![ofs A Furukawa Company logo]

Your Optical Fiber Solutions Partner®

InvisiLight® MDU Solution with InvisiLight Multifiber Cord

Installation Instructions

Revision 2.0

Contents

1.0 System Overview

The OFS InvisiLight® MDU Solution enables nearly invisible and fast fiber placement up risers and down hallways to reach living units in MDU buildings. OFS' InvisiLight ILU (In Living Unit) Solution sold separately, can enable virtually invisible, fast, and plug and play connections inside the living unit to the subscriber's Optical Network Terminal (ONT).

The InvisiLight MDU Solution consists of the InvisiLight Multifiber Cord which contains twelve EZ-Bend® optical fibers and is only 2mm in diameter. It is shipped on a spool with factory mounted OFS connectors (choice of MPO, SC, or LC) on the network end, or un-connectorized. The InvisiLight Multifiber Cord is adhered into place, and mechanical connectors or fusion spliced pigtails are field installed inside a point of entry (POE) module placed outside or inside each living unit. From that module, the InvisiLight ILU Solution can be installed to connect the subscriber to FTTH services.

The InvisiLight Multifiber Cord can be installed directly from the Main Distribution Frame (MDF) at the building entrance, up the riser and down the hallway or can connect to the riser in the telecommunications closet on each floor. Individual fibers are selected from the InvisiLight Multifiber Cord at each living unit to connect to the InvisiLight ILU Solution inside the living unit.

InvisiLight® ILU Solution in living unit

n a typical MDU residence — Bend Number

Module

Jumper to ONT

InvisiLight MDU Cord

Virtually Invisible within Crown Molding

InvisiLight SC-A Assembly

InvisiLight MDU Solution passes each living unit
- InvisiLight 12 fiber cord in riser and hallway
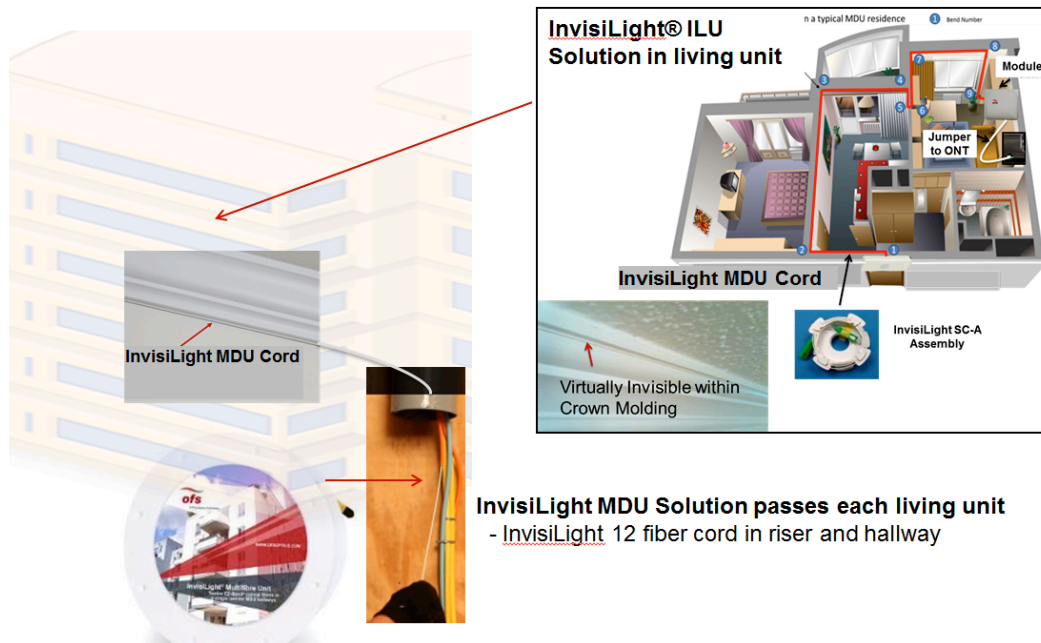
A completed InvisiLight MDU Solution hallway installation is shown below

2.0 Tools and Components

2.1 Adhesive and Installation Tool (sold separately)

Adhesive tube and nozzles

Installation tool with tube of adhesive

Mid Span Entry Tool – Jonard MS-6

2.2 System Components

InvisiLight Multifiber Cord, on a spool with factory installed connectors.

Plastic Clips, removable after use

Wall Hole Cap and Plug
Note the MDU cap is different from the single fiber cap as the cap has two port holes
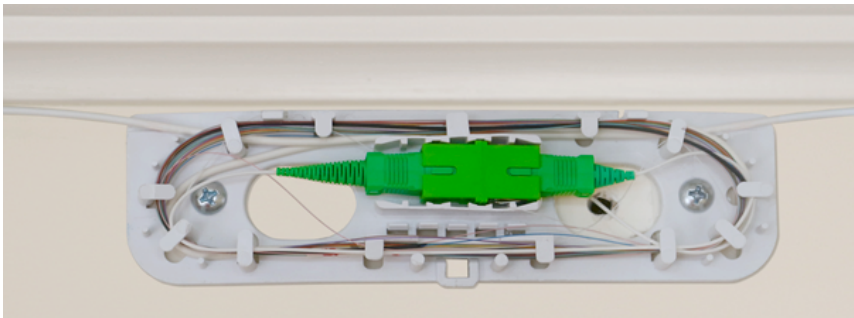
Inside and Outside Corner Protectors

Point of entry modules

Large POE module base with SC-APC adapter   POE module cover
133.35 X 63.5 x 19.56 mm (5.25x2.5x.78")

Compact POE module base
152.4 x 40.6 x 15.88 mm (6.00 x 1.60 X .625")

Note: The Compact Point of Entry module allows re-positioning of the adapter to accommodate the long boots of splice-on-connectors when used.

2.3 Additional helpful tools

The following tools can be helpful during an installation. They can either be assembled by the installer or purchased as a kit from OFS.

10mm (or 3/8") Drill Bit
10mm (or 3/8') x .46m (18") Drill Bit
Apron
Container (briefcase)
Head-mounted Flashlight
HeNe test light
Gloves or Finger Cots
Popsicle Sticks
Wooden Skewers, toothpicks, or dental picks with a pointed end
Scissors – heavy duty
Screwdriver – Slot and Phillips head
Side Cutting Long Nose Pliers
Tape measure
Painter's Tape
Utility knife
Moistened wipes or wet rags
Ziplock bags

3.0 Adhesive System Overview

3.1   The InvisiLight engineered adhesive is a water-based indoor adhesive, tested to be fully compatible with the InvisiLight Multifiber Cord. It provides a water-resistant bond without chemical smells, is acid-free, dries clear, and cleans up immediately with soap and water. It is non-flammable, flexible, water resistant, and not considered hazardous by the OSHA Hazard Communication Standard, (29 CFR 1910.1200 United State Occupational Safety). It is not toxic as defined by the US Federal Hazardous Substance Act. Safety goggles or safety glasses with side shields and latex gloves or finger cots are recommended personal protective equipment. A Material Safety Data Sheet (MSDS) is available from OFS upon request.

3.2   Recommended installation surfaces: Most common construction materials, brick, wood, dry-wall, plaster, wall paper, fabrics and painted surfaces. Not recommended for use on or with metals that will corrode, mirrors, natural marble (could stain)**,** polyethylene, and polypropylene, Nylon™ or Teflon™.

3.3   Installation conditions
- Store adhesive tubes above freezing
- Surfaces should be clean and dry
- Application temperature >10°C (50°F)
- Set Time and repositioning: 20 minutes.
- Dry time: 1 to 24 hours (depending on thickness)
- Dries clear within 1 – 3 hours depending on thickness.

4.0   Installation Procedure

Note: It is important to read the entire procedure before beginning installation.

4.1 Survey Route and Determine Placement Strategy

4.1.1   Identify location of the fiber entry point for each Living Unit to be passed, usually above or near a doorway in the hallway or in a closet near the doorway inside the Living Unit.

Typical fiber entry point
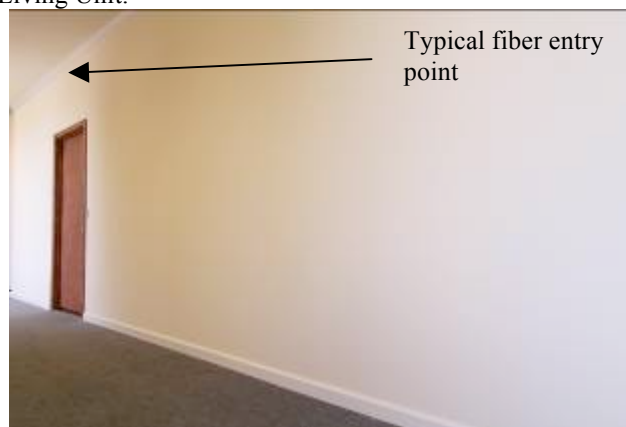
4.1.2   Determine the desired placement route past a maximum of 12 living units. The placement route is typically hallways on a floor. The route may also include

4.1.2.1 Riser spaces between floors
4.1.2.2 Grooves between ceilings and walls, ceilings and crown molding, walls and crown molding, vertical groove between 2 walls, and walls and door molding.
4.1.2.3 Across ceilings
4.1.2.4 Through walls
4.1.2.5 Through firewalls if the cord is placed inside an UL or country specific riser rated duct and proper fire stop material is placed.

Any combination of the above routing paths is acceptable. Routing the fiber adjacent to the ceiling or crown molding may require the use of a ladder in most cases. In the case where the module is located in the living unit, validate the location with the subscriber for the fiber entry and module. In instances where there are more than 12 living units per side or floor, additional InvisiLight Multifiber Cords can be installed.

4.1.3 Measure and record the length of the placement route and number of inside and outside corners. Include any length to be placed in a riser rated micro-duct and to reach an enclosure on the network end. Refer to the data sheet for the maximum number of outside corners supported by the InvisiLight Multifiber Cord.

4.1.4 For a factory connectorized InvisiLight Multifiber Cord, select an assembly at least 60 feet (18 meters) longer than the measured length of the placement route. This will account for the 41 feet of slack to be stored in 12 POE modules, plus any measurement errors.

4.1.5 For un-connectorized InvisiLight Multifiber Cord, the cordage can be cut to the desired length required after the installation is complete.

4.2 Mount the POE modules

4.2.1 Secure each POE module to the wall with screws or double sided tape, at the pre-identified fiber entry point for each living unit. Do not snap on the POE module cover until the installation is complete. For the situations where all customers are connected at the same time or the POE module is inside, the hole through the wall from the hallway into the living unit may be drilled at this time. Remove the adapter before drilling the hole (replace when finished), so debris from the hole drilling process does not enter the adapter. When customers are connected later, the hole may be drilled later when needed.

Splice holder

Point of Entry module pre-installed on a wall

Note that the splice holder is on the bottom section of the module and can support two splices.

4.3 Prepare the pathway

4.3.1 Wipe down the pathway with a clean soft dry cloth to remove heavy dust and dirt. If grease or oil is discovered in the pathway, seek a new pathway avoiding the grease or oil (and adjust the pathway measurement as needed), or get permission to clean the grease/oil using a company approved solvent.

4.3.2 Drill holes as needed using a 3/8" (10 mm) drill bit to later pass the cord through walls, for example between the Telecom Closet and hallway.

4.3.3 As the pathway is wiped, install corner protectors on **all** outside and inside corners, as shown below.

4.3.4 Place clips above each doorway to hold the cord off the floor so it is not stepped on and damaged, and is positioned closer to the ceiling to speed installation. The smaller clips shown below can be removed from wall surfaces and re-used.

InvisiLight Multifiber Cord supported by a clip above a doorway before it is adhered to the wall

4.4 Place the InvisiLight Multifiber Cord along the route (Preterminated Version)

4.4.1 Place the InvisiLight MDU cord assembly spool at the location where the terminated end will be plugged into an FDH or interconnect enclosure. Unspool the InvisiLight Multifiber Cord and gently pull it (12 lbs. /5 KG force maximum) along the selected route and over the clips. Be sure to push the cord through any holes or behind obstacles as it is placed along the route.

4.4.2 For riser installations, pull or blow the Cord into a pre-installed, riser-rated duct. The rating for the InvisiLight Multifiber Cord is "OFNR / FT-4". In between floors, through firewalls, or when not adhered to a supporting surface, it must be placed inside a duct. If there is a need to pull in a riser duct with tensions greater than 12 lbs., tie all of the aramid yarn at the end of the cord to the pulling device

or string, and pulling forces of up to 22 lbs. may be used.
Note: OFNR/FT4 is a US /Canadian Standard

4.4.3   To avoid potential damage, the cordage should be installed by pulling directly on the aramid strength members. To attach the aramid yarn to a pulling line when installing the cable through interior walls or conduit snip off about 12-18 inches of the outer jacket exposing the aramid yarn. The jacket can be removed using conventional wire strippers.

4.4.4   Cut the exposed fiber so that it will not tangle with the jacket when pulling. Twist the aramid strands together into a single bundle. If desired, tape the end of the bundle to hold the aramid strands together. Tie the aramid strands to the pulling line using a fisherman's knot or bowline. Wrap the knots with vinyl tape and the cord is now ready to pull.

4.4.5   The cordage will be pulled to the farthest POE. Position an empty spool at the farthest POE to take-up any slack that may needed as the loops are placed at each POE along the path. The slack will be cut off after the installation is completed and saved for any future rework that may be needed.

InvisiLight MDU Cord taken up on an empty spool after it is pulled through the route

4.4.6   Take up at the opposite end from the pay-off reel onto an empty spool.
Note that some portion of the cord may be pulled back off of the spool as storage loops are placed in each of the POE modules. For routes up riser conduit, it can be helpful to station someone at the opening of the conduit to make sure the Cord does not get hung up and experience excessive crushing or tensile forces.

4.5 **Place the InvisiLight Multifiber Cord (Bulk Cord Version)**

    4.5.1   For bulk cord versions, if the hallway is clear of obstructions that the Cord must pass behind, and free of holes the Cord must pass through, the Cord can be paid out and placed along the route directly from the reel starting at the unit furthest from the telecom closet. This is analogous to the "moving reel" method used to install outside plant cable. Do not cut the cord after it is placed, as additional length may be required as the cord is adhered into place.

    4.5.2   If the hallway is not clear of obstructions or holes, the method highlighted in section 4.4.1 and onward should be used.

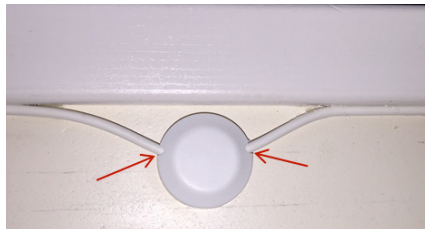**4.6 Adhere the InvisiLight Multifiber Cord along the route**

    4.6.1   **Preterminated Version** - Starting from the <u>floor telecom closet enclosure toward the living units</u>, apply a <u>small, approximately 1 mm bead,</u> of engineered adhesive, as shown below along the route until the first POE module is reached.

    4.6.2   **Bulk Cord Version -** Starting from the <u>living unit farthest from the floor telecom closet, toward the floor telecom closet,</u> apply a <u>small, approximately 1 mm bead,</u> of engineered adhesive, as shown below along the route until the first POE module is reached.

    4.6.3   Pull an index finger or the end of a popsicle stick along the path over the cord while gently pressing it in to the adhesive <u>up to the first POE module</u>. Nitrile gloves or a finger cot should be worn to avoid skin contact with the adhesive. Have a clean wet rag nearby to clean up excessive adhesive along the way if needed. At every outside and inside corner be sure to press the InvisiLight Multifiber Cord into the slots of each pre-installed corner protector. If a corner protector is missing from any corner, stop the InvisiLight Multifiber Cord placement, press-on a corner protector at that corner, and resume placement. If bending the InvisiLight Multifiber Cord on an open wall, maintain at least a 5 mm bend radius. Be sure to press the cord into the adhesive less than 20 minutes after the adhesive is placed.

4.6.4   Coil 3 wraps (about 41" or 104 cm) in the POE module as shown below. Note that 4 wraps are at the top and 3 at the bottom.
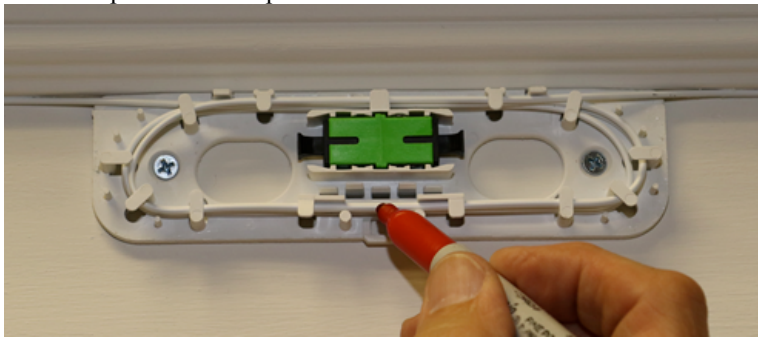

4.6.5   In the case where the POE module is located *inside* the living unit, loop the InvisiLight Multifiber Cord through the pre-drilled hole and then place both sections of the loop through the wall plug. Carefully place the cap on the plug so that the entering and exiting legs of the Cord are each aligned with one slot in the cap as shown. The "Through Wall" tool can be helpful in assisting this process.

4.6.6   Repeat the process of applying adhesive, adhering the InvisiLight Multifiber Cord to the wall, and grooming 3 wraps of slack in each POE module as previously described, until the InvisiLight Multifiber Cord has reached the last POE module (Preterminated version) or reached the Telecom Closet enclosure (Bulk Cord version).

4.6.7   Bulk Cord version – once the Telecom closet or MDF enclosure is reached, assure these is sufficient slack to enable terminating the cord into the enclosure (3 to 6 feet or 1 - 2 meters), then cut the cord, and strip the jacket and cut the aramid yarn, and terminate the fibers in the enclosure via fusion or mechanical splicing, fusion spliced pigtails, splice on connectors, mechanical connectors.

4.6.8   Preterminated version - Any excess cordage can be cut after the last POE module (furthest from the Telecom closet) is groomed.

4.6.9   Back at the enclosure in the floor telecom closet or MDF, carefully clean the connector end-faces and plug the connectorized ends into approved adapter(s) inside the enclosure. Allowing room for the connectorized ends to float freely, use painter's tape to secure the InvisiLight Multifiber Cord to a surface of the enclosure. Plug all of the connectorized ends into the adapters to avoid any accidental light exposure to the technician.
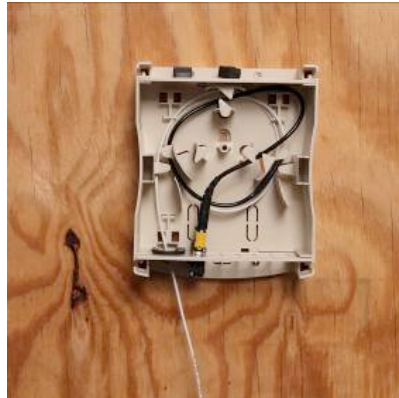
MTP terminated InvisiLight Multifiber Cord plugged into Slimbox 12 fiber MDU terminal Options for SC and LC are also available.

4.7   Connect a customer

4.7.1   Create path into the living unit from the hallway. Drill from the module into the living unit (or from the living unit into the hallway if the module is located in the living unit), using a 3/8" (10mm) drill bit. **CAUTION**: Prior to drilling, check to be sure there are no electrical wires, pipes, or other obstacles that may be in the path of the drill. If obstacles are present, move the hole location to where no obstacles exist. Remove the adapter from the point of entry module before drilling the hole, and replace after cleanup. Clean up debris resulting from the drilling process on both sides of the wall.

Note: If the customer installation is not taking place at the time of the InvisiLight Multifiber Cord installation then the slack is stored
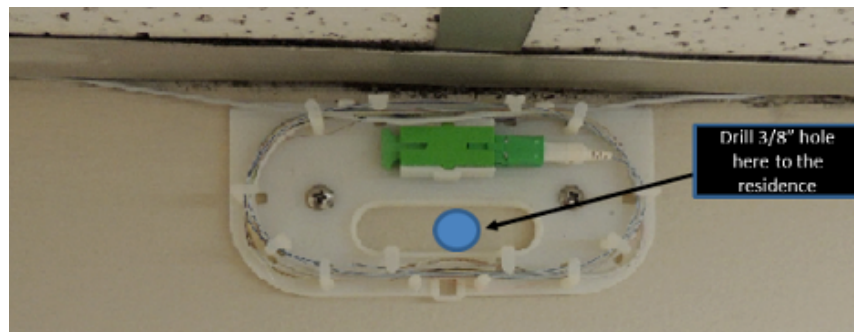
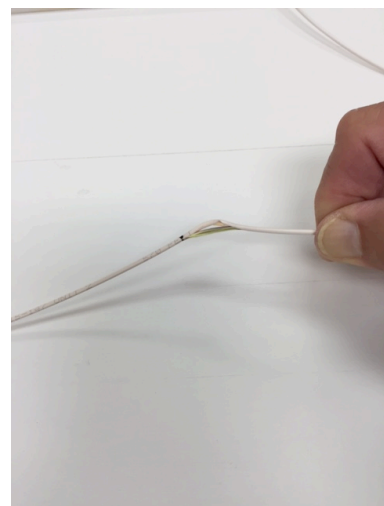4.7.2   Using a marker, mark the 3 wraps at the bottom of the point of entry module as shown in the red circle below.
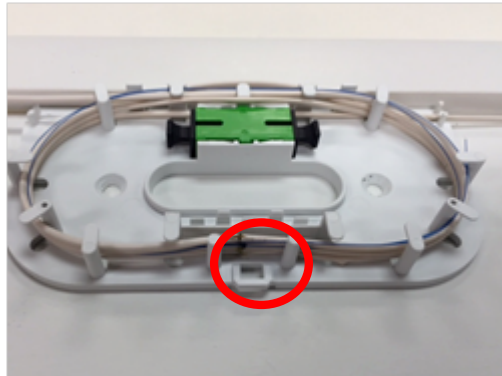
4.7.3   Unloop the Cord from the POE as shown below. Note the marks on the Cord as shown below.

4.7.4   Using the Jonard tool, place two slits 1 inch in length at each end of the loop, starting at the marks and moving toward the center. Using the thumb and index finger to smooth the jacket from the right slit to the left hand slit the jacket. This opens the left slit allowing ease of access to the fibers.

4.7.5   Separate and cut the desired fiber <u>at the slit farthest from the telecom closet.</u>
Using a popsicle stick can be helpful to serve as background for the fiber and
aramid. Each fiber is a different color to ease this process. Using a wooden or
metal pick separate the fiber needed, cut the fiber, and pull back the fiber from
the jacket. Prep the fiber for a mechanical connector, pigtail splice or splice on-
connector. The color code scheme is blue, orange, green, brown, slate, white,
red, black, yellow, violet, rose and aqua.
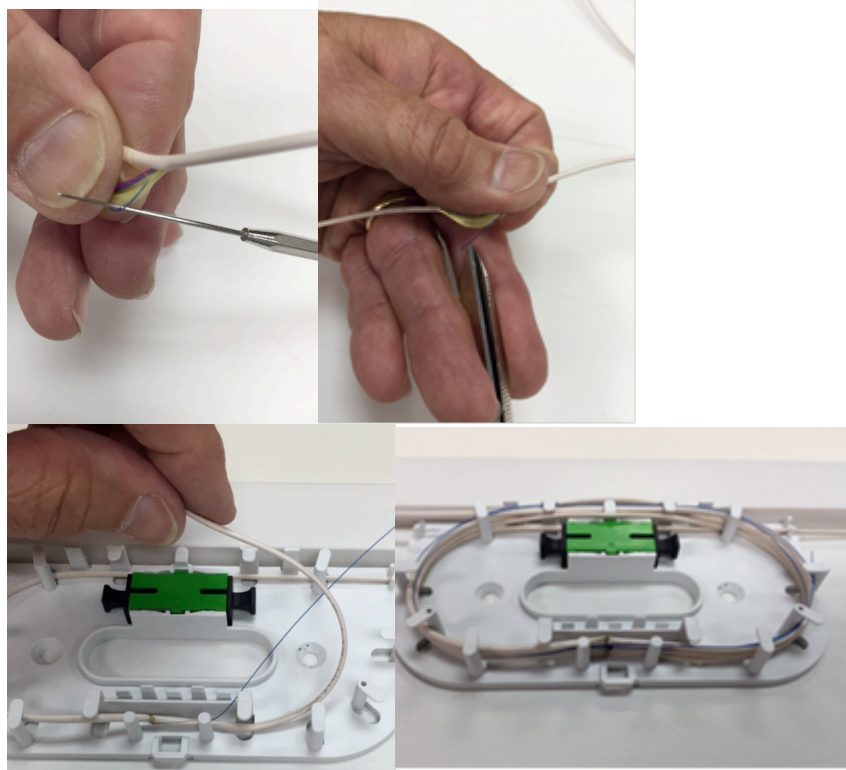
Making the connection to the in-residence InvisiLight ILU Solution

4.7.6   When the POE module is installed in the hallway, use the "Through Wall" tool to push the ILU connector from the living unit through the wall hole until the connector is at the entry location in the living unit module. Push through enough of the ILU fiber to store at least 1 loop of slack in the fiber management tabs.

4.7.7   Snap green grip on to connector. Grip key and beveled corners of white connector body should be facing up. An audible click will be heard as grip is fully seated. Grip should slide back and forth after placement onto the connector. Remove dust cap and Plug connector into the adapter in the POE module.
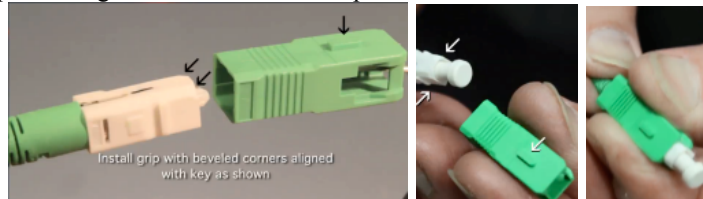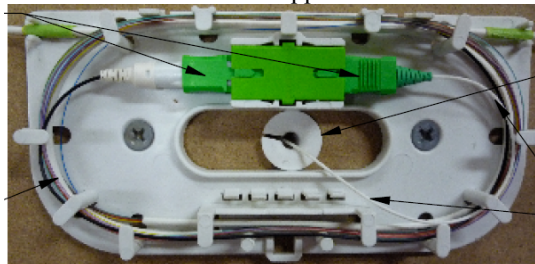

4.7.8   Install wall plug and cap in the living unit.

Note: Properly aligning the fiber and the cap slot prevents fiber breakage.

4.7.9   The finished POE should appear as shown and is ready for testing


POE Module base fully assembled

Note: Follow company, state, and country practices and codes for fire protection material. Walk through the installation for a final check of the installation using the adhesive for touch-ups to completely adhere the InvisiLight Multifiber Cord to the wall or ceiling.

5.0 Testing and Final Assembly

5.1 No active OLT - Use a power meter to record optical insertion loss of the installed InvisiLight Multifiber Cord using company established testing procedure, between the point of entry module adapter and the fiber entry point adapter.

5.2 Active OLT

5.2.1 Option A – Measure the received power (dBm) at the fiber entry point adapter (network facing adapter) and at POE Module adapter and the difference is the insertion loss of the InvisiLight ® Multifiber Cord

5.2.2 Option B –Connect an EZ-Bend Jumper from the Point of Entry Module to the ONT. If the green light on the ONT is illuminated, installation passes testing.

5.3 Place cover onto module.

5.3.1 After installing the mechanical connector to the living unit connector place the cover over the Point of Entry module.

SQUEEZE HERE TO DISENGAGE BOTTOM LATCH TO REMOVE COVER
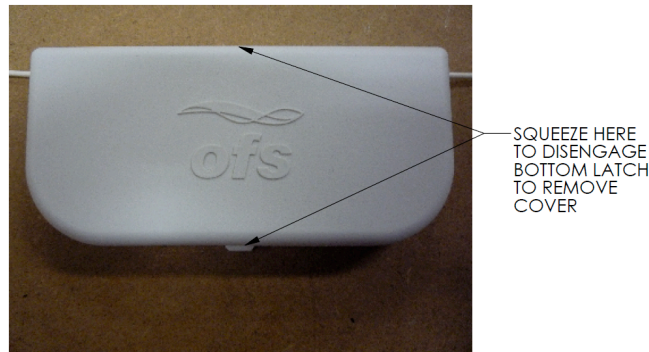
10. - 11.   ATTACH COVER TO MODULE BASE

6.0 Trouble-shooting and Repair

6.1.1 If test results show excessive loss, inject a "red light" into the connector on either end of the InvisiLight Multifiber Cord and the red light will visibly leak at any point where excessive loss or a fiber break exists.

6.1.2 If the fiber is broken in a section more than about 0.5 meters (1.5 feet) from a connector, replace the InvisiLight Multifiber Cord.

6.1.3 If the fiber is broken in a section less than about 0.5 meters (1.5 feet) from a connector, cut off the connector and replace it with an OFS fusion splice-on, OFS mechanical connector, or other company approved field installable connector

6.1.4 If all of the fibers are broken take a small section of InvisiLight Multifiber Cord and using the splice repair module splice the small section at the break point. Splice module depicted below. Note: The repair module is a regular sized POE module and is not available for the Compact POE

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