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Test and Evaluation Plan for Screener Proficiency Evaluation and Reporting System (SPEARS) Threat Image Projection

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16. Abstract

This document is the Test and Evaluation Plan (TEP) to evaluate the effectiveness of the threat image projection training and testing component of the Screener Proficiency Evaluation and Reporting System (SPEARS).

This TEP is for the test and evaluation of the EG&G Astrophysics Linescan Training and Testing (TnT™) system and will focus on determining its effectiveness in meeting the requirements set forth in the Critical Operational Issues and Criteria and Critical Technical Issues and Criteria provided by the Federal Aviation Administration.

The test and evaluation will be conducted at the Los Angeles International Airport. The results will be analyzed and become part of a later document.

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PREFACE

This test plan was developed to support investigation of the Critical Technical Issues and Criteria and Critical Operational Issues and Criteria set forth by the Federal Aviation Administration to assess the capability of the candidate Screener Proficiency Evaluation and Reporting System. The key FAA personnel supporting this testing effort are J. L. Fobes, Ph.D., Aviation Security Human Factors (AvSec HF) Program Manager and Engineering Research Psychologist for the Aviation Security Research and Development Division (AAR), and D. Michael McAnulty, Ph.D., an Engineering Research Psychologist with the Center for Aviation Simulation and Human Factors.

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LIST OF ABBREVIATIONS AND SYMBOLS

β	Beta, Operator Response Criterion
AAR-510	Requirements Analysis and Integration Branch
ACT-500	Simulation and Human Factors Division
ANOVA	Analysis of Variance
AvSec HF	Aviation Security Human Factors
c	Operator Response Criterion
CBD	Commerce Business Daily
CBT	Computer-Based Training
CO	Carry-On
COIC	Critical Operational Issues and Criteria
CTI	Combined Threat Image
CTIC	Critical Technical Issues and Criteria
d'	d prime, Derived Operator Sensitivity
DCS	Digital Control Systems
DOT	Department of Transportation
ERAU	Embry-Riddle Aeronautical University
FAA	Federal Aviation Administration
FTI	Fictional Threat Image
GSC	Galaxy Scientific Corporation
HF	Human Factors
HFE	Human Factors Engineering
HFT	Hidden Figures Test
HPT	Hidden Patterns Test
IED	Improvised Explosive Device
LAX	Los Angeles International Airport
MBS	Modular Bomb Set
MOP	Measure of Performance
N	Noise
N_{fa}	Number of False Alarms
N_h	Number of Hits
OT&E	Operational Test and Evaluation
P_d	Probability of Detection
P_{fa}	Probability of False Alarm
P_h	Probability of Hits
ROC	Receiver Operating Characteristic
SDT	Signal Detection Theory
SN	Signal-Plus-Noise
SPEARS	Screener Proficiency Evaluation and Reporting System
T&E	Test and Evaluation
TEP	Test and Evaluation Plan
TER	Test and Evaluation Report
TIP	Threat-Image Projection
TnT™	EG&G Astrophysics Linescan Training and Testing System
TRR	Test Readiness Review

TVRTM	Test Verification Requirements Traceability Matrix

1. INTRODUCTION.

1.1 GENERAL.

The Screener Proficiency Evaluation and Reporting System (SPEARS) is being developed to improve and maintain the effectiveness of security screening personnel employed at airport security checkpoints. The SPEARS consists of two components: (a) an off-line Computer-Based Training (CBT) system to teach screeners to detect various threat objects, and (b) an on-line threat image projection (TIP) training and testing component employed at airport security checkpoints. This latter configuration is to further develop and maintain threat detection proficiency by projecting simulated X-ray images of threat objects into X-ray images of actual passenger bags. The effectiveness of the CBT and TIP components will be addressed during separate test and evaluation (T&E) activities.

This Test and Evaluation Plan (TEP) addresses the Critical Operational Issues and Criteria (COICs) and Critical Technical Issues and Criteria (CTICs) established by the Federal Aviation Administration (FAA) for the TIP component of the SPEARS.

1.2 PURPOSE.

The SPEARS Operational Test and Evaluation (OT&E) for the TIP component is being conducted to evaluate the ability of the SPEARS to improve, maintain, and monitor airport X-ray screener performance. Maintaining a workforce of adequately trained and performing X-ray screening personnel is critical to the mission of aviation security, both domestically and internationally. This TEP outlines the methods and procedures to be used in ensuring that the candidate SPEARS devices meet the functional requirements established by the FAA as being necessary to produce this workforce. These methods include the collection and analysis of empirical data on the operational capabilities of candidate SPEARS devices.

1.3 SCOPE.

The TEP will be executed during an OT&E to evaluate the EG&G Astrophysics Linescan Training and Testing System (TnT™) on-line training and testing component. The TnT™ is currently the only SPEARS TIP device whose manufacture has agreed to an FAA evaluation. The OT&E will be conducted in two parts and the COICs will be evaluated during operational testing at the Los Angeles International Airport (LAX). Following operational testing, the CTICs will be evaluated during technical testing, either in the FAA Aviation Security Laboratory or at the vendor facility. The T&E will focus on determining how effective the SPEARS is in meeting the functional requirements embodied in both the COICs and CTICs, and in complying with Human Factors Engineering (HFE) design principles.

SPEARS provides training for many categories of threats. Historically, threat objects such as weapons have resulted in the highest detection rates in operational settings. In many cases, the detection rates associated with these types of threats would be difficult to improve. Comparatively, detection rates for Improvised Explosive Devices (IEDs) have been lower. IED detection performance is, therefore, of specific concern to this study, and operational testing will focus on the ability of SPEARS TIP training and testing to improve IED detection performance. Specifically, IED detection performance for one group of subjects trained using the SPEARS TIP component will be compared with a second (control) group of subjects not receiving such training. To ensure that the T&E addresses operational effectiveness, subjects will consist of certified airport screeners carrying out their normal screening duties at LAX.

1.4 BACKGROUND.

1.4.1 SPEARS Program Background.

The SPEARS Program was initiated in response to a congressional mandate (Aviation Security Improvement Act of 1990, Public Law 101-604) tasking the FAA to improve aviation security through the optimization of Human Factors (HF) elements in the U.S. airport security system. The issue of screener performance and effectiveness was highlighted as an area requiring evaluation to identify potential security improvements. An aviation security Department of Transportation (DOT) task force supported this thrust by concluding that human performance was the critical element in the screening process.

The mandate directed that screeners be effectively trained to use threat detection equipment properly. The detection of explosive and incendiary devices was critically important because of the potential for significant damage, causing a crucial loss of life and aviation resources.

The FAA's Aviation Security Human Factors (AvSec HF) Program published initial SPEARS functional descriptions in the Commerce Business Daily (CBD) to invite vendors to develop candidate SPEARS devices. Another objective of the CBD announcement was to determine if any available commercial equipment existed that could potentially meet the SPEARS objectives and functional requirements.

This research is sponsored by the AvSec HF Program, Office of Aviation Security Research and Development (AAR-510), located at the FAA Technical Center in Atlantic City, New Jersey. Support for the research is provided by the FAA Simulation and Human Factors Division (ACT-500), also located at the FAA Technical Center, and by AAR-510 support contractors.

1.4.2 X-Ray Screener Duties.

Airport security checkpoints are located outside of airline boarding areas and typically include a moving conveyor belt, an X-ray screening device and an X-ray display monitor. Passenger baggage is carried by the conveyor belt through the X-ray equipment, which produces images of the bag contents. The X-ray images are then displayed on the monitor for evaluation by certified screeners.

X-ray screeners generally work 8-hour shifts, comprising 15- to 45-minute shift intervals separated by 5- to 10-minute breaks. Screeners work in teams of two or more; however, only one screener is assigned to observe a given X-ray monitor at any one time. After baggage is loaded onto the conveyor belt and scanned, the X-ray image is presented to the screener observing the monitor. The screener visually scans the image and performs an initial image analysis. Image features are analyzed for attributes such as size, profile, angle, shape, and content components. The images may be enhanced by selected screen functions such as color coding, comparing black/white and color images, and magnifying sections of the image.

After initial image analysis and enhancement, the screener must decide whether an obvious or potential threat exists. The decision can result in one of the following five outcomes.

a. No Threat - If all items can be identified and the screener determines that no threat exists, the bag is passed on and the screener begins image analysis of the next bag.

b. Unidentified Items - If all items cannot be positively identified, the screener may reposition the bag and rescan. If the items are still not identifiable, the screener will call for a bag check (usually a hand check performed by another security worker) and continue scanning duties.

c. Potential Threat - If a potential threat is detected or objects cannot be identified due to clutter, opaque shading, or positioning; or if suspicious electronic devices are detected; the screener may stop the belt, alternate the position of the baggage, and rescan. If the baggage objects are still unidentifiable, or are in any way suspicious, the screener will call for a bag check.

d. Nonpermissible Item(s) - Nonpermissible items include hazardous or toxic materials like mace, chemicals, gasoline, and flammable liquids. If a nonpermissible item is detected, the screener will call for a bag check and indicate the location of the item(s) detected to the security team member performing the bag check. The bag is then released to the team member and the screener will continue with the next bag.

e. Obvious Threat - If the screener detects an obvious threat (such as a gun, knife, explosive, or grenade), the belt is stopped immediately and the article is retained under the X-ray scan. The screener will then depress an emergency button, notify the supervisor on duty, and instruct the baggage owner to wait until the baggage contents have been examined and secured. When a law enforcement agent arrives, the screener will identify the area and item of concern. When instructed, the screener will release the article and restart the belt.

1.5 FUNCTIONAL REQUIREMENTS.

The SPEARS TIP is intended to provide X-ray screeners and supervisory personnel with recurrent training, performance monitoring, and evaluation capabilities. A successful SPEARS should ultimately improve the airport baggage screener's threat detection performance in two ways. Exposure to a large image library of threat objects should enhance screener familiarity with images of actual threat objects. Screener performance monitoring and feedback, accompanying false image insertion, should also provide increased motivation and vigilance.

This TEP addresses only the requirements for the on-line testing and training component. The off-line instructional training portions of the SPEARS were investigated in an earlier T&E (see the Test and Evaluation Report [TER] for the Screener Proficiency Evaluation and Reporting System [SPEARS] Computer-Based Training [Fobes, et al., 1995]). Although separated for the purposes of T&E, the SPEARS components should be used in conjunction with one another for optimal training of screening personnel.

1.5.1 Literature Review.

For the SPEARS to be effective, it must increase human ability in the identification of targets, namely threat objects. The aim of the SPEARS TIP component is to enhance the ability of screeners to detect threats within baggage through regular exposure to a variety of threat images. This exposure is accomplished by using TIP to insert FTIs onto the X-ray images of normal baggage flow being X-rayed, or to insert CTIs consisting of fictitious images of passenger bags containing threat images into the normal passenger bag image flow. TIP exposure is expected to enhance detection performance in the following two ways.

a. Screeners will gain experience and thereby increase their ability to locate and identify a diverse array of threat objects under normal working conditions.

b. Regular exposure to threat images will increase screener attention levels, thereby maintaining the screener's ability to detect threats in cluttered bags.

The expected performance effects from the SPEARS TIP component are supported by a review of the applicable HF and psychology literature, specifically in the areas of Signal Detection Theory (SDT), vigilance theory, and training.

1.5.1.1 Implications of Signal Detection Theory for the SPEARS.

SDT considers, in part, the role of human vigilance in human detection of infrequent target signals. A description of SDT is provided in Appendix A. Key to the purpose of the SPEARS TIP is the concept of vigilance decrement. The vigilance decrement has been defined as a decrease in human performance as a function of time on task (Wickens, 1992). In experimental paradigms, signal detection rates and signal detection measures (d' [derived operator sensitivity] and β or $\underline{c}$ [Operator Response Criterion]) are collected in time increments, with the results demonstrating decreasing signal detection performance over time. Although many factors can contribute to this decrement, the factor most pertinent to X-ray screening of airline passenger baggage is criterion shifts associated with lower levels of target expectancy. Because the frequency of IED presentation for the screener in a real operational setting is extremely low, the screener may be unprepared to detect a threat object on the rare occasion when one is presented.

In SDT terms, the expectancy-derived vigilance decrement is attributed to an upward adjustment of the operator response criterion in response to a reduction in the perceived frequency (and therefore expectancy) of target events (Wickens, 1992). If the operator response criterion is based on perceived target frequency levels, then additional missed targets may result in the perception of even lower target frequencies. The corresponding effect may be a continual decrease in detection performance.

Nadler, Mengert, and Carpenter-Smith (1994) indicate that inserting TIPs into the normal flow of baggage should increase the expectancy levels of the baggage screeners, thereby counteracting this adverse criterion shift and increasing overall detection rates of actual threat objects. To increase screener expectancy levels, adequate and immediate knowledge of results for both real and artificial threats is required. TIP must also increase operator sensitivity so that the shift in criterion is not accompanied by an increase in false alarms.

Operational screener watch durations are relatively short. For carry-on (CO) baggage screeners, the watch duration ranges from 20 to 30 minutes, depending on the security procedures in use at the particular airport. Similarly, the watch durations for checked baggage screeners rarely exceed 1 hour. The majority of vigilance decrement research has focused on tasks with watch durations of 1 hour or greater, usually focusing on conventional work shifts of 2-, 4-, or 8-hour watches. While it is doubtful that the degree of vigilance decrements detected towards the end of the eighth watch hour are directly applicable to a 20-minute or 1 hour session, vigilance decrement effects are expected to accumulate across multiple screening shifts.

The lack of actual threat presentation over several weeks, months, or years is expected to result in dramatically reduced signal expectancy. This effect might be counteracted through the systematic use of techniques (e.g., by regular insertion of FTIs and CTIs into the baggage screening environment) that change the expectancy of threat events. According to SDT, therefore, the SPEARS TIP may result in enhanced screener detection performance by maintaining appropriate response criteria over extended periods.

1.5.1.2 Implications of Training Theory on the SPEARS.

The training literature reveals implications for the design and implementation of a SPEARS device. In a review of training literature, Goldstein (1986) found that distributed practice for procedural skills, such as X-ray screening, provides the most advantageous results over time. Massed practice sessions tend to show better immediate training results and also require less overall training time to achieve a minimum criteria. Massed, off-line, instructional training is, therefore, a necessary component of screener training. For retention over extended periods, however, the distributed or spaced training sessions will result in better overall performance. TIP, as a regular component of the screener's daily activities, should result in improved IED detection performance.

Practice alone will not provide adequate training retention. Adequate retention requires a series of interacting training variables, which includes an adequate knowledge of results and proper motivation of the trainees. Adequate and immediate feedback to TIP responses (correct and incorrect) should also help to improve screener performance.

Another factor critical to the acquisition and subsequent retention of job skills is the extent to which training is transferred to the operational environment. The TIP concept employs the principle of *identical elements,* in that the training task uses the identical environment and stimuli to that of the actual screening task. Training theory predicts that this training principle should result in a high level of transfer of TIP training to the operational environment, which should result in increased IED detection performance.

1.6 SYSTEM DESCRIPTION.

For this SPEARS TIP OT&E, only one vendor, EG&G Astrophysics TnT™, agreed to have their system evaluated.

1.6.1 EG&G Astrophysics TnT™.

The following is a technical description of the TnT™ components to be tested.

a. A color monitor and a black/white monitor mounted side-by-side, just as the monitors are mounted on the EG&G Astrophysics E-Scan X-ray machine.
b. A control panel mounted below the monitors that replicates the control panel on the E-Scan X-ray machine.
c. A trackball located to the right of the control panel that operators use to interact with the training programs.
d. A computer located inside the equipment housing that runs the training programs.
e. A variety of cables and connectors used to connect the training system to the EG&G Linescan X-ray and to the recording equipment, such as video recorders.

1.6.2 X-Ray Machine Modifications.

To allow for the connection of TnT™ workstations, input boards will be installed by EG&G Astrophysics to two of the Linescan System Ten X-ray machines at LAX, Terminal 2.

1.7 TEST OVERVIEW.

There are two categories of issues that will be used to assess the candidate SPEARS against the functional requirements: (a) operational issues and (b) technical issues. As these issues involve substantially different requirements and investigation methods, the overall SPEARS FIP OT&E is similarly partitioned.

1.7.1 Critical Operational Issues and Criteria Evaluation.

The Critical Operational Issues and Criteria (COICs) are those issues and criteria necessary to evaluate the SPEARS operational requirements at a field test at LAX. The field test will involve collecting data to assess the effectiveness of the SPEARS TIP testing and training on screener IED detection performance. Subjective rating and comment data will also be collected to determine the level of usability of the SPEARS and the representativeness of threat insertion using TIP.

1.7.2 Critical Technical Issues and Criteria Evaluation.

The Critical Technical Issues and Criteria (CTICs) are those issues and criteria necessary to evaluate the SPEARS against technical requirements, such as system customization, screener capabilities reporting, interoperability, feedback, security, insertion, and image content. The CTICs will be investigated using structured protocols during technical testing of system features. Examples of the features to be tested are the number of possible stored images, reporting capabilities, and the ability to receive new threat images through a modem.

1.7.3 Test Limitations and Impact.

In addition to measuring the vigilance aspects of detecting the FTIs and CTIs, the training aspects will be examined using a computer-based, black and white X-ray image presentation device. This study of the generalized performance improvements will involve presenting 25 CO test bag images, each containing a Modular Bomb Set (MBS), randomly inserted into a series of 175 comparison bag images (i.e., bags without MBSs). The primary reason for using the computerized device rather than actual baggage containing MBSs is to avoid the negative effects that multiple trials using actual bags would have on passenger flow and airline operations. The computerized testing lacks some aspects of operational representativeness, but the effects of this diminished representativeness include obtaining the screener's maximal capability. The screeners will analyze actual X-ray images and will be required to respond quickly to each image, simulating the passenger flow requirements at the checkpoint.

The SPEARS TIP is meant to be tailored by supervisors to individual screener abilities, training needs, and workload. Such tailored training and testing will not be possible during this OT&E, and a more generic training and testing protocol will be utilized (see section 2.4.2.1). Therefore, the optimal impact of the SPEARS TIP training may not be achieved for some of the screeners in this study.

1.8 CRITICAL OPERATIONAL ISSUES AND CRITERIA.

In the sections that follow, the top-level operational testing procedures will be discussed. Each operational issue is identified along with its criteria, Measures of Performance (MOPs), and test strategy.

The issues will be investigated through screener performance data collected during the study, and through subjective comments and ratings collected after the study's completion. Additional data for the usability issue will be collected by using a tailored Usability HFE Checklist (Appendix B) based on the *Guidelines for the Design of User Interface Software* (Smith and Mosier, 1986). The primary experimental design and test procedures are provided in sections 2.4 and 2.7, which include discussions about specialized data collection needs for usability and insertion.

1.8.1 Training.

1.8.1.1 Issue.

Does TIP enhance screener performance?

Criterion A. Projecting fictional images is accompanied by a sustained increase (statistical) in the screener's probability of detection (P_d) of IEDs.

MOP 1. The Number of Hits (N_h) for test bag images collected before and after exposure to the SPEARS treatment.

NOTE: The relationship between N_h and P_d will be discussed in section 2.7.1.2.

Criterion B. Projecting fictional images is not accompanied by a sustained increase (statistical) in the screener's probability of false alarm (P_{fa}) when scanning for IEDs.

MOP 2. The Number of False Alarms (N_{fa}) for comparison bag images collected before and after exposure to the SPEARS treatment.

NOTE: The relationship between N_{fa} and P_{fa} will be discussed in section 2.7.1.2.

Criterion C. Projecting fictional images is accompanied by a sustained increase (statistical) in the screener's d′.

MOP 3. The d′ to detect the test bag images collected before and after exposure to the SPEARS treatment.

1.8.1.2 Test Strategy.

MOP data will be collected concurrently for two groups of screeners during a field study at LAX. One group of screeners, the experimental group, will be exposed to the SPEARS TIP. The other, the control group, will be tested without exposure to the SPEARS TIP. To determine the effect of SPEARS training on IED detection performance, N_h and N_{fa} will be observed and recorded for individual screeners three times during the study: (a) during a pretest before the SPEARS TIP training begins for the experimental group, (b) during a posttest 4 weeks after the pretest, and (c) during a second posttest 8 weeks after the first posttest.

The MOP data will be used to derive P_d and P_{fa} for each screener. The values of P_d and P_{fa} will be compared between training and control conditions and across measurement periods to determine the effect of the SPEARS TIP on IED detection performance.

1.8.2 Vigilance.

1.8.2.1 Issue.

Does SPEARS TIP increase and sustain screener vigilance in detecting threat images?

Criterion A. There is a sustained increase (statistical) in P_d of FTIs for the TIP training group during the first 4 weeks of the study.

MOP 5. The N_h for FTIs collected across the period of the SPEARS treatment.

Criterion B. There is a sustained increase (statistical) in P_d of FTIs for the TIP training group during the last 8 weeks of the study.

MOP 6. The N_h for FTIs collected across the period of the SPEARS treatment.

1.8.2.2 Test Strategy.

MOP data will be collected during a field study at LAX. The SPEARS device will be installed at the airport and used by the experimental group of screeners over an extended period. To determine the effect of SPEARS TIP on screener vigilance, the number of FTI presentations and N_h will be observed and recorded for the experimental group screeners throughout the SPEARS intervention. Unfortunately, the SPEARS device does not record false alarms or the total number of passenger bags screened, so other measures (e.g., SDT measures) cannot be computed. The resulting Pd measures will be compared across weekly segments of the study to determine if screener performance increases from initial levels and is then maintained over time.

1.8.3 Usability.

1.8.3.1 Issue.

Are there any software or hardware factors or procedural aspects that degrade the screeners' or supervisors' ability to use the system effectively?

Criterion A. Investigative in nature.

MOP 7. Subjective ratings of system usability by screeners and supervisors.

MOP 8. HFE Checklist results.

1.8.3.2 Test Strategy.

During the screener off-line performance data collection sessions, usability evaluations will be performed. The usability issue is relevant to the supervisors who program the machine and to the screeners who must detect and respond to the TIP capability (i.e., TIP button on the TnT™). The usability evaluations will consist of structured interviews (Appendix C), the completion of rating scales by the participating screeners and supervisors, and the application of a tailored SPEARS Usability Human Factors Engineering (HFE) checklist (see Appendix B), which is based on the *Guidelines for the Design of User Interface Software* (Smith and Mosier, 1986) and MIL-STD-1472D.

1.9 CRITICAL TECHNICAL ISSUES AND CRITERIA.

This section identifies each technical issue, its related criteria, MOPs, and test strategy to be addressed by OT&E. The test methods to be used include the following:

a. Analysis - A method of verification that consists of comparing hardware or software design with known scientific and technical principles, technical data, procedures, and practices to validate that the proposed design will meet the specified functional or performance requirements.

b. Inspection - A method of verification to determine compliance with specification requirements that consists primarily of visual observations or mechanical measurements of equipment, physical locations, or technical examination of engineering support documentation.

c. Study - Not defined in DOT Order 1810.4F (1992), but a study usually entails a systematic field or laboratory investigation and is the ultimate measure of the usability of a system. It includes the verification methods of analysis, demonstration, inspection, and test (Cook and Campbell, 1979).

Several of the technical issues for this OT&E are redundant with technical issues tested in the SPEARS CBT T&E. For these issues, the data resulting from the CBT T&E will be incorporated into the SPEARS TIP Test and Evaluation Report (TER), with the source of the data appropriately annotated. All technical issues are restated here for clarity.

The following details the CTICs and associated MOPs for the OT&E. Unless otherwise stated, the MOPs will be collected through structured protocols conducted in either the Aviation Security Laboratory or on-site at the airport. The SPEARS device will be made operational at the testing site. Any training required on the operation of applicable system components will be requested from the vendor. The researcher will exercise the system to the extent necessary to evaluate the issue.

1.9.1 Image Content.

1.9.1.1 Issue.

Do images represent the range of current threats?

Criterion A. At least 300 different CTIs will be available representing threat categories of weapons, incendiaries, explosives, and other dangerous/deadly devices.

MOP 9. The number of CTIs available.

MOP 10. The threat category of each CTI available.

Criterion B. At least 300 different FTIs will be available representing threat categories of weapons, incendiaries, explosives, and other dangerous/deadly devices.

MOP 11. The number of FTIs available.

MOP 12. The threat category of each FTI available.

Criterion C. At least two different aspect angles will be available for each particular threat object.

MOP 13. The aspect angles available for each CTI.

MOP 14. The aspect angles available for each FTI.

Criterion D. The degree of detection difficulty varies.

MOP 15. Detection difficulty of the FTIs varies as a function of the contents of the actual bag being examined and will, therefore, not be assessed. CTIs will be assessed by ratings provided by screeners or subject-matter experts.

1.9.1.2 Test Strategy.

An inspection of the threat object database will be made to verify that at least 300 different CTIs and 300 FTIs are available, and that these are representative of the threat categories of weapons, incendiaries, explosives, and other dangerous/deadly devices. The inspection will also determine that at least two different aspect angles are available for each CTI and FTI and that the degree of detection difficulty varies for these different items in CTI displays. These evaluations will be accompanied by completing the SPEARS Image Content Checklist (Appendix D), which addresses the pertinent technical issues.

1.9.2 Customization.

1.9.2.1 Issue.

Can performance monitoring be tailored to individual screener needs?

Criterion A. Images can be selected for each screener as a function of threat category, difficulty, and aspect angle, which are archived along with the associated outcome of the FTI (hit, miss, false alarm, correct rejection).

MOP 16. The methods of selecting CTIs based on image factors.

MOP 17. The methods of archiving results for CTIs based on image factors.

MOP 18. The methods of selecting FTIs based on image factors.

MOP 19. The methods of archiving results for FTIs based on image factors.

Criterion B. FTIs and CTIs can be automatically or manually selected for presentation based on such factors as time of day, checkpoint activity, or screener identity.

MOP 20. The methods of selecting CTIs based on external factors.

MOP 21. The methods of selecting FTIs based on external factors.

1.9.2.2 Test Strategy.

During the OT&E, the SPEARS Customization Checklist (Appendix E) will be used to assess the degree to which TnT™ performance monitoring has been tailored to individual screener needs. The checklist items cover the methods for selecting and archiving of CTIs and FTIs using both manual and automatic processes.

1.9.3 Feedback.

1.9.3.1 Issue.

Is feedback provided?

Criterion A. The device will immediately inform the screener on whether each threat object was correctly identified.

MOP 22. The feedback provided by the SPEARS device regarding the accuracy of threat object disposition as determined by demonstration and inspection.

1.9.3.2 Test Strategy.

Test bags not containing actual threat objects will be passed through the X-ray scanning device. The SPEARS device will be used to insert threat object images onto the test bag images. In addition, test bags will be run through without receiving FTI projections. The researcher will correctly or incorrectly press the TIP key when an image is presented and record the feedback provided. For the purposes of this test, feedback is defined as any combination of visual or auditory messages that is intended to alert the X-ray screener and explain the status of the image scanning. Additionally, the checklist (Appendix F) will be used to determine the extent to which screener feedback is provided.

1.9.4 Capability Summaries.

1.9.4.1 Issue.

Are performance reports prepared?

Criterion A. The device automatically generates performance reports containing descriptive statistics and readily understandable interpretations to summarize records of threats presented and the outcomes.

MOP 23. The content and presentation method of summary reports provided by the SPEARS device as determined by demonstration and inspection.

MOP 24. The degree to which reports are determined to be understandable through interviews with screeners and supervisors and assessment using Human Factors (HF) checklist design principles and criteria.

Criterion B. Supervisors can be alerted when screener performance falls below operational requirements during a screening session.

MOP 25. The performance tracking and notification parameters provided by the SPEARS device as determined by description and inspection.

1.9.4.2 Test Strategy.

The performance reports will be automatically tabulated and produced by the SPEARS device upon prompting by the researcher. A SPEARS Capabilities Summaries Checklist (Appendix G) will also be used to evaluate the content and presentation methods employed in the performance summary reports.

1.9.5 Interoperability.

1.9.5.1 Issue.

Can the TnT™ equipment communicate with remote computers?

Criterion A. Additional FTIs and CTIs can be received from remote sites.

MOP 26. The method of remote connection to the SPEARS device.

MOP 27. Demonstration of CTIs downloaded to the SPEARS device.

MOP 28. Demonstration of FTIs downloaded to the SPEARS device.

MOP 29. Time required to transfer a CTI.

MOP 30. Time required to transfer an FTI.

Criterion B. The equipment will be able to transmit reports to remote sites.

MOP 31. The SPEARS remote performance monitoring capability.

1.9.5.2 Test Strategy.

The Interoperability Checklist (Appendix H) will be used to evaluate the extent to which the TnT™ equipment can communicate with remote computers. A computer will be installed at a remote location and connected by modem with the device at the test site. A researcher at each location will attempt to download new images to the SPEARS devices. Additionally, researchers will attempt to access reports from the remotely situated SPEARS device.

1.9.6 Security.

1.9.6.1 Issue.

Is access restricted?

Criterion A. Only authorized screeners and supervisors can access certain aspects of the system.

MOP 32. Computer Software Security Checklist results.

1.9.6.2 Test Strategy.

The security issue will be investigated though a combination of a structured checklist and a demonstration of security features. The security checklist is based on the *Department of Defense Trusted Computer System Evaluation Criteria* (DOD-5200.28-STD) and is contained in Appendix I.

1.9.7 Insertion.

1.9.7.1 Issue.

Can images consisting of an FTI or a CTI be automatically and unpredictably (for screeners) inserted on the checkpoint X-ray display? Each FTI consists of only a single threat object.

Criterion A. FTI position can be randomly determined.

Criterion B. FTI orientation within each bag is controllable.

MOP 33. Recording of presentation order for FTIs and CTIs, and image threat placement for FTIs, using a baggage content locator matrix, which will be used to determine any predictable presentation patterns and FTI orientation controllability.

1.9.7.2 Test Strategy.

Baggage not containing threat objects will be passed through the X-ray device and the SPEARS device will be used to insert FTIs onto the display of the bag image. In addition, a series of neutral bags will be run through the X-ray device and the SPEARS device will be used to insert CTIs into the baggage flow. For the bags that have FTIs inserted, the position of each threat image will be noted on a 3 by 3 cell grid. The order of placement in each cell across FTIs will be analyzed for randomness. In addition, the placement of CTIs and FTIs within the baggage flow will be recorded and analyzed for randomness. An Image Insertion Checklist (Appendix J) will be used to evaluate the proper insertion of images into the checkpoint X-ray display.

1.10 OPERATIONAL TEST AND EVALUATION MILESTONES.

Table 1 shows the milestones for planning and reporting the OT&E.

TABLE 1. OPERATIONAL TEST AND EVALUATION MILESTONES

Milestone	Date	Responsible Organization
Test Concept/Design Approval	03/15/95	AAR-510
Initial TEP Submittal	05/01/95	Contractor
Coordinate Test Site	04/03–05/95	AAR-510/Contractor

X-Ray Machine Modifications	07/13/95	Contractor
TEP Approved	07/14/95	AAR-510
Pilot Test	07/17–19/95	AAR-510/Contractor
OT&E Initiated	07/31/95	AAR-510/Contractor
TIP 1	08/04/95	AAR-510/Contractor
First Posttest	09/12/95	AAR-510/Contractor
TIP 2	09/18/95	AAR-510/Contractor
Second Posttest	11/06/95	AAR-510/Contractor
OT&E Completed	11/10/95	AAR-510/Contractor
TER Submitted	01/12/96	Contractor
Evaluation Briefing	01/26/96	AAR-510

2. OPERATIONAL TEST AND EVALUATION.

2.1 SUBJECTS.

Two groups of subjects, a training group and a control group, will be used to conduct the operational assessment of the SPEARS on-line training and testing. The control group will not receive SPEARS TIP training during the OT&E. If the control group is aware of the activities of the training group, the members might exhibit decreased performance over time caused by not being selected for special treatment. To reduce this effect, the training and control groups will be physically separated by conducting testing at LAX in two separate terminals.

The initial sample will consist of 30 baggage screeners selected from the day (0630-1500 hours) and swing (1430-2300 hours) shifts at LAX Terminal 7 (United Airlines) and 24 screeners selected from the day and swing shifts at LAX Terminal 2 (Northwest Airlines). The number of subjects for each group was chosen to account for anticipated attrition. It is expected that 20 screeners will remain in each group at the end of the study. The Terminal 7 screeners will participate in the control group and the Terminal 2 screeners will participate in the training group. To help control X-ray screening aptitude across treatment groups, the training and control group samples will be tested on the Embry-Riddle Aeronautical University (ERAU) computerized versions of the Hidden Figures Test (HFT) and Hidden Patterns Test (HPT) (Gibb, Banarjee, Bennett, Baker, and Kelly, 1995, and Appendix K). The tests will be used to form three blocking levels of high, medium, and low performance, with roughly equal numbers of subjects assigned to each blocking level within each experimental group

2.2 SUBJECT TRAINING.

The screeners will be briefed about the study in terms of their activities, schedules, and expectations as participants. They will also be asked to complete a consent form and a personal data form (see Appendixes L and M) before participating in the study. The screeners will also receive protocol instructions (see Appendix N) before the study and immediately before each major test activity.

Because training and experience will vary across subjects, all participants will attend a lecture session that will provide explanations of X-ray screening philosophy and procedures, image interpretation, and possible threat objects. This training will seek to equalize knowledge across subjects. The training is expected to require approximately 2 hours to complete.

Training on the use of the specific SPEARS device will be provided to the entire Terminal 2 screening staff. Because of the flexibility inherent in airport baggage screener duty cycles, there is a chance that a Terminal 2 screener may inadvertently receive a TIP, even though the screener is not a member of the training group. To account for this eventuality, all Terminal 2 screeners will receive training to recognize and properly resolve a TIP.

2.3 TEST ORGANIZATION.

2.3.1 Personnel Requirements.

The number of test administrators required varies across testing activities, as shown in Tables 2 through 4. A detailed description of the duties and schedules for each test administrator is included in Appendix O.

TABLE 2. PRETEST ADMINISTRATORS

Personnel No.	Title	Agency
1	Test Director a.m.	FAA
2	Test Director p.m.	FAA
3	Test Manager	GSC
4	Trainer a.m.	GSC
5	Trainer p.m.	GSC
1	Terminal 7 Data Collector a.m.	FAA
2	Terminal 7 Data Collector p.m.	FAA
4	Terminal 2 Data Collector a.m.	GSC
5	Terminal 2 Data Collector p.m.	GSC

TABLE 3. FIRST POSTTEST ADMINISTRATORS

Personnel No.	Title	Agency
1	Test Director a.m.	FAA
2	Test Director p.m.	FAA
3	Test Manager	GSC
1	Terminal 7 Data Collector a.m.	FAA
2	Terminal 7 Data Collector p.m.	FAA
4	Terminal 2 Data Collector a.m.	GSC
5	Terminal 2 Data Collector p.m.	GSC

TABLE 4. SECOND POSTTEST ADMINISTRATORS

Personnel No.	Title	Agency
1	Test Director a.m.	FAA
2	Test Director p.m.	FAA
3	Test Manager	GSC
1	Data Collector IED a.m.	FAA
2	Data Collector IED p.m.	FAA
4	Data Collector TnT™ a.m.	GSC
5	Data Collector TnT™ p.m.	GSC

2.4 TEST ORGANIZATION TRAINING.

The test organization will be trained on the candidate SPEARS device before the OT&E. The test organization will also receive a one-day training session on test procedures and protocol before the OT&E. The training will cover data collection procedures and methodology and the procedures to be followed in case of an emergency.

2.4.1 Operational Test Procedures.

2.4.1.1 Overview.

The operational test comprises five major activities, including a pretest baseline performance measurement, an initial 4-week period during which the training group screeners will receive SPEARS TIP, a first posttest performance measurement, a second 8-week SPEARS TIP period, and a second posttest performance measurement. The schedule for these activities is included in Appendixes P, Q, and R.

Five site visits to LAX will be required to complete the operational testing. An initial orientation visit will be conducted to provide briefings and coordinate test activity logistics with airline, airport, and screening company representatives. A pilot study will be conducted prior to the start of test activities to ensure all agencies involved in the test are adequately prepared. Finally, three visits will be required to conduct the pretest and two posttests.

2.4.1.2 Test Readiness Review.

A Test Readiness Review (TRR) will be held prior to the start of the OT&E (see SPEARS FIP OT&E Master Schedule, Appendix P). The review will assess the overall status of the system and resolve any open issues before beginning the test. The TRR will include an assessment of the test cases, test procedures, test site environment, test equipment, support software, test participant's roles and responsibilities, and data collection methodology and tools. Completion of the TRR will result in a go/no-go decision by the FAA Program Manager for the start of the OT&E. Additional TRRs may be scheduled as necessary.

2.4.1.3 Pilot Study.

A pilot study will be conducted approximately 2 weeks before the OT&E to verify the test protocol and data collection procedures. Data collection, the SPEARS TIP, and IED detection testing procedures will be verified. Two screeners will be required for the pilot study, one from each of the treatment groups.

2.4.1.4 Operational Test Protocol.

The protocol describes the manner in which data will be gathered to assess the operational effectiveness of SPEARS TIP. The specific protocol for each of these data collection exercises is described in sections 2.4.2 through 2.4.2.1.2.

Screening activities at LAX are carried out 24 hours per day, and are divided into three shifts. To obtain the required screener sample size, OT&E activities will be carried out during the morning shift (0630-1500 hours) and the swing shift(1430-2300). The two shifts overlap for 30 minutes between 1430-1500 hours to ensure a smooth transition between shifts. During the transition, the swing shift operates the screening stations and is monitored by the morning shift. Because data must be collected during two shifts, there are two equivalent data collection cycles during each day.

All briefing and data collection activities will take place in Room 2034 and at the Security Checkpoint of Terminal 2 and in the Aloha Room of Terminal 7. Diagrams of the terminals and the rooms are provided in Appendix S.

2.4.2 Pretest.

The pretest will be conducted to assess the baseline IED detection performance of the screeners participating in the study. Schedules for the pretest are included in Appendixes Q and R. Both the training and control groups will be pretested concurrently. The geographic separation between the training and control groups will require two sets of test administrators, one per group.

Data will be collected on days one through three of the pretest. Each screener in each treatment group will be required once for a 2-hour period. Two screeners will be tested simultaneously in each treatment group. Participants will be administered the Snellen equivalent High (96 percent) Contrast Vision Acuity Test (see Appendix T for the score sheet) and the ERAU HFT and HPT. These three activities will require approximately 60 minutes to complete.

Because the training and control groups will be matched on the HFT and HPT scores, it may be necessary to pretest more than the number of screeners required for each treatment group. Day 4 of the pretest is provided for this contingency. Following the HFT and HPT and selection as a study participant, each screener will be assigned a subject number which will be used to anonymously identify the screener during the study.

Participants will then receive the computerized IED detection performance test. Before beginning the performance measurement, the data collector will brief each screener using the instructions contained in Appendixes N, U, V, and W. Each screener will be informed that simulated explosive devices will be present in some of the bag images to be screened during the test trial. The screeners will be unaware of the physical appearance of the original bags or their insertion order. Screeners will carry out normal screening operations and will not receive operational direction from the test administrators.

This test will require approximately 35 minutes. Before each test session, the FAA data collector will assign an operator identification number to each screener for access to the test device and will ensure that the test device is operable and properly configured. If the test device malfunctions during the test trial, the data collector will inform the test manager, who will arrange for maintenance. If the malfunction cannot be resolved within a relatively short time, the test will be postponed until the test device is operable.

The data collector will start the test trial and ask the screener to begin the test. The testing device will automatically display the first bag image to the screener. The screener's task is to indicate whether the bag contains a threat image by pressing the appropriate key on the keyboard. After the screeners have responded to this initial question, they will be asked a second question based upon their response to the first question. They will be asked to indicate how confident they were in their original response concerning the presence or absence of an IED in the bag. The testing device will record the response and automatically forward to the next image. The data collector will stop the test when all bag images have been presented.

Each computerized test will consist of 25 test bag images containing MBSs within a series of 200 CO comparison bag images. A description of the test bag configuration is included in Appendixes X and Y. All screeners in the study will view the same test and comparison bag images. To control for presentation order, six randomly generated presentation orders for the 200 bag images will be used. The screeners in the training group will be arranged into groups of four. The screeners in the control group will be arranged into groups of five. All groups in each of the training and control groups will receive one of these six presentation protocols.

The control group will be returned to normal duties after the IED test. Instruction in the operation of the SPEARS TIP training equipment and the procedure for threat resolution when the TnT TIP feature is operational will be provided to the entire Terminal 2 staff. The training group is a subset of the total screening staff. However, all receive TIP equipment training because FTI presentation can only be controlled in terms of time and not on an individual screener basis. It is therefore possible that a screener outside of the training group will accidentally receive a TIP. Screeners in the training group will then again be briefed on the training that will occur during the balance of the OT&E. The participants will then be returned to their normal duties.

2.4.2.1 On-line Testing.

The basic task of the X-ray screener is to monitor X-ray images presented on display screens and identify potential threat objects within the images. The task for both SPEARS TIP and IED detection testing will match this basic operational task: Screeners will examine bags and identify those that contain a potential threat object.

The SPEARS TIP task involves the X-ray screeners carrying out normal screening duties at their usual screening station (Terminal 2 checkpoint). TnT™ devices will be connected to two of the three X-ray machines at the Terminal 2 checkpoint, as depicted in Appendix S. The TnT™ devices will be configured to have the TIP function insert up to 24 FTIs into the normal passenger baggage flow to be observed by each screener on a given day.

The method for FTI selection and insertion is as follows. The number of FTIs to be presented to each screener on a given day is detailed in the randomly generated protocol shown in Appendix Z. During each 8-hour shift, the duty cycle for a screener normally consists of a 20-minute period on the X-ray equipment, 20 minutes waning, 20 minutes performing bag searches, and 20 minutes off. A normal shift also includes a 30-minute lunch break. This duty cycle results in each screener being on the X-ray equipment a maximum of once per hour, and a total of approximately four sessions per shift. Because of the inherent flexibility of screening operations, it is impossible to determine when these four sessions will occur for each screener. For this reason, each hour of each shift will be divided into three, 20-minute segments. The number of FTIs to be presented to a screener on a given day will be doubled and spread across the eight-hour shift. The number of FTIs to be presented in each hour will be replicated in each 20-minute segment. Using this procedure, reasonable assurance is provided that each screener will receive close to the required number of FTIs and that all screeners will receive approximately the same FTI exposure on a given day. The flight schedule for Terminal 2 is included in Appendix AA. The ebb and flow of passengers will result in uneven FTI presentation rates across screeners. This is unavoidable given the operational environment and the way the device can be programmed.

When the X-ray screener believes a threat object is present in a bag (in this case, an FTI), the screener will press the TnT TIP button to probe the SPEARS device for feedback. If the bag contains an FTI, the SPEARS device will confirm the threat object and indicate it on the display. The threat object will then be erased from the screen, allowing the X-ray screener to ensure that there are no additional real threat objects in the bag. Only one FTI per bag will be generated by the SPEARS device, but the possibility exists that there is an actual object in the bag. If the bag does not contain an FTI, but the screener indicates a possible threat through the TIP key, then the bag is recorded as a false alarm, notification is given to the screener and supervisor, and normal security procedures are followed (see Appendix W. If the screener fails to detect the FTI, the TnT will notify the screener of the miss and record the presentation in the screener's database.

2.4.2.1.1 First Posttest.

The first posttest will consist of IED detection testing only. This testing will follow the same protocol contained in the pretest description. Each screener will, therefore, be required to take a test session lasting approximately 35 minutes. The first posttest will require 2 days to complete (see Appendix Q). The control group and training group will be tested concurrently

.

2.4.2.1.2 Second Posttest.

The second posttest will again involve a 35-minute IED detection test session for each screener. Following IED detection testing, each screener in the training group will complete a usability assessment form. The second posttest will require 3 days to complete (see Appendix Q). The training group and control group will be tested concurrently.

2.4.3 SPEARS Usability Assessment Methodology.

The tailored checklist will be completed during the testing of the technical issues.

The subjective ratings will concern the SPEARS operating procedures and feedback provided by the SPEARS device during real time baggage screening. The ratings will be provided through 5-point Likert scales (see Appendix BB) developed for the SPEARS training and testing and administered to each screener in the training group during the second posttest session.

The structured interview (see Appendix C) will be conducted to probe the usability of the SPEARS device and will be complementary to the Likert scale ratings.

Any procedural errors made by the training group when operating the SPEARS equipment will be noted.

2.4.4 SPEARS Insertion Representativeness Methodology.

The insertion representativeness analysis will be conducted by having each control group screener view images of baggage with inserted FTIs, images of CTIs, images of baggage containing actual threats, and images of baggage containing no threat objects. Each image will be rated as to its fidelity; for example, the degree to which the image appears like an image that screeners might encounter in performing their normal job functions. In addition, the physical properties of each image will be rated, including the density of the objects packed in the bags, the type of items packed in the bags, the order of placement of items in the bags, and the type of bag being presented. Each of these items will be rated on a seven-point Likert scale ranging from "Would Never Encounter" to "Very Likely to Encounter" a bag in the real world (see Appendix CC).

2.5 DATA.

2.5.1 SPEARS TIP Training and Testing Data.

For each of the pretest and the two posttests, the screener decision and confidence responses observed while scanning for simulated IEDs in the computerized passenger bag X-ray images will be collected for each screener in both treatment groups. During the TIP training periods, data will be collected on the number of TIP hits and misses for each screener.

2.5.2 SPEARS Usability Data.

The data resulting from the SPEARS usability analysis will be the HFE checklist data, the Likert scale responses, the responses to the structured interview, and any procedural errors noted when operating the SPEARS device for each subject in the training group.

2.5.3 Insertion Representativeness Data.

The data resulting from the insertion representativeness assessment will be the Likert scale responses for each screener in the control group.

2.6 TEST DATA MANAGEMENT.

The final operational test database (shown in Table 5) will contain the data required to statistically analyze the critical operational issues.

All technical and operational data will be retained by the principal investigator for the project for 5 years. In accordance with professional and ethical standards, the principal investigator will maintain separate records of performance data and the names of participating screening personnel. A complete set of data will be provided to the FAA Aviation Security Laboratory for storage as well, without the associated personnel records.

TABLE 5. SCREENER PROFICIENCY EVALUATION AND REPORTING SYSTEM ON-LINE OPERATIONAL TEST DATABASE

Screener ID
Screener Characteristics Check
Experience
X-ray Equipment Experience
Type of X-ray Equipment Used
IED Test Date
Vision Test Score
ERAU HFT Scores
ERAU HPT Scores
SPEARS FIP Performance
(IED Decision/Confidence Rating) Scores
Bag Number for Each Response and Confidence Rating
Usability Likert Scale Ratings
Usability Structured Interview Results
SPEARS Procedural Errors
Image Representativeness Likert Scale Ratings

2.7 DATA ANALYSIS.

2.7.1 Experimental Design.

The experimental design for the operational test will be an untreated control-group design with pretest and posttest measures (Cook and Campbell, 1979), which will allow for a direct assessment of the effects of the SPEARS TIP intervention on screener IED detection performance. The basic design will be modified to include a second posttest data collection to measure the retention of the skill over time. Using Cook and Campbell's (1979) notation, the experimental design is depicted in Figure 1.

time→

Training Group	O_1	X_1	O_2	X_1	O_3
Control Group	O_1		O_2		O_3

FIGURE 1. EXPERIMENTAL DESIGN

Where X indicates the SPEARS treatments (X_1 indicates the EG&G TnT™ system), and O, which occurs during X, indicates the ordinal number of screener performance tests.

2.7.1.1 Independent Variables.

There will be two independent variables for the SPEARS TIP evaluation in terms of IED detection performance. The independent variable, SYSTEM, will represent the SPEARS device and will have two levels: training and control. The other independent variable, TRIAL will represent the SPEARS training intervention and will have three levels: pretest, first posttest, and second posttest.

For the FTI performance evaluation, time seqments is the only independent variable. The data will be divided into weekly segments for analysis.

2.7.1.2 Dependent Variables.

The dependent variables will be derived from the off-line screener decision of IED presence for each bag and are the SDT variables of P_d, P_{fa}, d′, and c. These variables are not available for the TIP potion which is restricted to only the P_d for each weekly segment. The calculated values of P_d, P_{fa}, d′, and c will be compared across training conditions.

For each screener, the bag decisions will be corrected to hits and false alarms based on the correctness of screener yes-no responses to whether an IED was present. N_h and N_{fa} are the total number of hits and false alarms across all bags.

For each screener, N_h will be used to calculate P_d as follows:

$$P_d = N_h/N_T$$

where N_T is the total number of test bag images presented.
N_{fa} will be used to calculate P_{fa} as follows:

$$P_{fa} = N_{fa}/N_C$$

where N_C is the total number of comparison bags presented.

The confidence scores from the IED tests will be used to plot a Receiver Operating Characteristic (ROC) curve from which a value of d′ will be determined. A rating scale technique (Green and Swets, 1966) will be used, and will employ four confidence rating categories as follows:

Category 1 - yes - more sure
Category 2 - yes - less sure
Category 3 - no - more sure
Category 4 - no - less sure

These will provide the points needed to plot the ROC curve.

A value of $\underline{c}$ is the distance from the intersection of the signal-plus-noise (SN) and noise (N) distributions measured in z-score unites. The measure $\underline{c}$ is computed as follows:

$$\underline{c} = .5(Z_{fa} + Z_h)$$

After completing the IED test trials, the first step in the analysis will be to separate the MBS bag responses from the comparison bag responses and to total these separately for each subject according to the rating response each trial received (see Figure 2). The next step will be to convert the raw data into a set of hit and false alarm rates. This will involve starting with the strictest response category (1) and determining a P_d and P_{fa} value from the cell data. Two additional P_d and P_{fa} values are determined in a similar manner by collapsing the data across categories 1 and 2 and categories 1, 2, and 3. To obtain the points for the ROC curve, the values of P_d and P_{fa} will then be converted into Z_h and Z_{fa} by using the normal tables and plotting against one another. A linear regression will then be determined through the three points. A value of d′ will be determined from the point where the negative diagonal intersects this regression line.

	High Certainty Signal			High Certainty Noise	
Category	1	2	3	4	Total
Threat bags	n_{h1}	n_{h2}	n_{h3}	n_{h4}	N_T
Comparison bags	n_{fa1}	n_{fa2}	n_{fa3}	n_{fa4}	N_C
	$P_{d1}=n_{h1}/N_h$ $P_{fa1}=n_{fa1}/N_{fa}$	$P_{d2}=(n_{h1}+n_{h2})/N_h$ $P_{fa2}=(n_{fa1}+n_{fa2})/N_{fa}$	$P_{d3}=(n_{h1}+n_{h2}+n_{h3})/N_h$ $P_{fa3}=(n_{fa1}+n_{fa2}+n_{fa3})/N_{fa}$		

n_{ij} - number of hits or false alarms in each cell

FIGURE 2. RATING SCALE CALCULATIONS OF P_d AND P_{fa}

2.7.1.3 Controlled Variables.

TIP EXPOSURE: This variable is the rate that FTI bags will be presented in the normal passenger baggage flow. The TIP EXPOSURE will be used during SPEARS training and set to a maximum of 24 TIPs and a minimum of 2 TIPs for each screener shift. The sequence of TIPs within the normal passenger bag flow will be randomized. Screeners will receive feedback on detection performance.

2.7.1.4 Predicted Results.

2.7.1.4.1 Training Effects.

Two hypotheses can be tested to determine whether the SPEARS is operationally effective for the development and maintenance of baggage screening skills.

Hypothesis 1 Training: Screener performance in detecting IEDs will be significantly improved as a result of SPEARS TIP.

Hypothesis 2: Screener IED detection proficiency will be maintained over time through the use of SPEARS TIP.

The first hypothesis requires an improvement in P_d without a corresponding increase in P_{fa} for the training group relative to the control group. The second hypothesis requires that this performance effect be sustained over time. If this improvement in performance does not occur or is not sustained over time, then the SPEARS is not operationally effective for either or both. Some research indicates that the performance should continue to gradually increase to some asymptotic level. For this study, however, the degree of this gradual increase is not predictable. A hypothetical representation of the hypothesized results is provided in Figure 3.

2.7.1.4.2 Vigilance Effects.

Similar hypotheses can be posted for the effects of SPEARS TIP on screener vigilance, but they can only be tested over time with the training group. Therefore, TIP performance will be divided into weekly segments and tested for the following hypotheses.

Hypotheses 1: Screener performance (P_d) will improve at detecting TIPs during the initial weeks of presentation.

Hypothesis 2: Once P_d performance increases to asymlotic levels, it will not decrease during the later segments of the study (see also the trained performance line in Figure 3).

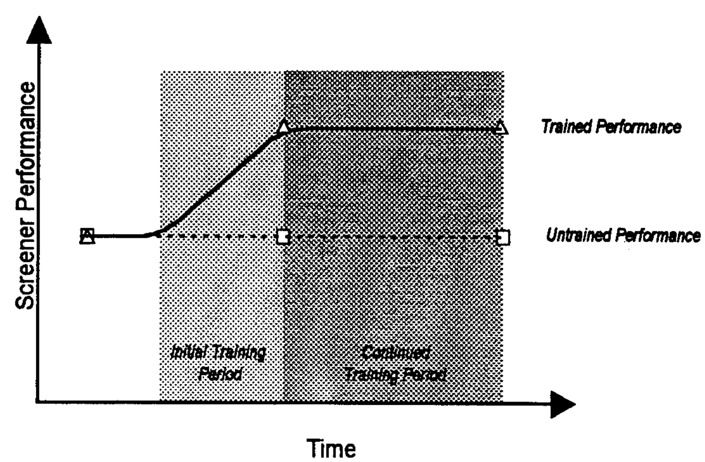

FIGURE 3. HYPOTHETICAL OPERATIONAL TESTING RESULTS

2.7.1.5 Statistical Analysis.

As noted above, an effort will be made to avoid contamination of the control group by selecting the training and control groups from two separate terminals at LAX. This control strategy does, however, impose some penalty on the statistical analysis of the resultant data. The primary penalty centers on the assumption of equivalent groups across the two treatment groups (Training and Control) within the SYSTEM variable. Statistical analysis procedures assume equivalent groups or a random assignment of individuals to groups. Without one of these control procedures, any effects discovered later in the study could be attributed to the mere differences in the group and not to the treatment.

Two approaches that control for these biases include experimental control and statistical control (Cook and Campbell, 1979; Kirk, 1982). A primary technique for experimental control involves blocking the members of each group by skill level using a predetermined criteria. Thus, each member of the training group would have an equivalent performing member in the control group, as determined by a pretest with a high correlation to screening skill, in this case, the HFT and HPT tasks.

This experimental control method will be employed and combined with a standard statistical analysis technique. A 3-Way Analysis of Variance (ANOVA) design will be implemented (Kirk, 1982), with the HFT/HPT measures used as a blocking variable in the analysis and the performance test measures used as the dependent measures. The resulting experimental design will allow for analysis of the main effect for SYSTEM, the main effect for TRIAL, and the interaction between SYSTEM and TRIAL. Significant effects within SYSTEM, TRIAL, and the SYSTEM x TRIAL interaction will be investigated using post hoc Neuman-Keuls tests. Table 6 is the ANOVA summary table representing this analysis.

TABLE 6. SCREENER PROFICIENCY EVALUATION AND REPORTING SYSTEM ON-LINE TRAINING AND TESTING OPERATIONAL TEST ANALYSIS OF VARIANCE SUMMARY

Source	df	SS	MS	F	p
Sys	1	SS_{Sys}	MS_{Sys}	MS_{Sys}/MS_{SysH}	-
H	2	SS_{H}	MS_{H}	$MS_{H}/MS_{S/SysH}$	-
SysH	2	SS_{SysH}	MS_{SysH}	$MS_{SysH}/MS_{S/SysH}$	-
S/SysH	34	$SS_{S/SysH}$	$MS_{S/SysH}$	-	-
T	2	SS_{T}	MS_{T}	$MS_{T}/ MS_{TxS/SysH}$	-
T x Sys	2	SS_{TxSys}	MS_{TxSys}	MS_{TxSys}/MS_{TxSysH}	-
T x H	4	SS_{TxH}	MS_{TxH}	$MS_{TxH}/MS_{TxS/SysH}$	-
T x SysH	4	SS_{TxSysH}	MS_{TxSysH}	$MS_{TxSysH}/MS_{TxS/SysH}$	-
T x S/SysH	68	$SS_{TxS/SysH}$	$MS_{TxS/SysH}$	-	-
Total	119	SS_{Total}	-	-	-

NOTE: Sys = System (TnT™, Control) - Between Groups, fixed
H = HFT/HPT (low, medium, high), Between Groups, random
T = Trial (T1, T2, T3), Within Groups, fixed
S = Subjects

Screener attrition may result in unequal numbers in the training and control groups at the end of the study. In this eventuality, an unequal-n ANOVA will be conducted if these numbers are not overly disparate. If a large difference exists between the final numbers of subjects in each group, screeners will be matched between groups based on their pretest scores. The unmatched screeners in the group containing more subjects will be excluded from further analysis.

There may be some confounding effects due to repeated exposures of the participants to the data collection procedures used to determine performance. For example, screener performance may be improved over time simply because the screeners are more comfortable with the data collection trials, and not due to any training effect.

These controls will be of less concern in analyzing the FTI performance, because all the data are collected on the same group. A one-way, repeated measures ANOVA will be used to analyze the effects of exposure to FTIs on FTI detection.

2.7.2 Usability Assessment.

Descriptive statistics will be produced for the Likert Scale data. Any Likert rating having an average score of unacceptable will be deemed to be a deficiency. Recommendations will be made to rectify the deficiencies. Any software, hardware, or procedural aspects that were marked as failures on the HFE checklist, received negative comment by the screeners, or were noted during operation of the SPEARS equipment will be reported and recommendations for improvement will be made.

2.7.3 Insertion Representativeness Assessment.

For each assessment category rated, an average rating and standard deviation will be determined across screeners for each image presented. Any average rating of 3 or less (below the "Likely to Occur" behavioral marker) will be considered to be a failure of the criteria for that specific rating category for that bag image. Data will then be collapsed across bags and subjects within each baggage category. Average ratings and standard deviations will then be determined for each rating category within each bag category. FTI bags and CTI bags will be compared to images containing actual threats using a t-test. Any significant difference in ratings between baggage categories will mean that the criteria were not passed for the FTI or CTI rating category in question.

3. PRESENTATION OF OPERATIONAL TEST AND EVALUATION RESULTS.

3.1 SPEARS TRAINING.

The results from the ANOVA carried out on IED P_d, P_{fa}, d', and c across time and training conditions will be reported, along with associated mean and standard deviation for each cell. The results of the post hoc comparisons conducted on any significant effects will also be reported. COIC A will be met by SPEARS if the P_d exhibited for the group receiving training is significantly higher than that for the control group. COIC B will be met by SPEARS if the P_{fa} exhibited for the group receiving training is lower than or not significantly different from that of the control group. There are significant positive differences between the training group and the control group for d.

3.2 SPEARS VIGILANCE

The results from the ANOVA carried out on FTI across weeks of the study will be reported, along with associated mean and standard deviation for each week. The results of the post hoc comparisons conducted on any significant main effect will also be reported. COIC A will be met by SPEARS if the P_d exhibited for the training group is significantly higher at the midpoint of the study than at the beginning. COIC B will be met by SPEARS if the P_d exhibited for the training group is not significantly lower at the end of the study than at the midpoint

3.3 SPEARS USABILITY ASSESSMENT.

Hardware, software, or procedural deficiencies noted will be reported in tabular form, along with any HF engineering recommendations for rectification.

3.4 INSERTION.

Results will be reported, including significant effects and associated means and standard deviations. Any average rating of "less than likely to encounter", as measured by the Insertion Representativeness Assessment form (see Appendix CC), will be deemed to be a deficiency and the criterion will not have been met.

4. TECHNICAL TEST AND EVALUATION.

4.1 TECHNICAL TEST PROCEDURES.

This section describes the manner in which data will be gathered to assess the technical compliance of the SPEARS TIP component. The technical testing protocols will consist of HF engineers evaluating the SPEARS device against the technical criteria using checklists and subjective ratings by screeners and supervisors.

4.1.1 Image Content.

Researchers will use a SPEARS Image Content Checklist (see Appendix D) to determine whether the technical criteria have been met by posing the following questions and documenting the answers accordingly:

a. Are 300 different CTIs and 300 FTIs available?

b. Do the CTIs and FTIs represent the required range of threat categories of weapons, incendiaries, explosives, and other dangerous/deadly devices?

c. What is the distribution of the 300 CTIs and 300 FTIs by threat category?

d. Are two different aspect angles available for each CTI and each FTI?

4.1.2 Customization.

The following research questions will be addressed during the course of the technical T&E and the results will be documented in a SPEARS Customization Checklist (Appendix E) accordingly:

a. Can CTI and FTIs be selected for each screener by threat category?

b. Can CTIs and FTIs be selected for each screener by difficulty? For the purposes of this test, assessments of difficulty will be provided by the vendor.

c. Can CTIs and FTIs be selected for each screener by aspect angle?

d. Can CTIs and FTIs be selected as a function or combination of categories a. through c.?

e. Can CTIs and FTIs be archived along with the associated outcome (hit, miss, false alarm, correct rejection) for each screener, along with the date and time of trial?

f. Can CTIs and FTIs be automatically or manually selected based on time of day?

g. Can CTIs and FTIs be automatically or manually selected based on checkpoint activity?

h. Can CTIs and FTIs be automatically or manually selected based on screener identity?

i. Can CTIs and FTIs be selected as a function or combination of categories f. through h.?

4.1.3 Feedback.

A HF engineer will answer the following questions using a SPEARS Feedback Checklist (Appendix F):

a. Does the SPEARS device provide adequate feedback for correct identification of a FTI?

b. Does the SPEARS device remove the FTI from the display to allow for further image scanning by the X-ray screener once the TIP key has been selected?

c. Does the SPEARS device provide feedback about a missed FTI?

d. Does the SPEARS device identify the location of a missed FTI?

e. Does the SPEARS device provide feedback for items that are identified as having threats, but do not contain false threat images?

f. What is the nature of the feedback for each of the situations listed above?

g. What is the time delay for feedback for each of the situations listed above?

4.1.4 Capability Summaries.

A HF engineer will answer the following questions using a Capabilities Summaries Checklist (Appendix G):

a. Does the SPEARS device automatically prepare summary reports?

b. Do the summary reports contain descriptive statistics?

c. Can the descriptive statistics be categorized according to the threats presented and outcomes?

d. Can the descriptive statistics be categorized by screener?

e. Can the descriptive statistics be categorized according to checkpoint activity level?

f. Can the descriptive statistics be categorized according to the time of day?

g. Are the summary reports readily understandable by the users?

NOTE: To assess readily understandable interpretations, HF checklists addressing information presentation principles will be used by HF engineers. Furthermore, HF engineers will conduct structured interviews with screeners and supervisors regarding the reports. The questions for the structured interviews are as follows:

1. Do you understand the purpose of the SPEARS TIP?
2. Given the intent of the system, do you understand the outputs from the system?
3. How could you use these outputs to make changes or improve the screener's performance?
4. Are there items on the reports that you are unsure about?
5. Is there information missing on the reports that could help you perform your job better?
6. Is the report format acceptable to you?
7. Are the graphics and numbers useful, or would you prefer a text explanation of the findings?
8. Are there any additional comments about the reports you would like to share?

h. Can the SPEARS device actively track the performance level of an individual screener within a given screening session?

NOTE: Performance level for this test is defined as P_d, P_f, and d'.

i. Can the SPEARS device, when queried, notify a remotely situated supervisor of performance levels?

j. Does the SPEARS device automatically notify a remotely situated supervisor of performance levels which exceed or fall below supervisor set criteria thresholds?

k. Is this notification of criteria thresholds adequate in terms of alerting or required response?

4.1.5 Interoperability.

A telephone connection will be established through modems between the SPEARS at the remote location and the SPEARS at the test site. This telephone connection will require access to the local telephone system for remote connection and, possibly, long distance connection. Using a second voice telephone connection, two researchers will attempt to download new images to the SPEARS devices. Additionally, a single researcher will attempt to access reports from the remotely situated SPEARS device. A HF engineer will answer the following questions using an Interoperability Checklist (Appendix H):

a. Can a device-to-device or a device-to-computer connection be accomplished over standard telephone communication lines, using two people?

b. Can this connection be used to download new CTIs and FTIs to the SPEARS device?

c. What is the time required to transfer a given CTI or FTI between remotely situated devices?

d. Can a device-to-device or device-to-computer connection be initiated remotely for the collection of status reports?

e. Can the remote connection access the report data and save these data to a local computer file?

f. Can the remote connection subsequently print out the status reports?

g. Are the status reports that are remotely available similar to those available on-site from the SPEARS device?

4.1.6 Security.

The Security issue will be investigated using a structured Security Access Control Checklist (see Appendix I). The security checklist is based on the *Department of Defense Trusted Computer System Evaluation Criteria* (DOD-5200.28-STD) and is contained in Appendix G.

The SPEARS computer software will be exercised to determine if adequate security is provided. The following questions will be answered in addressing this issue:

a. Can unauthorized personnel access the image library areas of the SPEARS?

b. Can unauthorized personnel access the stored personnel records in the SPEARS?

4.1.7 Insertion.

Examination of the insertion issue will occur using a structured Image Insertion Checklist (see Appendix J).

Baggage not containing threat objects will be passed through the X-ray device, and the SPEARS device will be used to insert threat objects onto the display of the bag image. In addition, a series of neutral bags will be run through the X-ray device, and additional CTIs will be inserted into the baggage flow. A HF engineer will answer the following questions:

a. Can an FTI be generated using a computer-generated threat object and a neutral passenger bag passed through an operational X-ray device connected to a SPEARS device?

b. Are the FTIs generated automatically by the SPEARS device?

c. Are the FTIs predictable in the random order that they are presented?

NOTE: For this test, based on data from the serial presentation of FTIs, a computer algorithm will be used to determine presentation order randomness.

d. Can a CTI be inserted into the flow of normal bags passed through an X-ray device connected to a SPEARS device?

e. Are the CTIs generated automatically by the SPEARS device?

f. Are the CTIs predictable in the random order that they are presented?

NOTE: For this test, based on data from the serial presentation of CTIs, a computer algorithm will be used to determine randomization of the presentation order.

g. Is the position of the FTI randomly determined?

NOTE: For this test, a series of 200 neutral bags will be passed through an operational X-ray device attached to a SPEARS device. FTIs will be projected onto each neutral bag and the resulting image will be stored for analysis. During analysis, each resultant image will be examined by dividing the bag image into nine sectors and categorizing where the FTI has been placed. The matrix of bag, bag order number, and corresponding FTI position will be entered into a statistical analysis package and analyzed for random position assignment.

h. Is the orientation of the FTI within each bag controllable?

NOTE: For this test, an insertion order will be established in the SPEARS device, with orientations pre-assigned. A run of test bags will then be initiated using neutral bags and FTIs imposed. The run will then be stored and re-examined to check for concordance between the pre-assigned orientation and the orientations produced by the SPEARS device.

4.2 DATA.

The data resulting from the technical MOPs include the answers to the structured interview question concerning summary report understandability, annotated results from the review of pertinent aspects of the SPEARS device against HFE checklists, assessments of FTI and CTI insertion order and FTI position assignment within bag images, image control, and researcher observations.

4.3 TEST DATA MANAGEMENT.

Data collected during the test will be transferred into electronic media and stored after the test of the SPEARS TIP. Original hand-written data and research observations will be maintained in Galaxy Scientific Corporation (GSC) files and will be made available to the FAA upon request.

4.4 DATA ANALYSIS.

MOP data for each technical issue will be assessed against its related criteria to ensure compliance with system technical requirements. The individual SPEARS technical issues checklists will be assessed to ascertain the extent these criteria have been met. Responses from the structured interviews will augment the IED test, TIP performance, and technical issue checklist data to enhance the comprehension of the results. Although the structured interview data are subjective, they will be evaluated relative to the extent that it supports the objective performance data.

5. PRESENTATION OF TECHNICAL TEST AND EVALUATION RESULTS.

The results of the technical issues investigations will be presented in terms of the technical criteria and associated MOPs developed previously. Technical test results will be categorized by technical issues and reported accordingly. System deficiencies evidenced by the data collected will be identified as an aspect of the SPEARS that did not meet the technical criteria. In this event, recommendations for resolution will be made.

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SIGNAL DETECTION THEORY AND APPLICATION

SIGNAL DETECTION THEORY AND APPLICATION

SIGNAL DETECTION THEORY (SDT) PARADIGM.

The Improvised Explosive Device Detection System operation features human operators engaged in tasks to detect an environmental event or signal. SDT is a mathematical representation of human performance in deciding whether or not a signal is present. An operational example of SDT is an airport security guard screening passenger bags for concealed weapons and Improvised Explosive Devices (IEDs).

There are two response categories that represent a screener's detection performance: Yes (a Modular Bomb Set [MBS] signal was present) or No (an MBS signal was not present). There are also two signal presentation states indicating that the MBS signal was present (signal) or absent (noise). A combination of screener responses and the signal state produces a 2 x 2 matrix (figure A-1), generating four classes of operator responses, labeled hits, misses, false alarms, and correct rejections (Wickens 1992). Considering the Screener Proficiency Training Evaluation and Reporting System (SPEARS) Test and Evaluation:

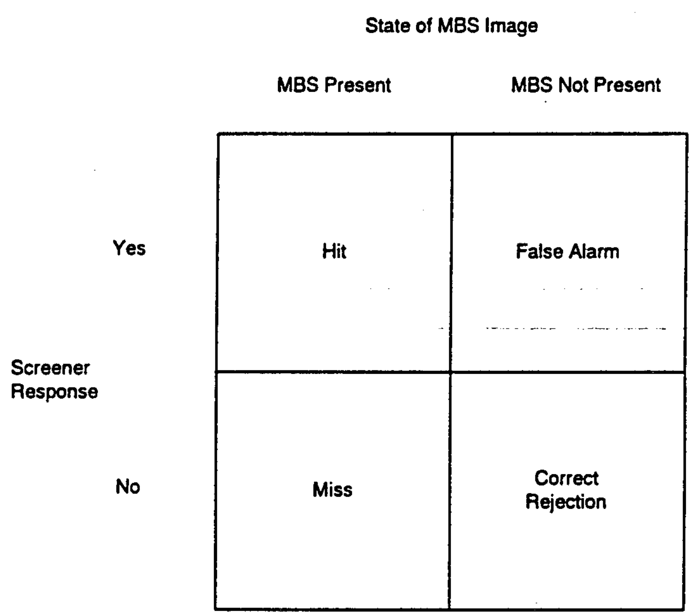


FIGURE A-1. 2 X 2 MATRIX OF SCREENER RESPONSES AND STATE OF MBS IMAGE

a. A Hit will be recorded when a baggage screener correctly detects an MBS in the scanned baggage.

b. A False Alarm will be recorded when a baggage screener detects an MBS in the scanned baggage when none is present.

As indicated by Wickens (1992), the SDT paradigm assumes that operators perform two stages of information processing in all detection tasks: (1) sensory evidence is aggregated concerning the presence or absence of the signal, and (2) a decision is made about whether this evidence constitutes a signal. According to SDT, external stimuli generate neural activity in the brain. On the average, there will be more sensory or neural evidence in the brain when a signal is present than when it is absent. This neural evidence, X, referred to as the evidence variable, represents the rate of firing of neurons in the brain. The response rate for detecting X increases in magnitude with stimulus (signal) intensity. Therefore, if there is enough neural activity, X exceeds a critical threshold, X_c, and the operator decides "yes." If there is too little, the operator decides "no." Because the amount of energy in the signal is typically low, the average amount of X generated by signals in the environment is not much greater than the average generated when no signals are present (noise). Furthermore, the quantity of X varies continuously, even in the absence of a signal, because of random variations in the environment and the operator's level of neural firing (i.e., the neural "noise" in the operator's sensory channels and brain).

The relationship between the presence and absence of a signal can be seen in the hypothetical noise and signal plus noise distributions contained in figure A-2. The intersection of the two curves represents the location where the probability of a signal equals the probability of noise. The criterion value, X_c, chosen by the operator, is shown by the vertical line. All X values to the right ($X > X_c$) will cause the operator to respond "yes." All X values to the left generate "no" responses.

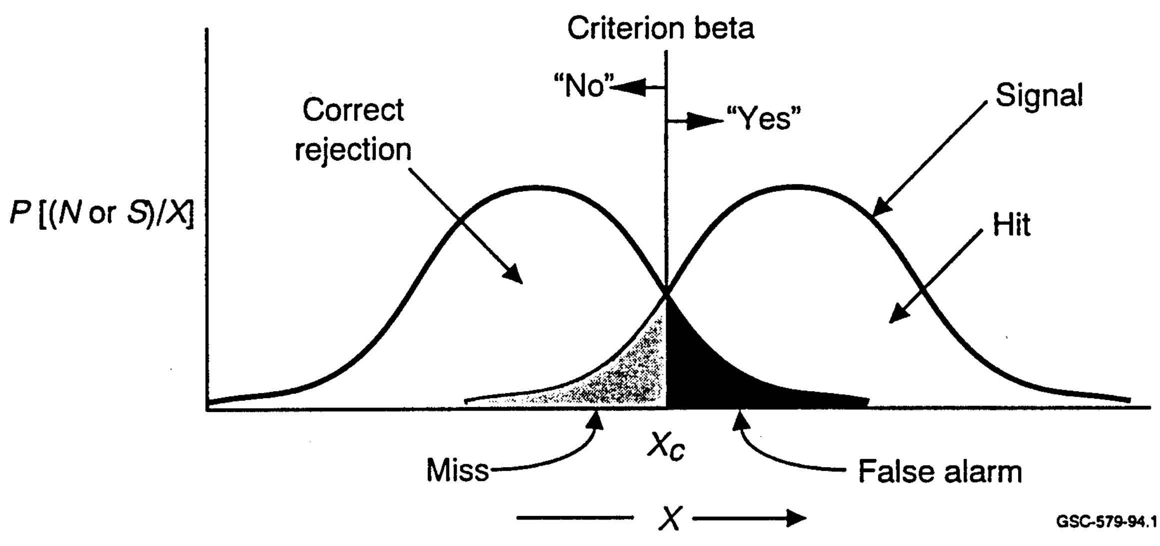


FIGURE A-2. HYPOTHETICAL SDT DISTRIBUTIONS (Wickens 1992)

The different shaded areas represent the occurrences of hits, misses, false alarms, and correct rejections.

The procedures to calculate SDT probabilities are as follows:

a. In SDT, the detection values are expressed as probabilities.

b. The probability of hit (P_h), miss (P_m), false alarm (P_{fa}), and correct rejection (P_{cr}) are determined by dividing the number of occurrences in a cell (figure A-1) by the total number of occurrences in a column.

c. The P_h (also referred as the probability of detection [P_d]) will be calculated by dividing the number of IEDs detected (number of hits) by the total number of hits and misses: $P_m = 1 - P_d$.

d. The P_{fa} will be determined by the number of false alarms divided by the total number of false alarms and correct rejections: $P_{cr} = 1 - P_{fa}$.

Operator Response Criterion.

In any signal detection task, operator decision making may be described in terms of an operator response criterion. Operators may use "risky" response strategies by responding yes more often than no. A risky strategy allows operators to detect most of the signals that occur, but also produces many false alarms. Alternatively, operators may use "conservative" strategies, saying no most of the time, making few false alarms, but missing many of the signals.

Different circumstances may require conservative or risky strategies. For example, an appropriate IED detection strategy requires screeners to respond "yes" when there is a question regarding baggage contents. This response may produce false alarms when no threatening objects are present.

As shown in figure A-2, risky or conservative behavior is determined by the location of the operator's response criterion, X_c. If X_c is placed to the right, much evidence of the signal is required for it to be exceeded and most responses will be "no" (conservative responding). If it is placed to the left, little signal evidence is required and most responses will be "yes," or "risky." A variable positively correlated with X_c is the quantity beta (β), which is determined as follows:

$$\beta = \frac{ORD_H}{ORD_{FA}} \qquad (1)$$

This equation is the ratio of the ordinate of the two curves of figure A-2 at a given level of X_C. The higher β values will generate fewer yes responses and, therefore, fewer hits. Lower β settings will generate more yes responses, more hits, and more false alarms.

Table A-1 provides a representative table of Z values and ordinate values of the probability distribution related to hit and false alarm responses. A complete table of standard normal distribution values will be used to calculate β for the Test and Evaluation Report (TER).

TABLE A-1. REPRESENTATIVE Z-SCORES AND ORDINATE VALUES OF THE NORMAL CURVE FOR DIFFERENT RESPONSE PROBABILITIES TO CALCULATE β AND d′

HIT/FA	Z	ORD	HIT/FA	Z	ORD
.01	2.33	0.03	.50	0.00	0.40
.02	2.05	0.05	.55	-0.12	0.40
.03	1.88	0.07	.60	-0.25	0.39
.04	1.75	0.09	.65	-0.38	0.37
.05	1.64	0.10	.70	-0.52	0.35
.08	1.40	0.15	.75	-0.67	0.32
.10	1.28	0.18	.80	-0.84	0.28
.13	1.13	0.21	.82	-0.92	0.26
.15	1.04	0.23	.85	-1.40	0.23
.18	0.92	0.26	.88	-1.18	0.20
.20	0.84	0.28	.90	-1.28	0.18
.25	0.67	0.32	.92	-1.40	0.15
.30	0.52	0.35	.95	-1.64	0.10
.35	0.38	0.37	.96	-1.75	0.09
.40	0.25	0.39	.97	-1.88	0.07
.45	0.12	0.40	.98	-2.05	0.05
.50	0.00	0.40	.99	-2.33	0.03

The procedures required to calculate β are listed below (Coren and Ward 1989):

a. Find the false alarm rate from the outcome matrix in the HIT/FA column of table A-1.

b. Read across the table to the ORD column (for ordinate, the height of the bell curve).

c. Determine the value tabled there and write it down.

d. Repeat these operations for the hit rate.

e. Calculate β using the following equation: $\beta = ORD_h/ORD_{fa}$.

One recent parametric measure of response bias is c (Ingham 1970; Macmillan & Creelman 1990; and Snodgrass & Corwin 1988). The chief difference between the measure c and its parametric alternative β lies in the manner in which they locate the observer's criterion. Whereas the bias index β locates the observer's criterion by the ratio of the ordinates of the signal-plus - noise (SN) and noise (N) distributions, c locates the criterion by its distance from the intersection of the two distributions measured in z-score units. The intersection defines the point where bias is neutral, and location of the criterion at that point yields a c value of 0. Conservative criteria yield positive c values, and liberal criteria produce negative c values. The measure c is computed as follows:

$$\underline{c} = .5(z_{fa} + z_h) \qquad (2)$$

Sensitivity (d′).

Sensitivity refers to the average amount of operator sensory activity generated by a given signal as compared with the average amount of noise-generated activity (Coren and Ward 1989). As explained earlier, baggage screeners may fail to detect (miss) an IED signal when employing a conservative β. Correspondingly, the signal may be missed because the resolution of the detection process is low in discriminating signals from noise, even if β is neutral or risky.

The perceptual analog of sensitivity, d′, corresponds to the separation of the means of signal and noise distributions (figure A-2). As the magnitude of the signal increases, the mean of the signal distribution moves to the right. The proportion of signals detected (the P_d) changes as the distance between the signal and noise distributions varies. According to Wickens (1992), if the separation between the distributions is great, sensitivity is great, an operator can readily distinguish a signal plus noise event from a noise only event. Similarly, if the separation between signal and noise is small, d′ measures will be low.

Table A-1 provides a representative table of Z values and ordinate values for the probability distribution related to hit and false alarm responses. A complete table of the ordinate values for the standard normal distribution will be used to calculate d′ for the TER.

The procedures required to calculate d′ are listed below (McNicol 1972).

a. Separate the data with respect to distribution (signal or noise), and total the data with respect to response (yes or no) and confidence rating (very sure or not very sure).

b. Calculate P_d and P_{fa} for each category.

c. Convert the values of P_d and P_{fa} to z_d and z_{fa} using the normal curve area.

d. Plot z_d against z_{fa} on a double-probability plot and determine the path of the ROC curve based upon the method of maximum likelihood.

e. Determine the ordinate value, for either axis, at which the ROC curve intersects with the negative diagonal. This value is equal to ½d′. Multiply this value by 2 for d′.

SPEARS USABILITY HFE CHECKLIST

SPEARS USABILITY HFE CHECKLIST

Human Factors Principle	Evaluation: Acceptable	Evaluation: Acceptable with Deficiencies	Evaluation: Unacceptable	Comments
1.0 Data Entry				
1. Users need enter data only once.				
2. Display feedback for all user actions during data entry; display keyed entries stroke by stroke.				
3. Provide fast response by the computer in acknowledging data entries.				
4. Incorporate a consistent method for data change.				
5. When critical data are to be processed, require an explicit "Enter" action to initiate the processing.				
6. Provide feedback for the completion of data entry.				
7. For repetitive data entry transactions, feedback should be the generation of or moving to the next data entry field.				
8. Choose defining abbreviations or other codes to shorten data entry that are distinctive to avoid confusion with one another.				
9. Allow users to enter each character of a data item with a single stroke of an appropriately labeled key.				
10. Treat upper and lower case letters as equivalent.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
11. Treat single and multiple blank characters as equivalent in data entry; do not require users to count spaces.				
12. For position designation on an electronic display, provide a movable cursor with distinctive visual features (shape, blink, etc.).				
13. Design the cursor so that it does not obscure any other character displayed in the position designated by the cursor.				
14. Ensure that the computer will acknowledge entry of a designated position quickly.				
15. Ensure that the displayed cursor will be stable, i.e., that it will remain where it is placed until moved by the user (or by the computer) to another position.				
16. When moving a cursor from one position to another, design the cursor control to permit both fast movement and accurate placement.				
17. Ensure that control actions for cursor positioning are compatible with movements of the displayed cursor, in terms of control function and labeling.				
18. If a cursor must be positioned sequentially in redefined areas, such as displayed data entry fields, ensure that this can be accomplished by simple user action.				
19. When there are areas of a display in which data entries cannot be made (blank spaces, protected field labels, etc.), make those areas insensitive to pointing actions, i.e., prevent the cursor from entering those areas.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
20. Ensure that an ENTER action for multiple data items results in entry of all items, regardless of where the cursor is placed on the display.				
21. Ensure that display capacity, i.e., number of lines and line length, is adequate to support efficient performance of tasks.				
22. When text has been specified to become the subject of control entries, highlight that segment of text in some way to indicate its boundaries.				
23. Unless otherwise specified by the user, ensure that entered text is left-justified, leaving right margins ragged if that is the result.				
24. Allow users to select and move text from one place to another.				
25. Inform users concerning the status of requests for printouts.				
26. Design text editing logic so that any user action is immediately reversible.				
27. An UNDO action should be able to reverse more than the most recent command.				
28. Make field labels consistent; always employ the same label to indicate the same kind of data.				
29. Protect field labels from keyed entry.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
30. Ensure that labels are sufficiently close to be associated with their proper data fields, but are separated from data fields.				
31. Choose a standard symbol for input prompting and reserve that symbol only for that use.				
32. Clearly delineate each data field.				
33. Provide cues in field delineation to indicate when a fixed maximum length is specified for a data entry.				
34. Distinguish clearly and consistently between required and optional entry fields.				
35. Provide automatic justification in computer processing; a user should not have to justify an entry either right or left.				
36. Require users to take explicit keying ("tabbing") action to move from one data entry field to the next; the computer should not provide such tabbing automatically.				
37. Make labels for data fields distinctive, so that they will not be readily confused with data or other displayed material.				
38. In labeling data fields, employ descriptive working or standard, predefined terms, codes, and/or abbreviations; avoid arbitrary codes.				
39. Include in a field label additional cueing of data format when that seems helpful.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
40. When a measurement unit is consistently associated with a particular data field, include that unit as part of the field label, rather than requiring a user to enter it.				
41. Employ units of measurement that are familiar to the user.				
42. Order data items in the sequence in which a user will think of them.				
43. The order of data items should represent a logical sequence of data entries.				
44. When a form for data entry is displayed, the computer should place the cursor automatically at the beginning of the first entry field.				
45. When sets of data items must be entered sequentially in a repetitive series, provide a tabular display format where data sets can be keyed row by row.				
46. Design distinctive formats for column headers and row labels, so that users can distinguish them from data entries.				
47. Ensure that column headers and row labels are worded informatively, so that they will help guide data entry.				
48. During tabular data entry, allow users to tab directly from one data field to the next, so that the cursor can move freely back and forth.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
49. When a user must enter numeric values that will later be displayed, maintain all significant zeros; zeros should not be arbitrarily removed after a decimal point if they affect the meaning of the number in terms of significant digits.				
50. For entry of tabular data, when entries are frequently repeated, provide users with some easy means to copy duplicated data.				
51. Provide users some means for designating and selecting displayed graphic elements for manipulation. When a user has changed or altered a displayed element, provide some indication so that other users will be aware of the consequences of that users actions.				
53. Ensure that every possible correct data entry will be accepted and processed properly by the computer.				
54. If automatic data validation detects a probable error, display an error message to the user. If data validation from a secondary source detects a probable error, allow the primary user access to all functions required to check data accuracy.				
55. If a user has deferred entry of required data, but then requests processing of entries, signal that omission to the user and allow immediate entry of missing items or perhaps further deferral.				
56. If a set of default values have been defined for a data entry sequence, allow a user to accept all default entries.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
57. When interface designers cannot predict what default values will be helpful, permit users (or a system administrator) to define, change, or remove default values for any data entry field.				
58. On initiation of a data entry transaction, display currently defined default values in their appropriate data fields.				
59. Provide users with some simple means to confirm acceptance of a displayed default value for entry.				
60. When data entries made in one transaction are relevant to a subsequent transaction, program the computer to retrieve and display them for user review, rather than requiring re-entry of those data.				
61. Provide automatic cross-file updating whenever necessary, so that a user does not have to enter the same data twice.				
2.0 Data Display				
1. Ensure that whatever data a user needs for any transaction will be available for display.				
2. Tailor displayed data to user needs, providing only necessary and immediately usable data for any transaction; do not overload displays with extraneous data.				
3. Display data to users in directly usable form; do not make users convert displayed data.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
5. For any particular type of data display, maintain consistent format from one display to another.				
6. Allow users to change displayed data or enter new data when that is required by a task.				
7. When protection of displayed data is essential, maintain computer control over the display and do not permit a user to change controlled items.				
8. Ensure that each data display will provide needed context, recapitulating prior data as necessary so that a user does not have to rely on memory to interpret new data.				
9. The wording of displayed data and labels should incorporate familiar terms and the task-oriented jargon of the users.				
10. Choose words carefully and then use them consistently.				
11. Ensure that wording is consistent from one display to another.				
12. Use consistent grammatical structure within and across displays.				
13. When abbreviations are used, choose those abbreviations that are commonly recognized, and do not abbreviate words that produce uncommon or ambiguous abbreviations.				
14. Ensure that abbreviations are distinctive, so that abbreviations for different words are distinguishable.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
15. Minimize punctuation of abbreviations and acronyms.				
16. If abbreviations are used, provide a dictionary/glossary of abbreviations available for on-line user reference.				
17. When a critical passage merits emphasis to set it apart from other text, highlight that passage by bolding, brightening, color coding, or some auxiliary annotation.				
18. Organize data in some recognizable order to facilitate scanning and assimilation.				
19. Display continuous test in wide columns, containing at least 50 characters per line.				
20. Display continuous text conventionally in mixed upper and lower case.				
21. Ensure that displayed paragraphs of text are separated by at least one blank line.				
22. Maintain consistent spacing between the words of displayed text, with left justification of lines and ragged right margins if that is the result.				
23. In display of textual material, keep words intact, with minimal breaking by hyphenating between lines.				
24. Use conventional punctuation in textual display; sentences should end with a period or other special punctuation.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
24. In designing text displays, especially text composed for user guidance, strive for simplicity and clarity of wording.				
25. Put the main topic of each sentence near the beginning of the sentence.				
26. Use short simple sentences.				
27. Use affirmative statements rather than negative statements.				
28. Compose sentences in the active voice rather than passive voice.				
29. When a sentence describes a sequence of events, phrase it with a corresponding word order.				
30. Format lists so that each item starts on a new line (i.e., a list should be displayed as a single column).				
31. When a single item in a list continues for more than one line, mark items in some way so that the continuation of an item is obvious (i.e., so that a continued portion does not appear to be a separate item).				
32. When listed items will be numbered, use Arabic rather than Roman numerals.				
33. Adopt some logical principle by which to order lists. When no other principle applies, order lists alphabetically.				
34. If a list is displayed in multiple columns, order the items vertically within each cell.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
35. For a long list, extending more than one displayed page, consider adopting a hierarchic structure to permit its logical partitioning into related shorter lists.				
36. When words in text displays are abbreviated, define each abbreviation in parentheses following its first appearance.				
37. When text is combined with graphics or other data in a single display, thus limiting the space available for text, format the text in a few wide lines rather than in narrow columns of many short lines.				
38. Separate the data in a table by some distinctive feature, to ensure separations of entries within a row.				
39. In dense tables with many rows, insert a distinctive feature to aid horizontal scanning at regular intervals.				
40. Ensure that row and column labels are distinguishable from the data displayed within tables and from the labels of displayed lists, such as menu options or instructions to users.				
41. When rows or columns are labeled by number, start the numbering with "1," rather than "0."				
42. Show columns of alphabetic data with left justification to permit rapid scanning.				
43. Justify columns of numeric data with respect to a fixed decimal point; if there is no decimal point, then numbers should be right justified.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
44. Use consistent logic in the design of graphic displays, and maintain standard format, labeling, etc.				
45. Tailor graphic displays to user needs and provide only those data necessary for user tasks.				
46. When graphics contain outstanding or discrepant features that merit attention by a user, consider displaying supplementary text to emphasize that feature.				
47. When a user's attention must be directed to a portion of a display showing critical or abnormal data, highlight that feature with some distinctive means of coding.				
48. Adopt a consistent organization for the location of various display features from one display to another.				
49. Make the different elements of a display format distinctive from one another.				
50. Use blank space to structure a display.				
51. Begin every display at the top with a title or header, describing briefly the contents or purpose of the display.				
52. Reserve the last several lines at the bottom of every display for status and error messages, prompts, and command entry.				
53. Ensure that displays are formatted to group data items on the basis of some logical principle.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
54. Provide distinctive coding to highlight important display items requiring user attention. Highlighting is most effective when used sparingly.				
55. If highlighting is used to emphasize important display items, remove such highlighting when it no longer has meaning.				
56. Adopt meaningful or familiar codes, rather than arbitrary codes.				
57. Adopt codes for display (and entry) that conform with accepted abbreviations and general user expectations.				
58. Assign consistent meanings to symbols and other codes, from one display to another.				
59. Treat brightness as a two-valued code, bright and dim, i.e., consider coding by difference in brightness for applications that only require discriminating between two categories of displayed items.				
60. Color code for relative values.				
61. It will prove safer to use no more than five different colors for coding.				
62. When selecting colors for coding discrete categories of data, ensure that those colors are easily discriminable.				
63. Employ color coding conservatively, using relatively few colors and only to designated critical categories of displayed data.				

Human Factors Principle	Evaluation: Acceptable	Evaluation: Acceptable with Deficiencies	Evaluation: Unacceptable	Comments
64. Make color coding redundant with some other display feature, such as symbology; do not code only by color.				
65. When color coding is used, ensure that each color represents only one category of displayed data.				
66. Choose colors for coding based on conventional associations with particular colors.				
67. Use brighter and/or more saturated colors when it is necessary to draw a user's attention to critical data.				
68. Use saturated blue only for background features in a display, and not for critical coding.				
69. When blink coding is used, select a blink rate in the rage from 2 to 5 Hz, with a minimum duty cycle (ON interval) of 50 percent.				
70. When data have changed, especially following automatic display update, consider highlighting those data changes temporarily.				
71. When standard data displays are used for special purposes, allow users to temporarily suppress the display of data.				
3.0 Sequence Control				
1. Defer computer processing until an explicit user action has been taken.				

Human Factors Principle	Evaluation: Acceptable	Evaluation: Acceptable with Deficiencies	Evaluation: Unacceptable	Comments
2. Employ similar means to accomplish ends that are similar, from one transaction to the next, from one task to another, throughout the user interface.				
3. Display some continuous indication of current context for reference by the user.				
4. Adopt consistent terminology for on-line guidance and other messages to users.				
5. Choose names that are semantically congruent with natural usage, especially for paired opposites (e.g., UP / DOWN).				
6. Ensure that the computer acknowledges every entry immediately; for every action by the user there should be some apparent reaction from the computer.				
7. Each menu display should permit only one selection by the user.				
8. When multiple menu options are displayed in a list, display each option on a new line, i.e., format the list as a single column.				
9. When a user has selected and entered an option from a menu, if there is no immediately observable natural response, then the computer should display some other acknowledgment of that entry.				
10. Display an explanatory title for each menu, reflecting the nature of the choice to be made.				
11. Design a menu to display all options appropriate to any particular transaction.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
12. Design a menu to display only those options that are actually available in the current context for a particular user.				
13. When menus are provided in different displays, design them so that option lists are consistent in wording and ordering.				
14. If menu options are included in a display that is intended for data review and/or data entry, ensure that they are distinct from other displayed information; incorporate some consistent distinguishing feature to indicate their special function.				
15. List displayed menu options in a logical order; if no logical structure is apparent, then display the options in the order of their expected frequency of use, with the most frequent listed first.				
16. Format a menu to indicate logically related groups of options, rather than as an undifferentiated string of alternatives.				
17. When the menu selection must be made from a long list, and not all options can be displayed at once, provide a hierarchic sequence of menu selections, rather than one long multipage menu.				
18. When hierarchic menus are used, design their structure to permit immediate user access to critical or frequently selected options.				
19. When hierarchic menus are used, display some indication of current position in the menu structure.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
20. When hierarchic menus are used, ensure that display format and selection logic are consistent at every level.				
21. When hierarchic menus are used, require users to take only one simple key action to return to the next higher level.				
22. When hierarchic menus are used, require users to take only one simple key action to return to the general menu at the top level.				
23. Design the general options list to show control entry options grouped, labeled, and ordered in terms of their logical function, and frequency and criticality of use.				
24. Make available to users a list of the control options that are specifically appropriate for any transaction.				
25. Offer users only control options that are actually available for the current transactions.				
26. When a user is performing an operation on some selected display item, highlight that item.				
27. Design the interface software to deal appropriately with all possible control entries, correct and incorrect.				
28. When a user completes correction of an error, require the user to take an explicit action to reenter the corrected material; use the same action for reentry that was used for the original entry.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
29. When a control entry will cause any extensive change in stored data, procedures, and/or system operation, and particularly if that change cannot be easily reversed, notify the user and require confirmation of the action before implementing it. Provide a prompt to confirm actions that will lead to possible data loss.				
30. Word the prompt for a CONFIRM action to warn users explicitly of any possible data loss.				
31. Ensure that any user action can be immediately reversed by an UNDO command.				
32. UNDO itself should be reversible, so that a second UNDO action will do again whatever was just undone.				
33. When a user requests LOG-OFF, check pending transactions and, if any pending transaction will not be completed or if data will be lost, display an advisory message requesting user confirmation. Ensure that the user is aware of the status of the system or any of its components after LOG-OFF is complete.				
4.0 User Guidance				
1. Design standard procedures for accomplishing similar, logically related transactions.				
2. Require users to take explicit actions to specify computer processing; the computer should not take extra actions beyond those specified by a user.				

Human Factors Principle	Evaluation: Acceptable	Evaluation: Acceptable with Deficiencies	Evaluation: Unacceptable	Comments
3. In applications where users must log on to the system, design LOG-ON as a separate procedure that is completed before a user is required to select among any operational options.				
4. Ensure that only relevant data are displayed by tailoring the display for any transaction to the current information requirements of the user.				
5. Create display formats with a consistent structure evident to the user, so that a particular type of data is always presented in the same place and in the same way.				
6. Format each different type of user guidance consistently across displays.				
7. Design display formats so that user guidance material is readily distinguishable from displayed data.				
8. Design cursors so that they are readily distinguished from other displayed items.				
9. Label all displayed data clearly.				
10. Ensure that symbols and other codes have consistent meanings from one display to another.				
11. Ensure that the names for functions and data are consistent for similar or identical functions.				
12. Adopt wording terminology familiar to users.				
13. Adopt task-oriented wording.				

Human Factors Principle	Evaluation: Acceptable	Evaluation: Acceptable with Deficiencies	Evaluation: Unacceptable	Comments
14. Adopt affirmative rather than negative wording for user guidance messages.				
15. Adopt active rather than passive voice in user guidance messages.				
16. When user guidance describes a sequence of steps, follow that same sequence in the wording of user guidance.				
17. Be consistent in grammatical construction when wording user guidance.				
18. Allow users to switch easily between information handling and associated guidance material.				
19. Provide some indication of system status to users at all times.				
20. When users must log on to a system, display appropriate prompts for LOG-ON procedures automatically at a user's terminal.				
21. If a user tries to log onto a system and LOG-ON is denied because of system unavailability, display an advisory message telling the user what the system status is and when the system will become available.				
22. When task performance requires data exchange and/or interaction with other users, allow a user to obtain status information concerning other people currently using the system.				

Human Factors Principle	Evaluation: Acceptable	Evaluation: Acceptable with Deficiencies	Evaluation: Unacceptable	Comments
23. Ensure that every input by a user will consistently produce some perceptible response output from the computer.				
24. Ensure that computer response to user entries will be rapid, with consistent timing as appropriate for different types of transactions.				
25. Provide some indication of transaction status whenever the complete response to a user entry will be delayed.				
26. Provide a unique identification for each display in a consistent location at the top of the display frame.				
27. When a user (or computer) action establishes a change in operational mode that will affect subsequent user actions, display some continuing indication of current mode.				
28. When the computer detects an entry error, display an error message to the user stating what is wrong and what can be done about it.				
29. Make the wording of error messages as specific as possible.				
30. Make error messages brief but informative.				
31. Adopt neutral wording for error messages; do not imply blame to the user, or personalize the computer, or attempt to make a message humorous.				
32. The computer should display an error message only after a user has completed an entry.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
33. Display an error message a maximum of 2 to 4 seconds after the user entry in which the error is detected.				
34. As a supplement on-line guidance, include in the system documentation listing and explaining all error messages.				
35. In addition to providing an error message, mark the location of a detected error by positioning the cursor at that point on the display, i.e., at that data field or command word.				
36. When an entry error has been detected, continue to display the erroneous entry, as well as an error message, until corrections are made.				
37. Following error detection, require the user to reenter only that portion of a data/command entry which is not correct.				
38. Ensure that a displayed error message is removed after the error has been corrected; do not continue to display a message that is no longer applicable.				
39. Ensure that specific user guidance information is available for display at any point in a transaction sequence.				
40. Display menu options in logical groups.				
41. Provide reference material describing system capabilities and procedures available to users for on-line display.				
42. In addition to explicit and implicit aids, permit users to obtain further on-line guidance by requesting HELP.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
43. Provide a simple, standard action that is always available to request HELP.				
44. When an initial HELP display provides only summary information, provide more detailed explanations in response to repeated user requests for HELP.				
45. Permit users to browse through on-line HELP displays, just as they would through a printed manual, to gain familiarity with system functions and operating procedures.				
5.0 Data Transmission				
1. Choose functional wording for terms used in data transmission, including messages, for initiating and controlling message transmission and other forms of data transfer, and for receiving messages.				
2. Design the data transmission procedures to minimize memory load on the user.				
3. Design the data transmission procedures to minimize required user actions.				
4. Design the data transmission procedures so that both sending and receiving messages are accomplished by explicit user action.				
5. Allow users to interrupt message preparation, review, or disposition, and then resume any of those tasks from the point of interruption.				

Human Factors Principle	Evaluation: Acceptable	Evaluation: Acceptable with Deficiencies	Evaluation: Unacceptable	Comments
6. Provide software capabilities to annotate transmitted data with appropriate highlighting to emphasize alarm/alert conditions, priority indicators, or other significant second-order information that could affect message handling.				
7. For addressing and identifying messages, provide a basic set of header fields that can be interpreted by all systems to which users will send messages.				
8. Allow users to print copies of transmitted messages in order to make hard-copy records.				
9. Ensure that transmitted data are protected automatically with parity checks to detect and correct any errors that may occur, and buffering until acknowledgment of receipt.				
10. Ensure that only one copy of a message will be transmitted to any individual addressee.				
11. For receiving messages, allow users to choose the method of receipt (i.e., files, display, printer) that will be the local destination.				
12. Ensure that computer aids and procedures for reviewing messages are consistent with other system capabilities for general data display.				
6.0 Data Protection				
1. Provide automatic measures to minimize data loss from computer failure.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
2. Protect data from inadvertent loss caused by the actions of other users.				
3. Provide clear and consistent procedures for different types of transactions, particularly those involving data entry, change and deletion, and error correction.				
4. Ensure that the ease of user actions will match desired ends; make frequent or urgent actions easy to take, but make potentially destructive actions sufficiently difficult that they will require extra user attention.				
5. Ensure that the computer changes data only as a result of explicit actions by a user, and does not initiate changes automatically.				
6. For conditions which may require special user attention to protect against data loss, provide an explicit alarm and/or warning message to prompt appropriate user action.				
7. Allow users to UNDO an immediately preceding control action that may have caused an unintended data loss.				
8. Design the LOG-ON process and procedures for user identification to be as simple as possible and consistent with protecting data from unauthorized use.				
9. Design the LOG-ON process to provide prompts for all user entries, including passwords and/or whatever other data are required to confirm user identity and to authorize appropriate data access/change privileges.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
10. When passwords are required, allow users to choose their own passwords.				
11. Allow users to change their passwords whenever they choose.				
12. When a password must be entered by a user, ensure that password entry can be private; password entries should not be displayed.				
13. Impose a maximum limit on the number and rate of unsuccessful LOG-ON attempts that will provide a margin for user error while protecting the system from persistent attempts at illegitimate access.				
14. Once a user's identity has been authenticated, ensure that whatever data access/change privileges are authorized for that user will continue throughout a work session.				
15. Establish user authorization for data access at initial LOG-ON; do not require further authentication when a user requests display of particular data.				
16. When displayed data are classified for security purposes, include a prominent indication of security classification in each display.				
17. When confidential information is displayed at a work station that might be viewed by casual onlookers, provide the user with some rapid means of temporarily suppressing a current display, and then resuming work later.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
18. When data must not be changed, maintain computer control over the data, and do not permit users to change controlled items.				
19. Make procedures for data entry/change as simple as possible.				
20. Allow users to enter logically related items with a single, explicit action at the end of the sequence, rather than entering each item separately.				
21. When a data entry error is detected by the computer, allow the user to make an immediate correction.				
22. Following error detection, allow users to edit entries so that they must rekey only those portions that were in error.				
23. Require users to take explicit action to confirm doubtful and/or potentially destructive data change actions before they are accepted by the computer for execution.				
24. When a user requests LOG-OFF, check pending transactions involving data entry/change and, if data loss seems probable, display an appropriate advisory message to the user.				

Human Factors Principle	Evaluation: Acceptable	Evaluation: Acceptable with Deficiencies	Evaluation: Unacceptable	Comments
7.0 Hardware (MIL-STD 1472D)				
Visual Displays				
1.0 Contrast. Sufficient contrast shall be provided between displayed information and the display background to ensure that the required information can be perceived by the operator under all expected lighting conditions.				
2.0 Location. Displays shall be located and designed so that they may be read to the degree of accuracy required by personnel in normal operating or servicing positions without requiring the operator to assume an uncomfortable, awkward, or unsafe position.				
3.0 Orientation. Display faces shall be perpendicular to the operator's normal line of sight whenever feasible and shall not be less than 3.14/4 rad (45°) from the normal line of sight.				
4.0 Reflection. Displays shall be constructed, arranged, and mounted to prevent reduction of information transfer due to the reflection of the ambient illumination from the display cover. Reflection of instruments and consoles and other enclosures shall be avoided.				
5.0 Frequency of use. Displays used most frequently should be grouped together and placed in the optimum visual zone.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
CRTs				
1.0 Viewing distance. A 400 mm (16-inch) viewing distance shall be provided whenever practicable. When periods of observation will be short, or when dim signals must be detected, the viewing distance may be reduced to 250 mm (10 inches). Design should permit the observer to view the CRT as close as desired.				
2.0 Reflected glare. Reflected glare shall be minimized by proper placement of the CRT relative to the light source and the use of a hood, shield, or optical coating on the CRT.				
3.0 Ambient surfaces. Surfaces adjacent to the CRT shall have a dull matte finish.				
4.0 Font legibility. Where alphanumeric characters appear on CRT-like displays, the font style shall allow discrimination of similar characters, such as the letter I and the number 1 and the letter z and the number 2.				
Audio Displays				
1.0 Type of voice. The voice used in recording verbal signals shall be distinctive and mature.				
2.0 Delivery style. Verbal signal shall be presented in a formal, impersonal manner.				
3.0 Message content. In selecting words to be used in audio warning signals, priority shall be given to intelligibility, aptness, and conciseness in that order.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
4.0 Volume control (automatic or manual). The volume (loudness) of an audio warning signal shall be designated to be controlled by the operator, the sensing mechanism, or both.				
Keyboards				
1.0 Numeric keyboard. The configuration of a keyboard used to enter solely numeric information should be a 3 x 3 + 1 matrix with the zero digit centered on the bottom row.				
2.0 Alpha-numeric keyboard. Keyboard configurations for entry of alphabetic and some numeric information shall conform to MIL-STD-1280.				
3.0 Slope. The slope of nonportable keyboards should be 260-435 mrad (15-25°) from the horizontal. The preferred slope is 280-300 mrad (17-18°).				
4.0 Resistance. The force required to operate alphanumeric or numeric keyboards shall conform to figure 11, page 91, and table X, page 95, MIL-STD-1472D.				
Touch Screen				
1.0 The dimensions and separation of responsive areas of the touch screen shall conform to S1, S2, and S3 of figure 14, page 119, MIL-STD-1472D.				
2.0 Resistance. The force required to operate force-actuated touch-screens shall conform to the alphanumeric resistance limits of table 11, page 91, MIL-STD-1472D.				

Human Factors Principle	Evaluation: Acceptable	Evaluation: Acceptable with Deficiencies	Evaluation: Unacceptable	Comments
Equipment Labeling				
1.0 Location. The gross identifying label on a unit, assembly, or major subassembly shall be located externally, in such a position that it is not obscured by adjacent items; on the flattest, most uncluttered surface available; and on a main chassis of the equipment.				
2.0 Functional labeling. Each control and display shall be labeled according to function, and the following criteria shall apply: (a) similar names for different controls and displays shall be avoided; (b) instruments shall be labeled in terms of what is being measured or controlled, taking into account the user and purpose; (c) control labeling shall indicate the functional result of control movement (e.g., on, off); (d) when controls and displays must be used together (in certain adjustment tasks), appropriate labels shall indicate their functional relationship -- the selection and use of terminology shall be consistent.				
3.0 Location. (a) Ease of control operation shall be given priority over visibility of labels; (b) labels would normally be placed above the controls and displays they describe. When the panel is above eye level, labels may be located below if label visibility will be enhanced.				
Workspace Design				
1.0 Kick space. All cabinets, consoles, and work surfaces that require an operator to stand or sit close to their front surfaces shall contain a kick space at the base at least 100 mm (4 inches) deep and 100 mm (4 inches) high.				

Human Factors Principle	Evaluation: Acceptable	Evaluation: Acceptable with Deficiencies	Evaluation: Unacceptable	Comments
Standing Operations				
1.0 Work surface. Work surfaces designed to support manual, worksheets, etc., shall be 915 +/- mm (36 +/- 0.6 inches) above the floor.				
2.0 Display placement, normal. Visual displays mounted vertically and used in normal equipment operation shall be placed between 1.040 m (41 inches) and 1.780 m (70 inches) above the standing surface.				
Seated Operations				
1.0 Work surface width and depth. A lateral workspace of at least 760 mm (30 inches) wide and 400 mm (16 inches) deep shall be provided whenever practicable.				
2.0 Work surface height. Desk tops and writing tables shall be 740 to 790 mm (29 to 31 inches) above the floor.				
Standard Console Design				
1.0 Dimensions. Consoles which constitute operator workstations should be designed to conform with the dimensions shown in table XX and figure 30, pages 154-155, MIL-STD-1472D.				
2.0 Viewing angle. The total required left-to-right viewing angle shall not exceed 190 degrees (see figure 2, MIL-STD-1472D). This angle should be reduced whenever possible through appropriate control-display layout.				

Human Factors Principle	Evaluation			Comments
	Acceptable	Acceptable with Deficiencies	Unacceptable	
Accessibility				
1.0 Structural members. Structural members or permanently installed equipment shall not visually or physically obstruct adjustment, servicing, removal of replacement equipment, or other required maintenance tasks. Panels, cases, and covers removed to access equipment shall have the same access requirements as replaceable equipment. Mounting provisions shall be visually and physically accessible by the maintainers. No special tools shall be required for removal or replacement, unless required by security considerations.				
2.0 Large items. Large items which are difficulty to remove shall be mounted so that they will not prevent convenient access to other items.				
3.0 Use of tools and test equipment. Sufficient space shall be provided for the use of test equipment and other required tools without difficulty or hazard.				
4.0 Rear access. Sliding, rotating, or hinged equipment to which rear access is required shall be free to open or rotate their full distance or remain in the open position without being supported by hand.				
5.0 Relative accessibility. Mission critical items which require rapid maintenance shall be most accessible. When relative criticality is not a factor, items requiring most frequent access shall be most accessible.				

Human Factors Principle	Evaluation: Acceptable	Evaluation: Acceptable with Deficiencies	Evaluation: Unacceptable	Comments
6.0 Skills. Access to items maintained by one technician should not require removal of critical equipment maintained by another technician, particularly where highly specialized skills are involved.				
Covers				
1.0 Securing covers. It shall be made obvious when a cover is not secured, even though it may be in place.				
2.0 If the method of opening a cover is not obvious from the construction of the cover itself, instructions shall be permanently displayed on the outside of the cover. Instructions shall consist of simple symbols such as arrows or simple words such as "push" or "pull."				
3.0 Clearance. Bulkheads, brackets, and other equipment shall not obstruct visual or physical access for removal or opening of covers on equipment within which work must be performed in the installed condition. Covers, doors, or panels which must be opened to perform on-site maintenance shall be visually and physically accessible to the maintainers.				

SPEARS OT&E USABILITY STRUCTURED INTERVIEW

SPEARS OT&E USABILITY STRUCTURED INTERVIEW

1. Were you made familiar enough with the SPEARS device?

2. Did you receive proper training on the SPEARS?

3. Do you think that the SPEARS will help you perform your job?

    If no, explain why.

    If yes, explain why.

4. How did the SPEARS device affect your ability to find explosives in bags ?

5. How useful was the SPEARS feedback?

6. How useful was the SPEARS Threat-Image Projection (TIP) training and testing?

7. What training needs improvement?

8. What training was most effective?

9. How understandable was the training?

10. How does the SPEARS effect your normal screening job?

11. How does the SPEARS effect the flow of baggage and passengers through the checkpoint?

12. Describe how difficult or easy it was to use the SPEARS machine.

SPEARS IMAGE CONTENT CHECKLIST

SPEARS IMAGE CONTENT CHECKLIST

SPEARS Image Content	Evaluation		Comments/Description
	Yes	No	
1. The number of images of CTIs provided by the system is _____.	NA	NA	
2. The number of images of FTIs provided by the system is _____.	NA	NA	
3. The number of CTIs of weapons is _____.	NA	NA	
4. The number of CTIs of explosives is _____.	NA	NA	
5. The number of CTIs of incendiary devices is _____.	NA	NA	
6. The number of CTIs of dangerous/deadly devices other than weapons, incendiaries, or explosives is _____.	NA	NA	
7. The number of FTIs of weapons is _____.	NA	NA	
8. The number of FTIs of explosives is _____.	NA	NA	
9. The number of FTIs of dangerous/deadly devices other than weapons, incendiaries, or explosives is _____.	NA	NA	
10. At least two different aspect angles are available for each CTI presentation.			
11. At least two different aspect angles are available for each FTI presentation.			

SPEARS CUSTOMIZATION CHECKLIST

SPEARS CUSTOMIZATION CHECKLIST

	Evaluation		
SPEARS Customization	Yes	No	Comments/Description
1. Combined Threats and Images (CTIs) can be selected for each screener as a function of threat category.			
2. CTIs can be selected for each screener as a function of difficulty.			
3. CTIs can be selected for each screener as a function of aspect angle.			
4. CTIs can be selected as a function of the combination of threat category, screener difficulty, and aspect angle.			
5. CTIs can be archived with the associated screener outcome (hit, miss, false alarm, and correct rejection).			
6. Each archived CTI with associated screener trial outcome includes date and time of day.			
7. Fictional Threat Images (FTIs) can be selected for each screener as a function of threat category.			
8. FTIs can be selected for each screener as a function of difficulty.			
9. FTIs can be selected for each screener as a function of aspect angle.			

	Evaluation		
SPEARS Customization	Yes	No	Comments/Description
10. FTIs can be selected as a function of the combination of threat category, screener difficulty, and aspect angle.			
11. FTIs can be archived with the associated screener outcome (hit, miss, false alarm, correct rejection).			
12. Each archived FTI with associated screener trial outcome includes date and time of day.			
13. CTIs can be automatically or manually selected based on time of day.			
14. CTIs can be automatically or manually selected based on checkpoint activity.			
15. CTIs can be automatically or manually selected based on screener identity.			
16. CTIs can be automatically or manually selected based on the combination of time of day, checkpoint activity, and screener identity.			
17. FTIs can be automatically or manually selected based on time of day.			
18. FTIs can be automatically or manually selected based on checkpoint activity.			
19. FTIs can be automatically or manually selected based on screener identity.			

	Evaluation		
SPEARS Customization	Yes	No	Comments/Description
20. FTIs can be automatically or manually selected based on the combination of time of day, checkpoint activity, and screener identity.			

SPEARS FEEDBACK CHECKLIST

SPEARS FEEDBACK CHECKLIST

	Evaluation		
SPEARS Feedback	Yes	No	Comments/Description
1. Feedback is immediate after correct, incorrect, or missed identification of an FTI.			
2. Feedback is displayed in a consistent position.			
3. Feedback is consistent in terms of format and content.			
4. Feedback is provided for correct FTI identification.			
5. Feedback is provided for missed FTI identification.			
6. Following missed FTI identification, the location of the missed FTI is provided on the display.			
7. Feedback is provided for threat items that do not contain threat images.			
8. FTIs are removed from the display to allow additional image scanning.			
9. The time interval between user initiation and system feedback for each condition of correct or missed identification, image removal, and threat items which do not contain threat images is _____.	NA	NA	

	Evaluation		
SPEARS Feedback	Yes	No	Comments/Description
10. The nature of the feedback (i.e., visual and/or auditory, graphical, textual, etc.) for each condition of correct or missed identification, image removal, and threat items which do not contain threat images is _____.	NA	NA	

SPEARS CAPABILITIES SUMMARIES CHECKLIST

SPEARS CAPABILITIES SUMMARIES CHECKLIST

	Evaluation		
SPEARS Capabilities	Yes	No	Comments/Description
1. Summary reports are automatically generated.			
2. Summary reports are generated on demand.			
3. Summary reports contain descriptive statistics.			
4. Descriptive statistics are categorized according to: a. threats presented and outcomes b. screener identification c. checkpoint activity level d. time of day			
5. Summary reports are readily understandable by the user (based on structured interview question results).			
6. Performance levels for individual screeners per screening session are actively and accurately reported as a function of the probability of detection (P_d).			
7. Performance level reports can be provided to a remotely situated supervisor.			
8. A remotely situated supervisor can be notified when performance levels are above or below supervisor preset performance criteria thresholds.			

INTEROPERABILITY CHECKLIST

INTEROPERABILITY CHECKLIST

	Evaluation		
SPEARS Interoperability	Yes	No	Comments/Description
1. A connection via modem can be established between two Screener Proficiency Evaluation and Reporting System (SPEARS) devices or a SPEARS device and a computer over standard telephone lines.			
2. The SPEARS remote connection requires no more than two people (one on-site, one at the remote site) to operate.			
3. New CTIs can be downloaded remotely to the SPEARS on-site device.			
4. New FTIs can be downloaded to the SPEARS on-site device.			
5. Status reports can be initiated remotely via the modem connection.			
6. Status report data can be accessed remotely and saved to a local computer file.			
7. Status reports can be printed out from the remote location.			
8. Remotely accessed status reports are similar to those available on-site from the SPEARS device.			
9. The time required to transfer a CTI remotely is _____.	NA	NA	
10. The time required to transfer an FTI remotely is _____.	NA	NA	

SECURITY ACCESS CONTROL CHECKLIST

SECURITY ACCESS CONTROL CHECKLIST

SPEARS Security Access Control	Evaluation		Comments/Description
	Pass	Fail	
1. The system provides controls to limit access rights.			
2. Access control can be limited to the granularity of a single user.			
3. The system provides controls to limit propagation of sensitive information.			
4. Files are protected from unauthorized access.			
5. Files are sensitivity labeled.			
6. File sensitivity labels are used as a basis for access control decisions.			
7. Data are protected during transmission.			
8. When data are exported, a sensitivity label is included that accurately represents the level of security of the file.			
9. All human-readable output is sensitivity labeled.			
10. Procedures are established to control access to printed data.			
11. Users can access files only if their security level is greater than or equal to the security level of the file.			
12. Users are required to enter identification before performing any actions.			

SPEARS Security Access Control	Evaluation		Comments/Description
	Pass	Fail	
13. The system maintains data to authenticate user identity and level of access.			
14. Authentication data cannot be accessed by any unauthorized user.			
15. The system maintains an access audit trail.			
16. The access audit trail is protected from modification, unauthorized access, or destruction.			
17. Hardware and/or software features are provided that can be used periodically to validate the correct operation of the on-site hardware and firmware elements of the system security measures.			
18. The security mechanism of the system can be tested and works as claimed in the system documentation.			
19. Anyone external to those who have been granted access privileges cannot read, change, or delete data.			
20. Documentation is provided that describes the protection mechanisms provided by the system, and their use.			
21. A manual is provided to the system administrator that presents cautions about functions and privileges that should be controlled to maintain a secure system.			
22. The manual describes the operator and administrator functions related to security.			
23. The manual provides guidelines on the consistent and effective use of the protection features of the system, how they interact, and how to successfully generate a new secure system.			

SPEARS Security Access Control	Evaluation		Comments/Description
	Pass	Fail	
24. Documentation is provided that describes how the security mechanism was tested. 25. Documentation is provided that describes the manufacturer's philosophy of protection and how this philosophy is translated into the secure system.			

SPEARS IMAGE INSERTION ISSUE CHECKLIST

SPEARS IMAGE INSERTION ISSUE CHECKLIST

	Evaluation		
SPEARS Insertion	Yes	No	Comments/Description
1. FTIs can be generated using a computer generated threat object and neutral baggage image.			
2. FTIs can be automatically generated.			
3. FTIs are not predictable in the order they are presented.			
4. CTIs can be inserted into the normal baggage flow.			
5. CTIs can be automatically generated.			
6. CTIs are not predictable in the order they are presented.			
7. When an FTI and neutral bag image are combined, FTIs perceptually appear inside the neutral bag.			
8. FTI position in the neutral bag can be randomly determined.			
9. FTI orientation in the neutral bag can be controlled.			

EMBRY-RIDDLE AERONAUTICAL UNIVERSITY
AIRPORT SECURITY SCREENING PROGRAM PROTOCOL

HIDDEN FIGURES TEST

This version of the Hidden Figures Test (HFT) is a two-part instrument with 32 items equally distributed between both parts. The instrument is a computer-based administration of a published paper-and-pencil test. Computer-based administration was selected to permit the assessment of reaction time measures, in addition to the standard accuracy measure.

The instrument is introduced to subjects as "a test of your ability to find which one of five simple figures can be found in a more complex pattern." The administration is completely automated and requires no experimenter intervention once initialized. Unlike the paper-and-pencil instrument, only one test item is presented at a time. Subsequent test items are not presented until a response has been entered for the previous test item, at which time the item responded to is permanently removed from the computer monitor. Each item presentation maintains the response set of five target patterns horizontally across the top of the computer monitor. Each of the five response targets are numerically labeled from 1 through 5 directly beneath the corresponding target patterns. The response set remains on the monitor any time the actual test administration is in progress and a test item is present. The complex background patterns are presented beneath the response set at approximately the center of the screen. Identical to the paper-and-pencil HFT, the complex background patterns vary in size, shape, and complexity.

The current version also differs from the original version in that the examples are dynamically displayed. Examples are displayed for subjects by first presenting the complex background pattern and then highlighting the target figure by use of color traced over the background pattern. Subjects are directed to respond by entering their choice on the computer numeric keypad.

This version of the instrument is further distinguished by having the subjects perform two examples. After an example is responded to, feedback is provided. For both correct and incorrect responses, the correct response (target pattern) is highlighted in color on the background pattern. Positive responses are provided with the textual feedback, "That's correct" on the monitor. Incorrect responses are provided feedback on the monitor with the text "Sorry, only the correct response number figure can be found in the pattern."

Several other directions appear interspersed in the instruction set and are provided to the subjects before they begin the actual test. These are all provided textually via the computer software and are subject-paced:

a. Subjects are informed that there is only one of the target figures in each complex pattern.

b. Each target figure will always be right side up and exactly the same size as the one in the complex pattern.

c. No additional lines can be added to the complex pattern. The target figure must be traceable on the existing complex pattern. (This is further demonstrated graphically in conjunction with the textual instruction.)

d. A score is calculated by subtracting the number of incorrect responses from the number of correct responses. Subjects are informed that it is not to their advantage to guess, unless they are able to eliminate at least some of the possible responses that they know are wrong.

e. Information is provided that advises there is no time limit, but to work quickly since response times are assessed and are, therefore, important.

f. The number of test items is clearly identified.

Since reaction times are recorded, each part of the test begins with a 10-second countdown that is prominently displayed in the center of the monitor with the preface "Test will begin in _ seconds." The textual command "Begin" appears 1 second after the countdown is completed, followed 500 milliseconds later by the first test item. A 10-second rest period occurs between the first and second parts of the test.

RESULTS

Introduction

Several analyses were conducted on both instruments to assess the psychometric properties of each one. These analyses were important to determine if the transition from a paper-and-pencil format to a computer-based presentation adversely impacted test characteristics of key interest:

a. The capability to identify individual differences.
b. The presence of speed-accuracy trade-offs.
c. The internal consistency of the instruments.

Post-test subject debriefing data were also examined to determine if alternate strategies were employed by the subjects to circumvent the assessment of the intended abilities.

Hidden Figures Test

This instrument is divided into two parts, each with 16 items. The computer-based version maintained this original structure. The mean and standard deviations for the accuracy score were M=7.00 (SD=9.03) and M=5.13 (SD=8.70) for parts one and two, respectively. These data indicate that the instrument is sensitive to individual differences and demonstrates a mean to standard deviation ratio greater than 1:1.25. Correct and incorrect reaction times were M=47.69 seconds (SD- 23.43) and M=72.84 seconds (SD=48.47), respectively.

An examination of individual differences was further pursued by comparing mean accuracy scores of both parts of the instrument by dividing the sample into upper and lower quartile groups using the accuracy score data. The mean accuracy scores for both parts of the instrument for the upper quartile group were M=16.00 and M=13.14. Respective mean accuracy scores for the lower quartile group were M=6.29 and M=-8.86. A t-test for differences yielded t(1,12)=18.15, p>.001 for part one, and t(1,12)=20.14, p>.001 for part two of the instrument in comparing quartile groups. The computer-based version of the HFT is effective in discriminating performance among examinees.

An item analysis was conducted between the quartile groups to determine if any test items were not useful in discriminating performance. This analysis indicated that all 32 items were predictive of performance differences, albeit of different magnitudes. All but two items resulted in differences at a minimum of the 50 percent level. That is to say, at least half of the lower quartile group scored incorrectly on all items that the upper quartile group responded to correctly. Based on these results, all 32 items were retained for the finalized instrument.

A split-half reliability analysis was also conducted to assess the internal consistency of the instrument. A Pearson Product Moment correlation coefficient between the first and second parts of the instrument demonstrated =.92(p>.01).

The presence of a speed-accuracy trade-off strategy in performing the test was assessed by examining the relationship between the accuracy score for both parts of the test combined and mean correct reaction time across all 32 items. A Pearson correlation coefficient of r=.24 indicates only a weak relationship between these two performance measures. There appears to be little reason to suspect that subjects sacrificed speed for accuracy or vice-versa. This was anticipated, given that the test instructions directed subjects to maintain a balance between these two performance goals.

HIDDEN PATTERNS TEST

The Hidden Pattern Test (HPT) was developed as a two-part instrument, with 100 items equally distributed between both parts. Test items do not increase in difficulty level throughout the test. This assessment tool is a computer-based administration of that developed by the Educational Testing Service. This revision of the instrument permits assessment of both accuracy and response time measures.

The HPT is introduced as a test of the ability to recognize a figure that is hidden among other lines. Instructions inform subjects that speed of recognition and response is important, but not to sacrifice accuracy.

Similar to the HFT, the instrument is fully automated and self-contained. Test items are displayed one at a time on the computer monitor and are removed once a corresponding response is made. Each trial permanently displays the target figure prominently in the center of the monitor any time the test administration is in progress. The target figure (to which the test item is compared) appears 3 centimeters below the test item. Both test items and target figures are identical to those used in the original paper-and-pencil instrument.

The design of the instrument is similar to the automated HFT in several ways: examples are dynamically presented; examples use a color trace of the test item over the target figure for illustration; a red "x" is displayed during example items when the test item cannot be found in the target figure; and all responses are made using a numeric keypad. Seven examples of the test item appearing within the target figure are provided, as are four examples when a match is not present. All examples are self-paced and are presented in multiple orientations.

The instructions further inform subjects that the test item may be found in the target figure in an upside down, right-side up, or rotated configuration. Similar to the HFT, an individual's performance is evaluated as the number correct minus the number wrong. Subjects are advised that it is not to their advantage to guess.

Each part of the test begins with a 10-second countdown identical to that used with the HFT. A brief, subject-controlled, rest period also occurs between the two parts of the test.

Only response keys "1" and "2" are activated after the instruction set terminates. Subjects are instructed to depress the number "1" key for those patterns in which the model appears, and the number "2" key for those patterns in which the model does not appear.

SUBJECT INFORMED CONSENT FORM

INFORMED CONSENT

I, ____, have received a briefing by the FAA representative as to the purpose of the FAA study. I fully understand the purpose of the study and have been provided with the opportunity to ask questions of the FAA representative. The FAA representative informed me that the study will require approximately 3 hours of training, followed by 3 baggage screening trials, and 30 minutes to complete a vision test and 1 hour to complete a hidden figures test.

I understand that this study will impose very little stress. The only stress I may experience in this experiment may be some initial frustration as I learn how to use the training system. As part of the data analysis, my data will be combined with that of other individuals and I will no longer be identifiable as a participant. I have been informed that my name will remain CONFIDENTIAL.

I have been informed that I have the right to withdraw from the experiment, and that the experiment monitor may terminate my participation in the interest of safety and the experiment. I also certify that I am at least 18 years of age.

I have been informed that if additional details are needed, I may contact any of the test administrators at the airport during the study, or contact James L. Fobes, Ph.D., (609) 485-4944; or Robert L. Malone, (609) 645-0900, upon completion of the study.

Signed: ____

Date: ______ / ______ /______

Witness: ____

Date: ______ / ______ /______

SCREENER PERSONAL INFORMATION FORM
(SPEARS OT&E SCREENER QUESTIONNAIRE)

FAA

SCREENER PROFICIENCY EVALUATION AND REPORTING SYSTEM

OPERATIONAL TEST AND EVALUATION

SCREENER QUESTIONNAIRE

DATE:______________________ SUBJECT NUMBER:______________________

1. What is your sex?

Male ______ Female ______

2. How long have you been a baggage screener?

___________Years ___________Months

3. How long have you been using X-ray equipment to screen baggage?

___________Years ___________Months

4. What is the highest level of education or degree that you have completed.

8th Grade or Less ______

Some High School ______

High School Graduate ______

Some College or University ______

College or University Graduate ______

5. Do you wear glasses while using the X-ray equipment?

Yes ______ No ______

FAA

SCREENER PROFICIENCY EVALUATION AND REPORTING SYSTEM

OPERATIONAL TEST AND EVALUATION

SCREENER QUESTIONNAIRE

(Continued)

6. Do you consider English to be your primary language?

Yes _______ No _______

If not, in which language are you most proficient? _______

If not, are you proficient with English? _______

PROTOCOL IMPROVISED EXPLOSIVE DEVICE (IED) DETECTION TEST

PROTOCOL
IED DETECTION TEST

READ TO SCREENERS:

This is a test of how well X-ray machines work for detecting Improvised Explosive Devices (IEDs). For this activity, we have put X-ray images of passenger bags in this computer. You will view the X-ray images, one bag at a time, and inspect each bag for an IED. The images will be displayed on the video monitor.

INSTRUCTIONS TO SUBJECTS

After you have determined that your subject number on the monitor is correct, press the "ENTER" key on the keyboard to start the practice test. Initially, you will be given 10 images to practice on before beginning the real test. Once you see the first X-ray image appear on the monitor screen, your task will be twofold:

First, you will respond to the question: "Is there an IED in this X-ray image?" (The question will be shown at the bottom center of the monitor frame.)

To indicate "yes," press the key labeled "yes" on the keyboard.

To indicate "no," press the key labeled "no" on the keyboard.

Should you press the wrong key, an error message will appear on the monitor telling you that you pressed the wrong key.

Because we want to know how well the machines work, it is important that you answer each question to the best of your ability. It is just as important for you to say "no" when you do not see an IED as it is to say "yes" when you do see an IED.

You will have 10 seconds to make your response. However, you should answer as quickly as possible. Once you have made your response, you will not allowed to go back and change it.

If you have not answered the question after 6 seconds, an audible alarm will sound, alerting you that you have only 4 seconds left to answer the question.

If you still have not responded after 10 seconds, the image will disappear from the monitor screen and will be replaced by a prompt which advises you that, "Time has expired, please answer."

After you have responded to the first question, a second question will be displayed on the video monitor:

"How sure are you?"
yes = more sure   no = less sure

Respond by pressing the "yes" or "no" key on the keyboard or keypad, regardless of whether your answer to the first question was "yes" or "no". In either case, you will use the same two keys that you used to respond to the first question.

You will have 5 seconds to make this second response. If you have not yet answered this second question after 5 seconds, the question will disappear from the monitor screen and the prompt appear again telling you: "Time has expired, please answer." The system will not forward to the next image until you have made your response.

You will repeat this procedure for each image until all images have been viewed. A message will then appear on the monitor indicating that the test has ended. The test should take a little over an hour to complete.

Do you have any questions?

Thank you for participating in this test. Press the "ENTER" key on your keyboard to start the practice test. When you have completed the practice test, press the "ENTER" key again to start the real test.

SPEARS ON-LINE OT&E
STATEMENT OF DUTIES FOR ADMINISTRATIVE PERSONNEL

SPEARS ON-LINE OT&E
STATEMENT OF DUTIES FOR ADMINISTRATIVE PERSONNEL

Test Director:

Responsible for directing and overseeing all test activities and personnel.

Federal Aviation Administration

Test Manager:

Ensures that screeners are greeted and completes required administration.
Conducts briefs and debriefs.
Manages daily test activities and starts and stops the test sequence as required.
Plans for and directs contingency activities.
Liaisons with security company administrative personnel.
Liaisons with airline personnel.
Ensures that the proper screener is in the required location at the required time.
Resolves any encountered problems with the test director.
Executes all required logistical activities.

Galaxy Scientific Corporation

Pretest Data Collector

Terminal 2 data collectors train screeners on procedures and use of TnT™ device.

Conducts contrast acuity tests on screeners using the required test forms.
Ensures that the screener's number is recorded on test forms.
Ensures that test forms are given to Galaxy Scientific Corporation personnel.
Ensures that each screener completes a questionnaire.

Briefs and debriefs screeners regarding Improvised Explosive Device (IED) detection test.
Provides guidance and assistance to screeners on matters pertaining to conduct of test.
Administers IED detection test.
Escorts screeners between security checkpoint and training and testing rooms.

Briefs and debriefs screeners regarding Hidden Figures/Patterns test.
Provides guidance and assistance to screeners on matters pertaining to conduct of test.
Administers Hidden Figures/Patterns test.

Federal Aviation Administration
Galaxy Scientific Corporation

Posttest 1 Data Collector

Briefs and debriefs screeners regarding IED detection test.
Provides guidance and assistance to screeners on matters pertaining to conduct of test.
Administers IED detection test.
Escorts screeners between security checkpoint and training and testing rooms.

Federal Aviation Administration
Galaxy Scientific Corporation

Posttest 2 Data Collector - IED

Briefs and debriefs screeners regarding IED detection test.
Provides guidance and assistance to screeners on matters pertaining to conduct of test.
Administers IED detection test.
Escorts screeners between security checkpoint and training and testing rooms.

Federal Aviation Administration
Galaxy Scientific Corporation

Posttest 2 Data Collector - TnT™

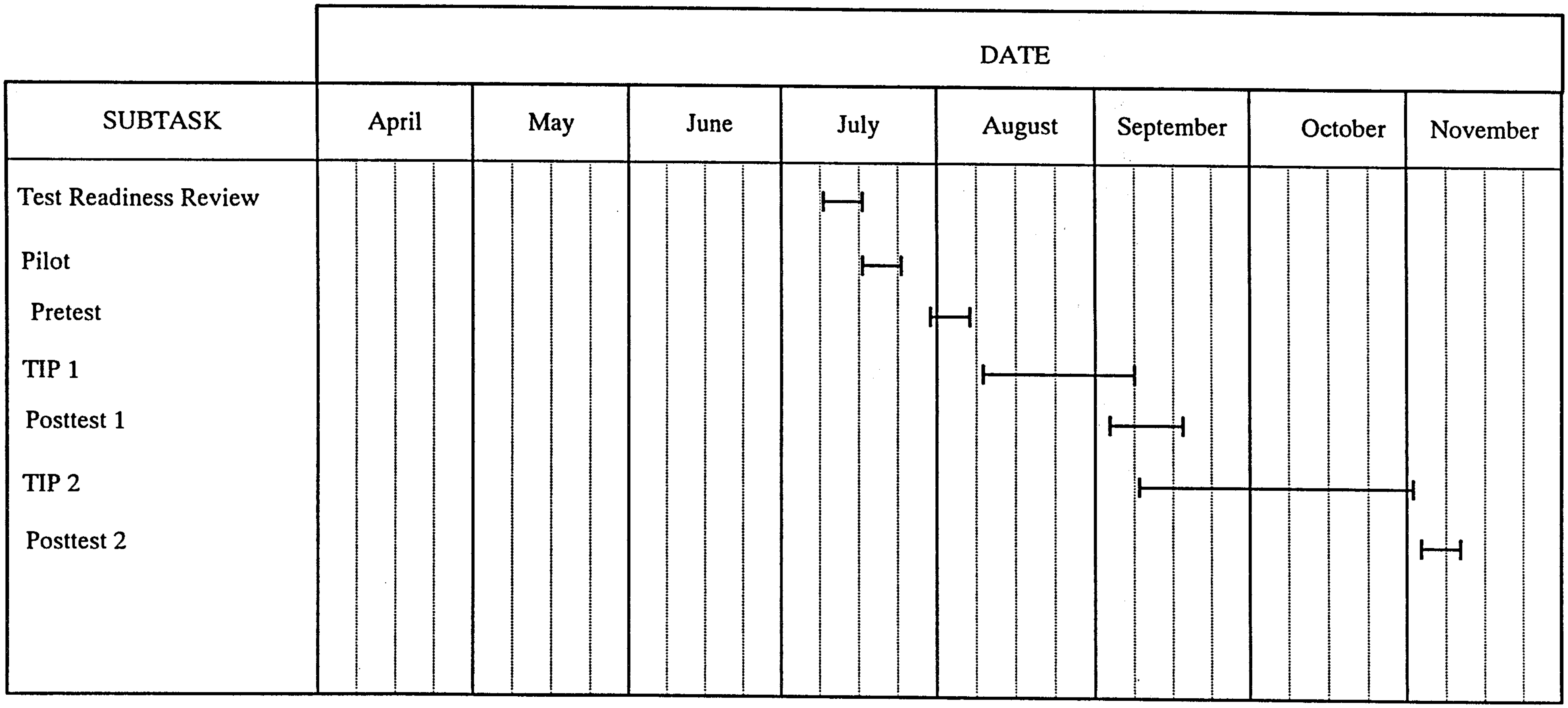
Terminal 2 data collector briefs and debriefs screeners regarding usability assessment.
Provides guidance and assistance to screeners in completing usability interview.

Terminal 7 data collector briefs and debriefs screeners regarding insertion representativeness assessment.
Provides guidance and assistance to screeners in completing insertion representativeness ratings.

Federal Aviation Administration
Galaxy Scientific Corporation

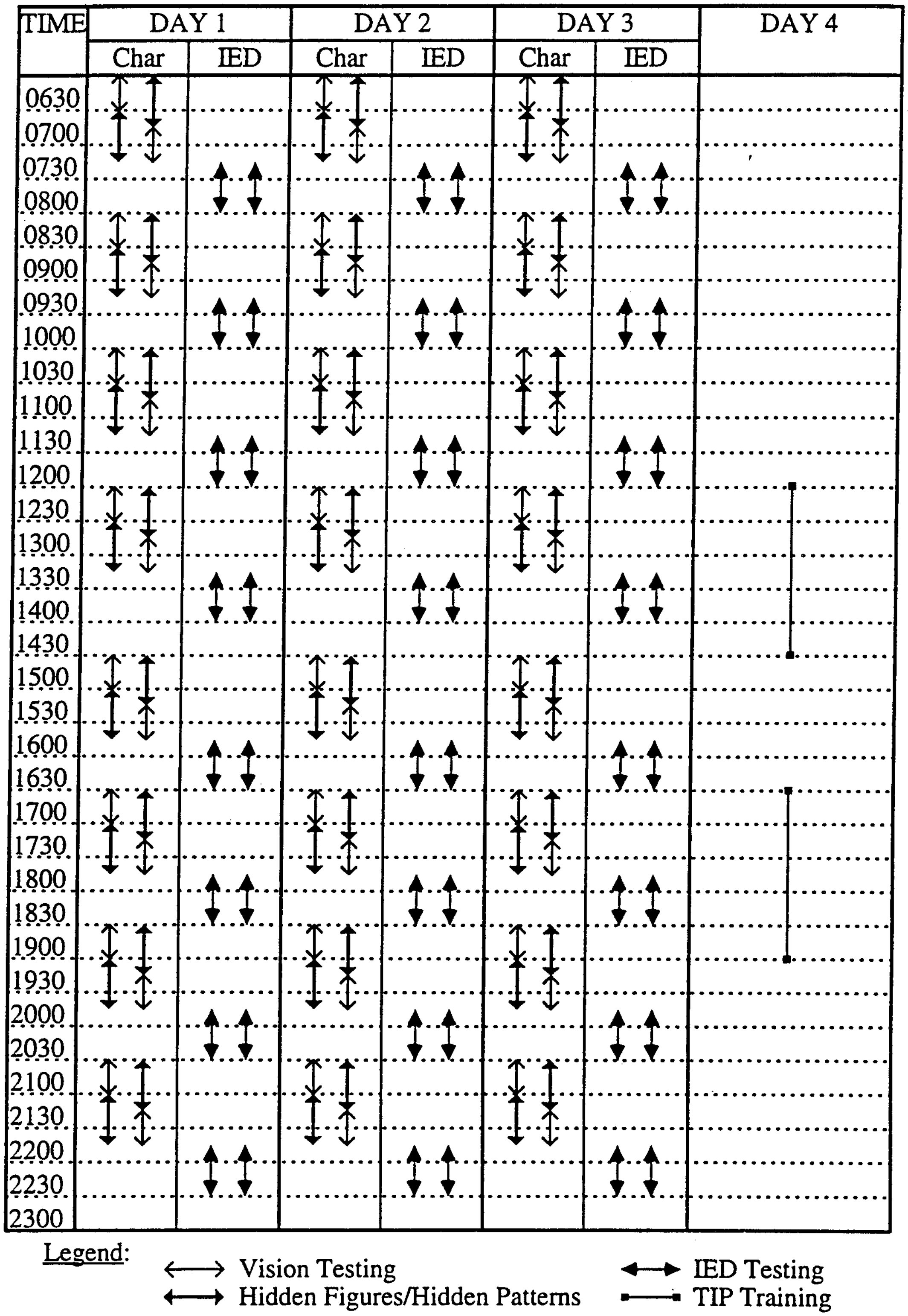
SPEARS ON-LINE OT&E MASTER SCHEDULE

SPEARS ON-LINE OT&E MASTER SCHEDULE

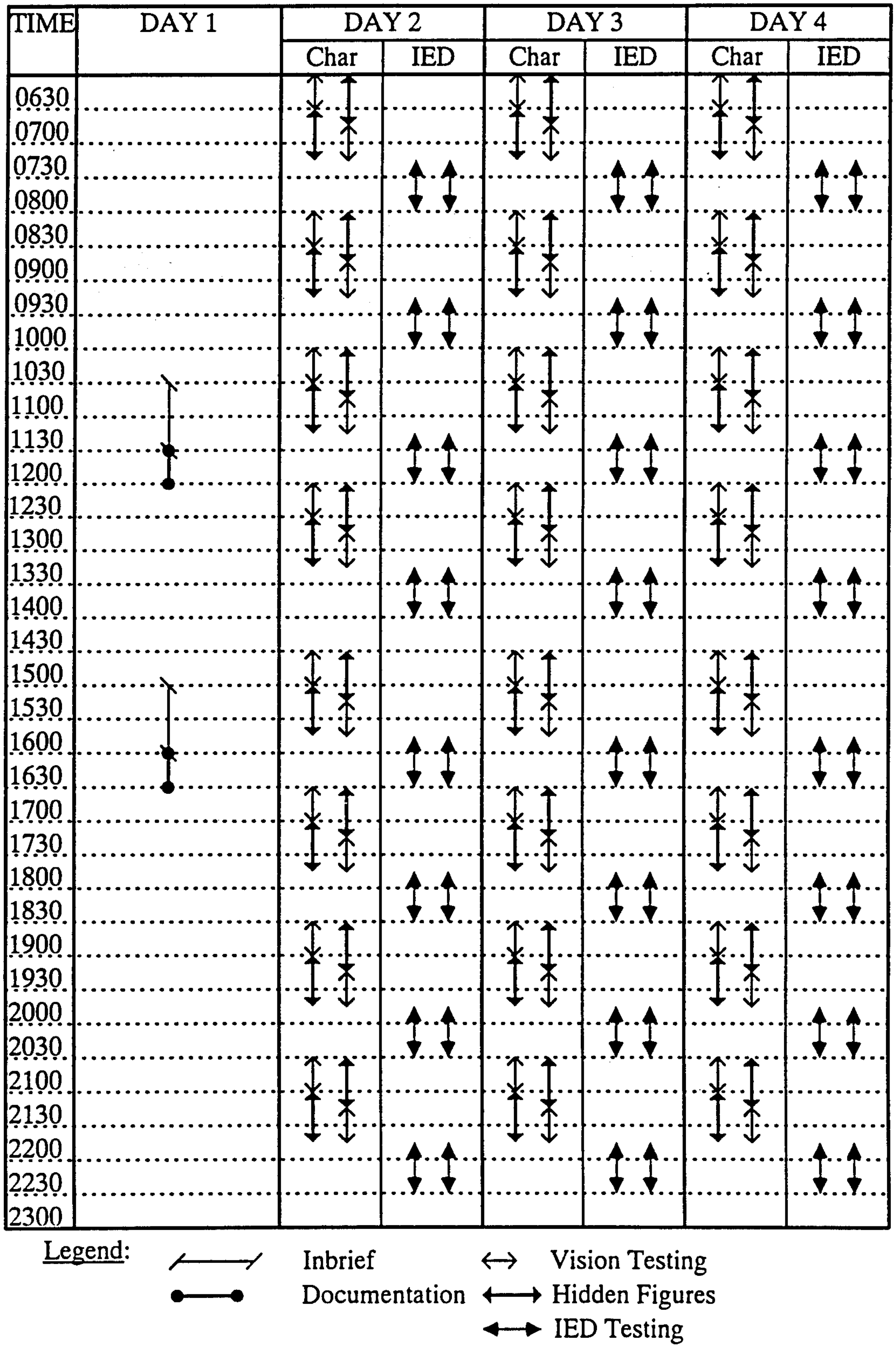


SPEARS DETAILED TEST SCHEDULES
(PRETEST, POSTTEST 1, AND POSTTEST 2)

SPEARS ON-LINE OT&E PRE-TEST
TRAINING GROUP



SPEARS ON-LINE OT&E PRETEST
CONTROL GROUP



SPEARS ON-LINE OT&E POSTTEST 1
TRAINING GROUP

TIME	DAY 1	
		IED
0630		
0700		
0730		
0800		↕ ↕
0830		
0900		↕ ↕
0930		
1000		↕ ↕
1030		
1100		↕ ↕
1130		
1200		↕ ↕
1230		
1300		↕ ↕
1330		
1400		
1430		
1500		↕ ↕
1530		
1600		↕ ↕
1630		
1700		↕ ↕
1730		
1800		↕ ↕
1830		
1900		↕ ↕
1930		
2000		↕ ↕
2030		
2100		
2130		
2200		
2230		
2300		

SPEARS ON-LINE OT&E POSTTEST 1
CONTROL GROUP

TIME	DAY 1	
		IED
0630		
0700		↕ ↕
0730		↕ ↕
0800		↕ ↕
0830		↕ ↕
0900		↕ ↕
0930		↕ ↕
1000		↕ ↕
1030		↕ ↕
1100		↕ ↕
1130		↕ ↕
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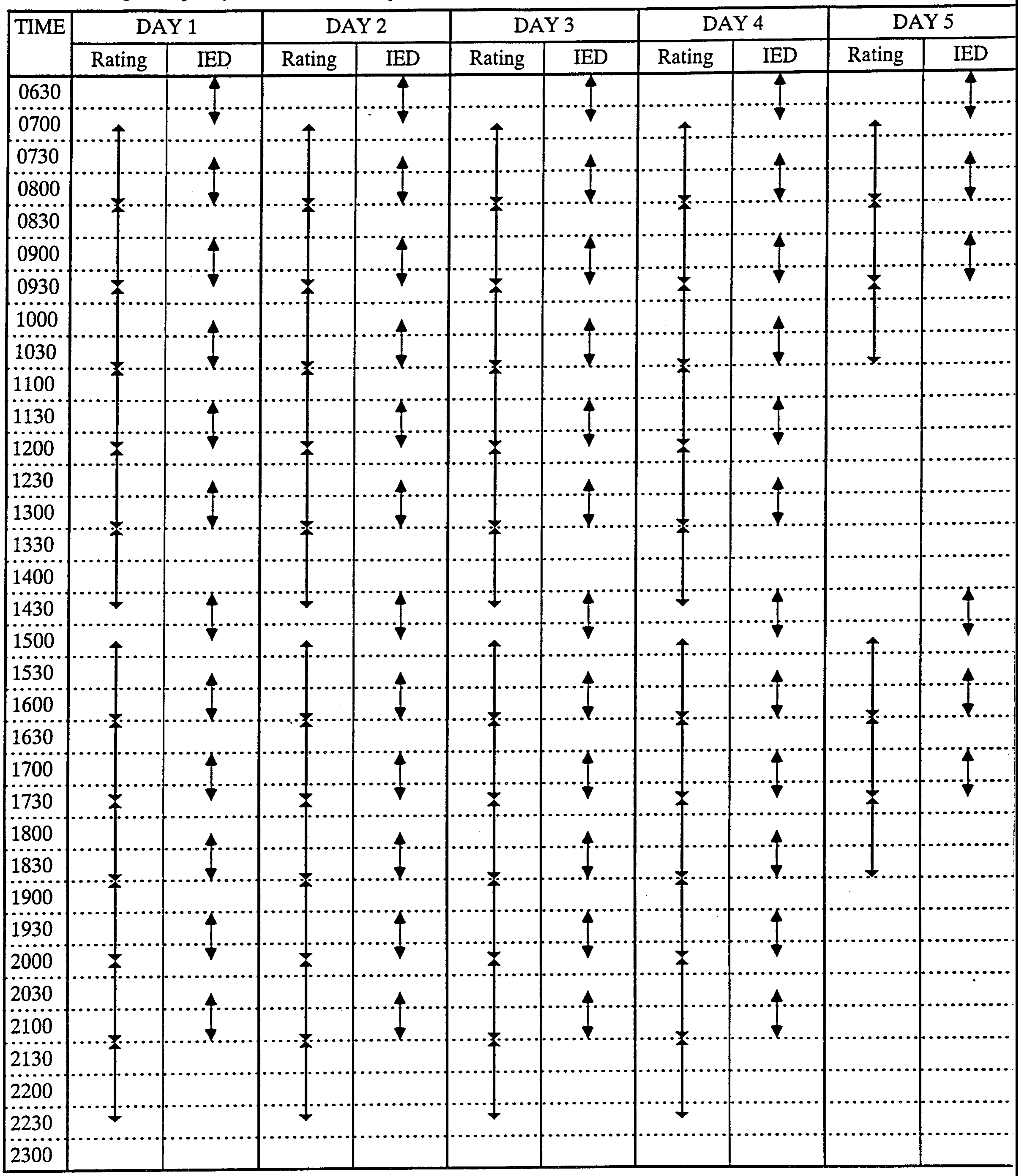
1630		↕ ↕
1700		↕ ↕
1730		↕ ↕
1800		↕ ↕
1830		↕ ↕
1900		↕ ↕
1930		↕ ↕
2000		↕ ↕
2030		↕ ↕
2100		↕ ↕
2130		↕ ↕
2200		
2230		
2300		

Note: Training Group Day 1-2, Control Group Day 3-5



SPEARS ON-LINE OPERATIONAL TEST AND EVALUATION (OT&E) SCREENER PERSONNEL SCHEDULE

SPEARS ON-LINE OPERATIONAL TEST AND EVALUATION (OT&E)
ABBREVIATED SCREENER PERSONNEL SCHEDULE

Legend:

Subject Number	Group	Shift
01-15	Control	Morning
16-30	Control	Swing
31-42	Training	Morning
34-54	Training	Swing

PRETEST

Control Group

Subject Name	Date	Time	Place	Activity
Morning Shift				
All Subjects	Day 1	1100 to 1200	Aloha Room	In Brief
		1200 to 1230	Aloha Room	Documentation
	Day 2	0630 to 0635	Aloha Room	Vision Testing
		0635 to 0720	Aloha Room	Hidden Figures/Patterns Test
		0720 to 0910	Aloha Room	IED Testing
	⋮			
	Day 4	1230 to 1315	Aloha Room	Hidden Figures/Patterns Test
		1315 to 1320	Aloha Room	Vision Testing
		1320 to 1510	Aloha Room	IED Testing

NOTE: This test schedule has been abbreviated due to space constaints. However, a complete copy of the test schedule will be provided upon request.

Swing Shift

All Subjects	Day 1	1530 to 1630	Aloha Room	In Brief
		1630 to 1700	Aloha Room	Documentation
	Day 2	1500 to 1505	Aloha Room	Vision Testing
		1505 to 1550	Aloha Room	Hidden Figures/Patterns Test
		1550 to 1740	Aloha Room	IED Testing
	⋮			
	Day 4	2100 to 2145	Aloha Room	Hidden Figures/Patterns Test
		2145 to 2150	Aloha Room	Vision Testing
		2150 to 2340	Aloha Room	IED Testing

NOTE: This test schedule has been abbreviated due to space constaints. However, a complete copy of the test schedule will be provided upon request.

Training Group

Subject Name	Date	Time	Place	Activity
Morning Shift				
All Subjects	Day 1	0630 to 0635	Room 2034	Vision Testing
		0635 to 0720	Room 2034	Hidden Figures/Hidden Pattern
		0720 to 0800	Room 2034	IED Testing
	Day 2	0630 to 0635	Room 2034	Vision Testing
		0635 to 0720	Room 2034	Hidden Figures/Patterns Test
		0720 to 0800	Room 2034	IED Testing
	⋮			
	Day 4	1200 to 1430	Room 2034	TIP Training
Swing Shift				
All Subjects	Day 1	1500 to 1505	Room 2034	Vision Testing
		1505 to 1550	Room 2034	Hidden Figures/Hidden Patterns
		1550 to 1630	Room 2034	IED Testing
	Day 2	1500 to 1505	Room 2034	Vision Testing
		1505 to 1550	Room 2034	Hidden Figures/Patterns Test
		1550 to 1630	Room 2034	IED Testing
	⋮			
	Day 4	1700 to 1900	Room 2034	TIP Training

NOTE: This test schedule has been abbreviated due to space constaints. However, a complete copy of the test schedule will be provided upon request.

POSTTEST 1

Control Group

Subject Number	Date	Time	Place	Activity
Morning Shift				
1	Day 1	0715 to 0825	Aloha Room	IED Detection Testing
2	Day 1	0715 to 0825	Aloha Room	IED Detection Testing
⋮				
15	Day 1	1710 to 1820	Aloha Room	IED Detection Testing
Swing Shift				
16	Day 1	1710 to 1820	Aloha Room	IED Detection Testing
17	Day 1	1835 to 1945	Aloha Room	IED Detection Testing
⋮				
30	Day 1	0105 to 0215	Aloha Room	IED Detection Testing

NOTE: This test schedule has been abbreviated due to space constaints. However, a complete copy of the test schedule will be provided upon request.

Training Group

Subject Number	Date	Time	Place	Activity
Morning Shift				
31	Day 1	0815 to 0925	Room 2034	IED Detection Testing
32	Day 1	0815 to 0925	Room 2034	IED Detection Testing
⋮				
42	Day 1	1420 to 1530	Room 2034	IED Detection Testing
Swing Shift				
43	Day 1	1545 to 1655	Room 2034	IED Detection Testing
44	Day 1	1545 to 1655	Room 2034	IED Detection Testing
⋮				
54	Day 1	2150 to 2300	Room 2034	IED Detection Testing

NOTE: This test schedule has been abbreviated due to space constaints. However, a complete copy of the test schedule will be provided upon request.

POSTTEST 2

Control Group

Subject Number	Date	Time	Place	Activity
Morning Shift				
1	Day 3	0630 to 0740	Aloha Room	IED Detection Testing
		0740 to 0855	Term 2 Screening Station	Ratings
2	Day 3	0745 to 0855	Aloha Room	IED Detection Testing
⋮				
15	Day 5	0855 to 1010	Term 2 Screening Station	Ratings
		0900 to 1010	Aloha Room	IED Detection Testing
		1010 to 1125	Term 2 Screening Station	Ratings
Swing Shift				
16	Day 3	1430 to 1540	Aloha Room	IED Detection Testing
		1540 to 1655	Term 2 Screening Station	Ratings
17	Day 3	1545 to 1655	Aloha Room	IED Detection Testing
		1655 to 1810	Term 2 Screening Station	Ratings
⋮				
30	Day 5	1700 to 1810	Aloha Room	IED Detection Testing
		1810 to 1925	Term 2 Screening Station	Ratings

NOTE: This test schedule has been abbreviated due to space constaints. However, a complete copy of the test schedule will be provided upon request.

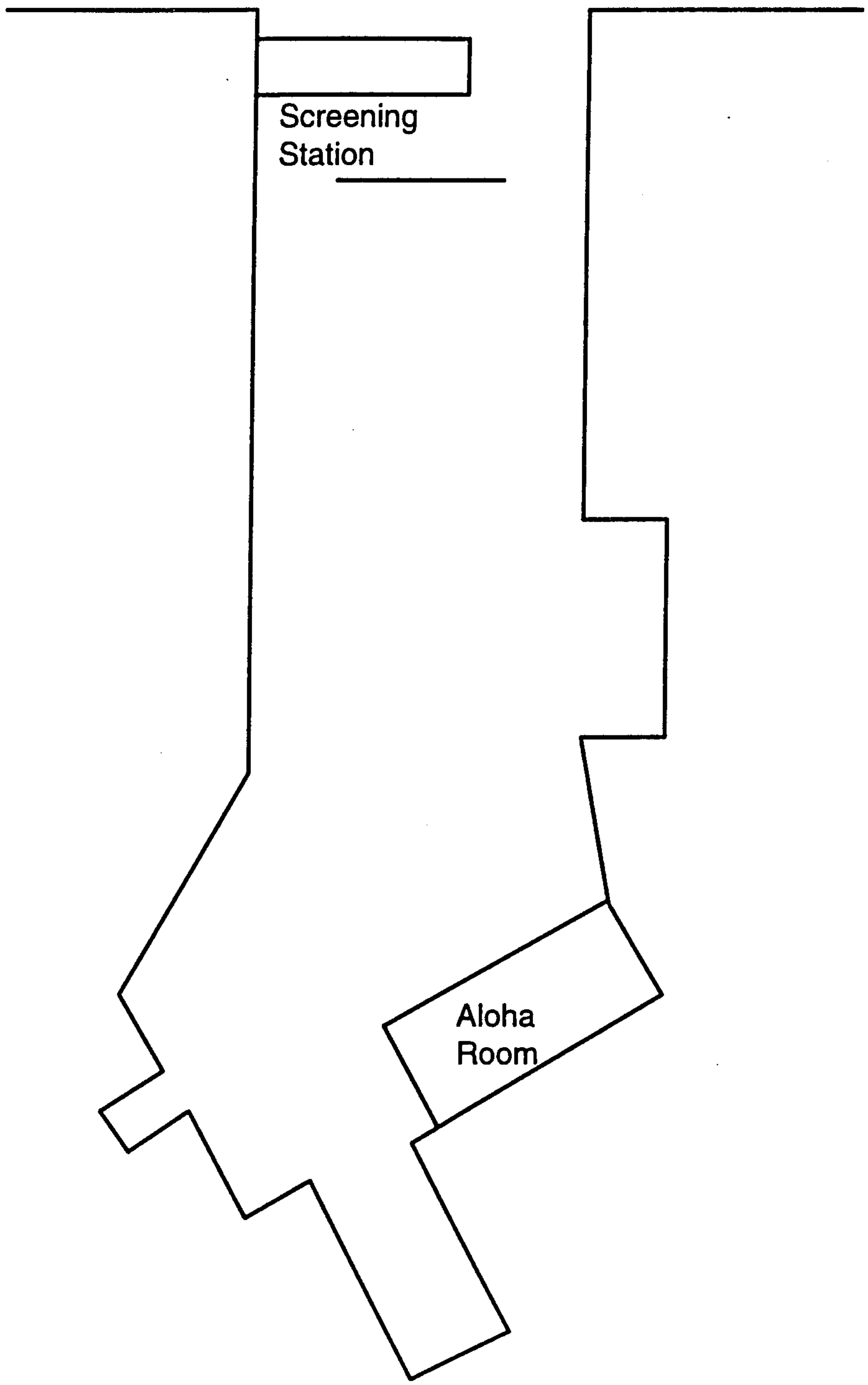
Training Group

Subject Number	Date	Time	Place	Activity
Morning Shift				
31	Day 1	0630 to 0740	Room 2034	IED Detection Testing
		0740 to 0855	Term 2 Screening Station	Ratings
32	Day 1	0745 to 0855	Room 2034	IED Detection Testing
		0855 to 1010	Term 2 Screening Station	Ratings
. . .				
42	Day 2	1245 to 1355	Room 2034	IED Detection Testing
		1355 to 1510	Term 2 Screening Station	Ratings
Swing Shift				
43	Day 1	1430 to 1540	Room 2034	IED Detection Testing
		1540 to 1655	Term 2 Screening Station	Ratings
44	Day 1	1545 to 1655	Room 2034	IED Detection Testing
		1655 to 1810	Term 2 Screening Station	Ratings
. . .				
54	Day 2	2045 to 2155	Room 2034	IED Detection Testing
		2155 to 2310	Term 2 Screening Station	Ratings

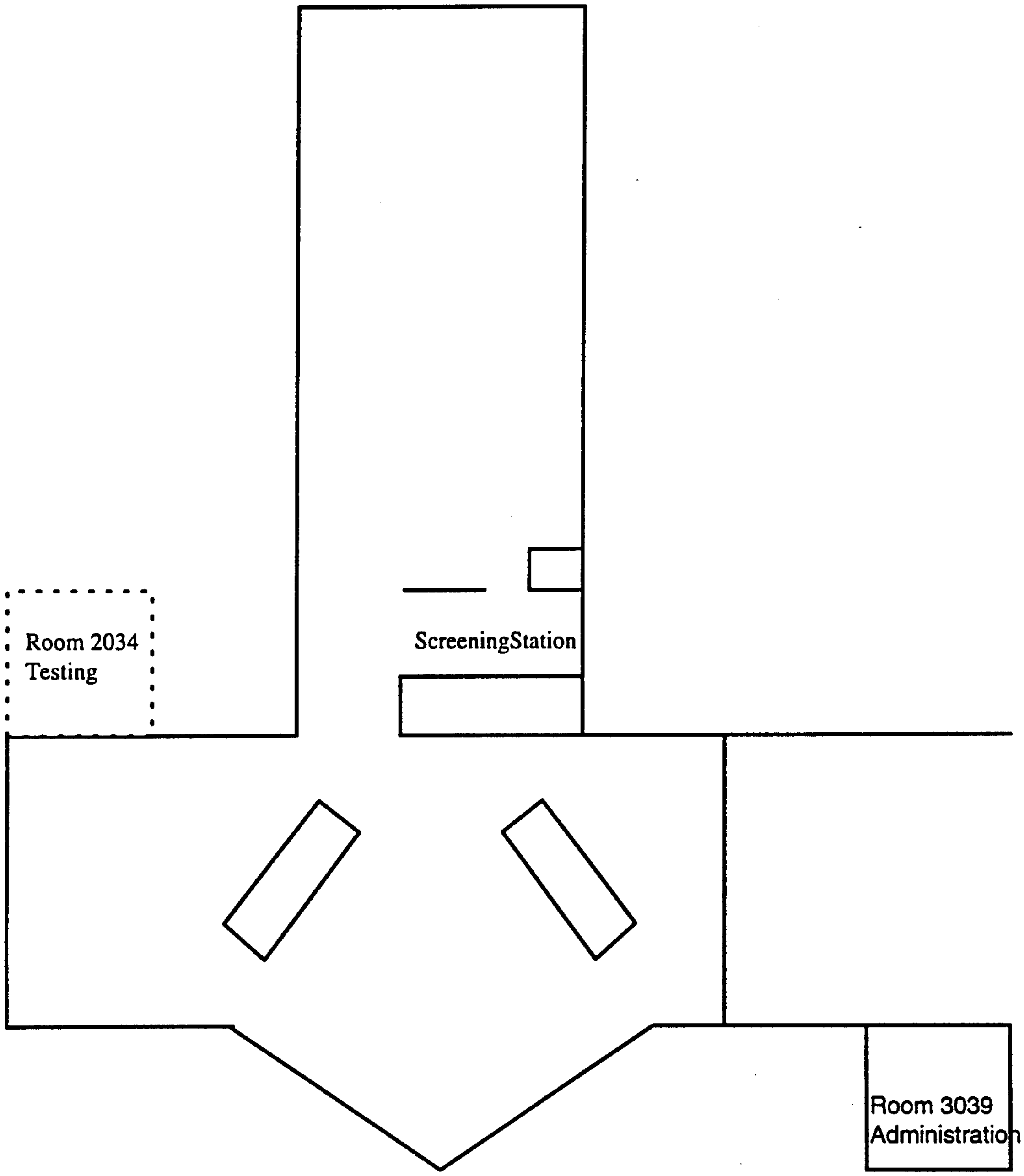
NOTE: This test schedule has been abbreviated due to space constaints. However, a complete copy of the test schedule will be provided upon request.

LOS ANGELES INTERNATIONAL AIRPORT
SITE MAPS

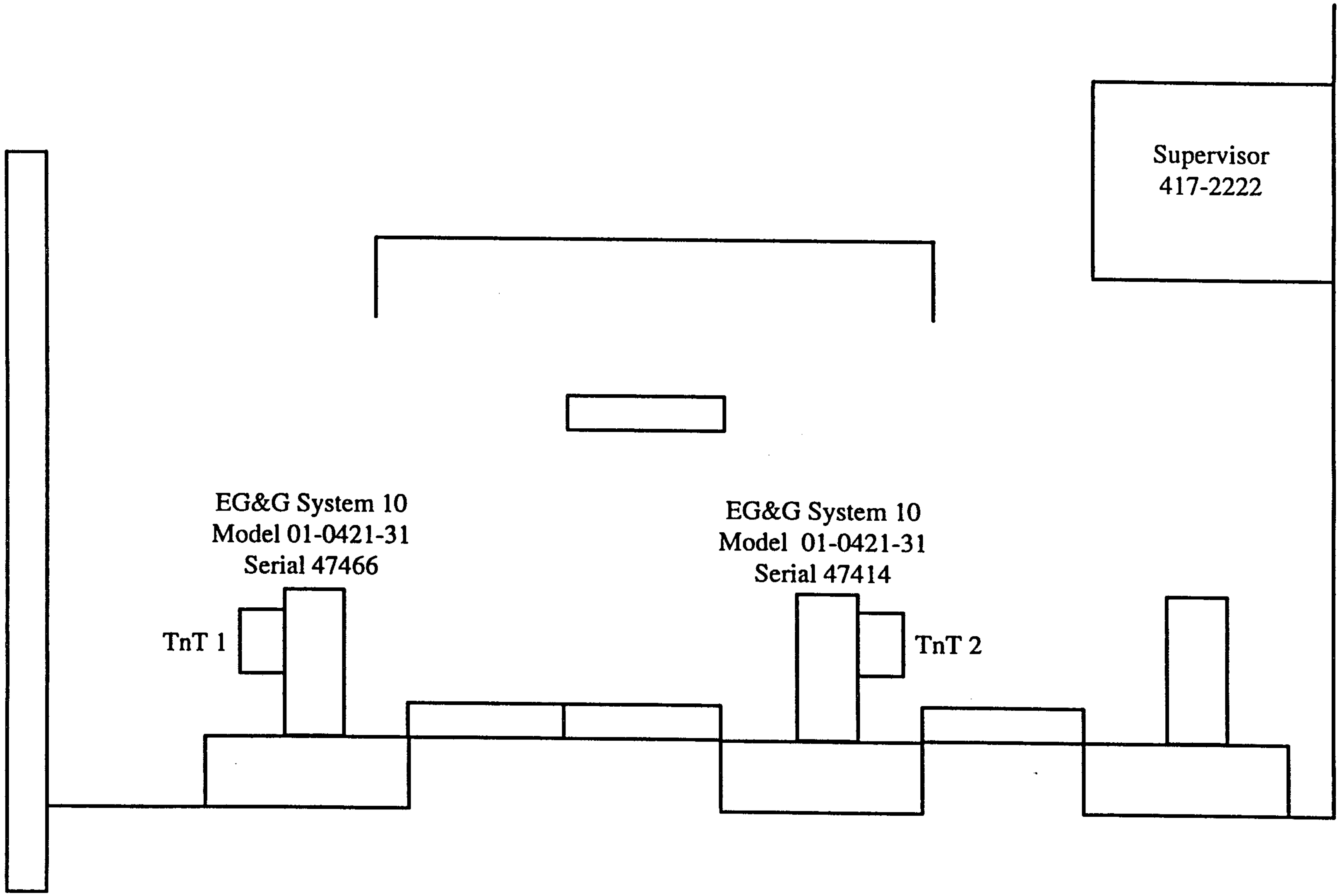
LAX TERMINAL 7



LAX TERMINAL 2



LAX TERMINAL 2 SCREENING STATION



REGAN HIGH CONTRAST (96 PERCENT) VISUAL ACUITY CHART

REGAN HIGH CONTRAST ACUITY CHARTS

SCORE SHEET
SERIES 1

Chart A - 96% Contrast

Patient Name .... Date ....

Left Eye

Z	R	D	O	V	C	N	S	1
H	R	V	C	O	S	K	Z	2
N	D	C	O	H	R	V	S	3
K	V	R	Z	C	O	H	S	4
Z	N	V	K	D	S	O	R	5
D	C	R	V	H	N	Z	K	6
O	S	K	C	V	R	Z	N	7
S	N	H	K	C	D	V	O	8
N	R	D	C	O	K	S	Z	9
V	H	C	O	R	Z	D	N	10
H	R	O	S	C	V	K	N	11

Number of Errors	Line Number	Score

Right Eye

Z	R	D	O	V	C	N	S	1
H	R	V	C	O	S	K	Z	2
N	D	C	O	H	R	V	S	3
K	V	R	Z	C	O	H	S	4
Z	N	V	K	D	S	O	R	5
D	C	R	V	H	N	Z	K	6
O	S	K	C	V	R	Z	N	7
S	N	H	K	C	D	V	O	8
N	R	D	C	O	K	S	Z	9
V	H	C	O	R	Z	D	N	10
H	R	O	S	C	V	K	N	11

Number of Errors	Line Number	Score

It is important to urge the patient to guess each letter, even when uncertain.
Mark each error by crossing out each letter missed.

SCREENER INSTRUCTIONS

SCREENER OPERATING INSTRUCTIONS FOR TnT™ TIP

These instructions are intended to help you operate the Linescan System E-Scan X-ray machine when undergoing on-line training and testing during this study. As you know, the X-ray machine is used to screen hand-carried parcels to identify security threats. A new training device has been developed to help screeners such as yourself learn to use the E-Scan X-ray machine by taking self-paced training lessons and on-line training and testing offered by the Linescan Training and Testing system. (Throughout the rest of this guide, the term *Linescan TnT™* is used to refer to the training and testing system.)

U.1 WHAT IS LINESCAN TnT™?

The Linescan TnT™ training system is a training tool developed to help you learn how to operate the E-Scan X-ray machine and how to identify security threats.

The training system itself is a combination of equipment and software (computer programs).

U.2 PURPOSE OF THESE OPERATING INSTRUCTIONS.

The purpose of these operating instructions is to provide you with all the information you need to use Linescan TnT™ in the on-line training and testing mode. With it, you will learn how to:

a. log onto the system,
b. use Linescan TnT™ with the X-ray machine for on-the-job practice, and
c. log out of the system.

These instructions are *not* intended to teach you how to operate the E-Scan X-ray system or how to identify security threats.

U.3 CONTENTS OF THESE INSTRUCTIONS.

These instructions cover the topics listed below:

a. Starting up the equipment.

b. Logging onto Linescan TnT™.

c. The Main Menu and the basics of using Linescan TnT™.

d. Instructions for using Linescan TnT™ when it is connected to the E-Scan X-ray machine for on-line training and testing when screening for parcels.

e. Logging out of Linescan TnT™.

U.4 WHAT IS ON-LINE TRAINING AND TESTING?

During *on-line training and testing,* you practice your skills in threat identification while operating the actual X-ray machine. You also learn what to do when you find a threat. On-line training and testing is conducted during an actual work shift.

For on-line training and testing, Linescan TnT™ is connected to the E-Scan X-ray machine. Your goal is to identify all threats that appear to pass through the X-ray machine. Linescan TnT™ then asks you to locate the specific threat you see in the X-ray image and to classify it as a gun, a knife, an explosive device, or a miscellaneous weapon. Then Linescan TnT™ displays a security procedure for you that tells you how to handle the kind of threat you have detected.

In on-line testing, your performance is recorded so that your manager can check your progress to see where your strengths and weaknesses are. This recording feature will be used by the FAA representatives to see how well the Linescan TnT™ trains screeners to find threats. **The recordings are confidential, and no one will know your results.**

U.5 GETTING STARTED.

This section tells you how to log onto the Linescan TnT™ training system as an authorized user. It also introduces the functions available to you as an operator and covers the basics of using the Linescan TnT™ screens. Finally, it tells you how to log out at the end of your work session.

U.5.1 Using the Trackball.

The most important part of learning to use Linescan TnT™ is learning to use the trackball. Take a few moments now to become familiar with using it.

Pointing

The trackball is a pointing device. As you roll the trackball, a pointer (usually but not always an arrow) moves on the screen in correspondence with the trackball's movement. You use the trackball to point at objects on the screen.

Sometimes the pointer is not an arrow. Sometimes it takes the shape of a pointing hand, usually when it is over a certain type of object on the screen. Other times, the pointer takes the shape of a wrist watch with hands that spin clockwise. This "wrist watch" indicates that the computer is processing your request and you should wait momentarily.

Clicking

In order to tell Linescan TnT™ what you want it to do, you have to do more than simply point at an object. To *select* the object (that is, to tell the computer you want to use that particular object), you *click* on it.

To click on an object that you have pointed at, press the pad on either side of the trackball. You will feel a slight "clicking" pressure, almost as if you have pressed a button, and you will hear a "click."

You use the actions of pointing and clicking throughout your interaction with Linescan TnT™. When this guide instructs you to select or to "click" or "click on" an object, you must first point at the object, then press the trackball pad.

U.5.2 Simulated Control Panel.

You will often see on a Linescan TnT™ screen a control panel that looks like the control panel on the actual TnT™ machine. To use the simulated control panel on the screen (figure U-1), you will use the trackball to point at and click on its simulated buttons. In particular, you will click the square buttons in the center and the round buttons on either side. You will not click on the labels next to the round buttons.

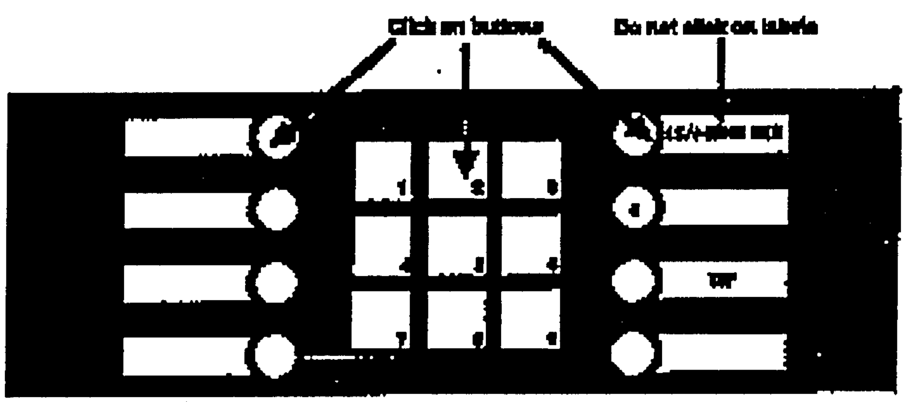


FIGURE U-1. SIMULATED CONTROL PANEL

U.5.3 Logging onto Linescan TnT™.

Logging on is the process of identifying yourself to Linescan TnT™ as an authorized user. Only authorized users are allowed to have access to the Linescan TnT™.

Before you log on

You need an operator identification ("ID") number and a password in order to log in. You should have been given your operator ID and a password by your manager.

When you log on, Linescan TnT™ will already be turned on and the login screen and simulated control panel (figure U-2) will be displayed on the left monitor.

NOTE: If the login screen and simulated control panel are not displayed on the left monitor, see your manager.

Logging on

a. On the logon screen and simulated control panel (figure U-2), enter your operator ID number. To do so, use the numbered buttons on the simulated control panel.

NOTE: The digits 1 through 9 are on the square buttons in the center, while the digit 0 is on the second round button from the top to the right.

1. Click on each of the digits in the ID number. (As you click each digit, a beep is sounded.)

2. After clicking on all the digits in the ID, click the ENTER button.

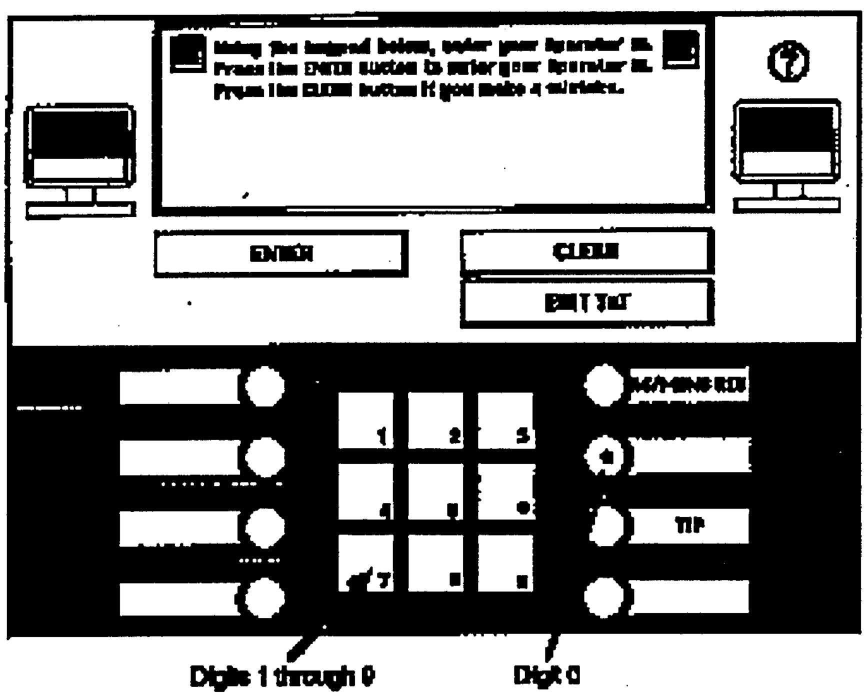


FIGURE U-2. LINESCAN TNT™ LOGIN SCREEN AND SIMULATED CONTROL PANEL

b. You can now use your password. To use your password, click on each of the digits in the password, then click ENTER.

U.5.3 Logging Out of Linescan TnT™.

Whenever you are finished using Linescan TnT™ or whenever you need to leave it unattended, even for a few minutes, you should log out (exit). By logging out, you ensure that no unauthorized person can access Linescan TnT™ information.

Logging out

a. Return to the Main Menu, if you are not already there.

If starting from some other Linescan TnT™ screen, click EXIT as needed until you return to the Main Menu.

b. At the Main Menu, click EXIT.

After a few moments, the Linescan TnT™ login screen and the simulated control panel appear on the left monitor. Linescan TnT™ is ready for another authorized user to log in.

> NOTE: If you are also responsible for turning off the Linescan TnT™ training station, see your manager for instructions.

U.6 USING X-RAY MODE (ON-LINE TRAINING AND TESTING).

This section tells you how to use Linescan TnT™ in conjunction with the E-Scan X-ray machine for on-line training and testing.

U.6.1 Overview of X-Ray Mode.

To use Linescan TnT™ with the X-ray machine, you need to know about X-ray mode, Threat Image Projection (TIP), on-line testing, and on-line monitoring. To prepare yourself for using X-ray mode correctly, read the following overview information before trying to use the X-ray mode.

What is x-ray mode?

When you use Linescan TnT™ with the X-ray machine for on-line training and testing, you are using X-ray mode. During X-ray mode, you use the actual control panel on the X-ray machine to screen parcels. You can strip the inorganic parts of an X-ray image, change it to reverse monochrome, and enlarge the image to get a closer view.

What is TIP?

To give you on-line training and/or to test your threat identification skills, your manager can instruct Linescan TnT™ to project threat images into actual parcels that pass through the X-ray machine. When Linescan TnT™ gets ready to project a threat image, it looks for a parcel that is large enough to hold the image it has to project. For example, if the image scheduled to be projected is a long item, and the next parcel that passes through the X-ray machine is a small, square package, Linescan TnT™ does not project the image into that parcel. It waits until it finds a parcel whose size is large enough to hold the projected image.

When Linescan TnT™ does find a suitable parcel, it projects the threat image into the X-ray image of the actual parcel. As far as you can tell, the projected image looks as real in the X-ray as the parcel itself.

A manager typically instructs Linescan TnT™ to project a certain number of images during a given period of time, such as a work shift. For example, he or she may schedule 20 images to be projected over 8 hours. Approximately every half hour an image will be projected. (However, remember that Linescan TnT™ may occasionally not project a threat image *if* it cannot find a parcel large enough to hold it.)

What is on-line training and testing?

On-line training and testing is the mode in which an X-ray will be used. In on-line training and testing, you will follow a procedure with several steps or stages.

When you think you have detected a threat (whether a projected threat or a real one), you will press the TIP button on the actual X-ray machine. (The TIP button on the simulated control panel of Linescan TnT™ is active as well.)

At this time, you are informed if you are being tested or not.

If the threat was a Projected Threat Image, it is now erased from the screen. All your responses are recorded by Linescan TnT™ so that the FAA representatives can see how well the TIP function works. You will learn more about this on-line testing later in this section.

What are hits, misses, and suspected threats?

A hit is a projected threat image that you successfully detected.

A miss is a projected threat image that you failed to detect. A miss occurs under two circumstances:

- The X-ray into which the image was projected may have stayed on the screen for too long without your detecting the projected threat. The amount of time in which you have to respond depends on how Linescan TnT™ has been set up.

- The X-ray image scrolled (moved) off the monitor screen before you pressed the TIP button.

A suspected threat is a threat that you perceived to be in the parcel but that was not projected by Linescan TnT™. It might be a harmless item, or it might be a real threat. When this happens during on-line monitoring, Linescan TnT™ automatically saves the X-ray so that you and your manager can review it later.

U.6.2 Using X-Ray Mode.

Starting up X-ray mode.

Before you can use X-ray mode, Linescan TnT™ must be connected to the X-ray machine. Your manager or a service technician will have already connected them.

a. On the Main Menu, click X-ray mode.

NOTE: If you see the following message and Linescan TnT™ is not connected to the X-ray machine, see your manager. You will not be able to continue.

PLEASE MAKE SURE THE X-RAY MACHINE IS ON AND ALL CABLES ARE PROPERLY CONNECTED

b. Now operate the actual X-ray machine as you have been trained to screen parcels for threats.

Important !!: The threats you see may be projected threat images or they may be actual threats.

c. Continue to the procedure "Finding a threat during on-line training and testing."

Finding a threat during on-line training and testing.

Recall that during on-line training and testing, you will be tested with threat images projected by Linescan TnT™.

Important: Read this entire procedure before trying it to learn about the actions you will be required to take. If you were to find an actual threat in a parcel, you must be able to act quickly.

d. If you think you see a threat in a parcel passing through the X-ray machine, press the TIP button on the actual control panel.

If the threat you see...

- is a projected threat image, the following message appears on the monitor. After reading it, continue with Step 3.

YOU HAVE CORRECTLY IDENTIFIED A PROJECTED THREAT! CLICK ON THE THREAT OBJECT.

- is not a projected threat image, the following message appears on the left monitor:

YOU ARE NOT BEING TESTED AT THIS TIME.
FOLLOW THE SECURITY PROCEDURES FOR THE SUSPECTED THREAT!
PRESS DOWN ON THE TRACKBALL PAD TO CONTINUE.

e. When you are ready to exit X-ray mode, refer to “Exiting X-ray mode” at the end of this section.

U.6.3 Exiting X-Ray Mode.

When you are ready to exit X-ray mode from either on-line training and testing or on-line monitoring, follow this procedure.

a. Press the TIP button on the TnT™.

If you are not being tested, an EXIT button appears in the lower left corner of the left monitor (as shown in the example in figure U-3).

> NOTE: If you *are* being tested, the EXIT button does not appear. You must follow the standard procedure for identifying the projected threat. Afterward, you can exit X-ray mode.

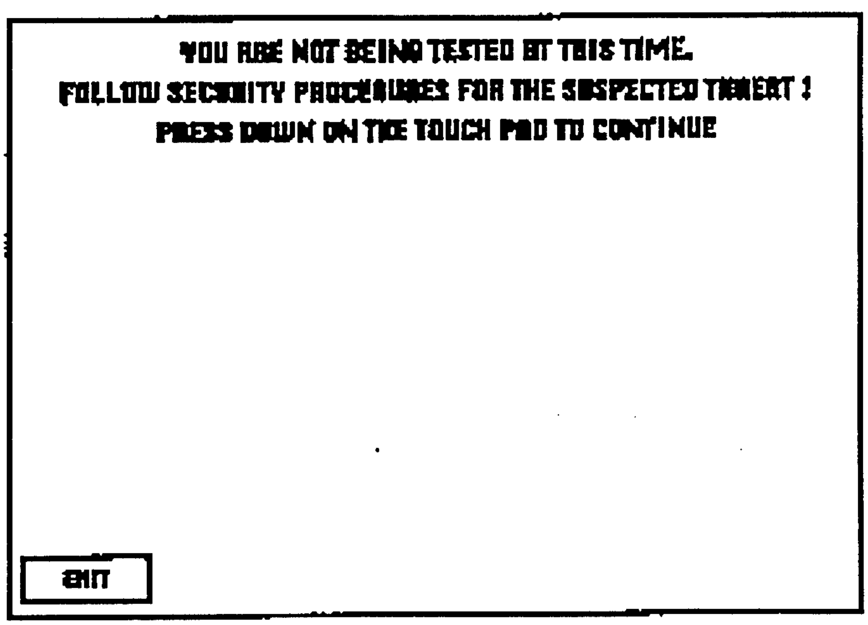


FIGURE U-3. EXIT BUTTON ON AN X-RAY MODE SCREEN

b. Click the EXIT button in the lower left corner. (If the button disappears before you have a chance to click it, just repeat from Step 1.)

c. X-ray mode is ended. After a few moments, you are returned to the Main Menu.

SCREENER OPERATING CHECKLIST FOR TnT™ TIP

CARRY OUT THESE STEPS EACH TIME YOU ARE ASSIGNED TO THE X-RAY MACHINE

1. _____ Ensure the log on screen is showing on the left hand TnT™ monitor. If it is not on the left hand monitor, see your supervisor.

2. _____ Enter your ID number. If you do not know your ID number, or have forgotten it, see your supervisor. Click on each digit of your ID number on the simulated control panel on the screen using the trackball and the clicking pad. After you have entered in all digits, press ENTER.

3. _____ Using the trackball and the clicking pad, press X-ray Mode on the Main Menu

4. _____ Operate the actual X-ray machine as you have been trained to screen parcels for threats.

CARRY OUT THESE STEPS EACH TIME YOU LEAVE THE X-RAY MACHINE

1. _____ Press the TIP button. If you are not being tested, an EXIT button will appear in the lower left corner of the monitor. If you are being tested, the EXIT button will not appear. See your manager.

2. _____ Using the trackball and the clicking pad, press the EXIT button on the monitor until you reach the main menu.

3. _____ Using the trackball and clicking pad, press EXIT on the main menu.

THREAT-IMAGE PROJECTION TRAINING AND TESTING AND OPERATIONAL TEST

THREAT-IMAGE PROJECTION TRAINING AND TESTING
AND OPERATIONAL TEST

Control Group

Subject	Password	Date
1	001	
2	002	
3	003	
4	004	
5	005	
6	006	
7	007	
8	008	
9	009	
10	010	
11	011	
12	012	
13	013	
14	014	
15	015	
16	016	
17	017	
18	018	
19	019	
20	020	
21	021	
22	022	
23	023	
24	024	
25	025	
26	026	
27	027	
28	028	
29	029	
30	030	

Training Group

Subject	Password	Date
31	031	
32	032	
33	033	
34	034	
35	035	
36	036	
37	037	
38	038	
39	039	
40	040	
41	041	
42	042	
43	043	
44	044	
45	045	
46	046	
47	047	
48	048	
49	049	
50	050	
51	051	
52	052	
53	053	
54	054	

IMPROVISED EXPLOSIVE DEVICE DETECTION SYSTEM

OT&E LINESCAN® TRAINING AND TESTING (TnT) OVERVIEW AND INSTRUCTIONS

THE LINESCAN® TESTING AND TRAINING (TnT) OVERVIEW

The Linescan® TnT™ system is a computer-based training tool developed by EG&G Astrophysics to help baggage screeners operate Linescan® X-ray equipment with E-Scan and identify security threats. The training system provides four distinct types of training and testing: training lessons, real-time testing, real-time monitoring, and ongoing training and testing. The Operational Test and Evaluation (OT&E) presented baggage screeners with customized training lessons on detecting Improvised Explosive Devices (IEDs).

The TnT™ offers on-line and off-line operations. On-line operation provides real-time training and testing where operators can practice their skills in threat identification while operating an actual X-ray machine. Off-line training allows operators to learn and practice threat identification skills by taking training lessons without operating the X-ray machine.

Baggage screeners received off-line training to identify threats using black/white and enhanced X-ray equipment.

The TnT™ system is used to train baggage screeners to improve performance in detecting threatening objects. Screeners were required to identify threats using both black/white and enhanced X-ray equipment.

Linescan® TnT™ System Components and Operation.

The TnT™ system consists of a combination of equipment and software. The equipment consists of the following:

a. A color monitor and a black-and-white monitor (mounted side-by-side, just as the monitors are mounted on the actual E-Scan X-ray machine).

b. A control panel (mounted below the monitors) that replicates the control panel on the actual E-Scan X-ray machine.

c. A trackball (located to the right of the control panel) with which operators interact with the training programs.

d. A computer (located inside the equipment housing) that runs the training programs.

e. A variety of cables and connectors used to connect the training system to the X-ray and to recording equipment such as camcorders and video cassette recorders.

During the OT&E, participating baggage screeners received seven pre-determined lessons from the TnT™ Lessons menu. All lessons were previously completed at the Federal Aviation Administration (FAA) Technical Center prior to conducting the OT&E. The FAA selected the training lessons for the OT&E. A copy of the TnT™ operating instructions was located on the TnT™, and an FAA representative monitored all screeners operating the TnT™.

All Linescan® TnT™ lessons were conducted in an office behind the United Airlines group check check-in counter.

The following instructions were provided to baggage screeners during the TnT™ training. An FAA representative was present during the training and provided baggage screeners with assistance when necessary.

LINESCAN® TRAINING AND TESTING (TnT) INSTRUCTIONS.

The Linescan® TnT training system is used to train baggage screeners to improve performance in detecting threat objects. By taking the following training lessons, one will learn to identify threats using both black/white and enhanced x-ray equipment. Review the seven training lessons identified in the Training Lessons Procedures list. Please do not take lessons that are not included on the list.

If there are questions at any time, ask the Federal Aviation Administration (FAA) representative for assistance.

Getting Started.

If there are questions about beginning the training lessons, turning the equipment on, or using available functions, ask the FAA representative for assistance.

Use the following procedures to begin the training:

Logon Procedures.

1. Using trackball, position the arrow on the visual display number pad.

2. Using the visual display number pad, enter the operator ID: 123

3. Press the **ENTER** button to enter operator ID.

4. Using the visual display number pad, enter password: 123

5. Press the **ENTER** button to enter password.

6. Press the **CLEAR** button if a mistake is made and to restart the logon procedures.

7. Press the **TIP** button on the TnT control panel.

Reviewing a Lesson.

After successfully logging onto the training system, complete the following steps:

1. Select the **Lessons** button from the opening screen.

   The Lessons menu appears.

2. On the Lessons menu, click **Review**.

   The Review menu appears.

3. To review a prior lesson, click **A Prior Lesson.**

   A checklist of the lessons previously completed is displayed. It shows up to 10 lessons at a time. To bring other lessons into view, use the up and down arrows to the right of the lessons.

4. To select the lesson to review, click on it.

   Table W-1 shows a list of the lessons to review. Review the lessons in the order presented in table W-1.

TABLE W-1. LIST OF LESSONS TO REVIEW

Unit 2	Lesson 1
Unit 4	Lesson 1
Unit 4	Lesson 3
Unit 5	Lesson 4
Unit 6	Lesson 1
Unit 6	Lesson 3
Unit 7	Lesson 1

   When the lesson is presented, complete it by closely reading the information presented on the screens.

5. Begin the appropriate lesson displayed on the right visual display (Lesson Screen).

6. When finished reviewing a lesson, immediately review the corresponding test.

TEST BAG CONFIGURATIONS

Requests for descriptions of test bag configurations should be submitted in writing to the FAA program manager supporting this effort.

CHECKED-CARRY-ON BAGGAGE - THREAT ARTICLE DEFINITION SHEETS

Requests for descriptions of threat article definitions should be submitted in writing to the FAA program manager supporting this effort.

THREAT-IMAGE PROJECTION INSERTION PROTOCOL

TIP 1 INSERTION PROTOCOL

TOTAL	8	12	10	3	12	9	9	7	4	2	2	6	5	6	5	5	11	12	12	6	9
	DAY																				
TIME	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
630	2	3	2	0	3	2	2	2	1	0	0	1	1	1	1	1	3	3	3	1	2
730	2	2	2	1	2	2	2	1	1	1	1	1	1	1	1	1	2	2	2	1	2
830	2	3	3	1	3	2	2	2	1	0	0	2	1	2	1	1	3	3	3	2	2
930	2	3	2	0	3	3	3	2	1	1	1	2	2	2	2	2	2	3	3	2	3
1030	2	3	2	1	3	2	2	2	1	0	0	1	1	1	1	1	3	3	3	1	2
1130	2	3	3	1	3	2	2	2	0	1	1	2	1	2	1	1	3	3	3	2	2
1230	2	3	3	1	3	2	2	1	1	0	0	1	1	1	1	1	3	3	3	1	2
1330	2	3	2	0	3	3	3	2	1	1	1	2	1	2	1	1	2	3	3	2	3
1430	2	3	2	1	3	2	2	2	1	0	0	1	1	1	1	1	3	3	3	1	2
1530	2	2	3	1	2	2	2	2	1	0	1	2	2	2	2	2	2	2	2	2	2
1630	2	3	2	1	3	2	2	2	1	0	0	1	1	1	1	1	2	3	3	1	2
1730	2	3	2	0	3	3	3	1	1	1	1	1	1	1	2	1	3	3	3	1	3
1830	2	3	2	1	3	2	2	2	1	0	0	2	1	2	1	1	3	3	3	2	2
1930	2	2	3	1	2	2	2	2	1	1	0	2	1	2	1	2	2	3	2	2	2
2030	2	3	3	1	3	2	2	1	1	0	0	1	1	1	1	1	3	3	3	1	2
2130	2	3	2	0	3	2	2	2	1	1	1	2	2	2	1	1	3	2	3	2	2
2230	0	3	2	1	3	1	1	0	1	1	1	0	1	0	1	1	2	3	3	0	1

TIP 2 INSERTION PROTOCOL
WEEKS 1-3

TOTAL	12	1	5	12	1	4	4	8	10	11	11	11	11	8	10	10	12	12	12	3	10
	DAY																				
TIME	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
630	3	0	1	3	0	1	1	0	2	3	3	3	3	0	2	2	3	3	3	0	2
730	2	1	1	2	1	1	1	1	2	2	2	2	2	1	2	2	2	2	2	1	2
830	3	0	1	3	0	1	1	0	3	3	3	3	3	0	3	3	3	3	3	1	3
930	3	0	2	3	0	1	1	1	2	2	2	2	2	1	2	2	3	3	3	0	2
1030	3	0	1	3	0	1	1	0	2	3	3	3	3	0	2	2	3	3	3	1	2
1130	2	1	1	2	1	0	0	1	3	2	2	2	2	1	3	3	2	2	2	1	3
1230	3	0	1	3	0	1	1	0	3	3	3	3	3	0	3	3	3	3	3	1	3
1330	3	0	1	3	0	1	1	1	2	3	3	3	3	1	2	2	3	3	3	0	2
1430	3	0	1	3	0	1	1	0	2	3	3	3	3	0	2	2	3	3	3	1	2
1530	3	1	2	3	1	1	1	0	3	2	2	2	2	0	3	3	3	3	3	1	3
1630	3	0	1	3	0	1	1	0	2	2	2	2	2	0	2	2	3	3	3	1	2
1730	3	0	1	3	0	1	1	1	2	3	3	3	3	1	2	2	3	3	3	0	2
1830	3	0	1	3	0	1	1	0	2	3	3	3	3	0	2	2	3	3	3	1	3
1930	2	1	1	2	1	1	1	1	3	2	2	2	2	1	3	3	2	2	2	1	3
2030	3	0	1	3	0	1	1	0	2	3	3	3	3	0	2	2	3	3	3	1	2
2130	3	0	2	3	0	1	1	1	3	3	3	3	3	1	2	3	3	3	3	0	2
2230	3	0	1	3	0	1	1	1	2	2	2	2	2	1	3	2	3	3	3	1	2

TIP 2 INSERTION PROTOCOL
WEEKS 4-6

TOTAL	10	9	8	6	3	12	6	10	3	5	9	4	12	2	2	3	11	4	3	7	6
	DAY																				
TIME	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**
630	2	2	0	1	0	3	1	2	0	1	2	1	3	0	0	0	3	1	0	2	1
730	2	2	1	1	1	2	1	2	1	1	2	1	2	1	1	1	2	1	1	1	1
830	3	2	0	2	1	3	2	3	1	1	2	1	3	0	0	1	3	1	1	2	2
930	2	3	1	2	0	3	2	2	0	2	3	1	3	1	1	0	2	1	0	2	2
1030	2	2	0	1	1	3	1	2	1	1	2	1	3	0	0	1	3	1	1	2	1
1130	3	2	1	2	1	2	2	3	1	1	2	0	2	1	1	1	2	0	1	2	2
1230	2	2	0	1	1	3	1	2	1	1	2	1	3	0	0	1	3	1	1	1	1
1330	3	3	1	2	0	3	2	2	0	1	3	1	3	1	1	0	3	1	0	2	2
1430	2	2	0	1	1	3	1	3	1	1	2	1	3	0	0	1	3	1	1	2	1
1530	3	2	0	2	1	3	2	3	1	2	2	1	2	0	0	1	2	1	1	2	2
1630	2	2	0	1	1	3	1	2	1	1	2	1	3	0	0	1	2	1	1	2	1
1730	2	3	1	1	0	3	1	2	0	1	3	1	3	1	1	0	3	1	0	1	1
1830	2	2	0	2	1	3	2	2	1	1	2	1	3	0	0	1	3	1	1	2	2
1930	3	2	1	2	1	2	2	3	1	1	2	1	2	1	1	1	2	1	1	2	2
2030	2	2	0	1	1	3	1	2	1	1	2	1	3	0	0	1	3	1	1	1	1
2130	2	2	1	2	0	3	2	3	0	2	2	1	3	1	1	0	3	1	0	2	2
2230	3	1	1	0	1	3	0	2	1	1	1	1	3	1	1	1	2	1	1	0	0

TIP 2 INSERTION PROTOCOL
WEEKS 7-8

TOTAL	10	6	12	9	9	3	6	8	12	10	10	10	5	10							
	DAY																				
TIME	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**							
630	2	1	3	2	2	0	1	0	3	2	2	2	1	2							
730	2	1	2	2	2	1	1	1	2	2	2	2	1	2							
830	3	2	3	2	2	1	2	0	3	3	3	3	1	3							
930	3	2	3	3	3	0	2	1	3	2	2	2	2	2							
1030	2	1	3	2	2	1	1	0	3	2	2	2	1	2							
1130	3	2	3	2	2	1	2	1	3	3	3	3	1	3							
1230	2	1	3	2	2	1	1	0	3	3	2	2	1	2							
1330	2	2	3	3	3	0	2	1	3	2	2	3	1	3							
1430	2	1	3	2	2	1	1	0	3	3	3	2	1	2							
1530	3	2	3	2	2	1	2	0	2	3	3	3	2	3							
1630	2	1	3	2	2	1	1	0	3	2	2	2	1	2							
1730	2	1	3	3	3	0	1	1	3	2	2	2	1	2							
1830	2	2	3	2	2	1	2	0	3	2	2	2	1	2							
1930	3	2	2	2	2	1	2	1	2	3	3	3	1	3							
2030	2	1	3	2	2	1	1	0	3	2	2	2	2	3							
2130	2	2	2	2	2	0	2	1	3	2	3	3	1	2							
2230	3	0	3	1	1	1	0	1	3	2	2	2	1	2							

Appendix AA
to SPEARS OT&E TEP

NORTHWEST AIRLINES DAILY DEPARTURES - LOS ANGELES INTERNATIONAL AIRPORT

NORTHWEST AIRLINES DAILY DEPARTURES
LOS ANGELES INTERNATIONAL AIRPORT

TIME	DEPARTURES					#/Total
6:30	MSP	RSW				
6:50	FAT					0.07
7:10	MEM	SAN				
7:30	SEA					
7:50	MSP	FAT				0.07
8:10	BOS	PSP				
8:30	DTW	SAN	YYZ			
8:50	HNL	NGO	SBP			0.11
9:10	MRY	PSP				
9:30	SBA					
9:50	SAN	SEA				0.04
10:10						
10:30	PHX					
10:50	LAS					0.03
11:10						
11:30	BOS	FAT	SAN	SAN		
11:50	LAS	MSP	SFO			0.15
12:10	DTW	HNL	KIX	MNL		
12:30	LGW	FAT	PHX	SAN	SEA	
12:50	MRY	ONT	PSP	SBA	SBP	0.20
13:10	MEM	MKE	NRT	PEK	SHA	
13:30						
13:50	SEL					0.01
14:10						
14:30	BOS	MSP				
14:50	SAN					0.04
15:10						
15:30	FAT	PSP	SAN			
15:50	MSP					0.09
16:10	AMS	DTW	MRY			
16:30						
16:50						
17:10						
17:30						
17:50	SAN					0.01
18:10						
18:30	FAT	ONT				
18:50						0.03
19:10						
19:30	LAS					
19:50	PSP					0.04
20:10	SAN					
20:30						
20:50	FAT					0.04
21:10	MRY	SBA				
21:30						
21:50						
22:10						
22:30						
22:50	DTW	FAT	LAS			0.08
23:10	ONT	PSP	SBP			

Legend:

AMS	Amsterdam
BOS	Boston
DTW	Detroit
FAT	Fresno
HNL	Honolulu
KIX	Osaka
LAS	Las Vegas
LGA	LaGuardia
LGW	Gatwick
MEM	Memphis
MIA	Miami
MKE	Milwaukee
MNL	Manila
MRY	Monterey
MSP	Minneapolis
NGO	Nagaro
NRT	Narita
ONT	Ontario
PEK	Beejing
PHX	Pheonix
PSP	Palm Springs
RSW	Fort Meyers
SAN	San Diego
SBA	Santa Barbara
SBP	San Luis Obispo
SEA	Seattle
SEL	Seoul
SFO	San Francisco
SHA	Shangai
YYZ	Toronto

Note: Northwest Airlines accounts for approximately 75% of enplanements using this checkpoint. Other airlines using this terminal checkpoint include Virgin Air, Asiana, Air Canada, Hawaiian Air, Vast, and Air New Zealand.

SPEARS OT&E EG&G ASTROPHYSICS LINESCAN TESTING AND TRAINING SYSTEM (TNT^{TM}) USABILITY SURVEY

SPEARS OT&E EG&G ASTROPHYSICS LINESCAN TESTING AND TRAINING SYSTEM (TNT™) USABILITY SURVEY

SUBJECT NUMBER: _____ DATE: __________

The FAA wants to know your opinion of the TnT™ training and testing you just received. Your ratings will play an important role in evaluating the TnT™ system. All information will be kept confidential, so please express your honest opinion. Your participation is greatly appreciated.

If you have any questions while completing this survey, please ask the FAA representative for assistance.

Please circle the number that best indicates your opinion of the statements in the following survey.

Not at all				Very much so
1	2	3	4	5

1. The SPEARS TIP training and testing improved my ability to detect explosive devices.	1	2	3	4	5
2. The SPEARS TIP training and testing will help me on my job.	1	2	3	4	5
3. I enjoyed taking the SPEARS TIP training and testing.	1	2	3	4	5
4. I would like to continue this training in my work.	1	2	3	4	5
5. The SPEARS TIP function is easy to operate.	1	2	3	4	5
6. The TIP key is easy to locate and depress.	1	2	3	4	5
7. The SPEARS machine showed me explosive images I had never seen before.	1	2	3	4	5
8. The false explosive images look like real x-ray images of explosive devices.	1	2	3	4	5
9. I could not guess when I would get a false explosive image from the SPEARS.	1	2	3	4	5
10. The SPEARS generated reports were understandable.	1	2	3	4	5
11. The SPEARS machine helped me to understand when I made the right and wrong decision about whether there was an explosive device in a bag.	1	2	3	4	5
12. The SPEARS machine did not slow down the movement of baggage and passengers.	1	2	3	4	5
13. The SPEARS machine did not interfere with the performance of my tasks.	1	2	3	4	5
14. The SPEARS machine is conveniently located.	1	2	3	4	5
15. The SPEARS machine x-ray enhancement buttons improved my ability to detect explosive devices.	1	2	3	4	5

INSERTION REPRESENTATIVENESS ASSESSMENT

INSERTION REPRESENTATIVENESS ASSESSMENT
ABBREVIATED DATA COLLECTION FORM

Instructions: You will be presented individual images of baggage, which may or may not contain one or more threat objects. You will rate how "real" each of these images is, based on the likelihood of their appearance during your regular working day.

When examining each image for "realism" and the likelihood of encountering it, please consider the following:

a. Types of objects in image.
b. Density of objects in image.
c. Placement of objects in image.
d. Bag type.

Please rate each image using the scale from 1 to 7 in the following, indicating how likely it would be to find this image in the real world. Put an "X" in the space that matches your choice.

	Would Never Encounter					Very Likely to Encounter
1	2	3	4	5	6	7

Image Number							
1							
2							
3							
.							
.							
.							
.							
.							
99							
100							

SPEARS OT&E FTI THREAT ITEM LOCATION MATRIX

SPEARS OT&E FTI THREAT ITEM LOCATOR MATRIX

DATE: ___________

IMAGE NUMBER: _______

1	2	3
4	5	6
7	8	9

This matrix will be used to track the location of projected fictional threat images within x-ray images.

SUBJECT CHECKLIST FICTIONAL IMAGE PROJECTION (FIP) TRAINING AND TESTING IMPROVISED EXPLOSIVE DEVICE (IED) DETECTION TEST

SUBJECT CHECKLIST
TIP TRAINING AND TESTING
IED DETECTION TEST

PILOT TEST

Subject	Password	Date
P1	P1	
P2	P2	

This checklist will be used to record the dates of fictional image projection training and improvised explosive device detecting testing.