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Fiber SenSys®
PERIMETER SECURITY

Standard Installation

FD500 series APUs

Application Note

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Contents

1. Introduction

This application note will instruct the reader on the proper methods for installing the entire cable assembly including: lead in cable, trunk cable, sensing cable, distribution box and breakout boxes.

Prior to installing the **Alarm Processing Unit** (**APU**) and deploying the sensor cable, the site to be protected must be assessed carefully so that all security needs are met and all potential threats against it are accounted for. Refer to **AN-SM-036 FD500 Series – Site Design and Assessment** for detailed information on how to properly assess a site, and how to design an **FD500** series system.

Ultimately, the method by which the sensor cable is installed and deployed is up to the end user. Fiber SenSys does not mandate one particular installation design over another; however, the general procedure for installing the fiber optic perimeter security system is as follows:

1. **Assess:** Survey the site to be protected and record all information needed for the site design phase

2. **Design:** Create a strategy for protecting the site. This includes planning the level of security, choosing the location of the APUs, provision of electrical power, and planning cable routing

3. **Install:** Proper deployment of the fiber optic sensor and correct installation of the Fiber SenSys system

2. Installing the Cable Assembly

The cable assembly is built on site; that is, the components are assembled in place along the secure perimeter. Assemble and install the cable assembly as follows.

CAUTION: Some components of the cable assembly are extremely fragile. Pulling on the sensor cables at any point with greater than 60 lbs. force can break optical fibers.

NOTE: The cable assembly should be installed only by Fiber SenSys personnel or technicians trained and certified by Fiber SenSys. The following pages describe the general procedure used to build and install the cable assembly.

The following installation instructions are for the **FD525** using a **DB-32** and for the **FD508**. For instructions on how to install an **FD525-HALO™** system, refer to the application note titled: **AN-SM-037 FD500 Series – FD525-HALO™ Installation Instructions.**

Installing the Lead-In and Backbone Cables

Route the lead-in cable to the location along the perimeter where the distribution box, or first breakout box will be located. Be sure to leave a minimum cable overlap of at least 36” at the distribution box location (see figure 2-1). Service loops and/or excess cable are recommended. In the event of damage to the system, this extra cable will be used to facilitate repairs.

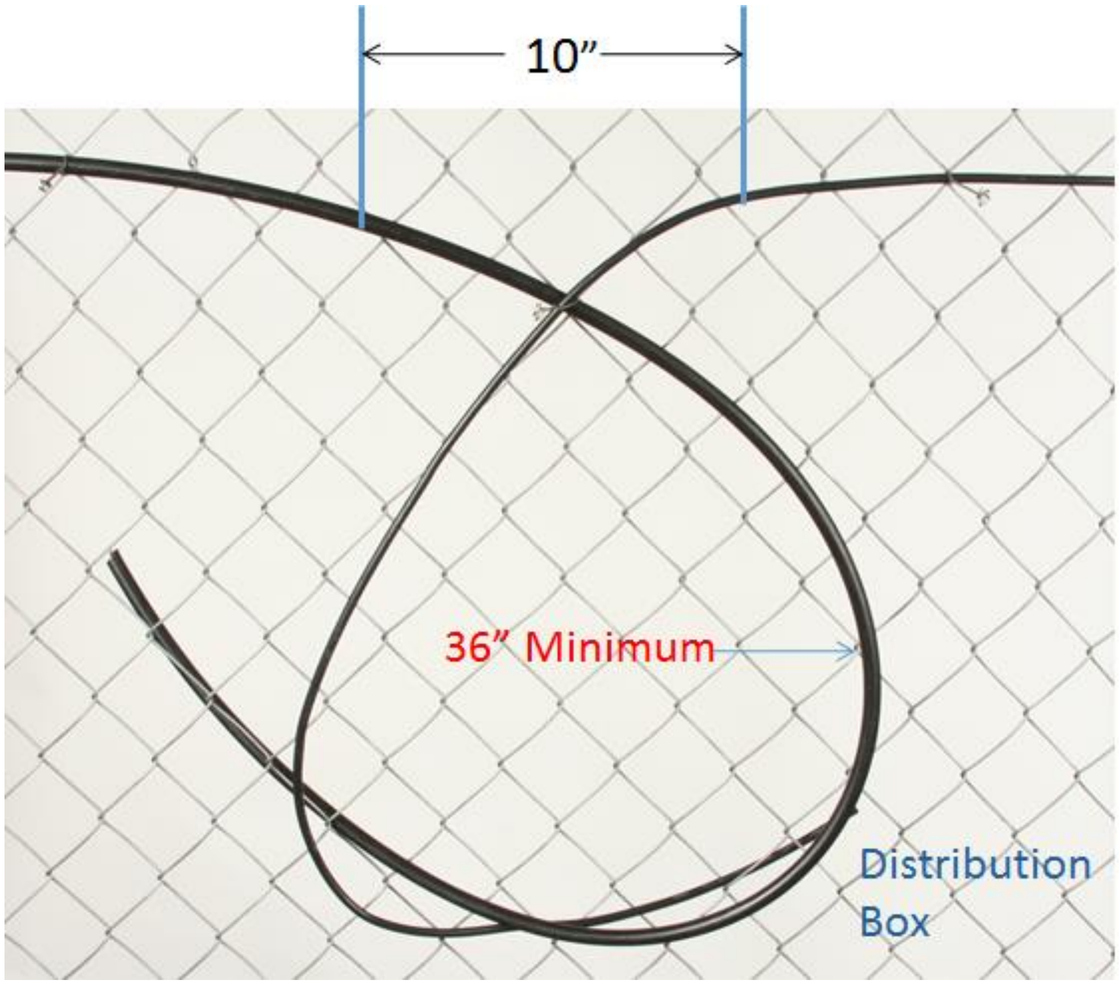


Figure 2-1. Leave 36" or more of overlap at the location where the distribution box will be mounted.

Route the backbone cable along the fence line. It is recommended to leave 3 meter service loops every 90 meters (~300 feet). Also leave 3 meter service loops at the locations of each breakout box to facilitate breakout box construction (see figure 2-2).

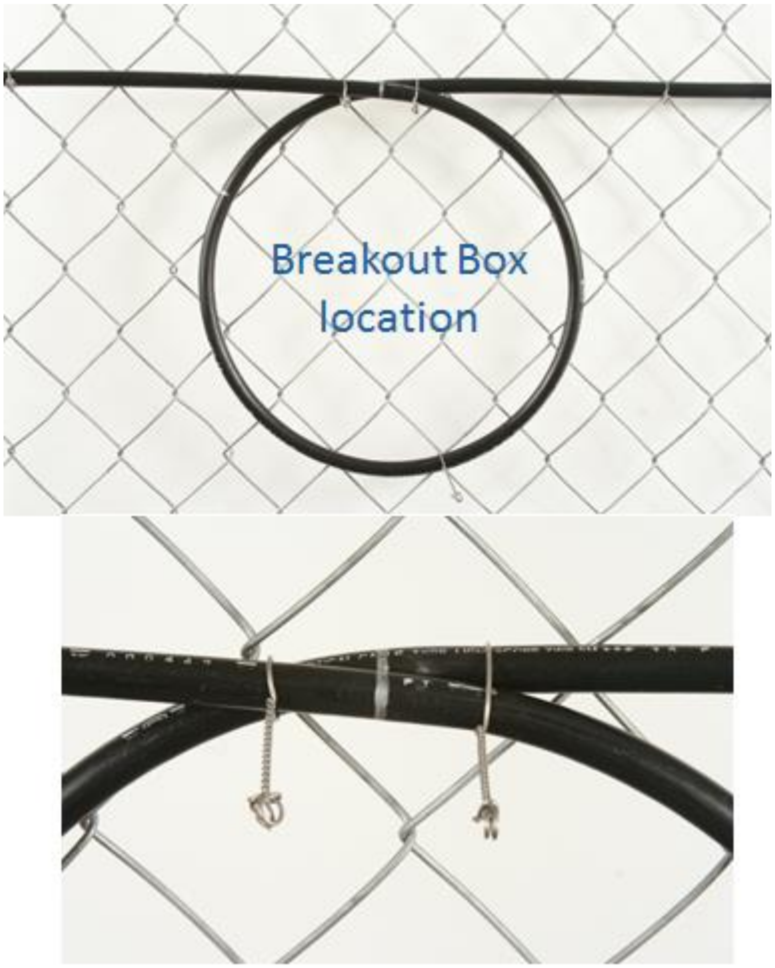


Figure 2-2. Service loops should be left every 90m (300ft) to facilitate repairs, and at every breakout box location to facilitate breakout box construction.

Attaching the Sensor Cable to the Fence

Where and how the cable is attached depends upon the type of fence and the possible threats against it. Generally, the sensor cable is attached in such a way that it detects movement or vibration from intruders but still remains as insulated from nuisances as possible. In addition, the cable is also attached in a secure fashion to prevent granting intruders' easy access.

Depending on the level of security, the cable in conduit may need to be routed between the chain-link panels and fence poles. Routing the cable around the outside of the fence poles rather than between the poles and panels decreases the sensitivity at the rigid pole sections. Routing the cable between the fabric and poles is also advantageous because it makes the sensor more difficult to remove. If the fence cannot be disassembled for routing we recommend pounding stakes in at each pole to create a gap, as shown in figure 2-3. Remove stakes after the sensor has been permanently attached to the fence.

Figure 2-3. Wooden stakes can be used to create a gap between the fence fabric and the fence post to allow for high security routing of the sensing cable.

Stainless steel wire ties offer the highest security method for attaching our sensor to chain link fences because of their extreme durability.

A special tool is then used to twist the tie so that the conduit/cable assembly is secure on the fence but isn't so tight it inhibits proper operation of the sensor or excessively compresses the conduit. The simplest process for attaching a wire tie is as follows:

1. Bend the tie at the midpoint so there is roughly a 45° fold
2. Route the tie through horizontally adjacent fence diamonds
3. Squeeze the circular ends together and insert the hook of the twist tool
4. Pull the tool towards your body for approximately 3½ pulls
5. Secure the tie so that it just begins to indent the conduit

NOTE:

In areas that are exposed to salt spray, limit the number of pulls to 2 (so that there are approximately seven twists in the tie). Ties in oceanic areas can be susceptible to "stress corrosion cracking" when high tension is applied and we have found that the solution to this phenomenon is applying less stress to the tie.

Logically one would assume that the best way to apply wire ties to a horizontal run of conduit would be to route the ties vertically between adjacent fence diamonds. However, the highest security method of routing ties on both vertical and horizontal conduit runs is by routing the tie through horizontally adjacent fence diamonds. When ties are routed through horizontally adjacent diamonds, the ties burrow tightly within the framework of the fence as shown in figure 2-4. If the ties are strung through vertically they do not conform to the fence, which leaves small gaps that can be cut from the non-secure side of the fence as shown in figure 2-5.

Correctly Installed Tie

Figure 2-4. Observe how the tie fits tightly within the framework of the fence when correctly routed across horizontally adjacent diamonds

Incorrectly Installed Tie

Figure 2-5. Observe that there is not a tight fit when the tie is routed through vertically adjacent diamonds

Frequency of Ties and Pull Tension

The disadvantages associated with not adding the proper amount of ties include increased ease of sensor removal and various aesthetic drawbacks. For the best results, add ties every 12 inches (30cm) and as close-fitting as possible on either side of each fence post (figure 2-6). Removing the sensor undetected becomes nearly impossible if enough ties are added and attached in a high security fashion.

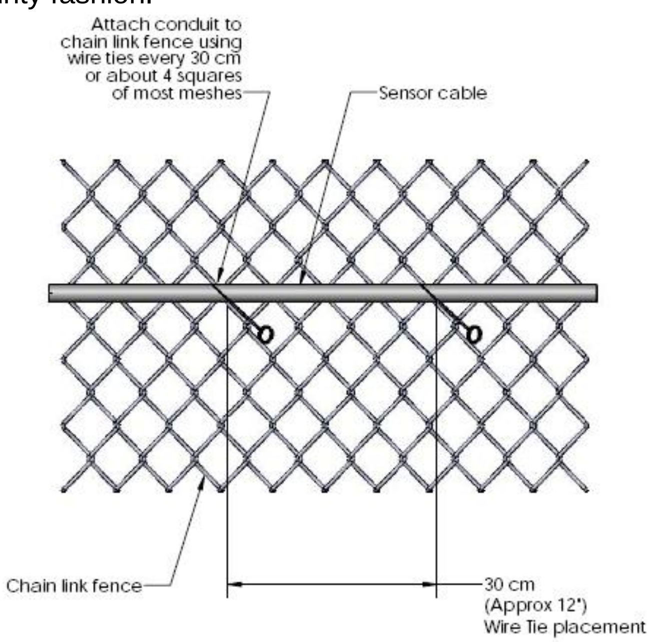


Figure 2-6. Tie Spacing

Additionally, adding the correct amount of ties and applying approximately 25lb (11Kg) of tension to the conduit during install helps to prevent hot and cold expansion, which results from the conduit expanding during higher temperatures (see figure 2-7). The tail end of the twist ties may either be left pointing horizontally or bent in a direction of the installer's choosing.

Figure 2-7. Observe the slight bend in the conduit due to hot and cold expansion; more ties and higher tension would prevent this phenomenon

The sensor cable is also attached to wrought iron fences, barbed wire or razor wire using wire ties. In each case, it is necessary to consider how best to attach the cable so it is less likely to be disturbed by minor nuisances without sacrificing its receptivity to detect the movements or vibrations of an intruder. In the case of wrought iron fences, the cable is attached to the top and bottom rail using wire ties every two vertical fence stakes.

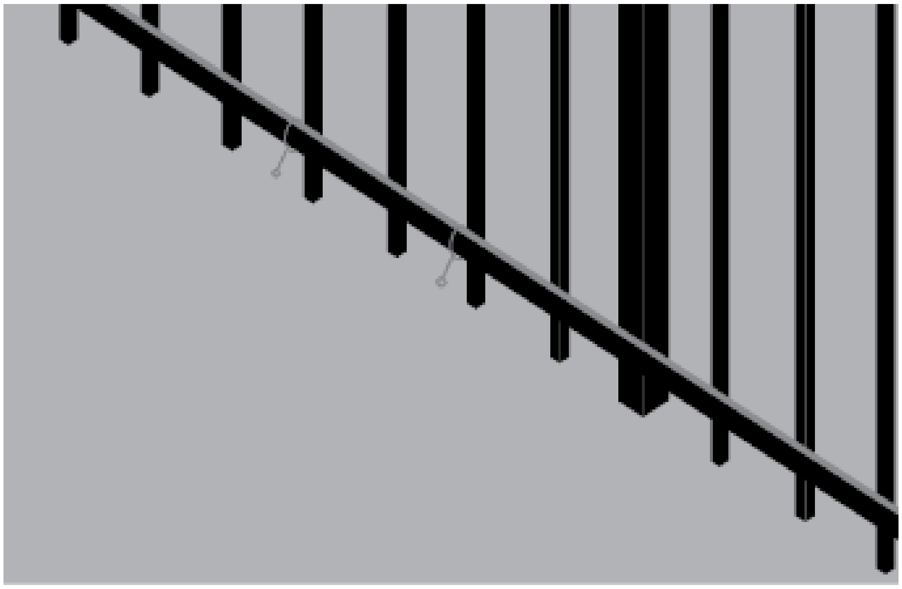


Figure 2-8. Attaching sensor cable to wrought iron fence

Terminating Sensing Cables

Trim the sensing cable to the final installed length. Remove 24” of conduit and set aside. Remove 10” of fiber, and strip 6” of jacket, trimming off Kevlar. Slide 18” of 3/16” heat shrink over fiber and back slightly into the conduit.

Figure 2-9. End of sensing element with jacket removed and heat shrink, ready for termination.

Cut off the SC/APC connector from the factory provided MMEOL Terminator and trim to 8”. Fusion splice the MMEOL Terminator to the end of the sensing cable. Slide the heat shrink to cover all the exposed fiber and heat both ends of the heat shrink to seal (heating entire length is not necessary.

CAUTION: Do not overheat the optical fiber.

Figure 2-10. MMEOL Terminator is fused to the end of the sensing cable and protectively covered by the heat shrink.

Replace the 24” of conduit that was set aside over the MMEOL Terminator and exposed sensing fiber. Use compression fitting to connect the pieces of conduit, and an end cap to protect against moisture. Attach end assembly to fence at a downward angle to prevent fiber migration.

Figure 2-11. Sensing cable termination mounted to the fence.

Installing the DB-32

The purpose of the **DB-32,** shown below, is to divide the 2 fiber lead-in cable into 32 fibers. The **DB-32** is intended for use with an **FD525** style APU, **FD508** APUs do not require a distribution box since each zone has a separate SC/APC connection on the rear of the APU.

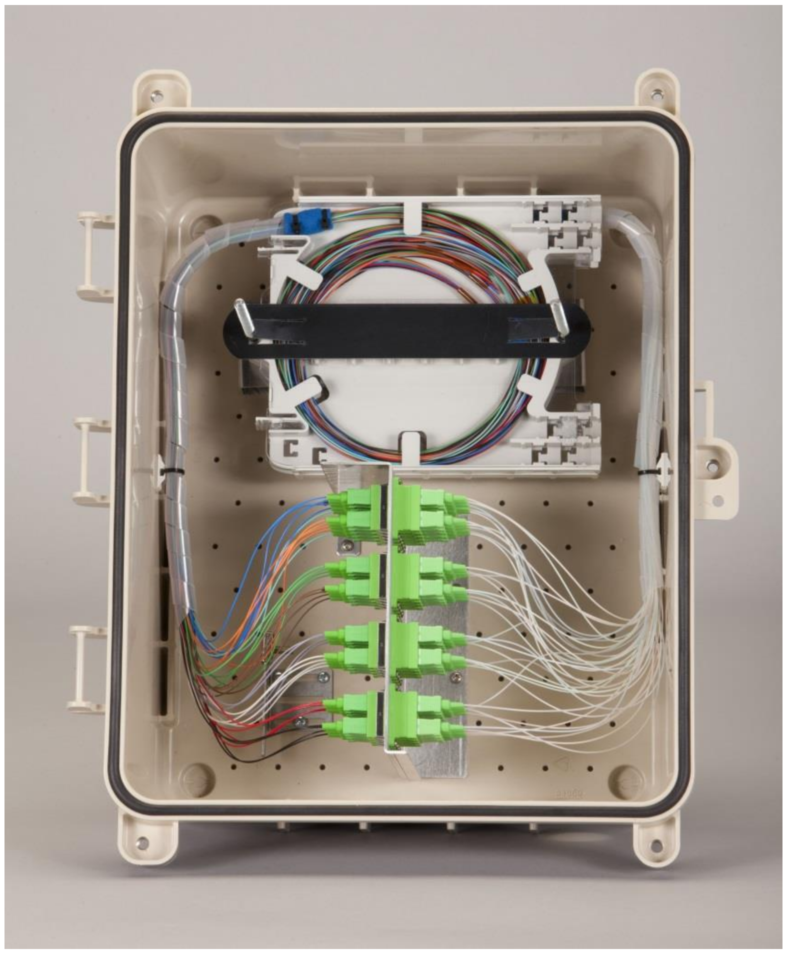


Figure 2-12. DB-32 distribution box

The assembly is comprised of 3 major components (see figure 2-13):

Demarcation Tray: The point at which the lead-in cable and backbone cable are trayed and spliced to pigtails.

Coupler Bulkhead: Configurable interface between optical splitter assembly and incoming cables

Optical Splitter Assembly: Splice tray housing factory assembled splitter array

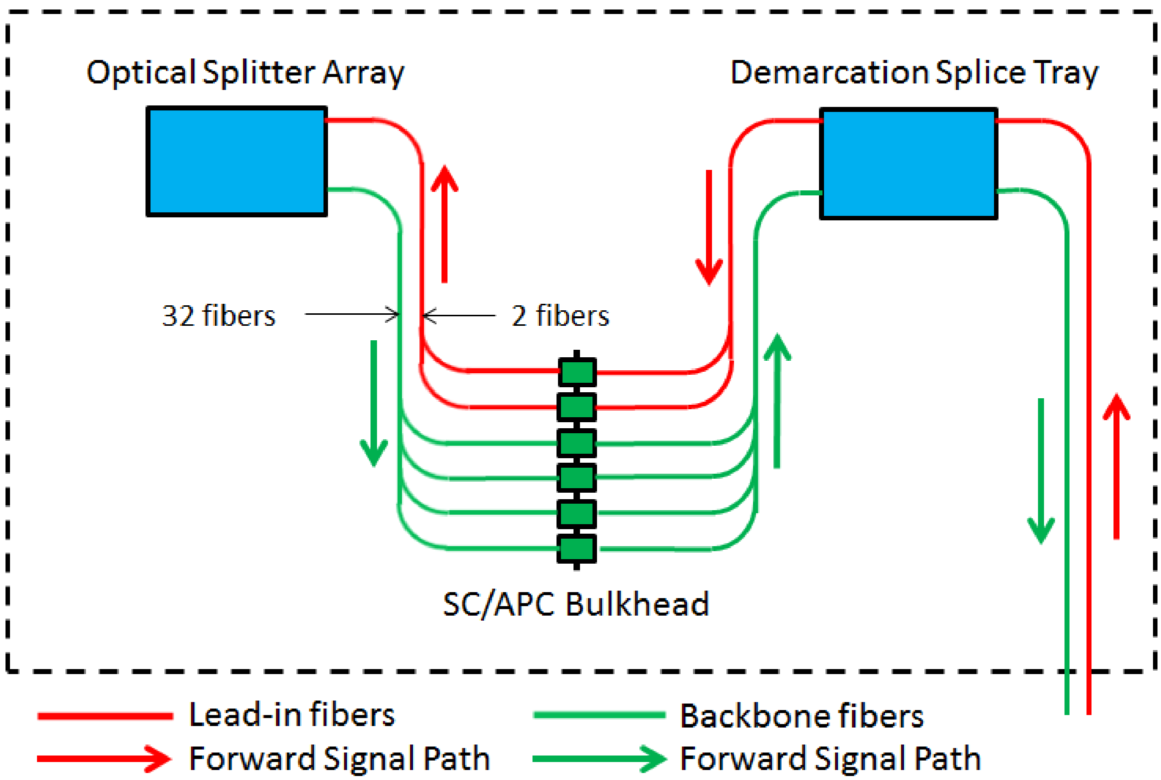


Figure 2-13. Layout of the DB-32.

Install the **DB-32** distribution box where the lead-in and backbone cables overlap, preferably on a rigid post to minimize vibration and movement. Remove appropriate port knockout from **DB-32** housing (see figure 2-14), install grommet assembly into vacant port and insert cables into grommet. Once cables are installed, remove all jacketing material from cables inside the **DB-32** enclosure.

Figure 2-14. DB-32 optical port and grommet assembly components

The **DB-32** will come with two splice trays (see figure 2-15): a demarcation tray for splicing pigtails to lead-in and backbone fibers, and a splitter array tray populated with the passive optical splitter assembly and delay coils. Do not remove cover from the splitter tray.

Figure 2-15. DB-32 as it arrives from the factory.

After the lead-in and backbone cables have been pulled into the distribution box and prepared, carefully route the lead-in fibers (path shown in red) to the vacant demarcation tray, and route two of the factory supplied pigtails from the demarcation splice tray to the SC/APC bulkhead (path shown in orange) and connect to “Lead-in” Ports as illustrated in figure 2-16. Fusion splice the lead-in fibers to the pigtails. Any excess fiber can be stored under the splice trays, if necessary.

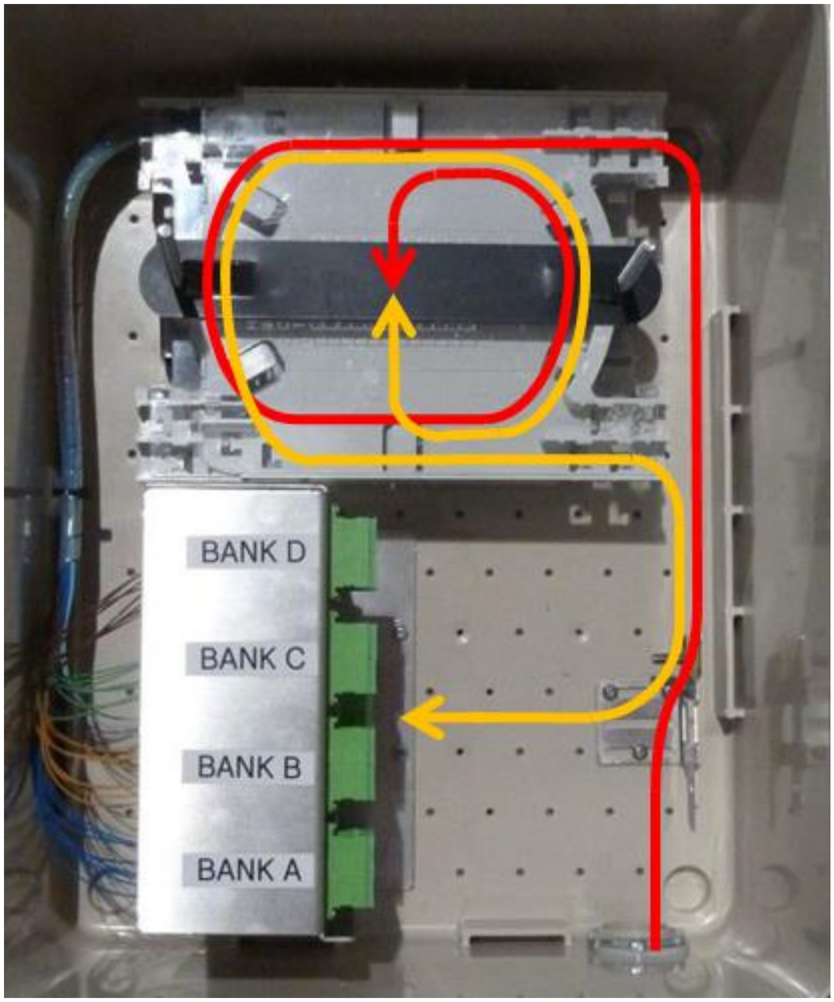


Figure 2-16. Path of lead-in fibers to the demarcation tray (red) and path of lead-in pigtails (orange).

Next, carefully route the backbone fibers to the demarcation splice tray (path shown in dark blue) and route the remaining factory supplied pigtails from the demarcation splice tray to the SC/APC bulkhead (path shown in light blue) as illustrated in figure 2-17, but **do not connect to ports**. It is recommended to leave at least one full wrap of bare fiber inside the demarcation splice tray to facilitate splicing.

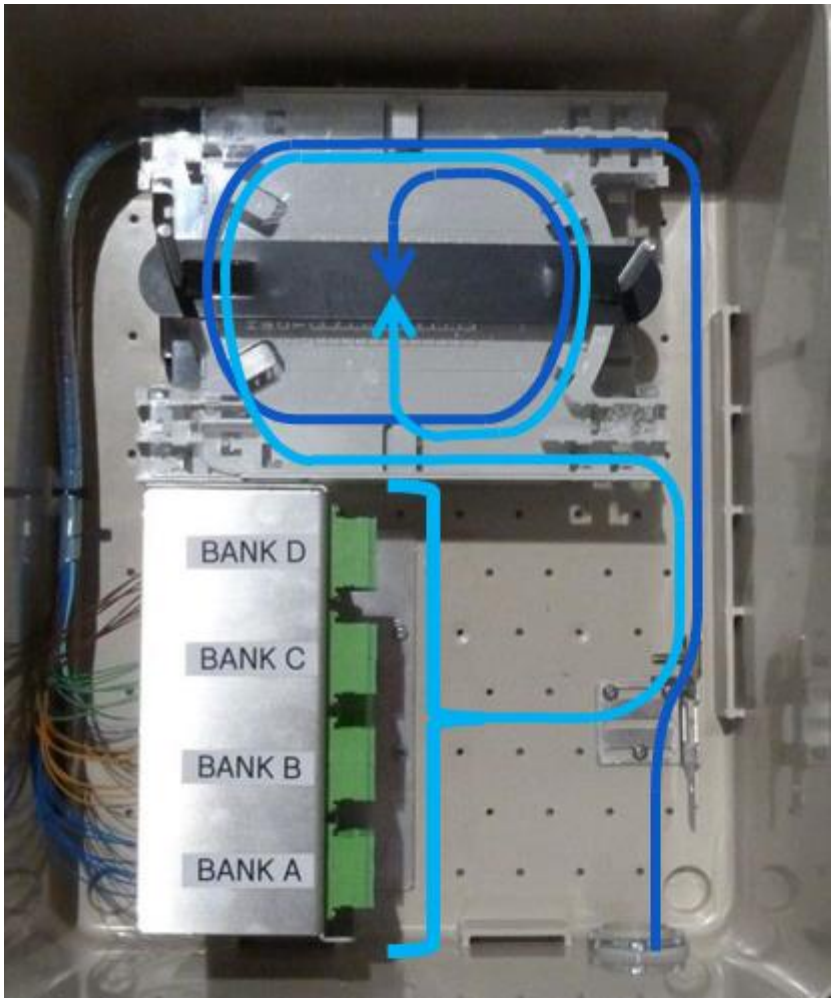


Figure 2-17. Path of backbone fibers to demarcation tray (dark blue) and path of backbone pigtails (light blue).

Fusion splice each pigtail to a backbone fiber and label each pigtail according to the respective zone that the fiber will be connected to. After the backbone cable, and sensor cable has been installed for all zones, the 500 Series Configuration Wizard will help the user assign connectors to specific ports. For detailed information about using the Wizard, see application note **AN-SM-023 Port Assignment Wizard**.

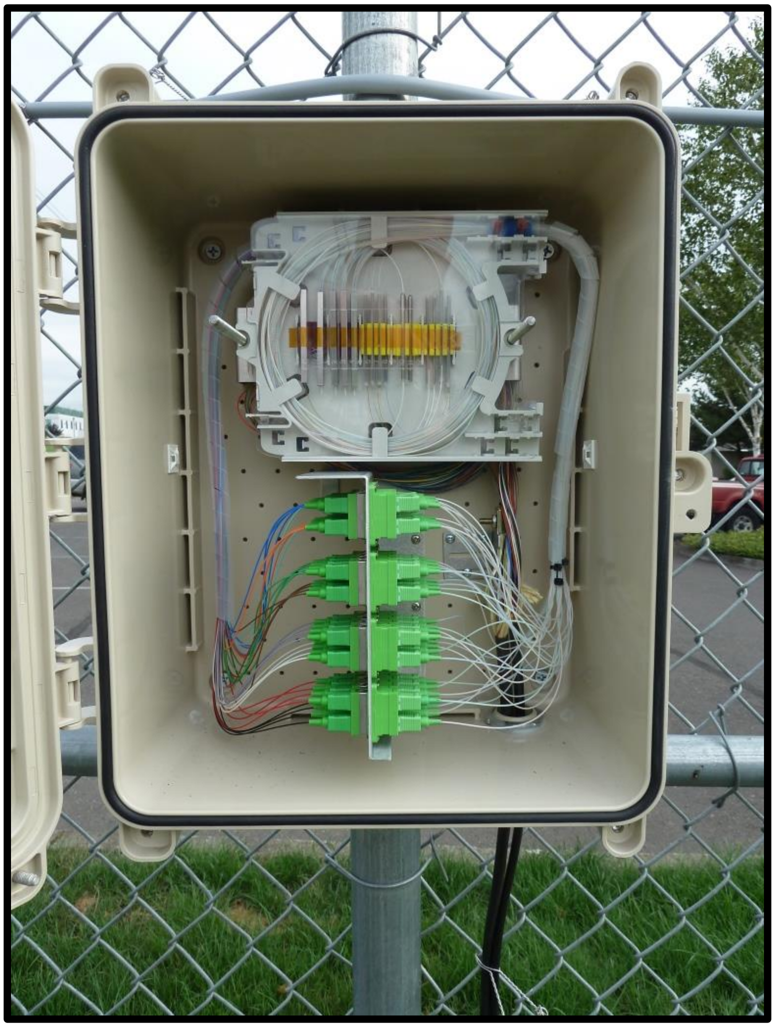


Figure 2-18. Finished DB-32 distribution box installed on the fence.

Installing Breakout Boxes

Begin by removing the cable loop from the fence. Hold the break out box base in the location that it will be mounted when complete and lay the backbone cable in the breakout box and mark where it enters (see Figure 2-19). Next make another mark on the cable 50" towards the other end of the breakout box.

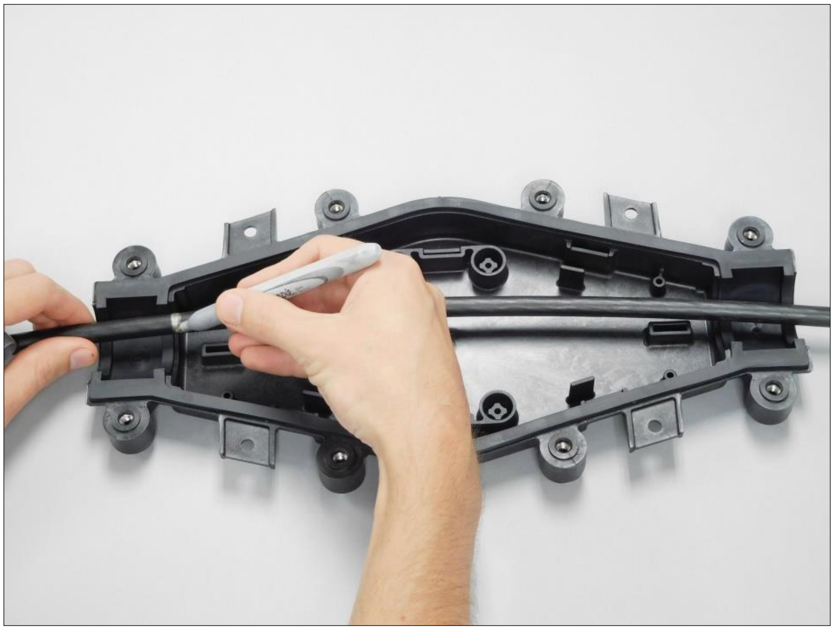


Figure 2-19. Cable marking in breakout box

Using a tool such as the Ideal 45-164 or a razor blade carefully ring cut the cable jacket at both marks. Starting on one end carefully slit the jacket open several inches along the two ridges in the cable. Next use a pair of needle nose pliers pull on the two halves of the cable jacket apart until all 50” of black cable jacket are removed.

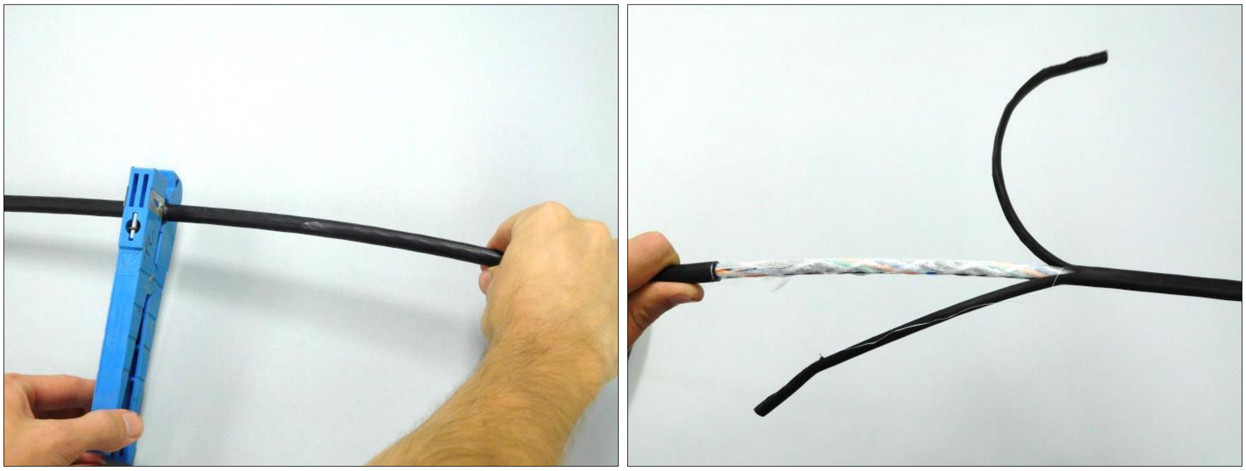


Figure 2-20. Ring cutting the cable jacket and separating the halves

Remove all wrappings and any material surrounding the buffer tubes. Remove all but 2” of fiberglass central strength members at each end of sheath opening. Remove all black filler tubes to the base of the cable jacket. These tubes contain no fibers and are only used for cable construction.

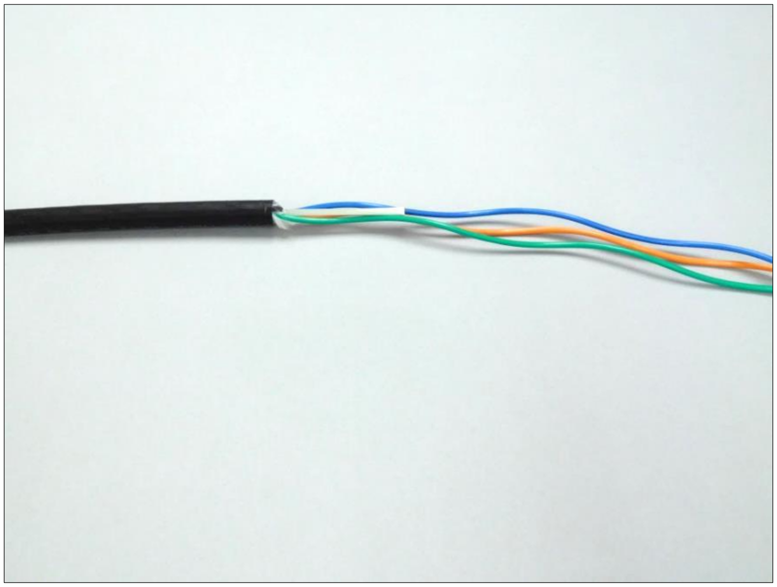


Figure 2-21. 36-Fiber trunk cable with empty buffer tubes removed and strength member trimmed

Place the backbone cable through the center of the grommet. It may be necessary to slice the side of the grommet. If you are using 24-fiber or greater cable route the buffer tube(s) that will not be accessed at the bottom of the breakout box.

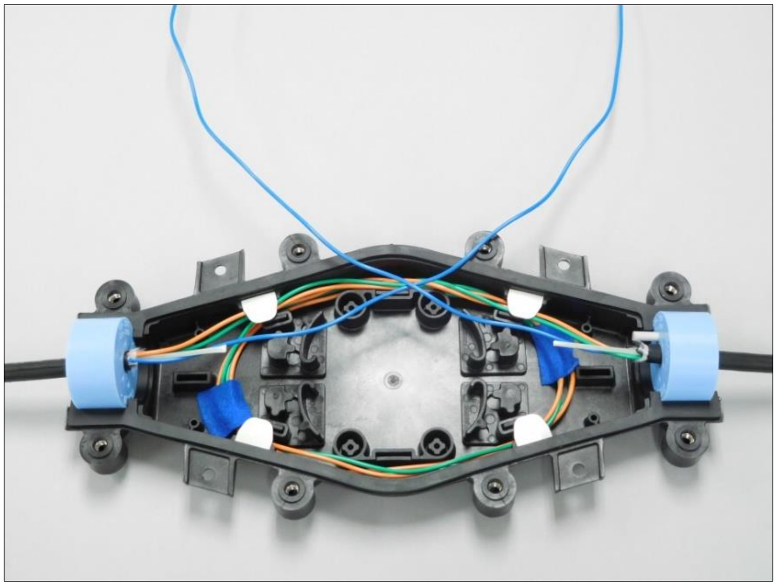


Figure 2-22. 36-fiber backbone cable with two spare buffer tubes routed along the bottom of the box.

After securing the fiberglass strength member to the retention brackets use a mid-span buffer removal tool such as the Miller MSAT5 pictured below to carefully open up the buffer tube containing the fiber(s) you need to splice.

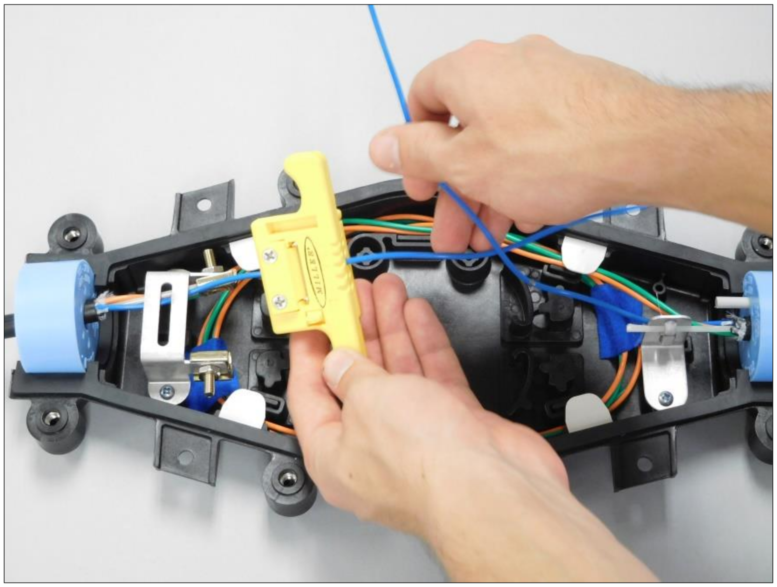


Figure 2-23. Using a mid-span entry tool to open appropriate buffer tube

Cut only the appropriate fibers for the zone(s) being spliced at the center of the loop. Store the unused uncut bare fibers from the buffer tube at the bottom of the spice box.

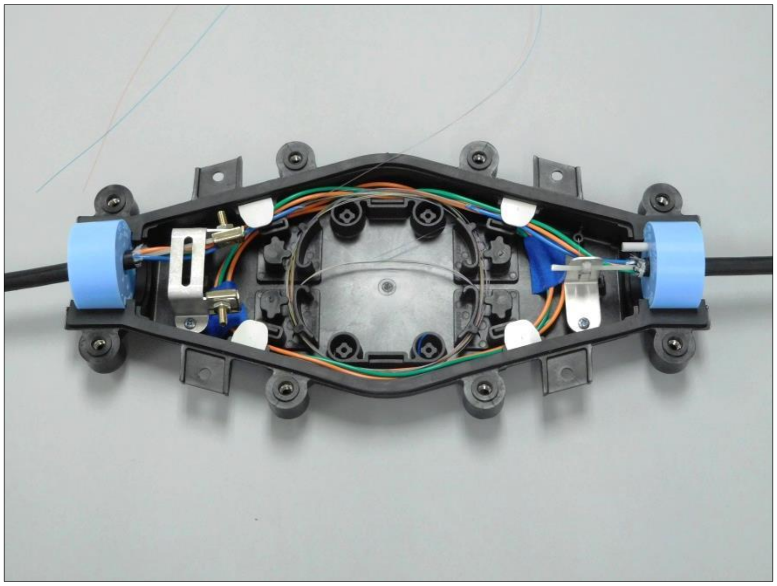


Figure 2-24. Spare fiber routed along bottom with appropriate zone fibers cut

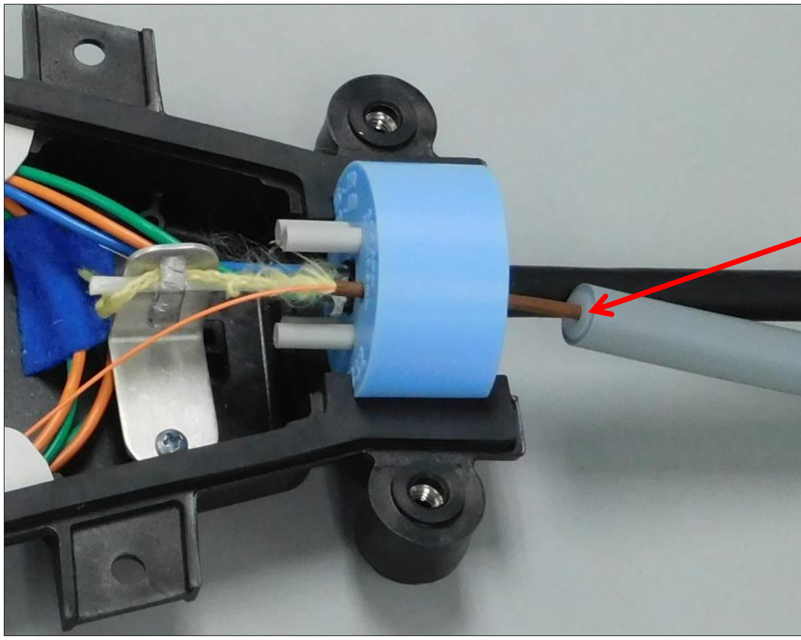


Figure 2-25. Bringing the sensor cable into the breakout box

Route the sensing cable(s) to the case edge and trim conduit to ½” away outside of the grommet.

Insert 1” white conduit plug into conduit end. This will protect the conduit from being crushed when clamped down.

Insert the sensor into one of the small grommet holes. Remove all but ½” of jacket and 6” of aramid yarn from sensing fiber protruding inward from grommet. Attach aramid yarn to retention bracket.

Trim all fibers to proper splicing length and splice the sensing cable to the appropriate backbone fiber. Snap in the fusion splice holding tray and secure the finished splices.

Secure any loose fibers by installing the small plastic clips and utilizing the adhesive tape that comes with the breakout box.

Figure 2-26. Splicing of single mode backbone cable to multimode senor

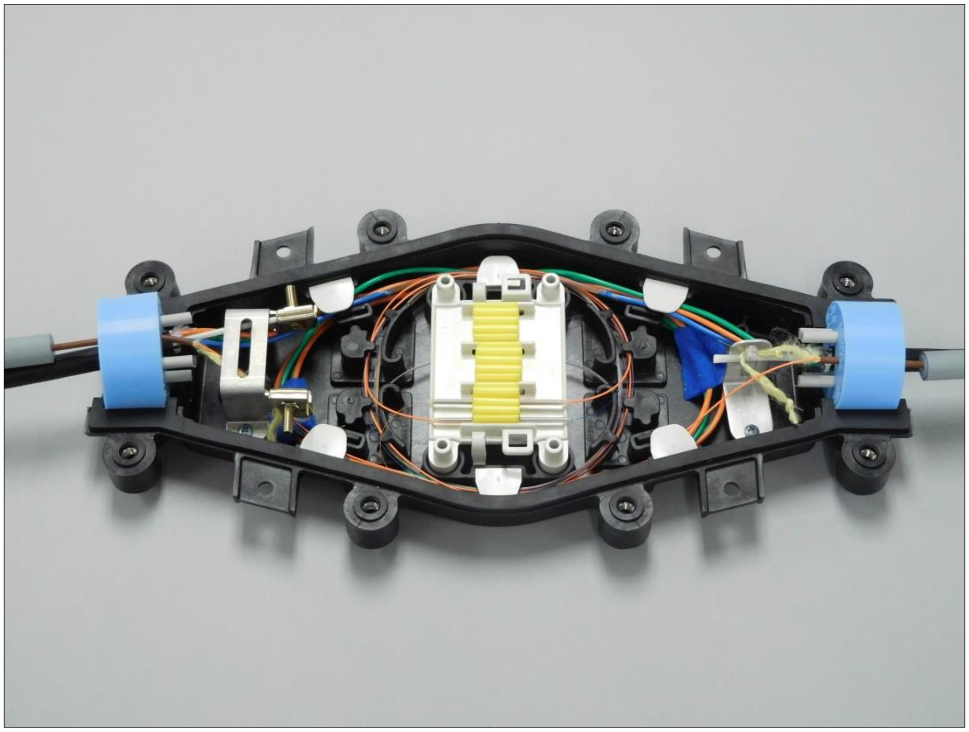


Figure 2-27. Completely constructed breakout box.

Before installing the cover, remove the 2 end bolts and plastic retainers. Discard plastic retainers and install cover over finished breakout box. Install sensing element retaining bracket with end bolts and tighten. Use stainless steel wire ties to fix sensing element(s) to retainer.

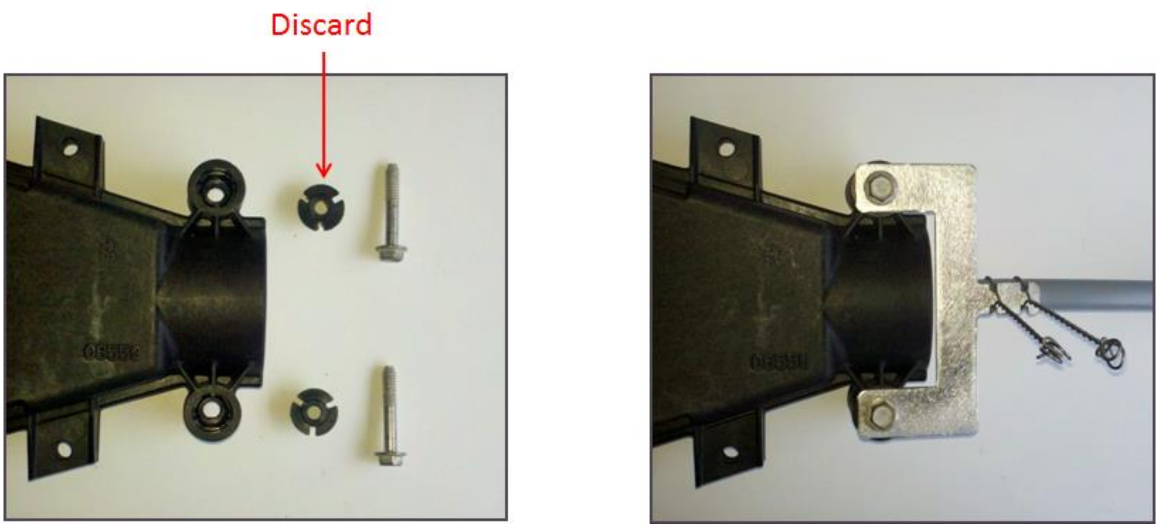


Figure 2-28. Sensing element retainer installation.

Cable Verification and Zone Setup

After splicing all of the breakout boxes for all of the zones has been completed the following steps should be followed to verify the installation and to set up the zones:

Step 1: Verify Each Zone

The first step after splicing should always be to verify the integrity of the installed cable. At the **DB-32** for 525 type APUs, or at the APU itself for **508** type APUs, test each zone cable individually using either an OTDR scan or using the APU.

To use the APU, connect a computer to the APUs **USB Configuration** port and run the **500 Series Suite** software. Select **500 Series Config**, the software should connect to the APU automatically. Set the lead length to the length of the cable from the APU to the beginning of the first zone. Set the backbone length to the length of the cable from the first zone to the very last zone (add a couple hundred meters for margin). Click the **Scan** button. With only one zone plugged into the **DB-32** or to the rear of the **508** APU there should be two peaks. The first peak will be the reference zone, the second peak will be the zone that was just plugged in.

Mark down the height of the zone, if only one peak is visible then there is a break in the cable. There should not be greater than 50% variation between zone peak heights, if there are, then the zone with peak 50% lower than any other zone needs to be investigated for damage.

After all zones have been tested and fixed as necessary, move on to **Step 2**.

Step 2: Run the 500 Series Wizard

Connect a computer to the APUs **USB Configuration** port and run the **500 Series Suite** software. Select **500 Series Wizard**. The wizard will run the user through a step by step procedure. For detailed information on using the **500 Series Wizard** refer to application note: **AN-SM-023 Port Assignment Wizard**.

The wizard will indicate to the user if delay coils are needed. Delay coils are uncommon, but may be necessary to avoid time-domain sensor interference. If the **500 Series Wizard** does indicate that delay coils are necessary, then Install delay coils as directed by the **500 Series Wizard**. Make sure to insert the delay coil between the trunk fiber and sensing element where design requires. Be sure to repeat **Step 1**, and check all zones if a breakout box is opened up and a delay coil is added.

The final step in the wizard is to connect all the zones to the ports, as instructed, and then click **Continue**. If the zones have been connected to the optical ports correctly, you will see a message of success. At this point proceed on to **Step 3**.

Step 3: Verify System

After the wizard is complete, it is good to verify that the system is set up correctly. Connect a computer to the APUs **USB Configuration** port and run the **500 Series Suite** software. Select **500 Series View**. The software should connect to the APU automatically.

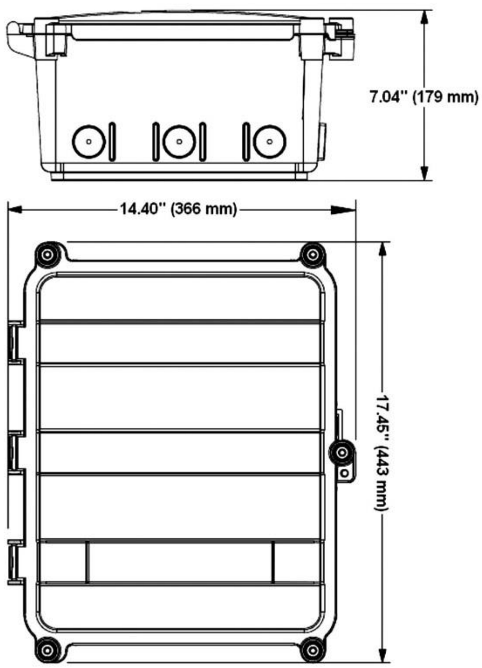
Go to the **Cable Status** tab and verify the heights of all the zones. The installation is performing adequately if all the zone reflections are above 35%.

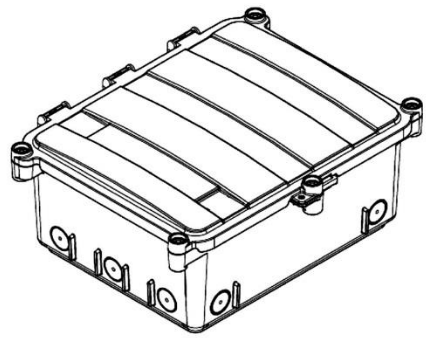
Appendix A. Telecommunication Color Codes

Table A-1. Telecommunication color codes for optical fibers

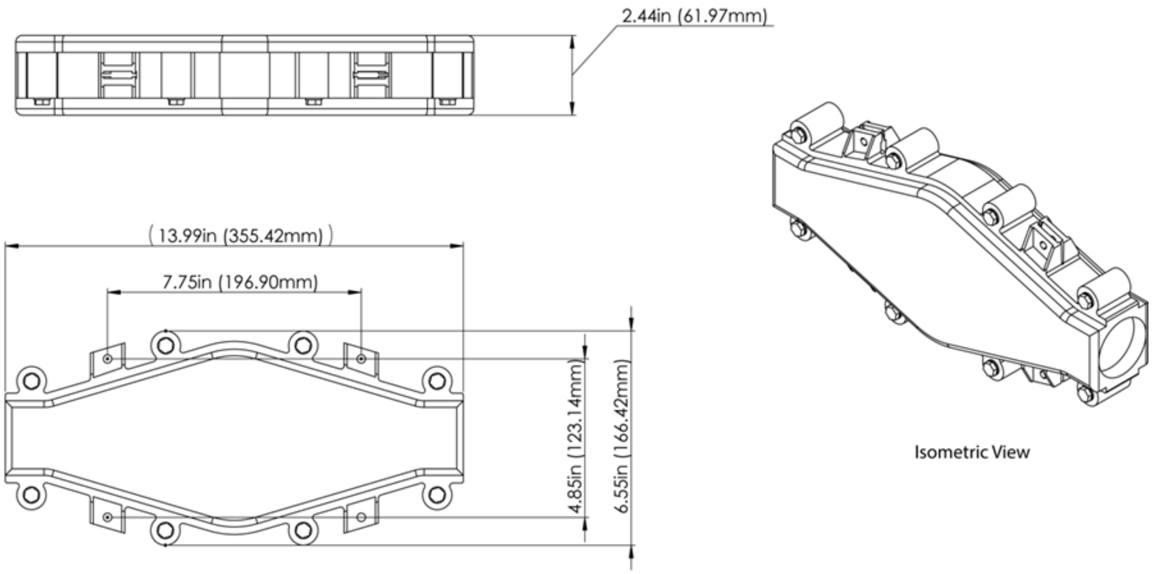
Sequence	Colors
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Rose
12	Aqua

Appendix B. Breakout and Distribution Box Specifications





DB-32 Distribution Box Specifications	
Exterior Dimensions	• Width: 14.4 in (36.6 cm) • Length: 17.45 in (44.3 cm) • Height: 7.04 in (17.9 cm)
Industry Standards	• NEMA Type 4 • ISO 9001 / 2000 manufacturing Compliance • Telcordia OR 771 Core
Enclosure Flammability	Evaluated and listed per UL 94-5VA
Operating Temperature	-40 degrees to +75 degrees centigrade (-40° to 167° F.)
Splicing Capacity	Up to six splice trays, 40 single fiber splices per tray
Couplers	Duplex SC/APC type polymer with zirconia mating sleeves
Weight	8.2 lbs.



Breakout Box Specifications	
Exterior Dimensions	Width: 6.55 in (16.64 cm) Length: 14.00 in (35.54 cm) Height: 2.44 in (6.19 cm)
Industry Standards	ISO 9001 / 2000 manufacturing Compliance Modified Telcordia TR-NWT-000251
Operating Temperature	-40 degrees to +75 degrees centigrade (-40° to 167° F.)
Splicing Capacity	Supports up to 48 single-fusion splices.
Weight	3.5 lbs.

Appendix C. Referenced Documents

AN-SM-023 Port Assignment Wizard
AN-SM-036 FD500 Series – Site Design and Assessment
AN-SM-037 FD500 Series – FD525-HALO Installation Instructions

Note: It is possible to download these documents online from the **Fiber SenSys** web page: www.fibersensys.com