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Fiber Optic Perimeter Detection Systems

Substation Physical Security Best Practices – Baltimore 2017

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Detection Sensor Deployment Options for Various Substation Barrier Systems

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Objective

- Each application dictates the appropriate barrier and detection system selection.

- The objective of this presentation is to provide guidance for the application of fiber optic sensor on the most commonly-encountered barrier variations.

Barrier Variations

- Chain-Link
- Steel Pales, Pickets
- Welded Mesh
- Anti-Climb Fabrics
- Expanded Metal
- C-Wire, Razor Ribbon
- Walls and Wall Tops
- Wrought Iron

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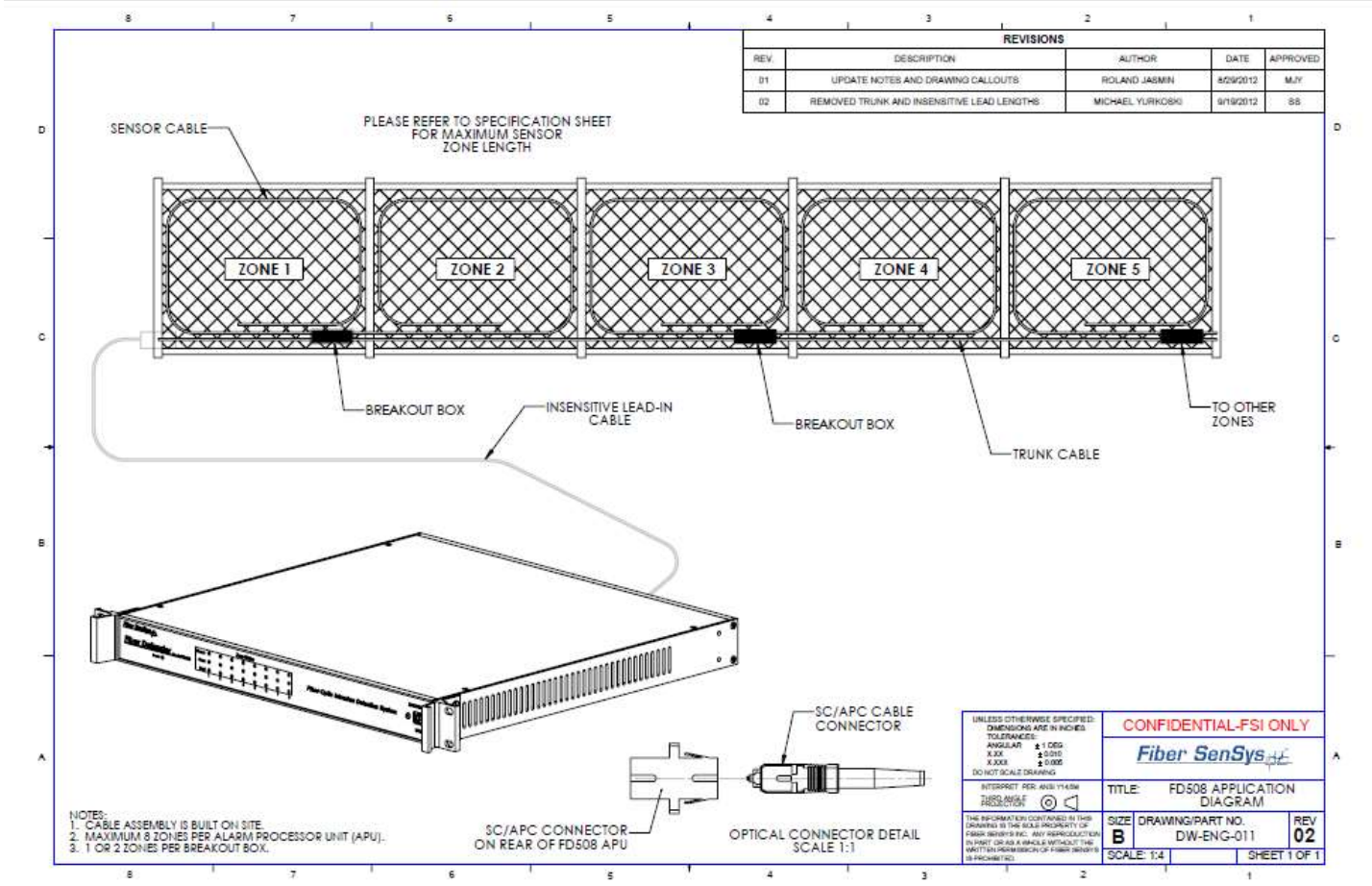
Fiber Optic Detection System Diagram



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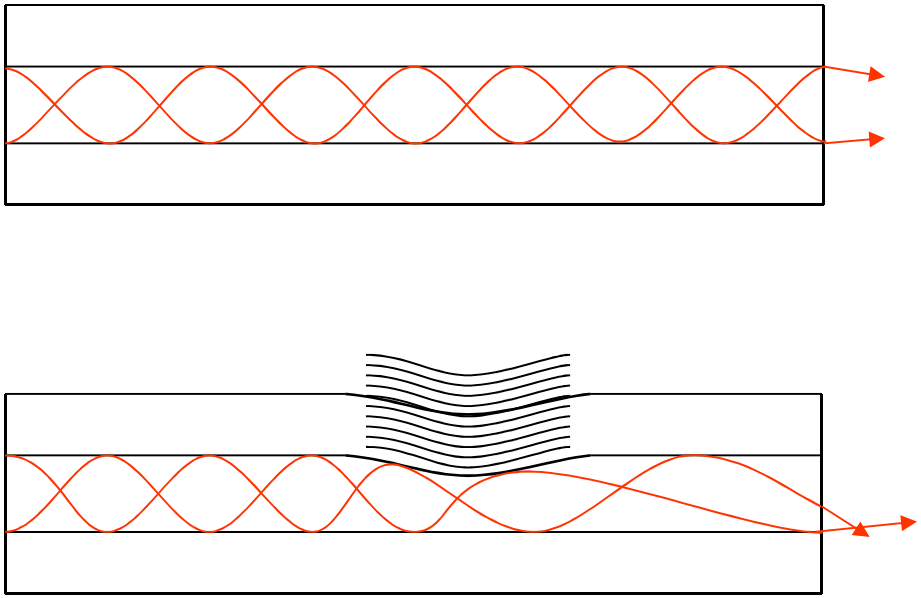
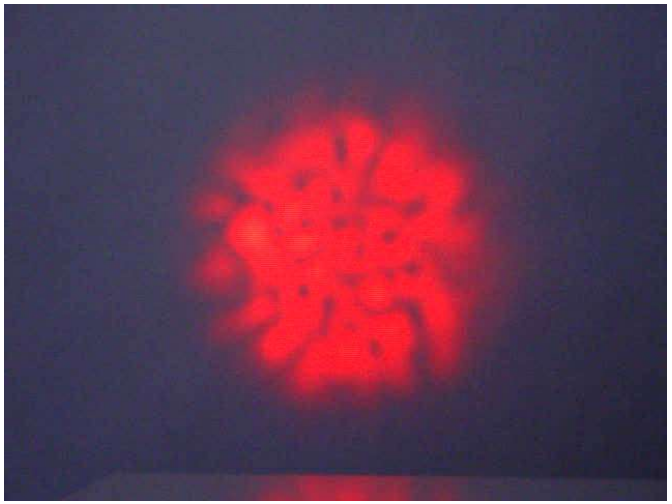
Fiber Optic Sensor – Theory of Operation

- The multiple modes of light found in multimode fiber form a random-intensity pattern known as a "speckle pattern." The speckle pattern remains relatively constant and stationary if the fiber is undisturbed.
- However, when the fiber is disturbed due to motion, vibration, or pressure, the alarm processor witnesses a change in the speckle pattern and is designed to determine what the nature of the event is.



Theory of Operation (cont.)

- Very small changes in the multimode speckle pattern are detected and analyzed by the system's digital signal processors



General Sensor Guidelines

- Apply sensor based on the threat(s)
  - Cut/Penetration: lower sensor run
  - Scaling and climb-over: all sensor runs
  - Ladder-assisted climb-over: upper sensor run

Sensor Location Guidelines

- Install sensor on the secure side of the barrier (inside of the outer fence fabric)

- Install sensor as close as possible to expected point of impact with the barrier
  - You want to use the minimal amount of “gain” or “sensitivity” to obtain the desired PoD. This minimizes NAR.

Sensor Location Guidelines (cont.)

- Accommodate coexistence on the barrier with other systems and infrastructure.
- Be mindful of vulnerability to vandalism/attack and maintainability when locating sensor.

Examples of Barrier Variations

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Galvanized Chain Link Fence

Vinyl-Coated Chain Link Fence

Climb-Resistant Chain Link Mini-Mesh

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Welded Mesh Fence

Rigid Fence with Anti-Climb Fabric

Steel Pale Barrier

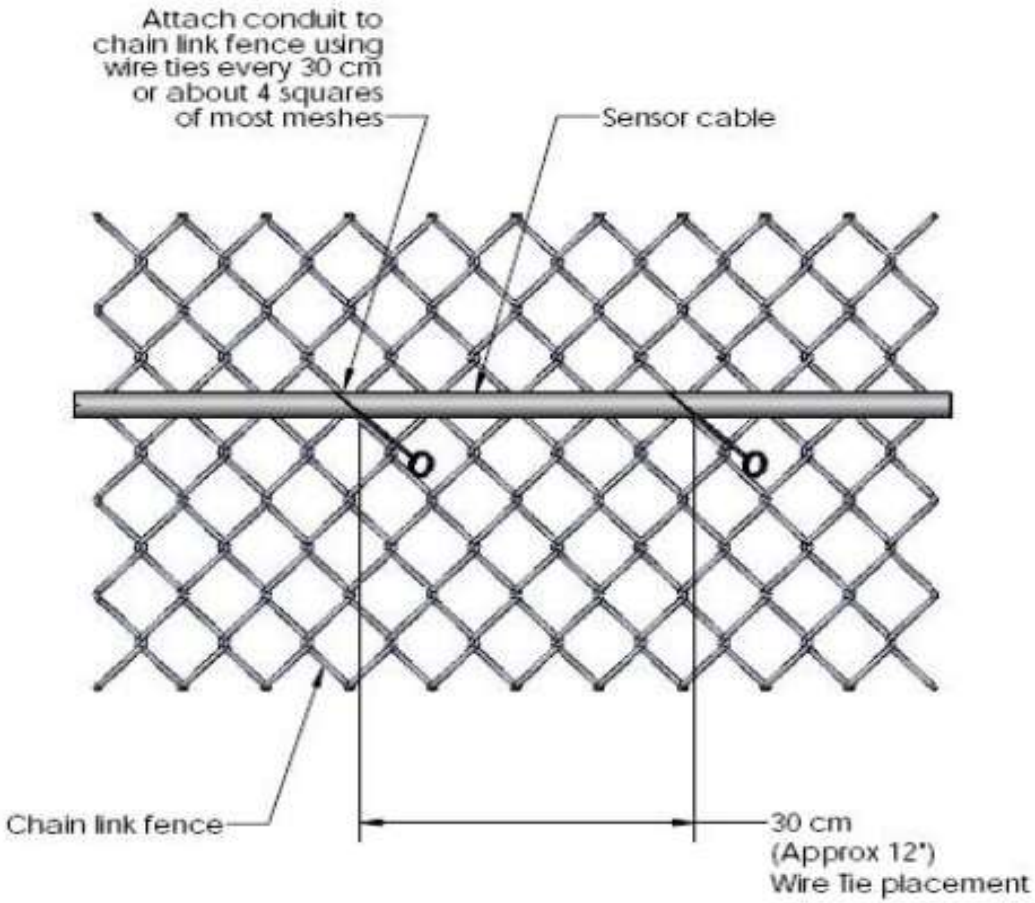
Concrete Wall

Masonry Wall

Fence Barriers

- Attach sensor (in flexible conduit) using stainless steel ties every one foot of sensor.
- Use two runs of sensor for the first eight feet of fence height for chain link, welded mesh, and expanded metal fabrics.
- Add a run of sensor for each additional four feet of fence height.

Sensor Attached to Chain Link Fence



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Sensor Attached to Expanded Metal Fabric

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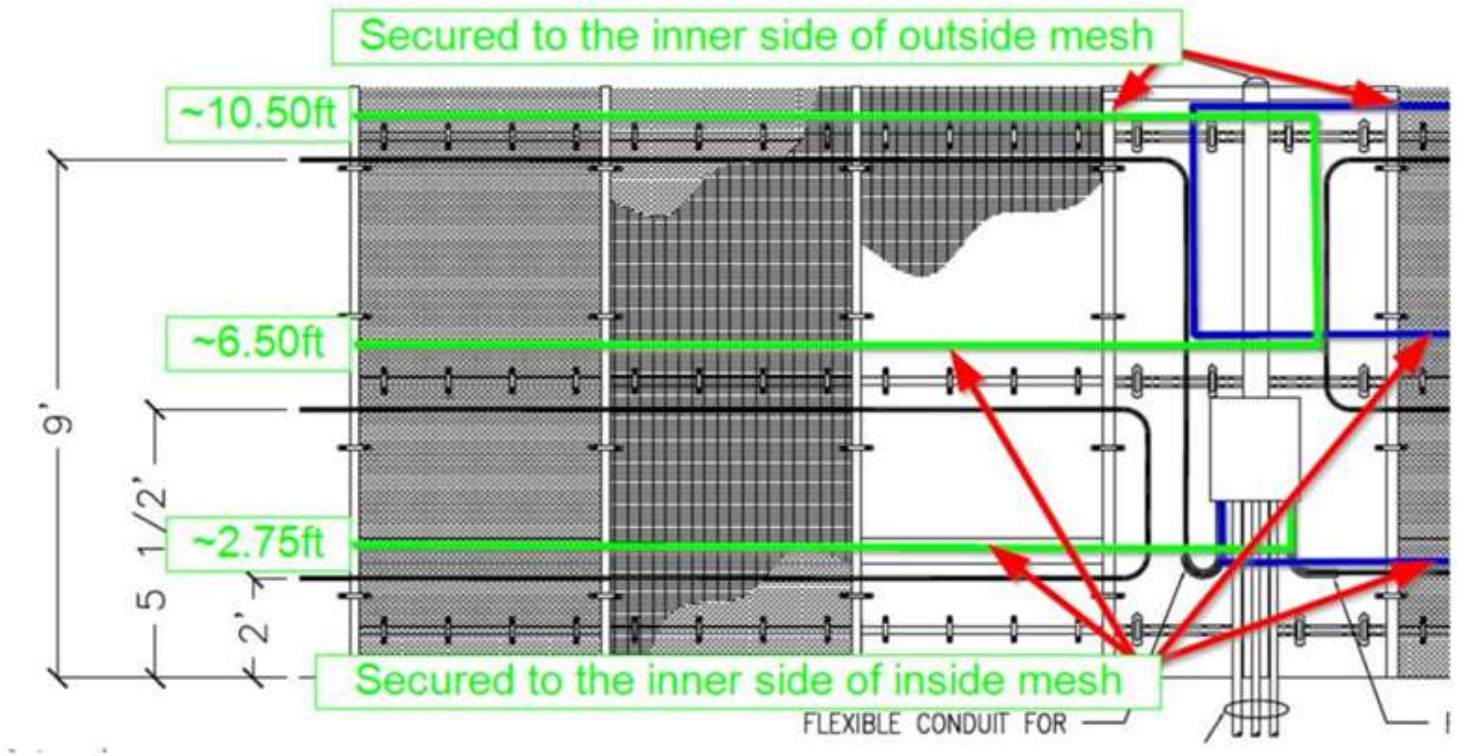
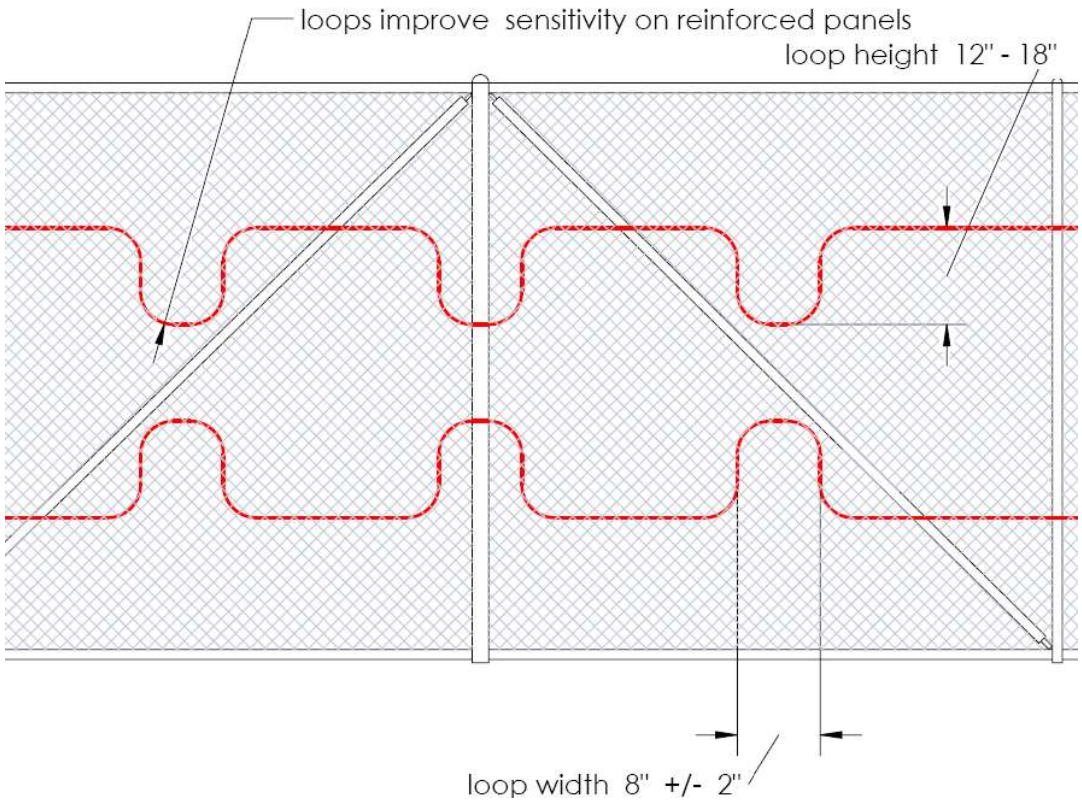
11 ft. Tall Fence With 3 Sensor Runs



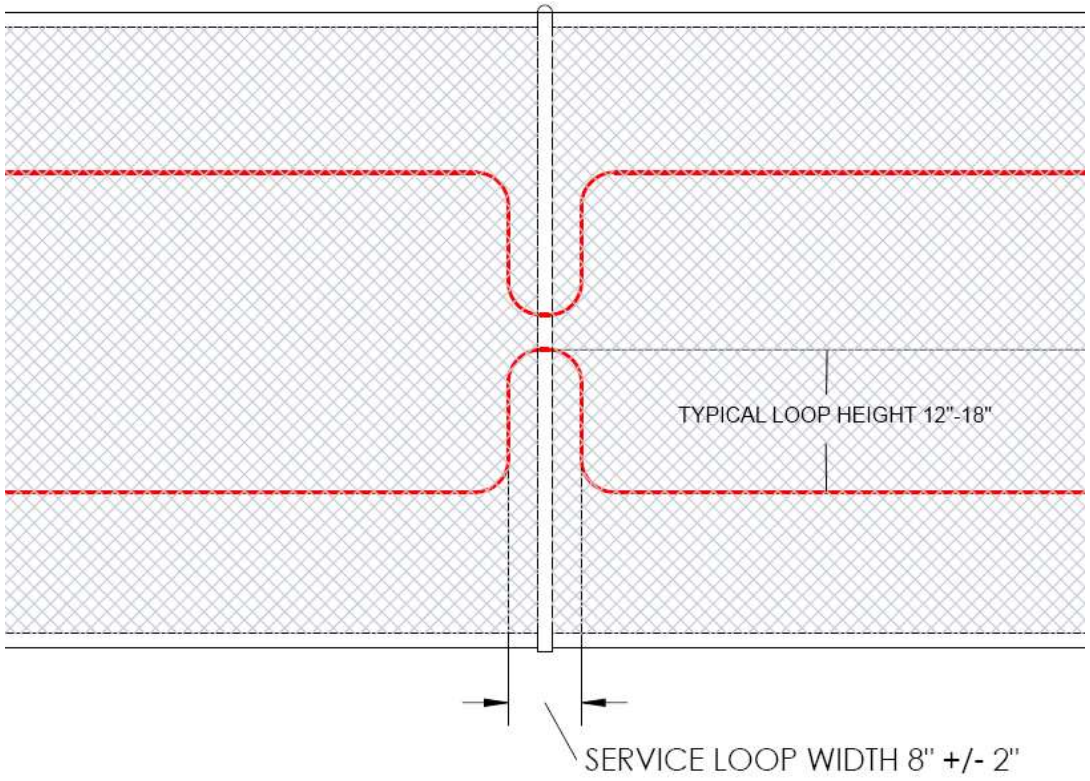
Fence Barriers

- Install additional sensor for reinforced panels, along pull posts, and for service loops.
- Within a detection zone, the barrier structure must be homogeneous. Do not combine different fence types such as chain link and expanded metal within a zone.

Add Sensor at Reinforced Fence Panels



Service Loops



Fence Barriers

- Keep in mind that the more rigid the structure, the smaller the propagation of vibrations.

Rigid Metal Panel Barrier

- Sensor is most often attached to the fence.
- Sensor may be installed in the fence, but this must occur in conjunction with the fence construction.

Sensor Attached to Barrier

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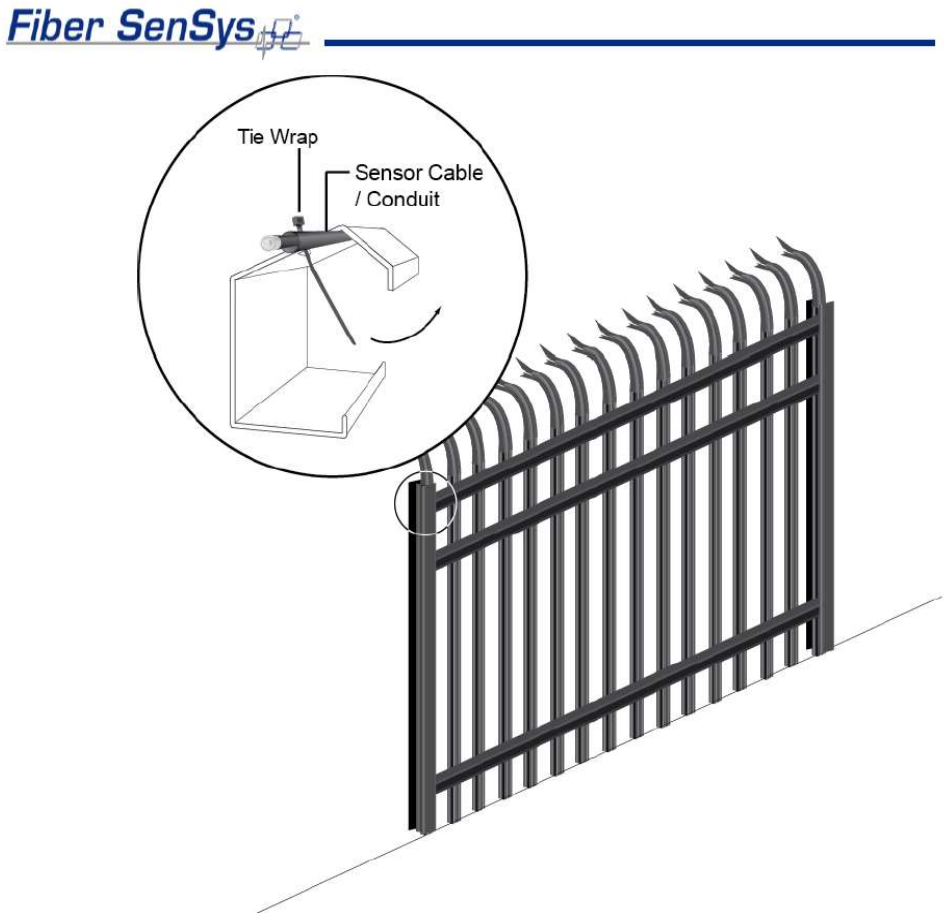
Sensor in the Rails

Steel Pale/Picket/Ornamental Barriers

- Run sensor along rails (horizontal members) or inside of rails

Sensor Installed in Steel Pale Barrier



Sensor Installed in Rail Using Clips

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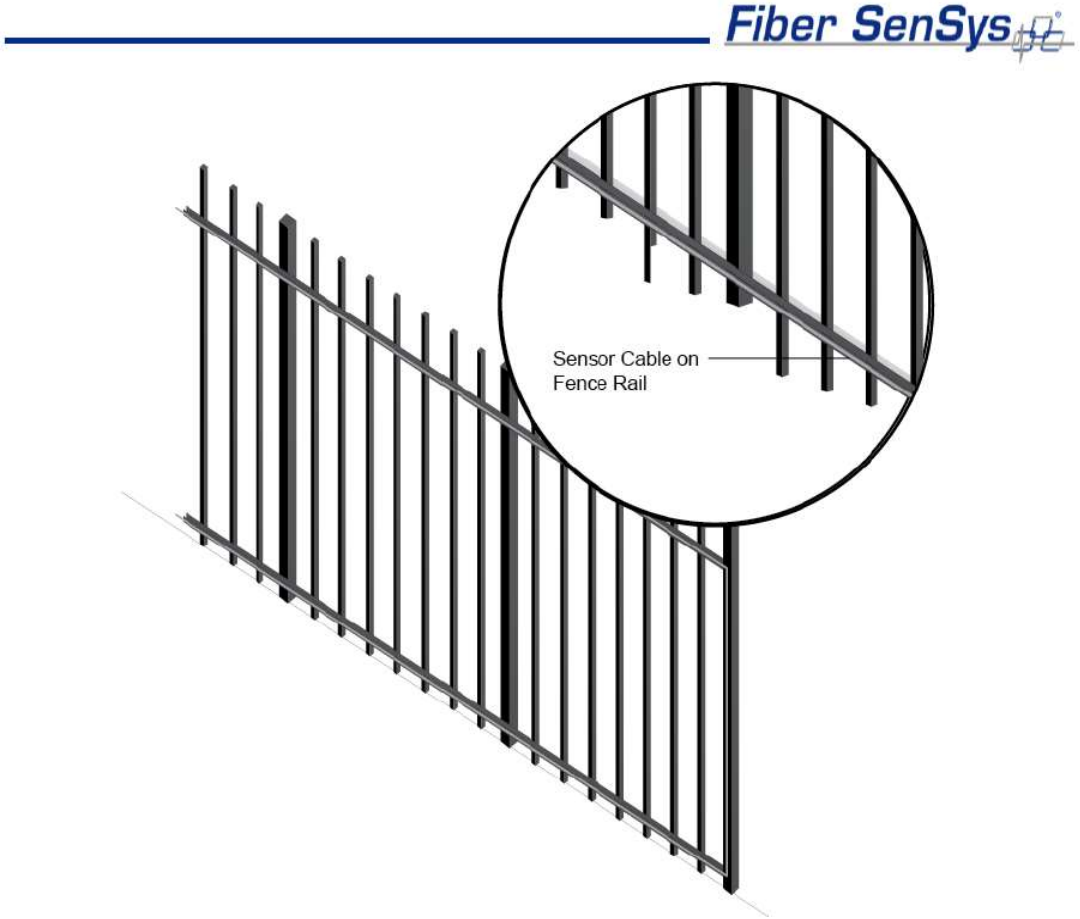
Sensor Attached to Ornamental Fence

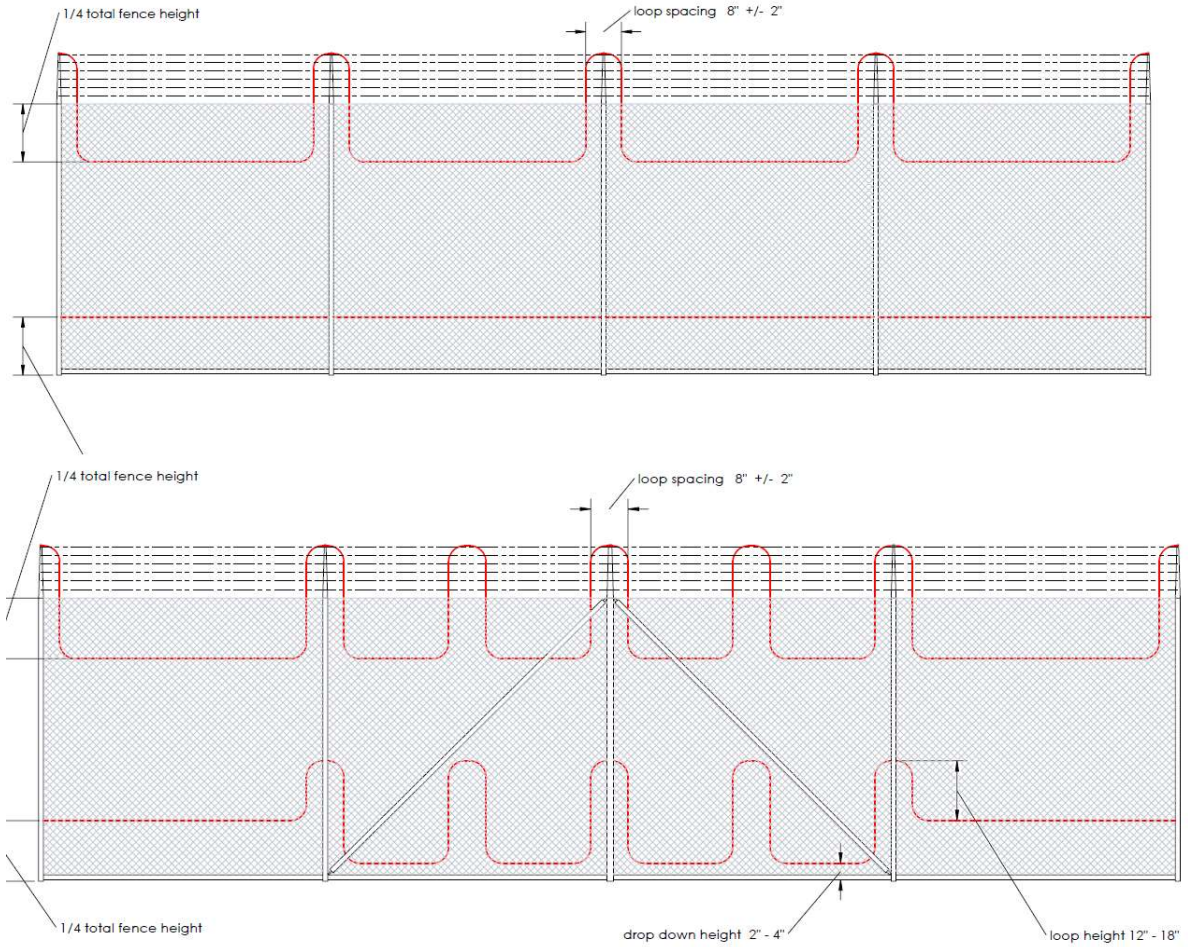


Detection in Top Guard Obstacle

- PL-1 military-style configuration
  - Top run of sensor extends to cover outriggers

- Separate detection zones for sensor run in top guard obstacles

MIL Sensor Configuration



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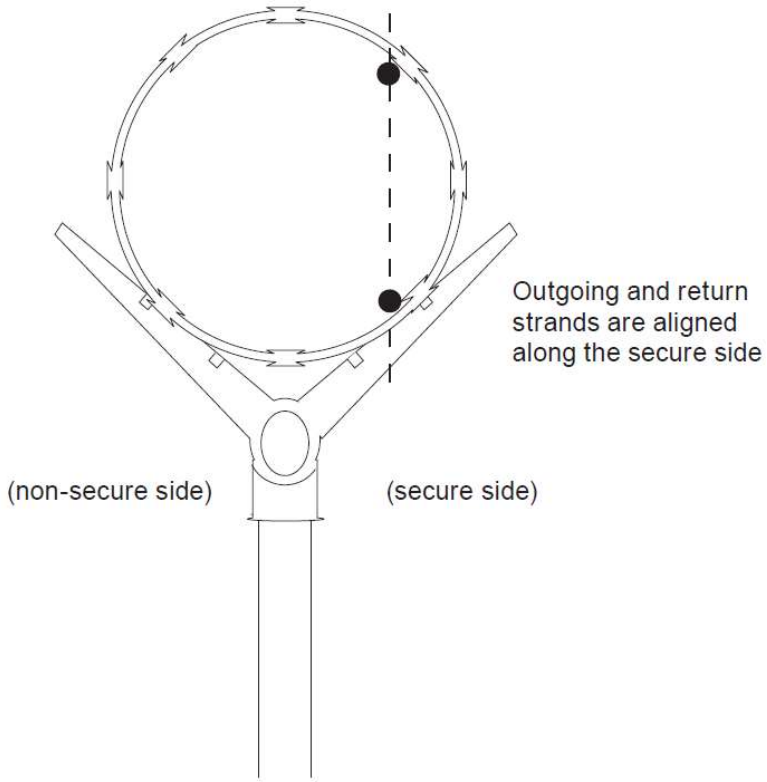
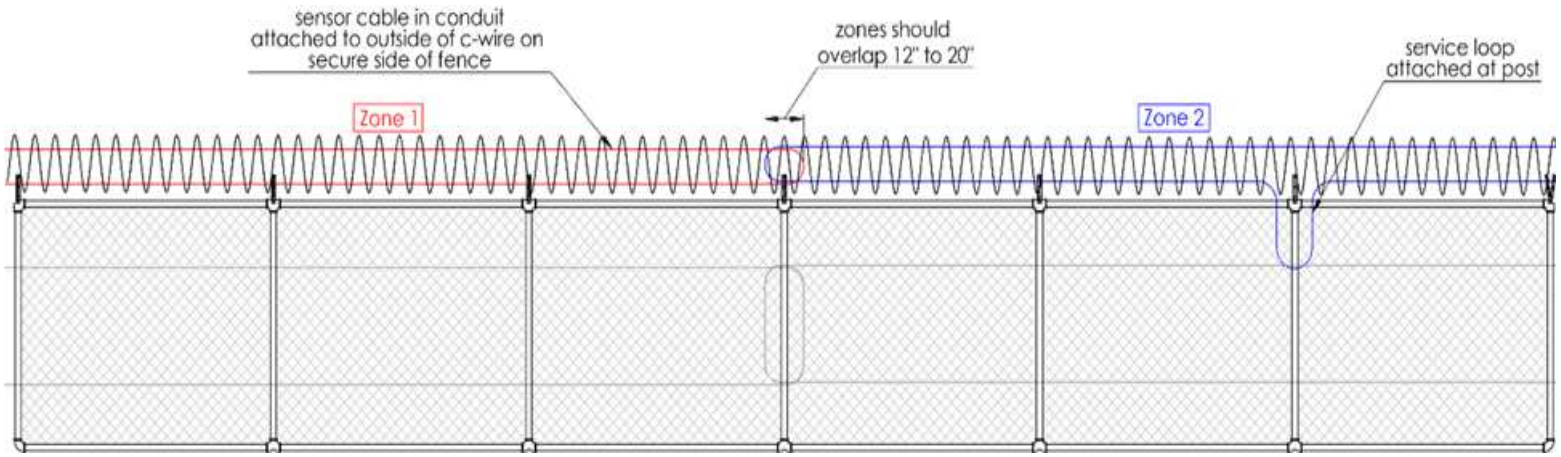
Sensor Attachment in Razor Ribbon



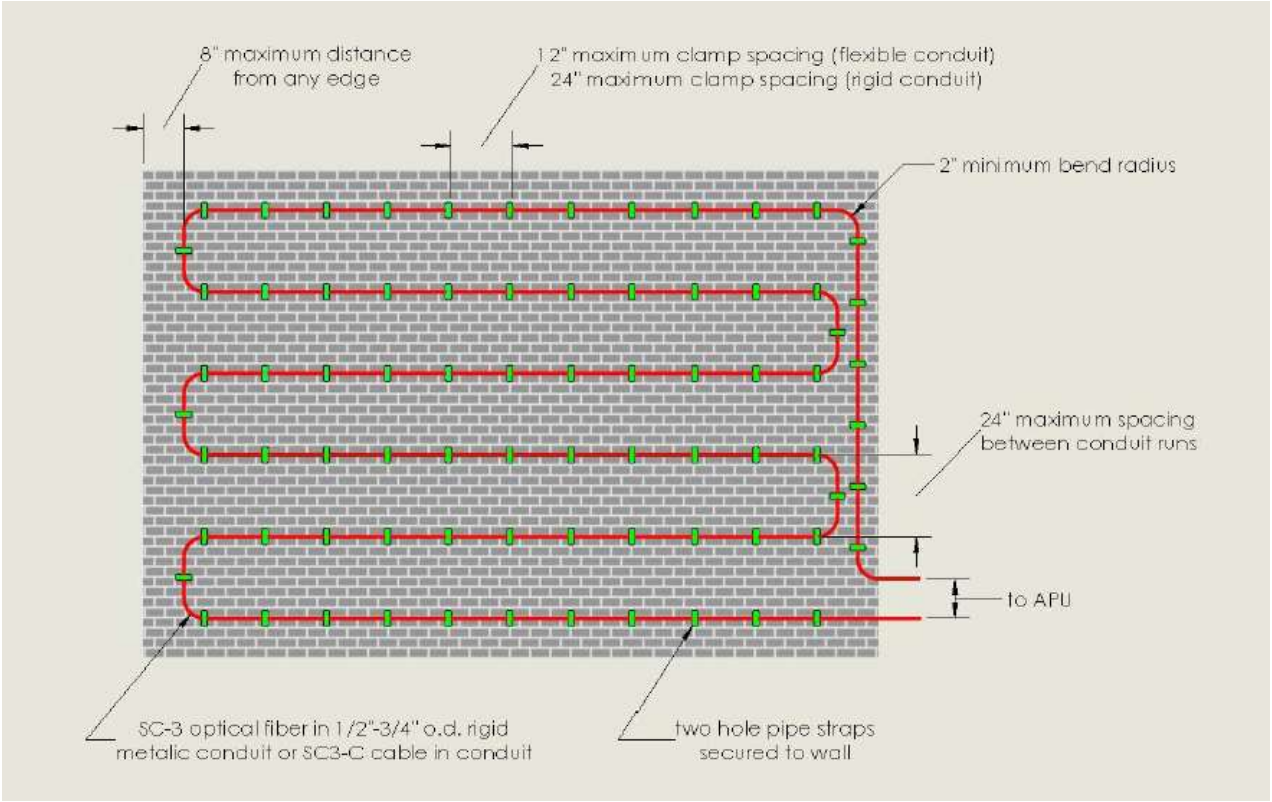
Sensor Installed in Top Guard



Walls

- Penetration detection
  - Sensor mounted to the secure side of wall in a “serpentine” pattern
- Climb-over detection
  - Sensor in top guard or on outriggers
  - Sensor on stand-offs to detect hand-hold or foot-hold attempts

Masonry Wall-Mounted Sensor



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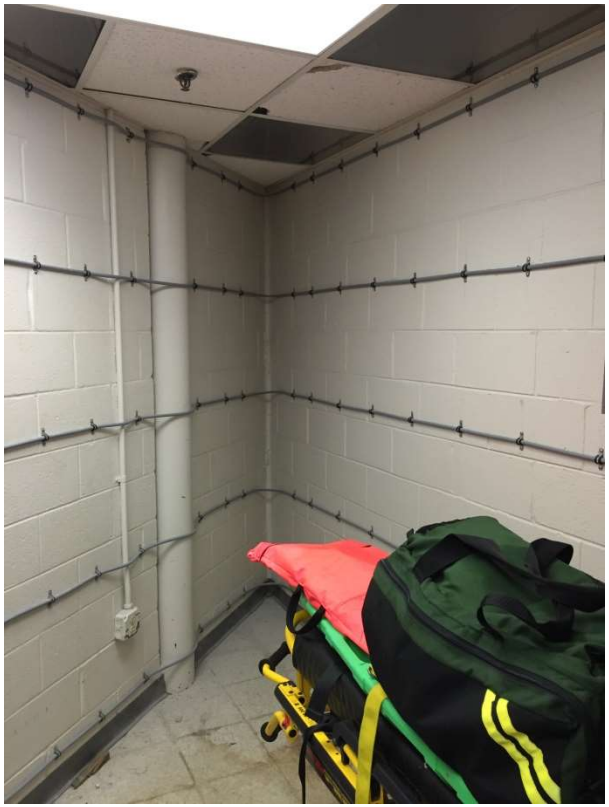
Sensor on Reinforced Concrete Block



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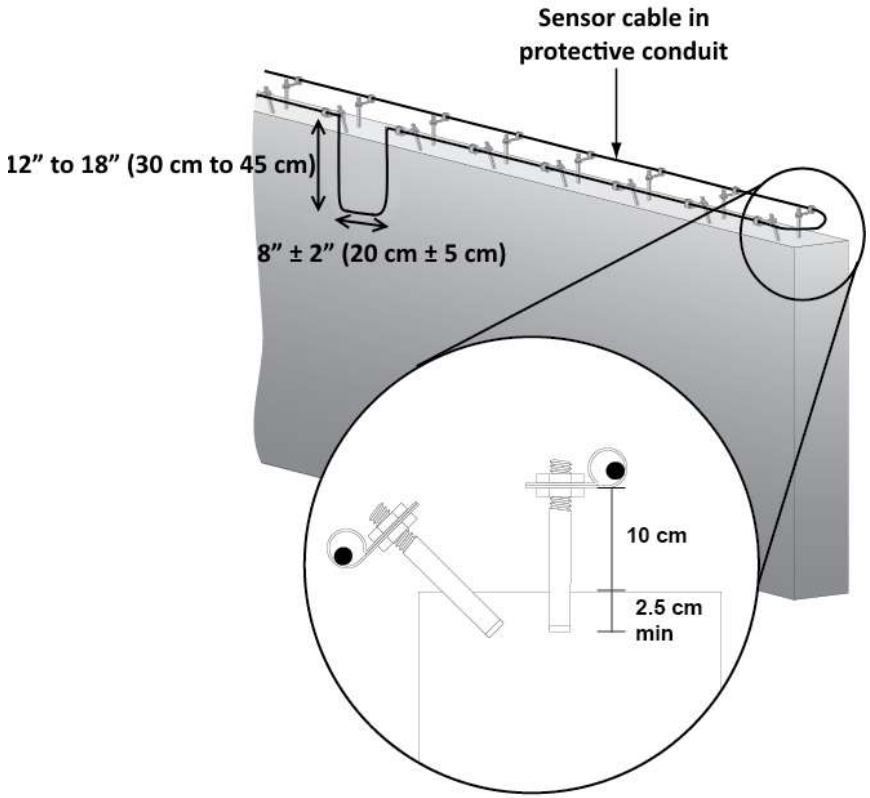
Sensor with Wall Top Outriggers

Wall Top Sensor on Stand-Offs



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Masonry Wall with Sensor on Stand-Offs

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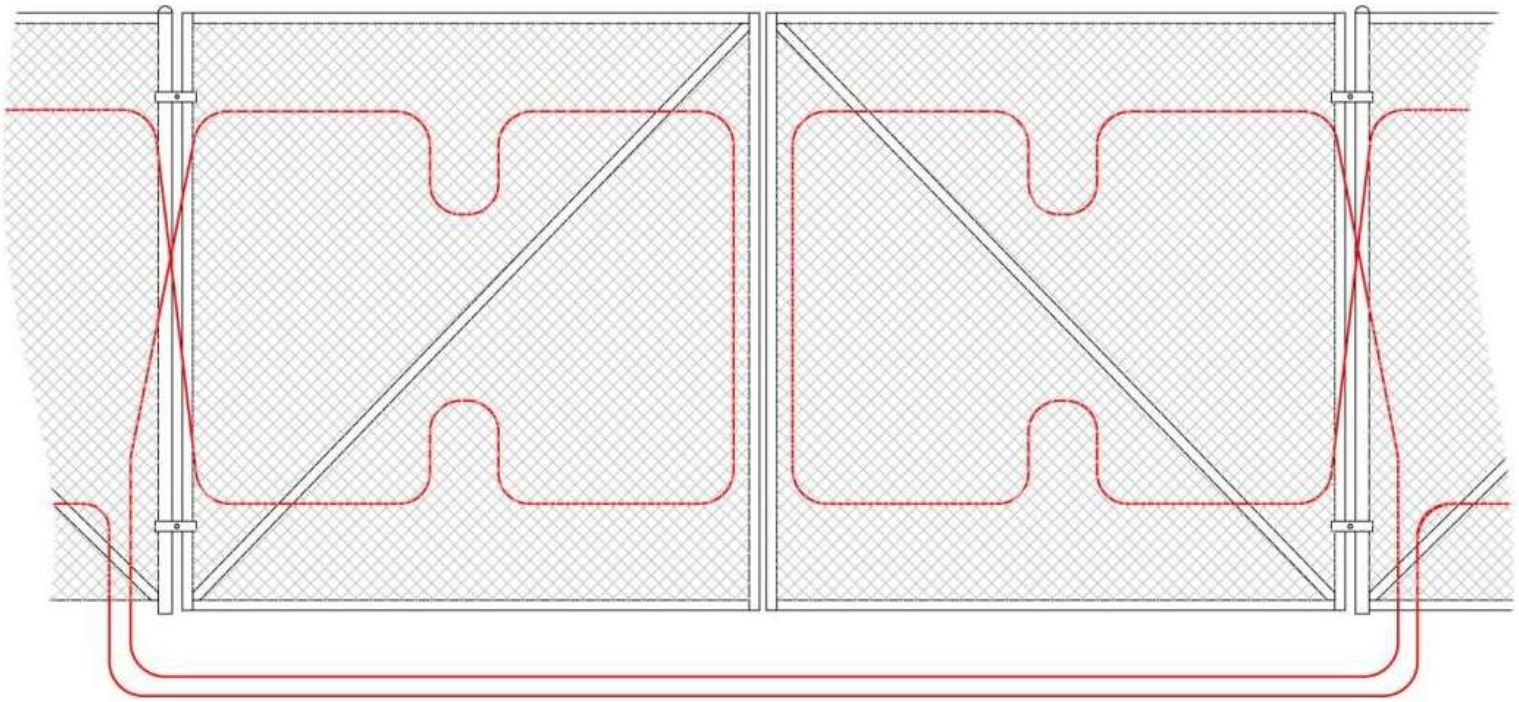
Gates

- Sensor can be installed on swing-type gates, crossing the hinge at a diagonal to prevent kinking of the sensor

- Use a cable trolley system or separate motion sensor to protect sliding gate areas

Double Leaf Swing Gate



Cable “Trolley” System for Sliding Gate

Other Concerns

- Loose fence fabric or components
- Loose signage
- Conduits run along interior of the barrier
- Drainage culverts
- Vegetation and overhanging tree branches
- Wildlife
- Weather
- Testing Methods

Sensor Woven in Culvert Grating

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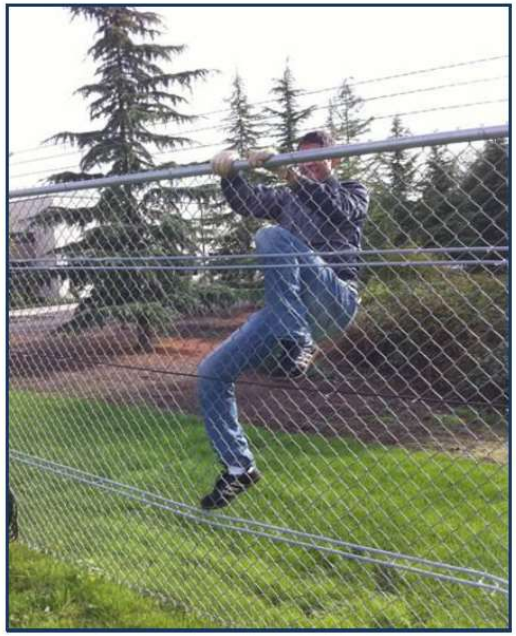
Testing Methods



Simulated intrusions should be performed in the same manner as the expected actual intrusions.

An inspection and test log will help ensure long-term performance and maintain accountability.

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Expanded Metal and Welded Mesh

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Sound-Dampening Panel

Perimeter Security
Today, it's more than just a fence.

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