

SYSTEM INTEGRATION TEST PROCEDURE (SITP)

FD-332 AND FD-342 FIBER DEFENDER SENSOR

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TEST INFORMATION

1.1 Test Background

Unit Under Test	The unit under test is a specific FD series model (FD-332 or FD-342) of a Fiber Defender Fiber-Optic Intrusion Detection System (FOIDS) ¹ from Fiber SenSys. Information specific to the unit under test will be annotated in Section 3 by the test team. The unit under test will be identified by its physical location, specified detection zone or sector, and/or its unique application. The specific FD series Fiber Defender sensor model used for the application will also be annotated in Section 3.
Test Event	System Integration Test Procedure (SITP)
Test Type	Performance Test
Performance Interval	SITPs shall be performed at the turnover of newly installed Electronic Sensor System (ESS) equipment and periodically thereafter in accordance with exterior sensor performance testing requirements. Annual testing of sensor or processor tamper switches should be conducted to verify they are working within specified parameters. System effectiveness testing shall also be required for the system following any maintenance that modifies the sensitivity or performance characteristics of the Fiber Defender sensor.
Data Management	Test data sheets shall be completed and retained by the maintenance organization. These acceptance test results shall be maintained as a baseline for comparison to future test results in order to track system issues that may occur over time. Performance measurements shall be maintained within the specifications of the site and the manufacturer's recommendations.
Procedure Purpose	The purpose of these procedures is to verify that an installed Fiber Defender system is operating at the appropriate level of performance to yield a 0.90 probability of sensing (P_s) at a 95% confidence level for its identified sensor detection zone or sector.
Procedure Scope	This document details the procedures necessary to complete a physical inspection of an installed Fiber Defender system to assure correct hardware installation and to verify correct system parameter settings. This document also details the procedures necessary to verify sensing performance. Results from initial testing may be used to establish an installation and performance baseline for the conduct of future performance tests.
Personnel Requirements	At a minimum, two individuals are required to perform this SITP: one individual will act as the adversary test subject to initiate alarms; the other individual will record test results and monitor alarms at the alarm console. This procedure shall only be performed by individuals authorized to conduct physical inspections and performance testing of this sensor.
Procedure Prerequisite(s)	Physical inspection will verify that the Fiber Defender system under test has been installed in accordance with site-specific application requirements, manufacturer's recommendations, and as recommended by Sandia National Laboratories (SNL) before performance testing is initiated. If physical inspection reveals deficiencies, corrective action shall be taken to assure proper installation <i>before</i> performance tests are conducted.

¹ Not to be confused with the registered trademark "Fiber Optic Intelligence & Detection System (FOIDS)" product from GM Merc (Europe) and GM COPE (USA).

Detection Requirements	<p>The following ESS detection requirements are applicable to this evaluation. At a minimum, the Fiber Defender sensor system shall demonstrate acceptable compliance with all applicable <i>Threshold</i> requirements.</p> <p>2.1.4: The ESS shall detect an individual weighing 35 kg or more climbing any sensed fence or exterior sensed building (Threshold).</p> <p>2.1.11: The detection probability of the ESS sensors should be greater than or equal to 90 percent and at a 95-percent confidence level (Threshold).</p>
Caveats/Requirement Deviations	<p>For test purposes, the following requirement deviations and/or test caveats are applicable:</p> <ul style="list-style-type: none"> ▪ If a 35 kg test subject is unavailable, a larger stature test subject may be used; however, every effort should be made to use the smallest stature test subject available. In all cases, the relative size and weight of the test subject shall be documented. ▪ When evaluated as the sensing <i>component</i> of an overall ESS, the Fiber Defender will be tested to determine P_S at a 95% confidence level rather than P_D.
Test Methods	<p>The following test methods will be used to verify the Fiber Defender sensor under test is installed correctly and is operating at the appropriate performance level:</p> <p><u>Physical Inspection</u></p> <p>The sensor under test will be physically inspected to verify it is installed and calibrated correctly for its specific site application or detection zone/sector.</p> <p><u>Performance Testing</u></p> <p>The "30/30" test methodology and binomial distribution will be used to yield P_S performance results at a 95% confidence level to verify that the sensor is operating at the appropriate level of performance for its specific site application. Using this methodology, if the sensor alarms 30 times when subjected to 30 attempted intrusions, the P_S value is equal to 0.90 at a 95% confidence level based on the values derived from a binomial reliability table [1].</p>
Adversary Approach Methods/Intrusion Modes	<p>For performance testing, the following adversary approach methodologies will be used:</p> <ul style="list-style-type: none"> ▪ Climbing ▪ Simulated Cutting. <p>Additionally, tests will be conducted to verify processor tamper switch functionality.</p>

1.2 Test Preparation

Test Preparation	<p>The test team shall perform all necessary prerequisite actions to assure communication and coordination with site security personnel before testing is initiated.</p>
Test Equipment	<p>At a minimum, the following test equipment is required:</p> <ul style="list-style-type: none"> ▪ Test device for simulated cut tests. (See Southwest Microwave website for Cut Simulator Tool.) ▪ Radio or similar device to facilitate communication between the adversary test subject and the alarm monitor. ▪ This procedure document to annotate test results.
Test Setup	<p>The test team shall perform all necessary prerequisite actions to ensure conditions are appropriate for testing, and that all equipment necessary for testing is in place before testing is initiated.</p>

1.3 Test Instructions

<p>Data Collection</p>	<p>Pass/Fail and overall test results will be recorded in Sections 3 and 4 of this document; additional relevant test data will be recorded on the attached data sheets.</p> <p>The location and identification of the unit under test, test conditions (e.g., weather conditions) test subject stature, system settings, and performance test results (to include derived P_s values) shall be annotated in Attachment A.</p>
<p>Pass/Fail Criteria</p>	<p>The following are the expected test results; if these results are not achievable, the test is considered a failure, corrective action is required, and subsequent testing is necessary to verify compliance with detection requirements. If a <u>Fail</u> result is corrected on-site to return a subsequent <u>Pass</u> result, then the procedure result is a <u>Pass</u>. Any and all corrective actions taken or recommended shall be documented.</p> <p><u>Physical Inspection</u></p> <ul style="list-style-type: none"> ▪ Physical inspection shall verify that the Fiber Defender system under test is installed and calibrated correctly for each application and specified detection zone or sector. ▪ If any physical inspection procedure returns a <u>Fail</u> result, corrective action must be taken to assure proper installation and/or calibration <i>before</i> performance test procedures are conducted. <p><u>Performance Testing</u></p> <ul style="list-style-type: none"> ▪ Performance testing shall verify that the Fiber Defender system under test returns a 0.90 P_s at a 95% confidence level against all adversary approach methods. ▪ For performance testing and P_s determination, an individual test trial shall be considered a failure if the adversary can climb to the top of the fence without generating an alarm or if a simulated cut test does not cause an alarm. ▪ Processor enclosure tamper switch tests shall verify that an alarm is received before the enclosure cover is opened more than one inch.
<p>Special Test Conditions</p>	<p>It is recommended that performance test procedures be repeated for varying weather conditions (e.g., rain, wind) to ensure compliance for efficient operation in all weather conditions.</p>
<p>Safety</p>	<p>The following minimum safety standards shall be employed throughout all phases of performance testing:</p> <ol style="list-style-type: none"> 1. If an unsafe condition is encountered during the course of testing, testing shall be stopped until the concern has been corrected and the test environment has been restored to a safe condition.

Safety (cont'd)	<ol style="list-style-type: none"> 2. All exterior systems are powered by low voltage power supplies that are located in the perimeter field junction boxes (FJB). These power supplies are supplied with 110 Vac from within the FJBs. All terminations of 110 Vac power within the panels are enclosed or designed to be finger safe; however, care should be taken when working within the field panels. 3. Appropriate safety measures shall be utilized when testing sensors located at heights above six feet, or if the test subject is required to work within six feet of the edge of a building.
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2 Test Procedure Descriptions

2.1 Physical Inspection Procedures

Physical Inspection Procedures	<p>Perform the following inspection procedures for each sector of the Fiber Defender system under test, as applicable, to verify proper installation.</p> <p><u>Procedure 1: Verify Conduit Spacing</u></p> <p>Verify that conduit is installed as applicable for the specific application. For fence-mounted applications, the upper stand should be installed approximately 24 inches down from the top of the fence fabric, and the bottom strand should be installed approximately 24 inches up from the bottom of the fence fabric.</p> <p><u>Procedure 2: Verify Conduit is Securely Attached</u></p> <p>Verify that the conduit is securely attached to the fence fabric at every 12-inch interval along the conduit. The ties should be secure, but not to the point of crushing the conduit.</p> <p><u>Procedure 3: Verify Sensitivity Loop Installation</u></p> <p>Verify that a sensitivity loop (approximately 18-inches in diameter) is installed at 1) each tension post, 2) each corner post, and 3) in the middle of each panel where a support post is located.</p> <p><u>Procedure 4: Verify Service Loop Installation</u></p> <p>Verify that a service loop (approximately 18-inches in diameter) is installed approximately every 100 feet (or every tenth panel).</p> <p><u>Procedure 5: Record Processor Settings</u></p> <p>Using the Spectraview software and a laptop computer connected to the serial port of the processor, verify that all processor settings are within specified and/or recommended ranges; document the system power, laser current, and loss parameters on the attached data collection sheet.</p> <p>Acceptable ranges for these parameters are as follows:</p> <ul style="list-style-type: none"> ▪ <u>System Power</u>: 12 to 24 Vdc ▪ <u>Laser Current</u>: 17 to 35 mA ▪ <u>Loss</u>: less than 25db
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2.2 Performance Test Procedures

<p>Notes</p>	<p><u>Resettling Time</u></p> <p>When performing the performance test procedures, allow sufficient time for the system under test to stabilize or re-set between each individual test trial.</p> <p><u>Verification of Failure to Alarm</u></p> <p>If an alarm is not received for a given trial, two more attempts may be made at the same location using the same test method. The trial can be considered a valid detection and testing can proceed <u>only if</u> both of the additional trials result in successful alarms. If either additional trial results in a failure, testing of the system shall cease and corrective action shall be taken. Following required maintenance or recalibration, the complete performance test procedure shall be conducted again using the same test methodology at all test locations (if possible) to verify acceptable sensor performance. If sensing performance does not meet requirements after all reasonable corrective actions have been attempted, the test shall be annotated as a failure.</p> <p><u>Test Performance</u></p> <p>Performance tests shall be conducted at 30 equidistant points along the length of the detection zone/sector. One or more test trials will be performed for each of the 30 test locations. Particular attention should be placed on locations where sensitivity might vary if the installation configuration varies from the norm, such as at corners, sector overlaps, and where the sector may overlap with another technology (e.g., IR towers).</p>
<p>Performance Test Procedures</p>	<p><i>Note: These procedures may be performed out of sequence at the discretion of the evaluation team.</i></p> <p><u>Procedure 1: Conduct Climb Tests</u></p> <p>Conduct 30 climb tests within the detection zone/sector to verify $P_S = 0.90$ at a 95% confidence level.</p> <p>Each sector shall be tested 30 times at points equidistant along the length of the sector. For this procedure, the adversary test subject shall attempt to climb the fabric from the outer (unprotected) side of the inner perimeter fence. When testing along the fence with the complementary fence-mounted Perifield-M sensor installation, climb tests shall be conducted from the inner (protected) side. When climb testing the fence from the inner side, do not use the fence support posts to aid in climbing. A failure shall be recorded if the adversary test subject can reach the top of the fence and start to go over without an alarm being generated.</p> <p><u>Procedure 2: Conduct Simulated Cut Tests</u></p> <p>Using the simulated cut device, conduct 30 simulated cut tests within the detection zone/sector to verify $P_S = 0.90$ at a 95% confidence level.</p> <p>Each sector shall be tested 30 times at points equidistant along the length of the sector. For each trial, use the cut simulation tool to strike the fence (releasing the plunger from the middle notch) _____ times at a point either 12 inches from the ground, 12 inches from the top of the fence, or at a point in the middle of the fence that is equidistant between both fiber conduits. Ensure that the test device is firmly pressed against the fabric when releasing the plunger. The strikes should be at approximately _____ second intervals. A failure shall be recorded if the tester can strike the fence _____ times within the designated timeframe without generating an alarm. (Note: These three times are user defined based on sensor processor settings.)</p> <p><u>Procedure 3: Verify Processor Enclosure Tamper Alarm</u></p> <p>Test the tamper alarm of the processor enclosure by slowly opening the door to the enclosure. A failure shall be recorded if an alarm is not received or the cover can be opened more than one inch before an alarm is received.</p>

3 Pass/Fail Results

To be completed by the test and evaluation team. Record overall results in Section 4; record test data on the attached data sheets.

3.1 Sensor Identifier

Identify the Fiber Defender sensor application by its physical location, specified detection zone or sector, or its unique application; indicate whether the sensor is the FD-332 or FD-342 series.

Sensor Location/Sector/Zone (as applicable): _____

FD-332

FD-342

3.2 Physical Inspection Pass/Fail Results

Notes:

1. If a **Fail** result is corrected on-site to return a **Pass** result, indicate “Pass” in the matrix below and describe 1) the conditions leading to the original failure and 2) all corrective actions taken to return and verify a subsequent Pass result. Summarize this information in the “Notes” column and provide additional details in Section 4.

Procedure Number	Test	Expected Result	Pass	Fail	No-Test	Notes
1	Inspect the system along all installation sections to verify conduit spacing.	Conduit strands are correctly spaced at approximately 24 inches down and 24 inches up from the top and bottom of the fence fabric.				
2	Inspect the conduit along the length of the installation to verify conduit spacing is securely attached.	The conduit is securely attached to the fence fabric at every 12-inch interval along the conduit.				
3	Inspect the system along all installation sections to verify sensitivity loops are installed at all appropriate locations.	Sensitivity loops are installed at each tension post, each corner post, and in the middle of each panel where a support post is located.				
4	Inspect the system along all installation sections to verify service loops are installed at all appropriate locations.	Service loops are installed approximately at every 100 feet (or every tenth panel).				
5	Using the Spectraview Software and a laptop computer connected to the processor serial port, verify processor settings are within acceptable parameters; record these settings on the attached data collection sheet.	Processor settings are within acceptable parameters.				

3.3 Performance Test Pass/Fail Results

Notes:

1. If any Physical Inspection procedure returns a **Fail** result, corrective action must be taken to assure proper installation before performance test procedures are conducted.
2. If a **Fail** result is corrected on-site to return a **Pass** result, indicate “Pass” in the matrix below and describe 1) the conditions leading to the original failure and 2) all corrective actions taken to return and verify a subsequent Pass result. Summarize this information in the “Notes” column and provide additional details in Section 4.

Procedure Number	Test	Expected Result	Pass	Fail	No-Test	Notes
1	Conduct 30 climb tests to determine P _S at a 95 % confidence level; record results on the attached data collection sheet.	The sensor demonstrates a P _S of 0.90 at a 95% confidence level.				
2	Conduct 30 simulated cut tests to determine P _S at a 95 % confidence level; record results on the attached data collection sheet.	The sensor demonstrates a P _S of 0.90 at a 95% confidence level.				
3	Verify tamper switch alarm functionality for processor enclosure; record results on the attached data collection sheet.	An alarm is received from the processor enclosure if opened (this test fails if the processor enclosure cover can be opened more than one inch without returning an alarm).				

4 Overall Test Results

To be completed by the test and evaluation team. If additional space is required to record notes or other information, use Attachment B.

Test Performed by	
Date(s) of Test	
Overall Results	<i>Indicate the applicable overall result.</i> <input type="checkbox"/> PASS if all pass/fail tests identified in Section 3 passed. <input type="checkbox"/> FAIL if any step failed. <input type="checkbox"/> No-Test if you were unable to complete any step of the test procedure.
Test Anomalies	<i>Indicate any conditions and/or problems that affected the conduct of the test or resulted in a No-Test parameter.</i>
Comments	<i>Indicate any events, variances from the test procedures, documentation discrepancies, etc. that did not affect the pass/fail criteria.</i>

Recommendations

Provide recommendations for those areas requiring investigative or corrective actions, including any requirements for re-testing. Include recommended design changes or waivers/deviations.

REFERENCES

- [1] Cooke, J.R., M. Lee, and J. Vanderbeck, *Binomial Reliability Table: Lower Confidence Limits for the Binomial Distribution*, NAVWEPS Report, NOTS TP 3140, 1964.

TERMS AND ACRONYMS

Acronym	Definition
db	decibels
ECP	Entry Control Point
ESS	Electronic sensor system
FJB	field junction box
FOIDS	Fiber-Optic Intrusion Detection System
ft/s	feet per second
in/s	inches per second
lb	pound
mA	milliamps
P_A	probability of assessment
P_c	probability of communication
P_D	probability of detection
PIDAS	Perimeter Intrusion Detection and Assessment System
P_s	probability of sensing
SITP	System Integration Test Procedure
SNL	Sandia National Laboratories
TADI	Test, Analysis, Demonstration, Inspection
Vdc	Volts Direct Current
VECP	Vehicle Entry Control Point

GLOSSARY

Term	Definition
Analysis	The processing of accumulated data obtained from other qualification methods. Examples are reduction, interpolation, or extrapolation of test results.
Demonstration	The operation of the system, or a part of the system, that relies on observable functional operation not requiring the use of instrumentation, special test equipment, or subsequent analysis.
Inspection	The visual examination of system components, documentation, etc.
Performance Test	A test performed to verify that an ESS sensor is operating at a level of detection to yield a 90% P_D at a 95% confidence level. When a sensor is tested as a component of an ESS, the relevant performance metric is P_S rather than P_D .
probability of assessment (P_A)	The probability of accurate assessment of an alarm.
probability of communication (P_C)	The probability that an alarm indication will be effectively communicated to an assessment point.
probability of detection (P_D)	The mathematical product of the probabilities of sensing, communication, and assessment ($P_D = P_S \times P_C \times P_A$).
probability of sensing (P_S)	The probability that an intrusion detection sensor will generate an alarm, or "sense" an unauthorized intruder within the sensor's detection envelope.
Special Qualification Methods	Any special qualification methods for the system, such as special tools, techniques, procedures, facilities, acceptance limits, use of standard samples, preproduction or periodic samples, pilot models or pilot lots.
System Integration Test Procedure (SITP)	A test procedure performed to ensure an installed sensor is functioning in accordance with performance requirements.
Test	The operation of the system, or a part of the system, that uses instrumentation or other special test equipment to collect data for later analysis.

Attachment A: Fiber Defender Test Data Collection Sheet

To be completed by the test and evaluation team

Sensor Identifier

Identify the Fiber Defender sensor application by its physical location, specified detection zone or sector, or its unique application; indicate whether the sensor is the FD-332 or FD-342 series.

Sensor Location/Sector/Zone (as applicable): _____

FD-332

FD-342

Processor Settings, as measured or indicated by the Spectraview software (Physical Inspection Procedure 6):

System Power: _____ Vdc (12 to 24 Vdc)

Laser Current: _____ mA (17 to 35 mA)

Loss: _____ db (less than 25db)

Performance Test Results

Test Date(s)				
Tests	Weather Conditions	Adversary Stature (weight and height)	Alarms/Tests (30/30)	Ps @ 95% Confidence Level
Climbing				
Cutting				
Tamper Switch Test	Alarm? (Yes or No):			

Performance Test Results (cont'd)

Comments	

Attachment B:
Additional Space for Data Collection
