Installation Practice IP-055
October 2019

Microcable Installation

Contents **Section**

1. Scope

1.1 This practice covers the basic guidelines for air-blown installation of OFS microcables. The practice assumes familiarity with microduct systems and cable blowing techniques and is intended for personnel with prior cable installation experience. While every effort has been made to provide a useful informative guide, it is not possible to cover every possible scenario. If in doubt about any practice or situation, it is recommended to seek advice from the equipment, microduct, or cable manufacturer.

1.2 OFS microcables are available in both loose-tube and central-core designs. Loose-tube microcables (MiDia® FX *PLUS*, MiDia Micro FX, MiDia Micro GX, MiDia 200 Micro FX, and MiDia 200 Micro GX) are available with various tensile load ratings and buffer tube diameters. MiDia FX PLUS and MiDia Micro FX cables have a 300 lb tensile load rating and are compliant with Telcordia GR-20 requirements. MiDia Micro GX cable has lower tensile strength but provides higher fiber density for applications where smaller cable diameters or higher fiber counts may be needed. MiDia 200 Micro FX and MiDia 200 Micro GX cables provide the highest fiber density by using 200 μm diameter fibers and packaging 24 fibers per buffer tube.

1.3 Central core microcables (DuctSaver® FX and DuctSaver DT) contain AccuRibbon® fibers and are intended for use in mass fusion splicing applications. DuctSaver cables containing 12-fiber AccuRibbons have a 300-lb tensile load rating and are compliant with Telcordia GR-20 requirements. DuctSaver FX cable contains a gel-filled core tube and is available with a maximum of 96 fibers. DuctSaver DT cable is a totally dry cable design and is available with a maximum of 144 fibers.

2. Cable Handling Precautions

2.1 OFS microcables are specifically designed for installation in underground or direct buried microduct systems using blown cable installation techniques. Because of their reduced size and strength, extra care must be taken during handling and installation of microcables. In some applications, short lengths of microcable may be pulled into a building through a subsidiary duct; however, microcables should be pulled by hand in these circumstances.

2.2 In general, OFS microcables are not intended for use in aerial applications. The reduced strength of the microcable does not provide sufficient tensile stiffness to limit the fiber strain when the cable is subjected to aerial storm loads.

2.3 Extra care must be taken during the construction of direct buried microduct systems. The microducts must be installed straight and uniformly as possible. Excessive undulations of the microduct will cause more contact points between the cable and duct and negatively affect cable installation. Direct buried microduct should be covered with six to twelve inches of select backfill to minimize deformation and damage to the microducts.

2.4 MiDia FX *PLUS* and MiDia Micro FX cables meet the requirements of ICEA-640 “Mid-Span Buffer Tube Storage Test” and are approved for use in pedestal splicing applications. However, MiDia Micro GX, MiDia

200 Micro FX, and MiDia 200 Micro GX cables are not recommended for use in pedestal applications. The combination of small buffer tube diameters, high fiber densities, narrow splice trays, and exposure to extreme cold temperatures may cause fiber macro-bending and increased attenuation of these cables in pedestal applications.

2.5 The cable reel should always be maintained in an upright position during transportation and installation. Care must be taken to prevent adjacent reels from colliding with each other. Cable damage may result if the flange of one reel is pushed against the drum of another. The cable reel should always be rolled in the direction of the arrow painted on the reel flange. Rolling a cable reel over long distances should be avoided.

2.6 Protective coverings on the cable drum should not be removed until the start of cable installation. This will minimize the risk of contamination, e.g., dirt and dust, which can impede cable installation. In dirty or muddy conditions, the cable should not be laid on the ground. Instead, the cable should be laid on tarps to minimize contamination of the cable jacket.

2.7 Care should be taken during installation to avoid loading the cable above its maximum rated cable load (MRCL). The MRCL is the maximum tension that can be applied to the cable during installation. DuctSaver FX (12 fibers/ribbon), DuctSaver DT, and MiDia Micro FX cables meet Telcordia GR-20 requirements and have a MRCL of 300 lb. However, many micro cable designs have lower MRCL and must be handled accordingly. Refer to Table 1 and/or the cable data sheet to determine the MRCL for your specific cable.

Table 1 – Maximum Rated Cable Load

Cable Type	MRCL lb (N)
DuctSaver FX • 6 – 48 fibers (6 fibers/ribbon) • 12 – 96 fibers (12 fibers/ribbon)	 135 (600) 300 (1335)
DuctSaver DT 144 fibers (12 fibers/ribbon)	300 (1335)
MiDia FX *PLUS* 2 - 144 fibers	300 (1335)
MiDia Micro FX 2 – 144 fibers	300 (1335)
MiDia Micro GX MiDia 200 Micro FX MiDia 200 Micro GX	consult data sheet

2.8 During installation, care should be taken to avoid bending the cable below its minimum bend diameter. Cable minimum bend diameters are specified for both static and dynamic conditions. The static condition applies to an installed cable. The dynamic condition applies to a cable during installation. The diameter of all rollers, sheaves, quadrant blocks, etc. used during cable installation must not be less than the appropriate minimum bend diameter given in Table 2 where OD = the cable outside diameter.

Table 2 – Minimum Bend Diameters

Cable Type	Static Condition	Dynamic Condition	Storage Coil in. (mm)
DuctSaver FX 6 - 96 fibers	30 x OD	40 x OD	24.0 (610)
DuctSaver DT 144 fibers	30 x OD	40 x OD	24.0 (610)
MiDia FX *PLUS* 2 - 144 fibers	20 x OD	40 x OD	18.0 (460)
MiDia Micro FX 2 – 144 fibers	20 x OD	40 x OD	18.0 (460)
MiDia Micro GX 2 – 288 fibers	20 x OD	40 x OD	18.0 (460)
MiDia 200 Micro FX 96 – 288 fibers	Consult data sheet		
MiDia 200 Micro GX 144 -288 fibers			

2.9 High ambient temperatures, direct sunlight, and high humidity can negatively affect the cable installation performance. If possible, these conditions should be avoided during installation. Do not exceed the recommended temperature ranges for cable operation, installation, and storage as shown in Table 3.

Table 3 – Operation, Installation, and Storage Temperatures		
DuctSaver FX and DuctSaver DT Cables		
Operation	-40°C to +70°C	-40°F to +158°F
Installation	-30°C to +60°C	-22°F to +140°F
Storage/Shipping	-40°C to +75°C	-40°F to +167°F
MiDia Micro FX and MiDia FX *PLUS* Cable		
Operation	-40°C to +70°C	-40°F to +158°F
Installation	-15°C to +60°C	5°F to +140°F
Storage/Shipping	-40°C to +70°C	-40°F to +158°F
MiDia Micro GX, MiDia 200 Micro FX, and MiDia 200 Micro GX Cables		
Operation	-30°C to +70°C	-22°F to +158°F
Installation	-15°C to +40°C	5°F to +104°F
Storage/Shipping	-40°C to +70°C	-40°F to +158°F

2.10 OFS optical cables are designed with sufficient crush resistance to withstand the forces of the installation equipment. Nevertheless, care must be taken to avoid standing on the cable or dropping tools on the cable because small sharp objects on the ground could cause cable damage.

3. Safety Precautions

3.1 Safety cones and traffic control devices should be used to protect all work areas. The project manager should coordinate this work with local traffic officials.

3.2 All manholes and vaults should be tested for combustible or flammable gas before entering the workspace. If combustible or flammable gases are detected, the project manager and local fire agency shall be contacted for advice. No personnel shall enter the confined space before getting further instructions.

3.3 Manholes and vaults should be tested for safe oxygen and CO levels prior to entry. An adequate supply of continuous fresh air must be provided at each manhole or vault.

3.4 Electrical supply cables should be inspected for damaged insulation or exposed conductors. Repair or replace damaged supply cables.

3.5 Air and hydraulic pressure hoses should be inspected for damage. Repair or replace damaged hoses as required.

3.6 Do not exceed any recommended air or hydraulic pressure levels.

3.7 Do not disconnect air or hydraulic hoses while under pressure. Allow sufficient time for pressurized hoses to bleed down to ambient pressure before disconnecting.

3.8 When proofing a duct, it is recommended that a suitable net or cage be securely fastened to the end of the duct to catch the projectile. Be aware that due to the use of pressurized air, the projectile can exit the duct at high speed and may cause injury.

4. Pre-Survey and Make-Ready Work

4.1 A site survey of the underground duct system is recommended prior to cable installation. Each manhole should be inspected for safety hazards and water levels. Pumps may be needed to remove water.

4.2 Manholes should be checked for adequate storage space for slack cable and splice closures. Manholes and/or handholes equipped with cable racks are recommended to support the microduct, microcable, slack storage coils, and splice closures.

4.3 Install microducts per manufacturer's instructions. See Section 5 for recommended microduct sizes. Microducts can be racked in manholes or handholes prior to cable installation. If possible, rack the microduct behind other cables to provide protection for the microduct and microcable.

4.4 An air pressure test should be conducted to confirm the integrity of the microduct system. The microduct should be pressurized to the maximum expected operating pressure and all couplers checked for leaking air. Excessive loss of air pressure or air flow will negatively affect cable installation. Poor quality couplers may blow apart during cable installation and cause cable damage. All damaged or leaking microduct couplers should be replaced.

4.5 All ducts should be checked for obstructions and/or damage prior to cable installation. Water, dirt, and debris should be removed from the innerducts and microducts prior to cable installation. Common practice includes blowing sponges through the microduct to clear out water and debris. The diameter of the sponge should be about two times the ID of the microduct. Next, a plastic ball or "bee-bee" should be blown through the microduct to confirm there is no deformation or obstructions that may impede cable installation. The diameter of the plastic ball should be greater than the OD of the microcable or at least 85% of the ID of the microduct. Alternatively, a short cable sample (about 4" long) can be blown through the microduct.

4.6 An installation plan should be developed following the site survey. Setup locations for the cable reel, compressors, and cable blowing machines should be determined based on the route configuration and elevation changes in the duct system.

5. Equipment and Materials

5.1 Microducts with a low friction liner or ribbed inner surface are recommended for use with microcables. In general, thicker walled microducts with higher crush performance are recommended for use in direct buried applications. Cable lubricant should be blown into the microduct prior to cable installation.

5.2 Diameter ratio and/or area ratio are used to determine the largest cable OD that should be installed in a microduct. Either ratio can be used, but consistently using one or the other is important to avoid confusion. Diameter ratio and area ratio are calculated as follows where the microduct ID and cable OD are shown in Figure 1.

$$Diameter\ Ratio\ (\%) = \frac{Cable\ OD}{Microduct\ ID} \times 100$$

$$Area\ Ratio\ (\%) = \left(\frac{Cable\ OD}{Microduct\ ID}\right)^2 \times 100$$

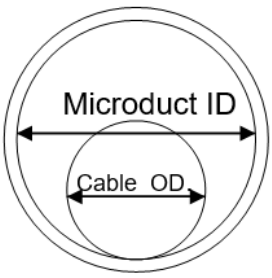

Figure 1 – Cable and microduct dimensions for use in diameter and area ratio calculations.

Recommended diameter and area ratios are given in Table 4 for microcable blowing applications. The nominal values of diameter (area) ratio in Table 4 are recommended for long haul applications where it is desirable to maximize cable installation lengths. However, in some cases it may be desirable to use higher diameter (area) ratios to maximize the fiber count in the duct. In these cases, the maximum diameter (area) ratio may be used to select the cable OD. Although OFS has successfully installed long cable lengths in these applications, high diameter (area) ratios may lead to difficult cable installations if the microduct is in poor condition. Also, the properties of the route, including the number and severity of undulations and bends in the route can affect the length of cable that can be installed for a given diameter (area) ratio.

Table 4 – Recommended Diameter and Area Ratios for Microcable Blowing Applications			
Diameter Ratio		Area Ratio	
nominal	maximum	nominal	maximum
75%	87%	56%	75%

5.3 Air compressors should be equipped with an air cooler, particularly in warm ambient temperatures. Hot pressurized air will increase the friction coefficient between cable and duct and reduce the maximum cable installation length.

5.4 A reel trailer is recommended to payoff the cable.

5.5 If automated figure-8 equipment will be used, Plumett's Figaro Cable Storage Device or similar equipment is recommended for use with OFS microcables. ***Caution:*** Figure-8 machines that wrap the cable onto a stationary drum may cause fiber and cable damage and are not recommended for use with OFS cables. Please contact OFS Customer Support at 1-888-FIBER-HELP (1-888-342-3743) for further information regarding the use of figure-8 machines.

6. Installation Procedures

6.1 The cable reel, air compressor, and cable blowing machine are all set up at the cable feed location as shown in Figure 2. Position the blowing equipment on level ground approximately 5 – 10 ft from the edge of the handhole or vault. The cable reel should be set up so that the cable pays off from the bottom of the reel into the cable blowing equipment. Minimize the angle (direction and elevation) from the cable reel to the blowing equipment. Inspect the cable reel flanges for any protruding nails or staples which could damage the cable during payoff.

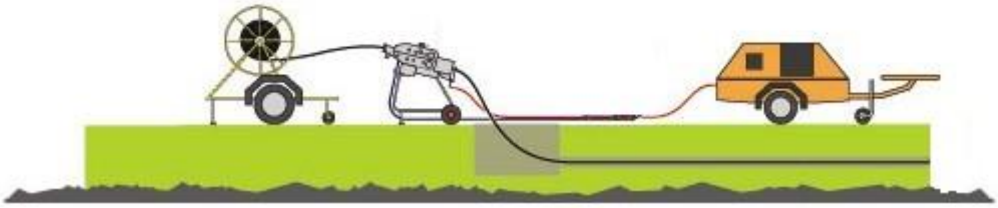

Figure 2 – Equipment setup at cable feed location.

6.2 If Figure-8 procedures are used, it is recommended that the cable be laid on tarps to keep it clean and free of contaminants. Dust and dirt that accumulate on the cable jacket will negatively affect cable installation. Observe the minimum bending diameter of the microcable and prevent excessive twisting. Do not create high stacks of cable as this may cause cable damage.

6.3 Two or more blowing machines can be cascaded together to achieve longer cable lengths between splice points. The additional blowing machines are set up at intermediate manhole locations. When the lead end of the cable reaches an intermediate blowing machine, the cable is fed out of the manhole, a slack loop of cable is formed at ground level, and the cable is fed into the next blowing machine and adjacent section of microduct (Figure 3). The slack cable loop is used as a buffer between adjacent blowing machines to accommodate variations in cable blowing speed. An air compressor and cable blowing machine are required at each intermediate blowing location.

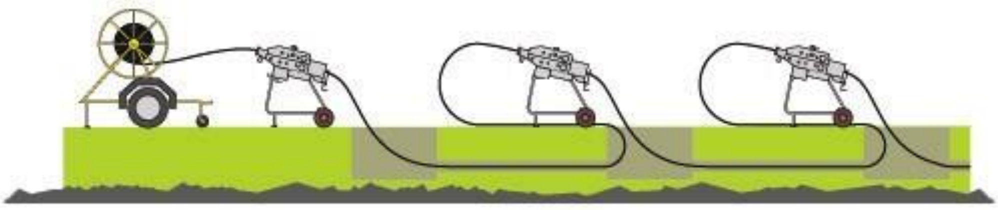

Figure 3 – Cascaded blowing machines. (Note: For clarity, the air compressors are not shown in Figure 3.)

7. Equipment Preparation and Setup

7.1 Prior to cable installation, a cable slip test should be conducted. This test will determine the maximum push force that can safely be applied to the cable by the drive system of the cable blowing equipment. Consult the equipment manufacturer's operating manual for detailed instructions describing this procedure. Increasing the push force beyond the maximum safe level may result in cable damage.

7.2 Equipment manufacturers should provide the maximum compressive force that is applied to the cable by the drive wheels or drive track of the cable blowing equipment. For OFS microcables, the maximum recommended compressive force is 200 N (45 lb).

7.3 Inspect the drive system of the cable blowing equipment. Confirm that the drive wheels or drive belts are the appropriate size for the cable. Replace any worn or damaged components as recommended by the equipment manufacturer. Thoroughly clean the cable drive system as recommended by the manufacturer.

7.4 Prior to cable installation, the microducts should be in place and the continuity and air tightness of all microduct couplers must be confirmed. Clean dirt and water out of the microduct by blowing a sponge through the microduct. The microduct should also be "proofed" by blowing a "bee-bee" through the microduct. The diameter of the bee-bee should be slightly larger than the cable OD. Proofing the microduct will ensure that there are no defects or deformation in the microduct that may impede cable installation.

7.5 Pour the recommended amount of cable lubricant into the microduct and blow a clean sponge through the duct to distribute the lubricant.

7.6 Connect the microduct to the air chamber using the correct seals and inserts as recommended by the equipment manufacturer.

7.7 Trim the end of the cable so that no strength members or fibers are protruding from the cable. It may be necessary to cap the end of the cable prior to placing. If required, use a small amount of quick drying epoxy to form the cap. The cap diameter should not exceed the cable OD.

7.8 Inspect the cable and measure the cable OD in several locations. Use either a micrometer or a diameter tape to verify the cable OD. Select the proper cable seals based on the measured cable OD. Place the cable in the blowing equipment and inspect to ensure that the seals fit properly. Complete the assembly of the blowing equipment per the manufacturer's instructions.

7.9 Pressurize the system to ensure that excessive air is not leaking through the cable or microduct seals. Release the air pressure from the microduct before starting the cable installation.

7.10 Manually push about 25 ft of cable through the equipment and into the microduct. Engage the drive system and continue to push the cable 200 - 500 ft into the microduct. Slowly apply air flow and gradually increase the air supply as required to maintain the cable speed. Do not apply full airflow at the start of cable installation as the high back pressure will tend to push the cable backwards out of the microduct.

7.11 The cable reel should be manually (or mechanically) driven to minimize the back tension on the cable. The blowing equipment should not be used to pull the cable from the reel. Do not allow the cable to drag on rough ground or other course surfaces which may damage the cable jacket. If dirt or other contaminants accumulate on the cable, the cable should be cleaned with a soft rag prior to entering the blowing equipment. If necessary, the rag can be soaked with isopropyl alcohol to clean the cable as it enters the equipment. Solvents which leave a residue on the cable may cause slippage in the cable drive system and are not recommended.

7.12 Run the installation equipment at a constant speed. As the installation progresses, adjustments may be required to the air pressure and drive pressure to optimize the cable speed and installed cable length. When necessary, make gradual adjustments to the air and drive pressures. As the cable speed decreases, the operator must take care not to exceed the maximum allowable push force. Attempting to exceed the maximum push force established in the cable slip test may result in cable damage.

7.13 If the microduct was not previously racked in handholes and/or manholes, the microcable and microduct should be racked following cable installation. If possible, rack the microduct and microcable behind other cables and secure to the cable racks. If desired, cable protection can be provided by installing split duct over exposed microcable and slack storage coils.

7.14 To avoid potential water ingress into the splice closure, microduct should not be terminated inside the closure.

8 Plumettaz Cablejet Equipment

8.1 OFS has completed several trials and customer installations using Plumettaz Cablejet[1] equipment and OFS microcables. This section details some the recommended operating parameters for the Cablejet system. Inclusion of this information is not intended as an endorsement of the Cablejet equipment and does not prohibit the use of other manufacturer's equipment. OFS will continue to evaluate alternative cable blowing equipment and update this section as needed.

8.2 When used with OFS microcables, the maximum recommended air pressure for the Cablejet drive system is 45 psi. The corresponding cable push force is estimated to be about 40 lb. The maximum recommended air pressure for the microduct is 160 psi.

8.3 The Cablejet uses a set of drive rollers to push the cable through the air chamber and into the microduct. Spacers are inserted between the drive rollers to accommodate different ranges of cable diameter. Table 5 provides a description of the proper spacers for different cable diameter ranges.

8.4 For a given spacer width and maximum cable OD, the Cablejet system exerts a maximum compressive force of 45 lb (200 N) lb on the cable which is within the maximum recommended compressive force for OFS microcables.

Table 5 – Recommended Spacers for Sherman & Reilly Cablejet	
Cable Diameter	Spacer Width
≤ 6.7 mm	0 mm
6.8 - 7.3 mm	1 mm
7.4 - 7.9 mm	2 mm
8.0 - 8.5 mm	3 mm
8.6 - 9.1 mm	4 mm

Note 1: *White spacers are 1.0 mm; green spacers are 2.3 mm.*

For additional information please contact your sales representative. You can also visit our website at www.ofsoptics.com or call 1-888-FIBER-HELP (1-888-342-3743) from inside the USA or 1-770-798-5555 from outside the USA.

[1] CableJet is a registered trademark of Plumettaz SA, Bex, Switzerland.