

CORNING


Duct Installation of Fiber Optic LSZH Steel Armor Cable

1. Safety Precautions


1.1 Confined Space Precaution

	WARNING: Follow all OSHA regulations concerning confined space entry and work.
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1.2 Lead Exposure Warning

	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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1.3 Cable Handling Precautions

	CAUTION: 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.
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Corning Optical Communications cable specification sheets are available which list the maximum tensile load for various cable types. The maximum pulling tension for stranded loose tube cable is 2,700 Newtons. Refer to the cable specification sheet for the specific allowed tension for each cable.

Corning Optical Communications cable specification sheets also list the minimum cable bend radius both during installation and after installation. The following formula may be used to determine general guidelines for installing LSZH steel armor fiber optic cable:

Minimum Bend Radius Requirements			
Operation		Installation	
MBR	20 x OD	MBR	20 x OD

However, refer to the cable specification sheet for the listed minimum bend radius:

Mechanical Characteristics Cable				
Fibre count	Nominal outer diameter	Min. bend radius installation	Min. bend radius operation	Max. tensile strength for installation
12 - 72	11.3 mm	230 mm	230 mm	2700 N
96	13.8 mm	276 mm	276 mm	2700 N
144	16.8 mm	336 mm	336 mm	2700 N

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 three feet (one meter) of each cable end before splicing. This will ensure that no moisture ingress is present.*



WARNING: Steel armored tape typically includes a seam where edges of the tape touch or remain in close proximity with respect to each other. It can be an edge-to-edge configuration or an overlap configuration formed by longitudinally overlapping edges of the tape.

During cable installation or operation where the cable is subjected to bending and/or twisting, external stress concentrates near to the uneven portion of the jacket, which may cause the jacket to split or “zipper”. Longitudinal splitting of cable outer jacket at metallic tape overlap or joint portion is known as “jacket zippering”

Zippering is more likely to occur at the point where jacket is joined to the edges of the metallic tape and sharp edge of the tape cut the jacket initiating the jacket to zipper. As ‘jacket zippering’ caused a crack/ gap in the outer jacket/ sheath, it destroy mechanical integrity of the cable and reduce in-service lifetime.

Jacket zippering is also subjected to the type of jacket material. HDPE (High Density PolyEthylene) is having better crack resistance as compare to LSZH (Low Smoke Zero Halogen)

2. Pulling Grips

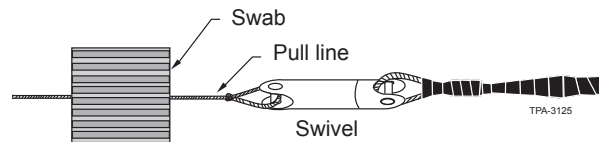
Corning Optical Communications recommends the use of a factory or field-installed wire mesh pulling grip and swivel during cable pulls. Pulling grips provide effective coupling of pulling loads to the jacket, aramid yarn, and central member of fiber optic cables.



For instructions on field installation, refer to [SRP 004-137, Installing a Wire Mesh Pulling Grip](#).

The use of a swivel between the pull-line and pulling grip is required to prevent the pull-line from imparting a twist to the cable. Check with the manufacturer for load variation on the breakaway swivel. This must be taken into consideration so that the maximum tension for the cable is not exceeded.

The main function of breakaway swivel is to break the swivel if excess tensions compare to cable tensile rating is applied during cable pulling.



NOTE: Check with the manufacturer for load variation on the breakaway swivel. This must be taken into consideration so that the maximum tension for the cable is not exceeded.

3. Temperature

Observe the temperature operating range. Install a cable in locations in which the temperature range imposed is within the temperature operating range. Violation of the temperature operating range can result in excessively high attenuation.

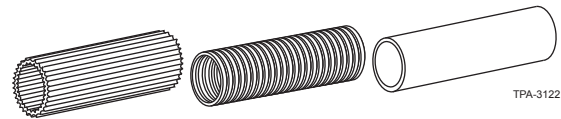
Temperature Range	
Temperature range, storage	-40 °C to 75 °C
Temperature range, installation	-5 °C to 50 °C
Temperature range, operation	-30 °C to 75 °C

4. Installation Equipment and Accessories

4.1 Innerduct

Innerduct is a way to subdivide the duct and to provide for future cable pulls. Three 31.75 mm inside diameter (I.D.) innerducts can usually be pulled into a 101 mm duct. Proper size and installation of the innerduct is critical for ease of cable installation.

Innerduct is available in ribbed, corrugated, and smooth-walled constructions of polyethylene or PVC material. Corning Optical Communications' fiber optic cable is compatible with all major brands of innerduct. Consult your company's practices for innerduct specifications.



Fill ratios are calculated by comparing the area of an inner diameter cross-section of the innerduct to the outer diameter cross-section area of the fiber optic cable. Larger diameter innerducts (which result in smaller fill ratios) will normally reduce pulling tension.

To calculate a fill ratio, use the following formulas from the chart: <https://www.corning.com/optical-communications/worldwide/en/home/Resources/system-design-calculators/fill-ratio-calculator.html>

Formulas Used to Calculate Fill Ratio		
First Cable $\frac{d^2}{D^2} < 65\%$	Second Cable $\frac{d_1^2 + d_2^2}{D^2} \leq 31\%$	Third Cable $\frac{d_1^2 + d_2^2 + d_3^2}{D^2} \leq 40\%$
Legend d = Cable Diameter d ₁ = First Cable Diameter d ₂ = Second Cable Diameter d ₃ = Third Cable Diameter D = Innerduct Diameter		

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Multiple cables may be pulled simultaneously into one innerduct. Pulling a new fiber optic cable over an existing one is not recommended due to the possibility of entanglement.

Should an innerduct become twisted during installation, the twisting (helixing) can dramatically increase pulling tension during cable installation. Corrugated innerduct has less “memory” than other types of innerduct, and may tend to lay flatter in the duct.

Innerduct often stretches during installation. Allowance must be made for the relaxation of this stretch by planning for extra slack to be pulled into manholes.

At points where innerduct will be continuous through a manhole, allow sufficient slack so that the innerduct may be secured on the manhole racks and maintain the cable's minimum bend radius.

At points where the innerduct is not continuous through a manhole, some provision must be made to provide a section to cover the cable in the manhole during and after placement. This may be accomplished through one of the following methods:

- Couplers which “splice” innerduct sections together are available from most innerduct manufacturers. Do not use couplers which reduce the inside diameter of the innerduct.
- Split duct may be applied to the cable during racking, see [Applications Engineering Note 167, Split Duct Cable Installation Guidelines](#)
- A section of innerduct which has an inside diameter greater than the outside diameter of the installed innerduct may be used in a sleeve operation. This section of innerduct must be slid over the innerduct coming from the entrance duct BEFORE the pull-line is installed. The section of larger innerduct must be long enough to reach from the entrance duct to the exit duct while passing around the periphery of the manhole where it will be racked, plus an additional 9 ft (3 m) on each end which will be inside the duct bank after racking.

After placement, all innerduct must be capped or plugged to prevent moisture or foreign matter from entering until the cable installation starts.

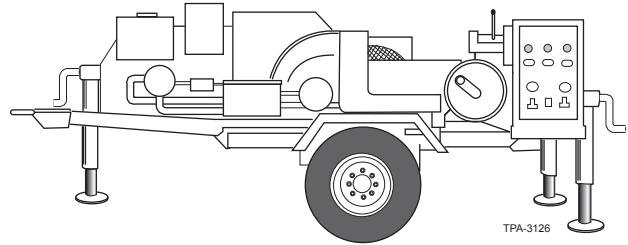
4.2 Tension-Monitoring Equipment

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 product.

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.

The use of a breakaway link (swivel) can be used to ensure that the maximum tension of the cable 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.

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.



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

5. Installation Techniques

Various techniques are available to ease the installation of long lengths of fiber optic cable. All have been used extensively in the field.

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.

In a center-pull operation, set up the cable reel near the center of the duct run to be pulled. Pull the cable in one direction to the next designated point ensuring it smoothly unwind from the reel payoff without damaging and not exceeding the maximum tension on the cable.

It is always recommended to use a cable reel payoff as per below image. Always roll the cable off the spool instead of spinning it off the spool end. This will put a twist in the cable for every turn on the spool! Never twist the fiber cable.

