Application Note

Installation Variations

SUMMARY

Installation requirements for deploying the fiber optic intrusion detection system can vary greatly from one site to the next. This document addresses some acceptable departures from normal installation guidelines and makes recommendations for each.

INTRODUCTION

Although Fiber SenSys publishes guidelines for installing and calibrating its fiber optic intrusion detection systems, the unique layout and protection requirements of each site may make it advisable to depart from such recommended practices. this inherent flexibility is a part of the system's design and is normally acceptable, provided some common rules of thumb are kept in mind.

Installation Rules of Thumb

- Whenever an installer deviates from published installation guidelines, the installer must first read and understand such guidelines (refer to the applicable system's user manual, A&E documentation and application notes, as applicable. As a minimum, the user manual must be read thoroughly). Doing so ensures the *principles* outlined in the published guidelines are properly understood and adhered to
- The fiber optic sensor cable is designed to detect the effects of vibration and pressure. To do so, the cable must be installed in such a manner that such vibrations and pressure from an intrusion attempt are transmitted readily to the cable. Thus, installing the sensor cable beneath a hard surface or enclosing it in a hard material (such as asphalt, cement, clay, ice, etc.) - which fixes the cable in place and prevents vibrations from affecting it - must be avoided
- The fiber optic cable is made of glass, and appropriate handling precautions, outlined in the applicable system user's manual, must be followed
- System calibration and subsequent, thorough system testing *must* take place immediately following system installation before a site is deemed "protected"
- The sensor cable is a uniform sensor. It exhibits the same degree of sensitivity along its entire length. To successfully apply a uniform sensor, more sensor cable is laid out in areas which produce less vibration or pressure changes. For example, in reinforced fence sections, additional cable is deployed in a local "loop" in the affected area to compensate for the rigid structure of the section
- All routine system maintenance prescribed in the published guidelines and user's manuals must be followed, regardless of any departures from normal installation guidelines

Following these rules of thumb will help ensure any installation variation will allow the system to operate at its optimal performance level.

Fiber Optic Cable Termination

As a field service-friendly alternative to epoxy ST connectors, Fiber SenSys offers "crimp-on" type ST connectors for terminating both the sensor cable and single-mode insensitive lead-in fiber optic cable. It is recognized that in cases where multiple zones are required, most installers will require a more time-efficient method of connecting fiber optic cable sections together. Epoxy-type ST connectors, readily available from the commercial marketplace, are perfectly acceptable for terminating the optical fiber. Equally as acceptable is fusion splicing a pre-terminated fiber optic "pigtail," or jumper cable which is terminated at only one end. Such innovative methods help reduce the time required to terminate all ends of a properly deployed fiber optic cable.

When connecting sensor cable to an insensitive lead using such a pigtail, the terminated end of the pigtail should connect to the ST connector of the sensor cable using an ST-type “feed-through” coupler. Feed-through couplers are available from Fiber SenSys or from other commercial sources. By connecting the terminated ends of the two cables together, difficulties associated with fusion splicing multimode and a single-mode optical fiber are avoided.

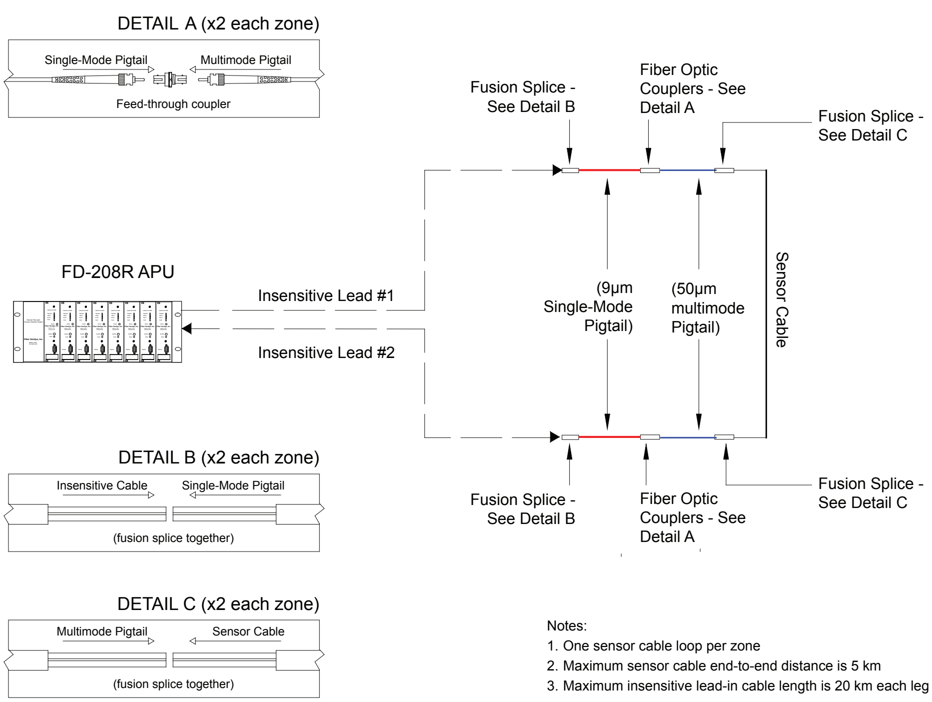
Multimode pigtail requirements

Alternatively, more time can be saved duirng the installation process by fusion splicing a multimode pigtail to the un-terminated end of the sensor cable. When selecting a multimode cable, a 50µm cable is recommended.

Fusion splicing pigtails

Once connected, the un-terminated end of the single-mode jumper can be fusion spliced to the insensitive lead-in cable. Insensitive lead-in cable can be purchased from Fiber SenSys (part number IC-3 or IC-4). Alternatively, standard 9µm/125µm single-mode fiber, available from any commercial source, can be used for an insensitive lead. For this reason, any pigtail used to connect the sensor cable to the insensitive lead must alse be standard 9µm/125µm single-mode fiber.

An example of such a layout is shown in figure 1.



Notes:
1. One sensor cable loop per zone
2. Maximum sensor cable end-to-end distance is 5 km
3. Maximum insensitive lead-in cable length is 20 km each leg

Figure 1 - Connecting sensor cable to insensitive leads using pigtails

Protecting splices

Whether using a pigtail or terminating the cable ends with ST connectors, all connection joints must be protected from exposure to the elements. This is best done by enclosing the joint in an encapsulation kit (Fiber SenSys part number ENKT-661). In addition, Fiber SenSys recommends placing the joint in a NEMA-rated junction box or similar rated housing.

Fiber optic connection joints should also be insulated from vibration in order to avoid nuisance alarms.

Associated Optical Losses

While connecting multimode fiber optic cable to single-mode is normally avoided in telecommunication applications, this is a normal practice when connecting the multimode sensor cable to the single-mode insensitive lead. Both the FD-208 and FD-340 series intrusion detection systems are designed to operate even with the high optical loss experienced under such circumstances. While most of the laser light is shed away when transferring from the multimode core of the sensor cable to the smaller core of the insensitive lead, the system continues to operate normally because the optics of the Alarm Processing Unit (APU) are concerned with analyzing the pattern of light on only a portion of the sensor cable's core profile.

System "loss" number

When reading the "loss" number reported by the APU (through use of the "STATUS" command - refer to the appropriate system's user manual), it is not unusual to find a loss figure between 1 and 10 for the FD-208 and FD-340 series. The APU derives this number by comparing the incoming optical power against a theoretical maximum loss number pre-programmed into the firmware at the factory. The loss number reported is really the difference between actual loss, measured at the APU's detector and the theoretical value. The true optical loss from one end of the system to the other can only be measured using an optical power meter and light source.

The actual system optical loss varies from one site to the next and is dependent largely upon the length of the cables. The APU of both the FD-208 and FD-340 series transmits at a wavelength of 1300 nm. Figure 2 shows the loss number associated with both the sensor cable and insensitive leads at this wavelength.

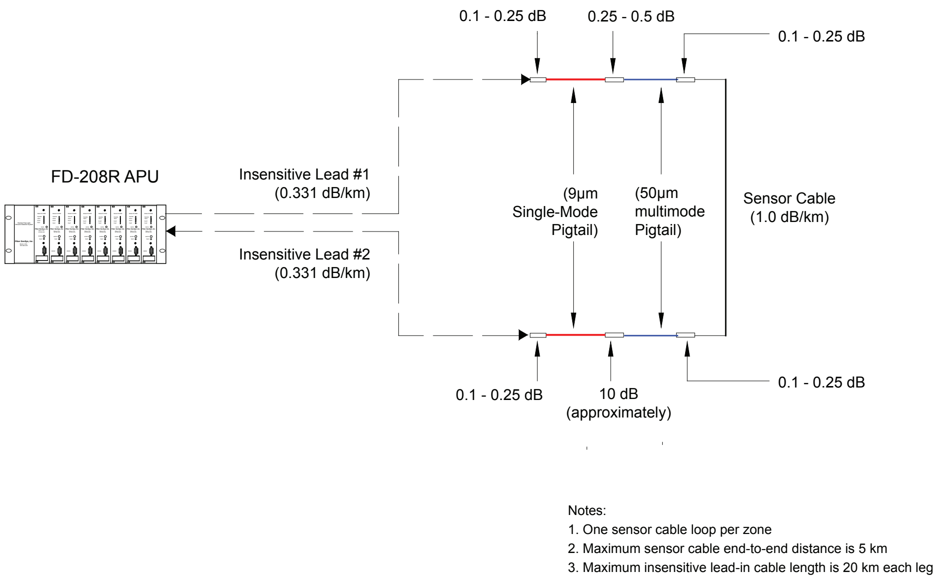


Figure 2 - Optical losses associated with the FD-208 and FD-340 series

Typical loss figures

Note the loss figure found at the connection joint between the multimode pigtail and the return insensitive lead or pigtail. As expected, this number is high (10 dB); however, the system has been designed to continue normal operation.

For an installation where the insensitive leads and sensor cable lengths are at the maximum allowable distance, the actual end-to-end loss is approximately 30 dB.

Buried Installations

The fiber optic sensor cable is designed to be buried in gravel, sod or sand. A properly buried sensor cable detects pressure and vibration from an intruder walking across atop it. The sensor cable can, however, be buried to detect and intruder digging or tunneling under a fence.

In order to be effective, some basic principles must be kept in mind:

Buried cable requirements

- The cable is sensitive to pressure and vibration. Whatever medium it is buried in (gravel), sand or sod), the medium must be loose and able to conduct vibration to the cable. Burying the sensor cable in concrete, asphalt or hard soil is not an accepted practice
- The sensor cable has a limited effective “detection zone” of approximately 12 inches surrounding the cable. In order to protect an area, the cable must be deployed in such a way that an intruder will either touch the cable during an intrusion attempt or pass through the cable’s “detection zone”

Soil requirements

Figure 3 shows an example deployment in which the cable is buried to detect intruders tunneling under the fence. The sensor cable in this example is deployed in soft, sandy soil which is kept soft at all times.

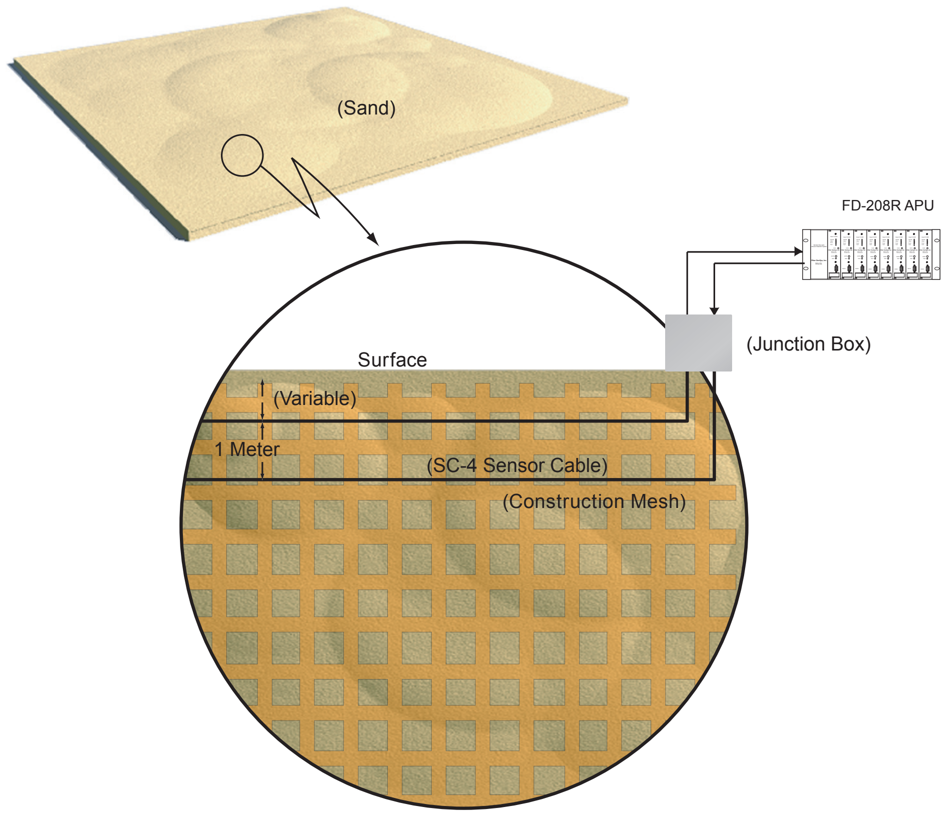


Figure 3 - Protecting against tunneling-type intrusions

Note that in this arrangement, with the cable deployed vertically (as opposed to horizontally), the cable is not deployed to adequately detect intruders walking across the top (the detection zone for a vertically-deployed cable is too narrow).

Standing water considerations

Under most circumstances, allowing standing water to accumulate in the soil is discouraged. This is because water can freeze, damping the effects of vibrations and lessening the effectiveness of the sensor cable. In some climates, however, where there is no danger of water freezing, this may be an acceptable condition. In such a circumstance, a couple of other factors must also be considered:

- The water must not be allowed to wash the soil away. To help prevent this, a site-walk through must be performed on a routine basis, especially after water has accumulated, to ensure the sensor cable has not drifted or become exposed
- While the sensor cable itself is immune to corrosion from water, the cable connectors must be kept dry and insulated from water (especially salt water). Fiber SenSys recommends enclosing the connectors in encapsulation kits as a minimum. It is recommended that the connectors be installed in a waterproof junction box, if possible

Poly "mesh"

To help prevent the sensor cable from wandering or shifting position over time, Fiber SenSys recommends attaching the sensor cable to a poly "mesh" material or something similar, using twist ties. Once buried with the calbe, the mesh helps prevent the cable from shifting.

System Testing

As a final step in the installation procedure, the system must be calibrated and tested thoroughly. In order to adequately test the cable, an intrusion attempt must be simulated. For the buried application shown in Figure 3, this means simulating a tunneling intruder. This can only effectively be done by actually tunneling under the fence.

Testing the application

While it is important to test a system at multiple points in a zone, Fiber SenSys recognizes that with such an application, this is not always practical or feasible. As a minimum, a test of the buried application should be performed early in the deployment stage, to verify the setup will detect a tunneling intruder. Upon completing the installation, at least one tunneling attempt should be made in each zone in order to verify successful calibration and deployment.

For more information on the variations available for deploying fiber optic intrusion detection systems, please contact Fiber SenSys' technical support team at +1.503.692.4430 or by E-mail at info@fibersensys.com.

Fiber SenSys®

2925 NW Aloclek Drive, Suite 130

Hillsboro, OR USA 97124

Phone: +1-503-692-4430

Fax: +1-503-692-4410

www.fibersensys.com