

Module 6. Performance Testing of Interior Detection Systems



Module 6 - Performance Testing of Interior Detection Systems

Integrated Performance Testing Workshop

SAND2012-9025P



Objectives

- Review role of interior detection sensors
- Define performance characteristics of interior sensor technologies
- Identify methods to conduct general performance tests of interior sensors

2



Acronyms used in this Module

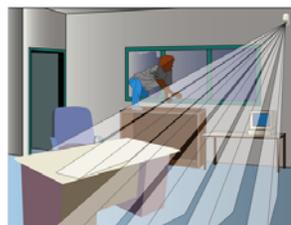
- **cm/sec** – centimeters per second
- **P_D** – probability of detection

3



Interior Sensor Classification

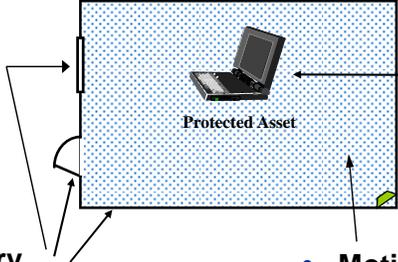
- **Passive or active**
- **Covert or visible**
- **Volumetric or line detection**
- **Mode of application**
 - **Boundary penetration**
 - **Interior motion**
 - **Proximity**



4

Modes of Application – Interior Sensors



- **Boundary**
 - Detection at doors, windows, walls, vents, floors, ceilings, etc.
 - Detection zone easily identified
- **Motion**
 - Detection in a volume of space
 - Detection volume usually not visible
- **Proximity**
 - Detection at an object

5

Balanced Magnetic Switch Performance Characteristics

- **Balanced Magnetic Switch systems include**
 - Sensor
 - Device on which sensor is installed
 - For example, door or window
- **Nuisance alarms**
 - Usually caused by worn or improperly adjusted door hardware
 - May be caused by improperly installed or adjusted Balanced Magnetic Switch



Sensors seldom nuisance alarm by themselves

6



Balanced Magnetic Switch Performance Tests



- With alarm in secure mode, open door
 - Was alarm properly initiated?
- With door closed and Balanced Magnetic Switch in secure state:
 - Remove cover from the unit
 - Verify that an intrusion alarm is initiated
- Remove cover and verify that tamper alarms
- Place magnet near Balanced Magnetic Switch unit
 - Is a tamper alarm or sensor alarm generated?
- Attempt to bypass Balanced Magnetic Switch
 - Can switch be physically bypassed easily?

7



Balanced Magnetic Switch Performance Tests *(continued)*



- With alarm in secure mode, open door multiple times
 - Was the distance of the door opening when the alarm occurred between 1.3 cm and 2.5 cm each time?
 - If no, check for proper installation and adjustment
 - Can door be opened without initiating an alarm?
- Conduct multiple repetitions to determine Probability of Detection (P_D)



8

Volumetric Sensor Technologies

- **Passive infrared** → 
- **Monostatic microwave** ↘ 
- **Dual technology (Dual-tech)** ↓ 

03/29/2005

9

Basic Principles of Operation: Passive Infrared and Microwave

- **Passive Infrared Sensor**
 - Receives infrared energy (heat) from objects in area
 - Detection of motion occurs by measuring changes in received infrared energy
- **Microwave Sensor**
 - Monostatic (transmitter and receiver co-located)
 - Detects Doppler shift of a known transmitted frequency
 - Most sensitive direction is directly towards or away from the sensor
 - Nuisance alarm sources
 - Movement of reflective objects, fluorescent lights, animals and insects, electromagnetic interference

10

Dual Technology Sensors

- **Sensor Classification**
 - Active and passive
 - Visible
 - Volumetric
- **Combines two sensor technologies**
 - **Passive Infrared and Microwave**
 - Most common
 - **Passive Infrared and Ultrasonic**
 - **Passive Infrared and Glass break**



11

Dual Technology Sensor Operation

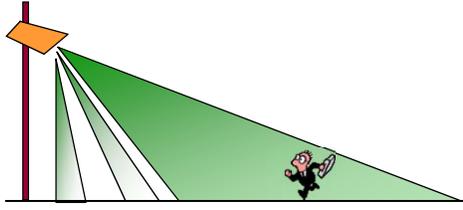
- **“AND” sensor outputs**
 - Both sensors must detect motion before alarm is generated
- **“OR” configuration**
 - If either sensor detects motion, an alarm is generated
 - Configuration is similar to placing two separate sensors in same location
 - With passive infrared and microwave, one sensor will not be as effective with regard to direction of motion
 - Nuisance alarms are not reduced



12

 **Volumetric Sensors** 
Performance Characteristics - P_D

- **Probability of Detection (P_D)**
 - **Most sensitive to movement across field-of-view**
 - **Also sensitive to**
 - Velocity of intruder
 - Size of intruder
 - Height and angle of installation

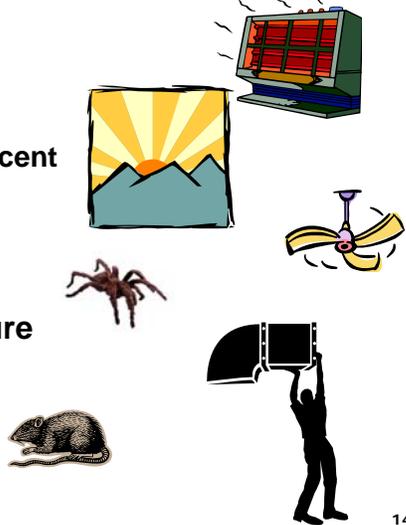


Side View

13

 **Performance Characteristics –** 
Nuisance Alarm Sources

- **Localized heating**
 - Heaters, radiators
 - Sunlight
 - Nearby unshielded incandescent light
- **Moving air**
- **Animals or insects**
- **Sensor and mounting structure vibrations**



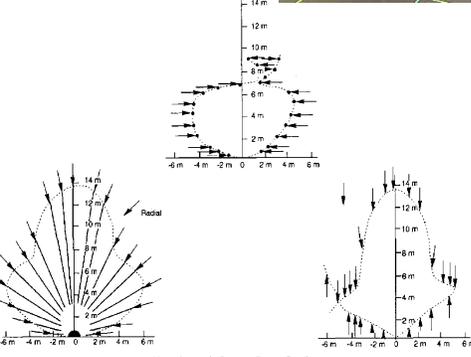
14

 **Volumetric Sensors**
General Performance Testing



- Conduct tests in least sensitive direction
 - Across sensor field-of-view
- Approach
 - Walk (30 cm/sec)
 - Crawl tests (30 cm/sec)
- Direction
 - Radial
 - Tangential (30 cm/sec)
- Verify manufacturer's published detection area





Note: Arrows indicate walk-test direction

15

 **Passive Infrared Sensor**
Performance Testing



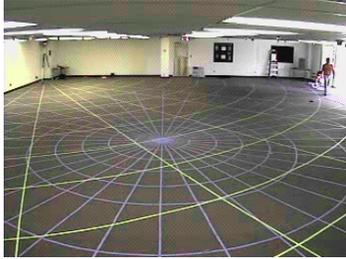
- Conduct tests in radial and tangential directions
- Perform slow walk
 - 30 cm/second
- Approach from least sensitive direction
 - Directly towards sensor
- Crawl
 - 30 cm/second
- Verify detection area and compare to manufacturer's published detection area



16

 **Dual Technology Sensor Performance Testing** 

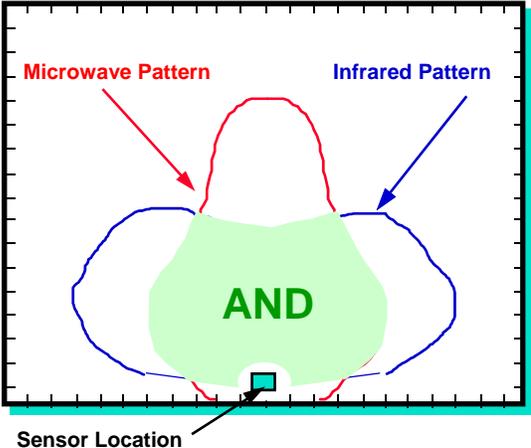
- Conduct tests in most sensitive direction of passive infrared sensor
 - Across sensor field-of-view
- Approach
 - Walk (30 cm/sec)
 - Crawl tests (30 cm/sec)
- Direction
 - Radial
 - Tangential (30 cm/sec)



17

 **Dual Technology Sensor Detection Pattern** 

Basic dual technology detection pattern with the intruder walking towards the sensor



18



Evaluation of Installed Sensors: Operability Testing



- **Operability testing**
 - **Performed on a frequent basis**
 - Daily or weekly
 - **Verify that the sensor is operational**
 - **Simple test**
 - Open door and verify correct alarm is received at the Central Alarm Station
 - Close door and verify secure state
 - Conduct walk test to verify volumetric detection
 - **Ensure correct alarm is reported to Central Alarm Station**

19



Evaluation of Installed Sensors: Effectiveness Testing



- **Effectiveness testing**
 - **Performed every 6 months, yearly, or per site requirements**
 - **Verify performance**
 - Complete detection coverage
 - Probability of detection
 - **Verify tamper operation and communication to Central Alarm Station**
 - **Includes review of**
 - Most likely ways of entry
 - Location of furniture, equipment
 - Sensor maintenance
 - False alarm rates and nuisance alarm rates histories



20



Summary

- Role of interior detection sensors
- Performance characteristics
 - Probability of detection (P_D)
 - Nuisance alarms
- Methods for general performance tests
 - Operability testing
 - Walk, crawl, or run tests
 - Door sensor tests
 - Effectiveness testing
 - Detection coverage
 - Tamper operation
 - Alarm communication



21



Questions



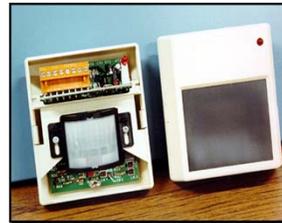
22



Exercise 6: Performance Testing of Interior Detection Systems



- **Two sensor technologies**
 - Balance Magnetic Switch
 - Passive Infrared
- **Activities – rotate through sensor stations**
 - Follow the test plan
 - Conduct performance tests
 - If time permits, conduct defeat tests
 - Present results
 - Probability of Detection



23



Module 7 - Performance Testing of Access Controls

Integrated Performance Testing Workshop

SAND2012-9025P



Objectives

- **Recognize the various types of access control systems**
 - Including associated strengths and weaknesses
- **Identify techniques for performance testing access control systems**

2

Acronyms used in this Module

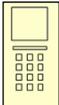
- PIN – Personal Identification Number
- TID – Tamper Indicating Device

3

Basis of Entry Control: Identity Verification

- **Something you possess**
 - Key
 - Card
- **Something you know**
 - Personal identification number (PIN)
 - Password
 - Combinations
- **Something about you**
 - Biometric feature

4

 **Combinations of Identity Verification Factors** 

- By combining all three factors used for identity, verification security can be increased



5

 **Identity Verification: Something You Possess** 

- **Something possessed by the individual**
 - Keys, tokens, and/or credentials
- **Credentials can be checked manually**
- **Coded Credentials**
 - Used to enter information into electronic security systems
 - Coded credential types include
 - Picture
 - Magnetic stripe
 - Proximity
 - Smart card



6



Tokens and Credentials Defined

- A token is something given or shown as a symbol or guarantee of authority or right
 - Example: crown or uniform
- Credentials are something that provides confidence or shows that a person is entitled to exercise official power
 - Example: driver's license or employee badge
- Coded credentials can be identified uniquely and therefore can distinguish between users
 - Example: magnetic stripe or smart card



7



Coded Credential Capabilities

- Maintenance of entry authorization records
- Provision of unique identification code numbers
- Termination of entry authorization without recovering the actual badge
- Provision for several levels of entry authorization



8



Performance Elements to Consider

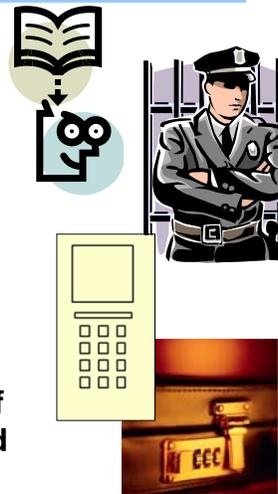
- **Usability**
 - A rate of user acceptance and flexibility of use
- **Throughput**
 - Expressed as time required to read and validate encoded data
- **Security**
 - In terms of counterfeit and tamper resistance
- **Reliability**
 - Expressed in terms of resistance to loss of data

9



Identity Verification: Something You Know

- **Something known that is shared between the authority and the person requiring access**
 - Takes the form of passwords, PINs, etc.
 - Unique personal knowledge for an individual
- **PINs are easiest to enter into electronic security systems**
- **Combinations are another method of interacting with both mechanical and electronic security systems**



10

Personal Identification Numbers (PINs)

- Used mainly at locations where it is unreasonable to provide a full keyboard
 - Automated Teller Machines are a good example of the use of PINs
 - PIN entry requires only a numeric keypad
- PIN is not very secure if used as the only criterion for identification
 - Recommend visual screens or other means to prevent PIN capture by adversaries
 - PINs are best used in conjunction with other criteria
 - Something you possess, or
 - Something about you

1

PIN and Password Length

- PINs with longer lengths are more difficult to guess but may also be difficult to remember
- PINs with short lengths do not have enough combinations for large enrollment populations
 - For example: At a company with 1000 employees, a 3-digit PIN is insufficient
 - If each PIN is unique, all combinations will be used
 - Any guessed PIN will be one that is enrolled
 - Even if not all PINs are unique, the probability of correctly guessing an enrolled PIN is high



12



PIN as the Only Criteria for Identification



- **Systems with PINs as sole means of identification**
 - Not recommended for high-security applications
 - When used for other applications, it is good practice to detect and report repeated attempts to enter PINs that are not in the enrolled database
- **For all systems, the number of possible combinations should greatly outnumber the number of people in the database**
 - By a factor of ten at least
- **Evaluation of PIN security is typically general observation and analysis**

13



Lock Combinations



- **A combination that opens a lock is another example of “something known” as a means to gain access**
 - **For most combination locks**
 - Only one combination is set for the lock
 - With only one combination, the combination has to be shared with all who need access
 - When the combination is compromised, it has to be changed and distributed to all who still need access
- **Testing generally is associated with procedures for maintaining security of combinations**



14

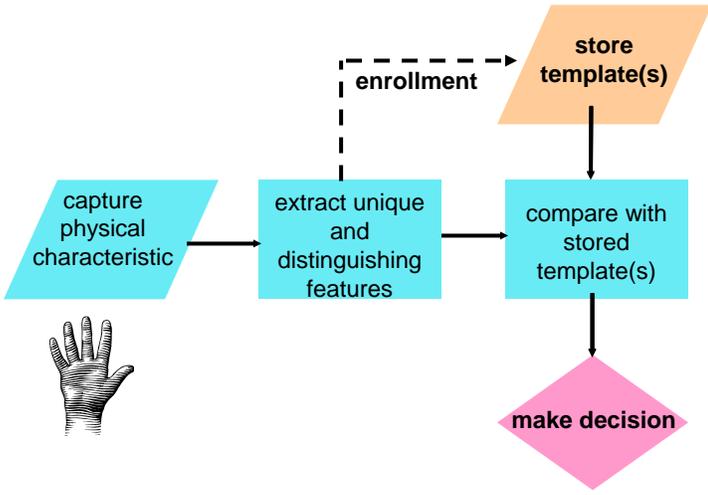
 **Identity Verification:**
Something You Are 

- **Biometrics are identity verification devices based on measurements of an individual's physical or behavioral features**
- **These devices can be based on**
 - **Eye features**
 - **Hand and finger features**
 - **Voice**
 - **Face**
 - **Other**

15

 **Generic Biometric System Processes** 



```
graph LR; A[capture physical characteristic] --> B[extract unique and distinguishing features]; B --> C[compare with stored template(s)]; C --> D{make decision}; B -.-> E[/store template(s)/]; E --> C; subgraph Enrollment; B -.-> E; end
```

The flowchart illustrates the generic biometric system processes. It starts with 'capture physical characteristic' (represented by a hand icon), which leads to 'extract unique and distinguishing features'. From there, the process branches into two paths: one leading to 'compare with stored template(s)' and another leading to 'store template(s)'. The 'store template(s)' step is highlighted in orange and is connected to the 'compare with stored template(s)' step by a solid arrow. A dashed arrow labeled 'enrollment' connects the 'extract unique and distinguishing features' step to the 'store template(s)' step. Finally, the 'compare with stored template(s)' step leads to a pink diamond labeled 'make decision'.

16

Biometrics Technologies

- Finger print
- Hand geometry
- Facial recognition
- Iris
- Voice
- Handwriting
- Gait (walking patterns)
- Fingernail bed
- etc.



17

Biometric Evaluation

- Usability
 - User acceptance and difficulty of use
- Throughput
 - Number of transactions per unit of time
- Security
 - Susceptibility to defeat, both by imposter and physical attack
- Reliability
 - Mean time between failure



18

Characterizing Performance

- **False Rejection Rate**
 - Ratio of false rejects to total attempts at verification
 - Typically expressed as a percentage
- **False Accept Rate**
 - Ratio of false acceptances to total imposter attempts
 - Typically expressed as a percentage

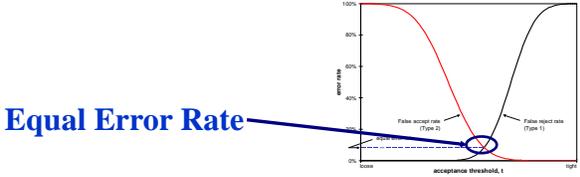


19

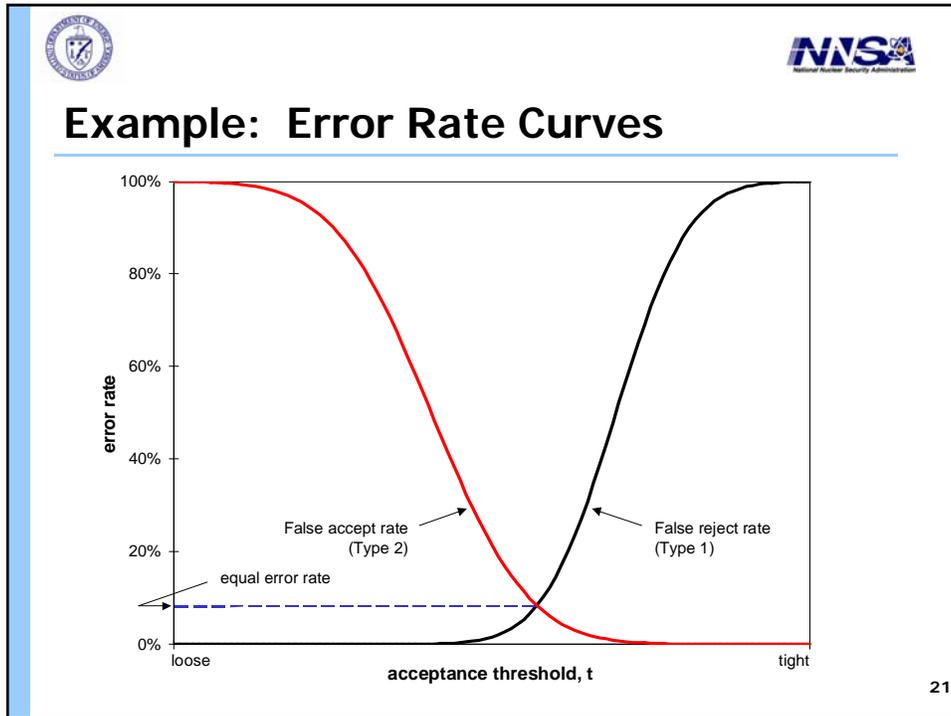
 

Characterizing Performance: Error Rate Curves

- **False Rejection Rate and False Accept Rate are used to generate error rate curves**
 - The point that these two curves intersect is the **Equal Error Rate**
- **Equal Error Rate curves are used to help determine the performance of biometric systems**



20



Environmental Factors to be Considered when Testing Biometrics

- Environmental factors can impact biometric acquisition
- Performance testing should consider the typical application of system and include these factors to determine impact on performance
 - Lighting
 - Artificial and natural
 - Dust and debris
 - Background noise
 - Electromagnetic noise



22

Personnel Characteristic Factors

- **Tests should include personnel characteristic factors that may impact biometric acquisition**
 - **Fingerprint:** Cold, very dry, oily, cuts, scars
 - **Face:** Hair, glasses, lighting, clothing, camera, presentation
 - **Hand:** Jewelry, bandages, weight change
 - **Eye:** Glasses, head movement, injuries, surgery
 - **Voice:** Speaker volume, illness, repeatability






23

Tamper Indicating Device (TID) Introduction and Purpose

- **Tamper Indicating Devices are used to safeguard sensitive information and materials**
 - Transportation and storage
- **Provides an indication that the contents of a package may have been compromised**
- **Used in item accounting control and management**
- **Common Tamper Indicating Device uses include:**
 - Utility meters
 - Transportation containers
 - Food and drug products
 - Hotel mini bar




24



Definitions

- **Tamper Indicating Device (TID)** - a device designed to leave non-erasable, unambiguous evidence of unauthorized access or entry
- **Seal** - a common name for Tamper Indicating Device
- **Passive seal** - requires an inspection to determine tamper
- **Active seal** - near real-time indication of tamper
 - Constantly monitored by electronic system

25



Tamper Indicating Device Types

- **Passive**
 - Loop
 - Tape – Pressure sensitive
 - Bolt
- **Active**
 - Loop



26

 **Tamper Indicating Device** 
Desired Characteristics

- **Testing or evaluation should be performed to verify:**
 - **Unique identification**
 - **Counterfeit resistance**
 - **Device integrity or tamper indication**
 - Readily indicates tamper or unauthorized access
 - Fragile component present
 - One-way only assembly
 - **Easy to install**
 - **Easy to verify**
 - **Low failure rate**



27

 **Tamper Indicating Device Durability** 
Factors Considered when Testing

- **Facility's environmental conditions**
 - **Temperature extremes**
 - **Humidity**
 - **Ultraviolet light**
 - **Radiation**
- **Facility's handling conditions**
 - **Storage**
 - Length of storage
 - Type of area
 - **Transfers**
 - Movement device
 - Movement frequency



28

 **Tamper Indicating Device Operational Factors** 

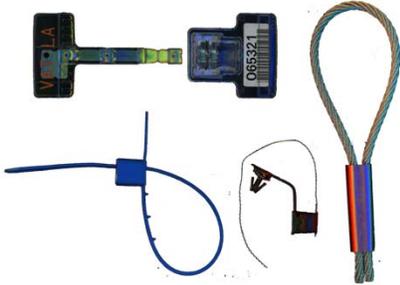
- **Container type**
 - Attachment mechanism
 - Size, shape, and material
- **Application issues**
 - Ease of
 - Application
 - Removal
 - Verification
- **Tools – application, removal, and verification**
 - Operational impact, including safety



29

 **Tamper Indicating Device Technical Factors** 

- **Tamper Indicating Devices can be defeated**
 - Requires mitigation measures
- **Vulnerabilities**
 - Counterfeit
 - Attack
 - Tamper indication



30

 **Tamper Indicating Device Program Test Factors** 

- **Full system test needs to consider:**
 - Procurement chain
 - Storage security
 - Access control to stock
 - Inventory control of stock
 - Accounting system as reported to competent authority
 - Chain-of-custody
 - Destruction documentation and records



31

 **Summary** 

- **Entry control**
 - Permit only authorized persons to enter and exit
- **Basis of entry control – identity verification**
 - **Something you possess**
 - Key, card
 - **Something you know**
 - Personal identification number, password, combinations
 - **Something about you**
 - Biometric feature
- **Equal Error Rate curves**
 - Used to help determine the performance of biometric systems

32



Summary *(continued)*

- **Methods of controlling access**
 - Manual and electronic security systems
 - Electronic locks
 - Tamper Indicating Devices - used to prevent undetected access to areas and containers
- **Performance Testing of access controls**
 - Consider typical application of system
 - Include factors to determine impact on performance

33



Questions



34



Exercise 7: Performance Testing of Access Controls - Biometric Device



- **Performance test biometric device**
 - **Gather biometric data on false accepts and false rejects**
 - **Plot the error rates**
 - **Determine the equal error rate**
 - **Determine if acceptance criteria is met**



Module 8 - Performance Testing of Exterior Detection Systems

Integrated Performance Testing Workshop

SAND2012-9025P



Objectives

- **Recognize the role of exterior detection sensors**
 - **Including strengths and weaknesses of sensor technologies**
- **Identify methods for conducting performance tests of exterior sensors**

2



Acronyms Used in this Module

- NAR - Nuisance Alarm Rate
- FAR - False Alarm Rate
- P_D – probability of detection
- P_S – probability of sensing
- P_A – probability of assessment
- VMD – video motion detection
- GHz – gigahertz
- MHz – megahertz
- kHz - kilohertz

3



Sensor Fundamentals

- Sensor classification
 - Principles of operation
- Alarm definitions
- Sensor performance characteristics
 - Probability of detection
 - Nuisance alarm rate
 - Defeat methods

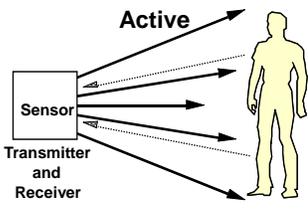
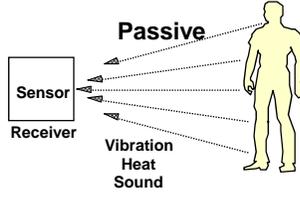


4

Sensor Classification

- **Passive or Active**
- **Covert or Visible**
- **Line-of-sight or Terrain Following**
- **Volumetric or Line Detection**
- **Mode of Application**
 - Freestanding
 - Buried
 - Fence Associated



5

Sensor Performance Characteristics

- **Probability of Detection (P_D)**
 - Likelihood of detecting an adversary within the zone covered by an intrusion detection sensor
 - $P_D = P_S * P_A$
 - P_D – probability of detection
 - P_S – probability of sensing
 - P_A – probability of assessment
- **Nuisance Alarm Rate: Expected rate of alarms unrelated to intrusion attempts**
- **False Alarm Rate: Expected rate of alarms not caused by intrusion attempts and that cannot be attributed to known causes**

6



Sensor Performance Characteristics *(continued)*

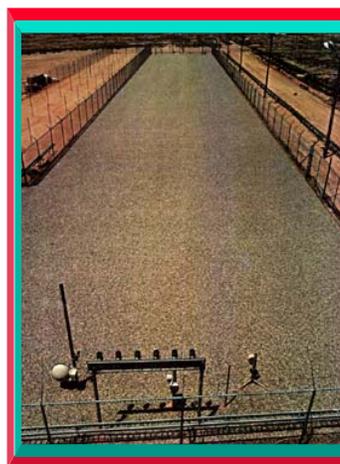
- **Vulnerability to defeat**
 - **Likelihood an intrusion detection sensor is exploitable due to design, installation, or maintenance**
 - ***All sensors can be defeated given the proper expertise, time, and tools***

7



Exterior Sensor Technologies

- **Ported Coax**
- **Microwave**
- **Fiber Optics**
- **Fence Disturbance**
- **Taut Wire**
- **Electric-field or Capacitance**
- **Active Infrared**
- **Passive Infrared**
- **Dual Technology Sensors**
- **Video Motion Detectors**
- **Extended Detection**



8

Microwave Sensor Classification

- **Microwave sensors**
 - Active
 - Visible
 - Line-of-sight
 - Volumetric
 - Freestanding
 - Bistatic or monostatic configuration



9

Bistatic Microwave Detection Parameters

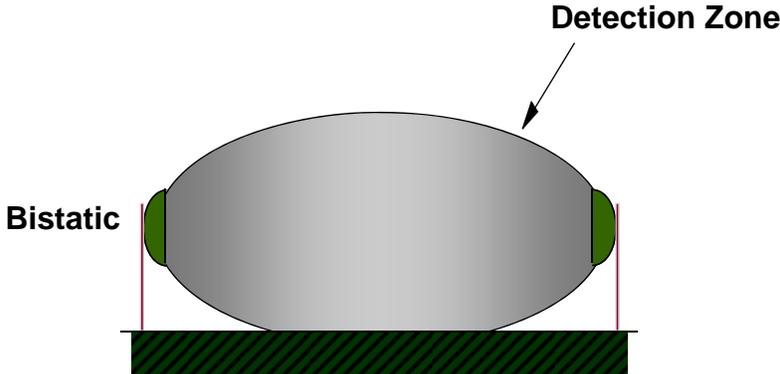
- **Detection accomplished by:**
 - Beam break
 - Multi-path signal changes
 - Jamming
- **Typical operating frequency**
 - 10.525 GHz +/- 25 MHz
- **Typical carrier modulation frequencies - 3, 5, 8, 13 kHz**
 - **Beam width is determined by**
 - Antenna size
 - Design
 - Frequency



10

Bistatic Microwave Detection Pattern



11

Performance Tests – Microwave Sensor

- Initial functional test
 - Walk behind unit to verify no detection
 - For example, back or side lobe
- Detection envelope
 - Walk tests
- Sensor deficiencies
 - Crawl detection
 - Ball drag
 - Jump-over detection
- The number of trials for each sector should be sufficient to verify acceptable Probability of Detection (P_D)



12



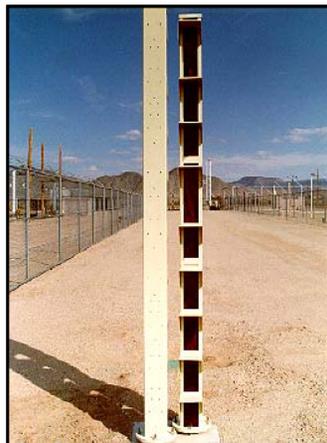
Walk Test and Ball Drag Test



13



Example of Active Infrared Sensor



14



Exterior Active Multi-Beam Infrared Sensors - Operational Principles



- Pulsed infrared light beams
- Beams transmitted in sequence
- Detection method - beam break
- Wavelength - 0.8 to 0.95 microns (non-coherent)
- Radiated power – low
 - Eye safe
- Detection zone height - typically 2 to 3 m
- Transmitter beam angle (receiver also) - nominally 1/2 degree (half power points)
 - Angles on some sensors can be as much as 3 degrees

15



Active Infrared Sensor Performance Testing



- Walk and run tests
 - Velocities
 - Low - 0.2 m/s (0.5 ft/s)
 - High - 0.5 m/s (15.2 ft/s)
- Crawl test
- Slow obscuration
- Alarm margins (function of alignment)
 - Optical filters
 - Opaque plate



16

Video Motion Detection

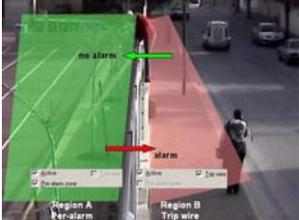


17

How Video Motion Detection Works

- **Detection algorithms**
 - Algorithms make decisions about what is moving and nature of movement
 - Motion, direction, speed, and other factors analyzed
- **Detection based on a set of rules and areas of interest**



18

 **Performance Tests of Video Motion Detection** 

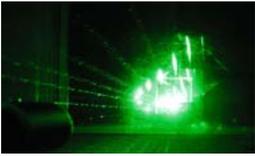
- **Similar to testing physical sensor**
 - **Targets of interest move through scene at range of speeds and varying aspect ratios**
 - **To ensure an alarm is created, if human is target of interest, movement includes**
 - **Walking and running at various speeds**
 - **Walking and crawling at normal speed**
 - **And extremely slow speeds**
 - **Tests should include a human doing a belly crawl covered by a fabric cover about same color as background or floor**



19

 **Performance Tests of Video Motion Detection** *(continued)* 

- **Test that alarms occur under the following conditions**
 - **Shine a bright light at camera lens**
 - **Cover camera with black plastic bag**
 - **Move camera so it is no longer viewing intended scene**
 - **Turn off lights in area to produce a low contrast image**
 - **In locations with sunlight, observe during daylight periods that alarms do not occur from sunlight**
 - **Or shadows created by persons walking next to areas protected by sensors**



20



Fiber Optic Fence Sensor

- Uses “Speckle Pattern” to detect vibrations on fence caused by cutting or climbing
- When threshold is exceeded, an **EVENT** occurs
- When preset number of **EVENTS** occur within preset time window, an **ALARM** occurs



21



Fence Sensor Testing

- Climbing
- Cutting
- Simulated cut
 - Tap or mechanical impact



22

Sensor Subsystem Performance Testing

- Installation
- Interactions
 - Alarm control and display system
 - Video assessment
 - Delay barriers
 - Entry control
- Sector testing
- Reliability and availability

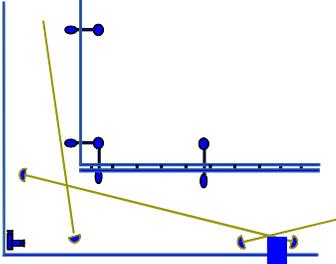


23

Sensor Installation Tests

- Sensor overlaps at sector boundaries
 - Is there a continuous line of detection?
- Alignment and coverage
 - Sensors aimed properly
 - Covers the desired area
 - Nuisance alarms from nearby objects minimized
- Calibration and sensitivity
 - Sensors tuned to detect appropriate threats



24



Alarm Control and Display Interactions

- **Alarm timing**
 - **Some polling systems may have delays in reporting alarms**
 - Especially units integrated with entry control functions
 - **Some sensors can be set to monitor weather conditions before an alarm occurs**
 - May add delay in alarm reporting
- **Alarm display**
 - **Does the alarm location indicated on the operator display match where the alarm occurred?**

25



Video Assessment Interactions

- **Sensor coverage**
 - **Entire sensor in field of view of the camera?**
- **Delays in video display**
 - **Small delays can result in missing some nuisance alarm sources like flying birds**
 - **Delays can also allow adversary to hide**
- **Live vs. playback**
 - **Automatic retrieval**
 - **Frame rates**
 - **Compression**
- **Resolution**



26



Delay Barrier Interactions

- **Assessment delays**
 - Adversary can take advantage of small reporting delays if barriers or distances are not adequate to slow intruder to allow assessment
- **Hiding places**
 - A short delay can allow an adversary to hide from the camera's view



27



Entry Control System Interactions

- **Sensors in access during peak operational times?**
 - Is area in access in full view at all times?
- **Reliance on human element for detection**
 - What other functions do the guards have?
- **Disruptions that may degrade sensor performance**
 - Cross fences
 - Pavement
 - Barriers and bollards
- **Replacement sensors**

28



Sector Subsystem Tests

- **Multiple Sensors**
 - **Are sensors complementary?**
 - Different nuisance alarm sources
 - Different susceptibility to attack methods
 - **Is there overlapping coverage?**
 - **Attack methods**
 - Running, jumping, crawling, bridging, etc.



29



Sensor Reliability and Availability

- **How often is sensor unreliable due to weather?**
- **Are compensatory measures required?**
- **Which sensors are most critical?**

30

 **Features of a Good Exterior Sensor System** 

- Protection in depth
- Balanced system
- Site-specific system
- Tamper protection
- Alarm combination and priority schemes
- Sensor configuration
- Continuous line of detection
- Clear zone



31

 **Summary** 

- Exterior sensor
 - Classification
 - Performance characteristics
 - Probability of detection
 - Nuisance alarm rates
 - Defeat methods
- Features of a good detection system
- Performance testing
 - Initial functional tests
 - Sensor detection deficiencies
 - Component and subsystem



32

Questions



33

Exercise 8: Performance Testing Exterior Detection Systems –MW Sensor

- Participants will discuss various factors that affect microwave sensor performance
- Conduct variety of performance tests
 - Walk and crawl tests
 - Determine detection pattern
 - Conduct additional performance tests
 - Jump and run tests



34



Module 9 - Performance Testing of Video Assessment Systems

Integrated Performance Testing Workshop

SAND2012-9025P



Objectives

- Review alarm assessment criteria
- Identify video assessment test procedures
- Describe ways to analyze performance

2

Acronyms used in this Module

- cm - centimeter

3

Purpose of Alarm Assessment System

- Determine cause of each sensor alarm
- Provide information about an intrusion
 - Relay information to response force
- End detection time



Detection Time	Alarm Assessed	Response Force Time	Adversary Interrupted
----------------	----------------	---------------------	-----------------------

4



Assessment vs. Surveillance

- **Assessment definition**
 - **Alarm information directed by sensor activation to a person to determine if an intruder has penetrated a area protected by a sensor**
 - Usually accomplished by some combination of live and recorded video
 - Recorded video shows some pre-alarm and post-alarm periods
- **Surveillance definition**
 - **Continuous use of a person as an intrusion detector to monitor several restricted areas that are NOT protected by intrusion sensor technologies**

5

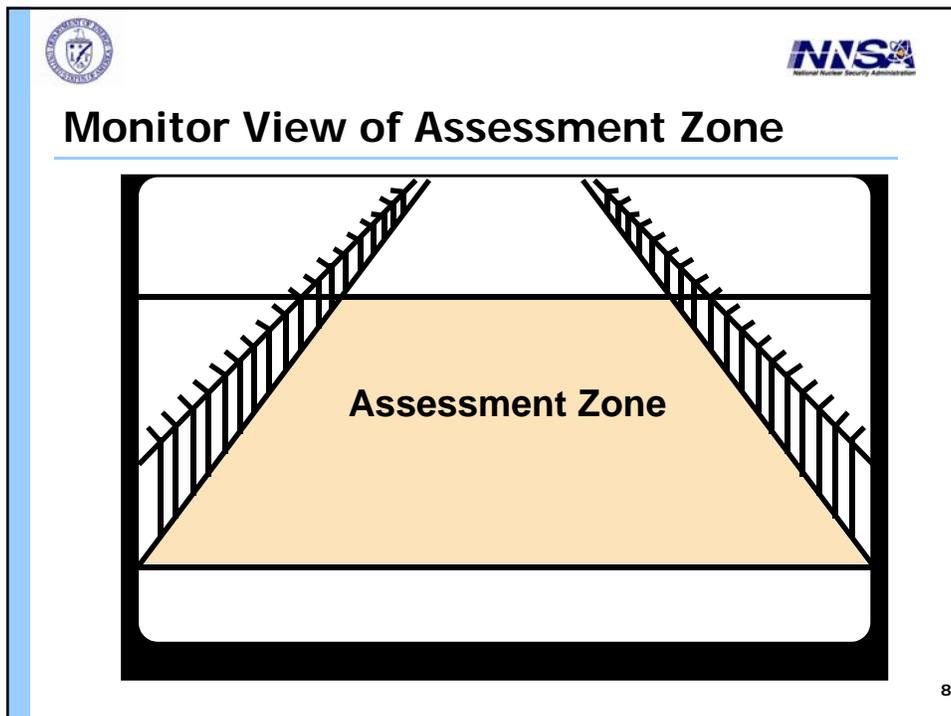
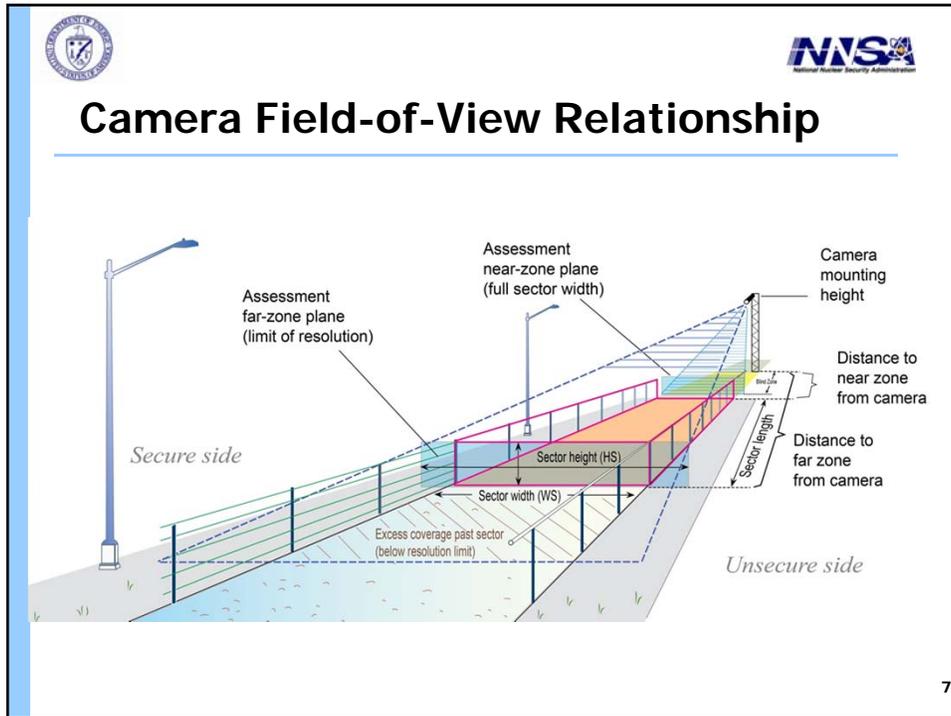


Camera and Sensor Relationships

- **Because the function of the camera is to provide images of the cause of the sensor alarm, the relationship between the sensors and the camera position must be understood**
- **Evaluating cameras that cover multiple sensors involves extra checks to ensure complete sensor coverage**



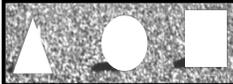
6



Performance Requirements of Video Assessment

- Minimum time between sensor alarm and video display
- Complete area coverage of intrusion detection zone and sensors
- Able to classify 30-cm target at far edge of detection zone
- Field of view at far edge of sensor zone
 - Height and width
- Continuous operation
 - 24 hours per day, 7 days per week
- Minimal sensitivity to adverse weather conditions



9

Levels of Resolution

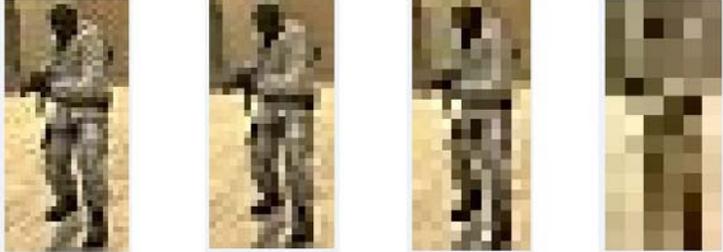
Detection	Classification	Identification
		
Determine the presence of a target	Classify the target (human vs. animal)	Identity of the target

10

Required Far Field Resolution

- The images below show the same scene with different resolutions
 - 8 per 30 cm recommended
 - 6 per 30 cm marginal



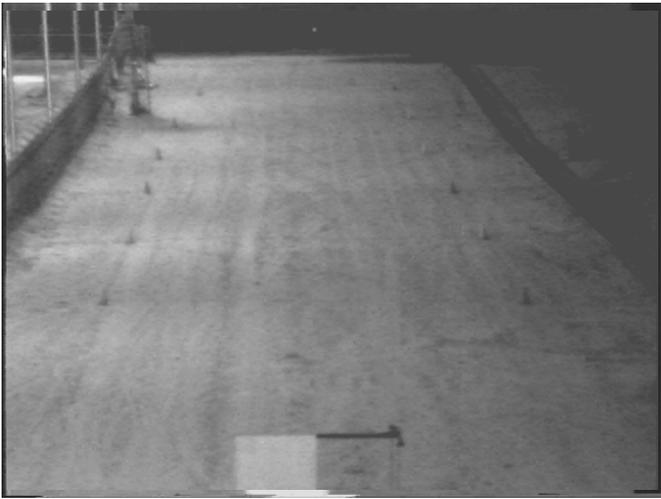
8 6 4 2

Pixels per horizontal and vertical 30 cm (square pixels)

11

Video: Contrast Ratios - 6 to 1



12



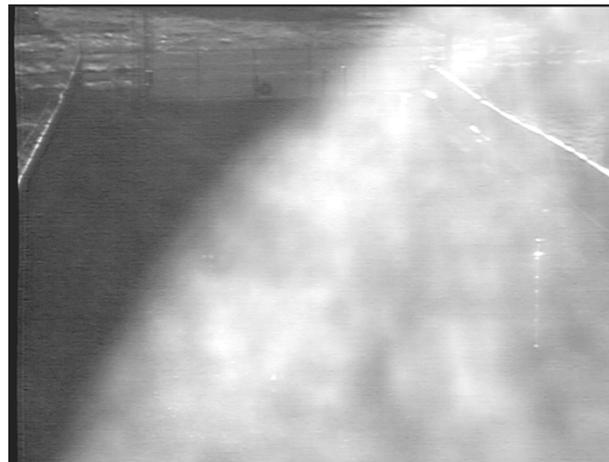
Video: Contrast Ratios - 24 to 1



13



Video: Dawn Glare on East Facing Camera



14



Monitor Layout

- **Note monitor layout relative to operator's head position**
 - Include monitors for assessment and surveillance
 - Note sizes, make, and models of monitors
 - Review repair log for monitor replacements
 - Note frequency of replacements
 - Time to repair



15



Camera Field Tests

- **Test each primary sector camera and any auxiliary cameras**
- **View camera from monitor location**
 - **Observe walk tester in field of view for**
 - Full sector boundary
 - Sensors covering sector
 - Any sensors that have possible obstructions, for example, fence type of sensors

16

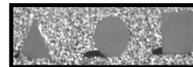


System Resolution Evaluation

- Central and Secondary Alarm Station monitors, and any monitor display area
- Bring selected interior and exterior cameras to all monitors at same time, if possible
 - Is presentation the same on all monitors?
 - Look for too light or too dark
 - All colors the same on all monitors
 - Use test target (white and black) objects in field of view of selected cameras - is presentation the same? Test targets pass or fail for system resolution
 - Check resolution for both recorded and live video



Good Contrast



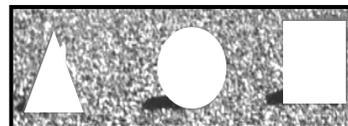
Poor Contrast

17



Target Tests

- The circle (30 cm diameter), triangle (30 cm base and height), and square (30 cm) targets
 - Use white side, then black side
 - Set one type at far field of view
 - Monitor tester, note shape
 - For all shapes, an observer at the monitor should be able to identify all targets on both live and recorded video
 - Set all three test targets on ground, capture still frame image
 - Repeat tests for day, night, dawn, and dusk - whichever is the worse case
 - Include east-facing and west-facing cameras



18



Video Switching and Recorders

- **For each assessment camera**
 - **Measure time from alarm activation to**
 - Stable live video display
 - Stable recorded video display
 - **Check recorded video for correct pre-alarm and post-alarm time relationships**
 - **Note differences in recorded versus live images**
 - Both recorded and live video should pass target tests



19



Measuring Lighting

- **Test at night, without a moon, and well after sunset or before sunrise**
- **Use calibrated light meter**
 - **Most do not measure infrared illumination**
- **Obtain multiple, evenly spaced light readings at 30 cm above ground - a minimum set covers 70% of camera's field-of-view**
 - **Light-to-dark ratio (highest value divided by lowest value)**
 - **Average light level**
 - Sum all readings divided by number of readings
 - **Reflectance value of the ground cover**
 - Meter down reading divided by meter up reading
- **Test restrike time**

20



Lighting Requirements

Requirements	
Minimum intensity	1.0 foot-candle for solid-state camera
Uniform illumination	6:1 light-to-dark ratio, maximum
	4:1 design goal
Extent of coverage	70% of field of view, minimum
	30% ground cover reflectance



21



Anomaly Tests

- **Cameras facing east or west**
 - **During dawn (east facing) or dusk (west facing)**
 - Note glare problems, capture with still frame image
 - Determine length of anomaly time
 - Note any seasonal change in length of time
- **Cameras facing north or south**
 - **During dawn or dusk**
 - Check for shadows from buildings, equipment, etc.
 - Note problems



22



Evaluation of Results

- **Qualitative versus quantitative**
 - **Qualitative interpretation is necessary**
 - Depending on experience and expertise of the evaluation team, results can be overly influenced
 - **Quantitative results can have large error margin**
 - Snapshot of time
 - All environmental conditions not tested



23



Finalized Results

- **Conservatively applied qualitative and quantitative results form the conclusions regarding the effectiveness of the alarm assessment system**
- **Accepted approach**
 - Start with probability of assessment numbers for assessed detection
 - Degrade from them for each major problem or set of problems identified during an evaluation
- **Document all assumptions and the rationale for the degradation of the assessment system for review by other evaluation teams**



24



Summary

- **Basic requirements of alarm assessment**
 - Determine cause of each sensor alarm
 - Provide information about an intrusion
- **Alarm assessment criteria**
 - Alarm response shall be sufficiently rapid to record an actual intrusion
 - Camera coverage must be complete
- **Test video assessment systems**
 - Record measurements
- **Conduct evaluation of both component testing and system testing**

25



Questions



26



Exercise 9-1: Camera Assessment System Performance Test – Day

- **Day Exercise**
- **Evaluate camera capabilities in sector**
 - **Determine camera assessment capability for near-field view**
 - Can entire alarm sector zone be seen within associated camera assessment sector zone?
 - **Determine assessment field resolution**
 - Detection, classification, identification
- **Discuss results**

27



Exercise 9-2: Performance Testing of Video Assessment System - Night

- **Night Exercise**
- **Make lighting measurements**
 - Evaluate light readings
 - Determine reflectance percentages
 - Determine if assessment lighting system meets performance criteria
- **Answer questions based on test results and observations**

28



Module 10 – Performance Testing of SNM / Contraband Detection Systems

Integrated Performance Testing Workshop

SAND2012-9025P



Objectives

- Recognize the various types of contraband technology, including detection for special nuclear material (SNM)
 - Strengths and weaknesses
- Identify techniques for performance testing of special nuclear material (SNM) and contraband detection systems

2

Acryonms used in this Module

- FAR – False Alarm Rate
- HPGe - High-purity Germanium
- IMS - Ion Mobility Spectrometer
- NAR – Nuisance Alarm Rate
- ng - nanogram
- PETN - Pentaerythritol tetranitrate
- RDD – radiation dispersal devices
- RDX - Cyclonite
- RIID - Radioactive Isotope Identifying Device
- SNM – Special Nuclear Material
- TNT - Trinitrotoluene

3

Contraband

- Contraband is any object or material that is prohibited in a security area
- Often contraband is any device or material that can be used by an adversary to gain an advantage in an attempt to commit an act detrimental to a facility







4

 **Purpose and Methods of Contraband Detection** 

- The primary purpose of contraband detection is to detect the presence of contraband objects and materials for the purpose of preventing their entrance into a security area
- Contraband detection seeks to detect contraband by a variety of means
 - Manual search
 - Machine assisted screening
 - Fully automated detection



5

 **Purpose of Contraband Detection Systems** 

Contraband: *An item that is prohibited in a protected area*

Allow Entry of - Authorized Material	Prevent Entry of - Weapons - Explosives - Other Contraband
Allow Exit of - Authorized Material	Prevent Exit (theft) of - Special nuclear material (SNM)

6

Metal Detection

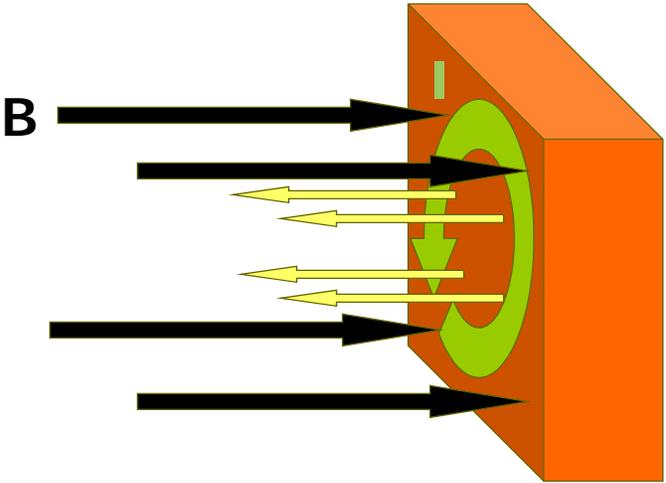
- Weapons
- Tools
- Shielding
 - For radiological materials
- Bomb parts
 - Batteries
 - Wire
 - Metal shrapnel
- Cell phones

7

Eddy Currents Produce Opposing Field

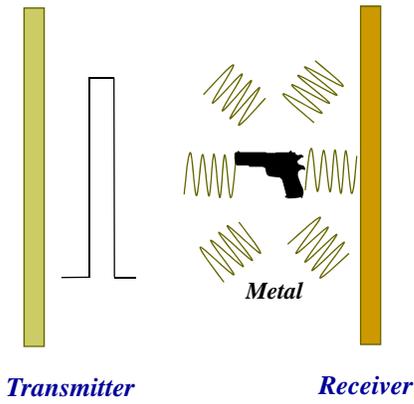


8

Pulsed Metal Detector Operation

- Short bursts of magnetic field are generated by the transmitter
- The burst induces eddy currents in metallic objects
- The receiver detects the rapidly decaying magnetic fields produced by the eddy currents



The diagram illustrates the operation of a pulsed metal detector. On the left, a vertical green bar represents the transmitter, which sends a pulse of magnetic field (shown as a square wave) through a gap. On the right, a vertical yellow bar represents the receiver. In the gap between them, a black handgun is shown as a metallic object. Eddy currents are induced in the handgun, creating a secondary magnetic field (shown as wavy lines) that is detected by the receiver.

Transmitter *Receiver*

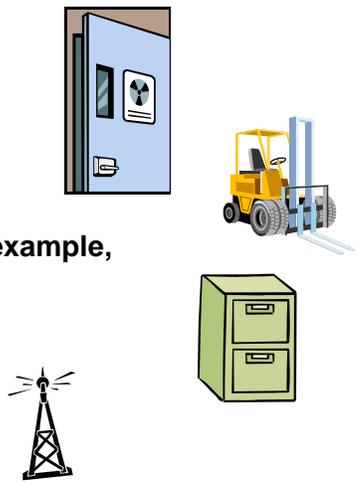
Metal

9

Factors Affecting Metal Detector Operation

- Environment
 - Metal doors
 - Equipment operating nearby
 - For example, fork lifts
 - Metal cabinets
 - Electromagnetic sources, for example,
 - Radio transmitters
 - Fluorescent lights



The illustrations show a blue metal door with a radiation warning symbol, a yellow forklift, a green metal cabinet, and a radio tower with signal waves.

10



Metal Detection Performance Testing

- **Test metal detectors for adequate detection of the worst-case threat item**
 - In the worst-case orientation, and
 - At the worst-case location in the detector
- **Test in the location where they are installed**
- **Test periodically to ensure their performance has not changed since installation**

11



Package Search Systems

- **Purpose**
 - **Detect any contraband contained in packages**
 - Weapons
 - Explosives
 - Others
- **Method**
 - **Active detection using X-ray energy (photons)**
 - Backscatter
 - Dual-energy
 - Computed Tomography



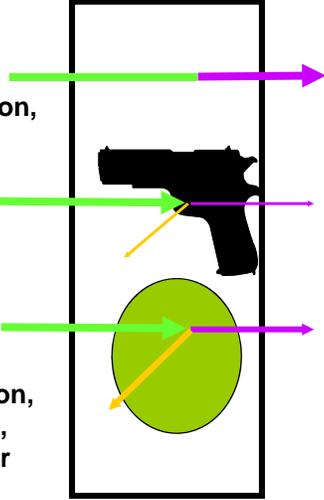
12

How X-rays Interact with Packages

- X-ray encounters:
 - Open volume
 - Very high probability of transmission, very low probability of absorption, very low probability of backscatter
 - High-density, high Z material
 - Low probability of transmission, high probability of absorption, low probability of backscatter
 - High-density, low Z material
 - Moderate probability of transmission, moderate probability of absorption, moderate probability of backscatter

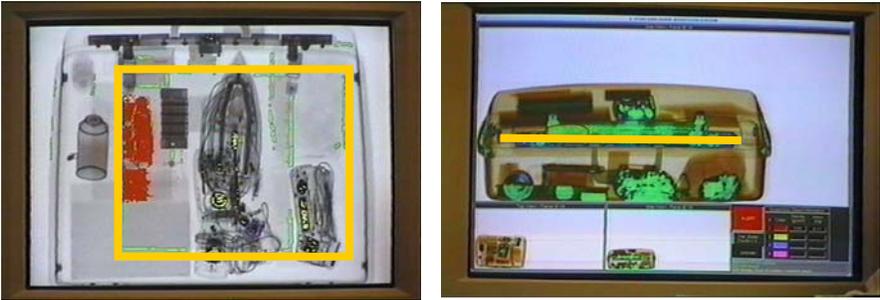
Z = atomic number



13

Dual Energy Package Search

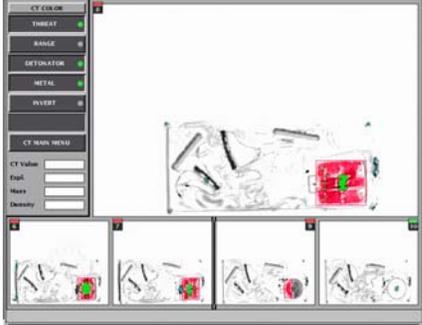


14

Computed Tomography X-Ray

- Certified 3-dimensional automated detection of explosives
- Cost is very high (~1 million dollars)
- Nuisance alarm rates are high (>20%)
- Throughput 400+ packages per hour

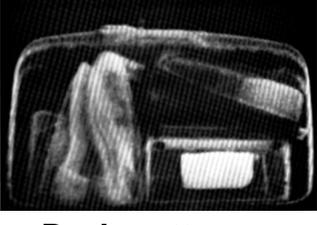



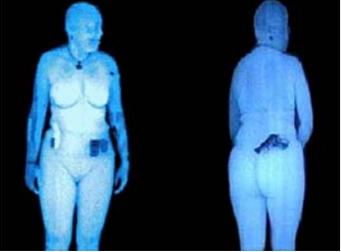

Images Courtesy of GE InVision, Inc. 15

Backscatter for Package and Personnel


Transmission


Backscatter



Backscatter Portal

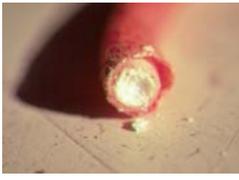
16

Explosives Detection


TNT ($C_7H_5O_6N_3$)
2,4,6—trinitrotoluene


Cyclonite = RDX
($C_3H_6O_6N_6$)


PETN ($C_5H_8O_{12}N_4$)
Pentaerythritol tetranitrate


Ammonium nitrate
($N_2H_4O_3$)


Nitroglycerin
($C_3H_5O_9N_3$)

17

Manual Search

- Cost effective, if low throughput
- Saves equipment cost
- Training is very important
- Potentially invasive, especially for personnel



18



Bulk vs. Trace Explosives

- **Bulk**
 - Detect a macroscopic amount of explosive directly
 - Already discussed bulk imaging techniques
 - Manual search, Raman, neutron activation
- **Trace**
 - Detect minute amounts of residual explosive material in the form of vapor or particles
 - Vapor pressure of an explosive affects detectability
 - Ion mobility spectrometry, canine, mass spectrometry, colorimetric

19



Trace Sampling - Swiping

- **Swipe sampling:** wipe a sampling medium across the surface
 - Direct physical contact to pick up adsorbed particulates



20




Swiping: Sources for Surface Contamination

- **Single fingerprint deposits ~100 micrograms (100,000 ng) of explosives**
- **Deposited explosive mass decreases:**
 - With subsequent fingerprints
 - If hands are washed
 - Through careful handling and use of gloves
- **Amounts deposited are normally large compared to detection limits**
 - 1 ng or less for state-of-the-art trace chemical sensors
 - $1 \text{ ng} = 1 \times 10^{-9} \text{ grams}$





21




Contraband Detection Tools: Trace Explosives

- **Detection of trace quantities of explosives on**
 - **Personnel** can be performed by portal explosives detectors
 - **Packages** can be performed by desk-top or hand-held explosives detectors





Hand-held

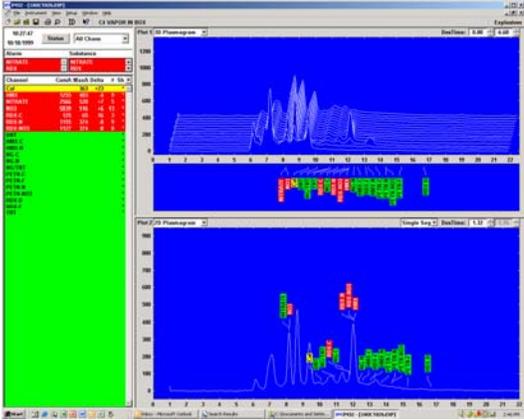
Bench top for swipe applications

22




Ion Mobility Spectrometer Spectra

- Typical drift times between 5 and 20 msec
- Drift time is a function of charge, shape, and mass of ion—lighter species have lower drift times
- System is programmed to detect peaks characteristic of TNT, RDX, PETN, etc.



Ion Intensity

Drift Time [ms]

23




Explosives Detection and Ion Mobility Spectrometer Performance Testing

- Right technology for right application
- Nuisance and False Alarm Rate logs
- Alarm resolution procedures
- Probability of detection and confidence levels
- Throughput rate
- Installation, calibration, maintenance
- Performance testing
- Operator interface
- Operator interpretation
- Standards
- Clean-up time (after alarms)



24

Nuclear Radiation Detection Systems

- Purpose
 - Detect theft of Special Nuclear Materials (SNM)
 - Discriminate among SNM, Radiation Dispersal Devices, and accidental contamination from natural, industrial, and medical radiation sources
- Principle of operation
 - Use detected gamma rays (and neutrons) to identify a threat
 - Small distance between the source and detector is important



25

Examples of Radioactive Isotope Identification Devices



Photos: David Mercer, LANL

26



Radiation Detectors - Plastic

- **Plastic**
 - Can be made very large
 - Widely used for screening
 - Very inexpensive in comparison to other technologies
 - **Poor selectivity**
 - Detects but does not classify radiation
 - Many false alerts due to radiopharmaceuticals and legitimate industrial radioactive materials
 - **Poor sensitivity to higher energy gamma radiation**

27



Radiation Detectors – Sodium Iodide

- **Sodium Iodide (NaI)**
 - **Smaller but large enough to be usefully sensitive**
 - Up to 10 × 5 × 40 cm pieces are in common use
 - **Relatively affordable**
 - < \$2,000 each
 - **Good selectivity**
 - Can be used reliably for automated identification and classification of radiation sources
 - **Now being preferred for screening in most portal monitors**

28



Radiation Detectors - Germanium

- **High-purity Germanium (HPGe) - often used for secondary analysis**
 - **Most expensive – typically \$30,000 to \$120,000**
 - **Medium size – typically 100 cm³**
 - **Requires cryogenic cooling**
 - Typically liquid nitrogen
 - **Best selectivity by far**
 - 30 times better than sodium iodide
- **Because it is much more expensive, less sensitive (smaller in size), and requires cryogenic cooling, HPGe is often used for detailed analysis once a threat is suspected by a Radioactive Isotope Identification Device**

29



Neutrons and Special Nuclear Material Detection

- **Neutrons are not a specific indicator Pu-239, Pu-240**
 - **There are many innocent sources of neutrons**
 - For example, soil density gauges, moisture sensors, and oil well loggers
 - **A higher count rate can result simply from moving a Radioactive Isotope Identification Device closer to a moderating source (heavy person, gasoline or water tank, etc.), which slows down more of the neutrons**
 - **False indication of neutrons also often results from energetic gamma rays interacting with the neutron detector material**

30

 **Example: Sodium-Iodide Spectroscopic Portal Monitor in Use** 



Photo: SNL 31

 **Radiation Detection Performance Testing** 

- Strength of source
- Energy of source and shielding
- Distance from the detector to the source
 - Inverse square
- Time of sampling matters
 - Speed of vehicle or person
- Throughput



32



Summary

- **Contraband is an item you prohibit in an area**
 - Weapons, tools, explosives, special nuclear material
- **Contraband detection techniques covered include**
 - Manual search (everything)
 - Metal detection (weapons, tools)
 - Package inspection (weapons, tools, explosives)
 - Explosives detection
 - Radiation detection (special nuclear material)
- **A good system integrates complementary techniques**
 - For example, metal detection (for shielding) plus radiation detection
- **Test factors (throughput, detection levels, etc.)**

33



Questions



34

34



Exercise 10-1: Performance Testing of SNM / Contraband Detection Systems

- Trace Explosives Detection
- Understand the use and application of trace explosives detection equipment
 - Determine the “limit of detection” for a bench-top explosive detection system
 - Observe clean-up time after alarms
 - Estimate throughput for swipe sampling and analysis
 - Answer questions based on test results and observations

35



Exercise 10-2: Performance Testing of SNM / Contraband Detection Systems

- Contraband Detection at Interim Storage Building
 - Entry Control Portal
 - Plan a performance test for a combined metal and radiation detection portal
- Develop and conduct a test plan for metal and radiation detector, including
 - Probability of Detection (P_D) and confidence level (CL) concept to determine number of trials
 - Shielded and unshielded radioactive material
- Present test data and findings

36



Exercise 10-3: Performance Testing of SNM / Contraband Detection Systems

- **Contraband Detection at Processing Facility**
 - **Entry Control Portal**
 - **Understand the use and application of manual metal and radiation detection equipment**
- **Become familiar with the handheld metal and radiation detector response to various test objects**
- **Conduct a search for theft of a radioactive source, shielding, and a handgun threat**
- **Answer questions based on the exercise results and observations**

37



Module 11 – Performance Testing of Access Delay Elements

Integrated Performance Testing Workshop

SAND2012-9025P



Objectives

- Define access delay, its role, and elements
- Define access delay performance measures
- Determine what issues affect access delay performance measures
- Identify the three common steps in access delay design and access delay performance testing
- Define the access delay performance testing process

2



Acronyms Used in this Module

- ASTM – American Society for Testing and Martials
- DBT – design basis threat
- DOS – Department of State
- GSA – government services agency
- kph – kilometers per hour
- NIJ – National Institute of Justice
- PPS – physical protection system
- UL – Underwriters Laboratories

3



Access Delay Definition, Role, and Elements

- Access Delay: The elements designed to slow down an adversary, **after they have been detected**, by use of fixed barriers, dispensable barriers, or responders
 - Delay is effective only after detection with assessment that initiates the response
 - Passive vs. Active Delay
 - Three elements – fixed, dispensables, and responders



Fixed Barrier



Dispensable Barrier



Responders

4

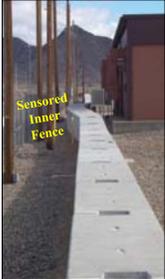
 

Access Delay Principles

- Provides delay immediately after detection
- Balances delay for all attack paths
- Exhibits balanced design - no weak links
- Uses delay-in-depth
- Access delay features should be present 100% of the time, or take compensatory measures
- Example: Massive door provides delay only when closed and locked







5

Example of a Fixed Vehicle Barrier Performance Test

- 61 cm x 122 cm steel box concrete / rebar filled
- Negative front slope angle to drive truck down
- 30.5 cm x 51 cm x 1.6 cm very deep posts in 91.5 cm diameter low strength concrete



- 29.5 metric tons @ 80.5 kph
- Passed with negative penetration (front edge of the cargo bed was behind barrier at the conclusion of the test)





Videos 6

Access Delay Performance Measures

- Performance measure for access delay: Time
- Time to defeat barriers depends on
 - Design Basis Threat
 - Adversary numbers, skills, and adversary toolkit
 - Adversary goal
 - Theft, sabotage, political embarrassment, etc.
 - Type of attack and adversary tactics
 - Force, stealth, deceit, or combination
 - Access delay protects against forcible entry, not deceit or stealth
 - Barrier design, location, and interaction with response teams
- Every barrier has a range of delay times based on these issues




7

Three Steps Common to Access Delay Designing and Performance Testing

1. Review commercial security products developed and already tested to a specific threat
2. Use an access delay database
3. Conduct access delay performance tests (a) based on a Design Basis Threat and a defined adversary toolkit and (b) under the actual conditions an adversary will encounter in attempting to breach the barrier (as close as possible)

8

 **Examples: Commercial Security** 
Product Delay Performance Standards

- Vehicle crash testing of perimeter barriers and gates
 - American Society for Testing and Materials standard test method for vehicle crash testing of perimeter barriers
- Forced entry and ballistic resistance of structural systems
 - Federal specifications for doors and vaults
 - Underwriters Laboratories 608 burglary resistant vault doors and modular panels
 - Underwriters Laboratories 687 burglary-resistant safes
 - Bullet resistance standards
 - Physical attack standards
 - Bomb blast resistance standards

9

 **Issues With Commercial Security** 
Products & Delay Performance Standards

- Example: Anti-Ram Vehicle Barriers
 - What are some limitations of vehicle test criteria with respect to meeting a site-specific delay performance requirement:
 - Non-perpendicular impact?
 - Vehicle weight?
 - Vehicle impact speed?
 - Vehicle center of gravity?
 - Tandem vehicle impact?
 - Cargo bed penetration distance?
 - Others?
 - Do limitations of the standards test criteria warrant a performance test?
 - Certification for impact is **not** certification for access delay
- Above issues apply to all commercial performance standards



10




Three Steps Common to Access Delay Designing and Performance Testing

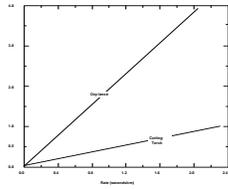
1. Review commercial security products developed and already tested to a specific threat
2. Use an access delay database
3. Conduct access delay performance tests (a) based on a Design Basis Threat and a defined adversary toolkit and (b) under the actual conditions an adversary will encounter when attempting to breach the barrier (as close as possible)

11




Delay Database – 3 Different Examples

1. Rate graphs
2. Tables for specific barrier
3. Database for similar barriers, but different attack tools



Thermal Cutting Rates Graph



Barrier Type with Multiple Attacks

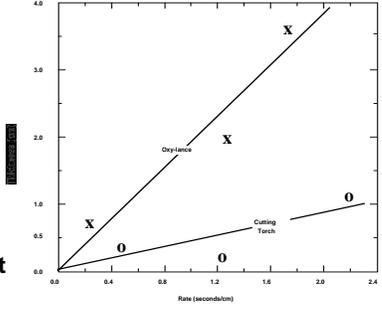
Attack	Tools	Time
Smash glass	hand	0:10
Cut mesh, smash glass	power	0:30
Cut louvers	hand	1:30
Cut hole	hand	3:30
Cut hole	thermal	4:00
Pry door jamb	hand	0:15
Pull exit bar	hand	1:00
Cut hinges	thermal	1:00
Remove cylinder lock, manipulate latch	hand	0:15

12




Estimates versus Actual Tests

- Why do estimates from a delay database not match an actual test or scenario?
 - An individual graph in a delay database typically requires extrapolation of a few test data points
 - An entire attack scenario timeline developed from a delay database is a collection of extrapolated test times
 - That is why a scenario delay estimate may not match an actual scenario performance test

13




Three Steps Common to Access Delay Designing and Performance Testing

1. Review commercial security products developed and already tested to a specific threat
2. Use an access delay database
3. Conduct access delay performance tests
 - a. Based on a Design Basis Threat and a defined adversary toolkit
 - b. Under the actual conditions an adversary will encounter when attempting to breach the barrier (as close as possible)

14



Reasons for Access Delay Performance Testing



- To certify performance prior to barrier procurement
- To evaluate
 - New barrier designs
 - New or improved attack tools on barriers
- As part of a vulnerability assessment
- When delay analysts are not able to extrapolate a meaningful delay estimate for the barrier from an access delay database
- To increase the fidelity of an access delay database
- To develop an access delay database

15



Access Delay Performance Testing Process



1. Develop test objectives
2. Establish the test criteria
3. Identify test equipment and attack tools
4. Develop the test procedures
5. Identify test personnel
6. Test risk mitigation
7. Test performance
8. Document test



16

Test Criteria

- Success and failure criteria
- Size of breach required
- Time limitations
- Data collection requirements
- Identification of test item
 - Location
 - Environmental conditions
- etc.



17

Test Equipment and Attack Tools

- Hand tools – augers, axes, bolt cutters, hammers
- Power tools – chainsaws, drills, saws (multiple blade types), electric bolt cutters
- Thermal cutting tools – oxyacetylene cutting torch and tanks, burn bar oxygen lance
- Heavy equipment – gas powered compressors, gas powered generators, bulldozers, front end loaders, forklifts
- Explosives – bulk charges, shape charges, detonating cord, tamping materials
- Vehicles - cars, trucks, boats, aircraft



18



Testing Procedures

- Specify planned attack scenarios
- Specify allowable changes in scenarios for unexpected events
- Obtain reviews and approvals by:
 - Safety engineering
 - Human Studies Board or Institutional Review Board
 - Test personnel
 - Customer
 - Federal and state agencies
 - Manufacturer?
 - Other?



19



Identify Test Personnel

- Attack team
 - Requisite training, skill, experience, etc.
- Test director
- Test observers
 - Personnel documenting time
 - Human factors experts and task note takers
 - Video specialists and photographers
 - Safety and emergency responders
 - Customer and sponsor
 - Barrier company representative
 - Federal and state agency representatives
- Others



20

Test Risk Mitigation

- **Attack scenario and mishap practices and rehearsals**
- **Safety equipment and gear**
 - Personal protective equipment
 - Fire truck, Ambulance 
 - Heavy equipment 
 - etc.
- **Emergency plans for the unexpected**
 - Injury 
 - Structure collapse 
 - Fire, Flooding 
 - Turning off electrical power 
 - etc.

21

Test Performance

- **Tests should continue to completion as established in the test criteria with the exception of:**
 - Emergency stops for near misses or injuries
 - Fires or other life threatening events
- **No “restarts” for forgotten tools or unanticipated events**
- **If a test participant becomes too weary to continue, either another test participant in the scenario takes over or the test participant rests until ready to resume tasks**
 - In either case, the clock continues running

22

 **Documentation of Access Delay Performance Testing Results** 

- Document everything including photos, video, etc.
- Were all test objectives met?
 - Further testing required?
- Identify
 - Delay performance time for barrier based on test
 - Overall task time and adversary team down times
- Notify
 - Barrier manufacturer and sites that use the barrier of the results
 - Federal oversight agencies of unexpected failures
- Include recommendations for improving barrier installation and delay performance




23

 **Access Delay Performance Testing Differs from other Performance Testing** 

- Delay testing is usually destructive
- Involves
 - Commercial as well as unique, expensive barriers
 - Testing of activated delay dispensables in combination with other barriers
- Can be significantly more expensive than detection or response force performance testing
- Often only a few (or only one) test can be performed on an expensive barrier
 - Significant analysis is required before the test to determine the optimal delay performance test to conduct



24



Access Delay Performance Testing Differs from other Performance Testing *(continued)*

- **Standardized delay performance tests are typically available only for lower threat level adversary tools**
- **Potential for significant injury or death during performance tests for high level threats against significant complex barriers**
- **Tests are specifically tailored for the Design Basis Threat, scenarios, and adversary toolkit**
- **Tests and results are often classified**
- **Common to use military forces or other highly trained personnel for access delay performance testing**

25



Summary

- **Access delay performance testing against high-level threats is not as well-defined as detection or response force performance testing**
- **Standardized access delay performance testing procedures do not exist for very-high level threats and attack tools against significant, complex barriers**
- **Potential exists for significant injury or death during performance tests for high-level threats against significant, complex barriers**

26

Questions



27

Exercise 11: Performance Testing of Access Delay Elements

- **Performance Tests**
 - List delay installation problems for the interim storage vault double doors
 - Collect delay times during demonstration on existing and upgrade ISV double doors
 - Collect additional delay time for other site delay components
- **Discuss delay performance testing questions**

Exercise 6-1

Performance Testing of Interior Detection Systems - Balanced Magnetic Switch (BMS) Sensor

Session Objectives

After the session, the participants will be able to do the following:

1. Plan a performance test for a balanced magnetic switch (BMS) sensor and develop a test plan.
2. Conduct an actual performance test on a balanced magnetic switch sensor.
3. Analyze performance testing results and present findings.

Estimated Time

45 minutes

Activities

1. Review test plan for balanced magnetic switch sensor.
2. Prepare for performance test.
3. Conduct performance tests (open/close door tests).
4. Conduct additional evaluation tests (introduction of external magnets).
5. Discuss test results and findings.

A technical subject matter expert (SME) will be located at the sensor station and will provide a brief description of the sensor (including principles of operation and description of element).

Group Discussion:

At the end of the subgroup exercise, the entire class will discuss the performance test and results. Discussion will be facilitated by the instructor. In addition, the instructor will review answers to any follow-on questions.

Attachments

See separate attachment for Table of trials and failures with probability of detection (P_D) for designated confidence level (CL) sorted by trials (Table A-1) and failures (Table A-2).

Acronyms

BMS – balanced magnetic switch

CAS – central alarm station

CL – confidence level

P_D – probability of detection

SME – subject matter expert

Activity 1: Review Test Plan for Balanced Magnetic Switch Sensors

The purpose of this exercise is to conduct a performance test of interior sensors in the hypothetical facility. The following performance test plan has been provided and will be used to conduct the test:

- Worksheet 1: Performance Test Plan

Participants will review the performance test, ask any questions for clarification, and then perform the test in the field.

Worksheet 1: Performance Test Plan

Performance Test Goal

A general statement of the overall desired outcome of the performance test (should describe the overall expected result).

This performance test is designed to determine the probability of detection (given the design basis threat) for an interior sensor (balanced magnetic switch) located in the interior of a building.

Objectives

A concise elaboration of the goal that describes the specific tasks to be tested:

- *Purpose of the test*
- *Tasks to be tested*
- *Conditions for the test*

This performance test will determine the probability of detection for an interior balanced magnetic switch sensor based on actual environmental conditions. The adversary tactics (modes of attack) that will be used for performance testing the protection element have been pre-determined for the test.

Location

The location of the performance test is simply where the test will take place.

The location for the performance test will be inside a building at the hypothetical facility.

Element(s) to be tested

Identify and describe the specific essential element that will be tested.

Intrusion Detection System – Balanced Magnetic Switch Sensor

Scenario Identification

Scenario identification involves describing the:

- *Element Being Tested*
- *Threat Facing the Element*
- *Facility or Location Involved*
- *Performance Test Boundaries*
- *Time Line or Schedule*

An interior balanced magnetic switch will be performance tested against the design basis threat. The test will be conducted inside a building at the hypothetical facility. The adversary tactics (modes of attack) that will be used for performance testing the protection element have been pre-determined for the test.

Test Methodology and Evaluation Criteria

Test methodology describes how the test will be conducted.

1. A goal probability of detection with a confidence level is provided. The sensor will be tested against the established goal.
2. A sampling plan will be reviewed - 20 tests per technology type will be conducted.
3. Testers will conduct performance tests as described.
4. Determine probability of detection based on tests.

Test evaluation criteria describe how the test will be assessed or scored.

Record total detected alarms for all test locations = _____ out of _____ tests

Probability of detection (P_D) = _____ with a confidence level = 85%

Summary of Results

Record if the element met or failed to meet the goal.

Goal probability of detection (P_D) = 88 %, with a confidence level of 85%.

Record test failed or met the performance level? _____

Test Coordination

Performance test coordination describes who needs to be involved or aware that a test will be conducted.

This test will be coordinated with Physical Protection personnel who will resolve any discrepancies.

Compensatory Measures

Compensatory Measures describe what is necessary to compensate for any degradation of readiness experienced while conducting the performance test.

There are no compensatory measures necessary. Physical Protection personnel will be physically present in both the building and central alarm station (CAS).

Approval of Performance Testing

Approval of performance test plans describes how the test plan is approved and who has to approve the test.

This test plan will be approved by the Facility Manager, Physical Protection Manager, and Response Force Supervisor.

Classification of Test

Determination of whether the test plan, source documents and/or results should be considered sensitive.

For an actual site, the source data generated from the performance test and the completed worksheets would probably be considered sensitive and should be marked appropriately. Because this is a class exercise, all data and results are considered to be non-sensitive.

Briefing and Critiques

After completion of the test, the performance testing team will provide a briefing of the test and results to the Operations Supervisor and the Physical Protection Manager. Should there be a failure, the Physical Protection Manager will determine what additional actions are required. A final report will be issued with the results of the performance test.

Activity 2: Prepare for Performance Test

In this activity, you must finalize a test plan for determining whether the performance of a balanced magnetic switch (BMS) sensor will be acceptable in the proposed design. The balanced magnetic switch (BMS) sensor is already properly installed, and the parameters have been set to optimal levels by previous preliminary testing. A technical subject matter expert (SME) will be available to provide guidance and consultation.

To finalize the test plan, follow the steps below:

Sensor to be tested: **BMS Sensor**

1. Test Criteria (Probability of Detection and Confidence Level)

The P_D to be used in testing is 88 %, with a confidence level of 85%. Develop a test plan that will determine whether the sensor meets or fails to meet the goal P_D .

NOTE: The higher the confidence level the more extensive testing required. (Keep in mind the limited time for the exercise and number of trials to be completed.)

Two tables are provided as attachments to help you select an acceptable P_D with desired confidence level:

- Table A-1: Trials and Failures with Probability of Detection for Designated Confidence Level—Trial Sort
- Table A-2: Trials and Failures with Probability of Detection for Designated Confidence Level—Failures Sort

2. Sampling Plan

Review and discuss Sampling Plan (i.e., number of trials; stopping points; failures tolerated). General description provided below:

a. Test methodology for the BMS: Because of time constraints, a methodology has been determined for you. Follow instructor's guidance.

b. Number of trials:

For each attack mode, you will conduct several tests (follow the test plan). If time permits, you can conduct additional tests.

- Number of failures allowed = **3** (test to be stopped when failures exceed this limit)

3. Adversary Tactics

The adversary tactics (modes of attack) that will be used for performance testing the protection element have been pre-determined for you. Normally, for a balanced magnetic switch sensor, these tactics would include opening and closing door, introducing external magnet, etc. Because of time constraints, two tactics have been chosen to ensure your team completes all the testing in the allotted time.

- a. Open/close door

b. Introduce external magnet

After finalizing your test plan, if you have any questions prior to testing ask your technical SME. You are now ready to start testing, proceed to your testing station.

Activity 3: Conduct Performance Tests

All team members (if willing) will be test subjects and will also record data and observations. The technical SME will demonstrate appropriate methods for testing (e.g., what an open and close door test looks like). Use the worksheets provided in this exercise for recording test data.

In this activity, you will conduct (1) the open/close door tests and (2) tests in which you introduce an external magnet. For each test, document the results. Test the sensor as many times as needed to obtain the probability of detection (only for open/close door tests).

You will conduct 4 sets of tests using 4 different balanced magnetic switch (BMS) sensor models so as to compare tests results from different sensor models.

Open/Close Door Tests

The technical SME will describe the test prior to initiation and demonstrate appropriate open and close door test.

1. With alarm in secure mode, the testers will slowly open door until an alarm is initiated (see Figure 1).
 - a. The tester will hold door at this position.
 - b. Using a ruler or other measuring device, measure the distance the leading edge moved from the fully closed position until the alarm was initiated.
 - c. Document this distance. (Note: balanced magnetic switch (BMS) sensor should alarm before opening door 2.5 cm (1 inch) from door jamb). The distance requirement is a standard established by the Springfield Processing Plant facility.
 - d. If an alarm does not occur, document “no alarm” in Worksheet 1.



Figure 1: Open/Close Door Test

2. Close door fully and repeat Step 1 twenty (20) times as required to determine a probability of detection.

- Run test for each of the 4 different balanced magnetic switch (BMS) sensor models, recording results in appropriate worksheets (Worksheet 1, Worksheet 2, Worksheet 3, and Worksheet 4).

Worksheet 1: Model 1 BMS Sensor (Door Open/Close) Test Results

Tester	Attempt	Alarm (Yes/No)	Distance (cm/inches)	Valid Alarm?*
1	1			
	2			
	3			
	4			
	5			
2	6			
	7			
	8			
	9			
	10			
3	11			
	12			
	13			
	14			
	15			
4	16			
	17			
	18			
	19			
	20			

* Valid alarm – must get a sensor alarm and the alarm must occur within 2.5 cm (1 inch) distance from door to door jam.

Total detected alarms for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection = _____ with a confidence level = 85%

Record if the element met or failed to meet the goal.

Indicate if the test failed or met the performance level established.

Goal probability of detection = **88 %, with a confidence level of 85%.**

Test failed or met the performance level? _____

Worksheet 2: Model 2 BMS Sensor (Door Open/Close) Test Results

Tester	Attempt	Alarm (Yes/No)	Distance (cm/inches)	Valid Alarm?*
1	1			
	2			
	3			
	4			
	5			
2	6			
	7			
	8			
	9			
	10			
3	11			
	12			
	13			
	14			
	15			
4	16			
	17			
	18			
	19			
	20			

* Valid alarm – must get a sensor alarm and the alarm must occur within 2.5 cm (1 inch) distance from door to door jam.

Total detected alarms for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection = _____ with a confidence level = 85%

Record if the element met or failed to meet the goal.

Indicate if the test failed or met the performance level established.

Goal probability of detection = **88 %, with a confidence level of 85%.**

Test failed or met the performance level? _____

Worksheet 3: Model 3 BMS Sensor (Door Open/Close) Test Results

Tester	Attempt	Alarm (Yes/No)	Distance (cm/inches)	Valid Alarm?*
1	1			
	2			
	3			
	4			
	5			
2	6			
	7			
	8			
	9			
	10			
3	11			
	12			
	13			
	14			
	15			
4	16			
	17			
	18			
	19			
	20			

* Valid alarm – must get a sensor alarm and the alarm must occur within 2.5 cm (1 inch) distance from door to door jam.

Total detected alarms for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection = _____ with a confidence level = 85%

Record if the element met or failed to meet the goal.

Indicate if the test failed or met the performance level established.

Goal probability of detection = **88 %, with a confidence level of 85%.**

Test failed or met the performance level? _____

Worksheet 4: Model 4 BMS Sensor (Door Open/Close) Test Results

Tester	Attempt	Alarm (Yes/No)	Distance (cm/inches)	Valid Alarm?*
1	1			
	2			
	3			
	4			
	5			
2	6			
	7			
	8			
	9			
	10			
3	11			
	12			
	13			
	14			
	15			
4	16			
	17			
	18			
	19			
	20			

* Valid alarm – must get a sensor alarm and the alarm must occur within 2.5 cm (1 in.) distance from door to door jam.

Total detected alarms for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection = _____ with a confidence level = 85%

Record if the element met or failed to meet the goal.

Indicate if the test failed or met the performance level established.

Goal Probability of detection = 88 %, with a confidence level of 85%.

Test failed or met the performance level? _____

Activity 4. Introduction of External Magnets

The technical SME will describe the test prior to initiation and demonstrate appropriate method for introducing an external magnet to evaluate the performance of the balanced magnetic switch sensor.

1. Tester will introduce an external magnet near switch (see Figure 2 for example).
2. In Worksheet 5, record if an alarm was generated when the door was opened.
3. Is a tamper alarm or sensor alarm generated when the magnet is near the switch unit? If so, record results in Worksheet 5.
4. Run test for all models of balanced magnetic switches, using Worksheet 5, Worksheet 6, Worksheet 7, and Worksheet 8 to record results for balanced magnetic switch models 1, 2, 3, and 4.



Figure 2: Reference Photos for Testing Balanced Magnetic Switch (BMS) Sensor with an External Magnet

Worksheet 5: Model 1 BMS Sensor - Introduction of External Magnet Test Results

Tester	Attempt	Alarm? (Yes/No)	Tamper Alarm Generated?(Yes/No)	Valid Alarm?*
1	1			
	2			
2	3			
	4			
3	5			
	6			
4	7			
	8			
5	9			
	10			

* Valid Alarm = BMS Alarm plus Tamper Alarm

Total detected alarms = _____ out of _____ tests

Note: results from this test are not used to determine a probability of detection value.

Observations/Notes:

Worksheet 6: Model 2 BMS Sensor - Introduction of External Magnet Test Results

Tester	Attempt	Alarm? (Yes/No)	Tamper Alarm Generated?(Yes/No)	Valid Alarm?*
1	1			
	2			
2	3			
	4			
3	5			
	6			
4	7			
	8			
5	9			
	10			

* Valid Alarm = BMS Alarm plus Tamper Alarm

Total detected alarms = _____ out of _____ tests

Note: results from this test are not used to determine a probability of detection value.

Observations/Notes:

Worksheet 7: Model 3 BMS Sensor - Introduction of External Magnet Test Results

Tester	Attempt	Alarm? (Yes/No)	Tamper Alarm Generated?(Yes/No)	Valid Alarm?*
1	1			
	2			
2	3			
	4			
3	5			
	6			
4	7			
	8			
5	9			
	10			

* Valid Alarm = BMS Alarm plus Tamper Alarm

Total detected alarms = _____ out of _____ tests

Note: results from this test are not used to determine a probability of detection value.

Observations/Notes:

Worksheet 8: Model 4 BMS Sensor - Introduction of External Magnet Test Results

Tester	Attempt	Alarm? (Yes/No)	Tamper Alarm Generated?(Yes/No)	Valid Alarm?*
1	1			
	2			
2	3			
	4			
3	5			
	6			
4	7			
	8			
5	9			
	10			

* Valid Alarm = BMS Alarm plus Tamper Alarm

Total detected alarms = _____ out of _____ tests

Note: results from this test are not used to determine a probability of detection value.

Observations/Notes:

Activity 5: Discuss Test Results and Findings

After all performance testing is completed for all sensors, be prepared to discuss:

- Summary of results
- Recommendations
- Lessons learned

Exercise 6-2

Performance Testing of Interior Detection Systems - Passive Infrared (PIR) Sensor

Session Objectives

After the session, the participants will be able to do the following:

1. Plan a performance test for a passive infrared sensor and develop a test plan.
2. Conduct an actual performance test on a passive infrared sensor.
3. Analyze performance testing results and present findings.

Estimated Time

45 minutes

Activities

1. Review test plan for passive infrared sensors
2. Prepare for testing.
3. Conduct performance tests.
4. Discuss test results and findings.

A technical subject matter expert (SME) will be located at the sensor station and will provide a brief description of the sensor (including principles of operation, detection pattern, and description of element).

Group Discussion

At the end of the exercise, the entire class will discuss the performance test and results. Discussion will be facilitated by the instructor. In addition, the instructor will review answers to any follow-on questions.

Attachments

See separate Attachment for Exercise: Table of trials and failures with P_D (probability of detection) for designated confidence level sorted by trials (Table A-1) and failures (Table A-2).

Acronyms

PIR – passive infrared

SME – subject matter expert

P_D – probability of detection

CL – confidence level

Activity 1: Review Performance Test Plan for Passive Infrared Sensors

The purpose of this exercise is to conduct a performance test of interior sensors in the hypothetical facility. The following performance test plan has been provided and will be used to conduct the test:

- Worksheet 1: Performance Test Plan

Participants will review the performance test, ask any questions for clarification, and then perform the test in the field.

Worksheet 1: Exterior Sensor Performance Test Plan

Performance Test Goal

A general statement of the overall desired outcome of the performance test (should describe the overall expected result).

This performance test is designed to determine the probability of detection (given the design basis threat) for an interior sensor (passive infrared) located in the interior of a building.

Objectives

A concise elaboration of the goal that describes the specific tasks to be tested:

- *Purpose of the test*
- *Tasks to be tested*
- *Conditions for the test*

This performance test will determine the probability of detection for an interior passive infrared sensor based on actual environmental conditions. The adversary tactics (modes of attack) that will be used for performance testing the protection element have been pre-determined for the test. Because of time constraints, two tactics (walk and crawl) have been chosen to ensure all testing is completed in the allotted time.

Location

The location of the performance test is simply where the test will take place.

The location for the performance test will be inside a building at the hypothetical facility.

Element(s) to be tested

Identify and describe the specific essential element that will be tested.

Intrusion Detection System – Passive Infrared Sensor.

Scenario Identification

Scenario identification involves describing the:

- *Element Being Tested*
- *Threat Facing the Element*
- *Facility or Location Involved*
- *Performance Test Boundaries*
- *Time Line or Schedule*

An interior passive infrared sensor will be performance tested against the design basis threat. The test will be conducted in the facility. The adversary tactics (modes of attack) that will be used for performance testing the protection element have been pre-determined for the test. Because of time constraints, two tactics (walk and crawl) have been chosen to ensure all testing is completed in the allotted time.

Test Methodology and Evaluation Criteria

Test methodology describes how the test will be conducted.

1. A goal probability of detection with a confidence level is provided. The sensor will be tested against the established goal.
2. Test locations along the detection zone for the passive infrared sensor will be reviewed.
3. A sampling plan will be reviewed - 10 tests will be conducted.
4. Two modes of attack will be used (walk, crawl).
5. Testers will conduct performance tests as described.
6. Determine probability of detection based on tests.

Test evaluation criteria describe how the test will be assessed or scored.

Record total detected alarms for all test locations = _____ out of _____ tests

Probability of detection (P_D) = _____ with a Confidence Level = 85%

Summary of Results

Record if the element met or failed to meet the goal.

Goal probability of detection (P_D) = 88 %, with a confidence level of 85%.

Record test failed or met the performance level? _____

Test Coordination

Performance test coordination describes who needs to be involved or aware that a test will be conducted.

This test will be coordinated with Physical Protection personnel who will conduct the performance testing and resolve any discrepancies.

Compensatory Measures

Compensatory Measures describe what is necessary to compensate for any degradation of readiness experienced while conducting the performance test.

There are no compensatory measures necessary. Physical Protection personnel will be physically present in both the building and Central Alarm Station (CAS).

Approval of Performance Testing

Approval of performance test plans describes how the test plan is approved and who has to approve the test.

This test plan will be approved by the Facility Manager, Physical Protection Manager, and Response Force Supervisor.

Classification of Test

Determination of whether the test plan, source documents and/or results should be considered sensitive.

For an actual site, the source data generated from the performance test and the completed worksheets would probably be considered sensitive and should be marked appropriately. Because this is a class exercise, all data and results are considered to be non-sensitive.

Briefing and Critiques

After completion of the test, the performance testing team will provide a briefing of the test and results to the Operations Supervisor and the Physical Protection Manager. Should there be a failure, the Physical Protection Manager will determine what additional actions are required. A final report will be issued with the results of the performance test.

Activity 2: Prepare for Performance Test

In this activity, you must finalize a test plan for determining whether the performance of a Passive Infrared (PIR) sensor will be acceptable in a proposed design. The PIR sensor is already properly installed, and the parameters have been set to optimal levels by previous preliminary testing. A technical subject matter expert (SME) will be available to provide guidance and consultation.

To finalize the test plan, follow the steps below:

Sensor to be tested: PIR Sensor

1. Test Criteria (Probability of Detection and Confidence Level)

The probability of detection (P_D) to be used in testing is 88 %, with a confidence level of 85%. Develop a test plan that will determine whether the sensor meets or fails to meet the goal probability of detection (P_D).

NOTE: The higher the confidence level the more extensive testing required. (Keep in mind the limited time for the exercise and number of trials to be completed.)

Two tables are provided as attachments to help you select an acceptable probability of detection with desired confidence level:

- Table A-1: Trials and Failures with Probability of Detection for Designated Confidence Level—Trial Sort
- Table A-2: Trials and Failures with Probability of Detection for Designated Confidence Level—Failures Sort

2. Sampling Plan

Review and discuss Sampling Plan (i.e., test locations, number of trials; stopping points; failures tolerated). General description provided below:

- Test locations for the PIR sensor:** Because of time constraints, test locations have been determined for you (Table 1). Figure 1 shows test locations.
 - Number of trials for each attack mode, you will conduct 10 tests (follow the test plan). If time permits, you can conduct additional tests.
 - Number of failures allowed = 3 (test to be stopped when failures exceed this limit)

Figure 1 shows the PIR test grid and test locations to be used in this performance test. Table 1 lists the test locations to be used.

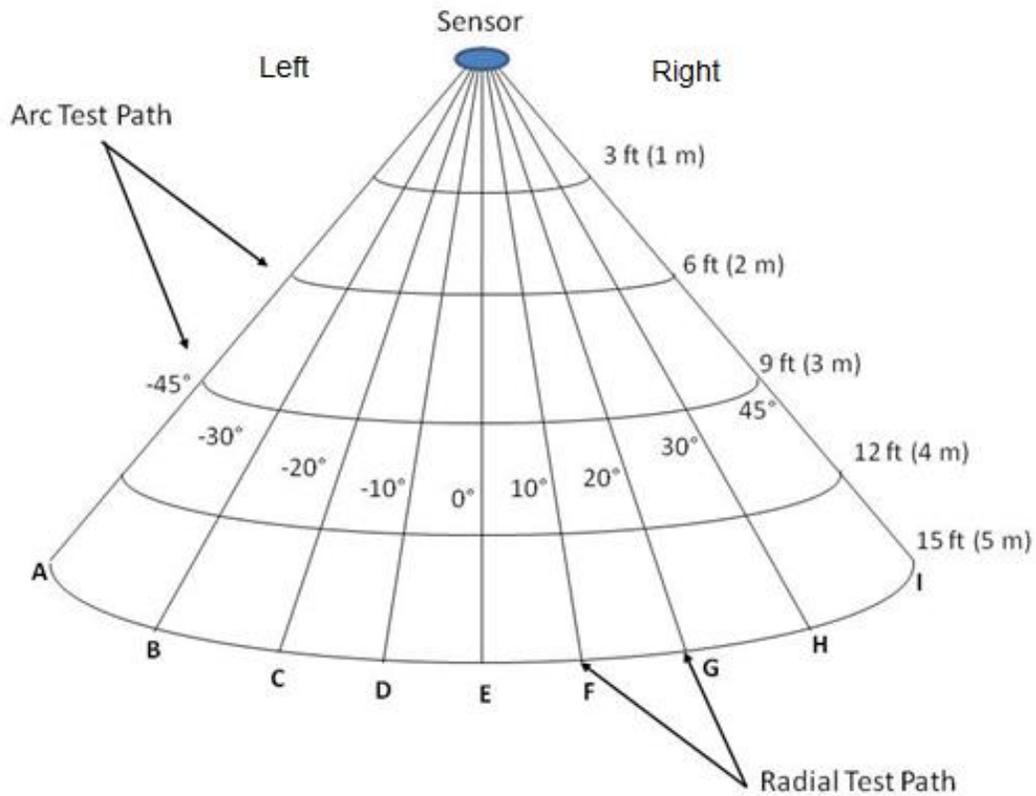


Figure 1: Passive Infrared Sensor Test Grid and Test Locations

Table 1: Test Locations (Radial Test Paths and Arc Test Paths)

Test Locations	Radial Test Path Locations	Arc Test Path Locations
Test Location 1	A	1 m
Test Location 2	B	2 m
Test Location 3	C	3 m
Test Location 4	D	4 m
Test Location 5	E	5 m
Test Location 6	F	
Test Location 7	G	
Test Location 8	H	
Test Location 9	I	

Module 6. Performance Testing of Interior Detection Systems
Exercise 6-2. Performance Testing of Passive Infrared Sensor

SAND2012-9025P

3. Adversary Tactics

The adversary tactics (modes of attack) that will be used for performance testing the protection element have been pre-determined for you. Normally, for a PIR sensor, these tactics would include walking, crawling, running, etc. Because of time constraints, two tactics have been chosen to ensure your team completes all the testing in the allotted time.

- a. Walk
- b. Crawl

After finalizing your test plan, if you have any questions prior to testing ask your technical subject matter expert. You are now ready to start testing, proceed to your testing station.

Activity 3: Conduct Performance Tests

All team members (if willing) will be test subjects and will also record data and observations. The technical SME will demonstrate appropriate speeds for testing (e.g., what a walk test looks like). Use the worksheets provided at the end of this exercise for recording test data.

Activity 3-1. Arc Path Walk Test

The technical SME will describe the test prior to initiation and demonstrate appropriate walk test speed along an arc path.

1. Beginning outside the detection envelope (Figure 2) from the left (Line A) at the 1-m arc test path, wait 20 seconds after the sensor resets.
2. Along the arc test path at the 1-m (3-ft) marker (see Figure 2), start walking at 0.3 m/s (1 ft/s) with arms folded across chest.



Figure 2: Sample Walk Reference

- a. When alarm occurs, stop and document results in Worksheet 2. (Repeat for a total of 3 times.) If no alarm occurs, document result in Worksheet 2.
 - b. Repeat Steps 1 and 2 along the remaining arc test paths.
3. Repeat Steps 1 and 2 walking in the opposite direction (right side of grid) along the same walk arc test paths.
 4. Calculate total alarms from left and right arc path test to determine your probability of detection.

The tester will wait 20 seconds outside detection zone for sensor resets.

Worksheet 2: Test Results for Arc Path Walk Tests

Arc Paths	Alarm			Arc Paths	Alarm		
Left (Line A)	Walk 1 Yes/No	Walk 2 Yes/No	Walk 3 Yes/No	Right (Line I)	Walk 1 Yes/No	Walk 2 Yes/No	Walk 3 Yes/No
1 m (3 ft)							
2 m (6 ft)							
3 m (9 ft)							
4 m (12 ft)							
5 m (15 ft)							
Total Alarms				Total Alarms			

Total detected alarms for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection = _____ with a confidence level = 85%

Record if the element met or failed to meet the goal.

Indicate if the test failed or met the performance level established.

Test failed or met the performance level? _____

Activity 3-2. Radial Path Walk Test

The technical SME will describe the test prior to initiation and demonstrate appropriate walk test speed.

1. Along Radial Test Path A (Worksheet 3) moving towards the sensor:
 - a. Begin the walk test at a speed of 1 ft/s (0.3 m/s) towards the sensor.
 - b. Stop when an alarm occurs and document in Worksheet 2 if an alarm occurred (indicate Yes).
 - c. Repeat two more times for a total of 3 test walks along each radial path.
2. Repeat Step 1 along all radial paths B through I.
3. Calculate the total alarms from all radial test paths A through I. This will be your total number of alarms versus attempts for your probability of detection calculations.

Worksheet 3: Test Results for Radial Path Walk Tests

Radial Paths	Alarm		
	Walk 1 Yes/No	Walk 2 Yes/No	Walk 3 Yes/No
A			
B			
C			
D			
E			
F			
G			
H			
I			
Total Alarms			

Total detected alarms for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection = _____ with a confidence level = 85%

Record if the element met or failed to meet the goal.

Indicate if the test failed or met the performance level established.

Test failed or met the performance level? _____

Activity 3-3. Arc Path Crawl Test

The SME will describe the test prior to initiation and will demonstrate appropriate crawl test speed.

1. Beginning outside the detection envelope (Figure 3), the tester will wait 20 seconds after the sensor resets.
2. Along the Arc test path at the 1-m (3-ft) marker, start crawling at 0.3 m/s (1 ft/s) (Figure 3).



Figure 3: Sample Crawl Test Reference

- a. When alarm occurs document results in Worksheet 4. Repeat for a total of 3 times.
 - b. Repeat Steps 1 and 2 along the remaining arc test paths (2 m (6 ft), 3 m (10 ft), etc.).
3. Repeat Steps 1 and 2 crawling in the opposite direction along the same arc test paths.

4. After crawl testing each direction along each arc path, use the test data to help you calculate probability of detection for arc crawl tests.

Worksheet 4: Crawl Test Results for Arc Path Tests

Arc Paths	Alarm			Arc Paths	Alarm		
	Crawl 1 Yes/No	Crawl 2 Yes/No	Crawl 3 Yes/No		Right (Line I) Yes/No	Crawl 1 Yes/No	Crawl 2 Yes/No
1 m (3 ft)							
2 m (6 ft)							
3 m (10 ft)							
4 m (13 ft)							
5 m (16 ft)							
Total Alarms				Total Alarms			

Total detected alarms for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection = _____ with a confidence level = 85%

Record if the element met or failed to meet the goal.

Indicate if the test failed or met the performance level established.

Test failed or met the performance level? _____

Activity 3-4. Radial Path Crawl Test

The technical SME will describe the test prior to initiation and will demonstrate appropriate crawl test speed along a radial path.

1. Along Radial Test Path A (Worksheet 5):
 - a. Begin the crawl test at a speed of 0.3 m/s (1 ft/s) toward the sensor.
 - b. Stop when an alarm occurs and document results in Worksheet 5.
 - c. Repeat for a total of 3 times.
2. Repeat Step 1 along all radial paths B through I.
3. After crawl testing along specified radial test paths, use the test data to help you calculate probability of detection for radial crawl tests.

Worksheet 5: Test Results for Radial Path Crawl Tests

Radial Paths	Alarm		
	Yes/No	Yes/No	Yes/No
A			
B			
C			
D			
E			
F			
G			
H			
I			
Total Alarms			

--	--

Total detected alarms for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection = _____ with a confidence level = 85%

Record if the element met or failed to meet the goal.

Indicate if the test failed or met the performance level established.

Test failed or met the performance level? _____

Exercise 7

Performance Testing of Access Controls - Biometric Devices

Session Objectives

After the session, the participants will be able to:

1. Gather biometric data on false accepts and false rejects.
2. Plot the error rates and determine the equal error rate for biometric devices.
3. Determine if acceptance criteria are met for biometric devices.
4. Performance test biometric devices

Estimated Time

45 minutes

Activities

1. Review test plan for biometric identity verification device
2. Conduct false accept and false reject testing
3. Class discussion
4. Prepare and conduct performance test on a hand geometry unit
5. Discuss test results and findings

A technical subject matter expert (SME) will be located at the biometric station and will provide a brief description of the equipment (including principles of operation, authorized access, and description of element).

Group Discussion

At the end of the study, the class will discuss the results. Discussion will be facilitated by the instructor. In addition, the instructor will review answers to any follow-on questions.

Acronyms

P_D – probability of detection

PIN – personal identification number

Activity 1: Review Performance Test Plan for Biometric Devices

The purpose of this exercise is to familiarize the participants to biometric identity verification device technology (hand geometry unit) and to learn how to qualitatively assess the device before conducting a performance test of a hand geometry unit located outside the Interim Storage Vault in the hypothetical facility. The following performance test plan has been provided and will be used to conduct the test:

- Worksheet 1: Performance Test Plan

Participants will review the performance test, ask any questions for clarification, and then perform the test in the field.

Worksheet 1: Biometric Identity Verification Device Performance Test Plan

Performance Test Goal

A general statement of the overall desired outcome of the performance test (should describe the overall expected result).

This performance test is designed to determine the probability of detection (given the design basis threat) for an interior access control element (biometric identity verification device) located in the interior of a building.

Objectives

A concise elaboration of the goal that describes the specific tasks to be tested:

- *Purpose of the test*
- *Tasks to be tested*
- *Conditions for the test*

This performance test will determine the probability of detection for an interior biometric sensor based on actual environmental conditions. The adversary tactics that will be used for performance testing the protection element have been pre-determined for the test.

Location

The location of the performance test is simply where the test will take place.

The location for the performance test will be inside the Interim Storage Building at the hypothetical facility.

Element(s) to be tested

Identify and describe the specific essential element that will be tested.

Access Control System – Biometric Identity Verification Device (hand geometry unit)

Scenario Identification

Scenario identification involves describing the:

- *Element Being Tested*
- *Threat Facing the Element*
- *Facility or Location Involved*
- *Performance Test Boundaries*
- *Time Line or Schedule*

An interior biometric identity verification device will be performance tested against the design basis threat. The test will be conducted in the facility just outside the interim storage vault. The adversary tactics that will be used for performance testing the protection element have been pre-determined for the test.

Test Methodology and Evaluation Criteria

Test methodology describes how the test will be conducted.

1. Review false accept and false reject testing for a biometric identity verification device.
2. The biometric identity verification device will be tested against the established goal.
3. A sampling plan will be reviewed – several trials will be conducted.
4. Testers will conduct performance tests as described.
5. Determine probability of detection based on tests.

Test evaluation criteria describe how the test will be assessed or scored.

Record total detected alarms for all test locations = _____ out of _____ tests

Probability of detection (P_D) = _____ with a Confidence Level = 85%

Record if the element met or failed to meet the goal.

Goal probability of detection (P_D) = 88 %, with a confidence level of 85%.

Record test failed or met the performance level? _____

Test Coordination

Performance test coordination describes who needs to be involved or aware that a test will be conducted.

This test will be coordinated with Physical Protection personnel who will conduct the performance testing and resolve any discrepancies.

Compensatory Measures

Compensatory Measures describe what is necessary to compensate for any degradation of readiness experienced while conducting the performance test.

There are no compensatory measures necessary. Physical Protection personnel will be physically present in the Interim Storage Building.

Approval of Performance Testing

Approval of performance test plans describes how the test plan is approved and who has to approve the test.

This test plan will be approved by the Facility Manager, Physical Protection Manager, and Response Force Supervisor.

Classification of Test

Determination of whether the test plan, source documents and/or results should be considered sensitive.

For an actual site, the source data generated from the performance test and the completed worksheets would probably be considered sensitive and should be marked appropriately. Because this is a class exercise, all data and results are considered to be non-sensitive.

Briefing and Critiques

After completion of the test, the performance testing team will provide a briefing of the test and results to the Operations Supervisor and the Physical Protection Manager. Should there be a failure, the Physical Protection Manager will determine what additional actions are required. A final report will be issued with the results of the performance test.

Activity 2: Conduct False Accept and False Reject Testing

This activity is designed to familiarize the participant to the false accept and false reject testing for a biometric identity verification device. The biometric device is already properly installed, and the parameters have been set to optimal levels by previous preliminary testing. A technical subject matter expert (SME) will be available to provide guidance and consultation.

Sensor to be tested: Biometric Identity Verification Device

Required Equipment

- Biometric data table
- Calculator
- Paper and colored pencils to record analysis and graph error rates

General Information, Instructions and Group Responsibilities

General Information: Biometric Identity Verification Devices compare a stored biometric template to one generated during the identity verification process. All biometric devices calculate a score that is then compared to a threshold to determine if the comparison between the stored template in the device database matches the generated template close enough to verify identity and grant access. Some devices calculate scores in a way that a high score is a close match and some calculate the score in such a way that a low score is a close match.

This exercise is based on a hand geometry reader (Figure 1) that calculates scores such that a low score represents a close match. These devices come from the factory with a default threshold setting of 100. Therefore if someone who is enrolled in the system uses the device and the entry attempt generates a score of 100 or below identity is verified and access to the secure area is granted.

General Instructions: Each group will organize the data presented in Worksheet 2 then calculate the error rates at various threshold levels and plot the error rates.

Group Responsibilities: Each group will count the number of data points within a specific range. They will then record the analyzed data. Next they will calculate the error rate for each threshold and plot that data point on the graph.



Figure 1: Hand Geometry Reader

Worksheet 2: Hand Geometry Scores from False Reject and False Accept Testing

False Reject (Hand Geometry Score when Tester is using their own PIN)	False Accept (Hand Geometry Score when Tester is using someone else's PIN)
9	50
12	98
15	100
22	101
22	106
25	108
25	110
26	120
28	125
30	125
42	126
47	132
51	138
57	140
57	149
63	149
71	157
84	160
88	169
88	190
89	199
89	200
90	201
90	210
90	220
91	250
92	260
93	268
93	275
95	299
99	320
110	475
119	552
121	560
121	575

Counting Scores in a Range

1. Count the total number of False Reject scores (from Worksheet 2) that are greater than the threshold level listed in each row of Worksheet 3. For instance, the first threshold listed in the threshold column of Worksheet 3 is 25. The number of scores greater than 25 are counted for the False Reject data in Worksheet 2 and this number is recorded in Worksheet 3 in the False Reject column.
2. This procedure is repeated for each threshold level.
3. Count the number of scores (from Worksheet 2) that are equal to or below the threshold level listed in Worksheet 3 and this number is recorded in Worksheet 3 in the False Accept column.
4. This procedure is repeated for each threshold level.

Worksheet 3: Scores in a Stated Range

Threshold	False Reject	False Reject %	False Accept	False Accept %
25				
50				
75				
100				
125				
150				
175				
200				
225				
250				
275				
300				
325				
350				
375				
400				
425				
450				
475				
500				
525				
550				
575				

Calculating the Error Rate Percentage

1. There are 35 total trials for False Reject and 35 total trials for False Accept.
2. Calculate the False Reject rate percentage by the following equation:
$$\text{False Reject \%} = (\text{number of scores above threshold}/35) \times 100.$$
3. Record these numbers in Worksheet 3.
4. Calculate the False Accept rate percentage by the following equation:
$$\text{False Accept \%} = (\text{number of scores equal to or below threshold}/35) \times 100.$$
5. Record these numbers in Worksheet 3.

Plot the Error Rates on the Graph

1. Once a percent rate for a given threshold has been calculated then that point can be plotted on the graph form (Figure 2). Use a different color pencil for the two types of error rates. For example use blue for False Reject and use red for False Accept.
2. Once all points are plotted connect the points to generate the rate curves again using different colored pencils.

Estimate the Equal Error Rate Point

After the curves are drawn in locate the point where the two curves cross. This point is an estimate for the equal error rate for this device.



Figure 2: Plotting Error Rates

Activity 3: Class Discussion

The facility requirement is that a biometric used at this facility will have an equal error rate no greater than 1%.

1. Does this device meet the performance requirement?

Discussion Questions

1. Will the implementation of a biometric at a facility impact the throughput rate for that portal?
2. If the secure area being protected by this biometric is an administrative area with no high consequence targets, should the biometric be operated at:
 - a. The equal error point?
 - b. Above the equal error point?
 - c. Below the equal error point?
3. If the secure area being protected by this biometric is an high security area with high consequence targets, should the biometric be operated at:
 - a. The equal error point?
 - b. Above the equal error point?
 - c. Below the equal error point?

Activity 4: Prepare and Conduct Performance Test

In this activity, you must finalize a test plan for determining the performance of a hand geometry unit. The hand geometry unit is already properly installed, and the parameters have been set to optimal levels by previous preliminary testing. A technical subject matter expert (SME) will be available to provide guidance and consultation.

To finalize the test plan, follow the steps below:

Sensor to be tested: Hand Geometry Unit

1. Test Criteria (Probability of Detection and Confidence Level)

The probability of detection (P_D) to be used in testing is 88 %, with a confidence level of 85%. Develop a test plan that will determine whether the sensor meets or fails to meet the goal probability of detection (P_D).

NOTE: The higher the confidence level the more extensive testing required. (Keep in mind the limited time for the exercise and number of trials to be completed.)

Two tables are provided as attachments to help you select an acceptable probability of detection with desired confidence level:

- Table A-1: Trials and Failures with Probability of Detection for Designated Confidence Level—Trial Sort
- Table A-2: Trials and Failures with Probability of Detection for Designated Confidence Level—Failures Sort

2. Sampling Plan

Review and discuss Sampling Plan (i.e., test locations, number of trials; stopping points; failures tolerated). General description provided below:

- a. Test for the Hand Geometry Unit:** Because of time constraints, the number of tests has been determined for you.
 - Number of trials for each test will be 10. If time permits, you can conduct additional tests.
 - Number of failures allowed = 3 (test to be stopped when failures exceed this limit)

After finalizing your test plan, if you have any questions prior to testing ask your technical subject matter expert. You are now ready to start testing, proceed to your testing station.

Conduct Performance Test: Testers will insert hand into hand geometry unit (Figure 1) and then insert their personal identification number (PIN). All testers will have authorized access. Indicate in Worksheet 4 if the unit allowed authorized access or not. After the test is complete, determine the probability of detection (P_D) and determine if the test met the established performance test goal or not.

Worksheet 4: Performance Test Results

Test	Access Allowed? (Yes/No)	Notes
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Total successful authorized access for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection (P_D) = _____ with a confidence level = 85%

Record if the element met or failed to meet the goal.

Test failed or met the performance level? _____

Exercise 8

Performance Testing of Exterior Detection Systems - Microwave Sensor

Session Objectives

After the session the participants will be able to do the following:

1. Learn how to determine the detection volume for a stacked bistatic microwave system.
2. Evaluate microwave sensors for their sensing capability using walk, run, crawl, and jump performance testing methods.
3. Conduct performance tests on a component of the intrusion detection system (microwave sensors).
4. Begin to evaluate the intrusion detection subsystem.

Participants will use the questions and evaluation checklists and worksheets as a guide to document test results from the exercise.

Estimated Time

90 minutes

Activities

1. Review test plan for microwave sensors
2. Prepare for testing
3. Conduct performance tests:
 - 3-1 Walk tests
 - Determine probability of detection (P_D) and confidence level (CL).
 - Determine detection pattern.
 - 3-2 Crawl tests
 - Determine probability of detection (P_D) and confidence level (CL).
 - Determine detection pattern.
4. Conduct additional performance tests:
 - Defeat tests
 - 4-1 Crawl tests
 - 4-2 Run tests
 - 4-3 Jump tests

5. Conduct subsystem performance tests:
 - 5-1 Determine the start and end of a sector.
 - 5-2 Verify alignment with video subsystem.
 - 5-3 Verify alarm reporting and timing and sensor integration with delay subsystems.
 - 5-4 Map out detection envelopes and identify overlapping coverage.
 - 5-5 Identify anomalies in sectors.
 - 5-6 Focus testing for best results.

A technical subject matter expert (SME) will be located at the sensor station and will provide a brief description of the sensor (including principles of operation and description of element).

Group Discussion

At the end of the subgroup exercise, the entire class will discuss the performance test and results. Discussion will be facilitated by the instructor. In addition, the instructor will review answers to any follow-on questions.

Attachments

See separate attachment for Exercise: Table of trials and failures with probability of detection for designated confidence level sorted by trials (Table A-1) and failures (Table A-2).

Acronyms

CL – confidence level

P_D – probability of detection

PIDAS – Perimeter Intrusion Detection and Assessment System

Activity 1: Review Performance Test Plan for Microwave Sensors

The purpose of this exercise is to conduct a performance test of exterior sensors in the facility Perimeter Intrusion Detection and Assessment System (PIDAS). The following performance test plan has been provided and will be used to conduct the test:

- Worksheet 1: Performance Test Plan

Participants will review the performance test, ask any questions for clarification, and then perform the test in the field.

Worksheet 1: Exterior Sensor Performance Test Plan

Performance Test Goal

A general statement of the overall desired outcome of the performance test (should describe the overall expected result).

This performance test is designed to determine the probability of detection (given the Design Basis Threat) for an exterior sensor (microwave) located in a PIDAS.

Objectives

A concise elaboration of the goal that describes the specific tasks to be tested:

- *Purpose of the test*
- *Tasks to be tested*
- *Conditions for the test*

This performance test will determine the probability of detection for an exterior microwave sensor based on actual environmental conditions. The adversary tactics (modes of attack) that will be used for performance testing the protection element have been pre-determined for the test. Because of time constraints, three tactics (walk, run, and crawl) have been chosen to ensure all testing is completed in the allotted time.

Location

The location of the performance test is simply where the test will take place.

The location for the performance test will be in the hypothetical facility PIDAS.

Element(s) to be tested

Identify and describe the specific essential element that will be tested for response.

Not applicable for this test.

Scenario Identification

Scenario identification involves describing the:

- *Element Being Tested*
- *Threat Facing the Element*
- *Facility or Location Involved*
- *Performance Test Boundaries*
- *Time Line or Schedule*

An exterior microwave sensor will be performance tested against the design basis threat. The test will be conducted in the facility PIDAS. The adversary tactics (modes of attack) that will be used for performance testing the protection element have been pre-determined for the test. Normally, for microwave sensors, these tactics would include running, jumping, walking (slow, fast), crawling (slow, fast), etc. Because of time constraints, three tactics (walk, run, and crawl) have been chosen to ensure all testing is completed in the allotted time.

Test Methodology and Evaluation Criteria

Test methodology describes how the test will be conducted.

1. A goal probability of detection with a confidence level is provided. The sensor will be tested against the established goal.
2. Test locations along the detection zone for the microwave sensor will be reviewed.
3. A sampling plan will be reviewed - 15 tests will be conducted.
4. Three modes of attack will be used (walk, run, crawl).
5. Testers will conduct performance tests (as described in Activity 2).
6. Determine probability of detection based on tests.

Test evaluation criteria describe how the test will be assessed or scored.

Record total detected alarms for all test locations = _____ out of _____ tests

Probability of detection (P_D) = _____ with a Confidence Level = 85%

Summary of Results

Record if the element met or failed to meet the goal.

Goal probability of detection (P_D) = 88 %, with a confidence level of 85%.

Record test failed or met the performance level? _____

Test Coordination

Performance test coordination describes who needs to be involved or aware that a test will be conducted.

This test will be coordinated with Physical Protection personnel who will conduct the performance testing and resolve any discrepancies.

Compensatory Measures

Compensatory Measures describe what is necessary to compensate for any degradation of readiness experienced while conducting the performance test.

There are no compensatory measures necessary. Physical Protection personnel will be physically present in both the PIDAS and Central Alarm Station (CAS).

Approval of Performance Testing

Approval of performance test plans describes how the test plan is approved and who has to approve the test.

This test plan will be approved by the Facility Manager, Physical Protection Manager, and Response Force Supervisor.

Classification of Test

Determination of whether the test plan, source documents and/or results should be considered sensitive.

For an actual site, the source data generated from the performance test and the completed worksheets would probably be considered sensitive and should be marked appropriately. Because this is a class exercise, all data and results are considered to be non-sensitive.

Briefing and Critiques

After completion of the test, the performance testing team will provide a briefing of the test and results to the Operations Supervisor and the Physical Protection Manager. Should there be a failure, the Physical Protection Manager will determine what additional actions are required. A final report will be issued with the results of the performance test.

Activity 2: Prepare for Performance Test

In this activity, you must finalize a test plan for determining whether the performance of a microwave sensor will be acceptable in a proposed design. The microwave sensor is already properly installed, and the parameters have been set to optimal levels by previous preliminary testing. A technical subject matter expert (SME) will be available to provide guidance and consultation.

To finalize the test plan, follow the steps below:

Sensor to be tested: **Microwave**

1. Test Criteria (Probability of Detection (P_D) and Confidence Level (CL))

The probability of detection (P_D) to be used in testing is 88 %, with a confidence level (CL) of 85%. Develop a test plan that will determine whether the sensor meets or fails to meet the goal probability of detection (P_D).

Note: The higher the confidence level the more extensive testing required. (Keep in mind the limited time for the exercise and number of trials to be completed.)

Two tables are provided in another attachment to help you select an acceptable probability of detection (P_D) with desired confidence level (CL):

- Table A-1: Trials and Failures with Probability of Detection for Designated Confidence Level—Trial Sort
- Table A-2: Trials and Failures with Probability of Detection for Designated Confidence Level—Failures Sort

2. Sampling Plan

Review and discuss Sampling Plan (i.e., test locations, number of trials; stopping points; failures tolerated). General description provided below:

- a. **Test locations for the microwave:** Because of time constraints, test locations have been determined for you (Table 1). Figure 1 shows test locations.

Table 1: Locations of Test Points

Test Point	Test Locations (from transmitter)
Test Location 1	3 m (10 ft)
Test Location 2	6 m (20 ft)
Test Location 3	9 m (30 ft)
Test Location 4	12 m (40 ft)
Test Location 5	15 m (50 ft)

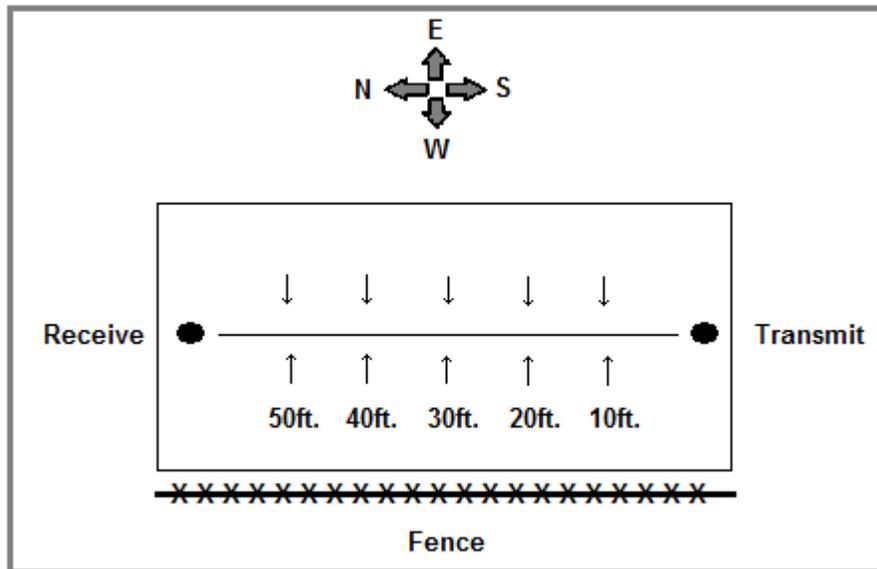


Figure 1: Test Locations

b. Number of trials

For each test, you will conduct 15 tests (follow the test plan). If time permits, you can conduct additional tests.

- Number of failures allowed = 3 (test to be stopped when failures exceed this limit)

3. Adversary Tactics

The adversary tactics (modes of attack) that will be used for performance testing the protection element have been pre-determined for you. Normally, for microwave sensors, these tactics would include running, jumping, walking (slow, fast), crawling (slow, fast), etc. Because of time constraints, three tactics have been chosen to ensure your team completes all the testing in the allotted time.

1. Walk (normal)
2. Run (similar to a jog)
3. Crawl (using simulated crawler – aluminum sphere)

Activity 3: Conduct Performance Tests

Activity 3-1: Walk Tests

No more than one person shall be within 9 m (30 ft) of the microwave zone being tested. The individual performing the tests must remain within 0.6 m (2 ft) of either fence line while moving to a new location and must limit movements for at least 30 seconds (sec) prior to walking across the test field.

Walk Tests Parallel to the Zone

Walk tests parallel to the zone are conducted to determine whether the sensor is misaligned or mounted too close to the fence. Such tests involve walking parallel to the zone approximately one meter from the fence and verifying that no alarm occurs.

If the sensor is located parallel to a fence, walk along the length of the detection zone, 0.9 m (3 ft) from the fence – does an alarm occur?

Yes No Not applicable

Walk Test across the Zone

Walk tests are conducted to verify operability and sensitivity, and to determine the width of the detection zone. A shuffle walk involves small slow steps without swinging the arms (steps of 5 cm (0.16 ft/sec) or less at 0.15 m/sec [0.5 ft/sec]). The width of the detection zone can be determined by monitoring alarm annunciation. A sensitivity test should be conducted at the mid-range of the sensor beam.

Begin walk tests at the transmitter end. An individual will walk at a rate of 0.3 m/sec (1 ft/sec) with arms at sides. Walk across the test field between microwave heads and observe an alarm signal (see Figure 2 for walk paths and direction). Walk across the microwave's field-of-view at each of the distances described in Worksheet 2. The test individual will conduct 3 walks at each specified location and document if an alarm occurred in the appropriate column in Worksheet 2.

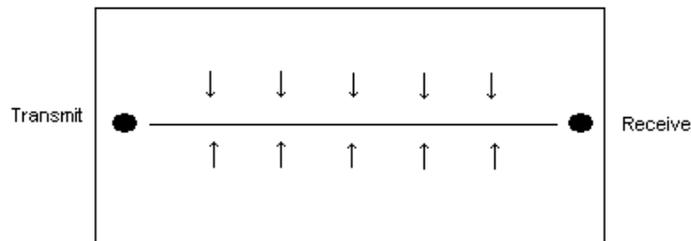


Figure 2: Walk Paths across Field of View

When an alarm is annunciated, mark the area with a wooden block. Document the detection pattern on the attached grid located on Worksheet 3: Grid for Detection Zone Drawing. You will walk across the field of view on both sides of the center line. After you have walked across all points, document and connect the detection points to illustrate the detection zone pattern.

Worksheet 2: Walk Test Data

Location	Alarm (Yes/No)		Total detected alarms	Distance from Center Line (meters/ft)	
	Left	Right		Left	Right
At crossover point near transmitter					
Half the distance between crossover and midpoint					
At midpoint					
Half the distance between midpoint and crossover					
At crossover point near receiver					

Total detected alarms for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection (P_D) = _____ with a confidence level = 85%

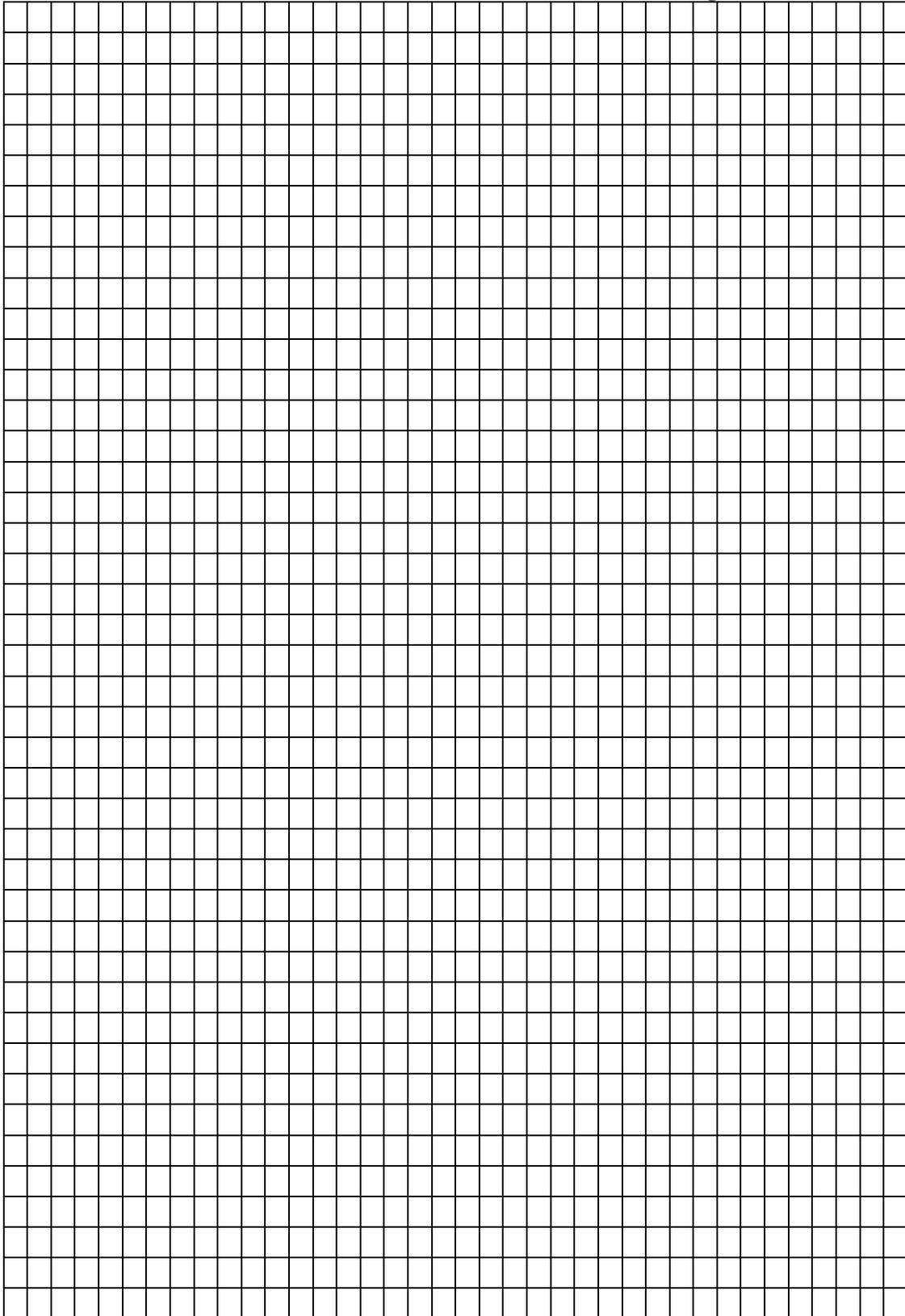
Record if the element met or failed to meet the goal.

Indicate if the test failed or met the performance level established.

Goal probability of detection (P_D) = **88 %, with a confidence level of 85%.**

Test failed or met the performance level? _____

Worksheet 3: Grid for Detection Zone Drawing



Activity 3-2: Crawl Tests

Crawl tests are conducted to verify proper detector alignment and sensitivity, and to determine whether terrain irregularities can be exploited. Crawl tests involve crossing the detection zone at selected points while minimizing radar cross section (intruder remains flat parallel to the beam, head down, with no reflective clothing). Tests should be conducted by a relatively small individual crawling at approximately 0.3 m/sec (1 ft/sec). Tests should be conducted at various points along the detection zone, including just inside the crossover point, at the mid-range, and wherever terrain features are likely to reduce detection.

Across

Use the aluminum sphere to simulate a stomach crawl. Set the aluminum ball out of the detection zone, approximately 4.5 m (14.8 ft) from the center line. One individual will be located on either side of the center line. Begin pulling the ball across the field-of-view of the microwave and verify if an alarm occurs. Pull ball at a rate of 0.3 m/sec (1 ft/sec). Document results in Worksheet 4.

Worksheet 4: Crawl Data

Distance	Alarm (Yes/No)		Total detected alarms	Distance from Center Line (meters)	
	Left	Right		Left	Right
At crossover point near transmitter					
Half the distance between crossover and midpoint					
At midpoint					
Half the distance between midpoint and crossover					
At crossover point near receiver					

Module 8. Performance Testing of Exterior Detection Systems
Exercise 8: Performance Testing of Exterior Detection Systems - Microwave Sensor
SAND2012-9025P

Total detected alarms for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection (P_D) = _____ with a confidence level = 85%

Record if the element met or failed to meet the goal.

Indicate if the test failed or met the performance level established.

Goal probability of detection (P_D) = **88 %, with a confidence level of 85%.**

Test failed or met the performance level? _____

Activity 4: Conduct Additional Performance Tests

Defeat Tests – Crawl, Run, Jump

Activity 4-1. Crawl Tests

If time permits, conduct the following additional performance tests.

Review the data obtained from the Performance Crawl Tests in previous activity; determine where terrain irregularities can be exploited. Crawl across the sensor field at these points and observe an alarm signal. Begin at the transmitter end and document the data in Worksheet 5.

Worksheet 5: Defeat Crawl Data

Distance in meters	Alarm (yes/no)						Total detected alarms
Crossover point							
Mid-range							
3 m (10 ft) in front of transmitter							
3 m (10 ft) in front of receiver							
Total detected alarms out of _____							

Activity 4-2. Run Tests

Run tests are conducted to verify whether receiver response is fast enough (Figure 3). Run tests involve crossing the detector zone at a fast run (approximately 5 m/sec [16 ft/sec]). Such tests are performed where the beam is narrow – approximately 6 m (20 ft) from the transmitter or receiver or just inside the crossover point (for overlapping sensors).

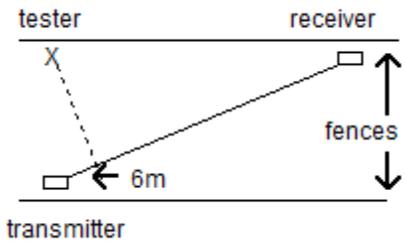


Figure 3: Run Test Configuration

1. Run across the center of the zone. Record results in Worksheet 6.
2. Stand close to the isolation zone fence across from the transmitter. When running across the detection zone, you should pass approximately 6 m (20 ft) from the transmitter. Run at about 5 m/sec (16 ft/sec) across the detection area. Record results in Worksheet 6.
3. In a manner similar to step 2, stand approximately 6 m from the microwave receiver. When the microwave has stabilized, repeat step 2.

Worksheet 6: Run Data

Intrusion Location in Zone	Alarm	No Alarm
Center		
Transmitter		
Receiver		

Activity 4-3. Jump Tests

A jump test is conducted to verify adequate detection height. Such tests involve attempting to jump over the beam, and are conducted where the beam is narrowest (that is, near the crossover point). Barriers, buildings at the perimeter, sensor posts, or mountings may be used as platforms for jumping.

Five jump tests will be conducted to verify if an adversary can jump over the detection zone. No more than five will be conducted because of time limitations.

In a manner similar to step 1 of the Run Test, stand approximately 6 m (20 ft) from the microwave *transmitter*. Run at about 8 m/sec (26 ft/sec) perpendicular across the detection area, jumping at least 0.6 m (2 ft) off the ground as you cross the beam centerline. You should try to raise your feet as high as possible as you jump. Record results in Worksheet 7.

Worksheet 7: Jump Data

Attempt Number	Alarm (yes/no)
1	
2	
3	
4	
5	
Total number of detections	

Activity 5: Conduct Subsystem Performance Tests

This portion of the exercise takes information and knowledge learned during the component testing to begin to examine the performance of the intrusion detection subsystem. An effective subsystem consists of individual components that must work together. This exercise begins to show how the components should work together; however, some portions will only be an introduction that will be expanded upon in later exercises.

Activity 5-1. *Determine the start and end of a sector*

The start and end of a sector is determined by a number of factors. Some sites may use a sign mounted on the fence to allow the response force to quickly find a sector location, however, the placement of these signs is usually more notional. In this exercise we will show how to determine the actual sector boundaries based upon the sensor installation, detection envelopes, and typical attack methods.

Activity 5-2. *Verify integration with video subsystem*

The video subsystem must work well with the sensor subsystem in order to have an effective overall system. In this exercise we will learn how to conduct some gross checks to verify the video cameras are aimed correctly and have the appropriate lenses to allow for adequate detection. The information learned in this exercise will be used again in later exercises for checking whether the video provides adequate resolution to make a proper alarm assessment.

Activity 5-3. *Verify alarm reporting and timing and sensor integration with delay subsystems*

This exercise performs some quick checks to determine if there appear to be any unusually long alarm reporting times that may result in poor assessment. A few simple run tests will be performed at different locations along a sector to show that the video is displayed quickly enough to allow the console operator to observe a fast moving adversary. If time permits, the console operator may also want to examine the recorded video to ensure that there the adversary is visible in the scene in the recording.

If there appear to be some delays either in the alarm reporting time, video display, or recorded video, are there features in the perimeter that an adversary could use to exploit this? Some sites may not have an inner fence. If not, is it possible for the adversary to be out of the video scene before the camera view is displayed? Perhaps an adversary can run through a sensor zone and hide around a corner. Are there objects in the zone that an adversary could hide behind to prevent detection?

Activity 5-4. *Map out detection envelopes and identify overlapping coverage*

Individual sensors must be overlapped effectively at sector boundaries to create a continuous line of detection. Multiple sensors in a sector may have overlapping coverage requiring an adversary to attempt to defeat the sensors simultaneously. This exercise will have the student examine the individual sensors and determine if there are places where an adversary can attempt to defeat the sensors individually to improve his chances of success. The student should also examine the sensor alignment to determine if the sensor detection patterns may be skewed by improper alignment. For example, if the antennas appear to be pointing downward, a jumping attack may be more successful. Individual attack modes such as running, jumping, crawling, and climbing should be considered. Can an individual find places in the sector where he can jump over one sensor and then crawl under the next or must he use the same attack method for both sensors? The student will not perform the actual attacks in this exercise, but will gather information to determine where to focus tests in the later exercises.

Map out the approximate sensor locations, fences, and expected sensor coverage on Worksheet 8: Grid for Sector Coverage.

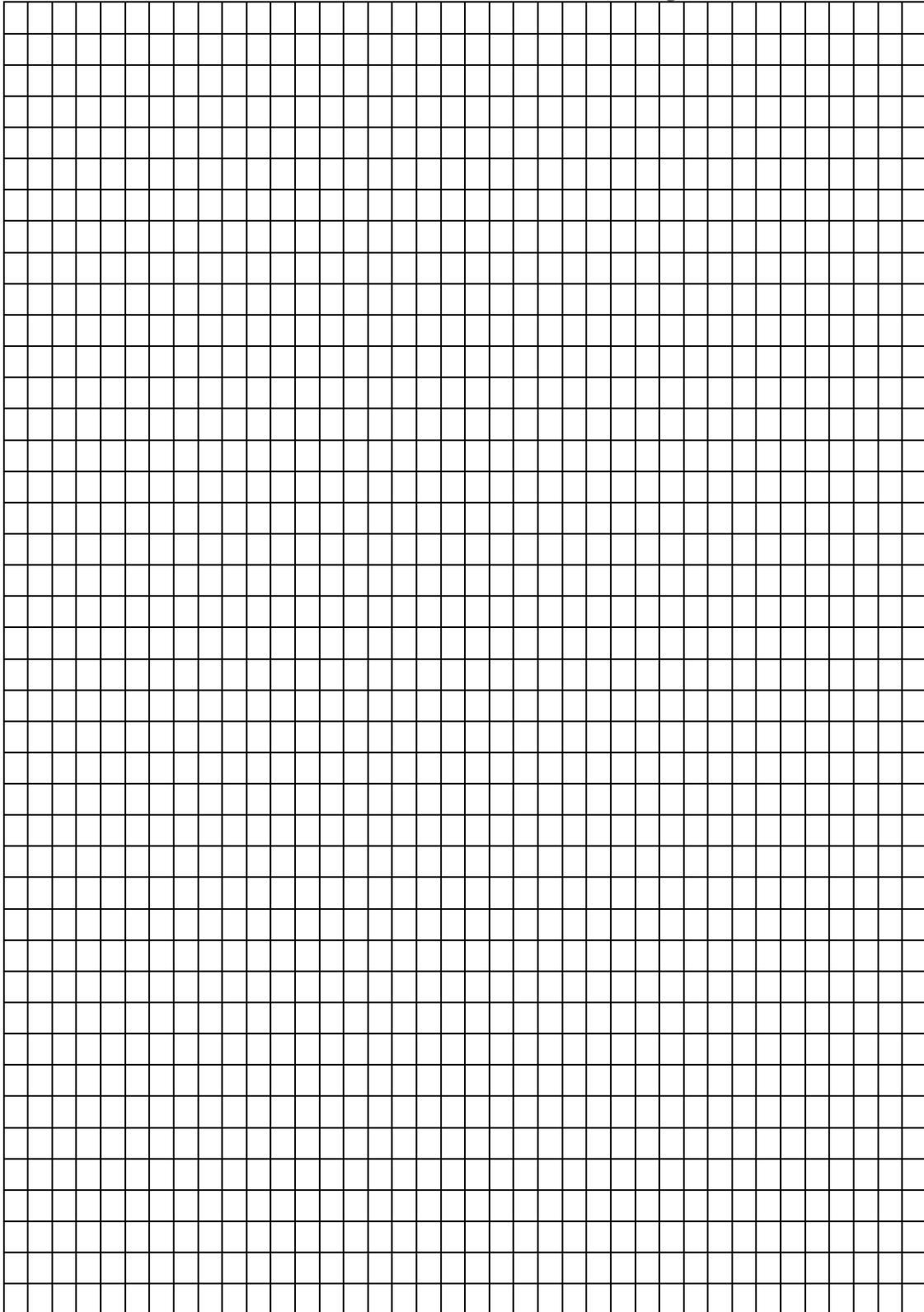
Activity 5-5. *Identify anomalies in sectors*

In this exercise the student will examine the sectors for anomalies that might provide the adversary an increased chance of defeating the sensor. Anomalies might include terrain changes, especially low spots, corners, cross fences, close proximity of the sensors to inner or outer fences, camera towers, fire hydrants, junction boxes, or anything else that the adversary might be able to use effectively. Can the adversary use these anomalies to defeat one or more systems? Map any possible anomalies on the grid completed in the last portion of the exercise.

Activity 5-6. *Focus testing for best results*

Using the information gathered from the previous exercises and using the knowledge gained from component testing, the students should now decide with the limited time they have which types of tests and which locations will provide the most information about effectiveness of the sensor subsystem. Trade-offs such as whether to run quickly in order to reduce assessment or to attempt a slow attack to try to defeat the sensors would be most effective for the adversary should be considered.

Worksheet 8: Grid for Sector Coverage



Exercise 9-1

Camera Assessment System Performance – Day Exercise

Session Objectives

After the session, the participants will be able to do the following:

1. Determine whether an entire alarm sector zone can be viewed within the associated camera assessment sector zone.
2. Determine at what distance an object can be identified as a nuisance or a real alarm.
3. Determine at what distance an object can be clearly classified.
4. Distinguish between the three levels of assessment resolution (detection, classification, and identification).

Estimated Time

45 minutes

Activities

1. Review test plan for video camera assessment system.
2. Determine camera near-field-of-view assessment capability.
3. Determine camera field resolution.
4. Discuss exercise, results, and follow-on questions.

Group Discussion

At the end of the exercise, the entire class will discuss the performance test and results. Discussion will be facilitated by the instructor. In addition, the instructor will review answers to any follow-on questions.

Attachment A

Attachment A includes data collection worksheets for the team members located in the central alarm station (CAS) during the performance test.

Acronyms

CAS – central alarm station

ECP – entry control portal

FOV – field-of-view

ISB – Interim Storage Building

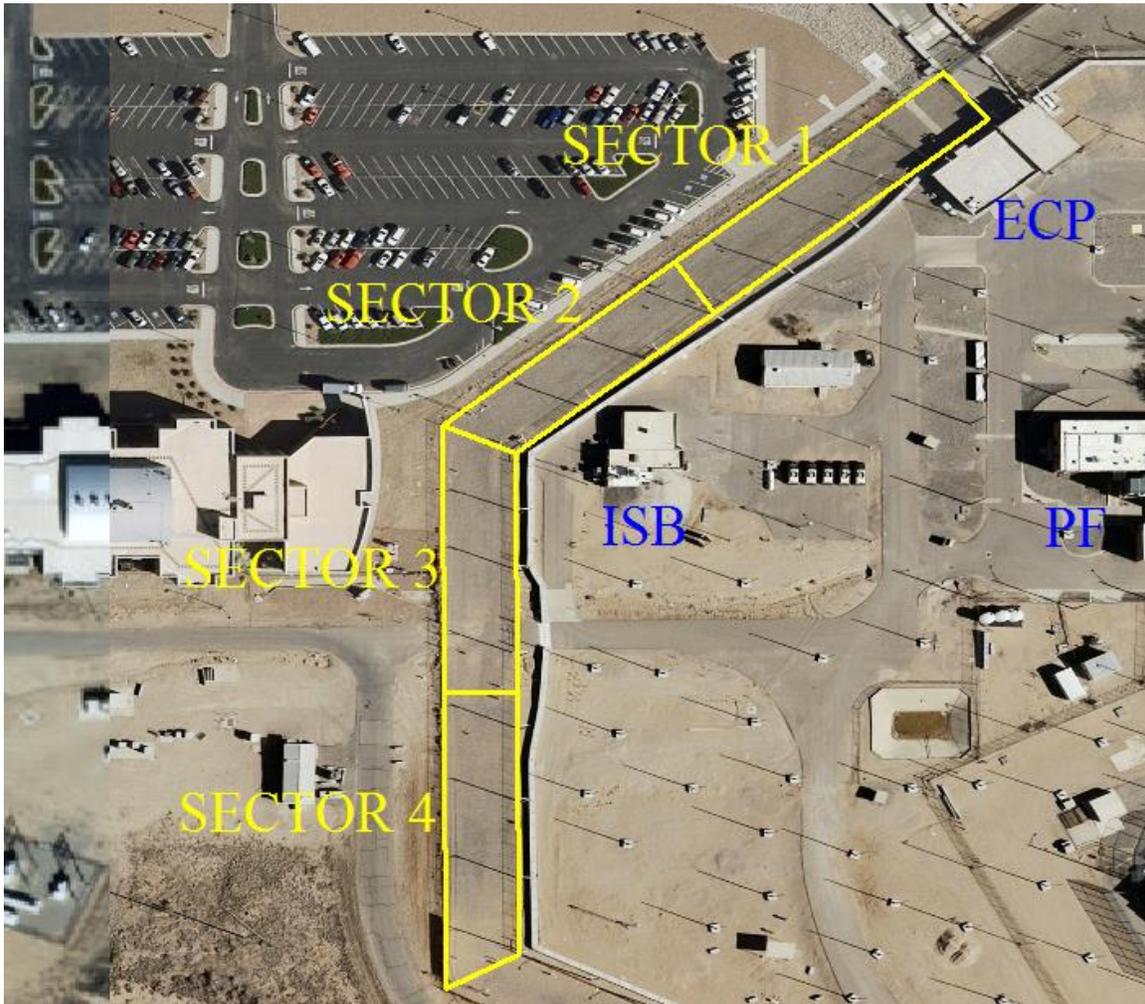
PF – processing facility

PIDAS – Perimeter Intrusion Detection and Assessment System

SPP – Springfield Processing Plant

Sector Map

Below is a map showing assessment Sectors 1 to 4 within the Perimeter Intrusion Detection and Assessment System (PIDAS) at the Springfield Processing Plant (SPP) facility. The teams will be conducting exercises in Sectors 2 and 3. This map is intended to be a reference for locating sectors.



Activity 1: Review Performance Test Plan for Video Assessment Systems

The purpose of this performance test is to determine whether an entire assessment zone can be viewed on the video monitor in the central alarm station (CAS). The performance criterion is that the camera's field-of-view needs to image the full sector width at the near field-of-view.

The following performance test plan has been provided and will be used to conduct the test:

- Worksheet 1: Performance Test Plan

Participants will review the performance test, ask any questions for clarification, and then perform the test in the field.

Worksheet 1: Video Assessment System Performance Test Plan

Performance Test Goal

A general statement of the overall desired outcome of the performance test (should describe the overall expected result).

This performance test is designed to determine the capability of a camera system to image an entire assessment zone on the video monitor in the central alarm station (CAS).

Objectives

A concise elaboration of the goal that describes the specific tasks to be tested:

- *Purpose of the test*
- *Tasks to be tested*
- *Conditions for the test*

This performance test will determine the capability of a video camera system to image an entire assessment zone based on actual environmental conditions.

Location

The location of the performance test is simply where the test will take place.

The location for the performance test will be within the Perimeter Intrusion Detection and Assessment System (PIDAS) at the Springfield Processing Plant (SPP) facility.

Element(s) to be tested

Identify and describe the specific essential element that will be tested.

Intrusion Detection System – Video Camera Assessment System

Scenario Identification

Scenario identification involves describing the:

- *Element Being Tested*
- *Threat Facing the Element*
- *Facility or Location Involved*
- *Performance Test Boundaries*
- *Time Line or Schedule*

Exterior video assessment system will be performance tested against the design basis threat. The test will be conducted within the Perimeter Intrusion Detection and Assessment System (PIDAS) at the Springfield Processing Plant (SPP) facility. The adversary tactics that will be used for performance testing the protection element have been pre-determined for the test.

Test Methodology and Evaluation Criteria

Test methodology describes how the test will be conducted.

1. Determine if the video assessment system meets a design goal of viewing an entire alarm sector zone.
2. Determine if the video assessment system can distinguish between the three levels of assessment resolution (detection, classification, and identification).
3. A sampling plan will be reviewed – a series of 8 tests for each sector and for each team (teams will change responsibilities for each test).
4. Testers will conduct performance tests as described.

Test Coordination

Performance test coordination describes who needs to be involved or aware that a test will be conducted.

This test will be coordinated with Physical Protection personnel who will conduct the performance testing and resolve any discrepancies.

Compensatory Measures

Compensatory Measures describe what is necessary to compensate for any degradation of readiness experienced while conducting the performance test.

There are no compensatory measures necessary. Physical Protection personnel will be physically present in both the Perimeter Intrusion Detection and Assessment System (PIDAS and central alarm station (CAS).

Approval of Performance Testing

Approval of performance test plans describes how the test plan is approved and who has to approve the test.

This test plan will be approved by the Facility Manager, Physical Protection Manager, and Response Force Supervisor.

Classification of Test

Determination of whether the test plan, source documents and/or results should be considered sensitive.

For an actual site, the source data generated from the performance test and the completed worksheets would probably be considered sensitive and should be marked appropriately. Because this is a class exercise, all data and results are considered to be non-sensitive.

Briefing and Critiques

After completion of the test, the performance testing team will provide a briefing of the test and results to the Operations Supervisor and the Physical Protection Manager. Should there be a failure, the Physical Protection Manager will determine what additional actions are required. A final report will be issued with the results of the performance test.

Activity 2: Determine Camera Near-Field-of-View Assessment Capability

One requirement of a perimeter assessment system is to display the clear zone including both the inner and outer fences. Camera and lens (1) selection and (2) positioning must ensure detection and classification of any visible cause of sensor alarms in the clear zone at any time.

Equipment Needed

- Camera
- Lens
- Tape measure
- Handheld radios
- Two 71-cm (28-inch) tall orange cones

Exercise Preparation

Preparation for the exercise will be conducted in the classroom prior to actual field test. The instructor will explain how the exercise is to be conducted in the field and what data is to be collected. Table 1 shows where the teams will be located initially for exercises.

Table 1: Team Initial Locations for Activity 2

Teams	Initial Location
1	Central Alarm Station
2	PIDAS (field)

Roles/Responsibilities

Before leaving the classroom for the field, all participants need to define their roles and responsibilities for the exercise. Participants will be changing roles throughout the exercises.

To begin, half of the class will be in the field (within the PIDAS), and half the class will be observing and collecting data in the central alarm station (CAS). After completing Activities 2 and 3, the PIDAS team and central alarm station (CAS) team will switch locations so that all participants have the opportunity to experience each part of the exercise (i.e., field testing and central alarm station (CAS) data collection).

Prior to leaving the classroom, the team members' roles and responsibilities will be defined primarily for the field part of the test. After each activity, roles and responsibilities will switch so that all participants have the opportunity to participate in a different aspect of the test

- CAS Monitor Observation Team: All participants in the central alarm station (CAS) will be observers and note takers, with at least one person assigned as the CAS radio communications person.

- Field Team (located in the PIDAS): The instructor will have determined the sector zone to be tested (the near field and far field of the sector zone will be marked in the field). Participants must be assigned to a role before departing for the field.

Note: There are two teams: the Field Team and the CAS Monitor Observation Team. The steps below constitute one trial; after completing two trials, the teams switch roles and perform these tasks again.

1. One person on each team is the designated radio communicator.
2. The Field Team places the orange cones alongside both fences at the beginning of a sector (see Figure 1). Two members of the field team (Tester 1 and Tester 2) are instructed to stand next to the two orange cones.
3. See Figure 1 for a schematic of the activity and initial location of field testing team.
4. When the cones are in position, the Field Team radios the CAS Monitor Observation Team to state whether they can see the entirety of the both cones in the monitor view.

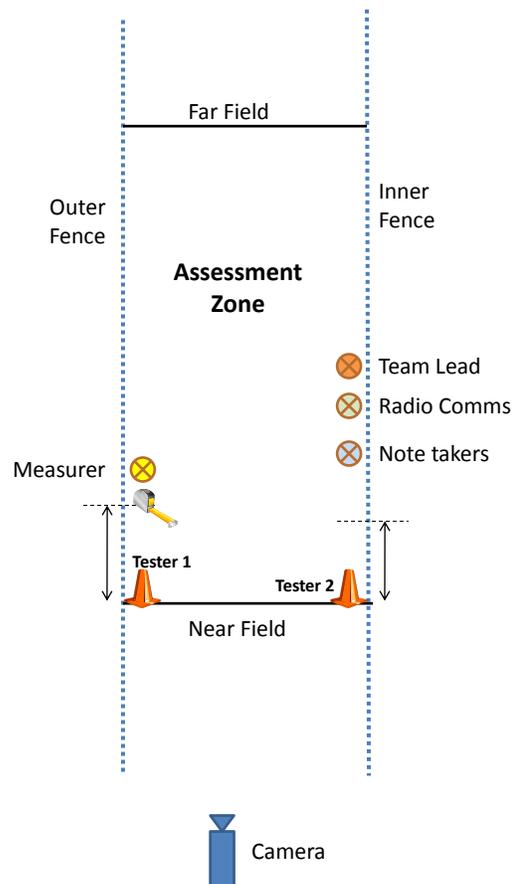


Figure 1: Schematic for Activity 1 (initial location of test personnel)

5. The CAS Monitor Observation Team states whether or not they can observe the entire cone in the camera field-of-view. Has the performance criterion been met? Observations are recorded on Data Collection Worksheet 1.
6. If the CAS Monitor Observation Team cannot see the entirety of the two cones, they request via radio that the Field Team have the person on the inner fence (Tester 2) slowly move away from the camera (remaining adjacent to the fence) until Tester 2 comes into camera view.
7. When Tester 2 comes into camera view, Tester 2 is told to stop. The measurement taker measures the distance from the orange cone to Tester 2 (center of cone to center of person's foot) and communicates the measurement to the CAS Monitor Observation Team.
8. The CAS Monitor Observation Team requests the Field Team to have Tester 1 (on outer fence) slowly move away from the camera until Tester 1 comes into camera view.
9. When Tester 1 comes into camera view, Tester 1 is told to stop. The measurement taker measures the distance from the orange cone to Tester 1 (center of cone to center of person's foot) and communicates the measurement to the CAS Monitor Observation Team.
10. The CAS Monitor Observation Team records the measurement data on the data sheet (Data Collection Worksheet 1). The measured distances are the shortfall in perimeter sector length not accessible by the camera.
11. Team members switch roles and steps 1 through 10 are repeated for another pre-determined sector (use Data Collection Worksheet 2 for recording results).

**Worksheet 1: Data Collection Worksheet for Camera Near-Field-of-View
 Assessment Capability – Trial 1**

Trial 1 – Sector _____					
Stage No.	Distance	Location of Tester and Cone	Entire cone in FOV? Yes/No	Tester in FOV? Yes/No	Observations and Comments
1	Starting Point (0)	Inner fence			
	Starting Point (0)	Outer fence			
2		Inner fence			
		Outer fence			
3		Inner fence			

Module 9. Performance Testing of Video Assessment Systems
 Exercise 9-1. Camera Assessment System Performance – Day Exercise
 SAND2012-9025P

		Outer fence			

Trial No. 2 is repeated with the Field Team in a different sector (pre-determined by instructor). Team members change roles for Trial No. 2.

**Worksheet 2: Data Collection Worksheet for Camera Near-Field-of-View
 Assessment Capability – Trial 2**

Trial 2 – Sector _____					
Stage No.	Distance	Location of Tester and Cone	Entire cone in FOV? Yes/No	Tester in FOV? Yes/No	Observations and Comments
1	Starting Point (0)	Inner fence			
	Starting Point (0)	Outer fence			
2		Inner fence			
		Outer fence			
3		Inner fence			
		Outer fence			

After Trial 2, the field team will switch places with the CAS Monitor Observation Team. The CAS Monitor Observation Team will repeat Trials 1 and 2 in sectors determined by the instructor (extra worksheets can be found in Attachment A).

Activity 3: Camera Field Resolution

The three levels of assessment resolution are detection, classification, and identification. One simple method of checking for a camera passing or failing the required resolution criteria is to use appropriately sized targets in an assessment zone and verify that the targets can be classified. By placing the targets at the far field of an exterior perimeter assessment zone and having an operator view the image and recognize (classify) each of the distinct shapes, we can rapidly determine if the system resolution is adequate. *The performance criterion is if the camera has sufficient far-field resolution to classify a 30-cm (1-ft) target at the far field (far end of sector).*

Equipment Needed

- Camera
- Lens
- Tape measure
- Handheld radios
- 30-cm (1-ft) triangle, circle, and square geometric shapes (white on one side, black on the other)

Exercise Preparation

There are two teams: the Field Team and the CAS Monitor Observation Team. After executing Activity 3, the teams switch roles and perform the activity again. Tasks for Activity 3 are as follows:

1. One person on each team is the designated radio communicator.
2. The Field Team takes the triangle, circle, and square shapes to the end of each sector to check the capability of each camera to resolve a 30-cm (1-ft) target at the far end of the assessment sector. See Figure 2 for a photo of the tester positions and Figure 3 for schematic of the exercise and initial location of field testing team.



Figure 2: Illustration of Testers 1, 2, and 3 for Activity 3

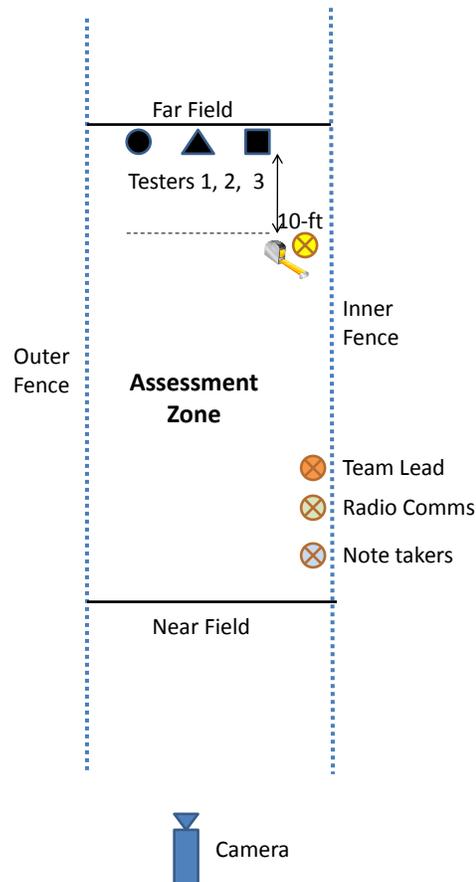


Figure 3: Schematic for Activity 3 (initial location of test personnel)

3. The test can be performed during the day or night.
 - For day tests, the black side faces the camera.
 - For night tests, the white side faces the camera.
4. The Field Team orients the three geometric shapes in any order and holds the shapes in front of and above their heads or on the perimeter ground surface. The shapes are oriented in any order and can be varied; such as upside-down triangle and rotating square 45 degrees to make a diamond.
5. When in position, the Field Team radios the CAS Monitor Observation Team to state the order of the geometric shapes viewed on the monitor.
6. When the CAS Monitor Observation Team states the observed order of geometric shapes, the Field Team radios back whether the observed order was correct. Observations are recorded on Data Collection Worksheet 3.

7. The Field Team changes the order and/or orientation of the geometric shapes and holds the shapes toward the camera.
8. When in position, the Field Team radios the CAS Monitor Observation Team to state the order of the geometric shapes viewed on the monitor.
9. When the CAS Monitor Observation Team states the observed order of geometric shapes, the Field Team radios back whether the observed order was correct. If the observed order was correct the performance criterion has been met and the CAS Monitor Observation Team records the data.
10. If the CAS Monitor Observation Team cannot correctly identify the object shapes or order of shapes, there is insufficient camera far field resolution for making adequate intrusion far field classification of target object.
11. If the CAS Monitor Observation Team cannot correctly identify the object shapes at the end of the sector, they are instructed to move 3 meters (10 ft) closer to the camera and the CAS Monitor Observation Team again tries to identify the shapes in their correct order.
12. The Field Team moves again 3 m (10 ft) closer to the camera until a positive identification of the shapes and their order is correctly made by the CAS Monitor Observation Team.
13. The distance from the end of the sector to the location where the shapes could be correctly identified is measured.
14. Measurement data is recorded on the data sheet (Data Collection Worksheet 3).
15. The activity is repeated for the next sector selected by the instructor.
Observations will be recorded on Data Collection Worksheet 4.

Note: Experience has shown that the black side toward the camera during the day and white side toward the camera at night provide the best contrast. The geometric shapes should be painted with flat gloss paint. Shiny surfaces reflect light better and assist the Monitor Observation Team in making better determinations due to the reflections rather than seeing the shape directly.

Data Collection Worksheets for Activity 3 – Camera Field Resolution

Additional worksheets are included in Attachment A for the team initially located in the CAS. In the third column of the worksheet “order of targets,” it is acceptable to sketch the targets (● ▲ ■) from outer fence to inner fence.

Worksheet 3: Data Collection Worksheet for Camera Field Resolution – Test No. 1

Test No. 1: Sector: _____							
Trial No.	Location of Testers	Order of Targets*			Target Color	CAS observation correct? (Yes/No)	Comments/Remarks
		Outer Fence		Inner Fence			
1	Far end of sector (0)				<input type="checkbox"/> White <input type="checkbox"/> Black		
2	Far end of sector (0)				<input type="checkbox"/> White <input type="checkbox"/> Black		
3	3 m (10 ft) from far end of sector				<input type="checkbox"/> White <input type="checkbox"/> Black		
4	3 m (10 ft) from far end of sector				<input type="checkbox"/> White <input type="checkbox"/> Black		
5	6 m (20 ft) from far end of sector				<input type="checkbox"/> White <input type="checkbox"/> Black		
6	6 m (20 ft) from far end of sector				<input type="checkbox"/> White <input type="checkbox"/> Black		
7**					<input type="checkbox"/> White <input type="checkbox"/> Black		
8**					<input type="checkbox"/> White <input type="checkbox"/> Black		

*Targets and order are switched around for each trial (orientation can be changed also)

**Identify the distance from end of sector to location where shapes are correctly identified by CAS team

Worksheet 4: Data Collection Worksheet for Camera Field Resolution – Test No. 2

Test No. 2: Sector: _____							
Trial No.	Location of Testers	Order of Targets*			Target Color	CAS observation correct? (Yes/No)	Comments/Remarks
		Outer Fence		Inner Fence			
1	Far end of sector (0)				<input type="checkbox"/> White <input type="checkbox"/> Black		
2	Far end of sector (0)				<input type="checkbox"/> White <input type="checkbox"/> Black		
3	3 m (10 ft) from far end of sector				<input type="checkbox"/> White <input type="checkbox"/> Black		
4	3 m (10 ft) from far end of sector				<input type="checkbox"/> White <input type="checkbox"/> Black		
5	6 m (20 ft) from far end of sector				<input type="checkbox"/> White <input type="checkbox"/> Black		
6	6 m (20 ft) from far end of sector				<input type="checkbox"/> White <input type="checkbox"/> Black		
7**					<input type="checkbox"/> White <input type="checkbox"/> Black		
8**					<input type="checkbox"/> White <input type="checkbox"/> Black		

*Targets and order are switched around for each trial

**Identify the distance from end of sector to location where shapes are correctly identified by CAS Monitor Observation Team

After Activity 3, Test no. 2, the field team will switch places with the CAS Monitor Observation Team. The CAS Monitor Observation Team will repeat tests number 1 and 2 in a different sector determined by the instructor (worksheets are in Attachment A).

Activity 4: Discuss Results

After completing Activities 2 and 3 in the field, the entire group will return to the classroom and respond to the following questions in their teams. They will then discuss as large group.

1. Can the orange cones be observed at the beginning of the sectors? _____
If not, what must be changed in the assessment system to ensure that the beginning of a sector appears in the camera near-field of view?

2. If the cones cannot be observed, are the outer and inner fence dimensions about equal or are the distances between the cone and the location where the fence can be viewed different?

If they are different, what does that mean?

3. Can the geometric objects be differentiated when they are located at the end of the sector?

If not, at what distance from the end of the sector, can the objects be identified?

4. At what distance can a security operator identify a target as a nuisance or a real alarm?

Attachment A: Data Collection Worksheets for CAS Monitor Observation Team

Data Collection Worksheets for Camera Near-Field-of-View Assessment Capability

Data Collection Worksheet 1					
Trial 1 – Sector _____					
Stage No.	Distance	Location of Tester and Cone	Entire cone in FOV? Yes/No	Tester in FOV? Yes/No	Observations and Comments
1	Starting Point (0)	Inner fence			
	Starting Point (0)	Outer fence			
2		Inner fence			
		Outer fence			
3		Inner fence			
		Outer fence			

Trial No. 2 is repeated in a different sector (pre-determined by instructor). Team members change roles for Trial No. 2.

Data Collection Worksheet 2					
Trial 2 – Sector _____					
Stage No.	Distance	Location of Tester and Cone	Entire cone in FOV? Yes/No	Tester in FOV? Yes/No	Observations and Comments
1	Starting Point (0)	Inner fence			
	Starting Point (0)	Outer fence			
2		Inner fence			
		Outer fence			
3		Inner fence			
		Outer fence			

Data Collection Worksheets for Activity 3 – Camera Field Resolution

In the third column “order of targets,” for ease of note taking, it is acceptable to draw the objects (shown below) from outer fence to inner fence.



Data Collection Worksheet 3							
Test No. 1: Sector: _____							
Trial No.	Location of Testers	Order of Targets*			Target Color	CAS observation correct? (Yes/No)	Comments/Remarks
		Outer Fence		Inner Fence			
1	Far-field View (0)				<input type="checkbox"/> White <input type="checkbox"/> Black		
2	Far-field View (0)				<input type="checkbox"/> White <input type="checkbox"/> Black		
3	3 m (10 ft) from far field				<input type="checkbox"/> White <input type="checkbox"/> Black		
4	3 m (10 ft) from far field				<input type="checkbox"/> White <input type="checkbox"/> Black		
5	6 m (20 ft) from far field				<input type="checkbox"/> White <input type="checkbox"/> Black		
6	6 m (20 ft) from far field				<input type="checkbox"/> White <input type="checkbox"/> Black		
7**					<input type="checkbox"/> White <input type="checkbox"/> Black		
8**					<input type="checkbox"/> White <input type="checkbox"/> Black		

*Targets and order are switched around for each trial

**Identify the distance from end of sector to location where shapes are correctly identified by CAS Monitor Observation Team



Data Collection Worksheet 4							
Test No. 2: Sector: _____							
Trial No.	Location of Testers	Order of Targets*			Target Color	CAS observation correct? (Yes/No)	Comments/Remarks
		Outer Fence		Inner Fence			
1	Far-field View (0)				<input type="checkbox"/> White <input type="checkbox"/> Black		
2	Far-field View (0)				<input type="checkbox"/> White <input type="checkbox"/> Black		
3	3 m (10 ft) from far field				<input type="checkbox"/> White <input type="checkbox"/> Black		
4	3 m (10 ft) from far field				<input type="checkbox"/> White <input type="checkbox"/> Black		
5	6 m (20 ft) from far field				<input type="checkbox"/> White <input type="checkbox"/> Black		
6	6 m (20 ft) from far field				<input type="checkbox"/> White <input type="checkbox"/> Black		
7**					<input type="checkbox"/> White <input type="checkbox"/> Black		
8**					<input type="checkbox"/> White <input type="checkbox"/> Black		

*Targets and order are switched around for each trial

**Identify the distance from end of sector to location where shapes are correctly identified by CAS Monitor Observation Team

Exercise 9-2

Performance Testing of Lighting Assessment Systems (Night Exercise)

Session Objectives

After the session, the participants will be able to do the following:

1. Calculate light-to-dark ratios.
2. Evaluate light readings.
3. Determine reflectance percentages.
4. Determine if the assessment lighting system meets performance criteria.

Participants will use questions and evaluation checklists/tables as a guide and to document test results from the exercises.

Estimated Time

90 minutes – night time session (field and classroom)

Activities

1. Review performance test plan for video assessment systems
2. Exterior lighting – light measurement grid.
3. Exterior lighting – reflectance percentage.
4. Answer questions based on tests results and observations for the exterior lighting.

Group Discussion

At the end of the exercise the class will discuss the test and the results. Discussion will be facilitated by the instructor. In addition, the instructor will review answers to any follow-on questions.

Acronyms

fc – foot-candle

Activity 1: Review Performance Test Plan for Video Assessment Systems

The purpose of this performance test is to determine whether the lighting used in a Perimeter Intrusion Detection and Assessment System (PIDAS) is adequate for a video assessment system. The performance criteria are that the minimum light level is 1 foot-candle (fc) or 11 lux; the greatest allowable maximum-to-minimum design ratio is 6:1 (an optimal design goal is 4:1); also some specifications also require a greatest allowable average to minimum ratio of 3:1.

The following performance test plan has been provided and will be used to conduct the test:

- Worksheet 1: Performance Test Plan

Participants will review the performance test, ask any questions for clarification, and then perform the test in the field.

Worksheet 1: Lighting Assessment System Performance Test Plan

Performance Test Goal

A general statement of the overall desired outcome of the performance test (should describe the overall expected result).

This performance test is designed to determine if the light levels for a video assessment system meet a design goal of 4:1.

Objectives

A concise elaboration of the goal that describes the specific tasks to be tested:

- *Purpose of the test*
- *Tasks to be tested*
- *Conditions for the test*

This performance test will determine the capability of a Perimeter Intrusion Detection and Assessment System (PIDAS) lighting system to meet a lighting design goal using existing lighting in actual environmental conditions.

Location

The location of the performance test is simply where the test will take place.

The location for the performance test will be within the Perimeter Intrusion Detection and Assessment System (PIDAS) at the Springfield Processing Plant (SPP) facility.

Element(s) to be tested

Identify and describe the specific essential element that will be tested.

Intrusion Detection System – Perimeter Intrusion Detection and Assessment System (PIDAS) Lighting System

Scenario Identification

Scenario identification involves describing the:

- *Element Being Tested*
- *Threat Facing the Element*
- *Facility or Location Involved*
- *Performance Test Boundaries*
- *Time Line or Schedule*

Exterior lighting system will be performance tested against the design basis threat. The test will be conducted within the PIDAS at the Springfield Processing Plant (SPP) facility. The adversary tactics (modes of attack) that will be used for performance testing the protection element have been pre-determined for the test.

Test Methodology and Evaluation Criteria

Test methodology describes how the test will be conducted.

1. The installed PIDAS lighting will be tested to determine if it meets a design goal of 4:1.
2. Test locations will be pre-determined within the PIDAS sectors.
3. A sampling plan will be reviewed – a series of tests will be conducted along a pre-determined grid system (differing distances from the fence line).
4. Testers will conduct performance tests as described.
5. Determine if the perimeter lighting system meets the lighting design goal.

Test Coordination

Performance test coordination describes who needs to be involved or aware that a test will be conducted.

This test will be coordinated with Physical Protection personnel who will conduct the performance testing and resolve any discrepancies.

Compensatory Measures

Compensatory Measures describe what is necessary to compensate for any degradation of readiness experienced while conducting the performance test.

There are no compensatory measures necessary. Physical Protection personnel will be physically present in both the Perimeter Intrusion Detection and Assessment System (PIDAS) and central alarm station (CAS).

Approval of Performance Testing

Approval of performance test plans describes how the test plan is approved and who has to approve the test.

This test plan will be approved by the Facility Manager, Physical Protection Manager, and Response Force Supervisor.

Classification of Test

Determination of whether the test plan, source documents and/or results should be considered sensitive.

For an actual site, the source data generated from the performance test and the completed worksheets would probably be considered sensitive and should be marked appropriately. Because this is a class exercise, all data and results are considered to be non-sensitive.

Briefing and Critiques

After completion of the test, the performance testing team will provide a briefing of the test and results to the Operations Supervisor and the Physical Protection Manager. Should there be a failure, the Physical Protection Manager will determine what additional actions are required. A final report will be issued with the results of the performance test.

Activity 2: Exterior Lighting – Light Measurement Grid

Approximate time required: 1 hour

Equipment List

- One light meter per subgroup

Preparation

1. Place 8 marker sticks on the ground along a fence and at 3-meter (10-ft) intervals away from the fence.
2. Attach the light meter sensor to a 30-cm (12-in.) high pedestal. Figure 1 provides an example of the setup.

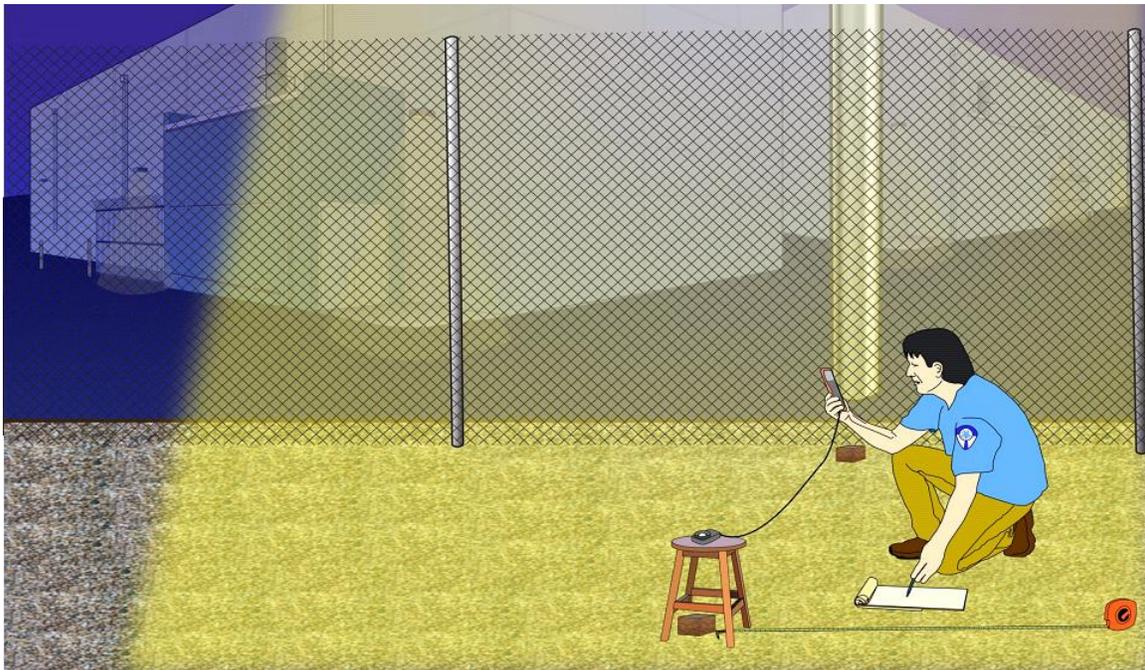


Figure 1: Example of Light Meter Setup.

(Note: In this activity, one participant will take the reading while the other records.)

Instructions

In this exercise you will take multiple light intensity measurements within a sensor zone and use this data to calculate the light-to-dark ratio, answering the questions below.

Note: When taking readings, be sure not to be in the path of the light or put the meter in the shadow of a nearby object (e.g., other participants, fence fabric, or equipment).

1. Using the grid below and a light meter, measure the light readings at approximate locations indicated on the chart.
2. Two participants extend the tape measure between the two marker sticks along the fence line and set the tape measure taut on the ground.
3. “Zero” the light meter by covering the light sensor and turning the meter on at the same time. Allow 10 seconds for the meter to calibrate and zero.
4. Position participants so that one participant is located at each 3-m (10-ft) distance along the tape measure.
5. Measure as follows and record your findings in Worksheet 1:
 - One participant is the scribe and records the light reading at each measurement location.
 - The participant at the “0” location makes a light measurement and the scribe records the reading.
 - The participant then hands the light meter and pedestal to the participant at the 3-m (10-ft) location.
 - The second participant makes a light meter reading and the scribe records the reading.
 - The light meter and pedestal are handed off to the participant at the 6-m (20-ft) location and the procedure continues until all readings are made for the locations along the fence line.
6. The tape measure is moved from the fence location to the marker sticks at the 3-m (10-ft) location.
 - Another set of participants position themselves at 3-m (10-ft) increments along the tape measure and another scribe records the readings at each measurement location.
7. The tape measure is moved to the sticks located at 6 m and 9 m (20 and 30 ft) from the fence and light measurements made at 3-m (10-ft) increments.
8. Light level readings can be made in either foot-candles or lux.

Worksheet 1: Light Measurement Grid

	15 m (40 ft) from Fence Line	9 m (30 ft) from Fence Line	6 m (20 ft) from Fence Line	3 m (10 ft) from Fence Line	Fence Line
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

Lights 



9. From the readings recorded in Worksheet 1, complete Worksheet 2.

Worksheet 2: Recorded Data or Calculation for Light Measurement Grid

Item	Symbol	Data or Calculation
Highest Reading (Maximum)	H	
Lowest Reading (Minimum)	L	
Sum of all Readings	S	
Number of Readings Taken	N	
Average Light Reading	$A = S/N$	
Maximum (H) to Minimum (L) ratio (highest reading divided by lowest reading)	H/L	_____ : 1
Average-to-minimum ratio (average light reading divided by lowest reading)	A/L	_____ : 1
Does this meet the minimum light level?		<input type="checkbox"/> Yes <input type="checkbox"/> No
Does this meet maximum to minimum ratio?		<input type="checkbox"/> Yes <input type="checkbox"/> No
Did the perimeter lighting system meet the lighting criteria? (must meet both minimum level and maximum to minimum ratio criteria)		<input type="checkbox"/> Yes <input type="checkbox"/> No
Did the perimeter lighting system meet the more stringent lighting criteria? (must meet minimum level, maximum to minimum ratio and average to minimum ratio criteria)		<input type="checkbox"/> Yes <input type="checkbox"/> No

The performance criteria are as follows:

- *Minimum light level is 1 foot-candle (fc) or 11 lux*
- *Greatest allowable maximum to minimum design ratio is 6*
- **Some specifications also require a greatest allowable average to minimum ratio of 3:1*

Activity 3: Exterior Lighting – Reflectance Percentage

Approximate time required: 30 minutes for Activities 3 and 4

1. Make a few readings from the light meter at the 6-m (20-ft) mark with the meter facing down at a distance of 30 cm (12 in.) from the ground
2. Enter readings into Worksheet 3, column 1 (Meter Down Reading). This value is a measure of the light reflected off the ground.

Note: Be sure to push the “hold” button on the light meter to preserve the light reading on the meter. Be sure to release the “hold” button for the next reading. You need to record only the reflectance at a few places along the 6-m (20-ft) distance from the fence line.

Worksheet 3: Reflectance Percentage

Meter Down Reading at 6 m (20-ft)	Meter Up Reading at 6 m (20-ft)	Reflectance Percentage

Note: Reflectance percent = (meter down reading) ÷ (meter up reading) × 100

Activity 4: Answer Questions Based on Tests and Observations

1. Do the reflectance readings match closely? _____ If not, is the material of the ground cover different? _____

2. Did the sensor zone meet the lighting criteria? _____
 - a. Average light? _____
 - b. Light-to-dark ratio? _____

3. If it is possible to do so, turn off one or two lights in the perimeter and retake the readings. Does the sector still meet lighting criteria? _____

4. If the electrical power is turned off for a few minutes, what is the "re-strike" time (seconds)?

5. What is the length of time (in minutes) to achieve full light output? _____
 - a. On initial start? _____
 - b. On restrike? _____

6. Of the total number of lamps in the system at the time of the evaluation, how many were not working? _____

Exercise 10-1

Performance Testing of SNM/Contraband Detection Systems – Trace Explosives

Session Objectives

After the session, the participants will be able to do the following:

1. Understand the use and application of trace explosives detection equipment.
2. Conduct tests for trace explosive detection equipment.
3. Determine the “limit of detection” for an explosive detection system.
4. Performance test an explosive detection system.

Estimated Time

45 minutes

Activities

1. Review test plan
2. Conduct familiarization exercise - determine limit of detection
3. Discuss test results and findings
4. Prepare and conduct performance test
5. Group discussion

A technical subject matter expert (SME) will be located at the station and will provide a brief description of the element (including principles of operation and description of element).

Group Discussion

At the end of the exercise, the entire class will discuss the performance test and results. Discussion will be facilitated by the instructor. In addition, the instructor will review answers to any follow-on questions.

Acronyms

CAS – central alarm station
SME – subject matter expert
SNM – special nuclear material
PETN –Pentaerythritol tetranitrate ($C_5H_8O_{12}N_4$)
TNT –Trinitrotoluene ($C_7H_5O_6N_3$)

Activity 1: Review Performance Test Plan

The purpose of this exercise is to (1) provide qualitative exercise so the participant becomes familiar with the trace explosive detector and then (2) conduct a performance test of contraband detection in a laboratory setting. The following performance test plan has been provided and will be used to conduct the test:

- Worksheet 1: Performance Test Plan

Participants will review the performance test, ask any questions for clarification, and then perform the test in the field.

Worksheet 1: Performance Test Plan

Performance Test Goal

A general statement of the overall desired outcome of the performance test (should describe the overall expected result).

This performance test is designed to determine the probability of detection for a bench top trace explosives detector located in a laboratory setting.

Objectives

A concise elaboration of the goal that describes the specific tasks to be tested:

- *Purpose of the test*
- *Tasks to be tested*
- *Conditions for the test*

A familiarization exercise will be conducted first to determine the limit of detection for a benchtop or ion mobility spectrometry-based detector in the classroom. A trace explosive (PETN) will be placed on grid cells by fingerprint. After participants swipe cells on the grid in a particular order, one at a time, each swipe will be analyzed to determine the limit of detection. The performance test will determine probability of detection for each test performed. A swipe with trace amounts of explosive will be analyzed by the detector to determine if the explosive detector alarms for each test.

Location

The location of the performance test is simply where the test will take place.

The location for the performance test will be in a laboratory setting.

Element(s) to be tested

Identify and describe the specific essential element that will be tested.

Detection System – Bench top explosives detector system

Scenario Identification

Scenario identification involves describing the:

- *Element Being Tested*
- *Threat Facing the Element*
- *Facility or Location Involved*
- *Performance Test Boundaries*
- *Time Line or Schedule*

This performance test will determine if the explosive detector alarms for each test. The test simulates detecting an adversary with trace explosives on his or her fingers.

Test Methodology and Evaluation Criteria

Test methodology describes how the test will be conducted.

1. Review and conduct familiarization testing
 - Testers will create grid of 40 cells.
 - One participant will place a finger on a container with trace explosive, then press the fingertip against each cell in the grid, starting with Cell 1 and ending with Cell 40.
 - Other participants, one at a time, will swipe a cell (starting with Cell 40 and moving backward) and have it analyzed.
 - When the detector alarms, the cell number is recorded as the limit of detection.
2. For the performance test the explosives detector will be tested against the established goal.
3. A sampling plan will be reviewed – several trials will be conducted.
4. Testers will conduct performance tests as described.
5. Determine probability of detection based on tests.

Test evaluation criteria describe how the test will be assessed or scored.

Record total detected alarms for all test locations = _____ out of _____ tests

Probability of detection (P_D) = _____ with a Confidence Level = 85%

Record if the element met or failed to meet the goal.

Goal probability of detection (P_D) = 88 %, with a confidence level of 85%.

Record test failed or met the performance level? _____

Test Coordination

Performance test coordination describes who needs to be involved or aware that a test will be conducted.

This test will be coordinated with Physical Protection personnel who will conduct the performance testing and resolve any discrepancies.

Compensatory Measures

Compensatory Measures describe what is necessary to compensate for any degradation of readiness experienced while conducting the performance test.

There are no compensatory measures necessary. Physical Protection personnel will be physically present in the laboratory area.

Approval of Performance Testing

Approval of performance test plans describes how the test plan is approved and who has to approve the test.

This test plan will be approved by the Facility Manager, Physical Protection Manager, and Response Force Supervisor.

Classification of Test

Determination of whether the test plan, source documents and/or results should be considered sensitive.

For an actual site, the source data generated from the performance test and the completed worksheets would probably be considered sensitive and should be marked appropriately. Because this is a class exercise, all data and results are considered to be non-sensitive.

Briefing and Critiques

After completion of the test, the performance testing team will provide a briefing of the test and results to the Operations Supervisor and the Physical Protection Manager. Should there be a failure, the Physical Protection Manager will determine what additional actions are required. A final report will be issued with the results of the performance test.

Activity 2: Determine Limit of Detection for an Explosive Detection System

A technical subject matter expert (SME) will provide description of exercise prior to initiating testing. Some participants will act as test subjects and also record data and observations.

Note: If any participant will be travelling in next few days, it is recommended that they not participate as a test subject (to avoid getting explosive residue on person).

Test Equipment:

- Benchtop or ion mobility spectrometry-based detector
- Trace quantity of PETN
- Large smooth clean surface (e.g., dry erase white board)
- Dry erase marker

Instructions:

In this activity, you will qualitatively test the “limit of detection” of a benchtop explosive detection system. Follow the steps below to complete the detection tests of fingerprint quantities of explosives contamination.

1. Use the poster chart provided. If none is available, make a grid containing at least 40 cells on a test surface with a dry erase marker. Number the cells needed are shown on Worksheet 2.
2. A participant will place their finger on a container that has trace PETN.
3. The participant with the contaminated finger will place his or her finger onto the first cell of the test grid (**Error! Reference source not found.**) and repeat the process on Cells 2 through 40, in order, until the finger has been pressed onto each cell.

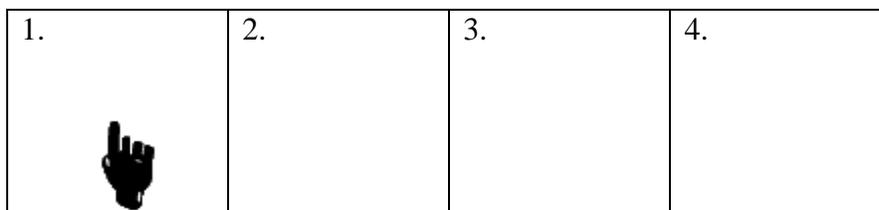


Figure 1: Place a sample of PETN on each cell of the grid

4. Care must be taken for the other participants *not* to come into contact with the contaminated participant’s hand.
5. Another participant will use a clean swipe patch to sample the *last* fingerprint made (that is, in Cell 40). With the guidance of the technical expert, the patch will be analyzed using the bench top explosives detector.
6. All participants will record the results on Worksheet 2.
7. Participants, one at a time, should repeat Steps 4 through 7, starting from Cell 40 and moving toward the beginning of the grid.

Module 10: Performance Testing of SNM/Contraband Detection Systems
Exercise 10-1. Performance Testing of SNM/Contraband Detection - Trace Explosives
SAND2012-9025P

- Keep track of which cells have been tested.
 - Allow participants to swipe and analyze a fingerprint sample from a grid cell until the detector reliably detects trace quantities in the fingerprints, or until all participants have had a turn.
 - Record the cell number where trace explosives were detected: _____
8. When an alarm is observed (meaning that trace quantities have been detected), record the time it takes to clean up the detector (that is, make it ready to detect and analyze).
- Time to clean up detector: _____
9. Record the time it takes to collect and analyze a sample.
- Time to collect and analyze a sample: _____

Worksheet 2: Test Results							
1.	2.	3.	4.	5.	6.	7.	8.
9.	10.	11.	12.	13.	14.	15.	16.
17.	18.	19.	20.	21.	22.	23.	24.
25.	26.	27.	28.	29.	30.	31.	32.
33.	34.	35.	36.	37.	38.	39.	40.

Additional Notes:

Activity 3: Answer Questions Based on Test Results and Observations

Indicate the cell number in which the first trace amount was detected: _____

Answer the following questions:

1. Using the assumption that the first fingerprint deposited 100 micrograms of PETN onto the first cell of the test surface, discuss what might be the quantity of TNT deposited by the 10th fingerprint, the 20th, the 30th, and 40th.

Cell no. 1 = 100 micrograms

Cell no. 10 =

Cell no. 30 =

Cell no. 20 =

Cell no. 40 =

2. What might be the trace quantity contained in the first fingerprint that resulted in a detection?
3. Have the original participant go wash his hands, come back, swipe finger on pad and try again for detection. What are the results?
4. How long does the instrument take to clean-up? What impact would this have on operations?
5. Consider an entry scenario where trace explosives detection is employed. What impact will trace swipe sampling and analyses have on throughput? Compare that with a shift change throughput expected at your facility.

Activity 4: Prepare and Conduct Performance Test

In this activity, you must finalize a test plan for determining the performance of testing using a trace explosive detector. The trace explosive detector is already properly installed, and the parameters have been set to optimal levels by previous preliminary testing. A technical subject matter expert (SME) will be available to provide guidance and consultation.

To finalize the test plan, follow the steps below:

Sensor to be tested: Benchtop or Ion Mobility Spectrometry-based Detector

1. Test Criteria (Probability of Detection and Confidence Level)

The probability of detection (P_D) to be used in testing is 88 %, with a confidence level of 85%. Develop a test plan that will determine whether the sensor meets or fails to meet the goal probability of detection (P_D).

NOTE: The higher the confidence level the more extensive testing required. (Keep in mind the limited time for the exercise and number of trials to be completed.)

Two tables are provided as attachments to help you select an acceptable probability of detection with desired confidence level:

- Table A-1: Trials and Failures with Probability of Detection for Designated Confidence Level—Trial Sort
- Table A-2: Trials and Failures with Probability of Detection for Designated Confidence Level—Failures Sort

2. Sampling Plan

Review and discuss Sampling Plan (i.e., test locations, number of trials; stopping points; failures tolerated). General description provided below:

- Test for the Trace Explosive Detector:** Because of time constraints, the number of tests has been determined for you.
 - Number of trials for each test will be 10. If time permits, you can conduct additional tests.
 - Number of failures allowed = 3 (test to be stopped when failures exceed this limit)

After finalizing your test plan, if you have any questions prior to testing ask your technical subject matter expert. You are now ready to start testing, proceed to your testing station.

Conduct Performance Test: Testers will swipe a sample that contains explosives residue and determine if the explosive detector alarms for each test. After all tests are complete, determine the probability of detection and determine if the test met the established performance test goal or not.

Module 10: Performance Testing of SNM/Contraband Detection Systems
 Exercise 10-1. Performance Testing of SNM/Contraband Detection - Trace Explosives
 SAND2012-9025P

Test	Alarms? (Yes/No)	Notes
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Total successful authorized access for all test locations = _____ out of _____ tests

Number of failures = _____

Probability of detection = _____ with a confidence level = 85%

Record if the element met or failed to meet the goal.

Test failed or met the performance level? _____

Exercise 10-2

Performance Testing of SNM/Contraband Detection Systems at ECP – Interim Storage Building

Session Objectives

After the session, the participants will be able to do the following:

1. Plan a performance test for a combined metal and radiation detection portal.
2. Conduct an actual performance test for a portal using radioactive material, shielding, and handgun.
3. Analyze performance testing results and present findings.

Estimated Time

30 minutes

Activities

1. Review a test plan for performance testing a metal and radiation detector.
2. Prepare for testing.
3. Conduct performance tests.
4. Answer discussion questions based on test results and observations.
5. Present test results and findings.

A technical subject matter expert (SME) will provide a brief description of the detection system (including principles of operation, detection pattern, and description of element).

Group Discussion

At the end of the exercise, the entire class will discuss the performance test and results. Discussion will be facilitated by the instructor. In addition, the instructor will review answers to any follow-on questions.

Attachments

See separate Attachment for Exercise: Table of trials and failures with P_D (probability of detection) for designated CL (confidence level) sorted by trials (Table A-1) and failures (Table A-2).

Acronyms

SME – subject matter expert
SNM – special nuclear material
 P_D – probability of detection
CL – confidence level

Activity 1: Review Performance Test Plan for Combined Metal and Radiation Detection Portal

The purpose of this exercise is to conduct a performance test of a special nuclear material and contraband detection system in the Entry Control Portal of the Interim Storage Building. The following performance test plan has been provided and will be used to conduct the test:

- Worksheet 1: Performance Test Plan

Participants will review the performance test, ask any questions for clarification, and then perform the test in the Entry Control Portal of the Interim Storage Building.

Worksheet 1: Combined Metal and Radiation Detection Portal Performance Test Plan

Performance Test Goal

A general statement of the overall desired outcome of the performance test (should describe the overall expected result).

This performance test is designed to determine the probability of detection (given the design basis threat) for a combined metal and radiation detection portal located in the interior of the Interim Storage Building.

Objectives

A concise elaboration of the goal that describes the specific tasks to be tested:

- *Purpose of the test*
- *Tasks to be tested*
- *Conditions for the test*

This performance test will determine the probability of detection for a combined metal and radiation detection portal. The adversary tactics (modes of attack) that will be used for performance testing the protection element will be selected by test participants based on the design basis threat. A sampling plan of test objects will be developed.

Location

The location of the performance test is simply where the test will take place.

The location for the performance test will be conducted in the Entry Control Portal of the Interim Storage Building.

Element(s) to be tested

Identify and describe the specific essential element that will be tested.

Detection System – Combined Radiation and Metal Detection Portal.

Scenario Identification

Scenario identification involves describing the:

- *Element Being Tested*
- *Threat Facing the Element*
- *Facility or Location Involved*
- *Performance Test Boundaries*
- *Time Line or Schedule*

A combined radiation and metal detection portal will be performance tested against the design basis threat. The test will be conducted in the Entry Control Portal of the Interim Storage Building. The adversary tactics (modes of attack) that will be used for performance testing the protection element will be selected by test participants based on the design basis threat. A sampling plan and test strategy will be developed to fit within resources and time constraints, and then probability of detection (P_D) is determined.

Test Methodology and Evaluation Criteria

Test methodology describes how the test will be conducted.

1. A goal probability of detection with a confidence level is provided. The sensor will be tested against the established goal.
2. Test locations of contraband test objects will be reviewed (at the head level, waist, or ankle).
3. A sampling plan will be reviewed - several tests will be conducted.
4. Speed of the tester will vary (fast, slow, moderate, other).
5. Testers will conduct performance tests as described.
6. Determine probability of detection based on tests.

Test evaluation criteria describe how the test will be assessed or scored.

Record total detected alarms for all test locations = _____ out of _____ tests

Probability of detection (P_D) = _____ with a Confidence Level = 85%

Summary of Results

Record if the element met or failed to meet the goal.

Goal probability of detection (P_D) = 88 %, with a confidence level of 85%.

Record test failed or met the performance level? _____

Test Coordination

Performance test coordination describes who needs to be involved or aware that a test will be conducted.

This test will be coordinated with Physical Protection personnel who will conduct the performance testing and resolve any discrepancies.

Compensatory Measures

Compensatory Measures describe what is necessary to compensate for any degradation of readiness experienced while conducting the performance test.

There are no compensatory measures necessary. Physical Protection personnel will be physically present in both the Interim Storage Building and Central Alarm Station (CAS).

Approval of Performance Testing

Approval of performance test plans describes how the test plan is approved and who has to approve the test.

This test plan will be approved by the Facility Manager, Physical Protection Manager, and Response Force Supervisor.

Classification of Test

Determination of whether the test plan, source documents and/or results should be considered sensitive.

For an actual site, the source data generated from the performance test and the completed worksheets would probably be considered sensitive and should be marked appropriately. Because this is a class exercise, all data and results are considered to be non-sensitive.

Briefing and Critiques

After completion of the test, the performance testing team will provide a briefing of the test and results to the Operations Supervisor and the Physical Protection Manager. Should there be a failure, the Physical Protection Manager will determine what additional actions are required. A final report will be issued with the results of the performance test.

Activity 2: Prepare for Performance Test

In this activity, you must finalize a test plan for determining whether the performance of a Radiation and Metal Detection Portal meets an established performance goal. The portal is already properly installed, and the parameters have been set to optimal levels by previous preliminary testing. A technical subject matter expert (SME) will be available to provide guidance and consultation.

To finalize the test plan, follow the steps below:

Test Equipment

- Radiation and Metal Detection Portal (Figure 1)
- Shielding (also referred to as a “pig”) for radioactive source
- Handgun (deactivated) provided by the course instructor (contraband test item)

Element to be tested: **Radiation and Metal Detection Portal**

1. Test Criteria (Probability of Detection and Confidence Level)

The probability of detection (P_D) to be used in testing is 88%, with a confidence level of 85%. Develop a test plan that will determine whether the **detection system** meets or fails to meet the goal probability of detection (P_D).

NOTE: The higher the confidence level the more extensive testing required. (Keep in mind the limited time for the exercise and number of trials to be completed.)

Two tables are provided as attachments to help you select an acceptable probability of detection with desired confidence level:

- Table A-1: Trials and Failures with Probability of Detection for Designated Confidence Level—Trial Sort
- Table A-2: Trials and Failures with Probability of Detection for Designated Confidence Level—Failures Sort

2. Sampling Plan

Discuss and determine a Sampling Plan (locations and number of trials at each location; stopping points; failures tolerated). Record the general descriptions in Worksheet 2.

- Test locations:** Test the portal metal detector using the contraband items provided. Include shielded and unshielded radioactive source. Record the test objects and locations in Worksheet 2.
 - If time is short, you might test only the positions you consider to be the most advantageous to the adversary. Note: When using the “pig” shielding, some concealment locations may not be practical.
 - You will conduct 10 tests (follow the test plan). If time permits, you can conduct additional tests.

- Number of failures allowed = 3 (test to be stopped when failures exceed this limit)

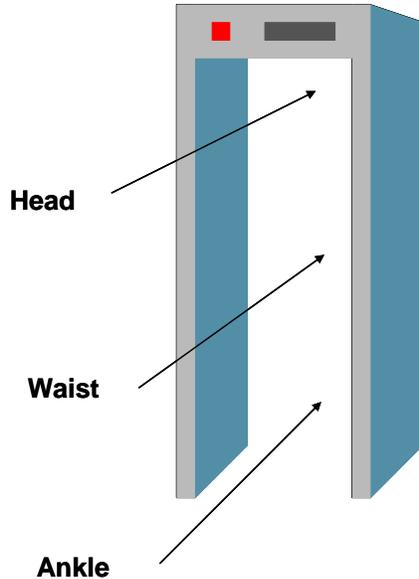


Figure 1: Test Locations for Performance Test

Worksheet 2: Test Locations (Radial Test Paths and Arc Test Paths)

Test Number	Adversary Test Object and Locations		Adversary Speed
	Describe the test object and location placed on the test person (e.g., at head location, waist, ankle, or other)		
	Test Object	Test Location on Person	Describe the speed of the tester (fast, slow, moderate, other)
Test 1			
Test 2			
Test 3			
Test 4			
Test 5			
Test 6			
Test 7			
Test 8			
Test 9			

Test 10			
---------	--	--	--

3. Adversary Tactics

Discuss all possible tactics, but select a few tactics to ensure you complete your testing in the allotted time. For example, indicate whether to use fast or slow speed. List the adversary speeds (modes of attack) that will be used for testing the protection element (metal and radiation detector) in Worksheet 2.

If you have any questions after finalizing the test plan and prior to testing, ask your technical subject matter expert. When you are ready to start testing, proceed to your testing station.

Activity 3: Conduct Performance Tests

All team members (if willing) will be test subjects and will also record data and observations. Use the worksheets provided for recording test data.

1. Select the test configuration (handgun, source, source and shielding) described in Worksheet 2.
2. One test participant will carry the contraband items through the portal using the appropriate location and speed, according to the test plan (Worksheet 2).
3. Record the results of each test set on Worksheet 3 (Test Results). Make extra copies of Worksheet 3, if necessary.

Module 10: Performance Testing of SNM/Contraband Detection Systems
 Exercise 10-3. PT of SNM/Contraband Detection at ECP – Interim Storage Building

Worksheet 3: Test Results						
Test Number	Contraband Object	Test Location (head, waist, ankle, or other)	Test Speed (fast, slow, etc.)	Number of Trials	Number of Detections	Number of Failures
1						
2						
3						
4						
5						
6						
7						
8						
9						
Total						

Total detected alarms for all tests = _____ out of _____ tests

Probability of detection (P_D) = _____

Module 10: Performance Testing of SNM/Contraband Detection Systems
Exercise 10-3. PT of SNM/Contraband Detection at ECP – Interim Storage Building

Record the summary of the results, including the resultant probability of detection (P_D) and if the detection element met or failed to meet the goal.

Resultant probability of detection (P_D) = _____

If you selected a probability of detection (P_D) to test, then indicate if the test failed or met the performance level established.

Goal probability of detection (P_D) = _____

Test failed or met the performance level? _____

Additional Notes:

Activity 4: Discussion Questions based on Test Results and Observations

1. Did the combination metal and radiation detector pass the test (did you successfully test it to your desired probability of detection and confidence levels)?

2. If you have time, perform some additional tests: Try carrying some common metallic items (typical pocket-carried items) through the detector to qualitatively determine the detector's immunity to nuisance alarms (use your own pocket-carried items for this test, for example, coins, paper clips, keys).

Which items caused nuisance alarms?

Which items did not?

3. Do you have any ideas on how an adversary might defeat a metal detector?

Activity 5: Present Test Data and Findings

As a team, put together a brief presentation of your testing activities, the test data and results, your recommendations, and lessons learned. Use the following outline for your briefing to the class:

- Summary of results
- Recommendations
- Lessons learned

Exercise 10-3

Performance Testing of SNM/Contraband Detection Systems at ECP – Processing Facility

Session Objectives

After the session, the participants will be able to do the following:

1. Understand the use and application of metal detection portal and handheld radiation detection equipment.
2. Become familiar with the metal detection portal and handheld radiation detector response to various test objects.
3. Conduct an evaluation tests that includes using both metal and radiation detection equipment to search for a handgun, shielding, and radioactive source.
4. Performance test SNM/contraband detection systems at an entry control point (ECP)

Estimated Time

45 minutes

Activities

1. Review test plan for special nuclear material and contraband detection systems.
2. Prepare for testing.
3. Conduct performance tests for metal detection portal.
4. Conduct performance tests for hand-held radiation detector.
5. Discussion questions for metal detector
6. Discussion questions for hand-held metal detector
7. Discuss test results and findings.

A technical subject matter expert (SME) will be located at the test station and will provide a brief description of the detection system (including principles of operation, detection, and description of elements).

Group Discussion

At the end of the exercise, the entire class will discuss the performance test and results. Discussion will be facilitated by the instructor. In addition, the instructor will review answers to any follow-on questions.

Acronyms

P_D – probability of detection

PT – performance test

ECP – entry control point

SME – subject matter expert

SNM – special nuclear material

Activity 1: Review Performance Test Plan

The purpose of this exercise is to conduct a performance test of a metal detection portal and a handheld radiation detection system at the entry control point in the Processing Facility. The following performance test plan has been provided and will be used to conduct the test:

- Worksheet 1: Performance Test Plan

Participants will review the performance test, ask any questions for clarification, and then perform the test in the field.

Worksheet 1: Performance Test Plan

Performance Test Goal

A general statement of the overall desired outcome of the performance test (should describe the overall expected result).

This performance test is designed to detect a metal object or radiation source (given the design basis threat) via contraband detection systems located at the entry control point in the Processing Facility.

Objectives

A concise elaboration of the goal that describes the specific tasks to be tested:

- *Purpose of the test*
- *Tasks to be tested*
- *Conditions for the test*

This performance test will determine the probability of detection for a metal detector and handheld radiation detector at an entry control point. The adversary tactics (modes of attack) that will be used for performance testing will be selected by the test participants based on the design basis threat. A sampling plan of test objects and locations will be developed.

Location

The location of the performance test is simply where the test will take place.

The location for the performance test will be at the entry control point in the Processing Facility.

Element(s) to be tested

Identify and describe the specific essential element that will be tested.

Detection System –Metal Detection Portal and Handheld Radiation Detector

Scenario Identification

Scenario identification involves describing the:

- *Element Being Tested*
- *Threat Facing the Element*
- *Facility or Location Involved*
- *Performance Test Boundaries*
- *Time Line or Schedule*

The metal detection portal and handheld radiation detector will be used in an entry and exit search (to simulate an adversary attempting to bring in contraband or steal nuclear material). The detectors will be used to detect a metal object (deactivated handgun) going into the facility and a sealed radioactive source with and without shielding leaving the facility. The detectors will be performance tested against the design basis threat. The test will be conducted in the Processing Facility. The adversary tactics (modes of attack) that will be used for performance testing the protection elements have been pre-determined for the test.

Test Methodology and Evaluation Criteria

Test methodology describes how the test will be conducted.

1. A goal probability of detection with a confidence level is provided. The sensor will be tested against the established goal.
2. Test locations of contraband test objects will be reviewed (at the head level, waist, or ankle).
3. A sampling plan will be reviewed - several tests will be conducted (entry and exit).
4. Speed of the tester will vary (fast, slow, moderate, other).
5. Testers will conduct performance tests as described.
6. Determine probability of detection based on tests.

Test evaluation criteria describe how the test will be assessed or scored.

Record total detected alarms for all test locations = _____ out of _____ tests

Probability of detection (P_D) = _____ with a Confidence Level = 85%

Record if the element met or failed to meet the goal.

Goal probability of detection (P_D) = 88 %, with a confidence level of 85%.

Record test failed or met the performance level? _____

Test Coordination

Performance test coordination describes who needs to be involved or aware that a test will be conducted.

This test will be coordinated with Physical Protection personnel who will conduct the performance testing and resolve any discrepancies.

Compensatory Measures

Compensatory Measures describe what is necessary to compensate for any degradation of readiness experienced while conducting the performance test.

There are no compensatory measures necessary. Physical Protection personnel will be physically present in both the Processing Facility and Central Alarm Station (CAS).

Approval of Performance Testing

Approval of performance test plans describes how the test plan is approved and who has to approve the test.

This test plan will be approved by the Facility Manager, Physical Protection Manager, and Response Force Supervisor.

Classification of Test

Determination of whether the test plan, source documents and/or results should be considered sensitive.

For an actual site, the source data generated from the performance test and the completed worksheets would probably be considered sensitive and should be marked appropriately. Because this is a class exercise, all data and results are considered to be non-sensitive.

Briefing and Critiques

After completion of the test, the performance testing team will provide a briefing of the test and results to the Operations Supervisor and the Physical Protection Manager. Should there be a failure, the Physical Protection Manager will determine what additional actions are required. A final report will be issued with the results of the performance test.

Activity 2: Prepare for Performance Tests

In this activity, you must finalize test plans for determining whether the performance of a Metal Detection Portal and Handheld Radiation Detector meets an established performance goal. The portal is already properly installed, and the parameters have been set to optimal levels by previous preliminary testing. The Handheld Radiation Detector has been determined to be calibrated for optimal performance. A technical subject matter expert (SME) will be available to provide guidance and consultation.

To finalize the test plan, follow the steps below:

Test Equipment

- Metal Detection Portal (Figure 1)
- Handheld Radiation Detector
- Sealed radioactive calibration source
- Metal shielding (also referred to as a “pig”)
- Handgun (deactivated) provided by the course instructor (contraband test item)

Element to be tested: Hand-held radiation detector and Metal Detection Portal

1. Test Criteria (Probability of Detection and Confidence Level)

*The probability of detection (P_D) to be used in testing is 88 %, with a confidence level of 85%. Develop a test plan that will determine whether the **detection system** meets or fails to meet the goal probability of detection (P_D).*

NOTE: The higher the confidence level the more extensive testing required. (Keep in mind the limited time for the exercise and number of trials to be completed.)

Two tables are provided as attachments to help you select an acceptable probability of detection with desired confidence level:

- Table A-1: Trials and Failures with Probability of Detection for Designated Confidence Level—Trial Sort
- Table A-2: Trials and Failures with Probability of Detection for Designated Confidence Level—Failures Sort

2. Sampling Plan

Discuss and determine a Sampling Plan (locations and number of trials at each location; stopping points; failures tolerated).

Test locations: Test the hand-held radiation detector and portal metal detector using the contraband items provided. Include shielded and unshielded radioactive sources. Record the test objects and locations in Worksheets 2 (metal detector) and 3 (radiation detector).

- If time is short, you might test only the positions you consider to be the most advantageous to the adversary. Note: When using the “pig” shielding (hand-held radiation detector), some concealment locations may not be practical.

- You will conduct 10 tests (follow the test plan). If time permits, you can conduct additional tests.
- Number of failures allowed = 3 (test to be stopped when failures exceed this limit)

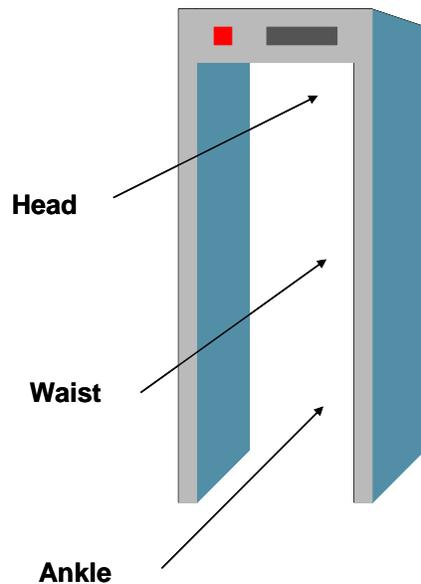


Figure 1: Test Locations for Metal Detection Portal Performance Test

3. Adversary Tactics

Discuss all possible tactics, but select a few tactics to ensure you complete your testing in the allotted time. For example, indicate whether to use fast or slow speed. List the adversary speeds (modes of attack) that will be used for testing the protection element (metal detection portal) in Worksheet 2.

If you have any questions after finalizing the test plan and prior to testing, ask your technical subject matter expert. When you are ready to start testing, proceed to your testing station.

Activity 3: Conduct Metal Detection Portal Performance Tests

All team members (if willing) will be test subjects and will also record data and observations. Use the worksheets provided for recording test data.

1. Select the test configuration (handgun or other metal test items) and document in Worksheet 2.
2. One test participant will carry the contraband item through the portal using the appropriate location and speed, according to the test plan (Worksheet 2).
3. Record the results of each test on Worksheet 2 (Test Results).

Worksheet 2: Test Description and Test Results for Metal Detection Portal						
Test Number	Contraband Object	Test Location (head, waist, ankle, or other)	Test Speed (fast, slow, etc.)	Number of Trials	Number of Detections	Number of Failures
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Total						

Total detected alarms for all tests = _____ out of _____ tests

Probability of detection (P_D) = _____, with confidence level = 85%

Goal probability of detection (P_D) = 88 %, with a confidence level of 85%.

Test failed or met the performance level? _____

Additional Notes:

Activity 4: Conduct Handheld Radiation Detector Performance Tests

All team members (if willing) will be test subjects and will also record data and observations. Use the worksheets provided for recording test data.

1. Select the test configuration (source, source and shielding) and document in Worksheet 3.
2. One test participant will carry the contraband items on his person and proceed to the guard monitoring for special nuclear material (SNM) radiation source, according to the test plans (Worksheet 3).
3. Record the results of each test on Worksheet 3 (Test Results).

Worksheet 3: Test Description and Test Results for the Hand-held Radiation Detector					
Test Number	Contraband Object	Test Location (head, waist, ankle, or other)	Number of Trials	Number of Detections	Number of Failures
1					
2					
3					
4					
5					
6					
7					
8					
9					
Total					

Module 10: Performance Testing of SNM/Contraband Detection Systems
Exercise 10-3. PT of SNM/Contraband Detection at ECP – Interim Storage Building

Total detected alarms for all tests = _____ out of _____ tests
Probability of detection (P_D) = _____, with confidence level = 85%

Goal probability of detection (P_D) = 88 %, with a confidence level of 85%.

Test failed or met the performance level? _____

Additional Notes:

Activity 5: Discuss Questions Based on Test Results and Observations for the Metal Detection Portal

1. Did the metal detection portal pass the test (did you successfully test it to your desired probability of detection and confidence levels)?
2. If you have time, perform some additional tests: Try carrying some common metallic items (typical pocket-carried items) through the detector to qualitatively determine the detector's immunity to nuisance alarms (use your own pocket-carried items for this test, for example, coins, paper clips, or keys).

Which items caused nuisance alarms?

Which items did not?

3. Do you have any ideas on how an adversary might defeat a metal detection portal?

Activity 6: Discuss Questions Based on Test Results and Observations for the Handheld Radiation Detector

1. Did the handheld radiation detector respond to the radioactive calibration source?
2. What is the effect of distance on the detector response?
3. What is the effect of shielding on the detector response?
4. Does the detector work for searches?
5. How would you employ similar handheld detectors for checkpoint screening of people and vehicles?
6. For radiation screening on vehicles, would one handheld detector be sufficient?
7. More than 1 in 10,000 people have had recent radioisotope medical procedures that can cause nuisance alarms in radiation detectors. Discuss the trade-offs for cost, throughput, and nuisance alarms using the handheld radiation detector.

Exercise 11

Performance Testing of Access Delay Elements

Session Objectives

After the session, the participants will be able to do the following:

1. Observe a delay barrier and identify potential weaknesses.
2. Develop performance tests to evaluate the observed weaknesses in the existing (baseline) barrier.
3. Develop upgrades for the confirmed baseline barrier weaknesses and conduct performance tests to determine the effectiveness of the upgrades.

Estimated Time

75 minutes

Activities

1. Review performance test plan.
2. List delay installation problems for the Interim Storage Vault double doors.
3. Collect delay times during performance testing of baseline and upgraded vault double doors.
4. Collect additional delay time for performance testing other facility delay components.
5. Discuss delay performance testing questions.

A technical subject matter expert (SME) will be located at the sensor station and will provide a brief description of the access delay element (including principles of operation and description of element).

Group Discussion

At the end of the exercise, the entire class will discuss the performance test and results. Discussion will be facilitated by the instructor. In addition, the instructor will review answers to any follow-on questions.

Acronyms

ISV – Interim Storage Vault

SME – Subject Matter Expert

Activity 1: Review Performance Test Plan for Access Delay Elements

The purpose of this exercise is to conduct a performance test of access delay elements in the hypothetical facility. The following performance test plan has been provided and will be used to conduct the test:

- Worksheet 1: Performance Test Plan

Participants will review the performance test, ask any questions for clarification, and then perform the test in the field.

Worksheet 1: Access Delay Element Performance Test Plan

Performance Test Goal

A general statement of the overall desired outcome of the performance test (should describe the overall expected result).

This performance test is designed to determine the delay times for baseline and upgraded access delay components (baseline and upgraded vault doors in the Interim Storage Building).

Objectives

A concise elaboration of the goal that describes the specific tasks to be tested:

- *Purpose of the test*
- *Tasks to be tested*
- *Conditions for the test*

This performance test will determine delay times for an existing (baseline) vault door and an upgraded vault door. The adversary tactics (modes of attack) that will be used for performance testing of the protection element have been pre-determined for the test. Because of time constraints, two doors (baseline and upgraded) have been chosen to ensure all testing is completed in the allotted time.

Location

The location of the performance test is simply where the test will take place.

The location for observation and discussion of the Interim Storage Vault doors will be in the Interim Storage Building. The performance test will be performed outdoors in a testing facility.

Element(s) to be tested

Identify and describe the specific essential element that will be tested.

Access Delay Elements – Baseline Vault Door and Upgraded Vault Door

Scenario Identification

Scenario identification involves describing the:

- *Element Being Tested*
- *Threat Facing the Element*
- *Facility or Location Involved*
- *Performance Test Boundaries*
- *Time Line or Schedule*

A baseline vault door will be observed and potential weaknesses identified using the design basis threat. The doors under consideration are double doors installed at the Interim Storage Vault at the hypothetical facility. The performance tests will evaluate the observed weaknesses and upgrades will be proposed. Performance tests will evaluate the effectiveness of pre-determined upgrades for the vault doors.

Test Methodology and Evaluation Criteria

Test methodology describes how the test will be conducted.

1. To become familiar with access delay features, the baseline vault door is observed and weaknesses are identified.
2. A technician will demonstrate how to defeat features of the baseline door using a specific tool for each test. During the demonstration, the participants will collect delay times (two trials per element).
3. The technician and subject matter expert will demonstrate how to defeat features of the upgraded door using specific tools. During the demonstration, the participants will collect delay times (two trials per element).

Test evaluation criteria describe how the test will be assessed or scored.

The test evaluation criteria are the collected delay times. Performance level measurement of an upgrade is increased delay time for the adversary over the baseline result.

Test Coordination

Performance test coordination describes who needs to be involved or aware that a test will be conducted.

This test will be coordinated with Physical Protection personnel who will conduct the performance testing and resolve any discrepancies.

Compensatory Measures

Compensatory Measures describe what is necessary to compensate for any degradation of readiness experienced while conducting the performance test.

There are no compensatory measures necessary. Physical Protection personnel will be physically present at the test location.

Approval of Performance Testing

Approval of performance test plans describes how the test plan is approved and who has to approve the test.

This test plan will be approved by the Facility Manager, Physical Protection Manager, and Response Force Supervisor.

Classification of Test

Determination of whether the test plan, source documents and/or results should be considered sensitive.

For an actual site, the source data generated from the performance test and the completed worksheets would probably be considered sensitive and should be marked appropriately. Because this is a class exercise, all data and results are considered to be non-sensitive.

Briefing and Critiques

After completion of the test, the performance testing team will provide a briefing of the test and results to the Operations Supervisor and the Physical Protection Manager. Should there be a failure, the Physical Protection Manager will determine what additional actions are required. A final report will be issued with the results of the performance test.

Activity 2: Prepare for Performance Test

In this activity, you must finalize the test plan for determining the performance of the baseline versus the upgraded vault doors.

A technical subject matter expert (SME) will be available to provide guidance and consultation.

To prepare for the performance test, observe the double doors at the Interim Storage Vault and list delay installation problems for these double doors by following the steps below:

1. An access delay demonstration will be provided prior to initiating the performance test.
2. Immediately following the Access Delay demonstration, participants will carefully study the Interim Storage Vault double doors.
 - Study the exterior side of the doors for 5 minutes.
 - The figures below show some access delay installation problems with the exterior baseline vault doors. Below the figures, list the problems that you observe.



Exterior View



Lock and Strike Plate



??

Exterior Observations:

Based on your observations, answer the following questions:

1. Is the information about the vault doors something that an outsider would try to obtain from an insider? If so, why?

2. After your observations and discussion is complete, the Instructor and the Certified Master Locksmith will:

- Describe the installation concerns with the baseline vault double doors.
- Describe potential upgrades to mitigate the observed installation concerns.
- Describe the performance tests that will be conducted on the baseline vault door and on the proposed upgraded door.

Activity 3: Conduct Performance Tests

The technical SME will explain the access delay component that will be performance tested. All team members will record data and observations. At least one participant will record the delay times using a stopwatch. All participants will collect the test data on the worksheets provided.

Activity 3-1. Collect Delay Times on Baseline Vault Double Doors during Demonstration

The technician will demonstrate attacking each vault door feature with a particular tool two times (Trials 1 and 2). The participants will collect delay times for the baseline doors, following the steps below.

1. Write the number of attackers in the second column of Worksheet 2.
2. One participant uses a stopwatch to collect delay times for the door feature.
 - When the technician indicates that the Test Trial is starting, the participant with the stopwatch presses Start.
 - When the feature is defeated, the participant with the stopwatch presses Stop.
 - The person with the stopwatch announces the time for the Test Trial, and all participants record the delay time (column 4).
 - Repeat for Test Trial 2 (column 5).
3. Repeat Steps 1 and 2 for all vault door features listed in Worksheet 2.

Worksheet 2: Baseline Vault Door Delay Times

Existing Vault Door Feature	Number of Attackers	Breaching, Cutting, or Penetration Tools	Trial 1 Delay Time (seconds)	Trial 2* Delay Time (seconds)	Comments/ Observations
Interior Door Lever Handle		<p>K-22 Lever Opening Tool</p>  <p>IF YOU CAN SLIDE THIS TOOL UNDER THE DOOR, YOU WILL OPEN IT! <small>This tool is to be used only by locksmiths and law enforcement agencies.</small></p> <p>Locksmith Bypass (under door) Tool</p>			
Mag-Lock Strike Sex Nut (outside)		 <p>Corded Drill with 1.3 cm (0.5 inch) chuck and metal cutting drill bits (2.5 kg/5.5 lb)</p>			

Existing Vault Door Feature	Number of Attackers	Breaching, Cutting, or Penetration Tools	Trial 1 Delay Time (seconds)	Trial 2* Delay Time (seconds)	Comments/ Observations
Upper Flush Bolt		 120 V/15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			
Lower Flush Bolt		120 V/15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			
Cut Outer Lever Handle and Door Thru Thickness. Then Use Ruler to open with Interior Door Lever Handle		120 V/15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			
Latch Bolt (on door)		 120 V / 20 amp Electric 0-3000 strokes/min Reciprocating Saw (7 kg/15 lb)			
Extra Latch Bolt (in Millwright vise)		 120 V/15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			
Full Length Horizontal Cut Underneath Middle Hinge		120 V/15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			

Module 11: Performance Testing of Access Delay Elements
 Exercise 11. Performance Testing of Access Delay Elements

SAND2012-9025P

Existing Vault Door Feature	Number of Attackers	Breaching, Cutting, or Penetration Tools	Trial 1 Delay Time (seconds)	Trial 2* Delay Time (seconds)	Comments/ Observations
Middle Hinge		 120 V / 20 amp Electric 0-3000 strokes/min Reciprocating Saw (7 kg/15 lb)			
Bottom Hinge		120 V / 15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			
Extra Hinge (in Millwright vise)		 Portable Oxygen Acetylene Cutting Torch with tanks and manual striker, (23 kg/50 lb)			

*Conduct second trial, if time allows.

Activity 3-2. Collect Delay Times on Upgraded Vault Double Doors during Demonstration

The technician will demonstrate how to defeat each vault door feature on an upgraded door with a specific tool two times. The upgrades include the following:

- Angle to prevent use of Locksmith Bypass Tool on Interior Lever Handle.
- No lip strike plate that allows for full length astragal without a notch like that seen in the baseline.
- Welded astragal full height of door that protects the latch bolt and flush bolts.
- Exterior plate to slow down cutting through door thickness after cutting exterior lever handle and that increases delay time for trying to use the interior lever handle.
- Security hinges (hinge pins) to hold door in place if the hinges are defeated.
- Upgrade Magnetic-Lock Sex Nut with tungsten rod.

The participants will collect delay times for the upgraded doors, following the steps below.

1. Write the number of attackers in the second column of Worksheet 3.
2. One participant uses a stopwatch to collect delay times for the door feature.
 - a. When the technician indicates that the Test Trial is starting, the participant with the stopwatch presses Start.
 - b. When the element is defeated, the participant with the stopwatch presses Stop.
 - c. The participant announces the time for the Test Trial, and all participants record the delay time (column 4).
 - d. Repeat for Test Trial 2 (column 5).
3. Repeat Steps 1 and 2 for all upgraded vault door features listed in Worksheet 3.

Worksheet 3: Upgraded Vault Door Delay Times by Feature Defeat and Tool

Upgraded Vault Door Feature	Number of Attackers	Breaching, Cutting, or Penetration Tools	Trial 1 Delay Time (s)	Trial 2* Delay Time (s)	Comments/Observations
Interior Door Lever Handle with angle protection		 <p><i>K-22</i> Lever Opening Tool</p> <p><small>IF YOU CAN SLIDE THIS TOOL UNDER THE DOOR, YOU WILL OPEN IT! This tool is to be sold only to locksmiths and law enforcement agencies.</small></p> <p>Locksmith Bypass (under door) Tool</p>			

Upgraded Vault Door Feature	Number of Attackers	Breaching, Cutting, or Penetration Tools	Trial 1 Delay Time (s)	Trial 2* Delay Time (s)	Comments/ Observations
Mag-Lock Sex Nut with Tungsten Rod Insert		 Corded Drill with 1.3-cm (0.5-inch) chuck and metal cutting drill bits (2.5 kg/5.5 lb)			
Mag-Lock Sex Nut with Tungsten Rod Insert		 120 V / 15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			
Upper Flush Bolt		120 V / 15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			
Lower Flush Bolt		 120 V / 15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			
Cut Outer Lever Handle and Door Thru Thickness. Then Use Ruler to open Interior Lever Handle		120 V / 15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			
Latch Bolt		120 V / 15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			

Upgraded Vault Door Feature	Number of Attackers	Breaching, Cutting, or Penetration Tools	Trial 1 Delay Time (s)	Trial 2* Delay Time (s)	Comments/Observations
Latch Bolt (in Millwright vise)		 Portable Oxygen Acetylene Cutting Torch with tanks and manual striker (23 kg/50 lb)			
Full Length Horizontal Cut Underneath Middle Hinge		120 V / 15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			
Middle Hinge		 120 V / 20 amp Electric 0-3000 strokes/min Reciprocating Saw (7 kg/15 lb)			
Bottom Hinge		120 V / 15 amp Electric Grinder 18-cm (7-inch) steel cutting and abrasive blades (6 kg/13 lb)			

*Conduct second trial, if time allows.

Activity 4 (Optional): Collect Additional Delay Times for Other Site Delay Components

If time permits, Technicians will demonstrate the penetration of other site delay components. Use Worksheet 4 to record the type of tool that is being used to defeat the feature. Use a stopwatch to collect delay times for a variety of adversary penetration methods.

Worksheet 4: Barrier Delay Times by Component Type and Tool

Component Type	Variation	Breaching, Cutting, or Penetration Tools	Trial 1 Delay Time (seconds)	Trial 2* Delay Time (seconds)	Comments/Observations
Chain link mesh fence fabric (man-passable breach)	1 person cut				
	2 person cut				
	1 person cut				
	2 person cut				
Low Security Padlocks	_____” as installed				
	_____” as installed				
Medium Security Padlock	_____” as installed				
	_____” as installed				
High Security Padlock	_____” as installed				

*Conduct second trial, if time allows.

Activity 5: Discussion Questions regarding Delay Performance Testing

After all delay performance testing has been completed, the group will discuss the following questions:

- Why might outsiders and insiders decide to attack the vault double doors rather than the vault walls, roof, or floor?
- Did the upgrades increase adversary task times to breach the doors?
- Why is it important to ensure that all paths provide balanced delay? Were the proposed upgrades to the vault doors balanced?
- Why is it important to use multiple and different barriers?
- Discuss how the performance tests could have been improved
- If the only detection sensors for the vault were the Balanced Magnetic Switch on the vault doors, why might the Outsider decide to take more time to do a full length horizontal cut on one door panel versus doing a faster attack?

Template for Performance Test Plan

Performance Test Goal

A general statement of the overall desired outcome of the performance test (statement should describe the overall expected result).

Objectives

A concise elaboration of the goal that describes the specific tasks of the performance test:

- *Purpose of the test*
- *Tasks to be tested*
- *Conditions for the test*

Location

The location of the performance test is simply where the test will take place.

Element(s) to be Tested

Identify and describe the specific essential element that will be assessed.

Scenario Description

Scenario identification involves describing the:

- *Threat facing the elements*
- *Facility or location involved*
- *Performance test boundaries*
- *Timeline or schedule*

Test Methodology and Evaluation Criteria

Test Methodology describes how the test will be conducted.

Test evaluation criteria describe how the test will be assessed or scored.

Test Coordination

Performance test coordination describes who needs to be involved or aware that a test will be conducted.

Compensatory Measures

Compensatory measures describe what is necessary to compensate for any degradation of the system performance experienced while conducting the performance test.

Approval of Performance Testing

Approval of performance test plans describes how the test plan is approved and who has to approve the test.

Classification of Test

Determination of whether the test plan, source documents and/or results should be considered sensitive.

Briefing and Critiques