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Applications
Engineering Note

Micro Cable Air-Assisted Installation Considerations

AEN096, Revision 9

When installing optical fiber cables into microducts, some unique parameters must be considered. Applications Engineering Note 049, titled “Air-Assisted Cable Installation Technique,” provides relevant information that is also applicable to the installation of optical fiber cables into microducts. This document, however, offers specific guidance and considerations that apply to micro cable installations, such as those using Corning MiniXtend® Cable, in addition to the information presented in AE Note 049.

Jetting vs. Blowing

Jetting and blowing are two common air-assisted cable installation techniques. Both methods require pushing the cable with a tractor mechanism while blowing compressed air into a preinstalled duct around the cable being installed. Both rely on airflow to help “float” the cable inside the duct, minimizing sidewall pressures to reduce friction between the cable and the duct.

Jetting and blowing differ, though, in how pulling force is applied to the cable. Jetting uses a reaction head (or parachute) attached to the cable. A differential pressure across the reaction head creates a pulling force on the cable. Blowing does not use a reaction head. Instead, the pulling force on the cable is due to fluid drag of air rushing along the cable. This pulling force is distributed along the cable length.

MiniXtend Cable

MiniXtend cables are designed with polyethylene (PE) outer sheaths in order to minimize friction with the inner surface of microducts. These cables were also designed with optimal stiffness properties to help ensure they will resist buckling forces yet easily negotiate changes in direction of the microduct along the installation route. The MiniXtend cable design also provides the highest fiber density, yielding a relatively small cable OD. The individual fibers are bundled into groups of 12 fibers within the cable’s buffer tubes. MiniXtend HD cables have bundles of 12, 24 or 36 fibers in each buffer tube depending on the total fiber count while MiniXtend XD cables have 24 fibers in each buffer tube, allowing for higher fiber counts for a given cable size or smaller cables for a given fiber count. The buffer tubes inside MiniXtend cable contain filling compound in order to prevent water migration along the length of the cable in the event of a breached cable sheath. The cables are rated for outdoor use and have been tested to meet the rigorous water ingress tests for outside plant cabling (i.e. IEC60794-5-10). In line with standard industry practice for micro cables, Corning recommends these cables be placed in a duct or microduct for protection.

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General - Corning (L4)

MiniXtend® Cable			Duct	
Maximum Fiber Count	Nominal Outer Diameter (mm)	Fibers per Buffer Tube	Smallest Recommended Microduct Size (ID, mm)	Calculated Fill Ratio (%)(1)
72	5.4	12	8	68
96	6.3	12	8	79
144	8.1	12	10	81

(1) Fill ratios have been calculated based on cable diameter vs. duct inner diameter

Table 1: Smallest Recommended Microduct sizes for MiniXtend Cable

MiniXtend® HD Cable			Duct	
Maximum Fiber Count	Nominal Outer Diameter (mm)	Fibers per Buffer Tube	Smallest Recommended Microduct Size (ID, mm)	Calculated Fill Ratio (%)(1)
12-72	4.5	12	6	75
144	6.3	24	8	79
192	7.5	24	10	75
216	8.0	24	10	80
288	9.7	24	12	81
288	8.0	36	10	80
432	10.8	36	14	77

(1) Fill ratios have been calculated based on cable diameter vs. duct inner diameter

Table 2: Smallest Recommended Microduct sizes for MiniXtend HD Cable

MiniXtend® XD Cable			Duct	
Maximum Fiber Count	Nominal Outer Diameter (mm)	Fibers per Buffer Tube	Smallest Recommended Microduct Size (ID, mm)	Calculated Fill Ratio (%)(1)
192	6.2	24	8	78
216	7.0	24	10	70
288	8.2	24	12	82

(1) Fill ratios have been calculated based on cable diameter vs. duct inner diameter

Table 3: Smallest Recommended Microduct sizes for MiniXtend XD Cable

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MiniXtend Ribbon Cable-200 Flow		Duct	
Fiber Count	Nominal Outer Diameter (mm)	Smallest Recommended Microduct Size (ID, mm)	Calculated Fill Ratio (%)(1)
96	6.4	8	80
144	6.4	8	80
192	7.5	10	75
288	7.9	10	79
864	12.5	16	78

(1) Fill ratios have been calculated based on cable diameter vs. duct inner diameter

Table 4: Smallest Recommended Microduct sizes for MiniXtend Ribbon Cable-200 Flow

Microduct

There are many different sizes of microducts available today with inner diameters ranging from 3.5 mm to 16 mm. Microducts are typically specified with an outer diameter and an inner diameter (i.e. 12.7/10 mm which is 12.7 mm outer diameter and 10 mm inner diameter). Fill ratio is very important when considering which duct to use. Corning Optical Communications recommends a target range between 50% and 80%. High fill ratios greater than 80% decrease the amount of airflow around the cable, resulting in decreased blowing distance.

Some microduct manufacturers use self-lubricating technology inside of the duct and do not require lubrication to be used during installation. Some blowing equipment manufacturers still recommend the use of jetting lubrication. Corning Optical Communications recommends consulting with the duct manufacturer to see if additional lubrication is needed. Today's microducts are suitable for many different types of installations. They can either be direct buried into the ground or can be pulled into pre-existing conduit and used as innerduct. Microduct can be used for aerial applications as well, including lashed or self-supporting options. Duct manufacturers also pre-bundle microducts allowing for faster installations. This duct network configuration allows service providers to blow in micro cables as needed to optimize initial system cost.

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Figure 1: Bundled Microduct

Figure 2: Microduct Coupler

Installation

The air-assisted installation technique involves pushing the cable with a tractor mechanism while blowing compressed air into a pre-installed microduct. This technique allows the cable to “float” inside the duct during installation while minimizing sidewall pressures by reducing friction between the cable and the duct wall. Corning Optical Communications has conducted field trials that have confirmed the capability of blowing MiniXtend® cable for distances up to 6,500 ft. (2000 m) at installation speeds up to 490 ft. /min (150 m/min). Distances beyond 6,500 ft. (2000 m) are possible in fully optimized conditions. A realistic target distance for most scenarios is between 3,000 ft. (915 m) and 5,000 ft. (1,520 m). Distances and speeds are dependent on a number of factors including the ambient temperature, microduct conditions (route and number of bends), fill ratio and blowing equipment utilized during the install.

A standard air compressor is used to supply air for blowing micro cables. An air cooler at the discharge of the compressor is recommended in order to maintain lower air temperatures within the microduct during installation. The lower air temperatures help to ensure the lowest friction between the microduct and the cable sheath. Additionally, the air should be as dry as possible for optimal jetting. The ideal compressor for this application would supply air at a pressure of 220 psig (15 bar) and a rate of up to 33 cfm (0.93 cubic meters/min) for the installation, although, excellent results can also be achieved using compressors with lower ratings.

The mechanical push force for the micro cable installation can be driven by either a pneumatic or an electric motor. For added protection of components, the motor should have an automatic shut-off or clutch feature that limits the push force that is applied to the cable. This can also be done by pre-calibrating the machine by completing a crash test before the installation starts. This ensures that cable and duct damage can be prevented in the event that the cable stops abruptly within the microduct during the installation process.

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Air-Assisted Installation Checklist

- ☐ MBD: Refer to the cable specification for the Minimum Bend Diameter (MBD) of the cable being installed. At all times during the installation the MBD must be maintained.
- ☐ Fill Ratio: The recommended fill ratio is between 50% to 80%

$$Fill\ Ratio(\%) = \frac{Outer\ Diameter\ of\ Cable}{Inner\ Diameter\ of\ Duct} \times 100$$

- ☐ Reel Bolts: Hand tighten reel bolts prior to starting, and again when reel is stopped during installation. Tighten bolts at the beginning, middle of reel, and when about 75% is off the reel. Refer to AEN165 for additional cable reel handling information:
- ☐ Bullet on cable: correct size helps jump over couplings – Corning recommends using a bullet on the end of the cable, and not a parachute.
- ☐ Compressor with cooler or separate cooler attached to the compressor used increases jetting performance and ensures temperatures are within the operating range of the cable installed. This is especially important when the ambient temperature is above 60 degrees Fahrenheit.
- ☐ Duct proofed: Using a mandrel or plastic ball that is 80% of the inside diameter of the duct helps ensure that there are no obstructions. Install a capture device on the end to catch the plastic ball, i.e.: wire mesh grip taped on the end. Sponges will not proof a duct since they can get past a partial obstruction.
- ☐ Lubrication: Lubricate the duct, use the blowing machine manufacturer's recommended lubricant and quantity per 1,000 ft of duct that is applicable for each size duct. Do not over lubricate. Pooling lubricant in the duct can cause cable obstruction and damage.
- ☐ Crash Test: Perform the blowing machine manufacturer crash test, consult with equipment manufacturer if this has not been provided. This will allow the blowing machine to stop the mechanical drive in the event the cable stops due to some obstruction.
- ☐ Cable pay off the top of reel: This helps installer to have control and manage the pay-off, do not pay cable from the bottom of the reel which can cause loosening of the windings and loss of control.
- ☐ Cable on outside reel flange: cut at one foot from hole and allow to squirt out during placing and cut off squirted cable during placing as necessary. Failure to do this can damage the inner wraps of the cable on the reel if cable squirts inside the reel.
- ☐ Cable Payoff: Ensure cable is clean when entering the jetting machine. Control cable paying off the reel – maintain back tension to not allow cable wraps not to loosen and cross each other. If any cable defect noticed, record length mark and take pictures. Notify Corning.
- ☐ Plug Ducts: After ducts are installed, they should be plugged to stop water entry into them. This can save time later when the cable is installed, and water must be blown out. Also plug ducts after cable is installed.
- ☐ Pulling Cable: Do not pull at all when jetting/blowing. Combining pulling and air assisted installation methods is not recommended.
- ☐ Follow jetting machine manufacturer's procedures of the machine being used for cable installation.

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Additional information on Corning Optical Communications recommendations can be found in AEN175, AEN165, and AEN173.

For additional questions, please contact Corning Optical Communications Customer Care at 1-800-743-2671.

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