

Clearfield's Recommended Best Practices

For FieldShield® Microduct and Fiber



Safety First

Be sure to wear all proper safety equipment and be familiar with safety practices at your work site. Perform all work in accordance with the applicable national, state and local codes and standards.

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Successful Installation of FieldShield Products

For a successful and trouble free installation of push and pull fiber, it is highly recommended that you follow these guidelines for creating the “best practice” for installation of Microduct set forth by Clearfield. These recommendations are for both Greenfield and Brownfield in OSP (buried and aerial) as well as for ISP (MDU/MBU).

Adhering to and following these recommendations is the key to a smooth install with the variety of FieldShield fibers available from Clearfield.

Pathway is critical!

The following chart lists the recommended **bend radius and installation tensile** of each type/size of FieldShield Microduct (MD).

When you exceed these recommendations, you put stress on the sidewalls of the MD, causing friction when pushing/pulling fibers. The chances of damage (i.e. kinking, stretching, or ovaling of the MD) increase dramatically.

Figure 1	Direct Buried 10/6 and 14/10 Tone and Non-Tone	Aerial (Figure 8 Style) 10/8 and 14/10	Plenum 10/6 and 12.7/10	Riser 10/6 and 14/10
Installation Tensile	10/6 (T and Non-T): 340lbf 14/10 (T): 264lbf 14/10 (Non-T): 346lbf	10/8: 2900lbf (500ft max span) 14/10: 1200lbf (200ft max span)	10/6: 340lbf 12.7/10: 340lbf	10/6: 340lbf 14/10: 340lbf
Bend Radius	10/6 (T): 7 inches 10/6 (Non-T): 6 inches 14/10 (T): 10 inches 14/10 (Non-T): 6 inches	10/8: 8 inches 14/10: 12 inches	10/6 (Supported): 6 inches 10/6 (Unsupported): 8 inches 12.7/10 (Supported): 8 inches 12.7/10 (Unsupported): 10in	10/6: 6 inches 14/10: 8 inches

Microduct (MD) is manufactured with a smooth core slip lining that allows the FieldShield fibers to be pushed and/or pulled through the MD with a very low coefficient of drag when MD is installed properly.

All installations should be smooth, even, free of kinks, and other disruptions that may have detrimental effects on the pulling tension of the cable.

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Pull Points

- There is no maximum distance when using the pull point installation process. Pull point maximum distances include one 360° (OSP) or one 270° (ISP) bend per pull point. This gives you the ability to maneuver around objects at no more than a 90° bend. As an example, four 90°s, or eight 45°s, are allowed in the 360° rule.
- Clearfield recommends 500 foot or less intervals between pull points, depending upon the type of fiber being installed. The following diagrams show the absolute maximum interval lengths for fiber products under ideal duct installation conditions.

FieldShield Pushable Fiber

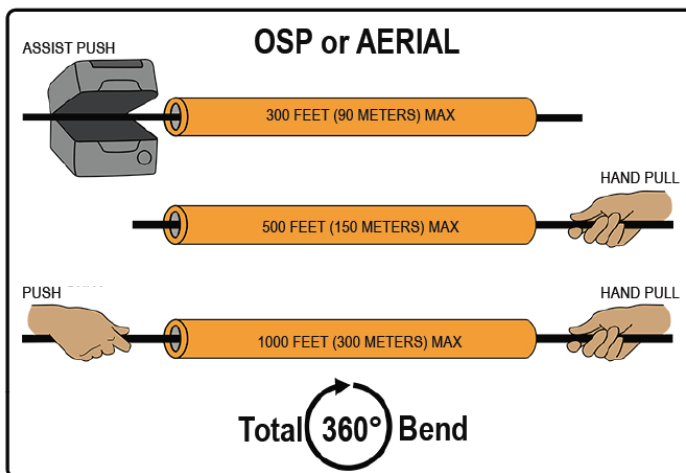
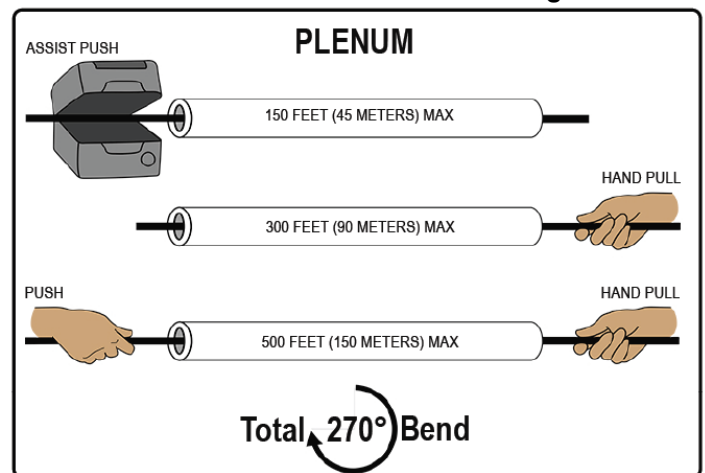


Figure 2



FieldShield FLEXdrop

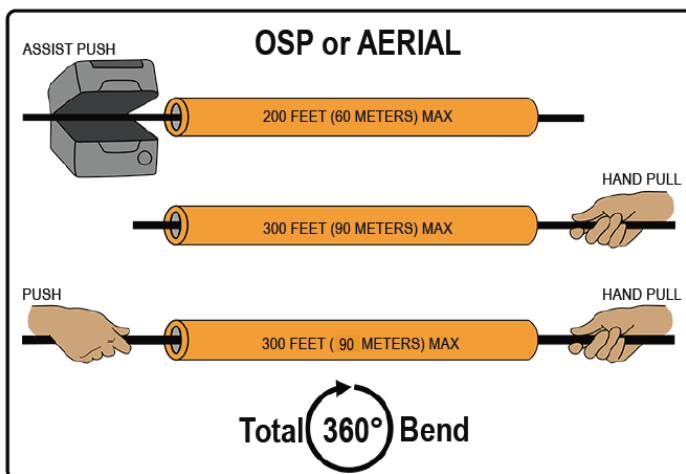
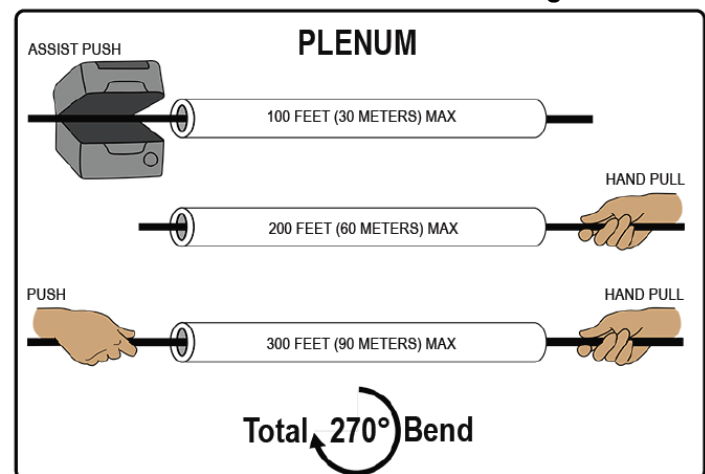


Figure 3





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Pull String

Pulling Tensile

- All Microduct is shipped with a pre-installed pull string with a **50lb pulling tensile**. This allows for enough strength to pull the fiber cables when the MD is installed correctly. When the MD is installed correctly, it should never feel difficult to pull. If it is difficult to pull this is an indication that the MD has exceeded the bend radius and the 360°/270° rule per pull point.
- **Exceeding the pulling tension will cause the string to cut into the duct.**
- When tying off Microduct to pull fibers, tie MD at an angle so that the pull string will not cut into the duct when tension is applied. Pull string cuts into the duct when the bend radius has been exceeded.
- If max pulling tension is exceeded while installing, the pre-connectorized fiber end (SC, LC or MPO) may break.

Secure Pull String

- If not utilizing the pull string immediately, expose enough pull string to catch in the end cap, or tape off at both ends, until fiber is ready to be installed.

Tape

- The use of tape inside the Microduct (taping pull string) is not recommended. The slip lining on both the MD and the fiber jackets will cause the tape to release. Tape can come off inside the MD and cause a blockage.

Pull Lube

- The use of a “pulling lube” is not required in Clearfield MD. It can become sticky/gummy when left to dry. This will cause issues if you ever need to replace the fiber. If using a water base, it can freeze in the MD and cause issues later on down the road as well.

Planning the Route

Keep the Route as Straight as Possible

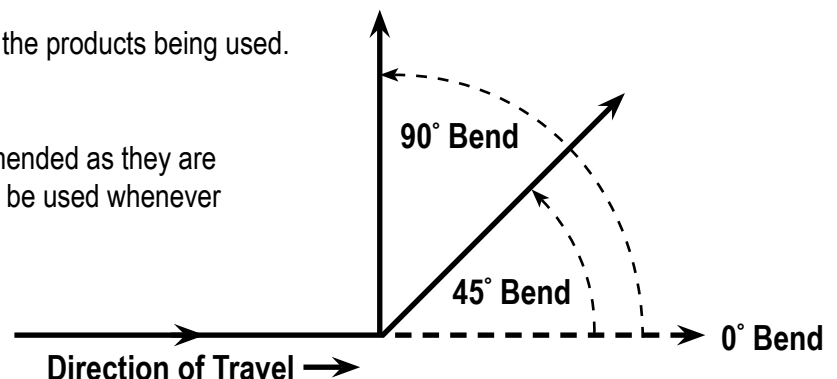
- Place the runs to minimize the amount of duct required. Choosing the route with the least amount of bends is key.

Pull Points

- Plan for pull points at intervals recommended for the products being used.

Long, Sweeping Bends

- The use of 45° sweeping bends is highly recommended as they are easier to pull through than 90° bends and should be used whenever possible.
- Be sure to maintain bend radius, see **Figure 1**.



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Installing Microduct

Leave 10ft of Slack Per Side

- If leaving MD for another team, leave 10 feet of slack at each end. This will allow the technician to find the pull string when tension has been applied and cut at installation. The pull string can and will relax back into the duct approximately 6-8 feet. Use of a rotary MD cutter is suggested to trim the MD to length while not cutting the pull string.

Pay From the Top

- When installing MD from a reel, pay the MD off over the top of the reel. Coming from underneath puts too much tension (ovaling/stretching the duct) when installing. If this occurs, you must remove the damaged MD before fiber can be placed.

Remove Twists

- Be sure to remove any twists before installing. This reduces the chance of kinking or unnecessary bends (undulations) especially during OSP installations (i.e. trenching). Excessive undulations reduce max installation distances.

Repair or Remove Damage

- Exceeding installation tensions (see **Figure 1**) of the MD will cause the MD to stretch. This can also happen when pulling around sharp edges.
- When kinked, stretched, or oveled, you must pull enough MD to remove the damage from an end point (terminal or pull point) or remove the section and repair with a coupler.

De-Burring and Coupling

- **De-burr** between coupled joints and use appropriate coupler for MD size.
- When coupling two MD's be sure to de-burr the MD ends before coupling. This will allow for a smooth transition for the fiber. Failure to do so can cause the fiber to break at the connector crimp tube.

Label Ducts

- Permanently label each end of the Microduct for easy identification later.

Cap the Duct Ends

- It is **IMPERATIVE** that the ends of the duct are capped/sealed. This will keep contaminants out of the duct (mud, sand, water, drywall dust, etc.). When end caps are not available, folding the end over and taping, or wrapping electrical tape to seal off the end is acceptable.



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Microduct Ground Implementation Guidelines

Regardless of ground implementation method make sure to always:

- Locate any buried cables prior to digging.
- Adhere to authority having jurisdiction.
- Consult local regulations for installation depths and restoration requirements.
- Respect the "right of way".

Buried Slack Loops

- **DO NOT leave excess slack loops buried. These are "extra" bends not desired when pulling fiber.**

Protect Duct

- While the MD does not require a "bed" of sand, as it is suitable for direct contact to soils, like any outside plant product it is important to protect the MD from sharp edges (rocks, etc.).

Buried Repair Kit

- Use of Clearfield's Buried Repair Kit (see "tools and accessories"), when needed to repair or extend the MD.

Best Plow Practices

Plowing

- Bullet plows are best for dry, sandy soils. Can stretch the duct if pulled too hard (exceeding installation tension).
- Chute plows are better overall. **Use of a ¾' chute is recommended**, or can oval the duct as it leaves the plow blade when exerting too much pulling pressure (when not feed assisted).
- Be sure to thread pulling eye in fully to the shoulder. This will provide a rounded tip for going around joints and corners as well as for maximum pulling tensions.

Pace

- Keep with a slow walking pace. Speed determined by in-ground conditions. Slower is better.
- **Slow and Steady.** DO NOT allow the blade to bounce aggressively. **SLOW DOWN!**
- Have a spotter. Four eyes are better than two. The reel could stop spinning and stretch the duct. Stretched area must be removed.

Obstacles

- **Avoid rocks.** They can flatten, cut, pinch or oval ducts.

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Open Trenching

Laying Duct

- Lay the Microduct one at a time, as flat as possible, removing the coils. Secure with a little dirt in spots along the route to keep the MD in place during backfill.
- This practice minimizes the number of undulations in the duct. **Excessive undulations** can greatly reduce the installation distances (of FieldShield Fiber) by creating excess friction.

Placing Microduct into Concrete

Bends

- Do not exceed recommended bends for pathway. Sweeping 45° bends are highly recommended.
- Maintain bend radius of MD.

Protecting Duct

- Sleeves (metal or plastic) are recommended as a protection around MD as it enters and exits concrete. Sleeves to be bent at a maximum of 90° for turns and a minimum bend radius for MD.
- Seal (end caps or tape) both ends of MD before installation.

Testing

- Test MD pathway to verify before concrete is poured.

Microduct MDU/MBU Implementation Guidelines

There are two types of MD specifically for indoor applications: plenum (white) and riser (cream).

- **Utilize BICSI and NEC codes for pull points.**
- Follow all local codes and practices as well as using fire stopping procedures.

Supporting Duct

- When installing ISP, vertical or horizontal straight runs should be supported every 16-24 inches. Use of plastic cable strap clamps is recommended. When multiple ducts, double up (2-hole) cable strap. Do NOT over tighten or crush MD.
- Use of MD organizing brackets are suggested.
- Sweeping 45° bends are recommended. Do not exceed 90° turns.

Installation

- Do not interfere with drywall installation .
- Drill your "right of ways" in a manner that will not interfere with the bend radius or add additional bends.

Hidden Slack Loops

- **DO NOT leave "slack loops" hidden. These extra bends are not desired when pulling fiber.**



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Verify Pathway

Once MD is installed (ISP or OSP), verify the pathway before placing dirt back into trench or placing cement, etc.

Recommendations for Verifying Pathway:

- When you have the ability to see ahead for obstacles, proceed in the path of least resistance. Stay away from the need to go around obstacles (air ducts, piping, trees, fences, etc.).
- Installing into occupied spaces can get your MD wrapped around existing cables/duct and cause stretching of the duct due to excessive pulling tension. This section must be removed/repaired before fiber installation.
- When able, walk pathway to verify proper bends and clearances (using left-over MD, create a "bend radius" measuring tool by creating a circle that is compliant to your MD bend radius (see previous table, **Figure 1**). Ex: If bend radius is 6 inches, your circle (diameter) should be 12 inches.

Testing

- Use of a proofing mandrel will provide the ability to pull through and check for any issues within the installation and adhere to recommended installation practices (**Figure 4**). When using these options be sure to pull in extra pull string for fiber installation later. See "tools and accessories" for options available from Clearfield.



Figure 4

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Installing FieldShield Fiber

Figure 5	FieldShield	StrongFiber	FLEXdrop	D-ROP	FLATdrop
Installation Tensile	20lbf	18lbf	20lbf	45lbf	50lbf
Bend Radius	38mm	10mm	10mm	120mm	80mm

Keep Fiber Clean

- Do not allow fiber to lie in dirt or water. If there is any type of foreign contamination on the fiber jacket it will end up in the MD and create a blockage inside the duct as there is a tight tolerance between cable O.D. and duct I.D.

Distances

- The images (**Figures 2 & 3**) show the recommended maximum distances for pulling fibers. Following these best practices have allowed longer pull distances.

Pull Sock/Loop

- Blunt end ruggedized fibers should be pulled using the pulling sock (see "tools and accessories").
- Single pre-connectorized fibers will be pulled with a pulling sock.
- Dual LC pre-connectorized fibers will be pulled using the pulling eye on the connector itself. Do not use a pulling sock on the pre-connectorized dual LC fiber.
- Pre-connectorized MPO fibers will be pulled using the pulling eye included with the MPO bullet.

Spool Deployment Method

- When installing a drop on a spool, the spool has a large hole where you can use a variety of items to pay off the fiber from the spool. We suggest utilizing a turn table (lazy susan) and cardboard dispensing box made for the drop wheel (see "tools and accessories" for these options available from Clearfield). Also, using an a-frame, a broomstick or even a long screwdriver placed through the hole and inserted into the ground (or held) is acceptable.

Relieve Tension

- When installing fiber it is helpful to take up the tension off of the reel when paying out the fiber. Keep a small amount of slack on the fiber as you guide it into the duct in a push-pull technique. This small amount of tension from the reel can greatly affect the force needed to pull the fiber into the duct. On longer runs this will especially important. This is the case even with the 900um deploy reels. By gently spinning the deploy reel we can help the puller on the far end a great deal.

Half Hitch

- When installing StrongFiber, be sure to follow the instructions to tie off (half-hitch) the pulling eye string to the metal crimp tube before pulling the fiber.

FieldShield Assist Module

- Allows one person to perform quick installations of drops (300ft OSP, 150ft ISP). Typically can be used for longer runs but follow directions in manual (i.e. low clutch, slow speed).



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Tools and Accessories



Couplers

Part Number	Description
FS-CPLR-7MM-7MM-10	FieldShield Microduct Airtight Coupler, 7 mm to 7 mm, 10 pack
FS-CPLR-8MM-8MM-10	FieldShield Microduct Airtight Coupler, 8 mm to 8 mm, 10 pack
FS-CPLR-10MM-10MM-10	FieldShield Microduct Airtight Coupler, 10 mm to 10 mm, 10 pack
FS-CPLR-12.7MM-12.7MM-10	FieldShield Microduct Airtight Coupler, 12.7 mm to 12.7 mm, 10 pack
FS-CPLR-14MM-14MM-10	FieldShield Microduct Airtight Coupler, 14 mm to 14 mm, 10 pack



Transition Couplers

Part Number	Description
FS-CPLR-8MM-10MM-10	FieldShield Microduct Airtight Transition Coupler, 8 mm to 10 mm, 10 pack
FS-CPLR-10MM-12.7MM-10	FieldShield Microduct Airtight Transition Coupler, 10 mm to 12.7 mm, 10 pack
FS-CPLR-10MM-14MM-10	FieldShield Microduct Airtight Transition Coupler, 10 mm to 14 mm, 10 pack
FS-CPLR-12.7MM-14MM-10	FieldShield Microduct Airtight Transition Coupler, 12.7 mm to 14 mm, 10 pack



End Caps

Part Number	Description
FS-END-STP-10MM-10	FieldShield Microduct End Caps, 10 mm, 10 pack
FS-END-STP-12.7MM-10	FieldShield Microduct End Caps, 12.7 mm, 10 pack
FS-END-STP-14MM-10	FieldShield Microduct End Caps, 14 mm, 10 pack



Microduct Repair Kit

Part Number	Description
FS-MD-FLD-RPR-KIT-7MM	FieldShield Microduct Field Repair Kit, 7 mm
FS-MD-FLD-RPR-KIT	FieldShield Microduct Field Repair Kit, 10 mm
FS-MD-FLD-RPR-KIT-14MM	FieldShield Microduct Field Repair Kit, 14 mm



Field Installable FlexConnector

Part Number	Description
FSD-FIFC-4PAK	Field installable FlexConnector in 4 pack
FSD-FIFC-SCA-4PAK	Field installable FlexConnector with splice-on SC/APC connectors, 4 pack



Rotary Cutter

Part Number	Description
FS-TCUT-8-10MM	FieldShield Rotary Duct Cutter, 8 to 14 mm microducts
FS-TCUT-3-4MM	FieldShield Rotary Duct Cutter, 3 to 4 mm jackets

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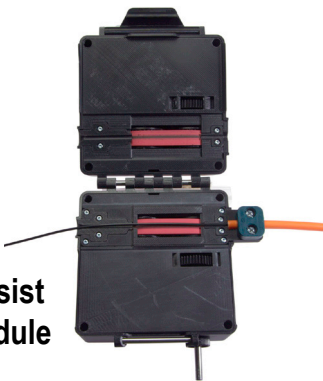
Duct Cutter

Part Number	Description
FS-DCUT-8-10MM	FieldShield Duct Cutter, 8 to 14 mm microducts



De-Burring Tool

Part Number	Description
FS-MD-DBR-TOOL	FieldShield Microduct De-Burring Tool, 8 mm to 10 mm, blue



Assist Module

Part Number	Description
FS-ASSIST-T	FieldShield, Assist Module, with mounting tripod
FS-ASSIST-KIT-BELT	FieldShield Assist Module, replacement belt kit (includes two belts)
FS-ASSIST-KIT-PLATE	FieldShield Assist Module, replacement wear plate kit (includes two wear plates)



FieldShield Pull Sock

Part Number	Description
FS-PUL-3-4MM	FieldShield Pull Sock, for 3 to 5.5 mm FieldShield Pushable Fiber
FS-PUL-5-9MM	FieldShield Pull Sock, for 5 to 9 mm FieldShield Pushable Fiber



Microduct Pulling Eyes

Part Number	Description
FS-PUL-CRT-6MM-M	FieldShield Microduct Pulling Carrot, 6 mm ID, metal, with string tie on
FS-PUL-CRT-10MM-M	FieldShield Microduct Pulling Carrot, 10 mm ID, metal, with string tie on



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Aerial Microduct Attachment

Part Number	Description
FS-DEADEND-AD10	FieldShield Aerial Microduct Attachment, large cable
FS-AERIAL-SPLICE	FieldShield Aerial Microduct Attachment, open wire splice, galvanized, BWG-10 0.134" x 14"



Turn Table

Part Number	Description
FMA-XXX-100	Turn Table, Small, for deploying FieldShield products, 12" base
FMA-XXX-101	Turn Table, Large, for deploying FieldShield products, 24" base



Proofing Mandrels

Part Number	Description
FS-DUCT-PROOFING-TOOL	Includes both 6mm and 10mm proofing mandrels
FS-DUCT- PROOFING-KIT	Includes both proofing mandrels and a spool of string



**FieldShield Dispensing Box
FS-SPOOLBOX-10**



**YOURx Breakout Pulling Tool
FS-PUL-YOURX**