

CORNING

FlexNAP™ System Cable Assembly Placing — Duct

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[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 (Figure 1). 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 a duct system.
- 1.3 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 step 2.7, Cable Handling Precautions, for specifications).
- 1.4 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.

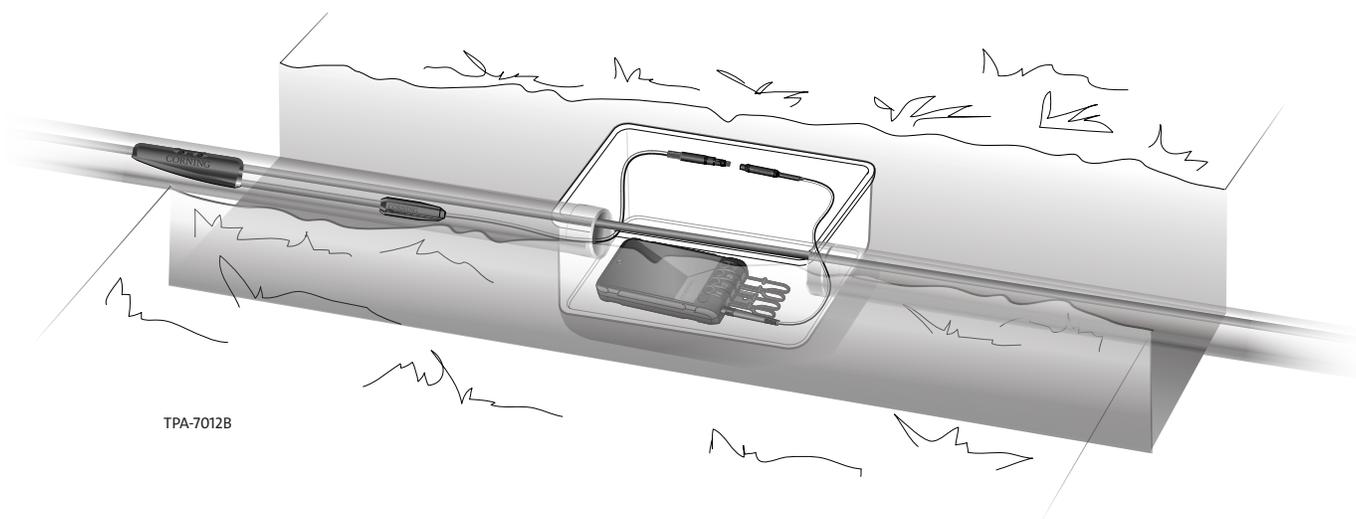


Figure 1

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.
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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.
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	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.
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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.
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2.4 Hazardous Gas Precautions

	WARNING: Explosive gases or vapors may be present in manholes due to leaking of nearby pipes or storage tanks of liquids or gases such as propane, gasoline, natural gas, or liquified petroleum gas (LPG). In addition, explosive gases may be organically generated (i.e., methane).
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- Never remove a manhole cover unless the area beneath it has been tested for explosive gas.
- Before entering any manhole, test the manhole atmosphere with an approved meter or test kit for explosive gases. Failure to do so may result in serious injury from an explosion created by the mixture of explosive gases, oxygen, and an ignition source.
- To test the manhole atmosphere, follow the instructions supplied by your company for the gas detection device and observe all company rules concerning explosive limits of gases.
- In addition to combustible gases, life threatening hazards may be present in the form of non-combustible gases (i.e., nitrogen, hydrogen sulfide, and carbon dioxide).

DO NOT USE ANY DEVICE WHICH CAN PRODUCE A SPARK OR FLAME IN A MANHOLE. Do not use lanterns, heaters, or any electrically energized devices in manholes unless they are certified for explosive environments. Never connect or disconnect electric lighting, tools, or heating equipment in a manhole. Mating or unmating of an electric circuit may cause an electric arc.

 **DO NOT BRING OPEN FLAMES, TORCHES, LIGHTED CIGARS, PIPES, CIGARETTES, OR MATCHES INTO A MANHOLE.** Failure to follow this warning may result in a fire or explosion. Observe all company rules concerning ventilation, purge time for manhole. As long as the manhole is open, continuous forced-draft ventilation at a **MINIMUM** rate of 500 cubic feet per minute should take place (Figure 2).

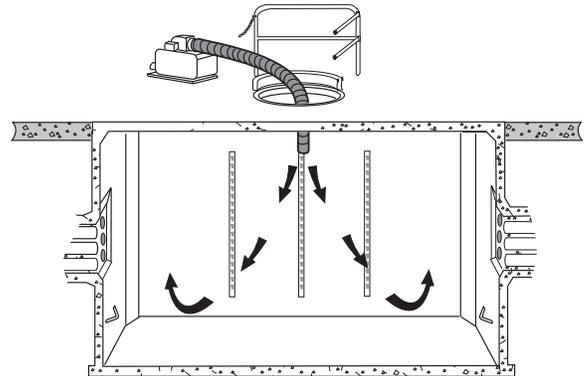


Figure 2 TPA-8021

2.5 General Safety Precautions

 **WARNING:** If trucks and other motorized equipment (generators, blowers, pumps, etc.) are not equipped with overhead exhausts, position such equipment so that the exhausts are directed away from the manhole opening and ventilation equipment.

 **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 can not 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.

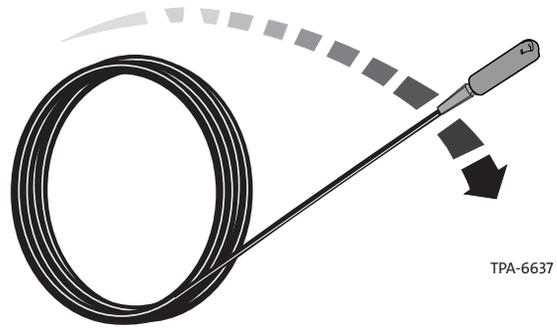
 **WARNING:** Employees normally should not enter a manhole or remain in a manhole during the placing or removing of any cable. If a craftsman must enter a manhole when an optical cable is being pulled, the craftsman should stay clear of the pulling apparatus. Before beginning any underground cable placing operation, all personnel must be familiar with their company's safety practices. Failure to do so may result in serious injury.

2.6 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.

2.7 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.

2.8 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.

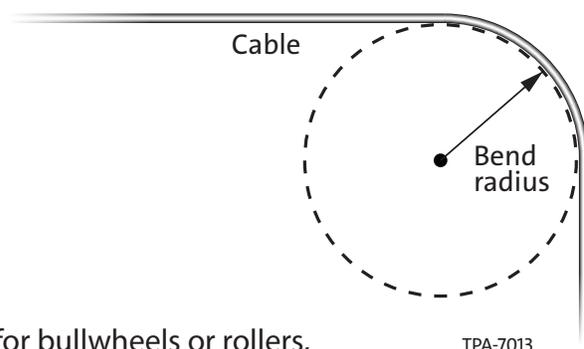
2.9 The FlexNAP System cable assembly specification sheet lists the minimum cable bend radius both "Loaded" (during installation) and "Installed" (after installation) conditions. If these sheets are not available on the job site, the following formulas may be used to determine general guidelines for 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)
 $15 \times 0.46 \text{ in. (11.8 mm) = 6.9 in. (177 mm)}$

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



- 3.0 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.
- 3.1 Protect the FlexNAP System cable assembly while unattended. Any damage to the FlexNAP System cable assembly may result in total replacement of the product.
- 3.2 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.
- 3.3 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.
- 3.4 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.”
- 3.5 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.
- 3.6 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.*

4. Planning and Preparation

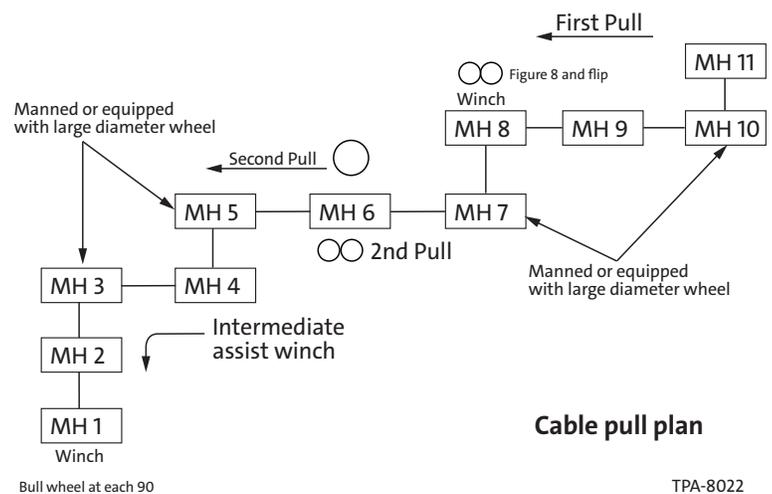
- 4.1 Consult Corning Optical Communications FlexNAP System engineering for guidance on planning an installation using the FlexNAP System product.

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

- 4.2 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. Additional slack placement should be considered where measurement uncertainty exists, for adjustment purposes.
- 4.3 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.
- 4.4 As for any duct installation, duct “rodding” or “slugging” is highly recommended prior to installing the FlexNAP System product. Deformed or crushed ducts can prevent the product from going through the duct.
- 4.5 The minimum duct ID required depends on the FlexNAP System type. The minimum diameter duct the smallest FlexNAP System cable assembly can be installed into is 1.25 inches (31.75 mm).
- 4.6 Inspect hand/man-holes for adequate storage and protection of cable slack, splice closures, and terminals. Also, make sure the minimum bend radius of the cable will not be exceeded.

4.7 The FlexNAP System cable assembly is normally pulled in toward the central office. Develop a cable pull plan based on the cable route survey (Figure 3).

NOTE: *The desired pull direction is one that allows the tether to trail the overmold as the cable is being installed. Care should be taken if pulling the tether end first.*



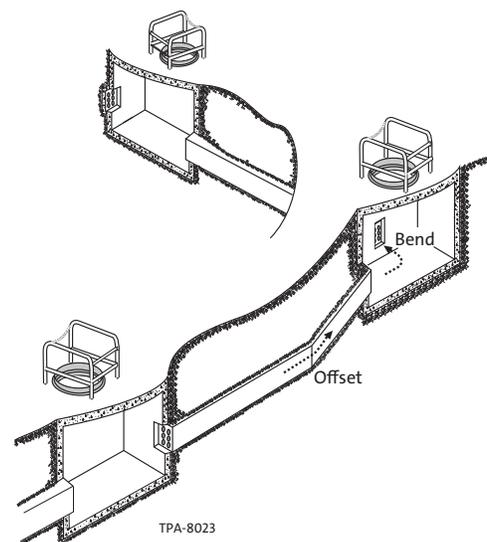
Cable pull plan

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4.8 Factors to consider in developing the pull plan include changes in elevation and the locations of bends and offsets (Figure 4).

- Bends describe pronounced turns in the routing of a duct system.
- Offsets in a duct system are more gradual variations from the ideal, straight path of a duct section. Offsets can impose greatly increased pulling tension. For example, a three foot offset in a 10-foot (3 meter) run of duct can add an estimated 120 pounds (54.5 kg) of tension to a pull.

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



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Figure 3

Figure 4

4.9 Installing multiple FlexNAP System cable assemblies or other cables in the same duct is not recommended.

5. Installation Equipment and Accessories

Duct

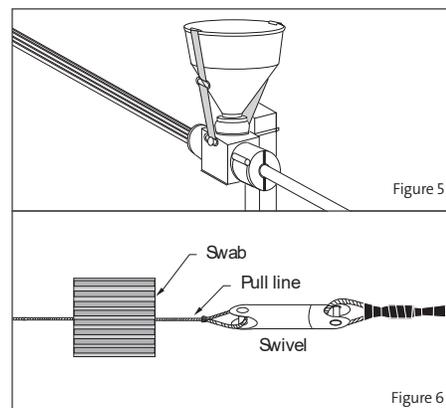
- 5.1 The duct that is commonly used for the FlexNAP™ System product is made of polyethylene and has either a ribbed or smooth inner wall with an minimum inner diameter of 1.25 inches (31.75 mm).
- 5.2 During duct placement, care must be taken to avoid excessive tension and deformation of the duct. Excessive pull force may cause smooth-walled and longitudinally-ribbed duct to “neck down,” reducing its inside diameter.
- 5.3 After placement, all ducts must be capped or plugged to prevent moisture or foreign matter from entering until the cable installation starts.

Pull-Lines

- 5.4 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 cut duct when under tension.
- 5.5 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.
- 5.6 Some duct is available with preinstalled pull tape or line. Otherwise, pull-line can be installed by rodding or blowing. Lubrication of the pull-line may be necessary for ease of installation or to prevent the line from cutting the innerduct.

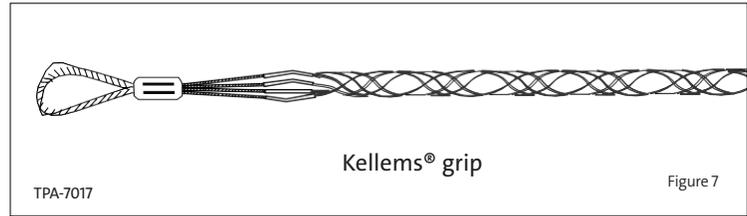
Lubricants

- 5.7 Cable lubricant is not required for the FlexNAP System product but can be used for most longer pulls. Short hand-pulls generally do not require lubricant. Considerations in choosing a lubricant are material compatibility, drying time, temperature performance, and handling characteristics.
- 5.8 As noted in the cable precautions, cable lubricants must be compatible with the fiber optic cable’s outer sheath. Refer to the lubricant manufacturer’s specifications. Use of incompatible liquids, such as liquid detergent, for a lubricant can cause long term sheath damage.
- 5.9 Lubricant should be applied according to the manufacturer’s recommendations. Some lubricant vendors recommend an applicator to coat the cable as it enters the duct (Figure 5), others suggest distributing lubricant throughout the duct by pulling a swab through the duct as part of the pull-line placement (Figure 6). Pumps or gravity feed devices can also be used to inject lubricant into the duct.



5.10 Additional lubricant should be added before bends and known severe offsets and sections with “uphill” elevation changes.

5.11 Corning Optical Communications recommends the use of a wire mesh pulling grip. Pulling grips provide effective coupling of pulling loads to the jacket, aramid yarn, and central member of fiber optic cables (Figure 7).



5.12 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 is recommended to prevent binding at high tensions.

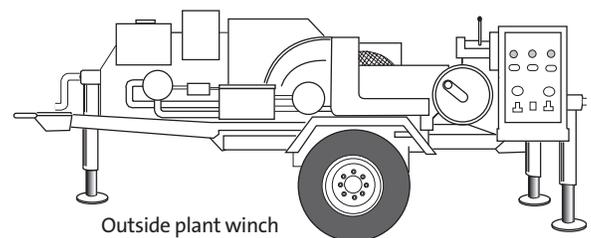
Tension Monitoring Equipment

5.13 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.

5.14 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.

5.15 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.

5.16 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 (Figure 8).



TPA-7018

Figure 8

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

Pulling Equipment

5.17 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.

5.18 Situations that require use of a radius-maintaining device are encountered at feed and pull hand/man-holes, at bends, and where entrance and exit ducts in a handhole/manhole are offset.

6. Installation Techniques

- 6.1 The FlexNAP™ System cable assembly is intended to be installed only in one direction, with the cable entering the duct on the field side and being pulled toward the Central Office with the tethers trailing the pulling direction. (Figure 9).

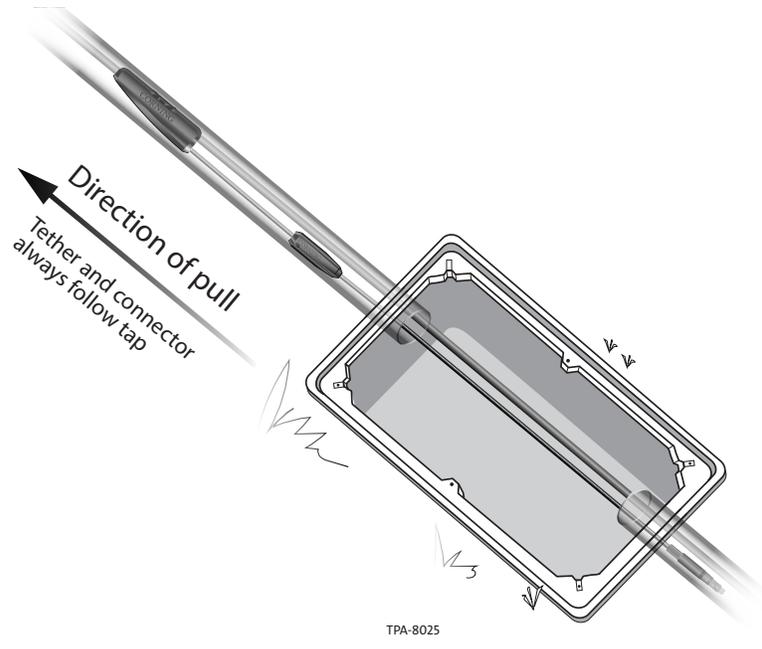


Figure 9

- 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 duct conditions, the equipment used, pulling technique selected, and the skill of the craftsmen. The preferred method is to hand pull completing one handhole/manhole at a time.

Intermediate Points

- 6.3 Longer continuous pulls can be accomplished by hand assisting the cable (Figure 10) or by setting up intermediate centering sheave (Figure 11) or assist winches at bends at cable access points.

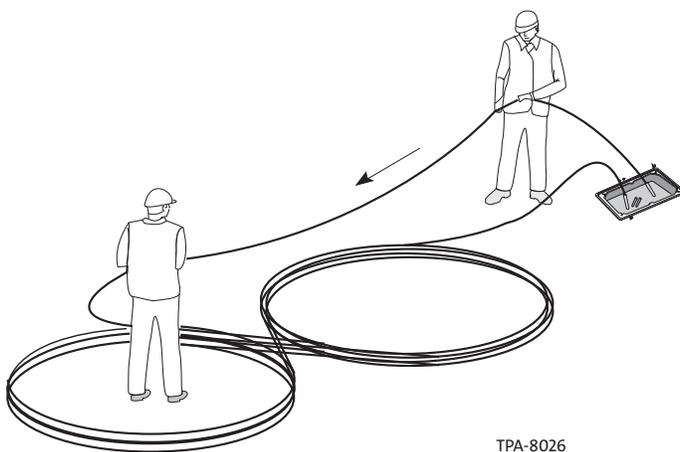


Figure 10

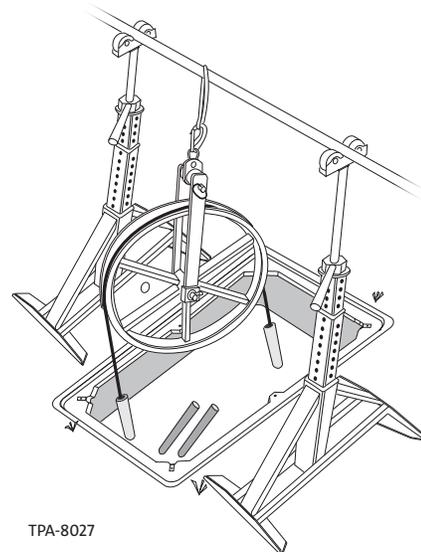


Figure 11

Center-Pulls and Backfeeding

6.4 Reverse pulling of TAPs is currently not recommended.

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

Progress should be monitored at each hand/man hole where the assembly must exit and re-enter the duct. The connector/tap should be guided into the next duct to avoid damage to the cable assembly.

7. Installation Procedure

7.1 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.plan.

7.2 Prepare the handhole/manholes in the duct section where the cable is to be placed:

- a) Place barricades
- b) Monitor gas if in a manhole
- c) Establish ventilation if in a manhole
- d) Pump water out
- e) Inspect ladder, racks, and ducts

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

7.4 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 duct on the field side and be pulled to the CO side of the duct.

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

7.6 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.).

7.7 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.*

7.8 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.

7.9 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.

- 7.10 Apply appropriate cable lubricant as required.
- 7.11 Verify communication lines are functional and crews are in place at feed, intermediate, and pull locations.
- 7.12 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.
- 7.13 Once the cable has moved a minimum of 5 feet (1.3 meters) into the duct, accelerate the pull smoothly to its intended speed (50-100 feet [15 to 30 meters] per minute is desirable).
- 7.14 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.
- 7.15 The FlexNAP™ System cable assembly should be visually observed during the following situations:
- passage between separated ducts such as in a hand/manhole.
 - 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.
- 7.16 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 (Figure 12).

Align the marker in the center of the handhole/manhole. If cable slack was specified at this point then manage that slack while maintaining the minimum cable bend radius. The slack amount may have to be adjusted to properly position the next FlexNAP System assembly toward the subscriber. The beginning and end of the slack segment are designated by YELLOW alignment markers.

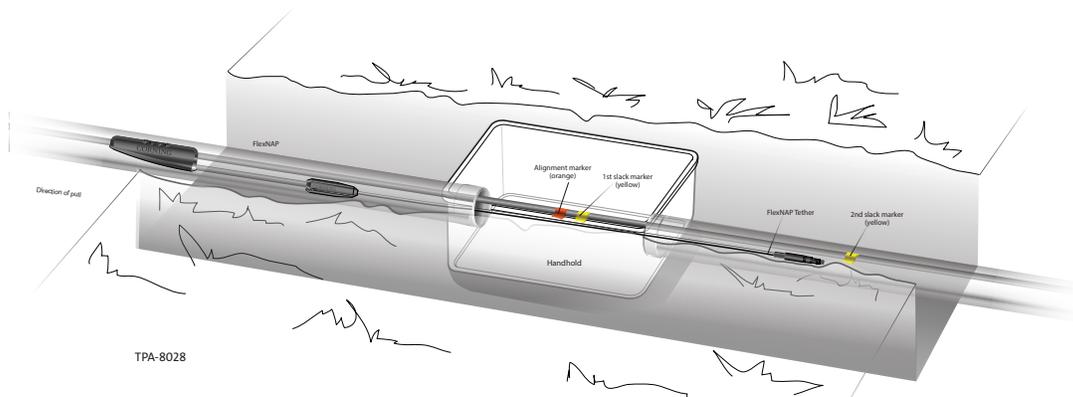


Figure 12

- 7.17 Intermediate points requiring cable “figure-eighting” should be in an area that will prevent damage to the cable.

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 as well.

7.18 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 (Figure 13).

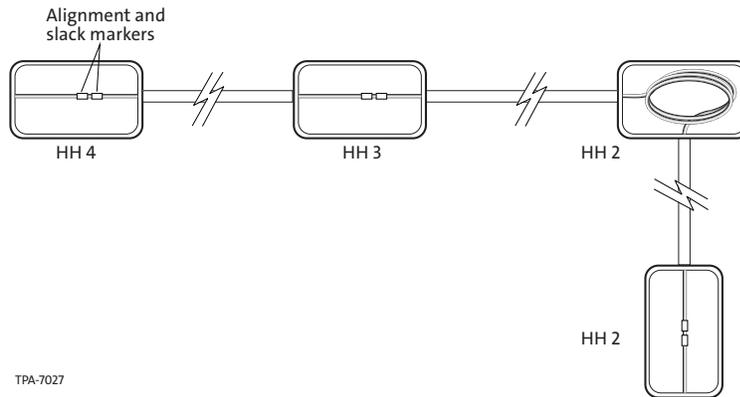


Figure 13

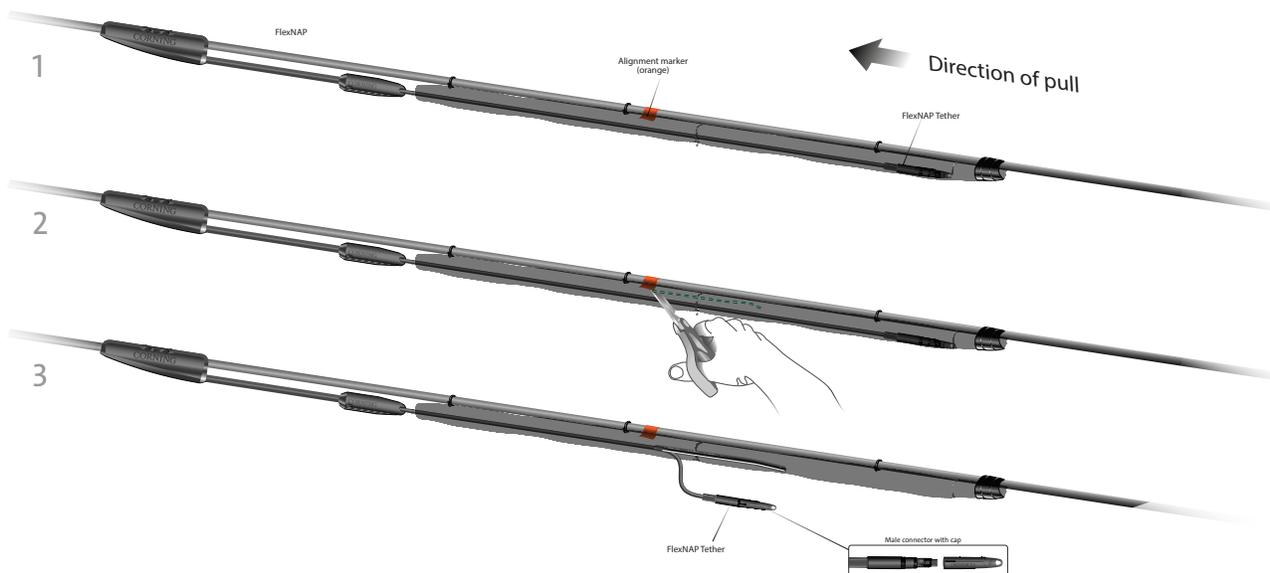
NOTE: FlexNap tethers may utilize an optional Locatable Dustcap. These dustcaps operate on a Telco pathway marker frequency (101.4 kHz). Use a marking device to locate the tether location.

IMPORTANT: If a FlexNAP System tether is not accessible, compare the build plan with the route plan. If the cable placement location 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.

8. Accessing the Tether

- 8.1 Once the FlexNAP™ System cable assembly is pulled into place and appropriate slack is available, verify all the FlexNAP SystemTaps™ are attached to the FlexNAP System cable using a tether release mechanism.
- 8.2 If not already exposed in step 6.18, release the tether from the cable. The tether is contained inside of a mesh sleeve, that is attached to the cable. To release the tether from the sleeve, cut a slit anywhere along the length. Be careful to not cut the tether, or kink the tether as it is being removed from the sleeve.

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



TPA-8029