable lengths. Consider the accessibility of these splicing locations by splicing vehicles. These locations should not fall in sites where access is inconvenient or hazardous.



The preliminary choice of splice locations during the route survey allows verification of the transmission design and provides the basis for cable order lengths.

If there are slack loops designed into the installation, the loops will be marked on the distribution cable by a pair of yellow SLack Alignment Markers (SLAMS) dictating the position and length of the slack loop .

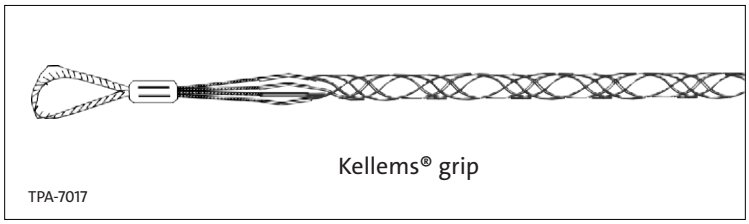


4. Installation Equipment and Accessories

4.1 Various types of pull-line have been used successfully with fiber optic cable. Pull-lines can be of either a round or flat cross section. Selection of a pull-line will depend upon the length and conditions of the pull. Small diameter pull-line may have a tendency to break when under tension.

4.2 Available pull-line materials include wire rope, polypropylene, and aramid yarn. For pulls using winches, materials with low elasticity such as wire rope and aramid yarn can minimize surge-induced fluctuations in pull-line tension. Consult your company's standard practices with regards to pull-line materials.

4.3 Corning Optical Communications recommends the use of a GRP series wire mesh pulling grip (Kellems® grip). Pulling grips provide effective coupling of pulling loads to the jacket, aramid yarn, and central member of fiber optic cables.



Kellems® grip

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4.4 The use of a swivel between the pull-line and the pulling grip is required to prevent the pull-line from imparting a twist to the cable. A swivel that contains ball-bearings such as the Corning Optical Communications GRP pulling swivel is recommended to prevent binding at high tensions.

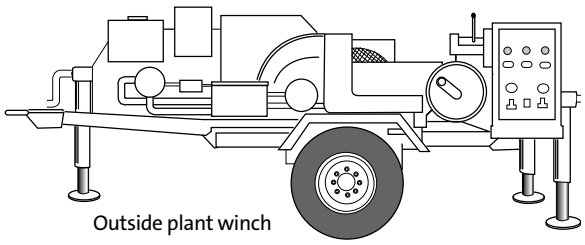
Tension-monitoring equipment

4.5 Fiber optic cable is subject to damage if the cable's specified maximum tensile force is exceeded. Except for short runs or hand pulls, tension must be monitored. Refer to cable specification sheets for maximum tension. Exceeding the specified maximum tension will void the warranty of the cable assembly product.

4.6 The use of a winch with a calibrated maximum tension is an acceptable procedure. The control device on such winches can be hydraulic or in the form of a slip clutch. Such winches should be calibrated frequently.

4.7 The use of a breakaway link (swivel) can be used to ensure that the maximum tension of the cable assembly is not exceeded. Breakaway links react to tension at the pulling eye and should be used as a fail-safe rather than a primary means of monitoring tension.

4.8 A dynamometer or in-line tensiometer may also be used to monitor tension in the pull-line near the winch. This device must be visible to the winch operator or used to control the winch. Special winches are available that monitor the tension remotely at the pulling eye via a wire in the pull-line. Such winches may also provide a record of the tension during pulls.



Outside plant winch

TPA-7018

NOTE: *Carefully select equipment that maintains bend radius. Not all outside plant equipment is well-suited for fiber optic cable installation.*

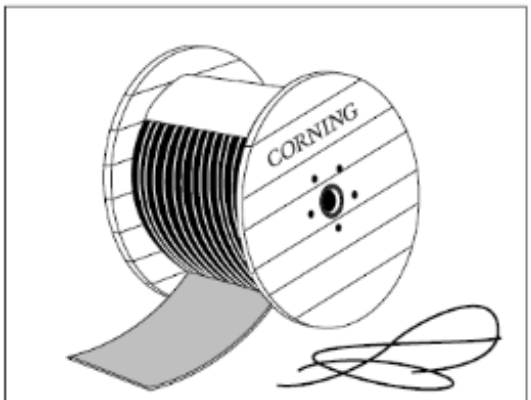
Pulling equipment

4.9 All pulling equipment and hardware which will contact the cable assembly during installation must maintain the cable assembly's minimum bend radius (see step 2.8). Such equipment includes sheaves, capstans, bending shoes, and quadrant blocks designed for use with fiber optic cable.

4.10 Situations that require use of a radius-maintaining device are encountered at feed and pull locations, at bends, and where pathways are offset.

Packaging removal

4.11 Upon arrival at the job site, remove the packaging from each cable reel. If the cable date sheet for the reel has been retrieved online from Corning, record the actual reel location on the sheet to further document the system.



TPA-7019 Reel packaging removal

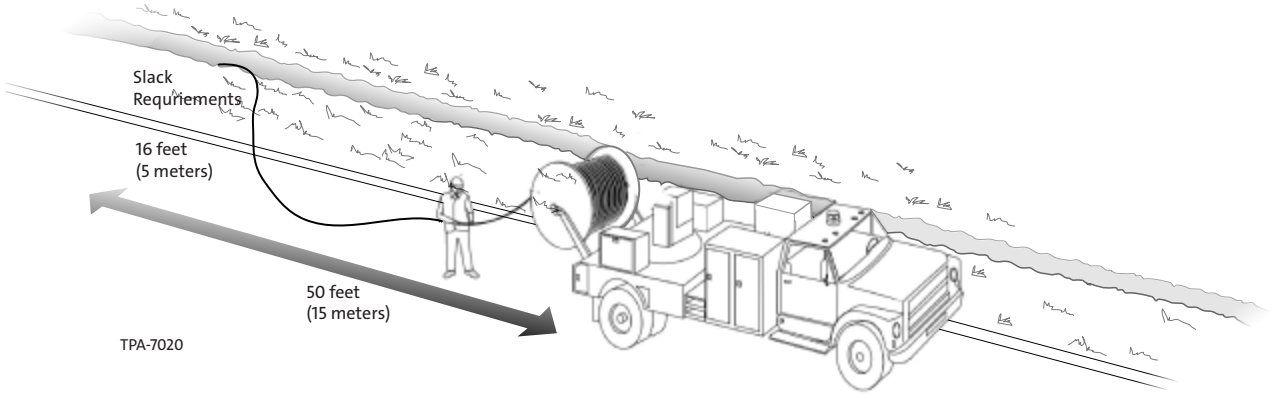
5. Moving Reel (Drive-Off) Method

5.1 In the moving reel or drive-off installation method, the cable is payed off its reel and placed into the trench as the placement vehicle(s) move (s) along the path. This method requires vehicle access to the side of the trench line, and the cable route(s) must not encounter road crossings, utility drops, and other obstructions. Any of these could negate the use of this placement method, for that cable section.

5.2 Begin the installation by unreeling an adequate, undamaged cable tail. This tail should be long enough to reach from the cable vault into a splicing vehicle, plus 16 feet (5 meters) left at the vault.

NOTE: *In addition, unreel enough slack to assure that the cable's minimum bend radius is not exceeded when the cable is lowed into the trench.*

Generally, the reel-carrying vehicle should be 50 feet (15 meters) ahead of the placing to assure a proper cable minimum bend radius between the reel and trench level.



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5.3 Verify that sufficient slack for splicing is available before securing the cable in the trench. Position the cable at the starting location, aligning the appropriate PAM marker with that location. The cable may need to be temporarily secured to prevent transition as the reel is driven off.

NOTE: *Corning recommends that the cable in the trench be constantly observed so that the reel can be stopped if the cable binds on something.*

5.4 As the placement begins:

a) Hold the cable end in place at the starting location to prevent any movement along the trench until the placing operation has progressed 100 feet (30 meters) down the trench line.

b) Cable payoff must be surge-free and allow the cable to smoothly enter the trench level. Control reel rotation to prevent:

1) Free running, which could result in cable coming in contact with obstructions.

2) Too-slow a payoff, which might subject the cable to excessive tension.

5.5 The reel-carrying vehicle must maintain its 50 foot distance ahead of the placing, and drive as close to the trench line as conditions permit during the placement. Vehicle speed must assure complete control of the placing operation. The speed used in the moving reel method of fiber optic placement can average up to 150 feet (45 meters) per minute, which is equivalent to a vehicle speed of 1.7 miles per hour.

5.6 Should it be necessary to stop the placing operation mid-span, the crew member controlling the cable must make sure that proper bend radius is maintained on the cable.

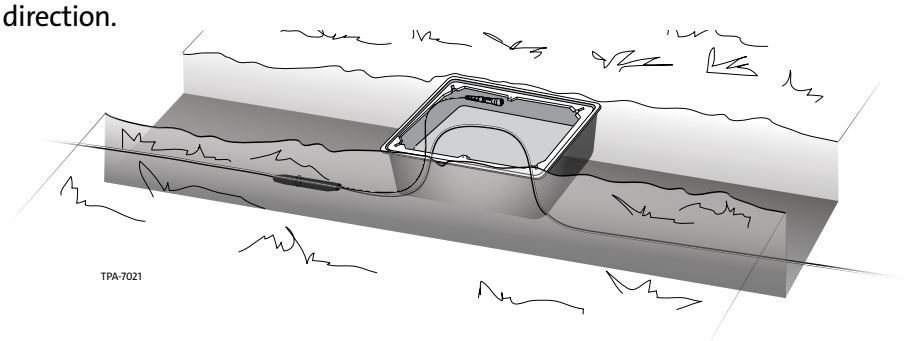
5.7 Upon reaching each tether along the route, stop the vehicle to assess the location of the PAM and tether is correct. If the tether is not aligned with its planned location, shift the cable or coil slack to re-adjust it.

5.8 Continue the drive-off installation, span-by-span, from the start-up point towards the end of the cable until the entire run is completely placed in the trench.

5.9 At the end of the run, verify the slack-span and splicing requirements with the installation supervisor. Depending on the system plan, either leave the reel at this site or unreel adequate cable slack before cutting and capping the cable.

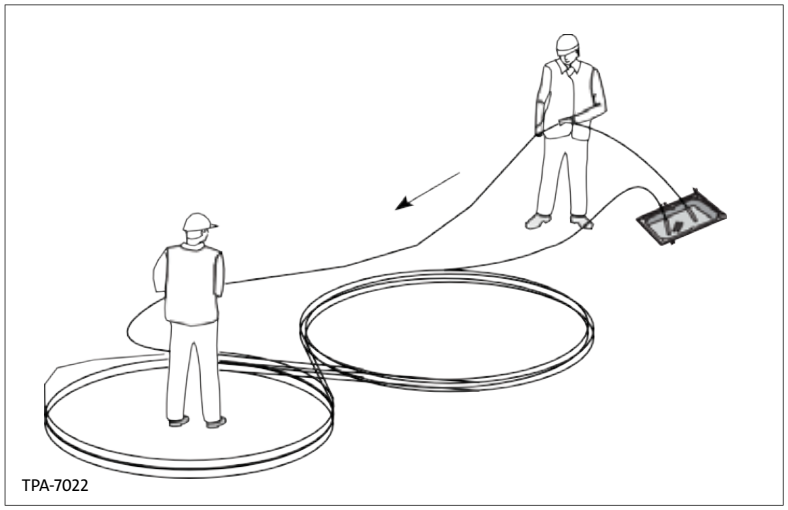
6. Stationary reel method

6.1 The FlexNAP™ System cable assembly is intended to be pulled only in one direction, with the cable entering the trench on the field side and being pulled toward the central office with the tethers trailing the pulling direction.



6.2 Various techniques are available to ease the installation of long lengths of fiber optic cable. The length of cable that can be pulled in one operation will vary with ground conditions, the equipment used, pulling technique selected, and the skill of the craftsmen. The preferred method is to hand pull, completing one span section at a time.

6.3 Longer continuous pulls can be accomplished by hand assisting the cable at bends/turns and at cable access points.



Center-pulls and back feeding

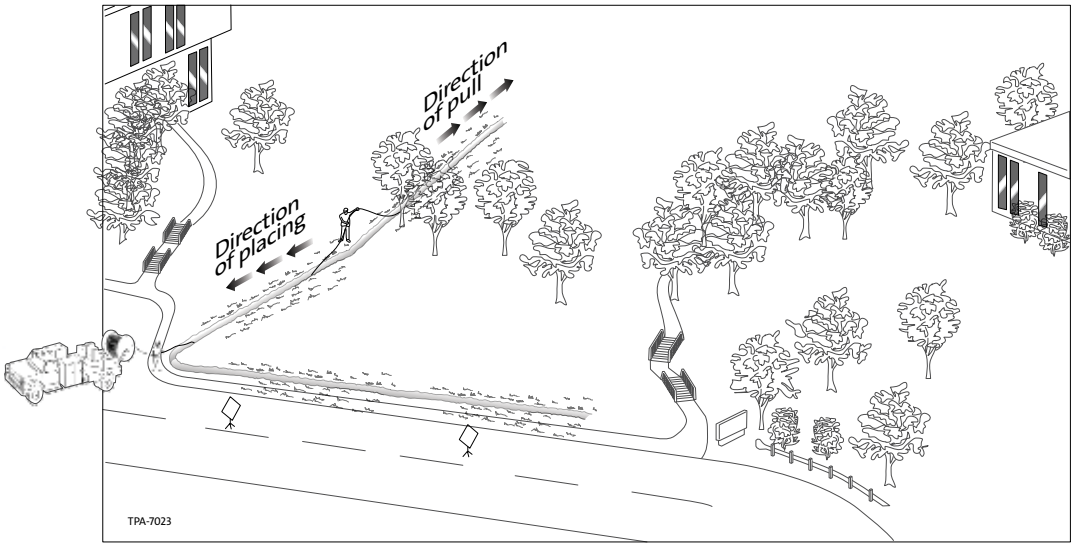
6.4 Reverse pulling of TAPs is currently not recommended, with the exception of the Preterm Lateral reverse tethers, which have a protective sleeve and are designed to be pulled in the opposite direction.

NOTE: *If the TAP is reverse pulled then the tether and tether connector should be protected by taping with electrical tape to prevent damage to the tether assembly and FlexNAP™ System cable assembly. Progress should be monitored constantly to avoid damage to the cable assembly.*

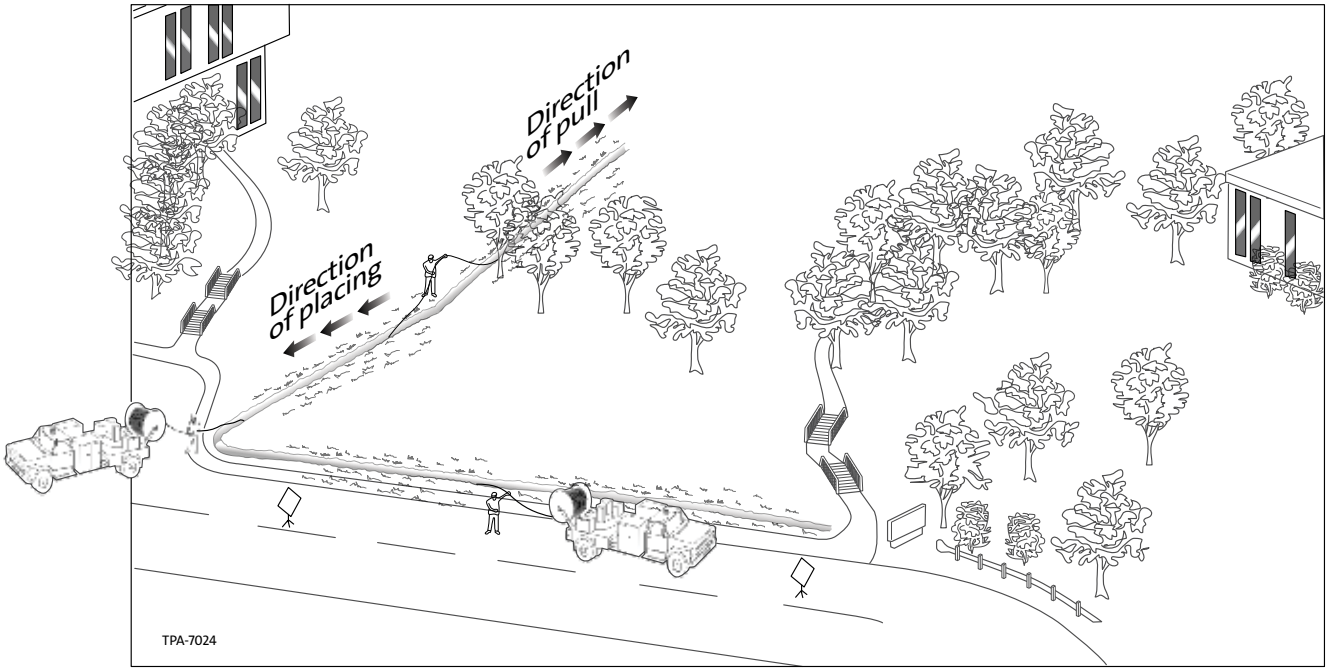
7. Combination methods

7.1 If the cable route has terrain, trees, or other obstructions which prohibit the complete use of a moving reel installation, stationary reel methods can be used to pull in the cable in sections inaccessible to vehicles.

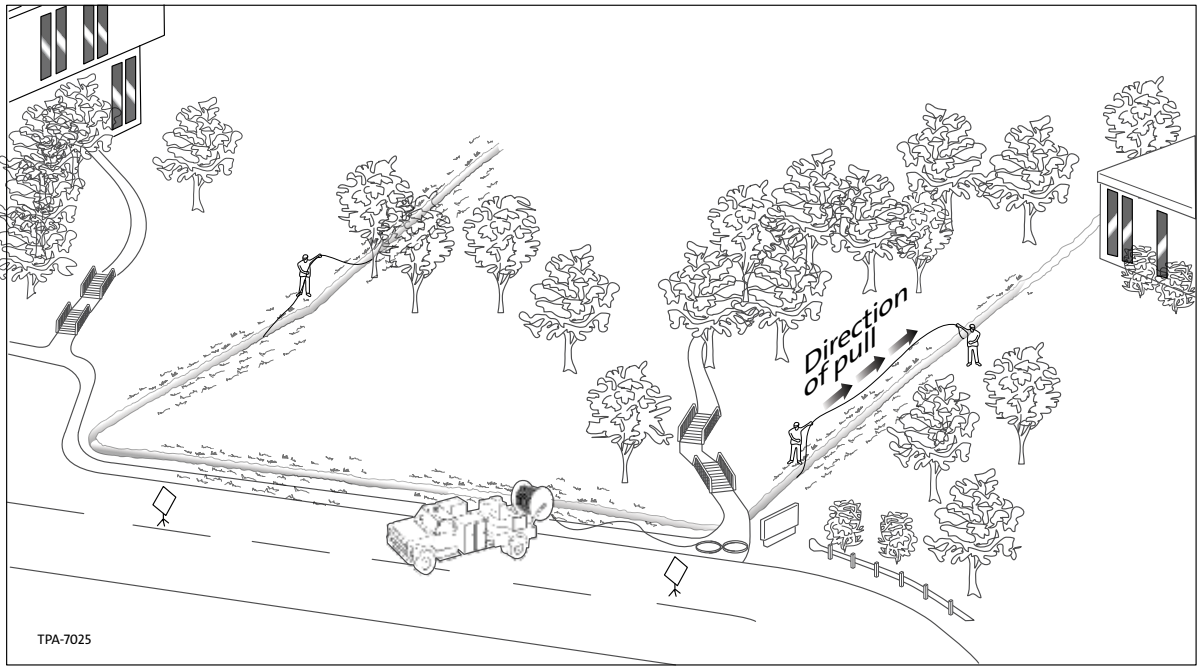
7.2 Set up the cable reel at an end point of the route in which the moving reel method is practical. Install the vehicle-inaccessible section using a stationary reel method.



7.3 Following placement of this section, install the vehicle-accessible remainder of the cable route with the moving-reel method.



7.4 If the destination of the route is also inaccessible to vehicles, unreel and figure-eight the cable to gain access to the other end of the cable. Pull the cable into place with a stationary-reel method.



8. Installation Procedure

8.1 This section will provide an overview of a placement operation. As noted earlier, your company's practices and local conditions may take precedence over these guide-lines.

8.2 Prepare the trench section where the cable is to be placed:

- Place barricades.
- Remove obstacles if possible.
- Remove large rocks or debris from the trench, as possible.

8.3 Set up winches, tension monitoring devices, bend radius devices (sheaves, capstans, bending shoes, etc.), and means of communication along the route prescribed in the build plan.

8.4 Locate the cable reel at the appropriate point of the route. Pulling should be in the direction of the CO. Standard FlexNAP™ System cable assemblies are packaged with the CO side on the outside of the reel. The CO end should enter the trench on the field side and be pulled to the CO side of the duct.

8.5 Remove any reel lagging or protection material and retrieve the cable build information.

8.6 Inspect the FlexNAP System cable assembly and reel for any damage. Also check for anything that may cause damage or issues during the installation (loose traverse, points that may contact the cable during payoff, etc.).

8.7 Ensure the reel payoff is stable and the reel turns freely without binding. The reel should be level during payoff.

NOTE: *Jack stands can be unstable and cause damage or injury if not set up properly. Consult your company's practices.*

8.8 Verify the top end of the cable is labeled with the appropriate tag specifying pull direction is CO. Failure to determine the correct installation start point will most likely result in cable removal.

8.9 If not previously installed, attach the pulling grip to the cable assembly and attach the grip to a break-away swivel rated for not more than the specificity maximum installation tension. Attach the pull line to the grip according to your company's practices or the pull line manufacturer.

8.10 Verify communication lines are functional and crews are in place at feed, intermediate, and pull locations.

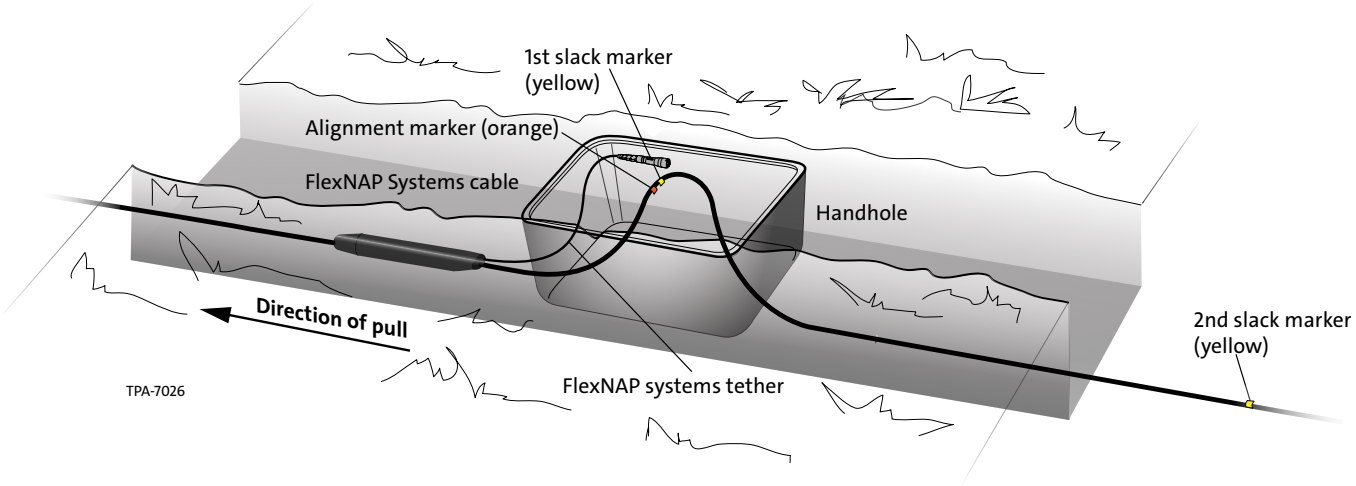
8.11 Start the pull at a slow speed, passing the pull-line and cable over and around the capstans, sheaves, and other devices required to maintain the minimum bend radius. Tension monitoring is recommended but in situations where the cable is being hand pulled, tension monitoring may not be possible. If necessary, aid the cable feed by turning the payoff reel by hand. Ensure that the cable is fed only as fast as the pull-line is moving. Prevent excess cable from being spooled off.

8.12 Once the cable has moved a minimum of 15 feet (1.3 meters) into the trench, accelerate the pull smoothly to its desired speed.

8.13 Continue the pull at a steady rate. If stopping is needed, then do NOT release the tension unless instructed to do so. Pulls can be easily resumed if tension is maintained on the pull-line and cable.

8.14 The FlexNAP™ System cable assembly should be visually observed during the following situations:

- passage under or around obstacles or crossings.
- where the use of a radius-maintaining device is required due to a bend or offset of the entrance and exit ducts.
- at intermediate-assist points..
- around turns or corners in the trench path.



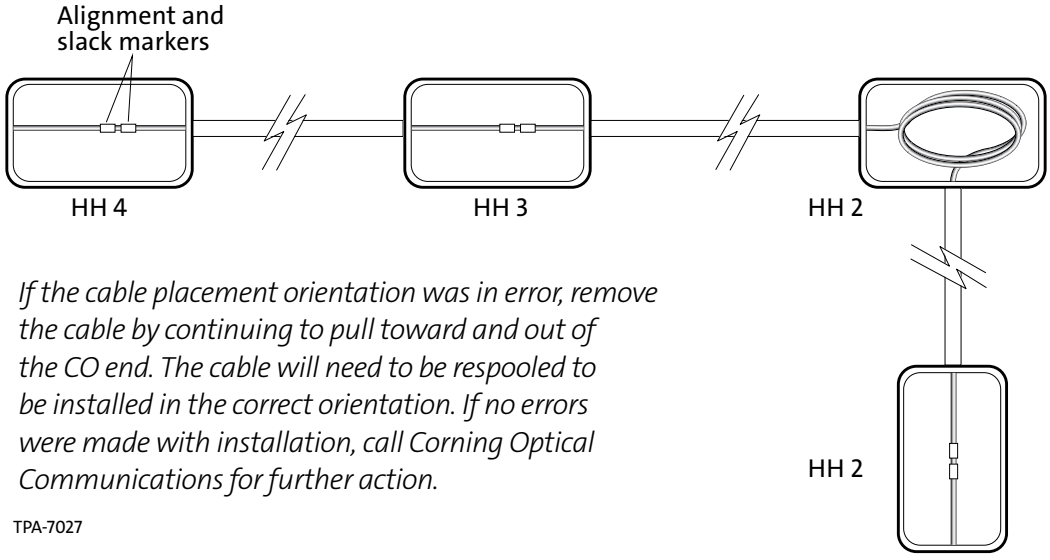
8.15 When a FlexNAP™ System tap point reaches its intended location, slow the pull speed. Each FlexNAP System tap point has an ORANGE alignment marker placed on the cable just after the FlexNAP System tap point.

Align the marker with the desired location, in the trench, based on the plan. If cable slack was specified at this point, then manage that slack while maintaining the minimum cable bend radius. The beginning and end of the designed slack segment are designated by YELLOW alignment markers. The slack amount may have to be adjusted to properly position the next FlexNAP System cable assembly toward the subscriber.

8.16 Once the FlexNAP System cable assembly is pulled into place and appropriate slack is available, verify all the FlexNAP System "Taps" are at the intended placement locations.

NOTE: *Care should be taken to avoid the tether release mechanism from being snagged. This not only applies to "figure-eighting," but going through or around guide devices and obstacles as well.*

8.17 Once the FlexNAP System cable assembly is pulled into place and appropriate slack is available, verify all the FlexNAP System "Taps" are at the intended placement locations.



IMPORTANT: *If the cable placement orientation was in error, remove the cable by continuing to pull toward and out of the CO end. The cable will need to be respooled to be installed in the correct orientation. If no errors were made with installation, call Corning Optical Communications for further action.*

TPA-7027

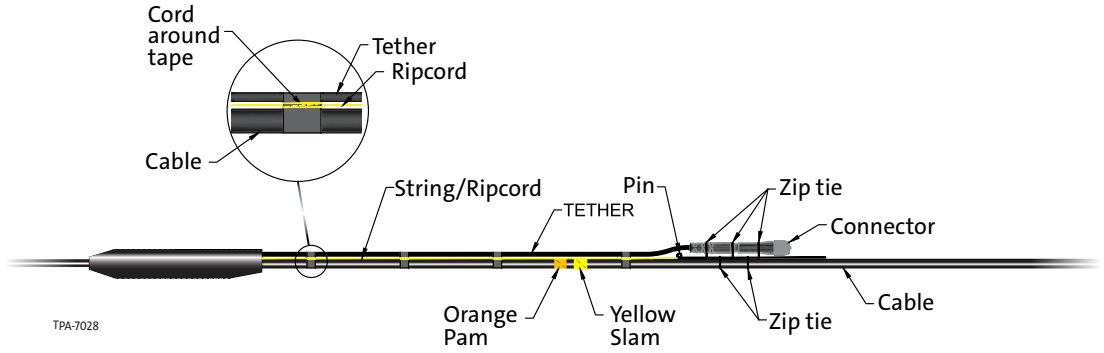
8.18 Also verify that the cable is placed in the correct direction. The tethers on the FlexNAP System cable are designed to point towards the "field" end of the cable, away from the CO/splice end.

8.18 When backfilling the trench, be careful to not push large or sharp rocks back into the trench. These rocks can cause pressure or cuts into the cable and potentially break the fibers. If rocks cannot be avoided during backfilling, it is recommended to cover the FlexNAP™ cable with sand or other fine material to prevent future compaction and damage.

9. Accessing the Tether

9.1 Current production below-grade tethers are 15 feet in length and are taped to the FlexNAP System cable at one-foot intervals, with a release string built in.

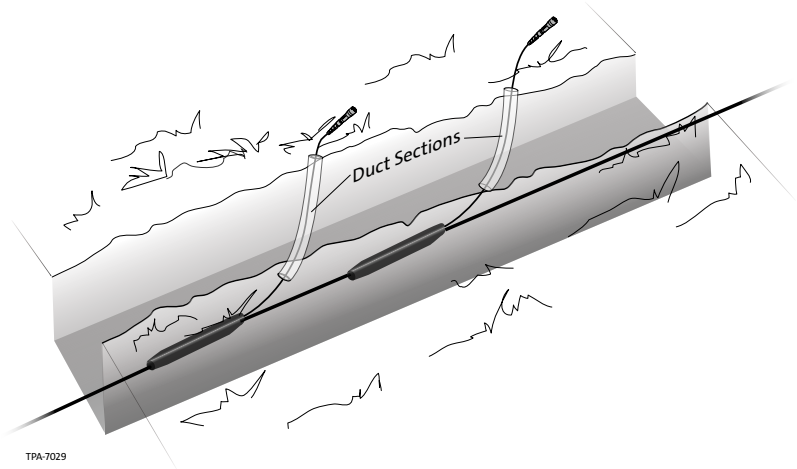
9.2 If not already exposed in step 8.18, cut and pull the tether release string that is attached to the FlexNAP System tether. It is best to cut this string as close to the TAP point as possible. This string is wrapped around the tape. By pulling on the string, the tape will be cut, and a pin removed from the connector attachment.



9.3 Once the release string and pin are loose, pull the tether up and out of the trench, and route it to the terminal location (pedestal, handhole, flower pot, etc.).

9.4 It is recommended to provide extra protection to the tether, especially during the backfilling process. One recommendation for doing this, is to place a short duct section over top of the tether, that transitions down into the trench.

NOTE: *Do not remove the tether dust cap until the terminal is ready to be connected.*



9.5 Fiber optic warning signs and location identification labels should be placed in appropriate areas to help identify the cable(s).

Corning Optical Communications LLC • 4200 Corning Place • Charlotte, NC 28216 USA
800-743-2675 • FAX: 828-325-5060 • International: +1-828-901-5000 • Corning.com/opcomm