DOT/FAA/AR-99/16

Office of Aviation Research
Washington, DC 20591

Test and Evaluation Plan for Integrating X-ray Screener Assist Technology and Nuclear Quadrupole Resonance

PB99-140899

Susan B. Monichetti
J. Michael Barrientos
J. L. Fobes, Ph.D.
Eric C. Neiderman, Ph.D.
David Fabry

Aviation Security Research and Development Division
Federal Aviation Administration
William J. Hughes Technical Center
Atlantic City International Airport, NJ 08405

February 1999

Test Protocol

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NOTICE

Technical Report Documentation Page

1. Report No. DOT/FAA/AR-99/16	PB99-140899	3. Recipient's Catalog No.
4. Title and Subtitle TEST AND EVALUATION PLAN FOR INTEGRATING X-RAY 'SCREENER ASSIST TECHNOLOGIES' AND NUCLEAR QUADRUPOLE RESONANCE		5. Report Date February 1999 6. Performing Organization Code AAR-510
7. Author(s) Susan B. Monichetti , J. Michael Barrientos, J. L. Fobes, Ph.D., Eric Neiderman, Ph.D., and David Fabry		8. Performing Organization Report No. DOT/FAA/AR-99/16
9. Performing Organization Name and Address U.S. Department of Transportation, Federal Aviation Administration William J. Hughes Technical Center Atlantic City International Airport, NJ 08405		10. Work Unit No. (TRAIS) 11. Contract or Grant No.
12. Sponsoring Agency Name and Address U.S. Department of Transportation, Federal Aviation Administration Associate Administrator of Civil Aviation Security, ACS-1 800 Independence Ave., S.W. Washington, DC 20590		13. Type of Report and Period Covered 14. Sponsoring Agency Code ACS-1
15. Supplementary Notes		

16. Abstract

This Test and Evaluation Plan describes the evaluation of Nuclear Quadrupole Resonance Technology working in conjunction with Screener Assist Technology. The test will evaluate equipment detection and screener alarm resolution. Machine and system performance measures on detection and alarm resolution will be recorded, analyzed, and evaluated, with results to follow in a Test and Evaluation Report.

17. Key Words Nuclear Quadrupole Resonance, Screener Assist Technology	18. Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Page	22. Price
Unclassified	Unclassified	34	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

PREFACE

This Test and Evaluation Plan addresses the Critical Operational Issues and Criteria for machine detection and screener alarm resolution performance established by the Federal Aviation Administration for the integration of Nuclear Quadrupole Resonance Technology with Screener Assist X-ray Image Technology. This plan was developed by the Aviation Security Human Factors Program at the William J. Hughes Technical Center, Atlantic City International Airport, New Jersey in support of the Associate Administrator for Civil Aviation Security, ACS-1. Key FAA personnel supporting this plan are Susan B. Monichetti, J. Michael Barrientos, J. L. Fobes, Ph.D., Brenda A. Klock, Eric Neiderman, Ph.D., Ronald Krauss, Ph.D., Lee Spanier, David Fabry, Lok Y. Koo, William T. Morgan, Theresa A. McGhee, Bill Petracci, and Kim W. Lee, all employed with the Aviation Security Research and Development Division.

ACRONYMS AND ABBREVIATIONS

ADX	Auto Detect X-Ray
c	Response bias
COI	Critical Operational Issues
d’	Sensitivity
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
IED	Improvised Explosive Device
MOP	Measure of Performance
NQR	Nuclear Quadrupole Resonance (also called QR)
P_d	Probability of Detection
P_{fa}	Probability of False Alarm
SAT	Screener Assist Technology
TEP	Test and Evaluation Plan
TER	Test and Evaluation Report

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

1. INTRODUCTION

1.1 General

Federal Aviation Regulations (FAR) Section 108 requires all air carriers in the United States to provide for the safety of their passengers and property. To comply, air carriers procure equipment and train personnel to screen passengers and their carry-on baggage before they board the aircraft. The Federal Aviation Administration (FAA) ensures compliance with these and other regulations through scheduled and random inspections at airports. Maintaining a proficient screening process is critical to the mission of aviation security, both domestically and internationally.

The FAA, working with the aviation industry, encourages the development of new technology and equipment to improve aviation security for the traveling public. X-ray systems currently in use at airports were designed to aid the screener in the detection of weapons such as guns, knives, and explosive devices like grenades. However, because of the increased sophistication of terrorists and Improvised Explosive Devices (IEDs), detection is difficult with existing X-ray systems to find such threats.

Various functions for X-ray systems and new technologies have recently been developed to help the screener detect explosive threats. Two such approaches, Screener Assist Technology (SAT) and Nuclear Quadrupole Resonance (NQR), can potentially aid the operator in finding explosive threats.

1.2 Purpose

The purpose of this test is to determine if NQR enhances overall checkpoint explosive detection in conjunction with SAT. This Test and Evaluation Plan (TEP) addresses the Critical Operational Issues (COI) and Measures of Performance (MOP) for the system to be tested.

1.3 Scope

This evaluation will include the collection and analysis of empirical data on the automatic explosive detection capabilities of X-ray equipment (SAT) and Qaudrupole Resonance technology (QR), as well as human factors issues involved in alarm resolution. The system being evaluated is the Qscan 160 developed by Quantum Magnetics. A Rapiscan Auto Detect X-ray (ADX) system with (SAT) will be used in conjunction with the Qscan. During this test, the screener will perform their normal duties and will be subject to all threat item types (IEDs, guns, knives) found in an airport environment.

1.4 Background

1.4.1 Program Background

The FAA is responsible for ensuring the safety and security of air travel. Airports pose a challenge to security since they must be readily accessible to the public. To meet this challenge, the FAA has developed a security concept involving a complex system of trained personnel, properly maintained and calibrated equipment, and appropriate procedures. This includes preboard screening of carry-on and checked baggage as well as passengers.

A number of policies affect pre-board screening operations. FAR Part 107, Airport Security, Section 107.20 states, "No person may enter a sterile area without submitting to the screening of his or her person and property in accordance with procedures being applied to control access to that area." FAR Part 108.9 and FAR 129.25 present screening policies for domestic and international airlines. Airlines may refuse to transport any person who does not consent to a search of his or her person and carry-on belongings. Checked baggage may also be examined for the presence of potential threats.

The threat to civil aviation security has changed in the last decade. Improvements with explosive device technology have increased airliner vulnerability to bombings. Today, explosive devices are less likely to be prefabricated and can be made from a variety of materials and made to resemble innocent objects. Timing devices have been miniaturized and digitized, compounding the difficulties of detection with current checkpoint equipment.

For these reasons, the potential for complete aircraft destruction with great loss of life and disruption of the world's air transportation system has become a great concern. This threat has increased the need for new airport security systems and operator training in these systems. Currently, a very effective defense against a variety of explosive devices in carry-on baggage is a hand inspection. However, this approach is labor-intensive and costly. Checkpoint X-ray systems and their current training programs, which rely on quick interpretation of complex, two-dimensional, X-ray images of baggage, may not be adequate to detect well-concealed IEDs (Neiderman, 1996).

1.5 Functional Requirements

Systems must be capable of detecting IEDs without substantially decreasing the baggage throughput rate. The following functional requirements are identified as key factors in the evaluation of SAT-QR integrated system.

1.5.1 Detection

This is a critical factor and requires that the Qscan 160 can detect explosive material.

1.5.2 Alarm Resolution

The QR system must assist in the operators' ability to resolve an explosives alarm.

1.5.3 Usability

The equipment and training must be such that an individual with at least a high school education can learn to use it effectively and rapidly.

1.5.4 Throughput

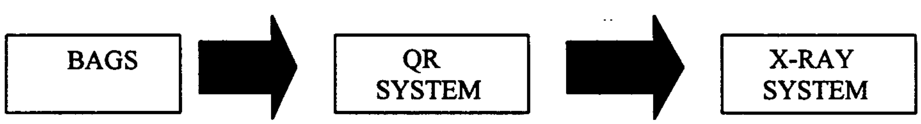
The addition of the Qscan 160 cannot affect the rate at which the bags are screened with a normal X-ray machine.

1.5.5 Trackability

Can the screener keep track of the bags as they go through the two machines?

1.6 System Description

The two types of technology that will be used are the Quantum Magnetics Qscan 160 which uses NQR for detection and an advanced X-ray system with computer technology to automatically identify potential explosive materials (Rapiscan's ADX machine with SAT). Suspected explosive threats will be identified by an alarm on the Qscan 160. The Qscan 160 uses radio frequency pulses that look for the unique chemical structure of explosives. The X-ray machine with SAT alarms by placing a circle around or highlight the suspicious area of the image. The image, along with advanced image manipulation options and a four-color palette, allow the operator to reconcile potential threats using the X-ray. Operator performance is a key measurement in determining overall system effectiveness. The two technologies are totally independent systems.



1.7 Test Overview

The current test will evaluate the two technologies combined to make up a carry-on baggage-screening checkpoint and determine if QR enhances overall checkpoint efficiency. The SAT X-ray detection rates were obtained previously (Fobes & Barrientos, 1997) and the SAT test will not be repeated.

This test is divided into four phases using airport security screeners to operate the systems. All phases (with the exception of Phase I) will consist of the NQR technology placed in front of the X-ray machine. Phase I, from which baseline data will be obtained, will consist of the X-ray machine alone with SAT off. Phase II will consist of the QR technology turned off and SAT being turned on. Phase III will consist of the QR technology turned on and SAT being turned off. Phase IV will consist of both QR and

SAT turned on. A pilot test will be given to ensure all test personnel perform their assigned duties.

Phases I - IV will consist of the screening of five explosive types made into IEDs. The two systems will be screening a total of 100 bags per each phase for four screeners (total number of bags screened by each screener is 400). Twelve bags will contain IEDs and three bags will contain either gun or knife threats. Machine and operator performance measures of the probability of detection (P_d), probability of a false alarm (P_{fa}), and the sensitivity measure (d') will be gathered. All data will be compiled and analyzed with results to be documented in a Test and Evaluation Report (TER).

1.7.1 Critical Operational Issues

Test location is a potential limitation for alarm resolution, as laboratory testing does not offer the same distracters as in the airport environment. In addition, the lab environment may also increase screener attention and motivation. The COIs and MOPs for alarm resolution are those issues and criteria necessary to evaluate how well the system meets operational requirements.

1.7.1.1 Issue 1 – System Effectiveness - Does the QR sensor enhance the operator's contribution to explosive detection?

Criterion 1-1 Investigative in nature.

MOP 1-1-1 Operators' mean P_d and P_{fa}.

MOP 1-1-2 Operators' d (sensitivity).

MOP 1-1-3 Operators' c (response bias).

1.7.1.2 Issue 2 – Usability – Are there any software or hardware factors or procedural aspects that degrade system usability by screeners?

Criterion 2-1 Investigative in nature.

MOP 2-1-1 Human Factors Subject Matter Experts (SMEs) will evaluate usability issues.

MOP 2-1-2 Deficiencies found through questionnaires, surveys, interviews, and debriefs with screeners.

1.8 Operational Test and Evaluation (OT&E) Milestones

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

TABLE 1. OT&E MILESTONES

MILESTONES	DATE	RESPONSIBLE PARTY
Approve TEP	February	AAR-510
Coordinate Screeners	February 18, 1999	AAR-510
Assemble IEDs	February 17, 1999	AAR-510 & 520
Prepare Baggage Sample Set	February 26, 1999	AAR 510 & 520
Brief Test Personnel	February 26, 1999	AAR-510
Pilot Test	March 8, 1999	AAR-510 & 520
Make Mods to the TEP	February 16-19, 1999	AAR-510
Test Run Phase I - IV	March 8-12, 1999	AAR-510 & 520
Analyze Phase I - IV Data	March 15-26, 1999	AAR-510 & 520

2. PILOT TEST

A pilot test will be conducted before the actual testing to ensure that all aspects are performed efficiently and effectively. The purpose of the pilot test is to experience and evaluate the collection of data and the coordination of baggage for testing. All discrepancies will be noted and corrected prior to testing.

2.1 Screeners

One airport security screener will participate in the pilot and receive up to two hours of training on both systems before testing and will not be used after the pilot phase.

2.2 Pilot Test Personnel

2.2.1 Test Director – responsible for briefing, monitoring, guiding test personnel and making sure the test protocol is being followed.

2.2.2 Data Collectors – observe and record both machine and screener performance for hits, misses, and false alarms. Also responsible for recording the throughput rate (i.e., number of bags screened per hour).

2.2.3 Baggage handlers/Explosive handlers – responsible for coordinating baggage for screening, making sure that the bag presentation is such that each bag is screened individually (bags given enough space so that they are separated, no bag will be placed directly next to or close to another bag). All baggage handlers must be explosive handlers since explosive threats will be inserted into various bags (as well as guns and knives).

2.3 Pilot Test Site

Aviation Security Research and Development Laboratory will be the test site location.

2.4 Pilot Equipment to Be Tested

Qscan 160 and Rapiscan X-ray machine with SAT.

2.5 Pilot Test Articles

2.5.1 Explosive Threats – two explosive threats will be randomly inserted in passenger baggage for screening (see Appendix A for explosive threat to be used).

2.5.2 Test Bags – twenty representative carry-on passenger bags will be randomly selected to be screened (see Table 3 for test baggage).

2.6 Pilot Data Collection

The FAA will record all operator and machine hits and false alarms. The FAA will also be responsible for consent forms and surveys included in the test protocol (see Appendix C for forms and surveys).

2.7 Pilot Test Protocol

One airport security screener will be assigned. Manufacturers will provide a maximum of two hours of training on how to run each of the systems. After the completion of training, the operator will screen 20 passenger carry-on bags two of which will contain a threat. System configuration will be Phase IV.

3. OPERATIONAL TEST AND EVALUATION

3.1 Test Site

The Aviation Security Research and Development Laboratory will be the test site location.

3.2 Screeners

For phases I through IV (Alarm Resolution), four airport security screeners will be the subjects. The table below (Balanced Latin square) shows the order in which the screeners will be presented the phases. This counterbalancing technique presents the different phases in an ordered and controlled manner.

Table 2 Latin Square Design

Screener 1	A	B	C	D
Screener 2	B	C	D	A
Screener 3	C	D	A	B
Screener 4	D	A	B	C

A=Phase I – (Baseline) X-ray with no SAT.

B=Phase II – QR off & SAT on.

C=Phase III – QR on & SAT off.

D=Phase IV – QR on & SAT on.

3.3 Test Personnel

3.3.1 Test Director –monitors and guides test personnel making sure the test protocol is being carried out.

3.3.2 Data Collectors – observe and record machine and operator responses for hits and false alarms.

3.3.3 Baggage Handlers/Explosive Handlers – responsible for coordinating baggage for screening, making sure that the sequence of bag presentation is followed. All baggage handlers must be explosive handlers since explosive threats will be inserted into various bags.

3.4 Test Articles

3.4.1 Explosive Threats – Phase I through Phase IV– Five types of explosive will be used and assembled into 12 IEDs, recorded, and randomly inserted into carry-on baggage (see Appendix A on explosives).

3.4.2 Test Bags – Phase I through Phase IV – 100 representative passenger carry-on bags (see Table 3) will be presented. For each phase, twelve bags with IEDs will be randomly placed among these. Two additional bags will contain gun threats and one other bag will contain a knife threat. Potential false alarm items will also be contained in some bags (i.e., toothpaste, peanut butter, chocolate, etc.).

TABLE 3. TEST BAGS

Bag Type	Comparison Bags	Test Bags
70% **rollaboards** **briefcases** **duffel/gym bags** **backpacks** **purses**	12 rollaboards 12 briefcases 13 duffel/gym bags 12 backpacks 13 purses	2 rollaboards 2 briefcases 1 duffle/gym bags 2 backpack 1 purse
20% **overnight cases** **shoulder bags** **PC carrying case**	4 overnight cases 4 shoulder bags 3 PC carrying case	1 overnight case 1shoulder bags 2 PC carrying case
10% **folding/hanging bags** **camera bags**	3 folding/hanging bags 4 camera bags	2 folding/hanging bags 1 camera bags
Total # of Bags	***85***	***15***

3.5 System To Be Tested

3.5.1 Quantum Magnetics' Qscan 160 and Rapiscan X-ray machine with SAT.

3.6 Data Collection

Data collectors will record all machine and operator hits, and false alarms. They will also be responsible for consent forms, personal information forms, surveys, and the usability checklist included in this test protocol.

3.7 Test Protocol

All test personnel will be briefed on explosive safety and test protocol for each phase. Four airport security screeners will be assigned to the test. Each screener will receive two hours of training from the manufacturers on how to operate the systems. After the completion of training, each screener will be tested with 100 bags per phase, some of which contain IEDs or other threats. For each test bag being screened, the data collectors will record the operator's decision (i.e., threat or no threat).

3.7.1 Alarm Resolution

An explosive threat that is correctly identified by the machines constitutes a machine detection or hit. An explosive threat that is not correctly identified constitutes a machine miss. A machine identification of a non-existent explosive threat constitutes a false alarm.

A threat that is correctly identified by the screener constitutes an operator detection or hit. A threat that is not correctly identified constitutes an operator miss. An operator identification of a non-existent threat constitutes a false alarm.

3.8 Data Analysis

All recorded machine and operator hits, misses, and false alarms will be analyzed as well as d and c sensitivity measures (see Appendix B). All personnel information and surveys filled out by the test subjects will also be analyzed.

4. REFERENCES

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APPENDIX A

IED CONFIGURATIONS

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APPENDIX B

SIGNAL DETECTION THEORY
MEASURES OF SENSITIVITY

SIGNAL DETECTION THEORY

The Signal Detection Theory (SDT) Paradigm.

SDT is based on the concept that the judgment by a person as to what is seen is affected by the expectations of the observer and the payoffs associated with the outcome of judgments to be made. This is the case even in a situation in which the physical input to the receptors is constant (Foley & Morey, 1987). In other words, perception is determined by the interaction of the physical parameters of the stimulus with the subjective control of the perceptual mechanisms by the observer.

The theory of signal detection is applicable to situations in which there are two discrete states (e.g., signal and noise) that cannot be easily discriminated (Wickens, 1992).

The Concept of Noise.

A central concept in SDT is that, in any situation, there is noise that can interfere with the detection of a signal. This noise can be generated externally from the person (e.g., noises in a factory other than a warning buzzer) and internally within the person (e.g., miscellaneous neural activity). This noise varies over time, thus forming a distribution of intensity from high to low. The shape of this distribution is assumed to be normal (i.e., bell shaped). When a 'signal' occurs, its intensity is added to that of the background noise. At any given time, a person needs to decide if the sensory input (i.e., what the person senses) consists of only noise or noise plus the signal (Sanders & McCormick, 1987).

Possible Outcomes.

The IED detection tests assess human operators engaged in tasks to detect an environmental event or signal (i.e., a threat object). Based on SDT, there are two responses that represent the screener's detection performance:

YES (a threat object was present), or
NO (a threat object was not present).

There are also two signal presentation states:

SIGNAL (a threat object was present), or
NOISE (a threat object was not present).

The combination of the screener responses and the signal state produces a 2 x 2 matrix (refer to Figure A-1) comprised of four quadrants. These quadrants are labeled hits, misses, false alarms, and correct rejections.

The Concept of Response Criterion.

One of the major contributions of SDT to the understanding of the detection process was the recognition that people set a criterion along the hypothetical continuum of sensory activity and that this activity is the basis upon which a person makes a decision. The position of the criterion along the continuum determines the probabilities of the four outcomes listed above. The best way to conceptualize this is in Figure A-2. Shown are the hypothetical distributions of sensory activity when only noise is present and when a signal is added to the noise. Notice that the two distributions overlap. That is, sometimes conditions are such that the level of noise will exceed the level of noise plus signal.

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 average, there will be more sensory or neural activity when a signal is present than when it is absent. This neural activity represents the rate of neurons firing in the brain. The response rate for detecting the neural evidence increases with the magnitude of the stimulus (signal) intensity. If there is enough sensory activity, the level of sensory activity exceeds a critical threshold, X, and the operator decides "yes." If there is too little, the operator decides "no." This is illustrated in Figure A-2.

SDT postulates that a person sets the criterion level such that whenever the level of sensory activity exceeds that criterion, the person will say there is a signal present. When the activity level is below the criterion, the person will say there is no signal. Figure A-2 also shows four areas corresponding to hits, false alarms, misses, and correct rejections based on the criteria shown in the figure.

Related to the position of the criterion is the operator response criterion quantity (i.e., beta). Numerically, the operator response criterion is the ratio (signal to noise) of the height of the two curves in Figure A-2 at a given criterion point. As the criterion is shifted to the right, the response criterion value increases and the person will say signal less often and hence will have fewer hits, but also fewer false alarms. This type of response criterion is considered to be conservative. On the other hand, as the criterion is shifted to the left, beta decreases and the person will say signal more often and hence will have more hits, but also more false alarms (Sanders & McCormick, 1987).

For the IED detection tests used in the demonstration testing:

a. A Hit will be recorded when a screener correctly detects a threat object (e.g., IED) in the bag image.
b. A False Alarm will be recorded when a screener reports a threat object (e.g., an IED) in the bag image and no threat object is present.
c. A Miss will be recorded when a screener reports no threat object in the bag image when one actually is present.
d. A Correct Rejection will be recorded when a screener reports no threat object in the bag image and no threat object is present.

Signal Presentation State

Screener Response	SIGNAL	NOISE
YES	HIT	FALSE ALARM
NO	MISS	CORRECT REJECTION

Figure A-1. Matrix of Screener Response and Signal Presentation State

Figure A-2, below, illustrates the key concepts of signal detection theory. Shown are the two hypothetical distributions of internal sensory activity, one generated by noise alone (left side) and the other generated by signal plus noise (right side). The probabilities of the four possible outcomes are depicted as the respective areas under these curves based

$\beta = b/a$

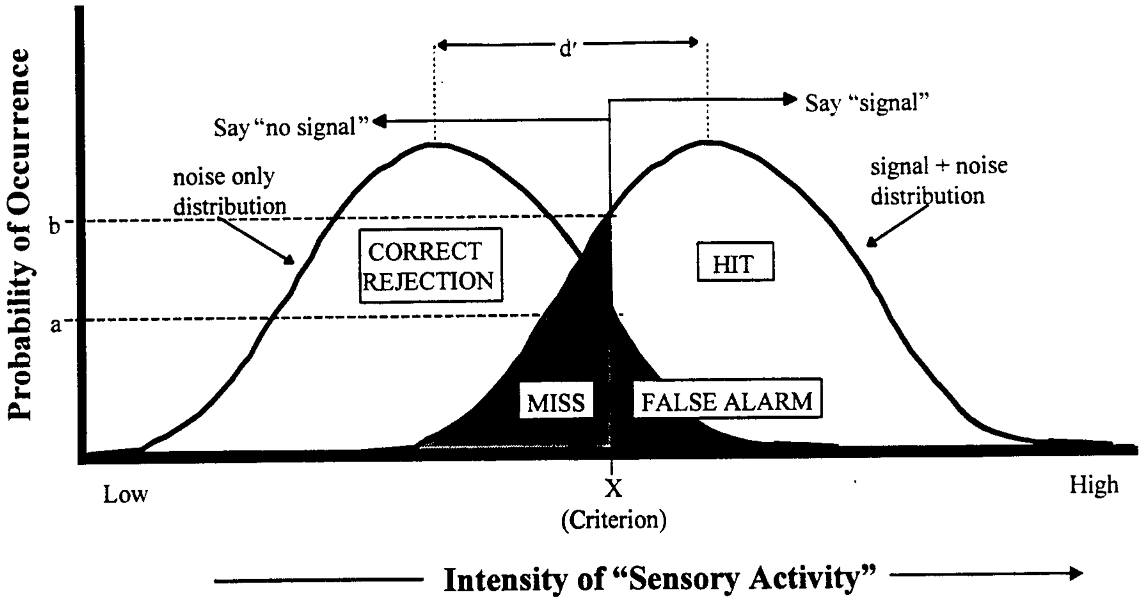

Figure A-2. Key Concepts of Signal Detection Theory.

on the setting of a criterion at X. Here, d′ is a measure of sensitivity, and β is a measure of response bias. The letters *a* and *b* correspond to the height of the signal-plus-noise and noise-only distributions at the criterion.

Influencing Response Criterion.

SDT postulates two major variables that influence the setting of the criterion: (1) the likelihood of observing a signal, and (2) the costs and benefits associated with the four possible outcomes. Consider the first. If field intelligence indicated that a terrorist had threatened a flight, thus increasing the likelihood of a threat object in a carry-on bag, the screener would be more likely to call an object on the X-ray a threat object. That is, as the probability of a signal increases, the response criterion is lowered (reducing β), so that anything remotely suggesting a signal (a threat object in our example) might be called a signal (Sanders & McCormick, 1987).

With regard to the second factor, costs and benefits, again consider the tasks of the airport screener. What is the cost of a false alarm (saying there may be a threat object when there is not)? The bag is hand searched and throughput at the checkpoint is decreased. What is the cost of a miss (saying that not threat object exists when there is one)? The threat object may get on to the aircraft and an act of terrorism may occur. Under these circumstances, the screener may set a low criterion and be more willing to call a suspicious object a potential threat. But what if the bag has to pass through three different checkpoints with different types of sophisticated detection equipment? In this case, the screener would set a more conservative criterion and would be less likely to call it a threat object.

Concept of Sensitivity.

In addition to the concept of response criterion, SDT also includes a measure of the person's sensitivity. That is, the keenness or resolution of the sensory system. Further, SDT postulates that the response criterion and sensitivity are independent of each other. In SDT terms, sensitivity is measured by the degree of separation between the two distributions shown in Figure A-2. The sensitivity measure is called d′ and corresponds to the separation of the two distributions expressed in units of standard deviation (it is assumed that the standard deviations of the two distributions are equal). The greater the separation, the greater the sensitivity and the greater the d′. In most applications of SDT, d′ ranges between 0.5 and 2.0.

Some signal generation systems may create more noise than others, and some people may have more internal noise than others. The greater the amount of noise, the smaller d′ will be. Also, the weaker and less distinct the signal, the smaller d′ will be. Another factor that influences d′ is the ability of the person to remember the physical characteristics of a signal. For example, when memory aids are supplied, sensitivity increase (Wickens, 1992). In the case of the X-Ray screener, better X-ray equipment and images, or X-rays of actual threat objects to compare with the X-ray under consideration, should increase sensitivity.

Procedures to Calculate SDT Probabilities.

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

b. The probability of a 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 (refer to Figure A-1) by the total number of occurrences in a column.

c. The P_h (also referred to as the probability of detection, P_d) will be calculated by dividing the number of threats 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: $P_{cr} = 1 - P_{fa}$

Procedures to Calculate the Response Criterion Measure β.

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

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

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

HIT/FA	Z	ORD
.01	2.33	0.03
.02	2.05	0.05
.03	1.88	0.07
.04	1.75	0.09
.05	1.64	0.10
.08	1.40	0.15
.10	1.28	0.18
.13	1.13	0.21
.15	1.04	0.23
.18	0.92	0.26
.20	0.84	0.28
.25	0.67	0.32
.30	0.52	0.35
.35	0.38	0.37
.40	0.25	0.39
.45	0.12	0.40
.50	0.00	0.40

HIT/FA	Z	ORD
.50	0.00	0.40
.55	-0.12	0.40
.60	-0.25	0.39
.65	-0.38	0.37
.70	-0.52	0.35
.75	-0.67	0.32
.80	-0.84	0.28
.82	-0.92	0.26
.85	-1.04	0.23
.88	-1.18	0.20
.90	-1.28	0.18
.92	-1.40	0.15
.95	-1.64	0.10
.96	-1.75	0.90
.97	-1.88	0.07
.98	-2.05	0.05
.99	-2.33	0.03

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APPENDIX C

CONSENT FORMS, PERSONAL INFORMATION FORMS, AND SURVEYS

INFORMED CONSENT

I, ______________________________________, have received a briefing by the FAA about the purpose of the test and have been provided with the opportunity to ask questions. The test will require training on a Rapiscan X-ray system and a Qscan 160 NQR system, then screening of carry-on passenger baggage, some of which will contain actual explosives. I have also been informed of the all safety precautions that will be taken to ensure all testing is to be carried out in a safe and secure manner. Training and testing will require approximately two days.

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 test, and that the Test Director may terminate my participation in the interest of safety and the test. I also certify that I am at least 18 years of age.

I have been informed that if I have any further concerns or questions, I may contact the Test Director, Susan Monichetti, (609) 485-6974; or Dr. J. L. Fobes (609) 485-4944.

Signed: ____

Date: __________/___________/_____________

Witness: ____

Date: __________/___________/_______________

PERSONAL INFORMATION FORM

Please provide some basic information about yourself. All of this information will remain confidential.

Name: ________ Date: ____ / ____ / 19__

1. At what airport do you work? ________________________________

2. For what screening company do you work? ______________________

2. What is your gender (please circle your answer)?

   Male Female

3. Is English you native or first language (please circle your answer)?

   Yes No

4. Do you wear eyeglasses or corrective lenses (please circle your answer)?

   Yes No

5. Please circle the highest education level that you have completed.

   8th Grade 12th Grade GED Some College College Graduate

6. How much computer experience do you have (please circle your answer)?

   None Very Little Some A Lot

7. Please circle your age:

   18-21 22-29 30-39 40-49 50-59 60-69 70 +

TEST ADMINISTRATOR SURVEY

NAME: ____________________________ **DATE:** ___/___/ 19__

LOCATION: ______________________

The FAA wants to know your opinion of the test. Your ratings will be an important part of evaluating the NQR Technology in conjunction with Screener Assist Technology (SAT). **All of your answers will be kept confidential, so please give your honest opinion.** Your help is greatly appreciated.

INSTRUCTIONS: Please circle the answer that best indicates your opinion.

1. The instructions for using the Qscan 160 were easy to understand.

Not at all ← 1 — 2 — 3 — 4 — 5 → Very Much So

2. The Qscan 160 in conjunction with the SAT feature was helpful in identifying explosive threats in carry-on passenger baggage.

Not at all ← 1 — 2 — 3 — 4 — 5 → Very Much So

3. Operators who use NQR with SAT should make better X-ray screeners.

Not at all ← 1 — 2 — 3 — 4 — 5 → Very Much So

4. I would recommend NQR with SAT as a useful tool in X-ray screening.

Not at all ← 1 — 2 — 3 — 4 — 5 → Very Much So

Do you have any additional comments, observations, or suggestions?
(Please use the back of this page if you need additional space.)

APPENDIX D

THREAT ARTICLE DEFINITION SHEET FOR CHECKED/CARRY-ON BAGGAGE

This material is 191 Protected

To obtain access, submit a written request citing this document and including justification to:

The Associate Administrator for Civil Aviation Security, ACS-1
U.S. Department of Transportation
Federal Aviation Administration
FAA Headquarters
800 Independence Ave., S.W.
Washington, DC 20591

APPENDIX E

DATA COLLECTION FORM

Qscan 160

Bag # 1 ________

Clear (No Threat) ________
Threat ________
Check ________
Bomb/Gun/Knife
Other/Shielded

Bag # 2 ________

Clear (No Threat) ______
Threat ______
Check ______
Bomb/Gun/Knife
Other/Shielded

Bag # 3 ________

Clear (No Threat) ______
Threat ______
Check ______
Bomb/Gun/Knife
Other/Shielded

Bag # 4 ________

Clear (No Threat) ______
Threat ______
Check ______
Bomb/Gun/Knife
Other/Shielded

Rapiscan X-ray with SAT

Bag # 1 ________

Clear (No Threat) ________
Threat ________
Check ________
Bomb/Gun/Knife
Other/Shielded

Bag # 2 ________

Clear (No Threat) ______
Threat ______
Check ______
Bomb/Gun/Knife
Other/Shielded

Bag # 3 ________

Clear (No Threat) ______
Threat ______
Check ______
Bomb/Gun/Knife
Other/Shielded

Bag # 4 ________

Clear (No Threat) ______
Threat ______
Check ______
Bomb/Gun/Knife
Other/Shielded

Notes: ____

____

____

____