FieldShield
Optical Fiber Protection System
Installation Manual

Ruggedized Microduct
Pushable Optical Fiber
Pushable Connectors
Accessories

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CLEARFIELD

Table of Contents

Technical Support

Clearfield, Inc. can be contacted for any issues that arise with the supplied product.

If you need to return the supplied product, you must contact the Clearfield, Inc. Customer Service Department to request a Returned Materials Authorization (RMA) number.

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Introduction

Proprietary Notice
About FieldShield Product Line Application

Its purpose is to provide the user with adequately detailed documentation to efficiently install the equipment supplied. Every effort has been made to keep the information contained in this document current and accurate as of the date of publication or revision.

However, no guarantee is given or implied that the document is error free or that it is accurate with regard to any specification.

Standard Warranty

Clearfield warrants to the original purchaser of the Product sold hereunder is free from defects in material and workmanship under normal use and service, subject to exceptions stated herein. Product purchased is warranted as follows: Clearfield designed and branded Products are warranted for five (5) years: Products manufactured by Clearfield to customer prints and/or specifications are warranted for one (1) year; and any Product Clearfield acquires from or through a third-party manufacturer or distributor and resells to Customer as the original customer will carry the manufacturer's pass-through warranty, if any. In all cases, the warranty period commences on the date of shipment to the original purchaser.

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If any Product purchased from Clearfield is found defective under the above warranty, the following basic procedure must be followed:

1) Customer must contact Clearfield and obtain a Return Materials Authorization
2) Following authorization, the Customer ships the product-freight collect-to Clearfield's manufacturing facility
3) Clearfield shall repair or replace the defective Product at its sole option and discretion, and return the repaired or replacement Product to Customer's site, freight prepaid

Note: *If the Product is not found to be defective at Clearfield, the product will be returned to the Customer and the customer billed for freight in both directions.*

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Correction of defects by repair or replacement, at the option of Clearfield Inc, shall constitute the exclusive sole remedy for a breach of this limited warranty. Clearfield shall not be liable under any circumstances for any special, consequential, incidental, punitive, or exemplary damages arising out of or in any way connected with the product or with agreement to sell product to buyer, including, but not limited to damages for lost profits, loss of use, or for any damages or sums paid by buyer to third parties. The foregoing limitation of liability shall apply whether the claim is based upon principles of contract, warranty, negligence or other tort, breach of statutory duty, principles of indemnity or contribution, the failure of any limited or exclusive remedy to achieve its essential purpose, or otherwise.

Clearfield will not be responsible for any labor or materials costs associated with installation or incorporation of Clearfield products at customer sites, including any costs of alteration, replacement or defective product, or any field repairs.

Other Limitations

Clearfield assumes no warranty liability regarding defects caused by:

1) Customer's modification of Product, excepting installation activities described in Clearfield documentation
2) Customer re-packaging of Product for shipment to third parties or destinations other than those originally shipped to by Clearfield, or any defects suffered during shipping where the Product has been re-packaged
3) Customer's installation or maintenance, excepting activities described in and performed in accordance with Clearfield documentation
4) Customer's improper or negligent use or application of Product
5) Other causes external to the Product, including but not limited to accidents, catastrophe, acts of God, government action, war, riot, strikes, civil commotion, sovereign conduct, or the acts or conduct of any person or persons not party to or associated with Clearfield

FieldShield Product Overview

The FieldShield Ruggedized Microduct and Pushable Fiber Platform is a new fiber delivery method aimed at reducing the installation and maintenance costs of "last mile" broadband deployment, while providing industry leading protection from environmental hazards. It starts by teaming a ruggedized microduct with a specially designed hardened cable assembly enabling users to push or pull fiber through a series of ruggedized microducts.

Traditionally, fiber is pulled through ¾" to 1 ¼" conduit. However, this delivery method is expensive and unsightly as burying the large conduit is labor intensive and tears up the surrounding area. By reducing duct size to only a 10mm microduct, fiber can be buried with the simplest and least invasive trenching techniques. Should the microduct be cut for whatever reason, the fiber is easily removed, duct repaired with a simple coupler, and fiber pushed back into place with limited interruption or inconvenience.

Ruggedized Microduct

FieldShield Ruggedized Microducts are 10mm O.D. conduits specifically designed to accept Clearfield Pushable Fiber Assemblies. By reducing duct size to 10mm or smaller, FieldShield Microducts can easily be placed through existing conduit, buried in the ground, or deployed in an aerial environment (either lashed from the pole or strung up the tower), providing a protective transport path from the distribution terminal to customer premise. The smooth inner wall and slip lining provide minimal resistance and allow FieldShield Pushable Fiber Assemblies to be pushed or pulled through the duct with ease. Longer distances can be accomplished through push/pull methods as all microduct products are supplied with a pre-placed 50 lbs pull string giving you choices to deliver fiber in a variety of environments.

FieldShield Pushable Optical Fiber

The FieldShield Microduct provides the pathway to quickly deliver the FieldShield Fiber Cable. Handled in much the same manner as a bend-insensitive patch cord, one to 24 fibers are housed in a rugged 3mm or 4mm jacket that is crush-resistant yet flexible -- without the risk of kinking or creating unacceptable light conditions.

Manufactured with bend-insensitive fiber, FieldShield Pushable Optical Fiber is strong enough to be stapled to walls and offers a built-in, bend limiting function to prevent damage to fiber during installation. Available in bulk reels, FieldShield offers total installation flexibility. Terminated with a FieldShield Pushable Connector, the polymer properties unique to FieldShield Pushable Fiber allow the assembly to be pushed or pulled through the FieldShield Microduct.

FieldShield Pushable Fiber Connectors

Terminating a FieldShield Pushable Fiber Connector onto the FieldShield Fiber Cable allows it to be pulled or pushed through the FieldShield Microduct. Developed in collaboration with Senko, this field-proven connector is terminated and partially assembled at the factory. The connector easily passes through the Microduct's 6.0 mm bore with the outer housing quickly and easily assembled by the technician in the field. This factory pre-connectorized approach enables lower installation costs by reducing costly labor in the field and presents a reliable, consistent and guaranteed performance level.

Microduct Ground Implementation Best Practices

Every application scenario is different but this document provides general guidelines and best practices to installing FieldShield Ruggedized Microducts. Regardless of ground implementation method make sure to always:

Locate Buried Telecommunications Cables before Digging

Make sure to call 811 a few days before digging. Calling 811 will route to the local one-call center and ensure that utilities in the area of installation will be located and marked.


Note: *Failure to properly locate and adhere to buried utilities may result in damage during installation, creating additional restoration costs and interruptions to the surrounding community.*

Adhere to Authority Having Jurisdiction

Secure required permits from city and company. Ensure that national and local building codes, OSHA and company safety work rules are observed and provisions made for street flags, barricades and cones.

Respect the Right of Way

Make sure to plan the route along, under and over the customer's property, as the most direct route may cross an adjacent property and not provide a legal route. Generally, you can trench along the roadway to enter the customer's property right of way before spanning to the residence.

Consult Local Regulations for Installation Depths and Restoration Procedures

The depth microducts can be buried will vary depending upon local conditions and regulations. Under all conditions, the microduct should be buried at a depth that will provide adequate protection during the frost cycle.

Rocks and debris should never be left in the bottom of a trench. If soil is predominately coarse with many rocks present, the bottom of the trench should be bedded prior to microduct placement. Backfilling with a finer grade of material such as sand will fill the voids between the duct and sidewall and provide additional strength.

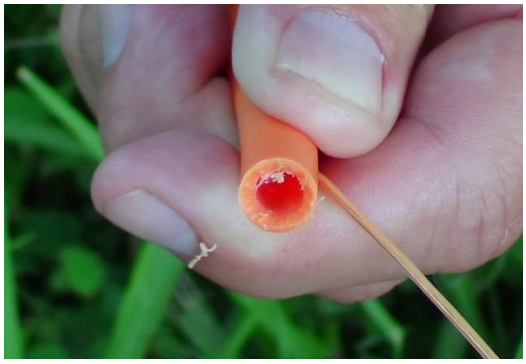
Maintain Minimum Bend Radius of Microducts

FieldShield microducts can be bent down to a 6 inch bend radius before straining the side wall integrity of the duct. Do not bend microducts tighter than this when cornering as it may cause the conduit kink. If space permits, it is always best to use two sweeping 45° turns rather than one 90° turn.

De-Burr Between All Coupled Microduct Joints

Prior to coupling two microducts, make sure to prepare the face of each microduct by de-burring the inside bore to a cone shape.

Properly de-burring the bore of the microduct reduces the chance of the fiber or pull string getting stuck or snagging when passing through the microduct coupler.



Pull Additional Microduct to Access Pull String

When installing microduct into a terminal or splice enclosure make sure to pull an extra 5 to 10 feet of microduct through the installation port to expose and access the integrated pull string. If fiber is not being installed at the same time, make sure to tape the pull string to the outside of the duct, prior to capping the duct.

Validate Microduct and Fiber Installation Prior to Restoration

When application permits, it is always best to install the fiber and ensure that it is working prior to restoring the installation path. This provides the most flexiblity when troubleshooting is required and eliminates restoration rework if obstacles arise. If fiber is not being installed at the same time as the microduct, but instead is being installated by a separate crew or when the customer turns-on service, the microduct path should be validated or proofed to ensure that the path is capable to install fiber at a later date.

Note: *Refer to* ***Page 47*** *of the installation manual for the microduct proofing process.*

Micro Trenching (Saw Cutting)

Micro trenching is a relatively new installation method developed to reduce installation time and minimize the environmental impact of deploying fiber. Traditional trenching can be time consuming and labor intensive, disrupting traffic due to road removal and restoration to access utilities below. Micro trenching can avoid many of these costs because it only penetrates the surface layer of the road. Traditional trenches are replaced by narrow slits that are sliced or sawed along the surface of the road or pathway.

Installation Location

Micro trenching is typically performed on asphalt and concrete pathways where traditional trenching would cause major disruptions to the community and its surroundings. Due to the quick cleanup and minimal community impact, micro trenching is ideally suited for installing fiber in high traffic urban areas.

Advantages

- Reduces costs by minimizing permits, excavate, street and restoration fees that can make build out costs prohibitive
- Little to no disruption to traffic - leaves existing roadways, sidewalks, and pathways intact
- Best solution in paved or concreted areas
- Great solution for urban areas
- Improves implementation efficiency by utilize a smaller workforce, less equipment, and less community impact
- Restoration leaves a small footprint that is barely visible

Disadvantages

- High equipment capital expense and specialized tools needed
- Sweeping turns make tight cornering difficult
- Requires the use of an additional backfill media
    - Super grout
    - Elasto-polymer
    - Hot Patch
- Limited installation depths - typical micro-trenching saws can only cut depths of 12 inches or less

Installation Best Practices

Tip 1: Before beginning to cut, it is best to plan and mark the entire installation path with marking paint (**Figure 1**).

The marked path should be used as a cut guide to ensure straight lines and maintain esthetic appeal to the surrounding community.

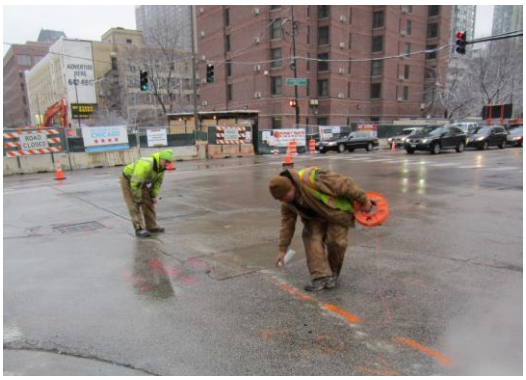


Figure 1

Tip 2: Make sure to following local procedures when micro trenching on roadways. Typically municipalities require the trench to be cut close to the seam where the road meets the curb (**Figure 2**). However, some cities recommend placing the micro trench along the center line of the road.

Careful consideration should be given to the depth required, as the structural integrity of the road will need to be restored to original values.

Figure 2

Tip 3: Blades should be sized to provide the desired trench width and depth depending upon the number of microducts being installed (**Figure 3**).

For a single stack of conduits, it is recommended to cut select a blade between 3/4" and 1" wide.

The depth range will vary depending upon installation medium and local regulations. This will need to be taken into consideration when designing the project.

Figure 3

The typical trench depth is between 6 and 18 inches deep. If the total number of conduits cannot fit into a single slot and allow for adequate backfill coverage, then a 1-1/2" or wider trench should be cut and conduits stacked in pairs of two.

Note: *Saw blades should never be less than ¾" wide. Trenches that are too narrow do not provide enough room to route duct around turns.*

Tip 4: While the products can withstand very high sidewall pressures, when making turns it is recommended that the two intersecting 90° paths should be connected by an intersecting 45° cut (**Figure 4**).

Note: *Pushable Connectors require a minimum bend radius of 2" to sweep around turns, as a result sharp 90° turns make it difficult to install fiber in the conduit.*

Figure 4

Tip 5: The main caution prior to placing the microducts in the trench is to ensure that no large debris has fallen into the trench prior to placing the microducts (**Figure 5**). At the same time, trenches should be checked for any jagged edges from rough cuts protruding from the sidewall of the micro trench (**Figure 6**). Failure to retrench these areas and remove protrusions may cause the microduct to bind between the edges during the frost cycle, potentially causing interruptions to service.

Note: *Periodically check the trench depth to ensure consistency is maintained. An excessive change in grade can create a bind point in the duct and cause issues when installing the fiber assembly at a later time.*

Figure 5

Figure 6

Tip 6: Simply pull the duct out and allow it to fall into the micro trench. If the microduct is maintaining the coil or twist from being spooled make sure to straighten out by twisting in the opposite/counter direction to the twist (**Figure 7**).

Note: *Failure to remove the twist can cause the fiber to spiral during installation and rub the inside wall of the duct. This increases the amount of friction exerted on the microduct inside wall and pushable assembly diminishing possible push and pull lengths. Extra care should be taken when laying long paths.*

Figure 7

Tip 7: When placing multiple microducts, place them one at a time (**Figure 8**). If placed at the same time, the tendency is for the ducts to overlap each other, thus creating undulations or waves that will greatly degrade placement distances. Placing microducts one at a time allows them to settle into the trench without creating this effect.

Note: *It is always recommended that at least one of the microducts have a tone wire to allow for accurate locating after backfill.*

Figure 8

Tip 8: Maintain the minimum bend radius of 6 inches to ensure that the duct is not bent or kinked around corners (**Figure 9**).

Note: *It is best to place a splint or shim between sharp corners and the microduct to pad the bind point.*

Figure 9

Tip 9: Back fill using an acceptable medium for the local environment (**Figure 10**).

Figure 10

Tip 10: Although bedding is not required it is recommended in order to maintain optimal structural integrity to existing roadways and pathways (**Figure 11**).

Bed the trench with approximately 1" of fine sand prior to placing the duct and cover the duct with another 1" of sand before backfilling with an appropriate grout or polymer.

Figure 11

Vibratory Plowing

Vibratory plowing is a trenchless ground implementation method for installing microducts. It involves feeding the conduit through a plow chute and inserting the duct into ground at the desired depth while moving forward. The installation depth is controlled by hydraulically adjusting the plow blade making adjustments for changes in surface terrain. Restoration is typically as simple as compacting ground disturbances, such as residual mounds or grooves, by driving the tire of the vibratory plow over the grade.

Installation Location

Vibratory plowing is a quick installation method typically performed in open Brownfield and Greenfield installations where minimal disturbance along the installation path is required.

Advantages

- Quick installation in open areas
- Less ground disturbance than open trenching
- Manageable equipment costs
- Uses common drop plow blade
- Little to no restoral
- Small crew needed (Typically 2-3 men)

Disadvantages

- Limited Depth
- Depth of placement and soils may require additional tow machine
- Cannot be used for all soil conditions – sometimes unusable in wet or muddy conditions
- Blind placement - increased possibility of damaging cables or underground utilities

Installation Best Practices

Tip 1: Carefully plan and lay the microduct along the entire installation path (**Figure 1**). If the product maintains the coil after unreeling, make sure to remove the coil by counter-twisting the duct against the twist (**Figure 2**).

Figure 1

Figure 2

Tip 2: When using a vibratory plow to install the microduct, it is recommended to use the smallest plow blade possible (**Figure 3**). Always start moving the plow slowly and gradually. Don't increase the speed until after all the microduct slack is taken up from the delivery system. When changing the plow attitude/depth make sure to gradually make the change (**Figure 4**).

Typical installation depths are between 12" and 24" below ground.

Note: *The installation depth must be continually adjusted to compensate for changes in terrain to ensure compliance depth criteria.*

Figure 3

Figure 4

Tip 3: Install the microduct just as you would any other product (**Figure 5**), keeping in mind that it must go in the plow chute under no tension (**Figure 6**).

Note: *Excessive tension can cause the microduct to become kinked, and/or elongate and distort the bore.*

Figure 5

Figure 6

Tip 4: Make sure to plan installation paths directly up or down the slope, parallel to the change in grade (**Figure 7**).

Figure 7

Tip 5: Keep the microduct installation path as straight as possible, by limiting for side-to-side movement (**Figure 8**). This allows the least amount of soil to be displaced while installing, thus creating less restoral.

Figure 8

Tip 6: Restoration is completed by driving the wheels of the vibratory plow over the installation trench (**Figure 9**).

Note: *If the plow makes contact with large obstacles such as stumps and boulders during installation it is best to retrench these sections by hand to reduce undulations and ensure a constant installation depth.*

Figure 9

Open Trenching

Open trenching involves digging a trench with either a chain trencher or excavator and setting the microduct directly into the trench. This installation method is accomplished by using specialized trenching machines that cut the trench and remove the soil in a single action and can be used to place multiple conduits over long or short distances.

Installation Location

Although open trenching the most common way to install conduits, it does have some limitations. Open Trenching can only be used when the ground above the utilities can be disturbed and there are no other obstructions in the way, such as landscaping, roadways, and sidewalks. As a result, open trenching is best suited for Greenfield scenarios.

Note: *Most installations use some form of open trenching in combination with other ground implementation methods.*

Advantages

- Most understood installation method
- Suitable for most ground conditions
- Trench provides easy access to the work area
- Wide work area allows additional utilities to be co-trenched with microduct
- Allows continuous excavation, laying and backfilling operations
- Most economical/cost-effective choice for Greenfield installations
- Easy to uncover obstacles

Disadvantages

- Requires more excavation and backfill than alternative methods
- Requires the widest work area – In congested spaces, it can be very difficult to find room for the excavation machine and/or trench
- Excavated soil can weaken and collapse due to excessive rain or heat causing additional rework
- Causes greatest disruption

Installation Best Practices

Tip 1: Carefully plan and mark the entire installation path prior to installation (**Figure 1**). Microducts can either be laid along the installation path prior to ground removal or unspooled and dropped into the trench after excavation has been completed (**Figure 2**).

***Note**: When setting the microduct along the installation path prior to ground removal it is best to cap each end of the duct to ensure debris does not fall into the bore.*

Figure 1

Figure 2

Tip 2: It is best to carefully dig the trench path by hand in tight areas (**Figure 3**). Make sure to respect the marks and use caution when digging near existing utilities.

Figure 3

Tip 3: Extra care must be taken to dig a straight and level trench, keeping the trench as narrow as possible to avoid unnecessary ground handling during installation and restoration (**Figure 4**).

Figure 4

Tip 4: When placing the microduct in an open trench, it is recommended that the product be placed one at a time as flat as possible (**Figure 5**) and secured with a small amount of dirt in spots along the route to keep the microduct in place during backfill (**Figure 6**). This practice minimizes the number of undulations in the duct. Excessive undulations can greatly reduce the installation distances by creating excessive friction.

Note: *If the product maintains the coil after unreeling make sure to remove the coil by counter-twisting the duct against the coil.*

Figure 5

Figure 6

Tip 5: When installing multiple microducts, microducts can be installed into a larger conduit prior to being placed in the trench to consolidate the installation path (**Figure 7**). However, this is not necessary as FieldShield microducts are rugged enough to withstand direct ground contact.

Figure 7

Figure 8

Tip 6: It is not necessary to “bed” this product in sand as it is suitable for direct contact with soils. However, as with any underground plant product, it is advisable to keep contact with rocks and debris to a minimum (**Figure 9**).

Figure 9

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Horizontal Directional Drilling (Directional Boring)

Horizontal Directional Drilling is a trenchless implementation method designed to install utilities from one point to another with minimum surface disturbance. A pilot bore is drilled and guided underground along a pre-determined bore path, then the conduit is dragged through the bore during back reaming. By boring underground, horizontal directionally drills are able to avoid existing utilities, landscaping, driveways, sidewalks, and other obstructions.

Installation Location

Horizontal Directional Drilling is typically used in Brownfield scenarios requiring quick restoration and minimal impact to the surrounding community. Directional Drilling usually has less impact to existing ground structures than open trenching or vibratory plowing.

Advantages

- Avoids existing infrastructure providing continuation of normal operation
- Maintains integrity of roadways, buildings, landscaping and natural features
- Minimal site restoration
- Very precise method of placement

Disadvantages

- Highest capital expense
- Requires a team of highly skilled operators
- Bed rock or other hard drill conditions may make the project cost prohibitive
- Entry/exit pits can be very messy
- Typically a very high installation cost per foot

Installation Best Practices

Tip 1: Before beginning any installation, make sure to devise a plan that, at minimum, details desired entry and exit points and angles as well as critical pitch and depths along the bore path.

Note: *Make careful considerations when crossing and/or nearing existing buried utilities along the installation path. It is extra important to closely monitor the progress when boring and back reaming near existing utility lines to prevent any accidental damage.*

Tip 2: Dig entrance and exit pits making sure that there is enough room for equipment (**Figure 1**). Usually the bore path is drilled from the customer premise towards the distribution terminal.

Figure 1

Tip 3: When drilling the pilot bore, make sure to minimize overcorrecting, undulations, and extraneous curvature (**Figure 2**). The bore path should contain gradual sloping curves and smooth straight runs with proper drill fluid circulation.

When boring down slopes make sure to keep the bore parallel to the surface to avoid accidently protruding the drill head from the ground. Carefully guide the bore at the necessary upward or downward angle to maintain the required depth below ground.

Figure 2

Note: *Maintaining proper drill fluid viscosity is essential to prevent soil cuttings from clogging the bore. A clogged bore creates excessive back pressure on the drill head, slowing production.*

Tip 4: After the pilot bore connecting the entrance and exit pits is completed, replace the drill bit with a larger back reamer to enlarge the bore to the desired diameter. Microducts can be attached to either a bridal or swivel directly behind the back reamer and installed during the initial pullback. If a clean bore was achieved during the pilot bore then the microduct can be pulled back without the need for the larger back reamer.

Note: *At 10mm in outside diameter, microducts typically fit through most 2 to 3" bore holes without the need for additional back reaming.*

Tip 5: Before attaching the microduct, make sure to fully plug the end that is being pulled to minimize the chance of dirt or other debris being pushed up into the microduct bore. For best results, attach a pulling eye, plug the microduct with either an end plug or end cap, and cover the cap with a couple rounds of tape to ensure the end cap does not fall off during pullback.

Note: *10-12mm conduit pull swivels are available in the market to plug the microduct bore and eliminate twisting during the pull back process.*

Tip 6: Attach the microduct to the drill head or back reamer and carefully pull back using the recommended settings for local conditions. If fiber is being installed at a later date, make sure to cap both ends to prevent debris and water from entering the duct.

Occupied Conduit Microduct Installation

Microducts are ideally suited for use in occupied conduit systems where additional fibers are needed and space is limited.

Installation Best Practices

Tip 1: The high crush rating allows microducts to be placed next to existing cables without worry of damage to the fiber (**Figure 1**).

Note: *An added benefit in a joint conduit is that it provides a distinct route for your fiber.*

Figure 1

Tip 2: Non-toneable microduct can be pulled into a conduit or tray system using traditional methods or as a fish tape for distances approaching 200 ft. Simply cap the end with and end plug and tape to keep debris out of the conduit system, and push the product just as you would a fish tape (**Figure 2**). Once installed, open the ends and place the fiber using the integrated pull string if needed (**Figure 3**).

Figure 2

Figure 3

Tip 3: Pull boxes (**Figure 4**) and ground boxes (**Figure 5**) should be used as access points to increase installation lengths by minimizing the strain of sharp 90° turns or by providing additional push/pull installation points in the microduct pathway.

Figure 4

Figure 5

Indoor Microduct Installation

When installing microduct indoors, always adhere to the local and state building codes. We recommend checking with your local building inspector before installing duct into a riser or plenum air space.

Utilize BICSI and NEC standards when considering sweeps, bends and corners.

Remember, the straighter the better. Even though the Microduct is designed to handle multiple bends, including 90 degree corners, it is still best to try to minimize the number of turns. This includes vertical and horizontal bends. Increasing the number of bends in a route exponentially increase the amount of friction exerted on the fiber during installation.

- **EIA/TIA-569-A 4.4.2.2**: No section of conduit shall be longer than 30 meters (100 ft) between pull points
- **EIA/TIA-569-A 4.4.2.3.1**: No section of conduit shall contain more than two 90" bends, or equivalent, between pull points (outlet boxes, telecommunications closets, or pull boxes). If there is a reverse (U-shaped) bend in the section, a pull box shall be installed.
- **NEC 353.26**: There shall not be more than the equivalent of four quarter bends (360 degrees total) between pull points, for example, conduit bodies and boxes.

The main reason for using pull boxes is to provide additional access points to fish the fiber and loop the run to the next section of microduct during installation. Pull boxes should never be used as splice enclosures. When a conduit enters a pull box make sure to use a bushing or adapter to protect the conduit and cable from abrasion unless the box, fitting, or enclosure provides adequate protection.

Note: *Push an extra 5 to 10 feet of microduct into the pull box to strip back and expose the pre-installed pull string. Pull strings should always be left in the conduit until after the fiber has been deployed.*

Microducts can be attached to studs and joists using the same zip ties, cable ties, or staples used to install RG6 coax cables.

Recommended Staple Sizes

- Duct: T59 Insulated Fasteners
- Fiber: T18 Round Crown Staples

Note: *Due to FieldShield Optical Fiber's durable outer jacket, it is strong enough to be stapled directly to studs and joists.*

Note: *For residential applications without an exterior conduit system, Clearfield recommends using the FieldShield Non-Toneable Black Microduct as a transition microduct between outside plant and indoor microducts because it is more esthetically pleasing to the surrounding community than bright orange.*

Aerial Installation

The typical aerial drop runs from the distribution terminal on the pole to the attachment point on the residence and then transitions using an 8mm-10mm transition coupler to one of the other duct products and continues to the test access point (TAP) or network interface device (NID). Aerial microducts can be placed in spans of up to 200 feet or lashed to an existing support strand. The finished drop will look much the same as a traditional RG6 coax or telephone drop.

Adhere to Authority Having Jurisdiction
Secure required permits from city and company. Ensure that national and local building codes, OSHA and company safety work rules are observed and provisions made for street flags, barricades and cones.

Respect the Right of Way
Make sure to plan the route along and over the customer's property, as the most direct route may cross an adjacent property and not provide a legal route. Generally, you can lash along the power or phone lines to enter the customer's property right of way before spanning to the residence.

Installation Procedure

Step 1: When installing, the attachment is typically made at the building end first, then the proper length is laid out along the route.

Step 2: Install an industry standard attachment hook (P-Hook, J-Hook, Rams Horn, Crows Foot, etc.) parallel to the ground into the customer premise.

Note: *When selecting an attachment point, it is best to choose a place that is close to the entrance location and maintains local ground clearance regulations. Never attach microducts directly to non-supportive structures such as gutters, existing utility lines, or chimneys.*

Step 3: Lay the conduit along the span path to measure the duct to the appropriate length. Make sure to take into account the entire distance it will take to reach the distribution terminal prior to cutting to length.

When Installing the Fiber at the Same Time as the Microduct:

Install the fiber into the microduct prior to taking the end to the attachment point.

Note: *If space permits, by installing the fiber in to the microduct prior to attaching the duct to the pole, installation times will be reduced because you will only need to make one trip up the boon truck for microduct attachment and installation into the distribution terminal.*

Step 4: To prepare the duct to be attached, score along both sides of the seam between the microduct and aerial support member (**Figure 1**).

Note: *After scoring the seam,* ***DO NOT*** *attempt to separate by pulling on the support member. Instead, carefully slide the knife along the duct to separate the support member.*

Figure 1

Step 5: After separating the strength member from the microduct, wrap approximately seven layers of electrical tape or tighten a zip tie around the end of the seam to prevent additional stripping due to tension from conduit sag and weather.

Step 6: Cut back the support member to the desired attachment length and use either a rotary duct cutter or a pair of wire strippers to expose desired amount of the support member to attach to the dead end or bond if needed.

Note: *Clearfield recommends using the FS-DEADEND with FieldShield Microducts or comparable dead ends designed to support 1.5mm support strands (**Figure 2**).*

Figure 2

Step 7: Prepare the duct to be attached by pre-twisting one side of the dead end around the support member.

Carry the prepared duct to the attachment point and loop the open end of the dead through the attachment eye loop.

Then twist the open end of the dead end around the side already attached to the support member (**Figure 3**).

Figure 3

Step 8: Using a boom truck, carefully carry the other end of the microduct to the attachment point on the utility lines. Prepare the microduct using the same attachment method as before.

Note: *Make sure to pull the microduct taunt prior to attachment to minimize conduit sag. Adhere to local regulations for acceptable sag tolerances.*

Step 9: Once the dead end is secured at the pole or strand, route the microduct into the appropriate port on the splice case.

Step 10: Remove any excess duct by ring cutting the duct.

Note: *If the fiber is already installed, slide the extra duct over the end of the fiber to remove the excess.*

General Microduct Installation Procedures

Direct Bury Toneable Microduct Coupling and Restoration

There are many situations where two microducts need to be coupled together to continue the conduit pathway. Regardless of whether the microduct was cut after initial installation or if the duct simply needs to be continued, this procedure provides a method to properly couple two microducts while ensuring tone wire circuit integrity for ground locating.

Note: *When performing a field restoration after a microduct is cut, a short piece of toneable direct bury microduct (typically 12" to 24" long) is required to connect the two sections of microduct. For these situations the restoration will need to be performed twice. As a result, Clearfield's FieldShield Field Repair Kit contains two of each component included in the kit.*

Recommended Tools / Parts List

- De-Burring Tool
- Rotary Cutter or Duct Cutter
- Utility Knife or Sheath Knife
- 22 – 18 AWG Wire Strippers
- 22 – 18 AWG Crimp Tool
- Vinyl Insulated 22 – 18 AWG Red Butt Splices
- FieldShield 10mm to 10mm Duct Coupler
- 5/16" Epoxy Lined Black Heatshrink Tubing
- 3/4" Epoxy Lined Black Heatshrink Tubing
- Hot Air Gun or Heat Source

Installation Procedure

Step 1: Use utility knife to score 4-5 inches of both sides of the seam/marriage webbing between the microduct and tone wire making sure to keep the blade as close to the microduct as possible. (**Figure 1**).

Figure 1

Step 2: Carefully slide blade along the microduct between the tone wire and microduct (**Figure 2**).

Note: *Do not attempt to separate by pulling tone wire from microduct. This may cause damage to the tone wire or protective coating to be removed.*

Figure 2

Step 3: Cut ½ - 1 inch of microduct from each end with duct cutter (**Figure 3**).

Note: *When pull string present, use rotary cutter so that pull string is not cut.*

Figure 3

Step 4: Insert De-Burring tool into end of microduct and rotate to bevel inside face of microduct ends (**Figure 4**).

Note: *Inner face should be conical in shape to reduce snagging when pushing fiber through coupler (**Figure 5**).*

Figure 4

Figure 5

Step 5: Use utility knife to score down excess tone wire protective coating material left on the top of duct to ensure proper watertight fit with coupler (**Figure 6**).

Figure 6

Step 6: Insert both ends of microduct into coupler and cut tone wire at the center of the coupler (**Figure 7**).

Figure 7

Step 7: Strip tone wire protective coating using 20 or 22 AWG wire strippers (**Figure 8**).

Figure 8

Step 8: Insert 3 inches of 5/16 inch epoxy lined heatshrink tubing over tone wire (**Figure 9**).

Figure 9

Step 9: Crimp both ends of tone wire together with 22-18 AWG inline butt splice (**Figure 10**).

Figure 10

Step 10: Center heatshrink tubing over inline butt splice and shrink with heat source (**Figure 11**).

Figure 11

Step 11: Center heatshrink tubing over microduct coupler (**Figure 12**) and heat with hot air gun, ensuring a weather proof seal, preventing water and dirt from entering duct (**Figure 13**).

Figure 12

Figure 13

Twisting Duct

Occasionally the duct retains the coil from being spooled when it is pulled off the reel. This is very easy to correct.

Installation Procedure

Step 1: Simply lay the duct along the desired installation path (**Figure 1**).

Figure 1

Step 2: Working from one end to the other, counter twist the duct in the opposite direction of the coil (**Figure 2**).

Figure 2

Pull String Insertion

There are times when the pull string may need to be re-installed into a microduct system either from breakage or if the pull string was removed from the conduit during microduct installation. If a pull string installation tool is not available, two alternative methods can be employed using either a shop vacuum or air compressor.

Method #1: Using an Air Compressor

Step 1: Take a 12 inch section of microduct and drill a 1/16" hole at a 45 degree angle approximately 1" from the end.

Thread the string through the hole and pull it out of the end of the microduct opposite the drilled hole (**Figure 1**).

Figure 1

Step 2: Tie a dart (this can be a piece of foam ear plug or a small piece of plastic bag) to the piece of pull string inserted through the duct. Insert through coupler and couple the section to the existing microduct (**Figure 2**).

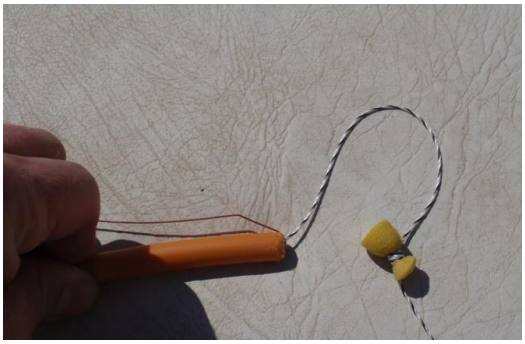


Figure 2

Step 3: Apply air through the end of the cut section of microduct and allow string to freely pull, keeping slack available where the string enters the drilled hole (**Figure 3**).

Figure 3

Method #2: Using a Shop Vacuum

Step 1: Tie a dart to the pull string (this can be a piece of foam ear plug or a small piece of plastic bag) and insert the dart into one side of the microduct (**Figure 1**).

Figure 1

Step 2: On the opposite end of the microduct, tape (using either duct or electrical tape) the hose of the shop vacuum to the bore of the microduct to suck the pull string through (**Figure 2**).

Note: *When re-inserting multiple pull strings, it is a good idea to create a quick release adapter using a 12" piece of microduct and coupler. Simply, tape or heatshrink the duct to the end of the hose or reducing adapter and attach a coupler to the opposite end.*

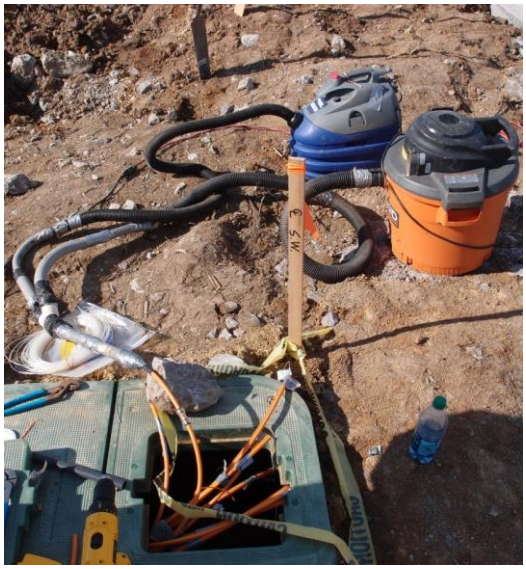


Figure 2

Testing “Proofing” Duct Pathway

There are many situations where the duct is installed independently of the fiber optic cable. The conduit may be installed during installation of the facility, but the fiber may be installed by another crew or may not be installed until the customer signs up for service. As a result, the conduit needs to be checked and verified to be able to accept a pushable fiber assembly prior to restoration during the duct installation. This method allows the microduct pull string to be utilized for testing and inserts a new pull string simultaneously.

Test Procedure

Step 1: Attach one end of a 4mm or 5/32” Conduit Test Mandrel to the microduct pull string and the other end of the mandrel to a reel of additional pull string.

Note: *Test each microduct pathway requiring its own installation run between pull boxes and access couplers should be checked independently. If a coupler in a coupled section will not be accessible after restoration, a longer pull string should be inserted between the connected microducts and the entire path be tested as a continuous pull pathway. If a pull string is not available, re-insert a pull string with either a pull string insertion tool or the method provided in this manual.*

Step 2: Pull the mandrel through the microduct to validate that the pathway can handle fiber installation.

Step 3: If the mandrel gets stuck during testing, mark the new pull string being inserted and remove the verification mandrel by pulling from the side the mandrel was inserted. Then measure the distance from the mark to the mandrel to local and troubleshoot the issue.

Step 4: Once troubleshooting has been completed, repeat steps **1 - 3** to verify the duct pathway.

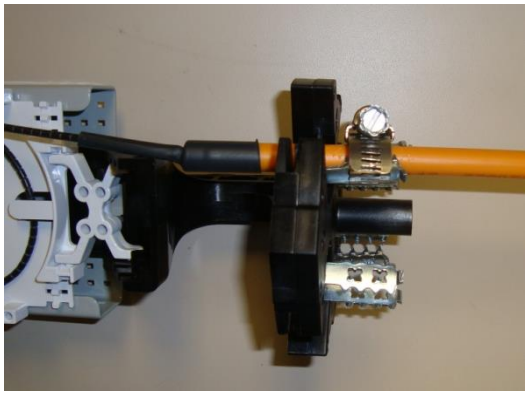
Step 5: After the microduct has been proofed and verified, fold the pull string over the edge of the duct and tape the string in place. Make sure to cap the ends of the duct with either an end plug or cap to ensure that debris and moisture do not enter the microduct bore.

Sealing the Microduct

Once the fiber has been pushed or pulled through the microduct, certain applications require the inner bore of the conduit to be sealed.

When using Direct Bury Toneable Microducts it is recommended to seal the duct to keep moisture, dirt, and other debris out of the microduct.

Also, some splice cases require the enclosure to be pressurized when sealed. The end of the duct must be sealed to prevent air from escaping because the microduct acts as a long tube, allowing the air to be release from the other side.



Note: *End Caps and End Plugs should be used to seal the microduct until the fiber is installed.*

Method #1 – Using Heatshrink

Step 1: Center a 4 inch section of heatshrink over the FieldShield microduct and fiber. Leave approximately 2 inches of heatshrink over both the microduct and fiber.

Figure 1

Step 2: Use a heat source to evenly heat the heatshrink. Heat from the end of the heatshrink covering the microduct and slowly work towards the fiber (**Figure 1**).

Note: *To achieve the best seal, rotate the heat source around the heatshrink in a spiral path. A little bit of epoxy should seep out of both ends of the heatshrink if the gel is properly heated.*

Method #2 – Using RTV Silicone

Step 1: After the fiber has been installed, fill the end of microduct with RTV Silicone. Make sure to fill approximately ½" to 1" of duct.

Step 2: Wipe away excess RTV Silicone and allow RTV to dry (**Figure 2**).

Note: *To remove a damaged assembly in the event of a repair, cut the microduct 1 inch from the end of the duct before installing a new FieldShield Assembly.*

Figure 2

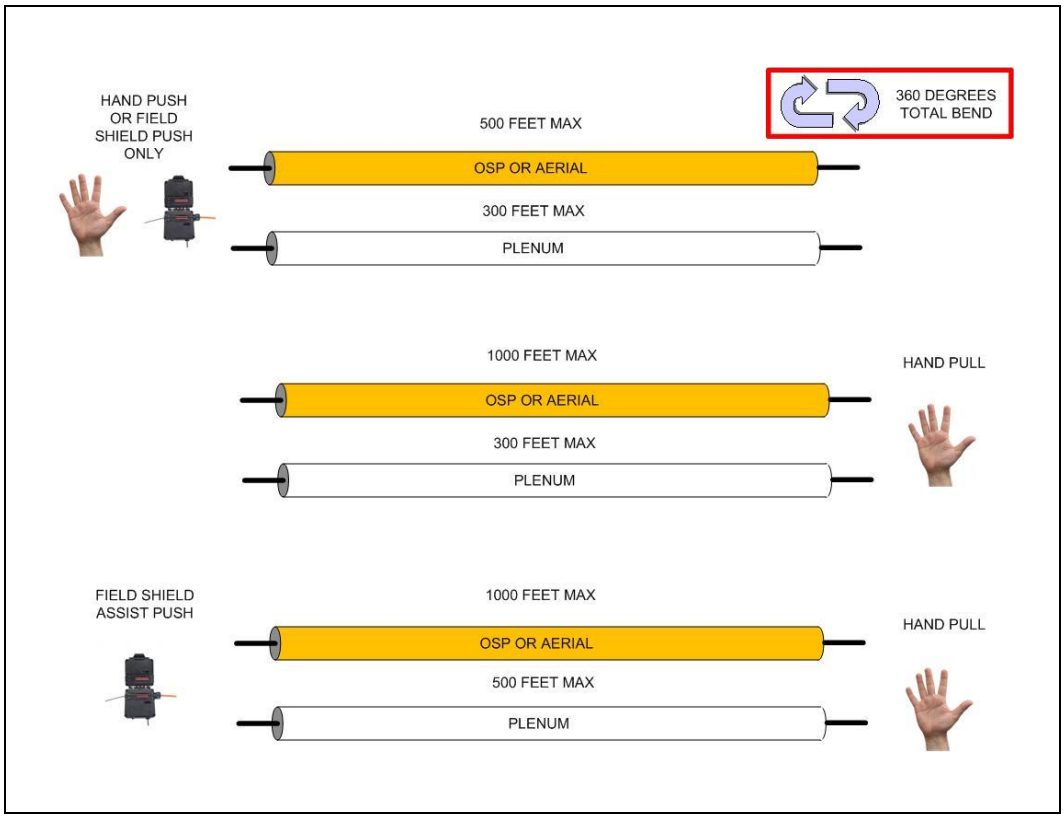
Fiber Installation

Clearfield's pushable fiber consists of a ruggedized jacket over various types and numbers of fiber optic strands. The unique coating provides greater protection for single fibers as well as a bundling compound for multiple fiber counts. The jacket also provides a smooth surface that glides into one of the microduct systems. Combining the slick inner surface of the microduct with the slick outer surface of the pushable fiber allows for installations using very little effort.

When do I pull, push or both?

Every situation is different, but as a general rule, it is typically easier to install fiber using a push and pull combination, rather than pushing or pulling by itself. By using a combination push/pull method, installers have access to the fiber from both ends of the microduct when troubleshooting.

Recommended Installation Distances



Note: *If a fiber gets stuck or snags during installation, the fiber can be pulled back a couple inches from the end being feed into the duct and re-pulled past the bind point. Sometimes the connector needs to be rocked past a snag point by carefully alternating pushing and pulling from both ends.*

Fiber Installation Best Practices

Whether pre-connectorized or not, here are a couple quick tips to use when installing pushable fiber into the microduct. These techniques have been used to install single fiber, connectorized fiber and multi-fiber assemblies at distances in excess of 500 feet.

Never Remove Protective Cover from Pushable Connectors Prior to Installation

If remove the protective plastic cover from a pre-connectorized pushable assembly before you place the fiber in the microduct, the connector acts as a sort of "cheese grater" down the length of the microduct. It will shave off the inner liner and then those particles bind around the fiber. In some cases, this causes the fiber to become stuck and usually results in a broken fiber.

Pulling is Faster than Pushing

While the fiber can be pushed in many instances, it can typically be pulled faster. With that being said, there are a couple of items that need to be addressed prior to pulling so the fiber can be installed without damage to the fiber or the connector.

Pull with Constant Pressure and Speed

This helps overcome the initial friction and allows for a smoother installation. You will probably notice as more fiber enters the microduct, the easier the pull becomes. This is because the fiber has a lower coefficient of friction than the pull string.

Maintain the Same Feed and Pull Rate on Both Ends

When using a push/pull technique, make sure to maintain the same rate of feed/pull on both ends. When pulling faster than pushing, you create the same effect that climbers use when rappelling. The fiber actually rubs on all the bends and, in effect, creates friction to the point where the fiber cannot move. The most common thing that happens here is that the pulling end feels the need to pull harder and the string breaks.

Note: *When you push faster than you pull, the fiber outruns the pull string and binds in the microduct. The effect is the same as pulling too hard and usually results in a fiber being stuck in the microduct or the string breaking.*

Attaching Pull String to Fiber

FieldShield Microduct comes preinstalled with a nylon pull string that can handle pull strengths up to 50 lbs. When attaching the pull string, never tie the pull string directly to the fiber or connector. This will cause damage to or pull the connector off. Also, never use tape over the string because the outside jacket of the fiber is slippery enough that tape usually comes off and clogs the microduct. Depending upon connector type there are two different methods to attach the pull string to the pushable fiber assembly.

Pre-Terminated Pushable SC and Blunt Drops

The first method uses a nylon pulling eye that slides over the end of the assembly and works with blunt drops as well as pre-terminated SC pushable assemblies.

Installation Procedure

Step 1: Slide the open end of the pulling eye over the plastic sheath of the SC Pushable Connector or the blunt end of the assembly (**Figure 1**). Make sure to push the assembly all the way to the end of the pulling eye and pull the pulling eye taunt (**Figure 2**).

Figure 1

Figure 2

Step 2: After the nylon pulling eye has been slid over the end of the cable, simply tie the pull string to the loop of the pulling eye (**Figure 3**).

Note: *When using SC Pushable Connectors, make sure to cut back the excess string left behind after tying the pull string to the pulling eye. Failure to remove the excess string can cause the connector to bind between the string and the microduct during installation.*

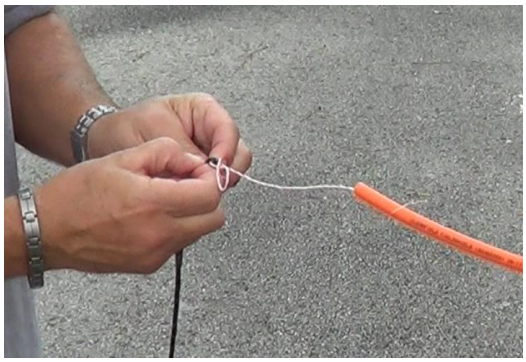


Figure 3

Pre-Terminated Pushable LC Drops

The second method uses a crimped pulling eye that was attached to the assembly during factory termination.

Installation Procedure

Step 1: Access the pulling eye by sliding the connector's protective sheath approximately 1" towards the opposite end of the assembly, stopping at the metal crimp ring.

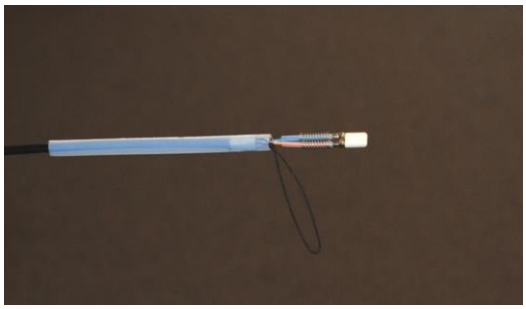


Figure 1

Step 2: Tie the pull string to the loop of the pulling eye and cut back the excess string left behind.

Note: *Do not to cut the string directly at the knot. Leave about 2 to 3 mms of excess string next to the knot.*

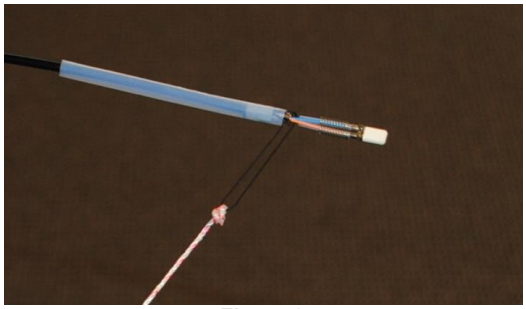


Figure 2

Step 3: Make sure that the springs are staggered one on top of each other then, push the protective sheath over the connector and knot from the pull string.

Note: *Failure to stagger the springs increases the width of the pushable connector, making it too wide to pass tight corners.*

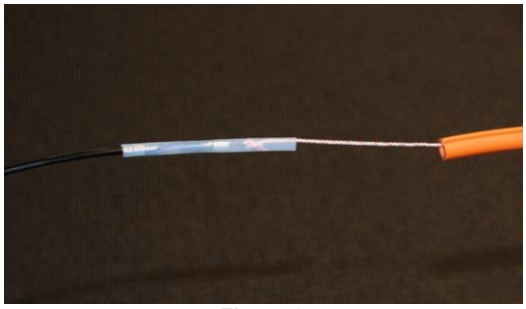


Figure 3

Terminating Fiber

Connector Cleaning

Regardless of whether pushable fiber assemblies are factory terminated or field spliced, clean connectors are essential for proper system operation. Even the smallest dust particle can cause transmission problems for the customer. As a result, for optimal network performance it is best to clean all connectors and adapters prior to mating.

Note: *Dust covers should never be removed until immediately before the connector is inserted into an adapter.*

The most widely used method in the industry to clean a connector is to wipe the connector ferrule with a lint-free paper or fabric wipe moistened with isopropyl alcohol. Isopropyl alcohol helps to dissolve any contamination that may be present on the ferrule. However, if the connector is allowed to air dry, any contaminates dissolved in the alcohol remain deposited on the ferrule after the alcohol evaporates. As a result, it is important to dry wipe the ferrule after cleaning with alcohol.

Installation Procedure

Step 1: To clean fold a lint-free wipe two to four plies high and place a couple drops of a 99% isopropyl alcohol on the wipe.

Note: *Make sure to leave a dry portion on the outside area of the lint-free wipe, so that the alcohol deposit is wiped from the connector during the cleaning swipe. Continuously rubbing the connector on a piece of dust could scratch the glass, causing permanent damage to the connector.*

Step 2: Holding the wipe in your hand, place the connector face in the center of the wet area of the wipe. Carefully slide the connector from the wet area to the dry area. It is best to repeat a couple times following a different swipe path each time.

Note: *Do not touch the connector ferrule with anything other than the lint-free wipe. Even the oils from your "clean" fingertips can contaminate the connection.*

Step 3: After adequately cleaning with alcohol, take a clean dry wipe and wipe the ferrule dry. Once dry, the connection should either be inserted into a termination port or re-capped with a dust cap to prevent recontamination.

Note: *Specialized solvents specifically designed to remove contaminates such as pulling lubricants and water blocking gels are also available. However, these solutions are not required because fiber installation does not require the use of assist lubricants.*

Additional Information

Many in the industry recommend dry methods, such as rubbing a lint-free cloth over the connector face in a figure-eight motion, as a first step in cleaning. Dry cleaning cassettes with an advancing tape and cleaning cubes or cards that dispense small single-use pieces of cleaning wipes are also available and can work well. Regardless of preferred method, properly cleaning the connector and adapter prior to initial mating can minimize the amount of troubleshooting later on.

SC Pushable Connector

Housing Assembly

Step 1: Remove the white protective dust cap from the unassembled connector (**Figure 1**).

Note: *The SC Pushable Connector has a keyed locking feature that holds the inner housing to the connector and aligns the ferrule when the two are correctly mated.*

To properly mate the connector, the key on the inner housing must bypass the ferrule alignment notch to properly lock into place.

Figure 1

Step 2: Align the black dot on the inner housing with the black line on the connector, then rotate the inner housing 45 degrees to offset the lock (**Figure 2**) and slide the inner housing half way over the connector.

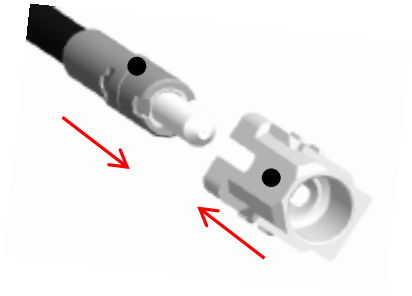


Figure 2

Step 3: Rotate counter-clockwise 45 degrees to realign the inner housing and connector and push the inner housing onto the connector until it snaps into place (**Figure 3**).

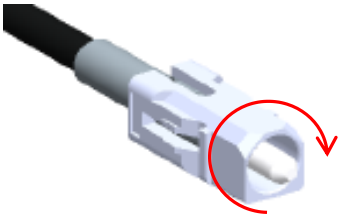


Figure 3

Step 4: Align the key on the outer housing with the black line on the connector, then slide the outer housing over the entire assembly until it snaps into place (**Figure 4**).

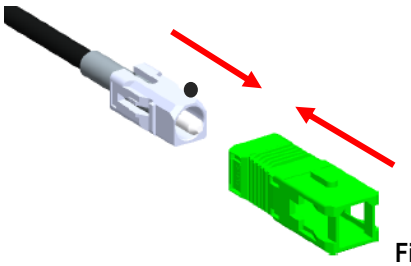


Figure 4

Step 5: Re-install the white protective dust cap (**Figure 5**).

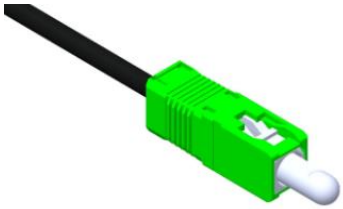


Figure 5

Simplex LC Pushable Connector

Connector Housing Assembly

Step 1: Remove protective dust cap and cut the pull string loop close to crimp (**Figure 1**).

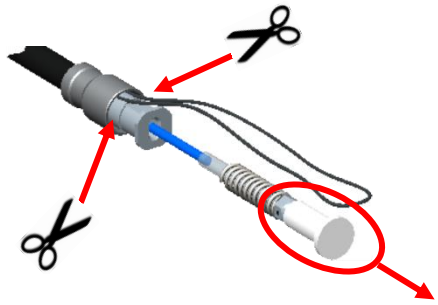


Figure 1

Step 2: A. Slide the inner clip over the fiber (**Figure 2**).

B. Align slot with housing latch and press together.

Note: *APC connectors will have dots on the ferrule to align with latch on housing.*

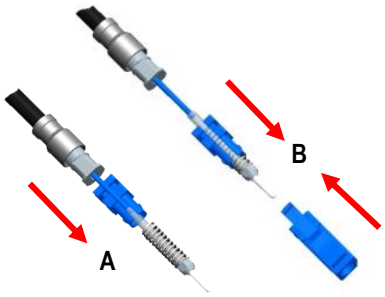


Figure 2

Step 3: Insert the cable crimp into the back of the lower body (**Figure 3**). Snap the connector into the front half of the lower body (**Figure 4**).

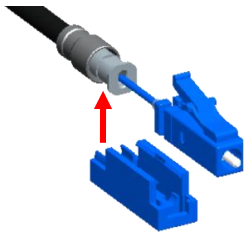


Figure 3

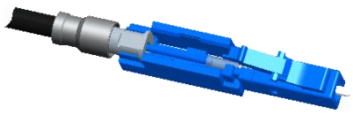


Figure 4

Step 4: Snap body cover onto lower half (**Figure 5**). Install the protective dust cap (**Figure 6**).

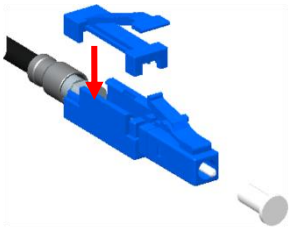


Figure 5

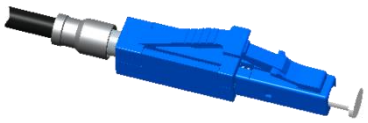


Figure 6

Duplex LC Pushable Connector

Connector Housing Assembly

Step 1: Remove protective dust cap and cut the pull string loop close to the crimp (**Figure 1**).

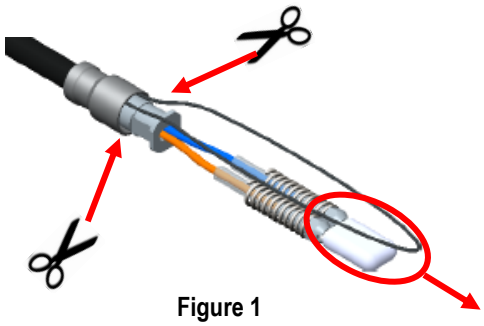


Figure 1

Step 2: A. Slide inner clips on the same colored fiber and over the springs (**Figure 2**).

B. Align slot with housing latch and press together

Note: *APC connectors will have dots on the ferrule to align with latch on housing.*

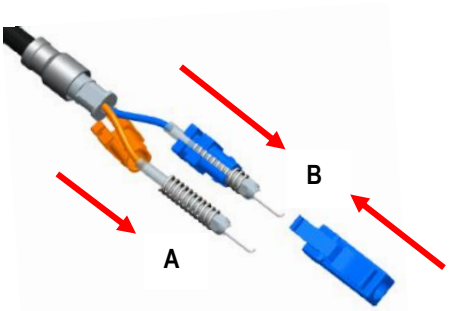


Figure 2

Step 3: Insert the cable crimp into the back of the lower body (**Figure 3**). Then, snap the connectors into the front half of the lower body (**Figure 4**).

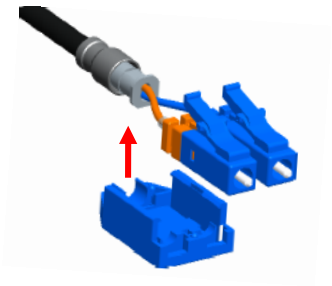


Figure 3

Figure 4

Step 4: Snap the body cover onto the lower half (**Figure 5**) and install the protective dust cap (**Figure 6**).

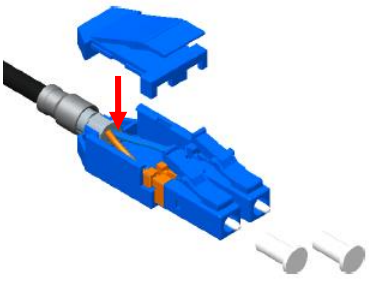


Figure 5

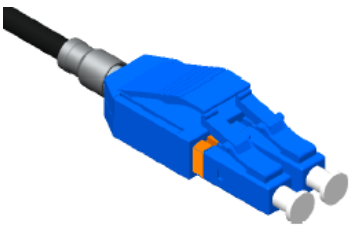


Figure 6

Fiber Polarity Switch

Step 1: Remove the top half of the body by prying the bottom half sides apart (**Figure 1**).

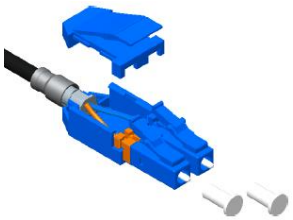


Figure 1

Step 2: Remove the lower half of the body (**Figure 2**).

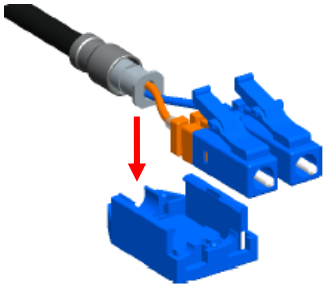


Figure 2

Step 3: Choose either a straight through or reversed polarity configuration and assemble the colored fibers as shown.

Note: *All pre-assembled Clearfield Dual LC connectors are factory configured as straight through.*

Straight Through

Reversed

Step 4: Snap the upper body cover onto the lower half of the body (**Figure 3**).

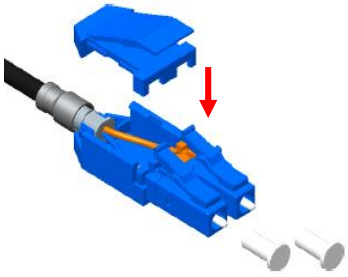


Figure 3

Preparing FieldShield Pushable Fiber for Splice-On Connectors

1-Fiber 250um FieldShield Cable

Recommended Tools / Parts List

- 1/8 Inch Adhesive Lined Heatshrink
- 900um Furcation Tubing
- 3-4mm Rotary Tube Cutter
- Snips/Cutting Utensil
- Isopropyl Alcohol /Cleaning Wipes
- Heat Source (Hot Air Gun/Blow Torch)
- Super Glue
- Ruler

Installation Procedure

Step 1: Determine the required 900um breakout length needed for your application and mark the FieldShield cable using an appropriate writing utensil (**Figure 1**).

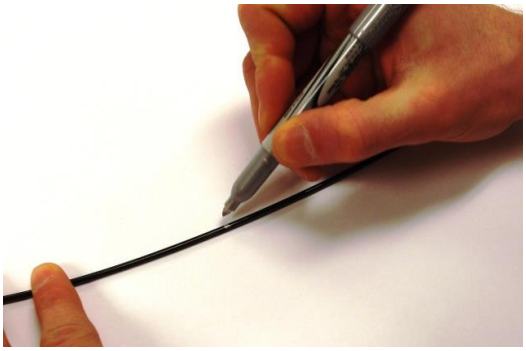


Figure 1

Step 2: Ring cut and remove the jacket using a rotary tube cutter available from Clearfield (**Figure 2**).

Note: *The jacket is removed using a score and snap process. Make sure that the rotary tube cutter blade has been adjusted so that it scores the outside of the jacket, but does not entirely cut through. Do not cut or nick the fiber.*

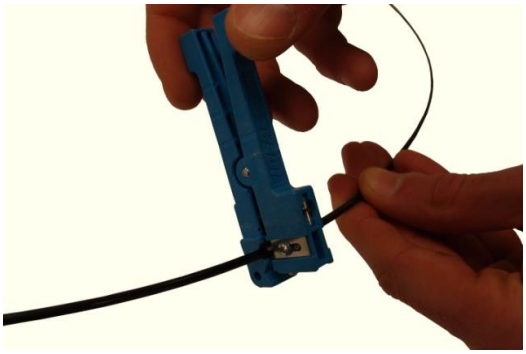


Figure 2

Step 3: Pulling from the cable, pull the 3mm jacket off in a straight line (**Figure 3**).

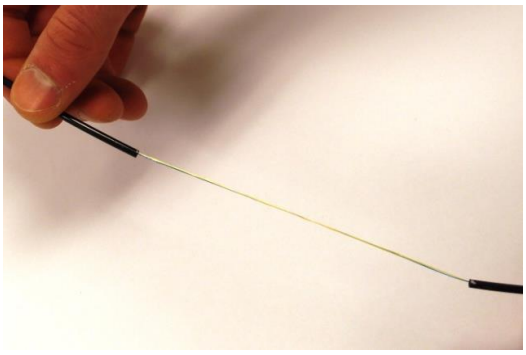


Figure 3

Step 4: Using a cleaning wipe and some Isopropyl alcohol, wipe clean the exposed 250um fiber (**Figure 4**).

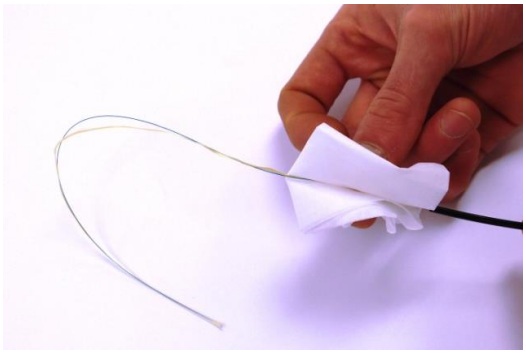


Figure 4

Step 5: Cut a piece of 900um furcation tubing 6" longer than the desired breakout. Mark the 900um tubing 6" from the end of the cut (**Figure 5**). This 6 inch mark will tell you how far to insert the 900um tubing into the 3mm cable.

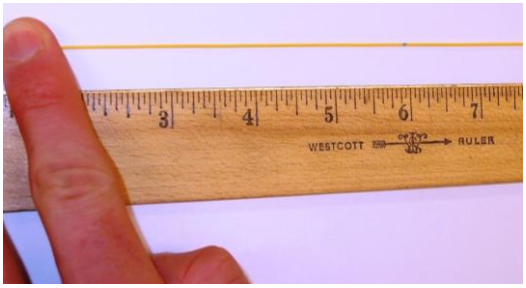


Figure 5

Step 6: Cut a 1" piece of 1/8" adhesive lined heatshrink (available from Clearfield), fold the Kevlar strength members back over the outside of the cable. Slide the heatshrink over the fiber and on to the outside of the 3mm cable holding back the Kevlar (**Figure 6**).

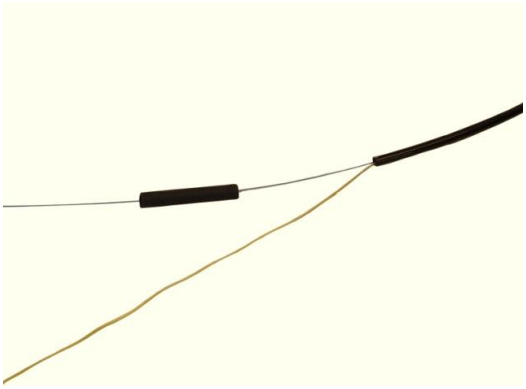


Figure 6

Step 7: Place heatshrink flush to the end of the cable and then apply even heat until the tubing is fully shrunk (**Figure 7**).

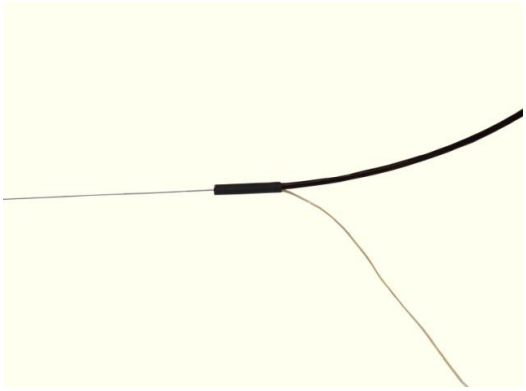


Figure 7

Step 8: Slide the 900um tubing over the 250um fiber inserting the 900um tube into the FieldShield 3mm cable (**Figure 8**).

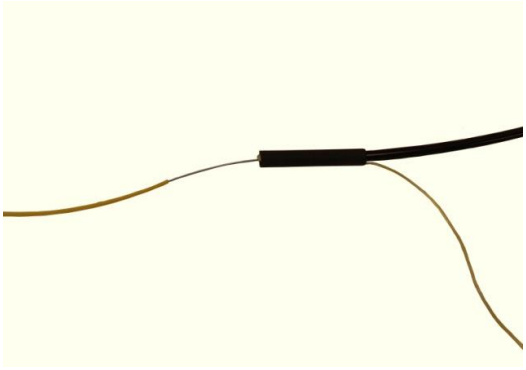


Figure 8

Step 9: Stop inserting the 900um tubing keeping the 6 inch mark approximately 1 inch from going into the 3mm cable as seen in (**Figure 9**).

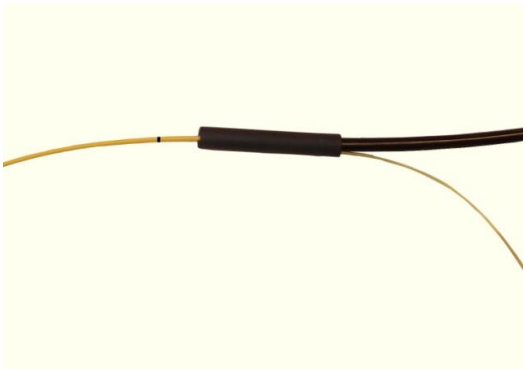


Figure 9

Step 10: Now apply a generous amount of super glue to the 900um furcation tubing between the FieldShield cable and the mark and then while rotating, slide the furcation tubing up to the 6 inch mark on the 900um tubing (**Figure 10**).

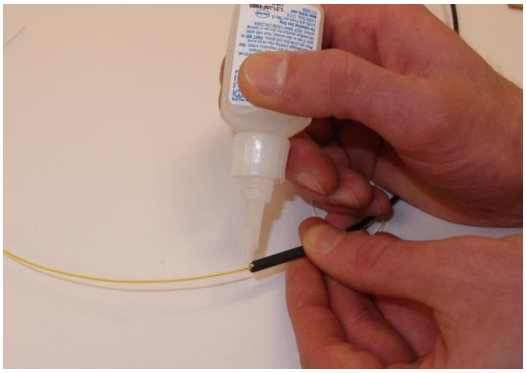


Figure 10

Step 11: Allow the glue to dry, and then trim the excess Kevlar strength members behind the heatshrink (**Figure 11**).

Note: *The CraftSmart Splice-On Connector can now be installed per standard instructions to the 900um furcated fiber.*

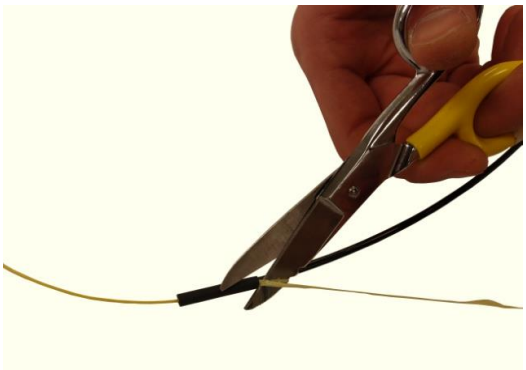


Figure 11

Preparing FieldShield Pushable Fiber for Splice-On Connectors

2, 6, and 12-Fiber 250um FieldShield Cable

These instructions detail the installation of 2, 6, and 12 fiber 900um furcation upjacketing kits. Each kit breaks out 250um fibers from a multifiber loose tube into individual 900um buffer tubes. The fiber can then be terminated using the 900um CraftSmart Splice-On Connector installation instructions.

Recommended Tools / Parts List

- Cover
- Base
- 24" 900um 2, 6, or 12 Fiber Terminal Assembly
- Heatshrink
- Heat Source (Hot Air Gun/Blow Torch)
- Electrical or Masking Tape
- Lint Free Wipes
- Indelible Marker
- Buffer Tube Stripper
- Gel Cleaner
- Needle Nose Pliers

Installation Procedure

Step 1: Locate and setup your work surface as close to the patch panel location as possible. This will minimize the strip length.

Step 2: Route the cable through the patch panel to the work surface.

Step 3: Measure backwards, from the end of the cable to the point at which it will attach to the patch panel, and add 39 inches (1 meter) to the length. Mark this length with a piece of tape. This is the strip point for the cable being terminated.

Step 4: Strip the cable back to the tape mark.

Step 5: Secure the cable to the patch panel.

Step 6: Clean any dirt and/or gel surrounding the loose tube.

Step 7: Select the first buffer tube and measure back 36 inches (90cm) and place a mark.

Step 8: Score the buffer tube and strip the loose buffer tube at the mark.

Step 9: Thread the heatshrink until it is flush with the end of the buffer tube and shrink in place.

Note: *Be careful not to melt or distort the tube due to excessive heat.*

Step 10: Tape the buffer tube to the work surface with 2 inches (50mm) overhanging the end of the work surface (**Figure 1**).

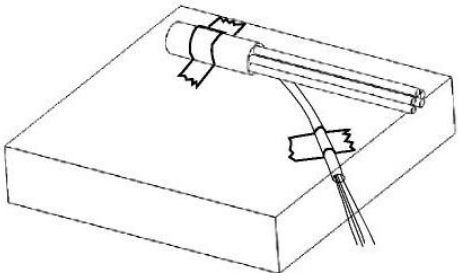


Figure 1

Step 11: Wipe all the gel from the exposed fibers using a gel cleaner.

Step 12: Place the buffer tube in the bottom of the furcation kit. Using pliers, press the tabs of the crimping fixture to hold the loose tube.

Note: *Crimp only enough to start to deform the tube. Twist and pull the terminal body to check if the crimp is secure. The tube should not slip or move in the crimp fixture.*

Step 13: Tape the terminal assembly in the vertical position 3 inches (75mm) to the side of the loose buffer tube (**Figure 2**).

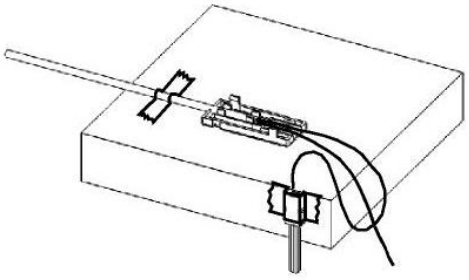


Figure 2

Step 14: Untangle the fibers and make sure they are completely free of gel filling compound.

Step 15: Talc the fibers to facilitate the threading operation. Cup the talc in the palm of your hand and apply along the whole length of the fibers.

Step 16: Select the blue fiber and thread 6 inches (150mm) into the blue tube of the terminal assembly (**Figure 3**).

Repeat this procedure for the remaining fibers, making sure the color coded fibers match the color coded 900um tubing.

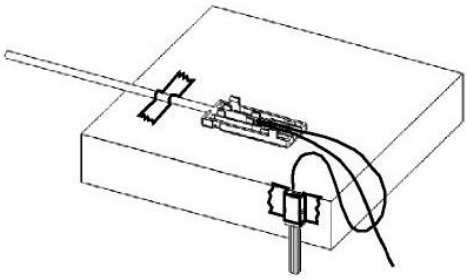


Figure 3

Step 17: When all fibers have been threaded, push the fibers as a group until the fibers start to protrude from the ends of the buffer tubes.

Step 18: Gently pull the fibers from the ends of the buffer tubing.

Note: *Do not pull the fibers taught. Leave sufficient slack so the fibers are not stressed.*

Step 19: Untape the buffer tube assembly and slide the assembly toward the loose tube while pulling the fibers from the end of the 900um tubing. If the fibers twist, rotate the terminal assembly in the opposite direction of the twist (**Figure 4**)

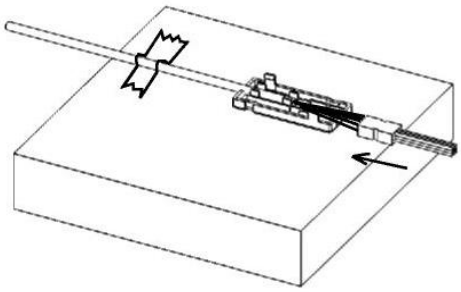


Figure 4

Step 20: Place the terminal assembly into the bottom of the terminal body. Align the top cover and snap into place (**Figure 5**).

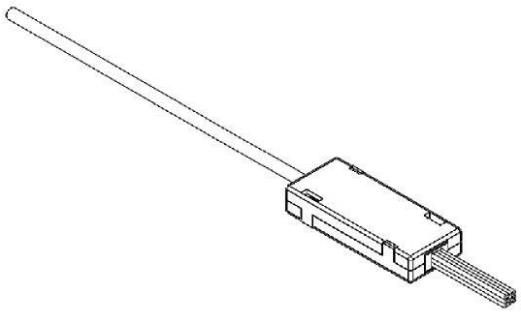


Figure 5

Step 21: Remove the tape from the loose tube and repeat this procedure for the remaining loose tubes.

Note: *The CraftSmart Splice-On Connector can now be installed per standard instructions to the 900um furcated fiber.*

CraftSmart Splice-On Connectors

Safety Precautions

- Please read and follow all fusion splicer manufacturer recommended procedures concerning splicing operation and precautions.
- Safety glasses should be worn when handling cleaved fibers. Cleaved fibers are sharp and can pierce eyes, skin or clothing.
- Never look into the end of a microscope or optical cable connected to an operating optical output device. Laser radiation is invisible, and direct exposure can severely injure the human eye.

Note: *Before starting this process, completely read through the entire installation document. If the splice machine you are using has a tensile test option, be sure to shut this option off on your machine.*

Recommended Tools/Parts List

1. Fusion Splicer
2. Cleaver
3. Jacket Ringer and Stripper
4. Kevlar Shears
5. Fiber Stripper
6. Splice Holders for Splicer
7. Marking Pen

Installation Procedure

Step 1: Remove the connector and components from the individually packaged tube.

Step 2: Separate all the parts and identify the parts you will be using for your application.

- Dust Cap with Handle
- Outer Housing
- Inner Housing Connector Assembly
- Fusion Splice Protection Sleeve
- Strain Relief Boot

Step 3: Remove the dust cap from the connector sub-assembly and put aside for later use (**Figure 1**).

Figure 1

Step 4: Remove Install the dust cap with the handle on to the ferrule (**Figure 2**).

Figure 2

Step 5: Carefully remove the fiber protection cover from the back side of the connector (**Figure 3**). Do not to touch the stripped end of the fiber or let anything bump against it.

Note: *The Fiber is already stripped, cleaned and cleaved to the exact dimension needed.*

Figure 3

Step 6: Insert the connector sub-assembly in to the fusion splice holder, making sure the fiber sits into the center of the fiber groove (**figure 4**).

Figure 4

Step 7: Following the splice machines instructions carefully insert the splice holder with the connector inside of the holder into one side of the machine (**Figure 5**). Using extreme caution, do not touch or bump the stripped fiber against anything.

Figure 5

Step 8: Insert the Strain Relief Boots narrow end first on to the 900um fiber that you will be splicing to.

Step 9: Insert the Fusion Splice Protection Sleeve on to the 900um fiber after the Strain Relief Boot.

Step 10: Following the Fusion Splicer's manufacturers recommendations strip the fiber to length.

Step 11: Place the fiber in the splice holder.

Step 12: Clean bare fiber with clean wipe and alcohol.

Step 13: Cleave the bare fiber to 10mm. If the cleave length is too long it will not be protected in the Splice Protection Sleeve.

Step 14: Following the splice machines instructions carefully insert the splice holder with the 900um fiber into the opposite side of the machine. Using extreme caution, do not touch or bump the stripped fiber against anything.

Step 15: Following the Fusion Splicer's manufacturers procedure splice the connector to the fiber.

Step 16: Once the splicer has completed the process and you are satisfied with the results, carefully slide the protection sleeve up to the fiber holder and remove the fiber and connector from the splicer.

Step 17: Slide the protection sleeve toward the connector centering it over the stripped bare fiber splice (**Figure 6**).

Figure 6

Step 18: Insert the fiber and protection sleeve into the protection sleeve oven with the connector all the way to one side of the oven keeping it out of the oven as the best as you can (**Figure 7**). If you cannot close the ovens cover then you can lay the splice protection holder over the protection sleeve to help keep the heat inside.

Note: *If the splice protection sleeve is not shrunk down all the way then you can run the heat cycle again. You may want to increase the ovens time duration if this continues to happen.*

Figure 7

Step 19: Slide the Strain Relief Boot up to the back of the connector and snap in place.

Step 20: Replace the dust cap with handle back to the original dust cap.