MAILROOM SCENARIO EVALUATION

FINAL REPORT

SCA, Inc.

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Executive Summary

The processing of mail in penitentiary mailrooms is a time consuming operation involving routine inspection, sorting, routing, and screening for concealed drugs. To improve the drug screening process, the National Institute of Justice sponsored an investigational effort to identify, evaluate, and demonstrate drug detection equipment and technologies.

Based on a market survey and initial engineering analysis, the systems listed below were chosen as the most promising for enhancing mailroom drug detection capabilities. A simulated mailroom environment was set up at the Thunder Mountain Evaluation Center (TMEC), and a scenario evaluation was performed on the systems. The drugs chosen for investigation were marijuana, cocaine, heroin, methamphetamine, ecstasy and LSD.

Technology Class	Type	Manufacturer & Model
Trace	Desktop Ion Mobility Spectrometry (IMS)	Barringer "IONSCAN Model 400B"
Trace	Desktop (IMS)	Ion Track "ITEMIZER"
Trace	Handheld (IMS)	Barringer "SABRE 2000"
Trace	Handheld (IMS)	Ion Track "VaporTracer"
Trace	Chemical Spray	Mistral Security "Cannibispray" & "Coca-Test"
Bulk	X-ray Transmission/Backscatter Scan	AS&E "Model 101"

The primary objective of the evaluation was to determine the performance of each drug detection instrument or technology in detecting mail items containing drugs. Due to various difficulties and hazards associated with handling most of the drugs of interest, only marijuana and cocaine were used in the scenario evaluation, per se. However, for the trace detection (IMS) instruments, the operational minimum detection level (OMDL) for all of the aforementioned drugs was measured in separate testing, and those results were used to extrapolate results of marijuana and cocaine testing to those drugs not tested in the mailroom scenario evaluation. The potential contamination of mail due to handling within the U.S. postal system was evaluated by comparing the level of drug residues on mailed items with that of a control group. This measurement was relevant to determine the potential problems from "background" contamination, since the trace detection instruments are sensitive to microscopic amounts of drugs. For the scenario evaluation, TMEC laboratory spaces were designed and set up to simulate a prison mailroom environment with the addition of the drug detection systems and technologies listed above. The mailroom scenario evaluation used letters, envelopes, and packages with prescribed contents that were either "clean" or had 0.1, 0.5, or 1.0 gram of drugs hidden within. The drugs were hidden in a variety of locations and, in the case of cocaine, as either absorbed liquid or powder form. Results for operational minimum detection level, U.S. postal system contamination, and the mailroom scenario evaluations are discussed in the report.

Several valuable conclusions were drawn from these evaluations. Items mailed through the postal system do not pick up any substantial amounts of drug contamination. The Ion Mobility Spectrometers (IMS) in general had high performance (greater than 89% probability of detection) for cocaine and fair performance (24% and 18% probability

of detection) for marijuana. The chemical reagent spray technology did not perform well for the concealment conditions and quantities investigated. The bulk detection system could see small amounts of drugs in individual and simple mail items when hidden in the seams or in the contents, if the drugs were in a concentrated (not distributed) form. The trace detection systems, in some cases, had high false alarm rates. This was judged to be the result of "spiked" mail contaminating "clean" mail during the testing and the improper adjustment of instrument alarm levels.

Although this evaluation has helped answer a number of questions about the potential of these technologies to detect drugs in the mail, the practitioner is expected to be most concerned about the following:

- Will the technology increase our success at finding drugs in the mail?
- How will using the technology impact personnel resources?

Of the systems evaluated, the ion mobility spectrometry (IMS) instruments are the most likely to allow us to answer the first question with a "yes." They demonstrated a superior capability for detecting microscopic traces of drug residue (e.g., overall probability of detection for cocaine was 90%). The major advantage of adding an IMS instrument to the mailroom's "tools" is seen in its potential for alerting inspectors to the presence of drugs that their manual inspection could miss – extremely small quantities, spread out powders, absorbed liquids, etc.

Addressing the second question, additional evaluation is needed to determine how to best employ the instruments. Detecting drugs with an IMS instrument involves wiping an object with a sampling "trap" (a small piece of porous paper), inserting it into the instrument and reading the result on the instrument display. This evaluation focused on the ability of a technology to detect the presence of concealed drugs. Screening methodologies for large volumes of mail were not devised or studied, nor were the speed and efficiency of the technologies evaluated. In the case of the IMS instruments, it took approximately 20 seconds to inspect each item. During a routine day, a mailroom may process several thousand items. It would take over 16 hours to process 3000 items at 20 seconds each. Clearly, existing staff could not accommodate this additional level of effort. Hypothetically, the instrument could potentially be used to an advantage in more efficient ways, such as, one (or a combination) of the following:

- Inspect suspicious mail items.
- Inspect the mail of all inmates that have received drugs in the past.
- Inspect the mail of inmates incarcerated for drug law-related violations.
- Inspect randomly.
- Sample multiple mail items (e.g., 50 at a time) prior to inserting the sample into the instrument. This would allow 3000 items to be inspected in approximately one fifth the time required for inspecting individually, i.e., 3 hours. (It was not possible to test this hypothesis during this evaluation due to funding constraints.)

Planned future evaluations will address this issue of how to best employ the instruments by testing the above approaches in a real world environment.

1 BACKGROUND AND PURPOSE

The processing of mail at penitentiary mailrooms is a detailed, labor-intensive operation. In addition to routine inspection, sorting, and routing, the mail is screened for concealed drugs. Virtually every item of mail receives a manual inspection. The National Institute of Justice (NIJ) sponsored an effort to identify and evaluate drug detection equipment and technologies. The goal of this effort was to improve the efficiency and effectiveness of the drug screening process for the Bureau of Prisons' (BOP) federal penitentiary mailrooms. During FY00, mailroom operations were studied to determine areas where drug detection devices and equipment could improve existing processes. A market survey was performed to identify applicable technologies and commercially available equipment. An evaluation was developed (Attachment A, "Mailroom Scenario Evaluation Plan") aimed at determining if the most promising of the identified technologies could aid in the detection of drugs in mailroom environments. The evaluation plan included detailed test protocols for preparation and processing of both clean and spiked mail, creating a simulated mailroom environment, and extending the results of the simulated mail room evaluation to drug types that were unable to be tested in the facilities used for the mail room evaluation. This report documents the evaluation, which was performed at the Thunder Mountain Evaluation Center [TMEC] in November 2001. It also documents the results of preparatory testing described below.

An example case study was used for insight in determining evaluation requirements. Mailroom personnel activities were observed and analyzed throughout the entire process of inspection and distribution of incoming mail, starting with receipt of the mail at the post office and concluding with the placement of mail in the inmates' cellblock mailboxes. Using those observations to depict the scenario to be appraised, the mailroom evaluation was designed to determine the utility of relevant technologies and equipment in augmenting the human inspector's ability to detect drugs entering prison facilities via the postal system.

An assortment of drug detection systems were evaluated. The systems fall within two general classes of technology: trace detection and bulk detection. Future reference within this document to "systems under test" (SUTs) should be understood to mean a system or technology without regard to the degree of hardware employed. For example, the chemical spray was considered as a SUT for the Mailroom Scenario Evaluation. Refer to the Mailroom Scenario Evaluation Plan for detailed system descriptions and specific details as to which phases of the evaluation that each system participated in. Figures 1-1 through 1-6 show the different instruments that were tested in the evaluation.

Figure 1-1: 101 Van, X-ray System

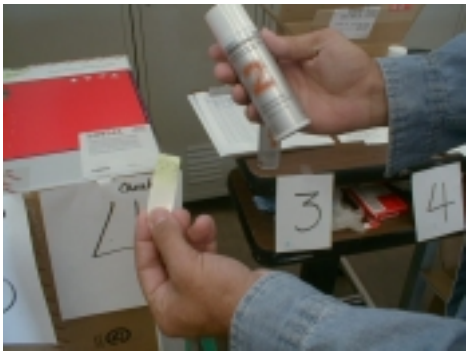


Figure 1-2: Mistral "Cannibispray" & "Coca-Test"

Figure 1-3: Ion Track Vapor Tracer

Figure 1-4: Ion Track Itemizer, Vacuum Wand

Figure 1-5: Ionscan, Desk Top Unit

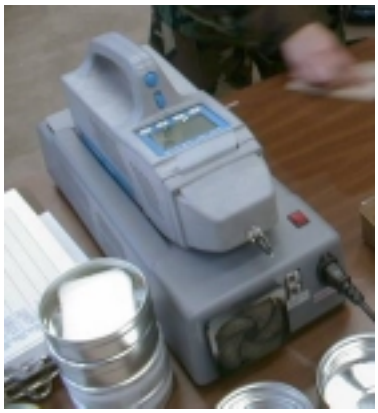


Figure 1-6: Sabre, Hand Held Unit

Trace Detection

Trace detection can be described as direct chemical identification of particles or vapors given off by a substance. It is based on the physical transport of these particles or vapors for sample analysis by methods, such as, gas chromatography, chemical luminescence, or ion mobility spectrometry. This detection technology commonly exhibits strength in

identifying the particular chemical substance but often lacks the ability to estimate the amount of chemical present.

Bulk Detection

Bulk detection technologies commonly operate by remotely sensing physical or chemical properties of an article being examined. The ratio of molecular densities within certain materials is a common example. Also geometric information such as size and shape are often employed for bulk detection systems

1.1 SCOPE

The Mailroom Scenario Evaluation was designed to evaluate the performance of various drug detecting instruments and technologies, while simulating a prison mailroom environment. Of the three basic types of evaluations (technology, scenario, and operational)[1], this evaluation is best defined as a "limited scenario" evaluation. Testing was conducted at the vendor's facilities, through the US Postal Service and at the Thunder Mountain Evaluation Center (TMEC), Ft. Huachuca, AZ, using detection systems supplied to TMEC by the vendors. The evaluation was conducted from June through November, 2001. The detection systems evaluated are summarized in Table 1.1-1. The ASE101 was substituted as the bulk detection system due to the unavailability of those bulk detection systems delineated in the Mailroom Scenario Evaluation Plan. Refer to the "Mailroom Scenario Evaluation Plan" for detailed system descriptions. The drugs investigated were Marijuana, Cocaine, Heroin, Methamphetamine, Ecstasy and LSD. Because several of these drugs are hazardous to handle or easily degrade over time the mailroom scenario phase of the evaluation included only marijuana and cocaine.

Table 1.1-1: Detection Systems Evaluated

Detection Class	Legend Key	Type	Manufacturer & Model
Trace	BNGRIS	Desktop Ion Mobility Spectrometry (IMS)	Barringer "IONSCAN Model 400B"
Trace	ITITEM	Desktop (IMS)	Ion Track "ITEMIZER"
Trace	BNGRSB	Handheld (IMS)	Barringer "SABRE 2000"
Trace	ITVPRT	Handheld (IMS)	Ion Track "VaporTracer"
Trace	MTRLCS MTRLCT	Chemical Spray	Mistral Security "Cannibispray" & "Coca-Test"
Bulk	ASE101	X-ray Transmission/Backscatter Scan	AS&E "Model 101"

The evaluation was a progression of tests culminating with the Mailroom Scenario Test. A progression of tests was established so that their accumulative results could be used to validate the mailroom test results and extrapolate the mailroom test results to other drug types not used in the evaluation. Test names, progression order, and test motives are shown in Table 1.1-2. For detailed test descriptions and procedures please see Appendix A, "Mailroom Scenario Evaluation Plan". Test results are presented for each test in sections 2.3, 3.3, and 4.3 of this report.

[1] As defined by P.J. Phillips, A. Martin, C. Wilson, M. Przybocki, in the article "Introduction to Evaluating Biometric Systems", published in IEEE Computer Magazine, February 2000.

Table 1.1-2: Mailroom Evaluation Progression of Tests

Test Order	Test Name	Motive for Conducting Test
1	Operational Minimum Detection Limits (OMDL)	Provide baseline information about SUT's performance against drugs that could not be evaluated in the mailroom testing.
2	USPS Contamination of Mail	Provide the Probability of False Alarms caused by potential contamination in the US Mail system. This information was helpful in validating the mailroom results.
3	Target Presentation Order	Provide information about detections and false alarms when multiple systems (SUTs) measure same piece of mail. In other words, could examination of a target mail item by multiple systems "Wear it out"?
4	Mailroom Scenario	Determine the performance (Probability of Detection and False Alarm) of each SUT when examining mail items containing drugs.

1.2 OBJECTIVES

The chief objectives of the mailroom scenario test and evaluation were to:

- Simulate the penitentiary mailroom environment and processes.
- Simulate receipt of a relatively few mail items containing drugs within an overall larger quantity of "clean" mail.
- Determine the performance of each drug detection instrument or technology as to its efficiency and efficacy in detecting mail items containing drugs.

As a prerequisite to the above listed main objectives, several secondary objectives were required in order to establish the influence that the methods and means of target movement and presentation, as well as specific system capabilities had on any reported test results. These secondary objectives included:

- Quantify the levels of drug contamination introduced into mail by the U.S. postal service for each drug and system used in the mailroom scenario test.
- Document the detection limit and calibration status of systems/technologies being tested.
- Determine the effects of target packaging and exposure methods.

2 OPERATIONAL MINIMUM DETECTION LIMITS EVALUATION

An operational minimum detection level (OMDL) evaluation was conducted in May 2001 for four of the systems under test (SUTs). The four SUTs tested were "off-the-shelf" trace detection units of nearly identical configuration to the units used in the Mailroom Scenario Evaluation. Barringer Technologies, Inc. (BTI) provided two of the units, namely an IONSCAN 400B desktop unit and a SABRE 2000 portable unit. Ion Track Instruments, Inc. (ITI) furnished the other two units, namely an ITEMISER desktop unit and a VAPORTRACER 2 portable unit. A member of the Mailroom Scenario Evaluation's Silver Team fulfilled witness and recording functions for the sample submissions and resultant SUT responses. Table 2.3-1 summarizes the results from the OMDL tests.

The SUTs use a technology known as ion mobility spectrometry (IMS). They operate by ionizing vapors and then measuring the travel time of these ions in an electric field. The time of travel (or drift speed) of ions through the field is proportional to their molecular mass. Chemical compounds have known specific drift speeds that allow for precise determination of the ion producing substances. A set of drift speed values for a variety of drugs were preprogrammed into the SUTs used during these tests. Alarm levels, based on the number of ions detected and the deviation in drift speed, produce a "Detected" or "Not Detected" condition for a user defined set of drug types. For all OMDL testing, SUTs were configured with alarms energized at levels that were expected to be used in the mailroom scenario evaluation, to follow.

2.1 PURPOSE

There were two primary objectives for the OMDL test. One was to determine the minimum detection level of each SUT for Marijuana, Cocaine, Heroin, Methamphetamine, Ecstasy and LSD. The other objective was to use the results of the OMDL testing to help extrapolate the mailroom marijuana and cocaine results to those drugs not tested in the mailroom evaluation. Of the three basic types of evaluations (technology, scenario, and operational), the OMDL evaluation is best defined as a "technology" evaluation.

2.2 PROCEDURES

The SUTs were carefully calibrated and/or subjected to quality control procedures by the manufacturer. All testing was done at each respective instrument manufacturer's facility in the months prior to the start of the Mailroom Scenario Evaluation. OMDL tests were conducted as prescribed in Section 5.3 of the Mailroom Scenario Evaluation Plan. The procedures used for the IONSCAN 400B and the SABRE 2000 were provided by Barringer Technologies, Inc., and the procedures used for the ITEMISER and VAPORTRACER 2 were developed by the Silver Team. Also, each manufacturer provided the necessary chemical standard solutions, dilution solvents, and equipment, as well as personnel, to perform all SUT operations.

2.3 RESULTS

The overall results of the OMDL testing for each instrument investigated are presented in Table 2.3-1. These results show that the IMS trace systems tested are most sensitive to cocaine and methamphetamine, somewhat sensitive to ecstasy, and not as sensitive to marijuana, heroin and LSD. Test results also showed that the overall

sensitivity of the IMS trace systems tested ranged from 0.01 to 150 nanograms (one billionth of a gram). This indicates all these instruments are very sensitive. The operational minimum detection levels are expressed as the lowest chemical loading level (in nanograms) that produced a "Detected" condition for the drug under test, for three samples in a row or three out of five samples submitted at that level.

Table 2.3-1: OMDL Overall Test Results

Operational Minimum Detection Level (OMDL) Test Results All results are shown in nanograms (ng.)						
INSTRUMENT	**MJ (THC)**	**COCAINE**	**HEROIN**	**METH**	**ECSTACY (MDMA)**	**LSD**
Barringer, IONSCAN MODEL 400B (desktop)	0.5	0.01	0.5	0.01	0.05	0.5
BARRINGER SABRE 2000 (handheld)	5.0	0.5	5.0	0.5	0.5	NA
ION TRACK ITEMISER (desktop)	5.0	10.0	50.0	50.0	20.0	150.0
ION TRACK VAPOR TRACER 2 (handheld)	NA1 & NA2	15.0	40.0	15.0	20.0	NA2
MJ – Marijuana, METH – METHAMPHETAMINE NA – LSD not tested at operator request due to SUT's insensitivity to this drug. NA1 –THC had peak location interference with heroin that operator was unable to resolve. Testing for this drug terminated at operator's request. NA2 – Testing for this drug terminated at operator's request.						

Note that not all drug types were detected by each SUT at the levels used. Table 2.3-1 was built from testing done by silver team personnel from OMDL testing performed at the facilities of each system's manufacturer. The specific individual OMDL results can be found in Appendix B.

2.4 LESSONS LEARNED

For the Operational Minimum Detection Limit testing phase of the Mailroom Scenario Evaluation, several items should be noted. First, the OMDL test should be conducted at a common venue with all SUTs being subjected to the identical chemical solutions and common sample introduction procedures. This is in accordance with the testing conducted during other phases of the evaluation. This would require an outside party to prepare the samples and provide a chemically clean laboratory environment. Agreement on the test protocols needs to be established prior to the test and adhered to during the implementation of the test. Second, the "operational" nature of the test needs to be strengthened. All SUTs should be set up and operated in a manner that mimics units deployed at field locations performing similar chemical detection tasks. Operation of the SUT for the OMDL test should preclude any during-the-testing modifications to sample intakes, alarm criteria, unit substitution, etc. Use of equipment operators with no vested interest in any particular SUT could well deter the desire for adjustments and

alterations based on test results. Third, a common set of SUTs and detection algorithms should be employed throughout all phases of an evaluation such as the Mailroom Scenario Evaluation. A more thorough exposure of the SUT manufacturers' or vendors' representatives to the overall test design and execution might have helped produce a more universal basis for comparing and extending test results from one phase of the overall evaluation to another. Perhaps including the ability to conduct hands-on trials during a pretest training/debugging exercise would have served to provide insight for the most germane single configuration of their particular SUT for use in all test phases.

This technology evaluation (what we have termed the OMDL) was very important from an evaluation theory standpoint. The results from this test will help interested parties understand future trace detection evaluations as it provides a good baseline to think off of. For example, people in the technology field often explain a nanogram by having a non-technical person imagine taking a paper clip and cutting it into a million pieces, then taking one of those pieces and dividing it into a thousand pieces – one of those pieces is a nanogram! Test results showed that these technologies can find this small of an amount (see Table 2.3-1). Now practitioners can begin to understand why there may be "false alarms" when using this technology – it finds extremely small amounts - amounts that can easily be from contamination**.**

3 PRELIMINARY TESTS

3.1 PURPOSE

The mailroom evaluation was a large effort. The evaluations of the SUTs required a progression of tests culminating with the Mailroom Scenario Test. This progression of tests was established so that the results of the overall mailroom evaluation could be validated and its results extrapolated to other drug types not used in the actual evaluation. The tests were conducted in the following order: 1) a test of the SUTs minimum operational detection limits (OMDL) for a variety of drugs, 2) a U.S. postal service (USPS) contamination test, 3) a target presentation order test, and 4) a simulated mailroom test. The USPS and target presentation order tests were done as preliminary tests to establish the false alarm rate and contamination levels caused by exposure to the USPS, and to establish if target presentation order would affect the results of Mailroom Scenario Test.

The primary objective of the USPS test was to measure the levels of drug contamination introduced into a small set of items mailed through the U.S. postal service system. The effort was designed to help quantify the levels of drug contamination for each drug and system used in the mailroom scenario test. To determine these levels a U.S. Postal Service (USPS) drug contamination test was conducted at TMEC on November 8 and 9, 2001 prior to the start of the mailroom evaluation test.

The objective of the Target Presentation Order test was to use its results to validate test procedures defined in the mailroom test plan. It was performed in order to establish if the order in which the SUTs were presented the targets would have any influence on the ability of the SUTs to accurately evaluate the targets. If the results of this test would have shown, which they did not, that presentation order did influence a system's ability to evaluate targets, then the mailroom scenario test plan defining the flow of targets into the mailroom would have been modified. For example, a larger number of targets would have had to be prepared.

3.2 PROCEDURES

USPS Test

The USPS test consisted of two separate mailings; each contained 15 "non-spiked" letters and 15 "non-spiked" packages. These mailings were sent to the simulated mailroom at TMEC via USPS First Class Mail. Additionally, a separate group of "non-spiked" items (15 envelopes and 15 packages) was kept as a control group in a clean location at TMEC. One of the mailed shipments was sent from Douglas, AZ and the other was sent from Phoenix, MD. Figures 3.2-1 and 3.2-2 show examples of the items used in the USPS test. Upon receipt at TMEC, the items from the two mailed shipments were

Figure 3.2-1: Small Envelope

Figure 3.2-2: Large Envelope

sorted into their respective groups and kept segregated from each other, the control group, and all possible contaminating sources. Shipping codes recorded in the return address section of the items were used to segregate the items into their respective groups.

Target Presentation Order

One container configuration was employed in the Target Presentation Order test, namely the small envelope with a 1 – 3 page letter enclosed. Two target configurations were used. The first was cocaine in its solid natural form, hidden under a mailing label at the level of one gram. The second was marijuana in its solid natural form, hidden under a mailing label at the level of one gram. Six of the trace detection SUTs were used. They were the ITEMIZER (#1), the VaporTracer (#2), the IONSCAN 400B (#3), the SABRE 2000 (#4), the Coca-test (#5), and the Cannabispray (#6). An assemblage of sixty identical target items (ten times the number of trace detection SUTs involved) was created for each of the container/target combinations for use in this phase of the test. Each assemblage was randomly divided into a number of groups equal to the number of trace detection SUTs involved (i.e., six groups of ten items). Each group of items was submitted for SUT inspection via a different sequential ordering of the SUTs. Specifically, for the six groups of the envelope/cocaine assemblage:

Group 1 envelope/cocaine items submitted in the order of SUT 1, 2, 3, 4, 5, and 6

Group 2 envelope/cocaine items submitted in the order of SUT 2, 3, 4, 5, 6, and 1

Group 3 envelope/cocaine items submitted in the order of SUT 3, 4, 5, 6, 1, and 2

Group 4 envelope/cocaine items submitted in the order of SUT 4, 5, 6, 1, 2, and 3

Group 5 envelope/cocaine items submitted in the order of SUT 5, 6, 1, 2, 3, and 4

Group 6 envelope/cocaine items submitted in the order of SUT 6, 1, 2, 3, 4, and 5

The same routine was followed for the six groups of envelope/marijuana assemblage. Each item in these two groups bore a unique item identification code written on the outside. This test denoted: order of presentation test item, drug type, group number, and item number within a group. Separate SUT detection results were recorded for each item in the test and an analysis was performed to determine the affects that the order of presentation has on the target's detection**.** It should be noted that the amount of target material (1 gram, solid form) as specified in the test plan was not well suited for the concealment method (under mailing label) used in this test. The amount was

modified to a more appropriate level of 0.1 gram based on a unilateral decision from the target item preparation team. Also, due to initial test results, and time and manpower constraints the presentation order test was terminated early. A total of 77 of the 120 prepared mail items were examined.

3.3 RESULTS

USPS Test

The overall results of the USPS test for each instrument are presented in Table 3.3-1 below. The contamination testing resulted in an overall false alarm rate of 5% (28 inspections showed positive out of the 540 total inspections). Table 3.3-1 summarizes the probability-of-false alarm (Pfa) results for the mailing groups (USPS), and the control group by drug type. As can be seen from the table the false alarm rate on the control mail was very similar to the false alarm rate in the USPS mail. Therefore, one can conclude that the USPS mail was uncontaminated and the false alarms were due to the threshold settings for the devices.

Table 3.3-1 USPS Test Results

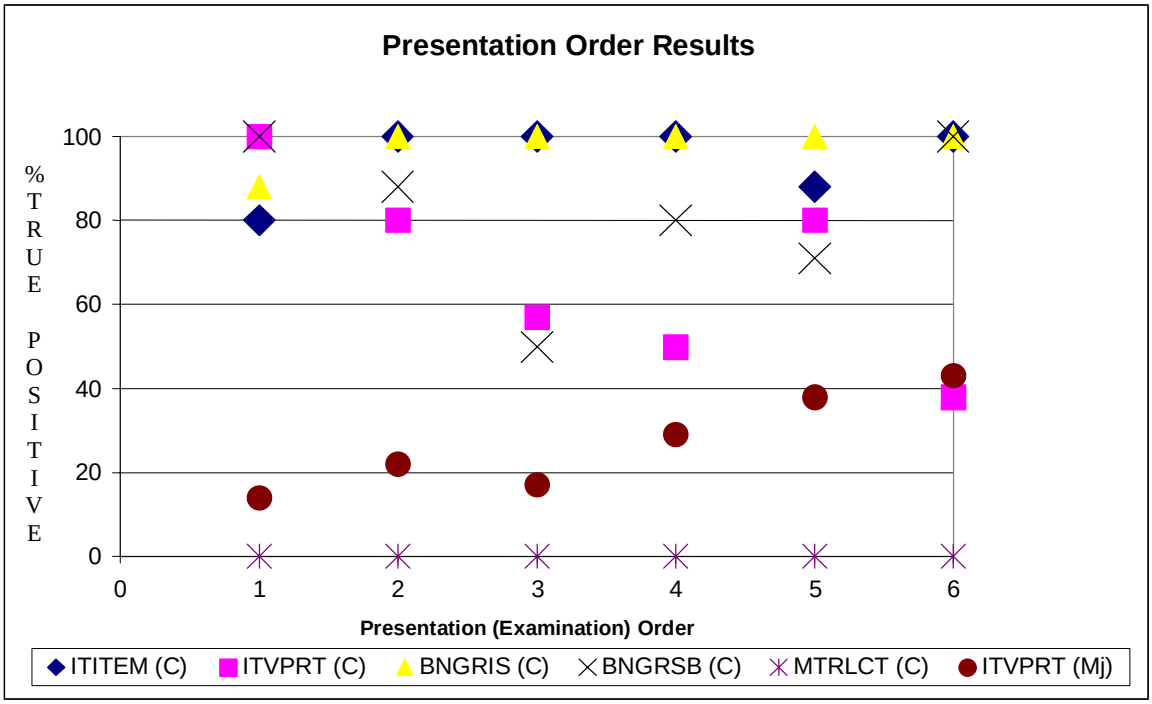
	Pfa Cocaine		Pfa Marijuana	
INSTRUMENT	USPS	Control	USPS	Control
ION TRACK ITEMISER	2.2 %	0.0 %	0.0 %	0.0 %
ION TRACK VAPOR TRACER 2	0.0 %	0.0 %	3.3 %	4.5 %
Mistral Security Chemical Spray "Cannibispray"	NA	NA	3.3 %	6.7 %
Mistral Security Chemical Spray "Coca-Test"	0.0 %	0.0 %	NA	NA
BARRINGER SABRE 2000	2.2 %	2.2 %	1.1 %	1.1 %
Barringer, IONSCAN MODEL 400B	2.2 %	1.1 %	0.0 %	0.0 %

Target Presentation Order

The graph in Figure 3.3-1 shows the percent of true positives measured by each SUT based upon target presentation order. If presentation order negatively influenced a SUT's ability to evaluate targets then the graph would show plots that started high (high percent of true positives) and decreased as the presentation order increased. This behavior would indicate that the targets were "wearing out" as more SUTs examined them. If presentation order positively influenced a SUT's ability to evaluate targets then the graph would show plots that started low (low percent of true positives) and increased as the presentation order increased. This behavior would indicate that the targets were "gaining strength", maybe from contamination, as more SUTs examined them. However, the graph of Figure 3.3-1 shows that the percent of true positives measured by the SUT remained relatively constant with respect to presentation order. This behavior indicates that the targets were not degrading and target presentation order was not significantly

influencing the SUT ability to detect the target. Therefore, the results of this test permitted the reuse of targets for multiple SUTs, during the mailroom evaluation.

It should be noted that the graph represents examination results from only a little more than half (77) of the 120 prepared mail items. Due to initial test results as indicated in the graph, and time and manpower constraints the presentation order test was terminated early. Early termination of the test caused the number of trials when a target was in a given position with respect to a specific SUT not to be consistent. This factor is what likely lead to the variability indicated by several of the plots shown in the graph. However, this variability is statistical insignificant.



Note: Abbreviations are defined in Table 1.1-1

Figure 3.3-1: Graph of Presentation Order Results

3.4 LESSONS LEARNED

Since these two phases were the inaugural of the "production" type testing conducted by the newly trained SUT operators, it might have benefited them to have performed the Target Presentation Order Test (all items spiked) before doing the USPS Contamination Test (no items spiked). This would have provided an earlier and greater exposure to target detection and the accompanying recording and sanitation procedures. Had time and resource constraints been more relaxed, a better exposure, prior to any "under-test" conditions, would have been accomplished by incorporating a practice session employing spiked mail items as part of the manufacturers' pre-test training session. In the Target Presentation Order Test, the amount of target material (1 gram, solid form) as specified in the test plan was not well suited for the concealment method (under mailing label). The amount was modified for this Target Order Presentation testing to a more appropriate level of 0.1 gram based on a unilateral decision from the

target item preparation team. The same change in amount of target material was not made for the main event, the Mailroom Scenario Test. To preclude any misinterpretation of testing intent and/or results all desired modifications of test plans or procedures need to be discussed and agreed upon prior to becoming a non-retractable part of the test.

4 MAILROOM SCENARIO TEST

4.1 PURPOSE

The Mailroom Scenario Test was conducted during November 13 through 15, 2001 at Thunder Mountain Evaluation Center (TMEC), AZ. TMEC personnel (with contractor support personnel) conducted this evaluation. The primary objective of the evaluation was to determine the performance of each SUT to detect drugs secreted within items of mail. Because several of the drugs studied in the OMDL test were hazardous to handle or easily degraded over time, the mailroom scenario evaluation included only marijuana and cocaine. Each SUT "looked" at approximately 373 items. Table 4.3-1 summarizes the mailroom test results and shows probability-of-detection (Pd) and probability-of-false alarm (Pfa) results, by drug type, for the SUTs. (These results indicate overall performance over the full range of test conditions, e.g., various concealment methods, target types and drug quantities).

4.2 PROCEDURES

The TMEC laboratory spaces were designed and set up to simulate a penitentiary mailroom environment with the addition of the drug detection systems and technologies discussed previously. Figure 4.2-1 shows the TMEC laboratory as it was set up for the mailroom evaluation. Letters and packages that were processed in the simulated mailroom were assembled and held in separate areas adjacent to the mailroom. Although the letters, parcels, and packages were processed within the mailroom at TMEC in a manner similar to that of penitentiary mailrooms, subjecting items to inspections by the various instrument systems and technologies were the focus of the test. A detailed protocol (Appendix A) for testing and documenting results was followed throughout the test.

Figure 4.2-1: Simulated Mailroom at TMEC

All evaluation results were recorded based upon a prescribed format and were stored in an electronic format when possible. Multiple sources of digital imagery were collected to document all phases of the test. Use of the customary TMEC laboratory and office facilities (hand tools, workspaces, telephones, photocopiers, etc.) not dedicated to the simulated mailroom were afforded to all participants of the test. All time keeping devices used to record date and/or time for notes, data records, computer images, computer files, etc., were synchronized at the outset of any TMEC testing to the local standard time (as determined by the Test Director) +/- one second. These devices were maintained as such throughout the duration of the test. Deviations from test protocol were recorded in test incident reports.

Concealment methods and amounts were based upon the report "Penitentiary Mailroom Operations Study" (prepared for: National Institute of Justice by: DoD/Counterdrug Technology Development Program Office, submitted on September 7, 2000), where a federal facility mailroom's mail inspection procedures and handling techniques were witnessed and evaluated. The Target matrix that was used in the test is shown in Figure 4.2-1. The figure shows there were 281 target trials and 92 non-target trials for a total of 373 trials. The "max number of items" shown in Tables 4.3-2 through 4.3-8 reflect the maximum number of items that a SUT examined for a given test condition (e.g., 0.1 gram drug amount, #10 business package type, etc.). This number was usually the same for each SUT although there were times when it varied slightly. (The sum of the max number of items shown in Tables 4.3-2 through 4.3-8 will usually equal the total number of trials, i.e., 373.)

TARGET TRIALS (281)

		CONTENT=	LETTER	LETTER	BOOK	MAGAZINE	CASSETTE	CASSETTE	CD-ROM or DVD	MATERIALS	SHREDDED PAPER	BUBBLE WRAP	DOCUMENT	
		SUB TYPE =	SMALL	LARGE			AUDO	VIDEO						TOTALS BY
		CODE =	LS	LL	BK	MG	CA	CV	CD	CM	SP	BW	DP	PACKAGE
PACKAGE	SUB TYPE	CODE												SUB TYPE
ENVELOPE	MEDIUM	EM	24	24	NV	NV	NV	NV	NV	NV	NV	NV	NV	48
ENVELOPE	SMALL	ES	24	24	NV	NV	NV	NV	NV	NV	NV	NV	NV	48
PARCEL	BAG	PB	NA	NA	21	0	21	0	21	NA	NA	NA	21	84
PARCEL	MAGAZINE	PM	NV	NV	NV	21	NV	NV	NV	NV	NV	NV	NV	21
BOX	SMALL	BS	NA	NA	0	NA	10	10	0	10	0	0	10	40
BOX	MEDIUM	BM	NA	NA	10	NA	0	0	10	0	10	10	0	40
TOTALS BY CONTENT SUB TYPE =			48	48	31	21	31	10	31	10	10	10	31	

NON TARGET TRIALS (92)

		CONTENT=	LETTER	LETTER	BOOK	MAGAZINE	CASSETTE	CASSETTE	CD-ROM or DVD	MATERIALS	SHREDDED PAPER	BUBBLE WRAP	DOCUMENT	
		SUB TYPE =	SMALL	LARGE			AUDO	VIDEO						TOTALS BY
		CODE =	LS	LL	BK	MG	CA	CV	CD	CM	SP	BW	DP	PACKAGE
PACKAGE	SUB TYPE	CODE												SUB TYPE
ENVELOPE	MEDIUM	EM	7	8	NV	NV	NV	NV	NV	NV	NV	NV	NV	15
ENVELOPE	SMALL	ES	8	7	NV	NV	NV	NV	NV	NV	NV	NV	NV	15
PARCEL	BAG	PB	NA	NA	4	4	4	4	4	NA	NA	NA	5	25
PARCEL	MAGAZINE	PM	NV	NV	NV	5	NV	NV	NV	NV	NV	NV	NV	5
BOX	SMALL	BS	NA	NA	2	NA	2	2	2	2	2	2	2	16
BOX	MEDIUM	BM	NA	NA	2	NA	2	2	2	2	2	2	2	16
TOTALS BY CONTENT SUB TYPE =			15	15	8	9	8	8	8	4	4	4	9	

Figure 4.2-1 Target matrix for Mailroom Scenario Test.

A strict protocol for testing and documenting results was followed throughout the mailroom test as documented in the "Mailroom Scenario Evaluation Plan", Appendix A. The SUTs for the mailroom scenario test effort were required to participate in calibration, quality assurance and order of target presentation test efforts to ensure result accuracy. Letters and packages that were processed within the simulated mailroom were first assembled and held in separate areas adjacent to the simulated mailroom. A Red Team of personnel was established to hide drugs in a randomly selected portion of the letters and packages. A strict drug hiding and preparation protocol had to be followed by Red Team members.

4.2.1 Drugs

As applicable, each system or technology tested was subjected to real drugs, in a variety of forms (solid, liquid, etc.). However, only those that could be handled safely within the scope of the effort were used. Marijuana and cocaine were the central drugs of interest for the Mailroom Scenario (probability of detection/probability of false alarm (Pd/Pfa)) phase of this evaluation. A wider range of drug types was employed in the "determination of operational minimum detection limit" test. (These are listed in Section 2.1)

4.2.2 Drug Concealment

Actual drugs and reasonable concealment methods were used wherever feasible. As applicable, each system tested was subjected to real drugs, in a variety of forms (solid, absorbed liquid, etc.). The range of deception techniques used in the evaluation were:

- Drug hidden under envelope seams, labels, and stamps
- Drug hidden with letter contents
- Drug hidden in parcel packing materials
- Drug absorbed into paper
- Drug distributed/spread throughout package, book, or document

Figure 4.2.2-1 shows gauze patches containing different amounts of liquid cocaine. These patches were concealed in test items. Concealment methods and amounts were based upon the report "Penitentiary Mailroom Operations Study" (referenced above), which documents a federal facility mailroom's mail inspection procedures and handling techniques. Figures 4.2.2-2 through 4.2.2-5 illustrates several of the concealment methods used in the test.

Figure 4.2.2-1: Liquid Cocaine in Gauze Patches

Figure 4.2.2-2: 1.0g C in CD in large Env

Figure 4.2.2-3: 0.5g C in T-Shirt, FedX Box

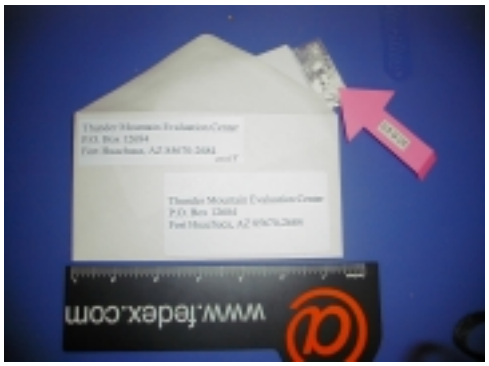


Figure 4.2.2-4: 0.5g MJ in Envelope

Figure 4.2.2-5: 0.5g C in Small Envelope

4.2.3 Target Preparation and Storage

Prior to the start of the Mailroom Scenario test "spiked" and "non-spiked" mail items were prepared for testing. Every item, after it was prepared, was sealed in a plastic bag before it was stored. This process is illustrated in Figure 4.2.3-1. To simulate smuggling efforts aimed at avoiding detection, mail items were handled very carefully as drugs were being hidden, in an attempt to avoid cross contamination of the outside of the envelopes/packages. We believe that on a 1 to 10 scale [10 being very careful] we were an 8 or 9. Letters and packages to be processed within the simulated mailroom were assembled and held in a separate room adjacent to the simulated mailroom.

Figure 4.2.3-1: Mail Item Sealed in Plastic Bag

4.2.4 Test Area Maintenance

During the start of the mailroom scenario phase of the evaluation a contamination problem arose. It was observed that sometimes work areas and instruments would give positive indications on clean items after a "spiked" piece of mail was tested. It was determined that this was probably due to the spiked mail leaving behind contamination on the work area and/or instrument. Upon that discovery, methods were established to reduce this

Figure 4.2.4-1: Test Area Being Cleaned with Alcohol

contamination. One such method was to thoroughly clean work areas with alcohol after each positive measurement. This method is illustrated in Figure 4.2.4-1. The work area would then be tested to ensure it was clean. If the work area gave a positive measurement then it would be cleaned again. This process would be repeated until the work area gave a negative measurement.

4.2.5 Background Contamination Test

A thorough background contamination test was done to ensure accurate test results. The primary objective of this test was to measure the amount of background contamination within the simulated mailroom in order to ensure that the test areas were not contaminated by outside influences or by test articles that were spiked with drugs. This test helped ensure the accuracy of the mailroom test results. This test established the amount of test space contamination for each drug and system used in the mailroom evaluation. Techniques used by TMEC for other chemical trace detection tests were employed for this test. The TMEC IONSCAN instrument was used to make the background measurements. The test included:

- Sampling significant areas (walls, floors, ceilings, desktops, equipment surfaces, etc.) of the test space.
- Recording test results into the electronic database. Test results were measured by Red Team personnel and delivered to a Silver Team member.
- If contamination was found, the area was sanitized and retested until no contamination was found.

4.2.6 Sampling

How mail items were sampled was an important component of the mailroom test. Sampling included how the item was handled (with or without gloves), how the item was

examined (swiped/vacuumed/x-rayed), and how the SUT was operated (cleared). All SUTs took less than a minute to collect a sample. During the test all systems were cleared after an alarm, as per procedure. Based upon the system this clearing process would take anywhere from 1 – 30 minutes. Table 4.2.6-1 shows the sampling procedures that were followed for each SUT used in the mailroom test.

Table 4.2.6-1: Sampling Procedures Used in Mailroom Evaluation

SUT	Handling Procedure	Examination Procedure	Operation Procedure
Barringer IONSCAN Model 400B	No gloves were used.	Barringer supplied swab was used with a wand. Swab was rubbed on all sides of the item including labels and seams then placed into unit for evaluation.	New swab for each item. System was cleared after every examination. Examination area was cleaned and tested after every positive hit.
Ion Track "ITEMIZER"	No gloves were used.	Ion Track supplied swap was placed in a wand. Swab was rubbed on all sides of the item including labels and seams then placed in unit for evaluation.	New swab for each item. System was cleared after every examination. Examination area was cleaned and tested after every positive hit.
Barringer "SABRE 2000"	No gloves were used.	Barringer supplied swap was rubbed on all sides of the item including labels and seams by hand and then placed in unit for evaluation.	New swab for each item. System was cleared after every examination. Examination area was cleaned and tested after every positive hit.
Ion Track VaporTracer	Gloves were used and changed after every positive hit.	Ion Track supplied swap was rubbed by hand on all sides of the item including labels and seams then placed in unit for evaluation.	New swab for each item. System was cleared after every examination. Examination area was cleaned and tested after every positive hit.
Mistral Security Cannibispray & Coca-Test	Plastic gloves were used to protect operator from spray.	Collection paper supplied by Mistral. Paper rubbed on all sides of the item including labels and seams and then sprayed with #1 spray and then with #2 spray (cannibispray only) then the paper immediately examined for color change.	New collection paper for each item. Clearing not required. Examination area was cleaned and tested after every positive hit.
AS&E "Model 101"	No gloves were used.	Item was taped to a wire frame and then passed through x-ray system.	System clearing not required (Please see note below). Examination area was cleaned and tested after every positive hit.

Operation Procedure Note for AS&E "Model 101". The criteria for an alarm (i.e. detection) was: did the operator, who was trained on the system and trained on what to look for, see anything that looked out of place. A manufacturer representative and a member of the silver team trained the operator, who had never worked on the system prior to the test. The training time was a day and included looking at many test mail items. The operator spent, on average, a minute looking at the images. Based upon on-

site observations the operator spent an equal amount of time on each type (backscatter and transmission) of x-ray image.

4.2.7 Drug Alarm Level Settings

The ion mobility systems' alarm level settings are documented in Appendix B. Prior to any items being sampled, the manufacturers' representatives prescribed and set all drug detection algorithm values (peak locations, widths, and alarm thresholds) for their respective system under test (SUT). These values remained constant throughout the test period. No change in the settings was permitted as per the test plan. However, some units are designed to automatically adjust peak locations based on such items as system operational temperature fluctuations, barometric pressure changes, periodic routine quality control checks against a known calibrant, etc. Only those values programmed for signatures related to this test (i.e., calibrant, cocaine, or THC) are documented. All readings were taken by a Silver Team member.

4.3 RESULTS

The Mailroom Scenario Test focused on each SUT's ability to detect drugs (cocaine and marijuana) secreted within items of mail. The overall results of the Mailroom Scenario Test for each instrument are presented in Table 4.3-1. Also, a breakdown of results by the test's key variables is given in Tables 4.3-2 through 4.3-8. These key variables are target type, target amount, package type, package content, and concealment method. The numbers in the tables are rounded to the nearest whole number.

Table 4.3-1: Mailroom Scenario Test Overall Detection Results by System

Performance for SUTs All Conditions				
SUT	Pd		Pfa	
	Cocaine	Marijuana	Cocaine	Marijuana
ION TRACK ITEMISER	100%	1%	50%	0%
ION TRACK VAPOR TRACER 2	90%	24%	8%	6%
Mistral Security Chemical Spray "Cannibispray"	NA	10%	NA	1%
Mistral Security Chemical Spray "Coca-Test"	0%	NA	0%	NA
BARRINGER SABRE 2000	89%	18%	8%	2%
BARRINGER, IONSCAN MODEL 400B	94%	1%	31%	0%
AS&E "Model 101"	38%	17%	3%	

The test results in Table 4.3-2 show that for both drug types the amount of drug used in the mailroom test had no significant impact on a SUT's ability to detect the drug. This conclusion is based upon the differences seen in each SUT's true positive results

which are not statistically significant over the range of drug amounts tested. For example, the results for the IonTrack Vapor Tracer show this SUT was able to detect cocaine approximately 90% of the time regardless of the amount of drug concealed. This is explained by the fact that the trace detection systems were detecting minute amounts of drug residues on the outside of the package, which were not directly correlated to the larger quantity of drugs within the package.

Table 4.3-2: Marijuana & Cocaine, True Positives by Drug Amount

SUT	TP, Marijuana			TP, Cocaine		
Drug Amount >	0.1g	0.5g	1.0g	0.1g	0.5g	1.0g
IonTrack Itemiser	0%	2%	0%	100%	100%	98%
IonTrack VaporTracer	17%	29%	22%	94%	87%	92%
Mistral Cocoa-Test	NA	NA	NA	0%	0%	0%
Mistral CannabisSpray	0%	19%	0%	NA	NA	NA
Barringer Sabre	6%	24%	17%	91%	90%	83%
Barringer IonScan	0%	2%	0%	92%	95%	94%
AS&E 101Van	11%	20%	17%	33%	37%	46%
Max number of items	18	42	18	49	105	49

The test results shown in Tables 4.3-3 and 4.3-4 show that for both drug types the type of package had no significant impact on a SUT's ability to detect the drug. Table 4.3-3 shows that all SUTs had difficulty detecting marijuana regardless of package type. Table 4.3-4 shows that all the trace detection SUTs, except for the Mistral Cocoa-Test, were successful in finding cocaine no matter the package type.

Table 4.3-3: Marijuana, True Positives by Package Type

	Package Type					
Marijuana	#10 business	#6 Standard	magazine	small box	medium box	padded bag
IonTrack Itemiser	0%	0%	0%	8%	0%	0%
IonTrack VaporTracer	25%	8%	0%	0%	33%	46%
Mistral Cocoa-Test	NA	NA	NA	NA	NA	NA
Mistral CannabisSpray	0%	0%	0%	25%	17%	4%
Barringer Sabre	17%	8%	17%	25%	50%	4%
Barringer IonScan	0%	0%	0%	8%	0%	0%
AS&E 101Van	42%	25%	17%	8%	17%	4%
Max number of items	12	12	6	12	12	24

Table 4.3-4: Cocaine, True Positives by Package Type

	Package Type					
Cocaine	#10 business	#6 Standard	magazine	small box	medium box	padded bag
IonTrack Itemiser	100%	100%	100%	100%	100%	98%
IonTrack VaporTracer	92%	89%	93%	79%	100%	88%
Mistral Cocoa-Test	0%	0%	0%	0%	0%	0%
Mistral CannabisSpray	NA	NA	NA	NA	NA	NA
Barringer Sabre	86%	89%	87%	82%	96%	91%
Barringer IonScan	94%	94%	80%	96%	100%	93%
AS&E 101Van	47%	47%	50%	29%	32%	32%
Max number of items	36	36	15	28	28	60

Table 4.3-5: Cocaine, True Positives by Concealment Method

Cocaine	Concealment Method				
	Under seam	in letter contents	in packing material	absorbed into paper	distribted pkg, bk, mag
IonTrack Itemiser	99%	100%	100%	100%	100%
IonTrack VaporTracer	89%	88%	94%	91%	93%
Mistral Cocoa-Test	0%	0%	0%	0%	0%
Mistral CannabisSpray	NA	NA	NA	NA	NA
Barringer Sabre	88%	92%	93%	82%	91%
Barringer IonScan	93%	96%	100%	100%	96%
AS&E 101Van	73%	63%	19%	6%	11%
Max number of items	70	24	16	35	58

The test results in Tables 4.3-5 and 4.3-6 show that for both drug types the concealment methods used in the Mailroom Scenario Test had no significant impact on the trace detection SUT's ability to detect the drug. No matter the concealment method, except for the Mistral spray, the trace detection systems were able to successfully detect cocaine. On the other hand, Table 4.3-6 shows that the trace systems had difficulty detecting marijuana regardless of the concealment method. Concealment method did have an effect on the bulk system (101 Van). If the drug was hidden under the seam of a mail item or in the contents of a simple letter the X-ray system had a better chance of detecting the drug. In these situations the drug is concentrated in a small area relative to the item it is hidden in. Thus, the bulk system can more easily detect it.

Table 4.3-6: Marijuana, True Positives by Concealment Method

Marijuana	Concealment Method				
	Under seam	in letter contents	in packing material	absorbed into paper	distribted pkg, bk, mag
IonTrack Itemiser	3%	0%	0%	NA	0%
IonTrack VaporTracer	26%	17%	25%	NA	26%
Mistral Cocoa-Test	NA	NA	NA	NA	NA
Mistral CannabisSpray	9%	0%	0%	NA	14%
Barringer Sabre	23%	8%	25%	NA	13%
Barringer IonScan	3%	0%	0%	NA	0%
AS&E 101Van	26%	25%	8%	NA	0%
Max number of items	35	12	8	0	23

Table 4.3-7: Marijuana, False Alarms by Package Type

Marijuana	Package Type					
	#10 business	#6 Standard	magazine	small box	medium box	padded bag
IonTrack Itemiser	0%	0%	0%	0%	0%	0%
IonTrack VaporTracer	2%	4%	0%	9%	5%	12%
Mistral Cocoa-Test	NA	NA	NA	NA	NA	NA
Mistral CannabisSpray	0%	0%	0%	3%	0%	1%
Barringer Sabre	0%	0%	10%	5%	0%	1%
Barringer IonScan	6%	2%	0%	18%	7%	5%
AS&E 101Van	NA	NA	NA	NA	NA	NA
Max number of items	51	51	20	44	44	85

The test results in Tables 4.3-7 and 4.3-8 show that the type of package used in the mailroom test had no significant impact on the false alarm rates of the SUTs. For example, the cocaine results (Table 4.3-8) show that, for any particular SUT, there was no statistical difference in false alarm rates regardless of the package type being examined. Also, Table 4.3-7 shows all the SUTs had relatively low marijuana false alarm rates

Table 4.3-8: Cocaine, False Alarms by Package Type

Cocaine	Package Type					
	#10 business	#6 Standard	magazine	small box	medium box	padded bag
IonTrack Itemiser	56%	30%	82%	54%	82%	31%
IonTrack VaporTracer	4%	7%	0%	7%	11%	12%
Mistral Cocoa-Test	NA	NA	NA	NA	NA	NA
Mistral CannabisSpray	0%	0%	0%	5%	0%	2%
Barringer Sabre	4%	4%	20%	11%	7%	10%
Barringer IonScan	15%	26%	9%	50%	50%	24%
AS&E 101Van	NA	NA	NA	NA	NA	NA
Max number of items	27	27	11	28	28	49

no matter the package type. We note that several numbers in Table 4.3-7 are relatively large (9%, 12%, and 18%). These numbers however must be considered within the context of the number of items tested which helps define the statistical significance of the data. At the 95% confidence level the measured Pd and the number of trials influence the size of error bars around a result. Figure 4.3-1 shows the change in error bar size that can be expected around a result with respect to the number of trials that produced the result. The plot shows error bar sizes for several values of confidence levels. Considering the maximum number of items tested (20 – 85) that created the results shown in Table 4.3-7, for a 95% confidence level the error bar size would fall between +/-0.17 and +/-0.07 (17% & 7%) of the measured data point. If this +/-17 to +/-7% error is added/subtracted to the false alarm rates shown in Table 4.3-7, then it can be seen that there is no statistical difference between the numbers. This same argument can be applied to all the tables of this section and should be considered when evaluating the results shown.

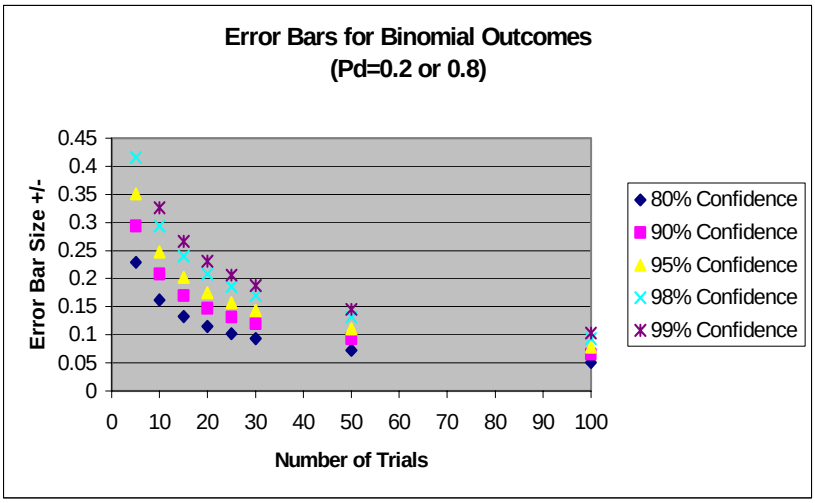


Figure 4.3-1: Confidence intervals for a measured Pd as a function of certainty, number of trials, and the value of Pd.

4.4 LESSONS LEARNED

For the Mailroom Scenario testing phase of the overall Mailroom Scenario Evaluation, there are multiple points to be addressed as lessons learned. The OMDL and mailroom testing showed that trace detection systems are sensitive to very small drug particles. This high sensitivity can be both a blessing and a curse. High sensitivity will allow for very small drug amounts to be found within mail items but can also lead to "false alarms" from cross contamination. When using trace detection technology one must be very aware of an instruments "alarm setting" and where this setting will place the system's performance.

Due to a miscalculation in the number of items to be examined, two instruments were left with an insufficient supply of consumables to complete the test. The time to replenish these supplies, despite the best efforts of the manufacturer's representative and UPS, forced these SUTs to be taken out of service until replacements arrived. The Barringer SABRE 2000 came back online after missing 12 items while the Mistral Cannabispray missed examining the last 62 items. A supply of consumables to cover in the order of twice the anticipated exam items is recommended for future tests of this type.

The path from SUT to SUT for the examined items was linear, the progression of items through the simulated mailroom was only as quick as the most time consuming SUT. A more parallel routing of the items should be considered to allow for out-of-service equipment or disproportional cycle times.

Use of electronic data entry at the SUT workstations could help alleviate most of the transcribing from readout to paper to spreadsheet to database, both saving time and reducing errors. While the test plan called for electronic data submission and provided data entry spreadsheets for all of the test phases for each of the anticipated SUTs, no

source for the computer resources necessary was designated. An appointed party to supply the computers and associated hardware should accompany the specification of electronic data recording in future test plans.

Assignment of personnel for test purposes should be construed to preclude, not add on to, other current duties. SUT operator staffing and continuity was compromised on occasion by loss of personnel to other more pressing obligations. At various times during this and other test phases personnel trained as SUT operators were committed to perform duties outside the scope of the test. This could be mitigated in coming tests with additional personnel committed to testing, more cross training of SUT operators, covering the duties of test participant with non-test obligated personnel, etc.

5 CONCLUSIONS

The Mailroom Evaluation was a large effort. The evaluation of the SUTs was actually a progression of tests culminating with the Mailroom Scenario Test. This progression of tests was established so that the results of the Mailroom Scenario Test could be validated and its results extrapolated to other drug types not used in the actual evaluation. The Mailroom Evaluation was also conducted to help determine if the SUTs, or systems similar to them, could assist in the detection of drugs in a real mailroom. The tests and the order in which they were conducted were: a test of the SUTs minimum detection limits for a variety of the drugs, a U.S. Postal Service (USPS) contamination test, a target presentation order test, and finally the simulated mailroom test. Conclusions drawn from the results of these tests are provided here.

1. The Ion Mobility Spectrometers (IMS) in general had high performance (greater than 89% Pd) for cocaine detection.
2. Two of the IMS systems had fair (24% and 18% Pd) performance for marijuana detection.
3. The spray technologies do not perform well for the concealment conditions and quantities investigated.
4. The bulk detection (x ray) system can see small objects in individual and simple mail when hidden in the seams or in the contents, when the drugs are kept in a concentrated form.
5. Items mailed through the USPS system do not pick up any substantial amounts of drug contamination as the control group false alarm rates were not statistical different than the mailed items. The false alarms seen were more likely an indication of the SUTs' own false alarm rates.
6. The false alarm rates seen in the Mailroom Scenario were the result of "spiked" mail contaminating "clean" mail during the testing.
7. False alarms and the detection rate were lower for marijuana, in the trace detection systems, than they were for cocaine.
8. Minimum sensitivity test results (see OMDL test results Table 2.3-1) showed that the overall sensitivity of the IMS trace systems tested ranged from 0.01 to 150 nanograms which indicates all these instruments are very sensitive.
9. Extrapolation of OMDL tests: Detection of methamphetamine and ecstasy will be similar to the detection performance of cocaine, if they are in powder form. Heroine detection may be slightly worse in performance due to less sensitivity in the SUT and the detection of LSD will be more like that of marijuana. If these drugs are in pill or

container form instead of a powder, or in an absorbed form, then the performance will be more like the marijuana detection, because the sample will be harder to get into the SUT.

In the first conclusion, we note that all of the Ion Mobility Spectrometer (IMS) systems demonstrated a high level of performance (greater than 89% probability of detection) for cocaine (see overall test results in Table 4.3-1). The desktop units performed somewhat better than the handheld units. However, they had significantly higher false alarm rates. We believe the higher false alarm rates seen in the desktop systems were due primarily to the sensitivity settings that were used during our tests. The basis for this conclusion is the tradeoff in probability of detection (Pd) versus probability of false alarm (Pfa) provided by a system's receiver operating characteristic (ROC). An example of a receiver operating characteristic, a plot of Pd versus Pfa, is shown in Figure 5-1. While a given system's ROC is unique and varies to some degree from this generic example, it can be seen that, in general, adjusting a system to provide higher detection sensitivity will result in an increase in false alarm rate. Therefore, we would expect the desktop systems' false alarm rates to drop, and be similar to that of the handheld units, if their sensitivities were correspondingly reduced.

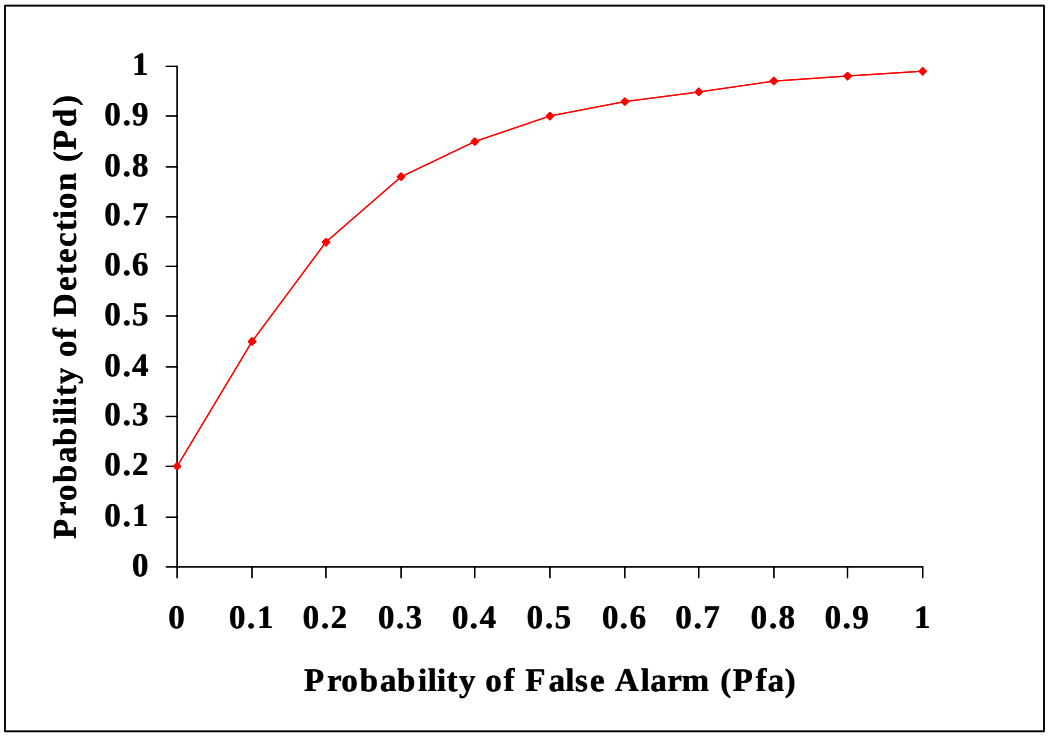


Figure 5-1: Generic Receiver Operating Characteristic (ROC) Example

False alarm rates in the mailroom scenario were higher than the rates seen in the USPS testing. The false alarm rates seen in the Mailroom Scenario Test were probably the result of "spiked" mail contaminating "clean" mail during the testing. This is supported by two facts. One, the test team experienced problems in the beginning of the testing while establishing methods to keep contamination of the work areas to a minimum. In the start of the Mailroom Scenario test, workspaces and instruments were

giving positive indications after a "spiked" piece of mail was examined at the work area. Two, the Pfa for the USPS test was low and then increased during the mailroom test. We believe that systems were being properly recovered/cleared, and, therefore, this was not a cause for the false alarm rates.

Conclusion number seven states false alarms and detection rates were lower for marijuana, in the trace detection systems, than they were for cocaine. This indicates, for this drug, if the thresholds were lowered we might see higher performance but also an increase in false alarms. The difference in the physical properties of the two drugs may also have contributed to the difference in their detection and false alarm rates. Powders like cocaine, with very small particle size and relatively sticky particles, are relatively easy to get onto swabs and into the trace detection systems. Marijuana is a leafy product whose signature is not detectable unless you get a portion of the leaf into the system. We believe the marijuana particles were not as easily brought into the trace systems as the very fine cocaine powder.

The OMDL testing was done to enhance extrapolation of test results on cocaine and marijuana from the Mailroom Scenario test to the other drug types specified for this OMDL test. The operational detection limit test results reported include cocaine, marijuana, heroin, Methamphetamine, LSD, and Ecstasy (MDMA). Using the results from the OMDL tests in conjunction with results from the other mailroom tests for cocaine and marijuana we conclude that the detection of methamphetamine and ecstasy will be similar to the detection performance of cocaine, if they are in powder form. This is based on the concept that the fine powder and the sticky particle behavior of these powders will be similar to the cocaine. We also base this on the concept that the major difference between the cocaine testing and the marijuana testing is the ability to get the sample into the system, not the OMDL differences observed. Heroine and LSD detection may be slightly worse in performance due to less sensitivity of the SUT. If these drugs are in pill or container form instead or a powder or absorbed form then the performance will be more like the marijuana detection as the sample will be harder to get into the SUT.

6 IMPLICATIONS OF TEST RESULTS ON THE USE OF THESE TECHNOLOGIES IN AN OPERATIONAL ENVIRONMENT

Which technology is best for prison mailroom drug detection? In order to judge the ability of these technologies to improve existing prison mailroom drug screening, two major criteria need to be addressed:

1. Will the technology increase the mailroom staff's ability to find concealed drugs? At the core of the typical prison mailroom drug screening process is the manual inspection; mail items are opened and methodically given a visual and tactile examination. Thus, to enhance the existing process, a drug detection system will need to provide a capability that is superior to that of the human senses.

2. How will use of the technology impact personnel resources? A large volume of mail must be inspected each day (typically, this quantity is in the thousands).

Therefore, the implementation of the technology and its degree of automation become highly important.

Focusing on these criteria, evaluation results for each of the following technologies are discussed below, along with subjective impressions on their ease-of-use. (Although a total of six systems were tested in this evaluation, four of the systems are of the same technology category and were found to perform similarly. It is useful to note that the technologies detect drugs in fundamentally different ways. The X ray system was used to "see" the actual drugs deposited inside mail items, while the other systems were used to detect drug residues unintentionally transferred to the outside of items by the "smugglers.")

- X ray
- Chemical Reagent Spray
- Ion Mobility Spectrometry

X ray- Despite the relatively small quantities (0.1 to 1 gram) used in these tests, the X ray instrument performed moderately well for cocaine when the drug target was concentrated (Tables 4.3-2, 4.3-4 and 4.3-5), but became ineffective when the target was spread out or absorbed into the paper (Table 4.3-5). In a number of the tests for marijuana detection, which was more difficult than cocaine detection for all of the instruments, the X ray performed roughly on par with the best of the other instruments (Tables 4.3-2, 4.3-3 and 4.3-6). As with cocaine, however, the X ray performance was greatly reduced when the substance was spread out (Table 4.3-5). How well does the X ray technology address the above criteria for enhancing mailroom drug detection? In a scenario where the mail cannot be opened, i.e., where non-intrusiveness is desired, the X ray demonstrated that it could provide an improvement over the human senses. However, since the prison mailroom rules allow the mail to be opened and manually inspected, this is of no particular advantage. Though not highly automated, the X ray instrument has some degree of automation in that it has a conveyor belt for moving items into and out of the viewing chamber. It also has an ability to help the operator spot suspicious items, based on atomic structure. Still, the operator must observe mail items one by one.

Chemical Spray- This technology probably has a niche as a low-cost means for occasional drug detection where extreme sensitivity is not required. In our mailroom scenario evaluation, drug concealment was done in a manner that emulated that of a fairly sophisticated smuggler. For the resulting microscopic residues transferred to the outside of mail items, the chemical spray technology was found to be inferior to ion mobility spectrometry in providing an improvement over the human senses. The chemical spray systems were also the most cumbersome to use, and most likely to impact personnel resources, if used on a regular basis. This judgment is based on the following. Whereas an item is tested with an ion mobility system by swabbing with a sample "trap" and inserting it into the instrument for simultaneous detection and identification of all targeted drugs, the chemical spray system requires that a drug-specific paper be selected, wiped across the item, and then sprayed with a drug-specific aerosol. Testing for the presence of several different drugs requires this process be repeated.

Ion Mobility Spectrometry (IMS)- Of the systems evaluated, the ion mobility spectrometry (IMS) instruments demonstrated a superior capability for detecting microscopic traces of drug residue, with typical probabilities of detection of 90% for cocaine (refer to the overall performance results shown in Table 6-1). The major advantage of adding an IMS instrument to the mailroom's "tools" is seen in its potential for alerting inspectors to the presence of drugs that their manual inspection could miss – extremely small quantities, spread out powders, absorbed liquids, etc. And, it is relatively easy to use; just wipe a surface with a sampling trap (a small piece of porous paper) and insert the trap into the instrument. Within a few seconds the instrument displays the results. As with the other technologies, the major problem lies in doing this for large numbers of items each day. Based on the results of this evaluation and the criteria presented at the beginning of this section, IMS is judged to be the most promising technology to improve prison mailroom drug screening. If initial procurement, and estimated maintenance and consumables costs are also considered, the IMS instruments maintain their advantage over the other technologies. Of the four IMS instruments tested, there is no clear-cut winner. Table 6-1 shows the overall performance of all systems tested. First note that both the Barringer and Ion Track handheld units demonstrated almost identical performance for probabilities of detection and false alarm. Observing the corresponding data for the portable/desktop units, we see higher detection probabilities accompanied by extremely high false alarm rates. The generic receiver operating characteristic, illustrated in Figure 6-1, helps to understand the probable reason for this result. Though the graph shown in the figure is not derived from actual measured data from the systems we tested, it shows typically what happens to false alarm rates as an instrument's sensitivity is increased – the false alarm rate can increase dramatically as the detection probability is increased to 100%. Based on this rationale, we would expect all the IMS systems would exhibit similar performance with equivalent sensitivity settings.

Table 6-1: Mailroom Scenario Evaluation Overall Performance

		Cocaine		Marijuana	
System	**Category**	**P Detection**	**P False Alarm**	**P Detection**	**P False Alarm**
Ion Track ITEMISER	**IMS Portable**	**100%**	**50%**	**1%**	**0%**
Barringer IONSCAN 400B	**IMS Portable**	**94%**	**31%**	**1%**	**0%**
Ion Track VAPORTRACER 2	**IMS Handheld**	**90%**	**8%**	**24%**	**6%**
Barringer SABRE 2000	**IMS Handheld**	**89%**	**8%**	**18%**	**2%**
AS&E MODEL 101	**Dual-Mode X Ray**	**38%**	**3%**	**17%**	**3%**
Mistral Security CANNIBISPRAY	**Aerosol Reagent**	**NA**	**NA**	**10%**	**1%**
Mistral Security COCA-TEST	**Aerosol Reagent**	**0%**	**0%**	**NA**	**NA**

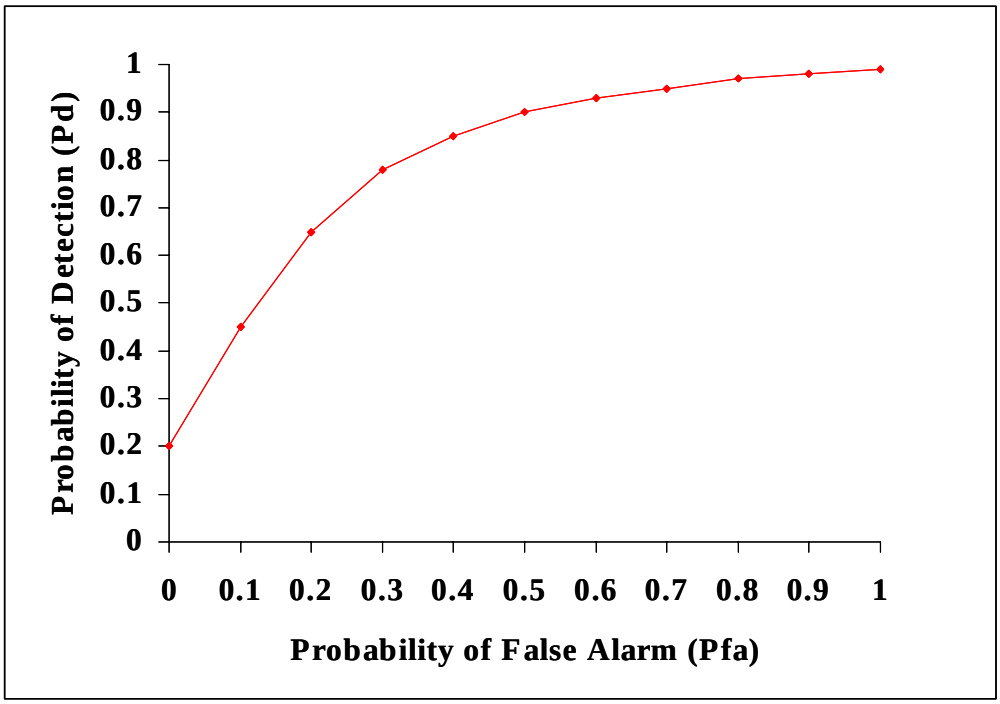


Figure 6-1: Generic Receiver Operating Characteristic (ROC) Example

Limitations- The most significant shortfalls of the IMS technology (as well as the other technologies evaluated) for the mail inspection application are:

1. Inefficiency, i.e., the time and effort required for inspecting large numbers of items, one at a time.
2. Reduced effectiveness in the detection of marijuana.

These shortfalls are addressed in the following.

Inefficiency- This evaluation focused on the ability of a technology to detect the presence of concealed drugs. Screening methodologies for large volumes of mail were not devised or studied, nor were the speed and efficiency of the technologies evaluated. In the case of the IMS instruments, it took approximately 20 seconds to inspect each item. During a routine day, a mailroom may process several thousand items. It would take over 16 hours to process 3000 items at 20 seconds each. Clearly, existing staff could not accommodate this additional level of effort. Hypothetically, the instrument could potentially be used to an advantage in more efficient ways, such as, one (or a combination) of the following:

- Inspect suspicious mail items.
- Inspect the mail of all inmates that have received drugs in the past.
- Inspect the mail of inmates incarcerated for drug law-related violations.
- Inspect randomly.

- Sample multiple mail items (e.g., 50 at a time) prior to inserting the sample into the instrument. This would allow 3000 items to be inspected in approximately one fifth the time required for inspecting individually, i.e., 3 hours. (It was not possible to test this hypothesis during this evaluation due to funding constraints.)

Reduced effectiveness for detecting marijuana- Marijuana, typically found in clumps of dried, crushed leaves, is more difficult to detect than powdered cocaine. This is because it is less likely that fine particles will separate and be collected in the sampling trap. Although the IMS instruments were not as effective in detecting marijuana when compared to detecting cocaine, they still offer a significant advantage over the human senses alone.

Additional research needed- This evaluation has significantly improved our understanding of how well these technologies can help us detect drugs in the mail. The major perceived shortfall of the IMS instrument is in the inefficiency of the sampling methods when applied to inspecting large numbers of items. Potential approaches to mitigating this limitation are noted above (sampling suspicious mail, random sampling, batch sampling, etc.). At this juncture, it is recommended that these approaches be evaluated either in a laboratory environment or in an operational evaluation at a prison or jail. Both venues have advantages. In a lab environment, it would be easier to employ actual drugs (or simulants) and control statistical relevance of data. However, if this next phase of evaluation were performed in a real-world prison or jail environment, an understanding could be gained on issues, such as, impact on performance of existing duties, staff acceptance, and training and maintenance requirements. The most advantageous approach would be to perform a brief scenario evaluation to determine the feasibility of the last hypothesis (above), followed by an operational evaluation using all approaches.

Looking further out into the future, research into the automation of the IMS instruments, combinations of instruments, and new technologies may provide the more efficient systems we need to enhance prison mailroom drug detection with minimal impact on staff.

Mailroom Scenario Evaluation Plan

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Report submitted 7/12/2001
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To: Duane Blackburn DoD/CDTDPO and NIJ Program Manager
And Stacy Wright Director TMEC

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MAILROOM SCENARIO
EVALUATION PLAN

1 OVERVIEW

The processing of mail at penitentiary mailrooms is a detailed, labor-intensive operation. In addition to routine inspection, sorting, and routing, the mail is screened for concealed drugs. Virtually every item of mail receives a manual inspection. The National Institute of Justice (NIJ) is sponsoring this project with the goal of improving the efficiency and effectiveness of the drug screening process for the Bureau of Prisons' (BOP) federal penitentiary mailrooms. The primary focus is to identify and evaluate drug detection equipment and technologies. During FY00, mailroom operations were studied to determine areas where drug detection devices and equipment could improve existing processes. A market survey was performed to identify applicable technologies and commercially available equipment. The test plan described herein is aimed at determining if certain technologies can aid in the detection of drugs in these mailrooms. The Thunder Mountain Evaluation Center [TMEC] evaluation is designed to determine minimum detection levels and the performance of systems within a mailroom scenario. This plan develops detailed test protocols for preparation and processing of both clean and spiked mail, creating a simulated mailroom environment and the performance of the testing. The subjects covered in this plan are organized according to the following test phases:

1. Calibration of systems and verification of calibration
2. Safe handling procedures
3. System detection limits
4. Test space contamination level
5. U.S. Postal Service contamination level
6. Target presentation order
7. Mailroom simulation

The test is broken into several phases. The first phase concerns system quality assurance. The second phase covers safe drug handling procedures and target material preparation. The third phase is designed to measure the minimum detection limits for a variety of the drugs. The drugs being investigated in this phase are:

1. Marijuana
2. Cocaine
3. Heroin
4. Methamphetamine
5. Ecstasy
6. LSD

Because several of these items are hazardous to handle or easily degrade over time we will only perform the mailroom scenario phase with marijuana and cocaine. Analysis of the detection limits experiment from the third test phase combined with analysis of other experiments will provide extrapolations as to the various technologies' effectiveness for detection of other drugs. The fourth phase will insure a less-than-detectable amount of background contamination in the test area.

The fifth phase of testing is planned to measure the contamination of mail due to handling within the U.S. Mail system. This phase is relevant to trace detection technologies that are sensitive to minute amounts of drugs. It is possible that 'innocent' mail may be contaminated because of contact with drug-containing mail or mail handling and thus may cause false alarms. We propose to conduct a mailing of a number of items to TMEC and to sample them with the trace detection systems before and after mailing to determine if the systems detect any contamination. The phase of the testing, called Target Presentation Order, addresses the issue of the volatility of the target items and the affects from multiple systems sequentially examining the same target items. This effort will establish the affect that the order of presentation of target items to the trace detection systems has on the detection of the targets. The results will establish the level of degradation of target strength due to system presentation sequence and may be used to modify the flow of targets for the actual mailroom scenario tests. The final phase of testing is to conduct a mailroom scenario test. Here we have identified a number of potential variables that may affect detection. For this test an item is defined as an individually mailed object requiring its own affixed postage. Each item is comprised of one setting of each of the following variables:

1. Package Type
2. Package Sub-type
3. Contents Type
4. Target Type
5. Target Form
6. Target Amount
7. Concealment Method

We have postulated 3 package types each with 2 sub types. There is a list of 11 contents for a package. There are 2 target types [cocaine and marijuana], 2 target forms, 3 target amounts and 5 concealment methods. Not all of these variables can exist in all combinations. For instance the content videocassette cannot fit in the package small envelope. Once we eliminate these types of cases we have a large number of potential cases [1053]. We have lowered the number of trials to 373 by selectively choosing trials in order to balance the variables. This has been done in a way to insure that we can investigate the effects of each major variable on probability of detection [Pd] and probability of false alarm [Pfa].

The following systems and/or technologies will be evaluated during this test. These systems were selected as representative of the classes of technology that have been used in previous evaluations for different drug smuggling scenarios.

Trace Detection-

- Desktop Ion Mobility Spectrometry (IMS)
  - Barringer "IONSCAN Model 400B"
  - Ion Track "ITEMIZER"
- Handheld Ion Mobility Spectrometry (IMS)
  - Barringer "SABRE 2000"
  - Ion Track "VaporTracer"
- Chemical Spray
  - Mistral Security "Cannibispray", & "Coca-Test"

Bulk Detection-

- X-ray Transmission/Backscatter Scan
  - AS&E "Model 66Z"
- X-ray Computed Tomography (CT) Scan
  - InVision "Model CTX2500"

2 INTRODUCTION

2.1 PURPOSE

This plan sets forth the data requirements and the evaluation methods to be employed in order to allow for satisfactory assessment of the performance of various instrumentation systems and technologies as to their capability to improve the drug detection rate of penitentiary personnel while conducting their mailroom drug screening duties.

2.2 BACKGROUND

This evaluation is being conducted in support of an extensive study underway to investigate technologies that offer the means to improve the efficiency and effectiveness of drug inspection processes at federal penitentiaries. Mailroom personnel activities have been observed and analyzed throughout the entire process of inspection and distribution of incoming mail, starting with receipt of the mail at the post office and concluding with the placement of mail in the inmates' cellblock mailboxes. Using those observations to depict the scenario to be appraised, the goal of this evaluation is to determine the utility of relevant technologies and equipment in augmenting the human inspector's ability to detect drugs entering prison facilities via the postal system.

2.3 SCOPE

This plan is designed to provide overall and detailed direction and guidance for testing methodology and data collection in order to evaluate the performance of various instruments and technologies (described below), while simulating the mailroom environment referenced above. Of the three basic types of evaluation (technology, scenario, and operational)[1], this evaluation is best defined as a "limited scenario" evaluation. Testing will be conducted at the Thunder Mountain Evaluation Center

[1] From P.J. Phillips, A. Martin, C. Wilson, M. Przybocki, "Introduction to Evaluating Biometric Systems", IEEE Computer Magazine, February 2000.

(TMEC), Ft. Huachuca, AZ, using detection systems supplied to TMEC by the vendors. The following types of systems and technologies will be evaluated.

- Trace detection equipment
- Trace detection spray
- X-ray equipment
- Computerized Axial Tomography (CT) scan equipment (this equipment will require leasing from vendor along with funding for technical support)

2.4 OBJECTIVES

The chief objectives of the mailroom scenario test and evaluation are to:

- Simulate the penitentiary mailroom environment and processes.
- Simulate receipt of a relatively few mail items containing drugs within an overall larger quantity of "clean" mail.
- Determine the performance of each drug detection instrument or technology as to its efficiency and efficacy in detecting mail items containing drugs.

As a prerequisite to the above listed main objectives, several secondary objectives will be required in order to establish the influence that the methods and means of target movement and presentation as well as specific system capabilities will have on any reported test results. These secondary objectives will include items such as:

- Quantify the test facility (simulated mailroom) background contamination level.
- Document the detection limit and calibration status of systems/technologies being tested.
- Determine the target packaging and exposure methods.

3 SYSTEMS TO BE EVALUATED

The following systems and/or technologies will be evaluated during this test. Future reference within this document to "systems under test" (SUTs) should be understood to include all items from this list without regards to the degree of hardware employed. Therefore, the chemical spray will be considered as a SUT for the Mailroom Scenario Evaluation. These SUTs were selected as representative of the classes of technology that have been used in previous evaluations for different drug smuggling scenarios. Refer to Section 5 for specific details as to which phases of this evaluation that each listed system will be a participant in.

Trace Detection-

- Desktop Ion Mobility Spectrometry (IMS)
  - Barringer "IONSCAN Model 400B"
  - Ion Track "ITEMIZER"
- Handheld Ion Mobility Spectrometry (IMS)

- Barringer “SABRE 2000”
- Ion Track “VaporTracer”

- Chemical Spray
  - Mistral Security “Cannibispray” and “Coca-Test

Bulk Detection-

- X-ray Transmission/Backscatter Scan
  - AS&E ”Model 66Z”
- X-ray Computed Tomography (CT) Scan
  - InVision “Model CTX2500”

The following descriptions for the detection systems (SUTs) to be employed in the Mailroom Scenario Evaluation are in large part direct excerpts or paraphrases of the respective manufacturer’s literature. While references to the applicable documents are provided herein, due to the volume of this material and its often-proprietary nature, rather than include them as attachments, the reader is directed to contact the manufacturers for access to their available product information.

3.1 TRACE DETECTION

Trace detection can be described as direct chemical identification of particles or vapors given off by a substance. It is based on the physical transport of these particles or vapors for sample analysis by methods such as gas chromatography, chemical luminescence, or ion mobility spectrometry. This detection technique commonly exhibits strength in identifying the particular chemical substance but often lacks the ability to estimate the amount of chemical present.

3.1.1 DESKTOP IMS SUTs

These IMS units offer a somewhat portable method to examine items for drug contamination. They are designed to operate on the typical desk or table space found in offices or other work environments.

3.1.1.1 BARRINGER IONSCAN MODEL 400B

The quoted material in this section is derived from the “IONSCAN 400B Operator’s Manual” provided by Barringer Instruments, Inc. While that document references both explosives and narcotics as the target material of interest, it is the intent of the Mailroom Scenario Evaluation to utilize this SUT for the detection of the drugs as specified below.

“The IONSCAN Model 400B, shown in Figure 3.1.1.1-1, consists of the Detector and a Swab Sampler. A DC Remote Sampler is optional. The IONSCAN Model 400B is a reliable, highly sensitive instrument designed for detecting narcotics and explosives.”

Figure 3.1.1.1-1 Front view of IONSCAN 400B with swab sampler.

The following technical specifications for the IONSCAN 400B are excerpted from the "Operator's Manual" provided by Barringer Technologies, Inc.

Technical specifications for the IONSCAN Model 400B

Input [redacted]oltage	110/220 [redacted]C + 10%, 50/60 [redacted]z ([redacted]utoswitching)
Power [redacted]equirements - Cold / Warm	600 / 300 W
Warm up Time	15 minutes
Analysis Time	6.6 - 8 seconds (typical)
[redacted]arm Type	[redacted]udio and visual, display indicates substances found
False [redacted]arm [redacted]ate	Less than 1%
Programmable Channels	45
External [redacted]as Supply	[redacted]one required
[redacted]mensions	41 x 34 x 33 cm
Mass	23 kg
[redacted]perating Temperature [redacted]ange	0°C to 40°C, <95% relative humidity, non-condensing
Installation Category	II
Pollution [redacted]egree	2
Altitude	2000 m
[redacted]age	Indoor

Narcotic	Detection Limit
Cocaine	0.5 ng
Heroin	3.0 ng
Amphetamine	0.3 ng
Methylenedioxy Amphetamine (MDA)	0.3 ng
Methamphetamine	0.3 ng
Methylenedioxy Methamphetamine (MDMA)	0.3 ng
Methylenedioxy Ethylamphetamine (MDEA)	0.3 ng
THC	1.0 ng

3.1.1.2 ION TRACK ITEMIZER

The quoted material in this section is derived from the "ITEMISER User's Manual" provided by Ion Track Instruments, LLC. While that document references both explosives and drugs as the target material of interest, it is the intent of the Mailroom Scenario Evaluation to utilize this SUT for the detection of the drugs as below.

"The ITEMISER System is designed and manufactured by ITI. It employs a newly patented technology to detect and identify controlled drugs, explosives, and other illegal substances. This new technology, called Ion Trap Mobility Spectrometry (ITMS), increases efficiency and sensitivity over conventional IMS (Ion Mobility Spectrometry) systems by several orders of magnitude. The system can be used to check people, baggage, vehicles, money, drivers licenses, tickets, time cards, and workplaces for microscopic particles and vapors of controlled drugs or explosives. Figure 3.1.1.2-1 illustrates the system and identifies its major components."

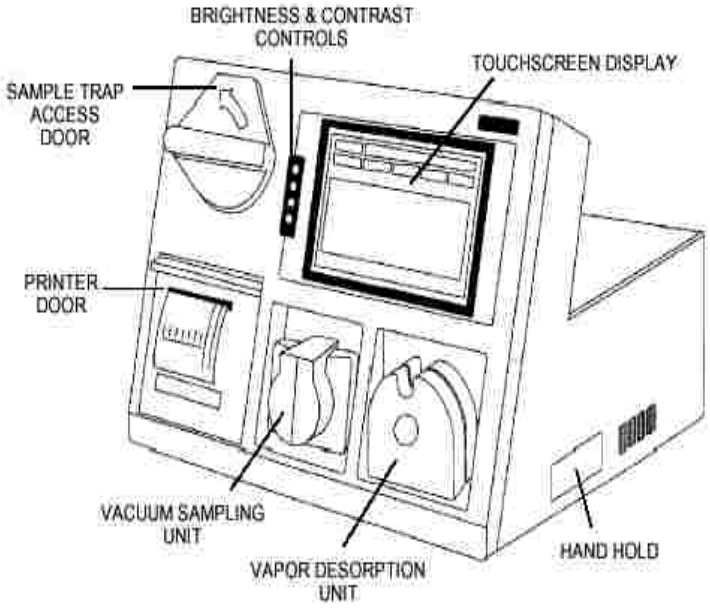

Figure 3.1.1.2-1 ITEMISER Front View Schematic.

The following technical specifications for the ITEMIZER are excerpted from the "User's Manual" provided by Ion Track Instruments, LLC.

Sensitivity: Better than 200 pg cocaine or RDX
Selectivity: <1% typical false positive rate on surface wipes
0.1% on air samples
Analysis Time: Variable from 4 to 10 seconds
Sample Acquisition: Surface wipe or air collection
Sample Flow: 1 liter/minute
Warm Up Time: Allow 1 hour minimum for system to stabilize
Power: 110 Volt 60 Hz, 150 W
220 Volt 50 Hz, 150 W
Detection Mode: Controlled drugs: Positive Ion Mode
Explosives: Negative Ion Mode
Computer: Pentium CPU, 32MB RAM
Signal Processing: Variable integration time, 4-10 seconds Plasmagram component peak deconvolution
Recognition on multiple peaks and multiple controlled drugs and explosives
Output to bar graph display or time-of-flight "plasmagram" display
Substance Libraries: **Controlled Drug**s- the most commonly abused controlled drugs, including cocaine, heroin, THC, Methamphetamine, MDMA, Amphetamine, PCP, LSD, MDA, morphine, and others.
Explosives
High Explosives or Detonable Explosives- Trinitrotoluene (TNT), Nitro Esters (PETN, nitroglycerine, ethylene glycol dinitrate), Ammonium Nitrate (AM_N03), dinitrotoluene (DNT), trinitrophenylmethylnitramine (Tetryl), and Tricycloacetone Peroxide.
Plastic Explosives- RDX (C4), PETN, and HMX
Users can easily add other substances to the libraries.

3.1.2 HANDHELD IMS SUTs

This class of IMS units offers greater portability with typically less interruption to the flow of items or persons being examined. Usually they are operated by a single person and have a response time of a few seconds.

3.1.2.1 BARRINGER SABRE 2000

The quoted material in this section is derived from the "SABRE 2000 Operator's Manual" provided by Barringer Instruments, Inc. While that document references explosives, drugs, and "Chemical Warfare agents" as the target material of interest, it is the intent of the Mailroom Scenario Evaluation to utilize this SUT for the detection of the drugs as specified below.

"Barringer SABRE 2000 detectors are based on a technology called Ion Mobility Spectrometry (IMS). The SABRE 2000 is a powerful analytical tool that can detect and accurately identify trace residues of, and vapors emitted from, a wide variety of chemical substances. It has been optimized for the detection of illicit drugs, explosives and now Chemical Warfare (CW) agents. Identification of many substances by IMS is made possible by a few basic principles:

- Many chemical substances give off vapors or particles that are adsorbed by or cling to the surfaces of materials they come into contact with (clothing, luggage, skin, containers, paper, and so forth).
- These traces can be collected by wiping the surfaces.
- Even microscopic traces of such chemicals can be desorbed from these particles (turned into a vapor) by the application of heat. In addition, vapor samples from an enclosure containing drugs, explosives, or CW agents can be collected.
- These vaporized substances enter the IMS through a membrane which selectively allows the target substances to pass through.
- Some explosives substances do give off vapors which can be collected onto a specially treated adsorbing material which can then be released into the IMS.
- The drugs, explosives, or CW vapors are ionized (converted to electrically charged molecules).
- When these ions are allowed to "drift" within a controlled electric field, they move at different speeds, depending on their molecular size and structure. The characteristic speed at which an ion moves (the ion mobility) is a distinct "thumbprint" that identifies the original substance."

Figure 3.1.2.1-1 below depicts the SABRE 2000 with its accompanying base station.

Figure 3.1.2.1-1 SABRE 2000 with Base Station.

The following technical specifications for the SABRE 2000 are excerpted from the "Operator's Manual" provided by Barringer Technologies, Inc.

Technology Ion Mobility Spectrometry (IMS)
Sample collection Trace Particle and Vapor
Input Voltage for Base Station 12VDC, 110VAC / 220VAC, 50 - 60Hz (auto switching)
1.5 hour battery
Convenient quick-release Base Station that allows for continuous
charging of battery and full functionality of unit.
Power Requirements - Cold / Warm 60W / 30W
Warm up Time Less than 15 minutes
Analysis Time Less than 20 seconds
Alarm Type Audio and visual, display indicates substances found
False Alarm Rate Less than 1%
Programmable Channels 30
External Gas Supply None required
Dimensions 33 x 10.5 x 11.5cm, 13 x 4 x 4.5in
Mass 2.6kg, 5.8lb
Operating Temperature Range -10 o C to +45 o C, less than 99% relative humidity,
non-condensing
Explosives detected by SABRE 2000 *
RDX
PETN
SEMTEX
Nitroglycerin
TNT
Ammonium Nitrate
DNT
Tetryl
Narcotics detected by SABRE 2000 *
Cocaine
Heroin
Amphetamine
Methylenedioxy Amphetamine (MDA)
Methamphetamine

Methylenedioxy Methamphetamine (MDMA)
Methylenedioxy Ethylamphetamine (MDEA)
Tetrahydrocannabinol (THC)
Phencyclidine (PCP)

3.1.2.2 ION TRACK VAPORTRACER

The quoted material in this section is derived from the "VaporTracer User's Manual" provided by Ion Track Instruments, LLC. While that document references both explosives and drugs as the target material of interest, it is the intent of the Mailroom Scenario Evaluation to utilize this SUT for the detection of the drugs as specified below.

"The VaporTracer2 System is designed and manufactured by Ion Track Instruments, LLC (ITI). It employs a newly patented technology to detect and identify the vapors and particles from controlled drugs and explosives. This new technology, called Ion Trap Mobility Spectrometry (ITMS®), increases efficiency and sensitivity over conventional IMS (Ion Mobility Spectrometry) systems by several orders of magnitude. The system can be used to check people, baggage, vehicles, and cargo for microscopic particles and vapors of controlled drugs or explosives. Figure 3.1.2.2-1 illustrates the system and identifies its major components."

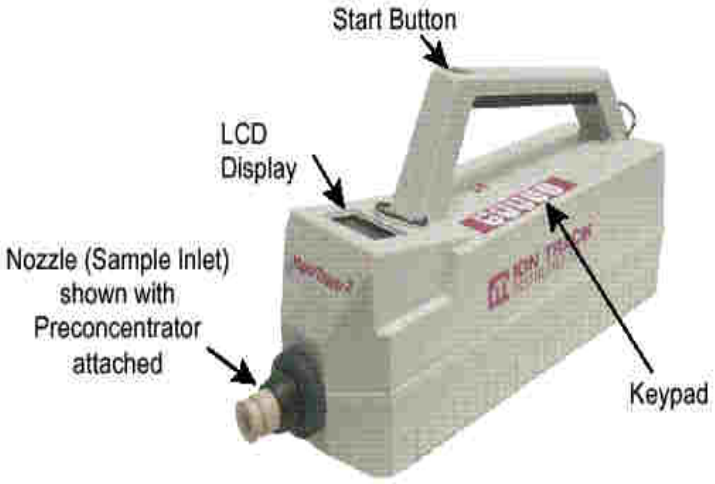

Figure 3.1.2.2-1 VaporTracer and its components.

The following technical specifications for the ITEMIZER are excerpted from the "User's Manual" provided by Ion Track Instruments, LLC.

Sensitivity:

Mass:	Cocaine < 30 picograms, RDX < 50 picograms, Heroin <80 picograms
Concentration:	Sub part per trillion screened vapor
Selectivity:	< 1% typical false positive rate
Analysis Time:	Variable from 2 seconds to infinity

Sample Acquisition:	Air collection for vapor, surface wipe for trace particles
Sample Flow:	4 liters/minute
Warm-up Time:	Allow 45 minutes minimum for system to stabilize
Power:	110/220 Volt 50/60 Hz, 30W (65W max during warm-up period), auto sensing 12 Volt DC (optional batteries)
Detection Mode:	
Narcotics Module:	Drugs; positive ion mode
Explosives Module:	Explosives; negative ion mode
Optional Laptop Computer:	Full specification provided at time of sale
Signal Processing:	Variable integration time Plasmagram component peak deconvolution Recognition on multiple peaks and multiple controlled drugs and explosives Output to bar graph display or time-of-flight "plasmagram" display

VaporTracer2 System Dimensions		
Height*:	8 inches	20.0 cm
Width:	5.5 inches	14.0 cm
Depth:	16 inches	40.0 cm
Weight:	9 lbs.	4.05 kg

3.1.3 CHEMICAL SPRAY

Chemical spray drug detection techniques commonly involve exposing a suspect surface or a collection sample obtained from some such surface to aerosol delivered reaction agents. Often a specially treated swab or sample collection paper is used. Typically a visual color change (similar to pH litmus testing) serves to identify the presence of a particular drug residue.

3.1.3.1 MISTRAL SECURITY – DRUG DETECTION SPRAY

The quoted material in this section is derived from the "Narcotic Detection & Identification Field Test Kits, Background and Direction for Use". This literature was provided electronically by Mistral Security, Inc. It is the intent of the Mailroom Scenario Evaluation to utilize this SUT for the detection of the drugs as specified below.

"Our family of drug detection, identification and forensic products provide law enforcement officers and investigators distinct advantages for field and laboratory use. As with all Mistral products, they are first and foremost non-toxic, non-carcinogenic and will not harm the environment. In addition, they insure a testing process which is convenient, fast and efficient. No glass ampoules, spatulas or waiting time required. Results appear in seconds. No

additional tools or equipment required. The identification/detection process requires no special training and testing can be performed "on the spot".

Cannabispray is an aerosol-based drug field test kit for the **detection** and **identification** of marijuana, hashish and related drugs. **Cannabispray** contains a patented, modified Fast Blue BB reagent. Product modifications have been incorporated to reduce the number of false positives, remove suspected carcinogenic elements and stabilize this well known reagent. Using our special collection paper, Model # 0530, simply wipe the suspected surface or touch the seized substance. Spray first with **Cannabispray #1** and then with **Cannabispray** #2. A reddish-purple color reaction on the collection paper indicates a positive reaction.

Coca-Test is an aerosol-based drug field test for the **detection** and **identification** of cocaine, crack and related drugs. **Coca-Test** contains a patented, modified Cobalt Thiocyanate (Scott) reagent. False positives, including lidocaine, are reduced. Using our special collection paper Model #0530, simply wipe the suspected surface or touch the seized substance and spray with **Coca-Tes**t. A turquoise color reaction on the collection paper indicates a positive reaction.

3.2 BULK DETECTION

Bulk detection techniques commonly operate by remotely sensing physical or chemical properties of an article being examined. The ratio of molecular densities within certain materials is a common example. Also geometric information such as size and shape are often employed for bulk detection systems. The sizes of the units employed for this evaluation allow transportation and/or operation via vehicles or in small rooms within buildings.

3.2.1 X-RAY TRANSMISSION/BACKSCATTER SCAN

This class of SUTs combines the effects of attenuation and scattering of x-ray level photons to produce results, typically in image form, based in the densities of the material scanned. Most often expertise of the operator is used to determine the presence of drugs based on interpreting a set of coded two-dimensional image displays.

3.2.1.1 AS&E MODEL 66Z

The quoted material in this section is derived from the “Model 66Z Technical Specifications Brochure” and the “Model 66Z Operator’s Manual” provided by American Science and Engineering, Inc. While those documents reference explosives, weapons, currency, agricultural products, and narcotics as the target materials of interest, it is the intent of the Mailroom Scenario Evaluation to utilize this SUT for the detection of the drugs as specified below.

“The MODEL 66Z’s slender profile and wheels allow it to be moved through standard doorways and to be conveniently relocated to security checkpoints for special events. AS&E’s MODEL 66Z for MailSearch and LobbySearch brings Z ® Backscatter imaging to mail-rooms, building lobbies and other vulnerable locations where bombs, weapons and drugs pose a real threat to government and business. The system can inspect small

packages, mail and hand-held baggage." Figure 3.2.1.1-1 provides an overall view of this unit.

Figure 3.2.1.1-1 Over view of Model 66Z with console and dual image monitors.

The following technical specifications for the Model 66Z are excerpted from a technical specifications brochure provided by AS&E, Inc.

Image Display System
Operator's console
Two high-resolution displays present separate Z ® Backscatter and Transmission images.
14-inch non-interlaced color monitors
640 x 480 pixels
8 MByte memory
256 density levels
User-friendly control panel.
System Performance
Resolution: 34 AWG tinned copper wire
Penetration: Equivalent to 19 mm (3/4") steel or equiv.
Complete coverage of objects in tunnel— no corner cutoff.
Detection Capability
Separate Backscatter display monitor clearly shows explosives, drugs, and plastics even when hidden in a complex X-ray background.
Detection Features
Zoom: 2x-4x magnification with joystick control to roam continuously through full field of view.
Reverse Video: Control to reverse polarity of white and black contrast.
Density Expand: Three controls for enhanced contrast of thin, medium or thick regions of interest.
System Options
Edge Enhancement: Sharpens and enhances thin wires often associated with bombs.
Colorized Images
Stainless Steel Extension Tray: 18", 36" or 72" lengths
Roller Transfer Tables: For entrance and exit conveyance
Printer
3.5" Floppy Disk Drive
Hard Disk
Remote Console
CD ROM Computer-Based Training
Operating Features
X-ray Source
140 Kev
Conveyor: Continuous operation in normal mode. Auto-return allows one-person operation.
Width 66 cm (26")
Height 85.1 cm (33.5")
Capacity 91 kg (200 lbs.)
Tunnel Opening
Length Unlimited
Width 66 cm (26")
Height 44 cm (17.3")
Throughput: Up to 1500 parcels per hour.
Mobility: Swivel castors allow convenient relocation of unit. Unit passes through doorways greater than 86 cm (34").
Overall Dimensions
Length 170 cm (67")
Width 84 cm (33")
Height 147 cm (58")
Weight ± 660 kg (1450 lbs.)
Environment
Temperature

Operating: 4° C to 40° C (40° F to 104° F)
Storage: -40° C to 60° C (-40° F to 140° F)
Humidity
10-95% relative humidity (non-condensing)
Power
1.8 kVA, 15A standard outlet
2.2 kVA, 20A with optional printer
120 VAC ± 10%, single phase
240 VAC ± 10%, single phase (option)
60 Hz/50 Hz
Health and Safety

Operator receives less than 5.*0*μ Gy/hr (0.5 mR/hr.) at 5 cm (2") from cabinet.
Complies fully with all applicable federal health and safety regulations: U.S. Bureau of Radiological Health Standards for Cabinet
X-ray Systems (21 CFR 1020.40); U.S. Federal Aviation Administration Use of
X-ray Systems (14 CFR 108.17 and 129.26).
0.*2*μ Gy (0.02 mR) per exposure (safe for all speeds of film).

3.2.2 X-RAY COMPUTED TOMOGRAPHY (CT) SCAN

SUTs utilizing computed tomography have the capability to greatly enhance the detection of drugs due to the ability of developing a three dimensional characterization of the scanned items from discrete two-dimensional cross-sections. This additional geometric portrayal is in addition to the material identification afforded by the x-ray attenuation/scattering function.

3.2.2.1 INVISION MODEL CTX2500

The quoted material in this section is derived from the "CTX2500 User's Guide" provided by InVision Technologies, Inc. While that document references only explosives as the target material of interest, it is the intent of the Mailroom Scenario Evaluation to utilize this SUT for the detection of the drugs as specified below.

"The InVision Technologies CTX 2500 is an x-ray based scanner that automatically screens baggage and parcels for explosive material, using technology derived from medical computed tomography (CT). The CTX uses a single x-ray device to produce both overall images and cross-sectional "slices." The operator controls the CTX from a workstation that features an ergonomically designed console and two computer monitors and with the hand-held Baggage Control Unit connected directly to the scanner. Refer to Figure 3.2.2.1-1 for typical operational console and display configuration. The CTX 2500 displays and automatically analyzes two kinds of images: scan projection (SP) and computed tomographic (CT). The CTX 2500's SP images are produced using the twisted scan projection (TSP) technique. The SP image (on the left-hand monitor) provides an overall x-ray view of a bag and its contents and shows the locations of the CT slices. The CT images (on the right-hand monitor) are cross-sectional slices that reveal objects (or parts of objects) residing only in particular slice planes. CT images eliminate the clutter inherent to SP images, and provide information for detailed analysis to determine the presence, location, and configuration of explosive devices and their components."

Figure 3.2.2.1-1 CTX2500 Operator's console and image monitors.

The following technical specifications for the CTX2500 are excerpted from internet materials provided by InVision Technologies, Inc.

SCANNER
Length 96 in. 2,443 mm
Width 75 in. 1,905 mm
Height 80.5 in. 2,045 mm
Weight 7,350 lbs. 3,334 kg
Footprint 43 sq ft. 4 sq m
Conveyor Height (±.75") 29.25 in. 740 mm
Loading Velocity 1.48 ft./sec 0.45 m/sec
Unloading Velocity adjustable
Throughput* 128 bph (FAA-Cert. Testing)

WORKSTATION
Console
Weight 15.4 lbs. 6.9 kg
Length 17.75 in. 450.85 mm
Width 13.50 in. 342.90 mm
Height 2.75 in. 69.85 mm
Monitors 2 x 17 in.
Monitor Resolution 800 X 600, 0.28
Image Depth 128 level gray + colors
Image Quality (X-ray) up to 30 AWG wire
Meets ASTM 1620
SP Screen Image Resolution 576 X 410 pixels
CT Screen Image Resolution 512 X 512 pixels
Threat Coloring red
Detonator Coloring green
Metal Coloring blue
Shield Coloring yellow
Controls (images, system) hard, soft keys, trackball, and hand control unit
Cable Length (standard) 25 ft. 7.6 m
Printer color inkjet

LUGGAGE
Maximum Dimensions
Length Maximum 39 in. 1000 mm
Width 25 in. 635 mm
Height 20 in. 510 mm
Maximum Weight 110 lbs. 50 kg

ENVIRONMENT (Operating)
Voltage-Nominal 350-510 V, 3 phase, 3 W+PE
Frequency 50 - 60 Hz
Rating 12 kVA nominal maximum
Voltage Tolerance ± 5%
Circuit Breaker Rating 30 A
Temperature 10 - 35° C (50 - 95° F)
Humidity <60% non-condensing

ENVIRONMENT (Storage/Shipping)
Shipping Crates non-waterproof
Housing in dry/weather-proof building
(left in shipping crates
until installation.)
Humidity <80% non-condensing

X-RAY SYSTEM
Operating Range 80-200 KV, 1-20 mA
Sensitivity 16 bit
Detectors 480
Voltage Tolerance ± 5%
Cooling continuous, oil filled

* operational throughputs may vary

4 TEST SAMPLES AND CONCEALMENT METHODS

4.1 DRUGS

The following list includes the drugs of interest for this evaluation. Actual drugs will be used. However, only those that can be handled safely within the scope of this effort will be used. As applicable, each system or technology tested will be subjected to real drugs, in a variety of forms (solid, liquid, etc.). Marijuana and cocaine are the central drugs of interest for the mailroom scenario (probability of detection/probability of false alarm (Pd/Pfa)) portion of this test. The other drugs will be employed in the "determination of detection limit" phase of the test.

1. Marijuana
2. Cocaine
3. Heroin*
4. Methamphetamine*
5. Ecstasy*
6. LSD*

* Because of handling precautions and chemical properties these drugs are used withinthe Operational Minimum Detection Limits portion of this evaluation only.

4.2 DRUG CONCEALMENT

Actual drugs and reasonable concealment methods will be used wherever feasible. As applicable, each system tested will be subjected to real drugs, in a variety of forms (solid, absorbed liquid, etc.). The range of deception techniques used in this evaluation will include the following:

1. Hidden under envelope seams, labels, and stamps
2. Hidden with letter contents
3. Hidden in parcel packing materials
4. Absorbed into paper
5. Distributed/spread throughout package, book, or document

These methods are based upon the report "Penitentiary Mailroom Operations Study" (prepared for: National Institute of Justice by: DoD/Counterdrug Technology Development Program Office, submitted on September 7, 2000), where a federal facility mailroom's mail inspection procedures and handling techniques were witnessed and evaluated.

5 TEST SYNOPSIS, RESPONSIBILITY, COORDINATION, AND PROTOCOLS

5.1 TEST SYNOPSIS

For the primary test phase, the TMEC laboratory spaces will be designed and set up to simulate a prison mailroom environment with the addition of the drug detection systems and technologies discussed previously. Letters and packages to be processed within the

simulated mailroom will be assembled and held in separate areas adjacent to the simulated mailroom. Although the letters, parcels, and packages will be processed within the simulated mailroom at TMEC in a manner similar to that of penitentiary mailrooms, subjecting items to inspections by the various instrument systems and technologies will be the focus of the test. A detailed set of protocols for testing and for documenting results will be followed throughout the test. All records will follow a prescribed format and will be of an electronic form where possible. It is anticipated that multiple sources of digital imagery will be employed to document all phases of this test. Use of the customary TMEC laboratory and office facilities (hand tools, workspaces, telephones, photocopiers, etc.) not dedicated to the simulated mailroom will be afforded to all participants of the test. All time keeping devices used to record date and/or time for notes, data records, computer images, computer files, etc., will be synchronized at the outset of any TMEC testing to the local standard time (as determined by the Test Director) +/- one second. These devices will be maintained as such throughout the duration of the test. Any deviations will require completion of a "Test Incident Report" as per Section 5.4 of this plan.

5.2 TEST RESPONSIBILITIES

The Department of Defense/Counterdrug Technology Development Program Office (DoD/CTDPO) is responsible for overall test management under a grant from the National Institute of Justice. The TMEC is responsible to the DoD/CTDPO for a detailed test plan, the test implementation, the test data evaluation, and a test report. The TMEC Director will have overall responsibility for all phases of the test including day-to-day facility operations, modification of test procedures, scheduling of resources and products, conflict/contradiction resolution, release of results, etc. The responsibility for performing the various duties of the test's operations will be partitioned into three elements. All effort required for the contraband smuggling portion of the test (obtaining, processing, packaging, etc., as well as any documentation thereof) will be the responsibility of a group denoted as the Red Team. Any efforts necessary for the mailroom inspection portion of the test (mail handling, visual scrutiny, operation of the systems under test (SUTs) instrumentation, etc., as well as any documentation thereof) will be the responsibility of a group denoted as the Blue Team. The effort needed to develop this test plan, to insure the test protocols are adhered to by all test participants, and to assess the test's resultant data products (organizing, analyzing, interpreting, etc., as well as any documentation thereof) will be the responsibility of a group denoted as the Silver Team. It is the responsibility of the manufacturer of each system under test to provide training in system operation, to ensure that said system is properly maintained and serviced so as to be in satisfactory operational condition throughout the test period, and to provide documentation for this purpose.

5.3 TEST COORDINATION

TMEC and CDTDPO personnel (with contractor support personnel) will conduct this evaluation. All test personnel will be under the direction of the Silver Team Leader, who will report to the Director, TMEC. The Director, TMEC, shall coordinate issues needing higher-level decisions (e.g., evaluation plan approval and evaluation plan changes

required during the test period) in concert with the DoD/CDTDPO. Throughout the test all data collected will be delivered to the Silver Team in a timely manner and in its appropriate form as specified elsewhere. The Silver Team will manage such data to enable prompt feedback to the Test Director for issues including overall test progress, significant test anomalies, indicated test plan modifications, etc., as well as to enable the data analysis and to determine the results from the mailroom scenario testing.

5.4 DETAILED EVALUATION PROTOCOLS

The evaluation program will consist of the following phases:

1. Calibration of systems and verification of calibration
2. Safe handling procedures
3. System detection limits
4. Test space contamination level
5. U.S. Postal Service contamination level
6. Target presentation order
7. Mailroom simulation

A detailed procedure for each of these test phases will be found in the subsections that follow. Reference is made within these sections to forms, documents, formats, and support materials that may be found in computer files and/or attachments to this test plan. Where warranted, items of greater volume (equipment operator manuals, chemical testing methods manuals, calibration and quality control guideline documentation, etc.) will be cited only and not become a physical portion of this document.

This document establishes the background, scope and objectives for the test. It also describes the equipment models and target types that will be used, and details the procedures to be used to conduct each phase of the test. This includes types of data to be collected, the methods of collection, and the forms and tables to be used for recording results. The test protocols are prepared in such detail that an independent agent would be able to conduct the tests. Approval of the protocols by the DoD/CDTDPO shall be a prerequisite for proceeding with remaining test phases. The planning phase of the test will be satisfied upon DoD/CDTDPO approval of this document entitled “Mailroom Scenario Evaluation Plan”.

The units of equipment (by SUT category, type, manufacturer, and model) to be used during this test are defined in Table 5-1.

All selected systems will be placed into the simulated mailroom setting and, as per the manufacturer’s guidelines, exercised to verify a fully functional status. All SUTs to be evaluated during the USPS contamination, Target Order and Mailroom scenario portion of this test will be placed into the simulated mailroom at TMEC prior to commencement of the onsite verification-of-calibration phase of the test. The arrangement of the SUTs will provide for operation of all SUTs simultaneously or each SUT individually as test conditions warrant. Each of the systems selected for the mailroom scenario test effort

will be required to participate in calibration, quality assurance and order of target presentation test efforts presented below. For each of the systems utilized during the mailroom scenario test effort, all information, as listed in the Excel workbook Silver_Team_Sheets.xls in the SILVER_SUT_DOC worksheet, is to be completed by the Blue Team, verified by the Silver Team prior to testing commencement.

Table 5.4-1 Systems to be used in the evaluation

SUT CATEGORY	SUT TYPE	MANU-FACTURER	MODEL	
Trace Detection	Desktop IMS	Barringer	IONSCAN Model 400B	
	Handheld IMS	Barringer	SABRE 2000	
	Desktop IMS	IonTrack	ITEMIZER	
	Handheld IMS	IonTrack	VaporTracer	
	Chemical Spray	Mistral Security	Cannibispray	
	Chemical Spray	Mistral Security	Coca-Test	
Bulk Detection	X-ray Transmission / Backscatter Scan	AS&E	Model 66Z	
	X-ray Computed Tomography Scan	InVision	CTX2500	

Additionally, citation of any occurrences of significant test procedure anomalies and/or test equipment abnormalities will be recorded and maintained as part of this test's documentation. These items will be referred to as test incidents and will require completion of a "Test Incident Report" (TIR). The Red, Blue and Silver Teams will have a place for recording these in the principle Excel Workbook that that team uses. Test incidents will include such issues as SUT equipment malfunctions, mailroom operation procedural changes, damage or alteration of mail items, events of note for target creation, etc. TIRs should be completed as soon as possible by test personnel observing such incidents (normally this will be the Blue Team or Red Team). Notification will be given to the Silver Team without delay, and the Silver team shall determine the appropriate action based on the incident.

5.5 CALIBRATION AND ON-SITE VERIFICATION

This effort will document the SUTs' calibrations at the outset of the test and verify their calibration status during the conduct of the test. Calibration tests will be performed on the equipment prior to the mailroom simulation test. Each system's manufacturer representative will provide documentation of these calibrations to the Blue Team. This calibration status will be verified via quality control (QC) checks onsite at the commencement of testing, during the testing, and at the conclusion of testing. The methods and means to be employed for each SUT will be based on the manufacturer's recommendation and are outlined below in Sections 5.5.1 to 5.5.7. The Test Director

may approve modification of such procedures in order to satisfy any operational conflicts. A minimum number of three QC checks will be performed for each SUT during this test, once at the beginning, once at the end of the evaluation, and once in the middle of the evaluation. Blind samples and duplicate samples may also be employed at the direction of the Silver Team leader to document SUT performance during the test. The Blue Team will assemble all calibration data and record all QC data collected onsite throughout the test and deliver the same to the Silver Team. Calibration data will normally be documented by completion of the BLUE_SUT_CAL worksheet within the *SystemName*_DATA_TABLES.xls workbook. There will be a separate workbook file for each system where the actual name of the system is used in place of the word *SystemName* e.g. AS&E66Z_DATA_TABLES.xls. Calibration data may take the form and format as supplied by the calibration test agent. However, this information must include: system calibrated (brand, model, & serial number), date, place, calibration test methodology reference, calibration agency contact information (mail, phone, e-mail, etc.), persons conducting the calibration test, calibration test results, any limits or exclusion applicable to the calibration status, etc. The Blue Team will document all onsite QC data in the BLUE_SUT_QC worksheet within the *SystemName*_DATA_TABLES.xls workbook. There will be a separate workbook file for each system where the actual name of the system is used in place of the word *SystemName*,e.g. AS&E66Z_DATA_TABLES.xls .

5.5.1 CALIBRATION AND QC FOR INVISION CTX2500

Prior to onsite setup at TMEC the vendor/manufacturer for the InVision CTX2500 will provide the latest calibration information for said SUT to the Blue Team. The Blue Team will transfer this information to a "SUT Calibration Form", as documented in the BLUE_SUT_CAL worksheet within the file CTX2500_DATA_TABLES.xls, which will be submitted promptly to the Silver Team (along with the original vendor/manufacturer calibration documentation) for insertion into an electronic database. After initial setup at the TMEC simulated mailroom and prior to any scanning of mailroom scenario test items, the InVision CTX2500 will be run through a QC check consisting of:

1. "Calibrate" and "Image Quality Test" procedures as described on page 46 (Section 4.3) of the "CTX2500 User's Guide".
2. All resultant screen-displayed text denoting the pass or fail conditions will be recorded on a "SUT QC Form" [see workbook CTX2500_DATA_TABLES.xls, sheet BLUE_SUT_QC for what will be recorded] and promptly delivered to the Silver Team for addition to the electronic database.
3. Any failure to pass this QC check will immediately require such procedures as recommended by the manufacturer until a passed condition is obtained.
4. This QC check will be performed at the start of each day prior to the scanning of any test items.

5.5.2 CALIBRATION AND QC FOR AS&E MODEL 66Z

Prior to onsite setup at TMEC the vendor/manufacturer for the AS&E Model 66Z will provide the latest calibration information for said SUT to the Blue Team. The Blue Team will transfer this information to a "SUT Calibration Form", as documented in the

BLUE_SUT_CAL worksheet within the file AS&E66Z_DATA_TABLES.xls, which will be submitted promptly to the Silver Team (along with the original vendor/manufacturer calibration documentation) for insertion into an electronic database. After initial setup at the TMEC simulated mailroom and prior to any scanning of mailroom scenario test items, the AS&E Model 66Z will be run through a QC check consisting of:

1. the "Daily Maintenance Tasks" as described on page 27 (Section 5.1) of "AS&E Model 66Z Operator's Manual"
2. Performance of the step wedge and wire image verification check.
    a. For the transmission x-ray image, utilizing an ASTM wire and step wedge (AS&E part number 11550-0051), lay the step wedge flat at the center of the conveyor belt and run it through the 66Z system with the x-rays on.
    b. Obtaining an image of the step wedge showing the number 24 wire through step five of the step wedge confirms that the transmission x-ray is performing to manufacturer's recommendations.
    c. For the backscatter x-ray image, using the plastic step wedge (AS&E part number 11550-0062) positioned at the center of the conveyor belt, run the wedge through the 66Z system.
    d. Obtaining an image showing all five of the steps of the wedge confirms that the backscatter x-ray is performing to the manufacturer's recommendation.
3. Results will be recorded on a "SUT QC Form" [see workbook AS&E66Z_DATA_TABLES.xls, sheet BLUE_SUT_QC for what will be recorded] and promptly delivered to the Silver Team for addition to the electronic database.
4. Any failure to pass this QC check will immediately require such procedures as recommended by the manufacturer until a passed condition is obtained.
5. This QC check will be performed at the start of each day prior to the scanning of any test items.

5.5.3 CALIBRATION AND QC FOR ION TRACK ITEMIZER

Prior to onsite setup at TMEC the vendor/manufacturer for the Ion Track ITEMIZER will provide the latest calibration information for said SUT to the Blue Team. The Blue Team will transfer this information to a "SUT Calibration Form", as documented in the BLUE_SUT_CAL worksheet within the file ITEMIZER_DATA_TABLES.xls, which will be submitted promptly to the Silver Team (along with the original vendor/manufacturer calibration documentation) for insertion into an electronic database.. After initial setup at the TMEC simulated mailroom and prior to any scanning of mailroom scenario test items, the Ion Track ITEMIZER will be run through a QC check consisting of:

1. The "Initial Calibration" procedures as described on page 33 (Section 3.3.6) of the "Ion Track ITEMIZER User's Manual".
2. All resultant screen-displayed text or light code indicators will be recorded on a "SUT QC Form" " [see workbook ITEMIZER_DATA_TABLES.xls, sheet

BLUE_SUT_QC for what will be recorded] and promptly delivered to the Silver Team for addition to the electronic database.
3. Any failure to pass this QC check will immediately require such procedures as recommended by the manufacturer until a passed condition is obtained.
4. This QC check will be performed at the start of each test day, prior to examining any test items, and every four hours of operation thereafter.

5.5.4 CALIBRATION AND QC FOR ION TRACK VAPORTRACER

Prior to onsite setup at TMEC the vendor/manufacturer for the Ion Track VaporTracer will provide the latest calibration information for said SUT to the Blue Team. The Blue Team will transfer this information to a "SUT Calibration Form", as documented in the BLUE_SUT_CAL worksheet within the file VaporTracer_DATA_TABLES.xls, which will be submitted promptly to the Silver Team (along with the original vendor/manufacturer calibration documentation) for insertion into an electronic database. After initial setup at the TMEC simulated mailroom and prior to any scanning of mailroom scenario test items, the Ion Track VaporTracer will be run through a QC check consisting of the "Calibration" procedures as described on page 15 (Section 1.11) of:

1. The "Ion Track VaporTracer2 User's Manual".
2. All resultant screen-displayed text or light code indicators will be recorded on a "SUT QC Form" " [see workbook VaporTracer_DATA_TABLES.xls, sheet BLUE_SUT_QC for what will be recorded] and promptly delivered to the Silver Team for addition to the electronic database.
3. Any failure to pass this QC check will immediately require such procedures as recommended by the manufacturer until a passed condition is obtained.
4. This QC check will be performed at the start of each test day, prior to the scanning of any test items, and every four hours of operation thereafter.

5.5.5 CALIBRATION AND QC FOR BARRINGER IONSCAN 400B

Prior to onsite setup at TMEC the vendor/manufacturer for the Barringer IONSCAN 400B will provide the latest calibration information for said SUT to the Blue Team. The Blue Team will transfer this information to a "SUT Calibration Form", as documented in the BLUE_SUT_CAL worksheet within the file IONSCAN_DATA_TABLES.xls, which will be submitted promptly to the Silver Team (along with the original vendor/manufacturer calibration documentation) for insertion into an electronic database. After initial setup at the TMEC simulated mailroom and prior to any scanning of mailroom scenario test items, the Barringer IONSCAN 400B will be run through a QC check consisting of:

1. The "Verification" procedures as described on page 3-5 (Section 3.7) of the Barringer IONSCAN 400B Operator's Manual".
2. All resultant screen-displayed text or light code indicators will be recorded on a "SUT QC Form" [see workbook IONSCAN_DATA_TABLES.xls, sheet BLUE_SUT_QC for what will be recorded] and promptly delivered to the Silver Team for addition to the electronic database.
3. Any failure to pass this QC check will immediately require such procedures as recommended by the manufacturer until a passed condition is obtained.

4. This QC check will be performed at the start of each test day, prior to the scanning of any test items, and every four hours of operation thereafter.

5.5.6 CALIBRATION AND QC FOR BARRINGER SABRE 2000

Prior to onsite setup at TMEC the vendor/manufacturer for the Barringer SABRE 2000 will provide the latest calibration information for said SUT to the Blue Team. The Blue Team will transfer this information to a "SUT Calibration Form", as documented in the BLUE_SUT_CAL worksheet within the file SABRE_DATA_TABLES.xls, which will be submitted promptly to the Silver Team (along with the original vendor/manufacturer calibration documentation) for insertion into an electronic database. After initial setup at the TMEC simulated mailroom and prior to any scanning of mailroom scenario test items, the Barringer SABRE 2000 will be run through a QC check consisting of:

1. The "Verification" procedures as described on page 29 (Section 6.4) of the Barringer SABRE 2000 Operator's Manual".
2. All resultant screen-displayed text or light code indicators will be recorded on a "SUT QC Form" [see workbook SABRE_DATA_TABLES.xls, sheet BLUE_SUT_QC for what will be recorded] and promptly delivered to the Silver Team for addition to the electronic database.
3. Any failure to pass this QC check will immediately require such procedures as recommended by the manufacturer until a passed condition is obtained.
4. This QC check will be performed at the start of each test day, prior to the scanning of any test items, and every four hours of operation thereafter.

5.5.7 CALIBRATION AND QC FOR MISTRAL SECURITY CHEMICAL SPRAY

Prior to onsite setup at TMEC the vendor/manufacturer for the Mistral Security Chemical Spray will certify the chemical test kits as useable and the chemicals and test strips as satisfactory for use during the test period. Conversations with MISTRAL have indicated that the materials will be useable without degradation over the test period. The Blue Team will transfer such certification information" for each of the chemical sprays to the appropriate "SUT Calibration Form", as documented in the BLUE_SUT_CAL worksheets within the files Cannibispray_DATA_TABLES.xls and Coca-Test_ DATA_TABLES.xls, which will be submitted promptly to the Silver Team (along with the original vendor/manufacturer certification documentation) for insertion into an electronic database. After initial setup at the TMEC simulated mailroom and prior to any scanning of mailroom scenario test items, each of the Mistral Security Chemical Sprays will be run through a QC check consisting of:

1. Use of the spray with a known sample of its detectable drug type.
2. All resultant visual indicators will be recorded on a "SUT QC Form" [see workbooks Cannibispray_DATA_TABLES.xls and Coca-Test_DATA_TABLES.xls, sheet BLUE_SUT_QC for what will be recorded] and promptly delivered to the Silver Team for addition to the electronic database.
3. Any failure to pass this QC check will immediately require such procedures as recommended by the manufacturer until a passed condition is obtained.
4. This QC check will be performed at the start of each test day, prior to the scanning of any test items.

5.6 SAFE HANDLING PROCEDURES & TARGET MATERIAL PREPERATION

This effort provides guidance on the safe handling of drugs as well as the prescribed methods for target preparation for test items used in this evaluation. For each specific drug employed under any phase, a written safe handling procedure will be followed. For each container and target combination utilized in the evaluation configuration matrix a method for target material preparation and concealment follows.

TMEC shall establish 2 areas for the creation and storage of target items. The first area shall have only the mail item materials for constructing the items [with the exception of the drugs], and also be the area for the construction of all mail items that do not contain drugs. The mail items with no drugs shall be stored in this space. The second area shall be dedicated to the making and storing of all mail items that contain drugs.

The specific Target Items are listed in the workbook ITEM_CREATE_LIST.xls. This spreadsheet file contains 3 worksheets for item creation documentation, one for each test for which TMEC will prepare target items [US Postal Service Contamination test, Target Order Testing and the Mail Room Scenario TestingThe actual targets will be made in the order specified in each worksheet. The first step is to assemble the materials for making the target items and to establish an area for the making of the targets.

The assembly area needs to be screened to insure that there is no contamination of the area. This will be done by following the steps below.

1. Using the TMEC Ion Scan system swipe the work surface, seating area and the storage shelves on which the target material will be placed.
2. Place the samples in the machine and determine that there is no positive reading for cocaine or marijuana
3. If there is a positive reading conduct the standard TMEC Cleaning Procedure to the areas and retest
4. Repeat steps 2 and 3 until there is a negative response for both drugs
5. Repeat this test each day during the target item construction process
6. Record the results in the sheet RedAreaContmination in the workbook file ITEM_CREATE_LIST.xls

The following tables list the package types and sub-types for items to be constructed and the contents to be placed in the items.

Table 5.6-1 Package Types

PACKAGE TYPES	SUB TYPE	CODE	DESCRIPTOR
ENVELOPE	MEDIUM	EM	#10, STANDARD BUSINESS SIZE, 4 1/8" X 9 1/2", WHITE, NO WINDOWS
ENVELOPE	SMALL	ES	#6 3/4, SMALL BUSINESS SIZE, 3 5/8" X 6 1/2", WHITE, NO WINDOWS
PARCEL	BAG	PB	#2, STANDARD PADDED MAILING BAG, 8 1/2" X 11", BROWN, NOT AIR BUBBLE LINED
PARCEL	MAGAZINE	PM	MAGAZINE, SUBSCRIPTION OR CATALOG TYPE, NOMINALLY 8" X11", NOT IN MAILER
BOX	SMALL	BS	SMALL BOX, NOMINALLY 12 1/4" X 10 7/8" X 1 3/8" INSIDE DIMENSIONS

BOX	MEDIUM	BM	MEDIUM BOX, NOMINALLY 13" X 11 1/2" X 2 3/8" INSIDE DIMENSIONS

7. Assemble all of the necessary materials for the creation of the mail items. The drugs and mail items containing drugs are to be kept in a separate area from the material assemble area. This material assemble area can be the area for the assembly and storage of items that will not contain drugs.
8. Document the material assembled using the worksheet Red_Material of the workbook ITEM_CREATE_LIST.xls
9. Each item of mail needs to be addressed with a return address and a standard address label as well as a stamp. The TMEC address should be used for each.
10. The item identifier code given to the specific item [see workbook ITEM_CREATE_LIST.xls, worksheets USPS_ITEMS, ORDER_ITEMS, and MAILROOM_ITEMS] should be part of the return address, printed in black ink by the maker of the item.
11. The size of the labels should be appropriate for the item but since the labels are one of the target hiding places the label should be generous in size.

Table 5.6-2 Mail Item Contents

CONTENTS TYPES			
LETTER	SMALL	LS	1 -3 SHEETS, XEROGRAPHIC, BOND, OR NEWSPRINT, NOMINALLY 8 1/2" X 11"
LETTER	LARGE	LL	3 -6 SHEETS, XEROGRAPHIC, BOND, OR NEWSPRINT, NOMINALLY 8 1/2" X 11"
BOOK		BK	HARD COVER BOOK OF MEDIUM SIZE, NOMINALLY 7" X 9" X 1"
MAGAZINE		MG	MAGAZINE, SUBSCRIPTION OR CATALOG TYPE, NOMINALLY 8" X11"
CASSETTE	AUDO	CA	AUDIO CASSETTE WITH CASE
CASSETTE	VIDEO	CV	VIDEO CASSETTE WITH CASE
CD-ROM or DVD		CD	COMPACT DISK OR DIGITAL VIDEO DISK WITH CASE
CLOTHING MATERIALS		CM	PANTS, SHIRTS, SCARF, HAT, ETC.
SHREDDED PAPER		SP	SHREDDED PAPER PACKAGING MATERIAL, LOOSE PACKED.
BUBBLE WRAP		BW	BUBBLE WRAP, SHEETED PLASTIC PACKAGING MATERIAL
DOCUMENT		DP	UNBOUND PAPER DOCUMENT, NOMINALLY 8 1/2" X 11" X 1", TYPICAL OF GOVERNMENT REPORTS

The target conditions and the target state and hiding methods are enumerated in the tables below. Not all combinations of conditions can apply.

Table 5.6-3 Target Types

TARGET TYPES		
COCAINE	CC	COCAINE
MARIJUANA	MJ	MARIJUANA

Table 5.6-4 Target States

TARGET FORMS		
SOLID NATURAL	SN	DRUG IS IN ITS NORMAL SOLID STATE
LIQUID ABSORBED	LA	DRUG IN SOLUTION IS ABSORBED INTO PACKAGE OR CONTENTS THAT ARE THEN DRIED TO AMBIENT CONDITIONS

Table 5.6-5 Target Amount

TARGET AMOUNTS		
SMALL	S	0.1 +/- 0.05 GRAMS
MEDIUM	M	0.5 +/- 0.05 GRAMS
LARGE	L	1.0 +/- 0.05 GRAMS

Table 5.6-6 Target Concealment Methods

CONCEALMENT METHODS		
1	HS	HIDDEN UNDER ENVELOPE SEAMS, LABELS, AND STAMPS
2	HL	HIDDEN WITH LETTER CONTENTS
3	HP	HIDDEN IN PARCEL PACKING MATERIALS
4	AP	ABSORBED INTO PAPER
5	DS	DISTRIBUTED / SPREAD THROUGHOUT PACKAGE, BOOK, OR DOCUMENT

12. As each mail item is assembled a minimum of one (1) and up to three (3) digital pictures of the configuration of hiding and the mail item are to be taken. The spread sheet columns for these image file names in the worksheets USPS_ITEMS, ORDER_ITEMS, and MAILROOM_ITEMS within the workbook ITEM_CREATE_LIST.xls shall be filled with a unique file name by using the item identifier code with the letters a (picture #1), b (picture #2), or c (picture #3) appended. For example, using the first item of the USPS_ITEMS worksheet, the three digital picture file names would become UC01a, UC01b, and UC01c. When a second or third picture is not taken those columns will be filled with NA. All digital pictures documenting the creation of items shall be in the Joint Photography Group (jpg) format.
13. The date and time that the item was created and the initials of the person making the item shall also be filed in the appropriate columns of

the worksheets USPS_ITEMS, ORDER_ITEMS, and MAILROOM_ITEMS within the workbook ITEM_CREATE_LIST.xls.

Drug Hiding and Preparation

14. The safe handling of drugs requires the following steps be observed to insure the personnel do not become contaminated and that the workspace does not become contaminated.
    a. The personnel doing the preparation shall wear 'clean room' over garments that are to be discarded after each target class [marijuana or cocaine] is prepared. They are to use throwaway plastic gloves that are to be discarded after each day and discarded after each target class [marijuana or cocaine] is prepared.
    b. When using cocaine in the powder form a passive respirator shall be worn to prevent aspiration of the material.
15. The preparation of the targets shall be done in the item order specified in the worksheets USPS_ITEMS, ORDER_ITEMS, and MAILROOM_ITEMS within the workbook ITEM_CREATE_LIST..xls.
16. A recently calibrated electronic scale shall be used to weigh the drug quantity specified in the ORDER_ITEMS or MAILROOM_ITEMS worksheet to within 0.1 +/- 0.05 grams. The measured quantity shall be recorded against the appropriate item in the ORDER_ITEMS or MAILROOM_ITEMS worksheet of ITEM_CREATE_LIST.xls
17. The procedure for concealment method 1 will be to place the drugs into a small piece of plastic wrap and then to flatten the wrap and place the wrap under one of the labels on the mail item.
18. The procedure for concealment method 2 will be to place the drugs into a small piece of plastic wrap seal the wrap with a small piece of clear tape and place the object into the envelope.
19. The procedure for concealment method 3 will be to place the drugs into a small piece of plastic wrap seal the wrap with a small piece of clear tape and place the object within the packing material.
20. The procedure for concealment method 4 will be to place the drugs into water and stir until dissolved and then pour the solution onto a piece of absorbent paper [this may take some experimentation. I would suggest using bond paper, which has a weave to it] and place the paper into the mail item.
21. Once an item is created, digital images documenting the item and the hiding place will be made. The required information for the item shall be recorded in the appropriate worksheet of ITEM_CREATE_LIST.xls
22. Each mail item containing drugs shall be placed into a sealed plastic bag and then into a container in creation sequence order. Target items

containing cocaine should be stored in separate containers from items containing marijuana.

23. Each non target mail item shall be created in the material assembly room and stored there, away from all drugs, until needed for testing.

5.7 OPERATIONAL MINIMUM DETECTION LIMIT (OMDL) CAPABILITY TEST PROCEDURES

This effort will establish the minimum detection limits (MDL) for four of the trace-detector SUTs to be employed in the mailroom scenario test phase. Because several of the drugs being investigated are hazardous to handle or easily degrade over time we will only perform the mailroom scenario with marijuana and cocaine. Using analysis of this minimum detection limits experiment combined with analysis from other experiments will provide extrapolations as to these technologies' effectiveness for detection of other drugs not utilized in the mailroom scenario test phase. X-ray and CT systems will not detect the differences in chemical composition of drugs and are therefore not being considered to have different detection limits for different drugs. The Mistral spray system requires each specific drug therefore detection limit testing is beyond the scope of our current investigation for this technology.

The drug types that will be used for this MDL test are:

1. Marijuana
2. Cocaine
3. Heroin
4. Methamphetamine
5. Ecstasy
6. LSD

The four SUTs, all trace detection systems, that will perform the minimum detection limit testing are the Barringer "IONSCAN 400B", the Barringer "SABRE 2000", the Ion Track "ITEMIZER", and the Ion Track "VAPORTRACER". These tests will be performed at the respective manufacturer's or vendor's facility on systems identical to those to be used in the simulated mailroom at TMEC. A member of the Silver Team will witness these tests and record the results. A summary table will be prepared for each instrument and drug type, reporting the total number of samples and the number of detections for each drug level as well as the MDL results. The methods and procedures for the minimum detection limit testing are:

GENERAL:

These tests will be conducted at the respective instrument vendor or manufacturer facility, typically within an office, laboratory, or standard workspace. The test environment, equipment, and reagents will be free of any substances or conditions

that might compromise the test results. All chemical practices, procedures and equipment will be of the type and standard as normally used at that facility.

DRUGS:

1. Document test drug standard solution source, concentration, and certification references. Nominal concentration will be 1mg/ml.

LIST OF DRUGS TO ESTABLISH OMDL FOR:

COCAINE
HEROIN
THC (Marijuana)
ECSTACY (MDMA)
LSD
METHAMPHETAMINE

2. Dilute each drug standard with inert solute to concentrations so as to provide sample loading levels covering the range from one order of magnitude above to one order of magnitude below the anticipated OMDL levels.
3. Record amounts and types of solute used and the resultant concentration level of each solution prepared for each drug.

INSTRUMENTS:

4. Document instrument name, model, and serial number
5. Bring instrument to operationally ready status. Set all detection and alarm parameters at the values[2] that will be used during the mailroom scenario testing to be conducted at TMEC.
6. Document these values.
7. Use appropriate calibration check sample to verify calibration of instrument. Allow system to clear as needed until a clean system (no drugs detected) status is reached.
8. Document that both conditions were reached.
9. For each drug to be tested select appropriate substrate and verify it is uncontaminated by running it as a blank sample.
10. For each drug starting with the highest loading level deposit appropriate amount of solution on this substrate, allow evaporation of solute, then analyze sample.
11. Follow with blank samples (with same substrate) as required to clear instrument.
12. Repeat with sample followed by blank(s) at this loading level until either 3 consecutive samples produce the alarm status for the drug under test or 5 samples followed by blank(s) have been run. Three (3) consecutive samples producing an

[2] The first sample for each new drug tested may be used to adjust the instruments peak location for optimizing that drug's detection.

alarm condition for the drug under test or 3 out of 5 samples resulting in an alarm condition for the drug under test will satisfy that the drug loading level is successfully detected.
13. Proceed to next lower drug loading level verifying cleanliness of substrate by running it as a blank and repeating the sample then blank(s) cycle at this loading level.
14. Repeat for each successively lower loading level until less than 3 out of the 5 samples are detected. OMDL will be recorded as the drug loading level above the level producing the "less than 3 out of the 5 samples detected" condition.
15. Record all samples and blanks run with drug type, solution concentration used, amount of solution deposited on substrate, drug loading level, alarm conditions produced, and comments as necessary.

Note: Replacement of substrate at any time requires it be run as a blank to verify substrate's cleanliness.

5.8 SUT TEST SPACE CONTAMINATION LEVELS

This effort will establish the amount of test space contamination for each drug and system used in the USPS Contamination test, the Target Order test and the Mailroom Scenario test. Techniques used by TMEC for other chemical trace detection tests will be employed for this test. Will the TMEC IONSCAN instrument be used? Can we reference a written document here? The procedure is :

1. Sampling of significant areas (walls, floors, ceilings, desktops, equipment surfaces, etc.) of the test space with examination of said samples by the trace detection equipment.
2. Test results will be recorded by the Red Team in the ITEM_CREATE_LIST.xls workbook file in the SUT_Area_Contamination worksheet and be delivered promptly to the Silver Team for inclusion in the electronic database.
3. If contamination is found the area will be sanitized and retested until no contamination is found in the random testing. Each attempt is to be recorded in the worksheet.
4. The target preparation and storage areas shall be tested and the results recorded as prescribed in section 5.6 above.

5.9 U.S. POSTAL SERVICE [USPS] CONTAMINATION LEVELS

This effort will help quantify the levels of drug contamination introduced into the test scenario by the U.S. Postal Service for each drug and system used in the mailroom scenario test. To determine these levels two separate mailings, each containing 15 "clean" letters and 15 "clean" packages, will be sent to the simulated mailroom at TMEC via USPS First Class Mail. Additionally, a separate group of 15 envelopes and 15 packages will be kept in a clean location at TMEC as a control group. One of the mailed shipments will be sent from Douglas, AZ and the other mailed shipment will be sent from Phoenix, MD. Each item in these three groups will bear a unique item identification code written on the outside. This code will be a four digit alpha numeric string of the type UP## where:

1st character = U - denotes USPS contamination test item
2nd character = C, D, or P – denotes mailing origin
C = control group, not mailed
D = Douglas, AZ
P = Phoenix, MD
3rd & 4th characters = sequentially assigned numbers 01 – 30 where:
the numbers 01 – 15 are the group's envelopes
the numbers 16 – 30 are the group's packages

Upon receipt at TMEC these items from the two mailed shipments will be sorted into their respective groups and these two groups will be kept segregated from each other as well as all possible contaminating sources. The three separate groups will be examined via the SUTs as per the standard mailroom testing protocol set forth below. Results will be recorded in each SUT's *SystemName*_DATA_TABLES.xls workbook in the BLUE_USPS worksheet and be promptly delivered to the Silver Team.

5.10 TARGET PRESENTATION ORDER

This effort will establish the affect that the order of presentation of target items to the trace detection SUTs has on the detection of the targets. The results will establish the level of degradation of target stability due to SUT presentation sequence and may be used to modify the flow of targets for the actual mailroom scenario tests described below. One container configuration will be employed, namely the small envelope with a 1 – 3 page letter enclosed. Two target configurations are to be used. The first is cocaine in its solid natural form, hidden under a mailing label at the level of one gram. The second will be marijuana in its solid natural form, hidden under a mailing label at the level of one gram. Six of the trace detection SUTs will be used. These will be the ITEMIZER (#1), the VaporTracer (#2), the IONSCAN 400B (#3), the SABRE 2000 (#4), the Coca-test (#5), and the Cannabispray (#6). An assemblage of sixty identical target items (ten times the number of trace detection SUTs involved) will be created for each of the container/target combinations for use in this phase of the test. For example, this means that for the envelope/cocaine combination there will be an assemblage of sixty identical items. The same is true for the envelope/marijuana combination. Each assemblage will be randomly divided into a number of groups equal to the number of trace detection SUTs involved (i.e., six groups of ten items). Each group of items will be submitted for SUT inspection via a different sequential ordering of the SUTs. Specifically, for the six groups of the envelope/cocaine assemblage:

Group 1 envelope/cocaine items submitted in the order of SUT 1, 2, 3, 4, 5, and 6
Group 2 envelope/cocaine items submitted in the order of SUT 2, 3, 4, 5, 6, and 1
Group 3 envelope/cocaine items submitted in the order of SUT 3, 4, 5, 6, 1, and 2
Group 4 envelope/cocaine items submitted in the order of SUT 4, 5, 6, 1, 2, and 3
Group 5 envelope/cocaine items submitted in the order of SUT 5, 6, 1, 2, 3, and 4
Group 6 envelope/cocaine items submitted in the order of SUT 6, 1, 2, 3, 4, and 5

The same routine will be followed for the six groups of envelope/marijuana assemblage. Each item in these two groups will bear a unique item identification code written on the outside. This code will be a four digit alpha numeric string of the type OM18 where:

1st character = O - denotes order of presentation test item
2nd character = C or M – denotes drug type used
C = cocaine
M = marijuana
3rd character = numbers 1 through 6 denoting group number
4th character = numbers 0 – 9 denoting item number within a group

Individual SUT detection results will be recorded for each item in the BLUE_ORDER worksheet of the appropriate SUT's *SystemName*_DATA_TABLES.xls workbook and be promptly delivered to the Silver Team. These results will be entered into an electronic database and an analysis will be performed to determine the affects that the order of presentation has on the target's detection.

5.11 MAILROOM SCENARIO TEST

This effort will require appropriate Red, Blue, and Silver Team manning to provide the mail for testing, to operate the simulated mailroom and test equipment, to document the SUTs' responses, to collect the results, and to resolve anomalies. The main objective for this phase of the test is to determine the level of probability of false alarms (Pfa) and the level of probability of detection (Pd) expressed on an overall basis as well as by SUT and by target groupings. We have examined the potential variables in how drugs might be smuggled into a prison via the mail and have attempted to create a matrix of conditions for which it would be desirable to measure the response from the candidate technologies. The following categories of variables are being considered:

1. Package Type
2. Package Sub-type
3. Contents Type
4. Target Type
5. Target Form
6. Target Amount
7. Concealment Method

These categories each have variations or levels that need definition and control in order for the experiment to have meaning. Table 5.11-1 below shows the various levels of each of these categories that are being considered for this evaluation. As can be seen we have attempted to define a set of exemplar conditions but if one goes into a 'brainstorming' session they would come up with many more definitions of packages, contents, concealment methods and potentially target forms and amounts. For this test an item is defined as an individually mailed object requiring its own affixed postage. The item container configuration and the item target configuration, as listed in Table 5.11-1, describe each item. The container configuration will be comprised of the package type, the package sub-type, and the package contents. The target configuration will be comprised of the drug type, its physical form, the concealment method, and its amount. Not all permutations of possible container and/or target configurations will be valid or allowed. Each item will bear a unique and legible, sequentially assigned, four digit,

identification code. A data table recording each item's container configuration and its target configuration will be initiated and updated as items are created [see workbook ITEM_CREATE_LIST.xls, worksheet MAILROOM_ITEMs]. Table 5.11-1 identifies the target types, target forms, the target concealment methods, and the target amount that we will create for the test. We hypothesize that each of these target variables can also have an affect on detection of concealed drugs. The item's contents are varied to insure that any affect that the contents would have on masking the detection of the drug is considered.

Table 5.11-1 Mailroom Scenario Evaluation – Overall item element listing.

CONTAINER CONFIGURATION ELEMENTS			
Package Types	**Sub Type**	**Code**	**Descriptor**
Envelope	Medium	EM	#10, standard business size, 4 1/8" x 9 1/2", White, no windows
Envelope	Small	ES	#6 3/4, small business size, 3 5/8" x 6 1/2", White, no windows
Parcel	Bag	PB	#2, standard padded mailing bag, 8 1/2" x 11", Brown, not air bubble lined
Parcel	Magazine	PM	Magazine, subscription or catalog type, Nominally 8" x11", not in mailer
Box	Small	BS	Small box, nominally 12 1/4" x 10 7/8" x 1 3/8" Inside dimensions
Box	Medium	BM	Medium box, nominally 13" x 11 1/2" x 2 3/8" Inside dimensions
Contents Types			
Letter	Small	LS	1 -3 sheets, xerographic, bond, or newsprint, Nominally 8 1/2" x 11"
Letter	Large	LL	3 -6 sheets, xerographic, bond, or newsprint, Nominally 8 1/2" x 11"
Book		BK	Hard cover book of medium size, nominally 7" x 9" x 1"
Magazine		MG	Magazine, subscription or catalog type, Nominally 8" x11"
Cassette	Audio	CA	Audio cassette with case
Cassette	Video	CV	Video cassette with case
CD-ROM Or Dvd		CD	Compact disk or digital video disk with case
Clothing Materials		CM	Pants, shirts, scarf, hat, etc.
Shredded Paper		SP	Shredded paper packaging material, Loose packed.
Bubble Wrap		BW	Bubble wrap, sheeted plastic packaging Material
Document		DP	Unbound paper document, nominally 8 1/2" x 11" x 1", typical of government reports
TARGET CONFIGURATION ELEMENTS			
Target Types			
Cocaine		CC	Cocaine
Marijuana		MJ	Marijuana
Target Forms			
Solid Natural		SN	Drug is in its normal solid state
Liquid Absorbed		LA	Drug in solution is absorbed into package and contents that are then dried to ambient Conditions

Concealment Methods		
1	HS	Hidden under envelope seams, labels, and Stamps
2	HL	Hidden with letter contents
3	HP	Hidden in parcel packing materials
4	AP	Absorbed into paper
5	DS	Distributed / spread throughout package, Book, or document
Target Amounts		
Small	S	0.1 +/- 0.05 grams
Medium	M	0.5 +/- 0.05 grams
Large	L	1.0 +/- 0.05 grams

We have attempted to identify a complete matrix of trials that are defined by Table 5.7-1. If all conditions were allowable then we would have 3960 different item conditions. However, certain item permutations are not possible. For example, a box containing a small letter, or a small envelope with bubble wrap are non conditions. Also marijuana does not absorb into things, so marijuana can not use concealment method 4 (absorbed into paper). Once these considerations are taken into account we have considerably fewer conditions to measure. The number of potential container configurations considered was 66 but when we consider the total allowable container configurations that make sense we arrive at 27 conditions. Table 5.11-2 shows the allowable container configurations. The next consideration is to determine the allowable target configurations. Here we have also determined that there were 60 possible target configurations however considering the definitions we pared this down to 39 conditions. Table 5.11-3 below shows these conditions. The total number of conditions is reduced from 3960 conditions to 1053 conditions. This is the first step in achieving a manageable test. Next the certainty level of the predictions that are made using these variables helps determine how we will cast our results. Each condition in the matrices of Table 5.11-2 and 5.11-3 are hypothesized as conditions that have an affect on the SUT capability to detect a target. If we are to measure this we need to statistically sample each condition and determine the SUT response for each condition. The measurement we are making is one of 2 conditions. Either in the presence of a target the SUT indicates the target [correct detection or True Positive] or in the absence of a target the SUT indicates a target [false alarm or False Positive]. The number of correct target detections divided by the total number of detection opportunities is commonly called the Probability of Detection [Pd]. The number of times the SUT indicated a target when there was none divided by the number of non target conditions is commonly called the Probability of False Alarm [Pfa].

In order to determine the error bars for a given measurement one must consider the chances that performing the measurement again would give a different result. In this case when one has a binary result [detected or not detected] then one can predict the confidence interval based on statistical theory. Figure 5.7-1 below shows the confidence intervals as a function of Pd, number of trials, and as a function of desired certainty [confidence level]. As can be seen the number of trials has a significant impact on the error bars. For the 80% confidence level, 10 trials at 50% measured Pd has an uncertainty of +/-20%. That is the value of the Pd is between 30% and 70% at the 80% confidence level. What this means is, if one were to repeat the experiment 100 times we would

expect the Pd to fall between 30% and 70% 80 times and below or above these values the other 20 times. If one wants to know what values the Pd will fall between 99 out of 100 times the Pd would range from 9% to 91%. Using the 80% confidence performing 30 trials reduces the range to 39% to 61% for a measured 50% Pd. Increasing the number of trials to 100 reduces the uncertainty to a range of 42% to 58%. We can see that the uncertainty gets rapidly smaller as we go from 1 to 30 trials but that this affect tends to level off once we reach 30 trials and the confidence intervals do not decrease as rapidly beyond about 30 trials. This gives a "rule of thumb" that when there are constraints on the number of trials one would like to perform, 30 trials may be a satisfactory compromise. Finally the value of the Pd also affects the uncertainty, if the measured result is near 100% or 0% after 10 trials then the uncertainty will be smaller and the result is most probably near these values.

Table 5.11-2 Allowable container configurations for Mailroom Scenario Evaluation. Items in red are assessed as not feasible conditions.

	CONTENT=		LETTER	LETTER	BOOK	MAGAZINE	CASSETTE	CASSETTE	CD-ROM or DVD	CLOTHING MATERIALS	SHREDDED PAPER	BUBBLE WRAP	DOCUMENT
	SUB TYPE =		SMALL	LARGE			AUDO	VIDEO					
	CODE =		LS	LL	BK	MG	CA	CV	CD	CM	SP	BW	DP
PACKAGE	SUB TYPE	CODE											
ENVELOPE	MEDIUM	EM	Yes	Yes	No	No	No	No	No	No	No	No	No
ENVELOPE	SMALL	ES	Yes	Yes	No	No	No	No	No	No	No	No	No
PARCEL	BAG	PB	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes
PARCEL	MAGAZINE	PM	No	No	No	Yes	No	No	No	No	No	No	No
BOX	SMALL	BS	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BOX	MEDIUM	BM	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5.11-3 Allowable target configurations for Mailroom Scenario Evaluation. Items in red are assessed as not feasible conditions

TARGET CONFIG. CODE	T01	T02	T03	T04	T05	T06	T07	T08	T09
TARGET TYPES	COCAI	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE
TARGET FORMS	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
CONCEAL METHODS	1	1	1	2	2	2	3	3	3
TARGET AMOUNTS	S	M	L	S	M	L	S	M	L

TARGET CONFIG. CODE	T10	T11	T12	T13	T14	T15	T16	T17	T18
TARGET TYPES	COCAI	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE
TARGET FORMS	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	LIQUID	LIQUID	LIQUID
CONCEAL METHODS	4	4	4	5	5	5	1	1	1
TARGET AMOUNTS	S	M	L	S	M	L	S	M	L

TARGET CONFIG. CODE	T19	T20	T21	T22	T23	T24	T25	T26	T27
TARGET TYPES	COCAI	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE	COCAINE
TARGET FORMS	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
CONCEAL METHODS	2	2	2	3	3	3	4	4	4
TARGET AMOUNTS	S	M	L	S	M	L	S	M	L

TARGET CONFIG. CODE	T28	T29	T30	T31	T32	T33	T34	T35	T36
TARGET TYPES	COCAI	COCAINE	COCAINE	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA
TARGET FORMS	LIQUID	LIQUID	LIQUID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
CONCEAL METHODS	5	5	5	1	1	1	2	2	2
TARGET AMOUNTS	S	M	L	S	M	L	S	M	L

TARGET CONFIG. CODE	T37	T38	T39	T40	T41	T42	T43	T44	T45
TARGET TYPES	MARIJ	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA
TARGET FORMS	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
CONCEAL METHODS	3	3	3	4	4	4	5	5	5
TARGET AMOUNTS	S	M	L	S	M	L	S	M	L

TARGET CONFIG. CODE	T46	T47	T48	T49	T50	T51	T52	T53	T54
TARGET TYPES	MARIJ	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA
TARGET FORMS	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
CONCEAL METHODS	1	1	1	2	2	2	3	3	3
TARGET AMOUNTS	S	M	L	S	M	L	S	M	L

TARGET CONFIG. CODE	T55	T56	T57	T58	T59	T60
TARGET TYPES	MARIJ	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA	MARIJUANA
TARGET FORMS	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
CONCEAL METHODS	4	4	4	5	5	5
TARGET AMOUNTS	S	M	L	S	M	L

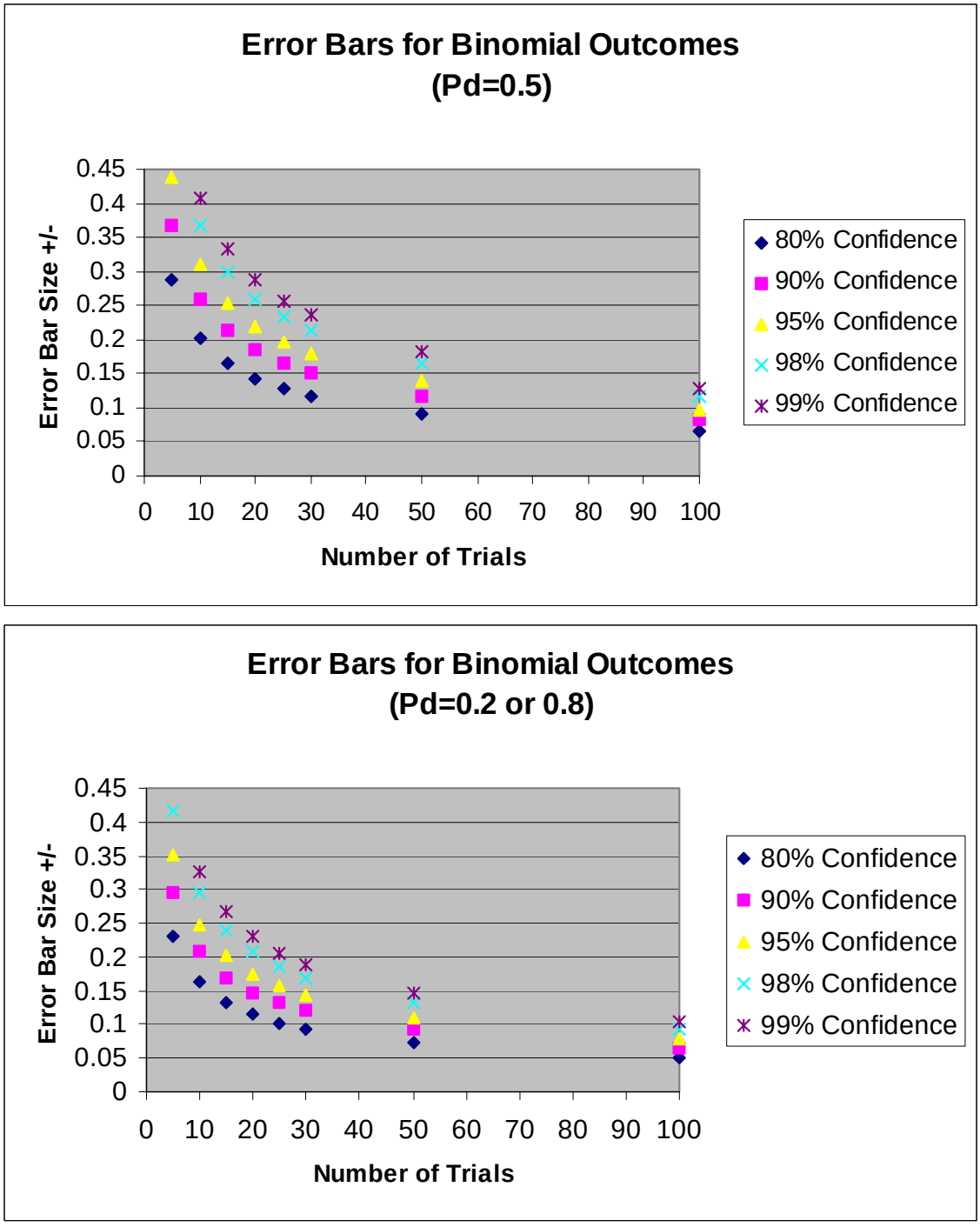

Figure 5.11-1 Confidence intervals for a measured Pd as a function of certainty, number of trials, and the value of Pd.

Based on the above conditions a test that would have 30 trials in each allowable cell yields reasonable confidence intervals on each measurement of Pd and Pfa. This would allow us to view each Pd to determine the significance of each of the hypothesized

variables. Unfortunately performing 30 trials in each allowable cell of Tables 5.11-2 and 5.11-3 will create 22,500 trials of which 21,690 have drugs. Just creating this number of items and entering their data records would be a daunting task. If we could devise a method to reduce the preparation time to 10 minutes per item it would require 90 man weeks to prepare the items and 30 weeks to perform the testing [at ~3 minutes per item]. This is clearly beyond the scope of our plans. We have explored several methods of reducing the number of trials to a level that can be supported within the scope of effort allocated for this evaluation. The purposed compromise method, as outlined below, reduces the total number of trials to 373 total trials, 281 of which are target trials. This will get the total number of trials into a category that can be accomplished in a reasonable time period.

Table 5.11-4 Proposed target matrix for Mailroom Scenario Evaluation. 281 target trials and 92 non-target trials for a sum of 373 total trials.

TARGET TRIALS (281)

		CONTENT=	LETTER	LETTER	BOOK	MAGAZINE	CASSETTE	CASSETTE	CD-ROM or DVD	MATERIALS	SHREDDED PAPER	BUBBLE WRAP	DOCUMENT	
		SUB TYPE =	SMALL	LARGE			AUDO	VIDEO						TOTALS BY
PACKAGE	SUB TYPE	CODE =	LS	LL	BK	MG	CA	CV	CD	CM	SP	BW	DP	PACKAGE SUB TYPE
		CODE												
ENVELOPE	MEDIUM	EM	24	24	NV	NV	NV	NV	NV	NV	NV	NV	NV	48
ENVELOPE	SMALL	ES	24	24	NV	NV	NV	NV	NV	NV	NV	NV	NV	48
PARCEL	BAG	PB	NA	NA	21	0	21	0	21	NA	NA	NA	21	84
PARCEL	MAGAZINE	PM	NV	NV	NV	21	NV	NV	NV	NV	NV	NV	NV	21
BOX	SMALL	BS	NA	NA	0	NA	10	10	0	10	0	0	10	40
BOX	MEDIUM	BM	NA	NA	10	NA	0	0	10	0	10	10	0	40
TOTALS BY CONTENT SUB TYPE =			48	48	31	21	31	10	31	10	10	10	31	

NON TARGET TRIALS (92)

		CONTENT=	LETTER	LETTER	BOOK	MAGAZINE	CASSETTE	CASSETTE	CD-ROM or DVD	MATERIALS	SHREDDED PAPER	BUBBLE WRAP	DOCUMENT	
		SUB TYPE =	SMALL	LARGE			AUDO	VIDEO						TOTALS BY
PACKAGE	SUB TYPE	CODE =	LS	LL	BK	MG	CA	CV	CD	CM	SP	BW	DP	PACKAGE SUB TYPE
		CODE												
ENVELOPE	MEDIUM	EM	7	8	NV	NV	NV	NV	NV	NV	NV	NV	NV	15
ENVELOPE	SMALL	ES	8	7	NV	NV	NV	NV	NV	NV	NV	NV	NV	15
PARCEL	BAG	PB	NA	NA	4	4	4	4	4	NA	NA	NA	5	25
PARCEL	MAGAZINE	PM	NV	NV	NV	5	NV	NV	NV	NV	NV	NV	NV	5
BOX	SMALL	BS	NA	NA	2	NA	2	2	2	2	2	2	2	16
BOX	MEDIUM	BM	NA	NA	2	NA	2	2	2	2	2	2	2	16
TOTALS BY CONTENT SUB TYPE =			15	15	8	9	8	8	8	4	4	4	9	

Table 5.11-4 shows the total number of target and non-target trials that will be conducted for each container configuration type. As can be seen the number of trials for any given cell is not large enough to measure the significance of this cell with respect to other cells unless the measured Pd for the cells being compared are very different. However, the design has been structured that certain conclusions can be made. For instance there are 96 trials with drugs in the envelopes. These 96 trials are evenly divided between small, medium, and large quantities of drug, therefore we can measure the affect of drug quantity on the result in envelopes. However, this is divided over all concealment methods, drug forms, and drug types. We can also examine the affect of concealment method but at a reduced confidence. We can look at drug type in envelopes regardless of concealment method or quantity to see if this variable had an affect. However, the further one tries to refine the combination of affects, the less one is likely to determine the significance of the detection result. Table 5.11-5 below shows the small number of trials that are to be conducted in any given container/target configuration combination. One could explore narrowing the number of container/target configuration combinations and

increasing the number of trials, however, this may not give a very good indication of usefulness in a real world scenario that spans even more package types, content types, concealment methods, drug types, etc. than we have hypothesized.

Table 5.11-5 Test matrices for cocaine solid concealment type 1 for all package types.

	Type	Form	Concealmen	Amount									
T01	COCAINE	SOLID	1	S									
		CONTENT=	LETTER	LETTER	BOOK	MAGAZINE	CASSETTE	CASSETTE	CD-ROM or DVD	MATERIAL S	SHREDDED PAPER	BUBBLE WRAP	DOCUMENT
		SUB TYPE =	SMALL	LARGE			AUDO	VIDEO					
		CODE =	LS	LL	BK	MG	CA	CV	CD	CM	SP	BW	DP
PACKAGE	SUB TYPE	CODE											
ENVELOPE	MEDIUM	EM	1	1	NV	NV	NV	NV	NV	NV	NV	NV	NV
ENVELOPE	SMALL	ES	1	1	NV	NV	NV	NV	NV	NV	NV	NV	NV
PARCEL	BAG	PB	NA	NA	1	0	1	0	1	NA	NA	NA	1
PARCEL	MAGAZINE	PM	NV	NV	NV	1	NV	NV	NV	NV	NV	NV	NV
BOX	SMALL	BS	NA	NA	0	NA	0	0	0	0	0	0	0
BOX	MEDIUM	BM	NA	NA	0	NA	0	0	0	0	0	0	0
T02	COCAINE	SOLID	1	M									
		CONTENT=	LETTER	LETTER	BOOK	MAGAZINE	CASSETTE	CASSETTE	CD-ROM or DVD	MATERIAL S	SHREDDED PAPER	BUBBLE WRAP	DOCUMENT
		SUB TYPE =	SMALL	LARGE			AUDO	VIDEO					
		CODE =	LS	LL	BK	MG	CA	CV	CD	CM	SP	BW	DP
PACKAGE	SUB TYPE	CODE											
ENVELOPE	MEDIUM	EM	1	1	NV	NV	NV	NV	NV	NV	NV	NV	NV
ENVELOPE	SMALL	ES	1	1	NV	NV	NV	NV	NV	NV	NV	NV	NV
PARCEL	BAG	PB	NA	NA	1	0	1	0	1	NA	NA	NA	1
PARCEL	MAGAZINE	PM	NV	NV	NV	1	NV	NV	NV	NV	NV	NV	NV
BOX	SMALL	BS	NA	NA	0	NA	1	1	0	1	0	0	1
BOX	MEDIUM	BM	NA	NA	1	NA	0	0	1	0	1	1	0
T03	COCAINE	SOLID	1	L									
		CONTENT=	LETTER	LETTER	BOOK	MAGAZINE	CASSETTE	CASSETTE	CD-ROM or DVD	MATERIAL S	SHREDDED PAPER	BUBBLE WRAP	DOCUMENT
		SUB TYPE =	SMALL	LARGE			AUDO	VIDEO					
		CODE =	LS	LL	BK	MG	CA	CV	CD	CM	SP	BW	DP
PACKAGE	SUB TYPE	CODE											
ENVELOPE	MEDIUM	EM	1	1	NV	NV	NV	NV	NV	NV	NV	NV	NV
ENVELOPE	SMALL	ES	1	1	NV	NV	NV	NV	NV	NV	NV	NV	NV
PARCEL	BAG	PB	NA	NA	1	0	1	0	1	NA	NA	NA	1
PARCEL	MAGAZINE	PM	NV	NV	NV	1	NV	NV	NV	NV	NV	NV	NV
BOX	SMALL	BS	NA	NA	0	NA	0	0	0	0	0	0	0
BOX	MEDIUM	BM	NA	NA	0	NA	0	0	0	0	0	0	0

As mentioned previously, the responsibilities for this phase of the test operations will be divided among three teams. The Red Team will perform all duties required to create the items for inspection, secret the drugs within selected items, affix item identification codes, document the items' container configurations and target configurations, determine the order of item examination, as well as escort the item through the examination process. The Blue Team will perform all the item inspection duties, such as, examining each item with the SUTs, determining the presence or absence of drugs within any item, recording the results of each item's inspection, and tracking the items through the simulated mailroom. The Silver Team will monitor and manage the overall process of this test phase, as well as, serve as the data recipient/coordinator for all documentation developed during these operations. The Sections 5.11.1 through 5.11.3, below, spell out in more detail each team's role and documentation responsibilities.

5.11.1 RED TEAM

All effort required for the contraband smuggling portion of the test (obtaining, processing, packaging, etc., as well as any documentation thereof) will be the responsibility of the group denoted as the Red Team. The Red Team shall develop the

actual test items as described in the ITEM_CREATE_LIST.xls file. The Red Team will use a random order without? or with? replacement process provided by the Silver Team in the workbook file ITEM_EXAM_LIST.xls in the worksheet MAILROOM_ITEMS in selecting the order of items for SUT examination. The Red Team will then deliver to the appropriate Blue Team SUT operators the selected item. The Red Team will transfer and track each item between SUT inspection stations and return the items to the appropriate item confinement area outside of the simulated mailroom. In addition, the Red Team will be responsible for completion and prompt delivery to the Silver Team of a "Test Incident Report" for test anomalies or abnormalities falling within its operational capacity. The incident shall be recorded in the Red Team Incident Report sheet of the ITEM_EXAM_LIST.xls file. The incident should be reported as soon as practical to the Silver Team and they will take appropriate action based on the report. The Red Team will be responsible for monitoring, documenting, and controlling the item creation and storage space contamination levels as well as the SUT area contamination levels.

5.11.1.1 RED TEAM FUNCTIONS

The functions of the red team are enumerated below:

1. Acquire any supplies, equipment, and materials needed for creation of test items.
2. Complete and deliver to Silver Team and Test Director a "Test Incident Report Form" for any observed test abnormality or anomaly related to item creation or handling.
3. Complete electronic spreadsheet type file that lists materials, equipment, and supplies along with descriptions and quantities of same that are used in the creation of test items.
4. Assemble all test items (target and non-target types) as per Test Director's procedures.
5. Adhere to "Safe Handling Procedures". Use care and reasonable judgement in the handling of any drugs or drug surrogates.
6. Randomly order the succession of item examination.
7. Deliver selected items to the Blue Team in a timely manner to insure no stoppage of SUT examination process. Handle each item between SUT stations and remove items to appropriate holding areas outside of simulated mailroom after that item has passed through all SUT inspections.
8. Document each test item with an affixed and legible item identification number, a prescribed electronically stored record of item description complete with examination sequence number, and at least one and up to three digital images with any secreted drug indicated. All images will be delivered in Joint Photographer Group (jpg) format.

5.11.2 BLUE TEAM

All efforts required to simulate the penitentiary mailroom personnel for the mail item inspection portion of the test (mail pick up and handling, visual scrutiny, sample collection, setup and operation of the systems under test (SUTs), etc., as well as any documentation thereof) will be the responsibility of the Blue Team. The Blue Team will perform all the item inspection duties, such as, examine each item with the SUTs, determine the presence or absence of drugs within any item, and record the results of each

item's inspection. The Blue Team is also charged with the completion of a "Test Incident Report" for any anomalies or abnormalities that occur within its arena of operations that may influence conclusions drawn from test results. This will include, but is not limited to, SUT malfunctions or irregularities, mail item flow or handling problems, level of operator training or interpretation of system response issues, data entry or digital file difficulties, etc. TIRs should be completed as soon as possible by test personnel observing such incidents (with a copy of the form being submitted to the Silver Team without delay. The Blue Team will assemble all calibration data and record all QC data collected onsite throughout the test and deliver the same to the Silver Team. All of the Calibration, QC, TIR and system responses to mail items shall be recorded into the appropriate work sheet of a file called *SystemName*_DATA_TABLES.xls. There will be a separate file for each system under test and this name will appear in the place of the word *SystemName* in the file, e.g. AS&E66Z_DATA_TABLES.xls.

5.11.2.1 BLUE TEAM FUNCTIONS

The functions of the Blue team are enumerated below:

1. Set up of simulated mailroom and SUTs in a manner that item inspection operations may proceed either sequentially or in parallel, and without one or more of the SUT being functional or present.
2. Complete a "SUT Documentation Form" for each SUT in the simulated mailroom.
3. Assemble SUT calibration information and deliver it to Silver Team prior to test startup.
4. Carry out necessary training to become proficient in SUT operation and drug detection.
5. Perform quality control procedures as per Sections 5.1.1 through 5.1.7 above and manufacturer's recommendations. Deliver documented results to Silver Team promptly.
6. Obtain items for inspection from Red Team.
7. Submit each item for inspection by the SUTs while insuring that each item is examined by each SUT.
8. Document the results obtained for each item/SUT combination. Deliver results daily to Silver Team.

5.11.3 SILVER TEAM

The effort needed to develop this test plan, to insure the test protocols are adhered to by all test participants, and to assess the test's resultant data products (organizing, analyzing, interpreting, etc., as well as any documentation thereof) will be the responsibility of a group denoted as the Silver Team. All test personnel will be under the direction of the Silver Team Leader, who will report to the Director, TMEC. Throughout the test all data collected will be delivered to the Silver Team in a timely manner and in its appropriate form as specified elsewhere. The Silver Team will manage such data to enable prompt feedback to the Test Director for issues including overall test progress, significant test anomalies, indicated test plan modifications, etc. The Silver Team we be responsible for performing necessary daily data analysis, for providing SUT performance updates, and to determine the overall results from the mailroom scenario testing. The Silver Team will

create and maintain an electronic database for all data collected during this evaluation. This database will provide for storage and retrieval of data related to SUT documentation, SUT calibration, SUT quality control, item documentation, item examination results, SUT performance, test incident reports, etc. covered under all phases of this evaluation.

5.11.3.1 SILVER TEAM FUNCTIONS

The functions of the Blue team are enumerated below:

1. Create, adjust, and communicate test plan.
2. Develop prototype forms and files for Red and Blue Team use in recording all test data components.
3. Witness trace detection limit testing of four SUTs at manufacturer/vendor site.
4. Supply to Red Team random order procedure for each item's examination order selection.
5. Create, update, and maintain test result database.
6. Provide incremental and final test analyses and reports.

5.12 SYSTEMS TESTING PROCEDURES

The following steps are to be adhered to in the conduct of the USPS Contamination Test, the Target Order Test, and the Mail Room Scenario Test. The use of specific spread sheets for recording data and procedures for calibration, quality control and incidents not expected have been covered in the previous sections.

1. The Silver team shall random order the items for testing and provide the ITEM_EXAM_LIST.xls to the Red team.
2. The Silver Team shall conduct the daily meeting of the Red, Blue and Silver team leaders
3. The Blue team shall conduct calibration and QC checks per their system schedule
4. The Red team shall pull the individual test items per the ITEM_EXAM_LIST.xls and deliver them to the Blue systems
5. The Blue team shall inspect the item with the SUT and record the result in the *SystemName*_Data_Table.xls workbook file on the appropriate sheet.
6. Any Test Incidents are to be recorded and delivered to the Silver Team when they occur
7. Repeat steps 4 to 6 until the end of the test day
8. Red Team collects all Red team and Blue Team Excel files and delivers them to the Silver Team
9. Silver Team reviews files and readies for next day meeting

Appendix B:

Test Data

Drug Alarm Level Settings

The ion mobility systems' alarm level settings are documented in the tables below. Prior to any items being sampled the manufacturers representatives prescribed and set all drug detection algorithm values (peak locations, widths, and alarm thresholds) for their respective system under test (SUT). These values remained constant throughout the test period. No change in the settings was permitted as per the test plan, however, some units are designed to automatically adjust peak locations based on such items as system operational temperature fluctuations, barometric pressure changes, periodic routine quality control checks against a known calibrant, etc. Only those values programmed for signatures related to this test (i.e., calibrant, cocaine, or THC) are documented below. All readings were taken by the Silver Team.

Unit: TMEC owned and operated unit -Barringer, IONSCAN 400A, SN: 93XX

Used to periodically check for mailroom area contamination during the test period.

Drug or Calibrant Code	Peak Location Or Drift Time (milliseconds)	Deviation Allowed (Full Width at Half Maximum method) (microseconds)	Amplitude Threshold for Alarm Trigger (digital units)
Cocaine	1.1600	50	50
CocHigh	1.1600	50	600
HashMar1	1.3618	50	40
HashMar2	1.2965	30	50
HashMar3	1.0599	50	20
HashMar4	1.0492	50	20
THC	1.0454	50	25

Unit: System Under Test #4 - Barringer, IONSCAN 400B, SN: 10653

Drug or Calibrant Code	Peak Location Or Drift Time (milliseconds)	Deviation Allowed (Full Width at Half Maximum method) (microseconds)	Amplitude Threshold for Alarm Trigger (digital units)
Cocaine	1.1600	50	50
CocHigh	1.1600	50	600
HashMar1	1.3618	50	40
HashMar2	1.2965	30	50
HashMar3	1.0599	50	20
HashMar4	1.0492	50	20
THC	1.0454	50	25
_V-1	1.5310	30	100
_V-2	1.2145	30	100
_V-3	1.1020	30	100

Unit: System Under Test #3 - Barringer, SABRE, SN: 20066

Drug or Calibrant Code	Peak Location Or Drift Time (milliseconds)	Deviation Allowed (Full Width at Half Maximum method) (microseconds)	Amplitude Threshold for Alarm Trigger (digital units)
Cocaine	1.1600	55	25
CocHigh	1.1600	55	150
HashMar1	1.3618	60	30
HashMar2	1.2965	60	30
HashMar3	1.0599	60	30
HashMar4	1.0492	60	30
THC	1.0454	50	25
_V-2	1.2145	50	30

Unit: System Under Test #2 - IonTrack, VaporTracer2, SN: 02014891015

Drug or Calibrant Code	Peak Location Or Drift Time (milliseconds)	Deviation Allowed (microseconds)	Amplitude Threshold for Alarm Trigger (digital units)
Cocaine	6.05	-0.06, +0.06	700
THC	6.38	-0.08, +0.06	150
VCHECK	4.47	-0.04, +0.10	500

Unit: System Under Test #1 - IonTrack, Itemizer3, SN: 08014902095

Drug or Calibrant Code	Peak Location Or Drift Time (milliseconds)	Deviation Allowed (microseconds)	Amplitude Threshold for Alarm Trigger (digital units)
Cocaine	7.318	-0.040, +0.040	500
THC	8.022	-0.120, +0.080	500
CALTRAP	7.284	-0.040, +0.040	500

Operational Minimum Detection Limits (OMDL)

BTI IONSCAN 400B and BTI SABRE 2000

Tables 6.1.1-1 and 6.1.1-2 present the detailed results recorded for the two Barringer trace detection systems (Ionscan 400B & Sabre 2000). In general it was found that sensitivities were at or below a nanogram of drugs. The SABRE 2000 was not capable of detecting LSD.

Table 6.1.1-1 - OMDL test results for BTI IONSCAN 400B

INSTRUMENT ID:		IONSCAN MODEL 400B - SERIAL NUMBER 10653		
TEST DATE:		23MAY01 & 24MAY01		
TEST LOCATION:		BARRINGER INSTRUMENTS, INC., WARREN, NJ		
OPERATOR:		RENO DEBONO, BTI		
WITNESS:		FORREST SCOTT, SCA		

DRUG TYPE	SOLUTION CONC. (ng/ul)	SOLUTION AMOUNT (ul)	DRUG AMOUNT (ng)	DETECTIONS PER NUMBER OF SAMPLES	OMDL RESULTS (ng)
MARIJUANA (THC)	10	1	10	5 OF 5	0.5
	1	1	1	5 OF 5	
	0.1	1	0.1	0 OF 5	
	1	0.5	0.5	4 OF 5	
COCAINE	10	1	10	5 OF 5	0.01
	1	1	1	5 OF 5	
	0.1	1	0.1	5 OF 5	
	0.01	1	0.01	5 OF 5	
	0.01	0.5	0.005	0 OF 5	
HEROIN	10	1	10	5 OF 5	0.5
	1	1	1	5 OF 5	
	0.1	1	0.1	0 OF 5	
	1	0.5	0.5	5 OF 5	
METHAMPHETAMINE	10	1	10	6 OF 6	0.01
	1	1	1	5 OF 5	
	0.1	1	0.1	5 OF 5	
	0.01	1	0.01	5 OF 5	
	0.01	0.5	0.005	0 OF 5	
ECSTACY (MDMA)	10	1	10	5 OF 5	0.05
	1	1	1	6 OF 6	
	0.1	1	0.1	5 OF 5	
	0.1	0.5	0.05	5 OF 5	
	0.01	1	0.01	0 OF 5	
LSD	10	1	10	5 OF 5	0.5
	1	1	1	5 OF 5	
	1	0.5	0.5	5 OF 5	
	0.1	1	0.1	0 OF 5	

Table 6.1.1-2 - OMDL test results for BTI SABRE 2000

INSTRUMENT ID:		SABRE 2000 - SERIAL NUMBER 20334		
TEST DATE:		23MAY01 & 24MAY01		
TEST LOCATION:		BARRINGER INSTRUMENTS, INC., WARREN, NJ		
OPERATOR:		RENO DEBONO, BTI		
WITNESS:		FORREST SCOTT, SCA		

DRUG TYPE	SOLUTION CONC. (ng/ul)	SOLUTION AMOUNT (ul)	DRUG AMOUNT (ng)	DETECTIONS PER NUMBER OF SAMPLES	OMDL RESULTS (ng)
MARIJUANA (THC)	10	1	10	5 OF 5	5
	10	0.5	5	5 OF 5	
	1	1	1	0 OF 5	
COCAINE	10	1	10	5 OF 5	0.5
	1	1	1	5 OF 5	
	1	0.5	0.5	3 OF 5	
HEROIN	10	1	10	5 OF 5	5
	10	0.5	5	5 OF 5	
	1	1	1	0 OF 5	
METHAMPHETAMINE	10	1	10	5 OF 5	0.5
	1	1	1	5 OF 5	
	1	0.5	0.5	5 OF 5	
	0.1	1	0.1	0 OF 5	
ECSTACY (MDMA)	10	1	10	5 OF 5	0.5
	1	1	1	5 OF 5	
	1	0.5	0.5	4 OF 5	
LSD	NOT TESTED	NOT TESTED	NOT TESTED	NOT TESTED	NA

LSD not tested at operator request due to SUT's insensitivity to this drug.

ITI ITEMISER and ITI VAPORTRACER 2

Tables 6.1.2-1 and 6.1.2-2 present the detailed results for the two Ion Track trace detection systems (ITI Itemiser & ITI Vaportracer 2). In general it was found that sensitivities were at or below 50 nanograms of drugs.

Table 6.1.2-1 - OMDL test results for ITI ITEMISER

INSTRUMENT ID:		ITEMISER - SERIAL NUMBER 02014871714			
TEST DATE:		19JUN01			
TEST LOCATION:		ION TRACK INSTRUMENTS, INC., WILMINGTON, MA			
OPERATOR:		ED GERAGHTY, ITI			
WITNESS:		FORREST SCOTT, SCA			

DRUG TYPE	SOLUTION CONC. (ng/ul)	SOLUTION AMOUNT (ul)	DRUG AMOUNT (ng)	DETECTIONS PER NUMBER OF SAMPLES	OMDL RESULTS (ng)
MARIJUANA (THC)	10	1	10	3 IN A ROW	5
	10	0.5	5	3 OF 4	
COCAINE	10	1	10	4 OF 5	10
	1	0.8	8	2 OF 5	
HEROIN	10	1.5	15	2 OF 5	50
	10	2	20	0 OF 4	
	10	3	30	1 OF 4	
	10	4	40	0 OF 1	
	10	5	50	3 IN A ROW	
METHAMPHETAMINE	10	1	10	0 OF 3	50
	10	2	20	2 OF 5	
	10	3	30	0 OF 3	
	10	5	50	3 OF 5	
ECSTACY (MDMA)	10	1	10	0 OF 3	20
	10	3	30	3 IN A ROW	
	10	2	20	3 OF 5	
LSD	25	1	25	0 OF 1	150
	25	2	50	0 OF 1	
	25	3	75	0 OF 2	
	25	4	100	0 OF 2	
	25	6	150	3 OF 5	

Table 6.1.2-2 - OMDL test results for ITI VAPORTRACER 2

INSTRUMENT ID:		VAPORTRACER 2 - SERIAL NUMBER 06014891994			
TEST DATE:		29JUN01			
TEST LOCATION:		ION TRACK INSTRUMENTS, INC., WILMINGTON, MA			
OPERATOR:		ED GERAGHTY, ITI			
WITNESS:		FORREST SCOTT, SCA			

DRUG TYPE	SOLUTION CONC. (ng/ul)	SOLUTION AMOUNT (ul)	DRUG AMOUNT (ng)	DETECTIONS PER NUMBER OF SAMPLES	OMDL RESULTS (ng)
MARIJUANA (THC)	10	1	10	0 OF 1	NA1, NA2
	10	2	20	0 OF 1	
	10	3	30	0 OF 3	
	10	4	40	1 OF 6	
COCAINE	10	1	10	2 OF 4	15
	1	1.5	15	3 IN A ROW	
HEROIN	100	0.5	50	3 IN A ROW	40
	100	0.4	40	3 IN A ROW	
METHAMPHETAMINE	10	1	10	1 OF 4	15
	10	1.5	15	3 OF 4	
ECSTACY (MDMA)	10	1	10	1 OF 3	20
	10	1.5	15	2 OF 5	
	10	2	20	3 IN A ROW	
LSD	25	1	25	0 OF 2	NA2
	25	4	100	0 OF 1	
	25	8	200	0 OF 2	
	25	16	400	0 OF 1	
	25	20	500	0 OF 1	

NA1 – Heroin and THC had peak location interference that operator was unable to resolve. Testing for this drug terminated at operator's request.
NA2 – Testing for this drug terminated at operator's request.